Crossrail – Review of Risks for the London Assembly

Lessons learned from other relevant programmes and projects

Disclaimer – this is a research paper prepared for Officers of the London Assembly with the purpose of providing a contextual briefing ahead of the London Assembly Transport Committee meeting on 6th January 2010. The information in this document has been derived from publicly available information except where stated, without access to Crossrail staff or any Crossrail documentation. Third parties may not rely on this document, and no assurances or warranties are offered or implied to third parties.

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1. INTRODUCTION

This report has been prepared in response to a request from the Officers of the London Assembly (ref Annex E), asking for a briefing paper in preparation for the Assembly's Transport Committee meeting on 6th January 2010, at which Crossrail will be the main Agenda item. This will be the first discussion of the Crossrail programme by the London Assembly Transport Committee.

This report considers the lessons learned from other similar projects, and sets the conclusions against Crossrail's current position – i.e. right at the start of the overall programme.

The report is based on a week's research by Dr Matthew Symes and Dr Michael Ebert, using the following methodology -

- Interviews with selected senior executives from relevant projects and organisations, e.g. Docklands Light Railway (DLR), High Speed 1/Channel Tunnel Rail Link (CTRL), the OGC and the Channel Tunnel;
- Literature review of UK and international case studies;
- Summaries of OGC and NAO best practice guidance;
- Analysis and assessment of case studies, of relevance to Crossrail.

The information in this document has been derived from publicly available information except where stated, without access to Crossrail staff or Crossrail documentation.

We would like to thank all of those who gave freely of their time at short notice to contribute to this study.

2. MANAGEMENT SUMMARY

From the report that follows, five sets of key points emerge for London Assembly's officers to consider –

Strong, streamlined governance is very important

- The National Audit Office (NAO) cited ineffective governance as one of the main reasons underlying the demise of Metronet. The NAO concluded that the governance was ineffective as the Department for Transport (DfT) had given away too many controls. When problems developed, DfT held few levers for corrective action;
- The 2012 Olympics has very complex stakeholder arrangements and interests. Its governance mechanism is currently successfully coping with this, bringing the main stakeholders together in an effective Board arrangement supported by underlying working groups.

The Governance of Crossrail should promote timely decisions by those empowered to take them. Role clarity between the DfT / TfL / London Underground Limited (LUL) and the Mayor of London will be essential - producing strong, singular coordinated client side control.

Robust business cases, updated regularly, and containing adequate contingency and strong change control disciplines are key

- "Mega projects" – i.e. projects which are very large and span long timescales, seem disproportionately hard to deliver. The reasons include the difficulty in estimating risk consequences over long timeframes, complex stakeholder environments, and changing scope requirements. Much has been written about this; Bent Flyvbjerg's work is very relevant (see references);
- The Olympic Games illustrates how difficult it is to estimate risks. Over the last 30 years, few Games have come in close to their budgets, despite reasonably predictable and stable scope requirements from the International Olympic Committee (IOC). For the London 2012 Games, a very significant risk allowance is now earmarked to cover risks not foreseen at the time of the bid (taking the cost potentially from £2.2bn to over £9bn).

Reassurance should be sought that sufficient contingency sums are available for Crossrail and held at the right levels, and that the business case is kept up to date, reflecting changes to scope, benefits and funding (including contingency) positions.

Simple procurement structures that create clear accountability and responsibility are vital, supported by a non-adversarial approach

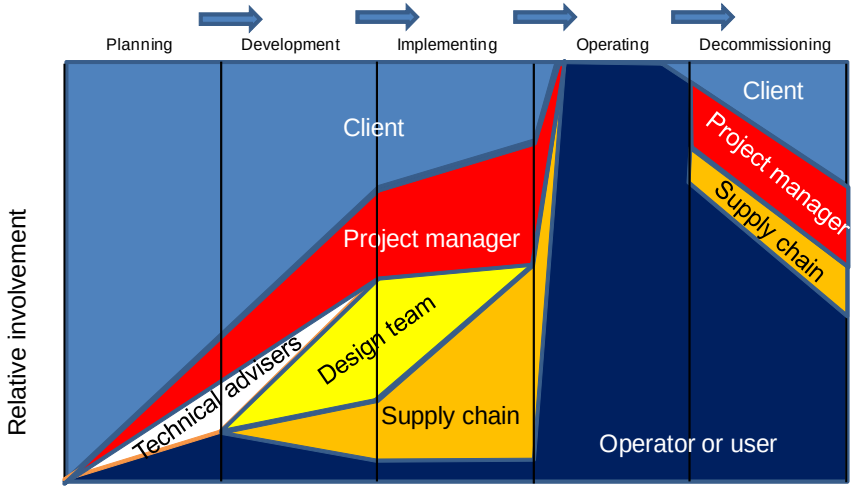
- On the Docklands Light Railway, the contract strategy resulted in complex sequences of contracts for elements of the work – for example the track was procured separately from the stations, from the signalling and from the control systems. At the outset, responsibilities for the overall integration and operation were not held with one single organisation. When the project got into difficulties, the initial contract structures were replaced with a simple "Prime" contract structure, with delivery and operational responsibility aligned;
- On the Channel Tunnel, there was no clear client structure in place from the outset. The procurement approach originated from contractor / bank proposals, not from a client-driven procurement strategy. As the project got into difficulties, the flawed procurement strategy, combined with by then an adversarial relationship between the client and the suppliers, created significant difficulties.

Reassurance sought be gained that the Crossrail contract structures are as simple as possible, and that modern approaches to supply chain management and collaborative working are in place. This goes beyond simply having a "project charter": the Public Sector Construction Clients' Forum (PSCCF), recommends collaborative working, appropriate forms of contract such as the New Engineering Contract, and financial transparency via project-specific bank accounts ensuring timely and fair subcontractor payments.

Operator involvement right from the outset is essential

- Successful projects, such as the Hong Kong Mass Transit Railway, have strong operator input right from the start;
- Projects that do not engage sufficiently with the future operator or operators early or deeply enough can run into difficulties - British Airport Authority (BAA)'s Terminal 5 handover offers many lessons;
- Crossrail does not have an operator yet, so TfL is providing that input; this raises inevitable risks about solution ownership;
- The Office of Government Commerce (OGC) observes that the challenge is to prevent projects being "engineering" driven – but instead operator-focussed.

Consideration should be given to Transport for London (TfL)'s operator input into the Crossrail Project at this important stage.



Proven off-the-shelf technology greatly reduces risk

- High Speed 1 believes that one of the main reasons behind the success of CTRL was the decision to use technology that was already proven. In its case, the underlying technology was French. It required only limited modification to adapt to CTRL's requirements;
- The Jubilee Line's "moving block" signalling system was unproven in the UK, and couldn't be made to work within the programme timescale. Eventually a simpler system was adopted after much delay and cost, which also adversely affected operating throughput.

The use of technology by Crossrail should be examined to check whether proven and readily available technology is being used, as this will reduce risks, and that whatever technology is adopted is fully compatible with connecting railway interfaces.

3. TEN THEMES RELEVANT TO CROSSRAIL

In the sections that now follow, we summarise some consistent and recurring patterns in the lessons learned on the running of projects, including several large infrastructure projects with similar characteristics to Crossrail.

The work relies on three main sources of information:

- Lessons Learned from Selected Interviews (summarised in Annex A);
- Generic Lessons Learned and Codified from the National Audit Office (NAO) and the Office of Government Commerce (OGC) (summarised in Annex B);
- Specific Lessons Learned from UK and International Projects (summarised in Annex C).

The lessons learned span the whole life cycle of projects, and for the purpose of this review a key task has been to identify the specific lessons learned that apply to the current stage of the Crossrail Project. London Assembly's Transport Committee has a scrutiny role with regard to Crossrail, and needs briefing information in a form that will enable it to fulfil this role.

Crossrail will already be subject to an assurance regime, e.g. OGC Gateway Reviews, OGC/HM Treasury Major Project Review Group scrutiny, funder / loan reporting, technical reviews, and so on. The purpose of this review is not to duplicate the project-specific assurance process, but to look outside the world of Crossrail, and into other relevant reference projects.

Ten Themes

The following ten themes have been distilled from the more detailed material in the annexes to this report.

1) **"Mega projects" particularly involving transport infrastructure have disproportionately high risk levels.** Mega projects often get into difficulty. Much has been written about this, and the reasons that mega projects get into difficulty seem to be the combination of their scale (demanding significant resource management skills), their duration (making it hard to anticipate properly risks and suitable contingency allowances), their stakeholder complexity (political, funder, operator and neighbour), their impact on and interaction with the environment (resulting in scope changes or delays), and finally their governance and accountability arrangements (which are often complex and do not promote timely decisions). Mega projects require extraordinary efforts from outstanding people.

   Relevant themes for LA Members –

   - Does Crossrail recognise the risks that mega projects often carry – and is the approach geared up to address them in terms of accountable governance structures, risk mitigation techniques, long range planning and enduring stakeholder management? What comparison work has Crossrail undertaken to learn from other mega project infrastructure projects?

- Is there adequate contingency in the budget? Given the long timescales on mega projects, unplanned events are often unaccounted for, leaving budget and other contingencies sorely inadequate. As a consequence, misinformation about costs, benefits, and risks is often the norm on mega-projects.

2) **Governance, Stakeholder Engagement and Decision Making Structures.** These mechanisms must be streamlined, efficient and effective, and involve all of the relevant stakeholders, with "decision rights" clearly understood. Good governance was cited by the NAO on the West Coast Main Line. On the Olympics the governance arrangements have performed effectively so far in terms of marshalling and representing the interests of the stakeholders, and in promoting timely decisions. Conversely poor governance was highlighted by the NAO as the main reason behind Metronet's collapse.

Relevant themes for LA Members –

- Do the governance structures place control at appropriate levels and with organisations best placed to manage the risk?
- Is a comprehensive stakeholder engagement plan in place and recognised as meeting stakeholder needs? Is it working effectively – spanning operator engagement though to the more day-to-day tasks of managing the impact on landowners, businesses and third parties?
- Are the decision structures affecting the funders in place and working – for example, the Boards and their authority levels relating to the combined DfT and TfL/Mayor's interests, and the necessary working groups beneath that level?
- Are the Business Case and Critical Success Factors - covering the whole life of the Crossrail Project, and not just the delivery of the infrastructure project and its services - kept regularly under review and updated as necessary?

3) **Funding, Finance and Cost Control.** Funding agreements need to be achievable and crystal clear at the outset including responsibilities for cost over-runs and benefits share. Lack of certainty on funding inevitably leads to nervousness in the stakeholders and backers. In the case of Crossrail, this uncertainty will remain at a high level at least until after the 2010 General Election.

Relevant themes for LA Members –

- Are the availability, sources and mechanisms of funding clear and being kept up to date? This is vital given
    - Crossrail's many stakeholder and funding sources;
    - the impact of the current recession on assumed funding availability (from government or contributing businesses);
- Are robust mechanisms in place for budgetary and expenditure control? The scale of the infrastructure works (including tunnels and stations) makes it important to allocate budgets and monitor costs across the whole programme at a detailed level;
- Have risks relating to the forthcoming general election and a possible change of Government in 2010 been addressed and mitigated (e.g. by placing contracts with break or pause clauses around the election in order to minimise the risk of claims for breach of contract, should the scope change or should the project be halted)?

- Are effective decision processes in place governing the release of contingency funds? Timely release of contingency sums for risks that materialise will be important in protecting the timetable, and the cost control management processes need to be working effectively.

4) **Procurement Strategy and Contracting Models.** Crossrail's contracting and procurement strategies will be critical for its success. These strategies must create clear delivery responsibilities, with risk placed where it can best be managed, fostering a collaborative "win-win" approach up and down the supply chain.

The British Airport Authority (BAA)'s Terminal 5 project broke new ground as a best practice exemplar during its construction phase in terms of the risk management, adopting the principle that ultimately the client always bears the risk, and contracting approach, a cost reimbursable form of contract based on the New Engineering Contract model. Conversely the Channel Tunnel project ran in to difficulties as it didn't have a strong client at the outset, and it adopted a very adversarial approach with the industry.

The experience on the Docklands Light Railway shows that integration between the contracts for track, control systems, signals, and stations is critical – with successful operational service (not physical sectional completion) the vital driving force.

Relevant themes for LA Members –

- Are an overarching Procurement/Sourcing Strategy and a Contracting Strategy in place, and are the suppliers and funders aware of them? These strategies should foster productive and collaborative working relationships, placing the risk where it can best be managed;
- Is a Market/Supplier Engagement Strategy and Plan in place?
- Has an integrated contracting framework been established, aiming at full service operation (rather than simply at completion of the works?

5) **Project Management Arrangements, Skills, and Capability.** These will have to be of the highest order, with hand-picked people appointed in leadership roles both on the "client side" (i.e. DfT / TfL and the Mayor's Office) and on the Crossrail side. The question of rapid resource build-up in the early phases needs careful consideration. The client side will need to act as a singular "intelligent client", making the right decisions and playing its part actively as the project progresses. Crossrail will want to make the very best of the skills available through the Delivery Partner (a relatively new concept, now being used as a resourcing solution on the Olympic Programme). Teams from different companies should be similarly incentivised, and should be co-located, sharing space and information.

Relevant themes for LA Members –

- Does the "client side" (i.e. DfT, TfL, Mayor's Office) have enough people with the right skills to act as an "intelligent client"?

- Is there clear ownership and leadership of the Crossrail project from Ministers, civil servants, and senior executives in the sponsoring organisations?
- Is the defined Senior Responsible Owner (SRO, the individual responsible for ensuring that a project or programme of change meets its objectives and delivers the projected benefits) appropriately skilled, respected, authorised and effective?
- Are the Programme Partner (Transcend) and Project Delivery Partner (Bechtel) performing effectively and efficiently and are they bringing the right numbers of skilled resources onto the programme without being adversely affected by competing requests from other programmes? In particular, have lessons been learned by Crossrail on the way to get the best out of a Delivery Partner, and are there mechanisms in place for monitoring the performance of these two key roles?

6) **Planning Processes and Timelines.** These need to be well thought through, with clear decision points and adequate time for decision cycles. The major milestones for the project will need to be clearly identified, and Crossrail and the key people in DfT, TfL and the Mayor's office will need to know exactly what they have to do to achieve them.

Relevant themes for LA Members –

- Have the ramifications of political uncertainty been thought through and the impact minimised, e.g. not relying on receiving key decisions around the general election, and ensuring that contracts contain suitable protection against scope and timing changes that might be associated with a change in government?
- Have the main consultation processes that are yet to take place been identified, and the associated impacts and risks on timings, scope and costs? These are typically a significant source of uncertainty and delay;
- Is TfL providing adequate and informed operator input into the business planning and the design principles, and is the planning for the handover phase advancing sufficiently, even at this very early stage?

7) **Information Management and Reporting Arrangements.** The right information needs to get to the right people, enabling timely decisions. CTRL's experience is that its plans had to be detailed at the working level, and well designed and presented at the management level, summarising progress and highlighting decisions. A classic case study on the pitfalls of "upwards only" reporting is in the NAO's review of the Trident nuclear programme, in which the reporting arrangements did not promote decision-taking at management level.

Relevant themes for LA Members –

- Will the reporting processes promote timely stakeholder decisions (e.g. Ministers and DfT officials, and the Mayor and his office)? Late or pressurised decision cycles are usually an adverse indicator;
- Is there, as far as possible, a common reporting system accessible to clients, suppliers and sub-contractors? This simplifies and speeds up reporting, and shrinks both the scope for error, and the scale of the project office support.

8) **Change Control Processes for Scope, Risks and Opportunities.** These processes must be streamlined, effective and enforced, covering all three areas. With large projects, the scope and attendant plans inevitably tend to evolve as the project unfolds, introducing risks of delays, increased costs and acrimonious disagreements, e.g. the Channel Tunnel, where the original 10% contingency proved woefully inadequate. The change control processes must encourage, through the contract mechanisms the timely resolution of cost and time impacts relating to changes in scope.

Relevant themes for LA Members –

- Is the Crossrail scope tightly defined, and if not where not?
- Are the principles in place to guide decisions on proposed amendments to the scope (e.g. new stations)?
- Is a framework of risks and mitigations in place for the project, placing each risk in the hands of the party best able to manage it – supported by a timely, fair and binding change control process?
- Are plans in place for managing third party dependencies, recognising that large infrastructure projects tend to be adversely affected by, and adversely affect, numerous third parties?

9) **Quality and Benefits Management.** All contributing companies must share the same Quality Management approach, which needs to cover the procurements, contracts, construction and operations. Benefits realisation needs to be a motivating aim throughout the whole life of the programme. On major programmes, such as the Olympics and CTRL, a programme-wide approach in this area has been adopted with great effect.

Relevant themes for LA Members –

- Are there suitable “pain / gain” incentives up and down the supply chains – aligning behaviours with intended benefits?
- Is a programme-wide approach to quality assurance in place, with the various elements of assurance (e.g. OGC Gateway Reviews, MPRG reviews, and technical reviews) managed in an integrated and holistic way?

10) **Environment and Sustainability**. Given the increasingly high priority given to environmental and sustainability issues, a coherent, transparent, audited approach to these issues is required from the outset. On the Olympics, an independent review function tests the stated objective to be the “Greenest Games Ever”, reporting directly to the Olympic Board.

Relevant themes for LA Members –

- Will Crossrail meet the principles of sustainable procurement, sustainable construction, and sustainable operations? In particular how is Crossrail demonstrating this?

ANNEX A: LESSONS LEARNED FROM SELECTED INTERVIEWS

Alongside desk-based research into similar large rail infrastructure projects set out later, the Review Team took the opportunity to interview some eminent individuals who have had key roles in large infrastructure projects.

These individuals were:

- **Stuart Baker** – Deputy Director Rail Projects, Department for Transport;
- **Malcolm Hutchinson** – Managing Director, brought in to recover the Docklands Light Railway Project;
- **Steve Mitchell** – Director, OGC Director of Major Projects;
- **Professor Tony Ridley** – Managing Director Eurotunnel Project; CEO London Underground; MD Hong Kong Mass Transit Railway;
- **Tim Smart** – Director Engineering and Assets High Speed 1.

The key findings from these interviews, of relevance to Crossrail, are:

- To ensure that the project is properly owned and sponsored, with clear governance and decision making mechanisms;
- To ensure that the business case is well-developed, maintained and quantified;
- To ensure that the contracts are integrated, with singular overall responsibility;
- To use proven technology, or recognise the risks to costs and timescales inherent in employing unproven or innovative technology (e.g. signalling equipment);
- To ensure the right blend of skills between in-house resources and external resources to provide value for money;
- To establish an integrated assurance framework covering all stakeholders, including an authorised approvals process;
- To ensure robust budgetary and expenditure control, including proper contingency planning;
- To ensure sufficient planning for smooth transition to the operational status;
- To design the project with integrated railway operations clearly in mind from the outset;
- To plan carefully all interfaces and dependencies, both internal and external to the project.

Summaries of the interviews now follow.

Telephone Interview with Stuart Baker – Deputy Director National Rail Projects, Department for Transport

Context for these comments

DfT is one of the two sponsors and principal funders for Crossrail. Stuart Baker has responsibility for portfolio of some £20bn of national rail infrastructure projects, excluding London projects. He has also been heavily involved in a work package sponsored by the European Commission studying large infrastructure projects across Europe (www.netlipse.eu). It was on the basis of this European Commission work that the questions were answered. A copy of the NETLIPSE book *'Managing Large Infrastructure Projects in Europe'* was supplied for reference.

Issues and Learning Points

Clarity of Commercial Purpose

- From experience of numerous large infrastructure projects, it is important to be clear exactly what the project is for. For example, a metro project in a major European city was principally launched not because the city really needed it, but because other cities in the country and in neighbouring countries had more extensive metro systems;
- The NETLIPSE research had confirmed that one European country deliberately routed an EC-sponsored road through a national park, because it did not want the countries at the end of new road to gain too much of a commercial advantage;
- An inner ring road around the docks in a large European city was so long under discussion that it was eventually halted because the opposition to the road showed that the original need would now better provided for through a less disruptive outer ring road;
- A freight route from Holland to Germany was terminated at the German border, because the Germans did not have the same priorities in terms of the promotion of Rotterdam docks, preferring the development of Hamburg.

Current and Quantified Business Case

- Given the typical 17-22 year gap between initial ideas and the opening of large infrastructure projects, it is important for the business case to be maintained and current in order to be relevant to changing circumstances at all times;
- The business case needs to be solid and quantified, and not just qualitative;
- A solid and updated business case provides some immunity from changed policy due to a change of government.

Interview with Malcolm Hutchinson – previously Managing Director of Docklands Light Railway (DLR)

Context for these comments

MH was initially brought in on the recommendation of Peter Levene, in order to stabilise the DLR programme.
Once stable, MH led the JV consortium of Docklands Railway Management Ltd with Serco. Successful bid. MH remains a non-exec Chairman of Serco Docklands operating on the third generation of the Franchise Contract.

Issues and Learning Points

Signalling system

- At the time, the signalling system was innovative and not enough people really understood it. It took four years deliver acceptable performance.
- DLR didn't have the commercial competence to deal with the contractual risks that successful delivery of this sort of technology needed.
- DLR has subsequently become a more complex system with a complicated management structure and is facing not dissimilar problems to those previously solved.

Procurement and contracting strategies

- Nine separate contracts had been awarded, covering trains, signalling, depot, infrastructure, stations and track. This created immense problems at the interfaces, pitting one supplier against another. No one had overall responsibility for the delivery of an integrated system delivering specified service performance.
- The management team replaced that whole arrangement with a single Prime Contract, based on output performance actually achieved (e.g. train frequency achieved, available volume capacity etc);
- Summarised as "Integrated Contracting".

Level of technical and commercial skill

- Too many consultants. Not enough real in-house skill. Many consultants were employed on day rates, but had been there for 3 – 4 years;
- The priority was to shrink the team size (700+ to 450), remove the consultants / interims, and dramatically increase the calibre / capability;
- The key to success was:
    - People with technical skills;
    - People with commercial skills.
    - A responsible, accountable and empowered leadership

Interview with Steve Mitchell – Director of Major Projects, OGC

Context for these comments

Steve Mitchell (SM) is responsible for leading much of the OGC's programme of review activity, principally Gateway reviews and follow-up activity but he is also closely involved in Major Project Review Group (MPRG) activity. He is an experienced programme director in his own right, and he personally leads High Risk Gateways and participates in MPRG reviews. He has working in BAA plc on infrastructure development and experienced a period in the rail industry as a consultant. As a coincidence, he participated in the MPRG Review of Crossrail itself, earlier this year.

The comments below were offered in an interview about wider learning points from Steve's general experience before and within OGC.

Issues and Learning Points

Managing the transition through the project phases into operation. Most infrastructure projects start as engineering challenges, with the main focus directed at solving engineering and technology challenges. This then evolves into a business challenge – making the emerging infrastructure work as a coherent solution. Finally, the project evolves into operational reality, as it goes live. The challenge is integrating the engineering, business management and operational management phases as the project progresses, and in having sufficient operational challenge at the outset. Often, the critical task is to balance funding requirements, scope (cost) demands and programme sponsorship ambitions. The **BAA T5** programme went well initially, but failed to integrate the operational transition properly, and apparently failed to engage the operator early enough.

Understanding the cost risk trade-off. It is vital to make sure that the costs are properly estimated, and that the risks are well understood and placed with the organisations best able to manage them, recognising that wherever they lie – they are still potential threats to the final outcome. With Crossrail, there is a complex stakeholder group, and hence risk evaluation, allocation and most importantly mitigation will be a crucial factor.

The Governance and Decision Processes are very important. There needs to be a streamlined and transparent decision / approvals process across major programmes, enabling timely stakeholder interactions and inputs. There is a frequent interplay between scope and risks, usually involving stakeholder decisions. By way of example, the governance arrangements for the **Olympics**, whilst complex, have been very effective so far, balancing out in the Olympic Board the often different requirements of the Government, the Greater London Assembly, ODA and LOCOG.

Programmes not in the public glare seem to do better than ones that are in the full public visibility. The High Speed 1 **St Pancras** programme went really very well – mainly because it was a low profile programme with a simple stakeholder / investor profile.

Integrated assurance is a good idea, especially where there are multiple stakeholders, but it is still a developing concept in the world of Project Management. On the Olympics, there are four main stakeholder organisations, each potentially with their own assurance requirements. The Olympics has developed a more integrated approach to obtaining assurance, so that all stakeholder requirements are satisfied, with each report building off common data and more ongoing stakeholder dialogue, rather than starting afresh on each review. Thus the review work of the NAO recognises the OGC's Gateway Reviews, which are working in tandem with the Department for Culture Media and Sport (GOE)'s "deep dives", and in turn link to internal and external audit activity.

Budgets and expenditure control is vital. On major capital infrastructure programmes, much of the budget becomes allocated to essential infrastructure expenditure, and it often turns out that there is little room (contingency) to cater for over-runs. It is very important to have adequate contingency allowances and clear prioritised trade-offs, and to have visibility and transparency of budget elements at all stages.

Safety Cases need early attention and the regulatory approvals process must be considered from the outset.

Passenger behaviour is also a factor to consider in the design phase. **Thameslink 2000's** operational performance planning had a significant risk associated with passengers not boarding trains within the (very tight) planned time allowances. There were two reasons for this. Firstly, passengers on the system had a wide range of possible destinations, and it was possible that trains would arrive out of sequence. Unless constantly fed with sufficient information, passengers might take longer than planned to board trains, and platform congestion could result. Secondly, the trains needed more doors to reach the planned passenger boarding throughput. Crossrail, while simpler in these regards, retains ambitious train volumes and boarding times.

Signalling systems are often a problem on major rail infrastructure programmes. **The Jubilee Line** experienced many difficulties, the main one being the use of complicated technology that was ahead of its time (the "moving block" signalling). This was not understood at the time, and proved impossible to install within the contract period. Furthermore, scarce labour supply (electrical contractors) realised their key positions, and went on strike asking for increased pay**. The West Coast Mainline** was also adversely affected by signalling system design and installation.

Interview with Tim Smart – Director of Engineering and Assets – High Speed 1 Ltd

Context for these comments

Tim Smart joined HS1 after it was refinanced in 2006. He has worked on many major infrastructure projects including the Jubilee Line, and for Network Rail. Most of the Learning Points listed here relate to Tim's recent experience on the CTRL contract associated with the entry of the route into London and the reconstruction of St Pancras.

Issues and Learning Points

Use proven signalling technology – CTRL used proven and commercially available systems. There were some modifications, but CTRL attributes much of its "on time, on budget" success to using Commercial Off-the-Shelf proven signalling solutions. This contrasts with the Jubilee Line, where innovative signalling technology was attempted, which in the end proved too advanced and had to be abandoned at great cost and delay.

Design with the integrated railway operations in mind from the outset – It is easy to get civil engineers to design the bridges, mechanical and electrical engineers to design the power solution etc, but the main thrust of the design process should always aim for operational integration. Savings presented by civil engineering solutions, whilst appearing attractive, can be unintentionally wiped away by cost increases later on signalling and control systems if no-one has the overall operational system in mind.

Understanding the system interfaces is critical.

- Within the project, e.g. line to power to stations to systems to signalling, etc;
- With external bodies, e.g. to Network Rail to power companies to London Underground – all of whom have set standards.

Establish an authorised approvals process for compliance with standards. CTRL established the Compliance Review Group (CRG), whose remit was to oversee all design proposals from a compliance perspective – e.g. for signalling, power, track access, etc. The CRG was fully mandated to approve plans, ensuring compliance with Network Rail standards.

Competency of Mechanical and Electrical suppliers needs to be managed carefully. Signalling competencies are generally high, but resource availability is an issue. Suppliers of Mechanical services tend to work on shorter planning horizons – which created a difficulty for CTRL given the naturally long timescales involved. CTRL had to work hard to overcome suppliers' short-term planning horizons.

Operational Maintenance planning is vital. In hindsight, CTRL would have wanted to focus earlier on the maintenance regimes, and who was going to be responsible for maintenance, especially at interface points along the length of the project.

Avoiding neighbourly nuisance **-** CTRL had taken steps to agree a Code of Practice relating to avoiding nuisance. However, despite compliance with it, there were several objections to the nuisance created during construction. This related in an additional Planning Inquiry – resulting in delays and modified ways of working.

Getting the budget right – this was a key element of success. The project budget was worked up on a realistic basis at the point of re-financing, including a reasonable contingency allowance. This proved sufficient to cover for the known and unknown risks that materialised during construction.

Contract conditions – The New Engineering Contract was used extensively (Option A, the Lump Sum option, and Option E, the reimbursable option). This promoted good project management behaviour, and really paid dividends.

Bank account transparency – CTRL could see into the contractor's bank account, and could check whether subcontractors were being paid on time. This helped ensure that contractors were paid fairly.

Strong programme planning capability. CTRL developed a strong in-house project planning capability – the high-level milestone reports gave the right sort of overview information, and progress reports enabled insights which were necessary on particular issues. CTRL's approach was to take a directive management style to the planning process, rather than letting the suppliers co-ordinate amongst themselves. CTRL focussed on the suppliers with the longest programme activities and fitted in the other suppliers around that.

The role of the Delivery Partner was vital. In this case, Bechtel brought a strong problem-solving approach to the project, geared towards protecting the timetable. Inevitably this put pressure on costs, but Bechtel also enforced a rigorous cost control culture – resulting in continuous downwards pressure. One of the big and effective "sticks" was the use of the "Disallowed Costs" mechanism in the NEC. This helped enforce a discipline across the programme of timely, comprehensive, valid cost reporting.

CTRL used "expediters" to gain a detailed understanding of sub-contractors' progress, and to inform the planning process. This promoted early identification of issues and led to reduced pressure on the critical path.

CTRL's management recognised the benefits of incentivising the supply chain where appropriate (e.g. acceleration payments in order to protect the timetable, or incentivised milestone payments).

The CTRL team was excellent. The core in-house team comprised people with very relevant experience. The supplier teams were of the highest order, with key personnel hand-picked for this job from within them.

Maintaining flexibility and a dynamic management approach was essential to the success of the project. CTRL was able to restructure the timetable at intervals, realigning milestones and bonus payments in response to priorities as they emerged during construction.

Contract packaging. CTRL saw that having the St Pancras part of the project delivered in two main packages (one for the old station's refurbishment and one for the deck extension) was going to lead to inefficiencies and unnecessary interfaces. So CTRL restructured the St Pancras works packages into a much more practical arrangement, whereby more flexible modes of working were introduced.

Interview with Professor Tony Ridley

Context for these comments

Professor Ridley joined the Board of Eurotunnel as a non-Executive Member in 1987. He was Managing Director of the Project for two years. Immediately prior to that, he was on the Board of London Transport for eight years and was Chairman and Chief Executive of London Underground Ltd. He was the first Managing Director of the Hong Kong Mass Transit Railway Corporation 1975-1980, and was the first Director General of the Tyne and Wear Passenger Transport Executive 1969-1975. The responses below were offered as suggestions for Crossrail, based on Professor Ridley's extensive infrastructure experience.

Issues and Learning Points

A strong client is essential. A project lives or dies by the strength and coherence of the client. It is all very well having a strong project team, but the client team must be strong, focussed and well organised:

- This was the root cause of many of Eurotunnel's problems. The project was 'invented' by the contractors. Only later was a client (Eurotunnel) created, with a different set of objectives from the contractors. Regrettably the ultimate leadership exerted a totally destructive chemistry, which created a "contractor bashing" culture. This non-partnership style of working was the cause of many delays, disputes and cost over-runs;
- In contrast, the Olympics has a complex client structure, but it has overcome this with an effective governance structure and by effective "intelligent client" support;
- On the Hong Kong Mass Transit Railway, the Government client personally took on the role of overarching project champion and promoter, which ensured that the right people were doing the right work, and then let them get on with it with no nit-picking and avoiding scope changes. The Corporation, created by the Government to deliver and operate the Railway, made sure that there was complete alignment of the objectives, the politics, the management ability, the operational purpose and the financing;
- Metronet ran into major difficulties too, firstly because of failure from the outset to align the interpersonal relations between the parties and an over-reliance on massive sets of contract documents, but also because of its poor corporate governance and leadership (five main stakeholders), and because DfT carried very high risk exposure, but without carrying sufficient formal levers to influence outcomes. DfT was obliged to rely on other parties, e.g. London Underground, TfL and the Mayor of London, which made it difficult to adopt a risk management strategy commensurate with the risks that DfT faced. All parties were hampered by a lack of good quality information.

Recognise that the whole point is to provide a service. In the early stages, projects like Crossrail are managed by designers and constructors. However, the key to success is to make sure that the service works as an integrated whole, and to get the operator on board as soon as possible. On the Hong Kong Mass Transit Railway, one of the very first appointments was the Director of Operations, who had a central involvement from the very outset.

ANNEX B: GENERIC LESSONS LEARNED AND CODIFIED FROM THE NAO AND OGC

The National Audit Office and the Office of Government Commerce have distilled lessons learned from surveys of the performance of a wide range of programmes and projects:

- *Common Causes of Project Failure (NAO / OGC, 2005).* The NAO and the OGC identified eight common causes for why programmes and projects typically fail or perform sub-optimally. The causes are generic, and apply to all types of programme or project, including large infrastructure projects like Crossrail;
- *Ten Causes of Confidence in Major Projects and Programmes (OGC, draft Version 6, July 2009).* More recently, the OGC reviewed the performance of programmes and projects from the opposite perspective, and asked what kind of characteristics typically give confidence that a programme or project is likely to succeed. The ten causes of confidence were derived from an analysis of the Major Projects Portfolio (MPP), a portfolio of more than 40 of the largest programmes and projects across UK Government. The MPP's approach is to determine a "traffic light" confidence level for each of a range of key project parameters in the form of a high level dashboard. This approach is also consistent with the Delivery Confidence Assessment, a process that has become a key component of the OGC's Gateway Review process over the last 18 months, and which is widely used across Government in the UK and increasingly worldwide. Note that this work has been presented informally by the OGC at conferences for discussion, and that development work is continuing on the emerging draft presented here.

The major themes emerging from these reports are as follows:

Common Causes of Project Failure (NAO / OGC):

1) Lack of a clear link between the project and the organisation's key strategic priorities, including agreed measures of success;
2) Lack of clear senior management and Ministerial ownership and leadership;
3) Lack of effective engagement with stakeholders;
4) Lack of skills and proven approach to project management and risk management;
5) Too little attention to breaking development and implementation into manageable steps;
6) Evaluation of proposals driven by initial price rather than long-term value for money (especially securing delivery of business benefits);
7) Lack of understanding of, and contact with, the supply industry at senior levels in the organisation;
8) Lack of effective project team integration between clients, the supplier team and the supply chain.

Ten Causes of Confidence in Major Projects and Programmes (OGC):

1)	Initial Assessment	Getting off on the right foot
2)	Programme Leadership	Having the right people
3)	Scope aims and benefits	Defining the task appropriately
4)	Position within a Department	Knowing your environment
5)	Managing the Time-Cost-Quality triangle	Keeping feet on the ground
6)	Assumptions, Risks, Issues	Knowing what could go wrong
7)	Skills and expertise	Having the right know-how
8)	Stakeholders	Appreciating who can help or harm you
9)	Business models	Making it work for real
10)	Managing suppliers/consultants	Getting through to the end

These themes are obviously generic and high level, but they represent analysis of hundreds of programmes and projects. The themes clearly demonstrate that programmes and projects tend to suffer from the same types of issue, and conversely that certain kinds of behaviour can lead to a high level of confidence that a programme or project will succeed.

Crossrail will undoubtedly be subject to the same causes of failure and causes of confidence, according to how well it is managed and assured.

The following table includes a range of questions from the original NAO and OGC sources. We have added an extra column with some specific questions and observations relevant to Crossrail at its particular stage of development. We have also carried forward the main themes to the main body of this report and the Management Summary.

NAO/OGC Common Causes of Project Failure (2005)	Relevance to Crossrail
The questions under each common cause of failure are written from the perspective of the leaders of a project asking these questions. They can readily be re-phrased from the perspective of an external scrutiny, such as that envisaged by the London Assembly Transport Committee. NAO and OGC note that if any of the answers to the questions below are unsatisfactory, an acquisition-based project should not be allowed to proceed until the appropriate assurances are obtained.	
1. Lack of clear link between the project and the organisation's key strategic priorities, including agreed measures of success • Do we know how the priority of this project compares and aligns with our other delivery and operational activities? • Have we defined the critical success factors (CSFs) for the project? • Have the CSFs been agreed with suppliers and key stakeholders? • Do we have a clear project plan that covers the full period of the planned delivery and all business change required, and indicates the means of benefits realisation? • Is the project founded upon realistic timescales, taking account of statutory lead times, and showing critical dependencies so that any delays can be handled? • Are the lessons learnt from relevant projects being applied? • Has an analysis been undertaken of the effects of any slippage in time, cost, scope or quality? In the event of a problem/conflict at least one must be sacrificed.	For Crossrail, "the organisation" is actually a question in its own right, since there are at least two main sponsoring and funding organisations (DfT and TfL with the Mayor of London). Individually and collectively the different groups ought to be able to answer the OGC's questions opposite. **Relevant themes for LA members** – • In the absence of the future operator(s), how effectively is TfL providing the relevant long-term operator viewpoint and requirements? • Is the client organisation side (individually within the respective organisations and collectively as a decision authority) properly organised into a coherent decision-making body? • Are early versions of the Business Case, CSFs and Benefits Management regime in place, and is there a strong theme of operational service evident as the dominant force? Do these documents cover the whole life of the Crossrail Project, and not just the delivery of the infrastructure project and its services?
2. Lack of clear senior management and Ministerial ownership and leadership • Does the project management team have a clear view of the interdependencies between projects, the benefits, and the criteria against which success will be judged? • If the project traverses organisational boundaries, are there clear governance arrangements to ensure sustainable alignment with the business objectives of all organisations involved? • Are all proposed commitments and announcements first checked for delivery implications? • Are decisions taken early, decisively, and adhered to, in order to facilitate successful delivery? • Does the project have the necessary approval to proceed from its nominated	For Crossrail, with multiple stakeholders and multiple sources of funding, enduring senior sponsorship and commitment will be vital. **Relevant themes for LA Members –** • Is there clear ownership and leadership of the Crossrail project from Ministers, civil servants, and senior executives in the sponsoring organisations? • What provisions are in place to minimise the impact of a possible change in Government in 2010? • Is there a defined Senior Responsible Owner and is he or she appropriately skilled, respected, authorised and effective?

NAO/OGC Common Causes of Project Failure (2005)	Relevance to Crossrail
Minister either directly or through delegated authority to a designated Senior Responsible Owner (SRO)? • Does the SRO have the ability, responsibility and authority to ensure that the business change and business benefits are delivered? • Does the SRO have a suitable track record of delivery? Where necessary, is this being optimised through training?	
3. Lack of effective engagement with stakeholders Have we identified the right stakeholders? • In so doing, have we as intelligent customers identified the rationale for doing so (e.g. the why, the what, the who, the where, the when and the how)? • Have we secured a common understanding and agreement of stakeholder requirements? • Does the business case take account of the views of all stakeholders, including users? • Do we understand how we will manage stakeholders, e.g. ensure buy-in, overcome resistance to change, allocate risk to the party best able to manage it? • Has sufficient account been taken of the subsisting organisational culture? • Whilst ensuring that there is clear accountability, how can we resolve any conflicting priorities?	The Crossrail Project Team should have in place a Stakeholder Engagement Strategy, and a Stakeholder Engagement Plan by now. Further, TfL and DfT as the main funders and stakeholders should have the capability to act as "Intelligent Clients" enabling them to retain control of the project and take decisions in a timely way. **Relevant themes for LA Members –** • Is there a comprehensive Stakeholder Engagement Plan in place? • Is it signed off and has it been communicated widely?
4. Lack of skills and proven approach to project management and risk management • Is there a skilled and experienced project team with clearly defined roles and responsibilities? If not, is there access to expertise, which can benefit those fulfilling the requisite roles? • Are the major risks identified, weighted and treated by the SRO, the Director, and Project Manager and/or project team? • Has sufficient resourcing, financial and otherwise, been allocated to the project, including an allowance for risk? • Do we have adequate approaches for estimating, monitoring and controlling the total expenditure on projects? • Do we have effective systems for measuring and tracking the realisation of benefits in the business case? • Are the governance arrangements robust enough to ensure that "bad news" is not filtered out of progress reports to senior managers? • If external consultants are used, are they accountable and committed to help ensure successful and timely delivery?	The Crossrail Project Team should ensure that all of these components of sound project management are in place, rigorously monitored and maintained throughout the life of the project. **Relevant themes for LA Members -** • Funding approval / affordability – are the financial resources in place for the current phase of work? How long will the funding commitment last, when is the next review point and what are the scenarios at that point? Are those scenarios reflected in the procurement and contract strategy? • Is the Programme Partner (Transcend) proving effective in the early stages? • Is the Project Delivery Partner (Bechtel) proving effective in the early stages? • What mechanisms does the Crossrail Project Team have in place for monitoring the performance of these two key roles? • Is the project making appropriate use of interims and consultants, given the long-term nature of the programme?

NAO/OGC Common Causes of Project Failure (2005)	Relevance to Crossrail
5. Too little attention to breaking development and implementation into manageable steps • Has the approach been tested to ensure it is not 'big-bang' for example in IT-enabled projects? • Has sufficient time been built in to allow for planning applications in Property & Construction projects for example? • Have we done our best to keep delivery timescales short so that change during development is avoided? • Have enough review points been built in so that the project can be stopped, if changing circumstances mean that the business benefits are no longer achievable or no longer represent value for money? • Is there a business continuity plan in the event of the project delivering late or failing to deliver at all?	It will be vital for the planning on Crossrail to be of the highest order, given the size of the project, and the numerous inter-dependencies both between the components of the project and the external dependencies. **Relevant themes for LA Members –** • Have the Crossrail Project Team and its partners developed a comprehensive project plan? • Is the project plan divided into well-defined stages and sub-stages with clear milestones, in accordance with PRINCE2 or another reputable project management methodology? • Is the Crossrail Team content that all other components of sound project management are in place? • Has the Crossrail Team developed a framework for independent reviews - OGC Gateway Reviews, MPRG Reviews and MPP - to be undertaken at key points befitting the nature of each type of review?
6. Evaluation of proposals driven by initial price rather than long-term value for money (especially securing delivery of business benefits) • Is the evaluation based on whole-life value for money, taking account of capital, maintenance and service costs? • Do we have a proposed evaluation approach that allows us to balance financial factors against quality and security of delivery? • Does the evaluation approach take account of business criticality and affordability? • Is the evaluation approach business driven?	This is very relevant to Crossrail – the key point being to drive today's decisions from the long term perspective of long term (whole life) costs. **Relevant themes for LA Members –** • Does the Crossrail Project Team have a Business Case that sets out how whole-life value for money will be achieved? • Is TfL (in the absence of the long term operator at this stage) sufficiently involved in the business planning, and in the design principles – and is TfL taking the long-term operational perspective?
7. Lack of understanding of, and contact with, the supply industry at senior levels in the organisation • Have we tested that the supply industry understands our approach and agrees that it is achievable? • Have we asked suppliers to state any assumptions they are making against their proposals? • Have we checked that the project will attract sufficient competitive interest?	With the Olympics competing for scarce resources, and with the lessons learned from the Jubilee Line and Channel Tunnel in particular, it will be very important to have a long term collaborative relationship with the supply industry. **Relevant themes for LA Members –** Has the Crossrail Project Team developed and started to

NAO/OGC Common Causes of Project Failure (2005)	Relevance to Crossrail
• Are senior management sufficiently engaged with the industry to be able to assess supply-side risks? • Do we have a clear strategy for engaging with the industry or are we making sourcing decisions on a piecemeal basis? • Are the processes in place to ensure that all parties have a clear understanding of their roles and responsibilities, and a shared understanding of desired outcomes, key terms and deadlines? • Do we understand the dynamics of industry to determine whether our acquisition requirements can be met given potentially competing pressures in other sectors of the economy?	implement: • A Market/Supplier Engagement Strategy? • A Market/Supplier Engagement Plan? • A Sourcing Strategy? • A Sourcing Plan?
8. Lack of effective project team integration between clients, the supplier team and the supply chain • Has a market evaluation been undertaken to test market responsiveness to the requirements being sought? • Are the procurement routes that allow integration of the project team being used? • Is there early supplier involvement to help determine and validate what outputs and outcomes are sought for the project? • Has a shared risk register been established? • Have arrangements for sharing efficiency gains throughout the supply team been established?	On a major programme such as Crossrail, it will be vital for a fully integrated team approach to be in place. **Relevant themes for LA Members –** Has the Crossrail Project Team developed and started to implement: • A Market Appraisal? • A Shared Risk and Reward Mechanism, with risks and rewards apportioned between the Authority and the various Suppliers according to where they best fit?

OGC's Ten Common Causes of Confidence (July 2009 draft, subject to development)	Relevance to Crossrail
1. Initial Assessment — Getting off on the right foot ▪ Have the initial Time Cost and Quality parameters been identified and what degree of flexibility there is within these? ▪ Have these been relayed to Ministers and discussions held on adopting a more flexible approach until Business Cases are fully developed?	With the project now "live", it will be very important to manage the trade-offs between costs, time and quality effectively, and to keep the business case up to date. **Relevant themes for LA Members –** • What is the current status of the Business Case and Project Plan – is the project on track to produce a "no surprises" next version? • What is the Crossrail Project Team's perception of the key risks with regard to time, cost and quality? • Is there a clearly stated trade-off criterion between cost, time and performance, and are the right people empowered to make those decisions?
2. Programme Leadership — Having the right people ▪ Does the SRO/PD-M have the relevant skills and experience for this role, and if not can he/she attend appropriate training and/or benefit from external mentoring or coaching whilst in the role? ▪ Does the priority of this role within the SRO's other responsibilities allow the bandwidth to spend a significant % of their time on leading the Programme? ▪ Will the SRO/PD be with the programme for the foreseeable future, at least until achievement of the next major milestone? ▪ If in a full time SRO role, is there a supervising Department Board level sponsor who provides the organisation-wide perspective and input? ▪ Do the SRO and PD have a clear mandate supported and endorsed by all parties (including other departments and organisations) and the wherewithal to ensure actions are taken? ▪ Is there sufficient support (from a Programme Office or equivalent) to enable the SRO and PD to be fully effective in their role? {See also Cause 7 Skills}	There are only a few people worldwide with the right skills and experience to lead this programme. Many have significant commitments on existing rail / infrastructure programmes. **Relevant themes for LA Members –** What is the degree of confidence in: • The governance mechanisms that are in place? • The leadership that is in place? • The relevance of the skills and background of the key personnel?
3. Scope Aims and Benefits — Defining the task appropriately ▪ Do the scope and aims make it clear what the specific outcomes of the Programme will be, with associated Critical Success Factors? ▪ Is it clear whether the Programme is delivering infrastructure enabling outcomes (such as new IT hardware/software, a new organisation or building), or delivery of	Given the recent calls for new stations and other likely pressures on scope creep, it will be very important to keep the scope under control via a robust change control mechanism. **Relevant themes for LA Members –**

OGC's Ten Common Causes of Confidence (July 2009 draft, subject to development)	Relevance to Crossrail
long term policy aims? ▪ Do the benefits claimed appropriately reflect the scope and aims? ▪ Is there clarity over who is responsible for delivery of long term benefits, both during the Programme life and after its formal closure? ▪ Does the Programme scope include the establishment of a Business Change process to implement and deliver long term benefits?	• To what extent is a robust change process in place, to control the scope and the resultant budget and timeframe? • How clearly stated are the benefits of Crossrail and who is charged with delivering them? • What mechanisms will be in place to ensure the delivery of the benefits over the whole life of the Crossrail service?
4. Position within a Department Knowing your environment ▪ Is the overall priority of the Programme within the Department's Portfolio explicitly stated and understood at Departmental Board level? ▪ Are the Department's Board Champion, PPM Leader and Chief Information Officer all regularly briefed on the programme's progress including receiving Gateway reports? ▪ What is the degree of Ministerial support and interest in the Programme and is the Minister regularly briefed on progress and deliverability? ▪ Are Departmental pressures appropriately reflected in the programme's Assumptions and Risk Registers and taken into account when planning timelines and milestones? ▪ Are there mechanisms for relating with other Programmes within the Department, to share experiences and learning, exchange or loan personnel, and make best use of resources within the Department?	Given the dual sponsorship of the project between TfL and the DfT, the arrangements within the two key organisations will need to work smoothly in order to deliver Crossrail effectively. **Relevant themes for LA Members –** • Does Crossrail have sufficient, enduring, priority in the DfT and TfL budgets? • How have dependencies been addressed in relation to the sponsor and partner organisations? • Are the management processes and resources within DfT and TfL suitably qualified and engaged?
5. Managing the Time-Cost-Quality triangle Keeping feet on the ground ▪ Are time, cost and benefits/quality parameters clearly stated in the Business Case and understood by all involved with the Programme? ▪ Is it possible to deliver to the extant Time Cost and Quality parameters? If not, is this being explicitly stated in reports to the SRO, Board, Department, and OGC? ▪ Are Ministers regularly briefed on the ability to meet Time Cost Quality parameters? ▪ Do the SRO and Programme Board regularly review the major external factors (such as the political, economic, stakeholder and technical environments) impinging on the Time Cost Quality parameters and their deliverability? ▪ Is there an understanding of the need to manage Time Cost Quality parameters as a dynamic model where changes to one parameter always involve changes to the others?	Given the current pressures on the Exchequer, and given the budget pressures on TfL and other sponsors, having a particularly tight management grip on the cost / time / quality parameters will be vital, as will the relationship with the funding stakeholders. **Relevant themes for LA Members –** • Are the time, cost and benefits/quality parameters clearly stated in the Business case? • What mechanisms are in place for managing, monitoring and reporting on delivery to the extant Time Cost and Quality parameters?

OGC's Ten Common Causes of Confidence (July 2009 draft, subject to development)	Relevance to Crossrail
6. Assumptions, Risks, Issues — Knowing what could go wrong ▪ Are the major assumptions underpinning the aims and progress of the Programme documented with their origin/authority/provenance? ▪ Are the major assumptions regularly reviewed by the Programme Board and SRO? ▪ Does the Risk Register reflect that major assumptions may become invalid or no longer relevant? ▪ Does the Risk Management process ensure that mitigating actions are assigned to responsible individuals who are then held to account for positive action? ▪ Do risk/assumption mitigating actions include contingency planning to cover major assumptions no longer applying?	Managing risks and opportunities will be a key part of Crossrail's daily life. The project team will need efficient timely risk management processes in place – communicated where needed amongst the stakeholder community. **Relevant themes for LA Members –** • What mechanisms are in place for identifying, monitoring and managing risks, issues and assumptions? • Are there realistic mitigations in place? • Is the contingency fund set at a realistic and practical level?
7. Skills and Expertise — Having the right know-how ▪ Has there been a comprehensive analysis of the skills and expertise needed to run and deliver the Programme and a resourced plan developed for filling these? ▪ Are the skills and expertise within the Programme regularly reviewed by the SRO and Programme Board to ensure the right skills are in the right place at the right time? ▪ Is there a willingness to use external sources, such as Consultants, for skills and expertise when these are not available within the Department? ▪ Have the procurement/commercial/contract management skills and expertise been appropriately identified and sourced? ▪ Has a fully functioning Programme/Portfolio Office been established early to ensure appropriate PPM practices are embedded from the outset?	Given the complex nature of the programme, it will be vital for Crossrail to have the right skills and know-how on board. Key skills will be Senior Responsible Owner, Project Director/Manager, Procurement Director/Manager, Contract Director/Manager, and Operations Director/Manager. Other large rail projects have run into difficulty due to scarcity of technical resource, notably innovative signalling specialists. **Relevant themes for LA Members –** • Are there suitably qualified team leaders (one level below Director level) deployed across the programme? • What reviews have been conducted to assure the project team? • Does Crossrail have sensible policies in place in regard to consultants and interims?
8. Stakeholders — Appreciating who can help or harm you ▪ Has a Stakeholder Management approach been developed that forms the basis for active stakeholder engagement throughout the programme, to ensure the appropriate degree of commitment and support as and when these are needed? ▪ Are the commitment levels of stakeholders and their degree of support or ability to undermine the programme regularly assessed and acted upon? ▪ Is there an active programme of communications with stakeholders that takes into account their specific needs and views? ▪ How are stakeholder views and concerns assessed and compiled to ensure an up-to-date picture that is reviewed by the SRO and Programme Board?	This is probably the single most important topic at this stage – and one where lessons can be earned from other relevant programmes such as the Olympics. **Relevant themes for LA Members –** • Has the Crossrail Project Team developed a Stakeholder Engagement Strategy and Stakeholder Engagement Plan? • Are the main funding stakeholders suitably engaged in the project? • Are relevant Ministers kept informed?

OGC's Ten Common Causes of Confidence (July 2009 draft, subject to development)	Relevance to Crossrail
9. Business Models Making it work for real ▪ Has a new top level operating model (Blueprint) been derived showing how the business will operate in the new world after the change programme? ▪ Have new business processes been developed to make the new model work? ▪ Have users and customers been involved in the evolution of the new business processes? ▪ Have changes in accountabilities and structures been considered, planned and/or implemented? ▪ Are timescales for implementation realistic and do they allow for "business as usual" services to continue with minimal disruption? ▪ If a big bang approach been selected, is there high level authority for this with an appropriate consideration of alternative options and risks? ▪ Has a Business Change Manager been appointed early to be involved in the design of the new business and oversee its implementation?	Experience from similar programmes (e.g. DLR, Hong Kong Mass Transit) shows just how important it is to get the operator(s) on board right from the outset and to include the operator's views and requirements in the business planning and the design development phases. **Relevant themes for LA Members –** • Is the future operator fully engaged in Crossrail? • Has the transition to live operations been given enough consideration at this stage?
10. Managing Suppliers/Consultants Getting through to the end ▪ Are suppliers (whether under contract or not) actively involved in the design, governance and progress of the Programme as a partner? ▪ Are there robust processes for sharing risks and information with suppliers? ▪ Is there sufficient transparency about what is happening within the suppliers and any associated sub contractors? ▪ Does the Programme have the appropriate skills and robust processes to monitor supplier (and key sub-contractor) activities with an agreed "no surprises" culture? ▪ Do the SRO and Programme Board routinely review supplier (and key sub-contractor) performance and issues? ▪ Is there a good awareness at Programme Board level of the pressures and issues that suppliers and contractors face and how these may impinge on their performance – and a readiness to engage with suppliers at the highest levels if needs be? ▪ Does the Programme have some external forms of Supplier Assurance that supplement its own monitoring and management of performance?	It will be vital to ensure that the suppliers are engaged, directed and managed in an integrated manner, if work is to be conducted effectively and value for money achieved. **Relevant themes for LA Members –** • Has the Crossrail Project Team developed a Supplier Engagement Strategy and Plan covering the whole length of the programme? • Are the suppliers appropriately incentivised (i.e. not simply employed on a cost reimbursable basis)?

ANNEX C: SPECIFIC LESSONS LEARNED FROM UK AND INTERNATIONAL PROJECTS

In addition to the generic lessons learned from the NAO and OGC, the Review Team carried-out desk-based research in regard to a number of specific UK and international large infrastructure projects.

The specific projects considered were:

- The Channel Tunnel Rail Link (CTRL): the high-speed link between the Channel Tunnel and St Pancras station in London;
- Thameslink 2000: the North-South scheme to increase commuter routes through London;
- Metronet: the contractor engaged in a Public-Private Partnership with London Underground for Tube maintenance and upgrade;
- Docklands Light Railway;
- London Underground Jubilee Line;
- West Coast Mainline;
- Heathrow Terminal 5;
- Olympics 2012;
- Amsterdam Metro;
- Other large infrastructure projects on mainland Europe - EC-sponsored road, Antwerp docks, road from Rotterdam to Germany.

Some of the key findings from this research of relevance to Crossrail are:

- To establish lean, unambiguous, efficient and effective governance mechanisms;
- To retain client control (DfT and TfL/Mayor) over the Crossrail programme;
- To ensure sufficient skilled and experienced resources on the client side to enable it to act as an “intelligent client”;
- To identify the remaining major consultative processes that need to be undertaken, and their likely impact on timings and costs;
- To ensure that the situation is clear with regard to the availability, sources and mechanisms of funding, including contingency funds;
- To ensure that risks are allocated to the most appropriate party, and that both the client side and the supplier side are fully aware of the risks and liabilities that they have taken;
- To ensure harmony between the various high-level stakeholders over plans.

The lessons learned have been marshalled against ten key areas as follows:

1 - "Mega projects" have disproportionately high risk levels. Mega projects run as regular projects get into difficulty.

Project; Location	Key features/ Learning points	Relevance to Crossrail
Mega projects and risk – Book by Bent Flyvbjerg (ref below)	Professor Flyvbjerg is a world authority on mega-projects and has published several books and many hundreds of papers on this subject. Professor Flyvbjerg observes that very large projects tend to over-run, e.g.: • Boston artery/tunnel project 196%; • Boston Washington-New York Rail 130%; • Great Belt Rail Tunnel, Denmark 110%; • Shinkansen Joetsu rail line, Japan 100%; • Washington metro 85%.	On large programmes spanning many years, the unforeseeable risks will be more significant than the foreseeable risks which should have already been mitigated against and costed. For Crossrail, it will be very important to have sufficient contingency, to allow for both the foreseeable risks and the unforeseeable risks. **Relevant themes for LA Members –** • Is there a significant contingency sum in the budget? If not, what distinguishes this project from the ones listed opposite in terms of cost certainty? This will very likely be a KEY ISSUE for Crossrail. • Is there a clear policy governing the use of the contingency sum?
London Olympics	Olympic Games programmes involve not only creation of new sports facilities, but also substantial infrastructure and regeneration programmes. Since 1948, the only Games programme not to have over-run is Atlanta. For London 2012, the bid submitted to the IOC contained predicted costs of £2.2 bn. However, the total budget including the revised contingency allowance currently stands at £9.6bn, recognising the need for much greater contingency sums to cover additional costs for security, the athlete's village accommodation (previously assumed to be provided by the market) and other scope changes.	Despite a reasonably predictable and stable set of requirements from the IOC, it still seems extraordinarily difficult for planners of Olympic Games to set a realistic budget at the outset. **Relevant themes for LA Members –** • In the worst case scenario, in which unexpected costs are identified necessitating an increase in funding, are there principles in place between the stakeholders to allow for increased funding to be provided? • Are there any dominant time objectives that will apply pressure to the costs?

2- Governance, Stakeholder Engagement and Decision Making Structures

Project; Location	Key features/ Learning points	Relevance to Crossrail
London Olympics	The objective is to build facilities for the Olympic Games in 2012, win a substantial medal haul (targeting fourth), regenerate the area around the Olympic Park and create a lasting legacy. **Interesting features** The Olympics has a multitude of stakeholders. The six main ones are : • The Government; • The LDA, on whose land the Games will run; • The British Olympic Association; • The Mayor; • LOCOG (running the Games); • The ODA (building the infrastructure). In addition, there are many hundreds of other stakeholders with an interest in the Games, including the general public and those who will attend the games. **In terms of Governance:** • The Government has created an Intelligent Client Unit, representing its interests as an informed client able to make decisions on time; • The Olympic Board is an effective forum for coordinating all policy requirements and major decisions; • The Olympic Programme Review Group is an effective forum for co-ordinating all project activity across the Games, and for sanctioning procurement strategies and procurement decisions.	The stakeholder and decision processes for Crossrail could well be as challenging as for the Olympics, given the length of the programme (time and distance), the number of stakeholders affected, and the number of significant interfaces and the level of risk. **Relevant themes for LA Members –** • How robust is the governance: o Stakeholder communications and stakeholder decision processes? o Procurement decision processes? • Above Crossrail, are the DfT / TfL and Mayor's office acting together as a well-informed intelligent client, equipped with the necessary information to take decisions, and doing so in a timely way?
Channel Tunnel	The objective was to build the Channel Tunnel, linking England and France. **Interesting features:** • The project was "borne" and developed by UK and French Contractors and was proposed to the UK and French Governments. As such, it was "supplier led", and suffered from a lack of strong client sponsorship (made doubly difficult by the international structure); • The relationships between the client and the suppliers was poorly conceived and adversarial, resulting in multiple disputes and claims	Given the complex stakeholder environment for Crossrail, it will be vitally important to ensure excellent client governance, communications and reporting. Crossrail cannot afford to allow adversarial relationships to develop, as were evident on the Channel Tunnel. It will be important to establish a non-adversarial client-supplier culture, in which roles, responsibilities and risks are unambiguous and clearly articulated and understood, and suppliers are rewarded

	for additional payment.	promptly and fairly in a transparent way. **Relevant themes for LA Members -** • The importance of having an effective client decision-body is clear from the Channel Tunnel experience. On Crossrail, with two main funding organisations, the KEY ISSUE is "who is the client"? • Is the stakeholder engagement plan comprehensive, practical and thought-through? • Is the stakeholder engagement plan actually being put into practice and is it working? • Is the supplier management strategy aimed more at collaborative working than adversarial positioning?
Channel Tunnel Rail Link (CTRL); UK	The objective of the CTRL was to provide a high speed link between the London St Pancras and the Channel Tunnel, thereby establishing a high speed link to mainland European destinations. **Interesting features:** • The CTRL project had a high profile, with significant public and political interest, and a wide range of stakeholders; • There were numerous interfaces with local authorities on planning and joint construction works; • Good CTRL transport links were seen as essential for the 2006 World Cup bid, and for the Olympics 2012 – thus providing impetus; • There was recognition of the need for ongoing positive PR. **Lessons learned:** • There are strong benefits from having a simple, straightforward governance structure; • A good stakeholder management process was essential – genuine engagement was a key element.	**Relevant themes for LA Members –** • Has the Crossrail Project Team established lean, unambiguous, efficient and effective governance mechanisms? • Are the many interfaces, both within the Crossrail project and with third parties, under control? • Has the Crossrail project team clearly identified the target benefits and processes for their ongoing measurement? • Does Crossrail have a Communication Strategy and Plan?
Metronet; UK	The objective of Metronet was to provide maintenance and development services to Transport for London under a Public Private Partnership contract for nine of the London Underground routes. **Key points:**	Adversarial customer-supplier relationships need to be avoided at all costs. A significant amount of press coverage showed the tense and adversarial relationships that developed between TfL and Metronet. Not only were there contractual disputes, and union unrest, but the governance was found

	• There was a prickly relationship between the London Transport Commissioner and bidders for the tube contracts from the start. Early on, talks with the Transport Commissioner aimed at securing contracts collapsed in acrimony (July 2001); • There was ongoing acrimony over whether the PPP was the right mechanism for tube maintenance and upgrade (see also below); • There was ongoing union discontent at the part-privatisation of the London Underground network, and there were a number of instances of industrial action which threatened to cripple the project. **Learning points:** • Direct quote from the NAO's report on Metronet (5 June 2009): ***"The main cause of Metronet's failure was its poor corporate governance and leadership***. *Many decisions had to be agreed unanimously by five shareholders, which all acted as Metronet's suppliers and had different motivations depending on their roles. The executive management changed frequently and was unable to manage the work of its shareholder-dominated supply chain effectively. These suppliers had power over some of the scope of work, expected to be paid for extra work undertaken and had better access to cost information than the management. The poor quality of information available to management, particularly on the unit costs of the station and track programmes, meant that Metronet was unable to monitor costs and could not obtain adequate evidence to support claims to have performed work economically and efficiently."* • The governance arrangements were flawed. DfT retained the majority of the risk, but gave away the main levers and controls. While there was reporting, this did not enable or promote effective governance intervention; • The stakeholder engagement process did not work – either upwards into government or downwards into the unions and the labour force; • NAO 2009: *"DfT was exposed to risk but lacked direct ways of gaining assurance over the management of this risk".*	materially wanting by the NAO in its recent review. **Relevant themes for LA Members –** • Have the two main stakeholders (DfT and TfL) retained sufficient control over the Crossrail programme, or has too much been "delegated away"? • Do DfT and TfL contain sufficiently skilled and experienced internal resources to enable them to act as an "Intelligent Client" and therefore fulfil their governance role properly? • Has the Crossrail Project Team agreed up-front the procurement strategy with the key stakeholders/funders? • Has the Project Team identified potential sources of industrial unrest (e.g. privatisation or part privatisation, loss of jobs, or changes to jobs or working practices), and taken mitigating action?
Thameslink; UK	The objective of Thameslink was to provide a North-South link across London . **Interesting features** • Thameslink was subject to lack of clarity of roles and resultant rows between the stakeholders notably the Strategic Rail Authority and Office of Deputy Prime Minister over the plans for Thameslink, with the Department for Transport and Network Rail also involved.	**Relevant themes for LA Members –** • Has Crossrail got a clear and unambiguous governance structure? • Has the Crossrail Project Team clearly identified any key strategic decisions that remain as risks to

		timescales, plans and costs? • Has the Crossrail Project Team identified the remaining major consultative processes that need to be undertaken, and their likely impact on timings and costs?

3- Funding, Finance and Cost Control

Project; Location	Key features/ Learning points	Relevance to Crossrail
London Olympics	• The initial contingency was far too low, due mainly to significant items – such as security provisions, the Olympic village and VAT - not being properly covered.	The lack of suitable risk allowance can create delay and gridlock in the programme's timetable. It is very important to have sufficient contingency, properly authorised and funded, so as to avoid delay. **Relevant themes for LA Members –** • Is there a reasonably thought-through contingency sum with appropriate delegated controls?
Channel Tunnel Rail Link (CTRL); UK	• There was considerable uncertainty, perhaps "crisis", over overall funding availability and sources; • CTRL operator London & Continental Railways (LCR) was in danger of collapse due to financial difficulties, with resultant uncertainty for CTRL operations and jobs. LCR survived by securing bonds for £1.6bn; • Shareholders should have put more money in, according to MPs; • There was a cost hike of £320,000 at Kings Cross station due to scope change.	**Relevant themes for LA Members –** • Is the situation clear with regard to the availability, sources and mechanisms of funding, and are there mitigation processes in place to cover the risks of key backers stepping back or defaulting? • Is there tight, effective, cost control? • Is there sufficient contingency money set aside for foreseeable risks? This is likely to be a top issue for Crossrail, with its multi-stakeholder and multi-funding sources.
Metronet; UK	• The public Private Partnership hit financial issues early on and throughout the term of Metronet's involvement; • Early on, Metronet had insufficient funds to proceed, requiring Government lawyers to agree to skew payments to allow the project to proceed; • Fines totalling £26.5M were imposed on Tube Lines and Metronet in the first two years of their contracts;	This is a key risk area: ultimately, the Government must step in to rescue failed public-private ventures. **Relevant themes for LA Members –** • Are both the client and supplier side fully aware

	• The shareholder companies in the Metronet consortium suffered substantial losses; • In July 2007, Metronet BCV and Metronet SSL went into administration when they became unable to meet their spending obligation; • The PPP Arbiter later said that Metronet was due up to £1.07bn from London Underground.	of the risks and liabilities that they have taken? • The consortium's behaviours were influenced by their shareholding / ownership interests. Is TfL satisfied that no such distortions exist in Crossrail's governance?
Thameslink; UK	• The government gave £30M to the Thameslink project for project planning and design development, with final decisions on funding the scheme - projected to cost around £3.5 bn - to conclude in summer 2007; • There was a lot of speculation and uncertainty over whether Crossrail would be built at the expense of Thameslink; • There were strong rumours that the Comprehensive Spending Review in 2007 could see the axe fall on Thameslink after almost two decades of development and delay. However, funding approval was given and construction began in late 2007.	Lack of certainty on funding inevitably leads to stakeholder nervousness. In the case of Crossrail, this uncertainty will remain at least until after the General Election, with a significant risk that Crossrail may be axed, delayed or mothballed. **Relevant themes for LA Members –** • What steps has the Crossrail Project team taken to minimise uncertainty over funding? • How is Crossrail aligning the contract strategy with known funding / affordability timescales?

4- Procurement Strategy and Contracting

Project; Location	Key features/ Learning points	Relevance to Crossrail
BAA Terminal 5 Project; UK	• BAA used a very collaborative form of contract for the construction programme, in which risks were shared appropriately, and in which incentives were aligned with outcomes. The Terminal 5 form of contract was based on the New Engineering Contract (NEC), which promotes collaboration and partnership, with the onus on all parties to follow best practice programme management.	It is important to use a contract that promotes collaboration and effective programme management. It is also important to have a team that genuinely embraces such techniques, rather than the "old school" approach (adversarial, claims oriented and non-collaborative). **Relevant themes for LA Members –** • Is Crossrail adopting a collaborative form of contract such as the NEC? • Does the project leadership espouse modern project management techniques and collaborative working?
Docklands Light Rail; UK	• The original procurement strategy resulted in a complex contractual environment, in which multiple contracts were awarded for the track,	Simplicity is good! Minimising the number of contracts, and therefore

	signalling, controls, and stations; • This created severe challenges at each interface, and meant that no one person held the integrated operating solution; • It also resulted in a significant requirement for an in-house team; • When the DLR was restructured and refinanced, the replacement arrangements were much simpler – a single contractual route via a Prime Contractor arrangement.	the number of potentially difficult interfaces, is good! **Relevant themes for LA Members –** • Will the procurement strategy lead to simple contract structures? • What is Crossrail's provision / capability for Interface Management?
Channel Tunnel Rail Link (CTRL); UK	• There was contractor anger at the time and expense in having to re-bid for Phase 2 of the project, having already gone to considerable expense in bidding for Phases 1 and 2 together. The client had decided that the latter stages of the project were insufficiently well-defined.	Crossrail's contracting and procurement strategies will be key factors in its success. This is a **top issue.** As well as having a keen eye on value for money for the taxpayer, Crossrail will need to be aware of, and be sympathetic to, costs to bidders, and ensure that the procurement process is as inexpensive as possible, subject to a robust and quality process. **Relevant themes for LA Members –** • Is there an overarching procurement strategy in place? If so, are the suppliers aware of it? • How is the Crossrail team guaranteeing value for money and quality procurement, whilst minimising procurement costs for both the customer and the bidders?
Metronet; UK	• The London Transport Commissioner described the tube PPP as: *"unsafe, uneconomic and a contractual nightmare"* and threatened to take the government to the European Court over its plans to part privatise the Tube; • The London Mayor launched another legal challenge to Government plans to part-privatise the Tube. He then lodged an appeal, challenging a previous High Court ruling; • Atkins (part of Metronet) warned LUL that profit clampdown could make PPPs unviable; • LUL criticised Metronet and its shareholders for poor performance on the PPP, and the PPP Arbiter also criticised the performance of Metronet; • Metronet went into administration in July 2007, and Metronet Rail transferred to TfL control in May 2008; • Ministers accused Metronet shareholders of corruption; • According to the NAO report on the Metronet collapse (June 2009), DfT's exposure to risk as a result of the PPP contracts resulted in it having to pay	**Relevant themes for LA Members –** • How to ensure sound procurement techniques for Crossrail? • Does the procurement strategy align with the risk profile in a sensible way? • Do the commercial incentives drive the desired behaviours?

	£1.7 billion of grant to London Underground. Under the governance arrangements, DfT had few formal levers to manage risk to the taxpayer of the Metronet collapsing. The Metronet PPP contract was a mess from many standpoints, and raised many questions: • Why enforce a contractual mechanism that no-one was happy with? • Was DfT really unaware that the ultimate financial risk rested with itself?	

5- Project Management Arrangements, Skills, and Capability

Project; Location	Key features/ Learning points	Relevance to Crossrail
London 2012 Olympics	Having to build up capability rapidly, the Olympic Delivery Authority sought to boost its resource capability very rapidly using a Delivery Partner. The Delivery Partner is a consortium, giving access to skilled resources and inputs on a pre-determined fee rate scale. The Delivery Partner was obtained following a Competitive Dialogue procedure, and offers the ODA flexibility to increase / decrease resource levels in line with changing demand and workload.	Obtaining access to key human resources is obviously of critical importance to the Crossrail programme. **Relevant themes for LA Members –** • Are the resources near the planned levels? • Is the method of obtaining resources realistic and well developed?
CTRL, UK	• CTRL "went out of its way to build a world class team", acquiring substantial experience and know-how; • CTRL boosted its team with the support of a Delivery Partner, in this case Bechtel. CTRL greatly valued Bechtel's commercial problem-solving approach, and planning skills – resulting in problems being identified early, solutions sought, and claim situations dealt with promptly and closed down.	In Crossrail's case, programme management skills in an infrastructure context will be very important. **Relevant themes for LA Members –** • What assurance has Crossrail taken to ensure that its skills and capability (allowing for its Delivery Partner) are what the project needs?
BAA Terminal 5	• The construction phase of the T5 programme was very well planned, involving thorough levels of project planning, off-site piloting and manufacture, and on-site proof of concept work as a guide to estimating durations and ironing out difficulties; • However, BAA failed to plan the transition from the construction project phase into the operational phase. This resulted in exceptional (and embarrassingly public) delays at the last minute, while the innovative baggage handling systems were brought to life.	It is very important to have the operator involved in any project right from the outset, with the operator input increasing as hand-over approaches. **Relevant themes for LA Members –** • How much Operator involvement is there in the planning of the Crossrail programme? • How advanced are the commissioning plans,

		that will take the completed capital programmes into live service?

6- Planning Processes and Timelines

Project; Location	Key features/ Learning points	Relevance to Crossrail
Channel Tunnel Rail Link (CTRL); UK	• Planning permission had to be sought and agreed for numerous aspects of the overall project; • Public enquiries introduced uncertainty into timings; • A planning row threatened a delay of 6 months; • There was a need for 24 hour working at St Pancras to avoid undue slippage; • There were skills shortages due to other competing projects; • There were delays due to the slow appointment of a commuter franchise operator; • CTRL introduced an effective way of ensuring that its complex compliance requirements were satisfied, so as not to jeopardise the decision timetable. The Compliance Review Group comprised a small group of experts mainly from Network Rail, charged with ensuring that all proposals (design, site access, construction method etc) complied with Network Rail's requirements.	Crossrail is beyond the initial Planning Permission phase, so this is less relevant. However ... **Relevant themes for LA Members –** • Has the Crossrail Project Team identified the main consultation processes that have yet to take place and the associated risks to timings, scope and costs? • Does the resourcing strategy make sense, reflecting market conditions and other competing projects? • Is the compliance / assurance process effective (especially in avoiding delays)?
Metronet; UK	• Disputes and wrangles over issues - such as the scope of works, timeframes and failure to deliver works on time - led to numerous delays; • London Underground Ltd (LUL) had to press the contractors to step up their recruitment drives for engineers so that they could resource the privately financed upgrade; • Metronet admitted that a basic programming error caused it to miss track renewal targets on five of the eight lines that it operated.	It is crucial somehow to ensure a harmonious relationship between the client and contractors. The adversarial relationship between LUL and Metronet was doomed to fail. **Relevant themes for LA Members –** • What steps has the Crossrail Project Team taken to ensure harmonious relationships between the client side and the various contractors (including client side partner contractors)? • How tight is the programme? Does it have one owner, and is it under control? Are there any early warning signs of slippage or disputes?
Thameslink; UK	• At one stage, Thameslink 2000 faced cancellation if CTRL did not go ahead, and later the project faced the prospect of being scaled down and built in two	Political decisions, or delays to them, can cause extensive delays to project timings.

	phases due to uncertainty surrounding phase two of the CTRL; • In 1999, Railtrack re-submitted plans for the Thameslink upgrade, including nearly £200M of variations to the original £580M scheme submitted in 1997, resulting from nearly 700 objections by local residents, lobby groups and local authorities; • Railtrack's plans were slated as unrealistic and taking no account of the long term strategic needs of the route by a report submitted to the DETR as part of the ongoing public consultation on the project, and there was also a row between the Strategic rail Authority and the Office of the Deputy Prime Minister over the latter's demands for more information on plans; • Delays to the organisation and running of public enquiries led to lengthy delays and uncertainty for the project; • Further uncertainty to funding was introduced by the Comprehensive Spending Review. **Learning Points:** • Critical dependencies kept arising – notably Thameslink on CTRL and vice versa, and the 2012 Olympics on Thameslink and Crossrail; • Public enquiries and other consultation mechanisms had significant ramifications for timings, scope and costs. • A clear a lack of harmony between the various high-level stakeholders over the Thameslink plans caused difficulties.	For Crossrail, who are the key decision makers, and who else has to have a say? **Relevant themes for LA Members –** • Has the Crossrail Project Team identified the main dependencies and taken appropriate planning and mitigating action? • How has the Crossrail Project Team tried to minimise the ramifications of political uncertainty? • How has the Crossrail Project Team tried to ensure harmony between the various high-level stakeholders over plans?

7 - Information Management, Reporting Arrangements

Project; Location	Key features/ Learning points	Relevance to Crossrail
Metronet; UK	NAO 2009 – *"The poor quality of information available to management, particularly on the unit costs of the station and track programmes, meant that Metronet was unable to monitor costs and could not obtain adequate evidence to support claims to have performed work economically and efficiently."*	**Relevant themes for LA Members –** • Do the management information and reporting mechanisms enable TfL to spot issues and adverse trends in a timely way? • Do the management information and reporting mechanisms meet the needs of clarity and transparency? Are they purposeful and do they stimulate the right management responses?

8 -Change Control Processes for Scope, Risks and Opportunities

Project; Location	Key features/ Learning points	Relevance to Crossrail
Channel Tunnel Rail Link (CTRL); UK	• There was a lot of acrimony over the failure to consider the North of UK in CTRL plans; • Two-year delays were threatened due to scope changes; • There was uncertain political will behind the Kings Cross ticketing hall; • CTRL minimised the potential for scope changes, by adopting proven off-the-shelf signalling technology. This required minimal adaptation and was cited as one of the main reasons for the project's successful outcome.	With large projects, the scope and attendant plans tend to evolve as the project unfolds, introducing risks of delays and increased costs. **Relevant themes for LA Members –** • How tightly defined is the Crossrail scope? This is a **top issue**. • To what extent is Crossrail using commercially off-the-shelf proven technology – versus innovative technology that is at the leading edge and yet to be proven?
Jubilee Line Extension	• The Jubilee Line Extension (in contrast to CTRL) adopted unproven signalling "moving block" technology. In the event, it turned out not to be possible to install this solution in the time available, and the solution had to be abandoned with significant costs and time impacts.	**Relevant themes for LA Members –** • As above - to what extent is Crossrail using commercially off-the-shelf proven technology – versus innovative technology that is at the leading edge and yet to be proven?
BAA Terminal 5	• BAA adopted a novel risk management approach on Terminal 5. The fundamental principle was that ultimately the client always bears the risk; • BAA's approach recognised the importance of considering carefully the risk management process, and placing this activity with those best able to manage it; • BAA's change control process was actively maintained, so that information in it was current and relevant; • The most important feature of the BAA project was Board level sponsorship, resulting in rapid and effective risk management and decisions.	**Relevant themes for LA Members –** • Does Crossrail have a well-developed approach to risk management? • Is Crossrail actively sponsored at the highest levels? • Are there any early indications of problems, such as large backlogs of changes to plans or scope?
Metronet; UK	• Contract variations were cited as allowing preferred bidders to leave the network in a far worse condition than originally expected; • LUL blamed DfT for causing a £320M cost hike on the King's Cross Tube station upgrade; • The Metronet chairman said that comments made by LUL about Metronet underperforming were unfair because it compared Metronet's performance against its original bid and not the revised scope.	Scope creep, and the financial responsibility for it, can lead to acrimony. Clients may try to enforce harsh contractual mechanisms, but contractors facing large losses will do whatever they can to recoup these losses, and neither side is likely to win. **Relevant themes for LA Members –** • What framework of risks and rewards has the Crossrail Project Team established, and does

		it propose to establish, between the client side and the various contractors, including partners?

9 -Quality and Benefits Management

Project; Location	Key features/ Learning points	Relevance to Crossrail
Olympics, 2012	*Assurance management* • A wide variety of stakeholders have interests in the Olympics, and there was potential for a number of stakeholders to insist on independent reviews being carried out. Without coordination, this could have created a significant management challenge, become distracting for the delivery teams and creating the potential for duplication; • To counter this risk, there is now an integrated assurance process, co-ordinating the various review requirements from bodies such as the OGC, LSA and NAO.	**Relevant themes for LA Members –** Is there an integrated assurance plan, coordinating and satisfying the needs of the inevitably wide range of stakeholder interests on Crossrail?
Channel Tunnel Rail Link (CTRL); UK	*Construction Challenges (numerous), e.g.:* • The CTRL route around London Underground tunnels was complex, with resultant LU nervousness; • There were breaches of live LU tunnel walls and other problems; • Construction had to take place over the eastern marshlands; • Piling had to take place through dumped asbestos; • Rapidly rising ground water necessitated extensive pumping operations; • Almost every type of geological material was encountered; • There was a row over the CTRL route crossing a London cemetery, and moving of bodies; • There was a collapse of uncharted wells leading to ground failure; • A CTRL piling rig was dropped onto a commuter line; • Spaces were very tight for construction sites in London; • A CTRL sewer diversion flooded a Thameslink tunnel. *Archaeology;* • A Neolithic house was discovered on the CTRL route; • A Stone Age elephant skeleton was discovered at Ebbsfleet. . *Health & Safety/Accidents;* • A miner was crushed in a rock fall during excavation, with resultant delays;	Crossrail can expect many similar challenges. Numerous construction challenges, some already known and some undoubtedly not known, will need to be faced and overcome. Weaving a path through the complex network of LU lines is likely to lead to nervousness again at London Underground. **Relevant themes for LA Members –** • Is there is a comprehensive risk assessment process, supported by a sufficient (large at this early stage) contingency fund? Top issue; • What are the decision processes around the release of contingency funds? Top issue; • What approach has Crossrail adopted with relevant interest groups for excavation in regard to known and unknown archaeological sites?

	• A huge polystyrene-fuelled fire damaged a key bridge.	
Metronet; UK	*Operational Challenges (numerous), e.g.:* • Flaws in LUL's/Metronet's track maintenance regime led to a train derailment at Hammersmith; • Metronet and Tubelines faced stiff financial penalties after snow and ice caused widespread disruption to London's Underground; • Metronet accused LUL of failing to provide enough guidance to prevent derailments occurring on the Tube network; • Metronet and Tube Lines refuted claims by the Commons Transport Select Committee that they failed to meet train availability targets; • Metronet faced a fine of at least £715,000 after completing the £40M Waterloo and City Line upgrade 10 days late; • Metronet faced fines after overrunning engineering work closed the Waterloo & City Line for two days during the peak time. *H&S/Accidents;* • Metronet was fined after a cleaner was trapped in an escalator and seriously injured.	The contractual penalties regime led to numerous fines on Metronet for failing to meet operational targets, but ultimately neither party really won. **Relevant themes for LA Members –** • As for CTRL above; plus... • What framework of risks and rewards has the Crossrail Project Team established, and does it propose to establish, between the client side and the various contractors, including partners?
Thameslink; UK	*Construction Challenges, e.g.:* • Thameslink was adversely affected by CTRL construction: o Contractors working on the Channel Tunnel Rail Link narrowly avoided disaster when they broke through the lining of a live Thameslink rail tunnel showering the track with debris; o Sewer diversion work for the Channel Tunnel Rail Link (CTRL) caused a major London railway tunnel to flood, putting it out of action for two days; • Network Rail consulted its legal advisers and demanded that 'unacceptable' levels of water leakage into the new Thameslink station box were reduced.	Crossrail could adversely affect, or be adversely affected by, a wide range of third parties, especially given the highly congested route through which it must be navigated. **Relevant themes for LA Members –** • What plans does Crossrail have in place for third party dependencies?

10 -Environment and Sustainability

Project; Location	Key features/ Learning points	Relevance to Crossrail
Channel Tunnel Rail Link (CTRL); UK	*Environment and Sustainability:* • CTRL was ordered to cut the number of pollution incidents; • Contractors were fined for polluting streams; • The CTRL route was made safe for animals.	The environment and sustainability are now much more high-profile than for CTRL, and members will doubtless be interested in the Environmental and Sustainability plans, though they may create more impact by addressing the more significant issues elsewhere in this report.

		Relevant themes for LA Members – • What provisions has Crossrail made to meet the principles of sustainable procurement and sustainable construction?

ANNEX D: SELECTED REFERENCES

Ref No	Reference	Implications for / relevance to Crossrail
1	**What causes cost overrun in Transport Infrastructure projects** Flybjerg, Holm and Buhl Transport Reviews, Vol 24, No 1, 3-18, January 2005, Taylor and Francis	• Accountability has a bigger influence on outcome than public / private ownership; • Long programmes are at much greater risk than short ones; • Railways have larger overruns than bridges, tunnels, and roads.
2	**Policy and planning for large infrastructure projects: problems, causes, cures** Flybjerg Environment and Planning B, Planning and Design, 2007, Vol 34, pp578-597	• The main problem in large infrastructure projects is pervasive mis-information about costs, benefits and risks; • The reasons are socio-political; planners and promoters misrepresent costs, benefits and risks to increase the likelihood of approval and funding ("survival of the unfittest" – those most misrepresented, get through); • The average rail cost increase is around 40%, and can be up to 140%.
3	**National Audit Office** **The Department for Transport: The failure of Metronet** Publication date: 05 June 2009 HC: 512 2008-2009 ISBN: 9780102954968	See main body of report for detailed references.
4	**Infrastructure Project Financing in Asia: Lessons Learned** Andrew D. Cao, PhD, Karim Solh Heidi Anderson May 1993 INTERNATIONAL PRIVATIZATION GROUP PRICE WATERHOUSE 1801 K. St, N.W Washington, D. C. 20006 http://pdf.usaid.gov/pdf_docs/PNACC396.pdf Examined different project financing methodologies.	Crossrail's finance strategy is already established, but the pros and cons argued here provide a wider review of the risks and risk transfer associated with major infrastructure programmes, and provide some useful reminders: • Establish trust and communication between the project participants; • Recognise the need for flexibility; • Recruit good contract negotiation experts; • Clarify the Government's objectives and constraints; • Establish the political risks.
5	**Private Participation in Infrastructure: Lessons Learned** Enhancing the Investment Climate: The Case for Infrastructure	

	OECD Global Forum for International Investment Istanbul, November 6th-7th, 2006 http://www.oecd.org/dataoecd/62/37/37697285.pdf	
6	**The Modernisation of the West Coast Main Line** REPORT BY THE COMPTROLLER AND AUDITOR GENERAL | HC 22 Session 2006-2007 | 22 November 2006 http://www.nao.org.uk//idoc.ashx?docId=6E2F64AF-8E1C-4D90-8427-3165902080BE&version=-1	Relevance to Crossrail: • Ensure that clear direction is provided to the project; • Ensure that governance arrangements are clear; • Ensure that the scope is clear and that tight change control is in place; • Ensure that costs are tightly controlled.
7	**Preparations for the London 2012 Olympic and Paralympic Games: Progress report June 2008** Publication date: 20 June 2008 HC: 490 2007-2008 ISBN: 9780102954197 http://www.nao.org.uk/idoc.ashx?docId=f7a1aaac-61dc-44c2-9869-e6a31de98a50&version=-1	
8	**National Audit Office** **Department of the Environment, Transport and the Regions: The Channel Tunnel Rail Link** Publication date: 28 March 2001 HC: 302 2000-2001 ISBN: 0102868018	A relevant paper covering the early difficulties of the CTRL project – necessitating in a complete restructuring of the deal, and listing several lessons learned of relevance including – • Revenue forecasts for start-up business are subject to great uncertainty; • Make sure that bidders are not encouraged to be over-optimistic; • The equity capital to be invested in a project should represent the risks of that project; • Government guarantees are unlikely to be costless; • Monitor risks from the start of the project; • Reallocate risks if necessary.
9	**High-speed Rail Projects in the United States: Identifying the Elements of Success** November 2006 Allison L. C. de Cerreño, Ph.D. Shishir Mathur, Ph.D. a report co-sponsored by the NYU Wagner Rudin Center for Transportation Policy & Management a publication of the Mineta Transportation Institute College of Business San José State University San José, CA 95192-0219	Relevance to Crossrail. A Review of high-speed rail projects in the US. Key findings - • Leadership coupled with means and authority are required to implement change; • Clear identification of goals and benefits.

ANNEX E: SPECIFICATION OF THE REQUIREMENT FOR THIS REVIEW

Review of risks to Crossrail

Background
The London Assembly Transport Committee is undertaking a review of Crossrail. The committee is due to publicly question the Chair and Chief Executive of Crossrail on 6 January 2010.

The Committee intends to publish a short report containing the findings of its review in spring 2010.

The Transport Committee is a cross-party committee of Assembly Members that examines and reports on matters of importance to Londoners as they relate to transport. It also considers the strategies, policies and actions of the Mayor of London, Transport for London (TfL) and the other members of the London Assembly Group where appropriate.

This research and advice is being commissioned to inform debate at the committee's meeting and provide additional evidence in relation to the management of risks to Crossrail and robustness of arrangements for delivery.

Requirements
1. To provide a short review paper setting out the main risks and challenges faced by Crossrail. It should establish the key issues that will need to be addressed and monitored to ensure that the project is successful. This may include, for example, issues such as:
   - Finance
   - Governance and decision making structures
   - Contracting and procurement models
   - Risk management frameworks
   - Cost control
   - Timelines and delays
   - Quality delivery and scope management

   The paper will not necessarily cover all of these issues. It should emphasise the key 3 - 5 risks to Crossrail. It should make reference to previous rail infrastructure projects to illustrate the risks faced, the potential impacts of those risks and how they might be best managed. The paper should also indicate where there is insufficient information to determine whether risks exist or whether proper arrangements are in place.

The paper should be suitable for publication, as background to the Committee's report.

2. To provide the following advice to the Committee: reviewing an internal briefing for members, which will be prepared by Committee officers (approx 5 pages), providing a short critical commentary of the transcript of the 2 hour meeting with Crossrail, reviewing the draft Committee report (approx 20 - 25 pages).

Bidding information

It is expected that the review paper will take approximately 25-40 hours. The paper should be approximately 4-5,000 words in length.

Bids should contain:

- A short proposal for delivering on the above requirements (including a sample of proposed sources);
- A breakdown of the number of hours it is proposed each member of the bid team will spend on the project;
- A lump sum cost for delivering the two elements of the requirement;
- Confirmation of ability to deliver a draft of the overview paper 16 December, with the final paper completed by 23 December;
- Confirmation of ability to review the internal briefing in the week beginning 21 December;
- CVs of bid team.

ANNEX F: CURRENT STATUS OF CROSSRAIL

This annex summarises the current status of Crossrail. The following information has been derived from publically available sources only, and is provided by way of general context, and as an aid to understanding the conclusions from the reference case studies in this report. During this short review, the Review Team has not had access to the Crossrail Board Members or Project Team.

Legislation

Crossrail Limited is the company charged with delivering Crossrail. Formerly known as Cross London Rail Links (CLRL), it was created in 2001 to promote and develop new lines that meet the needs of people and businesses throughout the South East, and to ensure that London continues in its role as the Europe's leading financial and business centre. It was established as a 50/50 joint venture company between Transport for London and the Department for Transport.

Royal Assent was given to the Crossrail Act in July 2008, giving Crossrail Ltd the authority to build the railway.

On 1 August 2008, in accordance with the Heads of Terms, the agreements published in November 2007 between DfT and TfL on the future funding and governance of the Crossrail project, the Crossrail Board was reconstituted with the appointment of four non-executive directors.

Crossrail Limited became a wholly owned subsidiary of TfL on 5 December 2008.

In December 2008, the Government and the Mayor of London signed the key funding agreements for Crossrail.

Strategic Business Case

According to Transport for London, Crossrail will deliver substantial economic benefits in London, the South-East and across the UK. The estimated benefit of Crossrail to the UK economy is at least £36 billion (TfL figures, May 2006). Crossrail will connect central London City, Canary Wharf, the West End and Heathrow Airport to areas east and west of the capital. It will bring 1.5 million people within a 60-minute commute of the city. Crossrail will be a high frequency affordable railway, with convenient and accessible services across the capital.

Status of Works

Preliminary works commenced in early 2009 and are continuing during 2009.
Main construction will start in 2010.
Crossrail is scheduled to commence passenger services in 2017.

Governance

Crossrail's Sponsors are the Mayor of London, through Transport for London, and the Secretary of State for Transport through the Department for Transport.

Crossrail's Partners are DfT, the Mayor of London, TfL (including Docklands Light Railway and London Underground), Network Rail, British Airports Authority, City of London, Canary Wharf Group and Berkeley Homes.

The *Crossrail Board* comprises:

- Terry Morgan CBE, Chairman;
- Rob Holden CBE, Chief Executive;
- David Allen, Finance Director;
- Andy Mitchell, Programme Director;
- Michael Cassidy CBE;
- Patrick Crawford;
- Sir Joe Dwyer;
- Sir Mike Hodgkinson;
- Robert Jennings CBE;
- Heather Rabbatts CBE.

Of the above members Rob Holden, David Allen and Andy Mitchell are executive.

Below the main Board is the *Executive Committee*, comprising the following Executive Directors:

- Rob Holden CBE, Chief Executive;
- David Allen, Finance Director;
- David Anderson, Engineering Director;
- Tina Bailey, HR Director;
- Keith Berryman, Land and Property Director;
- Lesley Calladine, Health and Safety Director;
- Mark Fell, Legal Services Director and Company Secretary;
- Clinton Leeks OBE, Corporate Affairs Director;
- Andy Mitchell, Programme Director;
- Valerie Todd, Talent and Resources Director.

Progress since Royal Assent

Since Royal Assent, progress on Crossrail includes:

- New Crossrail Board appointed with six Non-Executive Directors;
- Rob Holden appointed Chief Executive from 1 April 2009, and Terry Morgan appointed Chairman from 1 June 2009;

- Transcend appointed as £100m Crossrail Programme Partner on 11/03/2009;
- Bechtel Limited appointed as £400m Crossrail Project Delivery Partner on 01/04/2009;
- Main agreements underpinning governance signed;
- Compulsory Purchase Notices issued and property acquired at Tottenham Court Road, and contract issued for £500m London Underground works at Tottenham Court Road;
- £230m funding agreement with signed BAA;
- £350m funding agreement signed with the City of London;
- £150m funding agreement signed with the Canary Wharf Group, with CWG taking responsibility for design and construction of the Crossrail Canary Wharf station.

Costs of Crossrail

The budget for delivering Crossrail amounts to £15.9 billion cash cost over the expected period of construction up to 2017 when the railway opens. The costs within this budget have been extensively reviewed.
The project will be managed and run in line with the financial requirements and testing models of the Office of Government Commerce.

Overall funding of Crossrail

Crossrail's forecast cost of up to £15.9bn will be met by Government, business and fare payers.
Government will contribute by means of a grant from the Department for Transport of over £5 billion during Crossrail's construction. Crossrail fare payers will ultimately contribute through projected operating surpluses used to service debt raised during construction by Transport for London, and by Network Rail in respect of the works on the national rail network.
London businesses will contribute through a variety of mechanisms, including the Supplementary Business Rate.

Private Sector Contribution

The City of London Corporation agreed to make a direct contribution of £200m to the Crossrail project. In addition, the City Corporation will seek contributions from businesses of £150m, and has guaranteed £50m of these contributions. The Government will offer the Corporation its support, where necessary, to deliver these additional contributions
A £230 million funding package from BAA was announced on 3rd November 2008. An in-principle agreement has been reached with Berkeley Homes for them to construct, at their own cost and risk, a station box at Woolwich. Canary Wharf Group is to contribute £150m towards the costs of the new Canary Wharf Crossrail station. CWG will also design and build the new station.

Effect of Construction Inflation

The £15.9 billion budget for Crossrail is a fully inclusive cost, allowing for both contingency and expected inflation. These costs and allowances have been tested by independent advisers, according to strict Government guidelines. Specifically, the forecasts allow for construction inflation in excess of general inflation to mitigate the potential for higher than expected prices.
In addition, the construction process will be managed and run in line with the requirements of the Office of Government Commerce, which include testing for the impacts of different levels of inflation. Crossrail Ltd and the project's sponsors are confident that costs will be contained within budget.

Status of the Major Contracts

Design Frameworks Consultants

In December 2008, Crossrail announced the 12 firms that have secured Design Framework Agreements. The chosen firms will have the opportunity to compete for packages of design work on the Crossrail project, including work on tunnels and shafts, stations, and railway systems. The successful bidders are: Aedas Group Ltd, Atkins Ltd, BDP Ltd, Capita Symonds Ltd, Halcrow Group Ltd, Hyder Consulting (UK) Ltd, Jacobs Engineering U.K. Ltd, Mott MacDonald Ltd, Ove Arup & Partners International Ltd, Parsons Brinckerhoff Ltd, Scott Wilson Railways Ltd, and WSP UK Limited. The frameworks will run until the completion of the Crossrail scheme.

Programme Partner

On 11 March 2009, Crossrail Limited announced its intention to appoint Transcend, a joint venture between AECOM, CH2M Hill and Nicholls Group, as its Programme Partner for the Crossrail project. This is a significant appointment, worth in the region of £100 million. The Programme Partner role is one of strategic programme management. Transcend will help Crossrail to deliver safely the overall programme to time, to the desired standard and within budget. Transcend also brings additional qualified, skilled and experienced resources to supplement the core Crossrail team. Transcend started working on the project on 30 March 2009.

Project Delivery Partner

On 1st April 2009, Crossrail Limited announced its intention to appoint Bechtel Limited as the Project Delivery Partner for the Crossrail project. As Project Delivery Partner, Bechtel Ltd will be responsible for overseeing delivery of the core central tunnelled section of the Crossrail route and will also manage the design process. The value of the Project Delivery Partner contract is in the region of £400m. To deliver the actual construction of the railway, Crossrail Limited will subsequently award a series of design and construction contracts.

Procurement Process

Crossrail wishes to be seen as an attractive client and is very keen to attract the best quality suppliers which can work in a partnership approach to help deliver a successful project outcome. To help achieve this, Crossrail intends to engage closely with the supply chain in the development of the detailed procurement processes and arrangements. It should be noted that Crossrail's procurement procedures will be subject to normal UK Procurement Regulations. Crossrail understands the need for the supply chain to be able to plan and develop its resources to be able to help deliver a major project of the scale of Crossrail as effectively and efficiently as possible.