Three new competitions launched by the Future Railway programme

Three consortia funded to reduce railway asset costs using advanced materials

IPEMU ‘battery’ train successfully tested

137 active innovation projects

59 completed research projects

39 completed knowledge searches
Our research and innovation programmes are driven by the ambition of the Rail Technical Strategy to dramatically increase customer satisfaction and capacity whilst reducing cost and carbon. These are long term aims but also contribute to improved levels of performance in the short term and stimulate increased innovation in the supply chain.

The RSSB contribution to the industry’s Future Railway programme brings together research and innovation programmes that focus on identifying the technology and activity needed to deliver the railway of the future. The Future Railway programme promotes and encourages innovation to bridge the gaps. In addition, the R&D programme continues to support the industry by providing solutions to current railway problems and opportunities.

Over the past 12 months RSSB has worked with a number of partners, including Network Rail, to enhance, promote and deliver research, development and innovation programmes and projects within the rail industry.

There are currently 137 live innovation contracts at different stages of development and 14 which have completed in the past year. Solving some of the challenges and current restraints of rolling stock is a priority of the Rail Technical Strategy and has been a focus of the Future Railway programme. The first of several competitions in the Sustainable Rail Vehicle Programme was Tomorrow’s Train Design Today which delivered 48 entries, 10 of which went to feasibility and three have been chosen to develop demonstrators.

Some projects such as the IPEMU ‘battery powered train’ have reached the end of the demonstration process, marking the end of our funding, and are now looking for the next level of investment to bring the products to market.

The R&D programme currently has 85 live projects with a further 98 projects completed during the past 12 months. They include knowledge searches, 100% funded and co-funded research projects, and university collaborations.

During Control Period 5 (2014 to 2019) RSSB intends to fund the Future Railway programme with £52m, which will be allocated alongside £50m managed by Network Rail, further support from DfT (such as the £16.9m received in 2014/15), other public funding, and industry match funding.

Also during Control Period 5, DfT has indicated that it will offer further support in funding £46.4m for research and development. Our programmes will continue to expand activities through collaborative opportunities with innovators, other funding bodies, industry partnerships and partnerships with universities.

Although this funding is very beneficial, total funding for research and innovation in the rail industry remains well below the UK average of 1.7% of GDP.

As well as providing funding, RSSB encourages and enables organisations from within the rail industry and those from complementary industries to understand the challenges, processes and capabilities needed to deliver innovations in rail.

Read on for some of the highlights from the last quarter.
Innovation investment 2014/2015

The proportion of Rolling Stock projects in the programme is high at present for several reasons. Firstly, Rolling Stock is a high priority area in the Rail Technical Strategy. Secondly, the approach of the Future Railway programme has been to run a series of projects under a high priority theme, the first of these was the ‘Sustainable Rail Vehicle’ Programme to address rolling stock related challenges. Thirdly, this graphic represents projects in the RSSB managed portion of the Future Railway programme where notifications of awards have been made.

R&D investment and potential benefits 2014/15

Further benefits unlocked by the 10 completed knowledge creation projects £270m

Potential direct benefits from R&D completed in 2014/15 £86m

Total R&D investment including leveraged co-funding £15m

Total investment in cross industry R&D through the year £11m

Total Railway Innovation Investment £15m

Number of Projects

Future Railway Investment

Future Railway Portfolio

Match Funding

Total Railway Innovation Investment

Cross Theme Projects

Energy £1m £0.00

Command Control Communication £1.4m £1.3m

Innovation £4.3m £720,000

Customer Experience £2.6m £1.3m

Infrastructure £1.8m £1.2m

Information £0.00 £180,000

Rolling Stock £7.1m £10.4m

36

£17.6m

£2.8m

£3.9m

£3.8m

22

£5m

£35

6

£1.5m £1.2m

£2.7m

£2.6m

£18.000

£1.2m

£1.3m

£23
Looking to the year ahead

Over the next 12 months Research, Development and Innovation programmes from RSSB will work on projects which deliver both short term benefits and long term opportunities in line with the Rail Technical Strategy.

The R&D programme will continue to deliver priority research projects and knowledge searches which address current issues and opportunities, as requested by the industry, as well as building new research avenues in support of industry strategies.

The Future Railway programme will focus on driving and supporting innovation across the industry. Portfolio mapping will be used to highlight both immediate and long term requirements with prospective benefits.

Some of the confirmed investment in research and development in 2015/16

Proposed competitions to drive innovation in 2015/16
Competition progress pp07-08

- AIiR 3 - Customer Experience Competition jointly with Innovate UK
- Better services, better journeys, better value (RRUKA feasibility studies on data to improve the customer experience)
- Navigating in the right direction with a £4m COMPASS competition
- PowerTrain - Improving energy efficiency of self powered vehicles
- Predictable & Optimised Braking
- RSSB and EPSRC jointly fund £2m research on the reduction of railway asset costs

Open competitions pp08

- TOC’15 a £6m competition for Train Operator led innovations
- RISE - the always open innovation competition

Top stories pp09-11

Featured story
IPEMU - new battery technology

Supporting innovation
- Light after Dark (testing voucher scheme)
- Towards accessible facilities for testing innovations (T1039 and Project Pioneer)
- RIA Conference Innovation Award

Infrastructure
- Challenge 8: Monitor Optics Systems - Remote Condition Monitoring - Embankment Slip at Carlisle
- Update of CIRIA Manual on scour at bridges and other hydraulic structures

Command, Control and Communications
- Red Aspect Approaches to Signals (UoH project)

Rolling Stock
- Knowledge search - New materials and designs for wheelsets
- New train concepts respond to the challenges of tomorrow

News from other RSSB members pp12

Crossrail
- Crossrail’s Innovate18 programme
- Ultra low carbon concrete (Cemfree trials)
- Digitalised Red Line Review trials
AliR 3 - Customer experience competition

The third co-funded competition with Innovate UK as part of Accelerating Innovation in Rail received 36 entries which are now being evaluated.

The focus of AliR 3 is ‘Enhancing Customer Experience in Rail Travel’ and an incident on the network during the morning of the launch event, highlighted the theme as several guests and speakers spoke of difficulties with their journey.

The competition offered up to £6m for investment in projects to support business innovation specifically to address business challenges related to customer experience.

A call for feasibility studies: Better services, better journeys, better value for passengers

Novel ideas on how to use current data to improve the customer experience have been sought from universities.

The ideas should focus on accessibility, customer comfort, information and data sources.

Winners will be announced on 18 May 2015.

All presentations from the launch event are available on SPARK.

Navigating in the right direction with a £4m COMPASS competition

The recently closed COMbined Positioning Alternative Signalling System (COMPASS) £4m competition funded by Network Rail and the Future Railway programme.

COMPASS refers to a system being developed to enable trains to continue to move safely, should the signalling system fail. This is critical to safe running, reliability and in recovering the service more quickly. It will also provide signallers with a reliable alternative to Temporary Block Working (TBW) with a more accurate view of a train’s position, speed and direction of travel.

The competition hopes to find successful applicants to carry out an initial feasibility study to investigate the technical and commercial viability of their proposed solutions. Feasibility studies will be followed by further down-selections for a System Integration and Test Facility (SI&TF) demonstrator. Entries will be judged by a panel of industry experts including representatives from train operating companies (TOCs), Network Rail and RSSB.

PowerTrain - Improving energy efficiency of self powered vehicles

The competition seeking technical solutions to provide energy efficiencies for self-powered vehicles has selected nine entries for the feasibility stage.

28 entries were assessed and reviewed by a panel which announced the winners on 17 March. The nine chosen entries are currently in negotiations before entering commencing their feasibility studies.

On completion of that stage the most promising feasibility studies will receive further funding to develop and demonstrate their powertrain systems.
Predictable & Optimised Braking

The competition aim is to develop predictable and optimised braking in all conditions. This challenge provided an opportunity for UK design and manufacturing supply chain to showcase innovation.

Negotiations have begun with eight projects which have been chosen from the 18 applicants to enter the feasibility stage of this competition.

RSSB and Engineering and Physical Sciences Research Council (EPSRC) join forces to fund £2m research on the reduction of railway asset costs

Three new projects have been announced researching the potential for new materials to reduce the whole life costs of railway assets:

- **Whole-life cost assessment of novel materials railway drainage systems**
  University of Nottingham, focussing on application of new lightweight materials to reduce transport and handling costs of drainage components.

- **Rail-energy knowledge exchanges on emerging materials (ALCHEMy)**
  University of Sheffield, with a focus on laser cladding to extend the life of switchblades, crossing noses and insulated block joints.

- **Designing steel composition and microstructure to better resist degradation during wheel rail contact**
  Consortium project involving University of Huddersfield, Cranfield University, University of Cambridge and University of Leeds, with a focus on optimising steel grade choices for the wheel-rail interface.

For more information on our competitions go to [http://www.futurerailway.org/competitions](http://www.futurerailway.org/competitions)

Open competitions

**Industry wide £6m competition seeks innovative submissions from Train Operators**

TOC’15 builds on last year’s railway operator challenge competition (ROCC) and is offering £6m to co-fund innovative proposals to address key challenges faced by UK train operating companies.

We are looking for entries to include: innovative services, processes, designs and technology from proof of concept, to working operational prototype, and beyond. The competition closes on 15th May, a copy of the brief can be downloaded from the Future Railway website: [http://www.futurerailway.org/competitions](http://www.futurerailway.org/competitions)

**RISE**

The Rail Innovation Support Engine (RISE) is the always open co-funded competition managed by the Future Railway programme which provides financial and expert support to individuals, organisations and innovators in any industry proposing rail innovation. RISE is for innovations which do not match any other challenge competitions.

The RISE scheme was initiated in 2012 and since then it has received 140 applications, 11 have been given funding, 4 are complete, 14 are under review, 80 have accessed our expert advice and networking opportunities.

Over £1.6m has been invested in a variety of innovative projects so far with financial support ranging between £16,000 and £356,000 with the majority of the awards between £100,000 and £200,000.
IPEMU - The ‘battery powered train’

This project is part of a £7m collaboration between Network Rail, DfT, RSSB, Abellio and Bombardier. It was commissioned in CP4 and is funded by the Network Rail Development Fund and by RSSB through the Pilot Rail Innovation Fund.

The project has developed a prototype electric train, which is fitted with battery technology capable of powering the train without drawing electricity from overhead lines and provides a potential replacement option for diesel stock on branch lines where electrification would not be cost effective and to bridge other gaps in the electrified network.

Following its successful retrofitting and trials at test tracks in Derby and Leicestershire last year by Bombardier, the modified Class 379 Electrostar battery-powered train - also known as an Independently Powered Electric Multiple Unit (IPEMU) - ran in weekday timetable service for five weeks between Harwich International and Manningtree stations in Essex. The train successfully achieved all the performance objectives set for it.

The next stage of the programme will be to use the data collected from the trial to subject the batteries to accelerated testing on a load bank to establish the battery life which is a key component of the business case. A simulation model will also be developed to help assess which routes would be most suitable for the use of this type of train and a report will be published.

Supporting innovation

Light after Dark

As part of the Testing Voucher Scheme the Rail Alliance held ‘Light after Dark’ 2015

Light after Dark involved 20 companies who were able to trial/demonstrate a range of equipment focused on introducing innovations in productivity and safety for night working in the Rail Sector. A significant buyer reported:

“We are constantly looking at the rail market for new lighting products. The Light after Dark event provided us with an excellent opportunity to meet with suppliers in a focussed environment dedicated to rail lighting, which was exceptionally useful to us. We are really looking forward to attending the next Rail Alliance/ILP lighting event later on this year.”

Towards accessible facilities for testing innovations

Research project T1039 Economic assessment of a GB-based pantograph and overhead line testing facility has delivered a clear and positive business case for further investment in testing facilities for electrification systems.

The proposal to develop a network of Centres of Excellence linking university capabilities with testing facilities is now being explored in a wider feasibility study. This will consider the case for new facilities to support the introduction of innovative pantographs and OLE systems, as well as supporting the optimum maintenance of current systems.
Securing civil assets against extreme weather
Bridges and similar structures located in a river or Estuarine environment have always been subject to the effects of scour. The increasing frequency and intensity of extreme weather events over the past ten years has acted as a salient reminder of the potential vulnerability of these assets.

Through the Construction Industry Research and Information Association (CIRIA), both RSSB and Network Rail have contributed expertise and funding to update the manual on management of scour at bridges and other hydraulic structures. Active participation and the contribution of earlier research has ensured that the manual appropriately addresses management of railway assets and also secured free access to the manual for RSSB members via SPARK http://www.sparkrail.org. Asset managers can now apply best practice to protect bridges and other structures for many years to come.

Remote Condition Monitoring: Challenge 8: Monitor Optics Systems
Could fibre optics technology detect earthworks movements and landslip?
A contrived landslip was generated at Carlisle Kingmoor Network Rail yard to simulate earthworks movement to test the new sensing cables. The fibre optics technology, built into sensing cables, was buried in an embankment of spent track ballast before a generated landslip allowed the new technology to be tested.

This test was possible due to a co-funded Remote Condition Monitoring (RCM) competition. The competition focused on developing RCM techniques for asset areas that have been considered too difficult up until now.

The test used an excavator to ‘pull’ material away from the buried optical fibre to simulate earth movements, without moving the cable itself. The test successfully showed the change in strain to the cable when movement occurred in the vicinity. This could be developed into an early warning system before an embankment slip. The system would trigger alarms when distressed earthworks experience changes, before a collapse occurs.

RIA Conference Innovation Award
During the RIA Innovation Conference, 25 – 26 March, finalists for the 2015 Innovation Award (funded by the RSSB Future Railway programme) presented their final proposals with the hope of winning the initial £10k prize. This will open the second stage which will allow successful proposals access to remaining funding of up to £290k.

The three finalists were:

• Far UK - who developed a fire retardant composite material for use in the building of rolling stock.

• Interfleet - who wanted to develop a passenger assistance app that would particularly benefit persons with reduced mobility.

• Omnicom - who wanted to develop a cost effective train positioning system in order to know the exact position of every train.

The winners were Omnicom and they were presented with their prize of £10k at the conference by keynote speaker Clare Moriarty, Director General Rail Executive at the Department for Transport. Omnicom are now developing a second stage proposal in order to receive the remaining funding.

Infrastructure
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New train concepts respond to the challenges of tomorrow

Three concepts have been shortlisted to progress to the next phase with continued development of 4 highly commended submissions being dependent on the availability of further funding.

To view the shortlist visit [http://www.ribacompetitions.com/ttdt/shortlist.html](http://www.ribacompetitions.com/ttdt/shortlist.html)

42 Technology - Adaptable Carriage

A concept for a flexible-purpose carriage achieved through the automatic stowage and movement of seating. The key enabling technologies are:

- A novel seat that enables flexibility of orientation as a seat and perch, forward and rearward facing, as well as in a stowage position.
- A system for driving and controlling the movement in a safe and efficient manner.

Priestman Goode - Horizon

The Horizon train increases capacity and improves the passenger experience. The design includes the development of a seating concept that can flex between peak and off peak periods. Offering a standard seat during off peak and a commuter seat in peak hours, which allows greater capacity and an enhanced environment with table, power and connections for working whilst in commuter mode.

Aeroliner 3000

AEROLINER 3000 follows the consequent application of light weight thinking into the train world. The development of a combination of many singular elements concerning aerodynamics, traction, structure, interactive control systems and even passenger psychology will be orchestrated under the umbrella of a modern design and engineering culture informed by consequent lightweight thinking.

The finalists can be found via [http://www.ribacompetitions.com/ttdt/finalists.html](http://www.ribacompetitions.com/ttdt/finalists.html)

TTDT projects are 100% funded through the Small Business Research Initiative provided by the Department for Transport, and managed by the Future Railway programme. The competition was facilitated by the Royal Institute of British Architects (RIBA).
Crossrail

Crossrail’s Innovate18 programme

Crossrail is the largest construction project in Europe. The Innovate18 programme provides an opportunity for Crossrail to explore and capture the unique and pioneering ideas developed by those involved in the Crossrail project. Ultra low carbon concrete trials and digitalised Red Line review trials provide good examples of the diversity of innovative ideas being developed by Innovate18.

Ultra low carbon concrete (Cemfree trials)

Cemfree is an alkali-activated binder used in the generation of Portland cement. Alkali-activated binders use less energy to manufacture, and produces less carbon dioxide than conventional Portland cement. Cemfree was tested for its physical properties, workability and future durability on trial blocks (1m x 1m x 0.8m) and trial panels (surface rail track support slab and vehicle restraint wall). The trials demonstrated that whilst Cemfree is a potentially exciting low carbon alternative to cement, there are challenges to using it in a structurally critical context.

The information from the trial will influence future developments of similar low carbon products, and inform the debate on use of performance based standards in construction specifications.

Crossrail is considering whether the trial could be extended to include a sample of ultra low carbon concrete in one of the stations. It could provide further operational data about the characteristics and performance of the concrete over an extended period of time.

Digitalised Redline Review trials

Currently the Redline drawing review process used by Crossrail is the traditional, paper driven method data is gathered in the field. Drawings are marked up and notes taken, before a report is produced back in the office, when non-conformance and actions are formally recorded.

Innovate18 supported BaseStone, a SME company specialising in tablet and web based collaboration tools for architects and engineers in the construction industry, to undertake trials of their software at Paddington with the Costain-Skanska Joint Venture (CSJV). This allows users to create Redline drawings from the field, link information gathered from the field to the drawing, and improve the Redline drawing back in the office using any modern web browser on any computer.

This trial compared the current Redline review process with the digital BaseStone process, and indicated significant performance improvements, eliminating half of the required steps currently required in the manual process. Further trials indicated improvements when using the software for snagging reviews, and for site safety inspections.

The collaborative approach to these trials meant that BaseStone responded to user feedback, and tailored their product to align better to the required processes, including automating gathering of measurement metrics to support 6-sigma benchmarking.

We believe the use of this innovative product can contribute to significant process efficiencies for Crossrail throughout the remainder of the works, and we are currently engaged in 6-sigma trials at a number of other sites to measure comparative benefits.
Whole systems thinking

A ‘whole systems thinking’ pilot study has demonstrated how the structured selection of innovations and initiatives from within the Rail Technical Strategy (RTS) could be coherently brought together in the future to tackle the industry 4C challenges.

Taking the Woking to Waterloo route as a pilot, the objective was to identify the technical and performance requirements for doubling capacity and simultaneously reducing journey times without additional infrastructure. In this case the solution included reduced headways, lighter and more powerful trains, higher system reliability and higher track speeds.

Some of this can be done today and some will require research and innovation and helps us prioritise our programmes and demonstrate the ‘whole system’ benefits they can enable. The passenger benefits on this congested route would be significant, and the methodology has the potential to be further developed and applied to cost, carbon and customer challenges at other locations around the network as a powerful means of prioritisation for Rail Technical Strategy related initiatives.

Gauging programme meets next milestone

An extensive programme of R&D is being undertaken to define a new suite of standard vehicle gauges to simplify the process for introduction of new vehicle fleets and fleet redeployments.

Passenger standard vehicle gauges PG1 (20m vehicles) and PG2 (23m vehicles) have now been defined through research project T978 and are available for use prior to their incorporation in Railway Group Standard GE/RT8073. This adds to the previous publication of T977 Development of a revised lower sector vehicle gauge and will be further enhanced by a 26m gauge now being developed within research project T1092, and potential future work to define a locomotive gauge.

To ask a question or find out more about our Research, Development and Innovations programmes please email innovations@futurerailway.org.
Successful RISE projects - An onward travel app for cycle-rail users

A cycle app aiming to, amongst other things, allow complex cycle-rail journeys to be easily planned, clarify cycle carriage information and make it easier to understand has now been in use across the country for over a year.

Available as part of the National Rail Enquiries mobile app and developed as part of a joint project with ATOC’s Integrated Transport team, the resource has been very well received, winning an award at the National Cycle Rail Awards.

In addition, the cycle app has now been rolled out beyond Apps and into all National Rail Enquiry platforms.

R&D benefits numbers for closed projects

Research & Development which has been delivered during the last 12 months has the potential to lead to benefits against all of the 4C targets, for example:

**Carbon** An objective review of a range of carbon measurement tools (T1033) has enabled the industry to purchase an appropriate tool, so that embedded carbon impacts are taken into account in design of infrastructure projects.

**Cost** Research into the effects of railway traffic on embankment stability (T679) has provided new knowledge which can help to reduce the significant costs of maintenance.

**Capacity** A timetable modelling study (T1019) has investigated the system reliability needed to facilitate a high capacity railway, and has led to further work to develop practical timetable optimisation tools.

**Customer Experience** Development of a guide to complementary policing (T1021) has enabled good practice sharing to help TOCs and Network Rail to put in place the right levels of enforcement, investment and reassurance to deliver passenger security throughout their journeys.
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<td>Next Generation Rail: knowledge without borders</td>
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