HIGH SPEED RAIL
INDUSTRY LEADERS

Poised to deliver

How industry will build our new high speed railway

1. Introduction

There is widespread consensus that a modern, high capacity, railway is required to keep Britain's economy moving. Delivering this through high speed rail will bring a huge economic boost to Britain. Even on the most cautious assumptions the DfT 'Strategic Case' states that HS2's 'annual benefit could be £8bn'. Additionally, while all regions benefit, 'city regions in the Midlands and the North do particularly well'.

The industry stands ready, willing and able to make high speed rail happen. In this country we have vast experience at delivering similar projects all over the world, on-time and on-budget. We can, and will, do so in Britain.

All HSRIL members have significant UK-based operations, employ thousands of British workers and have built up an impressive record at home and abroad. We successfully built HS1 in the UK, and are in the midst of delivering Europe's largest infrastructure project in Crossrail.

Modern, comfortable, high speed trains are designed and assembled in this country and the UK leads the world in railway systems and signalling technology, with one of the world's first operating end to end ETCS level 2 systems in use already today.

The track record of companies in the UK is unquestionable.

As we build high speed rail, opportunities will extend well beyond the usual rail industry. As the Secretary of State for Transport announced in November 2013, there will be over £10bn of contracts on offer for HS2, running to everything from landscaping to food retailers. 2,000 jobs have already created with another 20,000 on the way before construction starts.

This will be part of the biggest investment in our skills base in decades, nurturing a new generation of world class engineers and experts across a range of sectors and creating exportable products and services which will boost the economy. It will allow the UK to build on world-class expertise, cementing our status as a global hub for engineering, infrastructure excellence and architecture.

The industry is poised to deliver. This report explains how it can be done.

2. Delivering the infrastructure for HS2

High speed rail is about more than speed. It is about resetting our entire expectations of what rail travel should be like in terms of efficiency, reliability and performance. Building a brand new railway line allows for the removal of level crossings, gentle curves rather than twisting tracks, modern signalling systems and other improvements that increase rail capacity, safety and performance.

Britain already has extensive experience built up in these areas. In fact the UK is a world leader. In all areas, construction, systems and in manufacturing rolling stock, industry is ready to deliver.

In fact, the vast majority of the design and environmental work completed to date on HS2 has already been performed by professional services organisations based in the UK (estimated to be over 95% of HS2 Ltd's spend to date). The expected breakdown of HS2 infrastructure capital costs provides a good guide to the nature of engineering skills and expertise the project requires:

Tunnelling	22%
Stations	26%
Line of route civil engineering (works and structures)	23%
Depot	8%
Railway systems	21%

Figure 2.1. Expected breakdown of HS2 capital costs (source: HS2 Ltd)

The vast majority of infrastructure investment relates to skills that are readily available from the UK construction sector, which of course operates internationally and is able to use lessons learnt and experience built up through projects carried out overseas.

2.1 Tunnelling

22% of capital expenditure will be in tunnelling, an area where UK companies excel. Valuable skills developed on London's Crossrail programme will be put to good use. Already the Thames Tideway Tunnel, National Grid and EDF electricity cable tunnels are benefitting from the legacy that Crossrail is creating and this base of expertise can be leveraged for Crossrail 2 and HS2

Case study: Crossrail's Tunnelling and Underground Construction Academy (TUCA)

£12.5 million has been invested in a purpose-built training facility that supports the key skills required to work in tunnel excavation, underground construction and infrastructure. TUCA has offered training to thousands of people already and after Crossrail will become an independent institution. It is the only soft-ground tunnelling training facility in Europe, building a significant and marketable expertise in the UK. Otherwise, the nearest tunnelling training centre is the hard-rock training centre Hagerbach in Switzerland.

2.2 Stations

Stations form 26% of capital expenditure. Some HS2 stations will be new build; others major renewals of existing facilities. The regeneration of the UK's classic rail network over the past decades has built extensive capacity in the country in the design, redevelopment and building of major new railway stations. Examples have included London Blackfriars, Birmingham New Street, Reading, King's Cross and St Pancras International. Stations for HS2 can be built using this same expertise.

Case study: A new station for Reading

An acknowledged bottleneck on the UK rail system for decades, Network Rail's upgrade of Reading involved the installation of five new platforms, two entrances, a new link bridge and retail outlets. Project managed by HSRIL member Bechtel, the smooth upgrade of the station, while it remained open and functioning was a complex undertaking, but one that was delivered so smoothly it opened a year ahead of schedule. The rebuilt station was reopened by Her Majesty The Queen on 17 July 2014.

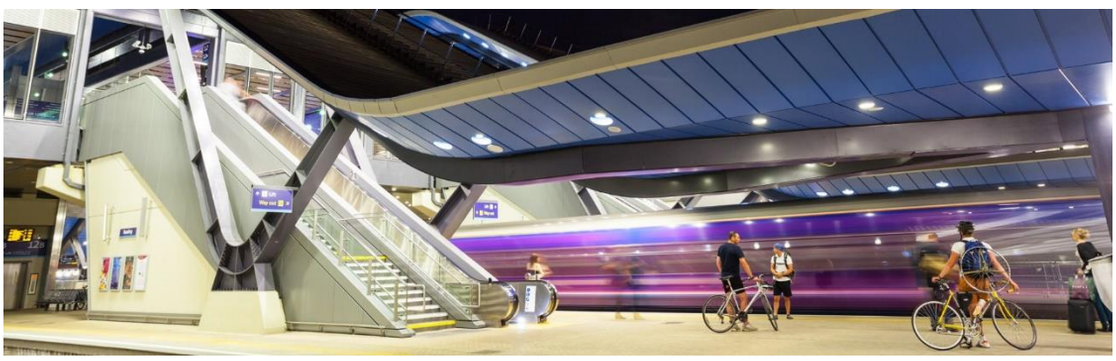

Figure 2.2. Reading's new station.
(courtesy of Bechtel / Network Rail)

2.3 Line of route civil engineering

Line of route civil engineering (23% of capital costs) presents some of the most exciting challenges for the use of new techniques that combine cost-efficiency with advanced environmental mitigation. Off-site prefabrication and logistics techniques, learnt from best practice around the world, can be deployed on HS2.

Case study: Delivering High Speed 1 (HS1)

Bechtel, Halcrow (now part of CH2M) and SYSTRA were founding partners of client organisation London & Continental Railways and Rail Link Engineering, the project management and engineering team, which delivered HS1 on time and within budget. Thousands of UK-based employees worked on the project, supporting the planning, design and construction engineering phases, many of whom have moved on to work on other major projects such as Crossrail, the 2012 Olympics and HS2. Bechtel led the project management team, with Halcrow as the engineering experts and Systra supervising the works performance programme and also designing the new line's testing programme. Alstom and partners TSO were responsible for delivery of the rail infrastructure and systems, and are now working together on the delivery of Crossrail. HS1 opened on time and on budget, without using contingency funds.

Figure 2.3. HS1, North Kent, England. (courtesy of LCR)

2.4 Railway systems

Railway systems (21%) represents a fast-developing area, epitomised in Network Rail's exciting digital railway programme. The current major investment in electrification of large parts of the UK rail network will ensure that the industry is well-equipped to efficiently deliver the necessary power connection and catenary system. The signalling system on HS2 will be a form of the European Train Control System (ETCS) which is being implemented on the UK rail network in stages before HS2 requires it.

Case study: Advanced new signalling for Thameslink

HSRIL member Siemens are currently deploying ETCS and automatic train operation (ATO) solutions for the Thameslink upgrade, which will be overlaid in the London Bridge area. These will enable all train movements to be controlled automatically, delivering 24 trains per hour in each direction on the Thameslink core route during peak times at the programme's completion in 2018. This is well before HS2 will need the capability.

Case study: Electrifying Britain's Railways

HSRIL member WSP Parsons Brinckerhoff is at the centre of electrifying key routes on the UK railway including the North West and Great Western mainline resulting in faster, greener, quieter and more reliable journeys for hundreds of thousands of passengers. As the engineering designer and systems integrator, this significant investment programme is deploying the latest technology of power distribution and catenary systems for the UK railway and is developing engineers with the latest skills well in advance of when HS2 will need the capability.

3. Delivering modern trains for HS2

Not only are these new trains fast, they are also greener than current rolling stock, offering weight saving features and regenerative braking like hybrid cars. They also offer an unparalleled passenger experience. Often a journey on a modern high speed train is as noticeable for its quiet operation, high tech facilities on board and comfortable carriages as it is for its speed.

The UK is becoming an expert at designing and building these modern trains. Rolling stock manufacturing, which has been in decline since the 1960s, is making a triumphant return to the country and this resurgence follows similar patterns to the well documented success of UK automotive manufacturing in recent years, and shows how national expertise is being built up and the potential for significant export growth is being opened up.

HSRIL members such as Alstom, Bombardier, Siemens, and Hitachi all have big UK operations, drawing on and building up skills in this crucial area. Already British designed and built trains are running at high speeds on networks in the UK and further afield and this is a trend that is only set to continue as investment increases in the UK.

Case study: Hitachi's InterCity Express Programme (IEP)

To support the Department for Transport's InterCity Express Programme (IEP), Hitachi Rail Europe has built its £82 million rail vehicle manufacturing facility in North East England, a flagship site which has recently been named a Gold Award winner at the Considerate Constructors Awards. The majority of the 122 Class 800/801 IEP trains, which will run on the Great Western and East Coast main lines from 2017 and 2018 respectively, will be manufactured at this facility, as will the majority of the new 70 AT200 commuter trains for Scotland.

Hitachi Rail Europe has also invested in a chain of train maintenance centres across the UK to service and maintain the IEP fleets: Stoke Gifford represents an investment of £80 million and £70 million has been spent at Doncaster Carr, in both cases building completely new facilities. Stoke Gifford won a Gold Award at the Considerate Constructors Awards for its community links and cutting-edge environmental practice.

Figure 3.1. Hitachi Class 800/801 series for the InterCity Express Programme

Case study: Siemens depot investment

HSRIL member Siemens has been investing in purpose built depots for decades, with two major projects – Hornsey and Three Bridges – being delivered now for the new Thameslink train fleet. And this approach extends right through the supply chain: Siemens invested in its Hebburn factory in Tyne and Wear to enable it to supply high-tech electrical components for the new Thameslink trains, with up to 300 jobs created in the region as a result and keeping manufacturing going on a site that has seen production in one form or another for over 100 years.

Siemens is also responsible for designing and building the new Eurostar high speed trains. The new trains are

scheduled to be introduced in late 2015, bringing compatibility with more of the European high speed network and greater capacity.

Figure 3.2. Siemens e320 – the new Eurostar

Case study: Bombardier's ZEFIRO

This pattern of widespread and continuing employment opportunities will be a feature of HS2. UK companies are also at the cutting edge of the Very High Speed rail industry worldwide. On 25 April 2015, the inaugural journey of the V300 ZEFIRO very high speed train took place in Italy. Named Frecciarossa 1000 by the customer Trenitalia, this train starts commercial service in June 2015, with a top commercial speed of up to 360 km/h. The V300 is manufactured locally in Italy with significant design and engineering input and support from Bombardier's world-class engineering team based in the UK.

Figure 3.1. V300 Zefiro

Case study: Alstom's AGV

HSRIL member Alstom's UK presence is huge, and they are most famous in this country for the Pendolino trains, mainly assembled in Birmingham, that ply the West Coast Main Line. However, it is their new AGV that combines the well-established design philosophy of the TGV and 30 years of technological expertise in very high speed rail with ground-breaking innovation. With articulated trainsets, distributed power, permanent magnet motors, electrodynamic braking and energy recovery, it is green as well as fast, and like many new high speed trains, it is designed to deliver the multimedia and connectivity services passengers expect in the 21st century.

Figure 3.2. Alstom AGV

4. Creating a legacy through training and apprenticeships

The skills gaps in science, technology, engineering and manufacturing in the UK are well-known. Work by the rail sector's skills academy (NSARE) has highlighted the scale of the challenge ahead. Currently only 17% of the workforce has skills above Level 4+ and a shockingly low 4% of the workforce is female. These are significant challenges for HSRIL and others to address.

However, the sustained building boom in London, the 2012 Olympic Games, the growth of offshore and onshore renewable energy generation, the nuclear power sector and the infrastructure-led investment programme of the last five years, have combined to revitalise the UK construction sector. While there is much more to do, programmes to radically change engineering practice for major rail schemes are already underway.

HSRIL member companies are working extensively with schools, colleges and universities to ensure that key STEM subjects are addressing the needs of the Industry before career choices are made and to promote the Rail and Construction Industries as appealing and attractive careers to school and university applicants. HS2 Ltd has already stated that they anticipate creating 2,000 apprenticeships as a direct consequence of the HS2 project.

HSRIL believes that a project of this magnitude covering so many disciplines should be able to deliver and probably exceed this ambitious target not least due to the planned strategy of embedding key socio economic factors into the procurement process, something that was delivered very successfully on the Crossrail project, and an approach that HSRIL has itself promoted and fully endorses.

While High Speed rail is not a new technology, there are differences to conventional heavy rail. That is why two High Speed Rail colleges have been proposed to up-skill and develop the next generation of engineers on this important project here in the UK. Due to open in 2017, the skills and competencies created will form the bedrock for future development of the high speed network within the UK. The colleges will also offer the opportunity for cross sector development to support other major infrastructure projects in the future after HS2, supporting a lasting legacy for the UK to compete both domestically and in the international market.

Because there is such a large scale investment in UK rail, HS2 is only a small part of the picture, but can be a large part of the solution. This is illustrated by the example of the critical signal engineering sector, where capital spend will reach £5.9bn over the five year period to 2019, while HS2 accounts for less than 6% of the total spend. HSRIL members are active across the field to build the skill base the country needs.

Type of Activity	No. of People
Total Infrastructure	86,500
Traction & Rolling Stock	13,500
Total	100,000
% Level 4+ (Engineers & Technicians)	17%
% Female	4%

Figure 4.1. Current Workforce (Source: NSARE).

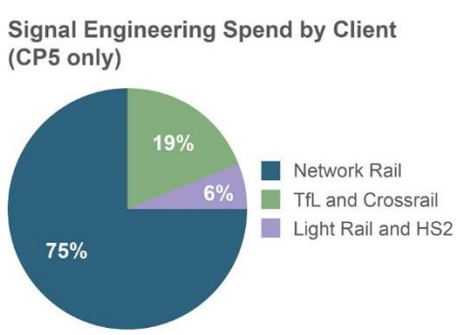

Figure 4.2. Signal Engineering (Source: NSARE).

Case study: The National Skills Academy for Railway Engineering (NSARE) and Siemens

Siemens, in conjunction with the National Skills Academy for Railway Engineering (NSARE), has invested £7m in the National Training Academy for Rail (NTAR) – the first dedicated Traction and Rolling Stock facility of its kind. This will operate a hub and spoke model based out of Northampton and will interface with the two planned National Colleges for High Speed Rail to train the next generation of engineers in this important area. This is not theory, the new building is almost complete, the curriculum has been developed and the doors will open in October this year.

With a capacity of 20,000 training days per annum, the curriculum offers training for career changers, young people starting out in the industry and a route for the current workforce to learn and become skilled in new technologies that are rolling out across the network.

Figure 4.3. Northampton Site (courtesy of Siemens).

Case study: The National College for High Speed Rail (NC HSR)

The NC HSR, with two sites, Birmingham and Doncaster, is forecast to graduate over 500 advanced technicians (Level 4, Traction and Rolling Stock, Power, Track and Infrastructure, Control and Communications, Advanced Construction) by 2020 rising to 700 advanced technicians per year by 2022. This represents the largest investment in advanced technical skills in the UK for any industry. Numbers graduating from the NC HSR are linked to NSARE skills forecasts. The NC HSR will be part of a coordinated national network of specialist training providers and FE Colleges, the latter to attract talent into the rail industry.

Case study: Laing O'Rourke and Design for Manufacture, Assembly and Maintenance of Bridges

Laing O'Rourke is investing in the development of 'Design for Manufacture and Assembly' (DfMA). As pioneers of 'offsite construction', they have driven this concept far beyond its earliest iteration. A team that includes Laing O'Rourke, Tony Gee and Partners and the University of Cambridge has developed an integrated digital delivery process for bridges and bridge parts. This addresses the whole lifecycle from identification and rationalisation of needs to manufacture, assembly, operation, maintenance and decommissioning.

Digital tools, data and virtual prototyping processes will lead to the automated manufacture of a set of standardised, validated parts and sub-assemblies at a controlled price, which are configured virtually and capable of meeting the requirements of the end users and operators. The project builds on the success of a previous work, funded by Innovate UK, which has successfully developed a parametric system to configure Overhead Line Electrification.

Case study: South Durham University Technical College

Hitachi Rail Europe is a co-sponsor, with the University of Sunderland and Gestamp Tallent, of the new South Durham University Technical College (UTC), due to open in 2016. Situated in the cradle of UK rail engineering, it is in a perfect position to draw on the UK's rich rail heritage, while ensuring the development of talent to help sustain the industry for years to come. The UTC will provide a technical and vocational STEM-focused education to students aged 14 to 19 interested in working in the engineering and advanced manufacturing sector. Once in full operation, it will be able to accommodate between 550 and 600 pupils.

5. Innovation and technology

The challenge of scale can be a barrier to investment in R&D, and that is why, in this space – just as much as in skills, training and apprenticeships – the major players in the UK have led the way and also why collaboration is a key characteristic in R&D investment, as the next example shows.

Case study: the Rail Systems Advanced Research Centre (RSARC)

Laing O'Rourke, Atkins, and Lafarge Tarmac have joined forces with others to create a new research facility, at Heriot-Watt University. Its key focus will be to deliver innovation in rail systems engineering and to transfer this knowledge into the rail sector.

RSARC's research in systems engineering activities will de-risk capital intensive programmes. It will comprise the creation of the most advanced test rig (GRAFT3) yet developed globally, a world-leading rolling rig system and a collaborative laboratory and research work space.

The Centre will give the UK the ability to develop the step change in rail technologies by putting in place the required testing facilities and operating environment for technology development, especially from small and Medium Enterprises. The Centre will focus on high speed railways since this market alone is estimated to be worth $1 trillion world-wide. As with Formula 1 motor racing which drives innovation picked up later in mainstream car designs, technologies developed for high speed are likely to find applications more widely across the national rail network.

Technology developed in the UK could potentially make major savings to construction costs and hence significantly improve business cases. Today, no facility exists in the world that can test these systems in a such a way at full-scale and full line-speed. The RSARC, through GRAFT3, will provide this global research facility.

Students would complete a Modern Apprenticeship in Engineering and a Higher National Diploma at a college partner and then progress to University study, so in the third year of the programme students would progress to study at Heriot-Watt University until the completion of the MEng after the fifth year. Discussions have started with FE providers, such as Edinburgh College who already run Network Rail-approved apprenticeships, and these skills development programmes will be developed with these partners during the first year of RSARC operations.

Links have already been established with the University of Sheffield Advanced Manufacturing Research Centre (AMRC), which is a world-class centre for advanced machining and materials research for aerospace and other high-value manufacturing sectors. It is a partnership between industry and academia, which has become a model for research centres worldwide. The RSARC aim is similarly high.

As this example shows, investment in R&D is proceeding apace. That more can be done is reflected in the Government's decision to commit funding, through the Department for Business, Innovation & Skills (BIS) and Department for Transport (DfT) to support, with industry, the Railway Supply Group.

6. Creating an export base to boost the UK economy

The UK rail sector is already contributing to the rebalancing of the UK economy and its scope to grow further through exports and in response to growing demand for rail travel in the UK is immense. It generates close to £10bn gross value added (GVA) and close to £4bn in tax receipts already.

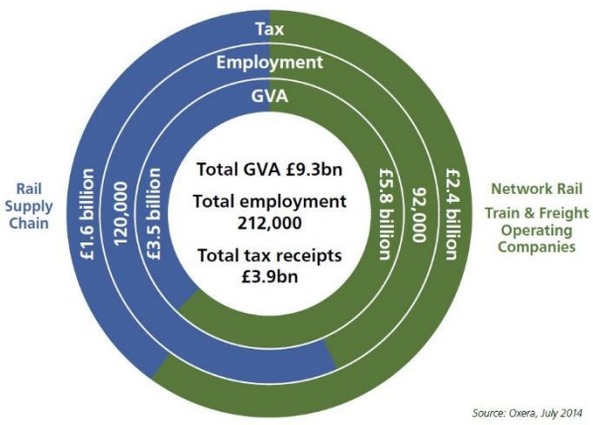

Figure 6.1. Rail sector contribution to UK economy.

The export potential growth in this area is illustrated by what is being achieved in France and Germany.

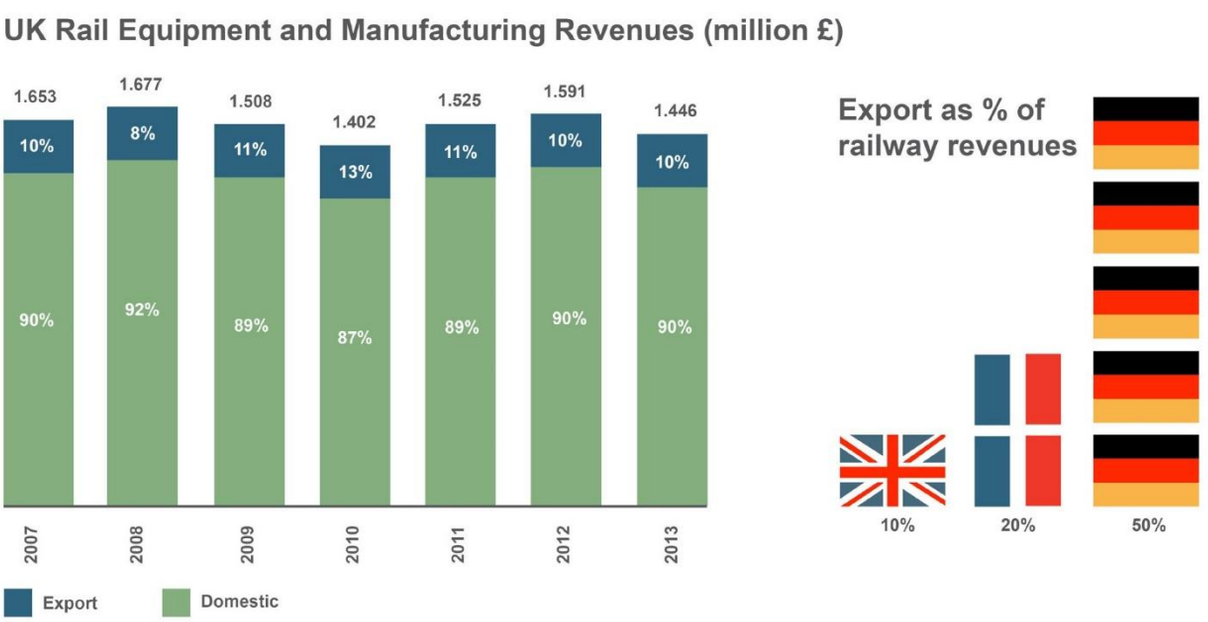

Figure 6.2. UK rail revenues Source: (Rail Supply Group)

HSRIL fully backs the new Rail Supply Group, co-chaired by Terence Watson of Alstom, supported by the Secretaries of State for BIS and DfT to use projects such as High Speed 2 amongst other rail projects as a core building block to further develop the UK supply chain to allow it to compete in the international arena. There are over 15,000km of high speed rail planned throughout the world: that is a £1 trillion potential export market for ‘brand Britain’.

7. Building on the success of Crossrail and HS1

Crossrail is currently Europe's largest construction project. Many of the HSRIL members are engaged as contractors and designers on the project. Since 2009, HSRIL member company Bechtel has been working as part of an integrated team with Crossrail Ltd to manage the appointed consultants and contractors for the design and construction of all the infrastructure and systems.

Construction is 65% complete, on schedule and within budget, and the target of employing 400 apprentices has recently been met. 10,000 people have been trained at the Tunnelling and Underground Construction Academy (TUCA) with upgraded skills to support not only the remaining works at Crossrail, but also the UK's future infrastructure projects. 12,000 people are working on the project with approaching 4,000 job starts.

Figure 7.1. Crossrail workforce.

"Crossrail is a textbook example of how to focus on the essentials of programme management, including defining a realistic scope, establishing a management team with the necessary skills and securing the required funding. Two years of planning took place before the construction programme began on Crossrail, allowing the scope of the programme to be well defined, resulting in only a handful of subsequent changes being required. Roles and relationships were clearly established in the programme's founding agreements, and Crossrail Limited had to pass the sponsors' early programme reviews to prove it had the right skills and capabilities in place.

> *Recommendation: The Department should capture the lessons it has learned from the Crossrail programme and apply these to its other projects, most notably High Speed 2. It should also promote the lessons from Crossrail, which are applicable to other major projects, widely across government."*

Source: House of Commons Committee of Public Accounts Eighth Report of Session 2014-2015: Crossrail

HSRIL member Bechtel's experience as both a contractor and project manager in the UK over the last 60 years supports the view that when the packages are the right size with the right interfaces then good market engagement follows.

HS2 Ltd reports interest in the supply chain from companies that employ a quarter of a million people and have a collective turnover of some £1 trillion. The challenge is turning that engagement into performance, which has been achieved at Crossrail with a collaborative approach to delivery throughout the supply chain.

Figure 7.2. Supply chain.

The UK has the ability to deliver large and complex rail projects. Crossrail when it was commissioned, represented a type of railway in which the UK had no contemporary experience: a high capacity, urban-regional express railway. The outturn, with 97% of businesses in the supply chain located in the UK, shows what can be expected with HS2.

8. Conclusion

As this report has shown, the expertise to design, construct and deliver HS2 lies here in the UK. When you look at the expertise of the HSRIL member companies, their skills base in the UK and their commitment to innovation and technology, it is obvious that the industry is ready to deliver this vital upgrade to our nation's infrastructure.

We have gained valuable experience from recent large scale capital projects like Thameslink, Intercity Express Programme, Crossrail and HS1. Those involved will bring that knowledge and expertise to HS2.

Our vision for rail is to join with automotive and aerospace as a national transportation engineering sector. In rail, we are already experiencing the resurgence, and HS2 is a critical part of the appeal of this key market that will add jobs and capability in UK manufacturing and engineering. Combined with the UK's continuing prowess in automotive and aerospace engineering there is a genuine potential to create a world beating export sector, leaving a lasting legacy in skills and opportunities across the country.

HSRIL members already have huge experience of delivering high speed rail projects all over the world. They do this from bases in Britain, using UK talent. Britain designs and builds high speed railways for the world, now it is time to deploy that expertise at home.

The track record of companies in the UK is established beyond doubt. The industry is poised to deliver. We look forward to working with HS2 and Government to make it happen.

High Speed Rail Industry Leaders (HSRIL)

HSRIL coordinates and shares the expertise and experience within the industry and aims to help ensure that Britain's national high speed rail network is delivered successfully to world class standards, leaving a lasting legacy for growth and jobs and skills.

In bringing together companies in the UK, HSRIL is creating a UK centre of excellence in high speed rail that complements the work of HS2 Ltd. HSRIL is open to all organisations with an operational base in the UK.

HSRIL members represent a wide range of UK-based companies which operate on a multinational basis. These organisations employ thousands of UK-based employees across a broad spectrum of disciplines, and have unprecedented experience in large capital projects both in the UK and overseas. These companies generate significant tax revenues for the exchequer and bring innovation, experience and technical leadership in a competitive environment to the UK rail industry.

We believe that HS2 will serve as springboard for the creation of an export-led UK rail industry. This is strategic Government investment that brings connectivity gains, additional capacity to the national transport network and helps create a lasting legacy of a re-born industrial sector.

We want to take an active part in ensuring this vitally important project for the UK is delivered successfully to the right specification on programme and to budget with strengthened UK-based businesses, right along the supply chain.

Membership Levels

Full Members

ALSTOM · ATKINS · BECHTEL · KIER · LAING O'ROURKE · BOMBARDIER the evolution of mobility · BOUYGUES CONSTRUCTION · ch2m· · WSP | PARSONS BRINCKERHOFF · SIEMENS · Keolis · COSTAIN · Hitachi Rail Europe · Railway Industry Association · SYSTRA · FLUOR

Expert Members

The National Skills Academy RAILWAY ENGINEERING · sh STEPHENSON HARWOOD · UNIVERSITY OF BIRMINGHAM · YRP YOUNG RAIL PROFESSIONALS

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