IN PARTNERSHIP WITH RAIL

NetworkRail

Network Rail: Britain's biggest builder

See inside for:

- Future proofing London Bridge
- The Great North Rail Project
- Crossrail: Europe's largest construction project
- Delivering value for money
- NR's new Supply Chain Strategy
- Taking a safety-first approach
- Getting a GRIP on costs
- Investing in people
- Electrification: the inside story

PLUS exclusive interviews and a look ahead to CP6

Rail Delivery Group

National Rail BRITAIN RUNS ON RAIL

Mark Carne

Chief Executive, Network Rail

Our railways are vital to the UK's economic growth; creating jobs, building homes and connecting communities. Continuing high levels of investment in our railway are essential if we are to continue to unlock the potential of our towns and cities, helping them to grow and to flourish by providing connectivity and the safe and reliable infrastructure they need.

With over 15,000 projects on our books, Network Rail is by far and away Britain's biggest builder. And delivering projects on time and on budget, during small, overnight slots, and at weekends and Bank Holidays forms the cornerstone of our role as custodians of the railway. This is increasingly challenging as demand for more services reduces access even more and we need to constantly innovate with the supply chain to find smarter ways of delivering.

Working together as one railway, the Government and industry are in the final two years of delivering a massive five-year Railway Upgrade Plan, investing £130m every week. Extending platforms, building new stations and platforms, building flyovers and new pieces of railway; introducing new technology and new signalling; replacing worn out track and junctions; increasing line-speeds and providing new passenger facilities at stations such as multi-storey car parks; all aimed at improving, expanding and growing our railway to meet the demands of an rapidly growing passenger base and to prepare the way for 6,400 extra services a day by 2020.

Some of these upgrades are the mega-projects, such as Thameslink, the Great North Rail Project, the Edinburgh Glasgow Improvement Programme, Crossrail, Great Western electrification, and the Waterloo and South West upgrade. These are no longer distant pipe-dreams - passengers will see a transformation in services over the next 18 months as much needed capacity, via new, more frequent and longer trains, is introduced.

But it has not all been plain sailing. I›m the first to say that the high-profile problems of the electrification projects at the beginning of the Control Period (2014/15) tarnished an otherwise strong record of delivery. Much has been written about how these problems arose, but the main thing is that now we will not enter into projects before understanding the scope and costs; confidence in delivery is essential for investors.

The good news is that the changes we have made are already making a difference. A recent independent global study of 400 project and engineering companies told us that we are now among the very best performing in the transport sector. That must help set us up to plan and secure investment for the next Railway Upgrade Plan for 2019 and beyond.

But now, we should take the time to celebrate our successes, those of our industry partners, and the thousands of engineers, designers, project managers, and scores of other roles that make the Railway Upgrade Plan possible. The projects they are delivering are among the largest, most complex and challenging in the world: British engineering at its best.

Paul Plummer

Chief Executive, Rail Delivery Group

Our railway brings Britain to life, so it›s vitally important that rail companies and their supply chains work together to build a bigger, better network for our country. By doing so they help to grow businesses that operate in local communities across the nation.

We are investing to improve, with companies working to deliver a £50bn-plus Railway Upgrade Plan that will make journeys better, connect the country, support a secure, skilled workforce and enable a strong economy.

Our most immediate challenge is to deliver these projects with minimal disruption and to do so efficiently. Having the best interests of our customers, passengers or freight users, and taxpayers at the centre of our thinking is key. Beyond this we need to prepare for the longer term and develop plans which can transform the customer experience and connect communities as well as businesses across the country.

This demands that all parts of the industry work together in partnership. The RDG›s newly-established partnership with the Rail Supply Group cements a long-standing and positive relationship and will ensure that we are even more co-ordinated at a national level working with Network Rail›s system operator and governments.

Even more importantly, the industry is developing new forms of partnership to develop plans and deliver change at a local level - Network Rail's Routes, passenger train and freight companies, the supply chain and property developers. As one team working together we can give the railway and the rail supply chain a more powerful voice.

In this supplement, snapshots of some of these projects, including the Ordsall Chord, Crossrail, and the redevelopment of London Bridge, help to highlight some of the ways in which we're investing both for now and for generations to come. We hope you find it a valuable insight.

"We are investing to improve, with companies working together to deliver a £50bn-plus Railway Upgrade Plan that will make journeys better and enable a strong economy."

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▲ **Dr Francis Paonessa, Managing Director of Network Rail's Infrastructure Projects business.** JACK BOSKETT/*RAIL*.

DELIVERING CHANGE

Network Rail's Infrastructure Projects arm is delivering billions of pounds worth of investment in Britain's railways while undergoing sweeping internal changes to make it more efficient. Paul Stephen talks to Dr Francis Paonessa, IP's Managing Director to discover how the business is changing.

Control Period 5 (April 2014-March 2019) will long be remembered as one of the most transformative Control Periods not only for Britain's railways, but also Network Rail itself.

NR is not just engaged in delivering the biggest programme of UK rail investment for more than a century, but has initiated sweeping internal changes that will make it a leaner and fitter organisation.

Internal restructuring and wholesale cultural shifts will ensure that NR emerges from CP5 as a more commercially-driven and customer focused organisation than the one that existed five years earlier.

Playing a leading role is NR's delivery arm Infrastructure Projects (IP), which is responsible for implementing more than £25 billion of enhancements and major renewals during CP5.

As a result, by 2019 there will be an additional 170,000 seats into major cities across the UK and a 30% increase in capacity into London at peak times. Those 170,000 seats equate to approximately 142,000 commuting cars, which would cause a three-lane traffic jam from London to Cardiff.

By 2020 there will also be enough additional capacity for an extra 6,415 carriages to run on the network - equivalent to a train 87 miles long.

With 4,300 employees, IP represents just 12% of NR's total workforce but over two-thirds of its spending power, utilising a supply chain of over 3,000 suppliers and more than 100,000 individual contractors.

Grand Scale

The scale of IP's construction activity is enormous. It spends more than £130 million a week and has more than 15,000 live projects at any one time, including headline programmes such as Crossrail, the Great North Rail Project and Thameslink.

Annual spend in 2016/17 was over £6bn, making IP responsible for delivering 22% of all new UK infrastructure. Its total workload has been estimated as the equivalent of delivering an Olympic Stadium every month, but with the added complexity of working in and around an operational railway.

The way IP delivers this work has undergone major changes since 2014, reflecting the wider decentralisation of NR and devolution of greater powers to its eight geographic Route businesses (plus its virtual Route for freight and national passenger operators).

IP now operates as a matrix delivery organisation, and is aligned with the Route-based structure via four regional delivery teams. These operate alongside separate delivery teams for IP's two largest projects, Thameslink and the Great North Rail Project, and specialist teams in track and signalling.

IP's Managing Director Dr Francis Paonessa explains: "Some people have a historical view of where we sit structurally within NR which is no longer accurate, and needs updating. We've done a lot to reposition ourselves within the business, and to alter how we interact with the rest of it.

"IP sits as its own project management and infrastructure delivery organisation, providing functional support to the Routes. The common →

"NR is not just engaged in delivering the biggest programme of UK rail investment for more than a century, but has initiated sweeping internal changes that will make it a leaner and fitter organisation."

misconception is that IP is spending IP's money but we don't actually have a budget. We spend the Routes' money, and provide support to them and in turn, their customers."

Under this new structure, the Routes and project sponsors define the scope of what enhancements are needed, and then fund them from Route-based settlements. IP then costs the work, and takes individual projects through NR's eight stage Governance for Railway Investment Projects (GRIP) process from output definition through to delivery, handback and project closeout.

Paonessa adds: "We spend about £2 in every £3 the Routes have, but we don't actually control scope, spec or access. Those outputs come from different parts of NR, and we act as that interface and intelligent client between what's wanted and the supply chain delivering it."

National Role

It is this vital national role that has prevented IP from being devolved to Route level, as has previously been suggested, not to mention the considerable benefits to be gained from the economies of scale and capability that a national IP business possesses.

Having a team with a national portfolio also enables a more efficient allocation of resources, as opposed to confining them to Route level where fluctuations in workload tend to be more amplified.

IP is also better placed to prioritise resources and expertise when there is limited capacity in the supply chain to where they are needed most, rather than operating on a first-come-first-served basis where key projects could be overlooked.

"I think we have the best of both worlds at the moment," says Paonessa. "We have the Routes, which are more outward facing and better placed to understand the needs of train operators and passengers, and then you have the size, scope and capability of the IP organisation to deliver that work effectively.

"Also, if you broke the teams up into eight geographic areas, it would be very hard to manage the peaks and troughs in planning workload. We smooth those out on a national level and can talk to the supply chain on behalf of NR as a whole, instead of eight different teams trying to engage with the same suppliers. It's far easier to do on an aggregated level, when you've got a consolidated and co-ordinated business."

Strengthening the relationship between IP and the Routes is a deep level of integration within NR. In addition to operating its four regional delivery teams, Paonessa attends NR's monthly Route Performance Review to hear how IP can better serve them, and reports back to Route Managing Directors on what progress has been made. In turn, Paonessa reports directly to NR's executive team to discuss any changes that need to be made on a national level, providing two separate layers of accountability to his Route-based customers.

"We are seeing if we can refine that relationship as the devolution model gains more maturity, and we constantly ask ourselves if there are better ways to align my team with the Routes. But we've come a long way from saying 'anything to do with budgets and delivery sits with IP' to the Route MDs having a new set of accountabilities."

"In the last two years IP has halved its number of possession overrun delay minutes, which now cause less than 0.3% of total delay minutes on the network."

▲ **IP has more than 15,000 live projects at any one time.** JOHN STRETTON.

▲ **"We are Britain's biggest builder with over 15,000 live projects on our books, accounting for 22% of all UK infrastructure spend."** NETWORK RAIL.

Operational Gains

These key structural changes have been accompanied by impressive gains in output, and notable improvements in IP's operational results.

For instance, in 2014, IP was hitting 62% of its entry-into-service milestones (GRIP Stage 6). By 2016 this had climbed to 92%, giving much greater certainty of the delivery of passenger benefits.

CP5 did not begin well for IP after an ambitious package of works over the Christmas 2014 period resulted in two well-publicised and disruptive over-runs. That was followed in November 2015 by the Hendy Review which recalibrated IP's portfolio in light of the over-optimistic timescales and inaccurate cost estimates applied to some major projects - the Great Western Route Modernisation in particular.

Although much improvement has been made in project delivery since 2015, Paonessa points out that almost 50% of CP5 enhancements were still in development at the time of the Hendy Review, and so IP is still dealing with the legacy left by those initial project difficulties.

Even so, significant advances have been made in the estimation and costings of projects, especially following the publication of illuminating research from University College London. This found that the level of 'optimism bias' commonly given to infrastructure projects was 66% at GRIP stage 1, reducing to 40% at GRIP 2 and 17% at GRIP 3.

Equipped with this knowledge, IP has amended the way it estimates the cost of enhancements, while also placing more emphasis on the need for greater cost effectiveness and efficiency.

For new projects, final cost estimates are now only provided once project development is complete, which is called the Final Investment Decision Point, and changes in scope beyond this point are strictly limited to prevent cost increases or delays in delivery.

"Our record of delivering enhancements that have come out of development is very good, and we're doing that to within 2.7% of budget at the moment. Most of the large cost increases came from the estimation phase and we've still got development projects that suffer from that historical optimism bias.

"They are now working their way into delivery and we are having to put some much firmer estimates next to them."

Better Possessions

Another area where IP has increased its understanding and proficiency is in access planning. IP requires up to 40,000 possessions a year, and Paonessa says that the greatest potential for unnecessary cost and disruption to projects lay here.

In the last two years IP has halved its number of possession overrun delay minutes, which now cause less than 0.3% of total delay minutes on ➜

the network.

But as part of its firmer grasp on access planning, IP must still strike a difficult balance between minimising disruption to passengers and completing projects within budget.

A doubling in passenger numbers since 1997/98 combined with more than a million more services every year has reduced access to the railway for engineering work, and increased the potential disruption caused by over-runs. But to achieve the same output by taking shorter possessions requires the mobilisation of increased resources, and therefore greater cost.

Even so, Paonessa is extremely happy with the progress that's been made by his team in this complex arena. Ever greater amounts of work are being completed on time and within budget but with minimal impact on Routes, train operators and, ultimately, the passenger.

"We have lots of data now on access planning, particularly for trackwork, where costs can double when you try and do it in shorter possessions. Two-thirds of our possessions are shorter than eight hours, and our greater-than-12-hour possessions are down by 40% on CP4, making it more expensive to mobilise the resources you need than for longer jobs.

"I wouldn't say that we don't have operational issues, but we're delivering the Great Western Route Modernisation at the moment with about 22 hours of access a week, broken up into short, typically four-hour blocks. It's a difficult environment in which to deliver that scale of work, and we're delivering that while still maintaining a 90% performance railway, which is incredible.

"The travelling public is just not prepared to accept large over-runs at short notice, which is fully understandable, so we've put a huge emphasis on reducing possession overrun delay minutes. I think we're now down to an acceptable level where we've got the balance of cost-versus-disruption about right.

"We know the railways are only going to become even more intensively used in future, so we've got to do this work in ever shorter windows. Our priority is therefore to develop the tools, techniques and capabilities to do that cost-effectively, while safety for passengers and the workforce remains paramount."

New Funding

Looking to the future, IP is being increasingly opened up to external contestability from the supply chain, so that its cost efficiency and competitiveness can be properly benchmarked.

This will also make it easier to bring in new sources of funding for the railways, and create attractive opportunities for the private sector to become more involved.

In December 2016, NR Chief Executive Mark Carne commissioned the Hansford Review which considered the best way to achieve these goals. On July 31 the findings of this review were published, recommending a raft of reforms within NR to remove barriers to investment, enabling third party funders to have a choice over who delivers projects for them, and for third parties to directly compete and deliver that work.

The reforms will include publishing a regular pipeline of third party opportunities, introducing flexibility in railway standards and the launch of a rewards scheme to share savings achieved from innovative ideas between NR and the company or individual.

Paonessa welcomes the recommendations made by the Hansford Review, and the increased contestability it will bring to IP. His view is that it will either confirm that IP is delivering projects in an optimal way, or bring good ideas to the fore which will enable it to improve. Whatever the outcome, it will mean gains for the taxpayer and reduce public spending on the network by increasing the efficiency of the supply chain.

"It's easy to see the things we don't do well, but it's very difficult to see the things that we do well, because there's no-one to compare to. I'd really like to see other people delivering the same kinds of projects in the same challenging environment. We'll either find we're doing a good job, or other people will set the bar even higher. I think we've moved forward a lot in three years and I can see a lot of opportunities from this. Being able to properly compare and contrast is at the heart of being a commercial organisation, and something I really welcome."

Enabling third parties to deliver enhancements is also a natural progression on the chosen delivery model for Crossrail, where Crossrail Ltd was the client and NR was directly commissioned to do a significant proportion of the work.

But Paonessa warns that IP was well placed to manage the risks of working on the operational railway by integrating its Crossrail programme with other workstreams, including the Great Western Route Modernisation.

This demonstrates the difficulties that a commercial organisation could face by working on the operational railway, where project overruns incur financial penalties.

Suitable mechanisms have yet to be created to balance that risk, but it is the focus of a report commissioned in December 2016 by the Secretary of State for Transport Chris Grayling into the potential private delivery and operation of the planned East West Rail link between Oxford and Cambridge.

It is being written by NR non-executive director and East West Rail chairman Rob Brighouse, but has yet to be published.

"Access can massively drive your costs, which can be quite a difficult thing for commercial organisations to deal with. It's the same reason that Crossrail Ltd is delivering the work within the portals, and we're delivering £2.3bn worth of enhancements on the existing network.

"There are some complex interfaces with the operational railway and what we anticipate we'll see from Rob Brighouse's report is the best way of managing those. How exactly do you manage that risk?

"But cost effectiveness is at the heart of all this, and we really want to be able to compare and contrast by opening up our schemes. It's up to the industry collectively to convince people that investing in our railways is a good thing, and that having investment delivered by IP is a good thing too." ■

▲ **IP delivered more than £6 billion worth of work in the last financial year including on the Great Western Route Modernisation. An Intercity Express Programme test train approaches Reading on April 29 beneath newly erected overhead line equipment, which will be energised next year.** JACK BOSKETT/RAIL.

"IP's total workload has been estimated as the equivalent of delivering an Olympic Stadium every month, but with the added complexity of working in and around an operational railway."

▲ **Dr Paonessa welcomes the challenges raised by the Hansford Review and the efficiency gains it promises to deliver.** JACK BOSKETT/*RAIL*.

Key Numbers: Network Rail IP

3,392
suppliers

£12,000
being spent every minute

£130
million a week

£6bn
enhancements and major renewals in 2016/17

50
bridge renewals each year

400km
track renewed in 2016/17

1
Olympic Stadium every month

46%
reduction in operating costs since 2003/04

25%
fewer possessions

22%
of all UK infrastructure being delivered by NR

15,500
live projects

CHANGING PERCEPTIONS

Network Rail is investing heavily in the next generation of engineers and project managers, giving them the opportunity to work on some of the biggest infrastructure projects in Europe, as Paul Stephen discovers.

By providing an exceptional opportunity to work on some of the biggest and most challenging engineering projects in Europe, Infrastructure Projects (IP) offers a highly attractive career path to some of Britain's most talented young individuals.

Each year it receives hundreds of applications to its graduate and apprenticeship schemes, where the intake is equipped with the practical skills and vocational training needed to build a career in programme management or engineering.

IP passionately believes in investing in its people to improve the safety, reliability and efficiency of the railway. NR has 26 training centres located across the UK, supporting a range of accredited vocational courses.

It also prides itself on immersing new entrants in practical front-line roles from the very beginning, while offering a wide variety of placements within different areas of the business.

Alison Rumsey, IP's Human Resources Director, explains: "We encourage people into our apprentice and graduate schemes to move around different parts of the business or change career paths if necessary, to tailor the experience to both their needs and those of the business.

"We also focus very heavily on giving people structured career paths to keep them in IP, because sharing learning and transferring it from one project to another is an important part of how we deliver."

"We've had a lot of success in attracting talent from a wider variety of sectors, bringing different approaches and innovative ideas."

Alison Rumsey, Human Resources Director, Infrastructure Projects

She adds: "We've had a lot of success and external recognition for our young talent and the projects that they work on, which have won a huge range of accolades. It demonstrates what a great place IP is to come and have a career. We want to use the skills, knowledge and experience that they have developed to enhance what we do and improve the way we operate."

Broader base

IP is also committed to broadening its appeal to reach all demographic groups. This is not only in line with NR's diversity strategy, which aims to tackle female under-representation in the workforce, but also to maximise the pool of talent it attracts.

A key part in achieving that aim is to change traditional perceptions of working in the rail sector. Rather than a heavily labour-intensive and unfashionable career choice, IP wants it to be viewed as a powerful vehicle to achieving a highly accomplished technical or professional career in roles including construction engineering or project management.

"We're actively trying to change the image that jobs in NR are exclusively in the 'orange army'," adds Rumsey.

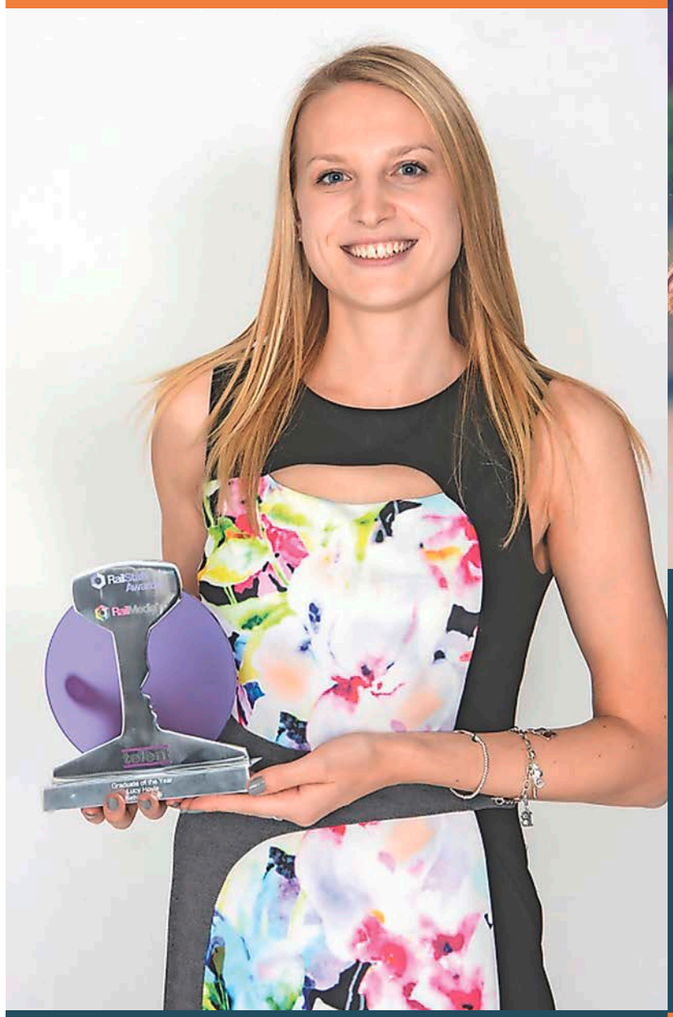
"We've done a lot in the traditional media and in social media to try and improve that understanding so that we're known as a diverse organisation and that people can benefit by making it their career choice.

"What we're trying to achieve on the diversity side is not just about ethnicity or gender, but the diversity of thought that comes with their background and experience. We've had a lot of success in attracting talent from a wider variety of sectors, bringing different approaches and innovative ideas.

"We've recruited people to the IP executive team, for example, who aren't from traditional railway backgrounds, but have great programme management experience in an allied sector. That brings diversity in its broadest sense by saying 'it's not just about whether you are a man or a woman, it's what experience you have and what you can bring to make IP a better organisation'. ■

IP passionately believes in investing in its people to improve the safety, reliability and efficiency of the railway. NR has 26 training centres located across the UK, supporting a range of accredited vocational courses.

Network Rail's Rising Stars



▲ Fjolle Bunjaku

National Rail Awards 2017 judging panel member

Fjolle beat off stiff competition from more than 70 Young Rail Professionals members earlier this year to win one of five places on the 2017 National Rail Awards judging panel.
Having joined NR's project management graduate scheme in December 2015, she currently works as a project manager in Development in track renewals.

Fjolle was selected for the NRA due to her strong belief in recognising the efforts of other bright stars in the industry for their hard work, and her close involvement in industry-wide efforts to encourage more young people to join the rail sector.

▲ Lucy Hoyle

Rail Staff Awards 2016 Graduate of the Year

Having studied Geography at University College London, Lucy joined NR's graduate scheme in September 2015. She was nominated for her role in IP's track transformation team, which is responsible for implementing new ways of working within NR. This required exceptional stakeholder management, and Lucy was praised for her networking skills and commitment to continuous improvement. She is now a Scheme Project Manager in Manchester, and is described as a huge asset to the IP business.

Ahmed Arteh

Young Rail Professionals 2017 Apprentice of the Year finalist

Ahmed was one of just three finalists shortlisted for this year's YRP Apprentice of the Year award. Having studied for a Foundation Degree in Railway Engineering at Sheffield Hallam University, Ahmed joined NR in September 2015.
The trainee permanent way engineer was part of the Star Track programme, under which he was seconded to Arup's permanent way design team in Manchester for a two-year design placement, before joining the company as an Assistant Permanent Way Engineer in June.

Case Study

FUTURE-PROOFING LONDON BRIDGE

Thameslink Programme Director SIMON BLANCHFLOWER tells PAUL STEPHEN how his team worked with local stakeholders to redevelop London's oldest station and prepare it for an even busier future.

▲ **Network Rail has created a bigger and better station at London Bridge, which handles 56 million passengers per year, while conserving many of its historical features.** JACK BOSKETT

Sitting at the heart of Infrastructure Projects' dynamic portfolio is the visually impressive redevelopment of London Bridge station.

Scheduled for completion in January 2018, it is a spectacular showcase for the delivery of significant capacity improvements and large-scale passenger benefits by sensitively adapting existing infrastructure.

Built in 1836, London Bridge is the capital's oldest station. Network Rail was permitted to remove listed structures for the work to take place, provided it had a robust design in place that would enhance the historical urban environment.

The redesign is a key element of the £7 billion Thameslink programme which will result in a greatly expanded cross-London network linking the Midland Main Line and Great Northern routes to destinations in Sussex and Kent. In total, the project will increase capacity at Britain's fourth busiest station by 65% - from 2018 the new dedicated Thameslink platforms will accommodate 16 trains per hour in each direction during during the peak.

On the eastern approaches to London Bridge a new diveunder has been built at Bermondsey to further increase capacity, while complementary major station improvements have been made at Farringdon and Blackfriars.

Key to the project is the new concourse at London Bridge. Two-thirds of it opened in August 2016, but once complete it will be larger than the football pitch at Wembley Stadium. Two new entrances have also been constructed to better connect the surrounding areas, and ample space is provided for retail and leisure activities.

Gaining Permission

Authority for much of the station reconstruction was granted via a Transport & Works Act (TWA) order granted by the Secretary of State for Transport. However, separate planning consent was needed from Southwark Council to alter and demolish parts of the station's historical fabric.

Thameslink Programme Director Simon Blanchflower says: "The original TWA published in October 2006 gave us overall compulsory purchase powers to acquire the extra land we needed and the power to divert highways and utilities, but we still needed to apply for second planning permission for London Bridge station itself, which I led.

"That main piece of work took place in 2011, and we formed a very successful collaborative relationship with Southwark Council's planning and heritage bodies to come up with a scheme that was appropriate for the station and fitted well within the overall context in which it sits.

"We worked really closely with the local authority through the pre-application process to understand its needs and requirements prior to making our submission. The key lesson is that the more you invest 'up front' in the planning process, the easier is it to deliver your product, especially when you are in a collaborative relationship."

New Access

One of the biggest selling points of the new design and an expanded station footprint was the opening of two new entrances on Tooley Street and St Thomas Street. These improve accessibility through the station where it had previously been a barrier between areas to north and south. Southwark Council also viewed the proposed layout as an opportunity to regenerate and enhance the surrounding area.

Strong efforts were also made to protect or restore much of the station's Victorian heritage, and full justification had to be given by Blanchflower and his team in the unavoidable case of its removal.

He adds: "A lot of the work we did was around exploring solutions concerning which parts of the building could be conserved within the upgrade and those that could not. For instance, the Grade II-listed train shed above the terminating platforms could not be retained due to the revised track layout, so we made an agreement to salvage what we could and enable it to be re-erected elsewhere and preserved. I'm pleased to say that it has now gone to Aberystwyth to be utilised as part of a heritage railway museum.

"On St Thomas Street, there were listed arches which could be retained, and we've restored the brickwork. The arch design has been replicated within the new part of the station, which has been well received by heritage groups.

"It shows that we've been able to enhance the heritage of the place, which is a key element of the whole consent process."

Blanchflower says that obtaining consents has been made easier by the work of organisations such as the Railway Heritage Trust, which is well placed to give advice on striking a balance between meeting the operational needs of the railway, and the conservation of items of historical or architectural interest.

In addition to making local authorities more sympathetic to NR's plans for delivering major capacity improvements, he says that it has also encouraged designers to treat historical features sympathetically, and as more of an asset. For instance, original quadripartite arches located beneath the platforms at London Bridge were not listed structures, but were mostly retained and modern replica four-way arches built to create a seamless transition between older parts of the station and the new concourse.

Network Rail was also required to enter into a Section 106 agreement with Southwark Council – a legal contract to deliver certain conditions attached to planning permission, including sustainability requirements as well as providing recruitment opportunities. Rather than viewing this as a burden, NR embraced these conditions.

"We are a publically funded organisation, which precludes certain ways of addressing Section 106 requirements. We cannot, for example, contribute large sums financially. But we've done some valuable work by hiring 61 apprentices, provided training to 200 long-term unemployed local residents, and work experience to more than 30 students. We also delivered a successful outreach programme with local schools and colleges by engaging with over 1,000 students on opportunities within construction.

"Southwark Council is extremely pleased with the contribution we've made economically and socially to the Borough, and we're happy to give something back to a community that we are affecting with this work."

The success of Thameslink's consents and planning team will not be lost now that the project is almost over; it is currently being captured in good practice guides to ensure that it is fed into NR's strategy for future projects. Resources will also be provided to members of Blanchflower's team to help support the deployment of some of these methods when they move on to new projects.

Simon concludes: "The people involved with London Bridge will be its greatest advocates when they leave Thameslink. A lot of their success is to do with attitude, and you can either see consents as a constraint or as framework for delivery in high-profile, critical locations. We don't want to battle against local planners, we want to work with them to achieve the outcomes we've agreed, as we have so successfully at London Bridge." ■

▲ **The Grade II-listed St Thomas Street façade was retained and restored using specialist contractors with very pleasing results. Quadripartite arches were also retained and then replicated, demonstrating that heritage features can be altered sympathetically to deliver capacity enhancements.** PAUL BIGLAND

"In total, the project will increase capacity at Britain's fourth busiest station by 65% - from 2018, new Thameslink platforms will handle 16 trains per hour in each direction during the peak.

ORDSALL CHORD: A SHORT LINK WITH HUGE BENEFITS

It may only be 350m long, but when the new Ordsall Chord opens in December it will have far-reaching effects for rail passengers across the north of England. PAUL STEPHEN discovers how the link was planned and built.

Due to open in December 2017, the Ordsall Chord is one of the latest extraordinary feats of engineering to be implemented by Network Rail Infrastructure Projects. It provides another powerful example of how collaborative working can deliver impressive results.

Constructed by an alliance of Network Rail, Skanska, BAM, Amey Sersa and Siemens, alongside Severfield, BDP, Parson Brinckerhoff and Aecom Mott McDonald, the £85 million project involves building 350 metres of new track to link Manchester's Victoria, Oxford Road and Piccadilly stations for the first time in their history.

As a key element of NR's £1 billion-plus Great North Rail Project, the link will provide much-needed relief to Piccadilly and help create additional train paths that will equate to a 25% increase in capacity by removing a notorious bottleneck in the city.

It will allow TransPennine Express trains between Leeds and Manchester Airport to be routed through Manchester Victoria and into Piccadilly's through platforms from the west, obviating the current need to approach from the east, reverse and negotiate the entire station throat to reach the airport.

Historic location

The chord links two existing railways on the western side of the city centre and, in just 350m, crosses the River Irwell, Trinity Way and the Manchester, Bury and Bolton Canal, forcing NR to embark on an ambitious design for the elevated structures required.

It also presented NR with a unique opportunity to celebrate the area's railway heritage, as the link passes close to the site of the world's first passenger terminus at Manchester Liverpool Road, now occupied by the Museum of Science and Industry (MoSI).

Many of the surrounding viaducts were designed and constructed by celebrated engineer George Stephenson for the Liverpool & Manchester Railway, which was the world's first inter-city line when it opened on September 15 1830.

Unfortunately, as part of the project, NR had to remove a short section of the Grade II-listed 'Zig-Zag' viaduct that carried MoSI's short rail link to the national network. However, by working in collaboration with English Heritage and Manchester City Council planners, NR enthusiastically grasped the opportunity to clean and renovate the nearby historic Stephenson's Arch.

During construction, NR was able to open up long-lost views of this Grade I-listed structure spanning the River Irwell by removing a redundant girder bridge built onto the side of it in 1860. A modern pedestrian footbridge was then built in its shadow, from which the original masonry can now be admired at close quarters for the first time in 150 years.

Signature structure

A new public space was also created in the immediate vicinity, while the project's lead architect, BDP, designed the centrepiece of the new alignment to be as striking and complimentary as possible. The result is an impressive 90-metre arched bridge spanning the River Irwell.

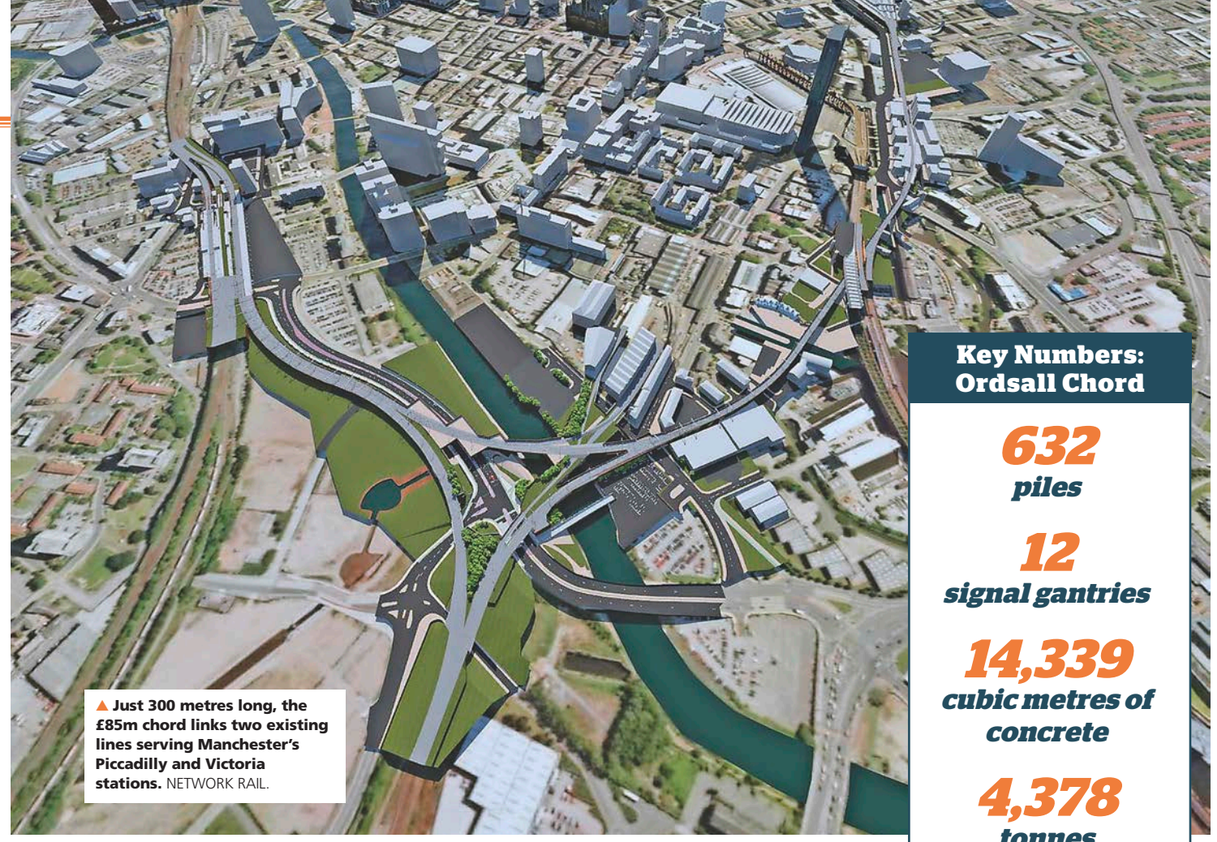
It is the first main line railway network arch in the UK (and as far as we aware the first main line asymmetric railway network arch in the world), using inclined hangers rather than vertical ones to give a more elegant design and accommodate the curvature of the track. Weighing 600 tonnes, it was lowered into place on February 21 using the biggest crawler crane in the UK.

Tracklaying and the installation of essential systems was almost complete as this issue of *RAIL* went to press, and less than 10% of the total work remained outstanding, including landscaping and adding architectural finishes, before the first trains can run over it later this year in preparation for the December 2017 timetable change.

Chris Montgomery, Major Programme Director for IP Northern Programmes, says: "Stephenson's Arch is Grade 1-listed which is the same status as the Houses of Parliament. What we've done is to open it up so that it receives the admiration it deserves. It will be illuminated at night and should become quite a feature of the area.

"We've worked closely with local authorities and English Heritage to achieve the necessary planning consents and deliver tangible improvements to this key part of our industrial history.

"It's a fantastic project to work on as we're enhancing part of the world's first passenger railway, not to mention putting in a network arch for the first time in the UK, so it's very much old meets new. I think George Stephenson would be very proud of what we've managed to do." ■



▲ **Just 300 metres long, the £85m chord links two existing lines serving Manchester's Piccadilly and Victoria stations.** NETWORK RAIL.

▲ **Weighing 600 tonnes, the Ordsall Chord's signature network arch was fixed into position on February 21 having been constructed on site.** PAUL STEPHEN.

▲ **The 63ft span of George Stephenson's Grade I-listed bridge over the River Irwell, built in 1830, has been revealed to full public view by Network Rail for the first time in more than 150 years.** PAUL STEPHEN.

"As a key element of over £1bn investment in the Great North Rail Project, the link will provide much-needed relief to Piccadilly and help create additional train paths that will equate to a 25% increase in capacity by removing a notorious bottleneck in the city."

Key Numbers: Ordsall Chord

632 piles

12 signal gantries

14,339 cubic metres of concrete

4,378 tonnes of steelwork

500 kilometres of cable

28,500 tonnes of ballast

98 engineering trains

22 Switching and crossover units

66 new or modified LED signals

74 new overhead line structures

▲ **Since the start of Control Period 4 in April 2009, Network Rail has managed to close 1,080 level crossings. While more closures are sought, around 6,000 are subject to an extensive risk reduction strategy.** PAUL BIGLAND

EVERYONE HOME SAFE, EVERY DAY

Network Rail's Head of Corporate Workforce Safety RUPERT LOWN tells PAUL STEPHEN how safety is fixed firmly at the heart of the company's plan to improve Britain's railways

For both passengers and workers, the safety of the UK rail network is second to none as it continues to register the best performance among Europe's ten largest railways.

Official statistics from the Office of Rail and Road (ORR) confirm that it is been more than ten years since a passenger was killed as a result of a train accident, while 2015/16 was the first year since ORR's current statistics began, in 2002/03, that no industry-caused workforce fatalities were recorded. Network Rail repeated the feat in 2016/17 on NR-managed infrastructure, although unfortunately one fatality did occur as the result of a road traffic accident.

The overall level of workforce harm also continues to decline as indicated by the industry's official measures - the workforce fatalities and weighted injuries measure (FWI) and Lost Time Injury Frequency Rate (LTIFR).

Two years ago (2015/16) we had a reduction of 23% in the LTIFR, and in 2016/17 we saw a further 16% improvement across Infrastructure Projects.

It's ample evidence that for employees and contractors working on Infrastructure Projects, NR's clear and simple safety vision of everyone home safe, every day is yielding dividends.

But despite working on the railways becoming much safer, the railway is still not immune from risk and NR continues to work towards its target of eliminating all workforce fatalities and major injuries.

Head of Corporate Workforce Safety Rupert Lown explains: "Infrastructure Projects has a good safety record at the moment, which is a really positive story. It was achieved through targeted improvements. It is very much a joint effort and our supply chain has been integral in helping us to improve.

"But there remain too many accidents. For example, in our last (four-weekly) monitoring period which finished towards the end of July, we still had 11 lost time injuries across the IP portfolio, and that's 11 too many. From that point of view we still have work to do.

"We're in a significantly better place than we have ever been before, but as you reduce your numbers it becomes harder and harder to get down to zero. We have to become more intelligent about how we do it."

Home Safe, Every Day

Underpinning NR's workforce safety performance is its Home Safe Plan, which is continually reviewed to focus on key areas that carry the greatest risks. Employees and contractors must comply with NR's Lifesaving Rules that make safe behaviour a requirement.

The Home Safe Plan includes road safety as a key priority, after road traffic accidents emerged as the main source of workforce fatality.

"For both passengers and workers, the safety of the UK rail network is second to none as it continues to register the best performance among Europe's ten largest railways."

ORR figures showed a 34% increase in the number of road traffic accidents involving NR staff or contractors on duty in 2016/17, and so NR is taking action to help staff drive within the speed limit. A number of safety arrangements have already been put in place under the Home Safe Plan. NR has rolled out a Vehicle Speed Warning System across its fleet of 7,500 vehicles. This provides the driver with real time audible and visual warning of road speed enabling them to alter their speed.

"Certainly, the most prevalent area of fatalities has been on the roads," adds Lown. "And we mustn't be complacent about that. If you go back across the last seven years we've had eight fatalities on the roads. These were all unacceptable, so this is one of our strong focus areas now. It's about reducing the potential for people to fall asleep at the wheel and getting →

people to change their behaviour off-site in the same way they've changed their behaviour on site.

"We calculated that NR has a fleet of 7,500 vehicles that covered in excess of 100 million miles in 2014/15, and that's without including the supply chain. We want to help everyone drive home safely at the end of their shift. This starts with the quality of the road fleet and making sure that it is properly maintained. But, we also need to have drivers appropriately trained and we need to make sure they are fully alert when driving home to see their families, so we undertake a lot of education around that."

Lown says that restricting the duration of hours spent on duty is more critical than limiting the total amount of distance travelled. IP therefore operates a 14-hour rule which includes time spent on-site and travel time either side. This is strictly enforced whether IP workers are part of the 5% directly employed by NR, or the 95% provided by the supply chain. It is very much a collaborative effort.

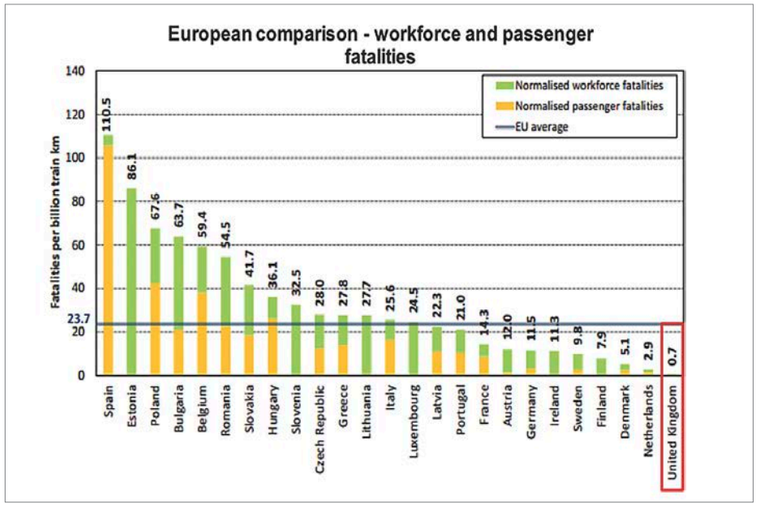
Reducing Risk

"Evidence suggests that after 14 hours the risk of fatigue starts to escalate and, in reality, there is a growing number of contractors that only work ten hour shifts and then have an hour either side for travelling.

"We have a legal framework with the supply chain to make sure this happens, and the supply chain has the same legal responsibility to work safely and organise itself effectively. We work collaboratively so when contractors go to the front line they know what to expect, and the rules and expectations are the same regardless of who you work for.

"There are lots of options around how people manage fatigue, and some people will be booked into hotels when they finish their shift so they can have a sleep before travelling home. But we know that some people don't want to take up those offers and just want to get back to their families.

"Getting people to act responsibly is sometimes difficult so we check to ensure those systems work. It's understandable that people want to see their families, but there is a balance to be struck and we want them to get home safely and correctly."



Source: NETWORK RAIL.

On-Track Safety

In terms of improving track safety, NR is rolling out its Planning and Delivering Safe Work (PDSW) process, which is transforming how IP projects are planned and implemented. It will mean the creation of a new, unified Safe Work Leader role which makes a single person accountable for all aspects of the work they are overseeing. This replaces a system of split accountability.

Lown says: "We've been working extremely hard to prevent track worker fatalities since the last one we had in January 2013 near Newark. That was a tragic event and we want to prevent it from ever happening again, so PDSW is about ensuring that when the team goes out to work on the track, they're not going to be struck by a train.

"It's about properly planning the work, and putting arrangements in place to change things for the better. We used to have someone who was in charge of preventing people being struck by a train, and then someone else in charge of doing the actual job. That seemed very sensible but part of what we've learned is that by having two people in charge, sometimes those plans don't align and the tasks cannot be done safely. With PDSW it brings accountability into one place so you have a single person who oversees the work and safety of the team.

"It's a significant change and has been in development for the best part of a year. It came into force across the network on July 3, and is being carefully phased in so that by September 23 everyone will be using the same system."

Safety Culture

As well as applying the highest standards in safety and analysing high risk areas, NR prides itself on the creation of a strong safety culture that has permeated through to all levels of IP. Accident prevention must come down to the individuals, who have all been empowered to report unsafe conditions or act decisively if a risk emerges.

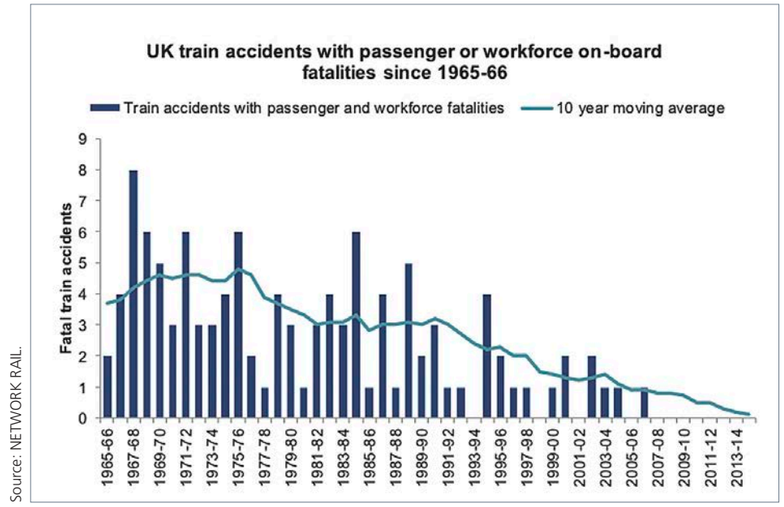
This strategy not only helps IP to live within its means by boosting efficiency, but ensures that it never undertakes any activities that could compromise safety.

"If we weren't safe then we wouldn't be efficient," says Lown. "You want your staff to come in the next day to do the work that you've trained them to do, and the only way to do that is to plan the job properly.

"If possessions do look like they are going to overrun, we'd far rather that teams checked their plans, ensured they were correct and did the job safely than rush to cram work in. That is not sensible as it elevates levels of risk. We've all got to make sure that when a difficult situation arises and a possession is going to overrun, we say 'you know what, we can't do this job safely so we'll take an extra half an hour to make sure it's done correctly'.

"When an error creeps in and we realise we're overrunning, we need to stop and work out how to do it safely so it's about managing the process properly and not taking shortcuts."

"As well as applying the highest standards in safety and analysing high risk areas, Network Rail prides itself on the creation of a strong safety culture that has permeated through to all levels of Infrastructure Projects."



Source: NETWORK RAIL.

"We're in a significantly better place than we have ever been before, but as you reduce your numbers it becomes harder and harder to get down to zero. We have to become more intelligent about how we do it."

Digital Opportunities

Looking to the future, Lown predicts that further safety gains will be delivered as a result of NR's Digital Railway programme, which principally aims to create additional train paths by deploying modern technologies to keep trackworkers separated from trains.

Looking to the future NR now has a strategy to harness the technology offered by Digital Railway solutions to reduce the risk of trackworkers being struck by trains. Due to the range of signalling architecture and the phased approach of introducing Digital Railway systems such as Traffic Management, ETCS and ERTMS there is not an easy 'one size fits all' solution. NR needs dynamic systems to suit the differing geography, signalling architecture and infrastructure, varying line speeds and train frequencies across the Routes.

NR is working closely with trades unions and investing in the development of new protection and warning systems. These will provide further opportunities to access the track to perform maintenance tasks and will be used for inspection, surveillance and non-intrusive activities, and will maximise the opportunity for asset maintenance and enhancement works. Over time they will reduce the reliance on historic systems of lower integrity containing multiple human error failure modes.

"Digital Railway will increase the number of trains on the network we operate, but there are some strong opportunities within that to improve safety, such as how can we use high-integrity signalling systems.

Our plans all revolve around preventing workers from being injured. We want Everyone to Go Home Safe Every Day. ■

Reducing Risk at Level Crossings

Level crossings perform a vital function but at each one, there is an opportunity for the public to come into contact with trains.

ORR figures show that although the number of fatalities remained low in 2015/16, it increased from four in 2014/15 to six a year later. NR policy is to close as many crossings as funding and timescales allow, and in 2016/17 it closed 67 and changed public rights of way at a further seven. But with 6,000 crossings still in existence, it must also implement a wide-ranging risk mitigation strategy for users, and use technology to improve safety even further.

Lown says: "We've got a whole range of crossing types so the integrity of those systems varies, but the question remains over how can we close as many level crossings as possible so that interactions can't happen.

"We can't wave a magic wand and shut them all, so it's about targeting high-risk locations and we continue to look at how technology can help to improve their overall design. How can we take thousands of half-barrier crossings and use warning systems to give greater protection?"

He adds: "In Control Period 5 we were challenged by the ORR to reduce that risk so we looked at the highest risk crossings to achieve that intelligently and cost-effectively. Our challenge has been to figure out how we bring in technology that allows us to build bridges more easily while using the railway.

"We will have groups of people who say 'we don't want a bridge because it's unsightly' and we need to respond with understanding, and reach out to reduce the risk in the best way that complements the local community."

▲ **Network Rail will have invested more than £230m in level crossing safety by the end of Control Period 5 in March 2019.** PAUL BIGLAND

"OUR SUPPLY CHAIN IS KEY TO OUR SUCCESS"

NR Infrastructure Projects Commercial & Development Director Matthew Steele tells Paul Stephen how improved relationships with suppliers, greater transparency and careful project planning will increase efficiency over the coming years.

As the UK's largest provider of infrastructure, a strong and mutually beneficial relationship with the supply chain is critically important to the operational success of Network Rail.

When spending more than £6 billion per annum with more than 3,000 mainly UK-based suppliers, the stakes are incredibly high for both the client side and for NR's contractors.

Having a robust supply chain strategy is key to not only unlocking innovation and value for money, but also for the sustainability and health of the nation's construction sector. NR's supply chain supports more than 117,000 jobs in the UK.

NR must provide its suppliers with a fair return for the projects they deliver and sufficient visibility of its long pipeline of tendering opportunities while, at the same time, advancing its commercial ambition to safely deliver growing volumes of work in an increasingly cost-efficient way.

The challenge of striking that balance falls to NR's Commercial and Development Director Matthew Steele, who switched from the organisation's Crossrail Programme in June.

At the top of his in-tray is the development of NR's new supply chain strategy for Control Period 6 (April 2019-March 2024), due to be published in early-2018. This strategy will not only need to satisfy the outcomes mentioned above, but also position NR as the client of choice in an increasingly competitive marketplace. By the end of the decade multi-billion-pound packages of work are expected to be procured to build a third runway at Heathrow Airport and a new nuclear power station at Hinckley Point, not to mention HS2, £6bn of contracts for which were awarded in July, with construction due to start on the London-Birmingham Phase 1 in 2018.

Dynamic Relationship

But, in Steele, NR has someone well placed to understand the dynamic relationship between the supply chain and NR, and their often-conflicting needs. This comes from his time at Crossrail where he had the unique experience of delivering the project on behalf of his client, Crossrail Ltd, but also fulfilling the client role by procuring up to £2.3bn worth of work from a network of sub-contractors to build the route's surface sections.

He explains: "It's extremely important that our contractors understand what we're trying to do and how we're trying to do it, because we know that we can only be as good as our suppliers.

"We also want to make NR an exemplary client because there are many more large infrastructure providers beginning to emerge.

"I was fortunate to have worked very closely with Crossrail Ltd, but also to deal with ten of the largest sub-contractors in the UK including the likes of Balfour Beatty and Carillion. I was able to learn the ways how they worked and what contractual arrangements delivered the best outcomes. I'm bringing those lessons back to the centre of Network Rail."

To support his own experiences and to further inform the development of the new national supply chain strategy, Steele and his team are working to decide how best to procure NR's renewals and enhancements in CP6.

It is a consultative process and Steele is working hard with his colleagues at route level to understand what improvements they would like to see, but also other internal teams such as the Digital Railway programme to understand what changes will be needed in how signalling is procured in the future.

Externally, Steele is engaging with small and medium enterprises (SMEs) by talking to the Rail Supply Group (RSG) and the Rail Industry Association (RIA), and he has formed a steering group with his Tier 1 suppliers which will meet every six weeks.

He adds: "We're working really hard to understand what worked in CP5, and what didn't. I'm having good quality dialogue and I'll be going to the suppliers in November with an update before publication of the strategy early next year."

Steele's work includes market analysis to better understand what the impact will be on capacity and availability of resources in the supply chain during CP6 given the competing demands of HS2 and other major projects.

He also has to take account of the uncertainty over what volume of work NR will require during CP6, in advance of its Statement of Funds Available (SoFA) being published by Department for Transport on October 13.

"We have a responsibility to deliver maximum passenger benefits and best value for money on behalf of the UK taxpayer"

Nevertheless, it remains within Steele's control to identify the most effective means of procuring that work, for all parties concerned.

"It's unlikely that I will be able to deliver everything the supply chain wants because we are governed by European law and we have to spend taxpayers' money efficiently through competitive tendering, but we are listening.

"I can't guarantee these companies any work, but I am working to maximise visibility and to stagger national tenders to make it easier for them to bid for a large quantity of renewals, and large scale enhancements as we commit to them on a case-by-case basis.

"We will also consider where we can use SMEs, develop local skills and bring local economic benefits, and that means taking down some of the existing barriers for SMEs."

Alliance Model

The new supply chain strategy will also contain NR's future contracting arrangements, including how alliancing models will be used. There are good examples which have been behind some of CP5's big successes.

Steele is an enthusiastic supporter of alliances for schemes where they have produced good outcomes such as the removal of a notorious bottleneck at Norton Bridge in Staffordshire, the construction of the Ordsall Chord and NR's various switch and crossing alliances.

But Steele says there is no one-size-fits-all model; the environment, the contracting terms and the scope all have to be right.

"We're looking very carefully in CP6 to make sure we build alliances where appropriate and where there are big risks and complexity, but not for the sake of it. Forced alliances don't work, and the supply chain has to choose its partners where possible and put themselves forward."

Steele has also been busy supporting recommendations made by the Hansford Review to consider increased contestability and third party funding and delivery of projects. Although this will not directly affect existing procurement of projects that NR's Infrastructure Projects (IP) team is selected to deliver, Steele has written to IP's 60 largest suppliers to explain what the review means for them. His team will also be arranging seminars to provide an opportunity for them to seek further clarity. IP will also provide specialist procurement support if required.

Steele is responsible for programme management and quality assurance, for example by providing internal peer reviews and scheduling cost control. He is also helping to develop the skills of people in the IP team, including providing greater support for development and administration of future projects.

Project Development

A large part of Steele's project management function concerns how IP manages its Guide to Rail Investment Process (GRIP), which encompasses the full project lifecycle from development (GRIP 1-3) through to delivery (4-8).

He explains: "GRIP 1-3 is where you're looking at options and considering how you'll solve problems. That sets the whole tone for the rest of the project so we're putting a lot of effort into improving that upfront planning segment.

"[IP Managing Director] Dr Francis Paonessa's instruction to me when I started in June was to make sure we get the governance around what we do today absolutely right, and that means getting GRIP working effectively and making sure we're well prepared with a robust supply chain strategy in the short and longer term.

"For us, it's about making GRIP as user-friendly as possible, something we continually review, and secondly to make sure it's used properly because, if you jump between stages too quickly, projects can end up late and over budget."

Steele is a keen advocate of GRIP, which emerged more than a decade ago from a Government developed system for administering large projects named PRINCE2. Its eight stages react the full lifecycle of a project and provide a more disciplined framework around a project.

Steel points to the Great Western Route Modernisation and the electrification of the Gospel Oak-Barking line as two projects where early development was not given enough priority, and where significant difficulties were then encountered during project delivery.

"GRIP is a good system; you would see something very similar if you went to any of the major car manufacturers, for example. We know that where GRIP has been followed well, we get a successful outcome, and where shortcuts have been taken, we haven't.

"They say imitation is the sincerest form of flattery and we've seen that Transport for London has also adopted GRIP for its own projects. It works because it allows you to stop every now and again and ask if you're doing the right thing, and getting best value for money."

And that has to be a good thing. ■

▲ **Network Rail is set to continue the use of its alliance model following several successes including the S&C North Alliance, pictured here in February using two Dynamic Track Stabiliser tampers on the East Coast Main Line at Sandy to renew three crossovers and a turnout.** NETWORK RAIL.

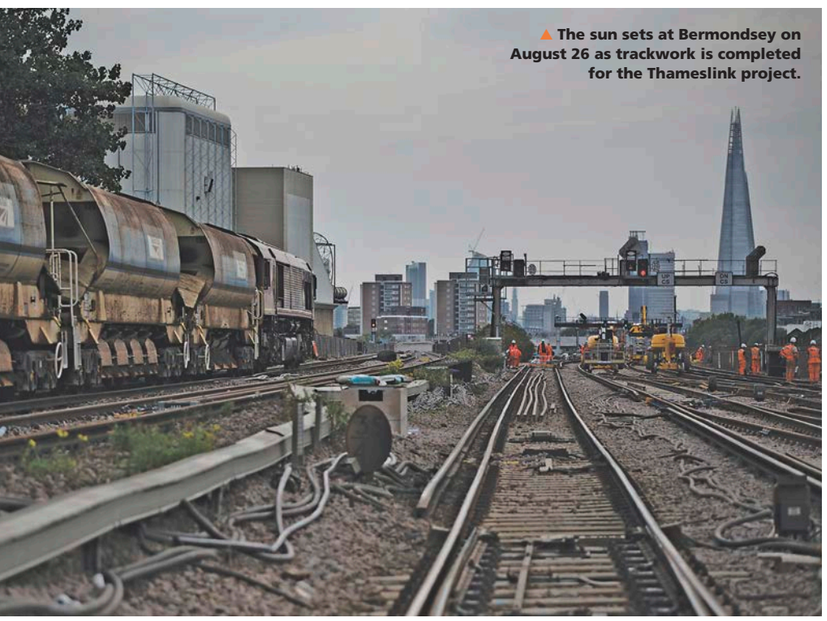
WATERLOO SUNSET

A series of images from Network Rail's intensive summer upgrade programme, including the August Bank Holiday weekend when £133 million worth of work was completed in just three days.

▲ The sun sets on Britain's busiest station on August 28, following a three-and-a-half-week partial blockade to increase capacity at Waterloo by 30%.

▲ Around 2,200 work hours were completed between August 26 and 28 to renew Harts Bridge at Whittlesey on the Peterborough-Ely line.

All images: NETWORK RAIL



▲ The sun sets at Bermondsey on August 26 as trackwork is completed for the Thameslink project.

▲ The Chase Line between Walsall and Rugeley Trent Valley re-opened on August 29 after a 16-day blockade to complete electrification works.

▲ A 1,000-strong team of engineers built 160 metres of new platform and laid 1,270 metres of track at Waterloo during the August blockade.

DELIVERING EUROPE'S BIGGEST CONSTRUCTION PROJECT

Network Rail's Infrastructure Projects division is playing a key role in delivering London's new £15bn railway by upgrading existing lines to the east and west of the capital that will be used by Crossrail trains from next year.

▲ **Built for Network Rail by Balfour Beatty, Abbey Wood makes a bold architectural statement with its 1,500 square metre concourse crowned by a wood panelled roof covered in zinc.** CROSSRAIL

This has proved to be an incredibly successful year for Network Rail's Crossrail surface works, with several milestones being reached on one of the largest projects ever undertaken by IP.

Apart from the 26 miles of tunnels constructed by Crossrail Ltd beneath central London, Network Rail is responsible for delivering £2.3 billion worth of work above ground, where the Crossrail route utilises existing parts of the network.

This includes modifying and enhancing 28 existing stations, mostly on the Great Eastern Main Line between Liverpool Street and Shenfield, and the Great Western Main Line between Paddington and Heathrow Junction and Reading. A shorter section on Crossrail's south-eastern arm runs from the eastern tunnel portal at Plumstead to Abbey Wood, where a new interchange is being built with Southeastern services on the North Kent Line.

On all three sections, NR's involvement is now at an advanced stage, and the new concourse at Abbey Wood is due to open to Southeastern passengers in October, when the Elizabeth Line platforms will also be handed over to Crossrail Ltd to begin testing.

Meanwhile, the first of 70 Bombardier Class 345 Aventra trains on order for Crossrail entered service with TfL Rail between Shenfield and Liverpool Street in June.

Elizabeth Line services will begin running from Paddington to both Shenfield and Abbey Wood in December 2018, and also to Heathrow from Paddington main line station. The full service to Crossrail's western extremity at Reading will follow in December 2019.

Minimising Disruption

In order to minimise disruption to the operational railway, much of the construction work has been concentrated into a series of overnight weekend and Bank Holiday blockades. This included a ten-day closure last December, during which IP completed its largest ever Christmas programme of works, worth some £30 million.

On the western section, NR was required to upgrade the Great Western Main Line to accommodate Elizabeth Line services, but also the new Intercity Express Programme fleet due to start work in October. Infrastructure work was also needed to enable the introduction, on January 3, of GWR Class 387 electric multiple units between Paddington and Hayes & Harlington.

Services into Paddington were therefore suspended to allow NR and its main contractors Carillion, Balfour Beatty, Alstom and Taylor Woodrow to install overhead line equipment (OLE) and for extensive resignalling. A number of platforms were also lengthened, and the station's main footbridge was raised to provide sufficient clearance for the OLE.

Moving further west, a new junction and the necessary signalling was installed at Old Oak Common, where a new depot and sidings have been built. A new diveunder was also fully commissioned after a four-year construction project that will significantly reduce conflicting movements with slow moving freight traffic entering and leaving Acton Yard.

The final stages of Stockley flyover, where the line to Heathrow diverges from the Great Western Main Line, were also completed and new switches and crossings were installed at Hayes & Harlington and Maidenhead.

Finally, the last 25kV AC wires were erected between Stockley and Maidenhead ahead of their energisation in May, when GWR's EMU services were extended from Hayes & Harlington.

Great Eastern

Meanwhile, on Crossrail's eastern side, engineering was completed at 13 locations by NR, Costain and Alstom ahead of the first TfL Rail Aventra trains entering traffic between Shenfield and Liverpool Street in June.

Overseeing the Crossrail works was NR's former Crossrail Programme Director Matthew Steele, before he became IP Commercial & Development Director in the summer.

"Network Rail is responsible for delivering £2.3 billion worth of work above ground, where the Crossrail route utilises existing parts of the network."

▲ **Acton diveunder (above) has been built to reduce pathing conflicts between high-frequency Crossrail services and heavy freights in and out of Acton Yard.** CROSSRAIL.

▲ **Acton diveunder (left) and Stockley flyover (above) were both fully commissioned in December 2016 during NR's largest ever package of Christmas works.** CROSSRAIL.

Last Christmas he was responsible for the deployment of more than 4,400 people working on sections of tracks being used by 250 machines and 74 engineering trains bringing in everything from ballast to track panels.

He says: "We packed that blockade with more work and resources than ever before. It took a colossal amount of planning, and the engineers rehearsed the scenario for nearly six months to ensure a safe and punctual handover of the line back to the operators.

"Working around an operational railway is expensive and can be disruptive, so I think blockades are a more efficient way to reduce that. There is short term pain but the long-term gain is massive.

"You can now get a 110mph air-conditioned Class 387 train into Paddington where you used to be on a 75mph Turbo. That was delivered in May, ahead of schedule, because of what we did at Christmas. That is probably my single proudest achievement at Crossrail because of the immense challenge to get the electrification in by resignalling, lifting bridges, upgrading the power supply and rewiring almost everything.

"But we shouldn't forget all the smaller bolt-on projects such as building West Ealing Sidings which, if you don't complete, you cannot run those services."

Although needed for Elizabeth Line services beginning in December 2019, the re-modelling of Maidenhead was brought forward by 18 months to enable GWR to extend its EMU services ahead of schedule and deliver benefits early for passengers.

Steele says this demonstrated not only the strength and flexibility of his delivery team, but also how well IP understood the operational environment and the needs of its customers.

He adds: "As programme manager, I spent as much time with Route MD Mark Langman as I did with the TOCs, so I could understand how I was disrupting their businesses. Ultimately, I needed access to complete the works, and we prided ourselves on having excellent relationships with our stakeholders.

"We also had some excellent contractors, and maintained a strong relationship with our client [Crossrail Ltd] on the delivery of the work. Accelerating the work was of mutual benefit because we got it done earlier and have brought the assets into use."

GWR is expected to extend its EMU services to Didcot in January 2018, and to Reading in December 2018, ahead of Elizabeth Line services beginning a year later. ■

CURRENT AFFAIRS

Despite a sharp reduction in the appetite for further electrification in the UK, Network Rail has good reason to be proud of its existing projects, says Infrastructure Projects Regional Director Neil Thompson.

▲ **A lack of understanding around the complexity of NR's electrification programme has led to many misconceptions, says Neil Thompson.** NETWORK RAIL.

If there is one part of Network Rail's Infrastructure Projects portfolio that can be described as contentious, then it is undoubtedly electrification.

Ongoing criticism of IP's implementation of several high-profile energisation programmes resurfaced in July, when the Department for Transport (DfT) curtailed schemes to electrify the Midland Main Line north of Kettering, the Great Western Main Line between Cardiff and Swansea, and the Windermere to Oxenholme branch.

DfT's policy now appears to have tilted firmly in favour of bi-mode trains, reigniting the debate over whether NR can effectively deliver electrification programmes on time and to budget.

But much of the criticism surrounding current projects is unfounded, says Neil Thompson, IP's regional director for Crossrail West and Wales, and therefore responsible for a large part of the £3 billion Great Western Route Modernisation programme.

Having been given the go-ahead in 2009, NR's handling of GWRM became heavily scrutinised in 2015 when the scope of the project was substantially revised, following the Hendy Review into NR's delivery programme for Control Period 5.

Recognising difficulties surrounding the programme, including its rising cost, it was decided to press ahead with a commitment to deliver the core section of electrification between Paddington and Cardiff by March 2019. Meanwhile, subsequent announcements have confirmed the cancellation of electrification beyond Cardiff, and the 'indefinite deferment' of associated schemes to Oxford, Bristol Temple Meads and the branches to Henley and Windsor.

Legacy Issues

Thompson says that the problems encountered on GWRM are legacy issues, however, and lie with decisions made long before a single spade had been put in the ground. They should therefore not be seen as a reflection on the abilities of contractors or IP employees and much has been done since then to improve planning and better co-ordinate decision making.

"It's easy to forget that NR is still engaged in the most extensive electrification programme in its history, of a scale not seen in the UK since the East Coast Main Line upgrade was completed by British Rail in 1991."

Neil Thompson, IP Regional Director for Crossrail West and Wales

He adds: "We started construction without the design being finished, and a completion date was fixed with the franchisees and rolling stock manufacturers that wasn't properly knitted together. But much was learned from that and we are now far more integrated with our operators and we work more closely with the DfT.

"It's incumbent on the builder to advise his client immediately if there's a problem so, although we might not be the architect or the cause of the problem, it is up to us to report it to the DfT. My advice is always to have a proper ground investigation and complete your design before making commitments.

"But my job isn't to talk about the past because if you keep recalling the negatives you can't successfully deliver a project with that sort of mentality. You've got to give your team confidence and keep everyone aligned and supportive."

With so much interest focused on which lines will not now be energised, it's easy to forget that NR is still engaged in the most extensive electrification programme in UK history. The last major electrification scheme was that for the East Coast Main Line, completed by BR in 1991.

IP is also delivering the £742m Edinburgh-Glasgow Improvement Programme (EGIP) that involves the electrification of some 93 track miles between Scotland's two biggest cities.

EGIP will be energised in October, followed by the Shotts line in 2019, while south of the border the North West electrification continues apace and will be completed by 2018, when routes to Preston and Blackpool are energised.

In southern England work is almost complete to upgrade or install overhead line equipment (OLE) on Crossrail's eastern and western surface sections to accommodate the phased introduction of Crossrail services, and work is underway to extend electrification of the Midland Main Line from Kettering to Corby.

Engineering Challenges

On the GW Main Line, Thompson's team successfully energised the OLE between Stockley and Maidenhead in May, allowing Great Western Railway to introduce electric units, and electrified Reading Depot 12 months ahead of schedule.

Thompson is now focused on electrification as far as Didcot by January 2018, and then to Cardiff by December next year. Finally, routes from Reading to Newbury and Royal Wootton Bassett to Chippenham will follow in March 2019 to complete the revised schedule.

"I regard the quality of my teams in Swindon and Wales as world leading, and the volume of work we're doing is huge. I know we're not going to convince the public or the press easily, but we just have to deliver to the timescales now.

"I can accept criticism when we go over budget or are late, but what I can't accept is that British engineers do not know what they are doing. We've hit all our critical dates since the Hendy Review in 2015 and the OLE infrastructure to Didcot is now 99% complete, so we're on track."

Thompson concedes that reputational damage has been inflicted by GWRM, but that public attitudes continue to underestimate the scale of the engineering challenge IP has faced in upgrading largely Victorian infrastructure.

Also, often overlooked is the rigorous regulatory environment in which IP must operate. This can make comparison with previous large-scale electrification schemes seem unfair, while allowing popular and pervasive misconceptions to form.

▲ **Far from being an Achilles' heel, electrification and moderniation of the Great Western Main Line to Cardiff in the last 18 months has demonstrated the UK's capability to deliver. Engineers install overhead line equipment near Didcot.** PAUL BIGLAND.

He says: "People say to me 'what is so difficult about sticking some posts in the ground and stringing some wires up?' Fundamentally the problem is trying to explain just how hard it actually is to do exactly that.

"Electrification is only about 50% of the job, and the rest is civil engineering and line speed improvements. It's achieving bridge clearances, and changes at platforms and level crossings.

"I can't talk about Great Western without also talking about the Brunel-built tunnels. We've completed the Severn Tunnel already and Chipping Sodbury is our challenge in the next few weeks. We've still got Patchway and Newport tunnels to do and they are very wet, constrained environments and some of the toughest places on the entire network to install electric wires."

He adds: "Some of my peers and mentors who worked on the East Coast ask me why it is so expensive, and one of the issues now is that consents and the whole planning legislation is much more difficult than it used to be. With regard to heritage consents and environmental concerns, you can't just put OLE through a station if it's a listed structure, and you have to be more sensitive to the environment."

Finally, NR's mission to become more customer focused has created added complexity for GWRM. The IP team must strike a balance between the need for disruptive possessions and maximising access for operators such as Great Western Railway.

"People sometimes forget how bad train performance used to be, and performance today is expected to be much better. But to deliver major enhancements when your operators are trying to achieve a PPM of 90% or more is extremely difficult.

"It makes it a different game for IP when we're trying to deliver the £3bn upgrade of the Great Western in five-hour weeknight shifts. If you lose an hour because of a late running train you can lose 20% of your production overnight, which is why it is so challenging. "But we're on schedule and we feel very positive." ■

KEEPING A GRIP ON COSTS

Overseeing annual spending of more than £6 billion, Infrastructure Projects Finance Director Anit Chandarana is well placed to understand the scale of the business and the challenges it faces in delivering value for money.

Everybody knows that upgrading Britain's railways is an expensive business, but few people are better placed to understand that than Anit Chandarana.

As Infrastructure Projects' Finance Director, he is responsible for developing and leading IP's overall financial management and its internal and external reporting, which means accounting for annual construction activities worth in excess of £6 billion.

A key element of his role has been to spearhead IP's drive to better understand the cost and delivery challenges associated with project completion, as it was tasked to do following Sir Peter Hendy's review into NR's investment programme published in November 2015.

This objective is now being realised, says Chandarana, following an intensive period of structural and behavioural change that has brought a new commercial attitude.

He explains: "When we're out there spending billions of pounds every year, we absolutely have to ask ourselves are we getting the books right? That might sound simple, but it's quite a large responsibility from both a taxpayers' and a value for money perspective.

"At the time of the Hendy review we weren't properly on top of it, and we know that there were some problems. In a capital world, it's easy in the short term to underplay problems and overplay successes. For example, an underspend could be a good thing, or it might just mean you're behind schedule. It's normally more clear-cut in an operating world.

"We understand things like that far more fully now and have some key metrics in place which add real value to the way we measure capital projects. For example, our monitoring of the overall portfolio position has been received so well by the Department for Transport, they're now asking other agencies to replicate it."

Effective Delivery

Those metrics explicitly relate to the effective delivery of passenger benefits in the way they have been promised.

Measured in terms of IP's schedule and budgetary adherence, the results speak for themselves. IP is delivering its current portfolio within 2.7% of budget.

"Having tighter control on project cost and duration not only benefits IP's internal route-based customers and its bottom line, but also every one of its external stakeholders including train operators and passengers."

What lies behind these impressive statistics is a comprehensive and carefully targeted plan to improve planning and drive down costs, which is now coming to fruition.

These improvements include successfully mitigating the significant levels of optimism bias that academic research has shown were traditionally applied in all sectors of the construction industry including large-scale infrastructure projects.

This was identified in research commissioned by the DfT and conducted independently by University College London which analysed projects started since 2014 and in the first half of Control Period 5 (2014-2019).

Published in January 2017, the subsequent report recommended that IP overestimated project costs by 66% at GRIP Stage 1, 40% at GRIP 2 and then 17% at GRIP 3, to account for uncertainties arising from potential optimism bias.

Separately, IP also launched an Enhancement Improvement Programme in October 2015. This programme included seven individual workstreams to drive many other improvements in the performance of IP's enhancements management and delivery.

It included the introduction of a new portfolio reporting system and the insertion of final decision points at key stages of the project cycle, so that commitments cannot be given until project development is complete.

The plan also highlighted opportunities for the increased accountability of decision-making via the wider use of independent project sponsors and higher levels of peer reviewing.

Much greater clarity has also arisen from IP's repositioning within NR as a matrix delivery organisation, and its alignment to its internal ➜

▲ **"When we're out there spending billions of pounds every year we have to ask ourselves if we're getting the books right." - IP Finance Director Anit Chandarana.** NETWORK RAIL.

"What is NR here to do?... It isn't here to run projects, it's to transport goods and people, so there is a real drive to reduce the amount of time we have access to the railway."

▲ As the railway gets busier, NR and its contractors have less time to undertake essential maintenance. PAUL BIGLAND.

▲ Tighter control on project costs benefits everyone on the railway, from NR to operators and passengers. PAUL BIGLAND.

customers - namely NR's eight route businesses.

"There have been many improvements since 2015 in how we cost projects, and we have now agreed with the DfT to allow for optimism bias," adds Chandarana. "This will resolve any issues for programmes moving forward, but we still have some legacy schemes where it hasn't been applied, such as the Great Western Route Modernisation, where firmer estimates have had to be retrospectively applied.

Stay Optimistic

"There is really strong empirical evidence that people are far too optimistic about project risks, always coming in on the upside and never the downside. We need to accommodate these in future because history says, if you don't allow for that level of uncertainty, you will come to regret it. "Part of the reason we employ our project managers is for their optimism; we want them to believe they can overcome the obstacles that will continually present themselves, and we want them to keep that. But we have to allow for the fact that we encounter some really unusual and challenging things and, therefore, model these into our estimates."

He adds: "This is about de-risking rail by developing projects properly, and being disciplined about where we declare price and scheme duration because it is very tempting to commit too early on those things. We've also got to hold ourselves open to challenge internally so that we can be really confident that the price we give the customer is one we can deliver."

Having tighter control on project cost and duration not only benefits IP's internal route-based customers and its bottom line, but also every one of its external stakeholders including train operators and passengers.

Some of the greatest strides towards operating like a commercial business have been made in this area, by giving greater recognition to the needs and expectations of the railway's end users.

Chandarana, with his IP executive colleagues, have therefore placed a firm emphasis on reducing unscheduled project over-runs, which feedback confirms is the greatest cause of passenger dissatisfaction. But this is a world where the overall amount of access in being reduced.

"What is NR here to do? It isn't here to close the railway all the time and run projects, it's to transport goods and people so there is a real drive to reduce the amount of time we have access to the railway, especially from over-runs.

"We've halved that delay from overruns from something like 100,000 minutes a year to 50,000 minutes, but that's still a very large number. We can't afford to be too self-congratulatory about it and we must continue to drive to make it better.

"Capital projects will not always go to plan, and we'd be naïve to think otherwise, but the question is what do you do about it? Passengers can be quite understanding about that sort of thing, but when we leave them in the lurch it's a real issue and we can overcome that through better planning, and having more robust contingency plans agreed with industry."

More work - less time

Reducing access has not come without its challenges, however, and IP must balance the desire to cause less disruption to passengers with the effective delivery of projects. It is a simple equation that to complete the same amount of work in a shorter timeframe requires greater resource. Meanwhile other efficiencies can be lost by the need to mobilise and demobilise that resource more frequently.

But Chandarana is optimistic this balance is being struck, and adds: "The flip side [of having less access] from a project delivery perspective is that it's not always very efficient when projects have to take a bit longer than they used to.

"Sometimes we probably need to be a bit clearer about that trade off because people see access and efficiency of renewals and enhancements quite separately. We think we've made the right call for our customers, but our funders might not consider that balance as always representing the best value for money."

Looking ahead, IP's next challenge is a new era of contestability that is about to dawn. Surviving external competition has long been one of the truest hallmarks of a successful commercial enterprise. Chandarana welcomes the opportunity it will bring to inspire innovation, and to induce IP and its supply chain to reduce the cost of enhancements and renewals further.

Published on July 31, the Hansford Review considered ways that NR can be opened up to external competition, by enabling third parties to fund and deliver projects without compromising safety or passenger satisfaction.

Third Party Opportunities

Network Rail responded swiftly to the review by outlining its next steps, which include providing third parties with a single point of contact to liaise with NR's internal departments, and regularly publishing a list of third party opportunities.

NR will also clarify how the commercial risk of operating on the railways can be best shared, with third parties potentially excluded from bearing certain risks entirely where NR is considered best placed to mitigate them.

Chandarana sees this increased level of contestability as a natural and welcome progression of existing programmes of work such as Digital Railway and East West Rail. Digital Railway will include a reward-sharing scheme where the cost savings delivered by innovative new digital technologies will be split between Network Rail and the third party, as a way to incentivise more innovation from the supply chain.

Meanwhile, East West Rail Chairman and NR non-executive director Rob Brighouse has written a report for the Secretary of State for Transport that is expected to pave the way for the construction of a new railway between Oxford and Cambridge. It is likely to be designed, built and then operated by the private sector, entirely independently of NR.

Chandarana concludes: "Although all the work we deliver undergoes a rigorous tender process, we haven't had to compete for the work we do before, so it is quite difficult for us to compare ourselves to anyone. I believe we can compete and even if we can't, it's a win for the taxpayer because it will sharpen our focus. We can do all the benchmarking studies we like, but we've now got actual competition to prove it one way or the other.

"The key area now is risk. Most construction contractors' net margins are around 2%, which is wafer thin, and if you look at the risk of handing back the railway late and the impact that could have on penalty payments to Train Operating Companies (TOCs), you're talking about wiping out a large chunk of that annual profit.

"We need to think about what level of risk the market can take for us to properly encourage competition, but we're beginning to see some green shoots such as Digital Railway and East West Rail. Commercial businesses are very good at understanding risk, so I'm very positive about that and finding the solutions we need." ■

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