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Welcome



The UK rail sector is facing a number of major challenges after a tumultuous year: falling performance; poor customer satisfaction; a network at capacity; and ongoing difficulties in delivering enhancements while maintaining current operations. There are calls from some quarters for 'nationalisation' and the Secretary of State has commissioned a comprehensive review of franchising in particular and the industry in general.

Amey has a unique perspective of the industry - as a consultant, as an engineering contractor, and more recently as an operator of services. We believe a great deal has been achieved over the past 25 years (not least a doubling in passenger numbers and record levels of safety) but that further, significant

change is now required.

One such change is the closer integration of train operations with infrastructure management, in order that a 'whole systems' approach can be better adopted to some of the challenges. Such integration has the potential to generate major operational efficiencies and passenger benefits.

We also support current moves to devolution of management and operational responsibilities, and would further suggest that such devolution should also support closer integration of regional social and economic policies with transport sector goals.

This supplement explores some of these issues and, we hope, contributes to the current debate within the industry.

NICOLA HINDLE
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CONTENTS

4 Track and train
 Why AMEY supports greater integration.

8 Bridge strikes
 Transreport's Internet of Things technology.

12 Data into action
 Intelligent rail solutions from SIEMENS.

14 Rail adhesion
 3SQUARED's innovative answer to 'leaves on the line'.

16 Platform for change
 Introducing the Arrakis smart communication suite.

18 Future focus
 BCRRE's thought leadership and technological prowess.

20 Sleeping giant
 How SMEs hold the key to unlocking the Rail Sector Deal.

22 Tomorrow's world
 SYSTRA's guide to enhancing the passenger experience.

BRINGING TRACK AND TRAIN CLOSER TOGETHER

On October 14 2018, a KeolisAmey joint venture took over the running of the Wales & Borders franchise in a deal that will run until 2033.

In addition to bringing much-needed investment, extra services and new rolling stock to this part of the network, the management and operational arrangements of the franchise herald a swift departure from the previous model.

That is because responsibility for the procurement and management of the current franchise has now been passed from Whitehall to the Welsh Government.

Meanwhile, TfW is due to assume control of heavy rail infrastructure on the Valleys Lines from Network Rail in support of its plans for a £1 billion South Wales Metro, which will include a fleet of new tram-trains and at least five new stations in a network of routes, both on and off-street, and centring on Cardiff Central.

Transport for Wales Rail Services has also

Amey's Consulting and Rail Development Director MARK BROWN tells RAIL why greater devolution and the closer integration of train and infrastructure operations should form the basis of future franchising

taken on infrastructure management on some 124 miles of track from NR on behalf of TfW.

The joint venture also helped TfW to develop its Metro plans, and will be responsible for delivering and then operating the new system after its expected completion date in 2022.

KeolisAmey is no stranger to holding the joint role of asset manager and service operator, with the same partnership also taking on the management and operation of both Manchester's Metrolink network (in

July 2017), and the Docklands Light Railway (December 2014).

Meanwhile, Amey has the added advantage of being one of the UK's largest suppliers of rail infrastructure and asset management services in its own right, giving it an almost unique perspective of the benefits and challenges of bringing infrastructure and operational service management together.

Amey Consulting's Development Director Mark Brown explains: "Amey has been an

infrastructure manager for some time, ever since being part of the Tube Lines consortium (with Bechtel) that maintained and upgraded three of London Underground's deep Tube lines (from 2003-2010).

"With DLR, Metrolink and now Wales & Borders, all of our operational experience has been as an integrated operator and asset manager, while we are also a key supplier to Network Rail - which has given us extra insight into running services over a network that is close to capacity."

According to Brown, the key to the successful running of two of the UK's largest light rail networks rests in having joint accountability and joint responsibility for the concessions it operates with Keolis on behalf of Transport for Greater Manchester and Transport for London.

The same applies to the Wales & Borders franchise, although Brown admits it is far too early to draw firm conclusions until the bulk of KeolisAmey's franchise commitments have been delivered.

He describes it as an 'emerging opportunity', however, to demonstrate how heavy rail across the UK can be more responsive to local needs by transferring franchise decision-making closer to the point of delivery.

Wales & Borders will pioneer this fresh approach, with the new franchise model promising to transform the passenger experience throughout the region and, in particular, the Valleys Lines, which passenger satisfaction surveys confirm to be among the poorest scoring lines in Wales.

In addition to delivering South Wales Metro, KeolisAmey's commitments include working in partnership with TfW to spend £800 million on new trains to boost capacity by 65%, with the current fleet in Wales to be replaced by 2023.

By the end of 2023, there will also be a 29% increase in services each weekday across Wales (285 extra), while Sundays will be boosted by 61% with an extra 294 trains.

All 247 stations in the franchise area will be modernised in a £194m scheme; smart ticketing is to be introduced and an extra 600 staff recruited.

Brown adds: "Most of the low hanging fruit has now been taken in terms of boosting efficiency and passenger satisfaction in the



Arriva Trains Wales 150283 pauses at Cardiff Queen Street on September 7 2018 with a Valley Lines service to Barry Island. A KeolisAmey joint venture took over the franchise in October 2018 which, unlike the previous franchise, was awarded by Transport for Wales under its devolved powers. PAUL BIGLAND/RAIL.

current wider structure, but it will not achieve improvements of the order of magnitude we've seen in the last 25 years. Something different is now required to optimise the system as a whole.

"It's still early doors with Wales & Borders so we cannot claim any success yet, but we have worked closely with TfW to develop a solution, and something radical to transform a rundown bit of the network.

"As a whole, all three (KeolisAmey-run) franchises can make a really strong case for bringing asset management and operations closer together and devolving control away from central government. We (and devolved transport authorities) all have a lot at stake, and there are lessons being learned on taking a common approach, of which we are all confident of achieving."

The future of franchising in the UK has been included in the remit of the industry-wide rail review that is currently being led by former British Airways Chief Executive Keith Williams.

Commissioned by Secretary of State for Transport Chris Grayling in September 2018, it has been described as the most significant assessment of Britain's railways since privatisation in the mid-1990s.

A call for evidence was made by Williams in December in order to inform his conclusions on the review's principles, including new commercial models and organisational structures for the provision of services.

The terms of reference of the review also make explicit reference to increasing integration between track and train and exploring options for the devolution of rail powers.

Brown says that he plans to supply evidence before the deadline at the end of May, which is likely to put forward the Wales & Border franchise as a blueprint for an overhauled UK-wide franchising system.

He stresses that the status quo must change, or else the industry risks generating more negative headlines like we saw last May, when infrastructure and train operators jointly failed to properly implement timetable changes on various parts of the network.

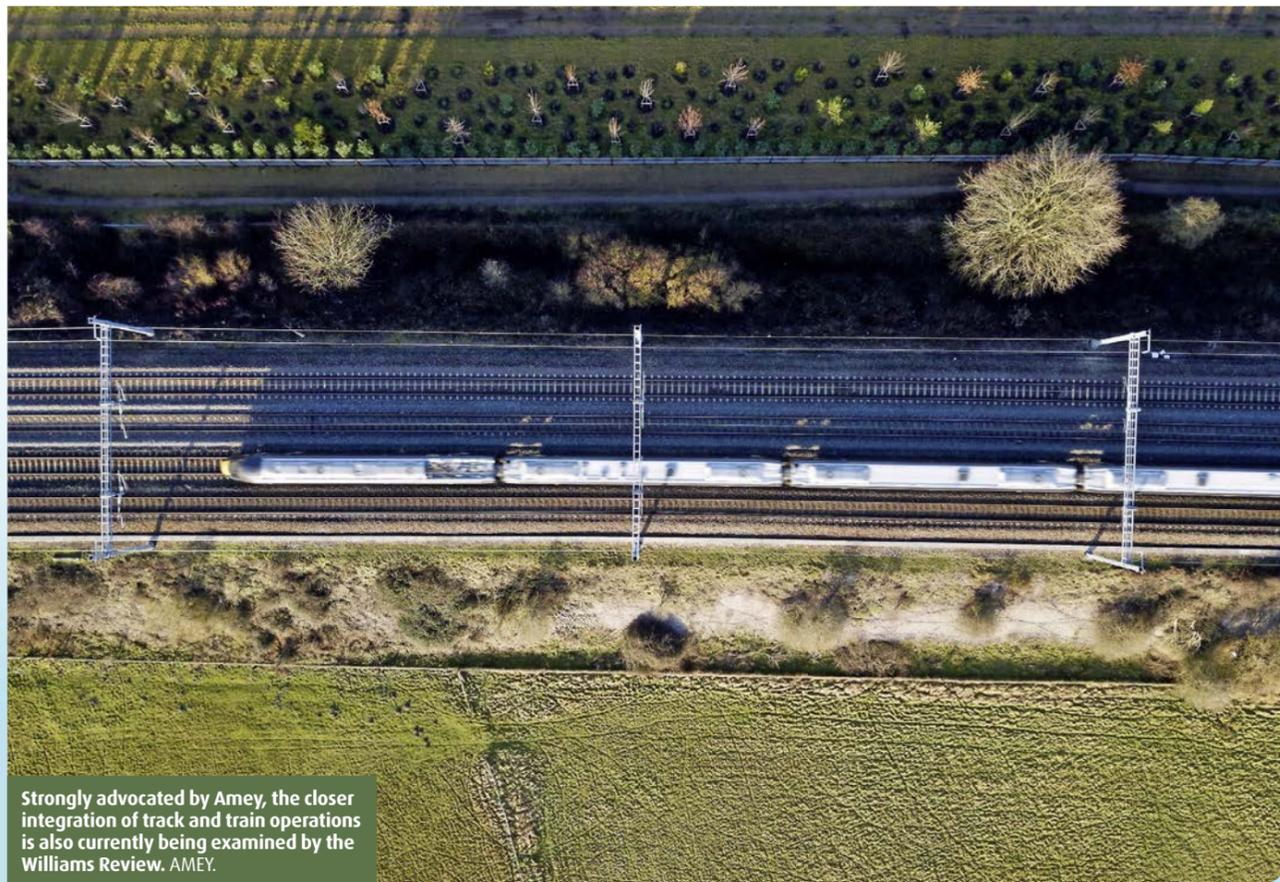
With Wales & Borders, decentralising franchise control away from central government is already prompting a willingness for devolved authorities to work more closely with operational partners such as KeolisAmey to deliver innovation and transformative change in rail services.

"We would encourage the review to look closely at the benefits of devolution and the potential for securing the significant benefits of much closer integration.

"Amey recognises there are risks, but we believe it is the right thing to do and the right way to run an integrated system. Inter-city and multi-regional franchises might need a slightly different strategy, but the case is definitely there for a more integrated approach on the rest of the network with more influential input from devolved authorities.

"The arguments against change and the excuses have been well rehearsed, but without change we will continue to spiral downwards into declining performance and customer satisfaction, which might lead to a lack of investment and a cycle of decline for that reason.

"We need new hope, and I think devolution and integration are two key ingredients to achieving that." ■



Strongly advocated by Amey, the closer integration of track and train operations is also currently being examined by the Williams Review. AMEY.



“The case is definitely there for a more integrated approach... with more influential input from devolved authorities.”

Mark Brown, Development Director, Amey Consulting

THE APPLIANCE OF DATA SCIENCE

IAN GORDON and JON JARRITT of Amey Strategic Consulting, part of the Amey Consulting business, explain how effective data sharing, information and analytics can be used to optimise network resources



Over the past 20 years, significant progress has been made in understanding how the physical assets that make up our transport infrastructure behave over their lifecycles, and how infrastructure managers like Network Rail can get the most from them.

Clearly, having improved engineering knowledge is useful from an asset management and whole-life-cost point of view, but that hasn't always translated into tangible benefits for transport operators and the travelling public.

Amey Strategic Consulting aims to provide a bridge between these two distinct worlds of asset management and operations, by using its expertise in physical assets, deep asset management capability, advanced data science and analytics.

This, it argues, will help its clients to offer

more reliable services and best value for money at a time of constrained capacity and - for rail at least - a rise in demand for services of more than 100% in the last two decades.

"A huge amount has been done in building up asset management knowledge, from a theoretical standpoint," says Jonathan Jarritt, a partner at Amey Strategic Consulting. "This is all crucial in setting strategic goals over the long term, but over the last two years our work has taken us into the operational field where we have not previously seen it being applied."

This has been demonstrated in highways, where Amey Strategic Consulting has worked with a number of tech start-ups and research bodies to look at how readily recorded data relating to traffic flows can be used to deliver shorter travel times and a safer system.

Meanwhile, understanding how the assets themselves deliver safe, reliable and modally

integrated journeys will become increasingly relevant as connected autonomous vehicles begin appearing on our roads.

In rail, the company has spent almost two years adopting this end-to-end approach with Network Rail's South East route in order to develop a deep and data-driven understanding of how conflicting and congested timetables interact with one another.

Connecting London with Kent, Surrey, Sussex and the continent, the South East route is NR's busiest and most congested in the country, with around 5,000 trains running each day over 2,000 miles of track.

By taking a fresh and holistic view of asset management, operational management, train and station operation, and organisational processes and business cultures across the route, Amey Strategic Consulting began to piece together how data that was already being

Southern 377609 and 377701 pass Norwood Junction on January 22 with the 1050 Caterham-London Bridge. Using its asset data and operational expertise, Amey Strategic Consulting worked with Network Rail on a two-year project to improve performance right across the South East route. ALEX DASI-SUTTON.

how trains were actually performing against those metrics, and in which areas time was frequently being lost.

By taking live train movement data and presenting it in a meaningful way to staff at all levels, Amey Strategic Consulting was able to provide the Network Rail Route team and staff employed by its primary train operating customers (Thameslink Govia Railway and Southeastern) with a more tangible understanding of their performance against their individual responsibilities, and also help them identify where there was room for improvement - for example, more closely matching staffing levels with demand at different times of the day.

Jarritt explains: "We worked with NR on a busy part of the network that has lots of performance issues, to try and unpick them. NR already had the ability to monitor every single train, but as an industry we'd never tried to draw that into one place and then ask what it meant in terms of our strategic planning assumptions.

"With the number of people now using the railway and the sheer lack of capacity that now hampers it, we are being asked to solve problems at a level of complexity that never used to exist. It's a huge challenge which requires a new approach, but we believe in using data science and analytics to turn that into action as one of the key vectors to meet this challenge.

"We've found that once you have discovered patterns then you can try and solve the problem - we don't see many other people in the industry thinking like that and talking about both infrastructure and operations together, in a fragmented industry that has lots of contractual boundaries and is a difficult space to change."

With that project now at an end, Amey Strategic Consulting has helped NR to employ its own data analysis staff while working with senior management to develop this new capability, and to further integrate it within the complex structure of the rail industry in order to continue to drive for further performance improvements.

According to Amey Strategic Consulting Project Director Ian Gordon, the changes made within NR and its TOC-customers are



"We're deeply embedded in a big and difficult contract, but we want to tackle the hardest problems as they are also the opportunities for making the biggest change."

Jon Jarritt, Partner, Amey Strategic Consulting

as much cultural as they are technical, by making individuals at all levels understand how they can utilise the information provided to them to establish their own performance, contribute to the bigger picture and deliver better outcomes for passengers.

He says: "It's one thing to make data accessible to people in an organisation, such as regression models, which you can then turn into a dashboard, but it usually only goes to executive staff.

"In order to change something as fundamental as the timetable you have to provide that information to people who might not even have an internet-connected device, so you can make them understand how they contribute to the running of the wider system and therefore make a difference."

Jarritt adds: "In the South East there were three different operators which didn't quite fit together and, even with very skilled data analysts, it took a long time to analyse anything.

"It's not realistic to say that artificial intelligence and data will be the silver bullets to solving everything, but we have shown that you can educate people in more effective ways to act, and that the network requires support from lots of different people."

Following the commencement of the Wales & Borders franchise last October by a KeolisAmey joint venture, Amey Strategic Consulting now finds itself consulting internally with other parts of the Amey Group to help support the delivery of the contract.

Combining the asset and operational spaces has particular relevance to this franchise, which requires KeolisAmey to not only operate main line services throughout Wales, but to maintain infrastructure on the Valleys Lines that has recently been transferred from NR to devolved transport authority Transport for Wales.

With services running close to capacity and ageing infrastructure and rolling stock in urgent need of investment, KeolisAmey is charged with improving performance in the short term while plans are developed for the construction of a £5 billion South Wales Metro, due to open in 2023.

But despite the scale of the challenge, Jarritt is confident that the holistic, data-driven approach honed on NR's South East route can be deployed throughout Wales to transform the passenger experience.

"Wales is a different beast (to the South East) really and we're still at an early stage, but we and Transport for Wales are learning and supporting an asset management piece in Cardiff and elsewhere in Wales.

"We're deeply embedded in a big and difficult contract, but we've spent a long time getting ready for it and we want to tackle the hardest problems as they are also the opportunities for making the biggest change.

"There's a lot to do there and we are confident that we can make a big difference, which is good for Wales but also Amey as a whole, because we are willing to hold ourselves to account, as well as providing consultancy externally." ■

HEADROOM FOR IMPROVEMENT

PAUL STEPHEN looks at how Internet of Things (IoT) technology is being used to create a potential solution to the infuriating problem of bridge strikes by tall road vehicles

On January 15, Network Rail reported that both it and Leicestershire County Council had been forced to close Kettering Road in Market Harborough after a bridge carrying the Midland Main Line was struck by a lorry.

With approximately 2,000 such 'bridge strikes' recorded across the network each year (at an average rate of more than five a day), this unfortunate incidence of driver negligence is an all-too-familiar tale of woe.

But what made events in Market Harborough all the more remarkable is that engineers had completed repairs to brickwork only minutes earlier, following a separate lorry collision the previous night.

Both incidents had occurred despite the presence of large fluorescent markings and signs clearly indicating the height restriction ahead, and regardless of the HGV drivers' legal responsibility to know the heights of the vehicles involved.

Each bridge strike delays freight and passenger trains by two hours while checks are carried out. The average cost to NR is estimated at around £13,000 (about £13 million a year) to carry out repairs and to compensate train operating companies.

The true annual cost to the economy of bridge strikes is much harder to quantify, but has been estimated to be up to £23m

once the value of undelivered goods and lost productivity to rail and road users from train delays and congestion are taken into account.

NR is able to claw back about half its annual outlay in insurance claims from the guilty parties, but is powerless to seek redress if a strike goes unreported by the driver.

Perhaps more worryingly, the obvious and immediate safety risk posed to members of the public and both rail and road users from bridge strikes cannot be combated unless further preventative action is taken.

NR stresses that it is taking the issue of bridge strikes increasingly seriously, and in October 2017 it launched a new campaign to coincide with a statistical peak that occurs in the winter months as road deliveries increase in the run-up to Christmas, and the nights draw in.

A national advertising campaign was launched in printed and social media, with eye-catching straplines such as 'Lorries can't limbo' and 'What the truck' to make drivers of HGVs and large vehicles more aware of the size of their vehicles.

It followed extensive research that revealed that 43% of lorry drivers do not know the exact height of their vehicle, and that more than half do not consider railway bridges at all when planning their routes.

Further stages of NR's campaign involved



A lorry driver squeezes under a bridge in Adlington (Cheshire) on September 30 2016. Almost all of the 2,000 or so annual bridge strikes on the rail network are caused by driving without due care and attention. ALAMY.

heavy engagement with some of the UK's largest hauliers (including Wincanton and Eddie Stobart), bus operators and trade bodies such as the Road Haulage Association, to ensure that relevant training and support to drivers is made a higher priority.

The campaign was then re-launched last August with drivers encouraged to 'wise up and size up' and to use newly compiled information and resources, provided for free on the NR website to support driver training, and help spread the message.

Speaking to RAIL in December 2017 (RAIL 842), NR's senior engineer and London North Western route bridge strike champion Mark Wheel said the campaign would also be accompanied by a call for much stricter enforcement of penalties for drivers when strikes happen, in order to create a more effective deterrent.

He said: "Historically, there has been a reluctance to prosecute drivers for careless driving and their failure to comply with

road traffic signs. We're not quite sure why, but we're working very closely with police, the Home Office and Driver and Vehicle Standards Agency and traffic commissioners to toughen up on enforcement.

"There is no panacea for bridge strike prevention, but it's about achieving incremental changes in behaviour which will build up over time. This campaign is not a one-hit wonder, and it will now feature in our national campaign schedule alongside the regular work we do to tackle trespass during the school holidays and suicide prevention.

"Promoting bridge strike prevention can be summed up very easily by the 'Four Es' - Education, Engineering, Enablement and Enforcement - and that is exactly what we'll do."

Also accompanying the campaign are NR's more longstanding efforts to identify

“Promoting bridge strike prevention can be summed up very easily by the ‘Four Es’ - Education, Engineering, Enablement and Enforcement.”

Mark Wheel, Senior Engineer and Route Bridge Strike Champion, London North Western

high-frequency sites where it can increase headroom or install steel beams to limit damage to infrastructure.

Better still, bridges such as the notorious Stuntney Road underpass in Ely have now been taken out of use completely following the opening of Cambridgeshire city's new Southern Bypass on October 21 2018.

The bridge was officially the most struck bridge in the country, having been hit an

incredible 32 times in the 12-month period preceding its closure to tall road vehicles.

NR has also pledged to encourage the development and trial of new and emerging technologies, such as in-cab low bridge warning devices, and even active brake assist systems that can automatically stop a vehicle without any intervention from the driver.

Route planning tools are also high on NR's agenda in response to an illuminating report published by standards body RSSB in 2012 into the causes of strikes.

Entitled *Reducing the number and impact of vehicle strikes on railway underline bridges*, the report's author Michael Woods found that part of the problem was drivers using cheap satnav devices, instead of specialist systems designed for lorries that can hold data on bridge heights to automatically route HGV drivers away from them.

NR has even supplied detailed information about its bridges to satnav manufacturers to make these systems more accurate, and →

TOP 10 BRIDGE STRIKE LOCATIONS (APRIL 2009-DECEMBER 2017)

Bridge name	Location	Reported strikes	Route
Stuntney Road	Ely	113	Anglia
Kenworthy Road	Homerton	99	Anglia
Thurlow Park Road	Tulse Hill	92	South East
Barrowby Road	Grantham	90	LNE
Abbey Farm	Thetford	87	Anglia
St John's Street	Lichfield	86	LNW
New Smithy	Chinley	85	LNE
St Mildreds Road	Hither Green	85	South East
Lower Downs Road	Wimbledon	77	Wessex
Harlaxton Road	Grantham	76	LNE

Source: NETWORK RAIL

→ yet hauliers are still opting for cheaper versions or the free services now offered by Google Maps.

Another person to spot this trend was MTR Crossrail Duty Head of Control Allison Dunn, who turned to tech company founder Jay Shen to ask if his company Transreport could develop a technological solution to fill this void.

Dunn had worked with Transreport in her previous role as Senior Information & Customer Experience Manager at South Western Railway, before she left for MTR in May 2018.

SWR had been one of four operators to test the Transreport-developed Passenger Assist app (that helps disabled passengers to navigate the railway) prior to its national roll-out in partnership with the Rail Delivery Group later this year.

Transreport is a small company of just 20 staff based in Hammersmith, but with an expanding global presence at offices in Beijing,

“Our solution would cost no more than £500,000 to put on every bridge, which is very cheap compared to the cost of disruption from bridge strikes.”

Jay Shen, Transreport

Hong Kong and (very soon) Australia.

Founded by Shen in September 2016, it started life in his home garage in Coventry while he completed his PhD in Engineering, IoT and Sensor Technology at the University of Warwick.

Shen describes Transreport as a ‘passenger-centric tech company, specialising in IoT and

Blockchain technology with a focus on the transport sector’, which is backed by largely Chinese investors.

With expertise in software programming, data science, engineering, architecture and finance, Shen and his team now believe they have created the perfect system to link NR’s bridge data into Google mapping, while providing a free app to hauliers to enable route planning.

The app provides access to information, such as locations of low bridges across the UK, and an application for drivers to plan risk-reduced routes by inputting vehicle measurements.

The platform is also multi-lingual to cater for foreign drivers who may have trouble reading signs and other information in English, or who struggle to understand imperial units of measurement.

The app alerts the driver when the vehicle is approaching a low bridge, and provides

them with real time navigation updates.

Shen says: “Allison and I used to work together at SWR and had kept in touch. She told me about the big problem the rail industry was still having with bridge strikes, and that this could be a really interesting project for us to work on.

“We did our research and read the reports and found it strange that nothing much had been done, despite strikes costing NR £13m a year. Allison and I both thought that with the technology we have, it wouldn’t be hard to come up with a workable solution that we could demonstrate to NR.”

Transreport’s solution relies on small matchbox-sized devices being attached to bridges that provide GPS data on their locations. But that’s not all they can do, with

BRIDGE STRIKES: KEY NUMBERS

£12.7m per annum paid to TOCs in compensation

Five strikes per day

1,800 strikes per year

132 minutes average delay per strike

162,348 minutes annual delay

32% of drivers unaware of their vehicle measurements

the devices also acting as vibration sensors that could instantly alert NR if a bridge is struck, helping combat the problems of unreported or delayed reporting of strikes.

The sensors can do this by utilising an IoT gateway that connects them to the cloud so that data is securely logged and alerts are

immediately sent to NR, drivers and insurers once a sensor detects conditions that exceed a predetermined threshold.

Crucially, the system also appears to be highly cost-effective, with Shen estimating that NR would need to find just £100,000 to fund its development and an initial trial, followed by a further £400,000 to roll it out across its entire network.

“We have software and hardware working together, and the technology is now very mature with a sensor costing just £200, but very accurate and easy to maintain, and with a battery life of up to 12 years,” he adds. “Previously it probably didn’t make much sense, economically, to install technology on bridges, but our solution would cost no more than £500,000 to put on every bridge, which is very cheap compared to the cost of disruption from bridge strikes.”

The next step is for NR to designate a test bridge, for which Dunn and Shen are still in negotiations. Installation would be non-disruptive, with no need for possessions to attach the small sensors.

“We would need to put four sensors on a medium-sized bridge so that we can start to gather vibration data and then set parameters to distinguish between trains passing overhead and actual bridge strikes. A one-month trial would be more than enough for us.”

Looking ahead, Shen believes this is not only a good opportunity to eradicate a seemingly persistent problem but to also send a strong signal of support to the UK’s fast-growing community of fledgeling start-up tech firms.

After all, NR’s procurement strategy for Control Period 6 (April 2019–March 2024) contains bold commitments to provide more support for UK-based SMEs, and to further develop the nation’s home-grown skills base.

“The industry doesn’t have a good image in terms of delays so if you look at this holistically, as a matter of customer satisfaction, then it makes total sense to do this. Also, how often can NR say they are supporting a new tech start-up which is looking at an innovative solution?”

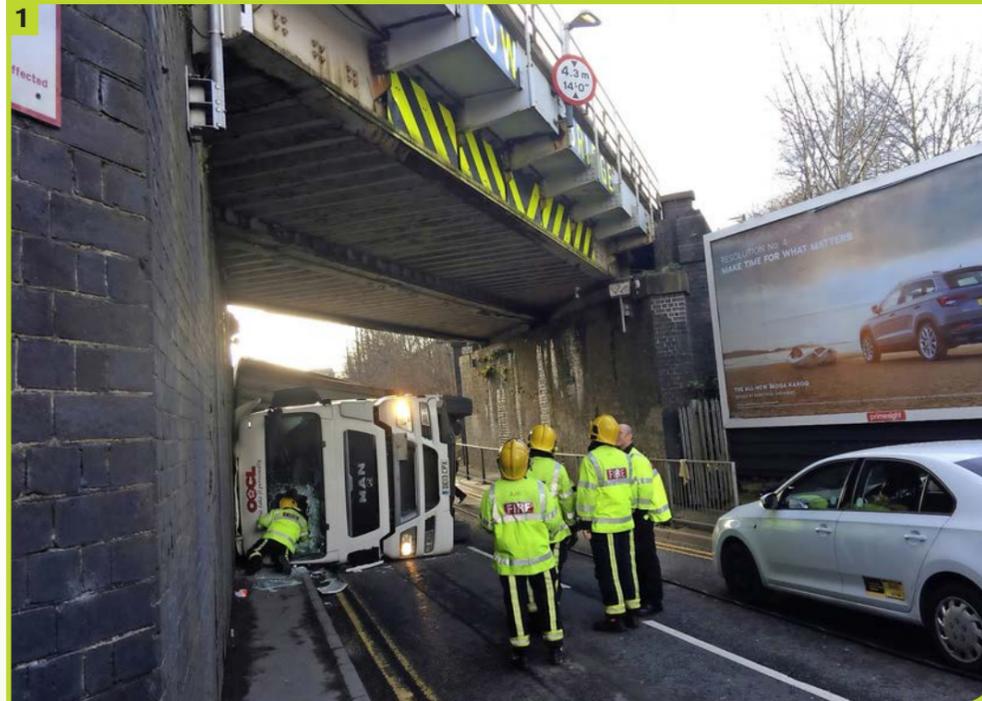
“I hope this gives confidence to other start-ups, because if NR is prepared to give us this chance, then we can give them a new perspective. If you want to solve a problem this old then you probably want to talk to an outside company, and I hope we can be the inspiration to solve one or two of these problems.”

Should Shen and Transreport make the mark they desire, then perhaps it won’t just be the people of Market Harborough who’ll want to thank him. ■

FURTHER READING

Bridge strikes: NR strikes back – RAIL 842
Five bridge strikes every day – RAIL 865
Bridges: it’s time for action – RAIL 867
Open Access: RAIL readers have their say – pages 64–67.

1. A lorry overturned after striking this bridge in Summer Road, Erdington (Birmingham) on January 31 2018. Services between Birmingham New Street and Lichfield were temporarily halted, although fortunately no structural damage was caused. WEST MIDLANDS FIRE SERVICE.



2. Significant track damage is clearly apparent following a bridge strike at Castleton Moor (North Yorkshire) on March 12 2018, causing train services to be suspended between Battersby and Whitby. NETWORK RAIL.

3. Denby Dale Road in Wakefield was closed for several hours on November 14 2016 after a lorry became wedged beneath the Double Two bridge in Thornes. NETWORK RAIL.

4. Barrowby Road bridge in Grantham is officially one of the top ten most struck bridges on Britain’s rail network. ALAMY.

5. Fire crews from Brixton, West Norwood, Peckham, Battersea and Croydon attended a bridge strike on Hinton Road, Brixton, in December 2018 in order to remove the driver, who suffered minor injuries. NETWORK RAIL.



TURNING DATA INTO ACTION



Siemens' HS2 Bid Manager KEVIN CLARK tells RAIL what benefits intelligent rail solutions are yielding for passengers and the wider industry

Throughout the last 200 years locomotive propulsion technology has proved to be a hotbed of innovation. Ever since the creation of the world's first full-scale railway steam locomotive by British mining engineer Richard Trevithick in 1804, main line trains have become increasingly faster, energy-efficient and more powerful as the steam age eventually gave way to dieselisation, followed by the spread of today's global network of modern electrified high-speed lines. More recently, the most significant advances in rolling stock have come in the implementation of intelligent software-based innovations, as the rail industry continues to

embrace modern digital technology and the improved connectivity it can offer. Siemens has been at the forefront of this transition, as exemplified by its National Rail Award-winning fleet of Class 700s, currently operated by Govia Thameslink Railway as part of the government-sponsored Thameslink Programme. As part of Siemens' Desiro City platform,



“Our Railigent platform allows us to look at lots of different systems and contextual data at the same time.”

Kevin Clark, HS2 Service Bid Manager, Siemens

a total of 1,140 vehicles have been built at the company's Krefeld manufacturing plant in Germany since 2013. The '700s' are fully digitally enabled, becoming the first main line trains in the world to operate using both Automatic Train Operation (ATO) and ETCS (level 2) in-cab signalling throughout the central Thameslink network.

Meanwhile, the train's intelligent software design provides fully automatic climate control and a passenger information system that displays real-time main line and London Underground travel information, plus individual carriage loadings.

Diagnostic data is also constantly gathered and then transmitted from the train to Siemens' service centre, enabling preventative action to be taken if required – and a new regime of predictive maintenance to operate at Thameslink's two depots at Three Bridges and Hornsey. “To me, intelligent rail is really all about turning data into action,” explains Kevin Clark, HS2 Service Bid Manager.

Siemens uses data from the fully digital-enabled Class 700 fleet to improve passenger experience. Govia Thameslink Railway 700005 approaches Blackfriars on November 30 2016. JACK BOSKETT/RAIL.

“We already have lots of data and more and more of it is being generated with every evolution of the train, so the crucial point is in our ability to bring that disparate information together into a single environment so that more informed decisions can be made and appropriate action taken.

“If we think about the last 20 to 30 years, components and systems on trains have become more intelligent but have largely been limited to talking to neighbouring equipment. We can now bring that all together in order to help clients make the right decisions, and to get whole-life value from their assets.”

According to Clark, the benefits to operators of procuring 'smart' trains like the Class 700 are manifold in terms of increasing fleet reliability and availability, while also reducing the cost of ownership.

For example, diagnostic data recorded and transmitted by GTR's fleet of Class 700s has enabled Siemens technicians to increasingly operate in a paperless environment at the depots, where they are equipped with handheld devices rather than the toolkits of old.

This facility allows them to view relevant performance data, technical information, and view 3D task instructions to quickly identify and remedy any reported faults.

With more than 20 million miles of service accrued since the first train entered service in June 2016, the Class 700 fleet is progressing through its reliability growth phase, already delivering improved reliability over its predecessor with ambitions to take this much further.

In order to achieve this, faults and items for improvement are logged and then stored in a database if they have occurred before. They then enter a 'performance pipeline' in which remedial action is taken either through hardware or software modification.

Clark adds: “This means that the train is in service more because we know when to perform maintenance by getting the right information at the right time. The success of trains like the '700' is underpinned by having lots of systems working together, so we have more information on which to base our decisions.

“The whole-life cost is a major output from intelligent rail, so the better the performance and reliability the more the cost of ownership is reduced.”

To help manage and understand big data, Siemens also offers clients access to its Railigent cloud-based mobile application suite. Powered by Siemens' cloud-based Internet of Things operating system MindSphere, Railigent can integrate with various applications and automated measurements which are then analysed and interpreted through a simplified dashboard.

Clark explains: “Our Railigent

platform allows us to look at lots of different systems and contextual data at the same time. For example, in the event of an operational incident occurring when passengers are boarding, we can look in real-time at CCTV footage and door motor currents rates in one place.

“That would have previously been done by looking at CCTV footage, GPS and brake data in isolation, so incident investigation now becomes far simpler and quicker. It all reinforces how the interconnectivity of all things is beginning to happen with a much wider overall benefit.”

Looking ahead, Clark believes that the operational and passenger benefits on offer from intelligent rail solutions will be of particular importance to flagship and technically demanding projects such as HS2.

Five bidders, including Siemens, have been shortlisted by HS2 Ltd to supply at least 54 train sets for Phase 1 of the line between London and Birmingham, which is scheduled to open in 2026.

A design, maintenance and manufacturing contract is to be awarded in spring 2020, with an estimated value of £2.75 billion.

The technical specification issued by HS2 Ltd requires the successful bidder to deliver some of the world's most advanced rolling stock, which can travel at speeds of up to 360kph (250mph).

Clark says that not only will passenger expectations of the new rolling stock be high, but journeys will be required by HS2 Ltd to be seamless, accessible, fast and reliable.

He concludes: “One of the key benefits of intelligent rail is that we as an industry can focus not only on service and operational reliability, but also on how passenger-facing systems are working. We can configure reports on cabin temperatures on Class 700s, for example, and compare that with performance data on the air conditioning system to see if that linkage triggers a set maintenance intervention, such as a fan replacement.

“Intelligent rail also enables dwell time analysis using CCTV-gathered information. The hardware of the train is only designed once, so we can design it to achieve targets in the first instance and then use the data available to refine that and then do what is needed to optimise passenger flows.

“The Phase 2 indicative train service specification is for up to 17 trains per hour to leave Euston. They will travel at 360kph, which is pushing the boundaries of what we've delivered before as an industry to date.

“You can design for that level of frequency but you also need to monitor how that is working and must be able to respond to that if high levels of performance are to be delivered.” ■

FURTHER READING

Velaro Novo focuses on efficiency – RAIL 858
Data mining for tomorrow's railway – RAIL 840
Dawn of the smart train – RAIL 863
A vision of the railway of tomorrow – RAIL 848

IMPROVING RAIL ADHESION

3Squared has taken an innovative approach to mitigating the perennial problem of 'leaves on the line'

Each and every autumn the rail industry resumes its annual battle with leaves on the line.

According to Network Rail, approximately 500,000 leaves fall onto its metals each year, where they can then be compressed by passing trains into a smooth, slippery layer.

The low adhesion that results from this problem means that trains need more time to stop and start in order to avoid wheelspin and overshooting platforms or signals – in much the same way that a car can be affected by black ice.

What's more, by interrupting the connection between track and train wheel, fallen leaves cause the electrical track circuits needed for signalling systems to become less accurate.

Aside from the obvious safety risk to passengers, leaf fall results in more than a million minutes of delay per annum. Reduced timetables are often required and trains are sometimes taken out of service at short notice if they incur wheel flats - all significant extra costs to operators.

There are a number of ways to partially mitigate the impact of leaf fall, however, with

NR employing a comprehensive year-round vegetation management programme.

Meanwhile, from early October to early December, a fleet of over 50 specialist railhead treatment trains are deployed on affected routes to blast away the fallen vegetation with water jets, and then apply a sand-based gel to further improve wheel grip.

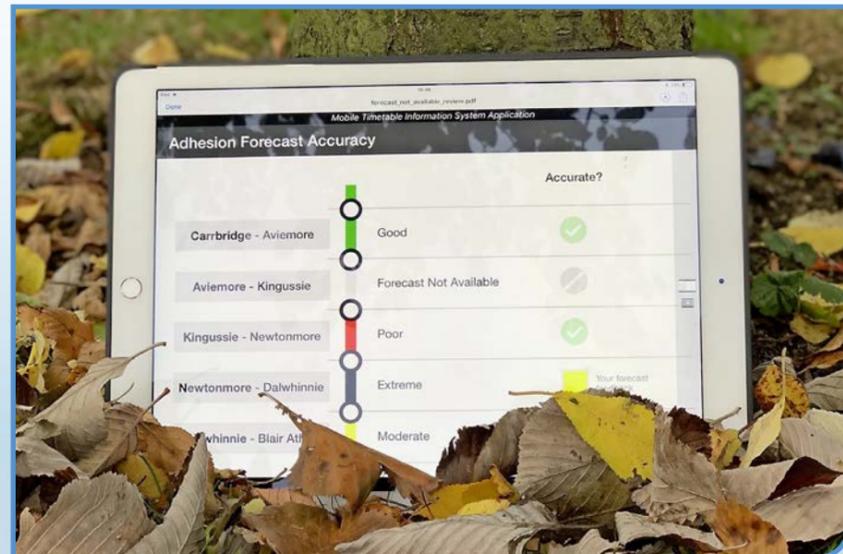
Although it is the effects of leaf fall that gains the most attention from both the media and wider travelling public, it isn't just in the autumn that low adhesion can occur, and it is often forgotten that railhead contamination can occur at any time of year from rust and grease. Snow and ice can also decrease adhesion levels in periods of low temperature, as can light drizzle after a long, dry period, or even morning dew.

In response to this adhesion challenge, award-winning technology consultancy 3Squared has stepped forward to develop an innovative digital solution, in conjunction with the Met Office and Colas.

The consortium's ADS (Adhesion Digital Solution) works by managing, coordinating and then disseminating real-time adhesion information.



GB Railfreight 73109 and 73119 top-and-tail the Tonbridge West Yard circular railhead treatment train (RHTT) as it nears Redhill on October 1 2018. The ADS project, led by 3Squared, is expected to complement existing ways of tackling low rail-adhesion, including Network Rail's vegetation clearance and RHTT programmes. JOHN RUDD.



Announced on November 19 2018, the ADS project was one of four projects to win funding through the RSSB's TOC17 innovation competition. 3SQUARED.

Data from the Met Office's existing low-adhesion forecasting model is combined by ADS with crowdsourced driver-reported data on actual railhead conditions to give operators detailed, up-to-the-minute, route-based adhesion forecasts.

ADS provides this high resolution and route-specific risk data to drivers via an app uploaded to a tablet device mounted in the cab so that informed decisions can then be made on train regulation that helps reduce safety risk and the likelihood of accidents.

Drivers are then able to report wheel slippage through the app, providing a warning to others in real time.

3Squared's Commercial Director James Fox explains: "This collaborative project takes a dramatically different and innovative, data-driven approach to solving a problem that continues to cause significant disruption on the UK network.

"We found that Colas was experiencing some big problems with wheel slip on heavy freight trains on some routes, the Met Office was keen to provide a more accurate forecasting tool, while we had the technological expertise - it was the perfect time to come up with a solution."

The funding to develop ADS from concept to delivery has come through the rail



"This collaborative project takes a dramatically different and innovative, data-driven approach."

James Fox, Commercial Director, 3Squared

standards body RSSB's TOC17 competition to identify projects that will improve operational performance.

3Squared has led the consortium developing ADS by providing project management, software development and systems integration expertise, while the Met Office has supplied its specialist data and Colas has tested the product on some of its services.

Fox adds: "We found that Colas was already being provided with a basic adhesion forecast by Network Rail, but it was vague and not particularly up-to-date or route-specific, so we thought we'd collaborate with the Met Office and the operator to provide a more accurate tool.

"The TOC17 competition was there and was a good fit, and it has really helped accelerate the development of the project. The trial with Colas over the autumn went really well - we've learned some valuable lessons and made further improvements, and now some other operators are keen to roll it out this autumn."

3Squared was in the process of compiling statistical information for RSSB on the exact operational benefits achieved by the trial as this issue of RAIL went to press, but Fox's attention has already moved to several other promising future applications of ADS.

He also points to the strong collaborative nature of the ADS programme, upon which 3Squared has prided itself since its formation in 2002.

It has been the formation of similarly close partnerships with other clients that has underpinned the company's rapid growth from a small two-man digital and creative agency based in Sheffield, to one of the rail sector's leading software solutions providers.

For example, 3Squared's collaboration with Stagecoach-owned train operating companies East Midlands Trains and South West Trains, plus freight operating company GB Railfreight, yielded the first of its flagship RailSmart suite of products in 2014 called RailSmart EDS (employee development system), that earned

3Squared a Queen's Award for Innovation (RAIL 864).

Meanwhile, in addition to ADS, 3Squared is also working closely with RSSB on an innovative software solution that helps improve disabled access to the railway, as part of RSSB's Rail Accessibility Challenge.

Fox concludes: "ADS has huge potential and we have people currently looking at sanders [train-mounted sandboxes that drop sand in front of the driving wheels to increase traction in wet and slippery conditions] where we could potentially link our software to operators' hardware in order to link automatically with these trains.

"There is also the potential to integrate the software with train-mounted cameras so that the Met Office can corroborate the data they currently provide, and subsequently increase the accuracy of its forecasting.

"ADS is still at an early stage of commercialisation, but the product's future looks very bright, and it is yet another example of the 3Squared mantra that we have 'collaboration in our DNA.'" ■

FURTHER READING

Collaboration Period One - RAIL 864

A PLATFORM FOR CHANGE



CrossCountry is using a new smart communications suite developed by Nexus Alpha that promises to transform the provision of information to staff and passengers. ANDREW RODEN explores the potential of Arrakis

These days, virtually any technological innovation – particularly when it comes to software – is heralded as a game-changer.

But a new system developed by Nexus Alpha and being deployed by CrossCountry just may justify the term. Called Arrakis, its bold aim is to transform the way that information is collected and disseminated to railway staff and customers alike.

Nexus Alpha's Tyrell IO control room system is widely used in the railway, and its data on incidents and train running is already used to keep staff informed. However, as CrossCountry Duty Control Manager Matt Reeves tells *RAIL*: "We have a number of products that provide information. The problem is that there's often multiple incidents and, as a result, too much information provided to staff – particularly train crews. At

times, they can't see the wood for the trees."

This is what Arrakis aims to solve. It draws information from across the railway (including Tyrell IO and the Darwin customer information system) and then, crucially, tailors that information to staff's specific needs.

So, while currently a CrossCountry train manager may receive information affecting the operator's entire network, Arrakis enables much greater personalisation of that information.

Using a mobile application, staff can enter details of the trains they are working on a given day, and select what sort of information they wish to be alerted about. This could include information about other operators on the train's route, details of punctuality of connecting trains, problems at stations, and so on. The aim is to provide staff with relevant information and avoid overload, giving them

more time to serve passengers.

Reeves explains: "It isn't just about our own trains – it can alert about other operators' services. That means we can give passengers better information about their journey – if staff have better information, then so do passengers."

Arrakis has long been in development by Nexus Alpha, whose pedigree in the railway information business dates back to the 1990s. And following CrossCountry's Direct Award extension in 2017, the operator's requirement to provide better customer information synchronised neatly with the system's development.

In its initial form it will provide onboard staff with: control room information; enhanced staff live departure boards; cancellation, part-cancellation and significant lateness status; and 'rainbow boards' which provide a

assistance – an area which the Office of Rail and Road is eager for the rail industry to improve.

When a passenger makes a request for travel assistance, Arrakis can allow staff to input the passenger's details and their specific needs, and then disseminate it to station staff. The details are received via an alert, to which staff can respond to accept the assistance request. This is relayed to the passenger, who can be reassured not only that assistance will be available, but that a specific member of staff will be helping them. It can also even be used on multi-leg journeys, so that at every point the passenger knows who will be assisting where.

This is made possible by the targeted nature of Arrakis information, meaning that assistance requests at (for example) East Croydon would only go to staff there, with requests for the end of the journey at London Victoria only being sent to staff at that station.

If providing better information and assisted travel were the limits of Arrakis' capability, it would mark a major step forward, but the potential is greater still. It would be perfectly possible for onboard staff to report incidents on their journey in real-time, with photographs if required, to enable Control Room staff to make more informed decisions.

In the case of a broken window, that ability to report and send images would mean a decision could be taken about whether to take the train out of service at the first opportunity, or to continue to its final destination. Admittedly, staff can do this already and send a message to control, but using Arrakis would mean that subscribers to such information would also automatically be informed.

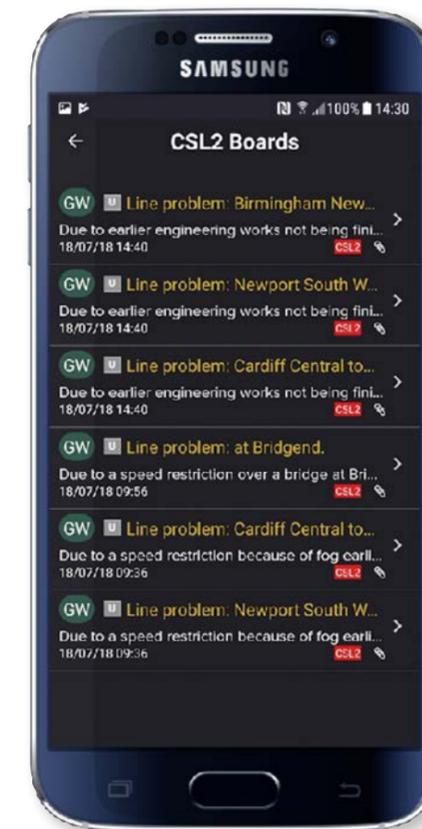
Arrakis can also provide analysis of train running and trends. Again, while some of the data is already in the railway systems, bringing it together makes it possible to identify issues and resolve them much more quickly. (Arrakis holds data associated with 100,000 route incidents already).

Consistently late departures from a station where catering supplies are loaded could be due to the time being taken on that task. But what if, on certain trains, it is simply greater numbers of passengers boarding and alighting? Or what if time is consistently lost on a specific section of track due to train regulation?

By pulling together multiple data sources, Arrakis can highlight potential issues and enable train operators to find a solution. And as more train running and operational data is added to the system, its machine learning algorithms mean it can provide ever more precise insight into operational issues.

Fares data could be added to the system to provide cues about expected heavy loadings at stations, feeding back into timetable planning – or even, potentially, the likes of advance fares to be changed to manage demand. It can even monitor social media feeds such as Twitter to identify customer sentiment and spot trends.

In the future, it is entirely possible that passengers could effectively use a version of the Arrakis interface tailored to their journeys with alerts about connecting trains



An example of the Arrakis app for CrossCountry, which features an instant snapshot of what is happening with neighbouring operators so that XC staff can avoid sending passengers to another operator which is also experiencing severe disruption. NEXUS ALPHA.

and other transport modes, with integration from Traveline and data from bus real-time providers. Its potential is only limited by the data fed into the system. It is this modular approach and flexibility which makes it so powerful.

Naturally, Nexus Alpha believes it has a winner on its hands, but so does CrossCountry. "I think it'll be a game changer," says Reeves. "Providing more information to passengers can only be a good thing."

At a time when the rail industry is under sustained fire for its provision of passenger information, it is hard to argue with his sentiment. Arrakis may just be the tool that the railway, staff and passengers have been wanting for decades. For hard-pressed passengers wondering what is going on at times of disruption, the wider rollout of such a tool cannot come soon enough. ■

ABOUT THE AUTHOR

Andrew Roden, Contributing Writer

Andrew Roden is a railway journalist, author and campaigner based in west Cornwall. A *RAIL* News and Features writer from 2000 to 2004, he is the author of four major railway books, and is a regular commentator on television and radio on rail matters in the South West.



FOCUSED ON THE FUTURE OF RAIL

It's been almost a year since the official launch of the UK Railway Research and Innovation Network (UKRRIN) at the Houses of Parliament on February 20 2018. Designed to create a powerful collaboration between academia and industry, UKRRIN brings together eight universities with 15 industry partners in order to drive innovation and initiate a systems-wide approach to enhancing the railway.

These universities have joined forces and combined their resources to form three Centres of Excellence - in Digital Systems (University of Birmingham), Rolling Stock (University of Huddersfield, Newcastle University and Loughborough University) and Infrastructure (University of Nottingham, University of Southampton, Loughborough University, University of Sheffield and Heriot-Watt University).

Meanwhile, a fourth Centre of Excellence has been created with a focus on Testing, which incorporates facilities at Network Rail's

Birmingham Centre of Railway Research and Education (BCRRE) is now clearly at the forefront of thought-leadership and technological prowess in the railway domain

Rail Innovation & Development Centres (RIDC) at Melton Mowbray (Leicestershire) and Tuxford (Nottinghamshire), and those of other key partners Transport for London and the Quinton Rail Technology Centre.

The four Centres of Excellence are currently benefiting from more than £90 million of investment in developing their research facilities, comprising £28.1m awarded by the Higher Education Funding Council for England and £64m from industry. All sites are due to be completed by 2020.

These world-leading facilities will be open to UKRRIN industry members from the railway supply chain so that research and development



concepts and new technologies can be brought more quickly from the early design stage to full commercialisation.

In turn, university researchers and students will have improved access to industry experts and real-life projects, helping to expand their skill sets and augment their employability.

It is hoped that this link-up will not only boost innovation, productivity and the export strength of the UK rail sector, but also make the industry a more attractive place for the next generation of talent to base their skills.

At the heart of UKRRIN is its lead partner Birmingham Centre of Railway Research and Education (BCRRE), which is also home to the network's Centre of Excellence in Digital Systems (CEDS).

Based at the University of Birmingham and led by Professor Clive Roberts, the CEDS at BCRRE specialises in four focus areas: Future Railway Operations and Control; Data Integration and Cyber Security; Remote Monitoring and Autonomous Systems; and Introducing Innovation.

Other BCRRE research extends across

RAIL INDUSTRY DATA PLATFORM AND DIGITAL TWIN

As part of BCRRE's contribution to the Government's Rail Sector Deal, it is extending existing plans for a Rail Industry Data Platform (initially intended to provide data crucial to R&D activity within the UK Rail Research and Innovation Network) to include the wider rail industry.

BCRRE's Professor Clive Roberts, Dr John Easton and Dr Lei Chen will combine their extensive expertise to ensure that the first full-release version is available from spring 2020.

"Currently it is difficult to understand the wider systems context of industry problems with any degree of confidence,"

says Easton, a lecturer in Computer Systems from the School of Engineering.

"The data platform will mean that rather than having access to just one or two datasets in isolation, we will have a range of data available that will allow us to look at the problem from several different angles."

Alongside the data platform, BCRRE will lead in the design of a cutting-edge Digital Twin, a fully functional digital replica of the railway that is intended to drive innovation by allowing high-level analysis and the ability to see opportunities or problems before they occur in the real world. BCRRE

has long been involved in world-leading simulation research, which in natural partnership with a Digital Twin will help deliver the next generation of railway traffic management and control systems.

Dr Gemma Nicholson, the Research Fellow who is leading this project alongside Professor Roberts, adds: "There is tremendous scope for railway Digital Twin technology. The Digital Twin will be the means to translate raw data into meaningful insight with real business value. It will allow us to take the real-time datasets, and exploit them to make sound decisions in the most appropriate way."

An artist's impression of the new 3,000m² building due to open at the University of Birmingham in spring 2020 to house UKRRIN's Centre of Excellence in Digital Systems. UKRRIN.

electric multiple unit into a hydrogen-powered train, called 'HydroFlex'.

Delegates at UKRRIN's inaugural annual conference, held in central London on November 13, heard from Professor Roberts about CEDS' scheduled opening in mid-2020, and on how procurement has already started for equipment, including train cab simulators, data platforms, 3D visualisation technology, and signalling and communication equipment.

He said: "These will be facilities for all, not just BCRRE. They will help us face a number of grand challenges as an industry in the next few years, including ensuring system-wide cyber security and achieving zero on-site testing for railway equipment."

As part of its UKRRIN membership, a number of new initiatives are also currently under way at BCRRE, including the hosting of a University Innovation Day by Siemens and two Network Rail engineering conferences and two *Digital Railway Delivering Differently* events.

It is also leading the DIGI-RAIL business support and demonstrator programme (see panel) to assist more than 100 small and medium-sized enterprises (SMEs) to exploit the opportunities created by NR's Digital Railway programme. ■

CYBER SECURITY

BCRRE is investigating fundamental questions about the use of electronic information in the transport domain.

Working alongside the security and privacy group from the School of Computer Science, an NCSC Centre of Academic Excellence in the field, BCRRE's security work is focused on the Operational Technology (OT) elements of the railway. Recent project work has included formal analysis of the ERTMS

train to trackside communication protocols, and the development of TRAKS, a post-quantum secure key management scheme for ERTMS.

The team is also part of the Research Institute in Trustworthy Interconnected Cyberphysical Systems (RITICS), led by Imperial College, and in this context has recently started work on an assessment of the implications of the EU NIS directive on the GB rail supply chain.

WORK WITH US

BCRRE recently signed a Memorandum of Understanding with Rail Alliance, which brings its extensive experience of working with SMEs in the rail supply chain to BCRRE.

In addition, BCRRE's existing relationships with top-tier companies means it will be able to offer the supply chain full service solutions across all technology readiness levels. As a rail technology combined capability, this is unmatched. The specialist facilities and departmental skills available within BCRRE will nurture and accelerate innovation, limiting the so-called 'valley of death' phase of product development by de-risking new technology.

Furthermore, the DIGI-RAIL project (part-funded by the European Regional

Development Fund) will help develop a unique Digital Railway demonstrator programme that brings together national and international rail industry buyers with West Midlands businesses.

It will provide research expertise to solve industry challenges and to develop digital products and services for the rail industry. The UK expects an efficient, reliable rail system, and DIGI-RAIL will have a key role in developing new technology for the UK network's transition to a Digital Railway.

The Rail Alliance will provide a strong and respected industry-facing element - in tune with the market, in touch with opportunities, and (importantly) understanding the language of real businesses. It's an exciting combination.

themes including: aerodynamics; weather and climate effects; geotechnical engineering and asset management; infrastructure and structural engineering; computational design; mechatronic and control systems; power electronics and drives; energy and power systems; and international benchmarking.

As the largest university-based centre for railway research and education in Europe, its pioneering research activities and multidisciplinary expertise have earned it an enviable reputation across the world for thought leadership and advanced problem solving.

Formed in the 1970s, BCRRE has now grown to cater for more than 140 people with a major research interest in railway science and technology, including 21 academic staff, 22

post-doctoral researchers, around 90 research students, international visiting researchers and honorary academics, plus 20 non-academic professional staff.

There are also 340 postgraduate students undertaking courses at the centre, and undergraduates enrolled in railway-specific degrees.

Its reputation was further enhanced in November 2017 when BCRRE was awarded a prestigious Queen's Anniversary Prize for Higher Education (2016-18) in recognition of its contribution to making railways around the world safer and more efficient.

It has also gained widespread media attention in recent months for its pioneering development of hydrogen train technology in the UK as a low-emission alternative to diesel traction on non-electrified parts of the network.

Students from BCRRE have already built a 10¼in-gauge prototype locomotive (named *Hydrogen Hero*) and a team from BCRRE is currently working with rolling stock owning company Porterbrook to convert a Class 319

“These will be facilities for all, not just BCRRE.”

**Professor Clive Roberts,
Head of BCRRE**

FIND OUT MORE

Professor Clive Roberts will be delivering a talk about BCRRE's role in the UKRRIN Centre of Excellence in Digital Systems at the University of Birmingham on April 9. Visit www.birmingham.ac.uk/railway for more details and to register.

Alternatively, contact BCRRE by emailing railway@contacts.bham.ac.uk or by following @bcrrre.

FURTHER READING

University Challenge – RAIL 837
Innovation Central – RAIL 855
The Innovation Game – RAIL 867

SMEs will be the key to fulfilling the ambitions of the Rail Sector Deal, including driving innovation and upskilling the industry workforce in Control Period 6, says Joseph Infante. NETWORK RAIL.



“If the Government gets it right, it could unleash the potential of the SME sector to address policy challenges that our bigger, more centralised and less agile competitors can’t meet alone.”

digital rail, provided the necessary data is made available and that we have the right level of investment in the right places. But we must not let the moment pass and slip back into the habits of mind and working practices that have stood in the way of innovation in the past.

As anyone with experience of working as a small business in rail will tell you, we have too often competed with the odds stacked against us because of opaque and poorly thought-out procurement procedures. The resources required to respond to a two-week deadline to tender for a major project, followed by what often seems like an indefinite wait for the verdict, are not easily available to many SMEs.

It is encouraging that the Rail Sector Deal promises improvements in procurement practice, but it is essential that this is more than lip service. We need to see huge improvements in transparency and in planning - more notice, more clarity and more collaboration.

A proper strategic approach to project planning that gets away from the boom and bust of previous investment rounds would allow earlier engagement with industry, and give the SME supply chain a chance to influence what is procured. Better specifications mean better bids that are more innovative, up-skilling through structured training, local employment and productivity.

In the Rail Sector Deal, the Government is committed to a minimum 33% spend on SMEs across all departments. That will become a reality in rail when the processes make it practical for SMEs to compete, but we will only know it has been achieved when we finally start to measure it in a fair and transparent way.

Amazingly, there are still no firm plans to create such a measure. And the truth is that as

things stand, we don't really have much of an idea what percentage of the Government's rail investment actually goes to the SME sector.

Anyone who knows the sector well will tell you that it is often less than it seems. Too often the SME involvement, in a major tender managed by a Tier 1 contractor, ends when the bid is submitted. In some cases, what looks like collaboration on paper may not translate into work where it really matters.

The Rail Sector Deal makes a lot of the right noises about these issues. We hope that the Keith Williams root-and-branch review of UK rail that reports at the end of 2019 will add some muscle.

If the Government gets it right, it could unleash the potential of the SME sector to address policy challenges that our bigger, more centralised and less agile competitors can't meet alone. SMEs are regional, spread widely across the country. We have local knowledge and relationships, and are flexible and quick to respond. We can create employment in the regions, and find and develop skills in places that the big organisations can't easily reach. This is good for the country and good for the rail sector, bringing skills and ideas to work that would otherwise be wasted.

The new year is in its infancy, and the post-Brexit world is looming ever larger - with all its terrors or opportunities, depending on your point of view. Uncertainty, it seems, is all around. But one thing is sure: whatever happens the future will be digital. We don't yet know what the tech will look like, we don't know how it will be used, but we are going to have to build it.

As the next wave of rail investment approaches with the arrival of the five-year spending round of Control Period 6, we can expect a sudden rush of excitement and project procurement. Let's hope that this round, in keeping with the ambition and vision of the Rail Sector Deal, is different... that the investment spreads beyond the usual suspects and finally unleashes the power of the SMEs. It's the only way that the digital future our rail deserves can be made to happen. ■

WAKING THE SLEEPING GIANT

The Rail Sector Deal launched on December 6 2018 announced a 'new approach' to collaborative working between the Government and the rail industry.

About time, you might think - especially if, like CPC, you work in an SME (a small or medium-sized enterprise). For a long time now, we have suffered the frustration of seeing talent in the UK underused, simply because it is not located in one of the big Tier 1 contract organisations.

The SME community in UK rail is, by just about any measure, the most effective and diverse in the world. But the rail network has not been getting the full benefit of that diversity, because of outmoded procurement practices and an operational culture that has looked too much to the past. The emphasis in the Rail Sector Deal on digital rail and new ways of working is a positive sign that this is about to change, and the stated aim to direct

JOSEPH INFANTE, CPC Partner, Transport & Infrastructure and Acting Chairman of the Rail Supply Group's SME Group, says small and medium-sized enterprises can be a huge asset for the rail industry

more spending through SMEs is the surest way to make certain that it does.

Smaller organisations can't compete with the industry leaders on sheer power, resources and financial muscle, but we can offer speed, agility, openness and innovation.

Everywhere you look - across many industries - digital innovation is being led by small, highly responsive, entrepreneurial organisations and networks. The same is inevitably going to be true for rail.

Future rail customers will rely on digital

platforms (apps) that bring them much closer to the rail operation, and which will change the way they use services and what they expect from them in ways that are almost impossible to predict with any great accuracy. When you are working in an environment with that degree of uncertainty and with the potential for such rapid change, flexibility and responsiveness become all important - and SMEs are where those qualities thrive.

It is exciting to see some recognition of these facts in the Rail Sector Deal, and even more

encouraging to see a positive commitment to free access data. Free the data and the apps will follow. The promised open data sharing platform is given as a priority, and we must make sure that it stays one. Data is the lifeblood of any digital system, and if we are going to find new ways to create a sustainable and environmentally responsible rail system we are going to need more and better data all the time.

We have the talent to lead the world in

Rail Sector Deal seeks to boost exports
Richard Clinch, Assistant Editor

GOVERNMENT has launched a Rail Sector Deal designed to reduce infrastructure costs and increase innovation. Under the plan, revealed on December 6, the deal is also designed to double the industry's exports by 2025. It forms part of the Government's modern Industrial Strategy and encourages exchange of ideas between the rail industry and other sectors. "Since their invention nearly two centuries ago, the railways have well-paid, highly skilled jobs." Government expects the deal will reduce the cost of building the railway, while supporting the sector to increase exports. This will be achieved partly by attracting small businesses to the market and encouraging young people to join the industry. Plans include significantly reducing digital signalling costs by 2025, supporting sector apprenticeships and increasing awareness of the opportunities available, and establishing a data sharing platform to support further innovation. "The rail network is vital to millions of Britons, and we want to ensure the sector continues to thrive in the future. Through increased use of digital technology, streamlining the cost of infrastructure, this new partnership between the Government and the rail industry will create a better experience for passengers and businesses, as well as boosting the economy," said Industrial Strategy Minister Richard Klavin.

Executive Darren Caplan welcomed the deal, adding: "It is an exciting time to be working in the rail industry, and the Rail Sector Deal will help the UK's railway deliver even more for UK plc, its economy and connectivity in the years ahead."

International Trade Secretary Dr Liam Fox said: "The industry's pledge to double the UK's export of rail-related goods and services is both ambitious and challenging, and we will work closely with the sector to help them achieve this. Our recently launched Export Strategy sets out how we will increase total exports from 35% to 35% of UK GDP. I encourage the rail sector and all businesses to make the most of our offer of support, which includes export credit from UK Export Finance and in-country backing from our network of overseas posts and HM Trade Commissioners."

The Modern Industrial Strategy
Published last year by Government, it sets out how the whole of the UK can build on its strengths. Six sector deals between Government and industry have been published - from construction and automotive to nuclear and the creative industries, including £1.9 billion of investment in the sciences and £1bn for artificial intelligence. Government says these are not only about attracting investment and growth, but also ensuring the country has the skilled, diverse workforce needed for the future.

Manufacturers develop high-speed learning plan
Hitachi and Bombardier have announced plans for a Global High-Speed Rail Learning Programme. The programme will provide a pathway from apprentice to study at degree level, which could include special high-speed collaborative design process to shape the final product, with the entrants and passenger offering.

Thirty responses for rail reopening
Thirty responses regarding possible railway reopening have been received by Government, according to such proposals in March. The responses covered a wide range of arguments, but that

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THE INTELLIGENT, PEOPLE-CENTRIC RAILWAY

SANJEEV RATHI, DOMINIC TAYLOR and JULIE CARRIER of SYSTRA describe how the technology of today has reached a critical mass, enabling the creation of the railway of tomorrow

Urbanisation, population growth and the continuously changing socio-economic landscape have led transport planners around the world to work towards integrated transport systems, in which the railway plays a key part.

Commuting is linked to economic growth and has an impact on both work and social life. Despite investment in new railway infrastructure, the challenge remains of trying to beat extended rush hours and making trains efficient “mobile offices”. The end user’s relationship with railway infrastructure is not a good one, with delayed and cancelled trains often blamed on overrunning engineering works, failure of asset(s), etc.

When things go wrong, the passenger relies on the quality of information received, whether that’s on the train or while waiting at the station. It is the responsibility of transport planners, engineers, infrastructure owners and operators to provide a seamless experience for the end user by designing and building infrastructure that offers a reliable journey, guaranteed to satisfy modern-day expectations. This article considers the whole-journey experience of a passenger and what is being done to improve it by harnessing the power of modern technology, data and

infrastructure design.

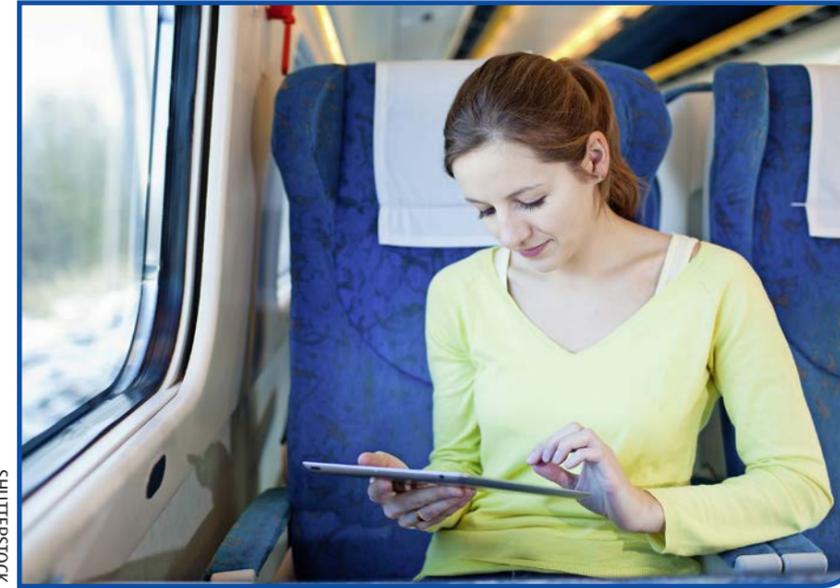
The passenger experience starts with planning a trip and invariably involves various modes of transport, considering journey times and buying the ticket, or tickets. This is very different from 20 years ago, as these activities can be carried out from any Internet-connected device supported by sophisticated search tools. Smart ticketing has the potential to further revolutionise this crucial part of the journey. It will also enable the dynamic regulation of ticket prices, which in turn will help regulate customer demand to better align with the available supply of train seats. This will provide better value for money for the passenger and enable an improved journey experience by incentivizing travel on less busy services.

Smart ticketing and electronic tracking of individual passenger journeys will enable passengers to be kept more up-to-date about changes to their journeys. The technology allows passengers to be compensated automatically in the event of any disruption. Furthermore, it will provide valuable data to enable operators to analyse people’s travel behaviours, identify customer preferences, understand daily needs and ultimately provide

a better service.

Sanjeev Rathi, SYSTRA’s UK Systems Engineering Manager says: “For most passengers, end-to-end journeys remain a conglomerate of small journeys by rail plus multiple other transport modes, rather than the seamless experience they might experience when travelling by car. Smart ticketing and integrated journey planning apps will make it possible to have one seamless transaction for the whole journey. Imagine buying just one ticket that covers taxi transfer to your local railway station, all the train journeys and onward travel via bus/metro, and to have it all planned and managed on your behalf with regular updates on changes, plus automatic compensation if you’re delayed.”

During journeys, stations are a key interaction point for the passenger. Moving through a busy station can be a stressful experience, but technology and thoughtful design can mitigate this. Good visual continuity, open spaces, ambient light, ventilation and accessible passenger information systems, in unison with well-planned retail and ergonomic consideration



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of how passengers interact with the station environment, makes for a more pleasant passenger experience.

To facilitate this, SYSTRA pioneered the SMART Station concept to make the station an interactive living space and a more pleasant part of the passenger journey. The SMART Station concept is an interactive tool that allows station operators to control the station environment in real time to improve passenger experience and reduce operation and maintenance costs.

Indoor and outdoor sensors collect data on the colour and intensity of the light, plus temperature, noise levels, ventilation performance and the number and location of people in the station. The controller can choose different pre-defined settings to adjust the lighting, air-conditioning, public address systems and information panels according to the needs of the passengers.

The connected station brings technological innovations like smart screen doors, smart lighting and digital and dynamic signs to improve daily operations and reduce energy consumption, making the journey more intuitive for passengers and reducing maintenance costs, as sensors can also be used to assess the station’s critical equipment.

This concept has been developed collaboratively with end users, architects and engineers, and data collected can be used to inform the infrastructure design of the station. This method has been successfully used for underground stations on Line 11 - the Paris Metro extension.

Director Julie Carrier adds: “The next evolution of the concept is to link the SMART Station with passenger health data, collected through wearable technology, to measure stress levels. This will allow the controller to intervene remotely to make the journey experience as pleasant as possible without the passenger being aware of it.”

Exploiting today’s digital signalling technology to monitor, predict and manage train running can enable passengers to be

presented with more accurate information about their journey and to plan accordingly. Smart ticketing gate lines can be dynamically reconfigured using passenger flow data to enable speedier passenger flow. SYSTRA has been working with Translink in Northern Ireland to develop this technology.

For the train journey itself, progress has been made in terms of more frequent train services and shorter journey times. Infrastructure and technology have played an unseen role in enabling these improvements, including bridge strengthening, track alignment improvement, longer trains and platforms, and signalling upgrades to improve capacity and reduce journey time. Combining modern digital technology (such as ETCS, TMS) with infrastructure alterations enables trains to run closer together (creating paths for more services) and faster (to improve journey times). To the passenger this means more flexibility over when they can travel, less time waiting for a train and less time spent getting to their destination.

The passenger experience is determined not only by the speed and frequency of the planned service but also how reliably that service can be delivered. Providing reliable and dependable transport means not only designing and building assets to the required standards but also keeping them in a maintainable condition.

While the assets are getting older and mobility needs are increasing, there is an accelerating effect on asset degradation. As operational constraints and limited maintenance access remain a challenge for asset management, use of digital technologies and data is being used to monitor assets’ actual condition in real time.

The concept of smart rail infrastructure is developing quickly, boosted by innovation from the Internet of Things (IoT) and sensor technology. Obtaining data from physical assets presents a major opportunity to enhance the knowledge of mass transit and rail assets. For example, creating a digital

replica of the railway assets using Building Information Modelling (BIM) and Geographical Information Systems (GIS) techniques, and using this data to plan maintenance.

SYSTRA is currently assisting SNCF Réseau, France’s national railway infrastructure manager, in asset management using BIM data to deliver the EOLE project in the Paris region. Although BIM is becoming a ‘must-have’ on greenfield railway projects, this modelling solution is not the only method of digitizing the assets. GIS, combined with a data lake (system or repository of data stored in its natural format) can be a relevant alternative, particularly for existing networks.

In 2017, Chile’s national railway company appointed SYSTRA to prepare a digital replica of their existing assets in a common data environment register.

“The use of Smart infrastructure with intelligent asset condition monitoring can predict failures before they occur,” says Dominic Taylor, Technical Head of Systems and Signalling. “As far as the passenger is concerned, this means a more dependable railway service that is open for business when it is needed.”

By predicting when maintenance is needed, trains and other critical assets do not have to be taken out of service and the need for repairs should be significantly reduced. In addition, with real-time data, maintenance teams will constantly be updated on the state of the assets and the asset management system can provide early warning of faults. SYSTRA is developing the Smart rail infrastructure concept using advanced data-analytic tools and the innovative Internet of Things (IoT), along with sensor technology, to help in reducing lifecycle costs and increasing asset reliability during operation.

During the actual journey, establishing what is most important to passengers is crucial to ensuring they receive the most appropriate on-train service package. Considerations include comfort of seats/legroom, on-board catering, power sockets/WiFi, luggage space and so on, the relative importance of which vary according to the type of journey and the individual. Customer feedback and data will help to make sure the right service packages are provided.

Passengers remember when things go wrong, and these are also the occasions when the railway hits the headlines. Investment in infrastructure and predictive asset management will help to avoid this. Modern digital traffic management systems can optimise services and facilitate faster recovery of normal operation, minimizing the adverse impact on passengers when lines are blocked or operating at reduced speed/capacity.

Sharing data from digital systems and using modern communication technology will enable passengers to be kept better informed during disruptions and allow them to efficiently plan alternatives. Smart ticketing will enable quick, automated identification of passengers inconvenienced by disruption so that they can be appropriately compensated.

SYSTRA is working with customers around the world to provide people-centric, intelligent rail solutions at every stage of their journeys. ■



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