RSSB Innovation Programme
Solutions Catalogue
(Projects)

1 November 2016
Solutions Catalogue (projects): Introduction

- This Catalogue provides information on RSSB Innovation projects that are part of the programme of investments (run by Network Rail and RSSB) delivering innovative technology-based solutions to the challenges facing the GB railway industry.

- The Solutions Catalogue is a live document, which is regularly revised to include new investments and updates on the status of existing ones.

- The investments support the goals of the 30-year Rail Technical Strategy which we expect to refresh and publish alongside the Initial Industry Plan.

- In the first instance, the catalogue has been developed for Planning Oversight Group (POG) members and planners for the Initial Industry Plan. Your feedback is welcomed.
This catalogue presents the RSSB Innovation programmes in order of the nine original themes from the Rail Technical Strategy (RTS) published in 2012, plus three additional themes:

01 Command, Control and Communication (CCC)
02 Energy
03 Infrastructure
04 Rolling Stock
05 Information
06 Customer Experience
07 Whole System Approach
08 Innovation
09 People
10 Europe
11 Multi-disciplinary Programmes
12 Innovation in Franchising
A rail-based positioning system with no reliance on GPS

PROGRAMME: FuTRO (Future Traffic Regulation and Optimisation)

PROBLEM STATEMENT: Within the FuTRO programme, we need to reliably identify a train's position to a high degree of accuracy in association with route knowledge.

SOLUTION: This project will deliver a positioning system with no reliance upon GPS, requiring no additional infrastructure other than existing parts of the track: rails and points. The system is track-side infrastructure-free, with all components fitted to the train. This completely removes a range of fail factors including infrastructure theft.

GoTRAX uses a low light sensitive infra-red camera to detect rails, points and distance travelled. GoTRAX fuses optical flow distance measurements with rail track and point detections to provide a specific track identifier and track position.

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ADVANTAGES:
GoTRAX uses the most reliable features available, the rails, to determine how far a train has travelled.

BENEFITS:
Increased capacity, reduced delays, simplified signalling

PROJECTED IMPLEMENTATION
To TRL 6-7 by late 2016

BENEFICIARIES:
TOCs, IM, passengers

KEY CHALLENGES:
Finding a suitable partner for the deployment in rail
A driver support system for route knowledge

PROGRAMME: FuTRO (Future Traffic Regulation and Optimisation)

PROBLEM STATEMENT: Accurate route knowledge recall can be challenging when driving diversionary routes, in poor visibility, during route learning and other instances where maintaining situational awareness is difficult.

SOLUTION: The Driver Support System (DSS) project enables a driver to maintain their situational awareness by displaying both the position of the train and also the relevant elements of route knowledge for that location. DSS is a tablet-based application that provides an in cab display to the driver of the route ahead. The DSS works in conjunction with the RDS Video Train Positioning System, which will also be provided.

A DSS demonstrator is to be developed and trialled in the second drivers position on a First Great Western Class 43.

Contact Information:
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Reliable Data Systems (RDS)
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Benefits:
Reduced driver stress, reduced delays, increased safety

Projected Implementation: To TRL 6-7 by late 2016

Beneficiaries:
TOCs, drivers

Advantages:
The enabling technology for the DSS application is the RDS Video Train Positioning System, providing real-time track-precise train location.

Key Challenges:
Business change necessary to realise the benefits
A network map to help locate trains

PROGRAMME: FuTRO (Future Traffic Regulation and Optimisation)

PROBLEM STATEMENT: Accurate route knowledge recall can be challenging when driving diversionary routes, in poor visibility, during route learning and other instances where maintaining situational awareness is difficult.

SOLUTION: The Map3 project is using the Network Rail network model to demonstrate two GNSS-based train positioning concepts which integrate a Digital Route Map (DRM) to enhance performance.

Map-Matching enhances train position reports at a back-office to support non-safety critical applications such as customer information systems.

Map-Aiding applies the map within an on-train positioning solution to support train control applications.

A third activity, Map-Improvement, involves finding and correcting errors within a map.

CONTACT INFORMATION:
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BENEFITS:
Better TOC/customer information, improved traffic management

PROJECTED IMPLEMENTATION
To TRL 5-6 by Q3 2016

BENEFICIARIES:
TOCs, IM, Passengers

ADVANTAGES:
The use of the network model as a DRM provides a means of enhancing both real time and offline train location information. This could benefit multiple applications and enable ETCS Level 3.

KEY CHALLENGES:
Subject to the robustness of the UK network model
COMPASS: Train location in degraded mode

PROGRAMME: Network Rail Programmes

PROBLEM STATEMENT: We need to develop a system for train location for when the signalling system fails and degraded mode working is in place.

SOLUTION: The Combined Positioning Alternative Signalling System (COMPASS) will provide signallers with a tactical picture of the railway, identifying the position of trains at any given point.

This will allow for improved operations during times of perturbation, resulting in reduced disruption to the travelling public and a reduction in delay payments for Network Rail.

Phase 1 (assessment and understanding of the system) has been completed. Phase 2, developing a backup traffic management system, which undertakes trials in a representative system, is now underway.

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BENEFITS:
Increased resilience to control system failures

PROJECTED IMPLEMENTATION
Potential operational status by 2019

BENEFICIARIES:
Passengers, TOCs, FOCs

ADVANTAGES:
COMPASS seeks to take advantage of all the modern forms of communication that enable train position, direction and speed to be determined in real time.

KEY CHALLENGES:
Operational Approval
Future-proofing against cyber threats

PROGRAMME: Network Rail Programmes

PROBLEM STATEMENT: We need to future-proof railway systems against cyber threats.

SOLUTION: The Telecoms Capacity Enhancement (Cyber Security Test facility) programme will develop a system level test facility to enable product development and early trials to be conducted in a safe but realistic railway environment.

This will aid in evaluating how emerging communications industry products can be applied to the railway while supporting traffic management and critical corporate systems.

Existing cyber threat detection is based around identifying and blocking known behaviours. This is a reactive approach, where the core capability is never up-to-date with emerging threats. The core need is to evaluate an approach which is capable of detecting and describing, in near real-time, emerging threats.

CONTACT INFORMATION:
Tim Lane
Safety, Technical & Engineering
Network Rail
Milton Keynes

ADVANTAGES:
The risk of cyber-attack is a rapidly developing threat, and this system will look at pre-emptive management through a test facility.

BENEFITS:
Security and safety risk reduction, reduced maintenance costs

PROJECTED IMPLEMENTATION
To TRL 6 by 2016

BENEFICIARIES:
Passengers, Railway Industry, DfT

KEY CHALLENGES:
Approvals process and system qualification
A more attractive OLE support structure

PROGRAMME: Aesthetic OLE

PROBLEM STATEMENT: We need to create a design that improves the aesthetics of the overhead line equipment (OLE).

SOLUTION: The Moxon Architects/Mott MacDonald design concept is for a single leg supporting mast (for 1 track), with an adapted version being developed for 2 or more tracks.

The vertical steel leg is in galvanised steel, fabricated in the form of a ‘V’. However, the design can be adapted to other types of leg, and the proposal is not restricted to this particular leg design.

The solution is aesthetically superior, with a modern, contemporary appearance including the warm appearance of the laminated wood element. It is also lower than the current system with fewer parts to install or maintain.

CONTACT INFORMATION:
Ben Addy
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ADVANTAGES:
This design is aesthetically superior to current structures, with reduced maintenance costs, and several patents ongoing.

BENEFITS:
Reduced environmental impact of electrification, reduced costs

PROJECTED IMPLEMENTATION
To TRL 6-7 by end 2016

BENEFICIARIES:
IM, public

KEY CHALLENGES:
Route to market
PROGRAMME: Aesthetic OLE
PROBLEM STATEMENT: We need to create a design that improves the aesthetics of the overhead line equipment (OLE).
SOLUTION: The proposal for an ‘Aesthetic Overhead Line System’ is a simple T-shape pylon configuration, centred between the tracks, serving two tracks at the same time. The solution is calm and aesthetically pleasing, having only one pylon rather than two, with consequent lowered foundation size and costs. It can easily integrate into a slab track solution, reducing the need for adjustment of the catenary system. Slab track will reduce the maintenance costs, the need for vegetation control, and give excellent riding comfort, etc. It has a small wire support arm, hanging as a "jewel" below the cross arm, which easily adjusts the catenary wire system.

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ADVANTAGES:
A visually very aesthetic T-shape configuration serving two tracks, with only a small catenary support arm.

BENEFITS:
Reduced environmental impact of electrification, reduced costs

PROJECTED IMPLEMENTATION
To TRL 6-7 by end 2016

BENEFICIARIES:
IM, public

KEY CHALLENGES:
Route to market, possible public opposition in the UK
A more attractive OLE support structure

PROGRAMME: Aesthetic Overhead Line Structures

PROBLEM STATEMENT: We need to create a design that improves the aesthetics of the overhead line equipment (OLE).

SOLUTION: The Tomahawk reduces the visual impact, the number of parts and organizes the conductors in a way that improves the adaptation to the surrounding landscape.

The ambition is also to make a cost efficient design that is easy to install and maintain.

This solution offers a simple design, easy to maintain and a possible alternative to current solution for overhead lines.

The design uses off the shelves components as well as true innovations. The unique feature is the “S-­­Tube” that supports the contact wire. The prototype is currently under construction.

CONTACT INFORMATION:
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ADVANTAGES:
The unique feature of this more aesthetic overhead line structure is the ‘S-­­Tube’ that supports the contact wire.

BENEFITS:
Reduced environmental impact of electrification, reduced costs

PROJECTED IMPLEMENTATION
At TRL 4, to TRL 6-­7 by 2017

BENEFICIARIES:
IM, public

KEY CHALLENGES:
Finding an end user willing to implement the design
PROGRAMME: Future Ticket Detection

PROBLEM STATEMENT: We need to respond to significant congestion in stations, particularly at gate-lines, which can lead to safety and crowd control issues, as well as revenue loss.

SOLUTION: Alternative and innovative solutions for detecting Tickets and protecting revenues are critical components in meeting increasing demands. The solution is to supply testers/volunteers with a media device (credit card size) which they will keep on their person while traveling. They will be able to bypass the Ticket Validation Gates and the need to purchase a Ticket.

With antennas placed in each train carriage, a passenger entering the train is recorded and when the passenger leaves the train at the destination station this is also detected and the completed journey is uploaded to the server for reconciliation.

ADVANTAGES:
A ticketing solution that will make it possible for a train station and a train operator to operate services without the need for Ticket Validation Gates and a reduction in Ticket machines.

PROJECTED IMPLEMENTATION:
To TRL 6-7 by mid 2017

BENEFICIARIES:
TOCs, Passengers, Station Operators

KEY CHALLENGES:
To fit within existing ticketing technologies and mediums

CONTACT INFORMATION:
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BENEFITS:
Improved customer experience, revenue protection, reduced congestion, travel flexibility
PROGRAMME: Future Ticket Detection

PROBLEM STATEMENT: We need to respond to significant congestion in stations, particularly at gate-lines, which can lead to safety and crowd control issues, as well as revenue loss.

SOLUTION: The proposal is to develop a “Gateless Gateline” concept demonstrator using advanced Video Analytics, and Bluetooth technology as well as all other ticket media. This will improve passenger experience and double throughput whilst ensuring revenue protection remains at the level it currently is (or better), all while ensuring safety for passengers is not compromised.

ADVANTAGES:
A potential 100% increase in passenger throughput at station gate lines. Maintaining revenue protection whilst enabling a gateless system.

BENEFITS:
Reduced congestion, improved customer experience, revenue protection maintained

PROJECTED IMPLEMENTATION:
To TRL 6-7 by mid 2017

BENEFICIARIES:
TOCs, Passengers, Station Operators

KEY CHALLENGES:
Uptake from passengers with consideration to novel ticketing methods and data protection

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PROGRAMME: Pantograph Challenge  

PROBLEM STATEMENT: We need methods for improving the testing and design of pantographs on rolling stock.  

SOLUTION: This project is developing a system for testing pantographs (which allow trains to get power from overhead wires) within depots in a realistic manner for maintenance purposes. This will assist operators to provide dependable rail services.  

In Phase one, a laboratory based system will evaluate pantograph performance and develop a suite of algorithms and a test procedure suitable for use as part of a standard maintenance process. The test process will include both vertical and lateral dynamic actuation of a pantograph.  

In Phase two a second, enhanced, test system will be manufactured and installed in the Bounds Green depot. This will remain in place for one year for continual testing.  

PROGRAMME:

A dynamic pantograph testing facility

UNIVERSITY OF BIRMINGHAM

CONTACT INFORMATION:
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ADVANTAGES:
The development of a dynamic pantograph test procedure and performance evaluation for analysing data sets, focussed on fault prediction.

BENEFITS:
Reduced maintenance costs, increased reliability

PROJECTED IMPLEMENTATION
To TRL 6-8 by 2017-18

BENEFICIARIES:
IM, TOCs

KEY CHALLENGES:
the complexities of installation on a depot site
PROGRAMME: Avoidance of Bridge Reconstruction

PROBLEM STATEMENT: We need to find ways to allow overhead electric lines to pass beneath existing bridges and tunnels, where space is limited, to enable further electrification.

SOLUTION: ‘PanSpace’ is a software tool that utilises technology based on complex algorithms to accurately calculate and simulate clearances available under bridges and tunnels. This approach uses dynamic and probabilistic gauging technology and provides an alternative to CAD systems which are typically used at the feasibility and option selection stage.

Phase 1 has demonstrated significant reductions in track lowering requirements. Therefore Phase 2 will develop the solution to meet the needs of designers, infrastructure managers and emerging group standards.

CONTACT INFORMATION:
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BENEFITS:
Reduced disruption and delays, reduced upgrade costs

PROJECTED IMPLEMENTATION
To TRL 7 by 2017-18

BENEFICIARIES:
IM

ADVANTAGES:
This dynamic pantograph gauging tool is an alternative to CAD systems which adjusts for the local track conditions (sway) and typical wire conditions (height, stagger, etc.).

KEY CHALLENGES:
To test and validate the process in a design environment
PROGRAMME: Avoidance of Bridge Reconstruction

PROBLEM STATEMENT: We need to find ways to allow overhead electric lines to pass beneath existing bridges and tunnels, where space is limited, to enable further electrification.

SOLUTION: This proposal investigates reduced depth track solutions at sites where track lowering is required. The solution examines new track bed products and construction techniques recently introduced to the market, and whether these can reduce the depth of track bed construction.

The study also examines techniques used in other industries and examines the potential to transfer technology into the rail sector.

By stiffening the track bed layers it is possible to improve its performance and reduce its depth while maintaining sufficient performance to the standard of track bed construction.

**ABR SC03-ABR-02**

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**BENEFITS:**
Reduced disruption and delays, reduced upgrade costs

**PROJECTED IMPLEMENTATION:**
To TRL 6 by 2017-18

**BENEFICIARIES:**
IM

**ADVANTAGES:**
The project determined that both asphalt sub-ballast and geo-web solutions provide construction depth savings compared to standard track bed construction techniques.

**KEY CHALLENGES:**
construction elements associated with the site trial
PROGRAMME: Avoidance of Bridge Reconstruction

PROBLEM STATEMENT: We need to find ways to allow overhead electric lines to pass beneath existing bridges and tunnels, where space is limited, to enable further electrification.

SOLUTION: PCAT proposes the use of a precast concrete slab track structure. This is ideally suited for the lowering of the track profile and can lower track levels by as much as 500mm, reducing costs and disruption. Compared with traditional track lowering using ballast, this approach includes recycling the existing lower ballast to provide a hydraulically bound material base, saving construction time, material costs and embedded energy.

Other benefits of the PCAT system include minimised carbon emissions, weather resilience and durability, and easy realignment after ground settlement.

CONTACT INFORMATION:
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PreCast Advanced Track Ltd (PCAT)
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ADVANTAGES:
The PCAT concept is the next generation track structure, made of a tough macro synthetic fibre reinforced slab and a patented joint system.

BENEFITS:
Reduced whole life cost, increased track reliability and sustainability

PROJECTED IMPLEMENTATION
To TRL 6 by 2016

BENEFICIARIES:
IM

KEY CHALLENGES:
Route to market and industry acceptance
Jacking techniques for masonry arch bridges

PROGRAMME: Avoidance of Bridge Reconstruction

PROBLEM STATEMENT: We need to find ways to allow overhead electric lines to pass beneath existing bridges and tunnels, where space is limited, to enable further electrification.

SOLUTION: The proposed solution involves jacking the masonry arch upwards to increase the headroom beneath the bridge, then reshaping the road above to suit the new height.

Masonry arches are robust structures when left alone, in place and undisturbed, relying on their mass to generate stability through arch action.

Lifting an arch has the potential to destabilise it, so consideration must be given to maintaining or replicating the arch action throughout the lifting operation. Permanent stability must be reinstated when the arch is at its new height.

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BENEFITS:
- Reduced disruption and delays, reduced upgrade costs

PROJECTED IMPLEMENTATION
To TRL 7 by end October 2016

ADVANTAGES:
- This may be the first time that a masonry arch has been lifted in this way, to reduce the time for possessions.

KEY CHALLENGES:
- Demonstration and final design completion

BENEFICIARIES:
- IM
PROGRAMME: Avoidance of Bridge Reconstruction

PROBLEM STATEMENT: We need to find ways to allow overhead electric lines to pass beneath existing bridges and tunnels, where space is limited, to enable further electrification.

SOLUTION: A Decision Support Tool (DST) is being developed to reduce risk and provide efficiencies in enabling electrification. The DST will help define the preferred option for installing overhead wires in an existing tunnel: that option can be taken forward to design. The DST would run alongside an existing Building Information Modelling (BIM) software package, which models structures: these packages could complement each other. 3D modelling of existing tunnel profiles will allow different alignment/geometric options to be compared and exploit the clash detection capabilities of BIM software.

CONTACT INFORMATION:
Mike Hill
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BENEFITS:
More cost-efficient design, increased safety, reduced delays

PROJECTED IMPLEMENTATION:
Not yet funded beyond TRL 3

BENEFICIARIES:
IM

ADVANTAGES:
The proposed innovative decision support tool would build on cutting edge BIM technology to produce site-specific solutions.

KEY CHALLENGES:
Funding the high cost of developing such a BIM-based tool
PROGRAMME: Avoidance of Bridge Reconstruction

PROBLEM STATEMENT: We need to find ways to allow overhead electric lines to pass beneath existing bridges and tunnels, where space is limited, to enable further electrification.

SOLUTION: The use of steel sleepers instead of the more traditional concrete sleepers can allow reductions in rail height of up to 150mm without disturbing the existing foundation.

However, the existing Network Rail steel sleeper is not permitted for use on Category 1 tracks. Tata Steel will develop a steel sleeper suitable for use in Category 1 tracks and that will be capable of carrying more than 10MGTPA.

The sleeper developed will have enhanced fatigue resistance at the rail seat and be formed of a stronger section than the current steel sleeper.

CONTACT INFORMATION:
David Benton
Tata Steel UK
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ADVANTAGES:
This sleeper uses a revised section that will enable it to be used in higher category tracks where electrification is being proposed.

BENEFITS:
Reduced disruption and delays, reduced upgrade costs

PROJECTED IMPLEMENTATION
Currently at TRL 7

BENEFICIARIES:
IM

KEY CHALLENGES:
Route to market
A system to optimise reduced clearance

PROGRAMME: Avoidance of Bridge Reconstruction

PROBLEM STATEMENT: We need to find ways to allow overhead electric lines to pass beneath existing bridges and tunnels, where space is limited, to enable further electrification.

SOLUTION: This proposal is the design of an insulation system for optimising reduced clearance under a bridge, providing a basic space below the bridge for wires to run. Where the air gap is too small to provide electrical clearance the system provides a basic insulation making possible the installation of cables or the fact of having passing pantographs closer to the bridge wall, ceiling or vault.

The removable solution meets the inspection needs of bridge inspections teams.

PROJECT DETAILS

CONTACT INFORMATION:
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Electren UK Ltd
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BENEFITS:
Improved business case for electrification, better reliability

PROJECTED IMPLEMENTATION
Product acceptance late 2017

BENEFICIARIES:
IM

ADVANTAGES:
This solution covers the length of the bridges, as opposed to current solutions which only mitigate local reduced clearance.

KEY CHALLENGES:
Network Rail Route Asset Manager’s product requirements
PROGRAMME: Avoidance of Bridge Reconstruction

PROBLEM STATEMENT: We need to find ways to allow overhead electric lines to pass beneath existing bridges and tunnels, where space is limited, to enable further electrification.

SOLUTION: This proposal is for a bespoke prototype for an overhead line (OLE) support which would suit any type of bridge shape, i.e., arched or flat, using an OLE electric system which can carry 8 times more current than the standard OLE system.

This will also reduce the risk of flashover (dissipation of energy from the wires to earth, with an accompanying flash) by adding special ‘dielectric blankets’ in susceptible areas.

This solution can gain around 170-200mm in headroom in comparison with the existing supports.

CONTACT INFORMATION:
Carlos Azuaga
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ADVANTAGES:
An OLE support design for bridges which uses an insulating bar and dielectric blankets, enabling closer installation and reduced flashovers.
A decision support tool for RCM alarms and response

PROGRAMME: Remote Condition Monitoring

PROBLEM STATEMENT: We need to set RCM alerts and alarms that are relevant, ensure the right operational response happens, and use the data to optimise safety and performance.

SOLUTION: CFAR Autotrend is a breakthrough automatic alert detection technology that detects events (e.g. leaves on the line), rather than levels in condition monitoring data. It has a very high probability of detection and very low false alarm rate making the defect detection accurate, timely and dependable. This means that organisations have the earliest possible detection of a defect and this provides the opportunity to optimise maintenance interventions.

This technology was initially developed for aerospace and is now being validated across a number of assets within the rail sector.

CONTACT INFORMATION:
Ken Pipe, Humaware
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 BENEFITS:
Reduced maintenance costs, reduced delay minutes and increased safety

PROJECTED IMPLEMENTATION
Available off-the-shelf in 2017

BENEFICIARIES:
IM

ADVANTAGES:
The CFAR Autotrend system has an adaptive threshold setting tool and very low false alert rates.

KEY CHALLENGES:
Integration into operations
PROGRAMME: Remote Condition Monitoring

PROBLEM STATEMENT: We need to set RCM thresholds within Intelligent Infrastructure which generate events that are optimised to minimise false alarms, and maximise the detection of true fault symptoms.

SOLUTION: Intelligent Infrastructure’s automatic threshold calibration provides a decision support capability that enhances fault symptom detection for track circuit and point switch assets. Automatic calibration produces a step change in operational efficiency, reliability, consistency and repeatability resulting in fewer false alarms and improved symptom detection rates.

The automatic calculation of threshold levels also reduces the time required for manual management by Flight Engineers, therefore reducing the associated costs.

**Project Details**

**THALES**

CONTACT INFORMATION:
Graeme Burden
Thales UK, Research and Technology
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ADVANTAGES:
The solution reduces the time and effort spent managing asset thresholds whilst improving the detection accuracy of fault symptoms.

BENEFITS:
Reduced maintenance costs, reduced time required from Flight Engineers

PROJECTED IMPLEMENTATION
To TRL 4 by 2017

BENEFICIARIES:
IM, II users

KEY CHALLENGES:
Determine if the system can calibrate thresholds for the most unstable assets in the infrastructure
Detecting objects and people on the infrastructure

PROGRAMME: Remote Condition Monitoring

PROBLEM STATEMENT: We need to be able to detect and prevent potential safety hazards using 24/7 high definition visual coverage of the network.

SOLUTION: The Object Movement & Human Intrusion Detection System (OHMIDS) uses CCTV built into trains to detect signs of unauthorised humans within the railway boundary (including trespass and vandalism), and to detect signs of landscape change that could adversely affect the track.

For humans, the feasibility testing was concerned with the ability to detect humans in the wide range of lighting conditions found in a train journey.

For objects, the system generates an 'interest map' of the track, and monitor for changes over time, looking for significant movements in that location.

PROJECT DETAILS:

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BENEFITS:
Early detection of incursions, reduced delay minutes and increased safety

PROJECTED IMPLEMENTATION
To TRL 6 by 2016

BENEFICIARIES:
IM, TOCs, general public

ADVANTAGES:
This solution minimises the hardware required for detecting objects, using cameras already built into the trains instead of a large network of sensors.

KEY CHALLENGES:
Achieving a low false positive rate
PROBLEM STATEMENT: How to detect early likelihood of flooding in risk areas with information provided in a timely fashion.

SOLUTION:

The flood inundation forecasting system will comprise the following components:

- Real-time live hourly forecast feeds, 24 hours in advance of flood related hydro-meteorological variables.
- Flood inundation simulation in real-time using a computationally efficient inundation model.
- Real-time flood map visualisation using internet-based map servers.

Forecasted flood extents offer a more directly translatable and useable variable with which to inform track closure decisions.

CONTACT INFORMATION:
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ADVANTAGES:
Advance warning to implement emergency procedures to deal with flooding, which in turn reduces the impact on delays.

BENEFITS:
Reduce delay minutes and costs, increased safety

PROJECTED IMPLEMENTATION
Feasibility completed by Aug 2016

BENEFICIARIES:
IM

KEY CHALLENGES:
Future-proofing the technology for national application
**Programme: Remote Condition Monitoring**

**Problem Statement:** We need to detect, monitor and prevent high-risk water levels indicating flooding or a lying water hazard on the rail network.

**Solution:** The Hydro-Mote is an advanced, low-cost, low-power GPRS solution that can be deployed in and around the rail network for monitoring of high-risk areas such as water levels in rivers, culverts and the water table of surrounding fields. The Hydro-Mote can be left in the field to remotely report the status of potential flood risk for up to two years per unit - including an on-board health check capability to warn of low battery or loss of communication. It can also be integrated into existing meteorological applications to provide real-time updates, set thresholds and provide multiple early warning alerts for deployment, flood mitigation and management.

**Project Details**

**Contact Information:**
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**Benefits:**
- Real-time monitoring of remote location culverts, rivers and ditches to give early flood warning information

**Projected Implementation:**
3 months from getting approval to proceed

**Beneficiaries:**
- IM, TOCs, other industries

**Advantages:**
- This solution is a real-time self-powered remote condition monitoring unit with user-definable thresholds and in-built communications.

**Key Challenges:**
- Further development to enhance the software package and tailoring to the end users requirements
PROGRAMME: Remote Condition Monitoring

PROBLEM STATEMENT: Detecting voids under track using existing equipment in-service trains.

SOLUTION: By the addition of accelerometer sensors inside the on-board cab radio the Siemens Nexus Tracksure RCM could be used to detect vibrations from voids or rough ride under both plain track and Switches & Crossings (S&C). An integrated GPS module accurately pin-points the location of these defects. Widespread use of the Nexus Tracksure fitted to UK trains would allow track void data to be collected quickly across the entire rail network, including small branch lines. The analysis of data from multiple trains will help to reduce false alarms and increase the accuracy of void size and location. The data from Nexus Tracksure could be fed into the network operators Intelligent Infrastructure, helping to provide prioritised and directed maintenance.

PROJECT DETAILS:

CONTACT INFORMATION:
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BENEFITS:
Potential to monitor whole network using in-service trains

PROJECTED COMMERCIALISATION
Aim to achieve TRL 8 by end of 2017

BENEFICIARIES:
Network operators & TOCs

KEY CHALLENGES:
Further live trials needed

ADVANTAGES:
Nexus Tracksure, if installed within the cab radio across a high volume of the UK fleet, has the potential to deliver cost-effective track condition monitoring (including small branch lines).

On-board rail defect sensors to detect track voids
**PROGRAMME**: Remote Condition Monitoring

**PROBLEM STATEMENT**: To detect developing or developed faults; characterise known faults.

**SOLUTION**: Previous research and development has determined that for effective track maintenance assessment two key functional capabilities are necessary: (i) Initial defect detection, which should be carried out from an in-service train capable of monitoring track alignment; (ii) The ability to deploy track-based sensors over a specific track section to monitor track degradation at an individual sleeper level.

The proposed solution includes plans to take both of these innovations from the existing initial prototype stage to approaches that can be developed and used, either separately or together in an integrated fashion, in an operational railway.

**PROJECTED IMPLEMENTATION**

To TRL 7-8 by 2016

**BENEFICIARIES**

Infrastructure managers, TOCs

**BENEFITS**

Improvement in the planning of maintenance, increased reliability

**ADVANTAGES**

Integrated with existing Network Rail information systems, low cost.

**KEY CHALLENGES**

Accurate and timely detection

**CONTACT INFORMATION**

Sarah Jordan
University of Birmingham
0121 414 2626
s.jordan@bham.ac.uk
Detecting and monitoring voids in the track

PROGRAMME: Remote Condition Monitoring

PROBLEM STATEMENT: We need to be able to monitor voids in critical and high risk junctions to anticipate if/when defects may grow.

SOLUTION: A Portable Void Measurement Device (PVMD) which is self-contained, battery operated and it is quick and simple to install.

The PVMD is able to detect the train as it approaches that particular section of the track, then it automatically starts logging the track movement at very fast sampling rates. After the train has passed, the device will transmit all data to a central server where it is analysed automatically, providing the end user with any alarms which have been detected.

ADVANTAGES:
The solution proposes a self-contained battery operated void monitoring device which is quick and easy to fit. The system will send notifications via SMS/email when the void has increased to a critical level.

CONTACT INFORMATION:
Eduardo Mendoza
Yeltech Ltd
+44 8450 523860
Eduardo@yeltech.co.uk

BENEFITS:
Reduced disruption and delays, reduced maintenance costs and increased safety

PROJECTED IMPLEMENTATION
Available by 2017

BENEFICIARIES:
IM

KEY CHALLENGES:
Management of data acquired by the system
PROGRAMME: Remote Condition Monitoring

PROBLEM STATEMENT: We need to be able to detect and predict the development of voids under Switches & Crossings (S&Cs).

SOLUTION: The Smart Washer is a multifunctional device which monitors the clamp force condition of safety critical fasteners deployed on S&Cs. With the addition of an accelerometer which, based on computer simulation and extensive data libraries, confirms that the enhanced smart washer would be able to detect voids as small as 1 mm and changes in inclination of 0.5°. In addition, it also enables overloading and excessive speeds to be detected, a contributing factor to both rail and ballast degradation.

Each smart washer has a unique ID and, along with a time and location stamp, embedded programmability and wireless comms, automates data management whilst eliminating human error.

CONTACT INFORMATION:
Roger Bromley
Smart Component Technologies
07710 486888
R.Bromley@hud.ac.uk

BENEFITS:
The operational benefits include increased reliability, capacity and safety, reduced costs and delays caused by voids and impact damage at S&Cs

PROJECTED IMPLEMENTATION
To TRL 6 by 2017

BENEFICIARIES:
IM

ADVANTAGES:
This solution is a low-cost versatile platform technology that incorporates a wide range of sensor options, user interfaces and data comms and integration into asset management systems.

KEY CHALLENGES:
Detailed cost-benefit analysis to optimise installation strategy
PROGRAMME: Remote Condition Monitoring

PROBLEM STATEMENT: Cast manganese crossings are considered golden rail track assets which cannot be inspected using traditional non-destructive techniques (NDT). Damage initiation and propagation are not understood satisfactorily.

SOLUTION: Acoustic emission (AE) is an online remote condition monitoring technique which can be applied for detecting crack initiation and propagation in crossings. The principle of AE is based on the application of an external load on a solid causing it to deform elastically. During crack growth in cast manganese steel high-frequency stress waves are released towards every direction with some of them being detected by piezoelectric AE sensors mounted on the wing of the crossing. A feasibility study has been carried out successfully concluding that AE is indeed capable of detecting damage growth in railway crossings.

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CONTACT INFORMATION:
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School of Metallurgy and Materials
The University of Birmingham
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ADVANTAGES:
There is currently no alternative technique proven to be able to monitor crack growth in crossings under actual operational conditions.

BENEFITS:
Improved reliability and safety, and optimised maintenance planning

PROJECTED IMPLEMENTATION
TRL 7 by end of 2017

BENEFICIARIES:
Infrastructure Managers, Train Operators, Rail Track Maintainers

KEY CHALLENGES:
Obtaining the necessary funding for full scale technology demonstrator
PROGRAMME: Remote Condition Monitoring

PROBLEM STATEMENT: We need to develop a robust method for the enhanced detection of fatigue cracks in cast crossings and improved measurement of their growth rate.

SOLUTION:
Low frequency ultrasonic testing, based on ultrasonic guided waves, enables the areas of concern within the large volume of the casting to be monitored using a minimum number of sensors, even in the presence of the coarse-grained cast macrostructure. Ultrasonic guided waves are generated in the foot of the rail by a transducer tool so flaws such as corrosion and fatigue cracks can be detected many metres from the location of the transducer tool.

CONTCT INFORMATION:
Peter Mudge
The Welding Institute Ltd
01223 899000
peter.mudge@twi.co.uk

BENEFITS:
Prevention of traffic disruption during periods of inspection and monitoring

PROJECTED IMPLEMENTATION
To TRL 9 by 2020

BENEFICIARIES:
Rail manufacturers and users

ADVANTAGES:
Guided waves offer rapid screening for in-service degradation, the ability to inspect inaccessible areas and a significant reduction in the cost of gaining access.

KEY CHALLENGES:
Detection of fatigue cracks in cast crossings and measurement of their growth rate during service
Detecting and monitoring cracks on rail crossings

**PROBLEM STATEMENT:** We need to achieve a reliable, successful system for monitoring crack development in rail crossings.

**SOLUTION:** ‘Crossing Watch’ uses existing but leading edge fibre optics sensing technology to measure cracks in rail.

The system directly measures variations in specific parameters (strain fields) in crossing structural elements (rails, etc.) caused by the onset and development of cracks.

The specific type of sensor used is Fibre Bragg Grating (FBG) which is a very sensitive transducer capable of detecting very small changes in strain fields.

The solution will be demonstrated on a live track under various conditions, to prove the system in a rail environment.

**CONTACT INFORMATION:**
James Preston
Monitor Optics Systems, Dublin
07792 650440
jpreston@monitoroptics.com

**BENEFITS:**
Reduced risk to inspectors, reduced delay minutes and increased safety

**PROJECTED IMPLEMENTATION:**
To TRL 8-9 by 2016

**BENEFICIARIES:**
IM

**ADVANTAGES:**
The solution proposes constantly monitoring railway crossings using fibre optics. It has been successfully applied in many other industries.

**KEY CHALLENGES:**
Determine if the system can survive the harsh railway environment
PROGRAMME: Remote Condition Monitoring

PROBLEM STATEMENT: We need to prevent trains running across track which is made unusable by movement of earthworks such as cuttings and embankments.

SOLUTION: The GNSS Landslide Monitoring Service (GLENS) is based on the highly innovative use of low-cost Global Navigation Satellite System (GNSS) equipment developed for the purposes of very precise and accurate monitoring of land movement. It is specifically applicable to land movement occurring next to railway track. The handling of all data is based at a back-office location and constitutes a monitoring service. The GNSS technology employed is accurate to less than 1cm.

CONTACT INFORMATION:
Michael Hutchinson
Nottingham Scientific Ltd.
01159 682960
michael.hutchinson@nsl.eu.com

BENEFITS:
Reduced disruption and delay minutes, increased safety

PROJECTED IMPLEMENTATION
Available 2017-2018

BENEFICIARIES:
IM

ADVANTAGES:
The solution enables small absolute land movements to be detected using expendable hardware.

KEY CHALLENGES:
Identifying an appropriate commercial model for the railway
Detecting the likelihood of flooding in risk areas

PROGRAMME: Remote Conditioning Challenge

PROBLEM STATEMENT: Early flood and embankment movement warning

SOLUTION: Calyx-PRIME software offers the integration of the newly developed PRIME geophysical monitoring instrument with the Calyx geotechnical information delivery dashboard. This captures 3D time-lapse, resistivity images of subsurface moisture movement and plots of ground surface displacements to be delivered automatically through a web portal in an intelligible and relevant form for potential end-users. This is a new tool for coupled tracking of internal wetting fronts and surface movement within asset management, enabling early warning and decision support.

CONTACT INFORMATION:
Dr David Gunn / Dr Jon Chambers
British Geological Survey
dgu@bgs.ac.uk
Nick Slater, ITM (Asset Monitoring)
nick.slater@itmmonitoring.com

ADVANTAGES:
Early warning of the subsurface changes that lead to movement; thus giving asset maintenance more time to implement early interventions.

BENEFITS:
Early warning for critical slopes

PROJECTED IMPLEMENTATION
To TRL 8/9 by 2018

BENEFICIARIES:
Network Operators; Asset Managers

KEY CHALLENGES:
Automated information delivery system currently being developed
PROGRAMME: Remote Condition Monitoring

PROBLEM STATEMENT: How to monitor the movement of earthworks.

SOLUTION:
An array of independent 360° viewing camera modules: each module can “see” other nearby modules and calculate their relative position. Modules are powered by solar cells and are linked wirelessly to Network Rail’s Intelligent Infrastructure system.

Sensor modules, at approx. 5m spacing, can be extended to cover any size of area by increasing the number of sensor modules employed and does not rely on GPS or similar power-hungry technologies to determine the device position.

This gives potential to monitor the positions of other natural or infrastructure objects (such as trees, gates, fences, signal posts, electrification masts etc.)

CONTACT INFORMATION:
Roger Hazelden
Conekt
0121 627 4242
roger.hazelden@zf.com

ADVANTAGES:
Provides a simple, robust, inexpensive system for accurately monitoring movement of earthworks.
Self-powered so no battery replacement.

BENEFITS:
Reduced delays through early warning of earthworks movement

PROJECTED IMPLEMENTATION
Feasibility at TRL2-3 confirmed.
Needs funding for demo at TRL5

BENEFICIARIES:
Infrastructure maintenance, train operators, passengers

KEY CHALLENGES:
Detailed design for robustness in outdoor railway environment

APSCAM (Array of Position Sensing Cameras)
Detecting and measuring embankment movements

PROGRAMME: Remote Condition Monitoring

PROBLEM STATEMENT: We need to prevent trains running across track which is made unusable by the movement of earthworks such as cuttings and embankments.

SOLUTION: ‘Embankment Watch’ uses existing but leading edge fibre optics sensing technology to detect movements within railway earthworks.

It will be able to detect small movements that may lead to failure within the earthworks and for this reason will be capable of being used as an early warning system. At the same time the solution will be able to detect large movements compatible with earthworks failure and be used as a tool to issue warnings to trains.

The specific type of sensor used is Fibre Bragg Grating (FBG) which is a very sensitive transducer capable of detecting very small changes in strain fields.

CONTACT INFORMATION:
James Preston
Monitor Optics Systems, Dublin
07792 650440
jpreston@monitoroptics.com

BENEFITS:
Reduced maintenance costs, reduced delay minutes and increased safety

PROJECTED IMPLEMENTATION
To TRL 8-9 by 2016

BENEFICIARIES:
IM, TOCs

ADVANTAGES:
The solution proposed introduces the capability of constantly monitoring earthworks using fibre optics based monitoring. It has been successfully applied in many other industries.

KEY CHALLENGES:
determine if the system can survive the harsh railway environment
PROGRAMME: Remote Condition Monitoring

PROBLEM STATEMENT: We need to prevent trains running across track which is made unusable by the movement of earthworks such as cuttings and embankments.

SOLUTION: UtterBerry has developed a low-power wireless sensor device with multiple functionalities. The wireless sensors provide remote monitoring of embankments and cuttings so that immediate preventative, evasive and remedial action to be taken to prevent trains from running onto track that is compromised by earthworks, creating a hazard.

This solution has been made possible through advancements in digital electronics, wireless communications and micro-electro-mechanical systems. These wireless sensor devices sense changes, process data and communicate this to other devices in real time.

Wireless detection of earthworks movements

CONTACT INFORMATION:
Heba Bevan
UtterBerry Ltd, WC2A 1LG, London
020 8123 5272
heba@utterberry.com

ADVANTAGES:
On-board acceleration, tilt, humidity and temperature sensors measure localised behaviour with a lightweight, compact and robust system.

BENEFITS:
Reduced maintenance costs, reduced delay minutes and increased safety

PROJECTED IMPLEMENTATION
To TRL 8-9 by 2016

BENEFICIARIES:
IM, TOCs

KEY CHALLENGES:
Issues around understanding earthwork movement
PROGRAMME: Remote Condition Monitoring

PROBLEM STATEMENT: To achieve improvements in track circuit reliability.

SOLUTION: To develop a track circuit simulator to simulate a variety of different track circuits in order to understand: failure modes; the sensitivity of key parameters; the appropriateness and any required thresholds for condition monitoring equipment.

Also to develop an RCM unit which is a low cost, low power microcontroller-based track circuit monitoring node that is able to provide fault detection and diagnosis capabilities for DC and AC track circuits. It will be possible to determine the appropriate thresholds, and optimum positioning of the node using the track circuit simulator.

Project Details

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CONTACT INFORMATION:
Sarah Jordan
University of Birmingham
0121 414 2626
s.jordan@bham.ac.uk

ADVANTAGES:
Simulator allows rapid evaluation of monitoring scenarios and equipment performance.

BENEFITS:
Low cost, low power RCM unit, proactive maintenance regime

PROJECTED IMPLEMENTATION
To TRL 5-6 by 2016

BENEFICIARIES:
Railway infrastructure managers, TOCs, FOCs, Rail Users

KEY CHALLENGES:
Simulation of complex multivariable system
Programme: Remote Condition Monitoring

ProBLEM STATEMENT: To enable the effects of track circuit faults to be simulated to demonstrate their effects on operational track.

SOLUTION: Characterise track parameters on plain track in order to develop mathematical models for a number of track circuit types. Fine-tune the models using data from problematic operational track circuits.

Project Details

voestalpine SIGNALING Fareham Ltd.

Contact Information:
Chris Bell
voestalpine SIGNALING Fareham Ltd.
01489 571771
chris.bell@voestalpine.com

Benefits:
Improve detection and diagnosis of track circuit faults via RCM

Projected Implementation:
To TRL 6-7 by early 2017

Beneficiaries:
IM, Maintainers, Flight Engineers

Advantages:
Allows a wide range of fault types to be investigated away from the trackside then validated against operational data.

Key Challenges:
Adoption of techniques by rail infrastructure asset management
Low cost asset condition monitoring of rail track circuits

PROGRAMME: Remote Condition Monitoring

PROBLEM STATEMENT: The UK railway network is very large, ageing and is made up of many complex assets. Network Rail states that one of their main goals is to manage maintenance and refurbishment assets efficiently, as well as provide early warning of any rapid deterioration.

SOLUTION: Using advanced technologies and components more commonly associated with ‘The Internet of Things’ developments, a low cost non-intrusive condition monitoring device can be produced to monitor track circuit receiver current levels while simplifying design, installation and maintenance.

Project Details

CONTACT INFORMATION:
Daragh King
talent Technology Services Ltd
07525 825860
Daragh.King@telent.com

BENEFITS:
Provide early warning of any rapid deterioration of track circuits. Reduction of costs associated with time lost due to circuit failure.

PROJECTED IMPLEMENTATION
Next step is to develop a prototype and provide a demonstrator which would last for 12 months. Expected implementation 2018

ADVANTAGES:
Remote sensing over distance beyond the distances supported by traditional twisted pair network systems.

BENEFICIARIES:
IM, maintenance teams

KEY CHALLENGES:
Established product offering currently in existence
PROGRAMME: Remote Condition Monitoring

PROBLEM STATEMENT: We need to be able to detect track-circuit failures due to faulty cable bolts that fasten the cable to the rail.

SOLUTION: The Smart Washer is a multifunctional device which monitors the clamp force condition of a cable fastener with added current flow detection. Each smart washer has a unique ID and, along with a time and location stamp, ensures that the data package contains all the information to both detect and predict Ohmic cable joint failure. For example, faults at installation or damage are immediately detected. Similarly, slow degradation can be trended to enable an optimised condition-based maintenance regime. An additional use of the current monitoring sensor allows improved extraneous fault diagnosis e.g. waterlogging to be inferred. The embedded programmability and wireless comms automates data management and track-side workflow whilst eliminating human error.

CONTACT INFORMATION:
Roger Bromley
Smart Component Technologies
07710 486888
R.Bromley@hud.ac.uk

ADVANTAGES:
This solution is a low-cost versatile platform technology that incorporates a wide range of sensor options, user interfaces and data comms and integration into asset management systems.

BENEFITS:
The operational benefits include increased reliability, capacity and safety, reduced costs and delays caused by cable joint failure

PROJECTED IMPLEMENTATION
To TRL 6 by 2017

BENEFICIARIES:
IM

KEY CHALLENGES:
Detailed cost-benefit analysis to optimise installation strategy
Signalling power supply reliability improvement

**PROGRAMME: Remote Condition Monitoring**

**PROBLEM STATEMENT:** Online Condition Monitoring of Signalling Power Supply Systems.

**SOLUTION:** Traditional Time Delay Reflectometry is a well-established method for fault detection and fault location. It is, however, often uneconomical and impractical to deploy on a large-scale complex system such as those used in railway power supplies.

This current project has developed an alternative approach in which rectifier sensors are attached to the system at appropriate locations, and their current signature analysed to provide fault location and magnitude information. This simple system has the potential to be very low cost and robust. The feasibility study has proved the system in a simulation and laboratory based study. A plan has been developed to produce an in-service prototype.

**UNIVERSITY OF BIRMINGHAM**

**CONTACT INFORMATION:**
Sarah Jordan
University of Birmingham
0121 414 2626
s.jordan@bham.ac.uk

**ADVANTAGES:**
Simplicity, ease of installation, lower cost.

**BENEFITS:**
The reliability of signalling systems will be improved

**PROJECTED IMPLEMENTATION**
To TRL 6-7 by 2016

**BENEFICIARIES:**
TOCs, ROSCOs, Rail users

**KEY CHALLENGES:**
Effective signal coupling, electromagnetic compatibility, fault location
Programme: Climate Change Adaptation

Problem Statement: We need to increase the resilience of the GB railway in response to anticipated changes in key climate variables.

Solution: This is phase 1 of the Tomorrow’s Railway and Climate Change Adaptation (TRaCCA) research programme. This will produce a knowledge base, assessing the likely impact of climate change and increased frequency of extreme weather events on the UK railway.

Phase 1 has provided a comprehensive knowledge review and knowledge gap analysis. Phase 2 is investigating knowledge of climate change vulnerabilities and support tools to increase resilience of the GB railway.

Project Details

Contact Information:
Jane Dobson
RSSB, Moorgate, London
020 3142 5402
jane.dobson@rssb.co.uk

Benefits:
Increased reliability, reduced delay minutes and increased safety

Projected Implementation:
Currently at TRL 2-3

Beneficiaries:
IM, TOCs, Passengers

Advantages:
This will apply modern climate response techniques to current railway problems in order to safeguard the network in the future.

Key Challenges:
Accepting climate change data, fitting into current programmes
PROGRAMME: Network Rail Monitoring

PROBLEM STATEMENT: We need to detect and monitor potential rock falls near the line to reduce delays and accidents.

SOLUTION: The Fibre Optics Rock Fall Detection programme is developing a new Distributed Acoustic Sensing system for the detection of rock fall and landslips on or near the line. This technology mitigates against the risk of trains colliding with fallen material. It is an integrated system that will use an interrogator unit to translate vibrations detected by a fibre optic cable into rock fall detection warnings. Development to early commercialisation is currently programmed, and we expect implementation to be possible within CP5.

CONTACT INFORMATION:
Kevin McCleland
Safety, Technical & Engineering
Network Rail
Milton Keynes

ADVANTAGES:
The new Distributed Acoustic Sensing (DAS) system for the detection of rock fall and landslips will reduce delays and could detect trains in long block sections.

BENEFITS:
Improved resilience & quicker service recovery

PROJECTED IMPLEMENTATION
2018-19

BENEFICIARIES:
IM, Passengers, TOCs, FOCs

KEY CHALLENGES:
System integration: power supply, data communication
PROGRAMME: Network Rail Monitoring

PROBLEM STATEMENT: We need to prevent trains running across track which is made unusable by the movement of earthworks such as cuttings and embankments.

SOLUTION: ‘iSMART’ is a 3-year research project to give better guidance on slope assessment, maintenance and repair methods through the creation of modelling software.

The software will provide a 4D visualised dynamic model of water movement in infrastructure slopes under a range of current and future environmental scenarios. This can be used to create a reliable slope assessment for planning infrastructure mitigation/adaption measures.

Once available to Network Rail, this could then be provided as a service to the Routes to support assessment of planning applications.

CONTACT INFORMATION:
Susan Millington
Safety, Technical & Engineering
Network Rail
Milton Keynes

ADVANTAGES:
This will enable Network Rail to forecast issues arising from climate change on slopes through a hazard identification process. This can be used to influence the CP6 business plan.

BENEFITS:
Civil engineering cost reduction and improved intervention planning

PROJECTED IMPLEMENTATION
To TRL 7-8 by 2018

BENEFICIARIES:
IM

KEY CHALLENGES:
Model testing and qualification, route to market
PROGRAMME: Network Rail Monitoring

PROBLEM STATEMENT: We need to investigate solutions to the high costs of track surveys.

SOLUTION: The High Speed Track Solution programme reduces infrastructure survey costs by rapidly surveying track gauge.

The Rail Infrastructure Alignment Acquisition (RILA) system completes high speed track surveys that produce 3-dimensional data for centre line, left/right rail, cant and gauge. It has already been successfully deployed in the Netherlands, and trials are currently taking place on the UK Network.

A project has been established to manage the adoption of the system as a “business as usual” alternative to traditional surveying methods within track renewals and enhancements.

Project Details

CONTACT INFORMATION:
Susan Millington
Safety, Technical & Engineering
Network Rail
Milton Keynes

ADVANTAGES:
Provides the ability to survey at speed locations where other surveying systems may not be suitable due to capacity requirements or the safety of track workers.

BENEFITS:
- Reduced cost of survey and improved safety

PROJECTED IMPLEMENTATION
Ongoing

BENEFICIARIES:
IM

KEY CHALLENGES:
Qualification, and deployment in a live rail environment
Automatic track survey with 3D outputs

PROGRAMME: Network Rail Monitoring

PROBLEM STATEMENT: We need to develop an automated system mounted on a rail vehicle for surveying the railway.

SOLUTION: The Portable Autonomous Survey System (PASS) programme allows a fully autonomous survey of the railway from a system that can be temporarily fitted to high speed passenger trains.

This is a portable self-powered system, approximately the size of a laptop rucksack and around 12kg in weight. The system will be temporarily fixed to the coupler of any train. The system will contain lasers, inertial systems, GPS, and multiple cameras that will record video and laser data of the track environment. The user can also view the 3D environment using an Oculus Rift virtual reality headset.

CONTACT INFORMATION:
Susan Millington
Safety, Technical & Engineering
Network Rail
Milton Keynes

BENEFITS:
Track survey cost reduction

PROJECTED IMPLEMENTATION
Available for deployment 2016

BENEFICIARIES:
IM

ADVANTAGES:
Parts of the rail network are at capacity and this system will help to reduce the ‘yellow’ trains used to inspect the railway, and reduce the need for possessions.

KEY CHALLENGES:
Route to market; capability development
PROGRAMME: Network Rail Monitoring

PROBLEM STATEMENT: We need to develop a system to mitigate the risk from earthwork failures due to adverse weather.

SOLUTION: The Weather resilience and Climate Change project will look at mitigating the safety risk from earthwork failures as far as reasonably practicable during adverse weather conditions at selected high risk locations.

The system will incorporate tilt sensors to detect movement before there is a failure and there is a safety risk to train operations.

PROJECTED IMPLEMENTATION: To TRL 7-8 by 2018-19

BENEFICIARIES: IM, passengers

KEY CHALLENGES: Capability development, accessibility to funding

ADVANTAGES: Predicting and mitigating the risk from earthworks failures as climate change intensifies is key to the future integrity of the railway network.

CONTACT INFORMATION:
Michael Brown
Senior Engineer Track & Civils
Network Rail
Milton Keynes

BENEFITS: Safety and cost avoidance

Earthworks monitoring for climate change
PROGRAMME: Network Rail Track

PROBLEM STATEMENT: We need to solve the problem of infrastructure life cycle costs and innovative approaches to track systems.

SOLUTION: The Asphalt Track programme will produce a more resilient, longer life infrastructure, reducing the need for frequent maintenance, improving availability and whole-life cost.

It will develop and demonstrate the materials, construction and monitoring knowledge needed to construct a high performance ballast-less track system, built from asphalt mixes, through from feasibility to the demonstration stage.

There is no track of this type in operational use and there is an opportunity to see how this technology could be applied.

Asphalt track to replace ballast for a longer life

Asphalt Base Course
2400mm
Top Asphalt Layer

CONTACT INFORMATION:
Tom Tivey
Safety, Technical & Engineering
Network Rail
Milton Keynes

BENEFITS:
Reduce track maintenance costs

PROJECTED IMPLEMENTATION
To TRL 6 by 2016, TRL 9 by 2019

BENEFICIARIES:
IM

ADVANTAGES:
Asphalt track systems can potentially reduce attrition, thereby improving the capacity and availability of the network while reducing whole life costs.

KEY CHALLENGES:
Demonstration opportunity in a live rail environment
PROJECT: Network Rail Track

PROBLEM STATEMENT: We need to look into ways to address adhesion on the railway which causes delays and safety issues.

SOLUTION: The ‘Wet Rail’ programme will develop and trial a software model to identify the causes of the ‘wet rail’ phenomenon (when there is poor adhesion between the wheel and the rail, without contamination).

It will address this with an assessment of the best and worst wheel/rail interfaces likely to be encountered. A range of parameters will be analysed, including fleet type, time of day, moisture levels and braking.

The model is also expected to have an impact on the Wheel Spin Protectors. It is a key part of developing an improved approach to adhesion.

CONTACT INFORMATION:
Brian Haddock
Sheffield University
and Network Rail
Milton Keynes

BENEFITS:
Improved resilience and schedule adherence

PROJECTED IMPLEMENTATION:
To TRL 3 by 2016, TRL 9 by 2017-18

BENEFICIARIES:
Passengers, TOCs, FOCs

ADVANTAGES:
The Wet Rail project will assist in developing a tactical approach to adhesion using existing technologies.

KEY CHALLENGES:
Providing a deployable solution
PROGRAMME: Network Rail Track

PROBLEM STATEMENT: We need to improve track worker safety on the line without reducing the efficiency of track maintenance.

SOLUTION: The TrackSafe programme aims to deliver a new location system to dramatically improve the safety of persons working lineside, and improve operational performance.

Both communication and location information are often lost on the railway infrastructure due to cuttings, bridges, tunnels, station canopies, etc. As a result, a system based on GSM radio and GPS cannot be relied upon for safety critical activity.

Whilst the strength of most radio systems is gradually lost (attenuated) as they travel through water and solids, magnetic fields are largely unaffected. The proposed system will be based on such fields, with users wearing tags connected to site safety managers.

CONTACT INFORMATION:
Zach Naylor
Signalling Innovation Group
Network Rail
Milton Keynes

BENEFITS:
Increase in worker safety through situational awareness

PROJECTED IMPLEMENTATION
2018-19

BENEFICIARIES:
IM, Rail Industry

ADVANTAGES:
Provides safer working conditions for trackside colleagues.

KEY CHALLENGES:
Qualification and certification
PROGRAMME: Network Rail Track

PROBLEM STATEMENT: We need to improve the stability of track formations to protect them from ground movement and reduce maintenance costs.

SOLUTION: The Micro Piling programme involves the use of small scale piles to stabilise the track formation to varying depths.

The current practice of removing infrastructure and regrading the track is considered disruptive, time consuming, resource intensive, and ecologically unsound.

This system will allow for track to be stabilised in situ, with less disruption and reduced costs. It is currently in use and expected to release substantial benefits in CP5.

CONTACT INFORMATION:
Susan Millington
Safety, Technical & Engineering
Network Rail
Milton Keynes

ADVANTAGES:
Provides a focussed, less disruptive track stabilisation method.

BENEFITS:
Large savings in infrastructure track maintenance

PROJECTED IMPLEMENTATION
Available for use

BENEFICIARIES:
IM

KEY CHALLENGES:
Deployment on the rail network and exploitation
Fast efficient track repair

PROGRAMME: Network Rail Track
PROBLEM STATEMENT: We need to look at more efficient alternatives to laying track to reduce delays and lower costs.

SOLUTION: The Modular Slab Track programme is a slab track system made up of three elements, which includes a track bed transition support.

This system can be installed as an alternative to track lowering. Sections of track can be installed in shorter times on very busy lines, at lower costs than conventional slabs.

The track system has been taken up by Network Rail and has already been installed at Asfordby tunnel. The next step is to determine the roll out strategy.

Potential sites include Winchburgh tunnel, Bowshank tunnel, Thames link canal tunnels, and Ordsall chord in the Northern Hub.

CONTACT INFORMATION:
Susan Millington
Safety, Technical & Engineering
Network Rail
Milton Keynes

BENEFITS:
Reduced infrastructure maintenance costs

PROJECTED IMPLEMENTATION
Available for use

BENEFICIARIES:
IM

ADVANTAGES:
Modular Slab Track is an alternative route to laying track where quality is controlled, costs are lower and possession times are shorter.

KEY CHALLENGES:
Deployment on the rail network and exploitation
Reducing welding time for track repair

PROGRAMME: Network Rail Track

PROBLEM STATEMENT: We need to reduce the time and cost of rail welding on site, to reduce delays and increase safety.

SOLUTION: The Induction Welding programme adapts modern welding technology for use in a rail environment, initially for use on switches and crossings layouts.

The current method for welding switches and crossings on site takes over an hour per weld, compared to around 15 minutes for induction welding.

Induction welding offers other significant benefits, including removing the need to transport gas cylinders or do heavy lifting, and requires fewer staff on track. Due to the unique system design, a patent has been filed to protect the innovation.

CONTACT INFORMATION:
Susan Millington
Safety, Technical & Engineering
Network Rail
Milton Keynes

BENEFITS:
- Reduced switches and crossings maintenance costs

PROJECTED IMPLEMENTATION
Available for deployment 2017

BENEFICIARIES:
- IM, Export market

ADVANTAGES:
This proposal for induction welding has the ability to deliver faster and safer welding, with no heavy lifting and a reduction of staff on track.

KEY CHALLENGES:
Route to market
Mobile phone controlled lighting

PROGRAMME: Network Rail Track

PROBLEM STATEMENT: Lights are being installed to enable night inspections, but due to access problems cables for switching the lights on/off could not be installed across the tracks.

SOLUTION: Network Rail have a programme of installing lighting at a number of key junctions across the country to specifically enable track inspections to be undertaken at night, making significant savings to the business.

William James came up with the idea of using wireless mobile phone technology to switch on/off using standard SMS text messaging. BCDG designed the system, it was built and tested in the factory, then subsequently installed on site. The user (Track Maintenance Engineer) was delighted with the system. This has been so successful that it is being used at future proposed sites and retro-fitted to existing sites.

Project Details

Buildings & Civils Design Group

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ADVANTAGES:
Wireless mobile phone technology to switch lights on and off improves safety and has the potential to be used for other applications.

BENEFITS:
Reduces installation costs, increases track worker safety

PROJECTED IMPLEMENTATION
Already installed on a number of sites

BENEFICIARIES:
IM, track workers

KEY CHALLENGES:
Unique design utilising equipment from control & automation industry
National level crossing risk reduction programme

PROGRAMME: Network Rail Track

PROBLEM STATEMENT: Within the East West Rail Phase 2 scheme extents there are 105 level crossings and the project aims to close all of them.

SOLUTION: The National Level Crossing Risk Reduction Programme is underway to reduce level crossing safety risk. By working within a coordinated environment, better risk mitigation has been achieved or identified whilst improving safety.

Use of a Data Management System meant a ‘single source of truth’ existed reducing mistakes whilst improving safety and efficiencies.

Through 3D modelling, this enabled multiple uses of a single design from stakeholder awareness and consultation right through to design coordination, design review and approval.

Project Details

Network Rail
Buildings & Civils Design Group
York

CONTACT INFORMATION:
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ADVANTAGES:
Coordinated approach to design, clash rendition, multiple usage (Visuals, consultations, designs), CDE data management, single version, better stakeholder engagement.

BENEFITS:
Removal of level crossing risk, asset management, increased safety

PROJECTED IMPLEMENTATION

BENEFICIARIES:
IM, Public, TOCs, Industry, FOCs, councils

KEY CHALLENGES:
Behavioural change, training, competencies and system interfaces
PROGRAMME: Signalling Innovations Group

PROBLEM STATEMENT: We need to develop modular signalling solutions to reduce costs and simplify complex signalling schemes.

SOLUTION: The Self-powered Wireless Remote Distance Signal (SWoRD) project will develop a wirelessly controlled signal for use in the Modular Signalling programme.

A method is needed to re-signal secondary routes on the network at much lower costs than is the norm for complex re-signalling schemes. A significant proportion of the cost of signalling renewals is the power and data cabling. SWoRD will solve this problem. This solution generates a cost saving during installation while avoiding the ongoing maintenance and risk of cable theft.

CONTACT INFORMATION:
Tim Lane
Safety, Technical & Engineering
Network Rail
Milton Keynes

BENEFITS:
Signalling renewal cost reduction, reduced maintenance costs

PROJECTED IMPLEMENTATION
2018-19

BENEFICIARIES:
Passengers, TOCs, FOCs

ADVANTAGES:
The wireless signal will assist in achieving the cost savings needed for the case for re-signalling rather than the continued refurbishment of existing assets.

KEY CHALLENGES:
Change established business practice, route to market
PROGRAMME: Signal Innovation Group

PROBLEM STATEMENT: We need a new tool to determine the field of view of CCTV cameras to more efficiently cover all parts of the network.

SOLUTION: The original tool was DOS based, contained rounding errors and was difficult to use. Furthermore new technology, namely a variable focus camera was not supported by the existing tool.

The CCTV Field of View Calculator assess the compliance of a level crossing CCTV camera field of view and camera column position. Furthermore it provides a record of the CCTV field of view for checking and verification.

CONTACT INFORMATION:
Signalling Innovation Group
Network Rail
Susan Millington
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BENEFITS:
Increased safety, reduced cost, saved time

PROJECTED IMPLEMENTATION
In service

BENEFICIARIES:
IM

ADVANTAGES:
Supports variable focus camera, is Excel-based for ease of use and alteration. Calculations are based on first principles and contain no rounding errors for increased accuracy.

KEY CHALLENGES:
An understanding of the principles is required
PROGRAMME: Signalling Innovations Group

PROBLEM STATEMENT: Creating the ‘Base Plan’ for re-signalling schemes is both time consuming and expensive.

SOLUTION: ISP-Scheme reads in asset data and map data to form the geographical view and schematic view. The asset data will be in the XML format prescribed by Asset Data Specification XML Schema. The operator can elect to view static images linked to the asset data in the CAD file. This data and subsequent input from the operator can then be exported as MicroStation design files in DGN format. The DGN files will also contain additional data to make them compliant with the PLANS tools. ISP-Scheme is configured to support Balfour Beatty’s and Westinghouse’s PLANS tool.

CONTACT INFORMATION:
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ADVANTAGES:
ISP Scheme imports data directly from the Asset Inventory Survey to significantly reduce the timescales required to draw the Base Plan.

BENEFITS:
Reduced signalling design effort, reduced design time

PROJECTED IMPLEMENTATION
Currently in service

BENEFICIARIES:
IM signallers

KEY CHALLENGES:
Implementing culture change for designers. GBS testing process
Signal Spacing Assessment Model (SSpaM)

**PROGRAMME:** Signalling Innovations Group

**PROBLEM STATEMENT:** A tool is required by Signalling Designers to provide what-if modelling of new and proposed signal spacing, speed, and train performance.

**SOLUTION:** SSpaM was created to assess compliance with signal spacing standard GK/RT0075 Line-side Signal Spacing and Speed Signage, guidance note GK/GN0675 Guidance on Line-side Signal Spacing and Speed Signage and parts of NR/L2/SIG/30009/D220 Signalling Principles Handbook – Signal Spacing.

**CONTACT INFORMATION:**
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**BENEFITS:**
Accuracy, Time, Costs

**PROJECTED IMPLEMENTATION:**
In service

**BENEFICIARIES:**
Signalling Design Community

**ADVANTAGES:**
The tool is widely used within the Signalling Design community. It provides significant advantages over undertaking the calculations from first principles.

**KEY CHALLENGES:**
The tool is SIL 1 rated, therefore Independent Safety Assessors were required to validate the Safety Case.
Signal Sighting Form Tool (SSiFT)

PROGRAMME: Signalling Innovations Group
PROBLEM STATEMENT: We need an improved form that can be used to document signal sighting issues.
SOLUTION: Signalling Sighting Specialists are required to complete a Signal Sighting Form (SSF) to document and record any changes to a signals properties. The SSiFT form is a master document used to ensure that train drivers can see and interpret signs and signals from appropriate distances.

The SSiFT form is approved by all stakeholders for that signal including TOCs and FOCs. The form is required to document any interferences for that signal.

Signal Sighting Form Tool v3 replaces the SSiFT automation toolset. It is an internet hosted application which maintains a similar appearance to the previous versions but on a more flexible platform.

CONTACT INFORMATION:
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BENEFITS:
Increased Automation, Time, Accuracy

PROJECTED IMPLEMENTATION
In service

BENEFICIARIES:
Signalling Design Community

ADVANTAGES:
The increased automation through the use of System Data Exchange Format (SDEF) ensures that the majority of the form is populated directly from information generated via other Design Tools.

KEY CHALLENGES:
Culture change within the Design Community
PROGRAMME: Signalling Innovations Group

PROBLEM STATEMENT: NSRL addressed the problem of not having a system that provided standard/consistent presentation of Signaller’s Route Lists with all the data being held centrally.

SOLUTION: The National Standardisation of Route Lists is an application, available on the Network Rail Portal for the management and production of Signaller Interlocking Route Cards. Route Lists are provided to ensure that Signallers have the necessary information to set power operated points to the required position for each signalled route when the signalling is in degrade mode.

To gain access to the NSRL application you must first contact your Network Rail Project Manager to authorise access.

**CONTACT INFORMATION:**
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**ADVANTAGES:**
This is a bespoke application to create Route Lists.

**BENEFITS:**
Safety, Cost, Time

**PROJECTED IMPLEMENTATION**
In service

**BENEFICIARIES:**
Signalling Designers

**KEY CHALLENGES:**
Details of key challenges in completing and getting to market
PROGRAMME: Signalling Innovations Group

PROBLEM STATEMENT: Signal Sighting Specialists are required to document the cant and curve for the location of each signal. A simple look up against signalling standards is also required to assess clearances.

SOLUTION: SCC allows users to easily obtain cant, curvature and track interspacing data for inclusion into Signal Sighting Forms.

The tool performs a lookup against business standards related to asset clearances to inform whether a lineside asset is at risk of being struck by passing trains.

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BENEFITS:
Safety, cost, time

PROJECTED IMPLEMENTATION
In service

BENEFICIARIES:
Signal Sighting Specialists

ADVANTAGES:
The SCC tool saves the Sighting Specialists from undertaking site visits to obtain geometry and clearance assessments.

KEY CHALLENGES:
Culture Change, Availability of Track Interspacing data from Asset Information.
PROGRAMME: Signalling Innovations Group

PROBLEM STATEMENT: All aspects of Signalling design have multiple data entry points. A considerable amount of the data entry is repeated. Repeat data entry is inefficient, and also provides opportunity for error.

SOLUTION: The Signalling Data Exchange Format allows the railway assets and signalling controls to be described in such a clear manner. This means that the information collected in the early stages of a scheme design, when the potential options are being assessed, can be passed to analysis tools and CAD packages without loss of information or the potential for errors during the human input stage of the transfer.

CONTACT INFORMATION:
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ADVANTAGES:
Future-proof, Validate designs & data, Increase automation, Multi-toolset compatibility, Schema conversion.

BENEFITS:
Safety, cost, time, increased automation, repeatability

PROJECTED IMPLEMENTATION
In service

BENEFICIARIES:
Signalling Design Community

KEY CHALLENGES:
Culture change from existing practises
PROGRAMME: Signal Innovation Group

PROBLEM STATEMENT: Can we improve the delivery of wiring diagrams to create a more intelligent system.

SOLUTION: Network Rail currently uses basic wiring tools such as Network Rail Circuit Design Tool (CNet). These tools date back a number of years and are ‘unintelligent’, providing only graphical information, without any automation. This limited functionality limits the complexity of work that may be done.

CNet2015 is being developed by the Signalling Innovations Group (SIG) for Network Rail’s signalling design engineers. Wiring Design Tools (WDT) will deliver a tool to improve the delivery of wiring diagrams through enhanced functionalities and incorporating ‘innovative intelligent’ features. This will be a development of Bentley Microstation internally developed CNet tool to CNet2015.

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ADVANTAGES:
CNET replaces outdated design tools and is compatible with modern IT infrastructure. The tool offers functionality to reduce the effort in the design process.

BENEFITS:
Safety, cost, time

PROJECTED IMPLEMENTATION:
In service

BENEFICIARIES:
Signalling Design Group Offices, Tier 1 suppliers

KEY CHALLENGES:
Implementing Culture Change for Signalling Designers. Pushing software through the GBS Testing process
POSITIONED VIDEO FRAMES (PVF)

PROBLEM STATEMENT: Designers frequently visit sites to undertake simple tasks. PVF was designed specifically to reduce the needs for site visits, with a simple to use tool.

SOLUTION: PVF is a video-based tool that allows users to view the railway and track layouts, take measurements and overlay virtual models of assets using video routinely recorded by Network Rail’s fleet of inspection trains.

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BENEFITS:
Safety, cost, time

PROJECTED IMPLEMENTATION
In service

BENEFICIARIES:
IP Signalling projects, SDG Offices, the whole NR organisation.

ADVANTAGES:
The tool has been designed in such a way in that its free of licencing costs for both the data and software. The functionality and simplicity of the tool, allows many different uses.

KEY CHALLENGES:
The limitations of the on train hardware.
PROGRAMME: Signalling Innovations Group

PROBLEM STATEMENT: The tool is the software client to access Asset Inventory Data for the Signalling Designers.

SOLUTION: Positioned Video Pixels (PVP) allows internal Network Rail users and Tier 1 suppliers access to the OmniSurveyor3D® tool from their desktop computers. This reduces the reliance on ‘stand alone kiosks’.

The tool allows the user to:

- Identify the accurate geographic and linear position of assets in a database.
- Take measurements from the desktop.
- Undertake Signal Sighting using the new Signal Tool.
- Export Signal Sighting data in SDEF format for use in SSiFT.
- Export Track Centre Line and Gradient data for use in scheme plan generation.

CONTACT INFORMATION:
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ADVANTAGES:
The tool has been created to allow access to the asset inventory for use in Signalling base plans. The tool saves significant amounts of time on site for users.

BENEFITS:
Safety, cost, time

PROJECTED IMPLEMENTATION
In service

BENEFICIARIES:
IP Signalling Projects, SDG Offices, Tier 1 suppliers.

KEY CHALLENGES:
NR internal network and IT capabilities
PROGRAMME: Signalling Innovations Group

PROBLEM STATEMENT: Typically, Design offices have bought in services to undertake manipulation of virtual signals in a video environment or model. This is costly and NR has been charged multiple times for the use of the same model.

SOLUTION: SSIM are 3-D virtual models of lineside assets in open file formats. They are tools to enable tasks such as signal sighting and constructability assessments to be done in the office to reduce the need for site visits. SSIM models are freely available for use by internal and external users.

CONTACT INFORMATION:
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ADVANTAGES:
The use of SSIM model in the PVP video environment has proved an extremely cost effective method for analysing the Sighting distances of signals and signs.

BENEFITS:
Safety, cost, time

PROJECTED IMPLEMENTATION
In service

BENEFICIARIES:
Signal Sighting Specialists

KEY CHALLENGES:
Consistency of cell libraries across tools. Accuracy of models against real-world assets
Programme: Signalling Innovations Group

Problem Statement: Network Rail’s Data Collection Service Team, in Asset Information required multiple resources in order to meet the needs of IP Signalling video survey projects.

Solution: Network Rail’s MPV enables geospatial, high-definition video, and 3D point cloud laser data to be captured using dedicated survey equipment developed and installed by the Signalling Innovations Group for IP Signalling Project Teams.

Accessible to 100% of the network, the MPV offers IP Signalling the facility to capture standard OmniSurveyor 3D® video and detailed 3D point cloud surveys. Laser profiles can be merged with the video imagery to allow Signal Sighting to be performed in tunnels and areas of low light.

Contact Information:
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Benefits:
Safety, cost, time

Projected Implementation:
In service

Beneficiaries:
IP Signalling Projects, SDG Offices

Advantages:
MPV is best suited where surveys are complex, and require increased relative measurement accuracy, which is provided by the laser scanner.

Key Challenges:
Vehicle access, Support from Asset Information
A new approach to switch operation

**PROGRAMME:** REPOINT

**PROBLEM STATEMENT:** We need to assess the future of switches which, as currently designed, significantly affect network delay performance (as single points of failure).

**SOLUTION:** The Redundantly Engineered POINTs (REPOINT) project for enhanced reliability and capacity of railway track switching offers improved performance over traditional switching solutions. Specifically reliability, capacity, safety, maintainability, ride quality, cost and space utilisation.

The key enabler for the multi-channel approach is an arrangement known as passive locking, whereby the switch rails are lifted to be moved laterally, and are locked in place.

Following the success of the scale demonstrator, the team are currently working with TfL and NR to develop a prototype suitable for testing on the TfL network.

**CONTACT INFORMATION:**
Sam Bemment
Loughborough University
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**ADVANTAGES:**
An arrangement known as passive locking, whereby the switch rails are lifted and locked in place, is an innovative approach to points.

**BENEFITS:**
Improved reliability, reduced life-cycle costs, increased capacity

**PROJECTED IMPLEMENTATION**
To TRL 6-7 by 2018, TRL 9 by 2019

**BENEFICIARIES:**
IM, TOCs

**KEY CHALLENGES:**
Meeting design requirements, testing in a live rail environment
**Programme: IPEMU (Independently Powered EMU)**

**Problem Statement:** We need to find alternative solutions to diesel power in areas where electrification is not economically viable.

**Solution:** The IPEMU is an alternative to conventionally electrified railway. The solution uses existing, but leading edge, battery technologies in a railway environment to operate trains.

Energy can be stored on trains to enable a discontinuous energy supply from the infrastructure. This could enable using electric trains on non-electrified lines, converting third rail DC to more efficient operation, and increasing freight electric traction.

The solution was successfully demonstrated on a live track under various scenarios, carrying members of the public.

**Contact Information:**
James Ambrose  
Network Rail, Milton Keynes  
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**Benefits:**
- Reduced fuel costs and emissions
- Alternative regional solutions

**Projected Implementation:**
At TRL 8-9, deployable by 2017

**Beneficiaries:**
- TOCs, Passengers, public

**Advantages:**
Battery technology offers an alternative or supplementary way to achieve electric powered train services to the conventionally electrified railway.

**Key Challenges:**
Implementation: currently being marketed to TOCs
PROGRAMME: Radical Train
PROBLEM STATEMENT: We need to look at options for developing a 'radical train' which will offer a measurable step change in performance of train systems on GB railways.
SOLUTION: The ACIS (Advanced Composite Integrated Structure) Project is developing composite components for train carriages which can provide significant mass savings. Lighter rail vehicles can lead to a reduction in energy usage and track damage, as well as increases in acceleration and braking performance.

Phase One has enhanced our understanding for using the technology, identified the commercially viable opportunities in rail vehicles, and developed an industry roadmap.
Phase two will be a demonstration of selected components from design for manufacture through to first off production and train installation.

PROJECT DETAILS:

**CONTACT INFORMATION:**
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richard.french@rail.bombardier.com

**BENEFITS:**
Lighter trains lead to better reliability and improved customer experience

**PROJECTED IMPLEMENTATION:**
To TRL 5/6 by late 2018

**BENEFICIARIES:**
TOCs, Train manufacturers

**ADVANTAGES:**
The use of composite materials for the manufacture of structural parts, and consideration of life cycle costs, are novel within the rail industry.

**KEY CHALLENGES:**
Technical and economic challenges of composite materials
Delivering the industry roadmap
Test the new traction system for rail vehicles

PROGRAMME: Radical Train

PROBLEM STATEMENT: We need to look at options for developing a ‘radical train’ which will offer a measurable step change in performance of train systems on GB railways.

SOLUTION: The ‘Wheelmotor’ Demonstrator is developing, testing and demonstrating a traction system on a Light Rail vehicle. This is based on new traction technology and advanced steering control.

It is addressing costly technical issues such as RCF on all track geometries, severe rail wear on tight radii curves, nuisance noise generated by wheel slip on these curves, and the restrictions of 25m radii curves in urban areas.

The solution delivers multiple benefits including superior dynamic performance afforded by directly acting permanent-magnet synchronous Wheelmotors and the removal of the need for trackside lubrication systems.

BENEFITS:
- reduced environmental impact
- enhanced performance

PROJECTED IMPLEMENTATION:
- To TRL 5 by early 2017

BENEFICIARIES:
- IM, Train manufacturers, public

KEY CHALLENGES:
- Integrating the new traction technology with the advanced steering control

ADVANTAGES:
- This solution will free the industry from the fundamental limitations imposed by the traditional solid axle wheelset.

CONTACT INFORMATION:
Neil Cooney
Stored Energy Technology Ltd (SET)
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Next steps
- Further development
- Testing
- Implementation
PROGRAMME: Radical Train
PROBLEM STATEMENT: We need to look at options for developing a ‘radical train’ which will offer a measurable step change in performance of train systems on GB railways.
SOLUTION: The ‘Seamless Interchangeability’ project is a radical approach to relieving the key capacity constraints of today’s railway network, using a network model.

This will demonstrate different approaches to relieving these capacity constraints, looking to modify the existing network over the 3-30 year time horizon, to ensure maximum benefit is derived from ERTMS, etc.
Seamless interchangeability is a concept for future rail travel, using long trains which can split and join on the move and allows passengers to walk through and ‘change’ trains without stopping.

BENEFITS: Increased capacity, improved customer experience
PROJECTED IMPLEMENTATION: Feasibility completed by 2016
BENEFICIARIES: IM, TOCs
KEY CHALLENGES: Ensuring the modelled network is appropriately complex

ADVANTAGES: This project aims to develop a fictitious, yet realistic, train network model to evaluate the potential benefits of radically different ways of running trains.
PROGRAMME: Radical Train
PROBLEM STATEMENT: We need to look at options for developing a ‘radical train’ which will offer a measurable step change in performance of train systems on GB railways.
SOLUTION: The Revolution VLR (Very Light Rail) Consortium is designing, testing and building a low carbon lightweight railcar as a concept demonstrator. This will promote low cost connections to regional and rural areas.

It includes a modular design and innovative interior packaging appropriate to shorter distances and relatively low speed operations.

It will build on the concept of a ‘self-propelled bogie’ (previously developed) featuring an integral diesel electric series hybrid drive train with regenerative braking and energy storage.

This will unlock the wider market for innovative light rail schemes (potentially including tramways in the longer term) in the UK.

**CONTACT INFORMATION:**
Martin Pemberton, TDI Ltd
Revolution VLR Consortium
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**BENEFITS:**
- Increased sustainability, improved regional customer experience

**PROJECTED IMPLEMENTATION**
Ready by 2018

**BENEFICIARIES:**
- TOCs, regional rail users

**ADVANTAGES:**
The modular design will enable localised assembly without the need for complex tooling and equipment, and will allow for different railcar configurations.

**KEY CHALLENGES:**
- Designing an economic, modular railcar body with appropriate crashworthiness levels
PROGRAMME: Powertrain

PROBLEM STATEMENT: We need alternative forms of train power (diesel) for areas where electrification cannot be justified.

SOLUTION: The proposed solution replaces the diesel engine in a train with a hybrid fuel-cell power pack, as used on various fleets of fuel-cell powered buses operating in the UK. Fuel-cells create zero emissions at their point of use, tare virtually silent in operation, and significantly cut maintenance and fuel costs.

The hydrogen that powers a fuel-cell can be generated from any electrical supply (including nuclear and renewables), or from natural gas. Both reduce pollution and carbon emissions compared with diesel power.

Further to this feasibility assessment, RSSB is unable to take this forward to demonstrator because of limited resources. Alternative funding streams would therefore be welcome.

UNIVERSITY OF BIRMINGHAM

CONTACT INFORMATION:
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BENEFITS:
Alternative to diesel, lowered emissions, reduced costs

PROJECTED IMPLEMENTATION
To TRL 7-8 by 2018-19

BENEFICIARIES:
TOCs, RoSCOs, UK Public

ADVANTAGES:
This unique fuel-cell solution offers the benefits of electric powered train services without the enormous cost and complexity of electrification.

KEY CHALLENGES:
Matching bus fuel-cell technology to the rail industry
PROGRAMME: Powertrain Challenge

PROBLEM STATEMENT: We need alternative forms of train power (diesel) for areas where electrification cannot be justified.

SOLUTION: This project will feature a high-efficiency transmission, the latest engine technology and new braking techniques. The new approach will significantly reduce energy consumption and operating costs and has the potential to reduce journey times through faster acceleration.

The solution combines a hydrostatic transmission, modern engine technology and braking energy recovery to offer a step-change in performance. It offers a substantial fuel saving, low capital cost and long service life, and has potential for widespread adoption.

A hydrostatic transmission for the railway

**Project Details**

**ARTEMIS INTELLIGENT POWER**

**CONTACT INFORMATION:**
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**BENEFITS:**
Increased capacity, reduced journey times, reduced fuel costs

**PROJECTED IMPLEMENTATION**
To TRL 7 by 2017

**BENEFICIARIES:**
TOCs, RoSCOs, Passengers

**ADVANTAGES:**
Digital Displacement® is a breakthrough technology for hydraulic machines and makes many new applications possible.

**KEY CHALLENGES:**
Matching this technology to the rail industry
A diesel-electric hybrid power-pack

PROGRAMME: Powertrain

PROBLEM STATEMENT: We need alternative forms of train power (diesel) for areas where electrification cannot be justified.

SOLUTION: The proposal is a diesel-electric-hybrid power-pack solution for railcars. This will have a diesel engine that is smaller than the ones currently installed, an exhaust energy recovery device, and an energy storage system. With the systems contained in a pack under the floor of the railcar, enabling quick easy-access maintenance and replacement when necessary, ensuring higher vehicle availability. The design of the power-pack will permit the railcar to be powered via the on-board diesel-hybrid system, and also offers the potential for power drawn from network electrification, taking advantage of the existing infrastructure. Further to this feasibility assessment, RSSB is unable to take this forward to demonstrator because of limited resources. Alternative funding streams would therefore be welcome.

Project Details

WARWICK
THE UNIVERSITY OF WARWICK

CONTACT INFORMATION:
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ADVANTAGES:
The proposed removable power-pack for a diesel-electric-hybrid railcar will be highly efficient, be removable, and reduce exhaust emissions.

BENEFITS:
More efficient fuel usage, reduced emissions

PROJECTED IMPLEMENTATION
To TRL 4 by early 2016

BENEFICIARIES:
TOCs, RoSCOs, public

KEY CHALLENGES:
Route to market, adapting technology to the UK environment
A dual-fuel alternative for the rail industry

PROGRAMME: Powertrain
PROBLEM STATEMENT: We need alternative forms of train power (diesel) for areas where electrification cannot be justified.

SOLUTION: This project is a demonstration of G-volution’s dual-fuel technology to reduce operating costs, lower emissions and adopt alternative fuels for diesel trains.

G-volution is active in the field of dual or multi-fuel engines which using our patented Optimiser control system evolve a diesel engine to a dual or multi-fuel unit.

G-volution’s proposal is to adopt this technology for railway vehicles (multiple units), thus offering a route to lower operating cost, lower emissions and a route to the adoption of new, alternative and renewable fuels.

This is in contrast to typical alternative uses in lower efficiency dedicated or monofuel spark ignition engines.

Contact Information:
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Benefits:
Cleaner vehicles, reduced fuel costs, reduced emissions

Projected Implementation
To TRL 6 by 2017

Beneficiaries:
TOCs, RoSCOs, public

Advantages:
G-volution’s technology permits existing engines to be evolved to dual-fuel powertrains without needing significant rebuilding of the vehicle.

Key Challenges:
Matching this dual-fuel road technology to the rail industry
Low Cost Flywheel for Efficient Railways

PROGRAMME: Powertrain
PROBLEM STATEMENT: We need alternative forms of train power (diesel) for areas where electrification cannot be justified.
SOLUTION: The solution proposed is a ‘Low Cost Flywheel for Efficient Railways’. Use of a hybrid flywheel powertrain reduces emissions and fuel consumption by recovering braking energy and allowing efficient engine operation. During all rail journeys, a significant amount of the energy is lost due to heat during frictional braking and engine inefficiency at part load. Flywheel hybrid technology offers the best option for the recovery of braking energy and frees the engine to work efficiently. The flywheel has a much longer life expectancy than batteries. This technology also reduces maintenance costs by decreasing the wear on mechanical brakes. The demonstrator phase focusses on implementing the technology on a rail-vehicle sub-system. This is seen as an interim step, fitting within available budgets.

CONTACT INFORMATION:
Arnold Fenocchi
Dynamic Boosting Systems Ltd
020 3417 4686
a.fenocchi@dynamicboost.com

ADVANTAGES:
DBS’ flywheel has a unique patented design which allows it to be safer and cheaper by limiting failure damage and increasing energy recovery.

BENEFITS:
More efficient fuel usage, reduced emissions

PROJECTED IMPLEMENTATION
To TRL 6-7 by 2018

BENEFICIARIES:
TOCs, RoSCOs, public

KEY CHALLENGES:
Route to market, adapting to the UK rail environment
PROGRAMME: Powertrain

PROBLEM STATEMENT: We need alternative forms of train power (diesel) for areas where electrification cannot be justified.

SOLUTION: This solution is based on a reversible fuel-cell which can be used as a traction drive motor.

This is an electrochemical device that provides power from hydrogen fuel when run in one direction, and provides hydrogen gas from electric power and water in the other direction.

The reversible fuel-cell solution has greater energy storage than a battery. When stopped, if an overhead line is available, it can similarly absorb power from the grid. If not, it can run on hydrogen fuel cells. Moreover, hydrogen, which is sometimes called the “universal fuel”, may readily be produced from a variety of energy sources. This has already been demonstrated in the US.

Further to this feasibility assessment, RSSB is unable to take this forward to demonstrator because of limited resources. Alternative funding streams would therefore be welcome.

**PROJECT DETAILS**

**CONTACT INFORMATION:** Arnold R. Miller
Vehicle Projects Inc.
+1 303 484 9522
arnold.miller@vehicleprojects.com

**ADVANTAGES:**
A hydrogen fuel cell, a uniquely versatile energy source, which has better storage than a battery and can absorb power from the grid when under overhead lines.

**BENEFITS:**
More efficient fuel usage, reduced emissions

**PROJECTED IMPLEMENTATION:**
To TRL 6-7 by 2018

**BENEFICIARIES:**
TOCs, RoSCOs, public

**KEY CHALLENGES:**
Route to market, adapting to the UK rail environment
PROGRAMME: Powertrain
PROBLEM STATEMENT: We need alternative forms of train power (diesel) for areas where electrification cannot be justified.

SOLUTION: This project looks at adapting waste heat recovery technologies for diesel rail vehicles (diesel multiple units, DMU).

Entropea Labs Limited and Brunel University have proposed a technology that consists of a mild-hybridisation of the DMU vehicle powertrain to reduce fuel consumption and pollutant emission.

A modular non-invasive Waste Heat Recovery System based on the Organic Rankine Cycle will be retrofitted to the DMU powertrain or placed on new vehicles.

The proposed technology focuses towards a mild-hybrid configuration, allowing for a cost-effective solution that improves the efficiency of a DMU vehicle.

Further to this feasibility assessment, RSSB is unable to take this forward to demonstrator because of limited resources. Alternative funding streams would therefore be welcome.

**CONTACT INFORMATION:**
Dr Benjamin Franchetti
Entropea Labs Limited, London
07540 176800
benjamin@entropea.com

**ADVANTAGES:**
The Waste Heat Recovery System based on the Organic Rankine Cycle is a novel concept to capture waste heat from combustion engines and convert it into useful energy.

**BENEFITS:**
Cleaner vehicles, reduced fuel costs, reduced emissions

**PROJECTED IMPLEMENTATION**
To TRL 7-8 by late 2017

**BENEFICIARIES:**
TOCs, RoSCOs

**KEY CHALLENGES:**
Availability of a DMU on which to place the prototype
PROGRAMME: Predictable and Optimised Braking

PROBLEM STATEMENT: We need technical solutions which can provide increased braking performance and reliable braking rates that are independent of wheel-rail conditions.

SOLUTION: The ‘linear induction motor’ solution will apply technology similar to ‘maglev’ trains in order to turn rotational motion into linear motion. This can be used for improved braking as well as train power. It prevents vehicle brakes from being degraded at the wheel rail interface. There is less friction and vibration in such systems, reducing wear on the motor and the brakes. This varies from previous electromagnetic and eddy current brake systems in that it is configured differently to address and avoid traditional concerns.

POB

 Linear induction motors for reliable braking

**CONTACT INFORMATION:**
Bob Silverthorne
Mole Solutions Ltd
Alconbury Weald, PE28 4WX
07971 199990

**ADVANTAGES:**
Linear Induction Motors, used for propulsion and braking in development work on freight pipelines, can be applied to railway applications.

**BENEFITS:**
- Improved adhesion, reduced delays, increased capacity

**PROJECTED IMPLEMENTATION**
At TRL 3

**BENEFICIARIES:**
IM, TOCs, passengers

**KEY CHALLENGES:**
Technical challenges, commercial exploitation within UK rail
PROGRAMME: Predictable and Optimised Braking

PROBLEM STATEMENT: We need technical solutions which can provide increased braking performance and reliable braking rates that are independent of wheel-rail conditions.

SOLUTION: The proposed Optimised Brake System will create an advanced braking system which optimises the performance of the existing friction braking systems, and supplements this with the latest developments in permanent braking techniques (magnetic eddy current braking).

The optimised and integrated software and hardware approach will ensure that the deceleration of the train stays within the required corridor in degraded adhesion conditions whilst optimising energy usage. This allows significant benefits to be achieved.

BENEFITS:
- Reduced braking maintenance costs, increased capacity

PROJECTED IMPLEMENTATION
- At TRL 4, to TRL 6-7 by 2018

BENEFICIARIES:
- IM, TOCs, train maintainers

ADVANTAGES:
- A new braking control system that improves the utilisation, blending and ultimate performance of the existing friction and dynamic braking systems.

KEY CHALLENGES:
- compatible with the existing infrastructure and rolling stock

CONTACT INFORMATION:
Phil Laxton
Alstom Transport UK
01902 874475
phil.laxton@transport.alstom.com
PROGRAMME: Predictable and Optimised Braking

PROBLEM STATEMENT: We need technical solutions which can provide increased braking performance and reliable braking rates that are independent of wheel-rail conditions.

SOLUTION: The project is about control of wheel/rail interface conditions using dry-ice blasting. The aim was to assess the feasibility of using dry-ice blasting as a new approach to achieve predictable conditions in the wheel/rail interface.

A combination of modelling dry-ice behaviour and small scale laboratory traction recovery tests were undertaken. This lead to high speed trials and full-scale wheel/rail tests designed to assess the technique’s capability.

This solution was chosen because it leaves dry surfaces, it can be closely controlled, and no damage to wheel/rail surfaces is anticipated.

CONTACT INFORMATION:
Roger Lewis
Sheffield University
0114 222 7838
roger.lewis@sheffield.ac.uk

BENEFITS:
Improved adhesion, reduced delays, increased capacity

PROJECTED IMPLEMENTATION
At TRL 4, to TRL 7 by 2018

BENEFICIARIES:
IM, TOCs, FOCs, passengers

KEY CHALLENGES:
Technical challenges, field tests required

ADVANTAGES:
This solution to adhesion uses a compact on-board device to generate and blast dry-ice, leaving no particles or wheel/rail damage.
PROGRAMME: Predictable and Optimised Braking

PROBLEM STATEMENT: We need technical solutions which can provide increased braking performance and reliable braking rates that are independent of wheel-rail conditions.

SOLUTION: The key to this solution will be an intelligent rail surface conditioning unit that will intervene in times of slippery conditions to provide a dry rail surface. To support this system, leading to a consistent, dry-condition environment in which braking durations and distances can be predicted, the process will be optimised through the development of a new formula brake pad. Used or worn brake discs on railways are currently scrapped when they reach the end of their usable wear limit. This project will cover research into designing a process for reconditioning the brake disc.

CONTACT INFORMATION:
Dr Tim Hodges
Federal-Mogul Friction Products Ltd
Derbyshire
Tim.Hodges@federalmogul.com

ADVANTAGES:
Reconditioning old and worn brake discs to increase friction and reduce the variability in braking performance.

BENEFITS:
Improved braking performance, reduced delays

PROJECTED IMPLEMENTATION
At TRL 3

BENEFICIARIES:
IM, TOCs, train maintainers

KEY CHALLENGES:
Finding demonstration funding, entry to the market
PROGRAMME: Predictable and Optimised Braking

PROBLEM STATEMENT: We need technical solutions which can provide increased braking performance and reliable braking rates that are independent of wheel-rail conditions.

SOLUTION: The ‘Controlled Water Addition to Improve Braking Performance’ project aims to assess the feasibility of using water application under a range of conditions (with bubbles, varying pressure, etc.) to achieve predictable adhesion in the wheel/rail interface.

Small scale traction recovery tests were used to inform full-scale wheel/rail tests designed to assess the capability of the technique.

This solution was chosen as water is readily available and can easily be applied to the wheel/rail interface from on-board systems. It is also an environmentally friendly solution that will leave no residue.

CONTACT INFORMATION:
Roger Lewis
Sheffield University
0114 222 7838
roger.lewis@sheffield.ac.uk

ADVANTAGES:
A braking solution that uses the application of water to achieve predictable adhesion in a variety of testing conditions.

BENEFITS:
Improved adhesion, reduced delays, increased capacity

PROJECTED IMPLEMENTATION
At TRL 4, to TRL 7 by 2018

BENEFICIARIES:
IM, TOCs, FOCs, passengers

KEY CHALLENGES:
Technical challenges, field tests required
A Linear Induction Motor for braking

PROGRAMME: Predictable and Optimised Braking

PROBLEM STATEMENT: We need technical solutions which can provide increased braking performance and reliable braking rates that are independent of wheel-rail conditions.

SOLUTION: The ‘Zero Wheel Slip Linear Induction Motor’ aims to reduce dependence on friction between wheel and Rail for traction and braking forces, but with minimal changes to the existing rolling stock and infrastructure. The concept is based on the well-known linear induction motor technology (LIM), which has been successfully employed in the railways through the idea of Eddy Current Brakes.

A more reliable stopping performance removes both the requirement for defensive driving and any issues of low rail adhesion conditions. This can greatly increase potential capacity on the network.

CONTACT INFORMATION: Roberto Paladin
Newcastle University
roberto.paladin@ncl.ac.uk

BENEFITS:
Improved adhesion, reduced delays, increased capacity

PROJECTED IMPLEMENTATION
To TRL 4 by 2016, TRL 7 by 2018

BENEFICIARIES:
IM, TOCs, FOCs, passengers

ADVANTAGES:
This braking solution uses known technology in a novel way, maximising the reuse of existing railway infrastructure by including the running rails as part of the design.

KEY CHALLENGES:
Technical challenges, translation to physical domain
Microwave technology to increase adhesion

PROJECT DETAILS

PROGRAMME: Predictable and Optimised Braking

PROBLEM STATEMENT: We need technical solutions which can provide increased braking performance and reliable braking rates that are independent of wheel-rail conditions.

SOLUTION: The key components which affect rail wheel adhesion are a thin film of rain water and damp, flattened leaf detritus which creates a hard friction layer on the top of the rail.

The ‘Summer braking all year round’ project solution uses microwave energy to dissipate that layer of water from the rail surface.

This solution offers a zero contact method of conditioning the rail which can be mounted to each train ahead of the wheel rail interface. This will enable each train to ensure controlled braking in all environmental conditions.

POB SC04-POB-07

CONTACT INFORMATION:
Julian Swan
The Imagination Factory Ltd
Power Road Studios, Chiswick
julian@imaginationfactory.co.uk

ADVANTAGES:
This energy efficient microwave technology has not been utilised previously in the conditioning and removal of water from the railhead.

BENEFITS:
Improved adhesion, reduced delays, reduced maintenance costs

PROJECTED IMPLEMENTATION
At TRL 3, to TRL 7 by 2018-19

BENEFICIARIES:
IM, TOCs, passengers

KEY CHALLENGES:
Energy requirement, removal rate and microwave placement
PROGRAMME: TOC’15

PROBLEM STATEMENT:
PASSENGER LOADING – customers are currently given limited information about how busy each carriage is on a train, making it difficult to know where to board trains.

SOLUTION will turn existing Loadweigh data from trains into a real-time data source, which will be integrated with train running information to allow frontline staff to inform customers of where to stand on platforms to board in the most comfortable locations.

Project Details

BENEFITS:
Greater comfort for customers, more efficient boarding and alighting

PROJECTED IMPLEMENTATION
April 2017

BENEFICIARIES:
TOCs, Customers

ADVANTAGES:
Increased efficiency when boarding and alighting trains, reducing delays incurred at platforms.
Greater comfort for customers who can find more space.

KEY CHALLENGES:
Developing data to transform it into usable, real-time information

CONTACT INFORMATION:
Arriva innovation team
Marylebone Station, Great Central House, Melcombe Place
London, NW1 6JJ
PROGRAMME: TOC’15

PROBLEM STATEMENT: Customers could receive more information about their journey and take decisions ahead of time, for example knowing where capacity is situated on train.

SOLUTION integrates customer data with journey planning to deliver “intelligent mobility”. It will identify vehicles with available capacity and direct customers to them. In addition the platform will enable 3rd party to notify customers of the temperature in carriages and catering and toilet availability on services.

MyJrny

Project Details

Chiltern Railways

If you think our way, travel our way.

CONTACT INFORMATION:
Arriva innovation team
Marylebone Station, Great Central House, Melcombe Place
London, NW1 6JJ

BENEFITS:
Richer intelligent information for the customer, easier to travel.

PROJECTED IMPLEMENTATION
June 2017

ADVANTAGES:
Offers the customer an intelligent solution which requires minimal manual intervention; the customer’s data is used to proactively notify them of important information relevant to them.

BENEFICIARIES:
Customers and TOCs

KEY CHALLENGES:
Developing new infrastructure for installation on trains
PROGRAMME: TOC’15

PROBLEM STATEMENT: The rail industry faces a tough challenge in improving operational performance and punctuality (industry PPM MAA over the last three years has steadily declined from 91.6% in March 2012 to 89.3% in December 2015).

SOLUTION The project will deliver a data warehouse which will gather incoming data from a wide range of sources and transform it into automated, real-time and useful reporting tools.

**Big Operational Data**

**Project Details**

**CONTACT INFORMATION:**
Arriva innovation team
Marylebone Station, Great Central House, Melcombe Place
London, NW1 6JJ

**ADVANTAGES:**
Operational Performance gains will come from PPM, improved identification of Timetable deficiencies and improved delay investigation and root cause identification.

**BENEFITS:**
Management of train performance is proactive, not reactive

**PROJECTED IMPLEMENTATION**
October 2018

**BENEFICIARIES:**
TOCs, Customers, Engineering, Control

**KEY CHALLENGES:**
Integration of multiple data sources
PROGRAMME: TOC’15

PROBLEM STATEMENT: Ticketing is still offered to customers in formats, such as paper tickets and barcode. Customers are increasingly demanding greater convenience.

SOLUTION This project will deliver a “post pay as you travel” customer proposition where passengers can enter the network using a smartphone application which will record their progress, and charge them best value for journeys made. No cash or cards are required as the solution is account based. The smartphone application would also allow passage through ticket gates.

CONTACT INFORMATION:
Arriva innovation team
Marylebone Station, Great Central House, Melcombe Place
London, NW1 6JJ

ADVANTAGES:
Requires no ticket selling facilities, no pre-payment and no product knowledge, offering the customer increased convenience.

BENEFITS:
Greater convenience to the customer, quicker and easier to buy tickets

PROJECTED IMPLEMENTATION
May 2017

BENEFICIARIES:
TOCs, Customers

KEY CHALLENGES:
Integrating new ticket validation into existing infrastructure
PROGRAMME: TOC’15
PROBLEM STATEMENT: WiFi is becoming more prominent on rail services, but there is a limited understanding of the capabilities it can enable and changes in behaviour we could see.

SOLUTION aims to investigate the impact on customer behaviours when WiFi is enhanced in order to identify potential opportunities generated by this. Customers were surveyed before and after enhancement took place to examine the impact on behaviours.

CONTINUOUSLY CONNECTED CUSTOMER

PROJECT DETAILS

Chiltern Railways

If you think our way, travel our way.

CONTACT INFORMATION:
Arriva innovation team
Marylebone Station, Great Central House, Melcombe Place
London, NW1 6JJ

BENEFITS:
Better understanding of how to make best use of enhanced WiFi

PROJECTED IMPLEMENTATION
February 2018

BENEFICIARIES:
TOCs, Customers

ADVANTAGES:
The increasing prominence of WiFi on rail services can be exploited with a better understanding of how it will impact on customers.

KEY CHALLENGES:
Interviewing a sufficient number of respondents to deliver a high quality outcome

CONTACT INFORMATION:
Arriva innovation team
Marylebone Station, Great Central House, Melcombe Place
London, NW1 6JJ
PROGRAMME: TOC ’15
PROBLEM STATEMENT:
DISRUPTION – TOCs commonly score less highly in the National Rail Passenger Survey (NRPS) for how disruption is handled and the information made available to customers.

SOLUTION aims to deliver a game which will act as an “adult learning” training and business improvement capability for frontline staff, based on learnings from previous disruptions. This project is being delivered with Aston University.

Project Details

Chiltern Railways
If you think our way, travel our way.

CONTACT INFORMATION:
Arriva innovation team
Marylebone Station, Great Central House, Melcombe Place
London, NW1 6JJ

BENEFITS:
Better information provision during disruption, faster service recovery

PROJECTED IMPLEMENTATION
May 2017

BENEFICIARIES:
TOCs, Frontline Staff, Customers

ADVANTAGES:
This project will deliver a more thorough and engaging development capability than traditional training methods by being designed scientifically to suit its target audience (our frontline staff).

KEY CHALLENGES:
Lack of defined output – “first of a kind” solution for rail
Programme: MANTRA (Millimetre-wave Access Networks for TRAins)

Problem Statement: WiFi data transmission speeds between trackside and train does not provide sufficient capacity to support the government level commitment for WiFi to all rail users.

Solution: Develop and trial a transmission solution to allow mmWave high speed data transmission trackside to train, raising data rates to in excess of 400 Mbps and increasing available bandwidth.

Contact Information:
Stuart Maclean
FirstGroup
stuart.maclean@firstgroup.com

Benefits:
High Speed WiFi provision supporting ever increasing on board demand

Projected Implementation:
August 2017

Beneficiaries:
TOCs, Industry, Passengers

Advantages:
mmWave technology has high data transfer rates and is the basis of proposed 5G mobile phone technology. Hardware is already on trial and this project therefore adapts existing technology.

Key Challenges:
Developing a robust interface between ground based infrastructure and fast moving vehicles.
PROGRAMME: Open GPS Gateway

PROBLEM STATEMENT: GPS data sources already exist on a large number of trains; however, this data may be in different formats, is not gathered in real-time and is not consolidated to provide an accurate real-time view of the location of trains.

SOLUTION: A gateway application is needed to receive this data from a number of sources and transmit it in real-time, in a common standard, to end-user systems.

CONTACT INFORMATION:
Taj Mankoo
First Group
taj.Mankoo@firstgroup.com

ADVANTAGES:
We’re pursuing an outcome that provides choice and flexibility to the industry, and which supports existing and future solutions to improve the transfer of information for both operational and customer benefit.

BENEFITS:
Ability to use real time, accurate GPS data, to detect and report the location of trains

PROJECTED IMPLEMENTATION
February 2017

BENEFICIARIES:
TOCs, Industry, Passengers

KEY CHALLENGES:
Being able to gather and interpret real-time, accurate GPS data from multiple different sources on trains travelling at high speeds
PROGRAMME: Understanding Passenger Numbers in real time

PROBLEM STATEMENT: To improve the customer experience through improved knowledge of passenger numbers.

SOLUTION: Research will determine the high value data sources and collection methods to use, both historical and real time. This data will be used to model, predict and deliver operational and customer information to help channel passengers to the optimum areas on stations and on trains in order to reduce overcrowding.

CONTACT INFORMATION:
Jason Durk, Senior Project Manager
Govia Thameslink Railway
Jason.durk@gtrailway.com

BENEFITS:
Improve customers’ ability to find a seat; improve operational decisions

PROJECTED IMPLEMENTATION
Delivers in summer 2018

BENEFICIARIES:
Customers, TOCs, Industry

ADVANTAGES:
Research will be carried out on a number of counting technologies and methodologies to determine the best fit for accuracy vs. cost.

KEY CHALLENGES:
Identifying the best solutions for counting people in real time
PROGRAMME: Tomorrow’s Train Design
Today
PROBLEM STATEMENT: We need designs for rolling stock interiors with a focus on flexibility and adaptability for all service requirements.
SOLUTION: Maynard have designed an integrated solution comprising a train interior and a smart device app.
The ‘Connect Me’ train concept offers a modular interior with flexible seating zones that help regulate capacity.

Complementing the interior flexibility is the Connect Me digital platform and application. This digital tool is used to define the interior layout regulation by communicating capacity data to the operator to provide real-time information and journey planning for passengers.
It includes Flexible seating that is pneumatically controlled, a modular interior, and more accessible storage.

Project Details

Maynard.

CONTACT INFORMATION:
Julian Maynard
Maynard Design Ltd
020 7724 9500
Julian@maynard-design.com

BENEFITS:
Improved customer experience, reduced dwell times

PROJECTED IMPLEMENTATION
At TRL 3-4

BENEFICIARIES:
TOCs, passengers

ADVANTAGES:
This flexible interior concept maximises on space, flexibility and convenience for both passenger and train operator alike.

KEY CHALLENGES:
Gaining buy-in from partners across the rail industry
PROGRAMME: Tomorrow's Train Design Today

PROBLEM STATEMENT: We need designs for rolling stock interiors with a focus on flexibility and adaptability for all service requirements.

SOLUTION: The Adaptable Carriage concept is that of a flexible-use carriage which can carry passengers during peak hours, and be converted for the haulage of low-density, high-value (LDHV) goods during off-peak hours. Train operating companies report that during off-peak hours, trains run with an average utilisation of just 25%. Trains which included Adaptable Carriages could be converted for the carriage of LDHV goods in order to relieve traffic from roads, decongest city centres, create a new revenue stream for TOCs, and stimulate the growth of regional SMEs. The University of Newcastle estimates that £18.9bn worth of freight could be moved from the UK’s roads to the rail system.

CONTACT INFORMATION:
42 Technology Ltd
St. Ives, Cambridgeshire, PE27 4LG
01480 302700
adaptablecarriage@42technology.com

ADVANTAGES:
Seats which slide along the length of the carriage to create a large amount of space for the transport of low-density, high-value goods.

BENEFITS:
Increased freight revenue for TOCs, reduced emissions

PROJECTED IMPLEMENTATION
To TRL 6-7 by 2017

BENEFICIARIES:
IM, TOCs, logistics companies

KEY CHALLENGES:
Gaining buy-in from partners across the rail industry
PROGRAMME: Tomorrow's Train Design Today

PROBLEM STATEMENT: We need designs for rolling stock interiors with a focus on flexibility and adaptability for all service requirements.

SOLUTION: ‘Horizon’ is a concept which incorporates a flexible seat into a train carriage, allowing the configuration to switch between peak and off-peak modes, increasing both seat numbers and capacity at peak times.

The concept allows more seating overall by reconfiguring the space and moving the luggage racks.

It offers an enhanced environment and experience for the most over-crowded trains, offering better value for money for many passengers who often stand for every journey.

This solution therefore increases the number of passengers who can board the train.

**Contact Information:**
Kirsty Dias
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020 7580 3444
kirsty@priestmangoode.com

**Benefits:**
- Improved customer experience, increased capacity

**Projected Implementation**
- To TRL 6-7 by 2017, TRL 8-9 by 2018

**Beneficiaries:**
- TOCs, passengers, RoSCOs

**Advantages:**
The Horizon concept offers an enhanced environment and experience for the most over-crowded trains, increasing train capacity.

**Key Challenges:**
- TOC appetite for risk and passengers’ ability to change
A flexible carriage with a fresh new outlook

PROGRAMME: Tomorrow's Train Design

Today

PROBLEM STATEMENT: We need designs for rolling stock interiors with a focus on flexibility and adaptability for all service requirements.

SOLUTION: The Air Train design proposal draws inspiration from clouds floating in the sky and it is intended that passengers should feel this way as they move freely through the carriages.

The interior floor, walls, ceiling, windows and seats are formed from a continuous ‘cloud skin’, which is designed to house all functions required in the train interior such as seating, lighting and air-conditioning.

The Air Train is not restricted by traditional fixed seats. Instead, air bladders manipulate the shape of the ‘cloud skin’ to deploy or retract seats to accommodate different needs at different times of the day.

Project Details

ARUP

CONTACT INFORMATION:
Piet Lycke (Architect)
OVE ARUP & PARTNERS JAPAN LTD
Tokyo, Japan
piet.lycke@arup.com

BENEFITS:
Improved customer experience, increased capacity

PROJECTED IMPLEMENTATION
At TRL 3-4

BENEFICIARIES:
TOCs, passengers

ADVANTAGES:
Not restricted by traditional fixed seats the ‘cloud skin’ space transforms itself accordingly to accommodate different needs.

KEY CHALLENGES:
Collaboration with innovative partners across the rail industry
PROGRAMME: Tomorrow's Train Design Today

PROBLEM STATEMENT: We need designs for rolling stock interiors with a focus on flexibility and adaptability for all service requirements.

SOLUTION: ‘FLEX’ is a more flexible premium-class carriage which, with all seats pre-booked, allows train operators to configure the seating to better suit its passengers. The solution is formed of two parts; a unique design of rotating seat (the product), and a booking algorithm which enables the product’s transformational use (the system). The combination of the two offers a quick and simple way to change the product to either suit an individual’s tastes and requirements, density demands or day/night operations. The FLEX bespoke booking algorithm efficiently manages the bookings of different sized groupings of passengers.

CONTACT INFORMATION:
Jeremy White
Seymourpowell, London, SW18 5JS
020 7381 6433
Jeremy.white@seymourpowell.com

BENEFITS:
Improved customer experience, alternative business models

PROJECTED IMPLEMENTATION
At TRL 3-4

BENEFICIARIES:
TOCs, passengers

ADVANTAGES:
Rotating seats and a booking system enables the transport business model to move away from selling seats to one of selling space.

KEY CHALLENGES:
Testing and validation in bringing this to market
Shorter rail cars for more customised train interiors

PROGRAMME: Tomorrow’s Train Design Today

PROBLEM STATEMENT: We need designs for rolling stock interiors with a focus on flexibility and adaptability for all service requirements.

SOLUTION: The ‘Foresee’ proposal will supersede a conventional 20m, 40 tonne rail car with a greater number of close-coupled smaller 6.5m long cars as an industry standard platform for passenger transport. These will be mass produced to a standard design, but with interiors that can be easily customised by individual franchisees to suite an infinite range of operating scenarios. Given the higher number of cars required, these can be volume produced using high-strength-to-weight composite manufacturing technology.

CONTACT INFORMATION:
Martin Pemberton
Transport Design International (TDI)
01789 205 011
martin.p@tdi.uk.com

BENEFITS:
Reduced whole-life cost, less track wear, better customer experience

PROJECTED IMPLEMENTATION
At TRL 3-4

BENEFICIARIES:
TOCs, passengers

ADVANTAGES:
The ‘foresee’ design envisages a train made up of smaller, more cost-efficient cars which is less ‘corridor’ or ‘airline’ like and is instead more compartmented.

KEY CHALLENGES:
Further funding for a demonstration required
A double decker coach within gauge

**Programme: Tomorrow’s Train Design Today**

**Problem Statement:** We need designs for rolling stock interiors with a focus on flexibility and adaptability for all service requirements.

**Solution:** The UK rail network has historically had a limited gauging (physical space for train passage), which does not easily allow for double decker or long vehicles.

AeroLiner3000 is developing a high speed double decker train capable of running on HS2 and also serving other existing routes.

The high speed double decker train is based on a systemic approach to the whole train. Bogie and gear design, locomotion, light weight structure and interior geometry and design play hand in hand.

It offers the potential to gain significant capacity improvements without neglecting comfort. The solution will be demonstrated as a full scale mock-up coach.

**Project Details**

**Benefits:**
- Improved customer experience,
  increased capacity

**Projected Implementation:**
To TRL 6 by 2016

**Beneficiaries:**
- TOCs, UK supply chain, passengers

**Advantages:**
An innovation driven design for double decker coaches within gauge from scratch allows a higher capacity on existing infrastructure.

**Contact Information:**
Andreas Vogler
German Aerospace Center, DLR
+49 173 357 08 33
Andreas.Vogler@andreasvogler.com

**Key Challenges:**
Consolidation of the train manufacturer market
RSSB Test Voucher Scheme (TVS)

PROBLEM STATEMENT: The existing testing and trialling landscape was found to lack sufficient availability and diversity of facilities, especially for SMEs, to meet the future demand for business as usual and innovation products.

SOLUTION: After a negotiated tendering procedure, the Testing Voucher Scheme (TVS) contract for Testing and Trialling was awarded to the Rail Alliance to act as facilitator through to the end of CP5. Part of the requirement of the contract is for the Rail Alliance to create and maintain a repository of all UK secondary and tertiary TVS facilities so that TVS requirement can be best matched to the appropriate TVS facilitator.

**PROJECT DETAILS**

**BENEFITS:**
Provides affordable interventions to support, enhance & realise innovation

**PROJECTED IMPLEMENTATION**
TVS currently in service until end CP5

**BENEFICIARIES:**
NR, TOCs, UK Industry, other sectors
UK plc (exports)

**ADVANTAGES:**
The Rail Alliance has experience in assisting over 115 UK companies achieve in excess of 250 company-test days under a limited TVS operating during 2013-15.

**KEY CHALLENGES:**
Product approval, commercialisation, educating procurers (sector acceptance)

**CONTACT INFORMATION:**
Rail Alliance, QRTC, Long Marston, Stratford-on-Avon, Warwickshire CV37 8RP
01789 720026
robert.hopkin@railalliance.co.uk
PROGRAMME: European Space Agency

PROBLEM STATEMENT: We want to adapt the technology used in space exploration to the requirements of the rail industry.

SOLUTION: The VTOL (vertical take-off and landing) flying wing is an ideal candidate for aerial inspections over large distances. It can be operated beyond the visual line of sight, and will save on time and resources. During severe weather conditions such as flooding or heavy snowfall, the operator can remotely control the system at the operating station, but still be able to view the actual flight operation in real-time.

This will advance the deployment of satellite applications for the monitoring of rail assets, and is partly made from recycled aluminium.

Further to this feasibility assessment, RSSB is unable to take this forward to demonstrator because of limited resources. Alternative funding streams would therefore be welcome.

PROJECT DETAILS:

VTOL Technologies

CONTACT INFORMATION:
VTOL Technologies
London Road, Reading, RG1 5AQ
0118 3766311
info@vtol-technologies.com

ADVANTAGES:
Flying wing unmanned aerial vehicles can fly for long periods at high speeds, and survey large areas of the rail network where access is difficult.

BENEFITS:
Lowered maintenance costs, reduced delays, improved safety

PROJECTED IMPLEMENTATION:
At TRL 7-8, deployable by 2016

BENEFICIARIES:
IM, Passengers

KEY CHALLENGES:
Route to market, engaging with the infrastructure manager
Identification of physical railway line blockages in support of inspection and recovery operations

PROBLEM STATEMENT: We want to adapt the technology used in space exploration to the requirements of the rail industry.

SOLUTION: The project considered a novel remote sensing system to monitor railway lines for blockages under extreme weather conditions and alert authorities about their presence. The sensing system envisaged is a passive imaging radar using Global Navigation Satellite (GNSS) transmissions.

Research on the application and its end users has shown that a technology demonstrator would be viable. Experiments with the scientific equipment has shown that the technology could be fit for purpose. Experiments with communications terminals have shown that there are no physical limitations in transmitting data from the sensing system to another location using existing communications infrastructure.

Further to this feasibility assessment, RSSB is unable to take this forward to demonstrator because of limited resources. Alternative funding streams would therefore be welcome.

ADVANTAGES:
Passive sensing technology integrated with satellite communications can provide early warning system capability to railway operations when lines become blocked.

BENEFITS:
Lowered maintenance costs, reduced delays, improved safety

PROJECTED IMPLEMENTATION
At TRL 5, deployable by 2019

BENEFICIARIES:
IM, TOCs, Passengers

KEY CHALLENGES:
Route to market, engaging with the infrastructure manager

CONTACT INFORMATION:
Sarah Jordan
University of Birmingham
0121 414 4247
s.jordan@bham.ac.uk
PROGRAMME: Customer Experience

PROBLEM STATEMENT: We need more implementable and practical innovative ideas to meet rail customers’ demands for information on services and disruptions.

SOLUTION: ‘Commuter Intelligent Passenger’ is a proactive mobile app that (when possible) displays real-time door-to-door public transport information to passengers. This app runs behind the scenes without user intervention to understand personal travel routines. This allows it to be ready with preloaded real-time advice about door-to-door journey options wherever they are at the time. It will proactively alert passengers of disruptions to their journeys in a more intelligent fashion than currently possible. By reassuring passengers with simple, proactive and intelligent support for these journeys, passenger stress can be significantly reduced.

AYOUPA + CYB

CONTACT INFORMATION: Ben Stewart, Ayoupa Ltd with Caution Your Blast Ltd
07823 443844
ben@cautionyourblast.com

ADVANTAGES: Real-time door-to-door itineraries for multiple comparative routes and personalised, predictive public transport travel advice.

BENEFITS: Improved customer experience, reduced stress, promotes rail industry

PROJECTED IMPLEMENTATION At TRL 6-7

BENEFICIARIES: TOCs, Passengers

KEY CHALLENGES: Design and implementation of the intelligence algorithms
**Programme**  
Customer Experience  

**Problem Statement:** We need more implementable and practical innovative ideas to meet rail customers’ demands for information on services and disruptions.

**Solution:** ‘OpenCapacity’ is a software platform with a variety of applications that can be used to predict the available space on Public Transport in real-time. This is achieved by utilising existing data sources already available on the railway combined with novel sensor innovations and advanced machine learning algorithms to measure, analyse, predict and communicate occupancy, performance and accessibility on public transport in real-time.

OpenCapacity allows using any existing data sensor as a baseline to provide occupancy forecast or to plug-in multiple sensors as add-ons when they become available.

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**OpenCapacity**

**Contact Information:**  
Dr Gerrit Boehm  
OpenCapacity, London, EC1R 0BE  
07788 594220  
gerrit@opencapacity.co.uk

**Advantages:**  
OpenCapacity is the ground-breaking technology that introduces real-time occupancy, accessibility and performance forecast to Public Transport.

**Benefits:**  
Improved customer experience, reduced dwell times,

**Projected Implementation:**  
At TRL 7-8

**Beneficiaries:**  
TOCs, Passengers

**Key Challenges:**  
Bridging the gap from development to commercialisation
PROGRAMME: Future Ticket Detection

PROBLEM STATEMENT: We need to respond to significant congestion in stations, particularly at gate-lines, which can lead to safety and crowd control issues, as well as revenue loss.

SOLUTION: A combination of mobile ticketing (buying and holding a travel ticket on a mobile device), Bluetooth technology and modern fare gates can be used to allow passengers who have a valid ticket to pass through fare gates without any user interaction.

This technology relieves the pressure in the ticket office as more tickets can be bought and used on the mobile device. As a result, fare media distribution costs are reduced as well as maintenance and replacement schedules of ticket vending machines.

Bluetooth LE offers a number of advantages as a contactless technology that other popular technologies do not.

CONTACT INFORMATION:
David Colgan
ByteToken Ltd, Edinburgh
0131 240 1298
www.bytetoken.com

ADVANTAGES:
A mobile ticketing solution that represents a step change not only in terms of customer experience, but also in how TOCs manage passenger throughput.

BENEFITS:
Improved customer experience, reduced congestion, increased safety

PROJECTED IMPLEMENTATION
To TRL 6 by late 2016

BENEFICIARIES:
IM, TOCs, passengers

KEY CHALLENGES:
The speed of advances in BLE hardware and software development
PROGRAMME: Driver Route Knowledge

PROBLEM STATEMENT: We currently spend considerably more on train crew route learning and retention than most other European railways – we need a way to resolve this.

SOLUTION: The Driver Route Knowledge programme is investigating new approaches (adopted from other industries) to assist train drivers in learning and maintaining route knowledge.

This programme is founded on a review of what route knowledge is truly needed (given advances in signalling and in driving-cab technology) and an improved understanding of how it can be best learnt.

CONTACT INFORMATION:
Paul MacGuire
RSSB, Moorgate, EC2M 2RB
020 3142 5300
Paul.macguire@rssb.co.uk

BENEFITS:
Reduction in driver training costs, increased safety

PROJECTED IMPLEMENTATION
Implemented by 2020

BENEFICIARIES:
TOCs, FOCs

ADVANTAGES:
Increased driver route knowledge using validated approaches from other industries can reduce training costs and increase route safety.

KEY CHALLENGES:
Change management within the industry
An app to enable cyclists to use the railway

PROGRAMME: Rail Industry Support Engine

PROBLEM STATEMENT: We need to assist passengers with bicycles in accessing the railway, and enable the end to end journey concept through intermodal connections.

SOLUTION: The ‘Cycling in the Mobile App’ project adds information about cycling amenities on trains and stations to give passengers the full picture of their whole journey when using the tool. With this new layer of dedicated content, cyclists can check the available facilities conveniently on their smartphones before they start their journeys.

The application is available on all smart phones, as part of the ‘National Rail Enquiries’ IOS/Android App.

The App has been very successful and very well received. It has been operational for more than a year now, and won an Award.

CONTACT INFORMATION:
Conrad Haigh
Head of Integrated Transport, ATOC
020 7841 8052
Conrad.Haigh@atoc.org

ADVANTAGES:
The Cycle App gathers information on each train network’s cycle policy, and adds this to the existing NRE App, to enable a more integrated journey experience.
PROGRAMME: Rail Industry Support Engine

PROBLEM STATEMENT: We need to simplify the maintenance of gearboxes and improve monitoring of bogie components.

SOLUTION: This project will monitor the vibration and temperature of the gearbox during continuous operation, and thereby develop an understanding of what healthy and unhealthy condition statuses for a gearbox might look like.

This will enable the maintainer to continue running the gearbox well beyond the prescribed overhaul milestone and ultimately until the point that it shows actual evidence of damage or under performance.

Vibration sensors would be mounted directly onto the gearboxes which would transmit the data to an on-board Data Concentrator that would then send it to the server via GPRS.

BENEFITS:
Reduced maintenance costs, fewer delays, better reliability

PROJECTED IMPLEMENTATION
To TRL 7-8 by 2016-17

BENEFICIARIES:
TOCs, RoSCOs

ADVANTAGES:
Vibration Energy Harvester is a patented technology that converts vibration into electricity, allowing improved monitoring of bogies.

KEY CHALLENGES:
Assessing false readings, testing in a rail environment

CONTACT INFORMATION:
Justin Southcombe
Perpetuum
07801 775718
Justin.southcombe@perpetuum.com

ADVANTAGES:
Vibration Energy Harvester is a patented technology that converts vibration into electricity, allowing improved monitoring of bogies.

KEY CHALLENGES:
Assessing false readings, testing in a rail environment
PROJECTS

PROGRAMME: Rail Industry Support Engine

PROBLEM STATEMENT: We need to improve capacity and reduce delays at critical junctions, improving reliability across the network.

SOLUTION: The Intertrain HV coupler is a compressed air coupler for use in station environments. This connects power between rail cars and it will fit onto the existing mechanical coupler.

This will be an improvement because all other couplers use oil or grease interfacial seals which are not suitable for frequent connect/disconnect cycles.

A proof of concept sample has been made and qualified to the present short time high voltage tests.

CONTACT INFORMATION:
Dave Minety
Thornley Electrical Design
Daveminety@hotmail.com

BENEFITS:
Reduced maintenance costs, increased energy efficiency

PROJECTED IMPLEMENTATION
Currently at TRL 3-4

BENEFICIARIES:
IM, TOCs

ADVANTAGES:
A 25kV intercoupler would reduce drag and pantograph costs, increase energy efficiency, and enable alternative operating methods for TOCs.

KEY CHALLENGES:
Requires buy in from the manufacturer and industry
PROGRAMME: Rail Industry Support Engine

PROBLEM STATEMENT: We need to provide a speed and positioning sensor that locates a train on a precise track anywhere on the network.

SOLUTION: RDS video positioning technology uses a forward facing camera to locate a train’s position using real time image processing. The solution provides a train-borne positioning sensor with low life cycle costs. It offers significant advantages over existing approaches that are heavily reliant on infrastructure equipment or GPS.

The patented RDS technology uses image processing algorithms to provide distance measurement output and also to identity infrastructure elements such as switches, crossings and signs.

**VTPS**

CONTACT INFORMATION:
Richard Shenton
Reliable Data Systems (RDS)
01483 225604
rds@rdsintl.com

ADVANTAGES:
An innovative approach to train positioning technology with low life-cycle costs.

**BENEFITS:**
Improved reliability, reduced delays, increased capacity

**PROJECTED IMPLEMENTATION**
To TRL 7-8 by late 2016

**BENEFICIARIES:**
IM, TOCs, suppliers

**KEY CHALLENGES:**
Finding industry partners for commercialisation
PROGRAMME: Rail Industry Support Engine

PROBLEM STATEMENT: We need to develop an automated system mounted on a rail vehicle for detecting and assessing signals.

SOLUTION: The ‘Automated Track Inspection System’ can be mounted external to the train for accurate detection, positioning, and video analysis of signals. The system has high definition cameras to record the imagery on a moving train, and uses high speed processors with automated image interpretation software to isolate signals. It uses GPS and line referencing sensors to index their position in a database. A visibility metric for signals is used to assess the distance up to which the signal is visible. All data processing is carried out within the system with an option to process data offline. This will create an accurate database of signal information.

CONTACT INFORMATION:
Sameer Singh
Rail Vision Europe Ltd
Leicestershire
01509 672211

ADVANTAGES:
While all existing systems are manual or semi-automated, this system of track inspection is fully automated.

BENEFITS:
Reduced maintenance costs, increased safety

PROJECTED IMPLEMENTATION
To TRL 6-7 by late 2016

BENEFICIARIES:
IM

KEY CHALLENGES:
Successful assessments in changing outdoor environments
Lightweight sensors for level crossing monitoring

PROGRAMME: Rail Industry Support Engine

PROBLEM STATEMENT: We need to reduce the safety risk and accident rate at level crossings using obstacle detection technology.

SOLUTION: UtterBerry’s Monitoring System (Rail Track Safety Network and Quality Sensors) is a low-power wireless sensor system that records, processes and transmits data on level crossing obstructions.

The system detects the presence of human, animal, or other obstructions in the track danger zone, alerting oncoming trains to stop or, cause automatic train brakes to be applied.

The technology is able to discriminate the presence of animals, humans and vehicles that have entered, or about to enter a level safety crossing zone by means of a series of intelligent, adaptive, wireless sensors.

CONTACT INFORMATION:
Heba Bevan
UtterBerry Ltd, London, WC2A 1LG
020 8123 5272
heba@utterberry.com

ADVANTAGES:
Sensors that are lightweight, tiny, and easily concealed in their environment, consuming minimal power which can be self-powered.

BENEFITS:
Improved reliability, reduced delays, increased safety

PROJECTED IMPLEMENTATION
To TRL 7 by late 2016

BENEFICIARIES:
IM, passengers, public

KEY CHALLENGES:
Live trialling, linking the system to signalling
A composite modular footbridge

**PROGRAMME:** Rail Industry Support Engine  
**PROBLEM:** We need a footbridge that is cheaper and easier to install than steel designs.  
**SOLUTION:** the composite modular footbridge is suitable for rail spans up to 36m and a 19m span will be installed on a Network Rail site in Oxford in autumn 2016.  
Because it is 70% lighter than a conventional steel span, it is easier to install – even where access is limited or difficult. The modules can be lifted by a small crane, and moved around site by hand if necessary.  
The capital cost is comparable with steel footbridges, and with lower operating costs. There are no hidden structural elements.  
What’s more, all public-facing components are non-structural and replaceable, so the footbridge is fully customisable.

**BENEFITS:**  
Reduced maintenance costs, reduced disruption

**PROJECTED IMPLEMENTATION**  
To TRL 6-7 by 2016

**BENEFICIARIES:**  
IM, public, passengers

**ADVANTAGES:**  
A lightweight glass fibre reinforced plastic modular footbridge system especially suited to difficult sites.

**KEY CHALLENGES:**  
Finding key location and clients within Network Rail

**CONTACT INFORMATION:**  
Ian Wise  
ARUP, 63 St Thomas Street, London, BS1 6JZ

**ADVANTAGES:**  
A lightweight glass fibre reinforced plastic modular footbridge system especially suited to difficult sites.
PROGRAMME: Rail Industry Support Engine
PROBLEM STATEMENT: We need to improve capacity and reduce delays at critical junctions, improving reliability across the network.
SOLUTION: This is a C-DAS (driver advisory system) Trial at Heathrow Airport Junction to look at ways to improve conflict management.
The focus of the trial was to provide a demonstration of a real-time system which can intervene in junction timings. In doing so, it will optimise the arrival time of trains at the Airport Junction in the “up” direction, to smooth train flows and maximise the potential of DAS to save energy.
The trial demonstrated that junction optimisation was able to smooth out train flows but that this did not produce the expected improvement in lateness of HST trains at the subsequent timing points between Airport Junction and Paddington.

**CONTACT INFORMATION:**
John Collins
Network Rail
Milton Keynes
John.collins3@networkrail.co.uk

**BENEFITS:**
Improved traffic management, reduced dwell times, fewer delays

**PROJECTED IMPLEMENTATION**
Complete system available 2017-18

**BENEFICIARIES:**
IM, TOCs

**ADVANTAGES:**
This trial at Heathrow Airport Junction was an attempt to combine new DAS technology at a junction with critical capacity problems.

**KEY CHALLENGES:**
The trial is complete and the system is available for further testing
How to automatically identify vehicles

PROGRAMME: Rail Industry Support Engine
PROBLEM STATEMENT: We need a standard approach to automatically identifying unique rail vehicles, and their components.
SOLUTION: The Automatic Vehicle Identification (AVI) project uses high frequency radio waves to identify vehicles and their location and orientation on the Network Rail infrastructure.

This is compliant with GS1, the global standards organisation.
It is an enabler for key industry benefit realisation in reliability-centred maintenance and data driven asset management. It is an open standard technology platform which is expandable for further applications.

CONTACT INFORMATION:
Dave Burbridge
Network Rail, Milton Keynes
dave.burbridge@networkrail.co.uk

BENEFITS:
Improved service recovery, reduced maintenance costs, better reliability

PROJECTED IMPLEMENTATION
To TRL 8-9 by early 2016

BENEFICIARIES:
IM, TOCs, RoSCOs

ADVANTAGES:
This solution is the only suitable technology already adopted elsewhere in Europe – our adoption encourages interoperability.

KEY CHALLENGES:
RoSCO adoption of fitment and rollout of trackside systems
PROGRAMME: Strategic University Partnerships (Network Rail)

PROBLEM STATEMENT: We need to determine better ways to assess and prevent the degradation of railway assets.

SOLUTION: The Strategic University Partnership with Nottingham University is developing a series of projects quantifying degradation of assets. This will assess the effect of asset interventions and failure relationships over the whole life cycle for critical infrastructure assets.

There is now a team of 26 researchers at Nottingham, a large majority dedicated to working on Network Rail defined projects. This will deliver 5 PhD theses on asset degradation and numerical modelling techniques for whole life costing (this is detached from the SUP 1 project).

CONTACT INFORMATION:
Kevin Blacktop
R, D & Technology Team
Network Rail
Milton Keynes

ADVANTAGES:
This provides the foundation of the development of understanding that enables technology development and supports awareness of railway development amongst graduates.

BENEFITS:
Technology innovation supporting 4C objectives

PROJECTED IMPLEMENTATION
Programme ends 2017

BENEFICIARIES:
IM, Academia

KEY CHALLENGES:
Mobilising and demonstration of benefit
PROGRAMME: Strategic University Partnerships (Network Rail)

PROBLEM STATEMENT: How can we improve our understanding of the wheel rail interface to reduce damage and increase safety.

SOLUTION: The Strategic University Partnership with Sheffield University is developing a project looking at the wheel rail interface. The rail wheel interface is critical to predictable acceleration and braking and wear of the rail surface. Undesirable effects of rail damage can be signals passed at danger or fatigue cracking of rails. This is based on developing test rigs and measurement methods that can allow further research in this area being completed. This can then be shared with relevant areas of the industry to improve the future situation.

ADVANTAGES:
Understanding wear and damage at the wheel rail interface can prevent safety incidents and test rigs can improve this understanding.

CONTACT INFORMATION:
Kevin Blacktop
Research, Development & Technology Team
Network Rail

BENEFITS:
Safety, resilience, more predictable operations, reduced maintenance

PROJECTED IMPLEMENTATION
TRL 3 before October 2016

BENEFICIARIES:
IM, TOC, passengers

KEY CHALLENGES:
Access to rails which have branched fatigue defects and stress data
PROGRAMME: Strategic University Partnerships (Network Rail)

PROBLEM STATEMENT: The nature of bridge collapse is little understood and requires further in-depth research.

SOLUTION: The Strategic University Partnership with Sheffield University is developing a series of projects looking at aspects of bridge behaviour.

Over half the bridge spans carrying UK rail traffic are of masonry arch construction and the methods currently used to assess arch bridges have limited predictive capability, making asset management more difficult.

There are two bridge research initiatives undertaken, these are Limit-State Behaviour of Soil-filled Masonry Arch Bridges and XiSPAN - Bridge Strengthening and Life Extension (Accelerating Innovation in Rail project with Heriot Watt University and Balfour Beatty).

CONTACT INFORMATION:
Kevin Blacktop
Research, Development & Technology Team
Network Rail

ADVANTAGES:
Bridge management can be improved through better understanding of the behaviour of bridge structures at the research level.

BENEFITS:
Lower cost bridge assessment and strengthening

PROJECTED IMPLEMENTATION
Outputs available before January 2016

BENEFICIARIES:
IM

KEY CHALLENGES:
None identified
PROGRAMME: Strategic University Partnerships (Network Rail)

PROBLEM STATEMENT: We need to develop more resilient OLE systems to reduce failures.

SOLUTION: The Strategic University Partnership with Sheffield University is developing a series of projects looking at behaviour of overhead line equipment (OLE).

OLE failures are disruptive and can be costly, so we need to increase OLE system resilience and develop models to better understand system behaviour and deterioration to enable us to develop better designs and also understand when to best undertake maintenance interventions before failures occur.

These related research initiatives contribute to a better understanding of the behaviour and performance of OLE and provide the background information to develop wear models and avoid fatigue failures.

CONTACT INFORMATION:
Kevin Blacktop
Research, Development & Technology Team
Network Rail

ADVANTAGES:
Detailed research at university level into improved OLE resilience will enable a better understanding of OLE structures and reduce the incidence of failures.

BENEFITS:
Lower cost bridge assessment and strengthening

PROJECTED IMPLEMENTATION
TRL 4-7 before March 2015

BENEFICIARIES:
IM

KEY CHALLENGES:
None identified
PROGRAMME: Strategic University Partnerships (Network Rail)

PROBLEM STATEMENT: We need to solve railway problems aligned to the RTS/NRTS.

SOLUTION: Birmingham University is undertaking a group of initiatives to evaluate the degree of similarity between datasets to provide better information and analysis tools. This includes datasets for Energy Efficiency, Wayside Rolling Stock Measurements, Options for Renewal Projects and the Value of Existing Data Sources project.

The Impact of Climate Change project has developed a tool that uses existing data on track condition, traffic volume and type, and combines these with predicted future weather data as influenced by climate change. The tool uses this to predict and quantify maintenance and renewal requirements for the UK railway network infrastructure based on predicted deterioration.

ADVANTAGES:
Combining datasets using bespoke tools can increase the efficiency of data collection and assist in predicting changes on the network.

CONTACT INFORMATION:
Kevin Blacktop
Research, Development & Technology Team
Network Rail

BENEFITS:
Not estimated at this time

PROJECTED IMPLEMENTATION
TRL 5/6 not before December 2016

BENEFICIARIES:
IM

KEY CHALLENGES:
Data compatibility, system interfaces, data sharing issues
PROGRAMME: Strategic University Partnerships (Network Rail)

PROBLEM STATEMENT: We need to solve railway problems aligned to the RTS/NRTS.

SOLUTION: Birmingham University is undertaking a group of initiatives that will consider traffic management simulation and the impact of automation on the capability of railway systems. This will develop tools that help to optimise services, through time and position management, regulation and related aspects of the railway. These projects also support our involvement with other research such as FuTRO, which aims to contribute towards the GB rail industry’s 4Cs objectives.

These projects contribute to the ongoing work that will allow for improved train operations, particularly during times of disruption, resulting in reduced inconvenience to the travelling public and reduced delay costs to Network Rail.

ADVANTAGES:
Developing tools to optimise services will improve traffic management and assist other major programmes such as FuTRO.

PROJECTED IMPLEMENTATION:
TRL 2/3 not before July 2016

BENEFICIARIES:
IM, TOCs

KEY CHALLENGES:
Development past the current remit

CONTACT INFORMATION:
Kevin Blacktop
Research, Development & Technology Team
Network Rail

BENEFITS:
Not estimated at this time
PROGRAMME: Strategic University Partnerships (Network Rail)

PROBLEM STATEMENT: We need to solve railway problems aligned to the RTS/NRTS.

SOLUTION: Birmingham University is undertaking a group of initiatives into information and communications technology. While work on establishing data ownership has been undertaken in the wider research community, and several sets of standards exist, little work has been done to establish how this relates to the rail domain and its mix of structured & unstructured documents, remote condition monitoring and other data systems.

As the railway industry moves towards a more data-driven decision making culture, an increasing proportion of investment decisions are being based on facts and figures derived from data resources both within and external to Network Rail. These models and the data driving them must be trusted and complete.

CONTACT INFORMATION:
Kevin Blacktop
Research, Development & Technology Team
Network Rail

ADVANTAGES:
Transferring communication technology and data ownership rules to the UK railway model will allow a more data-driven decision making culture.

BENEFITS:
Not estimated at this time

PROJECTED IMPLEMENTATION
TRL 3-6 not before December 2016

BENEFICIARIES:
IM, TOCs

KEY CHALLENGES:
Development past the current remit
PROGRAMME: Strategic University Partnerships (Network Rail)

PROBLEM STATEMENT: We need to solve railway problems aligned to the RTS/NRTS.

SOLUTION: Southampton University is undertaking a group of initiatives that will support the theme of earthworks, foundations and transitions. The projects include OLE structure foundations, earthworks saturation levels and transitions such as under track crossings on/off bridges.

The research proposed within this project will provide added confidence in more economical designs of OLE foundations in the future, through validation by means of field tests and more advanced analyses. This will in turn make electrification schemes more affordable.

Improved understanding of earthworks behaviour and transitions will lead to improved specifications for new and rebuilt structures.

CONTACT INFORMATION:
Kevin Blacktop
Research, Development & Technology Team
Network Rail

ADVANTAGES:
Detailed field tests and data analyses will improve the efficiency of infrastructure design and make upgrade schemes more affordable.

BENEFITS:
More economical designs of OLE and foundations in the future

PROJECTED IMPLEMENTATION
TRL 7-9 not before January 2018

BENEFICIARIES:
IM

KEY CHALLENGES:
Site access is essential to gain real life data
Research into ballast strength

PROGRAMME: Strategic University Partnerships (Network Rail)

PROBLEM STATEMENT: We need to solve railway problems aligned to the RTS/NRTS.

SOLUTION: Southampton University is undertaking a group of initiatives that will consider in detail the behaviour of the track bed system and components. It looks at the stiffness and strength of ballast and sub-grade as measured in static tests and the development of relatively stable internal force-transfer mechanisms that carry external loads. The projects will shed light on the conditions that promote the development of fabric structure in ballast, providing stable internal mechanisms of force-transfer.

CONTACT INFORMATION:

Kevin Blacktop
Research, Development & Technology Team
Network Rail

ADVANTAGES:

Research into the strength of the ballast and track foundations will help to develop improved materials and reduce track maintenance.

BENEFITS:

Less disruptive and costly track maintenance

PROJECTED IMPLEMENTATION

TRL 7-9 not before 2017

BENEFICIARIES:

IM

KEY CHALLENGES:

Site access is essential to gain real life data
Research into bridge scour

Project Details

PROGRAMME: Strategic University Partnerships (Network Rail)
PROBLEM STATEMENT: We need to solve railway problems aligned to the RTS/NRTS.
SOLUTION: Southampton University is undertaking a group of initiatives that will assess scour around bridge piers and abutments.

The most common method to assess scour and scour risk in rail bridges is based on surveys carried out by divers. This method suffers from considerable limitations relating to visibility and repeatability issues. Divers often can only provide outline qualitative and subjective assessments.

This research project is to define new, deployable and effective strategies to quantify scour risk around bridge infrastructure using state of the art high-resolution sonar technology.

UNIVERSITY OF Southampton

CONTACT INFORMATION:
Kevin Blacktop
Research, Development & Technology Team
Network Rail

ADVANTAGES:
New ways to survey bridge scour using new technology, avoiding manual inspections by divers, will increase the accuracy of our data.

BENEFITS:
More efficient surveying of pier and abutments and better survey data

PROJECTED IMPLEMENTATION
TRL 7-9 not before January 2018

BENEFICIARIES:
IM

KEY CHALLENGES:
Site access is essential to gain real life data
PROGRAMME: Railway Operator Challenge

PROBLEM STATEMENT: Current applications of condition monitoring of bogies tend to use a small number of sensors to manage single parameters (e.g. TAPAS to measure the performance of the door and brake systems, TRIME to monitor conductor shoes) and aim to identify imminent failure.

SOLUTION: Working in partnership with, GTR Southern, Humaware, OSIsoft and the Universities of Birmingham and Loughborough, this project will develop a condition monitoring and prognostic system for bogies that will measure the entire complex dynamic system. Modelling and data analysis tools will be integrated and applied to system performance data to generate a risk-based remaining useful life. This prognosis can then be used to improve maintenance procedures by enhancing scheduled maintenance with predictive maintenance practices.

Project Details

**BENEFITS:**
- Reduced cost of maintenance

**PROJECTED IMPLEMENTATION:**
- 2018

**BENEFICIARIES:**
- Train Maintainers, TOC’s

**CONTACT INFORMATION:**
- Richard Maries
- Point 3, Haywood Road, Warwick, CV34 5AH
- 01926 693867
- Richard.Maries@telent.com

**ADVANTAGES:**
- Savings and efficiencies in the operation of trains through using data to predict maintenance requirements

**KEY CHALLENGES:**
- Coordination of consortium, ensuring the availability of dynamic model parameters
PROGRAMME: Railway Operator Challenge

PROBLEM STATEMENT: We need to engage the train operating companies with the supply chain and respond to their current challenges.

SOLUTION: This project is about applying automotive electronic principles and systems to railway rolling stock to achieve improved operational performance.

The rail industry uses bespoke and often incompatible systems on trains that operate in isolation from one another. We will create a system-wide controller that can share information between systems to realise greater functionality, more redundancy, and higher reliability.

The ‘Processing Node Controller’ will be a generic system placed on a train capable of running a number of applications separately, whilst also sharing information between systems.

CONTACT INFORMATION:
Ivan Wilson
Embed Limited, Transform Tech.
02476 323250
ivan.wilson@embeduk.com

BENEFITS:
Increased reliability, reduced costs, improved customer experience

PROJECTED IMPLEMENTATION
To TRL 6 by late 2016

ADVANTAGES:
Shared information systems adapted from the automotive industry will enable suppliers to deliver more complex applications.

KEY CHALLENGES:
Adapting it to the rail environment, route to market

BENEFICIARIES:
TOCs, passengers
PROBLEM STATEMENT: We need to engage the train operating companies with the supply chain and respond to their current challenges.

SOLUTION: This project will create an automatic Vehicle Underframe Examination System (VUES) to detect and report changes in a moving rail vehicle. This is a continuous inspection using computer vision techniques. Specialist cameras and machine vision algorithms are used to detect problems such as overheating components, damaged equipment and leaks of certain fluids on trains in service.

Trains passing by the VUES system will be identified and the history of that train recalled. The system will gather data on the visible components on the underside of the train using a combination of cameras, which will be used to monitor how train components vary in all conditions.

CONTACT INFORMATION:
Javier
Gobotix Ltd
01743 387030
Javier@gobotix.co.uk

ADVANTAGES:
VUES is a multiple camera and self-learning system. The more images and data it gathers, the more focused the anomaly identifications will be.

BENEFITS:
Reduced maintenance costs, reduced delays

PROJECTED IMPLEMENTATION
To TRL 5 by mid2017

BENEFICIARIES:
IM, TOCs, train maintainers

KEY CHALLENGES:
Finding a suitable partner for deployment in rail
PROGRAMME: Railway Operator Challenge

PROBLEM STATEMENT: We need to engage the train operating companies with the supply chain and respond to their current challenges.

SOLUTION: The portable measurement equipment designed by MRX addresses the need for a fast, repeatable method of measuring damage (both surface and near-surface) on railway wheels.

The measurement equipment will reduce overall time spent on maintenance and optimise wheel turning; decreasing out-of-service time and increasing wheelset life.

Management of the recorded data will enable maintainers to identify problem vehicles or wheelsets and plan maintenance in advance. The portable hand held system can measure sub-surface defects up to 10mm in a wheel using magnetic flux leakage technology.

CONTACT INFORMATION:
Stephanie Klecha
MRX Technologies, Derby
01332 226676
SEK@mrxtech.co.uk

ADVANTAGES:
MRX has pioneered surface defect detection on rails that can be translated to surface defect detection in wheels.

BENEFITS:
Reduced cost of maintenance, increased safety

PROJECTED IMPLEMENTATION
To TRL 8 by late 2016

BENEFICIARIES:
IM, train maintainers

KEY CHALLENGES:
Clear route to market, few challenges foreseen.
PROGRAMME: Railway Operator Challenge

PROBLEM STATEMENT: We need to engage the train operating companies with the supply chain and respond to their current challenges.

SOLUTION: The Rail Diesel Carbon Efficiency Exhaust (RADICE) is an exhaust system for 4-stroke and 2-stroke diesel trains which would reduce pressure problems and allow better combustion and improved exhaust flow.

This vortex exhaust solution was chosen because it has proved effective in saving fuel in automobiles, trucks, and marine vessels that have diesel engines.

The vortex exhaust has novel vortex units which replace conventional mufflers or silencers and instead of deadening sound with baffles, use patented technology belonging to Vortex Exhaust Technology Ltd.

CONTACT INFORMATION:
Mike Campbell (PM)
Barry Mead (Director)
Vortex Exhaust Technology Ltd
mike.campbell@vortexexhausttechnology.com

BENEFITS:
Reduced fuel costs, reduced emissions

PROJECTED IMPLEMENTATION
To TRL 4 by mid 2016

BENEFICIARIES:
TOCs, train maintainers, public

ADVANTAGES:
This vortex exhaust reduces the carbon footprint of diesel train engines, increases engine efficiency and reduces consumption of diesel fuel.

KEY CHALLENGES:
Unknown performance on 2-stroke engines
The following project areas are based around the European collaboration schemes: Shift2Rail, In2Rail, and Roll2Rail. They are not currently projects, but areas of work proposed as part of the European schemes under which projects will develop once they launch.
PROGRAMME: Shift2Rail Europe

PROBLEM STATEMENT: IP1 Confronts the problem of developing cost efficient and reliable trains, specifically TD1.4 Running Gear.

SOLUTION: Next generation of light weight bogie systems with reduced infrastructure/wheel wear and damage and energy loss, whilst providing higher reliability and availability with lower maintenance costs.

BENEFITS:
Lighter more efficient rolling stock

ADVANTAGES:
The S2R Technical Demonstrators (TD) have been influenced to deliver UK network required technologies at a system level and are supported by EU grant funding.

PROJECTED IMPLEMENTATION
Go live April 2016, to TRL 7 before 2023

BENEFICIARIES:
IM, TOCs, ROSCOs

KEY CHALLENGES:
Initiation and then collaboration

CONTACT INFORMATION:
Natalie Allen,
R&D and Technology Team
Network Rail
Milton Keynes
PROGRAMME: Shift2Rail Europe

PROBLEM STATEMENT: IP1 Confronts the problem of developing cost efficient and reliable trains, specifically TD1.5 Rolling Stock Doors & Intelligent Access.

SOLUTION: Innovations in passenger access systems along with new solutions for autonomous boarding of persons with reduced mobility will optimise the flow of passengers and enhance system capacity and attractiveness.

Entrance systems with enhanced energy efficiency characteristics and thermal and acoustic performances will enhance passengers comfort.

CONTACT INFORMATION:
Natalie Allen,
R&D and Technology Team
Network Rail
Milton Keynes

ADVANTAGES:
The S2R Technical Demonstrators (TD) have been influenced to deliver UK network required technologies at a system level and are supported by EU grant funding.

PROJECTED IMPLEMENTATION
Go live April 2016, to TRL 7 before 2023

BENEFICIARIES:
IM, TOCs, ROSCOs, passengers

KEY CHALLENGES:
Initiation and then collaboration
PROGRAMME: Shift2Rail Europe

PROBLEM STATEMENT: IP1 Confronts the problem of developing cost efficient and reliable trains, specifically TD1.6 Rolling Stock Interiors.

SOLUTION: Innovative and modular design solutions for train interiors that enable the introduction of novel on-board value-added services.

These solutions will also improve important aspects of passenger comfort, such as accessibility, noise and vibrations. They will be developed based on new criteria and standards to evaluate passenger comfort and attractiveness of train interiors.

CONTACT INFORMATION:
Natalie Allen,
R&D and Technology Team
Network Rail
Milton Keynes

ADVANTAGES:
The S2R Technical Demonstrators (TD) have been influenced to deliver UK network required technologies at a system level and are supported by EU grant funding.

BENEFITS:
Lighter more predictable rolling stock

PROJECTED IMPLEMENTATION
Go live April 2016, to TRL 7 before 2023

BENEFICIARIES:
IM, TOCs, ROSCOs, passengers

KEY CHALLENGES:
Initiation and then collaboration
Adaptable communications

PROGRAMME: Shift2Rail Europe

PROBLEM STATEMENT: IP2 Confronts the problem of advanced traffic management and control systems, specifically TD2.1 Adaptable Communications for all Railways.

SOLUTION: This proposal uses packet switching/IP technologies, enabling easy migration from legacy systems, providing enhanced throughput, safety and security functionalities to support the current and future needs of signalling systems. It is resilient to interference and to radio technology evolution. It will develop a fail-safe, multi-sensor train positioning system by applying GNSS to the current ERTMS/ETCS core. It will boost the quality of train localisation information while reducing the overall cost of ERTMS, namely by enabling a significant reduction in all track-side conventional train detection systems.

ADVANTAGES:
The S2R Technical Demonstrators (TD) have been influenced to deliver UK network required technologies at a system level and are supported by EU grant funding.

CONTACT INFORMATION:
Natalie Allen,  
R&D and Technology Team  
Network Rail  
Milton Keynes

PROJECTED IMPLEMENTATION
Go live April 2016, to TRL 7 before 2023

BENEFICIARIES:
TOCs, ROSCOs, IM, Passengers

KEY CHALLENGES:
Initiation and then collaboration

BENEFITS:
Better train control
PROGRAMME: Shift2Rail Europe

PROBLEM STATEMENT: IP2 Confronts the problem of advanced traffic management and control systems, specifically TD2.9 Traffic Management System.

SOLUTION: Advanced traffic management systems should be automated, interoperable and inter-connected. They should be combined with Driver Advisory Systems (DAS) functionality to allow for predictive and dynamic traffic management, integrating and using real-time status and performance data from the network and from the train, using on-board train integrity solutions and network attached object control functions, supported by wireless network communication.

Systems should be scalable and easily upgradable, using standardised products with standardised interfaces, and enabling easy migration from legacy systems.

CONTACT INFORMATION:
Natalie Allen, R&D and Technology Team
Network Rail
Milton Keynes

ADVANTAGES:
The S2R Technical Demonstrators (TD) have been influenced to deliver UK network required technologies at a system level and are supported by EU grant funding.

BENEFITS:
Better train control, more reliable communications

PROJECTED IMPLEMENTATION
Go live April 2016, to TRL 7 before 2023

BENEFICIARIES:
TOCs, ROSCOs, IM, Passengers

KEY CHALLENGES:
Initiation and then collaboration
PROGRAMME: Shift2Rail Europe

PROBLEM STATEMENT: IP2 Confronts the problem of advanced traffic management and control systems, specifically TD2.5 On-board Train Integrity.

SOLUTION: Explore the concept of virtual coupling/uncoupling in order to maximise the flexibility of train operations and allow a higher level of service to be provided to passengers and freight operators, while allowing a reduction in fleet use. This would represent a paramount change of the approach to fail safe train distance concept in the railways field.

CONTACT INFORMATION:
Natalie Allen,
R&D and Technology Team
Network Rail
Milton Keynes

ADVANTAGES: The S2R Technical Demonstrators (TD) have been influenced to deliver UK network required technologies at a system level and are supported by EU grant funding.
PROJECTED IMPLEMENTATION: Go live April 2016, to TRL 7 before 2023.

BENEFICIARIES: TOCs, ROSCOs, IM, Passengers

ADVANTAGES:
The S2R Technical Demonstrators (TD) have been influenced to deliver UK network required technologies at a system level and are supported by EU grant funding.
PROGRAMME: Shift2Rail Europe
PROBLEM STATEMENT: IP2 Confronts the problem of advanced traffic management and control systems, specifically TD2.3 Line Capacity Increase through Fluid Moving Block.
SOLUTION: Develop and validate a high capacity, low cost, highly reliable signalling system based on moving block principles, thereby allowing more trains on a given main line, especially for high density passenger services.

The system should be backward compatible with existing ERTMS system specifications and enable evolutions towards CBTC functionalities for urban applications. The train integrity function shall be developed in the same time.

CONTACT INFORMATION:
Natalie Allen,
R&D and Technology Team
Network Rail
Milton Keynes

ADVANTAGES:
The S2R Technical Demonstrators (TD) have been influenced to deliver UK network required technologies at a system level and are supported by EU grant funding.

BENEFITS:
Better train control

PROJECTED IMPLEMENTATION
Go live April 2016, to TRL 7 before 2023

BENEFICIARIES:
TOCs, ROSCOs, IM, Passengers

KEY CHALLENGES:
Initiation and then collaboration
PROGRAMME: Shift2Rail Europe

PROBLEM STATEMENT: IP2 Confronts the problem of advanced traffic management and control systems, specifically TD2.4 Automation.

SOLUTION: Develop and validate automatic train operation (ATO) over ETCS up to Grade of Automation (GoA) 4 (unattended train operation) for urban and suburban applications, and at least GoA2 (semi-automated train operation) for other market segments, including freight lines.

PROJECTED IMPLEMENTATION: Go live April 2016, to TRL 7 before 2023

BENEFICIARIES: TOCs, ROSCOs, IM, Passengers

ADVANTAGES: The S2R Technical Demonstrators (TD) have been influenced to deliver UK network required technologies at a system level and are supported by EU grant funding.

CONTACT INFORMATION: Natalie Allen, R&D and Technology Team, Network Rail, Milton Keynes

KEY CHALLENGES: Initiation and then collaboration

BENEFITS: Better train control
PROGRAMME: Shift2Rail Europe

PROBLEM STATEMENT: IP2 Confronts the problem of advanced traffic management and control systems, specifically TD2.11 Cyber System Security.

SOLUTION: Achieve the highest possible level of cyber-security against any significant threat for the signalling and telecom systems in the most economical way, as well as protection from Cyber Attacks and Advanced Persistent Threats coming from outside.

CONTACT INFORMATION:
Natalie Allen,
R&D and Technology Team
Network Rail
Milton Keynes

ADVANTAGES:
The S2R Technical Demonstrators (TD) have been influenced to deliver UK network required technologies at a system level and are supported by EU grant funding.

PROJECTED IMPLEMENTATION
Go live April 2016, to TRL 7 before 2023

BENEFICIARIES:
TOCs, ROSCOs, IM, Passengers

KEY CHALLENGES:
Initiation and then collaboration
PROGRAMME: Shift2Rail Europe

PROBLEM STATEMENT: IP3 Confronts the problem of infrastructure that is safe, reliable sustainable, cost-effective, specifically TD3.1 Short-medium Term Switches & Crossings.

SOLUTION: In the short to medium term, the focus should be on improving the operational performance of existing S&C systems in terms of reliability and efficiency, by focussing on areas with the highest potential for innovation.

Technology developed should make point operating equipment more robust and immune to extreme weather, and integrate mechanical, electrical and software components to deliver improved capabilities.

Enhanced sensors, which can be embedded into the system and enable remote condition monitoring, as well as self-diagnosis and adjustment functions, based on the use of mechatronics, should be included.

CONTACT INFORMATION:
Natalie Allen,
R&D and Technology Team
Network Rail
Milton Keynes

ADVANTAGES:
The S2R Technical Demonstrators (TD) have been influenced to deliver UK network required technologies at a system level and are supported by EU grant funding.
PROGRAMME: Shift2Rail Europe

PROBLEM STATEMENT: IP3 Confronts the problem of infrastructure that is safe, reliable sustainable, cost-effective, specifically TD3.2 Long Term Switches & Crossings.

SOLUTION: Longer term S&C should look into the radical redesign of switch and crossing subsystems, concentrating on wheel rail interface and contact patch dynamics, kinematics of moving elements, improving motion control and cycle times, reducing noise and whole-life costs, while improving capacity, performance, availability, reliability and maintainability.

ADVANTAGES:
The S2R Technical Demonstrators (TD) have been influenced to deliver UK network required technologies at a system level and are supported by EU grant funding.

CONTACT INFORMATION:
Natalie Allen,
R&D and Technology Team
Network Rail
Milton Keynes

BENEFITS:
Radical S&C performance

PROJECTED IMPLEMENTATION
Go live April 2016, to TRL 7 before 2023

BENEFICIARIES:
IM

KEY CHALLENGES:
Initiation and then collaboration
PROGRAMME: Shift2Rail Europe
PROBLEM STATEMENT: IP3 Confronts the problem of infrastructure that is safe, reliable sustainable, cost-effective, specifically TD3.3 Short-medium Term Track.
SOLUTION: In the short to medium term, methods for measuring stress, degradation, stiffness, friction, defects, etc. on existing tracks need to be enhanced to increase track lifetime and facilitate precision asset management.

At the same time, damage prevention and mitigation strategies need to be enhanced, using integrated health monitoring systems and innovative methods for on-site rail manipulation.

Technologies should also be developed for facilitating the operation of services between systems with gauge differences, and systems with different overhead contact lines, allowing the use of a single pantograph for lines.

CONTACT INFORMATION:
Natalie Allen,
R&D and Technology Team
Network Rail
Milton Keynes

ADVANTAGES:
The S2R Technical Demonstrators (TD) have been influenced to deliver UK network required technologies at a system level and are supported by EU grant funding.

BENEFITS:
Improved Track performance

PROJECTED IMPLEMENTATION
Go live April 2016, to TRL 7 before 2023

BENEFICIARIES:
IM

KEY CHALLENGES:
Initiation and then collaboration
Programme: Shift2Rail Europe

Problem Statement: IP3 Confronts the problem of infrastructure that is safe, reliable, sustainable, cost-effective, specifically TD3.4 Long Term Track.

SOLUTION: Longer term track should seek to develop radically new concepts for track subsystems, as well as integrated track designs with standardised and modularised track components of limited complexity.

New track solutions should encompass improved fastening and rail pad solutions, sleeper solutions and track foundation solutions, looking into the use of new materials, to increase durability, track stability, and safety, while reducing vibration and noise.

Track solutions should also contribute to avoiding the “ballast pick up” phenomenon and be compatible with the use of eddy current braking systems (open points).

Radical track (long term)

Contact Information:
Natalie Allen,
R&D and Technology Team
Network Rail
Milton Keynes

Advantages:
The S2R Technical Demonstrators (TD) have been influenced to deliver UK network required technologies at a system level and are supported by EU grant funding.

Benefits:
Radical Track performance

Projected Implementation:
Go live April 2016, to TRL 7 before 2023

Beneficiaries:
IM

Key Challenges:
Initiation and then collaboration
PROGRAMME: Shift2Rail Europe

PROBLEM STATEMENT: IP3 Confronts the problem of infrastructure that is safe, reliable sustainable, cost-effective, specifically TD3.5 Proactive Bridge & Tunnel Assessment and Upgrading.

SOLUTION: Although many of Europe’s bridges and tunnels are close to their planned service life, it would not be economically feasible or realistic to envisage their replacement on a large scale so an extension of the service life of bridges and tunnels is a major priority. Activities should focus on developing faster and more accurate inspection methods and developing less disruptive repairing, strengthening and upgrading methods, using modern equipment and IT assessment tools. At the same time, new design concepts must maximise lifetime and minimise cost, while enabling the use of infrastructure by different segments, including high speed rail.

ADVANTAGES:
The S2R Technical Demonstrators (TD) have been influenced to deliver UK network required technologies at a system level and are supported by EU grant funding.

CONTACT INFORMATION:
Natalie Allen,
R&D and Technology Team
Network Rail
Milton Keynes

PROJECTED IMPLEMENTATION:
Go live April 2016, to TRL 7 before 2023

BENEFICIARIES:
IM

KEY CHALLENGES:
Initiation and then collaboration
S2R

Intelligent maintenance systems

PROGRAMME: Shift2Rail Europe

PROBLEM STATEMENT: IP3 Confronts the problem of infrastructure that is safe, reliable sustainable, cost-effective, specifically TD3.6, 3.7, 3.8 Intelligent Maintenance Systems: DRIMS, ISMES and RIMMS.

SOLUTION: Intelligent maintenance systems, including predictive, risk-based or condition based maintenance, should be built on cutting edge measurement and monitoring tools that provide static and dynamic data from all relevant components of the rail infrastructure. Data should be analysed using cutting edge data mining and analytics, capable of advanced system modelling for whole-life cost estimates. Automation should be achieved for routine maintenance checks. Activities should also contribute to developing a standardisation process in the area of for infrastructure measuring, monitoring and maintenance.

Project Details

CONTACT INFORMATION:
Natalie Allen,
R&D and Technology Team
Network Rail
Milton Keynes

ADVANTAGES:
The S2R Technical Demonstrators (TD) have been influenced to deliver UK network required technologies at a system level and are supported by EU grant funding.

BENEFITS:
More reliable, efficient management systems

PROJECTED IMPLEMENTATION
Go live April 2016, to TRL 7 before 2023

BENEFICIARIES:
IM

KEY CHALLENGES:
Initiation and then collaboration
PROGRAMME: Shift2Rail Europe
PROBLEM STATEMENT: IP3 Confronts the problem of infrastructure that is safe, reliable, sustainable, cost-effective, specifically TD3.10 Smart AC Power Supply.
SOLUTION: New smart AC power supply system enabling parallel operation of substations fed from different phases, and load flow control for peaks and minimised losses. DC integrated power supply concepts, using wayside controlled equipment to reduce distribution losses, and converters to provide complete flexibility to the energy network. Smart metering for a railway distributed energy resource management system, in order to finely manage the different energy flows within the railway system as a whole.
All solutions will have to guarantee the quality of energy, solve EMC issues and adhere to specific railway standards and regulations.

**PROJECT DETAILS**

**BENEFITS:**
Energy management

**CONTACT INFORMATION:**
Natalie Allen,
R&D and Technology Team
Network Rail
Milton Keynes

**PROJECTED IMPLEMENTATION**
Go live April 2016, to TRL 7 before 2023

**BENEFICIARIES:**
IM

**ADVANTAGES:**
The S2R Technical Demonstrators (TD) have been influenced to deliver UK network required technologies at a system level and are supported by EU grant funding.

**KEY CHALLENGES:**
Initiation and then collaboration
Customer Experience – Interoperability Framework

PROGRAMME: Shift2Rail Europe

PROBLEM STATEMENT: IP4 Confronts the problem of responding to customer needs by providing door to door intermodal journeys, specifically TD4.1 Interoperability Framework.

SOLUTION: Identify, formalise and document the requirements for interoperability using clear and unambiguous web technologies and open architecture and standard service interfaces.

Enable decentralised deployment (to local rail travel services companies, internet service providers, etc.), decentralised management (whereby providers and consumers of transportation services can publish their specification-compliant services).

A business analytics platform should provide engineering specifications for architecture, and develop modules for travel & transport big data development, as well as integration tests.

CONTACT INFORMATION:
Natalie Allen,
R&D and Technology Team
Network Rail
Milton Keynes

ADVANTAGES:
The S2R Technical Demonstrators (TD) have been influenced to deliver UK network required technologies at a system level and are supported by EU grant funding.

BENEFITS:
Better IT for the railway, improved customer experience

PROJECTED IMPLEMENTATION
Go live April 2016, to TRL 7 before 2023

BENEFICIARIES:
IM, Passengers

KEY CHALLENGES:
Initiation and then collaboration
PROGRAMME: Shift2Rail Europe

PROBLEM STATEMENT: IP4 Confronts the problem of responding to customer needs by providing door to door intermodal journeys, specifically TD4.4 Trip Tracker.

SOLUTION: Develop secured customer experience applications reflecting each ‘travel environment’ including customer preferences, itineraries, preselected payment means, and giving access to additional services such as on route assistance, etc.

The developed solutions should also provide real-time information on relevant events that could affect the traveller’s journey and match these with the traveller’s preferences and door-to-door itineraries. All the developments should be modular, based on open specifications.

Includes Travel shopping, Booking and ticketing, Trip tracker and travel companion.

PROJECTED IMPLEMENTATION
Go live April 2016, to TRL 7 before 2023

BENEFICIARIES:
IM, Passengers

CONTACT INFORMATION:
Natalie Allen,
R&D and Technology Team
Network Rail
Milton Keynes

ADVANTAGES:
The S2R Technical Demonstrators (TD) have been influenced to deliver UK network required technologies at a system level and are supported by EU grant funding.
PROGRAMME: Shift2Rail Europe

PROBLEM STATEMENT: IP4 Confronts the problem of responding to customer needs by providing door to door intermodal journeys, specifically TD4.3 Booking & Ticketing.

SOLUTION: Develop one-stop-shop solutions and applications for multi-modal shopping and ticketing enabling integrated door-to-door, multi-modal itineraries in answer to a traveller mobility query. All the developments should be modular, based on open specifications.

CONTACT INFORMATION:
Natalie Allen,
R&D and Technology Team
Network Rail
Milton Keynes

ADVANTAGES:
The S2R Technical Demonstrators (TD) have been influenced to deliver UK network required technologies at a system level and are supported by EU grant funding.

BENEFITS:
Better customer experience

PROJECTED IMPLEMENTATION
Go live April 2016, to TRL 7 before 2023

BENEFICIARIES:
IM, Passengers

KEY CHALLENGES:
Initiation and then collaboration
PROGRAMME: Shift2Rail Europe

PROBLEM STATEMENT: IP5 Confronts the technologies for sustainable and attractive European rail freight, specifically TD5.4 Novel Terminal, Hubs, Marshalling Yards, Sidings.

SOLUTION: Support the ‘Mix Trains’ implementation (flexible, multiple stops services with versatile and intelligent wagons).

Endorse the ‘Management Orchestration’ (quick-stop, network and dynamic path allocation, integrated node-path management, dynamic planning) ‘Minimise Operations’ (shunting through fast trains, automated couplers, reduction of handling time, automation in damage recognition, brakes check).

CONTACT INFORMATION:
Natalie Allen,
R&D and Technology Team
Network Rail
Milton Keynes

ADVANTAGES:
The S2R Technical Demonstrators (TD) have been influenced to deliver UK network required technologies at a system level and are supported by EU grant funding.

BENEFITS:
Better freight service and reliability

PROJECTED IMPLEMENTATION
Go live April 2016, to TRL 7 before 2023

BENEFICIARIES:
IM, FOCs

KEY CHALLENGES:
Initiation and then collaboration
PROGRAMME: Shift2Rail Europe

PROBLEM STATEMENT: IP5 Confronts the technologies for sustainable and attractive European rail freight, specifically TD5.5 New Freight Propulsion Concepts.

SOLUTION: Greater Flexibility and Interoperability and resilience (ability to operate under all climatic conditions in Europe).

Reduction on the operation costs (€/ton x km) through the operation of longer trains and dual power (master-slave operations) Sustainable and environmentally friendly solutions, including battery solutions.

Compatibility to New Generation of Wagons (interaction with Freight Electrification, Brake and Telematics).

CONTACT INFORMATION:
Natalie Allen,
R&D and Technology Team
Network Rail
Milton Keynes

ADVANTAGES:
The S2R Technical Demonstrators (TD) have been influenced to deliver UK network required technologies at a system level and are supported by EU grant funding.

PROJECTED IMPLEMENTATION
Go live April 2016, to TRL 7 before 2023

BENEFICIARIES:
IM, FOCs

KEY CHALLENGES:
Initiation and then collaboration
Freight – Access and operation

PROGRAMME: Shift2Rail Europe

PROBLEM STATEMENT: IP5 Confronts the technologies for sustainable and attractive European rail freight, specifically TD5.2 Access and Operation.

SOLUTION: Collection and processing of combinations of different transport chains for individual transport units (door to door planning system).

Combination of border crossing train path allocation and slots, including code sharing of train paths, e.g. by long trains.

Real time data for interoperability and maintained safety, reducing barriers to interoperability and preventing safety from being misused for discrimination.

Creation of incentives for product innovation and service quality networks. Vitalisation of the wagon load market Sharing of train and marshalling yards capacity.

CONTACT INFORMATION:
Natalie Allen,
R&D and Technology Team
Network Rail
Milton Keynes

ADVANTAGES:
The S2R Technical Demonstrators (TD) have been influenced to deliver UK network required technologies at a system level and are supported by EU grant funding.

BENEFITS:
Better freight service and reliability

PROJECTED IMPLEMENTATION
Go live April 2016, to TRL 7 before 2023

BENEFICIARIES:
IM, FOCs

KEY CHALLENGES:
Initiation and then collaboration
PROGRAMME: Shift2Rail Europe

PROBLEM STATEMENT: IP5 Confronts the technologies for sustainable and attractive European rail freight, specifically TD5.1 Freight electrification, brakes and telematics.

SOLUTION: “By wire” Communication and Electro-Pneumatic Brake System. Electric power supply/connection on freight wagons, including interface to intermodal loading units. Electronic End Of Train device and control freight wagon/train and goods status monitoring and data management/supervision, tracking, condition based maintenance.

Advanced condition monitoring, localization and diagnosis of locomotive and freight wagons in operation. Friction Brake Technologies, Disk Brakes, Wheel Slide Protection for Freight Wagons, etc.

Balanced braking regimes, on-board automatic solutions for freight track gauge change.

ADDITIONAL INFORMATION:

The S2R Technical Demonstrators (TD) have been influenced to deliver UK network required technologies at a system level and are supported by EU grant funding.
PROGRAMME: Shift2Rail Europe  
PROBLEM STATEMENT: Cross-cutting Work Area 5: Energy and Sustainability confronts the problem of the environment in rail, specifically CCWA5.1 Energy.

SOLUTION: The environmental performance of the rail sector is an important element, which can be addressed through different angles: the improvement of energy efficiency (leading to CO2 reductions), a better energy mix (electrification and use of renewables) and solutions to address externalities such as noise.

Energy savings should cover the entire railway system including operation, infrastructure, rolling stock, sub-systems and components. These savings are clear win-win as they will improve the already excellent environmental balance of rail while reducing the cost of energy, thereby making train travel more affordable and promoting modal shift to rail.

CONTACT INFORMATION:  
Natalie Allen,  
R&D and Technology Team  
Network Rail  
Milton Keynes

ADVANTAGES:  
The S2R Technical Demonstrators (TD) have been influenced to deliver UK network required technologies at a system level and are supported by EU grant funding.

BENEFITS:  
Support all S2R workstreams

PROJECTED IMPLEMENTATION
Go live April 2016, to TRL 7 before 2023

BENEFICIARIES:
All categories

KEY CHALLENGES:
Initiation and then collaboration
PROGRAMME: Shift2Rail Europe

PROBLEM STATEMENT: Cross-cutting Work Area 5: Energy and Sustainability confronts the problem of the environment in rail, specifically CCWA5.2 Noise and Vibration.

SOLUTION: Noise and Vibration (N&V) is one of the major concerns that needs to be addressed with a view to meeting the EU's goals of increasing the capacity and competitiveness of rail, particularly in the freight segment.

On some lines, the capacity has been restricted because of regulations governing N&V exposure to limit disturbance to nearby residents. In such cases, there is a clear economic case to reduce the noise emissions of passing trains.

The overall impact on future railway systems will be important to consider, since only a system approach with a combination of low noise rolling stock and infrastructure will assure a green high capacity European railway system.

CONTACT INFORMATION:
Natalie Allen,
R&D and Technology Team
Network Rail
Milton Keynes

ADVANTAGES:
The S2R Technical Demonstrators (TD) have been influenced to deliver UK network required technologies at a system level and are supported by EU grant funding.
PROGRAMME: Roll2Rail

PROBLEM STATEMENT: The Roll2Rail (R2R) programme is a European rail innovation funding vehicle that is a lighthouse programme for Shift2Rail, this is WP1: Traction.

SOLUTION: Three objectives are addressed by this work package: contribute to increase of capacity, system reliability and competitiveness (the SHIFT2RAIL global targets).

The aim is for the innovations to be developed in this WP to be taken up by the Traction activities within IP1 of SHIFT2RAIL.

ADVANTAGES:

The Roll2Rail Work Packages (WP) have been influenced to initiate EU rolling stock technologies and are funded 100% by EU grants.

CONTACT INFORMATION:
Amanda Webster
R&D and Technology Team
Network Rail
Milton Keynes

PROJECTED IMPLEMENTATION
To TRL 4 by end of 2018

BENEFICIARIES:
Railway, Europe, GB Plc.

BENEFITS:
Risk reduction for Shift2Rail Programme

KEY CHALLENGES:
Gaining funding for UK ideas
**WP2 Train Control Management System**

**PROGRAMME: Roll2Rail**

**PROBLEM STATEMENT:** The Roll2Rail (R2R) programme is a European rail innovation funding vehicle that is a lighthouse programme for Shift2Rail, this is WP2: Train Control Management System.

**SOLUTION:** The aim is to research on technologies and architectures to allow new generation of train communication systems based on wireless transmission for train control and monitoring (TCMS) functions, infotainment and CCTV, therefore reducing or even completely eliminating on board communication cables and simplifying the train coupling procedure.

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**ADVANTAGES:**
The Roll2Rail Work Packages (WP) have been influenced to initiate EU rolling stock technologies and are funded 100% by EU grants.

**BENEFITS:**
Risk reduction for Shift2Rail Programme

**PROJECTED IMPLEMENTATION**
To TRL 4 by end of 2018

**BENEFICIARIES:**
Railway, Europe, GB Plc.

**KEY CHALLENGES:**
Gaining funding for UK ideas
WP3
Car body shell

PROGRAMME: Roll2Rail

PROBLEM STATEMENT: The Roll2Rail (R2R) programme is a European rail innovation funding vehicle that is a lighthouse programme for Shift2Rail, this is WP3: Car Body Shell.

SOLUTION: The aim of the Work Package is the creation of a technical framework and recommendations to describe in detail all characteristics and minimum conditions to be met by the new composite or multi-material car body shell, as well as the definition of the composite material technological solutions for each car body shell subpart.

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ADVANTAGES:
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BENEFITS:
Risk reduction for Shift2Rail Programme

PROJECTED IMPLEMENTATION
To TRL 4 by end of 2018

BENEFICIARIES:
Railway, Europe, GB Plc.

KEY CHALLENGES:
Gaining funding for UK ideas
PROGRAMME: Roll2Rail

PROBLEM STATEMENT: The Roll2Rail (R2R) programme is a European rail innovation funding vehicle that is a lighthouse programme for Shift2Rail, this is WP4: Running Gear.

SOLUTION: Running Gear aims at pathing the way towards the implementation of innovative technologies in the area of running gear.

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ADVANTAGES:
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BENEFITS:
Risk reduction for Shift2Rail Programme

PROJECTED IMPLEMENTATION
To TRL 4 by end of 2018

BENEFICIARIES:
Railway, Europe, GB Plc.

KEY CHALLENGES:
Gaining funding for UK ideas
PROGRAMME: Roll2Rail

PROBLEM STATEMENT: The Roll2Rail (R2R) programme is a European rail innovation funding vehicle that is a lighthouse programme for Shift2Rail, this is WP5: Brakes.

SOLUTION: The approval process for the brake system raises the effort for the brake system hardware, the testing of the brake system and the documentation for the national requirements.

Also the risk (time, cost) for the homologation process in general is increased. Especially for homologation in more than one country the documentation and the verification is done separately for each country.

Finally the effort for homologation and the risks involved may be a constraint for innovation. This project is about harmonisation across Europe.

ADVANTAGES:

The Roll2Rail Work Packages (WP) have been influenced to initiate EU rolling stock technologies and are funded 100% by EU grants.

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BENEFICIARIES:
Railway, Europe, GB Plc.

KEY CHALLENGES:
Gaining funding for UK ideas

PROJECTED IMPLEMENTATION
To TRL 4 by end of 2018

BENEFITS:
Risk reduction for Shift2Rail Programme
PROGRAMME: Roll2Rail

PROBLEM STATEMENT: The Roll2Rail (R2R) programme is a European rail innovation funding vehicle that is a lighthouse programme for Shift2Rail, specifically WP6: Comfortable and Attractive Train Interiors.

SOLUTION: To understand what defines “attractiveness and comfort” for passengers, using available research.
To define what does the rail industry need to do to keep rail as the mode of transport of first choice for passengers.
To understand the possible future needs of passengers and propose technology and service developments to anticipate these.
To define the boundary conditions that apply to rail interior design.
To provide guidelines or best practice in ensuring the “voice of the passenger” is captured in future train specifications.

ADVANTAGES:
The Roll2Rail Work Packages (WP) have been influenced to initiate EU rolling stock technologies and are funded 100% by EU grants.

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PERSPECTIVES:
Risk reduction for Shift2Rail Programme
PROJECTED IMPLEMENTATION
To TRL 4 by end of 2018

KEY CHALLENGES:
Gaining funding for UK ideas

BENEFICIARIES:
Railway, Europe, GB Plc.
PROGRAMME: IN2RAIL

PROBLEM STATEMENT: Network Rail and 52 other partners from across Europe contribute to and benefit from the In2Rail (I2R) innovation funding vehicle, this is WP2: Smart Infrastructure – Innovative Switches & Crossings (S&C).

SOLUTION: The overall objective of WP2 is to create solutions for a radical redesign of the Switches & Crossing (S&C) system and deliver improvements to the existing S&C system, whilst embracing “state of the art” technologies.

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ADVANTAGES:
The In2Rail Work Packages (WP) have been influenced to initiate UK infrastructure technologies and are 100% funded by the EU.

BENEFITS:
Reduced infrastructure whole-life cost and improved efficiency

PROJECTED IMPLEMENTATION:
Feasibility phase completed by 2019

BENEFICIARIES:
IM, Europe

KEY CHALLENGES:
European integration; route to market
Programme: IN2RAIL

Problem Statement: Network Rail and 52 other partners from across Europe contribute to and benefit from the In2Rail (I2R) innovation funding vehicle, this is WP3: Innovative Track Solutions.

Solution: The scope of WP3 is to develop innovative plain line track solutions:
Develop, assess and validate local rail head repair solutions.

Establish a general framework for evaluation of innovative concepts and decision support.
Enhance the understanding of mechanisms and influential factors regarding track solutions.
Transfer the enhanced understanding into improved predictive models able to optimize solutions and life cycle cost estimations.
Customise noise reduction measures for specific operational conditions.

Advantages:
The In2Rail Work Packages (WP) have been influenced to initiate UK infrastructure technologies and are 100% funded by the EU.

Benefits:
Reduced infrastructure whole-life cost and improved efficiency

Projected Implementation:
Feasibility phase completed by 2019

Beneficiaries:
IM, Europe

Key Challenges:
European integration; route to market
PROGRAMME: IN2RAIL

PROBLEM STATEMENT: Network Rail and 52 other partners from across Europe contribute to and benefit from the In2Rail (I2R) innovation funding vehicle, this is WP4: Bridges & Tunnels.

SOLUTION: The following objectives will be handled in WP4:

- Define requirements for new inspection technologies to facilitate proactive maintenance; identify, benchmark and develop existing technology with respect to defined requirements; validation of developed subsystems on real structures and define further development in SHIFT2RAIL.

This relates to the overall objectives for Bridges and Tunnels in SHIFT2RAIL.

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ADVANTAGES:
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BENEFITS:
Reduced infrastructure whole-life cost and improved efficiency

PROJECTED IMPLEMENTATION
Feasibility phase completed by 2019

BENEFICIARIES:
IM, Europe

KEY CHALLENGES:
European integration; route to market
Programme: IN2RAIL

Problem Statement: Network Rail and 52 other partners from across Europe contribute to and benefit from the IN2Rail (I2R) innovation funding vehicle, this is WP5: Smart Infrastructure – COTS Monitoring (thermal stress and track geometry).

Solution: The purpose of WP5 is to develop innovative approaches for monitoring key track characteristics. To this end, existing inspection/measuring equipment will be integrated with improved data assessment and analysis. The overall purpose is to increase automatic detection of track defects in order to facilitate reduction of traffic disruptions and asset management costs.

Two key characteristics will be the main focus of WP5: track geometry monitoring by in-service trains and thermal rail stress monitoring. The starting point will be the analysis of current techniques, detectors and inspection systems/procedures.

Advantages:
The IN2Rail Work Packages (WP) have been influenced to initiate UK infrastructure technologies and are 100% funded by the EU.

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Benefits:
Reduced infrastructure whole-life cost and improved efficiency

Projected Implementation:
Feasibility phase completed by 2019

Beneficiaries:
IM, Europe

Key Challenges:
European integration; route to market
PROGRAMME: IN2RAIL

PROBLEM STATEMENT: Network Rail and 52 other partners from across Europe contribute to and benefit from the In2Rail (I2R) innovation funding vehicle, this is WP6: Smart Infrastructure - Maintenance Strategies.

SOLUTION: The objective of WP6 is to demonstrate a sound, consistent and holistic approach towards asset maintenance. This will make a difference not only to the reliability of the railway system/infrastructure, but also in a reduction in recurrent maintenance cost. Improving individual maintenance approaches or tasks alone are not enough – instead an integrated approach is required. To illustrate this approach the project shall consider the track and switches & crossings as a specimen.

ADVANTAGES:
The In2Rail Work Packages (WP) have been influenced to initiate UK infrastructure technologies and are 100% funded by the EU.

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BENEFITS:
Reduced infrastructure whole-life cost and improved efficiency

PROJECTED IMPLEMENTATION
Feasibility phase completed by 2019

BENEFICIARIES:
IM, Europe

KEY CHALLENGES:
European integration; route to market
PROGRAMME: IN2RAIL

PROBLEM STATEMENT: Network Rail and 52 other partners from across Europe contribute to and benefit from the In2Rail (I2R) innovation funding vehicle, this is WP7: Intelligent Mobility management (I2M) – System Engineering.

SOLUTION: The overall objective of WP7 is to provide the specification to validate the Intelligent Mobility Management (I2M) open integrated platform for the Traffic Management Systems (TMS) and dispatching systems of the future.

BENEFITS:
Reduced infrastructure whole-life cost and improved efficiency

PROJECTED IMPLEMENTATION
Feasibility phase completed by 2019

ADVANTAGES:
The In2Rail Work Packages (WP) have been influenced to initiate UK infrastructure technologies and are 100% funded by the EU.

BENEFICIARIES:
IM, Europe

KEY CHALLENGES:
European integration; route to market
PROGRAMME: IN2RAIL

PROBLEM STATEMENT: Network Rail and 52 other partners from across Europe contribute to and benefit from the In2Rail (I2R) innovation funding vehicle, this is WP8: Intelligent Mobility management (I2M) – Integration Layer.

SOLUTION: The overall objective of WP8 is to design, within the framework of the I2M Sub-Project, a standardised approach to information management.

This will include a train dispatching system enabling an integrated Traffic Management System (TMS).

It will form an Information and Communication Technology (ICT) environment supporting all transport operational systems with standardised interfaces and with a plug and play framework for TMS applications.

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ADVANTAGES:
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BENEFITS:
Reduced infrastructure whole-life cost and improved efficiency

PROJECTED IMPLEMENTATION:
Feasibility phase completed by 2019

BENEFICIARIES:
IM, Europe

KEY CHALLENGES:
European integration; route to market
PROGRAMME: IN2RAIL

PROBLEM STATEMENT: Network Rail and 52 other partners from across Europe contribute to and benefit from the In2Rail (I2R) innovation funding vehicle, this is WP9: Intelligent Mobility management (I2M) – Nowcasting and Forecasting.

SOLUTION: The overall objective of WP9 is to design and deliver an advanced asset information system with the ability to now-cast and forecast network asset status with the associated uncertainties from related data sources.

ADVANTAGES:
The In2Rail Work Packages (WP) have been influenced to initiate UK infrastructure technologies and are 100% funded by the EU.

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BENEFITS:
Reduced infrastructure whole-life cost and improved efficiency

PROJECTED IMPLEMENTATION
Feasibility phase completed by 2019

BENEFICIARIES:
IM, Europe

KEY CHALLENGES:
European integration; route to market
PROGRAMME: IN2RAIL

PROBLEM STATEMENT: Network Rail and 52 other partners from across Europe contribute to and benefit from the In2Rail (I2R) innovation funding vehicle, this is WP10: Energy Management – Intelligent AC Power Supply.

SOLUTION: The objective of WP10 is to work on the design of an intelligent traction feeding system for AC rail power supply. This will allow a controlled energy flow inside the rail power grid and optimise the interface with the public power grid.

WP10 covers the basic investigations and the design works at TRL 1-3 to implement the demonstrators for the system defined in the master plan of Shift2Rail.

The main investigation topics are for intelligent, digital substations to allow all necessary control on an interface level between public and the railway grid, based on interface requirements.

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ADVANTAGES:
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BENEFITS:
Reduced infrastructure whole-life cost and improved efficiency

PROJECTED IMPLEMENTATION
Feasibility phase completed by 2019

BENEFICIARIES:
IM, Europe

KEY CHALLENGES:
European integration; route to market
PROGRAMME: IN2RAIL

PROBLEM STATEMENT: Network Rail and 52 other partners from across Europe contribute to and benefit from the In2Rail (I2R) innovation funding vehicle, this is WP11: Energy Management – Smart Metering for a Railway Distributed Energy Resource Management System (RDERMS).

SOLUTION: The main objectives of WP11 are to design an open system dedicated to the fine mapping of different energy flows within the whole Railway System on a synchronized time basis.

ADVANTAGES:
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BENEFITS:
Reduced infrastructure whole-life cost and improved efficiency

PROJECTED IMPLEMENTATION
Feasibility phase completed by 2019

BENEFICIARIES:
IM, Europe

KEY CHALLENGES:
European integration; route to market
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