HIGHSPEED

SEE INSIDE FOR:

- Alstom's Avelia range
- Siemens' Velaro Novo
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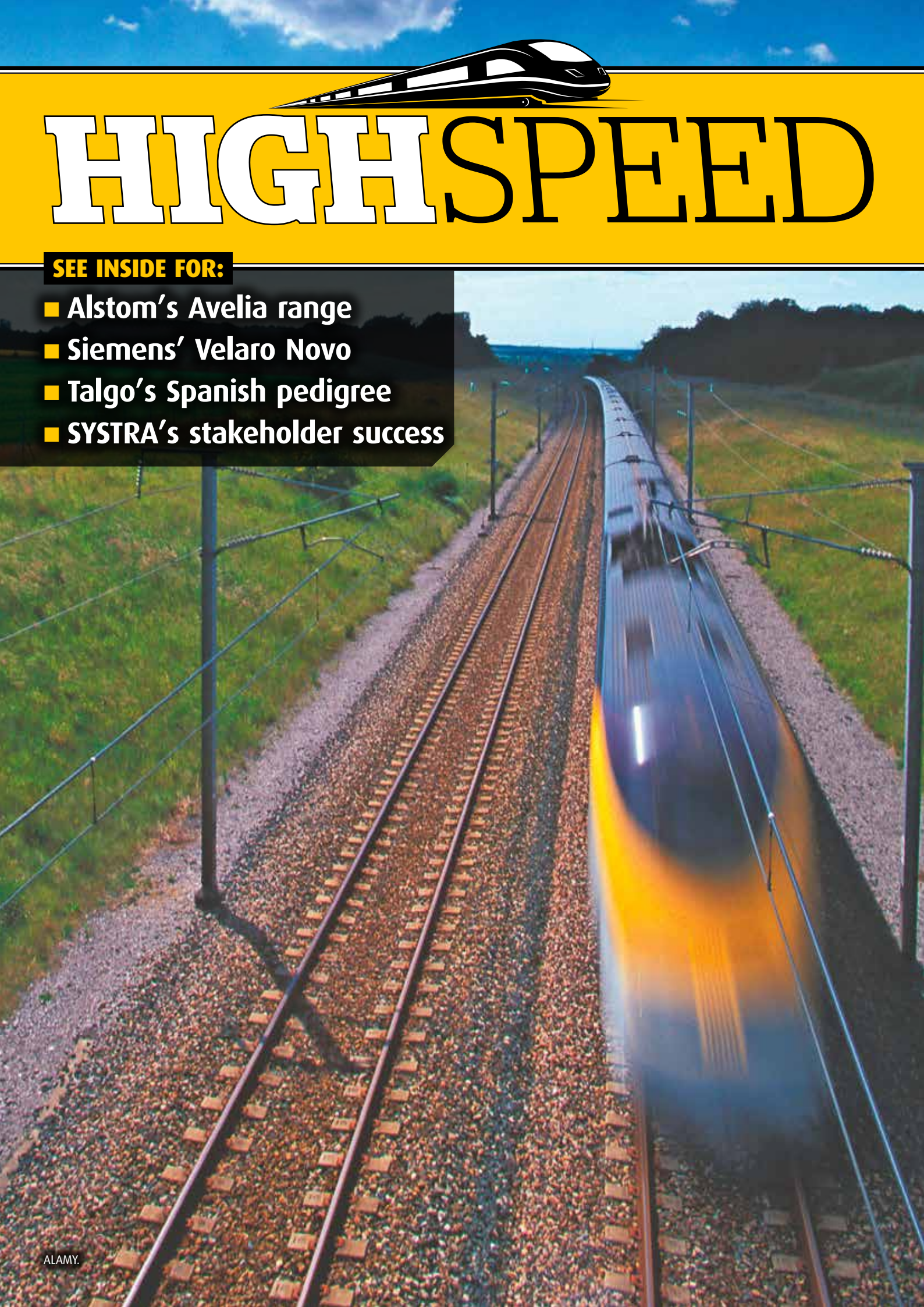
- SYSTRA's stakeholder success



ALAMY.

Welcome

2019 will be a pivotal year for the UK's £56 billion High Speed 2 project as enabling works draw to a close and the supply chain gears up for main construction work to begin on Phase 1 between London and Birmingham.

Government ministers are expected to issue a formal 'notice to proceed' on the bulk of these works in December, unless rapidly changing events at Westminster conspire to get in the way.

Much will depend on the outcome of the urgent review of HS2 that is due to be commissioned by new Prime Minister Boris Johnson. He claims there is a "weak business case" for HS2 but has pledged to prioritise a final decision on what would become Europe's largest construction project before the end of the year.

In the meantime, we can shortly expect a decision on which operator will be tasked with running the first trains on HS2 from 2026. The West Coast Partnership will be responsible for operating services on the West Coast Main Line from March 2020 to 2026, followed by five years as the integrated operator for the WCML and HS2 until 2031.

A decision should then follow next year on which bidder will build at least 54 classic-compatible trains for HS2, with Siemens, Alstom, CAF, Talgo, and a Hitachi/Bombardier Joint Venture all shortlisted for the £2.75bn contract. ■

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VALUE AND VERSATILITY

Alstom's UK Director of High Speed Rail JASON BALDOCK tells *RAIL* about the unrivalled flexibility offered by its next generation of high-speed trains

Alstom's recently unveiled HS2 train design would be part of the Avelia family. ALSTOM.

Alstom has an enviable reputation as one of the leading pioneers in high-speed rail.

Ever since the introduction of the first world-famous TGV in its native France in 1981, the company has gone on to sell 1,276 High Speed or Very High Speed Trains around the globe while also providing components for a further 300 trainsets in conjunction with other manufacturers.

The combined Alstom high-speed fleet is estimated to have covered more than 6.5 billion kilometres and carried four billion passengers with 22 different operators. It is also the only rolling stock manufacturer to have sold High Speed Trains to operators on four different continents.

Cementing its reputation further, it was an Alstom-built train that set the current world speed record for rail when a TGV ran at 574.8kph (357mph) on the newly built LGV Est line in April 2007.

On this side of the English Channel, Alstom was responsible for designing and building the UK's first Very High Speed Train when the Class 373 'e300' entered service with Eurostar in 1993. The '373s' were initially restricted to line speeds on existing main lines in southern England until the opening of High Speed 1 in November 2007, where several refurbished sets still regularly run at speeds of up to 300kph (186mph).

Alstom is also responsible for delivering the UK's most famous tilting train - the Pendolino - of which 56 are in operation with Virgin West Coast in nine and 11-car formations on the West Coast Main Line.

Running at speeds of up to 125mph, the trains continue to be maintained by Alstom at five different depots and have recently been repainted at Alstom's Transport Technology Centre in Widnes.

Opened in June 2017, the 300,000sq ft facility in Widnes has recently been affiliated with the National College for High Speed Rail as a technical training hub to help upskill a new generation of designers, engineers and managers for the UK high-speed rail industry.

Looking ahead, the Transport Technology Centre in Widnes looks set to not only play a key part in building the nation's high-speed expertise but also in the development of alternative low-carbon technologies.

Alstom enjoys a close partnership with the National College for High Speed Rail through its Transport Technology Centre in Widnes, and the donation of two former Eurostar power cars and one AGV carriage to NCHSR's Birmingham and Doncaster campuses. ALSTOM.

This is because Alstom and Eversholt Rail have pledged to produce their new hydrogen train for the UK market at Alstom's Transport Technology Centre in Widnes prior to their expected entry into service from as early as 2022.

Codenamed 'Breeze', the work will involve refurbishing Class 321s and converting them to Hydrogen Multiple Units (HMUs) by retrofitting hydrogen fuel cell technology that has already been deployed by Alstom on Coradia iLint trains in Germany.

Alstom's Director of High Speed Rail UK Jason Baldock explains: "From a UK point of view we have a long history dating back to the dawn of the industry, and we have been involved in some very innovative projects including the Pendolino - which has revolutionised journey times on the curved conventional tracks of the West Coast Main Line - plus the Eurostar and HS1.

"It's a really interesting heritage and we continue to be very committed to the UK market via our maintenance of the Pendolinos at our UK depots, and our close partnerships with the NCHSR and Eversholt Rail.

"We have the world's first hydrogen trains in Germany, which passengers are really enjoying, and have partnered with Eversholt to refurbish Class 321s for the UK. This partnership is going great guns and we are confident of getting the first order later this year with a view to completing the work at the Transport Technology Centre in in Widnes."

By drawing on nearly 40 years of experience in leading the way in rolling stock design, Alstom claims its latest generation of Avelia High Speed and Very High Speed trains represents the most flexible product portfolio of its type in the world.

The Avelia brand ranges from the AGV single-deck distributed traction solution to Euroduplex double-decker trains - which can offer up to 40% more capacity than existing, equivalent trains.

Meanwhile, the Avelia Horizon is being developed for French operator SNCF to offer even more capacity than the Euroduplex and a lower total cost of ownership, with a reported 20% reduction in acquisition costs and a 30% decrease in maintenance costs.

There is also Alstom's latest tilting train development, which is a single-deck concentrated traction train of which Amtrak has ordered 28 to operate on the United States' Northeast corridor between Boston and Washington DC.

Capable of travelling at 300kph, its articulated architecture provides enhanced safety, passenger comfort and stability, while Tiltronix anticipative tilting technology enables the train to negotiate tight curves safely and more comfortably at high speeds.

Baldock says: "We are enormously proud of the variety of tools we can bring to bear in building rolling stock that suits customers' requirements, whether that's in Morocco or the USA. Whatever the project, the Avelia range features all the building blocks needed.

"We are delighted to be working on the Avelia Liberty project with Amtrak and are looking to set new benchmarks in passenger comfort and the use of digital technologies, but there are also many other examples of how the Avelia range is the most flexible platform of rolling stock in the world that provides maximum adaptability to customer needs.

"For instance, the 25 AGVs which have operated in Italy since 2008 are incredible trains, not just owing to their futuristic external presence but because of the passenger experience. Designed to deliver a smooth and relaxing journey, the articulated bogies mean that interior noise is incredibly low and it's a fantastic environment."

With procurement of Alstom rolling stock comes its customisable maintenance programme, called Health Hub. This provides diagnostic information on train performance to ensure maximum availability.

An optional extra is TrainScanner, which has been installed at both Manchester Longsight and Oxley depots to scan Virgin West Coast's Pendolino fleet with lasers and cameras. This system captures data about the condition of equipment on passing trains and makes predictions about its remaining service life.

The technology can not only reduce inspection time but also the possibility of human error. It can initiate a cycle of predictive maintenance, further reducing the number of interventions by maintenance engineers.

Baldock adds: "We continue to monitor the Pendolinos. I think the complexity of that contract is a benchmark for Alstom globally and it invites a lot of interest from customers across the globe.

"In the UK we are leading the pack in terms of our maintenance capability, as demonstrated by the TrainScanner, which has digitised the maintenance requirement to improve fleet availability and reliability while also reducing costs." ■

"In the UK we are leading the pack in terms of our maintenance capability, as demonstrated by the TrainScanner."

Jason Baldock, *UK Director of High Speed Rail, Alstom*

HEARTS AND MINDS

SYSTRA UK Rail Director JULIE CARRIER describes how the firm's innovative approach is overcoming objections and resistance to major infrastructure projects

Engaging with stakeholders on complex infrastructure projects is becoming increasingly important - and rightly so. This is not just about fulfilling a contractual or legal requirement, or even a PR exercise, it is fundamental if we want to change the image and reputation of our industry.

Historically, keeping the public informed about enhancements to our railway infrastructure was relatively straightforward – we needed to advise what was happening, when and how.

As we become more ambitious in our plans for high-speed rail and digitisation of the existing network, the stakeholder landscape becomes more complex and the impacts of our proposals become more far-reaching, resulting in heightened emotion from organised protest groups and industry commentators.

Getting stakeholder engagement right is vital to securing the smooth passage through Parliament of infrastructure schemes, but are we doing this well as an industry, and is the way we engage with the communities affected by infrastructural changes effective?

Engaging with stakeholder groups representing diverse interests can be costly, time-consuming and challenging.

However, we have found that investing properly can provide benefits, not just to the approvals process but to the solution itself; different perspectives leading to creative, money-saving solutions.

A great example of this is the Nimes Montpelier High-Speed Rail bypass in France, where SYSTRA was lead engineer. The project had a diverse range of stakeholders including passenger and freight operators, maintenance organisations, highways authorities, local councils and the community.

We defined a process for early stakeholder engagement, and regular reviews to ensure the final design considered inputs from all perspectives.

Regular engagement meetings were held where stakeholders were given the opportunity to comment on proposals. Key to these meetings was clarity, not just on 'what' but 'why'.

The project was expected to deliver significant benefits, including the creation of 20,000 jobs, a one billion euro boost to the local economy, providing 30% more regional services, doubling of freight traffic and reducing passenger journey times, all of which was predicted to drive an economic transformation of the region. Their feedback led to significant changes to our proposals. For example, 21km of acoustic screens were constructed to protect local communities from noise, and alteration to the Overhead Line Electrification design was accommodated to avoid relocation of a local weather radar saving one million euros.

There was also a concern raised that the vibration from passing trains would affect the quality of the grapes grown in the region - we listened and carried out extensive testing to allay these concerns.

Using digital tools to engage with stakeholders was at the heart of our approach on the South East Altantique high-speed rail line. The SEA high-speed rail project led us to develop IMMERSE - a virtual reality tool that gives communities a sense of the visual and noise impact of the project in their local area. We can then adapt our design based on feedback.

IMMERSE allows people to explore proposals in three dimensions and use the application on-site to augment reality, so they could hold up their laptops or tablets to act as a 'digital window' and overlay the virtual reality images onto the real world. You can experience sitting in your back garden as a high-speed train goes past – this takes away the fear of the unknown and engages hearts and minds of communities.

Positive feedback from the community led us to incorporate heritage features into the design of new viaducts spanning rivers and valleys along the route.

Protecting local wildlife was important to local stakeholders – we listened and adapted our design. We incorporated concrete ledges in the hydraulic structures to alow small animals to cross watercourses without getting wet and added covered passages for shrews and voles that prefer to move unseen. We replanted 1,200 hectares of forest and grassland to safeguard and increase population numbers in the little bustard and the European mink - both species are in decline.

Our engagement created a real sense of pride in the project and what it would mean to the community. Over 18,000 people visited the construction site to see it for themselves. Not only did this allow them to share their ideas, for some it was an opportunity to consider a career in the sector.

We worked with local authorities to encourage as many local people as possible to consider a career in the railway. We targeted vulnerable people, women and those with disabilities, to really make a difference to the local economy.

The project was delivered on time and on budget, but its real outcome is its legacy. The project provided socio-economic benefits in terms of employment, local economy, urban development and protecting the environment. This was only possible through effective engagement with stakeholders, of which we are incredibly proud.

> ***"Our team managed, resolved and avoided conflicts between the client and stakeholders through thorough analysis of options."***

SYSTRA's consultation process is designed to help engender a real sense of pride in high-speed rail. PASCAL LE DOARE/SYSTRA.

Post-project commissioning of our engagement continues - an exhibition of the archaeological finds during construction is touring the region in a stakeholder engagement bus. We created organisations to support the ongoing preservation of the environment and financing of energy-saving projects, and the reduction of greenhouse gas emissions to reinforce existing public support schemes.

Management of industry stakeholders is becoming more complex as we create a railway network with high speed and conventional railway interfaces and start to implement digital technology.

We were part of the team commissioned by Network Rail that defined, then implemented the train protection overlay system to support the routing of HS1 services onto the heritage network facilitating calls at Ashford International station. This was essential to enable the new Class 374 (e320) Siemens Velaro trains working international Eurostar services to call at the station.

The challenge was to develop a safe and effective train protection system that did not have an impact on the timetable and minimised alterations to the existing signalling systems while delivering a safe, cost-effective solution.

We interfaced with NR, the contractor, operators and NR High Speed through progress meetings and electronic sharing of information. We ran a series of stakeholder workshops to develop the best solutions from cost, commercial risk, operations, safety and technical perspectives, based on a multi-stakeholder analysis of potential perspectives and interests. We used a balanced scorecard with selection criteria agreed by all to evaluate proposed solutions in an objective way.

Employing European Common Safety Method techniques, we ran workshops with the same diverse stakeholders to identify hazards and assess risk associated with the chosen option. Training rigs with real equipment were used to upskill frontline staff. This ensured the business change being implemented was safe and acceptable.

Engaging with the operator is fundamental - our solution has given Eurostar increased flexibility in its operational planning and provides the basis for ensuring that all future Eurostar services will be able to call at Ashford International.

Getting internal and external stakeholders on board with proposals led to significant capital expenditure savings on the Sydney Digital Systems project to deploy modern digital technologies – ETCS, ATO and TM – on the Sydney rail network.

This change needed to be employed to improve safety, increase capacity and enable efficient operations management so the railway network could carry more customers while offering a more frequent, reliable and safer service. TfNSW had already planned the rollout of ETCS as an overlay on the whole network. Funding was secured for 600km with AUS$1.6bn committed for completion across the network.

We developed the Digital System concept, based on ETCS + ATO + TM, for the core section of track. We proposed a limited functionality implementation of ETCS to bridge the gap between the funded areas and Digital System as a cost-effective solution. TfNSW found this so beneficial that it decided to change its ETCS deployment plan to use this limited functionality implementation of ETCS everywhere. Over a 25-year timescale, this delivers nearly the same safety benefits, realising a AUS$650m saving in capital expenditure. However, this was only possible with wider stakeholder buy-in.

We provided the interface between the client and stakeholders to ensure all parties were on board with these innovative proposals. We communicated complex, technical issues in a familiar language and provided independent, objective and impartial advice.

Our team managed, resolved and avoided conflicts between the client and stakeholders through thorough analysis of options and their impacts on all stakeholders and frontline teams. For instance, representatives of operator unions were involved in the business case development stage, and their feedback was taken into consideration in the selection of a technical solution.

> ***"Our engagement created a real sense of pride in the project and what it would mean to the community."***

Social media and digital platforms offer planners opportunities to communicate and engage with local communities in a different way. For example, the ongoing Grand Paris Express project, a major metro extension, had been met with huge concerns from local people about the potential noise impact. Using IMMERSE, we allowed the public to assess for themselves how they would be affected. The intervention not only allayed fears but helped obtain popular approval.

It is interesting to visualise how stakeholder engagement will develop in the next 20 years. Technology is evolving so rapidly it is hard for me, a veteran railway engineer, to imagine what the future holds. Hackathons and experience rooms will no doubt become business as usual, but from what I have experienced, these will never replace face-to-face engagement and clear two-way 'what's in it for me' communication that wins hearts and minds.

As we move in to an exciting period for our industry, with work having started on High Speed 2, funding agreed for the first phases of implementation of ETCS on the East Coast Main Line, and supporters of Northern Powerhouse Rail more vocal than ever, stakeholder engagement will become more critical to maintain the momentum we have created and enable us to efficiently implement these improvements to our railway. ■

SPANISH PEDIGREE

Spanish train manufacturer Talgo is enjoying a blossoming high-speed rail reputation, as it looks to expand its portfolio

As far as the high-speed rail market in the UK is concerned, Talgo may be a newcomer. But on a global level this is an industry in which it has a long and successful record of innovation and delivery.

The Spanish manufacturer is currently building trains for Renfe from its new AVRIL range. These trains are designed for maximum operational speeds of 330kph (205mph) and are being constructed at the company's Las Matas headquarters near Madrid and at Rivabellosa.

The order is the latest in a series of recent high-profile wins for the company, which also include up to 100 locomotive-hauled train sets ordered by DB for use in Germany as well as for cross-border trains. Talgo has also been successful in tendering to supply trains to Egypt.

Talgo says AVRIL is a technological platform that meets the current and future needs of a "demanding rail market". It says the platform not only increases the number of passengers an operator can transport per journey, the design means that dwell time at stations is significantly reduced.

That's because the 200-metre-long trains can carry 600 passengers without the need for a double-deck train. From a commercial point of view, this allows the operator to offer more competitive prices while reducing overcrowding on some of its busiest routes. It also enables operators to increase profits and provide a greater return to investors and taxpayers.

The design, as per other Talgo trains, is based on short articulated vehicles that use lightweight bodyshells. Indeed, before the vehicles are fitted with internal fixtures the vehicle can weigh as little as four tonnes.

The short vehicles have other benefits, too. Their lighter weight means lower energy consumption, allowing higher operating speeds. Cost is important here - the value of energy consumed throughout the working life of a Very High Speed Train (VHST) can be as much as 60% of the purchase price of the train; it's estimated that Talgo's latest AVRIL design brings running costs per seat that are significantly lower when compared with current trainsets.

Reducing energy consumption is also an important factor, and the new trains will compare favourably against the 138kWh/km of the Talgo 350 sets.

Performance is also improved. Almost half of the AVRIL ES axles are motorised, meaning higher acceleration.

A Talgo 350 stands at Valencia on April 1, having travelled from Madrid. The trains are capable of 330kph (205mph) and entered traffic in 2005. RICHARD CLINNICK.

> *"The design means that dwell time at stations is significantly reduced."*

Research carried out on the Madrid-Barcelona high-speed line shows that the economic weight of energy against commercial revenue was 5.2%. The energy cost for taking a passenger between the two cities at 300kph (186mph) was 2.91 euros.

Safety is also a principal feature of the design, with articulation providing a safer structure. Wider coaches also means better passenger comfort.

Innovation has been key to the company's success. Having recognised the problems created by its Spain's difficult geography - mountainous terrain surrounding major cities, and mountain ranges criss-crossing the plateaus, which has led to numerous curved sections with sufficiently low radii to have an impact on line speeds - the company created the 'Talgo pendular' train that was introduced in 1980, initially between Madrid and Zaragoza.

This allows the coaches to tilt towards the inside of the curves, which compensates (to a degree) the effects of centrifugal forces on passengers. Talgo's design enabled higher speeds to be achieved without any extra cost, and offers reduced journey times.

The first power car from the first AVRIL380 inside the paint facility at Las Matas, Spain, on April 1. RICHARD CLINNICK.

But all this doesn't explain the impact the company had on the Spanish railway. Railway academic Professor Andres Lopez Pita, in his book *Talgo and high speed; Technical and commercial operation*, writes: "It would be no exaggeration to say that without Talgo, the role played by this mode of transport in Spain, on conventional lines, would have been reduced significantly."

In 1988, the Spanish government's decision to incorporate high speed into its railways was the motivation for Talgo to start researching what was needed for the market.

This revealed the need for two kinds of trainset. The first would operate at 250kph (155mph) while the other would need to run at over 300kph.

As a result, for the past 14 years, the operator has supplied trains with a 330kph maximum speed to the Spanish market, and now the company is the largest supplier of high-speed rolling stock to Renfe, the Spanish operator. This is in a market that includes manufacturing giants Alstom, Bombardier and Siemens.

Writes Pita: "If in the past, on conventional railway lines, Talgo trains played a significant role in Spain, it can be said that in the last two decades, its contribution to the development and commercial success of high-speed technology has had a similar impact."

The company's latest offering is the AVRIL380 platform, which has a top speed of 380kph (236mph), and from which AVRIL ES is dervied. Construction is under way on the first trainsets.

The first order for AVRIL ES was received in 2016 from Renfe in a 786.5 million euro deal (£705m in 2019 prices) for 15 trainsets, as well as 30 years of maintenance. In 2017 a further 15 sets were ordered, with entry into traffic due next year. This additional order has resulted in a discount on the initial order.

During a *RAIL* visit to Las Matas on April 1, the first power car was being prepared for painting, while construction of other sets was well under way.

The design includes two power heads plus 12 intermediate cars featuring underfloor and roof-mounted equipment - 38% of AVRIL ES axles are motorised. According to Talgo, this increases capacity.

> *"Another key benefit of the design is that the coaches can be wider, and this means better passenger comfort."*

Train capacity offered to Renfe was 521 passengers in two classes in a 200m train (105 Business, including two meeting Persons of Reduced Mobility requirements, and 416 Tourist), while the additional 15 sets are all variable gauge units.

All the units will have three voltages: 1.5kV DC (France legacy); 3kV DC (Spain legacy); and 25kV 50Hz AC (France, Spain new lines); enabling them to use every electrified line in Spain and France.

To increase versatility still further, some trains will also be available with French train protection and control systems, to enable them to run in France.

But the development of the trains can only follow an analysis of what's required. Talgo has noted that the development of high-speed rail across the globe is in proportion with longer routes. Routes such as Paris-Lyon or Madrid-Seville are shorter than 500km (310.5 miles). But longer routes are now available, such as 1,121km (696 miles) for Barcelona-Malaga and 1,079 (670 miles) for Barcelona-Seville.

Performance is the other key. In his book, Pita highlights analysis carried out in France which shows there is a benefit to being able to travel at 360kph (223.5mph) on some routes from Paris.

While the time savings are small - perhaps 10-20 minutes - it enables the operator to increase demand by as much as 10% annually, while even as little as a five-minute journey time reduction could take 2% of market share from air travel.

The Spanish firm is making great strides to better understand its markets. With its plan to open a factory in Scotland and continued wins across not only Europe but also northern Africa, this work is clearly paying off. ■

The S112 was a development of the S102 and is known as the Talgo350. International orders include trainsets for the Haramain high-speed railway in Saudi Arabia. That deal was won in 2011, and the first sets entered traffic in September 2018. On November 9 2018, two power cars are tested at Talgo's Rivabellosa facility, at the base of the Basque region. RICHARD CLINNICK.

QUICKER AND SLICKER

Siemens Mobility's HS2 Service Bid Manager KEVIN CLARK outlines how the Velaro Novo sets a new standard for high-speed trains

The Siemens Velaro family of trains represents one of the most successful high-speed train platforms in the world.

Based on the ICE 3 train that is in service in Germany, four generations of the iconic Velaro have plied their trade across Europe, Russia, China and Turkey since 2000, with the global fleet currently covering more than one million kilometres per day.

This includes in the UK, where the Class 374 'e320' entered service with Eurostar in November 2015 to provide services from London St Pancras to destinations in France, Belgium and the Netherlands via the Channel Tunnel.

More recently, Siemens Mobility announced the launch of the fifth generation of this high-speed platform – the Velaro Novo.

Unveiled at the InnoTrans international rail show in Berlin on September 2018, the first trains from this series could be ready to enter service as early as 2023.

Said to 'set new standards for efficiency and sustainability, as well as passenger comfort and convenience', the launch marked the culmination of the intensive five-year development of the Velaro Novo concept.

Designed to operate at speeds between 250kph (155mph) and 360kph (223mph), much of the manufacturer's research was focused on cutting maintenance and fuel costs, which represent up to 50% of a train's whole life costs.

The results are impressive, with Siemens Mobility claiming that the Velaro Novo uses 30% less energy and provides 10% more space than previous Velaro models.

It will also be 15% lighter and cost 30% less to maintain, offering operators optimised capacity, energy consumption and maintenance costs without any compromise in passenger comfort.

"Energy consumption and environmental impact are becoming increasingly important."
Kevin Clark, *HS2 Service Bid Manager, Siemens Mobility*

An artist's impression of the Velaro Novo that was launched by Siemens Mobility at InnoTrans 2018. SIEMENS.

A Eurostar Class 374 'e320' set powers through Stratford International with a service to Paris Gare du Nord on February 2 2017. JACK BOSKETT/*RAIL*.

HS2 Service Bid Manager Kevin Clark explains: "The Velaro as it stood was configured in numerous ways to suit the various operational requirements of customers worldwide. For example, it could run on two different gauges and four different overhead line equipment designs.

"But since 2013, we have put in an enormous amount of engineering effort to take this solid platform and reconfigure it further for the changing marketplace, with reducing whole life costs being the principal objective in the development of the Velaro Novo.

"We recognise that train operators are placing increased focus on cost- and resource-efficiency. Our focus on whole life cost and sustainability featured heavily in the Velaro Novo development. Our products are already very efficient in this respect, but we quickly realised that in future we would need to do things even more efficiently."

Key to achieving a 30% reduction in energy consumption has been the improved aerodynamics of the Velaro Novo, for example keeping the train's pantograph shrouded when lowered and placing side skirts and underside panels around its bogies.

The train has also been made 15% lighter, thanks to thinner car body walls that are built using friction stir welding.

Further gains have been made by offering the Velaro Novo in a seven-car configuration instead of the more traditional eight-car setup for a standard 200m high-speed train.

With a vehicle length of 28.75m, a seven-car Velaro Novo is 202m long and 11mm wider than previous Velaros, which will give operators increased flexibility to provide wider seats, aisles and improved levels of passenger comfort.

The longer coaches will also mean a reduction in maintainable components compared to an eight-car train, which contributed to the overall reduction in mass.

Meanwhile, maintenance costs have been further reduced by the train's intelligent software design which uses more than one billion data points to transmit diagnostic data.

This information can then be used by technicians to improve reliability, enable preventative action to be taken if necessary and new predictive maintenance regimes to be introduced at depots.

"Our existing Velaro trains generate over one billion data points per year, but we expect the Velaro Novo to generate far more than that amount," says Clark.

"This data is then continuously transmitted to depots where it can be analysed to detect deviations from normal conditions and predict malfunctions.

"We have also installed automatic vehicle inspection (AVI) systems at our depots at Three Bridges and in Dortmund, where trains are inspected using lasers before the data is directly entered into a data management system. We can then use this to build an even more detailed picture of how the train is performing and anticipate where interventions need to be made more accurately."

He adds: "Our expectation is that increased use of AVI will lead to increased reliability as we can react to problems much earlier, rather than allowing faults to develop."

The innovative design of the Velaro Novo should not only reduce maintenance costs for operators but also infrastructure managers, with its 'track-friendly' design reducing wear and tear on the tracks.

Siemens Mobility also offers a range of track inspection and condition monitoring tools that can be incorporated into service trains to detect common problems, including cracks and rail breaks.

This allows for tracks to be repaired quickly and could reduce the risk of derailments, while also mitigating the need for traditional inspection techniques that often take much longer and require disruptive engineering possessions.

Clark says: "It comes back to reducing whole-life costs again and decreasing the cost of infrastructure maintenance. Lower train masses and axle loads can play a big part in that.

"As well as providing on-board diagnostics for train running, we also have systems on our train that will measure track geometry so the maintainer can intervene as soon as they are needed, reducing the need for reactions to emergencies and lowering the frequency of planned interventions."

In order to refine the Velaro Novo design even further, Siemens Mobility has been testing individual components in a test car equipped with hundreds of sensors that has been running in Germany since April 2018.

Integrated within a Deutsche Bahn ICE set, the aim is to amass some 100,000km of performance data with particular focus on structural dynamics, acoustics, running behaviour and brake tests.

Subject to receiving orders, Siemens Mobility will then be ready to take the Velaro Novo into full production and provide its customers with one of the most environmentally friendly high-speed trains in the world. ■

HS2: a matter of time

PAUL STEPHEN reports on how HS2 Ltd is planning to deliver one of the world's most reliable railways

Japan's railway system has a worldwide reputation for extreme punctuality. This was perhaps best demonstrated in November 2017, when passengers on the Tsukuba Express line between Tokyo and Tsukuba were famously issued with an apology for a train that had departed 20 seconds early.

Incredibly, a second case occurred barely six months later. A conductor felt compelled to say sorry for the "truly inexcusable" inconvenience caused to passengers when his train left Notogawa station a full 25 seconds before its booked departure time.

HS2 Ltd has now pledged to rival Japan's bullet trains for reliability, once Phase 1 of the £56 billion project has opened between London and Birmingham in 2026, followed by Phase 2 to Manchester and Leeds in 2033.

An average delay target of just 30 seconds will be put in place to not only ensure world-leading levels of customer service, but also out of necessity - in order to help deliver the capacity required to operate a service frequency of up to 18 trains per hour.

Speaking at Rail Live at Long Marston on June 19, HS2 Ltd's Commercial Director for Railway Operations Paul Seller said: "We are designing a railway that will operate at high levels of reliability, and trains will be no more than 30 seconds late on average across the year. Those levels of reliability are currently only achieved in Japan, and so much of our design is based on the Japanese level of high-speed railway.

"To run 18tph we not only need railway systems such as Automatic Train Operation (ATO), but for dwell times at stations to be no more than two minutes. One of the challenges we have, therefore, is not just to deliver the systems we want, but how we map the behaviours of people to get them on and off the trains in two minutes.

"Otherwise, we will bust those targets and we won't be able to deliver the capacity we promised in our business case."

One of the ways in which HS2 is looking to increase performance is by operating a 'seat-only' railway, whereby passengers would require a reservation to travel. This would effectively eliminate standing on long-distance routes, as well as overcrowding. Providing level access at the platform-train interface will further help reduce dwell times at stations.

According to Seller, many of these final operational decisions will need to be taken by the operator selected by government to run the West Coast Partnership (due to be awarded this summer to run on the West Coast Main Line from 2020, and as an integrated operator on the WCML and HS2 from 2026-31).

Nevertheless, HS2 Ltd has included passive provision for these measures in all its designs.

He adds: "We're building that capability into the railway so that passengers can book their seats up to a couple of minutes before departure, and to deliver an exemplary standard of customer service to our passengers.

"Ultimately, it will be for the future train operator to decide how this is all going to work, but we have already started to develop the customer journey by working with Transport Focus and by engaging on a weekly basis with an online customer community.

"These people are not just regular commuters, but people who have never travelled on railways before and who can tell us what the barriers are to them travelling by rail. That is allowing us to build those requirements into our systems, the rolling stock and the stations, so when we get an operator they can make those final decisions on how it operates."

A further challenge for HS2 is not just to build in requirements that are based on likely passenger expectations when the first phase of the line opens in 2026, but to allow for changing expectations over the next 20 to 30 years.

That has led to HS2 exercising increased flexibility over the timings of when it issues exact design specifications to the supply chain.

Seller explains: "We talk about how to make a railway fit for the future, which means that we're not designing a railway for today or even for when we begin to operate in 2026, but for 2030, 2040, 2050 and beyond.

"One of the key aspects we've therefore looked to bring into our programme and to push into our key contracts is the concept of 'last responsible moment', which means not making decisions on exact specifications of design until we really need to.

"On things like ticketing and revenue collection it's absolutely critical that we don't design now what we can design in three to four years' time, because with the rapid rate of technological change, to specify and design it now would quite simply mean getting it wrong." ■

"We are designing a railway that will operate at high levels of reliability."

Paul Seller, ***Commercial Director for Railway Operations, HS2 Ltd***

JACK BOSKETT/*RAIL*.

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