
railway-news.com
MAGAZINE
The latest news & reviews from the industry
HERRENKNECHT
Tunnelvortriebstechnik
Consorzio TAT
Infrastructure special
Switzerland's Gotthard Base Tunnel
A Look at 3 Important Railway Bridges
ISSUE TWO 2016

BT Cables

A world leader in cable manufacturing

Our enhanced product range now has more applications for the rail market.

Whether it is safety critical infrastructure cables like AzLM axle counter cables or fixed telephone network telecoms cables to in-station cabling for ticketing machines, digital notice boards or CCTV cameras, BT Cables has a product to suit your needs

and remember

at BT Cables we passionately believe in these key messages

- Your business success depends on the cables you use
- Experience counts in cable sourcing
- You need a cable partner you can rely on

Combined with the strength of BT Supply Chain we offer un-paralleled service and product solutions.

BT Cables – trust in our experience

BT Supply Chain - Rethink what your supply chain can deliver

A subsidiary of BT

Delaunays Road, Blackley,
Manchester, M9 8FP
Tel: +44 (0) 161 741 2345
Fax: +44 (0) 161 795 8393
Email: info.btcables@bt.com

www.btcables.com

Letter from the Editor

Welcome to the second magazine issue of 2016 for Railway-News.

Welcome to the second magazine issue of 2016 for Railway-News. Spring is here and the Railway-News website has been given a new, sleek and modern look. Do go and take a look at www.railway-news.com.

This issue focuses on infrastructure. Although we're in the rail sector, we can never help being a little bit excited by tunnels and the engineering feat that they are. So we are very pleased this issue to have an article about the Gotthard Base Tunnel in Switzerland, which goes under the Alps and opens on 1 June, ahead of schedule! We also take a look at railway bridges, starting with the 19th century Forth Bridge and finishing with the Third Bosphorus Bridge in Turkey, which is to open in May/June of this year.

We are also expanding our regular features section. In addition to an infrastructure piece and an article with a European focus in every issue, we are adding an interview and a cartoon. In this issue we take a look at the creation of the Single European Railway Area as our European article. The interview piece ties in nicely as we spoke to Richard French at Bombardier about its role in Shift2Rail.

We have guest contributions by Michelle Papayannakos, RSSB's sustainable development specialist. She discusses how we can increase sustainability for the rail industry. Sustainability is an increasingly important issue, not just for railways but for all areas of transport as well as for industry and private citizens. Jake Mason, CEO of Evolve, writes about the importance of visual communications in calming disgruntled rail passengers.

ASC (Advanced Sensors Calibration), with headquarters in Germany, introduces itself and discusses the typical applications of ASC sensors in the rail sector. Eltek presents its power conversion module that is perfectly suited for rail and metro. Finally, Argus Fluidhandling, part of the Alfa Gomma Group, announces the acquisition of Hiflex Europe Group.

All of us here at Railway-News hope you enjoy this issue as much as the last. If you have any questions or suggestions, please don't hesitate to get in touch. We would also very much like to hear any comments about anything you've read in our magazine. Our upcoming issue will be published just prior to the British referendum on its EU membership. How will the outcome impact the rail industry? Please email jcs@railway-news.com with comments. Meanwhile, enjoy the read and we will be back again in June.

Josephine Cordero Sapién, editor-in-chief

railway-news.com

ANDREW LUSH
Director
al@railway-news.com

JOSEPHINE CORDERO SAPIÉN
Editor-in-chief
jcs@railway-news.com

NICOLA BROWN
Head of Sales
nb@railway-news.com

NAOMI THOMPSON
Contributing Editor
nt@railway-news.com

AMBER GUY-KEMP
Head of Client Content
agk@railway-news.com

A2B Global Media
Third Floor
11–15 Dix's Field
Exeter EX1 1QA
United Kingdom

Office: +44 (0)1392 580002
Mobile: +44 (0)7432 725001

Email: info@railway-news.com
Website: www.railway-news.com

If you would like to submit editorial content, or you are interested in giving an interview for the magazine, please contact **Josephine Cordero Sapién**. If you would like your company to join Railway-News's online platform, please contact **Andrew Lush**.

To subscribe to our newsletter, visit **www.railway-news.com**.

COVER: Courtesy of Herrenknecht AG

WINDHOFF MULTIFUNCTIONAL VEHICLES - MPV®

INFRARAIL
12-14 APRIL 2016
EXCEL, LONDON, UK
Windhoff Bahn-und Anlagentechnik GmbH
find us on Stand D22

www.windhoff.com

... FOR CONSTRUCTION AND MAINTENANCE OF OVERHEAD LINE SYSTEMS & TRACK

Windhoff Modular Concept: Maximum versatility with the MPV® due to the modular vehicle design.

What has become recognised as "Windhoff technology" is a system that allows demountable work modules for various infrastructure work streams: a range of hydraulic cranes to give optimised capacity, flexible elevated work platforms & work modules configured for electrification and OLE - or track maintenance.

The MPV®'s operational use is widespread and fit for the future.

WINDHOFF DEPOT EQUIPMENT

UNDERFLOOR LIFTING PLANTS
LIFTING JACKS
TURNTABLES AND TRAVERSERS
ROOF ACCESS PLATFORMS
RAIL-ROAD SHUNTING VEHICLES

www.windhoff.com

Windhoff
Bahn- und Anlagentechnik GmbH

Contents

EDITORIAL FEATURES

REGULAR FEATURES

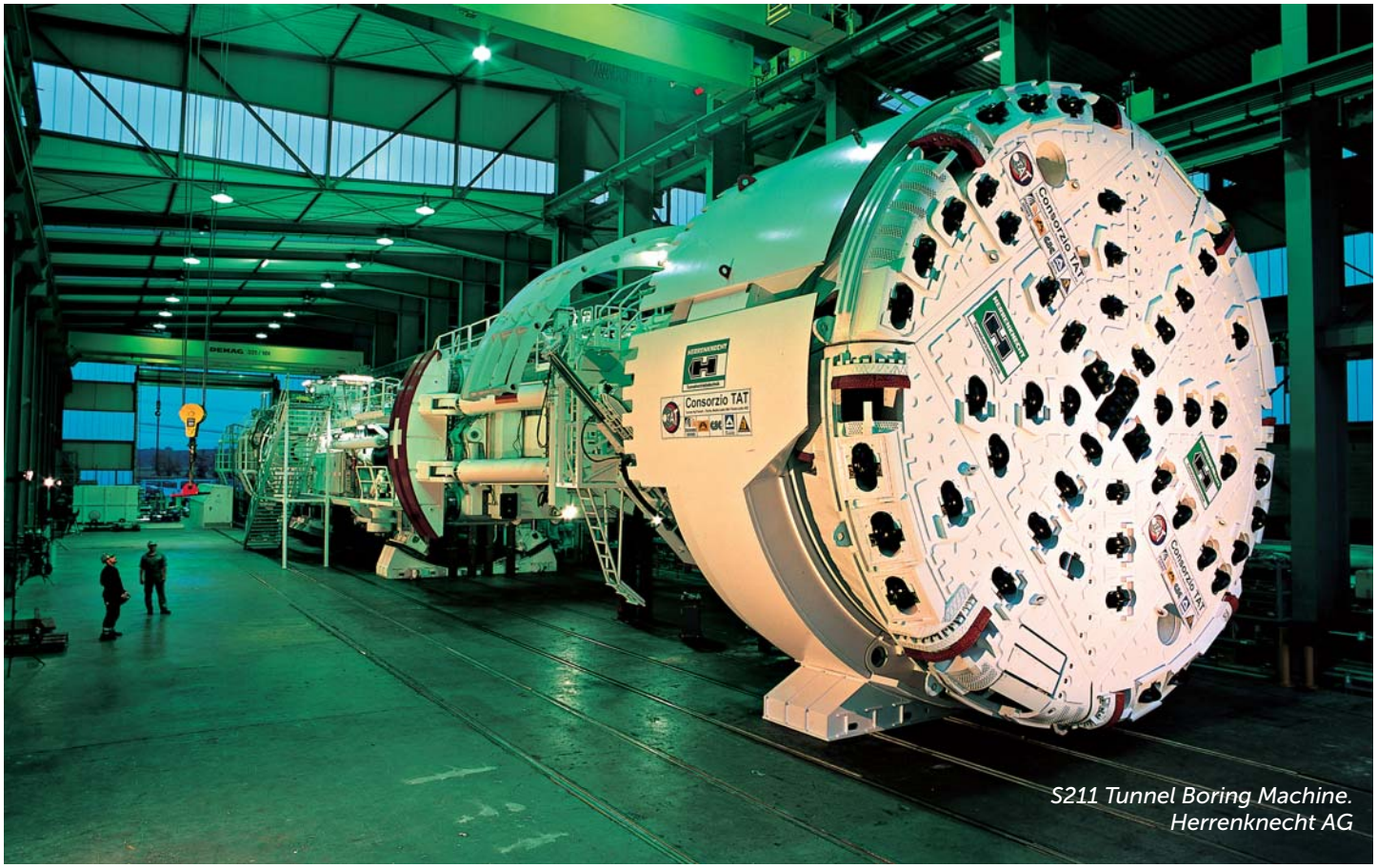
SUPPLIER FEATURES

Gotthard Base Tunnel

A Ground Breaking Project

By Naomi Thompson

Sedrun Shaft
© AlpTransit Gotthard Ltd.



S211 Tunnel Boring Machine. Herrenknecht AG

The first Gotthard Tunnel through the Gotthard Massif is 15km long and took ten years to build, from 1871 to 1881. Its construction required the use of explosives, entailed the deaths of hundreds of workers and originally ran steam trains – and although this makes it an engineering feat of its day, it rendered it a grim business nonetheless.

The latter incarnation, the Gotthard Base Tunnel, is equally as impressive an engineering achievement, but not nearly so grim. It is 57.1km long, it has taken 12 years to construct, and runs 600m below its predecessor. It will run electric trains at up to 150km/h, and at a cost €9.34billion, it will revolutionise north-south rail travel in Europe by linking Erstfeld and Bodio in Switzerland. It is the longest, deepest railway tunnel in the world, and is due to open, ahead of schedule, on 1 June 2016.

Construction

AlpTransit Gotthard, a wholly owned subsidiary of the Swiss Federal Railways (SBB) was responsible for the construction of the tunnels. The work was broken down into four segments, undertaken by the Transtec Gotthard consortium consisting of four companies: Atel Installationstechnik AG (lead), Alcatel-Lucent Schweiz AG/Thales Rail Signalling Solutions AG, Alpine Mayreder GmbH and Balfour Beatty Rail GmbH. Additional works have been carried out by partners ABB Schweiz AG, Burkhalter AG, IBM Schweiz AG, Kummler+Matter AG, Pöyry Infra AG and Scheuchzer AG.

The Challenges

600m below the earth could be safely described as hostile terrain. The climactic conditions, such as ambient temperatures of up to 40oC and humidity of up to 70%, all had to be contended with, as well as a high risk of corrosion from an aggressive saline environment, brake and concrete dust and soot particles in the environment.

Because of the narrow diameter of the tunnel, the logistics of transporting equipment and workers into the tunnel was intricate; nearly everything was transported as far as 40km into the tunnel by rail from two installation yards at the north and south portals. In addition, all equipment had to be transported and stored in containers which would protect them from the environmental conditions, making them heavy and cumbersome.

Also, larger equipment and materials had to be delivered in exactly the right order because there was no room to shuffle them once inside the tunnel.

Erstfeld Track Installation
© AlpTransit Gotthard Ltd.

There was sometimes no room to deliver components whole, meaning that some had to be assembled underground.

The tunnel was split into four sections, and each section was constructed in the same way – installing temporary structures and cables, which were systematically replaced by permanent ones, starting with the track in order that equipment and materials could be transported to the work site, and then catenary system to supply the electrics. There followed wiring, data points, technical systems and testing equipment. Measuring technology provided by Leica Geosystems and Amberg Technology was in constant use, ensuring that everything was carried out correctly on the first attempt.

Tunnel Boring Machines

The tunnel boring machines, named Gabi I and II, Sissi and Heidi, are big girls; S-210s and S-211s respectively. Both weighed more than 2,700 tonnes and were 8.8m in diameter for the first part of the tunnel, before being refitted with 9.4m heads for the second. They were both 440m long and tunnelled up to 40m per day requiring 17 men to operate them. They were operational 320 days a year. They cut through slate, gneiss and granite with 62 roller bits, requiring 2,500 kW energy to propel them, shifting a total of 28million tons of rock. The machines for the project were built by Herrenknecht AG.

Trackwork

The trackwork was undertaken by Balfour Beatty and Renaissance construction, who installed Sonneville Low-Vibration Track in both tunnels over the course of 39 months. The construction took 125 engineers working in shifts for 24 hours a day, seven days a week to lay 380,000 sleeper blocks, pour 131,000m2 of concrete and lay 290km of rails.

Catenary System

The R250 GBT overhead catenary system in the tunnel is cutting-edge; the overhead conductor rail consists of an aluminium profile and the copper catenary wire clamped inside, delivering the same power as a standard catenary system but reducing installation space, meaning that the tunnel diameter is smaller than would be expected from a standard overhead cabling system. The system is capable of supporting trains travelling at speeds of up to 250km/h. A peak value of 2,220 A over any 15 minute period in the R 250 GBT system meant that a parallel feeder cable was required.

Installing 57km of cable into two single-track tunnels was a logistical feat in its own right; installation specialists Kummler+Matter and Balfour

Beatty Rail undertook the venture. The saline conditions required that all components needed to be made of hot-galvanised steel, with all screw joints and relevant fixtures heavier than aluminium. Re-tensioning devices, cantilevers, drop tubes, feeder supports and silicon insulators were all tested extensively to meet the demands of the environmental conditions within the tunnel.

The tunnel holds 2,800km of cables for power supply and data communications. NKT Cables provided 170km of 120mm2 CuAG contact wire and 70mm2 of Bz messenger wire, as well as 850km of copper overhead lines, in addition to 100km of Al wires of different cross-sections as feeder and return conductors were being installed.

Signalling

Thales were the preferred bidder to supply the interlocking and signalling systems for the 300 trains per day that will run through the tunnels at speeds of 140km/h to 250km/h. The system installed will be European Train Control System Level 2 (ETCS 2), the standard signalling control system in Europe.

The ETCS signalling, control and train protection system, which was developed with the support of the European Commission in order to standardise signalling and control systems in Europe to enable easier cross-border travel, is an automatic train protection (ATP) system. It relies on real-time monitoring and communication between the radio block centre (RBC), track, cab and other trains, taking into account location, speed, predicted speeds (on bends, for example) and infrastructure integrity. It then analyses this data automatically and sends instructions directly into the train cab to instruct the driver on the safest and most efficient routes. The system does away with the need for red lights and manual braking.

Ventilation and Cooling System

The ventilation and cooling system was a two-phase project; the first was for the construction phase and the second is for passenger systems. During construction, with diesel engines, machinery, heat from the rock mass and tunnel walls, and the tonnes of cement which heated as they hardened, the cooling system was required to maintain acceptable working conditions.

It also had to be a compact system that would not interfere with the installation of the catenary system and track laying, and, to fulfil safety requirements, include airlocks at four points along the length of the tunnel. The incident tunnel had to be pressurised in order that it remain smoke-free in the event of a fire, and the fans and cooling towers had to be as unobtrusive as possible, and the whole system had to be robust enough to survive the environmental conditions.

Tunnel Control System

The tunnel control system was provided by Siemens who installed their LP60 Tunnel Control System, a pair of tunnel control centres (TCC) at the north and south portals of the tunnel, which will house two fully redundant Tunnel Control Systems (TCS). These systems monitor and control all of the electrical systems in the tunnel, collecting, consolidating and visualizing data in order to provide maintenance management strategies as well as emergency responses. A secondary, identical TCS is installed in the TCCs as backup, guaranteeing the highest level of safety.

The tunnel is continuously monitored, any malfunctions are immediately reported and a

First Test Drive
© AlpTransit Gotthard Ltd.

Sedrun Shaft
© AlpTransit Gotthard Ltd.


© Herrenknecht AG

Installation of the Ventilation System at Erstfeld
© AlpTransit Gotthard Ltd.

message navigation system identifies the exact point of issue, for example, the status of radio communication equipment, emergency calls and status of lighting and track monitoring systems. By delivering a visual overview to the operator of the status of the tunnel and the location of trains in the tunnel, the operator has a clear understanding of the status of the tunnel at all times.

In emergency scenarios, the first point of interest is the rail traffic monitoring function. Once

detected, a notice of malfunction would be delivered to the relevant electrical system via the "tunnel reflex" facility which initiates all scenarios to address the malfunction: activating appropriate ventilation to the area, switching lights on, opening doors at appropriate points so that an emergency evacuation can take place.

The system even goes so far as to drain the storm water reservoir at the north or south end of the tunnel so that the water is accessible to fire-fighting operations and to change the ventilation routes to minimise smoke damage. The system issues step-by-step instructions to the operator as to each course of action to ensure procedures are followed.

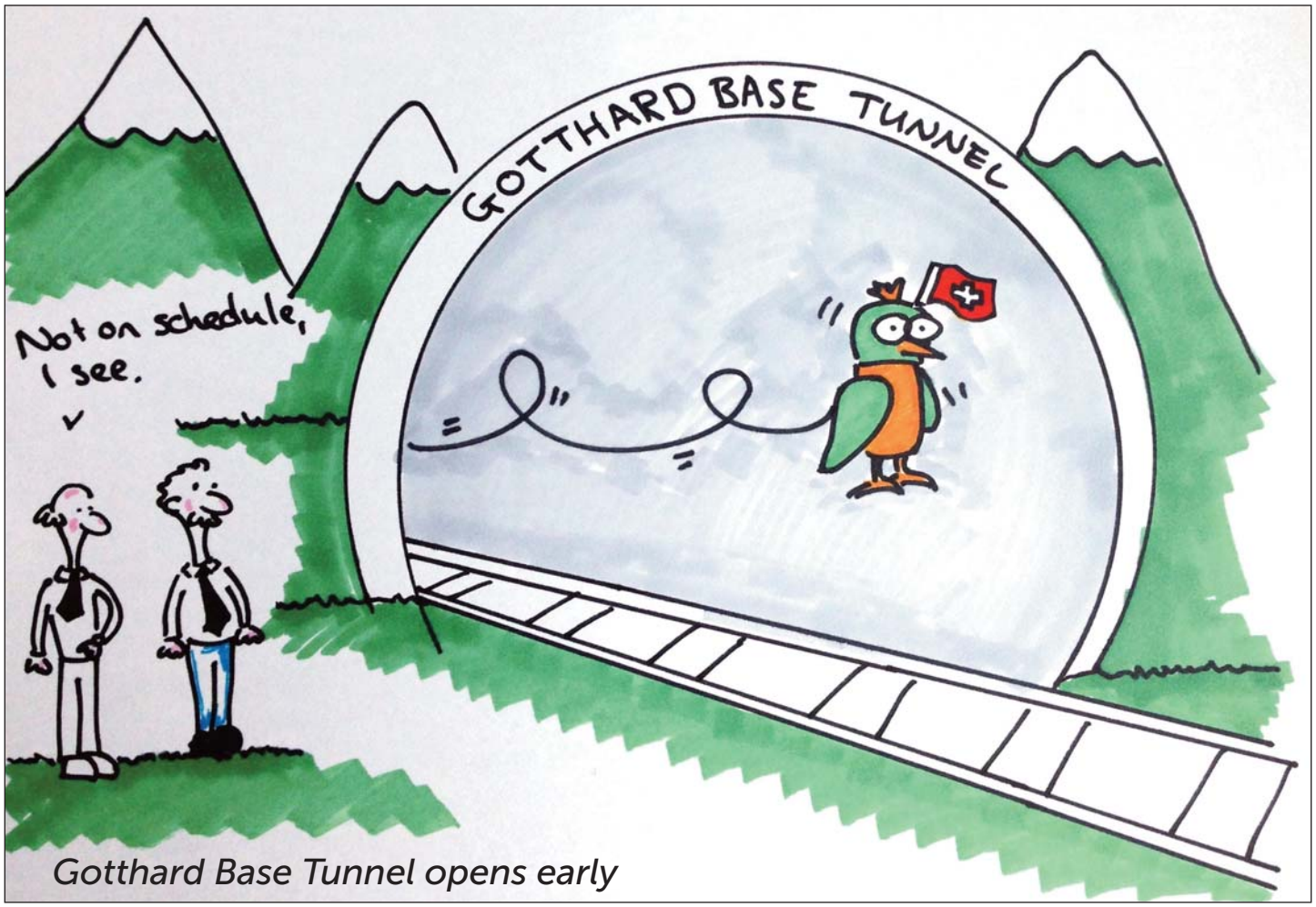
The system also enables reactive and predictive maintenance with a centralised planning system; alerting the operator as to what maintenance is required where, and even where the tools and components are stored with the relevant maintenance manuals.

Rolling Stock

Stadler Rail were the preferred bidder to supply the rolling stock for the tunnel. They have supplied 29 11-car EC250 trainsets, each 200m long with capacity for 400 passengers. They offer disability access with low floors and wide doors and aisles. They also have a dining car, quiet, family and business zones, and power-sockets at every seat. Their maximum speed is 249km/h.

A Once-in-a-Generation Project

The original Gotthard Tunnel used cutting-edge, innovative techniques in its construction; initially this was gunpowder and hand drills, boring around 75cm a day. Dynamite and pneumatic drills were introduced a year into the construction, increasing the boring rate to around four metres a day. It was physically demanding work in unsafe conditions, without the benefits of adequate cooling and ventilation systems, and no health and safety regulations to protect workers. That 15km tunnel, which is still in operation, was an engineering marvel of its day. It is therefore fitting that the 57km Gotthard Base Tunnel will be lauded as the engineering marvel of our generation.



Gotthard Base Tunnel opens early

Railway Bridges

By Josephine Cordero Sapién

Our railways have always been associated with major infrastructure projects. Just in the last issue of this magazine we saw the incredible engineering behind London's Crossrail project. In this issue we also look at the Gotthard Base Tunnel in Switzerland, a tunnel running 57km under the Alps, making it the longest railway tunnel in the world. It is set to open 1 June 2016. These engineering feats are not just reserved for underground construction, nor are they reserved for any particular period in history. The infrastructure projects of the past were just as impressive for their day as the engineering developments of our time. And indeed, the development of the railway was instrumental in driving forward the industrial revolution, a turning point in history for humankind. As our society has been transformed by ever-new innovations in every field including engineering and construction, away from a world of coal and soot and heavy materials such as iron towards light-weight, greener solutions, our railways have undergone the same transformation and now face a pivotal role yet again as the environmentally friendly, high-speed, clean form of transport for both passengers and freight.
As such, this article wants to celebrate some of engineering marvels that carry our railways: bridges. First we take a look at Forth Bridge in Scotland, which opened in 1890 and is a UNESCO World Heritage Site.

Forth Railway Bridge, Scotland accredited to: Dave Conner (http://ow.ly/10pXby), Creative Commons license

Forth Bridge
accredited to: Dr Michael Scuffil

Next, we look at the longest railway bridge in Europe, Øresund Bridge, which connects Sweden and Denmark and was opened in 2000.

Finally, we look at Yavuz Sultan Selim Bridge, or the Third Bosphorus Bridge in Turkey, which connects Asia with Europe. It is set to open in May/June this year.

Forth Bridge

Location: **Scotland, UK**
Completed: **1890**
Length: **2529m**
Type: **Cantilever Bridge**

The Forth Bridge in located in eastern Scotland. It crosses the Firth (estuary) of Forth, where the River Forth flows into the North Sea. Fife is located to the north and Lothian, home to the Scottish capital Edinburgh, to the south. Initially, the people who wanted to cross the estuary relied on ferries and indeed, there are records of a regular ferry service here dating back as far as the 12th century. Over time this ferry link become increasingly busy and the need for fixed-link crossing that was not weather-dependent became increasingly obvious[1].

At the same time it was known that a stiff wheel on a rigid rail was more energy-efficient than road transport per tonne-mile. It then became possible for the first time to mass-produce steel inexpensively in the mid-19th century. These two factor together triggered a period of great expansion of the railways. This development further highlighted the need for a bridge over the Forth. An engineer called Thomas Bouch put forward plans for suspension bridges to cross the Tay and Forth estuaries. Construction commenced, but the Tay Bridge collapsed, halting construction on the suspension bridge across the Forth. However, in 1881 John Fowler and Benjamin Baker submitted their plans for a bridge. They were approved by Parliament and construction of this bridge began in 1883 with the contract having gone to Messers Arrol & Co of Glasgow[3].

Forth Bridge is a cantilever bridge, meaning that it is constructed using cantilevers, i.e. horizontal structures that are only supported at one end, leading to a suspended span in the middle of the bridge. At the time of its construction, it was the longest cantilever bridge span in the world and even today it is still the second-longest[4].

During the peak of its seven-year construction phase, 4,600 men worked on the bridge. It is likely 63 men died building it and many were left crippled[5].

The early years of the bridge's construction were focused on building the granite piers. To allow the men access to the floor of the Forth, wrought iron cylinders were pushed into the riverbed; next the water was pumped out, providing the access. In fact, the bottom of these caissons had to be filled with compressed air for this reason, meaning the men had to go through air locks to access the site[6].

After the granite piers were complete, work began on the steel superstructure, first upwards, then outwards, allowing people to marvel at the sheer scale of the construction. Indeed, 53,000 tonnes of steel were used[7]. When it was complete, the bridge underwent load-testing, taking twice the load the bridge was designed for. In February 1890 the first complete crossing took place[8]. When the bridge was formally opened the following month by the Prince of Wales (later King Edward VII), he knighted Benjamin Baker during the ceremony[9].

The bridge runs a double track. In 2000, 54,080 passenger trains crossed the bridge, with 190–200 trains a day in 2006[10]. It is now owned by Network Rail.

The bridge was put forward by the UK Government as a candidate to be included on UNESCO's list of World Heritage Sites in 2011. In 2015 it was inscribed on UNESCO's list as a building of special architectural or historic interest, under criteria i and iv. UNESCO says:
"The Forth Bridge is an extraordinary and impressive milestone in the evolution of bridge design and construction during the period when railways

Øresund Bridge and Peberholm Island

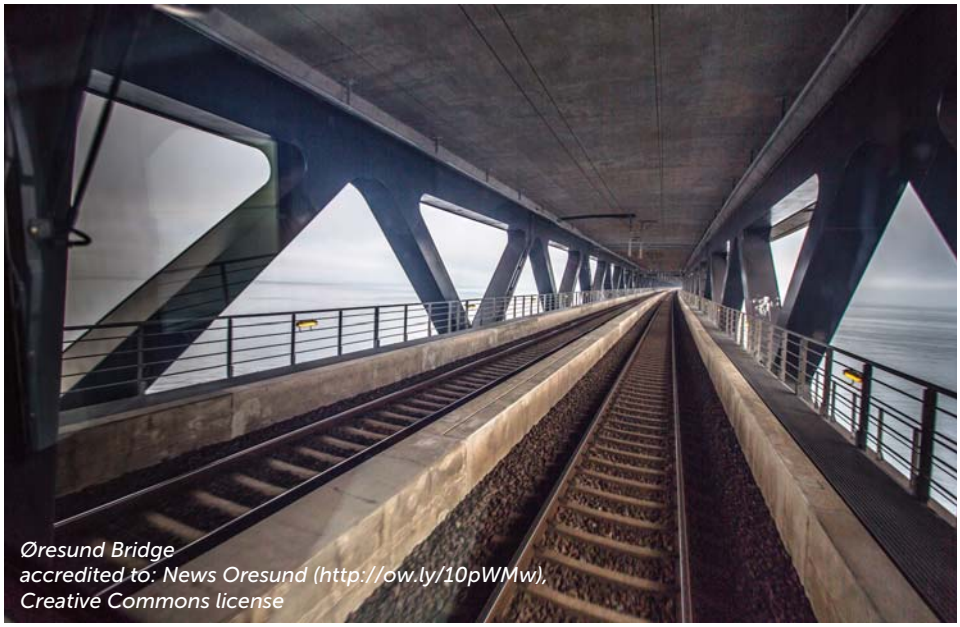
came to dominate long-distance land travel, innovative in its concept, its use of mild steel, and its enormous scale."[11]

Øresund Bridge

Location: **Sweden / Denmark**
Completed: **2000**
Length: **7845m**
Type: **Cable-stayed Bridge**

The Øresund Bridge is both a railway bridge and a road bridge. It crosses the Øresund Strait that runs between Sweden and Denmark. It crosses from the Swedish mainland to the artificial Danish island of Peberholm in the middle of the strait, whereupon the bridge joins the Drogden Tunnel, which emerges at Kastrup on Amager Island. Peberholm Island itself is a nature reserve that was made of the rock and soil dredged up when the bridge and tunnel were constructed[12].

The governments of Sweden and Denmark first agreed to build this bridge in 1973. The combined road/rail plans were approved by the Danish and Swedish parliaments in 1990. Construction ultimately began in 1995 and was completed in 2000[13]. The purpose of the link shifted over time, but the key objectives were to improve connections between northern Europe and Scandinavia, to promote regional development, taking into account Sweden's decision to apply for membership of the European Community, as a connection between the two largest cities in the region as they were struggling economically, and to improve access to Kastrup Airport, the main airport in the area[14].



Øresund Bridge
accredited to: News Oresund (http://ow.ly/10pWMw), Creative Commons license

As a cable-stayed bridge, it has two pylons on which cables are mounted that support the bridge structure. The 203.5m pylons are 490m apart, meaning that this bridge has the longest cable-stayed main span in the world for rail traffic[15]. The construction of the bridge was awarded to the Sundlink Contractors with 95% of the workforce coming from the Øresund region. During the peak construction period, around 5000 workers were involved, including off-site workers in Sweden and Spain. The sand and steel used came from Denmark, the granite from Sweden and quarried material from Norway[16].

Being in such an environmentally fragile area, the most stringent environmental regulations were adhered to with more than US$300 million being spent on environmental protection during the construction phase. Another major green benefit of this bridge is that the switch away from ferry travel across the strait has reduced air pollution in the area[17].

The rail track is a double track at standard gauge and the trains can travel up to 200km/h. The railway was completed on 1 December 1999, however, as Denmark and Sweden have different electrification and signalling systems, it was agreed that the railway would use the Danish standard over the crossing before switching to the Swedish standard

at the bridge's eastern end. Now more than 150 trains cross the bridge every day[18].

The bridge was opened on 1 July 2000, several months ahead of schedule. The bridge has featured in the news more recently as Sweden was granted a temporary exemption from the Schengen Agreement in January 2016 in light of the European migrant crisis. All travellers across the bridge have to carry photo ID, the first time in 60 years that identification has been required between Denmark and Sweden.

Yavuz Sultan Selim Bridge

Location: **Istanbul, Turkey**
Completed: **May/June 2016**
Length: **2164m**
Type: **Hybrid Cable-Stayed/Suspension Bridge**

Also known as the Third Bosphorus Bridge, this bridge will provide another link between the Asian and European sides of the Turkish city of Istanbul across the Bosphorus Strait. It is a combined road/rail bridge.

The purpose of the bridge is to address busy traffic in Istanbul by connecting the motorway to the city centre. It will also create a transport route for freight traffic between Turkey and Greece. In addition it is hoped that this bridge will aid with Turkey's goal of becoming one of the ten biggest economies in the world by 2023. It is to be a definite landmark feature for the country.

And it is indeed impressive. When complete, it will be the widest suspension bridge in the world, measuring 59m. It will also be the highest pylon in the world, standing tall at 322m[19], which also makes them taller than iconic structures such as the Eiffel Tower. Finally, it will be the longest suspension bridge in the world to also feature a rail system.

The bridge was designed by structural engineer Michel Virlogeux and Swiss company T-Engineering. Construction commenced in 2013 and has cost US$ 3 billion. The project is being delivered by IC Ictas – Astaldi Consortium. The bridge is expected to generate around 7000 jobs in construction and 500 operational jobs. Being both a road bridge and a rail bridge, the design features oblique suspended cables along with the traditional suspended cables in order to cope with the extra load. A derrick and a strand jack were used to lay the steel deck segments.

As the site is in an earthquake zone, situated on the Anatolian fault, the bridge design has also planned for severe earthquakes. The designing structural engineer Michel Virlogeux said: *"Earthquake is a big question mark in Turkey. Thankfully, the Bosphorus Region is more secure seismically when compared to İzmit shoreline. It is at a level of one-third of the İzmit shoreline. Our bridge was designed in a way that it will not be affected from any earthquake thanks to its flexibility."* [20]

The rail section of the bridge will have one high-speed track running in each direction. They are to have 25kV overhead electrification. The maximum length of the trains on the bridge, both freight and passenger, will be 400m with the freight trains being allowed to travel at 80km/h and the passenger trains at 160km/h. The rail system will run from Edirne to Izmit. Furthermore it will be connected to the Marmaray and Istanbul subways to make airport access easier[21].

The Yavuz Sultan Selim Bridge is a truly international project with French, Belgian and Swiss designers, Italian contractors, a South Korean sub-contractor and a Turkish main contractor. Michel Virlogeux called it the most important bridge under construction in the world right now.

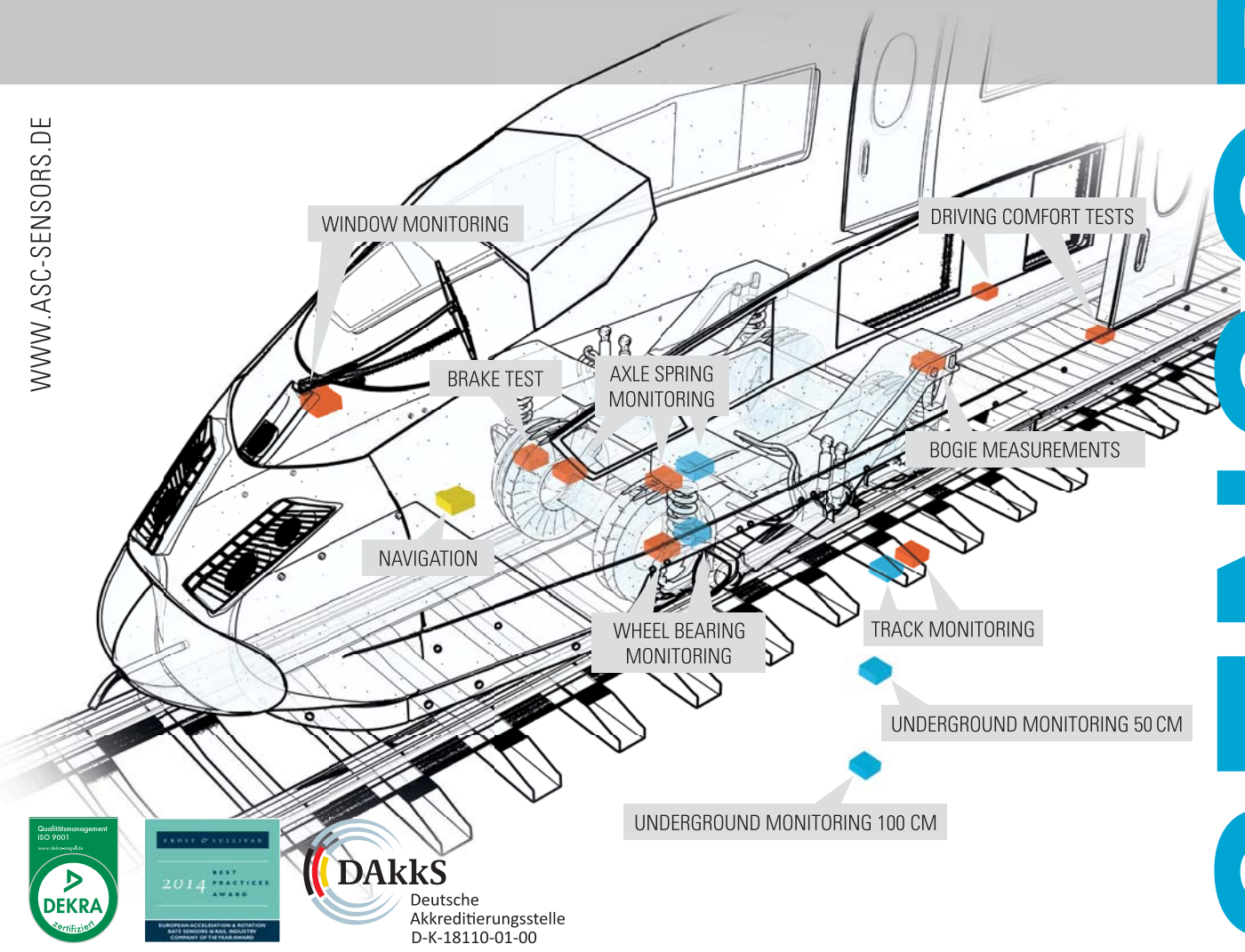
At 208m, during Third Bosphorus Bridge construction accredited to: Ugur Ceylan (http://ow.ly/10pW77), Creative Commons License

ASC
Advanced Sensors Calibration

Commissioning Applications.
Condition Monitoring Applications.

ASC SENSORS

WWW.ASC-SENSORS.DE



Qualitätsmanagement ISO 9001 DEKRA zertifiziert

FROST & SULLIVAN 2014 BEST PRACTICES AWARD

DAkkS Deutsche Akkreditierungsstelle D-K-18110-01-00

TESTING & COMMISSIONING APPLICATIONS

- Passenger Comfort & Ride Quality
- Brake & Crash Testing
- Modal Analysis
- Commissioning Tests in Laboratories

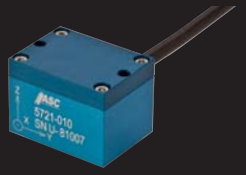
CONDITION MONITORING APPLICATIONS

- Bogie Monitoring
- Wheelset Monitoring
- Axle Box Bearing Monitoring
- Gearbox Monitoring

MISCELLANEOUS APPLICATIONS

- Track Condition Monitoring
- Ground-borne Vibration Monitoring
- Soil Quality Determination

CAPACITIVE ACCELEROMETERS



OFFSHORE ACCELEROMETERS

IEPE ACCELEROMETERS

ASC
Advanced Sensors Calibration

Acceleration and Rotation Rate Sensors

ASC (Advanced Sensors Calibration), headquartered in Pfaffenhofen, Germany, is one of the leading global manufacturers of acceleration and rotation rate sensors, and inertial measurement units (IMUs).

ASC sensors are used for crash tests in vehicle development, safety and wear monitoring of rail-bound vehicles, stability monitoring of turbines and measurement of fluctuations in container vessels.

ASC sensors are used in many different environments to perform a wide range of tasks, such as monitoring the vibration control of high-speed trains at injection-moulding machines. Diverse areas of application often require precisely customised solutions. Therefore, ASC experts co-operate with customers to develop new sensor solutions and customer-specific adjustments of individual parts, including cables, plugs and modified housings to customise sensors.

Typical applications of ASC sensors in the railway sector

1. Rolling Stock Testing & Commissioning Applications

Modal Analysis: modal parameters like resonant frequencies, structural damping, and mode shapes are essential in predicting the behavior of the train structure and providing inputs to the FEM model

Passenger Comfort & Ride Quality: the ride comfort index determines how good the vehicle and the track perform

Brake & Crash Testing: trains are driven into a solid barrier to determine crash survival; braking distance measurements and braking assessments

Commissioning Tests in Laboratories: measuring vibrations on in-service components; dynamic test of running, accelerometer-based method

2. Service Provider Applications

Bogie Monitoring: vibration sensors monitor the stability of bogies and the wear and functionality of shafts, brakes and wheels

Wheelset Monitoring: wheelset condition monitoring is implemented by a vibration sensor mounted on the axle box housing or integrated into the axle box bearing

Axle Box Bearing Monitoring: axle box bearing elements generate specific dynamic frequencies that can be analysed with additional knowledge of certain geometry data and shaft speed

Gearbox Monitoring: all rotating components of a bogie produce a typical vibration spectra, which makes it possible to identify each component via the frequency

3. Infrastructure Management

Track Condition Monitoring: track condition monitoring relies on the influence of the track condition on the ride quality as experienced by the passengers or by the driver

Ground-borne Vibration Monitoring: field measurements using accelerometers at different distances from the middle of the railway track (for instance, accelerometers mounted 50cm below the ground) to detect impact on nearby buildings

Soil Quality Determination: data is collected on the axle boxes of the test train, on the track, in the free field and in the buildings close to the track to check if the soil is suitable for track layout

			
ASC's capacitive accelerometers are used in ride comfort tests	ASC's Offshore accelerometers are used for bogie and wheelset monitoring	ASC's Industrial accelerometers are used for monitoring gearboxes and axlebox bearings	ACS's miniature triaxial IEPE accelerometers are used in modal analysis applications

Gyroscopes to measure rotating rate
ASC also produces gyroscopes to measure the rate of rotation (turn). ASC gyroscopes are based on MEMS Technology, which means that the sensors are shock-resistant and have a steady signal. ASC gyroscopes are offered in both uniaxial and triaxial models; both come with a range of 100°/s, 300°/s and 1,500°/s.

Inertial Measurement Units
IMUs (Inertial Measurement Units) are also part of the ASC product mix. The IMUs include three acceleration and three rotation rate sensors each, which measure along a total of six axes. The IMUs are used for driving comfort inspection and for indoor localisation in rail-bound traffic.

The ASC IMU is based on MEMS gyroscopes and MEMS accelerometers. The IMU can be obtained with acceleration range of 2g, 5g and 10g, and rate range of 100°/s and 300°/s.

Worldwide railway industry reach
ASC has catered to many leaders from around the world in different industries with the high quality of its products its customised solutions.

In 2010 ASC developed tailor-made sensors that are used at the bogies within the scope of a new monitoring system for Siemens Mobility's new Velaro-D high-speed trains. In order to control the oscillations of the bogie, the sensors designed by ASC are directly attached to the bogies. The acceleration sensors operate at a low frequency and are based on MEMS technology.

Repair and calibration service
ASC offers comprehensive services for sensor maintenance, repairs and calibrations for ASC and third-party products. DAkkS awarded the calibration laboratory of ASC the authority to execute calibrations according to DIN EN ISO/IEC 17025:2005 for acceleration.

ASC produces its products in small batches and with short delivery times, which is crucial for use in development departments. ASC is DIN ISO 9001-certified and ASC products meet a high quality standard that is ensured by production at its Pfaffenhofen site.

In the area of railways, ASC co-operates with leading players including Alstom, Balfour Beatty Rail, Beijing Environment Institute, Faiveley Transport, Italcertifer, Siemens Transportation Systems, Siemens AG Österreich, Strainstall, Trenitalia, IMC Test & Measurement and TÜV SÜD Rail GmbH, among others.

Frost & Sullivan Award

Based on the analysis of the rail acceleration and rotation rate sensors market, Frost & Sullivan recognized Advanced Sensors Calibration (ASC) GmbH with the 2014 European Frost & Sullivan Company of the Year Award. The award from Frost & Sullivan looks at the emerging market players in the rail industry and recognises their best practices that are positioned for future growth excellence. ASC has not only consistently delivered advanced technology and high-quality service, but has also improved its product range and expanded into other continents to emerge as a truly global competitor.

Contact Details:
ASC GmbH
Renate Bay, Managing Partner
Schäfflerstraße 15
85276 Pfaffenhofen
Tel.: +49 8441 7865470
Fax: +49 8441 7865479
Email: r.bay@asc-sensors.de
URL: www.asc-sensors.de

The Single European Railway Area

The European Union has set itself the ambitious goal of establishing a single European railway area, both for freight and passenger transport, with the aim of delivering an efficient, coherent, competitive rail transport system throughout the Member States.

By Josephine Cordero Sapién

©European Railway Agency

A lack of Harmonisation

There are many elements in any one country's rail system that can differ from those of a neighbouring country, making cross-border travel difficult, inefficient and time-consuming.

Starting with basics, trains can only run on one specific gauge track. Indeed, the reason why countries have different gauges in the first place was to prevent trains from another country from being able to use it.
Most of Europe has standard gauge track at 1435mm. However, Russia, Finland, Belarus and the Ukraine for example run on the Russian gauge at 1520mm or 1524mm, while Spain runs on a wider gauge of 1668mm.

Another non-standardised feature has been signalling. There are 19 different signalling systems within the EU, meaning that train drivers crossing borders would have to be familiar with more than one set of rules. For example, the Thalys PBK crosses 7 different signalling zones.

The different countries throughout Europe also use different electrification systems. Countries like Germany, Austria, Norway and Sweden use 15kV AC, while Portugal, northern France and the eastern European countries use 25kV AC, to name but two differences.

Safety standards and certification also need to be harmonized throughout Europe to bring all countries up to the same high standard and substantially reducing the risk of serious accidents.

The Single European Railway Area aims to tackle these issues to bring interoperability to the European rail network. Technical, regulatory and operational restraints would be removed. Apart from being simpler, these measures would make rail travel cheaper. Trains also have to be authorized in every Member State individually, which costs millions. Innovation takes a hit as well as new rail operators and new technical equipment struggles to find a way into the market.

Given that the Commission has stated in its Transport 2050 roadmap that it aims to ultimately have a complete European high-speed rail network, to triple the length of the existing high-speed rail network by 2030, to maintain a dense rail network throughout the Union and to move most medium-distance passenger transport to the rail sector by 2050, it is vital technical, safety and administrative standards are harmonized to open markets, promote competition and make the European rail network an efficient, cost-effective transport option.

The First Railway Package

The European Commission presented three proposals in 1998, which were then adopted by the Council in 2001 in the First Railway Package, or the 'rail infrastructure package'.

The directives in the package were:

- 2001/12/EC
- 2001/13/EC
- 2001/14/EC

The aim of this package was to give rail operators non-discriminatory access to the trans-European network and to improve Europe's freight choices, meaning that operators should have open access to railway lines even when thy do not own that rail infrastructure.

After directives get adopted by the EU, they are passed on to the Member States, whose job it is to implement them. In 2006 the Commission found that implementation of this package was not yet complete though it was already showing very positive effects. The fall in rail's market share has stabilised and it found that rail traffic did best in those countries where the rail freight market had been opened up relatively early, finding that *"between 2000 and 2005 Member States in which non-incumbent railway undertakings have undertaken the highest market shares achieved significantly better results in terms of rail freight traffic performance than Member States in which the market was still dominated by a monopoly"*[1].

The set of directives do not require that operating companies are private companies. The goal was to take the monopoly out of the rail freight sector to increase competition. It is now easier for companies to operate in other countries, though it must be noted that companies could still assert themselves on an international level to exercise market dominance.

The Second Railway Package

In 2002 then the European Commission put forward further measures with the goal of creating an integrated European railway area and increasing safety and interoperability. This second package was then adopted in 2004 in result of which the rail freight market became fully open to competition from 1 January 2007 (2004/51/EC).

It was also as part of this package that the Commission put forward regulation 881/2004, which sets up the European Railway Agency, which says about itself: *"The construction of a safe, modern integrated railway network is one of the EU's major priorities. Railways must become more competitive and offer high-quality, end-to-end services without being restricted by national borders. The European Railway Agency was set up to help create this integrated railway area by reinforcing safety and interoperability."*[2]

The Third Railway Package

The Third Railway Package contained proposals to open up the international passenger transport market by 2010, to harmonise passenger rights and to certify train crews. It was adopted in 2007.

This package introduced a European driver licence meaning that train drivers are allowed to work on the whole European network. To obtain this licence they will have to meet standards regarding their level of education, age, mental and physical health and practical training.

All passengers on all lines will enjoy a the same set of rights throughout the Union, for example, passengers with disabilities or reduced mobility may not be discriminated against[3]. Passengers now enjoy basic rights with regard to insurance and ticketing too.

Recast of the First Railway Package

In September 2010 the European Commission opted to amend the First Railway Package directives to simplify and reinforce the contents by bringing together the three directives and their amendments in one text. This recast must be implemented by Member States by April 2015. Some problem areas have also come to light in the past ten years,

which the recast will address, namely:

- "clear rules for the funding and management of infrastructure
- access to rail-related facilities (depots, maintenance etc.)
- independence and competence of regulatory bodies"[4]

The Fourth Railway Package

The Fourth Railway Package, which contains six legislative proposals from the Commission, aims to nurture competitiveness and innovation in domestic passenger markets as well as increase safety, interoperability and reliability.

There are four main goals: firstly, reduce costs for rail companies and make the European Railway Agency "the single place of issue for vehicle authorisations and safety certificates for operators"[5]. Secondly, train companies need to be wholly separate from the infrastructure managers to deliver financial and operational independence. Thirdly, this most recent package aims at opening up domestic passenger railways to competition, making "competitive tendering mandatory for public service rail contracts in the EU"[6]. This would come into effect in December 2019. Finally, the package seeks to pass measures that are designed to maintain a skilled, motivated workforce in this environment.

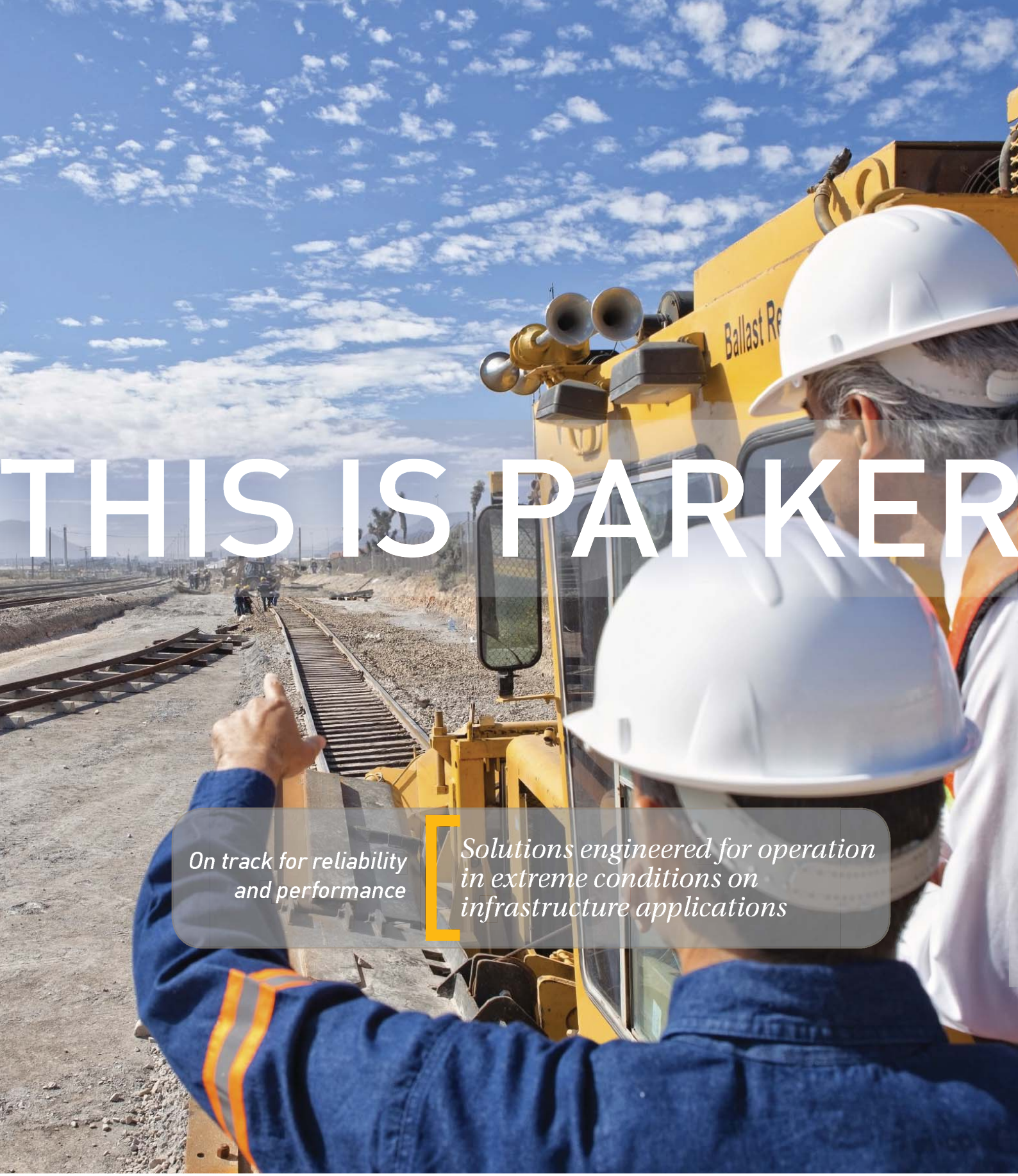
The Council has adopted the Fourth Railway Package at its first reading in December 2015. The next step is for the European Parliament to approve them formally at the second reading.

On 1 January 2014 the EU launched its Trans-European Transport Network, TEN-T, which identifies nine major transport corridors across the EU with the following aims:

- "remove bottlenecks
- build missing cross-border connections
- promote integration and interoperability between different modes of transport"[7]

This transport network will connect Europe north-south and east-west, allowing both passengers and freight to move freely and seamlessly throughout the Union.

With the creation of such a European-wide rail network that accesses the entire continent and with policies put in place that cut red tape and make it easier for companies to operate throughout the Member States, rail travel will become simpler and cheaper for operators and therefore more desirable for customers, both private passengers and freight companies. These two features together, along with other supporting undertakings (see the Bombardier interview in this issue about the role of Shift2Rail in the creation of a Single European Railway Area), will ensure that rail's modal share will increase, providing innovation and jobs in a sector that is environmentally friendly, convenient and cost-effective.



Parker's Xtreme solutions, manufactured to meet rail industry and international standards, enable rail industry partners producing track installation and maintenance vehicles to reduce costs; enhancing both life span and reliability.

Could you benefit from working with Parker's dedicated transportation team; ready to respond to your performance, application, cost, weight and space challenges?

Parker

ENGINEERING **YOUR** SUCCESS.

rail@parker.com
parker.com/rail

Sharing Risk to Take Risks

Railway-News Speaks to Bombardier about Shift2Rail

By Naomi Thompson

The cornerstones of the European Union are the principles of multi-national co-operation and raising the standard of products and services for all European citizens. It was inevitable, therefore, that the rail industry would at some point benefit, in the form of Shift2Rail. The Project Manager EU-funded R&T Projects, Richard French, from founding member Bombardier, took the time to speak to Railway-News about their involvement with Shift2Rail.

A Shared Vision

In the early years of this decade, there was an alignment of circumstances that engendered the creation of Shift2Rail: the frustrations of key European stakeholders with the fragmentation of the rail industry; the political will to address this at both a national and European level; an injection of funds by way of the Horizon 2020 research and innovation programme; and the pressures of non-European competitors to render an initiative like Shift2Rail a necessity in order to survive.

A series of publications from 2011 onwards, beginning with the white paper *"Roadmap to a Single European Transport Area – Towards a competitive and resource-efficient transport system"* setting out the first blueprints of the Single European Railway Area, followed by the publication of the "European Rail Research Advisory Council's Rail Route 2050" in 2012 among others, all of which created and were part of a growing momentum to homogenise the rail industry across all 28 Member States of the EU.

Prior to 2011, collaborations between companies were on a one-on-one basis; it was typical for Bombardier to team up with another company and a university to address a certain issue or topic. The industry was fragmented and evolving according to that fragmented design rather than a cohesive master plan. As it stands at the moment, Mr. French points out, there are more than 50 variants of ETCS (European Train Control System) in Europe, requiring 50 systems, 50 operators, 50 training regimens; in some instances drivers or trains have to be changed at national borders in order to meet the requirements of different Member States. This system is not tenable in the long-run.

Therefore, Bombardier and other big hitters in the industry, all co-ordinated by the European Rail Industry professional association, UNIFE, established the Joint Undertaking in 2014 to oversee a programme of research and development for the railway sector. With a budget of €920million (from 2014–2020) it supports market-driven solutions by enabling and investing in new and cutting-edge rail product innovations.

The specific aims of Shift2Rail are to enhance the competitiveness of the European railway industry by

doubling the capacity of the European railway system, increasing its reliability and service quality by 50% and halving lifecycle costs. In a more general sense, the initiative's ambition is to accelerate innovation and technology and to standardise and harmonise the European rail industry in order to remain competitive in an increasingly international market. By bringing the best minds from leading companies to the table, the issues facing the rail industry are brought to the top of the agenda.

Shift2Rail is part-funded by private investors and the EC. Its eight core members are, in addition to Bombardier, Alstom, Ansaldo STS, CAF, Network Rail, Siemens, Thales and Trafikverket. It also has 19 associate members and input from academic, industry and regulatory bodies on a number of committees that serve in an advisory capacity.

©Bombardier

Richard French - Project Manager
EU-funded R&T Projects
Bombardier

Sharing Risk

One of the key motivations which attracts governments and companies to support and apply to join Shift2Rail is that, by collaboration rather than competition, the risks associated with accelerations in innovations can be shared and therefore increase the positive impact on the whole industry should it work out, and minimise the negative impact on one company or body should it not.

Richard French said:

"We are able to collaborate on a high level to address problems that would not be possible for one company alone. That has always been one of the primary incentives for companies to apply and for Member States to support Shift2Rail."

Initially the focus was on traditional segments, such as mechanical and electrical engineering, lightweight solutions and propulsions. Increasingly, there is more interest in digital aspects such as big data, data collection and analysis, predictive maintenance services and security, as well as looking at improvements that could be made to the supply chain and customer-facing elements, including customer service, ticketing, information and infotainment. A greater importance is placed on energy-efficiency and environmental sustainability.

Sharing Knowledge

Mr. French describes the initiative as having a collegiate ethos, the companies involved enjoy an open and trusting culture. Having come from a corporate environment, individuals were initially tentative, *"can I talk to this person?"* was a common question, sharing ideas was counter-intuitive, but this was overcome. For the greater good, and from the top down, it was clear that all the members would respect each others' ideas and claims and they would be free to discuss controversial topics which would ordinarily be off the table for representatives of competitors.

In the establishment of Shift2Rail, it was required that members find compromises that didn't necessarily mean that everyone was fully satisfied, but the greater good has generally prevailed, with *an understanding that "relying and insisting on proprietary rights did not engender a sustainable way of working, that the future had to be different."* Although there is still room for intellectual property and copyrights, it has dawned on the key players that the old way of thinking is

outmoded in an ever more inter-connected and high-speed world.

For example, Shift2Rail wanted to follow the structure of the European Space Agency Joint Undertakings. With the help of the EU legal services, an agreement was hammered out that everyone could live with, and with each member allowed to play to their strengths; members with stronger research departments will contribute research, those with stronger technology development departments will contribute to that area, and so on.

As such, it has been an adaptive process. As issues have presented themselves, solutions have been found by way of an ongoing collaborative approach. There is very much the sense from Mr. French that a solution has been found to include all members in that process, and to speak with one voice. It is the highest of European ideals from start to finish – in the process as well as the product.

This collaboration has enabled innovation – it is jointly agreed by the members as to what should be subject of the innovation programmes and what the intended result would be. Each and every good idea is needed to achieve the goals of Shift2Rail; if a good idea will bring with it an improvement then the members are open to discussing it as part of an ongoing process, but not one that will hinder development. This is especially important in the innovation of digitalisation; with new technologies coming out every day, the industry is losing ground with every piece of bureaucracy that could delay the process.

Sharing Results

The creation of a homogenised, cohesive railway sector in Europe is not only of a benefit to the industry, but also a cultural benefit. In order to increase the market size and competitiveness, a team effort is invaluable. It is hoped that the collaborative ethos of Shift2Rail will bleed into the industry as a whole, moving away not only from different standards between corporations but also countries. As such, it is a bold step towards a united front that can stand together against the challenges facing the industry now and in the future.

By contributing to the increasing accessibility of rail corridors, which will become standard and enlarged in every country, there is expected to be a knock-on effect on economics and trade, while improving the experience of European citizens. The model is simple and inarguable – by freeing up resources usually spent on proprietary standards, issues such as energy management and energy reduction, as well as vibration and noise reduction can get some real attention, reducing the impact for people living close to railways. It will also make life easier for train operating companies, for customers and Member States by making it easier to save energy and meet their COP21 CO_2 targets.

A Shared Future

As a European initiative, Shift2Rail is governed on several levels, requiring regular meetings and multi-annual action plans, reports and high-level talks every few months to discuss the status of funding and procedure, as well as of progress and actions. Just the creation of Shift2Rail has been an extraordinary achievement. Only four years ago, *"not many people thought that Shift2Rail could be successful, there were many who thought it could never succeed. The industry has never worked in such a collaborative environment."* Just the creation of Shift2Rail and bring it to this point is, Mr. French says, *"is a project to be proud of."*

Activities will kick off this summer, the first cycle of open calls and grant applications have taken place. The members are now waiting to spring into action in the coming months in what promises to be an intense process of reinventing not only the rail industry, but the way things are done.

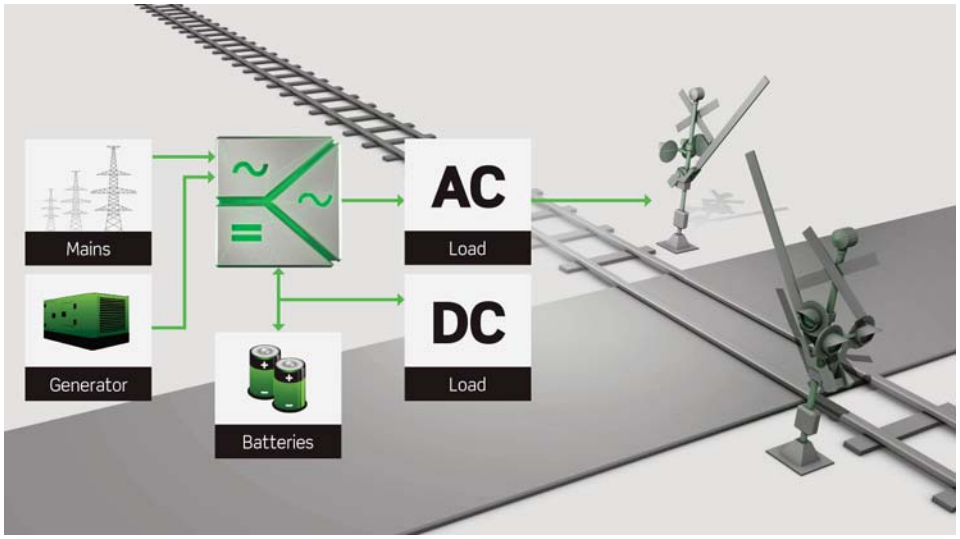
A breakthrough in power conversion ready for rail and metro

The Rectiverter is the world's first 3-port bidirectional power conversion module, combining the functionality of a rectifier and an inverter in one unit.

accredited to: Shutterstock

A railway network is a complex environment, with numerous critical and supporting applications – all relying on reliable and stable supply of power to work continuously and keep services running. Eltek's Rectiverter system significantly reduces complexity and increases overview, control and reliability of AC and DC powered equipment in the rail infrastructure.

In recent years, innovations in power technology have improved reliability and driven down cost. However, in rail environments, like everywhere else, there is a need for both AC and DC power. Today, there are a number of separate AC and DC power systems, sourced from different vendors. This entails separate training, separate monitoring systems and separate spares.



AC and DC power combined

The Rectiverter changes this completely. The Rectiverter is a 3-port bidirectional converter that provides both AC and DC power simultaneously. Whereas before you needed many systems or several power stages, now you only need one. This is a fundamental change. With its ability to feed both AC and DC applications, the Rectiverter system can replace many other systems. It reduces complexity, saves space and increases flexibility immensely.

Not only is it dual output, it is also genuinely modular and can be scaled according to future needs. It reduces wasted energy due to its high overall power conversion efficiency of 96% in mains mode and 94% when operating as an inverter.

Perfect for Rail & Metro

There are a number of Rail & Metro applications where the Rectiverter is a particularly attractive proposition. One example is level crossings, where, for obvious safety reasons, there are very long back-up times. Rather than using over-dimensioned AC UPS's with extra DC chargers, the DC capacity in the Rectiverter is sufficient to recharge the batteries. The added reliability with the modular design, redundancy and built in transfer technology, also adds to the attractiveness.

Reduced total cost of ownership

The bottom line is reduced total cost of ownership over the product's lifetime, and a future-proof power supply infrastructure for rail & metro environments. The Rectiverter is one of the the first new major power technology advances in rail & metro power conversion in many years.

The Rectiverter will make its debut at the Infrarail show in Eltek's stand (Stand B44).

ELTEK
A Delta Group Company

ELTEK
A Delta Group Company

Welcome to **a new world** in railway power

With both AC and DC outputs, the RECTIVERTER is a small revolution in the world of power supplies. It has the power to forever change the way you power your rail infrastructure equipment and applications.

Visit our stand
Infrarail 2016,
12 - 14 April,
Stand B44

Visit the campaign site
and find out more about the Rectiverter technology.

www.eltek.com/rectiverter

Universal Access to European Rail Transport

80 million people in the European Union are affected by a disability to some degree, which equates to around 16% of the total population.

By Naomi Thompson

With an aging population, this figure is expected to rise to 120 million by 2020, which will account for roughly a quarter of all European citizens.

"Disability" can cover a number of impairments, including limited mobility, visual and hearing impairments, intellectual impairments and mental illnesses. Some people may have multiple impairments. They range from slight to severe and have varying impacts on a person's ability to access public transport, and with it, independence and a full and active participation in society.

Wheelchair-accessible ramps at Fishbourne ©Network Rail

A Transport for London survey found that 93% of people living with disability say their impairments limit their ability to travel and get about, which, if extended across Europe, means that more than 70 million people in Europe suffer a lower quality of life for reasons flowing from their disability, rather than the disability itself. The rail industry is leading the charge, yet again, to amend this situation.

Because people with disabilities are often barred from driving cars by reason of their disability, they are more likely to be public transport users than able-bodied people. Although they are less frequent passengers because they are more likely to be unemployed and therefore have less requirement to commute, and also because the lack of access to

Senior ergonomist Kate Moncrieff and BEAP member Tracey Dearing try out the new platform surface from Pipex ©Network Rail

public transport precludes their use of it, both these elements would be positively impacted by universal access.

Accessibility and the Law

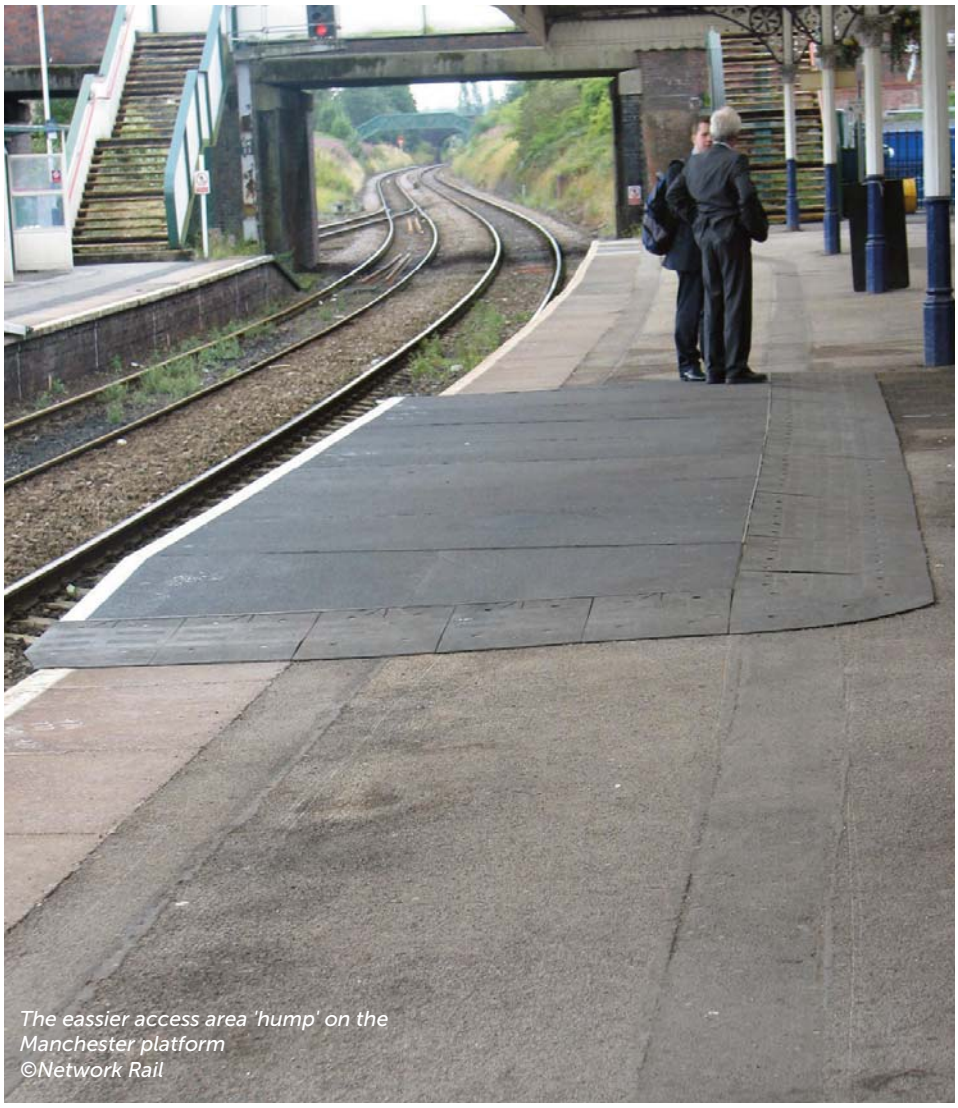
European Regulation 1371/2007 on Rail Passenger Rights sets out the rights of persons with disabilities and reduced mobility in relation to rail travel. This includes non-discriminatory access to facilities and services with no additional charge, access to information relating to the accessibility of facilities and services, free assistance on board trains and at staffed stations, and compensation if these needs are not met.

Primarily, it states that train operating companies and station staff should make all reasonable efforts to ensure that facilities and services are accessible to persons with disabilities and reduced mobility. In enacting this Regulation, Member States have created a fragmented and uneven marketplace, inhibiting cross-border travel as well as trade.

In response, on 2 December 2015, the European Commission proposed a European Accessibility Act (EAA), a pan-European legislative document which will require Member States to enable equal access to products and services. The EAA relates to, among other things, banking, telephony and audio-visual services, e-commerce and transport.

The EAA will put the principles of the 2011 UN Convention on the Rights of Persons with Disabilities (UNCRPD) into standardised practice based on functional requirements; rather than specifying the ways in which products and services should be modified, it only states what features need to be accessible. In the case of rail, this not only includes physical access to stations and trains, but also access to information and assistance.

People with disabilities and mobility impairments are a ripe market. Research conducted by the UK's Department for Transport found that journeys made by passengers with disabilities have trebled in the last 15 years in European countries which have taken firm action to accommodate them. Stakeholders are required to cater to their needs in law as well as ethically, but when they will account for 25% of the general population in only four years' time, catering to their needs also makes good commercial sense.



The eassier access area 'hump' on the Manchester platform
©Network Rail

Putting Law into Practice

Rolling stock manufacturers are now building and refitting trains and metros with accessibility features as standard. Siemens' ICE high-speed train, which operates in Germany, led the market in 2014, providing a large wheelchair space with height-adjustable tables and a service call button, as well as low floors, wide aisles and wide doors. In addition, it also features a tactile guidance system with floor strips and tactile seat numbers for sight-impaired

Mind the Gap

©George Redgrave (http://ow.ly/10iP7G) Creative Commons License: https://creativecommons.org/licenses/by-nd/2.0/)

passengers, grab poles in the longer-aisle sections and grab handles on all aisle seats, as well as stronger visible contrasts on internal and external doors.

Stadler's FLIRT (Fast Light Innovative Regional Train) is a market leader across the continent, and features space for wheelchair users, as well as wheelchair-accessible toilets, double doors and low floors to enable wheelchair access. Similarly, Alstom's Coradia Lint diesel trains all feature wheelchair-accessible features.

In designing the Flexity and MOVIA Series of Trams, Bombardier consulted with special interest groups in order to meet the needs of passengers with disabilities, increasing the number of priority zones and spaces for wheelchairs to eight in order to cater to the increasing usage of public transport by passengers with disabilities.

While much has been done to enable wheelchair users to board trains, and space has been made on trains to accommodate them, more attention is now being paid to a wheelchair user's safety in the event of a crash or secondary collision (colliding with objects internally), looking at such factors as wheelchair design characteristics, human factors and wheelchair space design structures in order to increase the safety of wheelchair users in the event of a crash.

However, despite advances in rolling stock meaning that wheelchair users can get on the train, many cannot get to it because of a lack of step-free access at stations. Only a quarter of London Underground stations have step-free access, and some step-free stations still have a gap between the platform and train. On the Paris Metro, of 303 stations, only 50 have step-free access, and even then only up to the train doors, with only one line featuring roll-on roll-off access on trains for wheelchairs. In Berlin, a more encouraging 92 of the 173 metro stations are accessible for wheelchair users.

Barcelona, which has been upgrading its Metro since 1992, has adapted an astonishing 140 stations out of a total of 156 to be wheelchair accessible. It also has voice-guided ticket vending machines on the whole network, door closure warning lights on most trains, a relief map of the metro network and a guide available in braille.

Passengers with Sensory Loss

Passengers with any impairment can request assistance to use most rail services in Europe. However, this limits spontaneous travel, is costly for service providers and train operating companies, and can be disempowering for the individuals in receipt of the service, as many would prefer to be able to use public transport independently.

Navigating around stations can be hazardous and frightening to passengers with visual impairments or blindness; multiple exits, entrances and access areas, ambiguous soundscapes and dense crowds can be confusing and intimidating. Features such as tactile paving are now standard at most stations, and increasingly, talking signs and emerging smartphone technologies, including infrared verbal guidance systems and tactile guidance systems, help.

The recent development of an app, which is being trialled in London, enables users to navigate their way around the London Underground using their smartphone and Bluetooth beacons, informing users that they're approaching escalators, ticket barriers and platforms. Technologies like this are especially useful in areas with limited cellular reception such as subways and underground metros.

Disabled Toilet
©'Médiathèque SNCF'

Passenger information is another key issue. Companies such as Infotec, who are supplying LED information boards to the UK's Crossrail project among other things, and who have designed the boards so that they are accessible to passengers with sight impairments, use the most easily read colours and fonts. In addition, next-train information boards are positioned above the platform edge doors (which screen the platform from the train) in order to make them easier to read.

For passengers with hearing impairments, travel information boards are crucial, especially on board trains where they are not as standard, or in the case of platform changes and emergency announcements. Text messages sent to the passenger are a standard by an increasing number of networks and operating companies.

Intellectual Impairments and Mental Illness

A key issue identified by special interest groups is that staff should be trained in assisting passengers with disabilities and impairments, and this is especially important for

passengers with intellectual impairments and mental illness, for whom travelling on public transport can be a confusing and frightening experience.

Invisible illnesses, such as anxiety disorders, social disorders, dementia and depression, as well as autism and Asperger's, are the largest source of disabilities in Europe, but largely unrecognised in disability figures. These illnesses can cause passengers to behave strangely in stressful situations, and a crowded station or train can be a stressful situation.

It is here that public awareness is important. At the first summit of its kind in the UK, the Mental Health and Transport Summit held on 25 February 2016, attended by TOCs, network operators and stakeholder groups, the needs of passengers with these invisible illnesses were discussed, and an "accessibility plan" will be drawn up and published later this year. It is likely that such initiatives will become standard across the continent as mental health issues become increasingly prominent in the public consciousness.

Concessionary fares for passengers with all disabilities are also crucial. In the UK, the costs associated with disability are an average of €600 a month, making transport unaffordable for many. With concessionary fares, passengers with disabilities are more likely to make use of transport networks that were previously out of reach. In the case of seat-only trains, such as the Eurostar and TGV, the spaces which would not be used are filled, making it profitable for operating companies.

In addition, providing access to public transport for people with disabilities means that they are more likely to work, more active and therefore many conditions are less likely or slower to deteriorate, and depression, long associated with physical disability, can be avoided altogether by enabling individuals to live full and participative lives. This, in turn, reduces the cost of disability on the state, which can only be good for everyone.

Disabled Seating on an e300 Eurostar
©Mark Smith - www.seat61.com

ALFAGOMMA Group acquires the entire share capital of the Hiflex Europe Group

Argus Fluidhandling Limited and Argus Fluidtechnik GmbH became part of the Italian Group

Vimercate, 15 January 2016 – On January 8, 2016 ALFAGOMMA Group, leader in the production and distribution of industrial hoses, hydraulic hoses and manipulated tube assemblies, acquired Hiflex Europe Group, a group founded in the UK with a long history of supplying hose and manipulated tube assemblies to global OEMs (Original Equipment Manufacturers).

Hiflex Europe Group contributes 40 million euro turnover to ALFAGOMMA Group working with prestigious and important clients. Hiflex Europe Group has over 320 staff and three production plants in Sunderland and Salisbury, England, and Ettlingen, Germany, strengthening ALFAGOMMA Group's presence in German and UK markets.

- This acquisition proves our willingness to grow coherently within our business model: a solid production base with cutting-edge plants and the local service

ALFAGOMMA Group will integrate the Hiflex Europe Group in a managed way over a period of time. The Hiflex Europe Group companies will continue to operate as Argus Fluidtechnik GmbH and Argus Fluidhandling Limited. The current management teams will continue to run the businesses with the exception of Mr David Oldham, former Chairman of Hiflex Europe Group, who retires at the end of January 2016.

that can meet the expectations of world class OEM groups, demanding irreproachable quality combined with the flexibility and responsiveness that only a worldwide presence can guarantee - say the brothers Enrico and Guido Gennasio, shareholders and Group Chief Executives of ALFAGOMMA Group - We are proud to consolidate the presence of our Italian company on the world markets. We expect this acquisition will further contribute to our objectives of always maintaining the maximum level of customer satisfaction and of becoming the best strategic supplier for our customers. Furthermore, with this acquisition, our goal of reaching 400 million euro turnover in 2016 appears much more achievable; however, the ambitions should not stop here. -.

Being one of the leaders on the world market for hoses and fittings since the 1970s and possessing the universally recognized brands, synonymous with high quality (Dunlop Hiflex, Argus), Hiflex Europe together with Dunlop Hiflex, acquired by ALFAGOMMA Group in 2005, is now returning to the international scene.

Hiflex Europe Group will benefit from the extensive technical and financial resources of the ALFAGOMMA Group, which celebrates its 60th anniversary this very year.

Making the railway more sustainable

RSSB's Sustainable Development Specialist Michelle Papayannakos, talks to us about what the industry is doing to make rail greener and gives us an insight into RSSB's Sustainable Development programme.

The railway industry is a significant energy user in the UK. Reducing energy consumption and therefore carbon emissions is fundamentally important for long-term global economic, social and environmental sustainability.
As the UK population continues to grow and with an increase in passengers using the railways the demand for new strategic infrastructure rises, as does the need to maintain, modernise and renew existing assets. In addition to this challenge, extreme weather events over the last few years have shown us that the rail industry must develop a 'predict and prevent' ethos to tackle climate change impacts on our rail infrastructure.

The Rail Industry Sustainable Development Principles:

These Principles represent the core values of the rail industry and are fundamental in delivering a sustainable railway at the centre of the transport system that meets the travel needs of society, without compromising future quality of life.

The principles' purpose is to inform and become an integral part of the industry's culture and decision-making processes, taking account of whole system and whole life cycle approaches. It is recognised that the principles will need to be balanced to achieve a sustainable transport system that contributes to prosperity, the wellbeing of people and the health of the planet.

In relation to energy and carbon the Rail Sustainability Principles necessitate:

- **encouraging a shift of passengers and freight from**

more carbon-intense modes to rail and accommodating increased demand for rail

- **reducing traction carbon intensity through new trains, further electrification and innovative technology**
- **reducing non-traction carbon usage through energy efficient technologies, including on lighting, heating and insulation. There are also significant opportunities for renewable energy generation on the railway estate, including solar photovoltaic systems, micro combined heat and power and heat pumps**
- **focusing on increasing understanding of whole life carbon, and identifying opportunities to reduce the emissions associated with the creation of an asset**

Sustainable Development is a programme included in rail safety body RSSB's innovation directorate and aims to embed the Rail Industry Sustainable Development Principles within the rail industry. This covers the environmental and socio-economic impacts on both the positive and negative aspects of the rail industry.

The activities of the sustainable development team narrate to the 4Cs (Capacity, Cost, Customer and Carbon).

The Rail Industry Sustainable Development Principles explained: Putting rail in reach of people Position rail as an inclusive, affordable and accessible transport system through the provision of information and accessible facilities.

The railway forms a means of accessing employment, health services and leisure activities for many people and should be accessible to all. This refers to the accessibility of the network for everyone and in particular in terms of:

- **Physical accessibility for the less able, elderly and those with children and/or luggage**
- **The availability of information on services and connections before and during travel**
- **The affordability of travel by rail**

Addressing these issues will help to remove the barriers to travel by rail, encouraging all sections of the travelling public and freight transporters to see rail as a potential part of their journey. Providing an end-to-end journey Work together with all transport modes to provide an integrated, accessible transport system.

Rail can provide the core part of many journeys. However, people travel door-to-door and freight travels from producer to customer, and by its nature rail can deliver only part of these journeys. The creation of an integrated transport system – linking modes and enabling each one to use its strengths to deliver the most sustainable journey – is key to achieving this modal shift.

The rail industry envisages working with operators of other modes and with transport and local authorities to improve the quality of the 'whole journey' in response to customer needs. This requires both a continuing focus on customer experience, and also a greater understanding of sustainable and acceptable ways of completing the non-rail legs of the journey.

Being an employer of choice Respect, encourage and develop a diverse workforce and support its wellbeing; actively consider and address the challenges of the future global labour market.

The rail industry recognises that it can only succeed with a skilled and motivated workforce and must therefore be a place where competent, skilled people choose to work.

Recruiting and retaining the right people is a challenge and to respond to it, the industry needs to be seen as a place in which people

can thrive. Driven, talented and imaginative people are needed to implement the sustainability vision and principles and meet the challenges the industry faces in becoming truly sustainable and successful. However, in common with many industries in Great Britain, the rail industry can see falls in head count in the short term if there are adverse economic conditions, and it is important that this is handled appropriately and support is given to impacted staff.

Reducing our environmental impact

Operate and improve the business in a way that minimises the negative impacts and maximises the benefits of the railway to the environment.

Whilst the railway can claim to be the most sustainable form of motorised transport in Great Britain for many journeys, the industry recognises that there are still many ways in which it can reduce its impact. Environmental impacts have been reviewed and priority areas identified for action at an industry level and by individual companies including:

- **Climate change (including energy use)**
- **Noise and vibration**
- **Waste and pollution**
- **Sustainable consumption and production**
- **Air pollutant emissions**
- **Biodiversity and the natural environment**
- **Land take**

Environmental protection and enhancement is particularly significant when the railway undertakes renewal and enhancement projects. Many of the significant infrastructure programmes being delivered today and planned in the near future (such as High Speed 2) have set challenging and ambitious environmental targets. This is to ensure that as well as delivering an infrastructure improvement they will do it with the least cost to the environment. In some areas the ambitious targets and measuring of these, such as 'no net biodiversity loss', are not just UK industry leading but globally as well.

Carbon smart

Pursue initiatives to achieve long-term reductions in carbon emissions through improved energy efficiency, new technology and lower carbon power sources and facilitate modal shift, helping others make more carbon-efficient journeys

The rail industry is committed to the pursuit of a lower carbon railway and we believe we can move towards being zero carbon in the longer term. The industry also believes it can make a significant contribution to reducing the carbon footprint of travel and logistics in Great Britain by encouraging a shift of passengers and freight from more carbon-intense modes to rail and accommodating increased demand for rail.

The industry has huge challenges over the coming years, especially as road and aviation are promising significant reductions in their own carbon intensity. The first step is to identify the areas where the industry can improve efficiency. In the medium to long term there are opportunities to achieve step changes in carbon intensity. These will arise through new trains and alternative power sources, further electrification, more efficient diesel engines and technology to capture braking energy. In the much longer term the industry anticipates that a combination of zero carbon electricity generation and a replacement for diesel traction that has no carbon emissions will enable us to become a zero-carbon railway.

Having a positive social impact
Focus on local social impact through better understanding and engagement, engaging in local plans, industry procurement and asset use.

Connecting people and communities is at the heart of the railway's purpose, but beyond the actual journey rail, with a network that is at the same time national and local, is in a unique position to have a wider social impact. To do this, we need to start by having an in-depth understanding of the issues and needs in a local area. Better information can help tailoring support to meet needs – whether this is around better access, youth unemployment or cultural diversity.

Rail-led regeneration can have a significant impact, but where major schemes aren't planned, the importance of integrating with local communities is just as critical. We will ensure pro-active communication and engagement with communities over their needs and our plans, and act on the results, ensuring rail is a good neighbour through our behaviours, working practices and relationships.

Supporting the economy
Boost the productivity and competitiveness of the UK, at a national and regional level, through the provision of efficient passenger and freight services and by facilitating agglomeration and

catalysing economic regeneration.

Rail is a key economic enabler and is determined to further improve its support for the economy. The Eddington Study identified three key transport markets that are crucial to the productivity and competitiveness of the economy:

- **Urban areas and their catchments**
- **Inter-urban corridors showing signs of congestion and unreliability**
- **International links via ports and airports showing signs of congestion and unreliability**

Rail has a role in each of these markets. It can provide reliable, high levels of accessibility along the main transport corridors in the country and to the locations that drive economic growth. Rail supports the economies of London and the wider South East region, other towns and cities of Britain, our industries and their markets, our tourist and leisure destinations, and our ports and airports.

Rail freight makes a significant contribution to the economy by supporting key industrial sectors and penetrating other markets where it can serve the trunk-haul function for distribution of other products.

Optimising the railway
Maximise the rail system's capability and build on its strengths to deliver a transport system that is efficient and offers good value for money.

Rail demand has been forecast to grow whilst at the same time public scrutiny over the allocation of public funds intensifies. In adverse economic conditions, this growth may be slower than anticipated and there will be additional pressure on Government spending and potentially reduced availability of private investment. The industry must therefore maximise the capacity and capability of the existing rail network to ensure as many services as possible can be run with existing assets. In addition, where greater capacity is needed, the aim is to deliver high value on investments.

It is also recognised that the industry needs to provide a value-for-money rail service, offering the optimal balance between customer requirements and investment. This will form a key part of ensuring rail remains affordable to GB plc in terms of Government funding, and to rail customers in terms of price, and that it can cope with forecast increases in demand.

Being transparent

Promote a culture of open and accountable decision-making and measure, monitor and report publicly on our progress toward sustainability.

The rail industry recognises the need to involve stakeholders in the development of a future strategy. It aims to improve this by embedding a culture where dialogue with Government, customers and those who have an involvement in rail, puts their needs at the centre of decision-making and follows this up by being open about decisions, performance and progress.

Many rail companies report publicly on their corporate responsibility and environmental performance. The industry's Sustainable Rail Programme (SRP) involves rail companies, Government and regulators facilitated by RSSB. Wider involvement is achieved through stakeholder participation in research and development activities sponsored by industry as part of the SRP, and all findings and final positions are published on the RSSB website.

As you can see, industry is doing a lot of work in this area. 2016 will also mark the full roll-out of the Rail Carbon Tool to enable staff to measure, monitor and ultimately reduce the industry carbon footprint. The long-term vision is that the tool will reduce carbon and in effect, cost and influence the shaping of new railway standards and embed sustainable development incentives into new rail franchises.

Once the use of the embodied carbon tool is more prevalent, RSSB will be working to support the development of a database which can provide industry benchmarks to enable organisations to verify their results and indicatively measure the performance of a project.
Learn more about what we are doing via **www.rssb.co.uk** and by following us on Twitter via **@RSSB_rail**

AUTHOR BIOGRAPHY:
Michelle Papayannakos is the Rail Sustainability Specialist at RSSB. She plays a key role in the delivery of the Sustainable Rail Programme (SRP) with a focus on stakeholder engagement and socio-economic issues. Based around the industry's ten sustainable development principles, the SRP is embedding sustainable development into rail industry policy, strategy and operations.

Upcoming Railway Events

May – June 2016

11–13 May
Rail Solutions Asia 2016

Kuala Lumpur, Asia

With an exhibition space of more than 2400 square metres, 1900 participants, 160 conference delegates and 10 Asian railway operators, talks will cover a wide range of topics on projects and planning, signalling and communications, permanent way and infrastructure, rolling stock, improving and expanding rail systems and operation and maintenance.
More info: **http://www.tdhrail.co.uk/rsa/**

16–18 May
CORE2016

Melbourne, Australia

This is the RTSA's biennial Conference on Railway Excellence, which will cover a broad spectrum of rail engineering, operation, planning and management topics. The keynote speakers are Martha Lawrence, a senior railway specialist at the World Bank, Lara Poloni from AECOM, Adrian Shooter CBE, chairman of Vivarail, SLC Rail and Global Travel Ventures, and Keith Suter, a futurist.
More info: **http://www.core2016.org**

24 May
Scandinavian Rail Development

Stockholm, Sweden

All major rail passenger and freight companies will attend this conference along with infrastructure manufacturers. Scandinavia is investing hugely into its rail sector, making it a leading force in Europe. Topics will include ERTMS, Sweden's first high-speed railway, the safety of Scandinavian railways, Sweden's East Link and many more.
More info: **www.scandinavianraildevelopment.com**

26–27 May
Asia Rail Summit 2016

Bangkok, Thailand

The sessions of this event are 'maximising Asia's rail potential', 'penetrating into Asia rail projects', 'connecting Asia rail operators and suppliers', 'modern rail technology showcase' and 'smart rail innovation and operation'. Representatives from the railway authorities as well as rail operators will attend and there will also be roundtables and Q&As.
More info:
www.ourpolaris.com/2016/ars/

26–27 May
World Metrorail Congress 2016

London, UK

The 12th time this event is held, it will once again bring together experts from the urban rail sector. It is co-located with LightRail, RailPower and RailTel so that attendees can put together a programme best suited to their needs. Scheduled speakers are listed as coming from, among others, Crossrail, the London Underground, Transport for London, the Moscow Metro, Wiener Linien and voestalpine Schienen GmbH.
More info:
www.terrapinn.com/conference/metrorail/index.stm

7 June
Iberian Rail Development

Madrid, Spain

A chance to speak with key figures in the Spanish and Portuguese rail industries. Focus points of the 6th annual conference include increasing rail performance through ERTMS, growing cross-border traffic, developing and maintaining a high-speed rail network and investment in rolling stock.
More info: **www.iberianraildevelopment.com**

28–30 June
RSSI C&S Expo

Grapevine, TX, USA

The 57th Annual Railway Systems Suppliers C&S Exhibition 2016. A trade show, fair and exhibition that is a place to find out about the latest developments in rail transport and logistics.
More info: **eventegg.com/rssi-cs-expo/**

28–29 June
Africa Rail 2016

Johannesburg, South Africa

The first day will open with a talk by Deutsche Bahn AG's Head of Strategy Passenger Transport, Simon Daum, who will discuss the future of transport and industry game changers. Talks then are streamed into 'investment and funding', 'communication and signalling', 'country spotlights – East Africa', 'data and analytics', 'asset management' and 'country spotlights – southern Africa'. On the second day the talks will be streamed into 'infrastructure', 'intermodality', 'country spotlights – West and central Africa', 'passenger rail', 'safety' and 'country spotlights – North Africa'. There will also be roundtable sessions and exhibitions.
More info:
www.terrapinn.com/exhibition/africa-rail/index.stm

©Bombardier

Designing a visual communications strategy is key to calming disgruntled rail passengers”

Britain gave birth to the railway, yet us Brits have a love-hate affair for the nation’s rail network.

By Jake Mason, CEO, Evolve

Britain gave birth to the railway, yet us Brits have a love-hate affair for the nation’s rail network. Millions of us squeeze on to cramped, overcrowded trains every day. We usually don’t moan too much, we just get on with it as a means of getting from A to B as quickly as possible; that is until we experience the train world’s most hated word... ‘delay’ (which of course is marginally better than ‘cancelled’).

News from a recent Which? poll of 7,000 commuters shows that we still feel we are getting a poor deal despite paying some of the highest fares in Europe. Whilst we can’t change the weather or that there are leaves on the line, as a designer I feel there’s so much more that could be done to help keep passengers happy.

Evolve has been lucky enough to work with some of the country’s biggest rail operators to develop visual communications for them trying to inform frustrated commuters of changes. For all transport networks, bus, rail and even boat and air, one of the biggest challenges is keeping passengers happy. Through clever communication they can keep passengers informed, and an informed passenger is a happier customer.

In all sectors, the consumer has taken centre stage and they now wield ever-growing power thanks to social media amplifying every complaint (on the flipside, when good news is shared, it’s great for the company involved). In all sectors, the consumer is also seeking power – and they want to be informed. Understanding this essential human need is still something some rail operators must comprehend and make a key part of their strategies.

I’d really like to see more transport operators putting the end user first

and similarly, I'd love to see more developers in the property sector doing this. The use of informative hoardings around new developments for example, either telling a story of the build, the location, its history, or even some art to make an alternative 'installation'. It's a really simple yet smart way of communicating with people around a new development, whilst also covering up the ugly early stages of building work.

When a transport system faces upheaval, what does this mean to the passengers who have to use it every day? This was actually key to our strategy with Thameslink when it had to radically overhaul First Capital Connect routes to make travelling to and from London a better experience. What would the customers feel? We researched their needs and looked at the emotions they would face such as anger and frustration. This informed our straight-talking approach that was underpinned by empathy. We were able to empathise with commuters' frustrations over the 12-year programme of upgrades, but also highlight the positive benefits it would eventually bring. We made the tone human, the images bright and striking, and ensured they stood out in a cluttered, urban environment. Commuter awareness levels of the programme rose to 85% in three months, peaking at 98% after six months.

So why does it work? A visually impactful campaign serves to keep commuters informed and feel valued. Don't we all feel better when we're valued? Obviously there are other ways commuters can feel valued. Tackling over-crowding is a massive challenge. It would be nice if we didn't feel like we were being herded into cattle trucks. But if I am standing, why not make that a better experience? You could ask train staff to use empathy and a sense of humour, when they ask people to move down the aisles over the loudspeaker system. Surely this would bring a smile to the most hardened commuter's face? A joke can be a great way to alleviate stress. If we can understand how to make commuters smile, surely that's pure rail gold?

If the railways could use a little more empathy and humour in their visual communications, it would help to oil the wheels of customer relations.

Footnotes

"Railway Bridges"

1 http://www.forth-bridges.co.uk/forth-bridge/history.html
2 ibid.
3 https://www.networkrail.co.uk/VirtualArchive/forth-bridge/
4 http://www.forth-bridges.co.uk/forth-bridge/history/construction-stats.html
5 http://www.forth-bridges.co.uk/forth-bridge/history/building-the-bridge.html
6 ibid.
7 https://www.networkrail.co.uk/VirtualArchive/forth-bridge/
8 http://www.forth-bridges.co.uk/forth-bridge/history/building-the-bridge.html
9 https://www.networkrail.co.uk/VirtualArchive/forth-bridge/
10 http://www.forth-bridges.co.uk/forth-bridge/history/growth-milestones.html
11 http://whc.unesco.org/en/list/1485
12 http://www.skanska-sustainability-case-studies.com/index.php/latest-casestudies/item/83-oresund-bridge-sweden-and-denmark?tmpl=component&print=1
13 http://www.omegacentre.bartlett.ucl.ac.uk/wpcontent/uploads/2014/12/SWEDEN_ORESUND_SUMMARY.pdf
14 http://www.omegacentre.bartlett.ucl.ac.uk/wpcontent/uploads/2014/12/SWEDEN_ORESUND_PROFILE.pdf
15 http://www.engineering-timelines.com/scripts/engineeringItem.asp?id=1448
16 http://www.skanska-sustainability-case-studies.com/index.php/latest-casestudies/item/83-oresund-bridge-sweden-and-denmark?tmpl=component&print=1
17 ibid.
18 http://www.engineering-timelines.com/scripts/engineeringItem.asp?id=1448
19 http://www.3kopru.com/eng/project/ABOUT-PROJECT/1
20 http://www.3kopru.com/eng/newsfromnmmp/3RD-BRIDGE'S-DESIGNER-DRMICHEL-VIRLOGEUX-"WE-ARE-BUILDING-A-UNIQUE-MASTERPIECE"/98
21 http://www.roadtraffic-technology.com/projects/yavuz-sultan-selim-bridgeistanbul/

"The Single European Railway Area"

1 http://ec.europa.eu/transport/rail/packages/2001_en.htm
2 http://www.era.europa.eu/the-agency/about-era/Pages/Home.aspx
3 To find out more about disabled access to the rail network in Europe, see the corresponding article in this issue.
4 http://orr.gov.uk/about-orr/what-we-do/the-law/eu-law
5 http://www.consilium.europa.eu/en/policies/4th-railway-package/
6 ibid.
7 ibid.

We hope you have enjoyed our latest Railway-News magazine. Be sure to look out for our next issue.

We are now producing a magazine on a quarterly basis so please do not hesitate to contact us at al@railway-news.com if you would like to feature your latest technology in an upcoming issue. Please also take a look at www.railway-news.com for all the latest rail news, events and technology.

Office Tel: +44 (0) 1392 580002 | **Mob:** +44 (0) 7432 725001 | **email:** al@railway-news.com

A2B Global Media | Third Floor | 11-15 Dix's Field | Exeter | EX1 1QA | United Kingdom

www.railway-news.com