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Lessons Learned from the Forth Replacement Crossing Project

2007 to 2017

Introduction

The Queensferry Crossing is the culmination of ten years of intensive work by Transport Scotland and its partners to deliver the Forth Replacement Crossing project.

Conceived from the outcomes of the Forth Replacement Crossing Study which commenced in 2006, and in acknowledgement of the operational concerns associated with the future viability of the Forth Road Bridge, development of the project commenced in 2008. The decision to proceed was based on the recommendation that a new cable stayed bridge be constructed immediately upstream of the Forth Road Bridge to maintain an unrestricted and reliable primary road link between Edinburgh, the Lothians, Fife and beyond, safeguarding the Scottish economy.

To deliver a project of this size and scale, key stages of delivery were achieved in accordance with the following timeline:

- 2008 – 2009: Scheme Assessment Process – Culminating in the publication of an Environmental Statement in November 2009.
- 2009 – 2011: Statutory Process – Powers to acquire land and construct the scheme obtained through passing of Hybrid Parliamentary Bill, leading to Royal Assent of the Forth Crossing Act in 2011.
- 2009 – 2011: Procurement Process - Three 'design and build' construction contracts tendered through the Competitive Dialogue process – the Principal Contract encompassing the Queensferry Crossing, and two subsidiary contracts, Fife ITS and M9 Junction 1A Improvements, with a further contract to provide a Contact and Education Centre.
- 2011 – 2017: Construction – Appointment of design and build contractors leading to construction completion of Fife ITS (December 2012), M9 Junction 1A Improvements (February 2013) and the official opening of the Queensferry Crossing on 4 September 2017.

Noting the extent and scale of the work required to complete each stage of the project, it was deemed appropriate that a Lessons Learned Register be developed to record aspects of delivery that worked well or that could be improved upon by implementation of a different approach.

From the initial stages of the project in 2007 through to the official opening of the Forth Replacement Crossing in September 2017, project staff across all disciplines and affiliated companies were tasked with contributing to the production of the Register. This resulted in a comprehensive list of findings being generated under a set of clear subject headings, with the intention of this document being to influence best practice techniques that may be employed on future projects within Transport Scotland, whilst recognising that many of the lessons are also relevant to projects in general.

Forth Replacement Crossing Lessons Learned Register 2007 – 2017

Discipline	Brief description of issue	Lesson learned/proposal for future
Communications	Publicity around project procurement, advanced works milestones and key events during construction (2010 – ongoing)	Proactively using significant milestones to highlight progress on the project is an effective vehicle for reiterating the project's key messages and countering negative or non-factual coverage. Undertake advance discussions where possible with key affected parties to discuss impacts/ mitigation etc. Provide opportunities for Ministerial events/media opportunities to highlight key milestones.
Communications	Comment from communities that Forth Replacement Crossing Study exhibitions spent insufficient time in most affected locations (Aug 2007).	Where possible exhibitions should be planned sufficiently in advance to ensure optimum benefit is derived. Flexibility in approach to timing as venue availability is key factor. Timings – previously opened 10:00-20:00 – amended in Jan 09 exhibitions to 10:30-20:30.
Communications	Joint meetings with affected Community Councils (2008-onwards).	Tailor specific sessions to geographic areas.
Communications	Withdrawal of Vinci from Forthspan consortium bidding for Principal Contract (July/August 2010)	Where forewarned of a potentially major project issue, advanced, pro-active development of a handling strategy and robust lines to take can minimise opportunity for unhelpful press speculation.

Discipline	Brief description of issue	Lesson learned/proposal for future
Communications	Short/lack of notice for meetings (2009).	Where possible, MSP events should ideally be planned with at least 3 weeks clear notice given. In addition, consideration should be given to providing information and briefing via correspondence to ensure those who cannot attend are catered for.
Communications	Maintaining supportive public relations during scheme development (2008 - end 2010)	<p>Articulating the interactive and progressive nature of scheme development (what information can be available at what stage)</p> <p>Consulting to determine local concerns and engineering to address where appropriate.</p> <p>Recognising that affected parties will not acknowledge communication efforts in the face of personal concerns, and nevertheless articulating impacts as far as possible in advance of statutory process.</p>
Communications	Name the Bridge Website - web hosting issues (2012-2013)	<p>Flexibility of TS web-based services required for bespoke, high-profile public-facing activities.</p> <p>Resource-intensive processes require outside support to enable successful delivery.</p>

Discipline	Brief description of issue	Lesson learned/proposal for future
Communications	Communicating with the general public and community groups during the construction phase (2011 onwards)	<p>Devote sufficient time to communities affected in order to build trust and understanding of issues.</p> <p>Engage contractor's Community Liaison Officers early in the process. Establish resource requirements and strategy earlier in order to ensure Contractor meets expectations. Early enforcement of Community Liaison requirements at outset.</p> <p>During construction regular update leaflets, letter drops and public meetings are essential to get public buy-in to the project.</p> <p>Undertake 1-1s with the most affected objectors</p> <p>Ensure even relatively minor issues are dealt with quickly and efficiently to avoid escalating to the wider community.</p> <p>Ensure Employers Requirements include provision of noticeboards to be placed at appropriate locations and regularly updated by the contractor.</p> <p>During construction – proactive engagement assists greatly in dispelling concerns.</p> <p>Contract has required the Contractor to produce a quarterly project Newsletter. Would be beneficial to link community engagement more heavily in terms of Key Performance Indicators within Contract in order to evaluate benefits (e.g. ascertain how many members of the public read the newsletter, gain feedback on content, etc.).</p>

Discipline	Brief description of issue	Lesson learned/proposal for future
Communications	Project website (2008-onwards)	<p>The public did view the website on a regular basis and were quick to criticise when accurate information is not displayed promptly therefore resourcing and updating was a key task best managed by the project team (for large projects). For similar high-profile projects, consider setting up a bespoke website managed by comms consultants or similar. A good example is the Borders Rail project website. A secondary website was introduced as part of the Forth Bridges Forum in 2014 and has contributed positively in terms of additional multi-media material being made available and accessible to the public.</p>
Communications	Contact and Education Centre - Exhibition Panels - Scope / Responsibility for provision and updating (2011-onwards)	<p>Consider removing from Contractor responsibilities under Contract and retain as Employer responsibility with commitment from Contractor to provide draft text / images etc. only to support production. However, with time (2014-2015) the Contractor became more efficient in renewing these materials which, to some extent, is related to the long duration of the Principal Contract and good relationships.</p> <p>Early consideration of exhibition layout required but depends on final design of available space and storage.</p>
Communications	Webcams / Time-lapse Cameras - Scope and specification (2010-Onwards)	<p>Need to plan for inclusion on website for public viewing.</p> <p>Consider output specification and obtain specialist input. Seek advice on future-proofing.</p> <p>Careful consideration of desired number to capture key activities appropriately.</p> <p>Excellent for publicity in showing long-term progress in a very short space of time.</p>

Discipline	Brief description of issue	Lesson learned/proposal for future
Communications	Comms and Stakeholders - raising profile with Contractors (2011 onwards)	Include Comms and Stakeholder Engagement as a topic for discussion during dialogue period or as separate briefing for tenderers. Communications Teach-ins during the Competitive Dialogue process would have been very helpful in reinforcing expectations and desired outcomes with contractors and would have potentially saved subsequent time resource.
Communications	Contact and Education Centre - Operational Planning (2012-2013)	Better co-ordination with the building operator to ensure all aspects considered fully in advance of opening (e.g. liability, Health & Safety, equipment, maintenance, etc.). Unique for this project but principles could apply on other contracts where visitor or other bespoke facilities are specified.
Communications	Virtual Reality Model. (late 2009 onwards)	Can be very labour intensive to produce and dependent on sufficient detailed information being produced by the contractor - which may be markedly different to the specimen design. Fast-moving technological advances mean that it is important to provide for updating/upgrading as software advances. Potential for integration into Building Information Modelling (BIM) for whole-project co-ordination.
Communications	Publish Agendas, Terms of Reference and Minutes from Forums and other Working Groups timeously on the project website (2011 onwards)	Openness and transparency should be encouraged. Requires adequate resources to ensure publication within required timescales.

Discipline	Brief description of issue	Lesson learned/proposal for future
Communications	Publishing environmental, traffic and contact/complaints information monthly on project website (Forth Crossing Act commitment) (2011 onwards)	<p>Requires advance planning and investment of significant management input as well as performance by Contractor to supply the information. Could be linked to a KPI to help ensure delivery on time.</p> <p>Very resource intensive and open to public criticism if information is delayed. Could consider means to automate production and publishing. Need to ensure capacity to react instantly to any comments/complaints once the data is published.</p> <p>Need to build-in time for clearance from third parties where appropriate.</p>
Communications	Public Meetings to explain scheme and to provide general and specific project updates. (2008 onwards)	<p>Requires good quality materials and preparation for such events.</p> <p>Require Contractor to provide evidence of presentation training and experience in public relations for relevant staff.</p> <p>Timing of such meetings require careful consideration to have maximum effect.</p>

Discipline	Brief description of issue	Lesson learned/proposal for future
Communications	A permanent Contact and Education Centre (CE Centre) was provided for the project (2010-ongoing)	<p>If a permanent facility is going to be provided, it must either be built early, or a temporary facility provided.</p> <p>Provision for management of the facility needs to be considered at an early stage.</p> <p>The legacy of permanent facility needs to be considered from the outset.</p> <p>Temporary facilities should be considered for other projects where permanent facilities are not practical.</p> <p>Dedicated physical infrastructure for face to face enquiries was well received and well used.</p>
Communications	Community Forums (2008 onwards)	<p>Timely production and publication of minutes and agendas.</p> <p>Adjusting the frequency of meetings to reflect the development of the project and of relationships with community groups. No less frequent than quarterly.</p> <p>High standard of materials in any presentations.</p> <p>Ensure Community Forums are geographically specific and appropriate in size. Ensure clear terms of references are agreed.</p> <p>Establish monitoring and evaluation framework for communications strategy at the outset.</p>
Communications	Dissemination of information to Employer's Site Staff (2011 Onwards)	<p>Sessions are kept brief but informative and ensure that the entire Employer's team is up to speed on the current site status (especially useful for those who are not out on a daily basis).</p> <p>Sufficient information is provided but not full detail. Should be implemented on future projects.</p>

Discipline	Brief description of issue	Lesson learned/proposal for future
Communications	Use of a core script and core presentation (2013 Onwards).	This helps to ensure that staff talking about the project to members of the public give a consistent message on progress and performance. Staff feel supported and able to work at the Contact and Education Centre. There is a feeling that some elements of the core script have not wholly reflected changing issues on site, such that staff find it difficult to adhere to it when they have more current knowledge. Should be updated on a regular (monthly) basis. Could be more clearly defined control over Contractor messaging.
Communications	Communication with the media (2007 Onwards).	Ensure the Employer has a dedicated communications resource/team with a single point of contact for interactions with the media. Ensure this is explicit in the Contract. The Employer's communications team must be part of the key management team.
Communications	Digital strategy (2014-Onwards).	Technological advances in media communications have moved very quickly during the lifetime of this project. The digital strategy that is in place now should be put in place from the start of new projects, to maximise the benefits of different communication methodologies. Have digital Communications plan ahead of the contract that anticipates interest of public, making sure digital platform can meet expectation. Strategy has allowed a dedicated webpage for the new crossing, which in turn allows a much greater quantity of focused information to be provided to the public.

Discipline	Brief description of issue	Lesson learned/proposal for future
Communications	Managing of social media policy (2011 Onwards).	<p>Not envisaged how prevalent personal social media might be. Need to better define and enforce social media constraints on employees to minimise risk of incomplete or misrepresented information in the public realm.</p> <p>Ensure all project team members (Employer, Contractor and sub-contractors/suppliers) are fully briefed on policy when first engaged on the project.</p>
Communications	Traffic management phasing public briefings, and information release (2014 - Onwards).	<p>Smart management of public information on public works, and proactive notification. Advance notification should be promoted to public re: road possessions and traffic management etc.</p> <p>Ensure Employer's Requirements/Specification include provision for Contractor engagement with the public on items affecting travel.</p>
Communications	Employer control of communications (2011 Onwards).	Single mailbox managed by the Employer, allocating enquiries to the party best placed to provide response, is essential to avoid confusion and ensure collaboration and consistency of response.
Communications	Management of site visitors (2011 Onwards).	<p>Scope potential demand / acceptable levels of site visits to be accommodated. Staff resource to be reviewed accordingly as the project progresses to ensure adequacy and quality.</p> <p>Existing Transport Scotland software and Outlook use has not been efficient as could be if a single, centralised booking system were used. When dealing with large volumes of requests, improved system/website required.</p>

Discipline	Brief description of issue	Lesson learned/proposal for future
Communications	Education Programme Operating Strategy and Advice from educational specialists (CEC) (2011 Onwards).	Engage early with educational specialists in order to define educational legacy and inform programme strategy. In future could scope potential demand / acceptable levels of operations throughout the programme with a view to resourcing accordingly as the project progresses. Ensure appropriate staff available to execute educational and other programmes.
Communications	Engaging with Communities' documents (2011 Onwards).	Important to update according to relevant stage in project programme.
Communications	Engagement with all stakeholders (2007 Onwards)	Positive and worth making the effort to undertake on future projects. Limits complaints and gives visibility of possible public issues so team can be proactive. Any Communications strategy has to be based on Stakeholder Mapping - and the need to know your audience.
Communications	Specification of minimum functionality of CCTV cameras providing views of progress to the public	Consider adding a Key Performance Indicator (KPI) that relates to the operation of cameras for monitoring progress and disseminating information to the public. Instigate minimum requirements for operation in any given month - would allow Employer to push the Contractor to address issues more quickly and avoid public complaints.

Discipline	Brief description of issue	Lesson learned/proposal for future
Contract Administration	Use of Dispute Resolution Panel (2011 onwards)	Dispute Resolution Panel must be put in place early in the life of the execution phase of the project. The existence of the DRP in itself may encourage the Employer and the Contractor to resolve issues without going to the DRP. Alternatively the existence of the DRP is a good and relatively cheap method for either side to obtain an independent view on a matter of disagreement before it becomes a major obstruction to the project.
Contract Administration	Construction Stage: Design submissions – informal meetings and reviews. (2011 onwards)	Continue this process in future contracts.
Contract Administration	Appropriateness of requirements for site establishment (2010-2011)	When specifying requirements ensure that technological advances are accounted for (e.g. wireless services, smartphones, surveying) as these can move much more quickly than the time lag between projects.
Contract Administration	Requirements for Construction Drawings in Employer's Requirements (ER) (2010-ongoing).	<p>Ensure that the ERs specify that the Contractor must supply Construction drawings where relevant and requested - i.e. the stage between design and as-builts. The Contractor has agreed to provide these on FRC but they were not obligatory and surveillance role would be very difficult without them.</p> <p>Better definition of sub-elements and interim submissions would have led to better supervision and documentation submissions by the Contractor.</p> <p>ER wording should be clearer on Interim Certification compliance; the Contractor only needed to submit, not get acceptance through successful review.</p>

Discipline	Brief description of issue	Lesson learned/proposal for future
Contract Administration	Project Close-Out - Commercial team resourcing (2011 onwards)	<p>Ensure sufficient resourcing of Employer's commercial team and ongoing monitoring of contractor programme.</p> <p>Engage with Contractor's senior management and commercial teams at an early stage to establish good working relationships.</p>
Contract Administration	Parliamentary Commitments (2010 onwards)	<p>Ensure Parliamentary Commitments and / or accommodation works are fully included in the contract. Ensure the Contractor understands implications during the tender dialogue and construction processes.</p> <p>Consider incentives / KPI deductions to ensure timeous delivery of commitments and accommodation works.</p> <p>Ensure the Contractor and Employer present united front to third parties concerned.</p>
Contract Administration	Dispute Review Board (Dispute Resolution Panel) - flexibility of operation (2011 onwards)	<p>Provide flexibility in arrangements for dispute resolution panels where used. Although contract starting point was three-monthly meetings, the Employer and Contractor agreed that six-monthly was more appropriate (also more cost effective) and in the latter stages relaxed to yearly.</p> <p>Reduction in DRB involvement has further reduced costs and has been brought about through appropriate risk share in the ER's and continued risk management over the course of the project together with good Contractor/Employer relations.</p>

Discipline	Brief description of issue	Lesson learned/proposal for future
Contract Administration	Review Procedure (2011 onwards)	The review procedure provides an excellent means of ensuring certainty of outcome as compared with the alternative TS procedure of simple acknowledgement. However, the process can be resource intensive and the Employer's team needs to be clear on the limitations of their role so as not to become a second Checker. Consider additional briefings for Employer's team to clarify role and identify level at which comments should be returned.
Contract Administration	Re-certification of design during construction (2011 onwards)	Review the Employer's Requirements in respect of re-certification requirements and the timing for re-certification. Consider formal processes for certification or requirements for the Contractor's Project Management Plan appropriate to the contract form.
Contract Administration	Contract Records: Use of Employer records to respond to claims/submissions. (2011 onwards)	Maintain/keep proper records to mitigate against variation/claims/contractual submissions. The value of keeping good records cannot be underestimated.
Contract Administration	Quality of Contractors' monthly reporting (2011 onwards)	Need to enforce minimum quality standards for Contractor reporting in future from start of contract. Consider monthly report pro-forma and / or linking to Key Performance Indicators (KPI) regime potentially specifying this in the contract documents so non-compliance carries a monetary penalty.

Discipline	Brief description of issue	Lesson learned/proposal for future
Contract Administration	Need for employer monitoring team to match Contractor design and construction disciplines (2011 onwards)	Ensure that the Employer has technical, contract and programme resource that is able to challenge corresponding Contractor disciplines
Contract Administration	Health and Safety File Production for JCT (Joint Contracts Tribunal) contracts (2012)	Consider contract-specific amendments to ensure continuous production of as-built record during construction (as per Principal Contract terms).
Contract Administration	Integration of Contractor's Design Team and programming of design delivery (2011 onwards).	<p>Early and continued visibility of the Designer is necessary to ensure that the Designer is a fully integrated part of the Contractor team including attendance at progress meetings and other key project meetings.</p> <p>Consider KPIs for design programme delivery or similar measures to enforce performance (linked to quality assessment at tender stage).</p>
Contract Administration	Team Building (2011 onwards)	<p>This should be encouraged on all contracts.</p> <p>Team-building events should be run more frequently throughout a long project where staff and activities change over time.</p>

Discipline	Brief description of issue	Lesson learned/proposal for future
Contract Administration	ITS documents (2010-2011)	<p>Consider adopting either a pure performance-based specification for ITS elements, or Employer design.</p> <p>Wherever possible superspan gantries should be adopted when implementing ITS on existing carriageways.</p> <p>Strategy for positioning and impacts on land and Ground Investigation (GI) contracts requires careful consideration at an early stage, and depends on on-line or off-line nature of carriageway.</p>
Contract Administration	Police Liaison Officer (2011 onwards)	<p>Full time officer was essential for this scale of project. It was of benefit that the police liaison officer was an ex-police officer.</p>
Contract Administration	Management of utility companies and performance (2011 onwards)	<p>Review the risk sharing of management of utilities and investigate means for control of costs.</p> <p>Wherever possible undertake utilities works in advance of the contractor's main works, at an appropriate stage when sufficient detail is available and firm.</p> <p>Consider Employer taking on responsibility for managing Public Utilities or dedicated Employer staff.</p> <p>Include amendment to Employer's Requirements (ERs) for Contractor to implement regular progress meetings with Utility companies, to which Employer is invited. Public Utility Working Group to be considered. Employer to be proactive and contribute to discussions, but avoid involvement in management of risk where the Contractor is responsible.</p>

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Contract Administration	High level of front end project definition and good communication (2011 onwards)	Consider providing greater detail within the specimen design on other major Transport Scotland (TS) projects where appropriate, particularly where there is a more defined component of the scheme (e.g. a major structure). Aim to utilise interim financial settlements on long-term contracts to minimise impact.
Contract Administration	Supervision of works by contractor.	Consider including further detailed requirements for minimum number of supervisory staff by the Contractor (including key sub-contractors) and Designer per team/area into Contract.
Contract Administration	Hyperlinking in electronic version of Employers Requirements (ERs) (2010 - 2011).	Hyperlinking should be standard practice in the production of future contract documents.
Contract Administration	Email control procedures (2011 onwards)	Future projects should consider a similar centralised system with appropriate management in place (i.e. time limited deletion of emails from personal boxes to encourage archiving).
Contract Administration	Contractor's Quality Assurance and Control	If operating this type of Contract again, the responsibility for quality should still rest ultimately with the Contractor, but the Employer should insist on a very strong and independent Quality Control /Quality Assurance team potentially setting minimum supervision ratios depending on the work scope. At tender stage, tenderers should be made to robustly demonstrate that sufficient allowance has been made in the bid to realistically deliver this supervision level.

Discipline	Brief description of issue	Lesson learned/proposal for future
Contract Administration	Commercial closure of issues could be quicker. Capture of Value Engineering Proposal's and Variation Instruction's in a timely manner	Pressure to be applied for changes to be commercially discussed and resolved alongside technical discussions. Better integration is required between Contractor's technical and commercial teams, and wherever possible Employer should attempt to encourage sufficient staffing of commercial and programme management teams.
Environmental	Environmental Reference Group (2008 onwards).	Initiate ERG at project outset, and make a sustained effort to ensure that all relevant stakeholders participate.
Environmental	Marine Ground Investigation (GI) Noise: Complaints from community about lack of communication regarding night-time noise from marine GI works (2008-2010)	Ensure early engagement with residents and adopt appropriate management measures. The 2008 measures were successful and were improved for the 2010 marine GI works with the addition of an intensive noise monitoring regime. Consider noise management in future Ground Investigation Multi-supplier Framework Agreements
Environmental	Integrate and embed Sustainability Appraisal from the start of project, including the options and feasibility stages and empower sustainability champion. (2008)	New wide ranging sustainability appraisal process was developed for major projects based on the four pillars of Sustainability. This could be promoted and rolled out to other TS projects for further development.
Environmental	Disproportionate amount of time and therefore staff cost required from Project Team in respect of ecological mitigation. (2010)	All parties involved in the ecological works and supporting contracts need to ensure a more detailed assessment of scope of work is undertaken and to ensure that minor, relatively small ecological works are given sufficient priority and resources.

Discipline	Brief description of issue	Lesson learned/proposal for future
Environmental	Project sought Project Board approval to pursue an independent review of the project from a global sustainability view through CEEQUAL. (2009)	Pursue CEEQUAL awards on major infrastructure contracts to help promote sustainability through all project stages.
Environmental	Advanced Plant/Tree Grow Contract (2011 onwards)	Careful management is required and the employer's requirements need to be aligned with the tree-grow contract to ensure a successful outcome - e.g. the employer's requirements should require an annual forecast from the contractor to provide the supplier with sufficient notice. Environmental and stakeholder/community benefits. To be promoted in future contracts.
Environmental	Environmental Management Plan - consultation with communities (2011 onwards)	Only require relevant parts of EMP to be complete prior to construction commencing e.g. limit to geographical or particular aspects of construction that are programmed to commence.
Environmental	Environmental Liaison Groups (2011 onwards)	Creates a means for mutual understanding of issues and a means to help the contractor overcome them, and for external parties to understand the project objectives, constraints and programme. Establish similar forums for appropriately sized or particularly environmentally sensitive contracts.

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Environmental	Appendix 5/R Process (assessing impacts of contractor's proposed changes post Environmental Statement) (2010 to 2013)	The Appendix 5/R processes were necessary in this case as the Parliamentary Approval process did not allow for an addendum to the Environmental Statement (ES). Scrutiny of any design changes was also required in order to comply with the Habitats Regulations (Appropriate Assessment). This process should be maintained in future.
Environmental	Air Quality/Noise Monitoring (2011 Onwards).	Environmental and community liaison benefits. Minimum requirements set in the contract; encourage contractor to exceed where possible to enhance community engagement. Proactive, so ready if residents raise issues.
Environmental	Programme for available planting areas (2011 Onwards).	Review and include prescriptive clauses in contract which give minimum notice requirement regarding availability of areas to be planted each season. Consider appropriate penalties for non-compliance.
Environmental	Programme for environmental benefits/commitments (2011 Onwards).	Include prescriptive clauses in contract regarding delivery and planning of environmental benefits/commitments for delivery within specified timescales allowed. Particularly relevant to long duration contracts.
Health and Safety	Behavioural Safety: Branding (from summer 2013)	For large projects or long duration projects, particularly with a Joint Venture (JV) contractor, encourage both contractor and employer organisations to avoid imposing organisation-specific branding or processes on behavioural safety. Development of a bespoke campaign assists in buy-in and ownership by the project team and encourages greater participation.

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Health and Safety	Employer site induction (2011 Onwards).	All Employer's site staff should get an induction briefing before attending site for the first time, and an overview of the Employer's and Contractor's H&S Plan. This is also a Legal Requirement.
Health and Safety	Contractor's approach to stand-downs, safety briefings and safety tours (2011 Onwards).	<p>A review should be undertaken as part of overall H&S plan at start of project as to how stand-downs could be employed to better effect.</p> <p>Consider specification of minimum frequency of senior management safety tours to ensure good practice and aligned communication between teams from the start on site. Define the responsibility for recording of site visits and who takes actions. Expected to be the Contractor but not always undertaken.</p>
Health and Safety	Employer's Site Team - Training and experience (NVQ 5, Marine, etc.) (2011 Onwards).	Fully brief and capitalise on H&S experience of full Employer's team for the monitoring of safety issues on site. More staff sufficiently trained in H&S practices improves project safety and provides added support to dedicated H&S team. Clear benefit to individual staff and wider team by providing additional qualified staff to reinforce safety monitoring and message (aside from just H&S Manager). Focus on graduate training helps to improve efficiency as Contract progresses, because a greater number of staff are able to be involved thereby helping to spread the workload. However, this will only work if a quality checking system is in place for outgoing documentation/correspondence. Recognise the differences in overall project programme from the outset and develop resource requirements accordingly for activities such as road order production.

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Health and Safety	H&S Resources (2011 Onwards).	Client should always be prepared to assess the safety progress on the project in relation to staffing.
Health and Safety	Welfare facilities on site (2011 Onwards).	Specify similar requirements within Employer's Requirements in future as appropriate for project size.
Health and Safety	Emergency drills initiated by the Contractor (2011 Onwards).	Emergency drills, especially those such as marine safety drills on this site, are good practice and should be encouraged early on the project and semi-regularly throughout construction to ensure procedures are understood and followed by all staff.
Health and Safety	Understanding of UK legislation and regulations (2011 Onwards).	It is important that EU/UK Legislation is understood, adhered to and adopted by the Contractor- especially when Contractors from varying cultural/national backgrounds are deployed. Ensure Contractor is up to speed on required ways of working within the UK at project site and has rigorous processes in place to ensure adherence (mainly issue where foreign contractors are employed).
Health and Safety	Use of accident prevention teams (2014 Onwards).	Accident prevention teams/cold eyes reviews should be adopted on future contracts of a reasonable size to help audit safety procedures and prevent complacency.
Health and Safety	Sharing of H&S Knowledge across contracts (2011 Onwards).	Work to maintain open lines of communication in relation to H&S practices. Share lessons learned and adopt a behavioural safety programme whenever practicable.

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Health and Safety	Safety Observation Reports (2011 Onwards).	<p>Consider tying SOR closure to KPIs to encourage the Contractor to undertake reporting, addressing and formal closure of each issue more timeously.</p> <p>Encourage wider team buy in to the SOR process. Also, identify those staff best placed to make regular observations based on site role.</p> <p>Need to maintain spirit of collaboration, open dialogue and safety discussions and nurture SOR's as a tool for monitoring trends and not allow to be used or viewed as exercise to 'catch' site staff not conforming.</p>
Health and Safety	Reporting, recording and classification of incidents (2011 Onwards).	<p>More defined procedure to be developed and strictly adhered to by both Employer and Contractor staff from project start.</p> <p>Procedure and documentation needs to be reviewed and interrogated as to actual implementation as part of overall H&S plan in future. More clarity in contractual documentation could be provided with regards to definitions and classifications of incidents/events/near misses.</p>
Health and Safety	Use of site vehicles (2011 Onwards).	<p>Consider specifying further advanced training for a wider range of staff (i.e. 4x4) who may have reason to drive on site, even if this is not their daily role, and at least require staff to demonstrate competence in full range of available vehicles (in addition to basic license requirements).</p>

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Health and Safety	Display Screen Equipment (DSE) Assessments (2011 Onwards).	Purchasing instructions and procurement process of equipment between the Employer and Contractor needs to be agreed from commencement. Ensure clarity in the Contract from the start for which contractual organisation has responsibility to provide what equipment.
Health and Safety	Joint Safety tours were positive	These joint tours should be introduced from early on in a project to encourage collaboration and a unified approach to H&S standards.
Health and Safety	Contractor's site inductions	The weight added to the inductions by attendance by most senior Contractor staff had important impact in relaying safety message to all new staff regardless of level.
ITS	Formation of Safety Management Steering Group, SMSG (2010 onwards)	Without this formal multidisciplinary group matters of operational safety policy would not be resolved to the satisfaction of all stakeholders. Group should become a TS standing committee.
ITS	ITS integration into the design and procurement of the overall project (2010-onwards)	ITS is a developing technology and consequently the related specification and procurement are not as well formulated and established as other aspects of roads construction. For the future, focus on effective management of integration of ITS into all TS road projects from the outset and review/update existing relevant design standards such that they are specific requirements as opposed to guidance documents. Assignment of dedicated resource to monitor and control ITS delivery has been an essential management focus.
ITS	Future proofing infrastructure - ITS (2010)	Possible to provide flexibility without compromising project objectives or adding substantially to costs.

Discipline	Brief description of issue	Lesson learned/proposal for future
ITS	Ensure adequate attention given to impacts of gantries and large signs during design development stage, particularly near built-up areas. (2011-2012)	Ensure contract provides sufficient flexibility to ensure all potential environmental impacts can be mitigated where design development retains some uncertainty at procurement stage.
ITS	Power Supplies to Gantries (2011-2013)	Consider reviewing with Traffic Scotland whether power supplies could be routed in trunk road verges or road boundary as an alternative. As technology evolves the potential for alternative power sources could be considered.
ITS	Traffic Scotland / Transport Scotland interface (2009 onwards)	In ITS intensive projects, it is essential that Traffic Scotland are involved as a key team member from a very early stage.
ITS	Competency of Contractor staff in the delivery of ITS, definition of roles and review of design through Consult and Comply process	<p>The Contractor should ensure that he has access to appropriate resource with sufficient understanding and experience of the delivery of ITS infrastructure due to its specialist nature.</p> <p>ITS Project Manager to be a defined role in the Contractors' organogram at time of Tender, and a sufficiently robust scope for the experience of said role to be defined within the Tender documents</p> <p>Allow sufficient time in the design development to discuss all aspects with NOpsTS and their supply chain, such that all parties are bought into the principles proposed</p>

Discipline	Brief description of issue	Lesson learned/proposal for future
ITS	Delivery of 'Contractor Products'	Where ITS equipment is to be provided by the Contractor and interfaces with Employer Issued Equipment (EIE), a robust review of the requirements associated with these elements should be undertaken to ensure suitability and the achievement or betterment of the Employer's Requirements.
ITS	Design/Constructability vs ease of maintenance	<p>Earlier and more pro-active engagement with end users to ensure that they are on board and bought in to the philosophy and approach undertaken by the designer, and that this is followed through into the construction phase, leading to a more collaborative approach.</p> <p>Proposed that a joint Maintainability audit is conducted prior to the signing of the consultation certificate for the design and when site works are nearing completion.</p>
Network Connections (Roads)	Future proofing infrastructure - Roads (2010)	Possible to provide flexibility without compromising project objectives or adding substantially to costs.
Network Connections (Roads)	Strategic Pipeline Crossings - difficulties in engagement with asset owner (2009 onwards)	<p>Avoid or minimise any interfaces with a known pipeline in early design stages. If not possible to avoid, consider making any crossing works Employer's design.</p> <p>Eliminate direct loadings on pipelines wherever possible, e.g. through use of large accommodation structures.</p> <p>Early engagement with asset owners (and the correct personnel) is vital.</p>

Discipline	Brief description of issue	Lesson learned/proposal for future
Network Connections (Roads)	Consult and Comply (2009-onwards)	<p>Further detailed dialogue should be undertaken pre-tender to encapsulate specific requirements of local authorities within the Contract, such that the provision of a detailed design by the Contractor is made easier with lesser emphasis placed on the consult and comply process for design related elements. This would help to reduce the amount of consult and comply required once construction begins.</p> <p>Need to plan for, and accommodate, staff changes within the third party organisation to ensure consistent approach (e.g. formal written record of agreements such as a Memorandum Of Understanding (MOU)).</p> <p>Ongoing dialogue with local and statutory authorities is essential during construction to ensure interfaces are managed, e.g. road maintenance, upcoming improvements on local road network, etc., and co-ordinating the Contractor's works (via consult and comply).</p>
Network Connections (Roads)	Traffic Management - Varioguard (or similar solid barrier) (2009)	Ensure solid barrier is a requirement for all traffic management works on live carriageways wherever practicable.
Network Connections (Roads)	Trunk Road / Side Road adoption interfaces (2008 Onwards).	The general principles for defining interfaces between trunk roads/ side roads and taking over responsibilities should be defined between the Employer and the Local Authorities pre-tender with further definition/agreement as the Contract develops. Final explicit agreement must be in place before handover to/from local authorities.

Discipline	Brief description of issue	Lesson learned/proposal for future
Network Connections (Roads)	Specification of additional pile testing (Particularly for large diameter piles) (2012 Onwards).	For large diameter piles in difficult ground conditions where voids are potentially likely, consider requirement for additional testing at completion of the piling to ensure bearing strengths are met on future projects. Review application of testing (e.g. for large-diameter piles for critical structures) and documentation in Employer's Requirements.
Network Connections (Roads)	Locations of chamber covers (2012 Onwards)	The Employers Requirements (ER's) should include a clause to avoid this issue and avoid re-work.
Network Connections (Roads)	Specification for testing of mechanical bridge bearings (2008 Onwards)	The Specification for testing of mechanical bridge bearings needs to be explicit. This should be covered by a specific clause in the Employers Requirement's where ambiguities exist in the specification.
Network Connections (Roads)	Specification for provision of recovery vehicles (2014 Onwards).	The contract requirements for recovery vehicles should be left to Standard Highway Specification such that any update or improvement to the standard specification would be reflected in the Contract.
Network Connections (Roads)	Specification for access to ITS Gantries (2010 Onwards).	Positive design choice included in the Contract as provides flexibility for maintenance without requiring road closure. Should be considered on future contracts.
Network Connections (Roads)	Specification of anti-graffiti coating (2015 Onwards).	The specification requires to be written such that aesthetics are fully considered along with the technical requirements of the coating. The aim is to colour match the concrete and provide consistency across the structure.

Discipline	Brief description of issue	Lesson learned/proposal for future
Network Connections (Roads)	Specification of ecological barriers (2008 Onwards).	The specification/Employers Requirement's need to be definitive on the need to exclude animals/birds from accessing structures (i.e. bearing shelves, underdeck beams, etc.).
Network Connections (Roads)	Specification for utility and ITS provision on structures (2010 Onwards).	The Contract requirements and/or Contractor's design must ensure adequate space for anticipated and future provision of ducts.
Network Connections (Roads)	Earthworks design statements (2011 Onwards).	Future contracts should only specify the need for a GIR and GDR only. As such EDS's could be omitted in future contracts thus avoiding repetition and consistency issues with documentation. Ensure Employer's Requirements for future contracts do not require EDS during Construction stage.
Network Connections (Roads)	Programme for side roads construction (2011 Onwards).	Consider introducing more opportunities for sectional early completion for parts of the Contract, particularly where interfacing with existing road users and local communities to further minimise impact over a long project duration.
Network Connections (Roads)	Specification of separation strip width between road carriageway and adjacent footpath (2010 Onwards).	Employers Requirements to specify minimum width of separation and need for full blocks only for separation strip.

Discipline	Brief description of issue	Lesson learned/proposal for future
Network Connections (Roads)	Specification of streetscape/ furniture (2010 Onwards).	<p>The Employers Requirements (ERs) should better coordinate different elements of streetscape, e.g. signposts, chambers, lamp standards etc. For example, the specification could be changed to make minimum widths, rather than exact ones for block paving and footways etc.</p> <p>Consider use of Building Information Modelling (BIM) and virtual reality modelling to envision full scope before implementation at early stage of design by Contractor.</p>
Network Connections (Roads)	Change from Standard Lighting to Light-Emitting Diode (LED) Lighting (2014 Onwards).	Need to amend the Employers Requirements (ER's)/Specification for LED lighting in future and also simplify requirements as LED provides significant savings in whole life cycle costs although a higher capital cost at outset.
Network Connections (Roads)	Changes to Intelligent Transport Systems (ITS) (2010 Onwards).	More specific contract terms in outlining integration requirements could reduce system development or modification costs associated with ITS deployment on future projects.
Network Connections (Roads)	Use of average speed cameras (2011 Onwards).	Specification of average speed cameras within the three main Contracts was highly effective in managing the traffic through the network during construction. However, need to ensure all parties associated with installation and enforcement are in agreement with the system specification and its implementation from the outset (e.g. police) to avoid the need for extensive consultation, additional costs, etc.

Discipline	Brief description of issue	Lesson learned/proposal for future
Network Connections (Roads)	Traffic Regulation Orders responsibilities (2011 Onwards).	Consider streamlining Traffic Regulation Orders (TRO) process and implementing Employer management of Traffic Regulation Orders as opposed to the Maintainer (e.g. local authority) where applicable. If responsibility held by the Employer, less likelihood of programme issues and risk of delay.
Network Connections (Roads)	Responsibilities for road maintenance during contract period (2011 Onwards).	Parties responsible for road maintenance throughout contract need to be more clearly defined and formalised to avoid confusion and conflict.
Opening Ceremony	Clarity of governance structure, planning and information sharing to be organised from the start.	Establish a robust governance structure from the outset is essential. All efforts should be made to limit late stage involvement or change instigated by outside parties. Those with decision making status or who would require input should be engaged from the outset and maintained throughout the planning.
Opening Ceremony	Need to utilise specialist knowledge and skills of event planning companies	Need to appoint event company early, agree scope, and allow flexibility to deliver the logistics in most efficient fashion possible. Engage experienced event coordinators and utilise their expertise in liaising with local stakeholders such as emergency services and on the provision of support staff for the event who are adequately trained.
Opening Ceremony	Acceptance of Social Media as an essential component of the communications strategy.	Public feedback and involvement in social media should be encouraged and captured. Plan for dissemination of positive feedback and responding to any criticism worked well.

Discipline	Brief description of issue	Lesson learned/proposal for future
Opening Ceremony	Need to engage with the Contractor earlier to understand what the site requirements are if events are held within scheme extents.	Event companies need to be briefed from the outset by the Contractor on what they need to do to satisfy H&S requirements on a live site. Feedback and input on safety matters should be sought from the site owner. Production of Risk Assessments and Method Statements by the event planning companies should be undertaken and shared with the Contractor as early as possible to allow sufficient time for feedback and collaboration.
Opening Ceremony	Consistency of branding and message across all events.	Consistent use of promotional materials is essential across all strands of the events including written and digital - consistent messaging. If using more than one event management company need to ensure collaboration from the start.
Opening Ceremony	Event dates not agreed until late stage due to several changes to the date of opening	Consider decoupling opening ceremonies/events from the physical asset opening date to avoid changing event dates as a result of construction. Attempt to set event dates well in advance so knowledge of likely weather effects, daylight, etc. can be accounted for and event planning companies engaged at an early stage.
Opening Ceremony	Engagement of project staff to support through public interaction at opening events	Provision should be made for future events to involve the project staff early and as far as possible in providing project knowledge and information directly to the public on the day.
Opening Ceremony	Scoping and appraisal of options undertaken early.	Engaging an event advisor and/or event company at an early stage is highly beneficial in effective scoping, planning and realisation of the events.

Discipline	Brief description of issue	Lesson learned/proposal for future
Opening Ceremony	Vision and objectives established at the outset.	Establish clear view of what is desired to be achieved and who is intended to be reached by the events. Once the overall vision and goal is established, check in regularly against this as planning stages move on.
Opening Ceremony	Engagement with transport provider.	Transportation considerations should feature early in the planning of any event and in the case of both the Queensferry Crossing Experience and the Opening Ceremony worked very well in checking, marshalling and transporting thousands of visitors.
Opening Ceremony	Use of dedicated online portal for ballot registration, user accounts, information (FAQs) and enquiries.	Utilising a centralised online portal for the management of ballot entries was essential to streamline the process, save time and prevent errors. The interface with the public was easy to use and well received. If undertaking future ballot based applications for events, utilise online publically accessible portal.
Policy / Governance	Availability of resources both for Transport Scotland, Scottish Government Legal Directorate (SGLD) and Jacobs Arup Joint Venture (JAJV) teams (2009/10).	Bill team should be fully resourced from the outset and, though not always possible, it would be useful if continuity is borne in mind. This is important alongside ensuring knowledge is shared across the wider team and does not rest solely with an individual. Co-location of all elements of Bill team greatly assists productivity and resolution of issues.
Policy / Governance	Ensuring the continuing support of Ministers and Cabinet (2008 onwards).	Ensure clear identification of key issues that require Ministerial support. Ensure strong support for day to day issues that attract Ministerial attention.

Discipline	Brief description of issue	Lesson learned/proposal for future
Policy / Governance	Maintaining and supporting appropriate governance structure (2008 onwards).	Establish limits of authority for project team in relation to critical issues which should be exposed to Project Board/ IDW/ Ministers representing risks, decisions or departures from agreed practice that could impact beyond the capabilities and resources of the team.
Policy / Governance	Effective leadership and co-ordination (2008 onwards).	Better leadership and more effective decision making and implementation stems from a well-defined management structure with clear understanding of issues and delegated responsibility.
Policy / Governance	Ensure the adoption of a relevant and suitable project management regime (2008 Onwards).	The appointment of dedicated project team members to establish and maintain effective systems Regular monitoring and updating of aspects of the Project Execution Plan are essential.
Policy / Governance	Role of Project Management Board (2008-2010), renamed Construction Management Board (2011 onwards)	The Board is an essential governance tool which provides a sound focus on monitoring/addressing project needs and progress. It is important to shift focus as project transitions to the construction phase. In concluding the commercial aspects of the project, it is important to include the relevant people in the key discussions with the Contractor to ensure that all decisions are fully understood.

Discipline	Brief description of issue	Lesson learned/proposal for future
Policy / Governance	Ongoing review of Project Execution Plan (PEP) (2008/09/10)	<p>To interrogate appropriateness of Project Execution Plan (PEP) on a regular basis so as to ensure project remains on sound footing.</p> <p>Acts as repository for historical information and documents as project progresses.</p>
Policy / Governance	Establishment of Employer's Quality Management System and corresponding documentation for Construction phase (2011 onwards).	The production of the quality documentation and systems requires significant effort and resource to complete. However, investing in these brings significant benefits for the smooth operation of the contract.
Policy / Governance	Role of Financial Risk Advisory Group - FRAG (formerly FAG). (2008 onwards)	<p>Providing a particular focus to key issues of risk and finance ensured appropriate level of clarity and attention on these important matters.</p> <p>The role of the group was reviewed once the construction contracts had been awarded and again after J1a and Fife ITS completion.</p>
Policy / Governance	Role of Project Board. (2008 onwards)	<p>Provision of information pitched at the right level of detail and importantly at the right time with a clear exposition of what was required of the Board.</p> <p>Need to review with the Board its requirements during the construction phase including its membership and frequency of meetings.</p>
Policy / Governance	Role of Supervisory Board (2008 onwards)	Provided focus of attention. Need to review relevance and timing of information sets for the Supervisory Board.

Discipline	Brief description of issue	Lesson learned/proposal for future
Policy / Governance	Effectiveness of undertaking Lessons Learned Register (2010 onwards).	<p>It is essential to ensure that the project team devote time in assessing the project in terms of what has gone well, what has not gone well, and to learn for the future.</p> <p>Regular review of the lessons learned register is required to ensure all aspects of the project are captured.</p>
Policy / Governance	Optimising value management (2008-2011)	<p>Ensure there is close scrutiny of the project brief to determine assumptions and presumptions that should be tested.</p> <p>Close and regular oversight by senior management of principal design choices and options being developed by design teams.</p> <p>Focus on the essential elements of agreed project brief and avoid scope drift through unnecessary “value” enhancements.</p>
Policy / Governance	Managing supporting design processes (environmental and traffic/ transportation) (2008-2009)	Recognise the timescales for survey and analysis, and match to the relevance within the project definition development (i.e. fundamental determinant of corridor or capacity, or secondary issue of mitigation).
Policy / Governance	Co-location/ Integration of Project Team (from Jan 2008)	Co-location helped to engender good team working and a partnering ethos, helping to solve problems timeously. That teams delivering projects should be organised in such a manner so as to maximise their effectiveness.

Discipline	Brief description of issue	Lesson learned/proposal for future
Policy / Governance	Ensure that there is a satisfactory handover period for any key staff leaving/joining the project to provide knowledge transfer and consistency (Date - various)	<p>Ensure as much notice and forward planning of staff changes is given in order to provide the least disruption and greatest continuity of knowledge/skills.</p> <p>Provide a reasonable handover period whenever possible. It is worth taking the time to ensure adequate handover as it ensures more efficient transfer of duties where staff changes are made.</p> <p>Do not underestimate the disruption caused by the absence of junior as well as senior staff when there is no handover period.</p>
Policy / Governance	Ensure continuity of staff for consistent engagement with stakeholders (Date - various)	<p>Consistency of staff when dealing with stakeholders greatly aids communication and often resolution of issues.</p> <p>If new staff require to be involved ensure that at least one existing staff member is provided for consistency. This usually assists in making the stakeholder feel “at ease”.</p> <p>When moving into the Construction phase from pre-construction phase and utilising Contractor's community liaison, ensure some continuity in staffing of the overall project team in this area to ensure consistency across the transition.</p> <p>Adopt this strategy on future projects.</p>
Policy / Governance	Continuity of Gateway Review/Peer Review/Key Stage Review team members (Various through Project)	<p>Consistency of reviewers aids efficient use of the time available to undertake the review – knowledge of the project does not have to be re-learned. It may also lead to a better understanding of the key issues. Wherever possible utilise the same or nearly the same review team to provide consistent approach and to aid understanding of the project.</p>

Discipline	Brief description of issue	Lesson learned/proposal for future
Policy / Governance	Quality Audit contract - allowances for travel and subsistence outwith Scotland (2011-2012)	Develop the Management Systems Audit Commission in future to allow for recovery of reasonable expenses incurred for such visits; specify basis for remuneration more fully in contract (SG rates applicable at the time to be used as basis for payment).
Policy / Governance	Quality Audit programme - ensure all parties included (2011-2012)	Consider the effect of the overall Contractor's structure in order that a more detailed view of the audit programme can be allowed for including discrete parts of joint venture partners. May be a limited issue to the FRC project due to unique scale and number of parties involved but may need to be considered for any JV/consortium arrangement.
Policy / Governance	Quality Audit contract - verification visits (2011-2012)	Whilst the Commission allowed for ad-hoc activities it could be developed in future to specifically anticipate and allow for verification visits in the overall audit programme as an essential part of the audit service.
Policy / Governance	Quality Audit contract - Administration and reporting (2011-2012)	Ensure that the Management Systems Audit Commission is developed in the future to highlight the requirement for appropriate tracking systems and reporting mechanisms to be in place to manage the complex information to and from the various parties.
Policy / Governance	Co-ordination of CoCP and Employer's Requirements - Comms and Stakeholders (2010-2011)	Where overlap of statutory and procurement processes occurs, ensure that final concurrent review of documents is undertaken to ensure consistency.

Discipline	Brief description of issue	Lesson learned/proposal for future
Policy / Governance	Continuity of Advisors: Potential change in expert Advisor's during the contract period (various dates)	<p>Serious risk of knowledge and service loss at critical junctures in the project if the contract is not of sufficient length.</p> <p>Seamless expert support with contract periods is preferable in long duration infrastructure projects (e.g. media advisor's inherent stakeholder knowledge and handling could be lost).</p> <p>Consider greater flexibility in procurement to recruit project-specific advisors for project durations.</p>
Policy / Governance	Engagement with Parliamentary Committees - regular updates and appearances to appropriate Parliamentary Committees. (2009 onwards)	<p>Solid preparation including practice sessions are extremely useful prior to appearance before the committees.</p> <p>Providing opportunity for the committee to visit site enables less formal communication and provides a better understanding of the realities of the project on the ground.</p>
Policy / Governance	Benefits of 'Cold Eye Reviews' (e.g. Programme and Budget audit) (2011 onwards)	Consider arranging similar reviews for other large-scale projects where applicable.
Policy / Governance	Code of Construction Practice - in practice (2011 onwards)	<p>Valuable document from both client and public perspectives. Provides clear set of 'rules' for the Contractor to follow.</p> <p>Need to ensure alignment between CoCP and Contract/ERs.</p> <p>Ensure project team is fully and regularly briefed on CoCP contents and commitments.</p> <p>Continued vigilance is required to ensure that the Contractor remains compliant throughout the project's construction phase.</p>

Discipline	Brief description of issue	Lesson learned/proposal for future
Policy / Governance	Project Team - Briefings (2011 onwards)	<p>Particularly relevant for long contracts or where requirements are not identical to previous projects and helps to avoid 'silo' mentality.</p> <p>Need to ensure team are fully conversant with all contract documents and maintain this knowledge - especially as new staff join the project. Need to cover Forth Crossing Act, Employers Requirements, FRC Contract, Code of Construction Practice etc.</p>
Policy / Governance	Independent Quality Authority - benefit to the project (2011 onwards)	<p>Valuable, if not essential, tool on projects regardless of size, in particular at an early stage when contractor is mobilising. Especially valuable for ensuring management plans and other early deliverables / activities are fully considered by the contractor.</p> <p>Has proved useful for auditing Contractor, Designer and Checker systems and providing independent view on improvements.</p> <p>Need to provide appropriate number of audits for stage and nature of the project and avoid overlap with Employer audits.</p>
Policy / Governance	Annual Review of Contractor Financial Standing (2010 onwards)	Valuable risk management tool that is easily implemented and should provide early warning of potential problems in Contractor organisation.
Policy / Governance	Employer's enforcement of Contractor's compliance with respect to enquiries, complaints and community contact protocols (outlined in Code of Construction Practice (CoCP) (2011 to 2017).	<p>Need to recognise requirements can change on site as works progress. Work with Contractor to develop strategies to enable compliance with requirements without unnecessary pressures being placed on the Employer.</p> <p>Protocols should be enforced regarding specific community liaison procedures.</p>

Discipline	Brief description of issue	Lesson learned/proposal for future
Policy / Governance	Need for clarity with public reporting of project completion dates as target v. contractual from start.	When the tenders were received and the contract was about to be awarded advantage could have been taken of the significantly reduced cost to manage the expectation of the opening to traffic date stating that the budget had been significantly reduced and that the project was targeted to be completed by the end of 2016 but the Contractual end date was Summer 2017.
Procurement	Duplication and revision of pro-formas included in the contract documents used in the Principal Contract. (2009/10)	Approved pro-forma not to be changed without prior agreement of the author. Pro-formas (or any other documents) not to be duplicated within contract documents.
Procurement	Time periods stated for the production by the Contractor and acceptance by the Employer of the Quality Management documentation, programme and Schedule of Payments too short (2011 onwards).	Time periods for production of this information need to be contract specific (i.e. appropriate for the scale of project) and realistic, recognising the mobilisation pressures of the contractor team, particularly when working as a joint venture, and the possible dislocation between the Contractor's bid team and the Employer. Give the Contractor more time when contract started to develop their programme. Along with more detailed programme/progress reporting controls written into Employers Requirements, (ER) could also consider allowing additional time at project start for Contractor to establish programme content. This would also potentially allow for necessary reviews by the Client before implementation.

Discipline	Brief description of issue	Lesson learned/proposal for future
Procurement	Ensure that a robust management strategy for resolving tender queries and issuing tender amendments etc. is put in place (Dec 2009 – 2011)	<p>The regime of weekly meetings ensured that all dialogue queries and issues are resolved at the earliest opportunity. By tracking responses from specialist staff, timeous updates of documentation and/or tender queries can be achieved.</p> <p>Electronic systems for raising and answering queries provide an ideal means of logging and tracking data.</p> <p>This strategy is to be adopted for subsequent dialogue/tender procedures.</p>
Procurement	Tender de-briefs (2011)	Such debriefs are essential, particularly for high-stakes tenders such as the Principal Contract.
Procurement	Ancillary Contracts: Timing of the procurement of the insurance advisor and delivery of wind tunnel contracts (2009).	<p>Avoid underestimating practical procurement timetabling and anticipate the cumulative effects of delays so that contract delivery is not allowed to slip past desirable dates.</p> <p>Develop a project procurement protocol so that all discipline leads understand timescales, authorisation and processes.</p>
Procurement	Conditions of Contract (2009/10).	Finalise terms of contract as far as possible in advance of going to tender.
Procurement	Creating a climate of trust between TS and Economic Operators/ Participants and confidence that project would proceed to award (2009/10).	<p>Be open and approachable in terms of meeting with prospective bidders</p> <p>Create additional structures to demonstrate client commitment i.e. (Tender support, Participation agreement)</p>

Discipline	Brief description of issue	Lesson learned/proposal for future
Procurement	Dialogue Period meetings strategy (2009/2010)	<p>Due to the significant number of issues scheduled for discussion at meeting, it was difficult to properly address issues in the time constraints.</p> <p>Smaller scale interim meetings were successful in addressing specific issues.</p> <p>In future could hold high level management meetings supported by specific specialist meetings.</p>
Procurement	Number of Participant commitments/comments on outline proposals (2011)	<p>A more focussed approach is required from the Employer's review teams to try and ensure comments are kept to a minimum level – this is likely to be a balance between 'must haves' and 'nice to haves'.</p>
Procurement	Two Party or Three Party contracts (2011)	<p>Feedback from the Contractors was positive in that there was a direct one to one relationship between the Employer and the Contractor. This approach also required a close interaction between the two teams and resulted in co-location of the two teams in the site offices for each contract.</p> <p>This approach required the Employer to have sufficient resource to administer the contracts effectively and these may be sourced either in-house or through use of consultants but this must result in a seamless team to be fully effective.</p>

Discipline	Brief description of issue	Lesson learned/proposal for future
Procurement	Adoption of an Owner Controlled Insurance Programme (2010 onwards)	<p>It is vital to clearly define what coverage the Owner Controlled Insurance Programme will provide and to have clear interfaces between the OCIP and any Contractor provided insurances.</p> <p>It is hard to make a direct comparison between the costs of an OCIP and Contractor provided insurances as Contractors may make use of their blanket annual policies rather than take out project specific insurances – e.g. Contractor All Risk and Third Party liability.</p> <p>Specifying minimum level of Contractor insurances may exclude some bidders if they do not normally carry such insurances.</p> <p>It is important to clearly define in the final tender documents exactly what the OCIP coverage, deductibles and exclusions will be as changes to the baseline after tender stage may prove difficult or costly to deal with.</p> <p>On the FRC this issue was dealt with by a side letter to the contract together with contractual clauses on insurance which defined a process for resolving any such issues including if a risk becomes uninsurable during the execution phase of the contract.</p>

Discipline	Brief description of issue	Lesson learned/proposal for future
Procurement	Basis of Contract for M9 J1A and Fife ITS is as per the Principal Contract (2011)	<p>Whilst the Principal Contract had sufficient time available for mobilisation built into its structure (bonds etc. required before commencement date, some months after award), both M9 J1A and Fife ITS required immediate mobilisation at award of contract. For “small” contractor organisations this can be difficult in terms of resourcing – Fife ITS in particular experienced this.</p> <p>Future use of such contracts need to build in time for contractors’ mobilisation following award.</p> <p>With regards to certification, the Contractor needs to ensure his programme reflects this accurately and that he has sufficient resource to manage the process.</p>
Procurement	High volume of information was required of Participants, particularly for the two smaller contracts (2011).	A more concise set of requirements – addressing the key areas required to demonstrate a compliant design capable of development to meet the contract would help reduce the volume of information. However, this may be in conflict with the requirements of the Contractors estimating team
Procurement	Ancillary Contracts: Provision of Procurement Protocol (2010)	Clearer understanding of procurement process including timescales, legal implications, etc.
Procurement	Difficulty in interesting sufficient participants (2009).	<p>Do not underestimate the amount of market sounding /warm-up required. In this case it is considered to have delivered the best response practically achievable in the prevailing market conditions</p> <p>Ensure the Pre-Qualification Questionnaire (PQQ) is easy to complete and easy to evaluate.</p>

Discipline	Brief description of issue	Lesson learned/proposal for future
Procurement	Complexity and number of parallel work streams made difficult the quick close out of a significant number of issues on the “issues list” which had a knock-on effect in terms of developing the documentation (2009).	<p>Clear structure of contract documents and placement of contents.</p> <p>Ensure careful programming of supporting development and process completion.</p> <p>Ensure availability of dedicated resources.</p>
Procurement	Procurement of Contact and Education Centre Tender Period and type of procurement (2011)	<p>Recommend that whenever possible, avoid reducing tender periods to a minimum on future contracts and ensure sufficient time for contract review.</p> <p>It is advantageous to add more time to the procurement process to have improved end-date certainty, and reduce the risk of poor quality tenders.</p> <p>Consider using the Competitive Dialogue procedure, if appropriate, to facilitate discussion of the contract requirements. Ensure there is an opportunity for dialogue on such contracts to reduce risks to both parties.</p>
Procurement	Expansion of Brief to incorporate Traffic Scotland Control Centre (2011)	The combined facility is a good example of making best use of scarce public resources.

Discipline	Brief description of issue	Lesson learned/proposal for future
Procurement	Contractor and Employer Health and Safety Managers (2011)	<p>For specialist projects (e.g. marine construction) it is vital that the Contractor's H&S Manager has relevant experience. Given the key importance of this role, this position should be highly specified, and made subject to Employer approval (as is the case with the Contractor's Project Director), within the contract documents.</p> <p>Ensure Employer appoints their H&S Manager at an early stage.</p>
Procurement	Early start to the procurement of the Geotechnical investigation & Topographical survey (Autumn 2007).	Careful planning can create significant time savings.
Procurement	Parallel authorisation and tendering of the project (2009/10)	<p>Sound Governance structure is essential allowing rapid decision making.</p> <p>Robust record management strategy e.g. PEP, action lists, meeting minutes, papers and reports etc.</p> <p>Adequate resources and integrated team.</p>
Procurement	Staffing continuity from Procurement phase to Site (2011).	Ensure continuity from Procurement Phase to Construction of the Employer's team where practicable.

Discipline	Brief description of issue	Lesson learned/proposal for future
Procurement	As-Built Requirements for Drawings (Fife ITS and M9J1a: 2009-2010, PC: 2009 - ongoing)	<p>Ensure that there is no ambiguity in the requirement for As-Built drawings to be supplied in Computer-Aided Design (CAD).dwg format.</p> <p>The production of the as-built archive in terms of format and structure requires careful consideration at tender stage, including consideration of technological advances such as Building Information Modelling (BIM) and cloud-based storage. Consideration of the operator/maintainer requirements in this respect is also key.</p> <p>Future contracts should specify the form of the project archive from the start of the project (i.e. electronic/hard-copy and storage software) and require as-builts to be produced throughout the contract as construction progresses, not just at the end for achievement of completion.</p>
Procurement	Term Ground Investigation (GI) contracts should be reviewed annually to ensure changes in statutory requirements are expressly addressed. (2010)	<p>Certain notification requirements of the Register can have a significant impact on programming of works.</p> <p>Clause on SRWR to be added to future ground investigation contracts.</p> <p>Current Ground Investigation Multi-supplier Framework Agreement (MFA) 2018 places general duty to consult on Contractor. Review effectiveness of this as well as changes in statutory requirements and include in GI MFA contract currently under development.</p>

Discipline	Brief description of issue	Lesson learned/proposal for future
Procurement	Need for complete management documents by Contractor prior to construction commencement (2011)	<p>Consider permitting submission of interim stages of key documents which cover sufficient activities to enable construction to commence, whilst ensuring compliance with statutory requirements (e.g. CDM Regulations).</p> <p>Where there is a public commitment to publish documents, there is a need to ensure that the public understand where interim stages are permissible.</p>

Discipline	Brief description of issue	Lesson learned/proposal for future
Procurement	KPI Deduction Regime - operation during construction (2011 onwards)	<p>Utilise KPIs on future projects to enforce the delivery of quality promises made in the tender. Ensure SMART (Specific - Measurable - Achievable - Relevant - Time-Orientated) KPIs are in place at Contract commencement.</p> <p>Consider alternative means for specifying KPIs to ensure that operation and measurement are agreed and clearly understood prior to commencement of the KPI regime.</p> <p>Consider whether KPIs should be pre-defined and give careful consideration to the operation in practice of the regime. Identify areas where Client may wish to monitor Contractor performance and introduce KPIs around them. More influence on KPI proposal and selection could be applied by the Employer rather than leaving to Contractor to propose.</p> <p>KPIs could be a lot tighter to ensure added value and that compliance level is set appropriately (i.e. as-built documentation and closure of NCRs).</p> <p>Assign a deduction if documentation not explicitly delivered within set timescales from completion of packages. Principal Contract uses a 'stick' approach of deductions, a 'carrot' approach of incentives could also be considered.</p>

Discipline	Brief description of issue	Lesson learned/proposal for future
Procurement	Advance Works provide significant programme benefits (2009-2010)	<p>Programming of all aspects of the works need to be fully considered at an early stage and split appropriately in terms of minimising risks and ensuring value for money. Advanced works should be commenced as soon as possible to provide the greatest benefit.</p> <p>Require careful management and monitoring of progress to realise benefits and avoid conflicts, especially when contractual responsibility lies with the Employer (e.g. power supplies).</p>
Procurement	Project Insurance Policy (PIP): Procuring an Owner Controlled Insurance Programme through the Official Journal of the European Union (OJEU) process was a difficult concept generally for the insurance market. (2010)	Although the insurance market is becoming more aware of the OJEU process, more education and training around the detail of response required may help future tender processes
Procurement	Project Insurance Policy (PIP): Ensure that appropriate Loss Adjusters are appointed and a clear and concise Claims Handling Procedure, including all contact details, is provided and relayed to all relevant project personnel (2010-2011)	Ensure that handling of incidents/claims reporting is addressed earlier in the process including the development of a Claims Handling Agreement and education of relevant personnel on the project

Discipline	Brief description of issue	Lesson learned/proposal for future
Procurement	Contractor selection - small value contracts (2010).	<p>Plan for proportionately greater Employer involvement for smaller value contractors.</p> <p>Consider increased quality percentage in selection and careful consideration of selection criteria.</p> <p>Consider appropriate and proportionate use of KPIs with financial impacts to ensure delivery of contractual objectives (e.g. programme, planning, community engagement, reporting).</p>
Procurement	Co-located Employer team with Contractor (2011 onwards)	<p>Co-location with the Contractor is to be encouraged on future larger scale TS projects and generally works well. Needs careful consideration and specification of facilities such as size, Wi-Fi, IT systems, parking, printing, VP connections, etc. Ensure new technologies are incorporated. Also consider canteen, transportation to site etc.</p> <p>Employer staff to be encouraged to arrange face-to-face meetings to discuss issues with Contractor, both formally and ad-hoc, rather than relying on email communications.</p> <p>Consider integrating Contractor and Employer teams by discipline.</p>
Procurement	Definition of 'construction vehicles' (2009)	Clear definition would assist in defining responsibilities for vehicle routing and restrictions on Contractor's/suppliers vehicle movements (e.g. supply of Spent Oil Shale from Winchburgh Bing).

Discipline	Brief description of issue	Lesson learned/proposal for future
Procurement	Contractor's Key Personnel (2010-2013)	<p>Include minimum qualifications and experience requirements for a wider range of senior positions, and only permit change with the Employer's consent to key staff. All changes during the Contract would need to be subject to this approval with sufficient handover allowed to retain knowledge and consistent delivery.</p> <p>Be more definitive with specific members of staff identified from Employer and Contractor (including the Designer where appropriate) demonstrating competence.</p>
Procurement	Construction Skills Certification Scheme (CSCS) Cards - non UK equivalents. (2010-2012)	Require full compliance with CSCS cards on future TS projects.
Procurement	Scope of health and safety requirements and measurement (2010-2013)	<p>A Behavioural Safety Programme should be a mandatory requirement as it helps to impart a significant positive culture change.</p> <p>Ensure metrics for H&S measurement are agreed in advance and / or captured by Key Performance Indicator (KPI) mechanism.</p>
Procurement	Early involvement of sufficient client/advisor health and safety resource. (2010-2011)	<p>Identification and deployment of dedicated health and safety professional at appropriate time to input into contract documents and to assist with monitoring of construction stage activities.</p> <p>Need to recognise distinction between Construction Design Management Coordinator (CDMC) role and construction health and safety specialist.</p>

Discipline	Brief description of issue	Lesson learned/proposal for future
Procurement	Use of trials in advance of permanent works (2011 onwards)	<p>Consider including requirements for trials of critical construction activities within future contracts and whether/how to include in the Employer's Requirements.</p> <p>In particular, ensure trials are undertaken in any areas on future contracts where unknowns regarding quality or methodology exist.</p> <p>Many trials only undertaken immediately in advance of permanent works which didn't leave much time to address issues. Push for trials to be undertaken even earlier before start of works to pick up any issues (i.e. grouting trials). The Employer's Requirements should have been more prescriptive about what was required from the post-trial reports, before the works can progress.</p>
Procurement	Implementing Eurocodes: Staged design basis documents for Geotechnics (2009-2013)	<p>Requirements for Eurocode 7 documentation are to be reviewed in order to clarify requirements. As of 2018, general understanding has improved with familiarity and experience of use and a fully revised Eurocode 7 which is to be issued in future will require consultation.</p> <p>Undertake early discussions with contractor and designer regarding documentation to ensure intentions of employer are met.</p>

Discipline	Brief description of issue	Lesson learned/proposal for future
Procurement	Dialogue Period Ground Investigations (GI) (2009-2011)	<p>A highly desirable process which should be used across all Transport Scotland (TS) projects.</p> <p>Process for rationalising scope of Ground Investigations (GI) from individual Participant's requests could usefully be reviewed.</p> <p>Ensure procedures used are recorded and made available for use in future Competitive Dialogues.</p>
Procurement	Lane Occupation Charges (2009 onwards)	<p>LOC regime is an effective method to reduce traffic delays and disruption and should continue to be applied on other contracts.</p> <p>Review LOC regime and contract drafting to simplify and provide flexibility whilst delivering core objective of minimising traffic congestion.</p> <p>Agree and record LOCs on a monthly basis and document in the monthly progress report and progress meeting.</p>
Procurement	Contractor mobilisation period (2011)	<p>Consider introducing a mandatory mobilisation period for design completion and preparation for site works - included in tender documents and contract. This would need to be dependent on the timing of contract award - ensuring that seasonally-sensitive construction operations are not put at risk.</p>
Procurement	Developing bespoke Employer's Requirements (ER's) (2008-2011)	<p>Time is well spent in preparation of thorough, bespoke documentation as well as full review of existing ER's that are relevant; it helps to improve the efficiency of the running of the Contract.</p>

Discipline	Brief description of issue	Lesson learned/proposal for future
Procurement	Completeness/appropriateness of Employers Requirements (ERs) and Specifications (2010 Onwards).	<p>Robust ER's are essential for a successful contract. Ensure that any overlap in specification requirements between major contract components are fully examined and documented.</p> <p>On long-term contracts, ensure Employer's Requirements are regularly reviewed to take account of surrounding industry changes in best practice or standards (i.e. use of electronic as-built records).</p>
Procurement	Flexibility allowed in conceptual design choices at tender stage (i.e. foundation and bridge deck type). (2010-2011)	Ensure flexibility is provided for wherever possible while ensuring desired end aesthetics and functionality are mandated.
Procurement	Contractor considered level of documentation/certification required excessive and did not allow sufficiently for this in his tender	<p>The Employer could undertake a review of the documentation protocol to ensure the correct balance is struck between sufficient documentation and excess paperwork.</p> <p>More importantly at tender, the evaluation process could require further demonstration by the tenderers that they had adequately budgeted for the work required in document production.</p> <p>Milestones were contained in the contract for payment being tied to the completed certification of works elements. Consideration should be given as to whether the value assigned to this delivery should be increased in future to provide emphasis on the need for continuous documentation production throughout the Contract and particularly at Contract handover.</p> <p>A possible improvement on the process could be to write into contract a minimum period for Contractor to respond to comments on documentation on a continuous basis.</p>

Discipline	Brief description of issue	Lesson learned/proposal for future
Programme and Budget	Management of Cost and Programme (Jan 2008 onwards).	<p>Create “financial trending programme” as soon as a conceptual design has been produced and costed.</p> <p>Trends should be monitored on a monthly basis to ensure that any changes are tracked and discussed at the appropriate level and to ensure that the overall budget is accurately reported.</p>
Programme and Budget	Creating reliable models to support financial assessments (2008)	<p>Recognise the important subjective elements within assessments which will be applied in numerical and systematic modelling. Interrogate assumptions to ensure appropriate application and ensure the optimum financial solution.</p> <p>Involve procurement practitioners as well as financial advisors in setting and testing these assumptions.</p>
Programme and Budget	Managing change in project scope (2008-2017)	<p>Set up clear change management processes (financial, procedural etc.).</p> <p>Scrutinise changes against the project objectives and brief to ensure focus on delivery of key outcomes without scope or cost creep.</p> <p>Seek early agreement with parties outside the direct project team.</p>
Programme and Budget	Agree protocol in respect of programme from other critical branches within TS at early stage in project. (2010)	<p>Need to agree delivery timetables well in advance but secure flexibility for major critical project works with all branches.</p>

Discipline	Brief description of issue	Lesson learned/proposal for future
Programme and Budget	Comprehensive monitoring of the Contractor's Programme (2011 onwards)	<p>Programme expertise within the Employer team is crucial to ensure that all activities are properly monitored and recorded so that when changes to the programme are made they are detailed.</p> <p>A monthly Employer's programme meeting is essential to ensure visibility of progress on all activities.</p> <p>A detailed Employer's record of progress and reasons for any delays is invaluable in addressing any commercial issues.</p>
Programme and Budget	Management of financial issues: ensuring prompt payments and management of accruals, compensation, etc. (2008 onwards)	<p>Early and continued dialogue through regular monthly meetings between the site team and TS finance is vital to ensure the smooth running of the financial management of the project. A similar process should be adopted on all projects, particularly those of a large value or with complex financial arrangements or multiple financial stakeholders.</p> <p>The Employer's team has demonstrated that a good understanding of the Contractor's forecast and reporting process and the maintenance of open and honest lines of communication across contractual parties ensures that fiscal targets can be met allowing both parties to be satisfied. This should be embraced as far as is possible on all future contracts.</p>
Programme and Budget	Preparation of Employer procedures and management plans. (2011 Onwards)	<p>Future projects should ensure that procedures and management plans are in place before the Employer's team starts on site. These documents are to be kept 'live' and modified in line with the evolution of practices on site; all change should be recorded and fully circulated to all staff.</p>

Discipline	Brief description of issue	Lesson learned/proposal for future
Programme and Budget	Pre-contract resources (Transport Scotland and Jacobs Arup Joint Venture - (JAJV)) (2008 - 2011)	Sufficient resources at pre-contract stage are vital to ensure project success. All projects must ensure proper and thorough resourcing.
Programme and Budget	Quality, accuracy and timeliness of Employer's correspondence. (2011 Onwards)	A central check/review of correspondence ensures clarity and consistency, leading to fewer queries. Important to reduce potential claims from delayed responses. On future project consideration should be given to appointing a single responsible person from project commencement to manage quality and timeliness of all contractual correspondence.
Programme and Budget	Image storage and tagging (2011 Onwards)	Instigating use of a suitable system from start of contract on future jobs to ensure searchable image archive for records, publicity, presentations etc. is essential. Having a single point of contact for system management ensures consistency and searchability is maintained. Consider a dedicated server for this purpose to ensure sufficiently rapid search times as volume of information increases over time.
Programme and Budget	Inspectors' diaries (2011 Onwards).	Need to have central filing from start of project as this aids future information searches for dealing with potential claims etc. For future, consider filing Inspectors' reports on a database rather than an Excel spreadsheet.
Programme and Budget	Business Collaborator. (2008 Onwards)	Ensure allowance for this included sufficiently in the original budget for use during pre-tender, tender and construction phases. Consider use on future projects as archive/filing tool.

Discipline	Brief description of issue	Lesson learned/proposal for future
Programme and Budget	Employer's Intranet page (2014 Onwards).	A useful tool that is adopted by all staff, but could be improved through more regular maintenance to ensure all links and information up to date.
Programme and Budget	Specification of hard-copies of documentation (2008 Onwards).	For future projects, the specification of electronic archive system and paper copy needs should be outlined in Employers Requirements (ER's) from start of project with a view to minimising the use of paper wherever possible.
Programme and Budget	File naming system protocol (2011 Onwards).	In order to access documents quickly and efficiently it is essential to adopt a strict file naming protocol and conduct regular checks to ensure it is adhered to by all staff. Ensure all new employee are briefed fully on protocol. Maybe add to new employee induction.
Programme and Budget	Communication of Programme information (2011 Onwards).	Future projects should specify the use of graphics for the conveyance of progress information around the team and outside stakeholders. This will allow staff and also stakeholders to be kept informed appropriately through a medium that can be universally understood.
Programme and Budget	Quality of Employer reporting (2011 Onwards).	Format and scope of reporting on future projects should be commensurate with the scale of the contract. However, there will always be a need to adapt to the specific content and audience desired when producing deliverables.
Programme and Budget	Employer look-ahead report. (2011 Onwards)	This should become a standard practice on future contracts to ensure all staff are aware of ongoing and upcoming activities on a detailed level.

Discipline	Brief description of issue	Lesson learned/proposal for future
Programme and Budget	Meeting reporting schedules. (2011 Onwards)	Meeting scheduling where programme and progress reporting is required should be reviewed to allow more/sufficient time for review and compiling reports between receipt of programme and meeting start date/time.
Programme and Budget	Financial interface between project team and Transport Scotland Finance Directorate staff (2011 Onwards).	Direct communication between respective financial managers supports effective reporting and should be encouraged on all projects.
Programme and Budget	Transport Scotland Consultant Budget Estimation. (2008 Onwards)	Continuous review of forecast and budget supports financial control and trust.
Programme and Budget	Joint auditing (2011 Onwards).	This approach to auditing should be employed on future contracts.
Programme and Budget	Management reviews and improvement groups (2011 Onwards).	This level of regular project review should be undertaken at all levels on future projects. Feedback should be disseminated to the entire project team so all are equally informed.

Discipline	Brief description of issue	Lesson learned/proposal for future
Programme and Budget	Non Conformance Report (NCR) process (2011 Onwards).	<p>Need to specify the process better, to ensure that Employer receives proper notification of NCR actions and close-out. KPI in relation to this to be made more robust with regards to minimum level for achievement.</p> <p>Monitoring of trends raised through NCRs could be improved to guide actions as project progresses.</p> <p>Not always an effective management tool for the Contractor but good for the Employer as a method of ensuring non-conformances were identified and actioned effectively.</p>
Programme and Budget	Risk reporting (2008 Onwards).	<p>Risk register links to financial reports support financial control and should be adopted on future projects. It is important to allocate specific risks to appropriate people to manage, monitor and mitigate.</p> <p>Regular overview by senior management is essential to ensure that the risk register reflects the current project status.</p>
Programme and Budget	Project cost estimates (2007 Onwards)	Projects should include an open and transparent estimate which is regularly reviewed and updated. This should include a high to low range of estimated costs to account for fluctuations.
Programme and Budget	Contract included advanced payment bond which was to be paid back over the life of the Contract	It is recommended that this mechanism is adopted on large-scale future projects wherever possible.

Discipline	Brief description of issue	Lesson learned/proposal for future
Project Management	Use of Employer's Inspectors on the Project	The Employer notes that from a Contractor's perspective, the inspectors did not fill a traditional role in that they had no power to directly affect change or influence the works. However, use of Employer's inspectors is essential to ensure that the Employer has an accurate record and 'eyes and ears on the ground' for any potential contractual issues. The importance of this may only be realised on projects which end up more adversarial with a more commercial and contractual focus.
Project Management	Use of internal project briefing presentations to educate Employer staff on all aspects of the project	Implement a method for sharing information across the wider Employer's team from the start of the project so all members are informed of the project status and elements as a whole. This encourages a team feeling and prevents falling into siloes. Also, provides an excellent method for the training of more junior staff.
Project Management	Geological Core retention during contract and subsequent disposal	Consider establishing and documenting policy and procedure for retention and disposal both within Transport Scotland and externally.
Project Management	Positive development of initial project Charter during team building exercises.	Having a Charter is a great endeavour and focuses the full project team (i.e. Employer, Contractor and Designer) on the overall goals of the project. Should be made mandatory for all new staff to be made familiar with the Charter so focus can be maintained as project moves on.
Project Management	Technical meetings were generally very productive.	Maintain good working relationship and regular communication between Employer and Contractor at all levels to allow channel for resolution of issues as they arise.

Discipline	Brief description of issue	Lesson learned/proposal for future
Queensferry (Main) Crossing	Main Crossing: Structures Design Statements (2011)	Recommend that the Structures Design Statements process be adopted for all Transport Scotland Design & Build contracts.
Queensferry (Main) Crossing	Main Crossing: Ship Impact Assessment (2008 – 2010)	<p>Transport Scotland (TS) able to take on board an acceptable level of risk regarding ship impact, based on European best-practice, providing a more appropriate allocation of resources.</p> <p>Timeous resolution of major issue within design of main crossing.</p>
Queensferry (Main) Crossing	Main Crossing: Design for maintenance (2009)	<p>Employers Requirements (ERs) ensure adequate thickness providing long design life when trafficked by modern heavy-axle vehicles. Planeable wearing course allows replacement of top layer through machine laying for better quality control.</p> <p>Chose form of structure which allows easy cable replacements. ERs ensure that bridge can operate with a cable removed (accidental damage or removed for maintenance); specify type of cable which allows replacement as a normal maintenance operation</p> <p>Design bridge to allow easy and safe access to all critical parts of the structure.</p> <p>Design to minimise moving parts on bridge. Awareness that all moving parts will wear out and will require replacement. Where moving parts are necessary, design for ease of future maintenance and replacement.</p>
Queensferry (Main) Crossing	Main Crossing: Ensure adequate marine navigation clearance (2009)	Designed Queensferry Crossing to ensure that lower extremities of inspection gantries are high enough to ensure that the FRC offers more navigation clearance than the existing bridges.

Discipline	Brief description of issue	Lesson learned/proposal for future
Queensferry (Main) Crossing	Main Crossing: Improve reliability of crossing to carry traffic in high winds (2008)	<p>Design of bridge included wind shielding to ensure reliability in most weather conditions.</p> <p>Second Severn Bridge studied as a good example of a reliable wind-proofed structure. Initial wind tunnel studies for the FRC Specimen Design included modelling the Second Severn wind shielding as a benchmark.</p>
Queensferry (Main) Crossing	Future proofing infrastructure - bridges (2008)	Possible to provide flexibility without compromising project objectives or adding substantially to costs.
Queensferry (Main) Crossing	Bridge Control Room (2013 - 2015).	<p>For future small building projects handled by Transport Scotland, try to ensure single point of contact/management from start of design through delivery to ensure control. Allow consideration of non-traditional contracts for TS if they are appropriate to the project scope/type (i.e. using JCT for small building).</p> <p>Clarity of project scope and stages would have been useful at specimen design but early definition is not always possible due to unknown requirements and the involvement of multiple stakeholders. In this instance there was the additional complication of future uncertainty of affected parties (i.e. FETA dissolution, unknown maintenance operator at project initiation, etc.).</p>
Queensferry (Main) Crossing	Employer's Boat specification (2011 Onwards).	Ensure that an Employer's dedicated vessel is specified whenever project works include a marine element.
Queensferry (Main) Crossing	Specification for the post-tensioning system (2010-2011).	Should have specified the use category of the post-tensioning system in Employer's Requirements (ER's) to enable effective use of the Eurocodes.

Discipline	Brief description of issue	Lesson learned/proposal for future
Queensferry (Main) Crossing	Specification for post tensioning, stay cable, concrete and repair testing (2010 Onwards).	Review of specification for post tensioning, stay cable testing and concrete specification and repair testing is required for all projects where these elements feature.
Queensferry (Main) Crossing	Sub-contractor use of Building Information Modelling (BIM) (2014 Onwards).	Shared data utilising BIM was shown to improve the standard of subsequent work. Consideration should be given on future project to expanding the use of BIM in general.
Queensferry (Main) Crossing	Interim Geotechnical Feedback Report (IGFR) (2011 Onwards).	Include requirement for the production of these reports as early as possible in future contracts. Effective in managing geotechnical risk for project-critical foundations and in encouraging early drafting by relevant staff and submission of Geotechnical Feedback Report (GFR) for review with non-critical timing. However, unlikely to be suitable for universal application on all foundations as could cause programme delays (effectively a Hold Point).
Queensferry (Main) Crossing	Geotechnical Feedback Report (GFR) at end of construction (2014 Onwards).	In Employer's Requirements, include requirements for both Interim and Final GFR's to be issued at completion of each works element within a specified timescale (e.g. one month after completion). Allows for review timescales to span across the contract rather than being concentrated at the end of the construction stage and any issues to be more easily addressed in good time.
Queensferry (Main) Crossing	Specification for Stainless Steel	There needs to be a specification for stainless steel relevant to thin and small components in addition to long life structural components.

Discipline	Brief description of issue	Lesson learned/proposal for future
Queensferry (Main) Crossing	Procurement of Equipment and Parts Spares	Functional requirements and/ or specifications wherever possible and practical should specify any spare parts (and number) required for project bespoke items and assemblies (e.g. road gullies and wind barriers).
Statutory Procedures	Ensure that the constraints and objectives of public consultation are well understood by the public (2008 – end 2010).	<p>Ensure “Engaging with Communities” strategy fully explains the extent to which feedback can be considered and possibly incorporated to help effectively manage expectations.</p> <p>Clearly explain each stage of the public consultation in relation to the scheme development process.</p> <p>Where possible, explore opportunities for earlier engagement with communities to establish constraints and objectives of the consultation process, understand their specific concerns and develop positive relationships.</p> <p>Refresh “Engaging with Communities” document at appropriate point in the project.</p>
Statutory Procedures	Consultation with Councils during scheme development (2008 - End 2010).	Be prepared to seek direct meeting with Council Leader or other senior Elected Members as well as officials.
Statutory Procedures	Understanding of Hybrid Bill process (2009).	Good relationships support effective contributions from the Promoter to the Bill process.

Discipline	Brief description of issue	Lesson learned/proposal for future
Statutory Procedures	Authorisation by means of Hybrid Bill (2009/10).	<p>Process necessitated concentration of resource over short period but ensured strict focus and lessened scope creep.</p> <p>More engagement required with objectors prior to Stage 1.</p> <p>Engaging with objectors at Stage 2 reduces points of objection and time in formal assessor sessions.</p>
Statutory Procedures	Land acquisition (2009/10)	<p>Seek to ensure that all aspects of scheme design are developed sufficiently to allow land requirements to be confirmed and included in the compulsory purchase documentation.</p> <p>Where the above is not possible, ensure coverage of additional land is included in project risk register so that work to secure wayleaves/land by agreement is able to be progressed by the relevant statutory undertaker as early as possible.</p>
Statutory Procedures	Code of Construction Practice Liaison /Working Groups (2011 onwards)	Consider establishing similar liaison groups for other large Transport Scotland projects.
Statutory Procedures	Obtaining wayleaves for power supply connections could have been achieved via Forth Crossing Act (2010-2013)	Wherever possible engage with electrical power suppliers (and other utilities) at the earliest stage possible to procure wayleaves, or consider alternative means such as statutory powers. Review Transport Scotland policy on individual power supplies for each gantry.

Discipline	Brief description of issue	Lesson learned/proposal for future
Statutory Procedures	Benefits realisation - before and after monitoring (2008 onwards)	<p>Larger projects require annual monitoring reports which capture ongoing monitoring of contractor performance and any benefits already accrued.</p> <p>Scope potential areas of operations throughout the programme for monitoring. Plan monitoring framework and resource accordingly as the project progresses.</p> <p>Consider both qualitative and quantitative monitoring to ensure that all potential benefits can be captured.</p>

Table 1: Forth Replacement Crossing – Lessons Learned



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ISBN: 978-1-911582-97-7

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Published by Transport Scotland, September 2020

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