

RESEARCH & INNOVATION

Quarterly Update
August 2021



A Better,
Safer
Railway



better disruption management | freight decarbonisation |
selective door operation | extreme weather

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RSSB's research programme develops new knowledge and solutions to make the railway more efficient, sustainable and innovative. Many of these projects need the rail industry to work together, and benefit greatly from the steer and review of an independent body.

The programme is predominately funded by the Department for Transport. We also owe a big thanks to people across industry who provide significant in-kind support to research, and work with us to put the findings into practice.

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I Quarterly Update

Welcome to the August 2021 Research and Innovation Quarterly Update

As is often the case, this quarterly update brings exciting news on the introduction of new solutions that draw on the latest technologies. We cover the successful pilot of 5G connectivity and Internet of Things sensors to monitor the temperature and humidity of carriages. And in the get involved section, we invite you to a workshop that will showcase research on improving train maintenance using cutting-edge technologies, and discuss how technology could revolutionise depot design.

Incremental innovation is also important. Doing more and better by adapting industry assets and processes plays a big role in improving the safety, experience, and value for money that we offer to rail customers. A toolkit on selective door operation will help operators run longer trains on short stations safely and efficiently, reducing the need for costly infrastructure work. Another story covers the new toolkit on better planning and resource management during disruption, and how it has already been put into action by two operators to improve contingency planning.

Our research often provides the evidence base for updating railway standards, and this is an important way we put our findings into action for the benefit of the industry. In this issue we report new research on blanket speed restrictions, freight decarbonisation, and technical solutions to prevent over-speeding. All of these have the potential to produce important results that will feed into the standards, guidance, and tools that RSSB provides to industry, which make the latest findings easy to apply.







One of our most widely adopted tools is the Vehicle Track Interaction Strategic Model (VTISM), a whole-life, whole-life cost model for the vehicle-track system. We are pleased to announce that work has begun on an updated and improved version of VTISM.

We always love to hear your experiences of using research findings and outcomes. We can also offer support to help you implement these—each story includes the expert's contact details, so please do get in touch.



Luisa Moiso

R&D Programme Director
Luisa.Moisio@rssb.co.uk

-  Easy to use for all
-  Lower emissions
-  Optimised train operations
-  Reliable and easy to maintain
-  Data driven
-  Enhanced health and safety

RESEARCH & INNOVATION IN ACTION

The dashboard, which displays the data downloaded from each train in real time, is already enabling maintenance technicians to identify air conditioning defects and arrange corrective action at the earliest opportunity. We are looking forward to the next stage of the project, where the machine learning will hopefully allow condition-based maintenance to be applied and air conditioning system reliability to be improved.

Dave Hatfield,
Fleet Director, Grand Central



Monitoring passenger comfort in real time

Internet of Things (IoT) sensor technology is being used to monitor saloon air temperature, pressure and humidity

Inexpensive, battery-powered IoT devices have been installed in Grand Central carriage interiors to help the operator identify potential maintenance issues and improve the customer experience. The trial of the technology, led by Pure Chaos and co-funded through RSSB's grant scheme, will run through the summer.

The sensors use 5G spectrum connectivity to transmit live data to a central hub. Grand Central can view a dashboard of real-time information about conditions on board carriages, and receives alerts when readings stray outside the expected norms.

The collected data is being used to train machine learning algorithms to predict heating, ventilation and air conditioning outages. It is expected to be used to inform pre-emptive maintenance planning and reduce the likelihood of disruption caused by trains being taken out of service.

The trial is also exploring the potential for using additional sensor accelerometer and GPS capabilities within the IoT devices to measure and improve ride quality.

Find out more

Read more about the work that led to the trial at [rssb.co.uk/research-catalogue](https://www.rssb.co.uk/research-catalogue) (search for COF-G23-01).

To discuss using this technology on the railway contact:

Simon.Rodgers@purechaos.co.uk

To discuss the research grant that led to this solution, contact Melissa Frewin, Research Grant Manager:

Meilssa.Frewin@rssb.co.uk

The IoT sensor mounted in the carriage ceiling



The IoT dashboard



Updated RAATS toolkit now available

The Red Aspect Approaches to Signals (RAATS) toolkit, released in October 2019, estimates the number of times a signal is approached at red. The aim is to provide data and analysis to help operators reduce the number of signals passed at danger (SPADs).

The toolkit provides a breakdown of the different types of approaches, and includes factors such as the train type, the time of day and day of week. A range of charts can be viewed for individual signals or groups of signals, and the underlying data can be exported for further analysis.

Following feedback from industry, RSSB has now added extra functions, including the capability to analyse approaches by operator. We have also improved the calculation and classification of approach types.

The RAATS toolkit is available for use by RSSB members at: catalogues.rssb.co.uk/safety-risk-model/raats-toolkit.

A RAATS User Group is providing feedback, insights and learning related to the toolkit. To find out more about participating in the group, or about the RAATS toolkit in general, contact Chris Harrison, Principal Risk Analyst:

Chris.Harrison@rssb.co.uk

Early adopters benefit from new disruption management toolkit

Operators are using the toolkit to improve contingency planning on their networks

In the Spring 2019 National Rail Passenger Survey, 50 per cent of respondents stated that how operators deal with delays is their greatest driver of dissatisfaction.

In light of this, and responding to requests from industry, RSSB funded a research project to develop a framework for managing disruption and improving performance. It provides good practice guidance for the management of disruption, improving how we manage operations and customer processes together to achieve the best outcomes.

RSSB supported a number of operators to embed the toolkit into their organisations. East Midlands Railway (EMR) was able to improve contingency planning, developing quick reference Service Recovery Plans for both intercity and regional operations. EMR also used the toolkit to establish a joint approach to disruption with Govia Thameslink Railway and Network Rail, developing a common set of processes and practices.

Great Western Railway used the toolkit to significantly increase the proportion of its network supported by service recovery and contingency plans. The operator also adopted processes set out in the toolkit to improve how it formally records the knowledge and experience of the most experienced controllers, so all current and future controllers can draw on proven best practice.

This work is the centrepiece project for improving disruption management. It links closely to key initiatives such as the Performance Improvement Management System, 21st Century Operations, and

Smarter Information Programmes. We are discussing wider industry roll-out with Network Rail and operators, to realise the benefits on an industry-wide scale.

Find out more

Read more about the projects at [rssb.co.uk/research-catalogue](https://www.rssb.co.uk/research-catalogue) (search for T1154). Network Rail and operators can also download the toolkit.

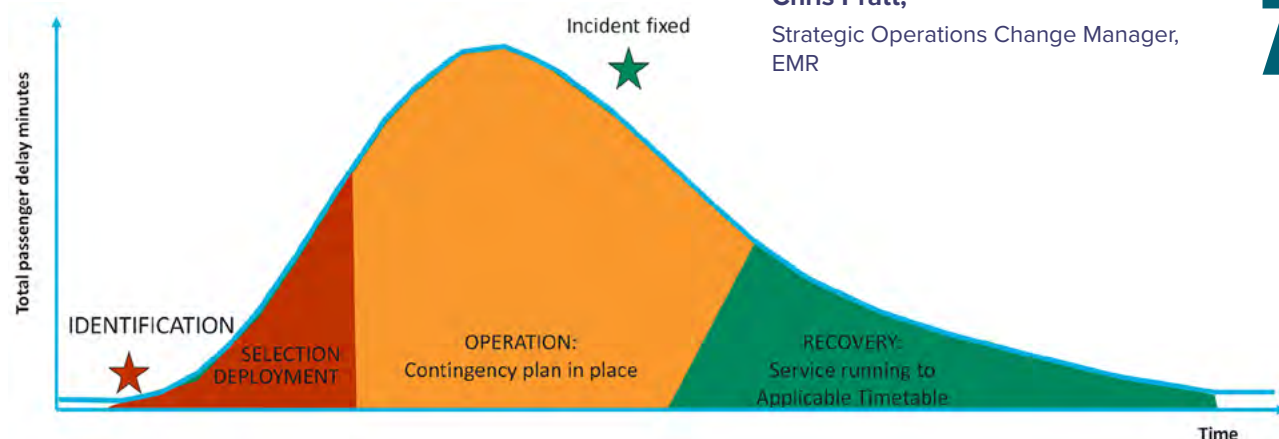
To discuss the work, contact Aaron Barrett, Senior Research Analyst:

Aaron.Barrett@rssb.co.uk



The May 2021 timetable change presented a real challenge to East Midlands Railway because we need to manage a more complex and frequent timetable with the existing number of controllers. This disruption management toolkit provides a more efficient means of selecting, implementing, and withdrawing contingency plans ... and a more consistent ability to apply contingency plans, which improves customer experience.

Chris Pratt,
Strategic Operations Change Manager,
EMR





In Action

Ready to use

In Progress

Get Involved

RESEARCH & INNOVATION READY TO USE

New toolkit for selective door operation

Opening selected train doors enables longer trains to stop at short platforms without costly upgrade works

A research project reviewed existing technology used for selective door operations (SDO), and recommended a national and consistent approach to introducing and managing SDO. The recommendations and best practice have been developed into a toolkit for operators.

Adopting this consistent, evidence-based approach will:

- reduce industry costs in introducing and managing SDO
- reduce SDO-related risks at the platform-train interface
- support operational performance
- improve the customer experience.

Implementation of the toolkit will bring direct, tangible business benefits, from a reduction in incidents and attributed delay minutes due to poor SDO application and management. Potential savings across the network have been estimated at £6m over 10 years.

Find out more

Download the toolkit at [rssb.co.uk/research-catalogue](https://www.rssb.co.uk/research-catalogue) (search for T1202).

To discuss the project, contact Marcus Carmichael, Professional Lead, Operations and Performance:

Marcus.Carmichael@rssb.co.uk



As Selective Door Operation is a common requirement for the railway network, this guidance provides a tool for industry to improve the introduction and management of this activity. This is key to improving capacity on the network, whilst working to effectively reduce safety concerns at the PTI and improve performance.

Emma Coogan,
PTI Risk Manager, West Midlands Trains

Protecting staff with air quality personal monitoring

Looking at personal levels of exposure to diesel engine exhaust emissions

Air quality is recognised as a significant public health issue, with transport a major contributor to emissions. Legally binding Workplace Exposure Limits (WEL) are in place for various pollutants (including NO and NO₂) to protect the health of workers.

A previous RSSB project 'Air Quality in Enclosed Stations' (T1122) used fixed air quality monitors to monitor emissions in two major terminals. This follow-up project recognised that wearable monitoring equipment allows an individual's exposure to be surveyed more accurately, providing information on that employee's exposure as they move between locations over a typical shift.

The project was carried out by Occupational Hygiene Solutions Ltd. It aimed to understand personal occupational exposure to airborne contaminants in representative locations across rail, and assess exposure against current and emerging occupational health standards. The project covered a wide range of job roles at several large train stations and depots on the GB rail network. In all job roles surveyed at all locations, exposures were found to be within the relevant WEL.

This project also produced a guide to help rail industry organisations carry out future occupational hygiene monitoring studies in an informed and consistent way.

Find out more

Learn more about the project and download the good practice guide from [rssb.co.uk/research-catalogue](https://www.rssb.co.uk/research-catalogue) (search for T1191).

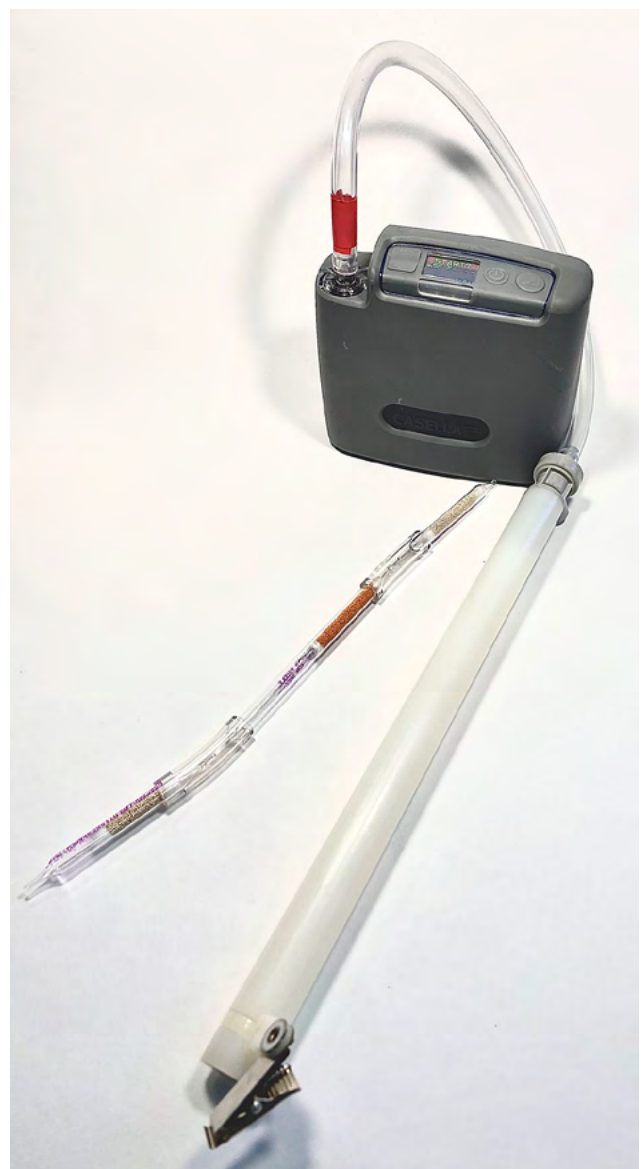
To discuss the project, contact James Wright, Air Quality Specialist:

James.Wright@rssb.co.uk



The outputs from this research were very helpful in relation to our obligations under COSHH Regulations with stations and depots. Static-only monitoring does not always demonstrate compliance with legislation.

Azhar Quaiyoom,
Air Quality Specialist, Network Rail



In Action

Ready to use

In Progress

Get Involved

Testing train horn audibility

Modelling and on-site testing to quantify the audibility of train horns by track workers

Following reported close call incidents involving track workers in 2019, there has been concern that some train horns, although compliant with standards, may not be sufficiently audible to workers on or near the line ahead of the train.

Building on documented requirements and previous studies, this project used modelling and on-site testing to quantify the audibility of train horns by track workers. Tests took place under a range of different installation, environmental and topographical parameters.



The project has provided industry with:

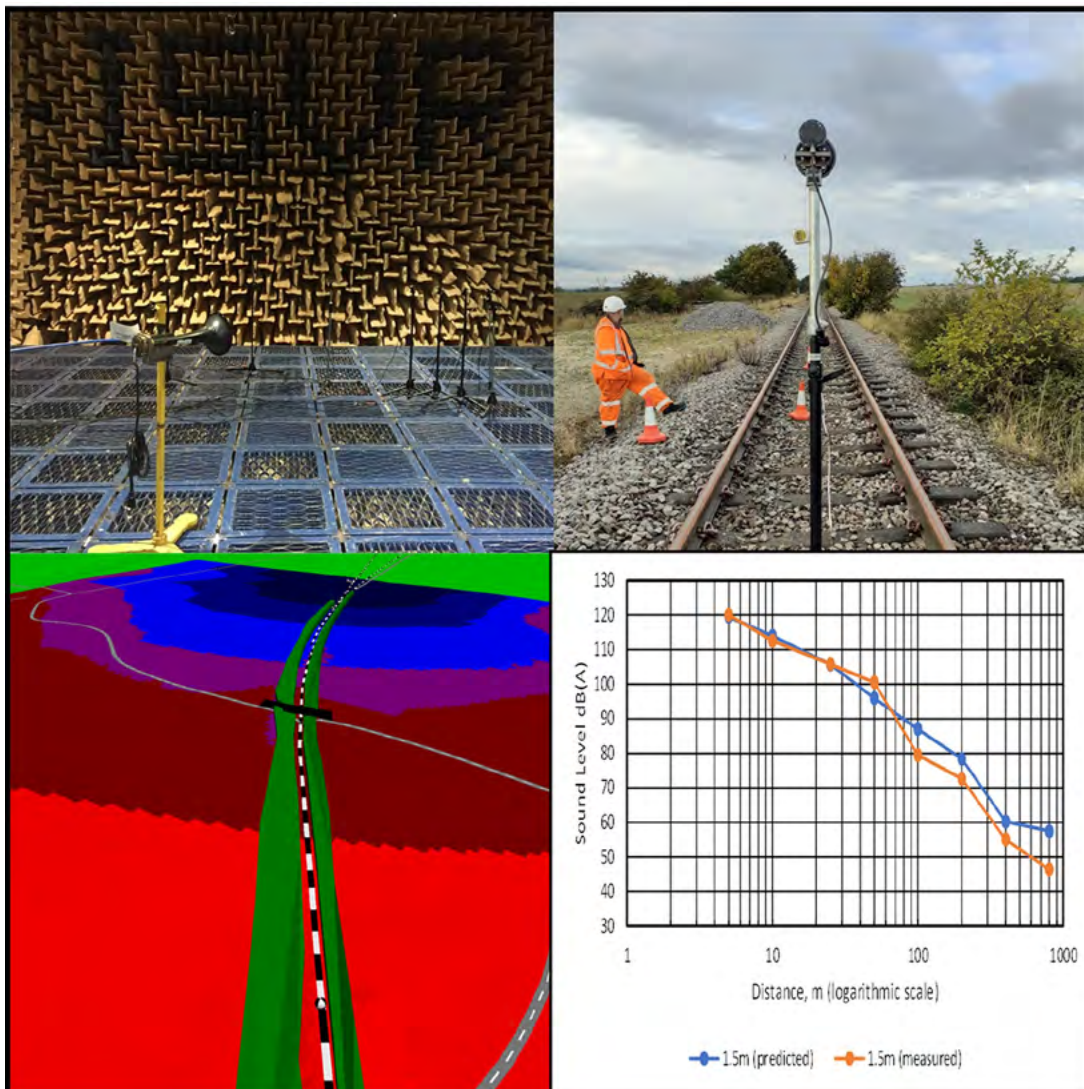
- a defined list of independent variables that can affect train horn audibility
- an evaluation of the effect that train horn maintenance may have on train horn audibility
- an assessment of the audibility of compliant horns under different operating, infrastructure, and environmental conditions
- a good practice guide for train horn installation and test set up.

Find out more

Read more about the research and download the good practice guide at rssb.co.uk/research-catalogue (search for T1205).

To discuss the project, contact Paul Ferraby, Principal Vehicles System Engineer:

Paul.Ferraby@rssb.co.uk



Social distancing has limited impact on performance

Modelling shows that social distancing increases dwell times, but effects are mostly local

As we welcome passengers back to the railway, we need to understand the impact of increasing numbers and possible social distance scenarios to better manage network performance. Service reliability will play a key role in rebuilding passenger confidence in the railway.

RSSB, in collaboration with the University of Sheffield and Risk Solutions, led new modelling work and research into the effects of social distancing on service reliability. The results show that, although social distancing might increase dwell times, the overall impact on train punctuality is not significant nor widespread.

Timetables do not need to be altered necessarily, but we advise operators to gain better intelligence on their network, by collecting data and understanding where localised conditions might occur.

This research modelled the effects of social distancing at stations and on platforms, particularly at the platform train interface (PTI). The work merged two tools:

- RateSetter, a pedestrian modelling tool focused on designing solutions to PTI, platform, and station challenges
- SaviRPM, a performance model that can quickly test new timetables, identify pinch points, and suggest changes to enhance feasibility, robustness and resilience.

RateSetter showed that social distancing increases boarding and alighting time. To assess the impact on dwell times, individual train services, and the wider rail network, we turned to SaviRPM.

Our analysis concluded that:

1. The impact of social distancing is larger for more heavily loaded doors (those with more than ten passengers boarding and alighting). Therefore, as passenger numbers increase, and if social distancing is still required or applied to some degree by passengers, the impact is likely to increase.
2. The risk from longer boarding and alighting times is likely not to be widespread, but localised at certain 'hot spots'. These hot spots are stations with timetabled dwell times of one minute or less.
3. The impact on overall service performance using the CP6 metric (>1 min late) will vary for different operators, routes and service groups. However, the impact is larger on frequently stopping local or commuter services with shorter timetabled dwells. Based on the modelling, these services may experience 2-7 per cent fewer on-time service stops, averaged across a full 24-hour period.

Get involved

Find out more and watch a video of the findings at [rssb.co.uk/research-catalogue](https://www.rssb.co.uk/research-catalogue) (search for COF-G22-01).

Please get in touch with RSSB if you are interested in a tailored analysis for your operations. Contact Giulia Lorenzini, Senior Partnership and Grants Manager:

Giulia.Lorenzini@rssb.co.uk



RESEARCH & INNOVATION IN PROGRESS

Can technology help to mitigate over-speeding?

Looking at ways to reduce risks from trains that exceed line speeds

Over-speeding is the failure to comply with emergency, temporary, or permanent speed restrictions, or with overall line speed. It is a risk factor for several types of rail accident, including signals passed at danger (SPADs).

Several over-speeding incidents have been reported in recent years, which have focused industry's attention on the issue. The Rail Accident Investigation Branch report on the Sandy South incident on 19 October 2018 advised that more needed to be done to improve the effectiveness of technological interventions for over-speeding.

A research project aims to identify and assess technological interventions that could mitigate over-speeding risk. The work will build on the safety risk analysis work undertaken by a Task and Finish group led by the Train Accident Risk Group (TARG). The TARG work focuses on the current hazards and controls of over-speeding, and identifies gaps through bowtie risk evaluation.

Get involved

To find out more or to discuss joining the steering group for this project, contact Marcus Carmichael, Professional Lead, Operations and Performance:

Marcus.Carmichael@rsb.co.uk



Decarbonising rail freight

A new pipeline of research to help the freight industry meet its decarbonisation targets

Every tonne of freight carried by rail instead of road reduces carbon dioxide emissions by as much as 76 per cent. Even so, according to ORR statistics, freight traffic makes up approximately 6 per cent of train kilometres on the GB mainline network but is responsible for an estimated 17 per cent of the CO₂ equivalent emissions from mainline trains.

More freight-focused research and investment are needed if the industry is to meet government targets to reduce emissions by 78 per cent over 1990 levels by 2035, and reach net zero by 2050.

RSSB has engaged with freight operators, Network Rail, the Rail Freight Group, the Department for Transport and the Office for Rail and Road to develop a comprehensive research pipeline that will inform the rail freight industry in its ongoing decarbonisation.

Projects in the pipeline focus on developing zero carbon traction, efficient timetabling, and traffic management optimised for freight:

- **Delivery of low carbon freight solutions (T1229)** will develop a model to assess power and energy demand on freight corridors and validate these on a range of typical freight journeys. It will also assess the power supply at pinch points on both the overhead line equipment and third rail networks, to identify what additional feeder stations and other infrastructure are needed to enable freight alongside existing traffic. The work will start in August 2021.

- **Efficient and low-emission path and regulation policy for freight trains (T1263)** will identify pathways and traffic regulation policies that can be practically applied, considering the trade-offs with the wider network. T1263 will start in Autumn 2021.
- **A review of freight permissible speeds (T1266)** will look for opportunities to rationalise and raise them. Raising freight speeds would mean easier traffic regulation decisions, and reduce the number of times freight services stop and start, with the associated energy and carbon efficiencies. This project will start in October 2021.
- **Model performance design requirements for new low carbon freight locomotives (T1268)** will begin in 2022 when the results from T1229 are available. This will allow us to match low-carbon freight locomotive performance requirements to typical journey demands.

Get involved

To find out more about the above projects, contact Andrew Kluth, Carbon and Climate Change Lead:

Andrew.Kluth@rssb.co.uk

The decarbonisation pipeline is one part of our work to identify and respond to the research needs of the rail freight industry.

To get involved or to keep up to date with the freight driven pipeline, contact Robert Staunton, Research and Innovation Account Manager:

Robert.Staunton@rssb.co.uk

Read more about all RSSB's work on sustainable rail at rssb.co.uk/sustainability.



A reference for vehicle/overhead contact system compatibility

Generalising compatibility will cut the costs, time, and uncertainty of case-by-case assessments

As new electric rolling stock is introduced or existing rolling stock is assigned to different routes, compatibility assessments are undertaken to ensure safe working between the pantograph and the overhead contact system (OCS). Often these assessments are carried out on a case-by-case basis, specific to that rolling stock and route combination.

The number of compatibility assessments is likely to grow over the coming years, as a large volume of newly designed rolling stock is introduced across the network. There is potential for increased variability in design features that affect the pantograph-OCS interface, such as multiple pantographs and higher speeds.

The Energy and Rolling Stock – Locomotive and Passenger National Technical Specification Notices define compatible parameters for both sides of the interface. However, this assumes that both subsystems are fully compliant with the requirements. The majority of the GB rail system has vehicles and OCS installations that pre-date these requirements.

Demonstrating compliance of a new combination of vehicle/OCS is proving to be expensive, time-consuming, and inconclusive. It can cause delays to introduction or operating restrictions that may not be necessary.

To reduce costs, timescales, and uncertainties, and to further exploit the capability of existing assets, a new project aims to describe and compile the compatibility of a range of pantograph types and arrangements with OCS types. We will work with the rail industry to define reference cases of varying combinations of pantograph/OCS interaction, to generalise compatibility assessment.

Get involved

We invite colleagues to get in touch to help us build a framework of pantograph/OCS compatibility. Contact Paul Gray, Professional Lead, Engineering:

Paul.Gray@rssb.co.uk



VTISM upgrade

Work on a new version of the widely used vehicle track costing model is underway

The Vehicle/Track Interaction Strategic Model (VTISM) is the industry-recognised tool for wheelset/track cost modelling. Since its introduction in 2007, VTISM has been used to design strategies that reduce maintenance costs during track design assessments, the introduction of new fleets, and changes in traffic patterns.

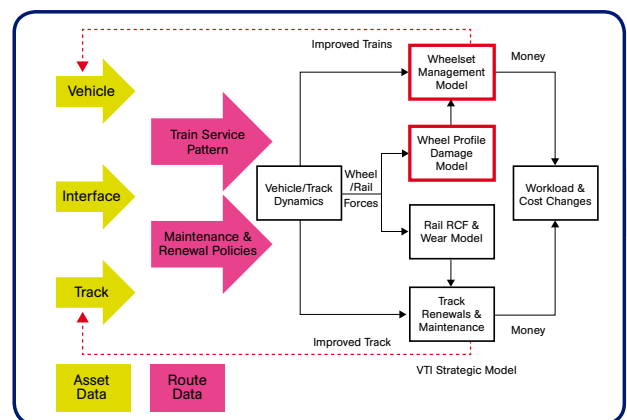
As the model is nearly 15-years-old, we need to move VTISM into up-to-date software so that it remains fully accessible to the industry. We will also update the underlying data to bring VTISM in line with Network Rail's current maintenance and renewal policies, and incorporate additional technical refinements and enhancements.

The timescale of the work aims to inform the Office of Rail and Road's review of track access charges, due as part of the 2023 Periodic Review of Network Rail's Outputs and Funding.

Get involved

We invite fleet owners and vehicle manufacturers to help to guide the VTISM upgrade, and work with us as a case study. Contact Paul Gray, Professional Lead, Engineering:

Paul.Gray@rssb.co.uk



Managing the effects of extreme weather events

Effective policies and tools to manage extreme weather

In August 2020, a passenger train collided with a landslip near Carmont, Aberdeenshire, resulting in the deaths of three people and injuries to six others. The earthwork failure followed a period of heavy rainfall, and Network Rail subsequently introduced changes to how it manages the risk from extreme rainfall events, including the use of blanket speed restrictions.

While speed restrictions mitigate the likelihood and consequence of derailments, they may increase the risk from other hazards; in particular signals passed at danger (SPADs), but also crowding, slips, trips, and falls.

Blanket speed restrictions also have a significant, and growing, effect on performance. In 2015-16 and 2016-17, they were responsible for a total of 43,000 and 49,000 delay minutes respectively. In 2018-19 and 2019-20, the figures were 104,000 and 109,000 minutes respectively—a 5-fold increase in 8 years.

Effectiveness of blanket speed restrictions

Research has started to develop a better understanding of whether current blanket speed restrictions are suitable and justified. We will characterise the risks that speed restrictions are intended to mitigate, analyse how they are applied, and compare alternative approaches to blanket speed restrictions that have proved effective in other countries.

A system risk model for extreme weather

We will also be developing a system risk model for extreme weather events, which aims to inform the design and implementation of measures to manage the risks from these events.

The quantified model will initially focus on rainfall and earthwork failures, but will be easily adaptable to other weather risks. Its aim is to determine the right balance between:

- Immediate risk: the reduced derailment risk from the speed restriction, considering both the increased probability of stopping short of obstruction and the reduced speed of any impact.
- Knock-on risk: the increased safety risk from events (such as SPADs, crowding, slips, trips and falls, and assaults) that may follow from increased delays and cancellations.

Get involved

To find out more or to discuss joining the steering group for the blanket speed restriction project, contact Marcus Carmichael, Professional Lead, Operations and Performance:

Marcus.Carmichael@rssb.co.uk

To discuss the system risk model, contact David Griffin, Principal System Safety Engineer:

David.Griffin@rssb.co.uk



RESEARCH & INNOVATION GET INVOLVED

World Congress on Railway Research 2022

Register now for the world's largest gathering on rail R&D

Would you like to share your RD&I capabilities and activities with CTOs, MDs and rail experts from across the globe, and hear from them in return?

If so, you will need to be in Birmingham on 6 – 10 June 2022, attending the World Congress on Railway Research (WCRR) 2022.

WCRR is the largest international gathering on railway research and development. The theme of this 13th congress is 'Reshaping our railway post pandemic: research with an impact'. It is the only forum providing opportunities to network with senior rail representatives and leading academic experts from

across the globe over five days of activity, including exciting technical visits.

There will be plenty of opportunities for delegates to exchange ideas, present research outputs, and forge global partnerships to support technologies and new solutions that address common challenges.

RSSB and University of Birmingham are the proud sponsors of the 2022 Congress. Early bird registration is now open, and sponsorship opportunities are available. If you are involved in R&D this is a key event for your 2022 diary!

Get involved

Find out more about the Congress and register at www.wcrr2022.co.uk, or contact Nailah Fraser-Haynes, Senior Partnerships Manager:

Nailah.Fraser-Haynes@rssb.co.uk



WCRR
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Reshaping our railways post-pandemic:
Research with an impact

Photo credit: RTRI

RSSB
A Better, Safer Railway

UNIVERSITY OF BIRMINGHAM

The future of maintenance

Join us for a workshop on how new technologies can improve the efficiency and safety of maintenance

Advancements in robotic and autonomous systems are presenting new opportunities to revolutionise train maintenance, and to rethink depot design and use.

The Centre for Autonomous and Cyber-Physical Systems at Cranfield University has been leading autonomous systems research in aerospace and marine applications for over 15 years. RSSB recently collaborated with the Centre and the West Coast Partnership to investigate the use of drones for inspections in enclosed spaces, like depots. Other Universities also have a wealth of experience in AI and robotics research and innovation, which has the potential to be developed into new technology for train maintenance applications.

On 19 October RSSB is hosting an interactive webinar to:

- showcase past and existing research that has the potential to improve train maintenance and depot efficiency and safety
- identify and disseminate train maintenance challenges that could benefit from increased automation
- initiate the development of a pipeline for research related to future train maintenance
- demonstrate industry's willingness to collaborate on fundamental (pre-competitive) research on this topic.



Get involved

The interactive webinar will take place on 19 October 2021. Go to rssb.co.uk/events to sign up.

Please get in touch if you have maintenance challenges that you would like to share or solutions that you would like to showcase.

Contact Sharon Odetunde, Head of Partnerships:

Sharon.Odetunde@rssb.co.uk



R&D research pipeline Summer 2021–Winter 2021

The value of the research delivered by RSSB is strongly influenced by both:

- rail industry stakeholders supporting RSSB in defining research requirements
- our industry partners' skilled research teams bringing specialist knowledge, creative approaches, and best practice from previous research.

To register your interest in any project listed below, contact us through the customer self-service portal: customer-portal.rssb.co.uk

This list reflects our plans at the time of publication, and may be subject to change.

Project reference (PROGRAMME)	Project description
T1227 (DECARB)	Assessing decarbonisation action plans from comparable industries to recommend regulatory and performance measurement systems
T1228 (DECARB)	Assessing decarbonisation action plans from comparable industries to recommend regulatory and performance measurement systems
T1235 (CLEAR)	Performance requirements and testing protocols for emissions mitigation
T1253	Development of an industry location gazetteer
T1256	Guidance on limits for freight train trailing length as governed by coupler strength
T1263	Tools and guidance for efficient and low emission timetabling and traffic management of freight trains
T1264	Informing the introduction of Digital Automatic Coupling on the GB network
T1266	A review of freight permissible speeds
T1267	Assessment of acoustic monitoring of axle bearings
T1268 (DECARB)	Developing performance design requirements for low carbon freight locomotives

Suggest research

We invite stakeholders from across the industry to tell us about the challenges they face and the new knowledge and solutions they need. If these would benefit from cross-industry collaboration and system-wide thinking, it is likely that the R&D programme can be of assistance.

Contact us through the customer self-service portal, and we will be in touch: customer-portal.rssb.co.uk

Find out more: rssb.co.uk/research-and-technology

Join us for a showcase or webinar: rssb.co.uk/events

Read our research findings:

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