



THE **PWI**

THE

JOURNAL

JULY 2025 | VOLUME 143 | PART 3

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MONITORING OF S&C VIA
WHEEL-RAIL CONTACT FORCE
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“ I AM **PROUD** TO BE PART OF THIS
INSTITUTION ”

EMPOWERING RAILWAY ENGINEERING

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SHARE YOUR CAREER STORY!

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GET READY TO HAVE YOUR SAY

This Autumn, The PWI Executive Team will be visiting Sections to discuss the up and coming PWI Name Change vote with Members.

Have your say - every voice matters.

EVERY MEMBER GETS A VOTE... THE PWI OR RailEI?

THE JOURNAL

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Member	£115
Members (67.5 or older on 01.01.25)	£47
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IEng Members*	£185
CEng Members*	£205
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Fellow (67.5 or older on 01.01.25)	£60
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* If you are professionally registered through the PWI, we will collect your annual Engineering Council Registration fee along with your PWI Membership fee and then pay the Engineering Council on your behalf. ** Includes the Engineering Council Registration entry fee.



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SUBMIT A JOURNAL ARTICLE

If you would like to share a project you've been working on within the Journal then please get in touch.



PRESENT A LUNCH & LEARN

If you would like to present a live Lunch & Learn session, please do let us know.



Cover photograph courtesy of John Merriman.

A CLOSING LETTER FROM YOUR PRESIDENT

A YEAR OF PRIDE, PROGRESS AND COMMUNITY

It only feels like a few weeks ago that I was at the AGM, receiving the President's chain from Steven Bell. Time really does fly when you're enjoying yourself. It has been an absolute honour and privilege to serve as PWI President this past year.

From day one, I was welcomed so warmly by our members, our volunteers, and our dedicated team behind the scenes. The pride, passion and enthusiasm within this Institution are unmistakable, and I've seen it in every conversation, event and seminar I've attended.

THE PRIDE, PASSION AND ENTHUSIASM WITHIN THIS INSTITUTION ARE UNMISTAKABLE, AND I'VE SEEN IT IN EVERY CONVERSATION, EVENT AND SEMINAR I'VE ATTENDED.

STANDING AMONG REMARKABLE PEOPLE

My standout moment of the year has to be the Annual Awards Ceremony. To present awards to Members for their Professional Registration or Diplomas was an incredibly moving experience. Meeting proud families, shaking hands with those who had worked so hard to reach this point, and hearing words of gratitude and pride, it reminded me just how meaningful these milestones are, not just professionally but personally.

One Member told me her mother would be thrilled to see the photo of "two Asian women" – one of whom happened to be the PWI President, standing side by side. That small moment stayed with me. Representation, pride and progress were all wrapped up in that photograph.

It was also a privilege to surprise our Honorary Life Members with their awards. Between them, they represented over 200 years of voluntary service to the PWI. Their humility and dedication were humbling. Recognising their contribution was one of the true high points of my term.

SEMINARS, SYSTEMS AND SHARED KNOWLEDGE

This year has been packed with high-quality Technical Seminars, each with a distinct focus, culture and energy. Whether we were discussing electrification, light rail, track renewals, or behaviour change, each event was a testament to our Members' appetite for knowledge and the diversity of engineering disciplines within our railway system.

Of course, the Water Management Seminar in May held a special place in my heart. As someone who has championed this topic for years, I was delighted to see it take centre stage. I hope my presidency has helped elevate the importance of water and drainage in the railway conversation and I'll continue flying that flag long after my term ends.

VISITING THE SECTIONS

Visiting and engaging with our Sections has been another privilege. I've met Past Presidents, apprentices, senior leaders, retirees and Members from across all disciplines. Your openness, your questions, and your willingness to share both challenges and successes have been inspiring. Thank you for making me feel welcome and heard, and for the kind follow-up messages many of you sent afterwards, they meant a great deal.

A FUTURE-FOCUSED PWI

This year has also seen important conversations about the future of our Institution. I know there are strong views on the proposed name change, both in favour and against. I've heard them all, and I understand them. I firmly believe this change is not about forgetting our

past; it's about better representing the present and future of railway engineering. Words matter. The way we describe ourselves matters. If we want to continue to grow our membership, support our community, and reflect the systems-based reality of today's railway, then we must evolve.

The PWI has always been the home of railway engineering and that home must be one where everyone feels a sense of belonging.

GRATITUDE AND HANDOVER

I want to thank the PWI Executive Team and Board, especially Joan, Kate, and the team for your tireless support. You've guided me, answered every question (even the silly ones), and helped make this year possible. To our Past Presidents, thank you for your wisdom. I've tried to follow in your footsteps and hope I've done you proud.

To our sponsors and exhibitors, thank you for helping us deliver CPD and networking opportunities that matter, none of which would be possible without your support.

And now, I pass the baton, and the gavel, to Chrisma Jain. I have no doubt she will lead with energy, empathy and vision. I'll be proudly supporting her in my role as Past President over the next two years.

Thank you again to every single member who makes the PWI what it is, a vibrant, expert, welcoming community. I'm proud to be part of it, and I look forward to what is next.

Yours truly,



MONA SIHOTA
PRESIDENT
president@thepwi.org



FROM THE CEO WELCOME TO THE JULY JOURNAL

MISSION, VISION, VALUES – WHO WE ARE, WHAT WE DO, AND WHY...

As I write the PWI team is gearing up for the Institution's presence at the Rail Live railway industry exhibition, open this year on 18 and 19 June. This now annual event, held at the Porterbrook Rail Innovation Centre at Long Marston, provides an unparalleled opportunity to meet many Institution members, old and new friends, and (importantly) potential members.

This year's event is particularly important for the Institution as it sees the launch of new Mission, Vision, and Values statements together with a new strapline and short "who we are" statement.

WE ARE:

A welcoming, professional railway engineering community, bringing people together to share, learn and build rewarding railway careers

OUR MISSION:

To educate, empower and connect people – sharing knowledge and experience, enriching careers and championing railway engineering

OUR VISION:

To be a globally renowned engineering institution – inclusive, progressive and shaping the future of a thriving railway industry

OUR VALUES:

Integrity. Inclusivity. Empowerment.

OUR STRAPLINE

Empowering Railway Engineering

These words don't just set direction and purpose: they also describe how the Institution will behave in pursuing its goals. The statements are inspired by the member consultation launched in January 2023 and informed by the subsequent survey of members and non-members carried out in mid-2024. Survey responses were received from nearly 500 members and over 100 non-members with findings summarised in the October 2024 Journal.

I very much look forward to discussing these five statements and their implications with visitors to the Institution's stand at Rail Live.

THE INSTITUTION'S STRATEGIC JOURNEY...

The launch of these guiding principles is part of the Institution's **Strategic Journey**, initiated by the Board in late 2022. As the Journey's duration is measured in years, it is perhaps easy to lose sight of the elements within it and how our Journey is progressing. I trust that the illustrated diagrams on pages 8 – 11 will help members and friends of the Institution understand

the important role they have had, and continue to have, in reaching decisions on the Institution's future, and see actual and proposed changes in context.

NAME CHANGE – PROPOSAL AND PROCESS

The overwhelming majority of responses to the 2023 member consultation supported changing the Institution's name and 2024's survey revealed widespread confusion and puzzlement over the term *Permanent Way* - both within and outside the railway industry. Whilst those insights do not themselves constitute a mandate for change, they do fully justify offering members an opportunity to decide whether to adopt a new name.

Further work on the process for taking this decision means that an Extraordinary General Meeting is likely to be convened in early Autumn and that a motion to change the Institution's name to **Railway Engineering Institution** will be put to that meeting. It is intended that the meeting will call for a formal poll of members which will be concluded before the end of 2025. The Institution is currently in discussion with an independent company specialising in providing digital and postal ballots for membership organisations, including several other professional engineering organisations. As I have repeatedly stated, it is the Institution's intention that every member will have the opportunity to vote on this important matter.

RAILWAY ENGINEERING INSTITUTION?

While on the topic of name change, I thought it would be helpful to set out - in straightforward terms - the rationale behind the proposed **Railway Engineering Institution** name.

Railway - is a clear and simple term, understandable by all inside the railway industry, in the broader engineering community, and in wider society. It signals an interest in all matters relating to railways.

Engineering - is an inclusive term, indicating our welcome for anyone working within, or having an interest in railway engineering.

Institution - makes clear our status as an engineering institution: an active member of the group of 39 established UK professional engineering institutions.

Overall, the name is clear, it expresses the Institution's purpose, it contains no jargon, and it is inclusive and accessible. The Institution now owns the trademark to this name together with the short form **RailEI**.

RAILWAYS AND GOVERNMENT – JUNE 2025 SPENDING REVIEW...

Announcement of the conclusions of the UK Government's Spending Review 2025 (setting out its capital investment intentions to 2029/30 and budgets for day-to-day spending to 2028/29) sent mixed messages to the country's various railway transport organisations. Light rail and integrated city transport appear obvious 'winners' with metro extensions planned for Greater Manchester, Birmingham, and the Northeast - the latter finally giving Washington (New Town) a rail-based transport link – well over 60 years after its establishment in 1964! A completely new tram/metro system is planned

for Leeds and the West Yorkshire conurbation, and Liverpool-Merseyside should see the construction of several new stations (though, in contrast to Washington, Skelmersdale - another 1960s New Town - appears fated to remain off the railway network for some decades to come).

The future for low-carbon integrated transport (the subject of the Institution's submission to Government in February 2025) also looks promising with strong support for policies that coordinate trains, metros, trams, and (increasingly electrically powered) buses to provide more multi-modal city-region networks.

So much for the good news... Prospects for the mainline railway industry are more nuanced. Financial provision for HS2 is intended to support delivery of the route from London Euston to Birmingham Curzon Street, and Funding for East West Rail (including a new route between Bedford and Cambridge) and the (North) Trans-Pennine route upgrade is maintained. However, the delivery timescales for HS2 and the final phase of East West Rail remain unclear (and extended).

Heavy rail gets some of the money allocated to integrated city transport - but the Review makes no mention of railway electrification – in contrast to continuing financial support for take up of electric road vehicles. This is disappointing given the strong cases for electrifying several short links important for rail-borne freight traffic, and for continuing the wiring of the Midland Main Line north of Wigston. Elements of the latter two schemes may appear as more of the background detail to the Review becomes available, and the detail of transport investment in Scotland is not given in the Review – I for one am crossing my fingers and hoping for some positive news on electrification from those fronts.

Day to day support for the UK's mainline network is set to reduce as passenger volumes continue to grow and the efficiencies promised by the establishment of Great British Railways are (hopefully) realised.

From an Institution perspective our growing support for Light Rail is timely as is our continued focus on how to deliver better engineered railways for less money. Innovation and advances in engineering management will both be required. We will also continue to press the case for further electrification (and for providing more railway route capacity north of Birmingham!).

AT LARGE WITH THE INSTITUTION

The Institution's Spring seminars in Manchester and London are both reported comprehensively elsewhere in this Journal, so I will only add my thanks to the presenters, delegates, and organisers who make our seminars such an informative and enjoyable combination of education and networking.

During a short holiday in Germany, I had the pleasure of visiting the railway plant and equipment exhibition, IAF Münster (IAF being *Internationale Ausstellung Fahrwegtechnik* or International Exhibition for Track Technology). It was great both to meet several Institution members advocating products and services from the UK and to see the ever-growing range of clever technology available to railway engineers. As I've previously noted, I believe the innovation we most need now is better (faster) ways of adopting and deploying such advancing technologies and capturing their consequent technical and financial benefits at pace.



Plasser and Eiffage demonstrate fully automatic (no operator) switch and crossing tamping.



System 7 tamping banks on new machine for Eiffage.

It was an honour to be invited to join the Chartered Institution of Railway Operators (CIRO) at a lunch to celebrate that institution's 25th anniversary. CIRO has transformed the railway operating discipline into a formal profession with all the opportunities for knowledge sharing, learning, and personal development one would expect from a professional institution. In my experience a good working knowledge of railway operations is invaluable when seeking to plan and manage engineering work on our networks in the most efficient manner. Affiliate membership of CIRO is a simple route to acquiring that knowledge that many railway engineers and technicians could find helpful.

WELCOME

As well as welcoming new and returning members to our Institution, I'm very pleased to welcome Molly Dalton to the executive team as Head of Technical Education. Molly introduces herself comprehensively on page 48 below, so I only need to say that I look forward to the application of her considerable knowledge, skill, and experience as she works with Technical Director Brian and Operations Director Kate to further develop and grow the Institution's education and training activities - to the benefit of Institution members.

Wishing you all safe - and hopefully relaxing – Summer breaks!

THINK
ARTICLE



STEPHEN BARBER

CEO
stephen.barber@thepwi.org

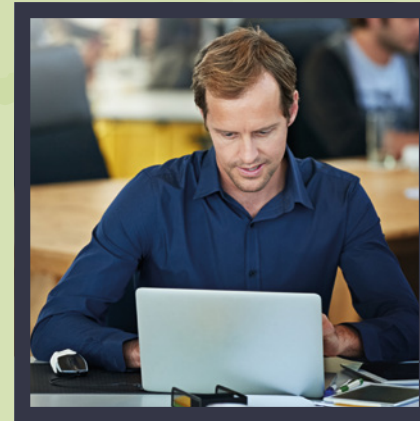
THE INSTITUTION'S STRATEGIC JOURNEY



2022-23
CONSULTATION PROCESS
WITH MEMBERS,
STAKEHOLDERS AND
WIDER INDUSTRY.



2023
**STRATEGIC DIRECTION
FOR THE INSTITUTION IN
2024 – 2028 AGREED.**

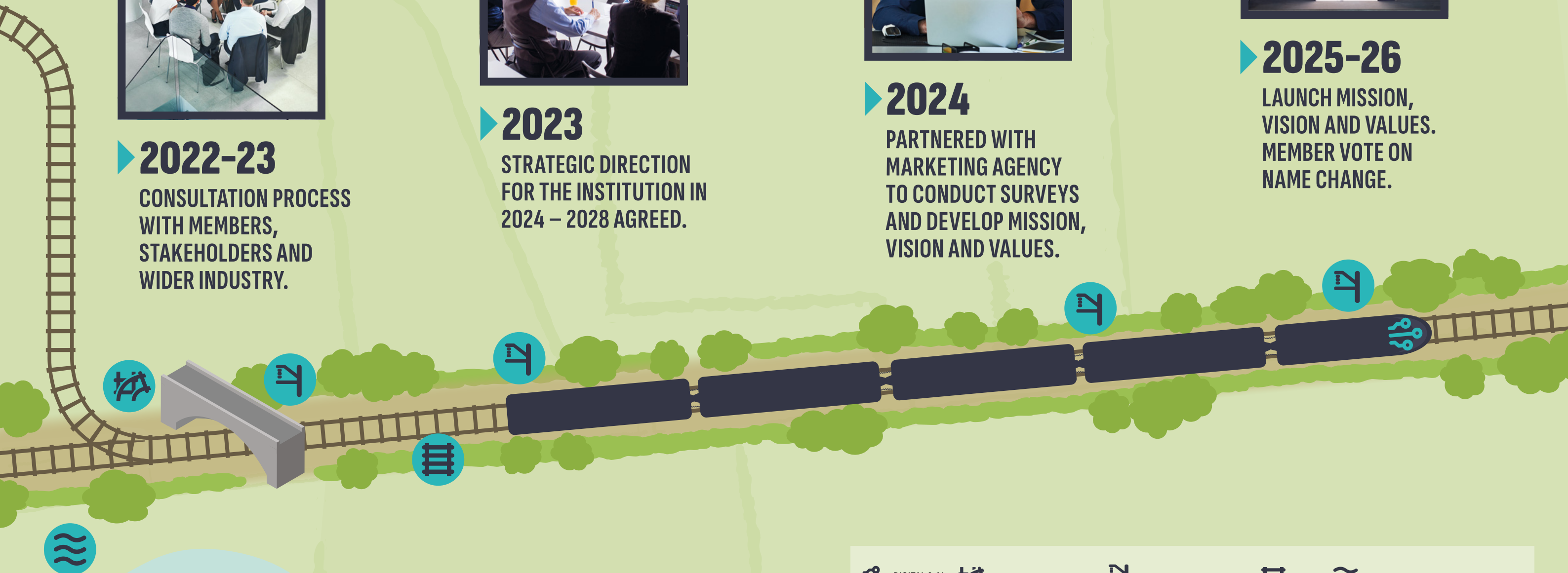


2024

**PARTNERED WITH
MARKETING AGENCY
TO CONDUCT SURVEYS
AND DEVELOP MISSION,
VISION AND VALUES.**



▶ 2025-26
**LAUNCH MISSION,
VISION AND VALUES.
MEMBER VOTE ON
NAME CHANGE.**



 DIGITAL & AI SWITCHES & CROSSINGS ELECTRIFICATION & PLANT TRACK EARTHWORKS & WATER MANAGEMENT

ROOTED IN OUR PAST. FOCUSED ON OUR FUTURE.

THE INSTITUTION'S STRATEGIC JOURNEY





DR BRIAN COUNTER
TECHNICAL DIRECTOR
technicaldirector@thepwi.org

WHAT A GREAT FIRST HALF OF 2025 WITH MORE PWI COURSES, REGISTERED ENGINEERS, KNOWLEDGE TRANSFER AND INTERNATIONAL NETWORKING

How time has flown since the last Journal, probably because there is a lot going on. I want more railway engineers to become PWI members as the benefits are enormous to both the railway and themselves. As well as all engineering students, we also welcome project managers, train operators and anybody working in the technical side of the industry.

Since the last Journal in April, I have had a busy and interesting time in Technical and Education activities. Firstly, a well-attended Technical Board in London and two PWI Technical Seminars in Manchester and London both with excellent presentations. Secondly, Joint Board of Moderators training and involvement in the Institute of Apprentices and Technical Education (IFATE) where there was further discussion on apprenticeship progress and the integrated railway apprenticeships.

In 2025 to date, PWI Technical Education and Training has delivered 22 courses involving 404 learners with another 20 planned and others being requested alongside our new exciting PWI courses.

I had working trips to Translink in Belfast, Irish Rail at Portlaoise, Hong Kong MTR, Canada and the USA for education, technical and registration purposes.



THE PWI
EMPOWERING RAILWAY ENGINEERING



Voestalpine stand at Railway Interchange 2025 (Photo courtesy of B.Counter).

I gave a keynote talk at the MTR HQ for the China Hong Kong Railway Institution entitled "WHEEL RAIL INTERFACE HISTORY AND CHALLENGES" where I was "challenged" about research development, especially in the relationship between rolling contact fatigue and cant deficiency.

I was pleased to visit a number of PWI

Corporate Members exhibiting at the Railway Interchange 2025 in Indianapolis, USA. It is interesting how many of them provide services to USA, Canada, UK and Europe. We have a lot to learn from this grouping especially in innovative products for track repair efficiency and defect detection such as broken rails. A couple of companies also expressed interest in becoming PWI Corporate Members. The IRSE is big in America and it was good to talk to them about track and signalling working together.

PROFESSIONAL REGISTRATION IS ON AN UPWARD TRAJECTORY... LET'S KEEP IT UP!

I recently heard from a PWI member that he was refused an interview for promotion because he was not professionally registered, so it is important to be qualified at the level you are operating. I say, "get on with it, you know you want to!"

Hopefully, our message is getting through that Liz, Charlotte and I can get you help on a one-one basis or preferably a team approach with your company. We are working with and want to work more with Corporate Members to provide support and there are successes particularly with TfL, Babcock, SPL, Amey and Balfour Beatty. TfL, to encourage their staff, have made a bulk PWI membership purchase linked to EngTech. Overall, in my opinion, it is still a "slow burn" and more effort is needed to encourage registration. We are working on this in a number of areas, including Network Rail Level 3 apprentices.

Liz Turner and I are also negotiating the next steps for the PWI Incorporated Engineer with Railway Engineering degree apprentice end point assessment in summer and autumn 2025 with London South Bank University and Sheffield Hallam University.

JBM training took place on 17 March with updates on Guidance, Ethics, Biodiversity and integrated Civil Engineer degree apprenticeships which the PWI could participate in as assessors. We are waiting to be updated on the progress of the amendment to JBM guidance to formally include railway engineering in accredited courses. Our representative on the working group is Prof Martin Crapper who is making positive steps towards this aim.

LINKED EVENTS AND TECHNICAL ACTIVITY

Our Technical Board that took place in February brought a good selection of Corporate Members together with excellent interaction on safety and people development. Presentations included Energy sector projects in the North of Scotland that may have a rail dependency from BAM Ritchies; Digital Surface modelling – Old Oak Common AECOM; Integrating Multi-Source Data for Proactive Railway Track Maintenance: A Case Study of the A2 Corridor in the Netherlands Fugro, Transition Zones Geobear.



PWI Track Engineering Diploma class MTR HK receiving their certificates Angel Wai Lam Ng (centre in black and white dress) who won MTR best in class (Photo courtesy of B.Counter).

PWI TECHNICAL EDUCATION AND TRAINING GOES FROM STRENGTH TO STRENGTH!

There is a further great demand probably due to railway skill shortages and people wanting to learn and progress. This is now a big part of the PWI activity and we are pleased to welcome Molly Dalton as our new Head of Technical Education. She joins us from Balfour Beatty with a great blend of railway knowledge and education.

We have delivered 22 courses so far in 2025 involving 112 Network Rail Graduates, 52 Network Rail Technicians, 50 Hong Kong MTR engineers, 40 Irish Rail engineers, and 150 others from other companies. Another 20 courses are planned in 2025.

We are working hard to improve our excellent delivery even more through videos and more group and practical work. The review of the electrification engineering courses is progressing well under the leadership of James Collinson to align them with the principles of safety and systems engineering, sustainability and net zero. Our ultimate idea on Electrification is to have 5-6 modules which we call "salad selection" in OLE, DC 3rd – 4th rail and Light rail.

The next phase of development planned for 2025 is a new course in "Advanced Switch and Crossing System Engineering" as we have perceived a great need for the multi-disciplinary aspects of points including signalling. This will be a two week course in November 2025 and February 2026 and is now being offered to track and signalling engineers. Content includes design, manufacture, installation, commissioning, through to maintenance focusing on safety and performance.

Celebration is a key aspect of education and we are always delighted to award the PWI Engineering Diplomas. Our 2026-2027 PWI President, Cathal Mangan, presented Track Engineering Diplomas to the first cohort at Irish Rail in Portlaoise alongside Bob Langford and Andy Steele, our principal Irish Rail track lecturers.

I was pleased to be invited to Hong Kong to present Track Engineering Diplomas to the second cohort at MTR. At the ceremony, the next cohort were also present.

TECHNICAL AND SAFETY

I always like to give a general update on safety on UK railways and this quarter has been good regarding technical issues with infrastructure. The Technical Authority of Network Rail have been looking closely at cracked S&C crossings and I was impressed by the work of Steve O'Brien in this area which I am sure it will assist the risk management in this challenging area.

Most of the recent general railway safety concerns relate to track worker safety, communication and third party ignorance. There was another track worker near miss at Bookham Tunnel, Surrey caused by miscommunication regarding which line was blocked. This is nothing new, I investigated this type of incident at Liverpool 20 years ago, where a trolley was placed on the open line and a Pendolino train struck it, thankfully with no injuries. We must find better fail-safe



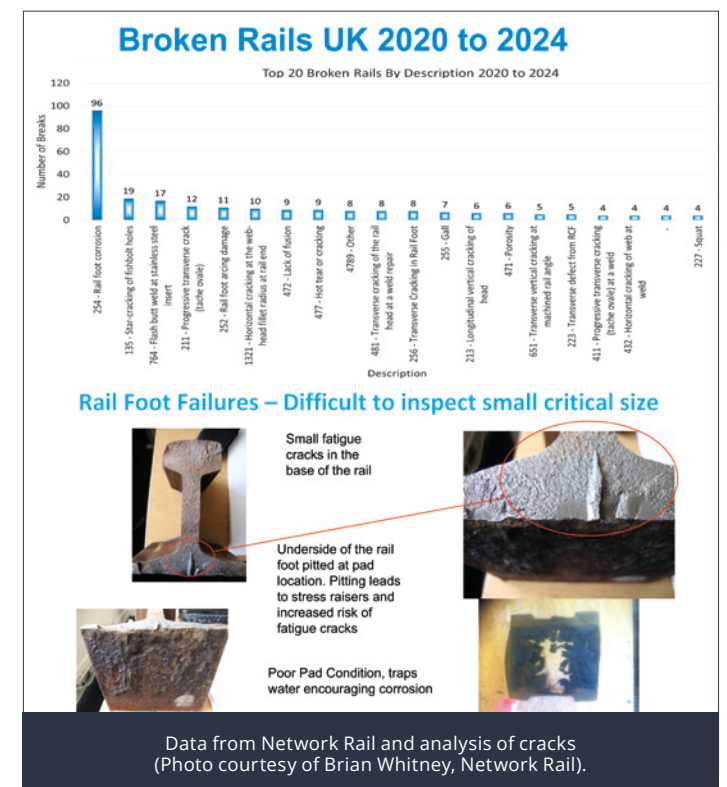
New Tracks on new Toronto East West converted from a highway Ian Knowles FPWI (Photo courtesy of B.Counter).

communication systems in this modern world. Also, thankfully, no one was killed when a fast train hit a tractor at Leominster, Herefordshire on May 22 probably due to ignorance of risk at user level crossings. Sadly, however, 6 people were injured; Rail Accident Investigation Branch is investigating.

As usual there are technical areas that I wish to share, firstly design of new environmental and sustainable railways and current practical track maintenance problems.

It was an interesting urban development in Toronto to use the highway profile to build a new light railway. This requires a great political focus to consider integrated urban transport and there can be no doubt that there are efficiencies here for construction. Also, two items to note, it is electrified and trams get priority at junctions which speed up journey times and obviously make it more attractive.

We are still facing challenges with broken rails in the UK and these are more difficult to detect when in the rail foot. I am pleased to report that more research work is going into this challenging area as we are aware of the safety and performance problems associated with broken rails. Usually they are detected early but as they do not fail safe, there is always the possibility that they could be combined with another perhaps climate related problem and derail a train. It was good to discuss this with Brian Whitney, the Network Rail expert, at the Network Rail PWI Graduate Training earlier this year and raise awareness of a known infrastructure risk. I acknowledge thanks to him for providing the following information.



ROUTE TO CHANGE: NAVIGATING TECHNOLOGY, INFRASTRUCTURE AND BEHAVIOUR

PWI SEMINAR 10 APRIL 2025

THE ENGINEERING BUILDING AT THE UNIVERSITY OF MANCHESTER

The PWI's *Route to Change* Seminar brought together industry leaders, technical experts and infrastructure professionals to explore how the rail industry can embrace change across technology, infrastructure, and behaviours. Reflecting on traditional ways of working and looking ahead to the opportunities of the future, the event challenged delegates to consider how innovation, collaboration and leadership can be harnessed to deliver meaningful progress across the railway sector.

With a programme designed to encourage open discussion and active participation, delegates were invited to engage directly with

presenters and panellists throughout the day. The event provided not only excellent technical content but also valuable opportunities for networking and knowledge exchange.

The PWI would like to extend our sincere thanks to the sponsors and exhibitors who supported this Seminar including KONUX as sponsor and exhibitors; BAM Richies, OnSite Rail Services, FUGRO, CRADLE/University of Manchester and Huddersfield University.



Mona Sihota, PWI President.

MORNING SESSION

The morning session was opened by Mona Sihota, PWI President, who welcomed delegates and set the tone for the day's discussions.

The keynote address was delivered by Dr Annette Pass, Deputy Chief Scientific Adviser at the Department for Transport, who provided a compelling overview of the case for change in the

delivery of major infrastructure projects. Addressing the question, "Why does Britain struggle with major infrastructure delivery?", Dr Pass emphasised that while Britain's outcomes are successful, delivery remains slow - a challenge that must be addressed if the industry is to realise its full potential. Drawing on insights from the IMF's *Cutting the Cuts 2024* report and the emerging *Planning & Infrastructure Bill*, she highlighted the importance of reducing timescales and promoting innovation through initiatives such as the UK Transport Research & Innovation Board and the Small Business Research Initiative (SBRI) First of a Kind (FOAK)-

sponsored innovation schemes. Dr Pass concluded with a call to action, challenging delegates to think differently and engage proactively in driving innovation across the sector.

The morning continued with Richard Crabtree, Partnerships Policy Lead for the Reform Programme for Great British Railways, (GBR) who shared an update on the journey towards GBR and the enthusiasm across the railway community for achieving a simpler, better railway for Britain. Referencing the DfT report *A Railway Fit for Britain's Future* and the English Devolution White Paper, Mr Crabtree detailed key opportunities for both operations and infrastructure, with a focus on correcting misalignments and enhancing passenger experience.

Dominic Trueman, Head of Research Implementation at the Rail Safety and Standards Board (RSSB), addressed the critical challenge of translating research into practice. Outlining the 'Idea to Impact' research journey, Mr Trueman provided examples of successful implementation, including low adhesion mitigation through variable rate sanders, updates to freight loading gauge standards, and the validation of curving rules. The audience was encouraged to contribute research ideas, reinforcing the importance of industry collaboration in advancing innovation.

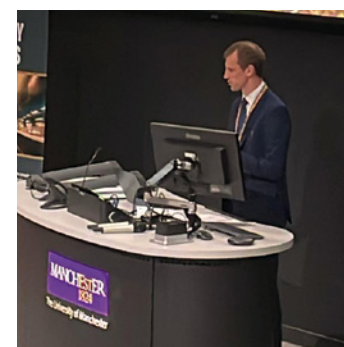


Richard Crabtree Partnerships Policy Lead - Reform Programme For Great British Railways.

The first morning session concluded with an engaging Q&A, where panellists responded to questions on freight demand, rural connectivity, low adhesion risks, and how to submit research proposals to RSSB.



Dr Annette Pass - Deputy Chief Scientific Adviser - Department For Transport.



Dominic Trueman - Head of Research Implementation - Rail Safety and Standards Board.



Professor Michael Fisher - University of Manchester - Centre for Robotics & AI.



Professor Yann Bezin - University of Huddersfield - Institute of Railway Research.



Ivan Mactaggart - Digital Delivery & Joao Rocha - Asset Management & Maintenance - East West Rail.



David Lawrance - Chief Engineer - TransPennine Route Upgrade.

Following a short break, Professor Michael Fisher (University of Manchester) and Professor Yann Bezin (University of Huddersfield) shared pioneering research on robotics, AI, and smart rolling stock maintenance. Their presentations highlighted both the technical possibilities and the business challenges associated with adopting advanced technologies including issues around data accuracy, component variability, and the integration of new systems into existing operational models.

Joao Rocha and Ivan Mactaggart of East West Rail provided insight into the development of the EWR Digital Spine, a project transferring best practice from the automotive sector into rail. With over 150 use cases identified through extensive consultation, the digital spine aims to enable better decision-making and safer, more reliable operations. Their presentation emphasised the long-term benefits of digital innovation in reducing costs and improving performance.

David Lawrance, Chief Engineer for the TransPennine Route Upgrade (TRU), delivered an update on this £11.5 billion programme, which includes journey time reductions, electrification, and fleet upgrades. Mr Lawrance shared examples of innovation within the programme, including the Checkpoint Authority App for track access and explicit risk assessments for mining hazards, alongside the TRU Carbon Challenge and digital conversion strategies.

A second panel discussion offered another opportunity for audience interaction, with questions on cross-sector engagement, digital twin sustainability, robotics applications, and knowledge sharing between major projects such as TRU and EWR.

AFTERNOON SESSION

The afternoon session began with a return welcome from Mona Sihota before moving into presentations that showcased emerging technologies and modern approaches to infrastructure delivery.

The day's final technical presentations focused on modernising maintenance and the application of data-driven technologies. Jonathon Stelling (Omnicon) introduced the RAVE project, which leverages unattended infrastructure inspection via service vehicles. Case studies demonstrated the benefits of historic data analysis and the ability to remove Temporary Speed Restrictions through evidence-based maintenance decisions.

Tim Flower (KONUX) and Rob Lacey (Network Rail Eastern Region) showcased the deployment of autonomous data capture and machine learning in track monitoring, including the KONUX Switch and wheel trajectory reconstruction systems. Their work highlighted significant safety and performance gains, supporting the ambition of removing "boots on ballast" for routine inspection by the end of the current control period.

The final technical paper was delivered by Ian Rosam (Bentley Systems), who addressed the challenge of advancing infrastructure delivery with Artificial Intelligence (AI). Mr Rosam emphasised the need to connect siloed data and workflows, drawing on examples from across infrastructure sectors. His presentation outlined Bentley's core principles of control, contribution, and trust in the use of generative AI.

PANEL DISCUSSION AND CLOSING REMARKS

The seminar concluded with a panel discussion chaired by Stephen Barber, CEO of the PWI, alongside the afternoon's presenters. This final session tackled key questions on the slow uptake of existing technologies, data reliance, cross-industry comparisons, and barriers to innovation.

In her closing comments, Mona Sihota reflected on the breadth and depth of discussion throughout the day, reinforcing the need for leadership, innovation, and collaboration to navigate the route to change. Feedback from delegates will help inform future events and ensure the continued relevance of PWI Seminars in supporting professional development.

All presentations from the event will be available on the PWI's Knowledge Hub. Attendance at this seminar contributes towards your Continued Professional Development (CPD).



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Jonathon Stelling - Engineering Project Lead - Omnicon.



Tim Flower Account Director - KONUX & Rob Lacey Principal Engineer - Eastern Region - Network Rail.



Ian Rosam - Director of Product Management - Bentley Systems.

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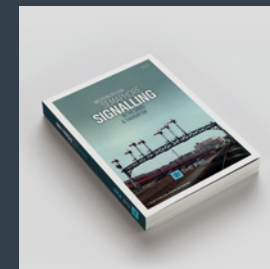
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WATER MANAGEMENT ON THE RAILWAY – WHAT DOES IT MEAN TO ME?

PWI SEMINAR 7 MAY 2025

ONE GREAT GEORGE STREET, LONDON

The PWI held its second Technical Seminar of 2025 on 7 May at One Great George Street, London, a setting befitting the subject matter. The content of the day was curated and chaired by our President Mona Sihota; Mona's day job is Head of Drainage and Lineside for Network Rail and the subject is her passion. Water is one of the world's most precious commodities and the interaction between the railway and the water cycle is significant. Rail infrastructure can suffer with both too little and too much water; water has no boundaries – it goes where it chooses, Mona's aspiration for the day was to raise awareness of the subject matter and to ask delegates from across disciplines to consider how they can provide adequate thought to the management of water in each of their roles.

The format of the day comprised presentation slots and three breakout sessions, where delegates had the opportunity to choose a topic they would like to explore in greater depth. The morning session began with the Key Note Speech (KNS) from Professor Sir Lord Robert Mair of Cambridge University who gave an impressive talk on the importance of Water Management for the Stability of Rail Infrastructure Earthworks. An important learning point which came up many times during the day, is the need to understand the history of a site; how it was constructed and changes that have taken place over time when considering possible solutions for today and into the future.



Professor Lord Robert Mair, Cambridge University giving the Keynote Address.



Flavia Giurca, Civil Engineer, Keolis MHI.

The presentations described below followed the KNS.

- Engineering Resilience: Adapting Railways to Climate Change and the unexpected, given by Flavia Giurca, a civil engineer working for Keolis MHI. Flavia spoke about her own personal experience of what she has encountered in her career to date.
- The importance of Catchment Analysis given by Dr Faye Beaman from Arup. Faye explained how catchments are defined and the considerations required when seeking a design solution.
- Learning from Grange Over Sands given by Tony Butler, an inspector from the Railway Accident and Investigation Branch (RAIB). This was a fascinating presentation, reinforcing the need to understand what has gone on before to help with current asset behaviour.

Following the morning break, delegates were offered the opportunity to attend a breakout session, with particular focus on the topics below. These sessions allowed for much greater audience participation and encouraged debate and conversation as opposed to the standard Q&A sessions.



Tony Butler, Railway Inspector, RAIB.



Nicholas Gruselle, Head of Drainage TFL and Jason Wakefield, Principal Engineering Leader, TFL responding to questions from the delegates.

BREAKOUT GROUP A:

Subject Matter: Improving designs, assessments and safety on the Railway – now, new, next.

Chair: Dr Faye Beaman, Associate Director, Arup.

Panel members: Alastair McFarlane, Head of Engineering and Asset Management (Civils), Network Rail and Andy Kervell, Associate with Arup.

BREAKOUT GROUP B:

Subject Matter: Creating partnership projects for better water management.

Chair: Julia Greene, Route Engineer Drainage and Lineside, Network Rail. **Panel members:** Heather Wells, Senior Flood Risk Consultant, AECOM; Steven Tupper, Deputy Director for Pipeline and Investment, Environment Agency; and Malcolm Dangerfield, Head of Planning and Development, National Highways.

BREAKOUT GROUP C:

Subject Matter: Challenging the status quo – whose responsibility is it to improve water management?

Chair: Gareth Dennis, Strategy Lead Test Tracks, Network Rail. **Panel members:** Phil Raynor, Water Resources and Flood Risk Technical Lead, East West Rail; Angus McGregor, Ground Engineering Professional, BAM Ritchies; and Sue Brocken, Associate Technical Director Arcadis.

Over lunch, there was the opportunity to network with other delegates along with visiting the many exhibition stands. Many thanks go to all sponsors and exhibitors; without their financial and on the day support, the PWI would be unable to run such events.



Mona Sihota, PWI President, closing the Seminar.



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Delegates resumed their seats in the Telford Theatre post lunch and listened to two very different presentations:

- Innovation in asset condition to detect the presence of groundwater, given by Andrew Wilson, Managing Director of Quantum Structures
- Transport for London (TFL): Flood risk and drainage system management, given by Nicolas Gruselle, Head of Drainage TFL and Jason Wakefield, Principal Engineering Leader TFL

Following Q&A on the above presentations, the chairs of the breakout groups were invited onto the stage to give a summary of the conversations in each of their groups. This led to some stimulating questions from the audience.

Closing the Seminar, Mona reflected on how the day had met her objective of raising awareness of the importance of Water Management across Rail Infrastructure and asked delegates to think about what they would take from the day.

All the presentations are available on the PWI's Knowledge Hub.



JOAN HEERY
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REPLACEMENT FLOODPLAIN STORAGE: LINKING ENGINEERING AND ENVIRONMENTAL DESIGN COMPATIBILITY



The HS2 Learning Legacy website was launched at an industry event in October 2021, and builds on the experience from the learning legacies of previous major projects. These include the Crossrail Learning Legacy, Thameslink Learning Legacy and the London 2012 Learning Legacy, and it contributes to an overall body of knowledge on major projects captured on the Major Projects Knowledge Hub. It aims to capture and disseminate good practice, innovation and lessons learned from HS2 aimed at raising the bar in industry, improving UK productivity and showcasing UK PLC.

HS2 is keen to engage with industry bodies and professional associations to work together to further disseminate the Learning Legacy following the launch, and part of this work is the publishing of a number of the HS2 Learning Legacy papers in the PWI Journal.

This technical paper provides a summary of the design stage associated with the development of replacement floodplain storage (RFS) and how environmental benefits have been integrated into the design process.

It introduces a novel approach, applicable to future large scale infrastructure projects, for designing RFS that not only alleviates flood risks but also creates environmental habitats and wetland features to move towards No Net Loss in biodiversity. This innovative concept adapts the conventional RFS design that often overlooks ecological enhancements.

This paper showcases a transformative strategy that harnesses Building Information Modelling (BIM), integrating flood risk

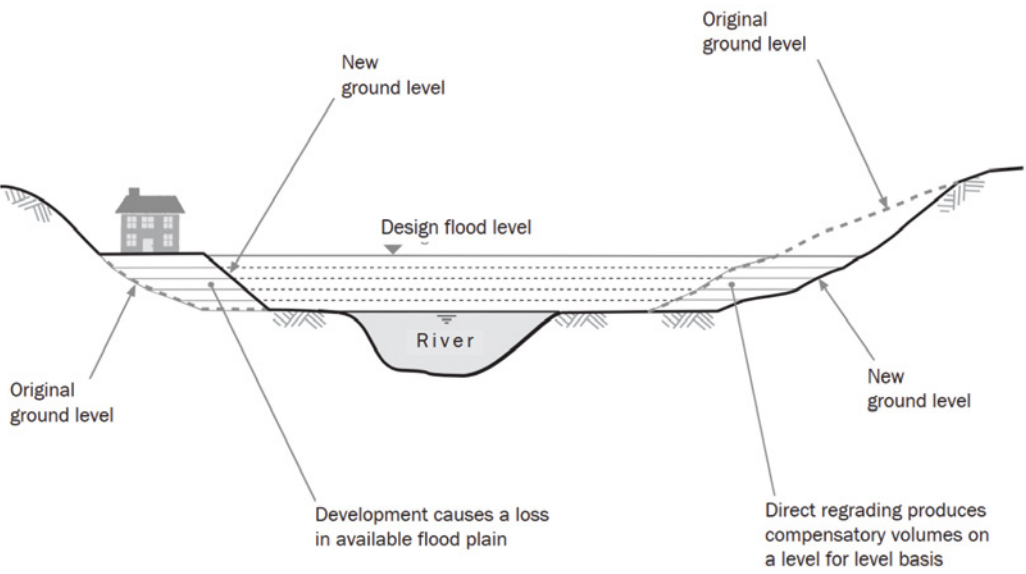


Figure 1: Illustration of direct replacement of flood storage (Source: CIRIA C624, 2004 [2]).

management with the creation of habitats, working toward No Net Loss in biodiversity at a route-wide level.

This forward-thinking methodology represents a significant advancement from traditional planning approaches, embodying the integration of engineering and environment to deliver the best outcomes of both and will be of use to those working on major infrastructure projects in the future.

BACKGROUND AND INDUSTRY CONTEXT

To comply with National Planning Policy Framework (NPPF) [1], Environment Agency (EA) and best practice design of replacement floodplain storage (RFS) detailed in CIRIA C624 [2], new developments must ‘create space for flooding to occur by restoring functional floodplain’. The HS2 technical standards and Environmental Statement (ES) [3] outline the requirements for protecting and enhancing the environment, with a requirement that ‘No Net Loss’ in biodiversity is achieved. HS2’s Blue Infrastructure Design Approach [4] also emphasises the importance of an integrated design approach around existing watercourses or other bodies of water. This approach aims to deliver multiple outcomes beyond the primary water supply, flooding and water quality considerations. The HS2 Flood Risk Technical Standard [5] underpins the design development of HS2.

Best practice replacement floodplain storage (RFS) design involves calculating the total volume of HS2 works in the floodplain up to the flood level associated to the 1 in 100-year return period, including an allowance for climate change. This is referred to as displaced flood volume. The displaced flood volume is then split into 200mm elevation bandings. To mitigate potential increases in water level and flood risk, the displaced flood volumes at each banding must be offset within the floodplain to ensure the storage fills at the same rate that it would have done under existing conditions. **Figure 1** presents an illustration of direct RFS design. This approach aligns with the requirement of CIRIA C624 [2], which is adopted by the EA as best practice. Demonstrating compliance with the technical standards and CIRIA C624 is essential for achieving development consent.

Reports, such as the ‘Achieving more: operational flood storage areas and biodiversity’ [6]) established that solutions benefitting the environment the most, often provide poor flood storage solutions (as summarised in **Figure 2**). For example, afforesting an RFS would interfere with its functionality. Conversely, an RFS with no environmental mitigation would be a detriment to the environment due to the large land take, environmental disruption, as well as the missed opportunity to achieve environmental targets.

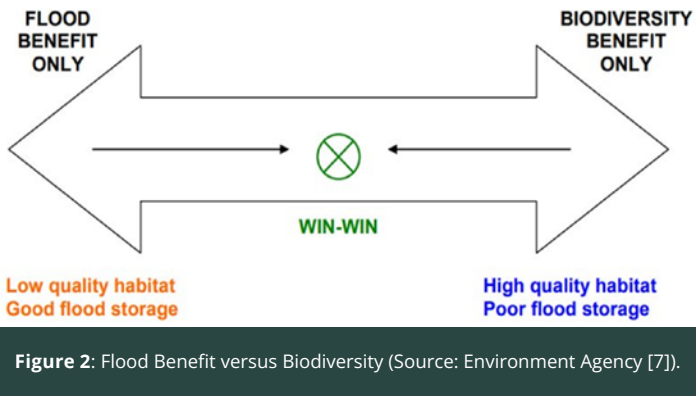


Figure 2: Flood Benefit versus Biodiversity (Source: Environment Agency [7]).

This technical paper outlines the successes of achieving, whilst working within project constraints, the balance between engineering and the environment. It is presented as part of the Main Works Civils Contract (MWCC) for the northern section of High Speed Two (HS2) Phase One including Long Itchington Wood Green Tunnel to Delta Junction and Birmingham Spur and the Delta Junction to the West Coast Main Line (WCML) tie-in, being delivered by the BBV Integrated Project Team which includes Mott McDonald.

APPROACH

HS2 Phase One is committed to achieving No Net Loss in biodiversity at a route-wide level, implementing the mitigation hierarchy which aims to avoid first, before mitigating and compensating for habitat loss, in seeking to minimise the impacts of the scheme on biodiversity. This process has been driven by collaborative working between the engineering design and environmental teams and has been informed by the consultation and engagement process associated with the ES [4], with key stakeholders including the Environment Agency, Natural England and Local Wildlife Trusts.

Where possible, the scheme has been designed to avoid impacts on sensitive ecological receptors which include protected and notable species and habitats. However, owing to the scale of the HS2 scheme, there are locations in which ecological impacts cannot be reasonably avoided or mitigated against, in which case compensation in the form of habitat creation can be proposed. Combining RFS with environmental features both contributes to No Net Loss through high-distinctiveness habitat creation, and offsets planning losses within the habitat.

The extent of habitat mitigation and compensation included within detailed design has been determined through application of professional judgement at a site-specific level, rather than through the use of a biodiversity offsetting metric or other loss-to-gain ratios. Instead, biodiversity metric calculations have been used as a means of quantifying progress towards the overall goal of achieving route-wide biodiversity No Net Loss. This has taken extensive management and coordination between design teams, environment teams, and relevant stakeholders such as the Environment Agency and Lead Local Flood Authorities (LLFAs).

Innovation in Replacement Floodplain Storage Function and Design

By design, RFS often requires a large amount of land, either as a single large area or several smaller areas. Innovation has been integral to the interdisciplinary design development of RFS to increase accuracy in calculating storage volumes, prevent over-digging and optimize the RFS design in terms of area, location, and land use.

A streamlined BIM process, illustrated in **Figure 3**, utilising 3D LiDAR combined with 3D scheme models created a full awareness of all existing and proposed constraints. This allowed the RFS designs to find all available opportunities and de-risk issues prior to the construction phase.

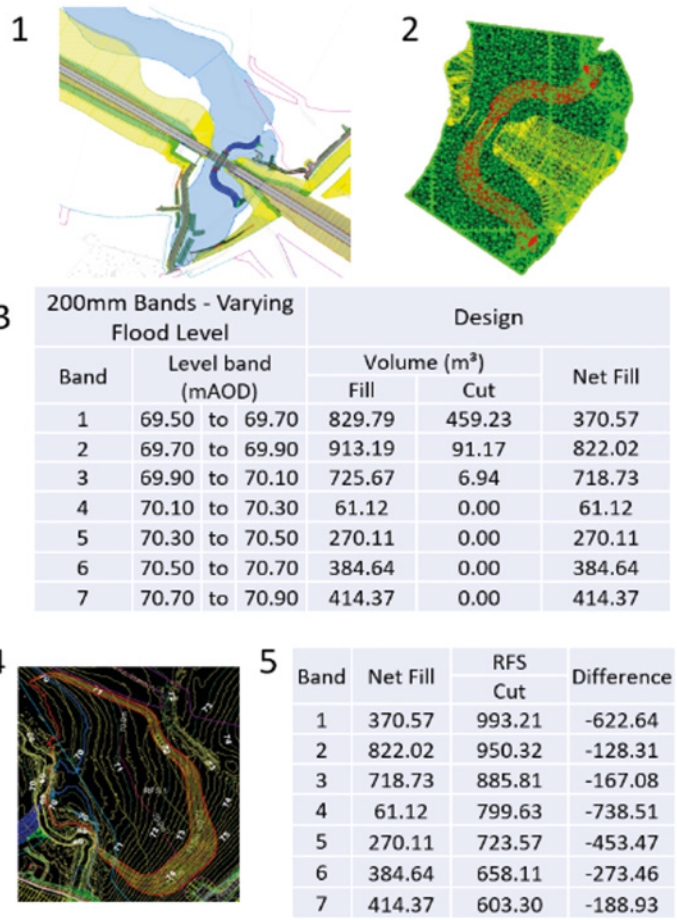


Figure 3: Representation of initial stage of BIM process to calculate displacement volumes (Source: Mott MacDonald, 2021).

1. Obtain a combined asset BIM model, known as the federated model and cut to the shape of the hydraulic flood plain extents.
2. Combine the topographic LiDAR data and extract the lowest and highest asset elevation, representing the upper and lower RFS levels.
3. Undertake BIM model processing to extrude asset surfaces and calculate the volume of new infrastructure within the flood plain. Analyse this data across 200mm level bands.
4. Identify suitable locations for RFS considering volume and level constraints.
5. At the 200mm level band calculate RFS volumes. Compare each level band against the volume to offset and ensure they are equal or bigger.
6. Review the RFS design against other design constraints before finalising the solution.

This streamlined RFS design process has enabled environmental benefits to be realised such as:

- RFS offers large bodies of water in which riparian habitat (wetlands adjacent to rivers and other waterbodies) can be created and existing habitats enhanced.
- a series of smaller excavations that minimise the potential for negative environmental impacts that require offsetting elsewhere;
- modifying river morphology to create depth variations lends itself to wetland planting and creation. For example Berms (**Figure 4**, overleaf) that widen of the river cross section at levels above median annual water level (2 yr Annual Exceedance Probability), and Scrapes that lower the ground adjacent to the river, can contribute towards aquatic habitat creation, support WFD objectives and contribute to RFS volume.

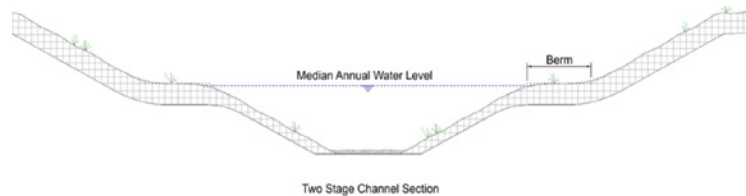


Figure 4: Typical Two-Stage Channel with Berm (Source: Mott MacDonald, 2022).

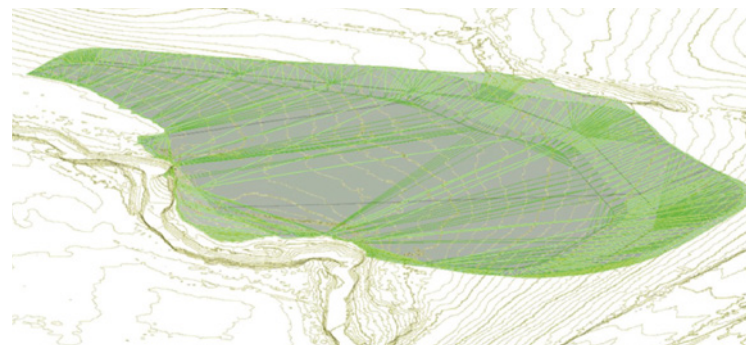


Figure 5: Initial design for Canley Brook Viaduct RFS prior to wetland features being added (Source: Mott MacDonald, 2022).



Figure 6: Example of Canley Brook Viaduct RFS and integrated ecological features in detailed design (Source: Mott MacDonald, 2023).



Figure 7: Example of wet grassland resulting in lowland meadow.

This approach has been implemented at HS2 sites including Canley, Finham and Balsall Common RFS. **Figure 5** is a representation of initial space proofing of an RFS following the volumetric analysis, which enables the excavation of sufficient volumes at each banding.

With further refining in BIM, the RFS can be made more attuned to the surrounding topography and environment for example with the incorporation of wetland features. BIM analysis also helps to develop novel landscaped RFS solutions in constrained spaces between HS2 assets and can often reduce volumes at the bandings most challenging to find space in the floodplain. Refining the RFS lessens the societal impact of HS2 by reducing the need to acquire additional land of local landowners.

Innovation in Habitat Creation within RFS

Wetlands Creation

A typical RFS design can require a large amount of land to construct, and thus result in a large amount of habitat loss. Wetland creation within the RFS has been proposed, providing a nature-based solution to flood risk management, whilst positively contributing to HS2's No Net Loss target. Wet grassland planting along realigned watercourses and within floodplains creates a diverse and connected habitat, encouraging a range of protected and notable species to pass through, forage and breed.

Further ecological enhancements to Canley Brook Viaduct RFS have involved the inclusion of ditches and scrapes within areas of wetland creation, shown in **Figure 6**.

Scrapes are shallow excavations which hold rain or flood water seasonally, staying damp for the majority of the year. Scrapes within wetland create a heterogenous habitat with a variety of vegetation structure and varying water levels, which contribute to wildflower-rich grasslands with a diverse invertebrate population. Large, shallow scrapes also provide valuable habitat to wading birds, amphibians and riparian mammals.

Once fully established (**Figure 7**) and under correct maintenance and monitoring, wet grassland planting will produce lowland meadow – a Habitat of Principal Importance, as defined under Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006 [6]. This habitat forms an important part of the foodchain by providing the primary feeding resource for nectar feeding invertebrates, as well as supporting biodiversity along watercourses. The wet grassland provides ancillary habitats to the aquatic habitats within the wider landscape which contain riparian species such as otter and water vole. Implementing this design will have a significant contribution to the HS2 Green Corridor Strategy [7].

Opportunities to create floodplain grazing marsh, a UK Biodiversity Action Plan (UKBAP) Priority Habitat, as defined by the Joint Nature Conservation Committee [8], have also been explored, which often compliments RFS design owing to its resilience to regular flood events.

UKBAP Priority Habitats are the most threatened and requiring conservation. This habitat comprises periodically inundated pasture or meadow with ditches or other features, and is particularly important for breeding waders and internationally important populations of wintering wildfowl, and support rich varieties of plant and invertebrate species [9]. Maintenance of grazing marshes typically involves low level grazing by livestock to achieve a varied, tussocky sward structure, whilst in turn creating microhabitats for invertebrates through trampling. This can provide landowners with the opportunity to continue their farming practices within the area following the completion of the scheme.

Tree Planting/Afforestation

There is generally a reluctance for incorporating tree planting into RFS design due to a loss of flood flow conveyance and storage volume. However, tree planting can connect adjacent woodland habitats and linear features, supporting the HS2 Green Corridor Prospectus [10] which aims to create a network of bigger, better-connected, climate resilient habitats. Tree planting is proposed along the realigned Canley Brook, adjacent to the RFS (see **Figure 6**).

The following considerations were taken into account through close collaboration between the environment team, flood modelling team, and river engineering team:

- The reduced storage capacity owing to the physical size of the plants. The volume of each tree (mature tree volume) is calculated to determine the reduction in floodplain capacity and RFS volume adjusted if necessary.
- A slower flow, caused by trees in the floodplain increasing roughness, could result in increased sedimentation, raising the floodplain level and reducing the effectiveness of the RFS. As such, the RFS were designed to be above the median annual water levels so the main sediment conveyance would remain in the channel.
- Debris from loss of leaves and branches should also be considered, as this could locally raise the ground over time. Other vegetation may grow around the trees further contributing to debris deposit, and there is a possibility of trees falling over, resulting in an increase in volume loss.
- Consideration of whether the location of the tree planting area would pose a health and safety risk whereby if trees became dislodged there would be a risk of blockage of an existing culvert or river control structure.

It is important to plant a range of native tree species that are suitable to the local climate and habitat type (e.g. alder, willow, hawthorn, hazel, birch, rowan), and are more resilient to persistent flooding scenarios.

Flood-resilient species such as hawthorn and rowan were selected and located along the realigned Canley Brook at 8m intervals, to maintain a key commuting route of importance for bats, which was identified within the ES. The proposed feature trees create a linear habitat which will guide bats along the brook and encourage them to forage around the RFS, where invertebrate populations will thrive as a result of the wetland habitat creation.

Towards achieving No Net Loss at route-wide level

HS2 is committed to being a highly sustainable and climate resilient railway, delivering no net loss to biodiversity on a route-wide scale. Biodiversity metric calculations were undertaken at the commencement of the scheme; these used available baseline information to calculate the number of biodiversity units generated by the habitats present within the land required for Phase One prior to construction and provide a comparison to the biodiversity units that will be present post-construction following habitat creation or enhancement.

The results in relation to grasslands are positive, route-wide, and suggest the habitat creation measures proposed will achieve a clear 'trading up' in the distinctiveness of created habitats, with an increase in the total number of biodiversity units generated by grassland. A higher proportion of these units will be generated by habitats of 'high distinctiveness' (i.e. those that would qualify as habitat of principal importance). Wetland habitat creation integrated within RFS design will help to contribute to this 'trading up' of habitats. Baseline habitats across the HS2 trace predominantly consist of low distinctiveness grassland or arable fields; RFS have been situated within these habitats and subsequently, higher distinctiveness habitats such as lowland meadow can be planted to achieve a better result post-construction than the initial baseline.

The overall increase from RFS represents 14.35 Biodiversity units representing 1.23% of our current No Net Loss deficit and full calculations and methodology are detailed within the No net loss in biodiversity calculation – methodology and results document [11].

In relation to watercourses, calculations predict a gain in watercourse biodiversity upon completion of the scheme. This result largely reflects the fact that the scheme will, in many cases, create a more meandering and diverse channel than is currently present. Wetland integration within RFS will further contribute to this increase in both watercourse biodiversity and increasing habitat distinctiveness, ensuring that flood risk management converges seamlessly with habitat creation to achieve Biodiversity Net Gain and working toward No Net Loss in biodiversity on a route-wide scale.

OUTCOMES

The creation of wetland habitats in conjunction with the requirements for RFS show how innovative thinking can bring engineering and environmental requirements together. The key environmental outcome

of this method is the positive contribution towards HS2's No Net Loss objectives. Initial calculations indicate that grassland habitat creation represents an overall gain in biodiversity units across the scheme, which will be further bolstered by the introduction of wetland creation within RFS design.

The innovative use of BIM to efficiently locate storage volumes has been utilised during HS2 delivery, meeting the goals set to mitigate flood risk linked to the proposed HS2 scheme including a consideration for climate change. Over-digging has been minimised while maximising the use of available space.

Integrating habitat creation with RFS construction across the HS2 scheme presents a highly effective nature-based solution to alleviating flood risks, providing benefits for both flood risk management and the environment.

Flood storage areas across the UK are already making an important contribution to national Biodiversity Action Plan (BAP) targets, however a high proportion of these areas support 'lower value' biodiversity [7]. The approach to wetland creation within RFS design that we have followed allows low distinctiveness habitats such as low maintenance grassland and arable field, which are common choices for RFS locations across the scheme, to be replaced with high distinctiveness Habitats of Principal Importance and in some cases UK Priority Habitats, representing a significant positive gain for biodiversity and leaving a legacy which contributes positively to these environmental targets.

Guidance was provided to landowners regarding RFS at the ES Stage of HS2, indicating that RFS would be returned to agriculture, with the RFS suitable for grazing as stated in the Basis of Design document for RFS [12]. The habitat creation approach followed allows land to be returned to landowners to continue their farming practices involving livestock, but also offers an enhanced, natural approach to the maintenance of grazing marsh habitats, in which livestock are a key component.

LEARNINGS AND RECOMMENDATIONS

BIM and multidisciplinary collaboration

Collaborating between design teams that have assets in the floodplain is crucial. This collaboration allows for accounting of design changes that may arise, impacting RFS size and location. Effective communication plays a key role in ensuring that proposed changes from other disciplines are comprehended. BIM serves as the ideal interface or presentation tool, facilitating clear understanding among design teams regarding the location of RFS and how their proposed alterations might impact this. This clear communication fosters a cohesive approach to managing floodplain assets.

Landownership

The habitat creation approach HS2 has followed allows land to be returned to landowners to continue their farming practices involving livestock but also offers an enhanced, natural approach to the maintenance of grazing marsh habitats, in which livestock are a key component.

Recommendations for the future projects are to seek greater opportunities for wider environmental enhancement during negotiating land purchase. Certainly, as climate change impacts are felt in the UK, increasingly larger areas of land will need to be purchased for RFS.

RFS design standards

HS2 Technical standards dictate the base slope of the RFS is no less than 1 in 100. However, this would preclude the creation of wetland habitats, which require a relatively flat base. However, an enhanced maintenance strategy for the wetland and to avoid siltation needs development (discussed below).

Groundwater interaction

Another factor required in the creation of sustainable wetlands is high groundwater level. Initially this was seen as a significant technical challenge due to risks associated with interfering with the groundwater level in the area. There were concerns about potentially creating a change to flows within local watercourses and drawdown of the groundwater table. Undesirable flow paths and rutting could occur, posing issues for future land use. However, with the

introduction of wetlands at several sites, the high groundwater level has proven to be key in providing enhancement and demonstrating that it's better to work with the natural environment than against it.

Maintenance of conventional RFS

During both the design and consenting processes, maintenance was discussed with relevant stakeholders. As there is no specific guidance on maintenance of RFS outlined in best practice or technical standards, it was understood that RFS should be treated as floodplain, allowing it to develop with natural river process. RFS is designed to mimic nature and should be treated as any other part of the floodplain. However, designs typically include additional storage to allow for a degree of silt buildup.

It is not always feasible to maintain an RFS as they are very large areas that would be environmentally invasive to dredge with any regularity. RFS should be designed to be self-sustaining whereby siltation/deposition processes are considered from the outset. Care should always be taken to ensure low or zero maintenance options are provided.

Maintenance of RFS with wetlands

Learning outcomes for RFS design improvements or environmental targets can conflict with regulators/consenting bodies. For example, shallow gradient or flat bases should be assessed for siltation risk and if a maintenance strategy may be appropriate. Siltation can also reduce the capacity of RFS or potentially introduce levels of silt beyond tolerance for wetland habitats.

The benefit of providing RFS volumes with wetlands to contribute to No Net Loss targets can conflict with standards for protection of aquatic habitats. Prior to determining the RFS design approach liaison with stakeholders and the regulator should be undertaken to understand any aquatic ecological constraints are relevant to the area. There is the potential for wetland scrapes to provide substantial ecological benefit but a post flood event review should be conducted to assess the risk of damage to wildlife (e.g. fish entrapment) to make sure there is an overall benefit versus risk.

Planting/Afforestation in RFS

In the guidance report 'Vegetation in Replacement Floodplain Storage' [13] we have developed a systematic approach to facilitate the design of planting vegetation on the RFS.

- Planting an RFS comes with several considerations, owing to the following effects:
- Planting will reduce the storage capacity of the RFS owing to the physical size of the plants, and potentially from long term debris accumulation.

Planting will increase the 'roughness' of the floodplain. By their nature, RFS are close to the watercourse and increasing roughness could slow the flow and increase flood water levels.

While native species are preferred, where RFS capacity is constrained or there are health and safety concerns with debris, poplar trees are recommended owing to their fast-growing nature, resilience to waterlogged condition and ability to be cropped in future. Poplar typically grow in a uniform fashion with little variance in trunk diameter, which also contributes to simpler RFS volume calculations.

CONCLUSION

The synergy between engineering and the environment is key to the success of the achieving goals set in the local and national planning policy and HS2 technical standards, whilst contributing to HS2s' No Net Loss targets.

The use of BIM has enabled an efficient calculation and placement of the RFS to minimise the impact on the environment as much as possible whilst achieving the strict flood risk target set out in the HS2 technical standards.

RFS design utilising relatively flat base gradients and consideration of groundwater level represent an opportunity for ecological habitat creation in the form of wetland habitat, afforested areas, scrapes and pastures. Geomorphological designs i.e. widened channels counted in RFS volumes has created aquatic habitats, while maintaining a typical daily flow regime. However, particular attention must be given to the

environmental risks of the area, particularly of the impact of an RFS to the aquatic environment. Additionally, critical to approval of wetland and non standard RFS by the regulator is a strategic maintenance considerations, for its life-cycle.

The close collaboration with the environment teams has allowed these wetland habitats to be designed and optimised, whilst the quantifiable environmental benefits have been able to work towards No Net Loss.

With the opportunities for meeting UK Biodiversity Action Plan targets for wetland habitats, being limited to those areas where sufficient water resources are available, the potential importance of RFS to contribute must not be overlooked. Further, the sympathetic development of RFS to provide water storage and biodiversity where wetlands would naturally occur, may reduce long term maintenance and works with the natural catchment processes, rather than imposing something that is less sustainable.

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Marko is a Data Scientist with a PhD in Solid and Structural Mechanics from Chalmers University of Technology in Sweden and a graduate degree in Civil Engineering from Delft University of Technology in the Netherlands.

Marko has approximately 7 years of research experience in railway mechanics, railway condition monitoring, and structural health monitoring of bridges - member of the CHARMEC excellence center. Additionally, he has more than 3 years of professional experience in the railway industry. Marko began his industry career in 2022 as a DinaTwin consultant specializing in condition monitoring and structural health monitoring systems. In 2024, he transitioned to KONUX, where he currently works as a Data Scientist.

REMOTE CONDITION MONITORING OF S&C VIA WHEEL-RAIL CONTACT FORCE AND WHEEL TRAJECTORY RECONSTRUCTION – A DIGITAL TWIN APPROACH



INTRODUCTION

Switches and Crossings (S&C) are elements that connect railway routes and enable efficient use of the network. This comes at a cost as S&C introduce load inducing discontinuities which rapidly increase their deterioration rates (compared to plain line) and put S&C resilience at the core of railway network punctuality.

Overall, it is estimated that S&C cause 20% of infrastructure delays and account for 15% of operational and capital expenditure [1]. With around 300,000 units in Europe, out of which some manage to provide only 2.5-3 years' service life, (considering individual key assemblies such as switch rails and/or crossings as opposed to entire turnouts), it is evident that railway managers need condition monitoring solutions that are able to improve maintenance planning, increase resilience and reduce costs.

S&C CONDITION MONITORING CHALLENGES

One of the key challenges in managing S&C is that their condition cannot be reliably determined by their visual "appearance" or even by direct non-destructive static or dynamic testing, but by their operational behaviour when trains are using them.

For example, newly installed S&C that are visually and structurally perfect may undergo rapid initial deformation, called plastic adaptation. This is a phase characterized by high dynamic forces caused by variations in operational wheel profiles. Therefore, maintaining S&C to be in an as-new condition is not always ideal, and highly adapted and optimal S&C conditions can be ruined by unnecessary maintenance.

Existing methods for S&C condition assessment include:

1. Dye Penetrant Testing for crack detection,
2. Straight Edges and Rail Height measurements for wear and batter estimation,
3. Void Meters for capturing peak displacement,
4. Track Geometry measurements for dip angle monitoring, and
5. Trolley and Robot measurements for rail profile monitoring.

While these methods provide detailed and in-depth information for tracking structural changes, they do not offer a clear picture of the operational behaviour of the S&C.

In terms of operational conditions, S&C can face temperatures ranging from below -25°C to instances where rails heat up to 70-80°C. This wide temperature range, combined with the fact that S&C is a much stiffer structure than regular railway tracks, can lead to severe thermal loads. On the trackbed side, frost and heavy rainfall can significantly affect track support conditions, directly impacting the dynamic properties of S&C. Additionally, on some European lines, trains cross S&C at speeds of up to 200 mph, with wheelset loads varying from a few tonnes for empty freight wagons to 25+ tonnes for fully loaded ones. Both light axle loads (causing strong lateral impacts) and heavy axle loads (causing vertical overload) damage S&C in different ways.

All of this indicates that the true condition of S&C can only be determined through continuous monitoring of its operational behaviour. Further, a continuous approach to S&C condition assessment is essential for enabling remaining useful life prediction and predictive maintenance.

The major challenge in this is designing a durable remote S&C condition monitoring system for such a harsh dynamic environment where some structural elements can even experience accelerations exceeding 5000G. Furthermore, with a resilient and durable remote system a big challenge still remains in how to interpret what is measured.

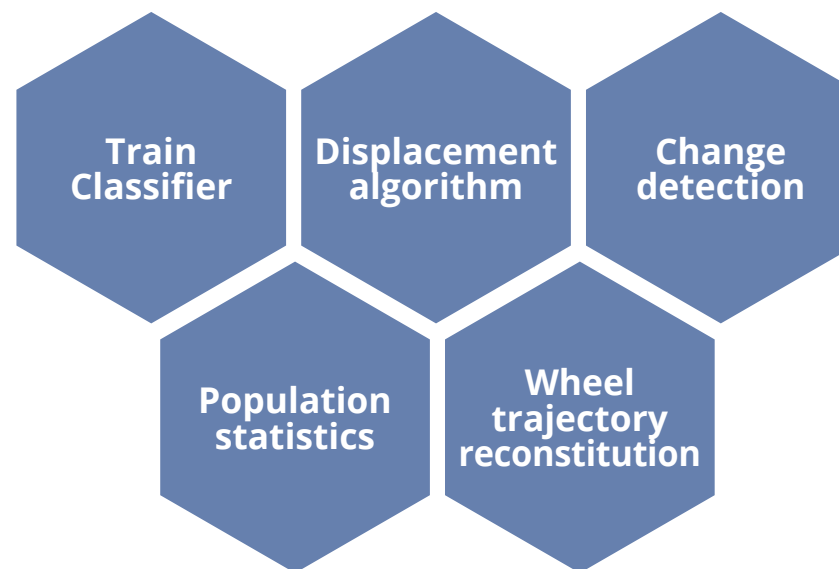


Figure 1: KONUX Switch system data processing algorithms.

KONUX SWITCH SYSTEM

The KONUX Switch system presents an answer for the aforementioned challenges and in-depth details can be found in [1]. As a short summary, the system is based on:

1. Sleeper vertical and lateral acceleration measurements via an advanced and resilient Internet of Things (IoT) device (5+ years in field, 5000+ sensors),
2. A combination of advanced machine learning and statistical models, data processing algorithms and physics informed digital twin multi-body and finite element models,
3. Extensive field experience.

The data processing component of the KONUX Switch system (see **Figure 1**) consists of a machine learning classifier and an axle detector, which determine train types, speed, load, and track accessibility. Furthermore, the classifier information is also utilized by the displacement reconstruction algorithm which is used for trackbed condition assessment. Population-based statistical analysis of vertical accelerations is used to determine how much a particular asset deviates from its subgroup, and also algorithms are employed for the automatic detection of both abrupt and gradual changes in processed data. Lastly, analysis extends from mathematical to physical models, including digital twin multi-body simulation (MBS) and finite element method (FEM) models which are used to determine S&C wheel-rail forces, wheel-rail dynamics, and interpret rail geometry. The end results of each of five distinctive pillars are analysed in a holistic manner to address S&C health, maintenance, and management.

This article focuses on the advances of the KONUX Switch system related to S&C digital twin MBS & FEM models, and their capability to determine S&C wheel-rail forces, wheel-rail dynamics, and interpret rail geometry. It also highlights the value of these system features for S&C condition assessment and providing maintenance instructions.

WHEEL-RAIL CONTACT FORCE (WRCF) AND WHEEL TRAJECTORY (WT)

S&C track structure deformation and deterioration is driven by the contact force between the wheel and the rail. The size and pattern of this force is determined by the wheel-rail dynamic interaction,

which, in turn, is determined by how the wheel moves on the rail. Existing manual or semi-automatic methods for S&C condition assessment can provide information such as the existence and magnitude of rail cracks, relative wear levels, the magnitude of track displacements, and detailed track and rail geometry. However, this information reveals little to nothing about the wheel-rail contact forces that excite the S&C structure and determine its operational behaviour. Thus, the following questions arise:

1. Is it possible to calculate the wheel-rail contact force (WRCF) in an S&C crossing transition from a measured acceleration signal that is excited by that force? and
2. Is it possible to compute a vertical geometry profile of the wheel-rail contact points - referred to as the Wheel Trajectory (WT) - that defines how the wheel moves on the rail and excites the system?

The previous questions can be answered by employing a physical digital twin model of the vehicle-railway track system and establishing force-dynamic response relationships.

Although simulation models and offline digital twins of railway turnouts are commonly available, the challenge is in scaling such a model to be computationally effective and to automatically calibrate itself in near real-time based on in field sensor measurements (closed-looped Digital Twin). In the following text, we explain how such a model was developed and integrated into KONUX Switch.

THIS ARTICLE FOCUSES ON THE ADVANCES OF THE KONUX SWITCH SYSTEM RELATED TO S&C DIGITAL TWIN MBS & FEM MODELS, AND THEIR CAPABILITY TO DETERMINE S&C WHEEL-RAIL FORCES, WHEEL-RAIL DYNAMICS, AND INTERPRET RAIL GEOMETRY.

DIGITAL TWIN MODEL DEVELOPMENT

The steps for computing WRCF and WT based on a digital twin model are as follows:

1. Development of the MBS and FEM vehicle-railway track model,
2. Calibration of the FEM model with accelerations measured in the field,
3. Inverse identification of WRCF from the measured accelerations using the calibrated FEM model, and
4. Calculation of WT by resolving the physical relationship between the WT and the WRCF.

For digital twin model development, the KONUX Switch system employs a non-linear flextrack MBS model developed in the commercial software Simpack. Research literature regarding the development, application, and validated range of such models can be found in [2-6]. The KONUX MBS model uses a 3D FEM-based representation of the track structure, a single bogie vehicle, and 3D scanned rail geometry.

The MBS part of the model is used for development and validation, and from it the FEM part of the model is further extracted and used for WRCF and WT reconstruction.

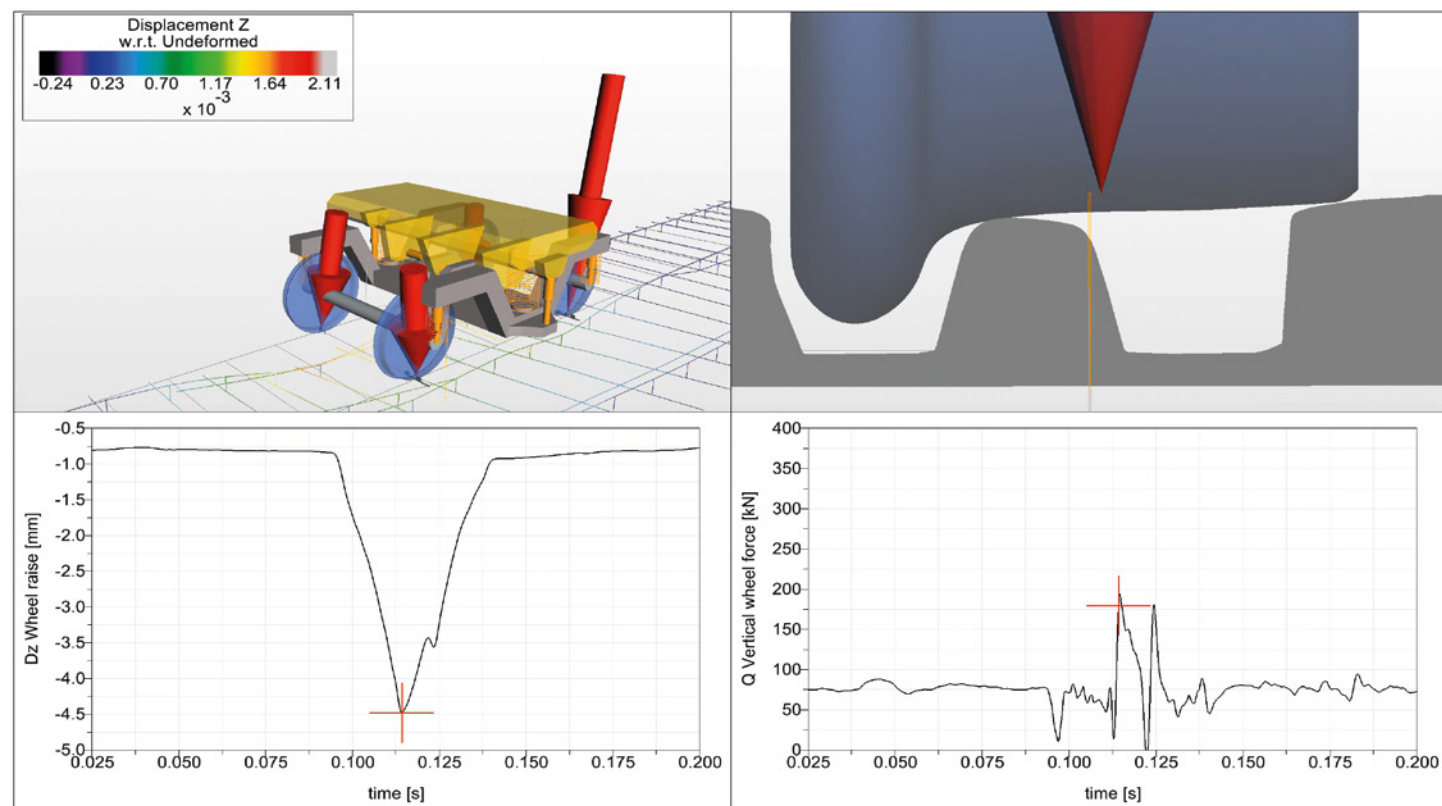


Figure 2: MBS model, simulation snapshot of crossing transition. Top figures show a single bogie vehicle facing a straight route crossing transition with 4 wheel-rail contact forces, and 2D cut of the front right wheel that is transitioning from wing rail to crossing rail. Bottom figures show the right front wheel trajectory and contact force.

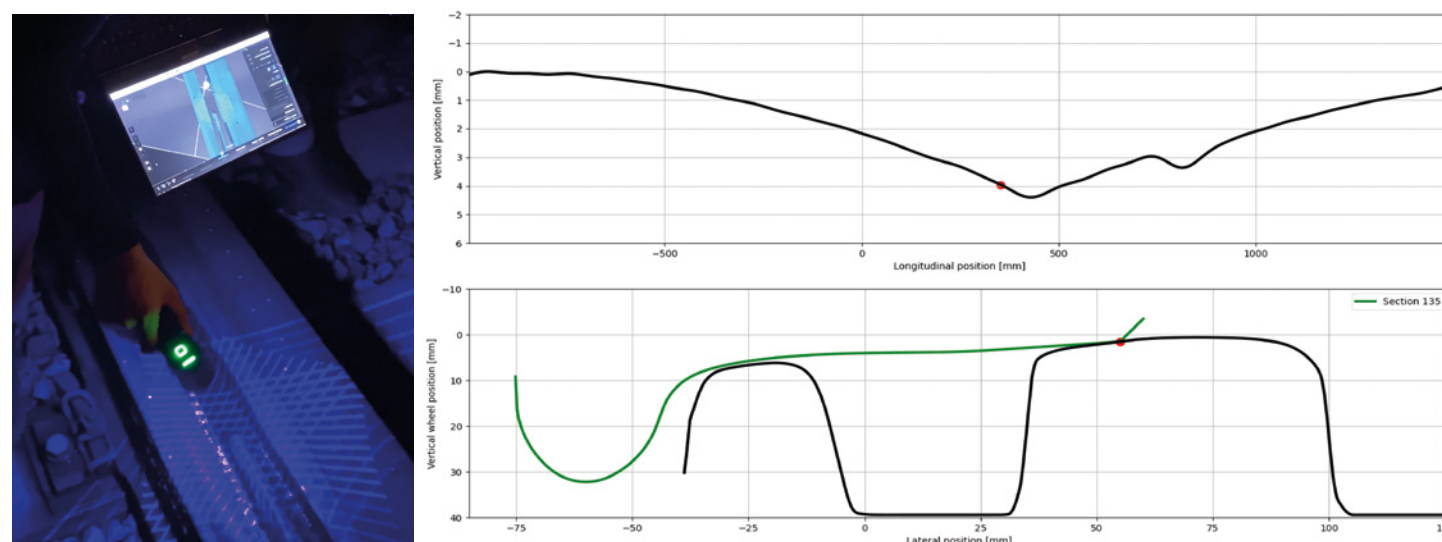


Figure 3: Field 3D scan (left) and extraction of 2D profiles and kinematic wheel trajectory from 3D cloud of points (right).

In **Figure 2**, a developed MBS model simulation snapshot is presented. It illustrates the point of transition of the wheel from the wing rail to the crossing rail, and it also shows the transitioning wheel trajectory and contact force. The developed MBS model uses 2D rail profiles obtained from the 3D geometry field scans, see **Figure 3**.

The MBS model with scanned rail profiles and field-measured accelerations is used for establishing the required complexity of the FEM railway track representation. Subsequently, the developed FEM model is used to reconstruct WRCF and WT from measured sleeper accelerations without the 3D scanned data.

NEAR REAL-TIME MODEL CALIBRATION AND WRCF&WT COMPUTATION

To reconstruct the WRCF&WT of a particular real-world S&C from the sleeper acceleration measured by the KONUX IoT device, the first step

is to assemble a FEM model for that asset incorporating known structural properties such as rail type, rail pad, track radius, and sleeper material.

Furthermore, the model's trackbed properties need to be calibrated, as they vary in time and have unknown characteristics. This calibration is based on sleeper displacements, which are calculated as the double integration of the measured sleeper accelerations. In this process, the passing train type and speed, for which sleeper accelerations are measured, must be identified beforehand and this is done using the KONUX Switch system's machine learning classification algorithm.

With the calibrated FEM model, the next step is computing the WRCF that produces sleeper accelerations in the simulation environment identical to the field-measured ones. Lastly, for the identified train type and speed, the WT which defines the wheel mass momentum change that produces the computed WRCF needs

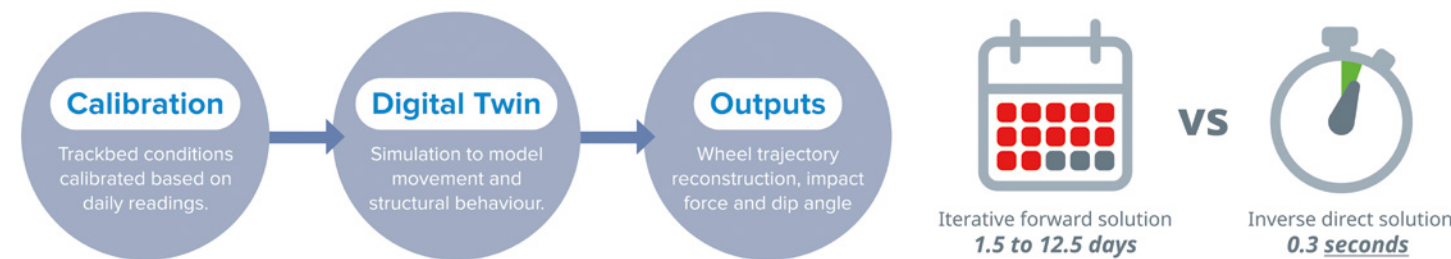


Figure 4: WRCF&WT computation steps.

to be computed. In **Figure 4**, the three main steps of WRCF&WT computation are presented.

REDUCING THE COMPUTATIONAL COMPLEXITY

The above-described problem can be computed in two ways:

1. Iteratively as a forward problem or
2. Directly as an inverse problem.

Concerning the iterative solution, during MBS model development and validation, one simulation run of a single bogie vehicle passage through an S&C crossing panel, depending on the model complexity and mesh size, takes 8-60 minutes. Solving an optimization problem for determining WRCF and WT with such an MBS model on average takes 300+ iterations. Thus, depending on the model complexity, the total WT computation time is between 1.5 to 12.5 days.

Apart from exhaustive computational effort, this optimization problem doesn't always yield satisfactory results as the solution is always an iterative approximation that satisfies the defined optimization problem criteria.

The second possible computational approach to WT identification is by inverse problem formulation. In structural dynamics, a dynamic response can be calculated as a convolution integral of the mechanical system functions and force functions that are exciting the system. These mechanical system functions are called Green's functions or transfer functions. In simple words they are functions that transfer forces acting on the structure into the structure's dynamic response.

The solution for this dynamic response is defined by the convolution integral for the mechanical system's Green's functions and force functions. It can be solved with linear algebra and matrix-vector formulation, which is the key aspect of inverse problem formulation, and this approach is called Green's Kernel Function Method (GKFM). It formulates the system response as a vector which is obtained as a multiplication of the GKFM matrix and force vector. Thus, it enables inverse problem solving for force vector computation as a multiplication of an inverse of the GKFM matrix and measured mechanical system response.

In general, the GKFM method can be used for both forward and inverse problem solving for dynamic systems simulations.

The computational effort for resolving GKFM matrices for and from the used FEM models ranges from 20-60 minutes. When pre-computed, forward simulations of the system's response with GKFM takes less than 0.05s, and inverse calculation of the excitation forces from

the measured system response less than 0.2s (for the used MBS/FEM S&C models). Finally, computing WT from WRCF uses forward GKFM and requires less than 0.1s.

In conclusion, the inverse problem solving with a precomputed GKFM matrix of the MBS model can compute a direct WT in less than 0.3s, compared to 1.5-12.5 days of the MBS-based forward iterative approach. (See **Figure 5**).

KONUX SWITCH SYSTEMS - CLOSED LOOP DIGITAL TWIN

An illustration of a closed loop digital twin WRCF&WT system is presented in **Figure 6**. The system has continuous readings from the KONUX IoT device and performs daily calibration of the FEM railway track model. For each detected wheel passage through the crossing transition the system reconstructs WRCF and WT. Reconstruction is based on a precomputed FEM and GKFM database stored in the cloud. The full workflow outputs tracked stiffness, WRCF, and WT. Further the WRCF and WT are analysed to extract peak force and

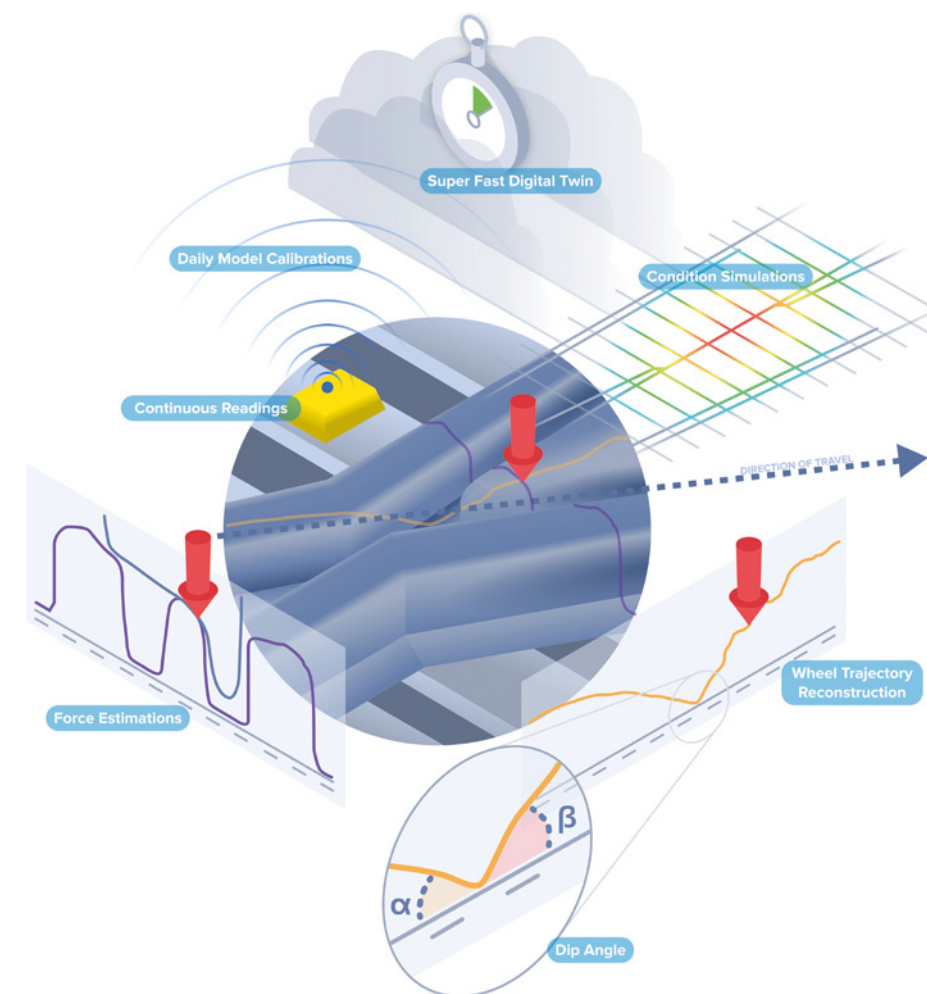


Figure 6: KONUX WRCF&WT digital twin illustration.

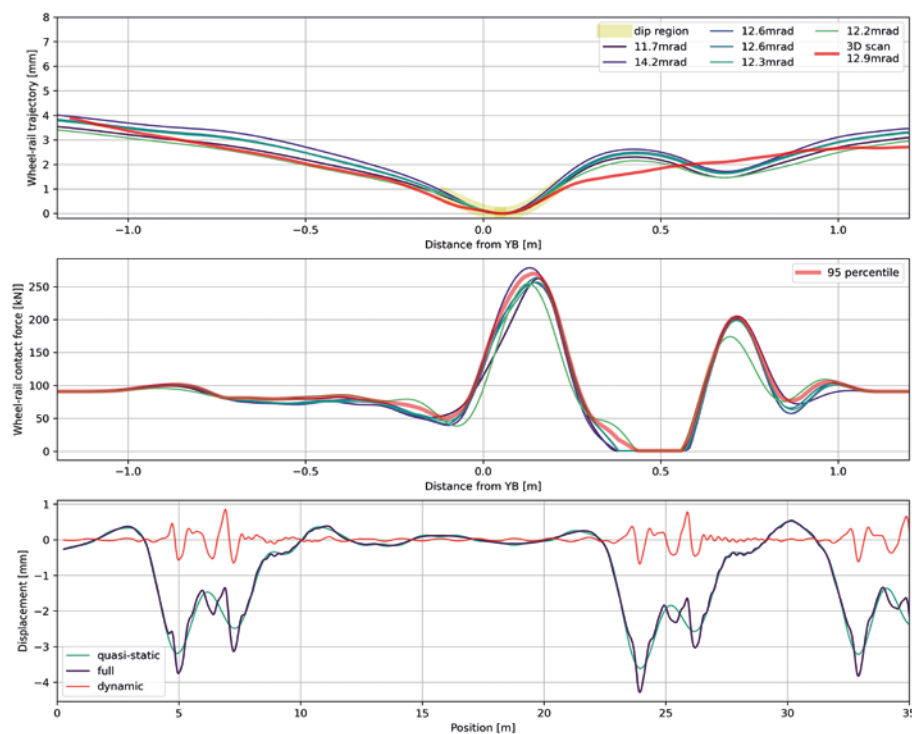


Figure 7: Loss of contact force and reloading impact scenario - Reconstructed and scanned WT (first row), reconstructed WRCF (second row), and sleeper displacements for a 35 m-long train passage segment (one "W" shape represents the passage of a single bogie).

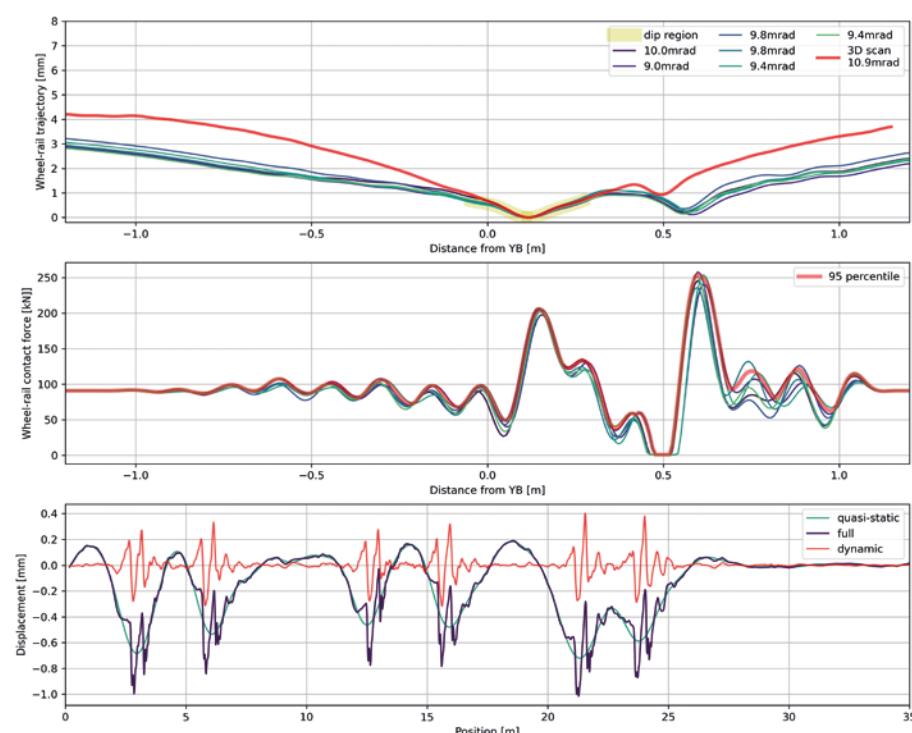


Figure 8: Additional defect double impact scenario - Reconstructed and scanned WT (first row), reconstructed WRCF (second row), and sleeper displacements for a 35 m-long train passage segment (one "W" shape represents the passage of a single bogie).

decompose WT into wheel declining angle alpha and inclining angle beta (the sum of which constitutes the well-recognised dip angle used in existing crossing and rail joint condition monitoring).

VALIDATION - DYNAMIC AND KINEMATIC TRAJECTORY

To validate the WRCF and WT reconstruction, examples of reconstructed WTs are compared with a trajectory extracted from a 3D rail scan. The trajectory extracted from the 3D scan is computed as the height profile of a laterally constrained rigid wheel rolling over a rigid scanned rail. This represents a fully kinematic trajectory that, however, does not account for any forces.

In contrast, the reconstructed WT represents a dynamic trajectory, where:

1. The wheel and rail are deformable elastic bodies that form a deformable elastic contact.
2. The rail undergoes displacement and deformation, meaning the initial static rail geometry can be altered.
3. The wheel and rail can lose contact, allowing the wheel to experience upward lift motion.
4. Depending on the type of crossing rail, some differential motion between the crossing rail and wing rail can occur.
5. The wheel can move laterally obtaining different paths on the rail and trajectory shapes.
6. The wheel can undergo upward lift motion due to contact with the sidewall of the wing rail.

Differences between the 3D scans and the reconstructed WT are therefore to be expected.

Figure 7 presents the first validation example. The graph in the first row shows the WT for multiple wheel passages of a single train, along with the trajectory extracted from the 3D scan (red line). For a direct comparison of trajectories, dip angle values representing the sum of declination and inclination trajectory angle within a ± 15 cm region from the transition are computed and shown in the legend. The graph in the second row shows the corresponding WRCF. It can be observed that in regions where the contact force is lost, the reconstructed WT rises above the scanned kinematic trajectory. Conversely, when the contact force is re-established, an additional dip is observed in the reconstructed dynamic WT.

To illustrate the track's dynamic response, the graph in the third row shows the sleeper displacements for a 35-metre-long train passage segment. This example reveals sleeper displacements reaching 4 mm, which can be considered significant. These large track displacements may also contribute to poor wheel-rail contact and the loss of WRCF.

Figure 8 is presented as a second validation example, analogous to **Figure 7**. In this example, an additional rail defect is present, causing a larger impact force than the transition impact from the wing rail to the crossing rail. It can be observed that the reconstructed WT is shallower than the scanned one and that the transition in reality most likely occurs slightly earlier than indicated by the scan.

Furthermore, the graph in the third row shows sleeper displacements with clear

physical signatures of two strong impacts per axle (one "W" shape representing a single bogie) and compact trackbed conditions with sleeper displacements remaining under 1 mm.

Figure 9 is presented as the third and final validation example. This example features a relatively stable transition with no complete loss of contact force. The trackbed conditions are compact, with sleeper displacements remaining under 1.5 mm and no higher-frequency energy as in **Figure 8** displacements.

In conclusion, a good resemblance is observed between the reconstructed dynamic WT and the scanned kinematic WT. It is evident that the WT can vary axle by axle, primarily due to variations

in wheel profile shapes and wheel lateral positions. Furthermore, it can be concluded that for a comprehensive and detailed assessment of crossing conditions, both WRCF and WT should be analysed. This is because multiple physical phenomena influence the operational behaviour of a crossing, and their effects are reflected in both WRCF and WT.

WHEEL TRAJECTORY IN KONUX USER INTERFACE (UI)

The WRCF and WT reconstruction process is configured to run on assets where trains travel at speeds above 55 mph, which accounts for approximately 70% of the KONUX-monitored assets. This process is triggered daily and is fully automated. The WT is displayed in the UI, while the WRCF and dip angles are stored in the database. As part of future developments, a more detailed representation of WRCF and WT in the KONUX UI is planned.

Figure 10 shows an example of the WT in the KONUX UI. The displayed WTs represent progression curves based on statistically processed characteristic daily WTs, derived from all processed train passages of that day. This particular example highlights the significant improvements in trajectory following a crossing replacement.

Figure 11 shows an additional example of WT on a different asset. Here it is combined with a recent image of the railhead condition at the crossing wheel transfer area provided through One Big Circle's AIVR platform. This WT is indicative of a short wheel transfer length along with some apparent wheel unloading, further confirmed through inspection of the track imagery. This combination of tools is designed to enable maintenance engineers to further contextualise data from remote condition monitoring systems and improve planning of remedial activities.

WRCF AND WT VALUE IN S&C CONDITION MONITORING

Compared to existing techniques for monitoring crossings, WRCF and WT reconstruction offer condition assessment that is fully remote, monitors response of the track to a wide variety of trains, requires no on-site work or calibration, provides actual impact force values rather than analogues such as kinematic dip angles, and delivers detailed information about the real-time operational condition of a crossing.

When combined with trackbed condition assessment, it enables to target maintenance actions and validate the effectiveness of those actions. The analysis of WRCF and WT is designed to detect:

1. Defects in the crossing transition that are not detectable by other means.
2. If poor wheel-rail contact occurs in the crossing transition, leading to multiple force unloading and reloading events.
3. If force and dip angle values exceed thresholds associated with a high risk of internal cracks, indicating that rail replacement is required - a condition where weld repair is likely to be ineffective.

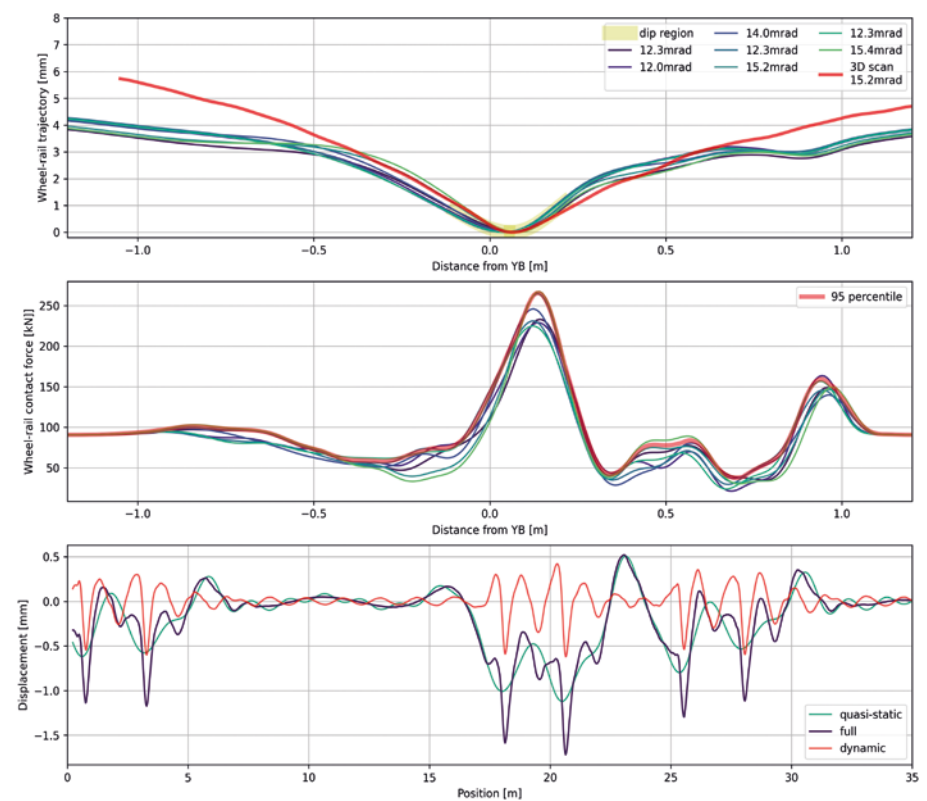


Figure 9: Stable transition with compact trackbed and medium impact force scenario - Reconstructed and scanned WT (first row), reconstructed WRCF (second row), and sleeper displacements for a 35 m-long train passage segment (one "W" shape represents the passage of a single bogie).

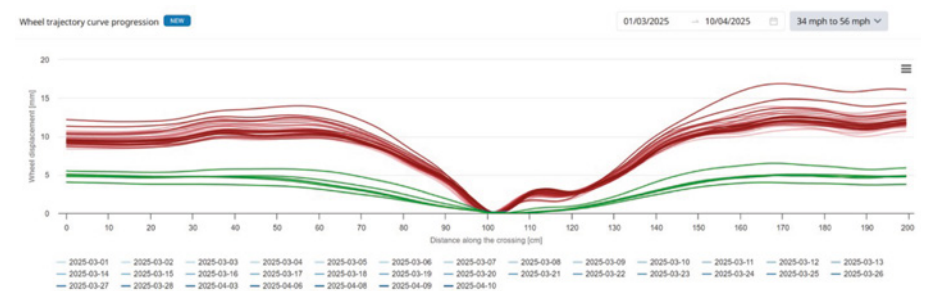


Figure 10: Wheel trajectory progression curve indicating changes following a crossing replacement. Old crossing (red), new crossing (green).

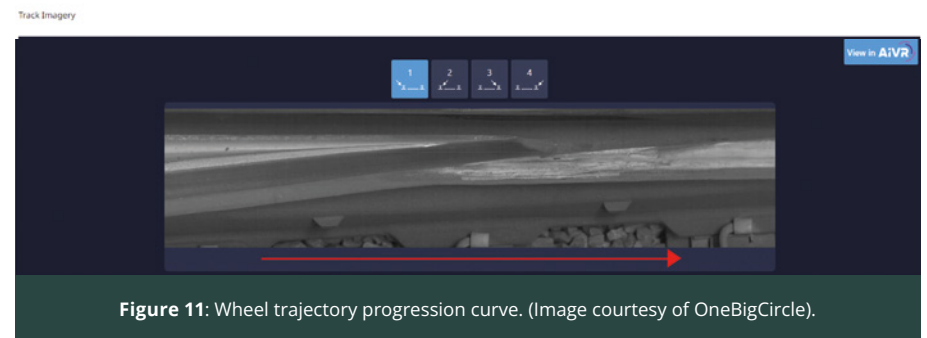
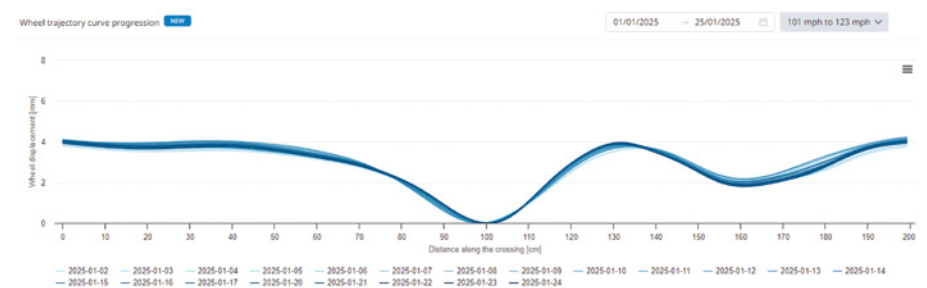


Figure 11: Wheel trajectory progression curve. (Image courtesy of OneBigCircle).

4. Whether the structure has significantly lost integrity and elasticity, necessitating additional maintenance actions to restore a compact and stable structure.

CONCLUSION

As railway infrastructure expands and modernises, the need for advanced monitoring systems that enhance safety, improve reliability, and enable optimal planning of maintenance activities will become increasingly critical. In this article we introduced a new feature of the KONUX Switch system for reconstruction of Wheel Rail Contact Forces (WRCF) and Wheel Trajectories (WT) on S&C with a Digital Twin calibrated in near real-time using acceleration measurements from IoT devices continuously monitoring the S&C. The WRCF and WT reconstruction provides an invaluable addition to existing approaches, such as visual inspections, track geometry measurements or crack detection systems. It enables monitoring of the behaviour of S&C under real operational conditions, and thus:

- 1. Better identify S&C with high risk of increased degradation and occurrence of faults,
- 2. Diagnose root causes of fast degradation and frequent occurrence of failures and
- 3. Provide targeted recommendation and evaluation of maintenance activities.

The Digital Twin for WT and WRCF reconstruction has been made available for thousands of S&C across Germany and the UK, and experiences gathered so far are underscoring its potential for broad adoption across the rail industry. The feature combines advanced physics based modelling (using FEM and MBS models), ensuring a sound representation of the structural behaviour of track systems, with statistical and computational methods facilitating the ability to scale the physics based model to thousands of different crossings. The online evaluation where the computation time was reduced from hours or even days to less than a second allows calibration of the model in near real-time and thus reflects the changing conditions in the track, e.g. after maintenance or when temperature changes. The feature will be further enhanced to broaden its domain of operation and will be integrated into the KONUX Switch predictive maintenance system.

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Jamie Kelly,
Programme Manager
Metro & Rail Projects,
VolkerRail

VOLKER RAIL – SUSTAINABLE DESIGN AND CONSTRUCTION OF LIGHT RAIL AND TRAM SYSTEMS



Jamie Kelly is an experienced Permanent Way Engineer, a specialist in Light Rail Construction & Renewal activities.

Starting his career with Grant Lyon Eagre in 1990, Jamie has gained valuable Permanent Way engineering experience on a wide variety of railway projects ranging from High Speed routes to radar rings for the military.

Jamie currently manages Volker Rail's Light Rail and Metro programmes on a national basis.

value that can be shared across stakeholders. For example, on urban renewals projects, the reuse of defunct materials and their reintegration into the circular economy supports a fully embedded approach to sustainability. This not only minimises waste but also maximises the utility of available resources.

Furthermore, preserving biodiversity remains an essential consideration. Effective route planning and the use of construction methods that avoid critical natural habitats can mitigate ecological disruption, while the incorporation of green infrastructure helps protect and enhance local flora and fauna.

Social Sustainability

Social sustainability in light rail and tram systems centres on creating transport networks that are accessible, inclusive, and capable of delivering long-term benefits to all members of the community. Accessibility is a fundamental consideration in system design, with infrastructure and rolling stock needing to accommodate people of all abilities, including disabled individuals, older adults, and young children, so that public transport remains equitable and usable for all.

Effective integration with other modes of public transport, such as buses and bicycles, is another key element in ensuring seamless, convenient journeys. This approach supports wider connectivity and enhances user experience. In addition, the repurposing of redundant assets, such as disused heavy rail corridors or first-generation tram routes, offers a sustainable and efficient means of expanding the network while preserving valuable transport corridors.

Light rail and tram systems also act as powerful tools for urban regeneration. By encouraging more sustainable land use, reducing car dependency, and enhancing the quality of urban environments, these systems contribute to the revitalisation of cities and the wellbeing of local communities.

A socially sustainable approach must also include investment in the future workforce. The industry carries a responsibility to attract, develop, and retain the next generation of infrastructure professionals. A pipeline of engaged school leavers, apprentices, and graduates is critical to building on the progress achieved to date in light rail and urban transport. Initiatives such as Volker Rail's 2025 apprentice programme, which supports 256 apprentices, demonstrate a clear and active commitment to fostering the talent needed to sustain the sector's long-term success.

Economic Sustainability

Economic sustainability in light rail and tram systems involves the efficient use of resources to support long-term economic growth and stability, while minimising adverse impacts on both the environment and society. It requires a careful balance between economic development and the preservation of ecological and social value, ensuring that today's investments do not compromise future resilience or prosperity.

A core principle of economic sustainability is cost management. Sustainable design aims to minimise construction, operational, and maintenance costs through effective planning, thoughtful design, and the selection of durable or reusable materials. These practices not only reduce long-term expenditure but also enhance the reliability and lifespan of the infrastructure.

Revenue generation also plays a critical role. In addition to fare collection, financially sustainable systems often diversify their income by incorporating supplementary streams such as advertising, rental of retail spaces within stations, and land value capture strategies that allow local authorities or transport providers to benefit from increases in surrounding property values.

Moreover, the development and operation of light rail systems have a direct impact on local economies. These projects generate

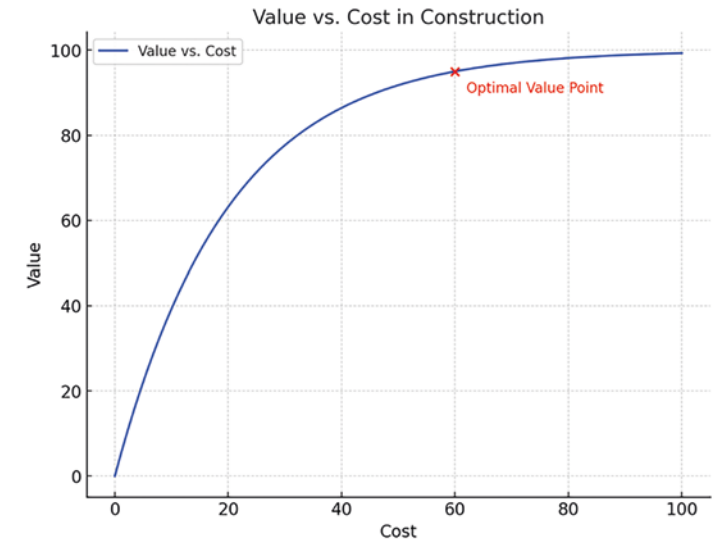


Figure 1: Value vs. cost in construction.

employment opportunities across a range of disciplines and can act as catalysts for economic development. By improving connectivity and supporting urban growth, light rail systems contribute to more dynamic, mobile, and economically resilient communities (Figure 1).

BENEFITS OF SUSTAINABLE LIGHT RAIL AND TRAM SYSTEMS

Investing in sustainable light rail and tram infrastructure delivers a wide range of benefits across environmental, social, and economic dimensions, making it a valuable asset for modern urban development.

From an environmental perspective, the adoption of electrically powered light rail systems, especially when sourced from renewable energy, contributes significantly to the reduction of greenhouse gas emissions along with ongoing efforts to remove diesel-powered buses and private vehicles. These systems also produce far less local air pollution, which in turn supports better urban air quality and lowers the health risks associated with particulate matter and vehicle emissions. Additionally, trams and light rail vehicles generate substantially less noise than road traffic, resulting in quieter, more pleasant urban environments.

Socially, light rail systems offer enhanced mobility by providing reliable, frequent, and safe transportation options that serve a broad cross-section of the community. This is particularly impactful for individuals who do not drive, such as older adults, young people, and lower-income households, helping to reduce social exclusion and improve daily access to services, education, and employment. The health benefits associated with public transport are also notable, as its use tends to encourage walking and cycling, supporting more active lifestyles. Moreover, the integration of green tracks and thoughtfully designed pedestrian infrastructure can enhance the visual appeal of urban areas, contributing to a more attractive and liveable public realm.

Economically, sustainable light rail investment can stimulate growth through increased property values, particularly in areas close to stations where improved connectivity attracts both residents and investors. Cities and their residents can also benefit from cost savings through reduced congestion, shorter travel times, and lower transport-related expenses. In addition, better accessibility along tram routes supports local businesses by increasing footfall and making commercial areas more attractive to customers.



Urban transportation systems worldwide are under increasing pressure to address issues of climate change, air pollution, and urban congestion. In response, light rail and tram systems are gaining popularity due to their ability to offer a cleaner, more efficient, economic and cost-effective alternative to buses and private vehicles. The sustainable design and construction of these systems requires a holistic approach that considers environmental impacts alongside social and economic factors. This paper explores the foundational principles, benefits, challenges and best practices essential for the sustainable design, construction, maintenance and renewal of light rail and tram systems. It also suggests how value can be defined and added for promoters and sponsors of light rail and metro systems from the perspective of a multi disciplined Contracting organisation such as Volker Rail Ltd.

THE THREE PILLARS OF SUSTAINABLE DESIGN IN LIGHT RAIL AND TRAM SYSTEMS

The concept of sustainability in transportation revolves around minimising the negative impacts on the environment, enhancing social equity, carbon reduction and promoting economic viability. In the context of light rail and tram systems, sustainable design principles can be categorised into three core areas, which align with the Institution

of Civil Engineers (ICE) definition which notes sustainability as the practice of reducing negative environmental impacts while enhancing social responsibility and carbon reduction performance. This involves balancing natural, social, human, and financial capital to achieve long-term value and meet the needs of the present without compromising the ability of future generations to meet their own needs.

Environmental Sustainability

Environmental sustainability focuses on reducing the carbon footprint and ecological impacts of rail systems through thoughtful design, construction, and operational strategies. One key area is the reduction of construction impacts, where sustainable practices such as minimising land disturbance, incorporating recycled materials, and adopting low-impact construction techniques can all significantly lessen the environmental footprint during the build or renewal of tram and rail lines. Energy efficiency is equally vital; the implementation of regenerative braking systems, the optimisation of traction power supply, and the use of energy-efficient rolling stock all contribute to reduced energy consumption. Alongside this, the integration of renewable energy sources such as solar and wind power to supply the electricity needed for network operations provides a direct route to lowering greenhouse gas emissions.

Experience in the construction and renewal of light rail infrastructure has consistently shown that the most sustainable approaches to on-site challenges are often the most efficient and offer tangible

CHALLENGES IN SUSTAINABLE INFRASTRUCTURE DESIGN AND CONSTRUCTION

While the benefits of sustainable light rail and tram systems are widely recognised, several challenges must be addressed to ensure their successful delivery and long-term viability. Chief among these is the high initial capital cost associated with building such systems. Significant investment is required for infrastructure, rolling stock, and associated technologies. This can act as a barrier, particularly in cities with limited budgets or where other infrastructure demands are competing for resources.

Land acquisition and route planning also present considerable difficulties. Identifying suitable corridors that balance cost, environmental impact, and social equity is often a complex task, particularly in dense urban environments. Acquiring land can be both costly and contentious, requiring sensitive handling to avoid displacement and community opposition.

Operational and maintenance costs pose an additional challenge. Sustainable systems demand ongoing investment to maintain service reliability, incorporate new technologies, and secure sustainable energy supply. Poorly maintained infrastructure can lead to service disruption and inflated operational expenses. A shift toward proactive rather than reactive maintenance offers significant benefits in this regard. Techniques such as deposition welding and condition-based interventions, supported by AI-driven assessment tools, enable timely and cost-effective actions that help avoid unplanned service interruptions and maximise asset life.

Integrating new light rail systems into existing infrastructure adds further complexity. Challenges arise in aligning tram systems with roads, utilities, drainage, and other transport networks. Projects such as the Tram Train scheme in Sheffield highlight both the opportunities and difficulties involved in system integration. Although the programme and budget issues of this pilot scheme were documented in reports such as the National Audit Office's 2017 review, the investment in learning significantly contributed to the industry's collective knowledge and future project planning.

Public acceptance and political will also play a crucial role. Even well-designed, sustainable transport projects can face resistance from stakeholders concerned about disruption, costs, or changes to the urban landscape. Securing long-term political commitment and building public trust through transparent communication and consultation are essential components of successful project delivery.

BEST PRACTICES IN SUSTAINABLE DESIGN AND CONSTRUCTION OF LIGHT RAIL AND TRAM SYSTEMS

To overcome these challenges and maximise the long-term value of light rail and tram investments, a number of best practices have emerged from recent experience, particularly within the United Kingdom's second generation of tram-building programmes. These approaches aim to embed sustainability into every stage of design, construction, and operation.

A holistic approach to planning and design is fundamental. This means integrating environmental, social, and economic considerations from the outset. Early stakeholder engagement, thorough environmental impact assessments, and strategic alignment with broader urban development goals all contribute to better, more sustainable outcomes.

The use of sustainable materials and technologies is also essential. Recycled materials such as steel and concrete can reduce the carbon footprint of infrastructure construction, while the adoption of green track designs featuring vegetation planted between the rails helps to mitigate heat island effects, manage stormwater, and improve the visual character of urban areas. Smart technologies, including energy management systems, real-time monitoring, and predictive maintenance tools, support operational efficiency and reduce resource use over time.

Energy-efficient systems play a critical role in reducing the long-term environmental impact of light rail operations. Regenerative braking, which recovers energy during braking and either returns it to the grid or powers other vehicles, provides measurable energy savings. Similarly, optimised vehicle design with lightweight materials and aerodynamic features contributes to lower energy consumption. Integrating renewable energy sources, such as installing solar panels on station roofs or sourcing electricity from green suppliers, further enhances the environmental performance of the system.

SOCIAL INCLUSION IS ANOTHER KEY COMPONENT OF BEST PRACTICE. ENSURING UNIVERSAL ACCESSIBILITY ACROSS STATIONS, VEHICLES, AND PUBLIC SPACES IS VITAL.

Social inclusion is another key component of best practice. Ensuring universal accessibility across stations, vehicles, and public spaces is vital. Clear and inclusive messaging regarding ticketing, along with contingency measures for situations such as ticket machine breakdowns, helps to ensure fairness and avoid punitive fines. This is particularly important for older passengers, non-native English speakers, and those unfamiliar with the system. Active engagement with local communities throughout all phases of the project helps build trust, ensures the network meets local needs, and encourages a sense of ownership and pride in the system.

Multi-modal integration enhances the overall value of public transport networks. Seamless connections with other transport modes, including buses, bicycles, and metro systems, increase convenience and efficiency for users. Integrated ticketing and payment systems simplify transfers and reduce barriers to use, making sustainable transport a more attractive alternative to private car use.

Finally, effective financing and revenue models underpin long-term viability. Public-private partnerships can help to manage the high upfront costs and associated risks, while land value capture strategies allow transport authorities to recoup some of the value created by improved accessibility. Diversifying revenue sources through advertising, commercial leases, and service contracts also contributes to financial resilience. However, success often depends on the accuracy and realism of business case assumptions, which can significantly influence both projected costs and the perceived return on investment. A clear understanding of these assumptions, along with the ability to challenge them, is critical to delivering successful and sustainable systems.

FUTURE DIRECTIONS IN SUSTAINABLE LIGHT RAIL AND TRAM DESIGN

As urban areas continue to expand and environmental pressures increase, the design and delivery of sustainable light rail and tram systems must evolve to meet new challenges. A number of emerging trends and shifts in thinking are likely to shape the future of the sector.

One such development is the advancement of smart and autonomous technologies. Artificial intelligence and automation have the potential to transform light rail operations. Autonomous trams could enhance safety, improve service frequency, and reduce energy consumption through real-time optimisation of routes and schedules. These technologies also offer the opportunity for more responsive and efficient system management, supporting more reliable and sustainable public transport services.

Climate resilience will also become increasingly critical. With the growing frequency of extreme weather events such as floods and heatwaves, light rail infrastructure must be designed to endure more variable and severe conditions. This includes the use of resilient materials, advanced drainage solutions, permeable pavements, and where appropriate, the elevation of tracks to avoid flood-prone zones.

Design decisions should incorporate future capacity as well as current requirements. For example, a 200-millimetre drainage pipe may meet today's needs, but questions must be asked about whether it will suffice for the drainage demands two decades from now.

In addition, the adoption of circular economy principles can significantly enhance sustainability across the full lifecycle of light rail systems. Designing infrastructure and vehicles for disassembly, reuse, and recyclability supports long-term resource efficiency and waste reduction. However, many current second-generation systems closely resemble their predecessors in key aspects such as rail profiles and metallurgy. While there has been notable innovation in areas like vehicle design and tram operating systems, infrastructure design has progressed more conservatively. A more forward-looking approach is needed – one that considers not only current installation needs but also how to ease the future burden on the next generation of infrastructure engineers through life-extension planning.

The issue of system renewal and life extension is especially pertinent. Many second-generation tram networks are now entering stages in their lifecycle that require more intrusive maintenance and asset replacement. While such projects are often less capital-intensive than full new builds, they still offer substantial opportunities for value-driven decision-making. Activities such as junction renewals or rail replacement come with inherent risks – financial, operational, and reputational – which must be carefully managed. Decisions around scope, timing, and intervention strategies should be informed by a clear understanding of both the benefits of the works and the consequences of inaction. The “do nothing” option is always present, but it carries its own costs, which must be evaluated in terms of long-term value rather than short-term savings.

Life extension and renewals should not be viewed as secondary to new builds. These projects are equally valid platforms for delivering value-added outcomes. However, they often involve multiple engineering disciplines and a broad range of stakeholders, and they are typically constrained by operational time windows. Sustainable outcomes in these contexts demand both strong technical coordination and an appreciation of local stakeholder concerns, public sentiment, and the political landscape. Recent debates around urban congestion charging, for example, have shown that public trust and political support are essential for implementing disruptive but necessary transport investments. The perceived value to users must be demonstrated clearly and credibly, and this value must be positioned within the wider public and political conversation.

THE OPPORTUNITY

The future of sustainable light rail infrastructure lies not only in adopting emerging technologies and materials, but in rethinking the fundamentals of how projects are planned, designed, and delivered. There is a clear opportunity to integrate planning processes more effectively, reducing the reliance on reactive interventions and driving greater certainty in project outcomes. Establishing integrated design and construction arrangements can minimise the number of interfaces between disciplines, enhancing coordination and efficiency throughout the project lifecycle.

A shift in mindset is needed, moving from design driven purely by construction cost to design focused on long-term reliability and resilience. This requires a commitment to using sustainable materials and adopting frameworks that prioritise people, planet, and purpose. The use of low-carbon concrete or other carbon-reducing methods in design can have a measurable impact, particularly when coupled with broader efforts to reduce waste and fully embrace circular economy principles.

Efficient delivery is also essential. Minimising time on site and reducing the need for extensive labour, plant, tools, and equipment not only helps to cut costs but also maximises infrastructure availability. These principles are not unique to light rail; they are common across the construction and infrastructure sectors. What is distinct, however, is the specific challenge of delivering these improvements within the operational and resource constraints that characterise light rail renewals and maintenance.

Typically, heavy maintenance and infrastructure renewals are scheduled during periods of lower service demand – often coinciding with school holidays and reduced commuter activity. This operational reality compresses a significant proportion of critical works into a narrow window, approximately eleven weeks out of every fifty-two. As a result, there is intense pressure on resources, and the requirement for skilled, trained, and motivated personnel becomes particularly acute.

This boom-and-bust cycle of demand does not support sustainable delivery or value at the point of execution. Skilled personnel are asked to perform the most demanding work during periods that may conflict with their personal and family commitments, especially in warmer months when school holidays are in effect. The challenge of sourcing sufficient competent staff during these times risks impacting programme certainty, safety, and project quality.

There is, therefore, a strong case for re-evaluating this cyclical approach. A more balanced and consistent demand for labour throughout the year could support better workforce planning, improve retention of skilled professionals, and ultimately lead to higher quality outcomes. Moving away from peak-period dependency could help the sector meet the universal demand for added value – ensuring infrastructure renewals are delivered not just efficiently, but sustainably and with long-term resilience in mind.

CONCLUSION

Sustainable design and construction of light rail and tram systems are integral to creating greener, more liveable cities. By adopting holistic planning approaches, leveraging advanced technologies, and fostering community engagement, cities can develop efficient and sustainable transit systems which offer significant environmental, social, and economic benefits. As urban populations continue to grow, and the impacts of climate change become more pronounced, sustainable light rail and tram systems will play a critical role in shaping the future of urban mobility. The successful implementation of such systems depends on addressing challenges, learning from best practices, and continually innovating to adapt to new environmental, social, funding and technological realities.

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ANALYSING ELECTRIFICATION



INTEGRATION ACROSS ALL AREAS OF THE RAIL INDUSTRY

THINK
ARTICLE

JOHN MERRIMAN
TECHNICAL MANAGER
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I have been in my role as PWI Technical Manager for Electrification since March 2025, since then I have had time to assess how the PWI can offer an improved service to those working both within Electrification, and those outside it. Over the course of the next eight PWI Journals we will be running a series of articles that will explore the diverse success stories in electrification. The series will be called **“Analysing Electrification”**.

This is an opportunity for the electrification industry whilst it seems to be going through a process of reflection in the UK, to share lessons learned, discuss what the industry does well, and to consider the shape of future programmes.

We will see articles from subject specialists as well as articles made up of contributions from a series of small pieces and interviews, these will offer insights from across the United Kingdom (UK) and beyond.

Articles will cover the wide range of disciplines, skills and strategies, technologies and solutions applied across the UK to deliver successful electrification.

ARTICLES WILL COVER THE WIDE RANGE OF DISCIPLINES, SKILLS AND STRATEGIES, TECHNOLOGIES AND SOLUTIONS APPLIED ACROSS THE UK TO DELIVER SUCCESSFUL ELECTRIFICATION.

HERE ARE SOME OF THE AREAS WE INTEND TO LOOK AT:

01: CSM & Rail Interoperability Regulations including Risk, Entry into Service (EIS) and Authorisation to Place in Service (APIS).

- A. Revealing the challenges set by legislation and meeting those obligations.
- B. Improving Quality and managing Risk.
- C. Working with technical stakeholders.

02: The early stage of programmes.

- A. How electrification programmes are developed through early PACE/GRIP Stages, we will look at the roles of Sponsor and development teams as they deliver:
 - i. Phase A. Initiate.
 - ii. Phase 1. Strategic Development and Project Selection.

03: Leadership, project management and stakeholder management.

- A. How electrification programmes are delivered through the later PACE/GRIP Stages:
 - i. Phase 2. Project design.
 - ii. Phase 3. Project delivery.
 - iii. Phase 4. Project Close.
- B. Reviewing the types of Contractual arrangement used. Team structures and how they are led.
- C. Shaping attitudes and perspectives towards delivering a successful product.
- D. How do we provide engineers with the support, communication and technical tools to support major programmes more effectively?
- E. Understanding perspectives, reflect on differing perspectives of client, designer and installation teams, and ensuring that we take our time and understand the engineering, programme and funding challenges faced by colleagues on a major programme.

04: Access and Possessions.

- A. What challenges are faced by different programmes and how they were overcome?
- B. What can we ask for in the future to improve productivity and reduce cost?

05: Surveys and BiM

- A. The critical use of surveys.
- B. Modelling, what is used across programmes.
- C. Modelling, the future.

06: Engineering governance and Innovation.

- A. How engineering governance is applied.
- B. How programmes apply standards effectively.
- C. Leading engineering innovations to reduce cost and stabilise programme.

07: Sustainability, climate change, environmental impact.

- A. How the industry responds to the demands of climate change, sustainability and managing the environment, and what can we do better.

08: Integration and systems management.

- A. How programmes address integration and multidisciplinary designs.
- B. Defining systems engineering in electrification. How the industry manages the integration of multidisciplinary solutions to specific challenging elements in electrification.
- C. This will include looking at track lowering and drainage solutions; delivering electrification through pinch points such as bridges, tunnels, crossovers and stations.
- D. We will look at how we manage electrification to limit disruption to signalling and telecommunications along the rail corridor.

09: Discontinuous Electrification.

- A. What is meant by discontinuous electrification, and the benefits it offers?
- B. Solutions considered in delivering discontinuous electrification.
- C. Impact on train operators and future route works by applying discontinuous electrification.

10: Asset management and maintaining the assets.

- A. Managing new assets during the build process.
- B. Handing back and managing new assets on a newly electrified rail corridor.

11: The Future

We will also look to the future, as discontinuous electrification programmes are introduced, we will consider what future challenges the industry faces and what delivery models may need to be employed to meet the governments' 2050 zero carbon target in rail transport, whilst also delivering the required simplified scope and cost that the UK can afford.

Midland Mainline: All photos courtesy of John Merriman.

As we develop the series, more subject areas will be included as we continue to engage with the teams who have delivered and continue to deliver in electrification.

During the series we will invite the members of the PWI to respond to the articles offering their perspectives and encouraging a healthy debate on how electrification can meet the legislative goal of zero carbon by 2050, (Climate Change Act 2008 [2050 Target Amendment] Order 2019), whilst managing scope and cost within realistic budgets.

If you have experience delivering success in electrification and would possibly like to contribute to the series, then please get in touch with me to discuss further:

john.merriman@thepwi.org

A CAREER IN DIGITAL & AI



Digital & AI technologies are transforming railway engineering by enabling smarter decision-making, predictive maintenance, and innovative design. Key areas include machine learning, mathematical modelling, generative AI, digital tools, and cybersecurity. These advancements drive efficiency, safety, and sustainability while securing the railway's digital infrastructure.

The integration of Digital & AI technologies is revolutionising railway engineering. From ensuring safer operations to optimising performance, these advanced tools and methods are propelling the industry into a new era. Whether you're starting your career in railway engineering or seeking to enhance your expertise, digital and AI understanding will increasingly become part of your competence toolkit.

Below, we've selected three essential resources and insights to stay ahead in this fast-evolving sector. If you'd like to dive deeper into the world of Digital & AI, our Knowledge Hub offers the tools you need to excel in this dynamic field. From technical guides to advanced training programmes, visit www.thepwi.org/knowledge/ to learn more.



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PWI LUNCH & LEARN: ADVANCEMENTS IN DIGITAL DELIVERY WITH CLOUD AND AI TECHNOLOGY

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THE DIGITAL TRANSFORMATION OF THE EAST COAST MAINLINE

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A CAREER IN EARTHWORKS & WATER MANAGEMENT



Earthworks & Water Management shape the landscapes railways traverse, ensuring stable foundations and effective water flow. This discipline addresses challenges like building on soft soils, managing stormwater, and preventing erosion and landslides. By incorporating climate resilience and nature-based solutions, it supports sustainable railway infrastructure.

Earthworks & Water Management play a critical role in the safety, reliability, and longevity of railway infrastructure. From embankment stabilisation to drainage design, engineers working in this field address the complex geotechnical and hydrological challenges that impact day-to-day operations.

For professionals working in, or moving into this discipline, understanding current design approaches, monitoring techniques, and asset performance under extreme weather is essential.

Below, we've highlighted three key resources from the Knowledge Hub to support your ongoing development. To explore further, visit our Knowledge Hub at www.thepwi.org/knowledge/. You'll find technical papers, webinars, and expert insights curated to keep you informed on the latest thinking and techniques in Earthworks & Water Management.



GEOTECHNICAL RISK AND PREDICTING EARTHWORKS FAILURE

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STABILISING BROWNEY CURVE: ECML EARTHWORKS ON A HUGE SCALE

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HOW WATER AFFECTS THE RAILWAY: KNOW YOUR ENEMY!

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A CAREER IN ELECTRIFICATION & PLANT



Electrification & Plant focuses on the systems that power and control railways, enabling sustainable, efficient, and reliable operations. Key components include overhead lines, traction power, and distribution systems, as well as earthing, and bonding. This discipline is integral to supporting renewable energy, reducing carbon emissions, and ensuring long-term railway resilience.

Electrification & Plant is essential to modern infrastructure, driving the sustainable and efficient operation of transport systems, industries, and public utilities. This field includes a variety of critical components – such as overhead line systems, traction power and distribution networks, and 3rd & 4th rail systems (also known as ETE) – that power the electric trains. Fixed plant includes other power supplies for depots, stations, escalators, lifts, yards and terminals including fixed cranes. Heating, ventilation and air-conditioning for operational assets and signalling power supplies are all included in the fixed plant portfolio.

Here are three helpful resources to support your professional development in this area. If you'd like to discover more, visit our Knowledge Hub at www.thepwi.org/knowledge/, where you can access specialist resources, on-demand learning, and expert perspectives covering both established practices and future developments in Electrification & Plant.



OVERHEAD ELECTRIFICATION – CAN THE NEGATIVES OUTWEIGH THE POSITIVES?

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PRACTICAL ELECTRIFICATION CHALLENGE 2024

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EUROPEAN ELECTRIFICATION EXPERIENCE

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A CAREER IN TRACK



Track Engineering is the foundation of railway infrastructure, involving the design, construction, and maintenance of track systems. Key areas include switches and crossings, rails and fastening systems, sleepers and ballast, and slab track solutions. By ensuring stability and safety, track engineering supports the smooth operation of modern rail networks.

Track Engineering sits at the heart of the railway – every train, every journey depends on it. Engineers in this field are responsible for maintaining the structural integrity of the track, understanding material behaviour under load, and applying design principles that optimise both performance and longevity.

As traffic volumes rise and performance expectations grow, there's an increasing focus on predictive maintenance, innovative materials, and data-informed asset strategies. Whether you're on site or in the office, working in track requires both detailed technical knowledge and a clear understanding of the bigger operational picture.

Below, you'll find three key resources to expand your knowledge and sharpen your practice in this essential area. To continue exploring, visit our Knowledge Hub at www.thepwi.org/knowledge/ – a collection of technical content, training opportunities, and up-to-date insights focused on track design, maintenance, and innovation.



IMPROVEMENTS IN TRACK CONDITION ASSESSMENT TO INFORM DECISION MAKING

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MAXIMUM RECYCLING, MINIMUM COST: IMPROVING TRACK EXCAVATION WASTE MANAGEMENT

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TECHNICAL BOARD UPDATE

The PWI Technical Board is our forum for all Corporate Members to share knowledge and the latest developments in railway engineering.

The quarterly PWI Technical Board met on Wednesday 4 June 2025. The meeting was preceded by a Technical Visit.

TECHNICAL VISIT

Those who were able to travel to Edinburgh in person enjoyed a tour of Progress Rail's South Queensferry facility, hosted by Hannah Persson with support from Calvin Lamb and the many others proud to explain the process associated with the design and manufacture of cast crossings and other items, including high-security bollards now commonplace around Westminster. Also, of great importance and interest was hearing about the day to day volunteering by their team to maintain a clean and safe environment for plants and animals on site including a recently completed toad watch!



Photograph of those who attended the tour.

TECHNICAL BOARD MEETING

The Chair welcomed on-line and in-person attendees to the second PWI Technical Board of 2025.

Jonathan Graham, Inspector at Rail Accident Investigation Branch provided his regular updating of recent/ongoing issues including:

- Collision between Passenger trains near Talerddig
- Derailment at Walton on Thames
- Runaway Trolley at North Rode
- Trackworker Near Misses at Chiltern Green, near Luton and Morton Junction near Chesterfield.

He also listed six main themes for 2025 from the recently published RAIB annual report:

- Track worker safety
- Platform safety
- Asset integrity
- Safety of the line following engineering work
- Safe operation of plant in possessions
- Management of trees.

Stephen Barber, PWI Chief Executive Officer updated the meeting on the PWI name change consultation timeline. Determining strategy for the PWI including potential name change started in October 2022 with ongoing work with all those involved right up to the recent PWI Board proposal to become Railway Engineering Institution. Members will be invited to vote on the name change later in 2025 or early 2026.

Joan Heery, PWI Technical Service Director confirmed 60 industry and 25 heritage members. Individual membership currently at circa 4,300. Updates on Technical Seminars in planning and the popular practical challenges confirmed being:

- Practical Trackwork Challenge week commencing 22 September 2025 at Llanelli & Mynydd Mawr Railway, Swansea
- Practical Electrification Challenge week commencing 6 October 2025 at Network Rail's Training Centre, Swindon.

Lunch and Learn continues to be popular with attendance averaging 190 people and many speakers confirmed.

The PWI publications committee is ongoing with support for a new publication on DC 3rd – 4th Rail Electrification in the same format as the existing Overhead Line Electrification for Railways. Support for other PWI publications, specifically British Railway Track, is being sought with plans to update in 2026.

Brian Paynter, Network Rail Track Programme Director presented his thoughts regarding a Track Community of Practice and industry objective of dealing with an affordability crisis. This included ongoing challenges to all those involved in the industry to supply and install materials into renewals and other projects. Specific themes could include:

- Welders, volume and availability to support track renewals
- Strategic review of Plant including cranes and undercutters
- Cost and volume metrics and ensuring fair comparisons
- Various Safety initiatives, including the monitoring of exclusion zones around plant
- Innovation, continuous improvement and challenges to Rail Standards
- Future procurement moving forward in Control Period 8.

Liz Turner, PWI Registration Manager provided an update on Professional Registration with the PWI, she confirmed registrants to date in 2025 is broadly in-line with 2024 but highlighted an industry concern regarding female registrants for Professional Registration. She encouraged industry partners including PWI Corporate Members to ensure fair representation is achieved. Liz reported that a large number of Incorporated and Chartered Engineers this year have come via the Experiential Learning route and that there is typically great conversion to professional review for those who successfully complete this route. Regarding Corporate Member Engagement with Professional Registration Liz asked:

- Would a Corporate Member League table of registrants be useful?
- Are people and organisations aware of the free EngTech allowance?
- Do Organisations give incentives for gaining Professional Engineering titles?

Brian Counter, PWI Technical Director updated on PWI Education Courses. Courses continue to be popular with a new Advanced Switch and Crossing Systems engineering course starting in November 2025.

The Chair concluded the meeting with a thank you to all those who support Technical Board, and particularly to Progress Rail for hosting the Technical Board meeting and facilitating the Technical Visit.

OUR CORPORATE MEMBERS



Corporate Members are fully involved in the development of the PWI, ensuring that our products and services meet the needs of the rail industry for technical expertise.

For details of Corporate Membership please contact **Joan Heery, Technical Services Director** (joan.heery@thepwi.org)

OUR HERITAGE MEMBERS



Heritage Members can benefit from the expertise the PWI provide to help run their largely volunteer led organisations.

For details of Heritage Membership please contact **secretary@thepwi.org**



LIZ TURNER
REGISTRATION MANAGER
liz.turner@thepwi.org

PROFESSIONAL REGISTRATION

Professional Registration is an important step in pursuing a career in engineering and it lends itself to a ready-made career path, progressing through the titles as your experience broadens and deepens.

Putting those letters after your name – EngTech, IEng or CEng – instantly tells employers, clients and wider society that your competence and understanding of engineering principles has been independently assessed, that you have the knowledge, skills and professional attitude they value, and that you are committed to developing and enhancing your competence. It sets you apart from your non-registered colleagues.

The right Professional Registration title for you is based on your academic and professional competence.



ENGINEERING TECHNICIANS

Apply proven techniques and procedures to solve practical engineering problems.

They hold Level 3 Engineering/Technology qualifications and 2-3 years industry experience, OR 3-5 years industry experience.



INCORPORATED ENGINEERS

Maintain and manage applications of current and developing technology, and may undertake engineering design, development, manufacture, construction and operation.

They hold Level 6 (Bachelors) Engineering/Technology qualifications and 3-5 years industry experience, OR 5-10 years industry experience.



CHARTERED ENGINEERS

Develop solutions to complex engineering problems using new or existing technologies, and through innovation, creativity and technical analysis.

They hold Level 7 (Masters) Engineering/Technology qualifications and 3-6 years industry experience, OR 10-15 years industry experience.

STAY COMMITTED, COMPLETE YOUR APPLICATION

WORK TOGETHER IN AN ACCOUNTABILITY GROUP

We often hear from Members that they want to achieve Professional Registration, but making the time to complete the application can prove difficult. That's why we actively encourage you to set up an accountability group alongside colleagues who also want to complete Professional Registration. This is a great way for you to stay accountable and keep the momentum going as you work on your application.

Why not speak to your line manager to see if they would be willing to support you and your colleagues on this journey? We even have a free downloadable guide for organisations who want to set up their own in-house accountability group.



SCAN TO DOWNLOAD

Our Corporate Member Accountability Group guidance

CPD AUDIT 2025

Our **annual CPD Audit** has begun and if you were randomly selected to participate, you will have already received a direct email from us, setting out what you now need to do. If you've not heard from us – relax!

We will share the learnings from this Audit in early 2026. Scan the QR code on the right to see learnings from previous Audits.



SCAN TO VIEW LEARNINGS

EAMONN'S JOURNEY TO CHARTERSHIP

Eamonn Maloney, Managing Director of Pro Rail Services Ltd, achieved Chartered Engineer status with the PWI at the end of 2024 and kindly shared his Professional Registration journey with us.

Continuing professional development and personal challenges are really important to me. I don't believe in standing still, and I really enjoy learning and developing my skills to the best of my ability. The route to Chartership by the PWI gave me a realistic chance to find the time and get the support I needed to achieve my goal of becoming a Chartered Engineer. I want to use my achievement to inspire my colleagues to go on and achieve their EngTech, IEng and CEng qualifications in due course, aiding with their continuing professional development.

Undertaking my CEng application was hard work, but if you follow the process as outlined by the PWI, allow realistic time in your diary, and have a supportive team around you, then achieving this goal is realistic. From a lessons learned perspective I would advise everybody to seriously read the competence criteria at the start of the process to aid with structuring your submission.

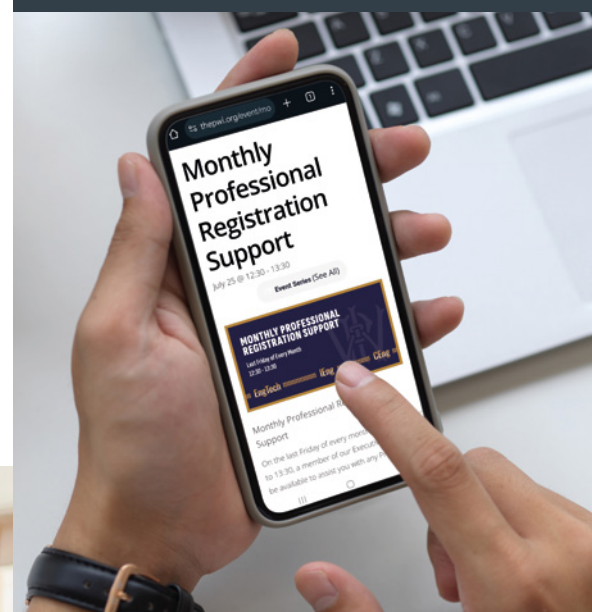
At this stage in my career as Managing Director of Pro Rail Services Ltd, and with two sons and a niece who work in the railway sector, my job now is to inspire the next generation coming through, to support their careers and to bring benefit to the project delivery of UK Railway Infrastructure Projects.

CONTINUING PROFESSIONAL DEVELOPMENT AND PERSONAL CHALLENGES ARE REALLY IMPORTANT TO ME. I DON'T BELIEVE IN STANDING STILL, AND I REALLY ENJOY LEARNING AND DEVELOPING MY SKILLS TO THE BEST OF MY ABILITY.

THE ROUTE TO CHARTERSHIP BY THE PWI GAVE ME A REALISTIC CHANCE TO FIND THE TIME AND GET THE SUPPORT I NEEDED TO ACHIEVE MY GOAL OF BECOMING A CHARTERED ENGINEER.



Eamonn Maloney,
Joint Managing Director,
Pro Rail Services Ltd.



GET YOUR QUESTIONS ANSWERED PROFESSIONAL REGISTRATION MONTHLY SURGERY

Get all your Professional Registration application questions answered

- ▶ 25 July 2025
- ▶ 26 September 2025
- ▶ 24 October 2025
- ▶ 28 November 2025
- ▶ 19 December 2025



SCAN TO BOOK THE DATES IN YOUR DIARY

Book on to our Professional Registration Surgery and ask any questions you have with regards to your application. If you don't have any questions, you are still welcome to join and listen in to the guidance and advice being provided.

READY TO SUBMIT YOUR APPLICATION? DATES FOR YOUR DIARY

INTERVIEW DATES

If you are going for IEng or CEng, use the submission deadlines – linked to our quarterly Professional Review Interview dates – to set your progress milestones. Whilst our 2026 dates are not yet confirmed, they will likely follow these broad timescales.

SUBMISSION DEADLINE

(at least six weeks prior to interview)

- 28 July 2025 →
- 20 October 2025 →
- Late January 2026 →
- Late April 2026 →
- Late July 2026 →
- Late October 2026 →

INTERVIEWS IN W/C

(to be held remotely)

- 15 September 2025
- 8 December 2025
- March 2026
- June 2026
- September 2026
- December 2026

INTRODUCING MOLLY, OUR NEW HEAD OF TECHNICAL EDUCATION

Firstly, I would like to thank the PWI community for such a warm welcome into the organisation. People have reached out so kindly to welcome me, sharing wonderful experiences from their time in the railway industry, as well as listening to mine. I am very excited for the next chapter of my career.

So who am I? Well, I am the daughter of a train driver, with 34 years of service to the industry. It was fairly inevitable that my early experiences of the railway would shape my future path. In fact both me and my brother caught the railway buzz, and he is also now a Mobile Operations Manager (MOM)! We would often on a Sunday morning get the first train into London to wander around before London woke up. I have very fond memories of those experiences, and this has extended into my adult life where if there is an opportunity to see some heritage stock, or get to a vantage point to see the track from above (or below Ribbleshead Viaduct), I am never usually far away. I am so proud of my Thameslink career which saw me planning staging designs for track installations from design through to construction that my dad had been driving over for all of his working life.

My career so far has been varied. It has seen me work on railway from Northumberland to Charing Cross station. I have installed S&C panels to millimetre precision using rail-mounted cranes, and was part of a team who installed 71 miles of O-gauge model railway along the Great Glen Way and the Caledonian Canal from Fort William to Inverness. My MEng thesis was all about the circular economy, evaluating the impact of early design decisions to reuse signal gantries, compared to building structures new. Now, 10 years later, the need to be sustainable in our choices and innovative in our approach to our asset management, has never been greater, as the impacts of Climate Change on our railway are starting to become more frequent and severe. I am endlessly fascinated by the complexity of

our track system, and trying to balance, often conflicting, requirements. The railway really is the dream of anyone who is keen to problem-solve, I guess I was always going to end up here. I am looking forward to continuing my railway journey working for an organisation whose sole purpose is to bring railway people together.

I AM ENDLESSLY FASCINATED BY THE COMPLEXITY OF OUR TRACK SYSTEM, AND TRYING TO BALANCE, OFTEN CONFLICTING, REQUIREMENTS.

I hope in this new role, I will continue as a teacher to inspire people to continue to strive for life-long learning; as a passionate Track Engineer to share my knowledge with all of the PWI community; and as a mother, to continue to support the ongoing success of the railways of the UK and beyond for my daughter and future generations. I hope they get to enjoy the railway network just as we have enjoyed what we have inherited from those before us!

As I embark on this new chapter - please reach out to me. If you have knowledge to share or you are looking for technical training, I will only be a few stops away.

Kind regards,



MOLLY DALTON
HEAD OF TECHNICAL EDUCATION
molly.dalton@thepwi.org



Lovely basestone installation at London Bridge Thameslink project awaiting track installation, a rare sight to see a platform without any track (Photo courtesy of Molly Dalton).



My first S&C installation waiting to kick off at New Cross Gate (Photo courtesy of Molly Dalton).



Trainspotting at Ribbleshead Viaduct (Photo courtesy of Molly Dalton).



2 completed platform installations at London Bridge (Photo courtesy of Molly Dalton).



THE PWI

LEARN WITH US

TRAINING
DELIVERED BY

INDUSTRY EXPERTS



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TO READ
TUTOR
BLOG



ROUTE TO
EngTech

ADVANCED TRACK TECHNICIAN COURSE

LEVEL 4 IN-PERSON DERBY

One course, three weeks.

The aim of this course is to give delegates advanced technical knowledge and understanding of track systems, and their associated methodologies and plant. It is comprised of three consecutive modules and involves 120 hours of taught study all mapped to HE Level 4.

PROGRAMME AIM

Delegates learn how innovations in survey, design, maintenance, renewal, and project work can be harnessed to help make safe and efficient plans. Diversity and sustainability issues are explored, as are the interdependencies between the various engineering functions and train operations, so that key management skills including decision making, prioritisation, record keeping, data analysis, and report writing are developed. Practical skills are developed in plain line and S&C surveying and inspection, rail and rail defect management, mechanised alignment maintenance, and rail stressing.

WHO IS THIS COURSE FOR?

- Newly-qualified technician level technical staff
- Maintenance, renewals or project-based staff
- Good for people looking to increase site-based skills



SCAN
TO SIGN UP



EARTHWORKS, DRAINAGE & OFF-TRACK ENGINEERING COURSE

LEVEL 5 IN-PERSON DERBY

One course, one week.

This course provides delegates with the knowledge, understanding, and insights necessary to manage the risks presented by earthworks, drainage and associated Off-Track railway infrastructure assets.

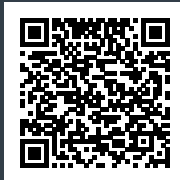
PROGRAMME AIM

Delegates will learn about track formation, earthworks, drainage and water management, vegetation, level crossings, line-side security, and their relationships with interfacing engineered systems such as track. Weather related effects are examined and the potential longer term impact of climate change explored.

Through theory, worked examples, case studies, and exercises, attendees will gain an appreciation of good practice in the design, installation, and ongoing safe management of critical Off-Track assets.

WHO IS THIS COURSE FOR?

- Anyone looking to learn more about Earthworks, Drainage and Off-Track
- Those who currently or previously work in these disciplines
- Those who work in Track/Civils looking for EDOT knowledge



SCAN
TO SIGN UP

GREATER APPRECIATION OF HOLISTIC SYSTEM INTEGRATION ACROSS ALL RAILWAY DISCIPLINES.

REINFORCED AND
CONTEXTUALISED BEng
ACADEMIC LEARNING;
HELPING PREPARE FOR
ADDITIONAL STUDY.



Daoud Hamdani,
EDOT Course attendee
► Rail Degree Apprentice/
Assistant Project Engineer,
TRU West

TRAINING TO SUIT YOU.

PWI training started over 100 years ago and has been providing high level technical training for engineers and professionals operating at all levels ever since.

Our courses are designed to develop skills and knowledge in all aspects of rail infrastructure repairs, renewals and projects – and can help you on your journey to Professional Registration. Not only will you gain an understanding of the underlying theory, you will develop an appreciation of the real-life challenges facing engineers from our team of experienced rail infrastructure lecturers.

TECHNICAL EDUCATION AND TRAINING PROGRAMMES: COURSES



NEW
FOR 2025

ADVANCED SWITCH & CROSSING SYSTEMS ENGINEERING COURSE

LEVEL 5 IN-PERSON DERBY

One course, two weeks.

This course has been designed to support positive coordination of S&C maintenance between track and signalling teams. It has been curated to equip you with the knowledge and tools to optimise reliability, reduce failures and improve safety and train performance. The course is mapped to HE Level 5.

PROGRAMME AIM

This course aims to take a systems engineering approach, to increase your understanding of the complex interdependencies which exist between all railway disciplines relevant to S&C. It also equips you to consider a whole life-cycle approach to this critical railway asset. This course will provide you with valuable hands-on experience in S&C measurement for replacement. This course has been developed due to a strong industry-wide need for specialised S&C education.

WHO IS THIS COURSE FOR?

- Maintenance Engineering roles (Track or Signalling)
- Design roles
- Asset Management roles



SCAN
TO SIGN UP



S&C REFURBISHMENT COURSE

LEVEL 5 IN-PERSON DERBY

One course, one week.

This course provides the knowledge and skills needed to plan and deliver safe and effective S&C refurbishment. The processes for scoping, specification and quality assurance have been produced in conjunction with Network Rail and identify good-practice. The course is mapped to HE Level 5.

PROGRAMME AIM

Delegates will gain a comprehensive knowledge of S&C and how to undertake refurbishment safely, efficiently and to the required engineering quality. The course covers both the track assemblies and the trackbed under S&C. Participants undertake detailed analysis and inspection of layouts so they can scope and specify work to provide the necessary life extension of the layout. The course then ensures that delegates understand the various maintenance interventions suitable for S&C and its components and can plan those required in the correct sequence.

WHO IS THIS COURSE FOR?

- S&C Refurbishment
- Track engineers and managers



SCAN
TO SIGN UP



DC 3rd – 4th RAIL ELECTRIFICATION COURSE

LEVEL 5 IN-PERSON DERBY

One course, one week.

In today's UK railway, DC 3rd – 4th Rail Electrification Systems still have a strategic part to play in the future of rail transport and the journey towards its sustainable future. This programme aims to give delegates an understanding of the electrification principles, their application and safe practices within the context of the integrated railway as a whole.

PROGRAMME AIM

Delegates will gain a comprehensive knowledge of DC 3rd – 4th railway electrification systems in their context; be able to describe the principal elements of the DC electrification system, from the supply of the bulk energy, its transmission and distribution along the rail route, to its conversion and feeding as usable power for train traction and other operational systems.

WHO IS THIS COURSE FOR?

- Both newly qualified and experienced engineers
- Electrification professionals



SCAN
TO SIGN UP

TECHNICAL EDUCATION AND TRAINING PROGRAMMES: LEVEL 6 DIPLOMAS



ROUTE
TO IEng

TRACK ENGINEERING DIPLOMA

LEVEL 6 IN-PERSON DERBY ONLINE

One Diploma, three modules.

Delegates are taught by experienced rail infrastructure engineers who share their wealth of experience. Attendees receive three technical textbooks, comprehensive course materials and coursebooks with worked examples to support their learning.

PROGRAMME AIM

Delegates gain an understanding of the principles of the theory and practise of track engineering in the UK. It is comprised of three consecutive modules and involves 100 hours of taught study all mapped to HE Level 6.

Upon successful completion of all three modular assessments, candidates are awarded the PWI Diploma in Track Engineering. These courses are aimed at newly qualified and experienced engineers and gives delegates the knowledge and skills needed for professionals in track engineering.

WHO IS THIS COURSE FOR?

- Engineers looking for academic recognition of track knowledge, possibly to support registration
- Useful for people new to railways/ track engineering looking for CPD



SCAN
TO SIGN UP



ROUTE
TO IEng

ELECTRIFICATION ENGINEERING DIPLOMA

LEVEL 6 IN-PERSON DERBY LONDON

One Diploma, three modules.

The Diploma is comprised of three consecutive modules involving 100 hours of taught study, all mapped to HE Level 6. Delegates receive a technical textbook and comprehensive course materials with worked examples to support their learning.

This course is aimed at newly qualified and experienced engineers and gives delegates the knowledge and skills needed for professionals in electrification engineering.

PROGRAMME AIM

Delegates gain an understanding of the principles of the theory and practice of Overhead Line Electrification engineering in the UK.

Upon successful completion of all three modular assessments, candidates are awarded the PWI Diploma in Electrification Engineering. For further development we offer a stand-alone DC 3rd – 4th Rail Electrification Course.

WHO IS THIS COURSE FOR?

- Engineers looking for academic recognition of electrification knowledge, possibly to support registration
- Useful for people new to railways/ electrification looking for CPD



SCAN
TO SIGN UP

TRAINING
TO SUIT
YOU



SCAN
TO READ
TUTOR
BLOG

“REALLY ENJOYED THE
PASSION
SHOWN BY ALL THE
PRESENTERS
AND THE
ENGAGEMENT
FROM THE AUDIENCE
WAS GREAT!”



TOP-UP
QUALIFICATION
TO IEng

The PWI Track and Electrification Engineering Diplomas are a form of further learning and, together with a short Supplementary Report, fill the academic gap to IEng for those with relevant HND or Foundation degree qualifications.

ADVANCED SWITCH & CROSSING SYSTEMS ENGINEERING COURSE



NEW
FOR 2025

Switches and Crossings (P&C, S&C) are critical to railway performance, yet maintenance of these assets often lack complete coordination between track and signalling teams. **The Advanced S&C Systems Engineering course** bridges this gap. Equipping engineers with the knowledge and tools to optimise reliability, reduce failures and improve safety and train performance.

The course will contain case studies of how to run effective planned preventative maintenance regimes for S&C and how to identify and analyse potential failure modes for track and signalling components. The course will be 60% track and 40% signalling engineering. This is ideal for: Track Maintenance Engineers and Assistants, Signalling Maintenance Engineers and Assistants, Designers and Asset Managers.

WHAT YOU WILL LEARN

- The fundamentals of S&C and Points Operating Equipment design, function and failure modes.
- A systems engineering approach including interfaces with track, signalling, power, electrification, structures, drainage and earthworks, Safety (CDM), Sustainability and Climate Change.
- The lifecycle from design, manufacture, installation, commissioning, maintenance, operation.
- How track and signalling teams can work together effectively with joint inspections and maintenance.
- How to measure up S&C for replacement and interpret REPW and 1:50 drawings and understand liaison with the various manufacturers.
- How to develop an Infrastructure approach to maintaining railway junctions including Points and S&C in a planned preventative manner.
- Hands-on experience of detailed inspection of Points and S&C, diagnosis and rectification of the faults found and review of case studies of track and signalling faults.
- Updates on University and Industry research into product and component innovation.

COURSE DETAILS

LEVEL 5 IN-PERSON DERBY

Module 1
17-21 November 2025
9-13 March 2026
22-26 June 2026
21-25 September 2026

Module 2
2-6 February 2026
18-22 May 2026
7-11 September 2026
23-27 November 2026

Cost per module: £1295
Accommodation cost: £545



► www.thepwi.org

OUR COMMUNITY

NEW MEMBERS:

We're honoured to have you on board and look forward to working with you. Watch out for us in your inbox, we don't want you to miss a thing! We're here to help, so if you have any questions, then get in touch!

Ashford: Jackson Herron, Pipe Akinkuolie

Birmingham: Vishal Kizhakkumkara Ramakrishnan, Johnnoy Griffiths, Devonte Mulholland, Daniel Michael, Harry Smith, Salma Omar

Cheshire & North Wales: Michael Pressler, Tony Knowles, Daniel Roberts

Edinburgh: Mary Avraam

Exeter: Ben Harris

Glasgow: Jonathan Tomnay, David Smith

International: Mahdev Dhaanna, Jeroen Schuddebeurs, Dora Carracha, Stefan Vonbun, Gabriel Leite da Silva, Matthew Kyakulaga, Terence Reverdin

Ireland: Ciaran O'Domhnaill, William Cooper, Colm O Gorman

London: James Stanley, Elijah Hagler, Hussain Khan, Ching Wei (Edgar) Leung, Rafik Guendouze, Austin Lindsey, Thomas Stoddart, Kemal Huseyin, Liam O'Sullivan, Chad Warren, Martha Chilote, Winnie Kyewalabye Nambojera, Prabesh Tripathy, Felix James, Charles Purcell, Stephen Bradford, Rhys Fletcher, Annie Thomas, Liam Russell, Robert Dempsey, Rory Walcott, Daniel Oliver, Hamza Chiadmi, Terry Currie, Spencer Mahaffey, Gary McLean, Nicole Chigbu, Adam Tubby, Sam Graves, Jon Lee

Manchester & Liverpool: Luis North, Hannah Schumacker, David Lawrance, Adrian Wong, Sufiyan Shaik, Mohamed Eban

Milton Keynes: Shukri Barre Hassan, Simon Ockwell-Rolph

North East: Dan Parmley, Liam McGuire

Nottingham & Derby: Sam Divall, Graham Smith, Daniel Tryner, Adam Norton

South & West Wales: Nathan Butler, Asger Eriksen, Scott Cullen, Joshua Long, Aneurin Jones

Wessex: Julius Emeka, Clifford Elsey, Fionn Purcell, Stefano Palmieri

West of England: Alex McCann, Abdimajid Ahmed, Sebastian Bucknell, Mac Williets, Finlay Reid

Yorkshire: Daniel Heath-Holmes, Muhammad Daji, Malcolm Smith, Natalia Marsden, Qinning Liu, Samuel Crabb, Ben Chipman, Thomas O'Hare, Thomas Li

ENGINEERING TECHNICIAN:

Callum Lawson, Bogomil Staykov, Stephen Allman, Daniel Tryner

INCORPORATED ENGINEER:

Alex Thistlethwaite

CHARTERED ENGINEER:

Javier Sanchez, Mark O'Callaghan, Sandeep Singh, Stephen Wilson (Additional)

FELLOWSHIPS:

Martin Crapper – North East, Donald McCartney – North East, Anne Watters – Nottingham & Derby

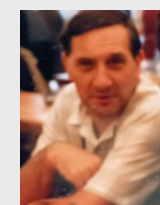
PWI ADVANCED TRACK TECHNICIAN:

Ramon Bak, Daniel Roberts, Luke Payne, Alexander Page, John Harris-Downham, Graham Ovenden, Daniel Mitchell, Oliver Tallent, Steven Blake, Carl O'Neill, Jonathan Walesby, Deon Russell, Sam Graves, Richie Williams

PWI TRACK ENGINEERING DIPLOMA:

Pui Yin Chu Louis, Jimmy Cheuk Yiu Cheung, Paul Kai Chun Tam, Billy Sum Moon Lau, C F Chi Fung Law, Derek Man Kit Lee, Angel Wai Lam Ng, John Tsz Ho Tsoi, Daisy Tung Sin Cheung, Anson Chun Hon Chan, Charles Yin Fung Lee, Samuel Yan Ho Chan, Rachel Yin Ching Lo, Keith Yin Ki Cheng, Jonathan Ka Chun Tsui, Sonia Ching Man Chan, Adrian Chan, Jacky Kwai Hang Tam, Curtis Cheuk Hei Ng, Rebecca See Wai Wong, Oscar Ho Cheung Lau, Anthony Kei Wan Tong, Isaac Chun Ho Cheung, Peter Kung Tat Lam, Meg Yee Lam Mak, Billy Pak Lun Ng, Zachary Yue Ching Chiu, Tony Kwok To Chan, Ka Wing Chan, Christie Ying Yat Man, Jason Corbett, Joseph Leneghan, Niall Gorman, Seamus Hannon, James Mackey, Vincent Quirke, Peter O'Sullivan, Jason O'Dwyer, Eddie O'Gorman, Martin Kearns, Aidan Linehan, Stephen Scully, Paul Kearney, Martin Hewitt

OBITUARY



Tribute to John Stanley Hayes

The PWI Lancaster Barrow and Carlisle Section has recently heard that long standing Member, Stan Hayes died last year after a long illness. Stan was a well known character in the DCE/ ACE office at Ladywell House, Preston during the 1970s and 80s and will be remembered with affection by his friends and colleagues.

EngTech
IEng
CEng

APPLYING FOR FELLOWSHIP?

Fellowship of the Institution is the highest honour a member can receive. It raises your professional standing, increases recognition of your expertise, and enhances your network. But it is not just a badge of honour: Fellows are expected to engage and further the work of the Institution.

Scan the QR code to learn more:



SCAN TO LEARN MORE

FINDING MY PLACE ON THE TRACKS: LIVING AND WORKING WITH AUTISM AND ADHD IN RAILWAY ENGINEERING

From a young age, I knew exactly what I wanted to do. While many children struggle to choose a path, I was always drawn to railways. My fascination started on a family holiday in Weymouth in the late 1970s, watching the trains running along the quay. I remember it vividly: that moment of pure excitement, while others may have found the noise frightening. Trains have always brought me comfort, order, and a sense of wonder.

That deep interest never left me. I've now worked in railway design since 2000 and have been with Network Rail for fourteen years, currently serving as a Principal Design Engineer (Track) within the Engineering Services – Design Delivery team. But while my passion for the industry has been constant, my personal journey, particularly my experience with autism, ADHD, and mental health, has taken a different route.

A LATE DIAGNOSIS

For much of my life, I didn't know I was autistic. Like many others, I developed coping strategies without fully understanding why certain things felt harder for me than for others. It wasn't until my 40s that I was diagnosed with autism and ADHD, and that clarity changed everything.

Suddenly, things made more sense: my intense interests, my tendency to hyperfocus, the mental exhaustion that came from social interactions, and the emotional overwhelm I experienced in busy, high-pressure environments. These weren't personality flaws or quirks. They were part of a neurodevelopmental profile that I'd carried unknowingly for decades.

Getting a diagnosis as an adult can be both liberating and challenging. There is the relief of understanding, but also the sadness that comes with realising how long you've had to struggle without the right support. In my case, it also prompted a period of reflection on how these conditions had affected my career and wellbeing.

“GETTING A DIAGNOSIS AS AN ADULT CAN BE BOTH LIBERATING AND CHALLENGING. THERE IS THE RELIEF OF UNDERSTANDING, BUT ALSO THE SADNESS THAT COMES WITH REALISING HOW LONG YOU’VE HAD TO STRUGGLE WITHOUT THE RIGHT SUPPORT.”

THE WEIGHT OF MASKING

Before I understood I was neurodivergent, I spent a lot of time masking. That is, I would suppress my natural behaviours in order to fit into expected social norms. This is a common experience for autistic people and can be incredibly draining.

In the workplace, masking often meant trying to appear more extroverted, attending large meetings without showing discomfort, or pretending I wasn't overwhelmed when I really needed time to decompress. Over time, that constant pressure to adapt led to burnout and periods of poor mental health.

I want to be honest about those darker times. It is easy to focus only on the positive outcomes, and there have been many, but there were days when everything felt too much. I hope that by talking about this, it helps normalise these feelings and encourages others to reach out for help sooner than I did.

SUPPORT AT WORK

Thankfully, the support I've received since my diagnosis has made a real difference. My team and line manager have been understanding and proactive in helping me work in a way that suits my strengths. One of the most helpful steps has been implementing reasonable adjustments: practical changes that allow me to thrive.

For me, this has included:

- Having quieter working spaces and more control over my environment
- Being able to communicate preferences around meetings and social settings
- Allowing for flexible work routines when needed

This is not about getting special treatment. It is about recognising that we all work differently. Small adjustments can have a huge impact on someone's productivity and wellbeing.

Beyond policies and adjustments, what has mattered most is having colleagues who are willing to listen. Just being able to talk openly, without judgement, helps reduce the stigma around mental health and neurodiversity.

UNDERSTANDING THE LABELS

There is still a lot of misunderstanding about conditions like autism and ADHD, especially when they co-occur. People often assume these are purely childhood issues or that they look the same in everyone, but they don't.

For instance, ADHD is not just about being hyperactive. For me, it means racing thoughts, difficulty regulating attention, and the need for structure to stay on track. Similarly, autism is not just about social challenges. It also affects sensory sensitivities, the need for routine, and the way we process information.

“THE QUALITIES THAT SOMETIMES SET NEURODIVERGENT PEOPLE APART ARE OFTEN THEIR GREATEST STRENGTHS: FOCUS, CREATIVITY, PATTERN RECOGNITION, AND DEDICATION. IN AN INDUSTRY LIKE OURS, THOSE QUALITIES ARE AN ASSET.”

I also think it is important to talk about the language we use. Terms like “trainspotter” or “anorak” might seem harmless, but they can reinforce stereotypes, especially when used to mock people with niche interests. For many autistic people, those interests are not trivial. They are a source of joy and identity.

In fact, the qualities that sometimes set neurodivergent people apart are often their greatest strengths: focus, creativity, pattern recognition, and dedication. In an industry like ours, those qualities are an asset.

WHAT INCLUSION LOOKS LIKE

Inclusion is not just about hiring diverse people. It is about making sure they can succeed once they are through the door. That includes creating a workplace culture where people feel safe to disclose their needs and supported when they do.

For neurodivergent staff, that might mean:

- Flexible working arrangements
- Clear and consistent communication
- Quiet spaces or hybrid working options
- Managers who are trained to recognise and support neurodiversity
- Peer support and mentoring networks

These are not complex changes. They are about empathy, awareness, and a commitment to seeing each person as an individual.

That support should also extend to mental health. We talk a lot about resilience in engineering, but real resilience means knowing when to pause, when to ask for help, and when to rest. Nobody should feel they have to pretend everything is fine just to be seen as “professional”.

A COMMUNITY THAT CARES

Looking back, what has kept me going through the challenges has been a sense of community. Whether it is a colleague checking in, a manager who genuinely listens, or a professional network that values authenticity, those moments matter.

And sometimes, it is the small things that remind us we belong. I still laugh about the time someone suggested I was so passionate about trains that I must have had a model railway in a glass case at home. It wasn't true, but the enthusiasm behind that image, and the curiosity it sparked, made me feel seen.

I also want to say that if you're reading this and recognising some of these signs in yourself, it is okay to ask questions. It is okay to seek support. You do not need to have a diagnosis to deserve understanding.

FINAL THOUGHTS

We often talk about engineering as a problem-solving profession. But the most important problems we solve are not always technical. They are human. How do we create environments where everyone can do their best work? How do we support each other through difficult times? How do we ensure that people do not just survive in their roles, but thrive?

For me, being open about autism, ADHD, and mental health hasn't always been easy. But it has been worth it for my own wellbeing, and for the chance to make the path a little clearer for others.

If even one person feels more able to speak up because they read this, then I'm glad I shared my story.



PHILIP SEYMOUR
PRINCIPAL DESIGN ENGINEER (TRACK)
Network Rail

SHARE YOUR STORY

We would be interested to hear from our Members who would like to share their own experiences with the wider membership.



STUART MURPHY
TECHNICAL MANAGER
stuart.murphy@thepwi.org

ENVIRONMENTAL SUSTAINABILITY COMMITTEE UPDATE

A number of points of interest to our readership have been highlighted at the PWI Environmental Sustainability Committee over the past 6 months; the purpose of this article is to keep members up to date and to provide links to explore some of these items in more detail should they be of interest.

ENGINEERS 2030: A CATALYST FOR CHANGE

Led by the Royal Academy of Engineering (RAEng) on behalf of the National Engineering Policy Centre (NEPC) and majoring on **clean technologies** and **Artificial Intelligence (AI)** as fundamental skillsets required for our future Engineers.

The project identifies how engineering knowledge, skills and behaviours are changing in the 21st century and what is needed to attract, educate, recruit and support the engineers and technicians of the future. Engineers 2030 challenges how we think about engineering today, and how the engineering workforce needs to be different in the future. The world faces both challenges and opportunities that depend upon substantial engineering input, chief amongst these being the climate emergency and the rapid progress in AI and related digital technologies. It examines what and how we teach and professionally develop young people and our existing engineers and technicians. This transformation requires engineers with a broader range of skills, from environmental awareness to greater data and digital skills. Ultimately, it will determine whether the systems, cultures, and policies currently in place across the United Kingdom are ready to deliver what we need from our engineering and technology workforce now and for the next 25 years.



VISION AND PRINCIPLES FOR ENGINEERS 2030

Take a look at Vision and Principles for Engineers 2030, which is the framework for RAEng thinking. The PWI was consulted and provided feedback to the RAEng for this project.



SCAN TO VIEW

In March 2024, the National Engineering Policy Centre (NEPC) launched a public consultation seeking feedback on a new Vision and six guiding Principles aimed at shaping the engineering profession through 2030 and beyond.

The Vision and Principles were developed in partnership with the National Engineering Policy Centre and engineering community stakeholders through roundtables and a consultation process.



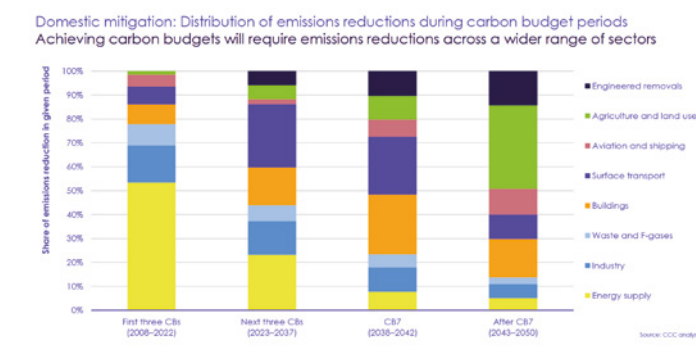
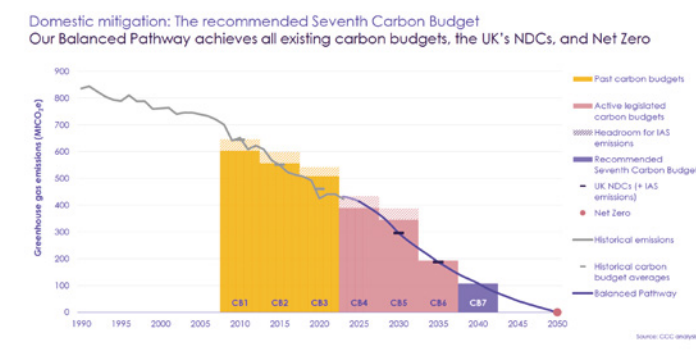
SCAN TO VIEW

PRIORITIES FOR UK CLIMATE POLICY FOLLOWING COP29 - WESTMINSTER ENERGY, ENVIRONMENT & TRANSPORT FORUM POLICY CONFERENCE

In April, the Westminster Energy, Environment and Transport forum an influential, impartial, and cross-party forum held a conference to look at the priorities for the UK climate policy following COP 29 held in Baku, Azerbaijan last year. The opening presentation entitled '**Key outcomes from COP29 and implications for UK policy and stakeholders**,' was given by Richard Millar, Head of Adaptation, Westminster Climate change committee. In particular, 2 slides highlighted the scale of the challenge, and the part expected of the railway (and other surface transport providers) in meeting this challenge.

Slide 1 shows UK progress on the path to net Zero in 2050 indicating we have achieved a 50% reduction since 1990. Acceleration is needed to achieve the target of 81% by 2035. The target was raised from 78% to 81% in latest UK Nationally Determined Contribution (NDC) i.e. the UK's commitment confirmed at COP29.

Slide 2 shows the shifting relative importance for Carbon reduction of key industries as we move into the future towards net Zero. Since 2008, energy has traditionally made the biggest impact but with grid decarbonisation progress, the emphasis changes to surface transport



Slide 1 (top) and Slide 2 (bottom).

so the rail industry will become key to achieving net Zero when electricity generation is largely renewable and nuclear. Perhaps the key challenges therefore for the railway are a combination of a modal shift to more railway usage and electrification to take advantage of the renewable (and nuclear) generation.

The half day conference had a number of expert speakers, and resources and materials can be found by scanning the QR codes below.

WESTMINSTER ENERGY, ENVIRONMENT & TRANSPORT FORUM POLICY CONFERENCE RESOURCES

CONFERENCE DEBRIEF AND AVAILABLE MATERIAL

Password: WEETpfucp25

Debrief and available material from this event can be accessed by scanning this QR code.



SCAN TO ACCESS

CONFERENCE TRANSCRIPT AND SLIDE RESOURCES

A transcript of proceedings and speakers' slide material can be accessed by scanning this QR code.



SCAN TO ACCESS

CONFERENCE DELEGATE PACK RESOURCES

A delegate pack including agenda and speaker biographies can be accessed by scanning this QR code.



SCAN TO ACCESS

NATIONAL ENGINEERING POLICY CENTRE (NEPC) CLIMATE AND SUSTAINABILITY COMMUNITY GROUP (C&SCG)

The NEPC have been active in the environmental sphere establishing a Climate and Sustainability Community Group. This led to the first meeting of the **NEPC Climate and Sustainability Staff Reference Group** on 16 April. This group, comprising representatives from the UK Professional Engineering Institutions (PEIs) has been set up to share ideas, activities and best practice through the engineering community. This first meeting invited partner PEIs to provide a brief update on current and future activities and priorities related to climate and sustainability and specifically:

- What are the current activities around climate and sustainability? (projects, consultations responses, conferences etc.)
- What are upcoming priority topics of issues you are currently exploring or on the radar?
- What key climate and sustainability topics or priorities are on the agenda for your wider stakeholders, including policymakers?

The PWI were happy to share details of the following related activities:

- The PWI Environmental Sustainability Committee,
- Technical Conferences which feature environmental issues as a main topic or as part of the wider discussion around a main technical topic.
- Lunch and Learn sessions including many environmental topics
- Quarterly Journal articles
- Amongst Current issues

- AI and digital engineering - state of railway resilience for climate impacts.
- Impact of regulatory budgets on climate resilience and adaptation measures.
- Combining climate issues with AI and digital engineering in order to better understand the state of railway assets and modelling how infrastructure will react in the face of increasing climate change.

A Sharepoint site (digital Whiteboard) has been developed for collaboration and better visibility on all NEPC work and activities including collaboration on the Staff Reference Group. This whiteboard will be a place for PEIs to show current and future climate related activities so will help coordinate initiatives and activities. More of this to follow as the C&SCg evolves. As a result of C&SCg information exchange, members may be interested in the events below.

RAEng CHANGE AND CLIMATE CHANGE LECTURE

Delivered by Lord Browne of Madingley FEng FRS

This lecture was presented in April and the full version can be viewed at by scanning the QR code.



SCAN TO ACCESS

IMechE CLIMATE ADAPTATION CONFERENCE IN PLANNING

14/15 October 2025

Further information about this event can be viewed at by scanning the QR code.



SCAN TO ACCESS

ICE CONFERENCE RE. ENABLING BETTER INFRASTRUCTURE

10 October 2025

Further information about this event can be viewed at by scanning the QR code.



SCAN TO ACCESS

ENVIRONMENTAL
SUSTAINABILITY
NET ZERO
CONFERENCES
CLIMATE
CLEAN TECHNOLOGIES
DIGITAL
ENGINEERING
CHANGE
AI



UPCOMING SECTION MEETINGS

AUTUMN 2025

SEPTEMBER 2025

WEST OF ENGLAND SECTION

**WESTBURY SOUTH S&C
RENEWAL – XMAS 2024**

3 September 17:00 - 18:00

Adrian Everson

HYBRID

OCTOBER 2025

WEST OF ENGLAND SECTION

**PAST AT DANGER – THE LEARNING
FROM LADBROKE GROVE**

29 October 12:45 - 14:00

Greg Morse

HYBRID

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TO NETWORK WITH LOCAL
ENGINEERS, SHARE GOOD
PRACTICE AND LEARN
SOMETHING NEW.

Please note: This information is
correct at the time of going to print.

Please check up-to-date information
on the website, as on occasion
topics, speakers, venues, times
and dates may change:

thepwi.org/whats-on/section-meetings

**SCAN HERE TO RESERVE
YOUR PLACE**



- 1) Log into your Member Dashboard
- 2) Book an event
- 3) Your CPD will be automatically recorded.

THANKYOU TO OUR PAST VICE PRESIDENTS

We would like to thank our two past Vice Presidents, Hannah Persson and Andy Franklin, for their efforts in the role, and wish them well for the future.



HANNAH PERSSON
PAST VICE PRESIDENT
Scotland



ANDY FRANKLIN
PAST VICE PRESIDENT
South West England

EVERY MEMBER WELCOME AT EVERY MEETING

Join other PWI Members and rail professionals in your region by attending your local Section meetings, where you can listen to expert talks and discuss aspects of rail infrastructure engineering. Section meetings are open to all PWI Members, so you can dip into other regions whenever you want. Non-members are also welcome as a taster.

If you would like to give a presentation or become more active within your local Section, why not get in touch with them and see what opportunities are available?

17 LOCAL SECTIONS **200+** MEETINGS PER YEAR
LOCAL TECHNICAL **FACE TO FACE**
SITE VISITS AND ONLINE MEETINGS

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CAN BE ANYONE THAT IS A PROFESSIONALLY REGISTERED ENGINEER WITH
THE ENGINEERING COUNCIL, AT OR ABOVE THE SAME LEVEL YOU SEEK.**

EMPOWERING RAILWAY ENGINEERING

**THIS AUTUMN, THE PWI EXECUTIVE TEAM WILL BE VISITING SECTIONS
TO DISCUSS THE UP AND COMING PWI NAME CHANGE VOTE WITH
MEMBERS. HAVE YOUR SAY - YOUR VOTE MAKES A DIFFERENCE.**

**EVERY MEMBER
GETS A VOTE**



✓ **MY VOICE MATTERS**

**I CAN SHAPE
OUR
FUTURE...**

**THE PWI
OR
RailEI?**

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SECTION UPDATES

JOIN OTHER PWI MEMBERS AND RAIL PROFESSIONALS IN YOUR REGION

By attending your local section meetings, you can listen to expert talks and discuss different aspects of rail infrastructure engineering. Section meetings are open to all PWI Members, so you can dip into other regions whenever you want. Non-members are also welcome as a taster.

PWI YORKSHIRE: GOOLE SWING BRIDGE VISIT

The first of our Yorkshire Section visits was to Goole Swing Bridge on 28 May. A massive thanks goes to Rob Sellers at AmcoGiffen and Jon Davis at Network Rail Eastern Routes Capital Programmes for facilitating a fascinating evening visit for PWI Yorkshire members.

It's a unique rotating river crossing that is mind-blowing to visit and appreciate today, so I can only imagine what the Victorians thought of it 160 years ago when entered into service.

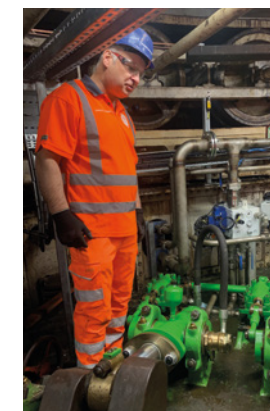
Well done AmcoGiffen for completing a multi-year, multi-disciplinary renewal project, in a manner sympathetic to the heritage of the structure.



BEN BROOKS
VICE PRESIDENT
North-East England



SCAN TO
LEARN MORE
ABOUT GOOLE
SWING BRIDGE



VOLUNTEER OPPORTUNITIES

WHY VOLUNTEER WITH THE PWI?

Volunteering with the PWI is an opportunity to channel your passion for the railway industry into meaningful contributions. It's not just about enhancing your career; it's about giving back to the community, sharing your expertise, and playing an active role in advancing the Institution. Your involvement helps support the growth of the PWI and the development of others in the railway engineering field, making a lasting impact on the industry you care about.

There is a wide range of ways that you can get involved by volunteering for the PWI. Volunteering with the PWI is a fulfilling way to give back to the railway engineering profession while advancing your own career. Whether you're interested in joining a committee, supporting professional registration, or contributing to our marketing efforts, there's an opportunity for you to make a difference.



Contact us today to learn more about how you can support the PWI through volunteering.

SCAN TO LEARN MORE



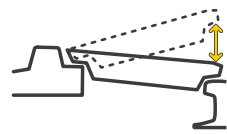
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Presenter: Darren Sharp
Date: 16 September 2025

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Monitoring: Advancing reliability
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& Decision-Making**
Presenter: Matt Weingarth
Date: 30 September 2025

**How can we limit wear on key rail
infrastructure components?**
Presenter: Steve Nicklen
Date: 14 October 2025

Probabilistic Gauging
Presenter: David Johnson
Date: 28 October 2025

How London's Underground was built
Presenter: Tony Badsey-Ellis
Date: 11 November 2025

SCAN TO
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PLACE



If you would like to volunteer in chairing a session in our Autumn/Winter 2025 programme, please contact stuart.murphy@thepwi.org

PWI TECHNICAL SEMINAR

WORKING TOGETHER TO MAKE TRACK RENEWALS AFFORDABLE

5 NOVEMBER 2025



KNOWLEDGE 200
TRACK

GREAT HALL, BIRMINGHAM UNIVERSITY

For multiple reasons, the costs associated with Track renewals has increased significantly over the last number of years. In its 2023-24 annual report "Cost benchmarking of Network Rail's maintenance and renewals expenditure" the ORR conclude the average annual increase in unit costs of conventional track renewals is 3% per year since 2014-15 (in real terms). These figures consider factors such as track length and extent of electrification but not all project-specific factors.

Network Rail are not alone in the challenge to deliver track renewals at an affordable cost. Other railway administrations around the world face similar challenges.

In this Seminar we will hear about Network Rail's recently formed "Track Community of Practice"; a group of relevant stakeholders who have come together to understand their cost drivers and what can be done to achieve efficiency in delivery. Workstreams from within this community will share details of their action plans and intent.

Transport for London will present on the work they have undertaken in recent years to deliver their track renewals portfolio as efficiently as possible and there will also be contributions from other railway administrations.

This Seminar will include opportunities for delegate interaction and participation, offering facilitated discussions and Q&A.

Ready to be part of the conversation? Book now to advance your knowledge and understanding of the challenges facing track renewals.

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We really value your responses and thanks for taking the time to share your thoughts.



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19-22 October 2026

Module 3

20-23 October 2025
13-16 April 2026
6-9 July 2026
23-26 November 2026

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9-12 November 2026 ●

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27-30 April 2026
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