Key to icons indicating which strategic goals for the railway each project addresses:

- Increased capacity
- Reduced carbon
- Lower costs
- Improved customer satisfaction
- Enhanced safety
Welcome to the May 2019 Research and Innovation Quarterly Update.

Having recently submitted our request for future funding to the Department for Transport, it feels timely to reflect on the importance of and need for a publicly funded cross-industry R&D programme. Without it, the industry would not be able to gain new knowledge or pursue those solutions deemed too risky or not delivering enough benefit for any individual company.

The many different organisations that play a part in the railways are all connected and dependent on one another. Their primary concern is to provide 20,000 passenger services every day, and move at least 75 million tonnes of freight every year, punctually and safely. There is limited time and resource left over to invest in R&D, and this is generally and comprehensively focussed on pursuing tangible and short-term benefits. And yet for rail to thrive and meet its customers’ needs, more radical and system-wide R&D is needed. Thanks to government funding and the industry’s significant in-kind contributions, our cross-industry R&D programme provides a tried-and-tested facility to pursue collaboratively incremental and radical solutions to cross-industry challenges.

Take for example, seat comfort, where recently completed research created an evidence-based, scoring system for the assessment of seat comfort on trains. Thanks to this work, comfort can now be measured and is no longer a secondary consideration. New fleets and heavy-duty overhaul can be specified using this seat comfort scoring methodology, and this will lead to more comfortable journeys for passengers. Because of the funding and governance of the R&D programme, this work is authoritative and independent, has cross-industry buy-in and involvement up-front, and the outcomes are freely available to all including passengers!

This quarterly summary also features a piece on ‘inerters’, a novel suspension technology used in Formula One that could be applied to improve train curving performance and reduce wear and rolling contact fatigue. In the innovation journey to reap the benefits of this technology in rail, the private sector has a key role to play once the early feasibility has been assessed and demonstrated. The latter can only happen because of a publicly funded cross-industry R&D programme.

Read on to explore examples of R&D findings currently in use in industry, and gain more details on findings and outputs now ready for use. Do take a closer look at our work and get in touch with us at RSSB if you want to know more about how to get involved, or if you have ideas for putting research into practice.

Luisa Moisio, R&D Programme Director
luisa.moisio@rssb.co.uk
Research and innovation in action

Tangible value from reduced safe electrical clearances

Research recently showed that electrical clearances are safe at much closer distances than existing allowances in all situations when using insulated pantographs – which reduce the electrical contact area of the pantograph horns – and/or surge arrestors, which protect electrical equipment from over-voltage caused by short circuits. This work is already being put to effective use, and more is underway to make full use of the findings.

In developing some of their new trains for GB, Hitachi Rail have used the comprehensive data from the high voltage tests, that were undertaken as part of the project (ref. T1120), to justify a reduction in the electrical clearance of 270mm specified in GLRT1210. The test data provided supporting evidence to show that, if used in conjunction with a surge arrester, a pantograph to vehicle roof dimension of 206mm did not pose a significant risk. This meant the passenger headroom for the Hitachi AT400 (for the HS2 project) could be increased by an additional 64mm.

With regards to pantograph design using insulated horns, RSSB and Network Rail have started working with partners to trial them.

For more information, contact Paul Gray (ref. T1120):

paul.gray@rssb.co.uk

Hitachi AT400
Enabling better planning and resource management during disruption

Service disruption adversely impacts the customer experience and industry reputation. To counter this, contingency plans set out the principles by which train services will be amended against the base timetable, in response to an incident and/or disruption, on a temporary basis. The ability to implement the plan effectively will be dependent on its robustness, resource availability and staff competence. Research is underway to bring these core elements together in good practice toolkits, helping industry to implement the quick wins and enable better recovery from disruptions.

The first toolkit to improve contingency plans was delivered as an initial part of the project in January 2019 and has already been deployed as an in-service pilot by Greater Anglia, ScotRail and GTR to assess its real benefits and impact.

Application of the toolkit is expected to support Network Rail’s development of a Performance Management System by providing a clear definition of what constitutes a good contingency plan and how it should be managed.

For more information, contact Hassan Khalil (ref. T1154):

hassan.khalil@rssb.co.uk
Enabling low carbon design

The RSSB Rail Carbon Tool is a web-based tool freely available for use by those working in GB rail, to understand carbon footprint and prompt its reduction throughout our supply chain. It uses verified, centrally available carbon factor data to measure embodied carbon (the carbon footprint of a material). Construction in rail infrastructure projects is carbon-intensive and one area in which the measurement of embodied carbon is therefore of particular importance. Calculating embodied carbon at the early design stages allows for options to be compared and carbon hotspots identified, leading to better informed decisions for a low carbon design.

In the last year, the number of users accessing the Rail Carbon Tool has increased by 23% and there has been a 40% increase in the number of projects created.
within the last year, showing a strong growth in interest. In the new standard published by Network Rail in March, all projects over £1million that include track, structures, earthworks, buildings, electrification or fixed plant are required to use the Rail Carbon Tool to identify opportunities for carbon reduction, with a compliance date for this new standard having been set for the end of 2019. We can expect to have over 1000 users by the end of the year.

Real examples of how the Rail Carbon Tool has been used to reduce carbon on UK infrastructure projects such as the Camden Town Station Capacity Upgrade project and the Edinburgh Glasgow Improvement Programme, can be found on the RSSB website, as well as webinars and other supporting materials.

To find out more, contact: sustainablerailprogramme@rssb.co.uk.
Seat comfort: measure it to improve it

Current seat specifications focus on crash and fire worthiness. This project set out to ensure that seat specifications can also fully cater for comfort by defining objective, measurable, requirements and targets for it.

As a result of this research we now have the first ever method to measure seat comfort on trains. This will help to ensure that seat comfort - a key aspect of the passenger’s comfort and rail journey experience – can be properly specified and assessed.

For the first time those involved in the design, selection and appraisal of train seats can use a common language and an evidence-based scoring that:

- Includes a set of minimum seat comfort requirements that fit the adult 5th to 95th percentile population;
- Uses a robust test methodology that is repeatable to test a seat’s dimensions, seat pad hardness and scoring;
- Includes a seat attractiveness and appearance requirement that asks passengers for feedback on seat comfort preference;
- Provides different target scores for different journey types, from metro to high speed.

Next steps:

All details required to apply the seat comfort scoring methodology are in the final report available from the RSSB website. With so many new trains in the process of entering service, this can help both trains still being specified and those closer to introduction so that change can be managed as best as possible.

The use of the seat comfort scoring methodology, including the minimum set of seat comfort requirements and the target scores for different journey categories, will be included into the next revision of the Key Train Requirements (KTR).

For further details and to discuss early results and issues in applying the seat comfort methodology, please contact Robert Staunton (ref. T1140):

robert.staunton@rssb.co.uk
As a specifier of new or refurbished seats for a Train Operator, I will be using the output of this project to assist me in future product specification and procurement activities. Like any new tool, we recognise that it’s not ‘perfect’, so we implore the industry to embrace it, use it in anger and help to hone and develop it further.

Greg Newport
Engineering Manager Virgin Trains
Rail Life: making the railway more customer-centric

Understanding rail customers is key to running a service which works for them. Thales and Arriva Rail North (Northern), through the RSSB TOC’16 innovation competition sought to apply digital technology in this area to uncover new levels of understanding into passenger feelings, behaviours and needs.

Working together with digital communication specialists Saturn Communication Ltd and wellbeing specialists Robertson Cooper Ltd, they created Rail Life and put out the call to customers of Northern to become a Citizen Scientist and help Northern better understand their passengers to improve their overall experience. Over 400 passengers took part, clocking up over 12,000 journeys. Customers were provided with wearable technology (fitness and activity trackers) to monitor their heart rate during travel. This worked in tandem with an app enabling passengers to report how they feel and record what caused these feelings throughout the duration of their journey.

The Rail Life team now have a unique dataset which provides Northern with unparalleled insight and understanding of their customers’ wellbeing and overall satisfaction. They have gained insight into the true nature of delay versus sentiment, number of days to recover from a net negative journey sentiment and which areas of the network and service keep passengers happy.

Next steps:

Thales are currently appraising where to take this technology next. To find out more about the project, results and how you could apply it, contact:

david.taylor@uk.thalesgroup.com
Managing cognitive underload: a growing challenge in an increasingly automated railway

For many years the rail industry has known that high mental or physical workload (or ‘overload’) can cause people to make mistakes, but there has been very little recognition of what happens at times when workload is low (underload).

This research looked in particular at train driving which can involve long periods of repetitive work, where running on green signals over long distances, along the same routes, with the same hazards and indications, can get monotonous. In these situations, it can be difficult to maintain concentration, and this can lead to mistakes associated with cognitive underload.

It is clear from the evidence that a single approach is not always suitable as different drivers need different mitigations. Therefore, the research identified and collected together some effective techniques to try and address this, along with the triggers that indicate when cognitive underload may start to become an issue.

The project worked with drivers to create and test these triggers and techniques so that they were developed by drivers for drivers. As a result, a toolbox of techniques is now available for use to provide real tangible help to drivers in managing this issue.

Next steps:
To help further support the use of the toolbox a short video is being produced. For further details and to discuss how best to embed this new toolkit with drivers, please contact Justin Willett (ref. T1133):
justin.willett@rssb.co.uk
Supporting drivers with the right adhesion information

As part of the ADHERE research programme, this project worked with a number of train operators, including Southeastern, East Midlands Trains, Northern, Govia Thameslink Railway and Direct Rail Services Limited, to understand how to review and improve the information that drivers receive and use to deal with low adhesion.

The research identified four key opportunities to provide different types of information to drivers – driver briefings and publications; booking-on and before driving; information received while driving; and driver-to-driver information sharing – and also the key messages that should be provided to enhance driver confidence, for example details about how on-board systems relating to managing adhesion function and how to use them to achieve maximum benefits.

A toolkit has been developed to help operators select the right information and briefing options, and understand the usability of the information.

Next steps:

For more information on using the toolkit in their preparation for Autumn 2019, please contact Anisha Tailor (ref. T1156):

anisha.tailor@rssb.co.uk
Forecasting techniques to improve adhesion management: four feasibility studies underway

RSSB awarded funding to three data-driven feasibility studies as part of a £300,000 research competition to develop innovative solutions to improve its ability to predict poor adhesion, and therefore take effective mitigation actions. This is expected to improve customer experience and reduce costs related to low adhesion management.

The three project teams, led by the University of Sheffield, the University of Huddersfield and Liverpool John Moores University, have started working with industry partners including the Met Office, Network Rail, South Western Railway, Merseyrail, Virgin Trains, Arriva Rail North and Sheffield Supertram. They look at integrating different data feeds, including operational data such as On Train Data Recording (OTDR), Network Rail data such as TRUST and TD, weather data and others, to enhance knowledge of adhesion conditions and industry forecasting capabilities.

One project, led by the University of Huddersfield, aims to investigate what improvements could be made in adhesion forecasting if OTDR data was used to increase knowledge of adhesion conditions on a chosen route. The project led by Liverpool John Moores University is working on integrating multi-source data into a framework able to validate the effectiveness of current adhesion mitigation strategies and provide a decision support tool for drivers. Lastly, the team from the University of Sheffield is looking at developing verification standards for adhesion forecasting at different spatial and time resolutions. This will enable greater confidence in the use of forecasts.

Following the successful grant of a Research Chair position to Professor Roger Lewis from the University of Sheffield, a fourth project has started with Arriva Rail North and Ikon Risk Consulting. This research will assess the feasibility of using an on-train camera system and a ‘trained’ neural network to predict local adhesion conditions.

Get Involved:

If you are interested in learning more about any of the Forecasting Adhesion projects, get in touch with Giulia Lorenzini (ref. COF-FCA):

giulia.lorenzini@rssb.co.uk
Inerters prototype development

Through our strategic partnership with the University of Huddersfield we have been looking into the use of inerters, a novel suspension component, to improve passenger vehicle suspension. Initially developed in 2002, used under the pseudonym ‘J-damper’ in Formula One, the inerter is a passive, two-terminal mechanical device, in which the force exerted is proportional to the acceleration between its terminals.

An early feasibility study investigating the application of inerters in the primary lateral suspension of passenger vehicle bogies demonstrated that primary yaw stiffness can be reduced by up to 47%, while still achieving good ride quality and stability. Reduced primary yaw stiffness has been demonstrated to improve curving performance, reducing rates of wear and rolling contact fatigue which could translate to a 26% decrease in variable track access charges.

Network Rail and train manufacturers are very excited by these early results, and remain closely involved for the next stage which will develop a prototype. If successful, this will be followed by full-scale testing and freight applications will be explored.

Get Involved:
If you want more details, contact Sharon Odetunde:
sharon.odetunde@rssb.co.uk
Good train regulation practice in an ‘on time’ railway

CP6 has seen the introduction of new industry performance metrics, to better reflect the passenger experience. Punctuality is now measured at every possible recorded station stop on the train’s journey.

This introduces new challenges to train regulation practice, which is a complex industry process that controls the running of trains through key junctions in the network. Broadly it aims to deliver fair and robust routing decisions, optimising efficient use of available infrastructure, minimising overall delays to passengers or freight, maintaining agreed connections between services, and avoiding undue discrimination between TOCs. This process is particularly challenging in congested areas where multiple train operators provide services over the same line and signallers have limited time available to make a sound regulation decision. Poor decisions can negatively impact the customer experience by increasing delays.

The aim of the research, soon to start, is to define what needs to be included and considered in an effective regulation policy, and how the successful application of the policy can be achieved and measured in practice.

Get Involved:

If you want more details, or are able to contribute information and data, contact Justin Willett: justin.willett@rssb.co.uk

Punctuality at all recorded station stops (4 Feb 2018 - 9 March 2019)

<table>
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<th>Early</th>
<th>On time</th>
<th>Within 3 minutes</th>
<th>Within 5 minutes</th>
<th>Within 10 minutes</th>
<th>Within 15 minutes</th>
<th>15 mins +</th>
<th>20 mins +</th>
<th>30 mins +</th>
<th>Cancelled</th>
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<td>63%</td>
<td>82.7%</td>
<td>90.3%</td>
<td>96.5%</td>
<td>98.3%</td>
<td>17%</td>
<td>7%</td>
<td>0.4%</td>
<td>2.9%</td>
</tr>
</tbody>
</table>

CP6 on time metrics
Get involved

Research and Innovation Showcases

Are you aware of the RSSB research and innovation that could benefit your business? We run Research and Innovation showcases to get you linked in to existing findings and outputs relevant to your challenges, and enable you to contribute and steer research underway.

Our latest Research and Innovation Showcase took place on 8th May in London and the next one will be on 24th July from 1500 onwards, at the University of Huddersfield.

Get Involved:

We welcome the opportunity to come to your organisation and focus a showcase around your opportunities and challenges. If you are interested in hosting a showcase or for more details on future showcases, please contact Robert Staunton:

robert.staunton@rssb.co.uk

Data Sandbox+: new funding opportunities for industry and innovators to work together

Getting greater value from data is a key workstream of the PERFORM programme. The Data Sandbox+ research competition builds on the success of the original “Data Sandbox” initiative that RSSB launched in 2017, which funded five feasibility studies to look at how data could be used in novel ways to support performance improvements.

Data Sandbox+, is making £650,000 available to fund demonstrator projects that build on the work that has been already carried out or feasibility studies which propose new approaches and ideas. Network Rail has additional funding available within the CP6 R&D portfolio to also support suitable projects up to £650,000 through this initiative.
Data Sandbox+ builds on the repository of data that was made available for the original competition and includes new and refreshed content from Network Rail, Rail Delivery Group, Transport Systems Catapult, and a variety of TOCs, Met Office and others.

**Get Involved:**
If you are a train or freight operator, or another organisation, and would like to get involved by sharing data samples to enhance the repository and supporting future research, please get in touch.

If you are an innovator, supplier or academic institution, the deadline to submit your application is 5 July 2019.

For more information about the competition visit the Data Sandbox+ hub or contact Giulia Lorenzini:

giulia.lorenzini@rssb.co.uk
What is the role of the rail industry in this emerging mobility services landscape?

Our new ‘Over The Horizon’ blog series, in partnership with the Connected Places Catapult (merger of the Transport Systems Catapult and the Connected Cities catapult) is about to start.

The series will present a view of how transport services will look like in 5-10 years, and will discuss the role of the rail industry in this new mobility services landscape. We will look into passenger demographics and evolving transport needs, opportunities and challenges brought by intermodal transport developments, potential new entrants in the transport sector and the impact of likely disruptive innovations, the imperative of more flexible and granular demand management, and much more.

Get Involved:
Want to know more about the future of transport, and share your own views on what is likely to change the face of urban and rural transportation in the coming 10 years? Want to discuss and get ready for the coming challenges and opportunities for rail? Join the discussion on LinkedIn and Twitter, or email Olivier Marteaux: olivier.marteaux@rssb.co.uk
What R&D is needed to improve resilience and seasonal readiness?

Seasonal environmental changes present regular challenges for all of our railway. Whilst mostly recognised as an Autumnal issue, each season creates its own difficulties in maintaining service delivery. Following positive discussions with a range of routes and passenger operators who are already working hard in this area, RSSB, in collaboration with the newly formed Seasonal Challenge Steering Group (SCSG), a subgroup of National Task Force, are beginning to scope a coordinated programme of research activities to deepen the understanding of the root-causes and current mitigations, and begin to propose, develop and assess novel solutions.

We want to work in collaboration with industry to gather data on historic performance, how seasonal preparation and mitigations are tested, and the success of these and the remaining challenges for which new knowledge and solutions are key. This is intended to help us to progress towards the aim of a climate-agnostic railway, widening the range of environmental conditions for which safe, reliable operation is viable, and a reduced impact of seasonal variation on passenger and freight transit, with lower operational costs.

Get Involved:
To share R&D work in this area and help us identify the key challenges that would benefit from cross-industry R&D, please contact Andi Flint:
andi.flint@rssb.co.uk
SPARK is a knowledge hub with over 20,000 records where you can discover who is doing what in rail-related research and innovation. In SPARK you can find the Research and Solutions Catalogues that provide information on research and innovation managed by RSSB on behalf of the GB railway industry. www.sparkrail.org

Suggest research
The research programme is driven by the rail industry’s needs. We receive and review hundreds of ideas each year. New research ideas are always welcome. Drop us an email and we will be in touch to discuss your research needs and ideas further.

Request a knowledge search
Do you want to know if research has been done on a topic, and what knowledge already exists? Our Knowledge Services, which include horizon scanning activities, support the R&D programme, cross-industry groups and RSSB members by finding out relevant knowledge and analysing it.

enquirydesk@rssb.co.uk
knowledgesearch@rssb.co.uk