



Delivering High Speed 1: the successes and the lessons

Seminar 139 held at Savoy Place, London
7th February 2008

Summary

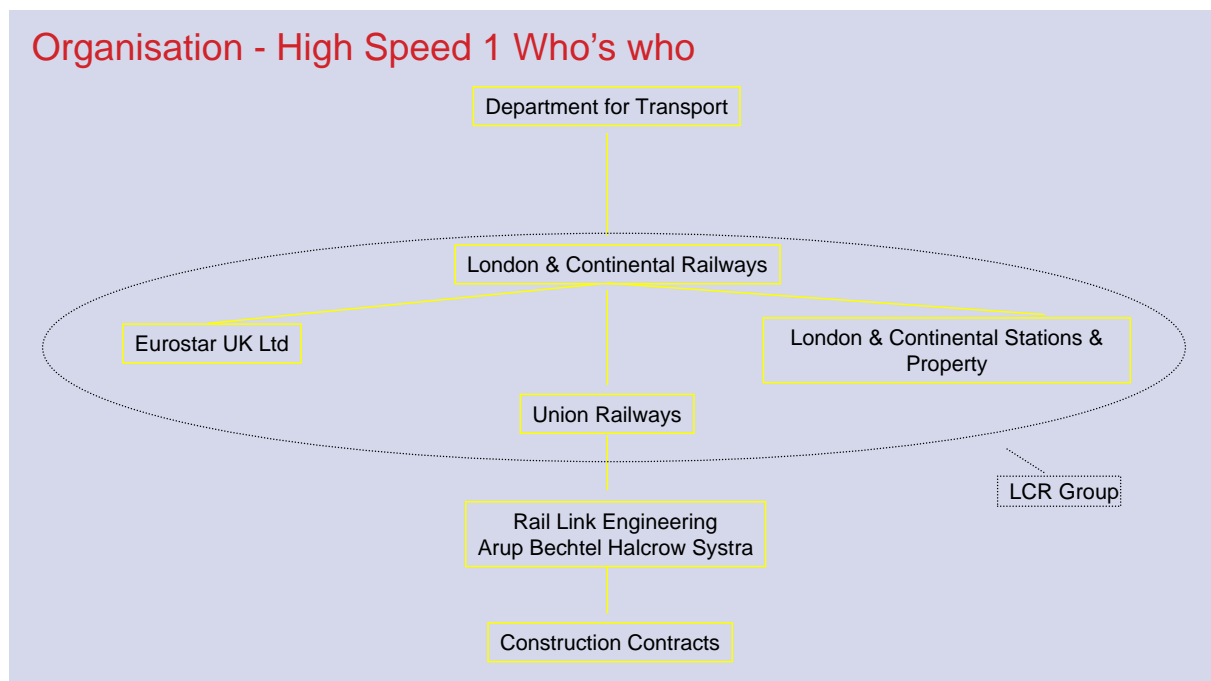
Introduction

On 14 November 2007, some 13 years after the start of Eurostar services between London, Paris and Brussels, Britain's first genuine high-speed railway line was completed, on time and within budget.

Originally known as the Channel Tunnel Rail Link (CTRL), the project was renamed High Speed 1 (HS1) in November 2006. HS1 is the UK's first major new railway in over a century: a high-speed line allowing trains to run at speeds of up to 300 km/h between the Channel Tunnel and London.

Presentations from the key organisations involved on the programme provided an insight into one of the UK's most successful major projects in recent years, and an opportunity to explore aspects that should be transferred to the many new projects now under way. The seminar examined the planning, financing and project management that went into building the railway, and the work involved in the successful launch of Eurostar services on HS1.

The Chairman provided an overview of the organisational structure of HS1:



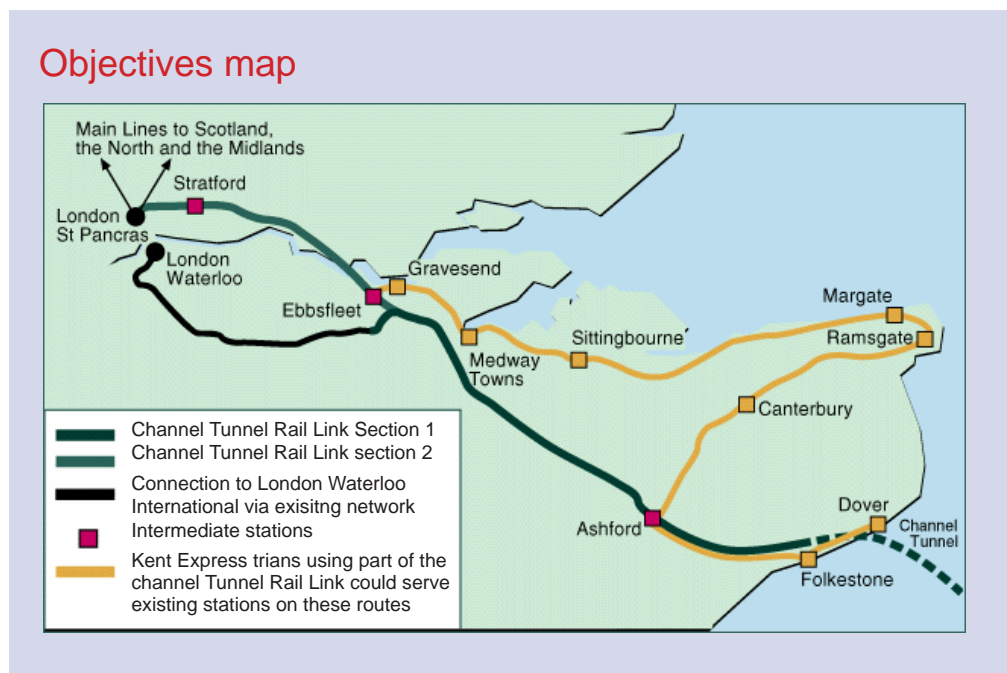
The Department of Transport (DfT) had oversight of the project and handled the procurement of the concession, which went to London & Continental Railways (LCR). London & Continental Stations & Property provided the services for acquisition of rights of way and the land required for the railway. Union Railways handled the conceptual engineering, developed the specification and alignments, and managed the finances for the actual construction. Rail Link Engineering (RLE), a joint-venture consortium made up of Arup, Bechtel, Halcrow and Systra, provided the project management.

From the outset the aim was to weld these organisations into one, removing the usual interfaces present on a major project in order to improve communications and trust, and in the process encourage the joint utilisation of talent, fast decision making, innovation and efficient operation.

What is High Speed 1? Route selection, engineering features and challenges

RLE set the scene by providing a brief history of the HS1 project from the 1986 Channel Tunnel treaty until the present day, followed by an outline of the vision and objectives of the project.

1. International objectives
 - To provide the main railway link between Britain and continental Europe
2. Commuter objectives
 - To provide a major increase in capacity and improvement in the quality of journeys between Kent and London
3. Development objectives
 - To provide the transport spine for the East Thames Corridor development, shifting development pressure from the west to the east of London
 - To provide stimulus for the rejuvenation of the derelict inner city areas around Stratford and King's Cross



The differences and complexities of the two main project stages – Section 1 and Section 2 – were outlined. Section 1, constructed between 1998–2003 is essentially a rural railway, running from the Channel Tunnel to Waterloo, while Section 2 is an urban railway running from Gravesend, under the Thames and into St Pancras. Some of the lessons learned were highlighted, for example the importance of RLE's policy of addressing environmental and planning considerations as key design factors in the engineering from the outset, rather than treating them as an additional activity.

Overall, the project posed a vast array of challenges to which the integrated RLE team produced innovative solutions in the engineering and construction techniques employed. A number of examples were discussed, such as the successful push launch of the Medway Bridge (one of a total of 144 new bridges); tunnelling methods, in which the key to success was the specification of the tunnel boring machines; and the rejuvenation of St Pancras station, which was a major project in its own right.

The client view

The Department for Transport explained the Government's role as the sponsor and ultimate client for HS1. There was an insight into how this major project was kept going through periods of great financial uncertainty, the achievements and the factors that enabled the project to succeed.

The Channel Tunnel Rail Link Act (1996) provided the authority to build the railway, with the Government as customer and funder. A delivery framework then had to be put in place and the funding mechanisms considered. Examples of events from both within and outside the project that had the potential to destabilise the programme were discussed. It was noted that political commitment by the then Deputy Prime Minister John Prescott, combined with a belief by both major political parties that the project should go ahead, helped to carry the programme forward.

The Government's objectives for the project extended beyond the creation of a new international rail link, and included:

1. A new direct link connecting the Channel Tunnel to London and cities to the North, to avoid potential congestion on the existing network through Kent.
 - To date there is a fast, highly reliable train service to central London.
2. The regeneration of poor and less developed land areas in East London and North Kent. Regeneration was to be encouraged by faster domestic train services in North and East Kent, enabling easier access to and from London.
 - There is now major regeneration in the King's Cross St Pancras area, and at Stratford, one of the most deprived areas in London. Stratford City will accommodate facilities for the 2012 London Games, with construction due to start later in 2008
 - By 2009 there will be 29 high-speed domestic trains in service which will have a role in enabling regeneration in the areas served by the railway
3. To gain the assets at an affordable and predictable cost and to transfer risk to the private sector.
 - There has been a successful outcome in terms of funding and costs
 - Risks have been transferred to the private sector where possible

Financing and structuring of risk transfer arrangements

LCR looked at some of the reasons behind the successful delivery of the £5.8 billion HS1 railway project on time and within budget. One of the most important factors was a radically different approach to the project financing structure in terms of designing and building the railway as well as the financing and risk transfer arrangements.

The approach focused on the client's participation in the implementation of the project, with low-cost funding and an overlay of risk transfer. The HS1 project achieved substantially greater risk transfer than the vast majority of projects in the PFI and PPP project programme to date in the UK.

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The basic components in LCR's approach included:

1. The fundamental role of the project client in the delivery structure: LCR's subsidiary, Union Railways, took primary responsibility for supervising the integration of the project teams throughout the programme, handling key interfaces and managing the client's interests.
2. The funding platform of low-cost finance for the needs of the entire project, which created stability and certainty in the project's financing.
3. The extensive use of target price contracting, which was the principal means of transferring and reducing risk at the front line and creating incentives.
4. The introduction of front-line risk-sharing in the areas where cost overruns were most likely to materialise.
5. The creation of an experienced management team with the ability to work together across the range of disciplines needed to deliver the project successfully.

Procurement strategy, agreements and contracts

Drawing on experiences from the construction of both Section 1 and Section 2, the presentation from CTRL (UK) Ltd explored four key areas that have contributed to the success of HS1, and highlighted lessons learned.

1. Packaging the contracts:

Good and bad examples across the project were discussed. Successes included the tunnels, where the form of packaging allowed the creation of a tunnels alliance and a structure which allowed the various contracting groups to work together on delivery and share resources. This proved to be a fundamental part of getting through the early risks of the programme without significant delay. Less successful areas included the fit out strategy at operational stations, where in hindsight it was felt that there should have been more flexibility in the way the contracts were packaged.

2. The contract and technical schedules:

The form of contract used was [NEC2](#) (New Engineering Contract 2), which provided important features, such as visibility of cost at all times. The importance of having a clear, approved programme was stressed. An important clause which was added specifically into the contracts was the contractual ability to take scope from one contractor and give it to another in the event of non-performance. The importance of detailed technical schedules was also emphasised – for instance details of the testing and commissioning process were included from the outset.

3. Running into difficulties:

Many projects experience a 'mid-life' crisis during their life cycle, and HS1 was no exception. A thorough review was carried out, the cost and programme re-assessed and strategies developed. Having an appropriate balance between autonomy and governance, with the freedom to take difficult decisions, was crucial to success, as was the commitment of all parties to deliver as a team,

4. Close as we go strategy:

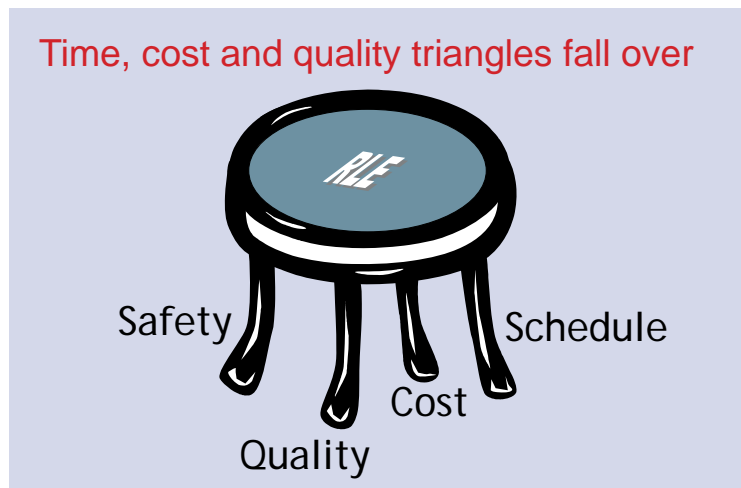
The aim was to achieve full and complete commercial and contractual close out by the time the railway opened. To achieve this, a 'close as we go' strategy was employed, tailoring the approach to different packages. On 14 November 2007, only three contracts were not fully closed out, all in areas where work was still in progress; these contracts are now closed.

Delivering the programme – achieving time, cost and quality

Bechtel, as overall project manager, explained some of the key challenges of the HS1 construction programme from the perspective of RLE, the integrated design and project management team comprised of Arup, Bechtel, Halcrow and Systra. It was explained how the importance of the project structure, a clear delineation of responsibilities, a dedicated client organisation, and the right team members were essential to the success of the project.

Safety was a key element: a step-change in safety management was targeted and achieved over the duration of the project, and the accident frequency rate was far better than the industry norm both at the start and finish.

Control was maintained by carefully challenging the orthodoxy of having to make concessions to balance the triangle of time, cost and quality – as outlined in the illustration below, RLE wanted a stable four-legged stool, with safety as a primary goal. It was stressed that stumbling on any one of the legs is likely to lead to problems in the other areas.



Programme schedule is key to success or failure, and the role of programme management tools, control schedules and performance metrics was outlined.

Some change is inevitable on projects of this size, and controlling that change is an important part of what has to be accommodated to deliver the programme successfully. Two years before the end of the project the decision was made not to accept any further changes unless they were safety critical, or critical for the opening on 14 November 2007.

Changes to the delivery model over the course of the project were discussed, in particular how lessons learned on Section 1 were implemented to bring about improvements on Section 2. The conventional wisdom of project management was contrasted with the realities of completing an infrastructure project of the size of HS1.

Commissioning and setting to work

Union Railways outlined the principles of testing and commissioning and how these were applied on HS1 in close collaboration with RLE, the project managers.

The approach on large infrastructure projects is to break the whole system down into its smallest elements. In the case of HS1, it meant splitting the system into approximately 2,000 commissioning lots on the main part of the route and then developing the dependency logic between those lots and the programme of work.

Five phases of commissioning were used:

- Factory acceptance tests
- Static tests
- Static integration tests.
- Dynamic integration tests
- Operational readiness tests

The first three phases were managed by the project within the project construction site; the fourth phase was managed by the project within the construction railway; and the fifth phase was managed by the operator on behalf of the client in a full railway environment.

During planning, assumptions are made that works will be carried out in a linear order. In reality, works progress at different rates, and the process has to adapt. To illustrate the complexities of the commissioning process two of the key railway systems were looked at in detail: 25 kV traction and tunnel ventilation. Both systems highlight some of the practical issues faced in testing and commissioning, and what adaptations have to be made to overcome them to ensure the programme is kept on schedule. The presentation concluded with an overview of some of the lessons learned in testing and commissioning the railway.

The Eurostar Migration Project

Eurostar UK examined the challenges involved in moving the Eurostar business from Waterloo International, where it had been based since its launch in November 1994, to St Pancras. The transfer of the entire operation to its new base was called the 'Eurostar Migration Project', and in effect comprised 80 smaller projects in marketing, engineering and human resources.

The change in location had to be achieved seamlessly, with minimum disruption to the existing business and its customers. Similarly, the disruption to staff and their working patterns had to be understood and planned for. There was also the need to promote new services and facilities in order to maximise the enhanced business opportunities created by HS1.

The switch took place overnight on 13–14 November 2007. The presentation looked at the work involved, and considered whether the objectives set at the start of the project three years earlier had been achieved, what problems were encountered and what lessons had been learned.

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The critical success factors were summarised as follows:

- Staff were fully conversant, competent and motivated for the launch
- The publicised launch date was met
- The launch day was flawless and successful
- The total project was delivered within budget
- HS1 trains are efficient, safe, secure and reliable
- Passenger operations are efficient, safe, secure and exceeding customer expectations, though some station facilities are still to come
- Depot maintenance is efficient, safe, and reliable
- The majority of Waterloo customers were retained (only five customers arrived at Waterloo by mistake) and new ones gained, while revenues are currently 25% up on the same period last year

Conclusion

The Chairman concluded the seminar by stressing not only that the HS1 project was brought in on schedule and under budget – a remarkable engineering achievement – but that it is an operating railway of extraordinarily high quality. He added that in 50 years of working in the industry, this was the first major project on which every contract was satisfactorily closed out within two months of completion of the asset.

Participating organisations

Arup
Atkins plc
Balfour Beatty plc
Bechtel Ltd
Bircham Dyson Bell
Bovis Lend Lease
British Energy
CMS Cameron McKenna LLP
Comply Serve Ltd
Cross London Rail Links Ltd
Denton Wilde Sapte
Department for Transport
EC Harris LLP
EDF Energy
Ernst & Young LLP
European Investment Bank
Eurostar UK Ltd
Freshfields Bruckhaus Deringer
Henley Management College
Herbert Smith
High Speed 1
Imperial College
Jacobs Group
John Laing plc

Linklaters
London 2012 Programme
London & Continental Railways
London Development Agency
Major Projects Association
Ministry of Defence (DPA)
Mott MacDonald Group Ltd
National Air Traffic Services Ltd
National Audit Office
Nuclear Decommissioning Authority
QinetiQ
Rail Link Engineering
Risk Solutions
Rolls-Royce plc
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