Research, Development and Innovation
Quarterly summary
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Contents

Rolling stock p4-5
- Double-decker trains
- Very Light Rail
- Space saving seats

Infrastructure p6-9
- Space-based technology
- Masonry arch bridge lift
- Rail void monitoring device
- Level crossings
- Shift2Rail initiative
- Costs of electrification

Customer experience p10
- RRUKA call for research

Knowledge, technology, innovation p11-12
- RTS capability delivery plan
- University of Huddersfield test site
- RSSB knowledge and technology transfer service

Innovation and research impact p13-14
- SPARK
- RRUKA conference
- Rail carbon tool

People p15-16
- Non-technical skills
- Supporting a fair culture

Awards p16
- IET Innovation Award
Introduction

RSSB work to support delivering the vision of the Rail Technical Strategy to improve the railway, while continuing to support the industry by providing solutions to current railway problems and opportunities.

There are currently 109 research and development projects and 44 active innovation programmes, comprising 80 innovator projects at different stages of development and delivery across the two teams, with a further 17 innovator projects currently being negotiated.

The following updates represent a selection of projects in our portfolio.

If you would like to find out more about any individual projects visit www.sparkrail.org and search for a key word or visit RSSB.co.uk
RSSB competition funds double-decker train prototype

Andreas Vogler Studio, one of the winners of Tomorrow’s Train Design Today competition, has designed a double-decker train capable of running on GB rail infrastructure.

The AeroLiner3000, which made its debut at September’s InnoTrans in Berlin, could increase capacity on Britain’s crowded network by 30%, allowing for greater passenger comfort.

Andreas Vogler Studio partnered with the German Centre for Aerospace. The companies used lightweight technology common in space and air travel, and the new design will reduce CO2 emissions and operating costs.

The competition offered a total of £3.5 million to small firms and businesses who could provide innovative solutions to rolling stock issues, improving cost, capacity, carbon emissions and customer experience.

Very Light Rail

RSSB has funded Transport Design International (TDI), to develop a unique self-powered bogie for Very Light Rail (VLR). With an integral hybrid propulsion system and using commercial vehicle components where possible, the bogie is designed to reduce costs and improve reliability and maintainability on the railway.

The bogie technology design, supported by the University of Warwick’s WMG (Warwick Manufacturing Group) and Unipart Rail, was successfully demonstrated in the laboratory early in 2016.

The next stage is to develop and build the VLR vehicle body and integrate it with the bogie technology. Existing regulations and safety standards relating to very light railcars have also been evaluated establishing what needs to be changed to enable the VLR technology to be successfully taken up by the industry.

‘In aviation, lightweight is top priority. With the AeroLiner3000 we show that lightweight construction can trigger a change in the world of rail vehicles.’

Andreas Vogler
Launch of space-saving train seats

Two new seating innovations, funded by RSSB, were displayed for the first time at a launch event in central London in October.

The launch gave those attending the chance to try out the seats designed and created by PriestmanGoode. The project, which is part of the Tomorrow’s Train Design Today programme, produced two seating solutions named Horizon and Island Bay to help maximise passenger capacity and comfort. Both designs can be installed on new or existing trains and trams with the aim of boosting capacity on carriages by up to 30 per cent.

The UK launch was streamed live on RSSB’s Twitter account. RSSB’s Innovation Programme Director, Neil Webster, and PriestmanGoode’s Chairman, Paul Priestman delivered the welcome speeches. This was followed by an interactive session testing out the two new styles of seats.
Freyssinet, the structural repair contractor, has successfully trialled the world’s first masonry arch lift, with funding from the RSSB Avoidance of Bridge Reconstruction competition.

The ElevArch masonry arch jacking trial saw the bridge arch raised 900mm vertically over a six-hour period before being lowered to 450mm above the original position with the gap in the abutment filled to restore permanent support.

The world’s first bridge lift of its kind, used a patented technique which involved cutting the masonry arch free from its abutments and wing walls and jacking it upwards to enlarge the space below. As the jacks lifted, hardwood timber crib stacks were inserted beneath to support the bridge before the gaps were filled with concrete to restore permanent support to the arch. The road embankments approaching the bridge were raised to adjust to the new bridge height.

The trial held in October at Moco Farm Bridge was on a section being recommissioned on the East-West Alliance route between Bicester and Bletchley.

Launched in February 2014, the competition was devised to find an alternative to the demolition of overbridges when electrification or larger rolling stock must be accommodated on the railway.

With a growing emphasis on electrification, the ElevArch innovation could prove a cost-effective alternative for Network Rail in the future.

‘With something in the region of 500 over bridges getting in the way of Britain’s electrification programme, the future for this bold but simple technique is expected to be bright.’

Kevin Bennett, Sales and Technical Director, Freyssinet
Space-based technology

Two projects designed to encourage space-based technology in the rail sector have produced feasibility studies.

The Space for Rail programme includes The University of Birmingham’s remote line blockage detection which is aimed at using satellites to detect line blockages, and the VTOL Technologies Ltd unmanned aerial vehicle programme designed to inspect railway infrastructure using autonomous aerial drones.

The deployment of light autonomous aerial drones operating beyond visual line of sight for surveillance and inspection can provide cost savings and significant improvements in performance over traditional helicopter or foot methods available. The system has the potential to exploit integrated space-based technology including precision GNSS (Global Navigation Satellite System), satellite communications and potentially earth observation and satellite weather information.

The application of remote line blockage detection using a novel passive imaging radar and GNSS transmissions remote sensing system can provide a reliable means for monitoring railway lines for blockages under extreme weather conditions alerting authorities.

Both studies funded by RSSB and the European Space Agency’s (ESA) integrated applications programme have the potential to change how Network Rail’s assets are managed.

The ESA, RSSB and Network Rail are encouraging the innovators to take the technology to demonstrator level.
Portable Rail Void Monitoring Device

Yeltech, one of the winners of RSSB and Network Rail’s Remote Condition Monitoring competition, have produced a system for void detection using on-track installed sensors.

The Rail Void Monitoring Device (RVMD) will provide infrastructure managers with data via an email or SMS giving information on how quickly the void is deteriorating so failures can be anticipated and maintenance planning improved helping to reduce the cost of repairs, while improving safety and customer experience.

One of the top causes of point failure is voiding, where a gap or void appears near the points. The infrastructure managers, who look after the track, must monitor the health of railway voids to diagnose defects and anticipate failures.

The RVMD is a self-contained, battery operated sensor and Yeltech are progressing to the next stage of testing which will see the sensors mounted onto tracks to obtain more ‘real data’.

The testing will take place on Network Rail infrastructure near Guildford.

Level crossings

UtterBerry’s monitoring system is a low-power wireless sensor system that records, processes and transmits data on level crossing obstructions. It was developed under the RISE (Rail Innovation Support Engine) scheme as part of the RSSB Innovation programme.

The trial for the sensors commenced in October 2016 on two level crossings in West Sussex and finished in January 2017. The purpose of the trial was to examine the viability of using the UtterBerry wireless sensor network on a level crossing system. It can detect in real time the number of vehicles, people and animals passing through the level crossing plus the vehicle speed. The innovation can also process and interpret data at the source, transmitting precise, instantly useable information in real time to any internet-enabled device. The sensors can also analyse trends in data to enable greater safety planning in level crossing areas.
Shift2Rail initiative

RSSB alongside other UK rail partners, has secured EU funding for two major railway innovation projects, which form part of the Shift2Rail initiative set to transform the European railways of the future.

S-CODE - Switch and crossing optimal design and evaluation

The overall aim of the S-CODE project is to investigate, develop and integrate radically new concepts for switches and crossings that have the potential to deliver increases in capacity, reliability and safety while reducing investment and operating costs.

The project, coordinated by Birmingham University, RSSB and Loughborough University, will identify different technology concepts that can be integrated to significantly improve performance based around new operating concepts including super-fast switching and self-healing switch. It will build on existing European and national research projects (the lighthouse project In2Rail, Capacity4Rail, Innotrack and REPOINT, led by Loughborough University).

Reducing costs of electrification

When the overhead power supply fails, trains cannot run through the affected section of track. The greatest impact on services is not just on trains stranded in the affected section, but on those behind the section. Trains need to be rerouted, but this can only happen if there is an alternative route available, and there is power available to get to that route.

An RSSB research project, Optimising the sub-sectioning arrangements on AC electrification, has examined the relationship between the length of subsections of the electrification network, track switches that would allow trains to move to diversionary routes, and the costs involved in installing the necessary equipment. The research developed an assessment tool to determine the appropriate sub-sectioning distances in terms of reliability and cost.

The project suggests that there is no one size fits all length for electrical subsections and distance between switches. Traditionally sub-sectioning has been at 10 to 15 kms but the optimal interval is dependent on a range of factors between 2 and 8 kms.

Based on the two case studies developed within the project, when diversionary routes are available, the net benefit from optimising the length of electrical subsections would be significant. For example on the 40km route from Didcot to Swindon, which was used as one case study, the benefits have been estimated to be £130k per year.
Faster, safer and better boarding and alighting

Four projects have started following the call for research seeking novel solutions to improve the Platform Train Interface (PTI):

- University of Surrey and University of Loughborough will investigate whether and how improving information for passengers on an approaching train will influence their behaviour on the platform.

- University of Loughborough will use a detailed simulation model to modify or design trains to ‘kneel’ by adjusting their heights and lateral positions to reduce the platform train gap.

- Lancaster University will assess the feasibility of improving PTI interaction by augmenting current CCTV technology with real time analysis of passenger movement to correctly stream passengers to the most appropriate part of the platform for their requirements (luggage, passengers with reduced mobility, cycles etc).

- University of Sheffield will use CCTV on current trains and platforms and integrate them with novel parallel computing techniques to identify the importance of features such as door design and platform management to optimise combinations for passenger flow.

RRUKA facilitated the call and the projects, funded by RSSB, are scheduled to complete by February 2018.
Rail Technical Strategy Capability Delivery Plan

A showcase highlighting the new Rail Technical Strategy Capability Delivery Plan was held at RSSB in November.

The event attracted over 90 delegates from over 50 organisations who were given the opportunity to explore the 12 key capabilities with rich pictures, narrative and milestones for each one. In addition, a selection of innovators and SMEs were on hand to showcase their work demonstrating how their products and solutions will contribute to the delivery of the Rail Technical Strategy.

RSSB will look to deliver similar events in other parts of the UK.

University of Huddersfield opens new test site

The University of Huddersfield, which is partnered with RSSB through the Institute of Railway Research Strategic Partnership (IRRSP) has opened a new test facility.

The £4.5 million Centre for Innovation in Rail, created to fast-track new railway technology has opened in Huddersfield. The 150-ton test rig, funded by the Regional Growth Fund, is the only one of its kind in Europe.

The test rig will be used to carry out a wide range of experiments on a full-sized railway bogie, enabling in-depth investigation of the issues around the contact area between the wheel and rail which are key to the cost and safety of the railway.

For the UK, the test rig means that innovative proposals to improve the interface between the wheel and the rail will be tested in a secure environment, allowing proof of concept to be reached more quickly. New products will be able to reach the operational railway more quickly, ultimately improving the safety, capacity and customer experience, and reducing cost and carbon emissions.
Knowledge and technology transfer service

The RSSB knowledge and technology transfer service supports the cross-industry research, development and innovation programmes and carries out knowledge searches, including technology and horizon scanning, for RSSB members and other key industry players.

Two of the latest searches are below –

Hyperloop

This knowledge search was conducted to gather information on the concept of hyperloop, the business model in place and the technology being developed. The search assessed the disruptive potential of this technology for the rail industry.

Findings from this suggest there is no evidence of this technology being successfully integrated and tested on a wide scale system level. The findings suggest there remains many unaddressed engineering and safety issues (heat dissipation, thermal expansion, provisions against system failure, hazard for neighbouring areas) that hinder the chances of a passenger Hyperloop system being ready for deployment in the next decade.

Vandalism on the rail network and vandalism proof technologies

This knowledge search was undertaken to find information on vandalism within the GB rail network, with a focus on rolling stock. A key finding is that prompt graffiti clean-up is one of the best deterrents and prevention methods to further vandalism. Refurbishing and/or renovating infrastructure also constitutes good preventive measures along with the use of surveillance technology and secure station layout. The deployment of new materials can also bring remediation possibilities. Coatings that self-heal or self-clean, repelling water-based or oil-based substances have been trialled and deployed in the automotive industry with excellent results and could bring similar benefits to the rail industry.
New SPARK portal

SPARK is RSSB’s knowledge sharing hub. Originally launched in 2011, SPARK now provides access to over 22,000 publications, reports, innovation and R & D related materials from organisations across the globe. Following user feedback, we have launched a new site with new features. SPARK now provides:

- Improved search features to help find what you’re looking for with ease
- Upgraded discussion forums to enable collaborative thinking and cooperation
- New content collections and an explore SPARK page to help locate items which are most interesting or useful
- Brand-new pinboard feature which enables you to save items of interest to a personal pinboard, allowing you to easily come back to them later
- Adaptive pages to provide a better experience on phones and tablets
- Improved login procedures and a simpler registration process for new users.

Log in details for existing users will continue to work in SPARK. To find out more go to - www.sparkrail.org

If you have any comments, feedback or suggestions, or would like to find out more about contributing to SPARK, contact spark@rssb.co.uk

RRUKA Annual Conference

Industry and academia came together to share and collaborate at this year’s RRUKA Annual Conference at the Kings Place, London.

The one day conference provided opportunities for both industry and academia to share knowledge and help shape the future of UK academic rail research.

During the conference, Yousif Muhamedsalih, a Research Fellow from the University of Huddersfield, was named as the Best Young Rail Researcher, based on his research into Economic Tyre Turning (ETT) on GB railways. Yousif’s work provides strong evidence to support the case that train operators should be allowed to implement ETT policies without having any significant detrimental effect on the infrastructure where they operate - leading to cost savings.

The work could have a considerable future impact on the rail industry by helping to avoid the unnecessary costs incurred replacing wheelsets at heavy overhaul when they still have significant life remaining.

In addition, October’s rail-themed issue of the ICE Transport journal was produced in conjunction with RRUKA. The journal highlighted nine papers selected from those presented at last year’s RRUKA conference. They covered three broad themes: railway planning, management and operation, railway sustainability (two papers on energy sustainability) and rail vehicle/infrastructure interfaces (three technical papers).

‘I would definitely participate in an RRUKA event again. This is a valuable forum to spread ideas and meet new people.’

Nick Swift, Asset Manager, Eversholt Rail
Innovation and research impact

Rail carbon tool

Over 500 people in the rail industry are now using the RSSB Rail Carbon Tool to help reduce the industry’s carbon footprint.

RSSB’s Rail Carbon Tool (RCT) helps organisations calculate and analyse the carbon emissions from rail projects and activities, supporting the identification of low carbon alternatives. The tool can be used on projects of any size, from station refurbishment to platform extensions and new footbridges.

The RCT registered users range from engineers and environment teams to graduates and project managers. The number of projects using the tool has tripled from 21 in January 2016 to over 65 currently. Significant projects using the tool include the Camden Capacity Upgrade, and East West Rail 2 which is the first project to use the tool for a whole project and lifecycle assessment.

All the information on accessing and using the tool can be found on RSSB’s website. This includes 13 Rail Carbon Tool ‘how to’ films, which provide demonstrations on the key features.
Non-technical skills

RSSB has developed multimedia training materials to support the training of non-technical skills (NTS) to rail industry staff. NTS complement technical skills by underpinning knowledge to help staff understand how to approach tasks and mitigate for risks.

Operators can integrate the materials, which comprise videos, puzzles and scenarios into their formal NTS training programmes or use components in isolation as part of refresher days and routine safety briefings. The materials introduce valuable consistency in the inclusion of NTS to a range of roles and add to the existing work already implemented for driver roles. Once trained, staff will be able to better understand their own performance and limitations, identifying any threats or errors to their task performance and develop strategies to improve their application of NTS. This will help reduce the number and severity of safety incidents involving non-driver railway staff. In addition, improved NTS has the potential to enable a range of staff to deliver their roles more effectively delivering overall improved train performance.

The suite of tools was piloted during RSSB’s 2016 September NTS training course. Delegates from train and freight operating companies including Network Rail, reported that the tools helped them better understand how NTS applied to safety critical roles and that they could effectively use it within their own organisations.

‘The project established there is a real benefit in developing the skills of all staff involved in the movement of trains on and off the rail network. Using the Risk-Based Training Needs Analysis Toolkit and the training course helps to focus our organisations on non-technical skills for all grades and eventually make us even more resilient to errors.’

Kevin Langley, Operations Standards Manager, DB Cargo UK
Supporting a fair culture

Understanding the theory around fair culture and current best practice in the industry has enabled RSSB to develop a guidance document on the Competence Development Plan (CDP) process. The research helps the rail industry to move away from the historical and natural tendency to blame those responsible for incidents and accidents to more of a learning approach, helping them improve their performance in the future. The guidance enables managers and investigators to understand and learn from operational incidents and near-misses and help proactively manage operational safety risk. A fair culture approach to incident investigation promotes more open safety discussions within organisations and participation in safety processes by encouraging the reporting of near misses and identifying safety concerns.
Repoint technology wins award

Repoint, a radical new track switch product funded by RSSB and developed by Loughborough University’s Control Systems Group, has won a prestigious IET Innovation Award in recognition of its potential to support increased levels of day-to-day rail traffic across the network.

The patented technology triumphed over a quality field of nominations including Cambridge University and Heathrow Airport, to win the Transport Category.

Repoint introduces the concept of using several actuators to operate the same points, meaning that in the event of a single failure the remaining actuators continue to function safely. With this additional redundancy built into each machine, rail traffic can still pass and remedial maintenance can be scheduled without causing immediate disruption to services.

The award follows the announcement in October that a consortium led by Ricardo Rail will develop the first full-scale Repoint for integration with London Underground infrastructure in early 2018.