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MAGAZINE

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Crossing London

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How Resilient are Our Railways to Climate Change?

ISSUE ONE 2016

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Letter from the Editor

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

Many changes have been afoot here at the Railway-News office. I have taken on the position of editor-in-chief, a challenge and opportunity I'm very much looking forward to. Our editorial department has expanded and many exciting things lie in store.

This issue has an emphasis on safety and security in the rail industry. As such, we look at how resilient our railways are to climate change. We have an article examining ENISA's report on cyber security and Luke Upton from SmartRail World writes about how different countries are responding to the terrorist threat in the rail and metro sector. A second contribution by Luke Upton looks at the NTSB's Most Wanted List for safety improvements. Finally, we have an overview of what the Internet of Things means to the rail sector.

We are also introducing regular features to our magazine. Every issue will feature an article with a European focus as well as one on a major infrastructure project. This issue's European feature is Copped Out, which takes a look how the COP21 climate change negotiations that took place in December 2015 completely failed to give any consideration to public transport and the contributions it could make to reducing its environmental impact. Happily, the railways have been receiving massive investment of late and we believe they are the choice of the future as they are the most environmentally friendly form of public transport. Therefore the opportunities are huge. This is obviously good news for the rail sector and investment is pushing forward new projects. So for this issue we'll be looking at Crossrail and what it will do for London.

Zetica looks at trackbed inspection and how it enhances track safety, while Parker Hannifin discusses pneumatic solutions for extreme operating conditions, a timely piece to complement our look at climate change. Goldschmidt Thermit looks at how the life cycle of rails can be improved and Wayside Inspection Devices write about tracking position. Monitoring this is a key safety feature as issues with tracking position could ultimately lead to derailment. Finally, BT Cables introduces itself to our readers.

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. Meanwhile, enjoy the read and we will be back again in March.

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COVER: Courtesy of Bombardier

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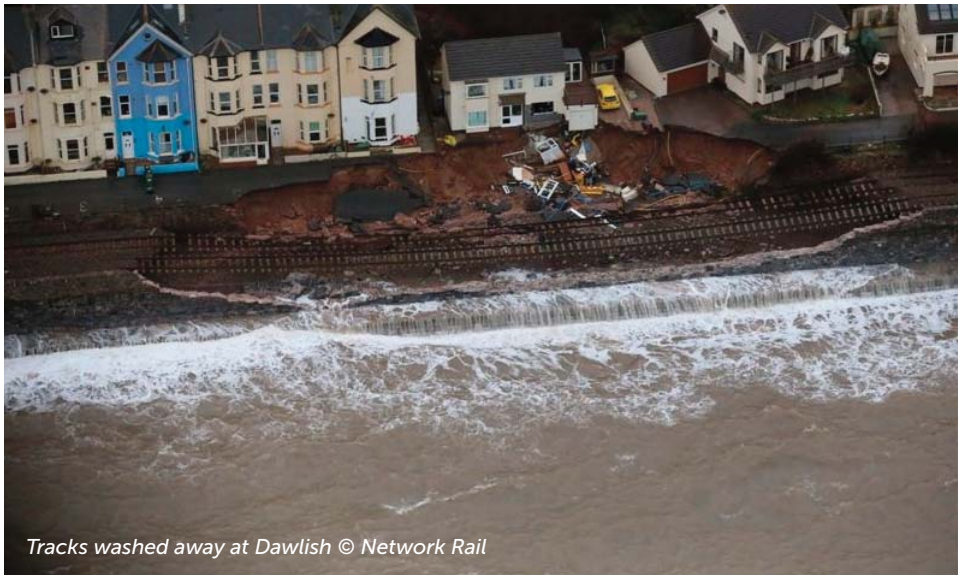
How Resilient are Our Railways to Climate Change?

Our railways are green and therefore a perfect transport choice for the future, but can they withstand the challenges put upon them by our climate?

By Josephine Cordero Sapién

Our transport network has always been impacted by our climate and natural events. This is true for air, sea, road and rail transport. Storms and high winds will stop ferries from sailing and snow and ice regularly cause chaos on the roads. Other more one-off events, such as the eruption of Eyjafjallajökull in Iceland in April 2010 caused huge disruption to air travel, with up to 19,000 flights per day being cancelled[1], with the resulting economic impact.

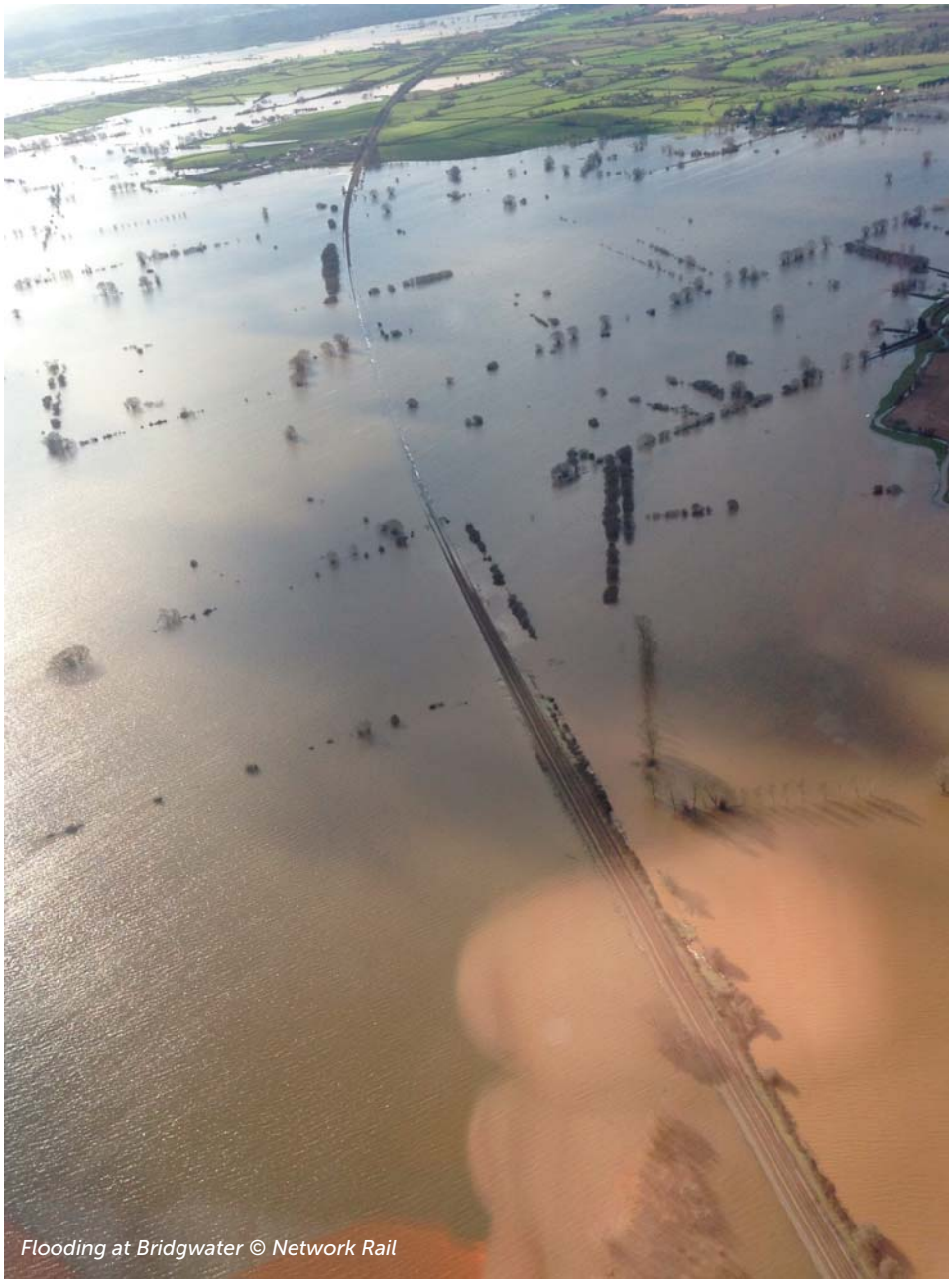
So how about the railways? In January, icy rain in Germany stopped an Intercity Express train carrying 600 passengers in its tracks for more than 22 hours. This was because the overhead lines were frozen, preventing the electrified train from onward travel. On the same journey, there was another unintended stop due to frozen points. Some of the passengers spent the freezing cold night on the train, others on makeshift beds in a waiting room, with blankets and food supplied by the German Red Cross[2].



Tracks washed away at Dawlish © Network Rail

On 4/5 February and 14 February 2014, the constant barrage of low-pressure weather systems hitting Britain from the Atlantic caused the railway line at Dawlish on the main line between Plymouth and London to close after 100 metres of sea wall washed away, causing substantial stretches of track to fall into the sea. The only rail connection to the Southwest of England was closed for 2 months as a result[3].

In the UK, where tracks are laid on sleepers and ballast, hot weather can put tracks at risk of buckling, because the steel expands in the



Flooding at Bridgwater © Network Rail

heat. Measures are undertaken to prevent this, such as including extension joints to allow this process to happen safely. Simple measures such as painting track white also help and fitting track sensors is vital to alert railway staff of such expansion. Trains are either cancelled or slowed as a result, as occurred frequently over the summer of 2015[4]. Indeed, 2015 was the hottest year on record, beating the previous record just a year earlier in 2014. The UK Met Office has estimated 2016 will be at least as warm, if not warmer[5]. We are therefore set to see an increase in such delays and economic losses, as well as a need for more investment to prevent catastrophic outcomes such as derailments. Hotter countries with railway lines have to use slab track, for example, where the tracks are laid on to reinforced concrete. This construction measure is four times as expensive[6].

December 2015 was the wettest on record. In fact, it was the wettest calendar month since records began in 1910. Storm Desmond brought more than a month's rainfall to parts of Cumbria. Further heavy rainfall throughout the month caused major flooding in the North of England, affecting tracks, bridges and viaducts and causing multiple railway lines to close[7].

In the United States meanwhile, rail services on the east coast were closed during the weekend of 23/24 January 2016 because of near record amounts of snowfall. The tracks had to be de-iced and ploughed before service could resume[8].

Climate change has been a growing concern for some time. Our climate will see more temperature extremes, increased flooding, sea level rises, increased amounts of rain and snow and more frequent, severe storms. This will put added pressure on our transport system that is already susceptible to being impacted by the weather. It is likely that these impacts will only become more plentiful and severe[9].

December 2015 saw COP21 – the 21st Conference of the Parties to the United Nations Framework Convention on Climate Change being held in Paris. Its goal was to obtain international agreement to keep global warming to below 2ºC[10] and to minimize the extent of climate change. The message here is clear: climate change is happening and our weather patterns will become increasingly erratic and all we can do now is to keep these effects to a minimum by cutting down drastically on greenhouse gases.

It was widely recognized that rail travel is the most environmentally friendly form of (powered) transport we have, which is why world leaders from as far away as Mongolia chose to attend the

Snowy tracks in Scotland © Network Rail

conference by train[11]. As a result, rail travel plays a vital role in our transport needs for the future, moving passengers and freight across the world sustainably. A quarter of the world's CO2 emissions come from transport, with railways being the lowest-emitting form. It is therefore clear that shifting to rail from other forms of transport such as shipping, aviation and road traffic will help with the climate change goals set out by COP21.

However, our railways will have to adapt and become more resilient. Obtaining more and accurate data is a clear factor in successful management. Citing the Climate Change Act, Defra, the Department for Environment, Food & Rural Affairs, requested reports from key infrastructure providers, including the railways, to assess the risks and solutions posed by climate change. As the examples above suggested, the focus for the rail sector here will be on flooding of tracks, stations and depots, track bucking and train failure in heat, coastal vulnerabilities and maintenance challenges in ongoing poor weather[12].

Storm damage in Dawlish © Network Rail

The Rail Safety and Standards Board (RSSB) has overseen a project entitled Tomorrow's Railway and Climate Change Adaptation, which looks at how our changing weather patterns will affect British railways, how they can be made safer and more reliable and provide value for money in light of our changing climate. Phase 1 of the project was published in June 2015. Phase 2 of this project will look at how the British rail industry can adapt to more extreme weather and will be published in the spring of 2016[13].

John Dora, Network Rail's Principal Engineer on Climate Change, said about the study: "Britain's railway today is resilient to adverse weather but to

safeguard its future we must continue to stay prepared in managing the impact from a changing climate. At Network Rail, we are ahead of the game with a clear climate change adaptation strategy. We are currently working with RSSB in pioneering an impact analysis study and a modelling tool to understand the impact of climate change on the railway. This also means that we are able to start early dialogues and debates with key stakeholders, including the Environment Agency and the Department for Transport, to influence changes that are vital to protect our railway."[14]

In October 2015, Transport for London (TfL) issued its second round report on climate change adaptation. It demonstrates that sensible, tangible measures can be taken to allow our railway system to function reliably in the face of extreme weather. For instance, with the increased likelihood of flooding, new flood risk studies need to be conducted and adhered to for new construction projects. Flooding response strategies need to be in place and second nature for when these events strike existing infrastructure. Air-conditioning in the Underground trains can help with heat. Communication with passengers about when to travel is vital. The UK also stands to learn a lot from adopting construction methods and materials used in countries that already experience the weather phenomena the UK is set to experience with greater frequency[15].

In some cases, more drastic action might have to be taken. In the case of the Dawlish railway line for example, Network Rail has received government backing to look at abandoning the route and moving to an alternative one, after repair works cost £35m[16] and the line remains as vulnerable as ever due to its location.

In conclusion, climate change is happening and we need to adapt the way we travel to minimize the effects. Rail travel for both passengers and cargo is the most environmentally-friendly form of transport and its use should be increased. Weather affects the railways in very different ways, requiring individualized responses, big and small. Being able to make intelligent decisions thanks to the availability of data and having the right technology available to prevent problems will allow the railways to adapt from their once Victorian industrial past to the green, sustainable transport option of the future and to cope with the challenges presented to them by a changing climate.

[1] *https://www.iata.org/whatwedo/Documents/economics/Volcanic-Ash-Plume-May2010.pdf*
[2] *http://www.welt.de/vermischtes/article150591791/Nach-20-Stunden-im-Intercity-kippt-die-Stimmung.html*
[3] *http://www.networkrail.co.uk/timetables-and-travel/storm-damage/dawlish/*
[4] *http://www.mirror.co.uk/news/technology-science/technology/uk-weather-trains-cancelled-theres-5982432*
[5] *http://www.metoffice.gov.uk/news/releases/archive/2015/global-temperature*
[6] *http://www.mirror.co.uk/news/technology-science/technology/uk-weather-trains-cancelled-theres-5982432*
[7] *http://www.itv.com/news/2015-12-27/flooding-compounds-travel-woes-across-north-england-and-wales/*
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[14] *See note 12.*
[15] *https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/466603/climate-adrep-tfl-appendix.pdf*
[16] *http://www.bbc.co.uk/news/uk-england-devon-30292756*

Buckling © Network Rail

COP21 – Copped Out on Transport

Why did the final agreement of the climate change negotiations of December 2015 make no mention of transport?

By Naomi Thompson

While the COP21 Agreement, which was signed on 12 December 2015, has been hailed as a (not very French) revolution against the tyranny of climate change, one glaring issue turned out to be the elephant in the room: transportation.

Train to Paris

When world leaders arrived in Paris in trains for COP21 as part of the Train To Paris initiative, it looked like this was going to be a big moment for the railways. All the indicators pointed to it. The industry and stakeholder groups were geared up; UNIFE was on fire, Shift2Rail were out in force, UTIP were on form, Lima-Paris were excited about trains, operators and industry stakeholders were on Twitter to plug their sustainable innovations and the rail industry media was ready to report.

Prior to the Summit, dozens of countries pledged their commitment to focus on low-carbon modes of urban land transport, with many such as Benin, Turkey, Azerbaijan and UAE delivering detailed plans to develop and promote urban rail infrastructure. Much of South America pledged to develop public transport, while others such as Canada, Guinea, Morocco, New Zealand, South Korea and Bangladesh released plans to improve the energy efficiency of existing fleets.

The statistics backed up the expectation that rail would play a significant role in COP21; rail, in its many forms, is the most environmentally friendly form of transport after canal barges. It was logical – it was expected that world leaders would formally agree to assist a modal shift towards rail as a primary source of transportation for passengers and land freight.

Transport's Lack of Prominence

In the early days of the Summit, it seemed promising. Transport got a press conference to itself, but the rail industry had to share it with shipping and aviation, the big emitters of the transport industry (3% and 2% of total international carbon emissions respectively).

The press conference on transport was very specifically on modes of transport that need to change, and the rail industry is already on the right track (pun intended), meaning that commuters and rail freight companies are already using sustainable technologies to travel. So because there was no need for the rail industry to change so much as keep doing what it was doing, it didn't get much of a mention.

The Agreement was signed on Saturday night, and in it there was no mention of transportation. Transportation, which contributes 22.7% of global carbon emissions, which is more than the United States and Russia combined, is not mentioned anywhere in the Agreement. Even electric cars, which received a press conference to themselves, were not mentioned.

Transportation – Aviation and Shipping

Transportation can be divided into four principal forms: automotive, rail, shipping and aviation. The automotive industry is already frantically moving away from its reliance on fossil fuels, with innovations in fuel economy and electric and hybrid cars coming out all the time, which are promised to be affordable to 30% of road users within the next 15 years. The rail industry is also leading the way in environmentally sustainable innovations.

The aviation and shipping industries, however, are yet to catch up. Biofuel is the only realistic alternative to fossil fuels for both, but biofuels come with their own set of problems – in a world where a billion people face food insecurity every day, giving over fertile land to grow biofuels could create further food shortages, and create a brand new kind of localised ecological instability.

The other alternatives are nuclear power and electric batteries, but the former is unpopular with passengers and could potentially fall into the wrong hands at sea. The latter are heavy and don't last long enough. So both industries are looking at innovations to make fossil-fuels more economical, reducing carbon emissions by single-digit percentage points once every five years.

Aviation and Shipping Carbon Emissions

The aviation industry is under the spotlight for its carbon emissions, and has been accordingly reducing them with innovations that reduce their quotas by single percentage points every five years. This is, in part, because they are seen flying over the skies of civilised countries, they are visible and ordinary people use them, and so they are in our consciousness. But the COP21 Agreement has not bound them to do so.

Shipping, on the other hand, is not in the public consciousness and therefore has little incentive to reduce its carbon emissions. It happens out at sea where most people never see it. Despite it being a relatively low-carbon (by weight of goods per kilometre) form of transport, it still accounts for around 3% of global greenhouse gas emissions, which have increased by 70% in the last 25 years and will rise by a projected 50–250% by 2055 if left unchecked. This will account for a 5% share of global emissions.

Aviation and Shipping Do Not Belong

However, because shipping and aviation occur offshore, they aren't included in any national quotas of emissions. Therefore, colloquially speaking, no one owns it. If it was acknowledged in the final agreement it might have to belong to nations, and national quotas would rise, making them all the more difficult to reduce in line with the two degrees Celsius ambition.

The other likely reason it wasn't included in the final Agreement was equally as pragmatic, and equally as political. While the Europeans like trains and invest heavily in innovations and technology to make public transport an attractive and sustainable form of transport, as does South East Asia and increasingly, Africa, America does not.

So many concessions had to be made to the U.S. Republican Senate in this Agreement, some of whom criticised President Barack Obama for having travelled all the way to France to have a chat about the weather, and it seems likely that transport was one of them. They trade with Europe, Asia and Africa and that means shipping and aviation are necessary evils, and in order to avoid mentioning them, electric cars and high-speed rail, those potentially planet-saving modes of transportation, were also left out of the final draft.

In 2008, Dr. Rajendra Pachauri, Chair of the UN's Intergovernmental Panel on Climate Change, said:

"The shipping industry has so far escaped publicity. It has been left out of the climate change discussion. I hope [shipping emissions] will be included in the next UN agreement. It would be a cop-out if it was not. It tells me that we have been ineffective at tackling climate change so far."

Freight Emissions

Freight transport is soon to overtake passenger transport. It currently makes up 40% of global transportation with that set to rise in the near future. Innovations in telecommunications mean there is less need to transport people; video conferencing and instantaneous communication of information and bulky paperwork via the internet mean that there are not many occasions when anyone has to actually attend in person.

Freight is therefore key, and rail is a powerful player in the freight industry, and closest to carbon neutral of any form of transportation. As such, the rail freight industry is concentrating on improving the cost competitiveness and the reliability of freight services. While it can compete with road freight, and is doing so with European freight stakeholders pledging to shift 30% of road freight to rail by 2030, and 50% by 2050, it cannot ship items over water.

COP21 Solutions

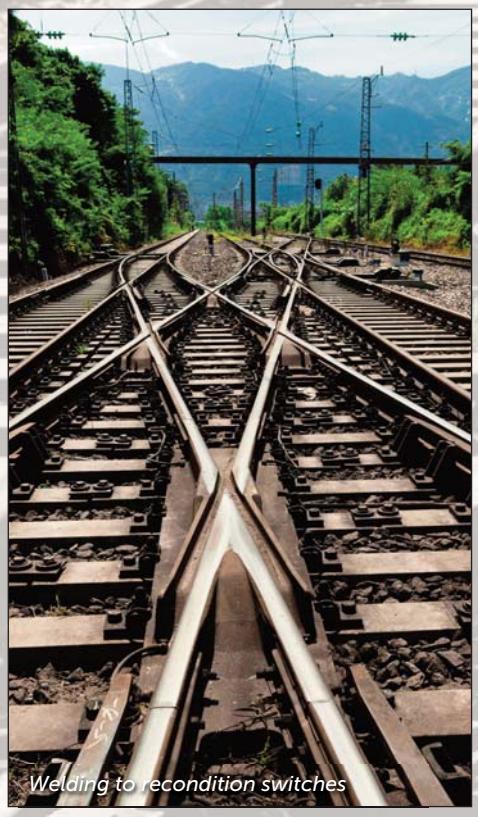
The mood of the COP21 was optimistic, and remains so. World and industry leaders are now solutions-orientated, looking at what can be done to meet the new targets. Of course, rail will play a huge part in the future of transportation precisely because it is environmentally friendly and getting more so every day. Modal shifts will be encouraged by signatories of the Agreement as lines are electrified and innovations make it on to the tracks. But it seems unfair that this wasn't explicitly said in the Agreement.

It could have championed rail as an ideal alternative to aviation and shipping, and yet it did not. While world leaders might have taken the train to Paris, it looks like they all flew home.

Lengthening the Rail Life Cycle

Given the immense stresses rails are put under constantly in all weathers, what can be done to improve their life cycle?

An immense amount of pressure, often every few minutes and in all weathers: rails have to withstand a lot. Reliable and perfectly co-ordinated maintenance and repair measures enable greater economy, travel comfort, safety and a longer life cycle for rails.



Welding to recondition switches

Welding to recondition switches

Safety comes first on the tracks. This necessitates the thorough removal of any damage to switches caused during operation on underground networks, tramways, light rail and mainline networks. The switches and especially the frogs are reliably reconditioned using the proven process of arc welding in connection with specially developed materials, whereby repeated reconditioning is possible.

The timely use of welding to recondition switches makes it possible to increase operational safety, lengthen the service life of the switches and wheels, reduce the life cycle costs of the switch, avoid operational disruptions and simultaneously reduce side wear of the rails, noise emissions and rail corrugation.

Thermit® Head Repair

In order to ensure the operational track is in the best-possible condition, preventive maintenance according to the condition of the track is absolutely essential. This leads to a reduction in life cycle costs and guarantees safety. Locally limited rail defects such as head checks, squats or breaks are individual defects in the rail head which do not extend over a long section of track. Depending on the form of the defect, it may be necessary to cut out the affected

Thermit® Head Repair

sections and fit replacement rails. In many cases, however, welding can also be used to carry out the repair without the more expensive solution of replacing rails.

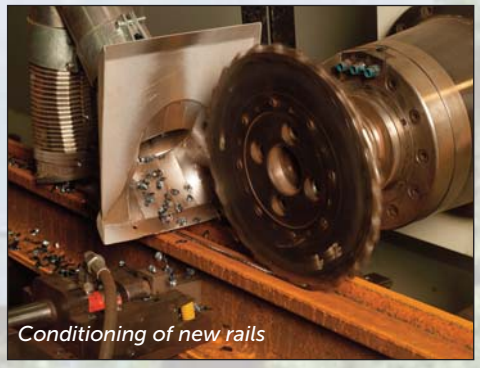
Our aluminothermic repair welding process Thermit® Head Repair (THR) provides a high-quality, economical alternative to conventional arc welding. THR draws on more than one hundred years of proven Thermit® technology, which has been successfully implemented for many decades for the continuous welding of rails. In comparison to arc welding, the decisive advantages of the Thermit® Head Repair are its easy application, which enables repair welds with a high process reliability and excellent quality. The Thermit® Head Repair process can be used with different rail profiles and is suitable for use with new and worn rails.

Track maintenance

The maintenance of rails and switches is one of the most important preventive measures against heavy wear caused by permanent strain. Professional maintenance sustainably lengthens the life cycle of rails and switches and lowers noise emissions from wheel-to-rail contact, especially on curved sections of track.
Mobile work units carry out welding work on laid track and switches. The area of arc welding includes the maintenance of curved stretches of track and wheel-bearing track sections subject to heavy wear. This requires a considerable amount of welding work to recondition the switches, and the frogs in particular, and also to repair operationally-related rail damage. Afterwards, special machines are used to process the welded rails and recreate their original profile or wear profile according to customer requirements.

Conditioning of new rails

Public transportation networks have special requirements regarding railway infrastructure. Tight curves with a radius of, at times, considerably less than 80 m cause heavy wear on rail running edges and wheels. Screeching on curves is annoying for local residents and requires appropriate measures to reduce the noise level. Heavy wear on grooved rail switches (flat grooves, gauge face, gauge corner) leads to increased maintenance costs. Replacing rails is much more expensive than conditioning the open superstructure.
New rails are conditioned to prevent corrugation in the long-term and avoid noise, whereby the running surface and gauge corner are milled out and welded on fixed installations. A filler metal is used here which is largely resistant to deformation caused by the wheel. The special material ETEKA5 is characterized by a strength of 480 HB and despite this has an extremely low surface roughness of less than 6 µm. A wear test with over 40,000 rolling actions at the system engineering centre of the German railways at Kirchmöser (in Germany) confirmed that the solution reduces rail wear by 85% and reduces wheel wear by 95% compared to rails with the quality classification R200.


Conditioning of new rails

Conditioned rails which are simultaneously welded on the running surface and side to prevent rail wear have a longer life cycle, lower maintenance costs and lower noise emissions. And last but not least they make rail travel more comfortable and safer overall.


Track maintenance

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3 Ways to Achieve Reliable Pneumatic Performance in Extreme Operating Conditions

Dave Walker outlines some key considerations when selecting pneumatic solutions for extreme environments.

Extreme operating conditions bring a varied range of challenges for rail operators when keeping their components and systems active. Selecting components designed to deliver in difficult conditions can maximize productivity. Dave Walker, Parker Hannifin's Market Development Manager for the rail industry, outlines some key considerations when selecting pneumatic solutions for extreme environments.

Railway vehicles are expected to operate constantly and reliably whilst fulfilling the high demands for minimal life cycle costs, often in some of the most challenging conditions. It is crucial that these vehicles withstand extreme temperatures and attacks from aggressive contaminants as well as endure severe shock and vibration. It is a fundamental design prerequisite to ensure the engineering technology selected is robust and dependable and delivers long lasting reliability.

With extremes of weather come extreme challenges, from ice forming on rail vehicles to equipment contamination from dirt; all of which contribute to unnecessary friction and an increase in the power required to deliver motion control. The correct selection of pneumatic equipment by vehicle manufacturers can significantly improve performance.

1. Sealing technology specified to extreme temperatures

The specification of products designed especially for use in extreme environments is key, particularly as these products feature seal technology that can withstand temperature extremes whilst retaining operational performance.

The ability of seal materials to recover and maintain material characteristics, allowing them to provide effective sealing over a wide temperature range, and ensuring that all elements in the construction of the product can achieve ultimate performance should be key considerations during the product design process.

An excellent example of this is the Parker Xtreme range of body ported valves: a standard product range that can still deliver results in temperatures from +60°C down as low as -40°C. These hard-wearing valves have also successfully passed in-service "winterisation" tests, which demonstrated the valves' effective operation when rapid temperature changes were applied in order to simulate the kind of thermal shocks that occur upon entering and leaving tunnels in cold environments.

The valve design of the Xtreme range features an over-moulded single piece spool, resulting in fewer moving parts and, with a short spool movement, provides outstanding extreme temperature performance with high reliability.

Complementing the Viking Xtreme valves, Parker offers the P1D-Xtreme range of cylinders which, along with adhering to ISO15552, demonstrate a proven capability from -40°C up to +150°C. Combining the most sought-after features of seal technology, these low-temperature pneumatic cylinders deliver high reliability, low leakage and long service life. The seals are specifically engineered for low temperatures and designed for optimal performance when operating at -40°C to +80°C as the material retains its elastic properties even at extremely low temperatures.

Available as standard production units, these extreme cylinders and valves are suitable for various applications and are readily available for maintenance or for direct replacement of existing components. With the population of skilled maintenance technicians declining, those remaining need componentry that is easy to understand and readily available. Having straightforward and modular solenoid valves and air cylinders helps make replacements an easy plug-in process.

2. Operating performance matched to extreme environment requirements

Temperature may be one of the most recognized and talked about issues when considering extreme operating conditions. However there are other factors in the operating environment that can have devastating effects on performance and reliability and, if not considered and acted upon, can severely compromise life cycle cost.

Spikes in power supply

Solenoids such as Parker's Xtreme valves have a wide voltage tolerance to provide continued

reliable performance across typically +/- 30% of nominal voltage. This negates the need (and costs) for protected power supplies.

Attacks from the environment
Valve bodies need to be anodized and have passed aggressive salt spray testing. Parker's Viking valves are made entirely of anodized aluminium for good corrosion resistance. The smooth design, with no dirt-collecting pockets, makes the valve suitable for most environments. The valve has stainless steel fixing screws for the end covers to withstand aggressive environments.

Shock and vibration due to vehicle dynamic movements
Parker's Viking Xtreme valves are tested and approved to meet the required standards for shock and vibration: IEC6173: 1999 Cat 1 Class B

3. Specify components and systems approved for use in the rail industry

There are many components available in the global marketplace. However, it is important to ensure that they are suitable for the rigors of the rail industry as opposed to general industrial use and that have been subjected to approval to the required industry standards.

Of course pneumatic product performance in extreme environmental conditions is also dependent on the quality of air being supplied. It should come as no surprise then that Parker also supplies class leading air filtration, as well as complete filtration and dryer packages for the rail industry, with the capability to provide air to NF F11-100 Air Quality Standards.

In conclusion, the selection of the most appropriate pneumatic components contributes to a reduction in required maintenance activity and enhances the life cycle costs of both equipment and vehicles. When considering the best solution, utilising a complete system approach – from air treatment through to components designed for extreme environments – promotes long and reliable performance from each of the system elements. Choosing from the Parker range offers the additional significant benefits of the availability of standard component ranges that can be integrated into existing systems and, of course, the peace of mind that comes from partnering with a reputable company with a proven track record.

Parker Hannifin is a global manufacturer offering an extensive range of robust and durable pneumatic, fluidic and electromechanical motion control solutions. With proven expertise, and more than 40 years' experience supplying solutions to the railway industry, Parker provides customers with a wealth of product and application knowledge.

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

Contact us to discuss your solution **needs on rail@parker.com.**

Parker

"New efforts are essential..."

– Rail, Metro and the Terrorist Threat

If further proof was even needed, the past year, and its wave of succession of terrorist incidents have brought security on our transport networks into sharp focus. Following each attack there have been calls for changes to the existing security practices. But realistically, a railway or metro system could not deploy airport-style security checks without causing huge changes to both station usage and passenger behaviour, to make no mention of the costs. Instead, a number of other changes are being made around the world. This article takes a look at some of the global rail and metro responses to the increased security challenge.

In France, which saw in August a failed attack on the Amsterdam-Brussels-Paris Thalys train, and the horrific events in Paris of 13 November, a number of measures have been outlined to improve security at stations. New equipment to enable passengers and their luggage to be scanned prior to boarding Thalys services in Paris and Lille have been installed. Other measures mooted by Minister Ségolène, whose portfolio includes transport, could include the introduction of named tickets (as required by Eurostar and airlines), limiting access to platforms for ticket holders only and employing security checks similar to those employed at major public venues or events.

On 23 November, New York Governor Andrew M. Cuomo announced two new efforts to enhance the New York State's ability to fight terrorism. 'These new efforts are essential pieces in our fight against terrorism,' Governor Cuomo said, stating that 'We have stepped up our preparedness in the aftermath of the Paris attacks, and we continue to remain vigilant against those who seek to spread fear and violence...'

The new 'See Something, Send Something' campaign encourages New Yorkers to report suspicious activity through a simple mobile app on their smart phone. And the Metropolitan Transportation Authority will hire 46 more police officers to increase counterterrorism capabilities at Grand Central Terminal, Penn Station and throughout the Metro-North Railroad, Long Island Rail Road and Staten Island Railway systems.

'See Something, Send Something' allows anyone to capture suspicious activity as a photo or written note and send the information to the New York State Intelligence Center. From there, the tip will be reviewed and, if relevant, sent to the appropriate law enforcement agency. By using the app, which can be downloaded for free for iPhone and Android phone users, there is no worry about who to send the tip to or what phone number to call – users can simply send a photo of the suspicious activity using their device's camera, by choosing a photo from its library, or sending a written note. It also includes information on what to look for and when to report suspicious activity. The service is already available in Colorado, Louisiana, Ohio, Pennsylvania and Virginia.

The 46 new MTA police officers will staff counterterrorism surge assignments at Grand Central and Penn Station, as well as other deployments to ensure the traveling public is protected in the MTA network. The officers are included in the MTA's 2016 Final Proposed Budget and will have an impact of approximately $3 million. All members of the MTA Police Department have been

trained in techniques to counter active shooters, such as those who have been implicated in recent terrorist attacks elsewhere in the world. Rather than wait for heavily armed Emergency Service Unit teams to arrive, officers are taught to immediately engage, pin down and neutralize any potential threat in order to minimize casualties.

In Washington, the Metro Transit Police Department announced that it continues to co-ordinate with its federal law enforcement partners and has taken the following steps in response to the Paris attacks: increased patrols across the network, additional canine sweeps, the MTPD has more than 20 canine teams in service conducting security sweeps in and around rail stations and other critical infrastructure and expanded random explosives screening at station entrances. Any bag or package carried on to the system may be subject to screening by MTPD officers. Although the MTPD is keen to stress that the screening process is 'non-invasive,' meaning the bag or package is not opened unless follow-up investigation is required.

The Moscow Metro has also strengthened security measure as Russia has become more actively involved in Syria. Vladimir Muratov, the chief of the subway security said that the intelligence has compelled the Metro to strengthen security measures and to work on transport security and anti-terrorist protection. Security personnel numbers have been increased as have the number of passenger inspections. Earlier in 2015 the Russian Ministry of Transport announced that all the stations of the Moscow Metro should be equipped with the passenger inspection zones by 2017. The first security apparatus has already been deployed at Dobryninskaya Station and includes metal detectors, and X-rays for screening passengers and baggage. Sensors to detect radioactive and other hazardous substances will also be mounted in the entrance doors of stations.

The terrorist acts in Europe, occurring at a time when increasing numbers of refugees from the Middle East and Africa are seeking safety in the EU, have reignited a debate in the 24 European countries that make up the Schengen Area, where there is no passport control at the borders, and it seems likely that border checks will soon be reinstated. This is likely to hamper plans to develop further Europe-wide rail transport and a single rail market. Whilst a direct international line, like the Eurostar's London to Paris employs airport-style checks and always has, a line that cuts through multiple countries and stations would find this more difficult. Would every station from which an international journey can begin need a security check and passport control? And if security checks began on international journeys, would that make national trips without such measures more vulnerable?

Industry View: No public place can ever be 100% secure and a fine balance has to be employed that can increase security, but not add onerous levels of time-consuming and obstructive security checks. People are used to arriving two hours early for a flight, but people don't fly twice a day, five days a week, which is how they use rail. That's simply a non-starter. So it might fall to technology to offer solutions – facial recognition software for CCTV already exists and cameras can also detect 'suspicious activity' such as unattended bags. But there are no easy answers and hard choices remain ahead in increasing security within rail and metro infrastructure as well as in our wider world.

By Luke Upton

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Christian Schang, Director of Projects, SNCF:

"The merging of the former Infrastructure manager and SNCF Infra last year offers a huge change for the national network. The adding and sharing of tools creates huge potential. But we always have to consider that innovation is required everywhere within a railway system to achieve our future targets."

Cyber Security Threats to Public Transport

A closer look at ENISA's Cyber Security and Resilience of Intelligent Public Transport report.

By Josephine Cordero Sapién

Since the creation of the internet in the late 20th century and the availability of this technology on portable platforms, it has entered virtually all aspects of our lives, informing us at home, at work and on the go, entertaining us, making our lives easier and more convenient and introducing us to whole new ways of communicating and behaving.

However, this technology also leaves us vulnerable to threats, on the smaller scale, such as identity theft and online fraud to large-scale cyber-attacks. We now live in a world where security hacks have become so large-scale, they are being termed 'megabreaches', with the average cost of a data breach now at US$3.79million, according to the MIT Technology Review[1]. And these attacks are not just carried out by individuals, but also by countries. Individuals, companies and countries are all on the victim list.

JP Morgan Chase was hacked by individuals in July 2014, while North Korea hacked Sony Pictures Entertainment in November 2014. In June 2015 the U.S. Office of Personnel Management was breached by individuals in China suspected of being affiliated with the government[2]. These breaches all involved the theft of things like names, emails, addresses and phone numbers and the costs to combat these attacks are astronomical.

But what if the costs are much more serious than money? The ability to undermine another country's critical infrastructure is a massive threat. We are already well aware of terrorist attacks on our transport systems. The July 2005 bombings on the London Underground and the 2004 Madrid train bombings are just two examples. As we have embraced Intelligent Public Transport, our transport infrastructure has an additional area of vulnerability. It is therefore vital that we learn how we can be as resilient to such cyber-attacks as possible.

Imperial College London has just announced that two research teams will collaborate with colleagues from Singapore on a three-year project to research the resilience of the UK's infrastructure from cyber-attacks and how data can be shared safely[3].

The European Union Agency for Network and Information Security, ENISA, published a report entitled Cyber Security and Resilience of Intelligent Public Transport in January 2016[4]. This article will look at that study in more detail. Intelligent Public Transport integrates ICT systems to optimise transport services. This opens public transport to cyber threats. As the authors of the study, Dr.

Cédric Lévy-Bencheton and Ms. Eleni Darra, note there is not yet an EU policy on cyber security for transport and it is difficult for operators to allocate budgets to address this threat[5].

However, they have identified seven threat categories[6]:

- Physical and large-scale attacks, "which aim to achieve maximum distraction, disruption, destruction, exposure, alteration, theft or unauthorised accessing of assets"[7]. The threats in this category come from terrorism, violence, shootings, unauthorized access and the theft of data and/or infrastructure and can affect transportation safety and security as well as traffic and vehicle management[8].
- Acts of nature and/or environmental incidents
- Accidental errors, malfunctions, failures
- Disruption and/or outages
- Nefarious activities and/or abuse (cyber attacks): data breaches, identity theft, malware and viruses, falsification of records, wiretapping / eavesdropping, abuse of information leakages and the hacking of wireless, connected assets, which again impacts transportation safety and security as well as traffic and vehicle management[9].
- Unintentional damage
- Insider threats

The authors note that these threats open up intelligent public transport to vulnerabilities that all IT systems share. The scale and complexity of our public transport system is immense, making it difficult to manage these threats. IPT has to cope with multiple interdependent systems and is dependent on access to real-time data[10]. It is this combination of threats and vulnerabilities that produces risks for our public transport system. On a societal level, if these threats are carried out, it could mean the Intelligent Public Transport services become unavailable, which in turn leads to a disruption of society. Alternatively, passengers' health and safety are put at risk and members of society see their privacy being eroded, as more tracking and real-time behaviour evaluation come into play[11].
It is clear that our public transport system is open to attack in both established and new ways and that this poses real risks to society. There are, furthermore, barriers in place that impede advancement in protecting against these threats. As part of the report, the authors undertook a survey, during which they found that "transport organisations still do not grant the necessary importance to cyber security within their company. Spending on cyber security also appears to be inadequate in response to the range of multifaceted cyber threats affecting IPT"[12].

They found that only 20% of operators spend money on cyber security and of those 20%, half spent less than 2% of their budget on this area, while the other half did not know[13].

Dr. Lévy-Bencheton and Ms. Darra put forward recommendations for operators. Operators should conduct risk assessment that looks at cyber and information security on a regular basis. The appropriate physical security measures, such as locks and CCTV systems, should be installed. At the same time operators must keep their digital access to networks and data secure, by means of firewall, passwords etc. Operators further need to use encryption and create private communication networks. It is vital that operators can deactivate their assets remotely, in the event of stolen assets for example. Finally, it is important for operators to allow their systems to continue functioning at a minimal but critical level[14].

The authors put forward several recommendations for both decision makers and transport operators.

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Decision makers[15]:

- "EC and MS institutions should promote public/private collaboration on IPT cyber security at national level and EU-wide
- EC institutions and agencies should promote and facilitate the development of a common EU approach to IPT security
- EC institutions and agencies should develop a comprehensive EU strategy and framework for cyber security in IPT
- EC and MS should integrate and converge security efforts made in other sectors of activity
- EC and MS should foster the development of harmonised cyber security standards for IPT"

Transport operators[16]:

- "IPT operators should integrate cyber security in their corporate governance
- IPT operators should develop and implement an integrated corporate strategy addressing holistically cyber security and safety risks
- IPT operators should implement risk management for cyber security in multi-stakeholder environments including external contractors and dependencies
- IPT operators should clearly and routinely specify their cyber security requirements
- IPT operators should annually review organisational cyber security processes, practices and infrastructures"

We are all aware of the traditional threats to our transport system and the huge impacts such events have on our citizens and our infrastructure. And we have seen the vast impact cyber attacks can have on corporations and nations. When these two threats are combined, the potential for harm is momentous. This article is intended to raise awareness of this threat to our public transport system in general as well as our railways more specifically. Operators can learn what measures to take before, during and after an attack to minimize the risk of one occurring or the impact of one in the event of an attack taking place. In addition, governmental guidelines and policies would send a strong message that the cyber security of our public transport infrastructure is of fundamental importance in our increasingly digital world.

If you are interested in further reading about cyber security and the threats, vulnerabilities and good practices to our transport infrastructure, we suggest:

- **The Future of Smart Cities: Cyber-Physical Infrastructure Risk, published by the U.S. Department for Homeland Security in August 2015:** https://ics-cert.us-cert.gov/sites/default/files/documents/OCIA%20-%20The%20Future%20of%20Smart%20Cities%20-%20Cyber-Physical%20Infrastructure%20Risk.pdf

- **Cyber Security for Smart Cities – an Architecture Model for Public Transport, published by ENISA in December 2015, link available here:** https://www.enisa.europa.eu/activities/Resilience-and-CIIP/smart-infrastructures/intelligent-public-transport/smart-cities-architecture-model cert.gov/sites/default/files/documents/OCIA%20-%20The%20Future%20of%20Smart%20Cities%20-%20Cyber-Physical%20Infrastructure%20Risk.pdf

- **Cyber Security for Smart Cities – an Architecture Model for Public Transport, published by ENISA in December 2015, link available here**: https://www.enisa.europa.eu/activities/Resilience-and-CIIP/smart-infrastructures/intelligent-public-transport/smart-cities-architecture-model

[1] *http://www.technologyreview.com/news/545616/cybersecurity-the-age-of-the-megabreach/*
[2] *See note 1.*
[3] *http://www3.imperial.ac.uk/newsandeventspggrp/imperialcollege/newssummary/news_27-1-2016-12-47-46*
[4] *https://www.enisa.europa.eu/activities/Resilience-and-CIIP/smart-infrastructures/intelligent-public-transport/good-practices-recommendations*
[5] *C. Lévy-Bencheton and E. Darra, Cyber Security and Resilience of Intelligent Public Transport, published by ENISA, December 2015, p.7. Available from: https://www.enisa.europa.eu/activities/Resilience-and-CIIP/smart-infrastructures/intelligent-public-transport/good-practices-recommendations*
[6] *C. Lévy-Bencheton and E. Darra, op. cit. 5, p22*
[7] *C. Lévy-Bencheton and E. Darra, op. cit. 5, p22*
[8] *C. Lévy-Bencheton and E. Darra, op. cit. 5, p24*
[9] *C. Lévy-Bencheton and E. Darra, op. cit. 5, p24*
[10] *C. Lévy-Bencheton and E. Darra, op. cit. 5, p27*
[11] *C. Lévy-Bencheton and E. Darra, op. cit. 5, pp30–31*
[12] *C. Lévy-Bencheton and E. Darra, op. cit. 5, p31*
[13] *C. Lévy-Bencheton and E. Darra, op. cit. 5, p31*
[14] *C. Lévy-Bencheton and E. Darra, op. cit. 5, pp35–36*
[15] *C. Lévy-Bencheton and E. Darra, op. cit. 5, pp44–45*
[16] *C. Lévy-Bencheton and E. Darra, op. cit. 5, pp45–46*

Zetica: The RASC® Pod – Rethinking Trackbed Inspection

Part 1 of this two-part feature looks at the improved return on investment for inspection and enhanced track safety.

Traditional approaches to track inspection focus on track geometry measurements carried out on dedicated inspection trains or hy-rail vehicles.

Track geometry measurements can detect unstable track and prompt slow orders to mitigate the risk of a derailment. However, track geometry measurements in themselves cannot determine the root cause of unstable track, so the time to fix problem track may be delayed while this is investigated. Derailments can also occur on track without a measureable track geometry fault.

Specialist measurement trains are expensive and require a dedicated path to be assigned on revenue-earning lines. The cost of planning a survey, occupying track and manning the train is high.

The RASC® Pod is an innovative trackbed inspection solution that has the potential to improve:

- the return on investment in data capture systems
- track safety
- the cost-effectiveness of follow-on maintenance

The system illustrated below is a versatile platform that can be mounted on a wagon in conjunction with a revenue-earning train (above left) or on the chassis of a hy-rail (above right). The RASC® Pod offers exceptional flexibility with a range of above and below-ground measurement systems linked to a core of on-board power, data management, accurate location and climate control systems. The pod is deployable wirelessly; data is captured autonomously and can be monitored remotely.

The unified data stream allows integration of above and below-ground information to determine the root cause of problem track (fix problems first time), flag derailment risk areas and reduce the cost of maintenance.

This article describes the potential improvement in return on investment (ROI) for inspection and enhanced track safety.

A future article will cover the use of the combined data for improved trackbed maintenance planning.

Improvement in the ROI for inspection

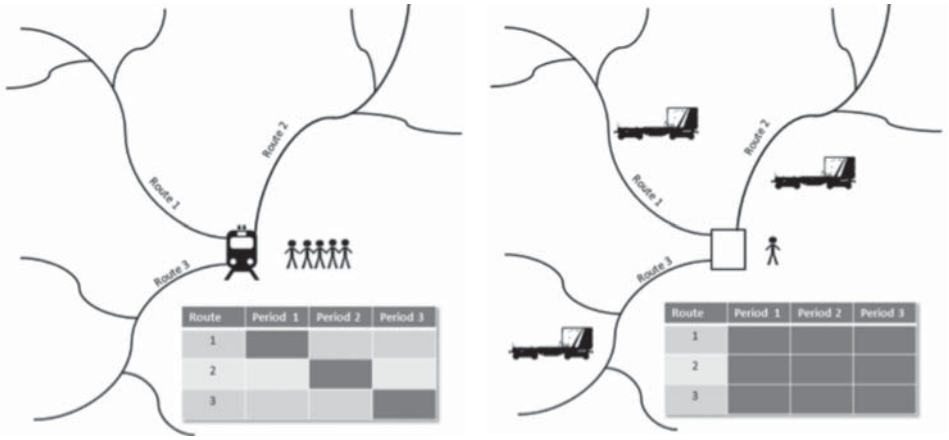
The RASC® Pod can simultaneously collect data from track geometry, rail profile, linescan imaging, 2D and 3D high-speed lasers, accelerometers, video, 2D and 3D ground-penetrating radar (GPR), thermal imaging and catenary inspection systems.

The illustration below depicts the deployment of a dedicated inspection train (left) and 3no. RASC Pods (right) on a hypothetical network consisting of 3 routes.

The inspection train has a 5-man crew and a schedule to survey each one of the 3 routes once between periods 1–3. The inspection train requires forward planning to determine a path and minimise the impact on revenue-earning trains.

The RASC® Pods are distributed across 3 routes and are controlled centrally with a schedule to repeat scan each route during periods 1–3 whilst mounted in conjunction with in-service trains.
Multiple RASC® Pods can be deployed for the cost of a single inspection train so the improved ROI for inspection is in better coverage, less impact on revenue-earning traffic and less manpower.

The RASC® Pod weighs less than three tons and can easily be deployed where it is needed on any flat bed. This is beneficial where sections of track require a survey, for example, following heavy rain (to identify the risk of washouts) or after maintenance (quality control).



Enhancing track safety

Track geometry measures changes in the relative position of running rails, which can be affected by above and below-ground influences.

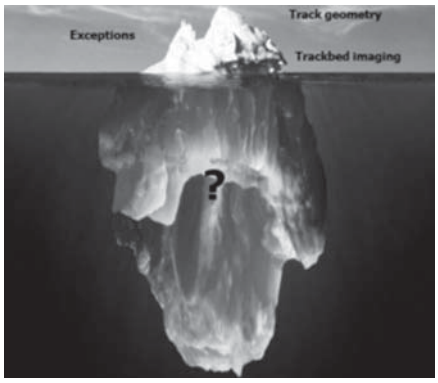
Values in excess of predetermined safety margins are flagged for maintenance and, depending on the severity, could result in slow orders, which limit the speed of revenue-earning traffic over unstable track.

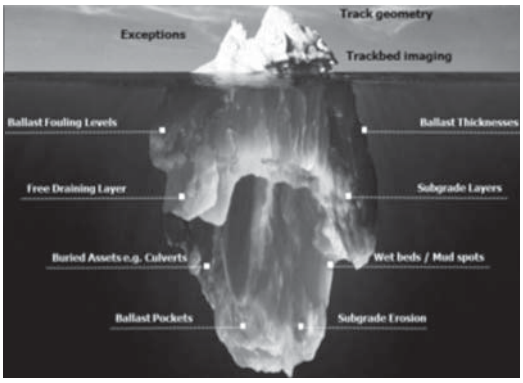
Track geometry in itself cannot verify the root cause of unstable track so the time to fix problem track can be delayed.

The RASC® Pod has autonomous solutions for extracting above and below-ground data streams targeted on track geometry exceptions. Combining these measurements speeds up the determination of the root cause of track geometry faults and can lead to the problem being repaired correctly first time. The benefits are reduced delay times and a decrease in costly revisits, which translate into improved train speeds.

A useful analogy for this collective approach is an iceberg where track geometry and visual measurements represent just the top of the

trackbed structure (below left) and combined above and below-ground measurements more fully describe the whole trackbed (below right).



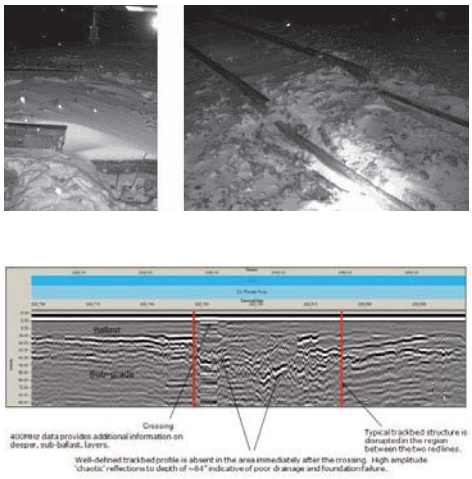


Derailments can occur on track without a measureable track geometry fault or where incorrect maintenance was applied due to incomplete knowledge of the cause.

Examples are provided below where prior knowledge of the below-ground condition of the track could have helped prevent a derailment event.

UK: Cause of cyclic top condition which caused derailment (shallow formation) was not addressed.

Australia: Undetected weakness in the track formation. Dip in track and adverse twist caused bogie to derail.



USA: Failed formation at a road crossing shown by GPR measurement. There were no recorded track geometry exceptions leading up to the derailment event (broken rails).

Measurement of both above and below-ground trackbed attributes using the RASC® Pod can help to better characterise irregular trackbed that may require closer inspection and enhance track safety.

Part 2 will deal with integrating data for improved maintenance planning.

Profile:
Zetica Ltd is an experienced service provider offering an integrated above and below-ground measurement solution for trackbed inspection that offers the following benefits:

- Identification of subgrade erosion as well as drainage and ballast fouling issues which could affect track stability and explain track geometry exceptions
- Provision of a system to target trackbed maintenance effectively using evidence-based information, thus reducing wasted time and resources unnecessarily maintaining track where this is not needed
- Reduction of material costs by optimising ballast cleaning and trackbed rehabilitation programmes
- Provision of an effective means of quality controlling new-build trackbed or recently maintained trackbed to verify the work carried out
- Update of above-ground asset mapping information

In 2015 the RASC® Pod received vehicle acceptance certification for carrying out work on the UK rail network.

More details are available at **www.zeticarail.com**

Multi-Contact Invests

in a Modern Testing Laboratory for Railway Technology Components

In 2015, the connector manufacturer Multi-Contact opened the doors to its new testing laboratory at the company's centre for railway technology in Hésingue, France. The highlight of the modern laboratory, which covers an area of 800 square metres, is a test bench for testing shock and vibration in combination with thermal stress. In addition, the laboratory is also equipped with a salt spray chamber, which allows Multi-Contact to simulate the effects of the environment on exposed connectors that are installed in railway rolling stock systems in a realistic manner. The electrical testing equipment makes it possible for Multi-Contact to perform tests in-house with an applied current of up to 3000 A, or for partial discharges, of up to 100 kV. "This investment allows us to subject our products to a wide range of tests, many that even exceed the requirements laid out in testing standards," explains Michel Schmitt, head of the Railway Technology Market at Multi-Contact. "The goal of all of this testing is to develop products that are even more compact, more powerful and more durable." With over 40 years' experience in the railway technology sector, Multi-Contact places its focus squarely on its modular connector systems. "In carriages and locomotives, we need solutions to reduce the time required for maintenance and repair work. Interfaces must be able to be connected and disconnected extremely quickly in order to prevent extended downtimes or train cancellation, for example," Schmitt continued.
Multi-Contact sees itself as a development partner for the industry. Its expertise in a wide range of areas is also tied in with the railway industry and allows the company to develop interface solutions that are perfectly tailored to the application in question. The patented MULTILAM is at the heart of the MC product range. This contact technology ensures efficient energy transfer with low performance loss and thus a long product service life. Thanks to their compact, modular design, the power connectors from the MPC series are ideal for creating solutions for railway rolling stock. Modular Power Connectors allow engineers to create connections easily and safely for inter-car couplings, traction converters, inverters and batteries on the roof and under carriages, as well as to traction motors.

Reliable in Harsh Environments

www.multi-contact.com

Railway*line*

Industrial connectors




Electrical Connector Systems for Rolling Stock

Modular Power Connector MPC
The compact and modular system has been designed to carry out the connections between several functions of the electrical chain of traction as well as the power connection between the cars.

The Modular CombiTac System
CombiTac allows customized combinations of different contact types for countless applications. The new rackable version CT-HE is particularly suited for slide-in systems and fulfils the railway standards for operating temperature, shock, vibration and fire protection.

Multipole Connector for Harsh Environments
The Powerline connector in its sturdy cast aluminum housing provides a reliable technical solution for the electrical connection between railway carriages, ensuring excellent performance and safety.

Connectors for Busbars
Where there are inverters in railway vehicles, busbars are used to distribute the high currents. Connectors in the CLIPLAM CL-T and GSR Fork plugs ranges are a superior solution for connecting busbars in every respect, no drilling or screwing required.

Advanced Contact Technology

Multi-Contact

MC

STÄUBLI GROUP

Crossing London

A detailed look at the Crossrail project being built in and under London right now.

By Naomi Thompson

The largest infrastructure project in Europe is taking place beneath the streets of London, while above ground it is barely noticed but hotly anticipated.

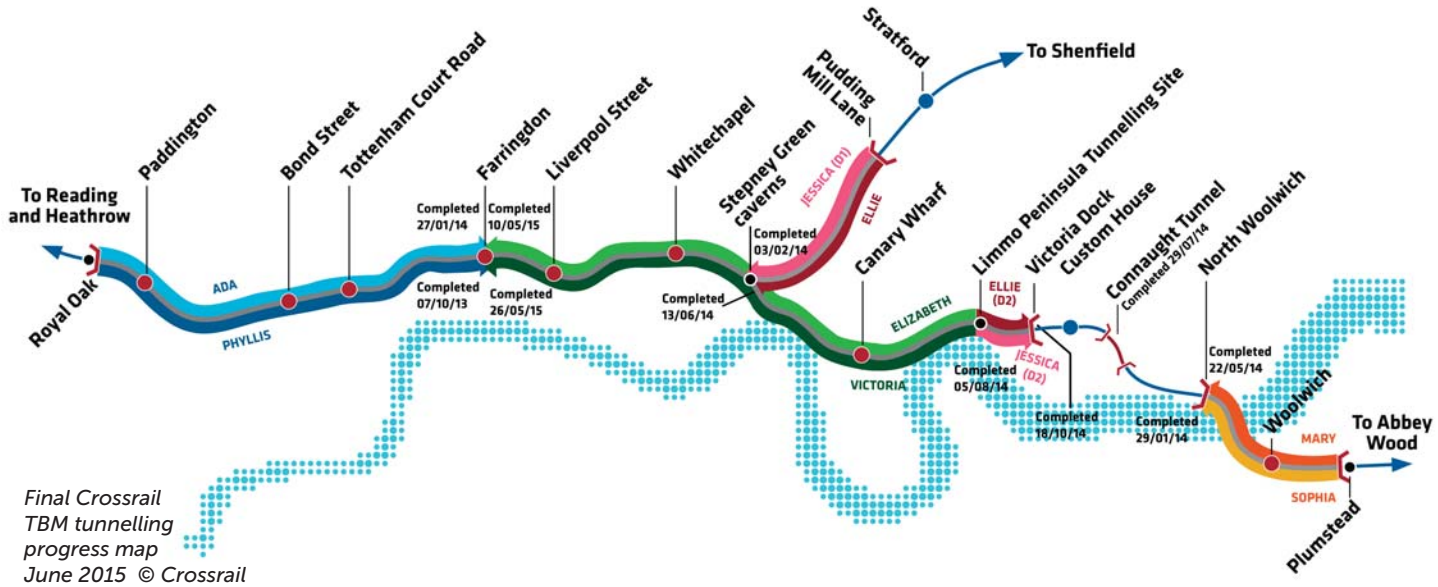
The figures alone are staggering – £14.8billion budget; 117km of track; 42km of tunnels up to 40m below ground; 30 refitted stations and 10 new ones; 200–240m trains; 10,000 employees (5,000 of whom have received their training at the Tunnelling and Underground Construction Academy, a college purpose-built especially for this project); 8 tunnelling machines boring an average 38m a day.

The project will connect Shenfield in Essex with Reading in Berkshire. Construction began in 2008, and is scheduled to be fully operational in 2019. In November 2015, it was announced that the surface works were half-way completed, on schedule, preparing the existing rail network for Crossrail's opening.

The Necessity of Crossrail

London is one of the busiest cities in Europe – its transport infrastructure is of vital importance to the UK economy, and trains are the arteries of that infrastructure. Of the 1.17 million people who travel in London in the morning rush hour, 526,000 use trains, and 246,000 of them transferred to the London Underground or DLR services (light rail).

The population of the city is expected to reach 10 million by 2030, by which time the transport infrastructure, without Crossrail, would be woefully inadequate. Crossrail will increase the city's rail transport capacity by up to 10% and bring an additional 1.5 million people within commuting distance to Central London. This



Final Crossrail TBM tunnelling progress map June 2015 © Crossrail

Multi-purpose gantry lifting sleepers into place in Thames Tunnel © Crossrail

in turn will allow up to 30,000 new jobs in the capital within a decade of opening, sustaining the growth of the UK economy.

Tunnelling

The logistics of the project have been impressive. Five Atkins-designed twin bore tunnels, each 6m in diameter required eight 1,000-tonne tunnelling machines, the last of which, Victoria, was dismantled beneath the surface in August 2015 to be removed and recycled. The tunnelling itself began in the summer of 2012 and was completed in June 2015.

This would have been impressive in any environment, but was more so because the ground beneath London is not empty space; it is a hive of underground lines and stations, catacombs, sewers, rivers and even a few deep air raid shelters. At Tottenham Court Road there is a point known as "the eye of the needle" – a 7m space between the Northern Line tunnel and an escalator, which had to be navigated.

Track Construction

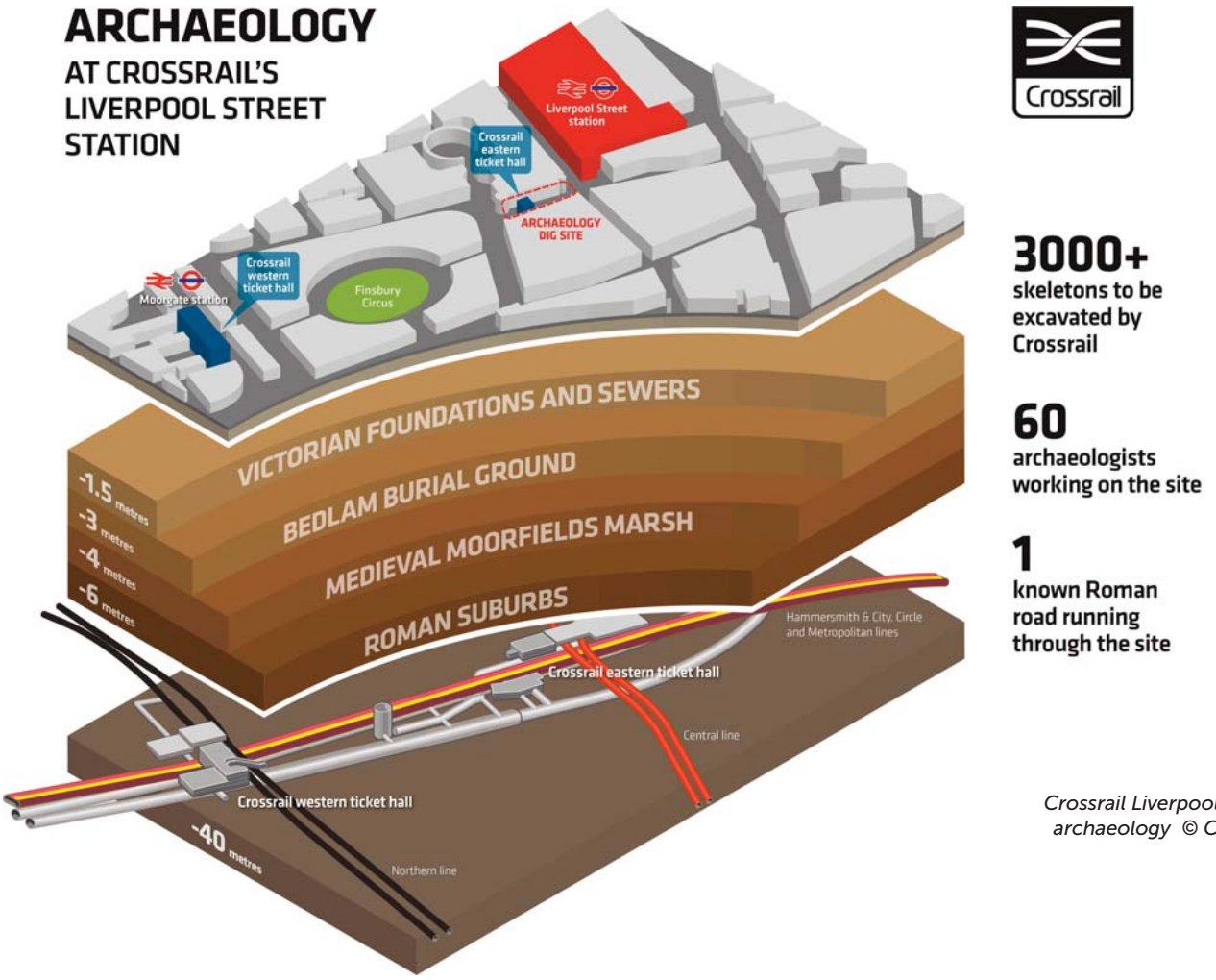
Much of Crossrail's track will be built especially for it, with tracks running in parallel to existing mainline lines. Balfour Beatty were contracted to construct sections of the track, the most notable of which runs from Abbey Wood to the Plumstead portal, providing access to the new tunnels.

The tracks themselves will be 1.435mm standard gauge so that they are compatible with the existing mainline tracks. They will have a 25kV 50Hz AC overhead power line, some of which will be installed on to the mainline, e.g. sections between Reading and Heathrow, as part of the project. The trains will run at up to 160km/h overland, and 100km/h underground.

Responsible and Sustainable Construction

The tunnelling process uncovered significant archaeological finds dating back 2000 years, the most notable of which was the excavation of 3,000 skeletons from beneath Liverpool Street Station dating from the Great Plague in 1665. The 10,000 artefacts unearthed by the works will be provided to the Museum of London for archive and display.

With 4,500 buildings potentially



Crossrail Liverpool Street archaeology © Crossrai

affected by the tunnelling (of which 250 are historically listed), it was often delicate work, but required the demolition of only one listed building. Even the earth removed from the tunnelling works was transported to Wallasea Island which will become a new wildlife sanctuary. Every effort was made to ensure that the project was and is as sustainable as possible.

Suspected 1665 Great Plague pit unearthed at Crossrail Liverpool Street site © Crossrail

Rolling Stock

The rolling stock for Crossrail, the bespoke designed Bombardier 345s, will have capacity for 1,500 passengers. The trains will be 200m long and will sport wide, interconnecting gangways with three double doors on each side of every carriage. Cutting-edge technology will deliver on-board passenger information systems and real-time travel information.

The trains will have on-train energy management systems, which will control air-conditioning and lighting, and will re-generate energy back into the supply during braking. They will be lightweight and constructed using cutting-edge, energy-efficient methods.

The trains, made in conjunction with TfL in the final design phase,

will be manufactured at Bombardier's UK plant at Derby. The first trains will be delivered in May 2017. The manufacture and delivery will sustain 760 UK manufacturing jobs and 80 apprenticeships. Approximately three quarters of the contract spend will remain in the UK.

The construction of the trains hit an important milestone in November 2015 with the completion of the first test carriage, which will be used to perfect the final design and manufacturing technique. 66 Crossrail trains will be delivered in total, which translates to a total of 594 carriages. The roll-out will begin in 2017 at London Liverpool Street, and by 2019 will run full services.

Final Crossrail TBM Victoria's cutterhead dismantled © Crossrail

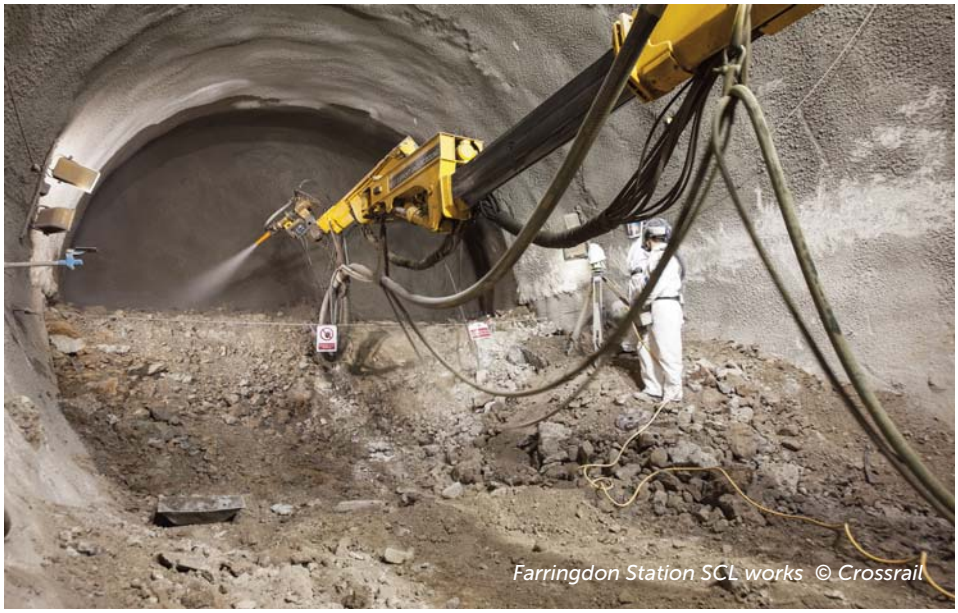
Signalling

The signalling will be supplied by Signalling Solutions Ltd (SSL), Alstom's UK signalling joint venture with Balfour Beatty, now solely owned by Alstom, which was awarded a €54 million contract in March 2015 to design, manufacture, supply, install, test and commission the signalling control system for the line. The signalling system will use Alstom's Smartlock interlocking technology and ECTS 2, with cab-based display and information management systems.

The bulk of the signalling work will take place between Pudding Mill Lane Junction on the Great Eastern Main Line in the East of London through to Shenfield in Essex, with expected delivery to take place in August 2018.

Stations

The 40 stations that Crossrail will call at each require 250m platforms to accommodate the long trains. Notable works on stations include Paddington, Bond Street, Tottenham Court Road, Farringdon, Liverpool Street, Whitechapel, Canary Wharf, Custom House, Woolwich and Abbey Wood. One of the design requirements for the news stations is that they last a century.



Farringdon Station SCL works © Crossrail

The design teams for the stations were comprised of world-class engineers and architects such as WSP, Arup, Atkins, Burns & Nice, Weston Williamson and BDP. The stations will be as deep as 40m below the surface, with many of the mainline, London Underground and DLR stations enjoying a facelift as part of the works.

In order to ensure the final dimensions of the stations, a perfect mockup of the platform was constructed from foam and plywood, experimenting with various materials and finishes for both an aesthetic and practical effect. Crossrail will also learn from the experiences of TfL in terms of signage, lighting, layout and cladding systems.

The flagship station will be

Paddington, which receives passengers from Heathrow airport and therefore needs to impress international visitors. Because the building is Grade I Listed, meaning that it cannot be altered either internally or externally without consultation and permission from Historic England, the new design will be sympathetic to Isambard Kingdom Brunel's original designs dating back to the 1850s.

As part of the upgrade to Paddington, the taxi rank will be moved, a new Hammersmith and City Line station will be built to ease over-crowding, and there will be improved pedestrian access and provision for future development above the new line alongside the canal.

Bond Street is less hindered by historical sensibilities, and will therefore benefit from a brand new, sleek and modern ticketing hall. For the new Tottenham Court Road station, buildings in the surrounding area have been demolished to make way for an impressive new station. Crossrail is changing the face of London.

Operation

MTR will operate Crossrail services, following a competitive procurement process for the £1.4billion contract, which will last for a duration of eight years with an option to extend for a further ten. MTR began operating services in May 2015 between Liverpool Street and Shenfield, using existing operating stock until the Bombardier 345s are rolled out.

MTR's appointment as operator will require that they liaise with TfL, Bombardier and Crossrail Ltd (the corporation overseeing the construction of the project), as well as Network Rail, from whom they will require track access agreements to run trains on Network Rail lines for some sections of the route.

The service will operate 24 trains per hour at peak times in each direction from Paddington to Whitechapel, taking twenty minutes off the travel time from Heathrow to Central London. It is estimated by Crossrail that approximately 200 million passengers will use the service annually.

Crossing London

London is an unusual city, with an ever-changing identity it evolves more than grows, dynamic in both its form and function. Crossrail is another evolution in its history, an addition to the web of history beneath the ground. It will enable economic expansion in the short-term, it will transport a generation, and has created iconic buildings which will stand for a century. And that is quite a thing.

TBM Elizabeth breaks through into Stepney Green cavern © Crossrail

The Internet of Things and the Railway Industry

With machine-to-machine connectivity now commonplace, how is the Internet of Things impacting our railways?

By Naomi Thompson

The interconnectivity of devices, from phones to homes, or tracks to wheels, has brought us into an age where science fiction is a mundane reality. The novelty of communication and transfers of data between people and people, people and objects and now objects and objects, has worn off. And the latter, which is arguably the most extraordinary development in the last twenty years of technological evolution, has been reduced to the nebulous phrase, the "internet of things".

The internet of things, which is to say, the capacity for transference of data between objects, is transforming our world. The capacity to bring objects into the communication network will allow for the creation of applications that improve safety, efficiency and ease of use. Machine to machine (M2M) communication as part of a cloud-based, centrally managed system, will enable safe and efficient use of existing and future assets and transform the railway industry.

The Railway of the Future

The railway of the future is predicted to be many things: ergonomic, seamless, integrated, efficient, safe. And busy. Global passenger traffic is expected to double in the next five years, creating a hive of underground, overground, light rail, high speed, urban and intercity trains all travelling on to-the-second schedules that allow for no margin of error – because a single error could result in human tragedy.

So to avoid that human tragedy, the human element must be removed as far as possible. Indeed, safety integrity levels (SIL) are generally higher the less human involvement a system requires. The greater the interconnectivity between track monitoring, train, and signalling systems, the safer, more efficient and, ironically, more ergonomic than they are.

Safety

The first rule of train operation is "don't crash". However, trains, being large, heavy and typically fast moving, have a stopping distance usually measured in kilometres, which means that last-second responses do not usually stop accidents. Systems which enable data transfer between trains, control centres and other trains can very accurately predict train movements and are therefore most effective at preventing accidents.

The various systems which contribute towards operating a train are subject to SIL assessments and given an SIL rating, defined by looking at the probability of an incident, the severity and the environmental, material and human factors. This makes train management systems (TMS) a key priority in improving SIL ratings in the rail industry.

A TMS turns a train into a communication hub, connected

to other trains and control centres so that all elements (train, track, signal, interlocking and station) know where everything else is and will be. This not only makes trains safer, but means they can operate in closer proximity and therefore on tighter and more efficient schedules.

Signalling

The next-generation signalling system is the European Railway Traffic Management System (ERTMS), currently being rolled out across Europe. The project is being developed by Alstom, Ansaldo STS, AZD Praha, Bombardier Transportation, CAF, Mermec, Siemens Mobility and Thales, working with the European Union and GSM-R (Global System for Mobile Communication – Railway) and other industry stakeholders to create an adaptive and intelligent system with real-time traffic management and decision support systems.

It is intended that ERTMS will develop existing technologies and new innovations, such as GPS, high-speed, high-capacity data transfer and voice communication systems, as well as automation technology and innovations in real-time data collection, processing and communication systems. All of these elements can then be brought together within a single TMS to make it a holistic entity which can consolidate and efficiently organise a railway network.

As part of the project, a single automatic train protection system (ATP) will replace existing national systems (of which there are more than 20) to create a uniform network in all member states as part of the creation of a Single Railway Area. Currently, the Thalys train, which runs from Paris to Cologne, has to be equipped with seven different train control systems. The changing systems mean that sometimes locomotives and often drivers have to switch at national borders to ensure compatibility and competence with a foreign ATP.

Most high-speed routes in Europe are now built with ETCS Level 2, which delivers constant communication between the train and the group using GSM-R, a wireless communication platform which delivers voice and data communication between the track and train, providing data to control centres. This means that the movement of any train, in relation to all other trains, is closely monitored and controlled by software systems, which then communicate with interlocking systems in order to avoid collisions at junctions, using complex software.

However, the replacement of traditional signalling systems with ERTMS is not simple, easy or cheap. The rollout of ERTMS throughout Europe is delayed in several countries. Most recently, the Netherlands put ERTMS rollout on hold pending a review of management, spending and other priorities. France and Germany have also encountered difficulties adapting their railways, forcing the European deadline for mainline rollout to 2030.

Should ERTMS work as it is envisioned and be developed into a holistic information management system, it will firmly establish itself as a world-standard signalling system.

Rolling Stock and Track Maintenance

Onboard and trackside sensors constantly monitoring equipment and components mean that predictive maintenance can be undertaken at the right time, thereby reducing the costs of asset management. From sensors which monitor track vibration, in-ground sensors which measure water table levels and potential landslide spots, to software which calculates distance travelled plus weight of cargo mean that maintenance and replacement works can be carried out before they fail but not so early that it becomes economically unviable to run a network.

By developing high-performance technologies for traction and critical structural components, command control and cabin environment applications, the life-cycle of rolling stock is extended

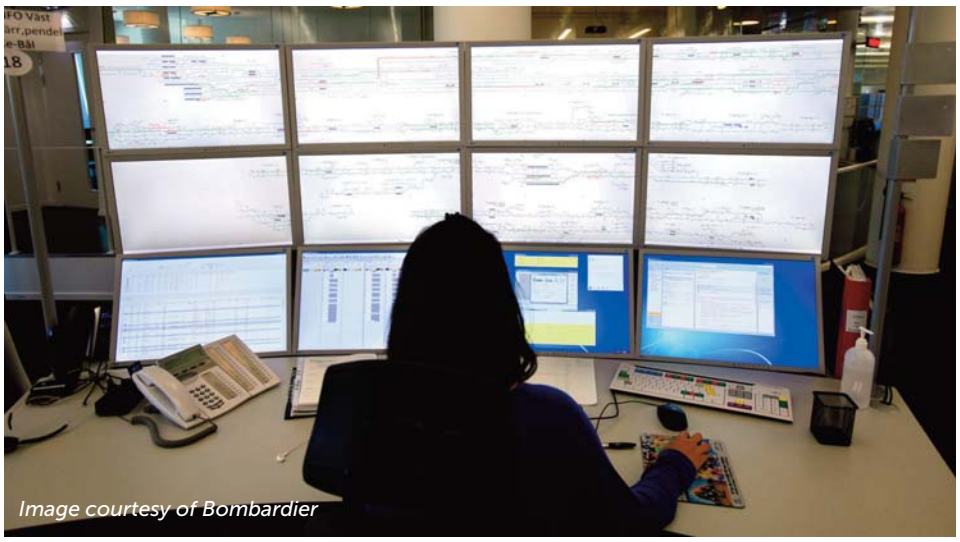


Image courtesy of Bombardier

and their energy efficiency improved, which in turn makes railway networks safer, reduces costs and increases the attractiveness and competitiveness of rail over other modes of transport, thus encouraging further investment to improve further.

It also eliminates the need for engineers and technicians to carry out maintenance checks on site, thus it avoids disrupting services, saving time and money that these checks require, as well as ensuring the safety of staff. Track-to-train communication also means that obstacles or faults can be immediately spotted, crews can be dispatched immediately, services diverted accordingly and passengers informed within seconds.

Passenger Information

With the Internet of Things, passenger information is transformed. Without the need for human input, travel information can be relayed directly trains, tracks to control centres and then directly to passenger information boards, mobile phone apps and websites delivering real-time data.

With the development of technology, rail transport can be seamlessly integrated into passengers' devices to fulfill their transportation needs by improving IT, management and cross-industry collaboration to integrate rail into other forms of transport.

Using linked data, innovations in connectivity, the internet and social media, rail operators can communicate with passengers and receive information in return to improve customer services and create a more cohesive passenger experience. This experience is enhanced further by analytics of passenger behaviour, looking at patterns of seating choice and crowd movements, systems can be put in place, and advice sent directly to passengers via smartphones, which will in turn make journeys smoother.

Automated Trains

Automatic train operation is increasingly becoming the norm on metro networks internationally, from Budapest to London, Singapore and New York. Although some still employ drivers as a last-resort failsafe, driverless automated trains are increasingly successful, with everything up to the doors opening and closing carried out without human involvement. As such, fully automated trains are discussed now as a safety feature, and an inevitability that they will become standard on all metros in the near future, and mainline services not long after that.

Security

Because of the rigorous testing that each system undergoes, they are effectively failsafe. Therefore, and bringing us full-circle, the greatest threat to a fully automated railway network is human beings – which is to say – cybersecurity. Previously, a terrorist actually had to show up in order to derail a train; now it can be done from the comfort of his own bunker.

Cybersecurity, protecting against not only threats of violence, but also industrial espionage and theft of passenger information, is an ongoing battle. Not long after a system is fully protected is it breached again as hackers find new ways to circumvent security measures.

Risk management systems have to account for broadening boundaries around networks, which, in the railway industry, is an almost countless number of sensors, control rooms, cloud-based architecture systems and personnel, right down to the smartphones held by passengers, which are all constantly uploading and downloading data, which at any point could be intercepted.

Early warning systems are crucial to the security of networks, with a well-designed and implemented cyber threat intelligence strategy that evolves as fast as the threats they manage. Incidence reporting and detection is equally as important in order to ensure a rapid response. Co-operation with other stakeholders, from international to local authorities and partners, also minimises risk.

The Internet of Things

The rail industry is a sector of innovation like few others. It has become the greenest, safest form of mass transport in the world precisely because it has taken advantage of new technologies; from innovations which harness breaking energy to entirely automated metro networks.

Most passengers do not realise that they are travelling in a partially self-powered vehicle, driven by a computer, communicating with other self-powered, computer-driven vehicles in a tight and highly orchestrated formation while it transports a population. And that is science fiction, reduced to the banal, nebulous phrase, "the Internet of Things".

Tracking Position: Wearing Out the Wheel-Rail Interface

With wayside inspection becoming much more sophisticated, how can it be used to improve the safety of rail infrastructure and rolling stock?

By Paul Bladon

Wayside condition monitoring of rolling stock is becoming increasingly advanced, and the last 20 years in particular have seen large leaps in technology, from simple wheel sensors in the 1970s to the modern-day implementations of complex sites with multiple instruments.

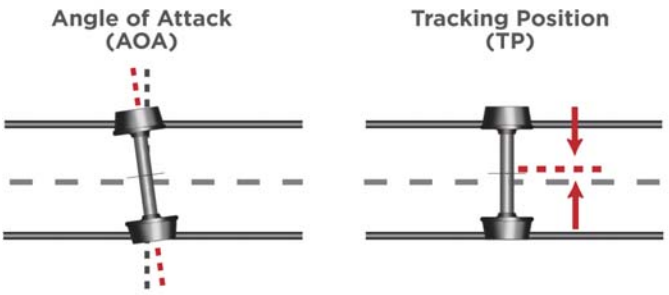
Wayside monitoring the condition of rolling stock requires monitoring several key aspects of bogies. The wheel-rail interface is a relatively closed system; sub-optimal bogie condition will be reflected in the rail, and vice-versa. It also means that different aspects of bogies, such as flange wear, side bearings, springs, steering performance and lateral stability are all interrelated.

Wayside systems employing non-contact measurement technologies have been developed to evaluate the condition of specific bogie components such as wheel profiles, journal bearings, wheel surface, brake blocks, springs, etc. All this data is useful, but how does it translate to what is being experienced at the wheel-rail interface? In other words, how is the bogie performing?

Angle of Attack (AOA) is a key parameter used to characterise the wheel-rail interface. Tracking Position (TP) is an equally important parameter, but is not as well known.

A wheelset's AOA is defined as the angle between the centreline of the wheelset axle and the radial line of the curve, which would be a line perpendicular to the rails for straight (tangent) track. Tracking Position is defined as the lateral displacement of a wheelset between the middle of the wheelset and the track centreline.

FIGURE 1



The wheelsets of a bogie on tangent track should have an AOA of zero and a TP of zero, i.e. the wheelsets should be centred between the rails, and the axle centreline of the wheelsets should be perpendicular to the rails. A deviation from this condition would be detrimental to the wheel-rail interface.

Deviations from the ideal wheelset TP and AOA values may manifest themselves in one or both wheelsets of a bogie, and in different combinations. The different combinations result in specific wear to the bogie's wheels and components, and similarly inflict specific wear regimes on the rail.

All of these combinations can ultimately result in derailment.

If the root cause(s) are identified, the sequence of wear can be broken and both wheels and the rail enjoy significantly longer lifespans as a result. Derailments are also reduced.

The various combinations of AOA and TP manifested on two-axle bogies can be classified into four elemental patterns (IAM, ROT, TE, SHIFT) as well as instability (HUNTING) – see Figure 2.

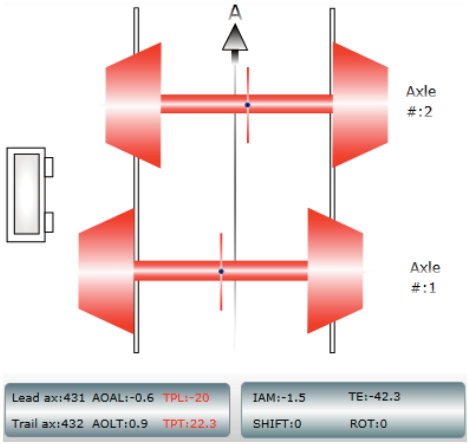
Each of these combinations is observed on wagons in revenue service and point to specific root causes.

This is the purpose of the TBOGI (Truck Bogie Optical Geometry Inspection) wayside system, which measures these defects on tangent track at line speed.

The TBOGI System

This article will examine Tracking Position errors specifically, and how they manifest in bogies as either Tracking Error or Shift.

Once TE begins to manifest, it typically degrades quickly, leading to severe wear of the wheels and rail, and ultimately derailment.



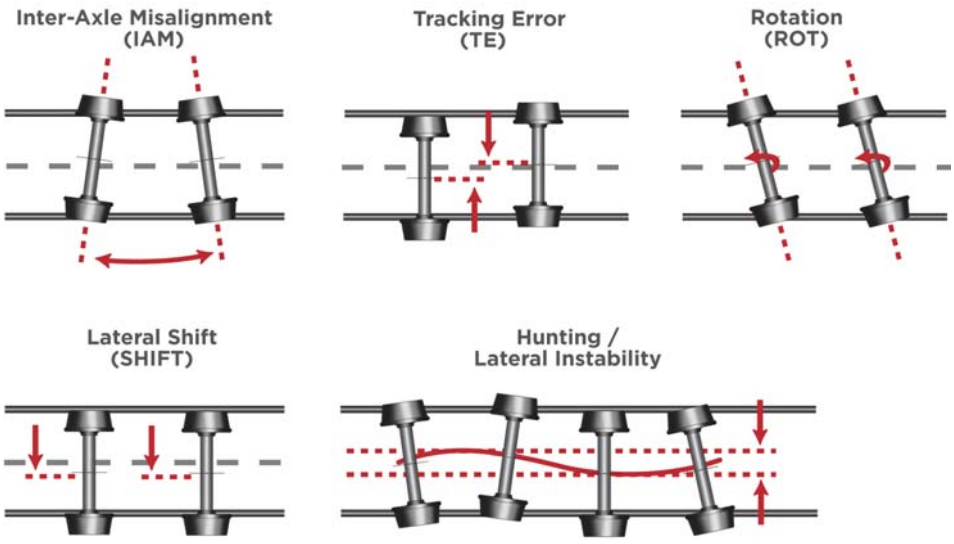
Example Extreme Tracking Error (42.3 mm)

Where do Tracking Position defects come from?

Tracking Position defects have specific sets of common root causes, and the stresses cause interrelated wear/damage between these components.

A single axle with a Tracking Position defect will develop asymmetrical wear, until one flange is thin, and the mate wheel experiences hollowing. The most common causes are mismatched wheel diameters, or uneven brake beam movement, applying excess brake shoe pressure on one side.

FIGURE 2



What does this mean for rail infrastructure and rolling stock?

Rail Infrastructure: defective tracking behaviour is a primary cause of accelerated rail wear throughout a rail network. Each type of defect manifests as specific types of rail wear:

Tracking Position Defects	Angle-of-Attacks Defects	Hunting (Instability) Defects
(a) Head checking / gauge corner cracking (b) Shelling (c) Longitudinal fatigue cracking (d) Flow of flash-butt material on the gauge corner of the rail (e) Greater derailment risk	(a) Intermittent crown wear as lateral material flows, particularly in curves (b) Deformation discontinuities form as corrugations or material flow (c) Lateral fatigue cracking and that can lead to rail breaks (d) Surface breaking cracks which develop into rail squats (e) Greater derailment risk	(a) A combination of wear patterns (b) Repeated flange impacts (c) Spin creep and 'scrubbing' action against the rail (d) Greater derailment risk

When the bogie itself experiences a Tracking Position defect – either as TE or Shift – both wheelsets are experiencing misalignment. Therefore, fixing one thin flange will most likely not fix the issue and the bogie will continue to wear out wheels (and other bogie components) at an accelerated rate. Depending on whether the defect is TE or Shift, there are common underlying cause(s) that are well understood – such as bearing adaptors, springs, wedges etc. – and railways are directed to these specific components to improve efficiency and reduce costs.

Tracking Error falls under the category of a Tracking Position Defect, so is primarily responsible for longitudinal fatiguing on the rail as well as gauge corner wear.

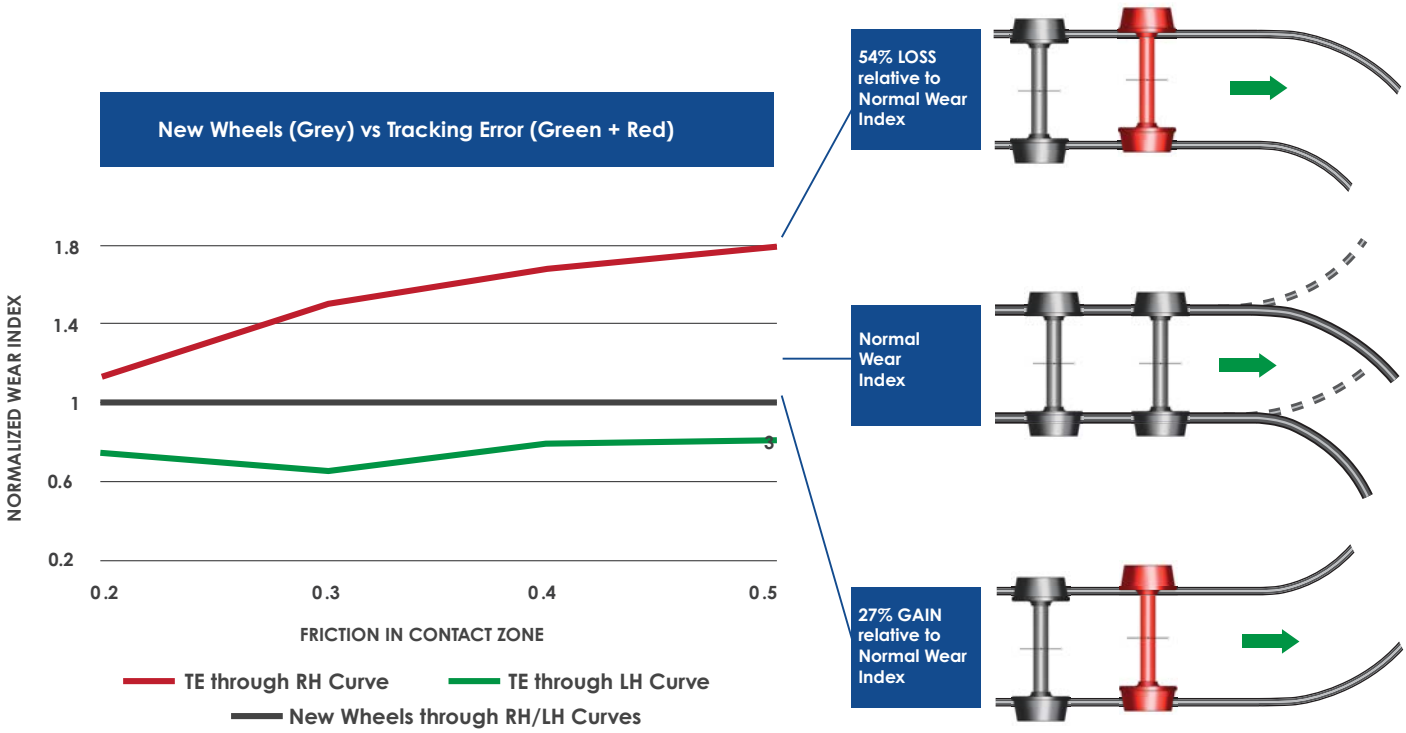
Rolling Stock: by monitoring tracking behaviour, rolling stock operators are able to identify whether a wheelset or bogie is compromised. For example, repairing individual defective components without knowing the underlying cause(s) is analogous to attempting to fix a car's suspension by watching the tyre's tread wear: it cannot be known why the wear is actually there, and components can be fixed and released but it will not be known if that has been successful or not until the wear re-emerges, by which stage the damage/wear has been re-done and the costs re-incurred.

Wheelsets can be swapped out with newly profiled wheels, but if the bogie still has a severe TE (for example) upon release, then it should be identified immediately (well before the wheels have worn out again) and maintenance directed at the root causes of the issue.

Alerts can be set up before the most costly wear has occurred (or derailments have occurred) – along with actions to address why it has occurred so issues can be prevented from happening again, not simply caught once they have happened again.

For TE specifically, as it degrades it puts more wear/stress on components such bearings and springs, and ultimately reaches the point where the wheelsets of the bogie will have thin flanges and hollowing/heat checking – typically on opposite sides of each wheelset. Individual components/wheelsets can be swapped out, but unless the TE is addressed it will simply wear out those components repeatedly until the fundamental issue is addressed. TE can also be a common cause of derailments.

Strain gauges are useful for load imbalance detection, but are not suited to monitoring these defects. A strain gauge may give a high force reading, but what does that mean? Forces are highly variable depending on speed, loaded condition, direction, rail friction coefficient, and track curvature. TBOGI is largely immune to all of these variables. Also, strain gauges measure lateral and vertical forces but have limited visibility of longitudinal forces, and are therefore limited in knowing how the data translates to the bogie. Strain gauges do not measure hunting directly – rather,



they infer it as a factor score. TBOGI measures bogie geometry and tracking behaviour on tangent track where the bogies are in a free rolling condition un-coerced by curving forces. TBOGI's optical data is more dependable, more meaningful, more repeatable and can be accurately trended.

Bogies exhibiting TE will steer favorably through a specific curve orientation, but extremely poorly through curves of the opposite orientation. Such performance reinforces the degenerative and accelerated diagonal wheel wear pattern on the bogie. Illustrated on following page[1]:

What results are achievable by monitoring Tracking Error?

The following are some example results of monitoring and addressing Tracking Error[2]:

- By reducing bogies with extreme TE, BNSF has been able to reduce TE related derailments from 7 per annum in 2010, down to 2 per annum in 2013.
- By using a wayside super-site to identify bogies presenting derailment risks from poor TE, ArcelorMittal Infrastructure Canada has not had a related derailment since 2003, and has experienced huge improvements in reduced rail wear, and increased wheel lifespan.
- BNSF was able to reduce the most costly and dangerous TE defects from 51.6/100,000 in 2009, down to 3.9/100,000 in 2014.
- CSX was able to reduce the most costly and dangerous TE defects from 6.9/100,000 in 2009, down to 0.8/100,000 in 2014.

Conclusion

The tracking behaviour of wheelsets and bogies are crucial to an optimal wheel-rail interface. Railways that monitor and address these defects have proven histories of improved safety and reduced costs.

Of these behaviours, Tracking Position is an important defect to monitor in order to manage derailment risk, wheel wear, rail wear, and maintenance cost. The defect corresponds to specific damages to the rail and to the bogie wheels/components.

The TBOGI system monitors these parameters, and provides railways with easy ways to manage the data.

[1] Excerpt from: Izbinsky G., Sirois G., Liu Y., D'Aoust D., "Monitoring Bogie Performance on Straight Track. Part 1. Wheel set tracking position". The 7th World Congress on Railway Research, Montreal, June 2006

[2] Excerpts from: Bladon, P., K. Bowling, H. Braren, J. Deslauriers and D. D'Aoust 2015 "The Challenges of Integrating Novel Wayside Rolling Stock Monitoring Technologies, A Case Study." In, Proceedings of 2015 International Heavy Haul Conference, Perth. International Heavy Haul Association (IHHA), 417-426.

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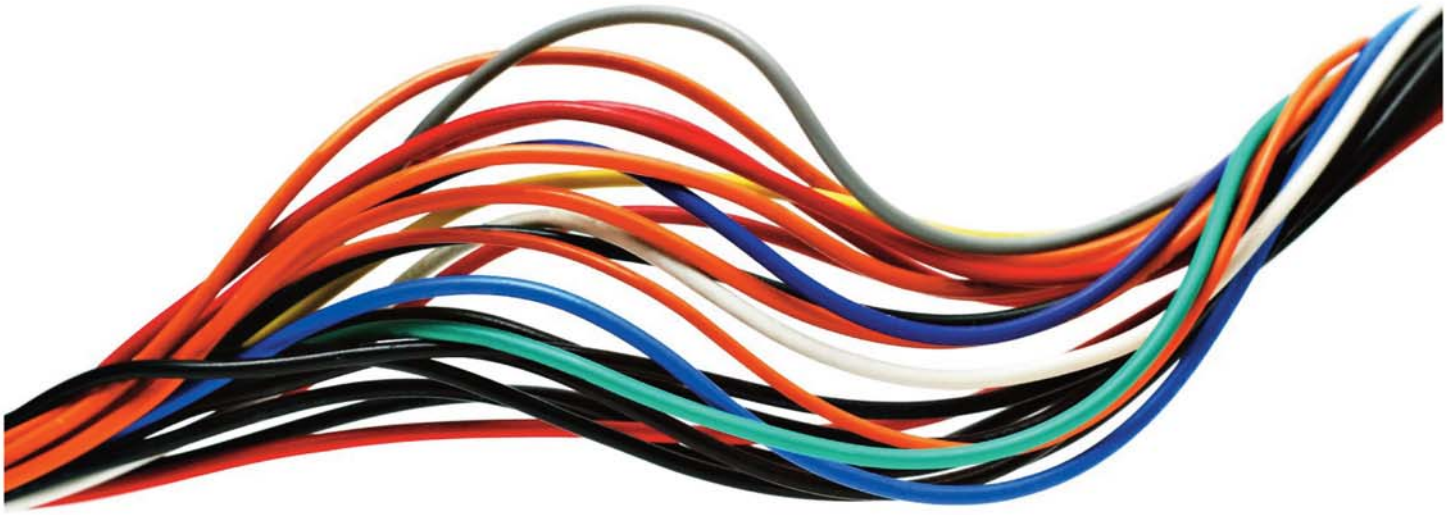

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BT Cables

BT Cables discusses its growth, performance and social responsibility commitments.

BT Group plc acquired the business in July 2012, launching BT Cables and providing financial stability. Significant investment in the Manchester manufacturing plant has followed and we have embarked on a strategy to build a profitable growth business. Since acquisition, BT Cables has grown to annual sales of £75m, with 130+ customers across Europe and the Middle East. The product range has extended to include cable solutions for buildings and infrastructure, as well as optical fibre. Key customers include Network Rail, Openreach, Telefonica, Virgin Media and Cyta (Cyprus Telecom).

BT is committed to the BT Cables copper manufacturing base in Manchester, and is in the business for the long-term. Optical fibre cables are manufactured at a state-of-the-art plant that has a successful track record in supplying fibre cables to blue chip companies such as Telefonica and ADIF.

We continue to seek to add value to the products we supply through our wealth of technical expertise in cable design and supply chain processes.

BT Supply Chain

Standing alongside BT Cables is BT Supply Chain (BTSC), an emerging player in the supply chain and logistics sector for businesses with a large engineering field force. BTSC undertakes around 50,000 unique orders daily across varied B2B and B2C channels, including cable supply and contingency cable solutions. We have two national distribution centres, 98 forward stock locations, 38 managed kit rooms supporting network spares, 60 cable compounds and in-house transport operation of 200+ vehicles. Other in-house capabilities include broadband hub tests and refurbishments, network and end-user technology staging / configuration, and safety testing and repair for field engineer equipment.

We believe that this provides unique opportunities for us to provide E2E cable management solutions that simplify the supply chain, minimise inventory holdings and working capital, and importantly provide operational cost savings.

We deliver quality products, competitive pricing and additional value to our customers that stand apart from the offerings our competitors can provide. We are passionate about our business.

Recycling

BT Cables has a recycling operation on site in Manchester that manages surplus cable, damaged cable and scrap. We have carried out recycling and/or re-use programmes for customers in the past, and this is an aspect that helps our customers minimise waste.

Quality Assurance

BT Cables is accredited to ISO9001, ISO14001 and OHSAS18001. We also run a Kaizen Continuous Improvement Programme that is at the heart of everything we do. The programme has been running continuously since 1999 and in that time has transformed the business.

Business continuity management BCM is a significant part of risk management and we have a comprehensive BCM plan. This plan covers:

- Disaster recovery plan for the factory and logistics hub
- Alternative supply arrangements for finished goods from approved sources in the event of a disaster at the factory
- Risk mitigation in our inbound supply chain through multiple sourcing arrangements

Corporate social responsibility (CSR)

BT has a vested interest in maintaining the reputation of its brand identity, and as an organisation we have a commitment to ethical trading. For this reason we have a rigorous CSR programme which has been running for over a decade. Our standards are based on:

- Applicable labour, safety and environmental laws within the country of manufacture
- The principles captured in the United Nations Universal Declaration of Human Rights
- The core and non-core conventions of the International Labour Organisation

BT Cables – trust in our experience

NTSB's Most-Wanted List

A 'Road Map from Lessons Learned to Lives Saved' Puts Focus on Rail Technology

NTSB's Most-Wanted List – A 'Road Map from Lessons Learned to Lives Saved' Puts Focus on Rail Technology

The National Transportation Safety Board, the US government agency responsible for civil transportation accident investigation, including those involving railroads, has unveiled its 2016 Most-Wanted List of safety improvements calling it a 'road map from lessons learned to lives saved'. The list focuses on 10 broad safety improvements on which the NTSB has made recommendations and that have not yet been implemented. This year's list has a major focus on technology in saving lives, preventing accidents and lessening the number and severity of injuries from accidents. This article takes a look at the list in further detail.

The NTSB list called for completion of rail safety initiatives, including once again the implementation of Positive Train Control (PTC) , which first appeared on the list in 1990 and whose deadline was pushed back to 2018 from 2015. Congress changed the law and implementation deadline late last year to avoid a possible rail transportation shut-down.

NTSB Chairman Christopher Hart cited PTC implementation as an example of why a sense of urgency is needed in implementing the Most-Wanted List improvements. 'Every PTC-preventable accident, death and injury on tracks and trains affected by the law will be a direct result of the missed 2015 deadline and the delayed implementation of this life-saving technology,' Hart said.

The NTSB's push to improve rail transit safety oversight was in part a result of the agency's investigation into a deadly smoke event last January near Washington's L'Enfant Plaza Metro station. The accident exposed many safety issues, some of which resulted from shortcomings in the safety oversight of WMATA (Washington Metropolitan Area Transit Authority). This year, the NTSB will continue to examine the way that the Federal Transit Administration is implementing such oversight – not only in Washington, but nationwide. Improving rail tank car safety by phasing out the use of DOT-111 rail tank cars to transport flammable liquids, such as crude oil and ethanol, is another improvement addressed in the 2016 Most-Wanted List. The deadline for implementing such tank rules is 2025. Until these tank cars are removed from service, people, their towns and the environment surrounding the rail system remain at risk the NTSB argues.

Chairman Hart invoked the memory of the accident at Lac-Mégantic, Canada, in 2013, which

killed 47 people and burned down more than 30 buildings, in a Washington Post report of the launch: 'We've been lucky thus far that derailments involving flammable liquids in America have not yet occurred in a populated area,' Hart said. 'But an American version of Lac-Mégantic could happen at any time. Instead of happening out in the middle of a wheat field it could happen in the middle of a big city.'

Distraction (especially from portable electronic devices) and fatigue continue to be serious safety issues in all modes of transportation, and the NTSB's 2016 Most-Wanted List addresses them all. The list also notes that undiagnosed and untreated medical conditions have caused or contributed to accidents and calls for operators and regulators to require medical fitness for duty.

The most-wanted transportation safety improvements are the result of the NTSB's accident investigations. And the NTSB reiterated that their most powerful tool to learn safety lessons from accidents is data recorders. Thus, the list calls for their increased use in all modes of transportation.

Chairman Christopher A. Hart of the NTSB is a lead speaker at the upcoming SafeRail (incorporating the PTC World Congress) taking place in Washington D.C. 22–23 March 2016. Chairman Hart will be joined by Yves Desjardins-Siciliano (CEO, VIA Rail Canada), Mike Marino, Director/General Manager (Port Authority of NY & NJ (PATH)), Jeff Moller (AVP Safety, AAR) and many more experts in rail safety and PTC.

By Luke Upton

Vincent Weeda, Traffic Analyst at ProRail:

"In 2016 ProRail will address the impact of disruptions (by prevention, fast fault repair, and optimal traffic management around the problem). After improving punctuality in regular operations to a fairly high level, the focus of our Performance Analysis Group will now shift to limiting cancellations as a result of disruptions."

Windhoff will deliver...

35 self-propelled On-Track Machines to Swiss Federal Railways SBB

Windhoff Bahn- und Anlagentechnik GmbH, Germany has obtained a contract for the design, production and delivery of 35 self-propelled On-Track Machines from SBB in Switzerland. This is the largest individual contract in the company`s history.

From spring 2017 onwards the new vehicles will be delivered successively to SBB and - according to the current scheduling - the last OTMs will be rolled out in 2021. During this time SBB is entitled to opt for the additional delivery of further vehicles of the same type.

The new machines will be used for scheduled maintenance of the infrastructure as well as trouble-shouting in case of urgent repair works. SBB had put the contract out to public tender; the final decision in favor of Windhoff is based on the fulfillment of the criteria "Quality" and "Efficiency". Contributing to this decision – among other things – is the innovative design of the running gear: it combines low wear and high tractive effort with extraordinary curve negotiating characteristics.

Each vehicle will be equipped with a loading platform and a loading crane. For improved access from the track bed the loading platform is partly lowered to a height of only 1.000 mm above rail-level. The high diesel engine output and the optimum applicable and efficient distribution of the driving torque onto both axles enable maximum traction forces for all upcoming vehicle applications. Even fully loaded (total weight 40 tons) a maximum travel speed of 100 km/h can be realized. Thanks to performance reserves gradients can be passed without loss of speed.

The vehicle layout features two independent driver's positions which allow for both a seated and standing position of the operator to enable safe vehicle movements when running in open line and in

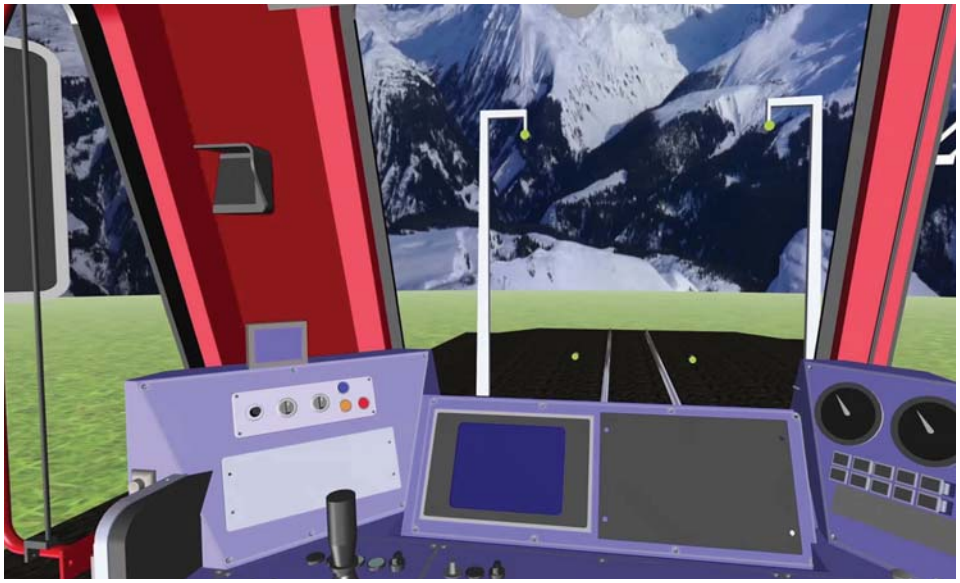
possession respectively during shunting.

Visibility was permanently tested during the tendering phase and optimized for the current solution. Initially a number of 5 vehicles will undergo a 6 months testing period in full operation and all gained experiences herein will be transferred into serial production before final takeover.

Apart of minimized life cycle costs SBB emphasizes low fuel consumption for the new OTM fleet. This will be achieved by a twin-engine power installation with energy-saving automatic start-stop function.

For the first time these new OTMs will be equipped with "ETCS-only" as the standard cab signaling equipment in Switzerland. The challenge to meet the requirements of this technical novelty was successfully implemented by the Windhoff engineers.

Again the Windhoff team was able to provide the best technical and economical solution for a tailored system.



Upcoming Events

February – April 2016

International Railway Summit

17–19 February 2016

Vienna, Austria

February's railway events kick off with the International Railway Summit, featuring exciting talks about Shift2Rail, a look at European railways and big data in the railway context, the 4th railway package and urban rail, with Supeo as the headline sponsor.

More info:
www.irits.org/index.html

Rail Business Awards 2015

25 February

London, UK

Hosted by Nick Hewem, of The Apprentice fame, categories for the 2015 awards include Rail Business of the Year, Train Operator, Women in Rail Award, Young Professional, Train Operator and Rail Engineer of the Future.

More info:
www.railbusinessawards.com/

12th UIC World ERTMS Conference

29 February – 2 March

Brussels, Belgium

Hosted by the International Union of Railways (UIC) and INFRABEL, this conference, "ERTMS – Managing long term safety investment in a rapidly changing world" will feature six main topics: long term and future vision safety, migration, global challenges, financing and asset management, operation, evolution.

More info: **www.uic.org**

4th Railway Forum Berlin 2016

29 February – 1 March

Berlin, Germany

Deutsche Bahn AG and the Institute for Production Management organize this annual supply chain conference as a management platform in the railway industry. It will feature 500 conference participants, 70 decision makers from Deutsche Bahn AG, 50 exhibitors as well as partners and sponsors.

More info:
www.railwayforumberlin.com

IT Trans

1–3 March

Karlsruhe, Germany

Organized by UITP, March starts with this conference that looks at IT solutions for public transport. There will be a conference and an exhibition. The exhibition will see businesses and associations of the public transport industry present developments and innovations, while the conference will provide a discussion platform to come up with IT solutions to support public and sustainable urban transport.

More info: **www.it-trans.org**

Eurasia Rail 2016

3–5 March

Istanbul, Turkey

Organized by ITE Turkey, the 6th International Rolling Stock, Infrastructure & Logistics Exhibition will feature conferences and seminars with an expected 300 exhibitors and 10,000 visitors. Topics will include urban railway issues, railway legislation, railway safety management systems and special issues for railways.

More info: **www.eurasiarail.eu**

Middle East Rail 2016

8–9 March

Dubai, United Arab Emirates

A great place to buy and demo new technology and learn about future projects, exhibitors come from the fields of engineering & construction, signalling, communication & IT, rolling stock, tunnelling, safety & security and consultants, lawyers & banks amongst others.

More info:

www.terrapinn.com/exhibition/middle-east-rail/index.stm

American Passenger Rolling Stock 2016

16–17 March

Washington D.C., USA

The two-day event will host high-level executives and engineers from all sectors of the rail industry with a vested interest in the longevity and cost-reduction in operating passenger rolling stock.

More info: **www.passenger-rolling-stock-maintenance.com**

SafeRail Congress

22–23 March

Washington D.C., USA

Hosted by the Global Transport Forum, our featured event of this issue, this conference is all about ensuring safety, security and operational efficiency on North American rail networks. Topics include positive train control, IT and homeland security in rail transportation and cybersecurity.

More info:

www.SafeRailCongress.com

Intermodal Asia 2016

22–24 March

Shanghai, China

This 3-day container, transport and logistics event will take place in China, one of the world's most important logistics markets, allowing attendees to discover innovative products and meet suppliers to help their businesses. The conference will focus on strategy, innovation and technology.

More info: **www.intermodal-asia.com**

Short Line & Regional Conference

3–6 April

Washington D.C., USA

This event will feature committee meetings on safety & training, railroad police & security, finance & administration, human resources, technology, veterans recruitment and legislative policy as well as a young professionals gathering.

More info:**www.aslrra.org/aslrra2016connections**

EXPO Ferroviaria 2016

5–7 April

Turin, Italy

Italy's leading rail event is a showcase for the latest railway equipment, products and services. The show will be attended by suppliers and manufacturers from many sectors, including vehicle maintenance, security systems, communications technology and freight terminal equipment.

More info:

www.expoferroviaria.com/eng/page.cfm/Link=1/t=m/goSection=1

Infrarail 2016

12–14 April

London, UK

An exhibition devoted to railway infrastructure and the feature event of the second issue of our magazine in 2016. Taking place every two years, railway infrastructure is currently seeing huge investment in the UK – HS2 and Crossrail are examples of that. With that in mind, people from the industry can do business, find out about trends in technology and network in this field that is receiving massive investment.

More info: **www.infrarail.com**

SmartRail Europe

19–20 April

Amsterdam, Netherlands

This event features four congresses, smart signalling & telecoms, smart IT networks, smart train, and smart passenger in one show. A wide variety of topics will be covered, from maximising capacity and performance with ERTMS, what big data can do for rail, meeting performance objectives for rolling stock and optimising operations to meet customer expectations of service.

More info:

www.SmartRailEurope.com

MENA Transport Congress & Exhibition

24–27 April

Dubai, United Arab Emirates

Hosted by UITP, the International Association of Public Transport, this congress and exhibition features categories such as signalling and traffic control tunnelling, electrification equipment, components for rolling stock, track building and maintenance and many more. The slogan of this year's event is "Urban Mobility – Think Big". The goal is to liberate the cities of the future from the environmental, social and economic consequences of traffic congestion.

More info: **www.uitp-mena.com**/

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PASSENGER TERMINAL AMSTERDAM
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"SmartRail provided me with a valuable overview of the innovation challenges ahead and good opportunities to meet up with people from different parts of the industry."

ARJEN ZOETEMAN, SENIOR POLICY ADVISOR, DEPARTMENT OF INNOVATION & SUSTAINABLE DEVELOPMENT, PRORAIL

4 CONGRESSES, 1 DEFINITIVE SHOW

SMART SIGNALLING & TELECOMS
Hear international ERTMS best practice to address todays technical issues

SMART IT NETWORKS
Reduce cost, improve service and maintenance, and reach operational excellence with integrated IT

SMART TRAIN
Improve rolling stock ROI and meet customer expectations with big data analysis and design innovation

SMART PASSENGER
Satisfy customer expectations of on-board services, train comfort, service performance and connectivity

KEY SPEAKERS INCLUDE:

Gottfried Eymer
CEO
DB Schenker Rail Scandinavia

Bjorn Westerberg
CEO, **Association of Swedish Train Operating Companies**

Carsten Carstensen
CEO
Hamburg Koln Express

Teemu Rintala
Head of Data Analytics, VR
Finnish Railways

Stefan Engdahl
Executive Director - Market and Planning
Trafikverket

Márton Feldmann
Deputy CEO, Business Affairs
MÁV

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