

Proceedings of SBG Workshop on Steel Bridge Construction

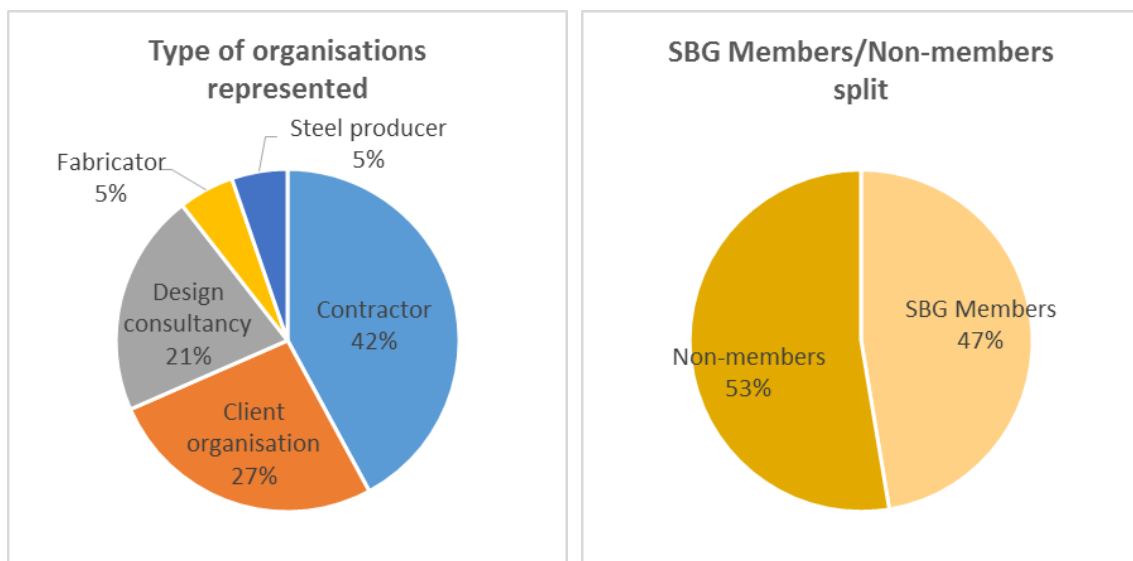
Workshop objectives

The Steel Bridge Group (SBG) Workshop on Steel Bridge Construction, held on 3rd May 2017 in Birmingham, was primarily aimed at main contractors involved in construction and maintenance operations as well as client organisations. The workshop sought to identify the problems they face throughout the lifecycle of steel bridge projects and investigate what can be done to make steel bridge solutions more competitive, easier to procure and more appealing from a whole-life perspective. Open discussion was encouraged in order to collate as much feedback as possible on the drivers for and barriers to the use of steel in bridge construction, and the outputs from the workshop will be used to define future SBG activities.

Workshop attendance

The workshop attracted a total of 19 delegates (both Members and Non-members of the Steel Bridge Group) representing the following organisations:

- ArcelorMittal
- Arup
- Atkins
- Balfour Beatty
- Costain
- Highways England
- Hochtief
- Network Rail
- SCI
- Skanska
- Transport for London
- Welsh Government
- WSP



Overview of workshop activities

The workshop started with a review of the feedback received from the SBG questionnaires that were sent to main contractors at the end of 2016 (many of whom attended the workshop), as such feedback was used to support the discussions during the three group exercises held during the day. The objectives of the group exercises were as follows:

- **Group Exercise 1:** Identification of the key issues within each of the project lifecycle stages which need to be addressed to support the efficient and effective use of steel bridges on the UK transport network;
- **Group Exercise 2:** Assessment of issues identified during Group Exercise 1 in terms of 'Impact' and 'Ease', the impact of an issue referring to its overall effect on the successful 'delivery' of steel bridge projects and the ease referring to the ease of addressing such issue (in terms of time, cost and complexity).
- **Group Exercise 3:** Assessment of the interests of 'decision makers' throughout the whole project lifecycle and quantification of the relative importance of such interests within the decision making process.

Each of the above group exercises were followed by cross-presentations to consolidate the findings of the groups. The consolidated findings are presented in the following sections.

All the issues identified and discussed during the workshop have been summarised in a 'Mindmap' format (see enclosed document).

Key issues identified within the whole project lifecycle and Impact / Ease assessment

The outcomes from Group Exercises 1 & 2 are presented in Tables 1 and 2. Table 1 lists the issues identified during Group Exercise 1 sorted according to their 'Impact' scores (which have been averaged across all the workshop delegates), whereas Table 2 lists them sorted according to their 'Ease' scores (also averaged across all the workshop delegates). For information, the combined 'Impact' and 'Ease' score is also provided for each issue in both tables.

Key for Tables 1 and 2 as well as Figure 1:

- Impact: 0 = low impact and 10 = high impact;
- Ease: 0 = difficult to address / implement and 10 = easy to address / implement.

Table 1: List of identified issues sorted according to their 'Impact' scores

Ref	Issue	Impact	Ease	Overall score	Lifecycle stage
1	Early engagement of all parties	8.9	4.1	13.1	Planning
2	Collaboration and cooperation key to avoid problems onsite	8.6	5.7	14.3	Construction
3	Designer / contractor / fabricator interaction / collaboration	8.5	4.4	12.9	Construction
4	Lost generation - competent resource availability	8.3	2.8	11.1	Erection
5	Early involvement not consistent with competitive tendering	8.3	3.4	11.7	Planning
6	Early contractor involvement for improved construction sequence	8.2	5.4	13.6	Design
7	Need to maintain competence of design teams	8.1	5.1	13.3	Design
8	Greater emphasis on operation / maintenance in AIP process	8.1	6.6	14.7	Operation & Maintenance
9	Early involvement of maintainers	7.9	5.5	13.4	Operation & Maintenance
10	More tolerant painting specifications	7.9	4.5	12.4	Operation & Maintenance
11	Temporary works not always considered by designers	7.6	5.4	13.0	Fabrication
12	Need standardisation of specifications	7.6	4.7	12.3	Construction
13	Fabricators not able (anymore) to advise designers	7.5	3.5	11.1	Design
14	Detailing & tolerances	7.5	5.5	12.9	Construction
15	Robust Quality Assurance and Quality Control	7.2	6.2	13.4	Construction
16	Site preparation for erection underestimated through lack of appreciation	7.2	5.9	13.1	Construction
17	Trial erections - early decision making	7.1	6.5	13.7	Erection
18	Protective coatings (site painting)	7.1	4.9	11.9	Construction
19	Need of proactive Temporary Works Coordinator involvement	7.1	6.1	13.2	Erection
20	Some (small) projects lack rigorous procedures / collaboration	6.9	5.1	12.1	Construction
21	Project management by some fabricators is lacking	6.9	4.3	11.1	Fabrication
22	Fabrication shop optimisation vs. erection	6.9	4.6	11.5	Erection
23	Whole life costing - lack of numerical data available	6.8	4.7	11.5	Planning
24	Lack of visibility of design guidance - need pointing in right direction	6.7	7.3	14.1	Design
25	Quality and timely delivery of as-builts (Health & Safety file)	6.6	5.9	12.5	Commissioning & Handover
26	Lack of knowledge of Technical Approval process	6.5	7.1	13.6	Planning
27	Option for performance specifications (for maintenance)	6.1	4.5	10.6	Operation & Maintenance
28	Lack of appreciation of variation of drop-out of camber	5.8	5.9	11.7	Design
29	Difficult to check model against design drawings	5.8	5.7	11.5	Fabrication
30	Clarification of what is a fabrication drawing	5.6	7.3	12.9	Commissioning & Handover
31	Bird protection	5.6	6.6	12.2	Operation & Maintenance
32	Bridge re-use	5.4	2.5	7.9	Demolition & Reconstruction

Table 2: List of identified issues sorted according to their 'Ease' scores

Ref	Issue	Impact	Ease	Overall score	Lifecycle stage
24	Lack of visibility of design guidance - need pointing in right direction	6.7	7.3	14.1	Design
30	Clarification of what is a fabrication drawing	5.6	7.3	12.9	Commissioning & Handover
26	Lack of knowledge of Technical Approval process	6.5	7.1	13.6	Planning
8	Greater emphasis on operation / maintenance in AIP process	8.1	6.6	14.7	Operation & Maintenance
31	Bird protection	5.6	6.6	12.2	Operation & Maintenance
17	Trial erections - early decision making	7.1	6.5	13.7	Erection
15	Robust Quality Assurance and Quality Control	7.2	6.2	13.4	Construction
19	Need of proactive Temporary Works Coordinator involvement	7.1	6.1	13.2	Erection
16	Site preparation for erection underestimated through lack of appreciation	7.2	5.9	13.1	Construction
25	Quality and timely delivery of as-builts (Health & Safety file)	6.6	5.9	12.5	Commissioning & Handover
28	Lack of appreciation of variation of drop-out of camber	5.8	5.9	11.7	Design
2	Collaboration and cooperation key to avoid problems onsite	8.6	5.7	14.3	Construction
29	Difficult to check model against design drawings	5.8	5.7	11.5	Fabrication
14	Detailing & tolerances	7.5	5.5	12.9	Construction
9	Early involvement of maintainers	7.9	5.5	13.4	Operation & Maintenance
6	Early contractor involvement for improved construction sequence	8.2	5.4	13.6	Design
11	Temporary works not always considered by designers	7.6	5.4	13.0	Fabrication
7	Need to maintain competence of design teams	8.1	5.1	13.3	Design
20	Some (small) projects lack rigorous procedures / collaboration	6.9	5.1	12.1	Construction
18	Protective coatings (site painting)	7.1	4.9	11.9	Construction
23	Whole life costing - lack of numerical data available	6.8	4.7	11.5	Planning
12	Need standardisation of specifications	7.6	4.7	12.3	Construction
22	Fabrication shop optimisation vs. erection	6.9	4.6	11.5	Erection
27	Option for performance specifications (for maintenance)	6.1	4.5	10.6	Operation & Maintenance
10	More tolerant painting specifications	7.9	4.5	12.4	Operation & Maintenance
3	Designer / contractor / fabricator interaction / collaboration	8.5	4.4	12.9	Construction
21	Project management by some fabricators is lacking	6.9	4.3	11.1	Fabrication
1	Early engagement of all parties	8.9	4.1	13.1	Planning
13	Fabricators not able (anymore) to advise designers	7.5	3.5	11.1	Design
5	Early involvement not consistent with competitive tendering	8.3	3.4	11.7	Planning
4	Lost generation - competent resource availability	8.3	2.8	11.1	Erection
32	Bridge re-use	5.4	2.5	7.9	Demolition & Reconstruction

The Impact / Ease chart shown in Figure 1 plots the identified issues according to their respective Impact and Ease scores. The numbering of the issues is according to the Reference number provided in Tables 1 and 2.

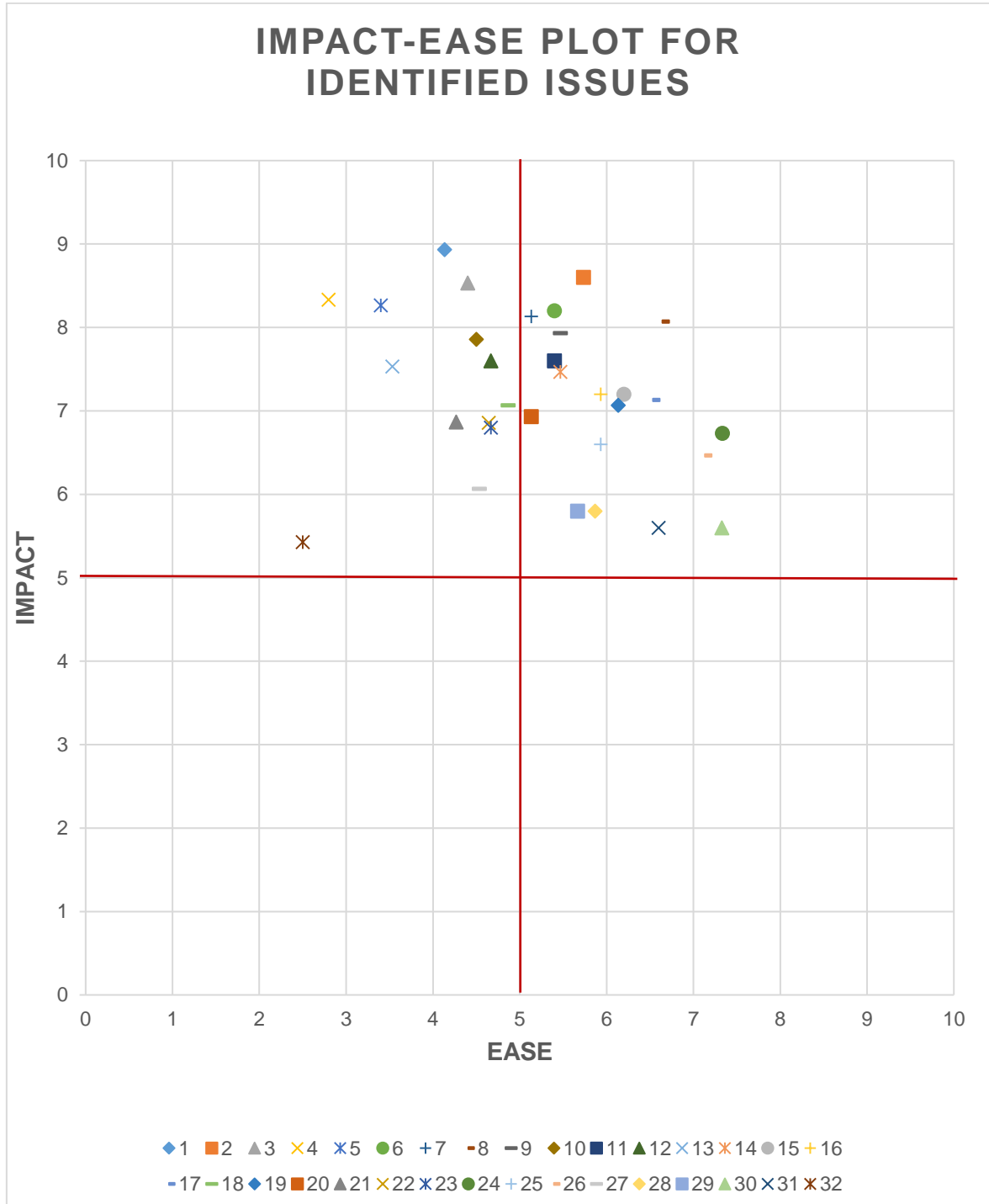


Figure 1: Impact / Ease chart for identified issues

Identified decision makers' interests

The key factors taken into account by decision makers were identified by each of the groups during Group Exercise 3. The relative importance of such factors within the decision making process was also assessed as reported in Tables 3 and 4.

Table 3: Output from Group No. 1

INTERESTS of decision makers	Decision maker	Weighting	Rank	Comment?
Ease of inspection / maintenance	Maintainer	20%	1	
HSE (+sustainability) - throughout	ALL	20%	1	
Value for money	ALL	15%	3	
Ease / speed of construction	Contractor	15%	3	
'Fit and forget'	Client	5%	5	
Aesthetics	Client	5%	5	
Combination of bridge elements (different trades, etc.)	Designer	5%	5	
Standardisation (NB not STANDARD)	ALL	5%	5	
Innovation	ALL	5%	5	
Commercially sustainable (business case)	Client	5%	5	
TOTAL		100%		

Table 4: Output from Group No. 2

INTERESTS of decision makers	Decision maker	Weighting	Weighting (normalised)	Rank	Comment?
Paint systems - long term liability	Client	-10.0%	-5.0%	2	Big factor / Concern
CAPEX vs. OPEX	Client	100.0%	50.0%	1	
Minimising impact on the network	Client	27.5%	13.8%	3	
Ease & speed of construction	Contractor	27.5%	13.8%	3	
Physical constraints	ALL	10.0%	5.0%	5	
Spans (design constraints)	ALL	10.0%	5.0%	5	
Certainty of cost from day 1 to day 100	Contractor	10.0%	5.0%	5	
Trust / Repeat work / Support	Fabricator	8.5%	4.3%	8	
Assembly (integrated and detailing)	Contractor	8.5%	4.3%	8	
Sustainability + robust + flexibility (long term)	Client	8.0%	4.0%	10	
TOTAL		200.0%	100.0%		

Initiatives to be undertaken by the SBG as a result of Workshop outcomes

The outcomes from the SBG Workshop presented in the above sections were discussed at a Steel Bridge Group Meeting held at the end of June 2017 with a view to decide and prioritise future SBG activities. SBG Members considered the identified issues with the highest impact (i.e. top half of Table 1) as well as the easiest to address (i.e. top half of Table 2) whilst also taking into account the decision makers' interests identified during the workshop. In light of the above, it was decided that the following will be undertaken:

Gap analysis for topics requiring additional guidance

Several topics namely 'Collaboration', 'BIM', 'Design for operation & maintenance' and 'Design competence' clearly emerged from the workshop discussions as requiring additional guidance. These could be addressed, for instance, by developing additional SBG Guidance Notes (GNs). As a first step, it was decided to identify gaps in existing guidance (including non-SBG guidance) in relation to these topics, the objective being to report on the findings at the next SBG meeting to be held at the end of 2017. An overview of these topics, based on the outputs from the workshop, is provided as follows.

Collaboration

The discussions held during the SBG Workshop highlighted the need for better collaboration across the delivery chain, coupled with the identification and management of critical interfaces between the various parties.

The 'Collaboration' topic is closely linked to the forms of contract used for bridge projects as well as the use of BIM. An increased awareness of the information needs at each of the process interfaces between the various parties involved in bridge projects (planner > designer, designer > contractor, contractor > fabricator, designer > maintainer, etc.) would be very beneficial, and it was suggested that this could take the form of a series of 'prompt' questions or an outline Service Level Agreement. Guidance on this topic would need to address the following issues identified during the SBG Workshop:

- Early engagement of all parties;
- Collaboration and cooperation key to avoid problems onsite;
- Designer / Contractor / Fabricator Interaction / Collaboration;
- Early involvement not consistent with competitive tendering;
- Early contractor involvement for improved construction sequence;
- Early involvement of maintainers;
- Temporary works not always considered by designers, nor are Contractor decisions always communicated early enough; more collaboration needed;
- Other supply chain (tier 2) not often engaged early enough to work effectively with designers
- Site preparation for erection underestimated through lack of appreciation;
- Trial erections - early decision making;
- Need for pro-active Temporary Works Coordinator involvement;
- Some (small) projects lack rigorous procedures/collaboration;

- Fabrication shop optimisation vs. erection.

Relevant guidance / tools to review may include:

- SBG Guidance Notes, SCI;
- NHSS Scheme 20, SSACS, UKAS;
- Lean Improvement Division, An Introduction to the Collaborative Planning System, HE;
- SIPOC (Supplier, Input, Process, Output, Client) LEAN methodology;
- 'Last Planner' process, LEAN methodology.

BIM

The use of BIM is closely related to the 'Collaboration' topic. There is currently a requirement for Level 2 BIM on all central government projects, and compliance with higher BIM Levels in the future will require significantly more collaboration between all the parties involved in bridge projects.

A key benefit of BIM is to act as a database of design related information for the operation and maintenance of an asset.

Available guidance on BIM needs to be reviewed from the SBG perspective in order to identify areas where SBG guidance may be necessary. Guidance on this topic would need to address the following issues identified during the SBG workshop:

- Detailing and tolerances;
- Quality and timely delivery of As-builts (Health & Safety file);
- Difficult to check model against drawings;
- Clarification of what is a fabrication drawing;
- Balancing benefits of BIM for Contractor and ultimate client as they want different things from BIM;
- Fabricators not engaged early enough to influence 3D models

It was identified that new SBG guidance on the following may be useful:

- Guidance to clarify requirements for fabrication drawings & records, etc.
- Guidance for designers on how to set up BIM models for fabrication purpose.

Design for Operation and Maintenance

There is an increased awareness that the whole-life performance of a structure needs to be considered from the early stages of the design process in order to account for the whole life costs of an asset and also optimise its operation and maintenance. Guidance on this topic would need to address the following issues identified during the SBG workshop:

- Greater emphasis on operation/maintenance in AIP process;
- Early involvement of maintainers;
- Protective coatings (site paintings)
- Whole life costing - lack of numerical data available;
- As above for whole life sustainability

- Lack of knowledge of Technical Approval process;
- Option for performance specifications (for maintenance).
- Design for re-use and/or adaptation;

Design competence

A balance between 'competence', 'self-certification by contractual parties', 'quality' and the need for 'supervision and checking' needs to be achieved.

Whilst clients are not always willing or able to pay for supervision and checking for regularly operated processes and products, the value of independent peer review and early challenge of designs or outputs that are novel should be recognised as being in the interests of the ultimate customers.

Guidance on this topic would need to address the following issues identified during the SBG workshop:

- Lost generation - competent resource availability;
- Need to maintain competence of design teams;
- Fabricators not able (anymore) to advise designers;
- Robust Quality Assurance and Quality Control.

Raising awareness of existing bridge design guidance

Participation to bridge engineering conference and publication of articles

It was also clear from the workshop discussions that there is a need to raise awareness of existing bridge design guidance, and it was suggested that the recent release of the new SBG Publication (SCI P418) on the completion of Appendix 18/1 would be a good opportunity to do so. As such, SCI and the SBG will seek to publish articles / adverts in 'The Structural Engineer' and 'NSC' for this purpose, and it was also decided to investigate whether giving a presentation and/or exhibiting at the Bridges 2018 conference to be held on 14th March 2018 in Coventry would be possible.

Investigating new ways of disseminating guidance

The idea of investigating new ways of disseminating guidance (online) to better suit how the new generation of engineers looks for technical guidance was raised. It was suggested that the lifecycle of bridge projects could be used as a thread to provide more interactive / accessible guidance, and that a collaborative area (forum) could also be useful. A lot of good guidance on bridge design is already available from several online sources including websites such as SCI's [Steelbiz](#) and [Steelconstruction.info](#), but it would be useful if an online 'tool' could provide a 'one-stop-shop' for all available guidance (links could be provided for non-SBG guidance). This could also lead to a new way of working for the SBG as new guidance could be released more dynamically as compared to the usual lengthy development of Publications. Such a tool would also allow to increase awareness of and revitalise existing SBG guidance. SCI and the SBG will investigate possible solutions.

Potential development of concise guide on selection of paint systems

The SBG has also been recently made aware of a proposal for the development of a concise guide for 'Professional Practitioners' on the selection of paint systems, which was another key issue highlighted by the SBG Workshop. It is understood that there may be some interest from the Institute of Corrosion Protection in the development of such a guide, and SCI and the SBG will investigate whether they can contribute to developing such guidance.

Delegate list

The following participants attended the meeting:

Name	Organisation
Neil Tilley	ArcelorMittal
Richard Hornby	Arup
Chris Hendy	Atkins (<i>SBG Chair</i>)
Nick Boyle	Balfour Beatty
Mick Jennings	
David Dickson	Consultant
Andrew Morse	Costain
Arran Wharton	
Geoffrey Bowden	Highways England
Joaquim Ferreira	Hochtief
Nataliya Aleksieva	Network Rail
Steve Williams	
Guillaume Vannier	SCI (<i>SBG Secretary</i>)
Robert Dunn	Skanska
Faraz Ulhaq	
George Kaiser	
Gandhi Suppiah	Transport for London
Tudor Roberts	Welsh Government
Steve Matthews	WSP