SUPPLIER DAY

T1159: Evaluating variability in train driving under different adhesion conditions

22 October 2018

Agenda

- RSSB Research & Development Programme
- *The ADHEsion REsearch challenge (ADHERE)*
- Background to T1159 and other research projects on Cross-city line
  - ADHERE: Piloting Enhanced Sanders on the GB mainline
  - ADHERE: Quantifying the effects of Railhead Treatments on adhesion
  - ADHERE: Autumnsense - Wet rail monitoring using a network of sensors to improve autumn resilience
  - **ADHERE: T1159 Evaluating variability in train driving under different adhesion conditions**
- Questions

RSSB Research & Development Programme

RSSB | ADHERE

The ADHEsion REsearch challenge (ADHERE)

Achieve 'adhesion conditions that are unaffected by and independent of the weather and climate.

Driver behaviours
Improving driver confidence and performance in low adhesion conditions

Fundamental science and modelling
Advancing the ability to model low-adhesion contaminants and braking; and enhancing knowledge on low adhesion caused delay

Changes to train design
Exploiting train-borne technologies, including sanders and magnetic track brakes

Rail cleaning and re-contamination
Enhancing knowledge on the effect of rail cleaning activities and treatments

Forecasting adhesion
Achieving better adhesion forecasting and observation capabilities to improve decision making

Current Planned Research on this route

- IMP-T1107

Piloting enhanced sanders on the GB Mainline

- COF-AUT

Autumnsense: Wet rail monitoring using a network of sensors to improve autumn resilience

- T1159

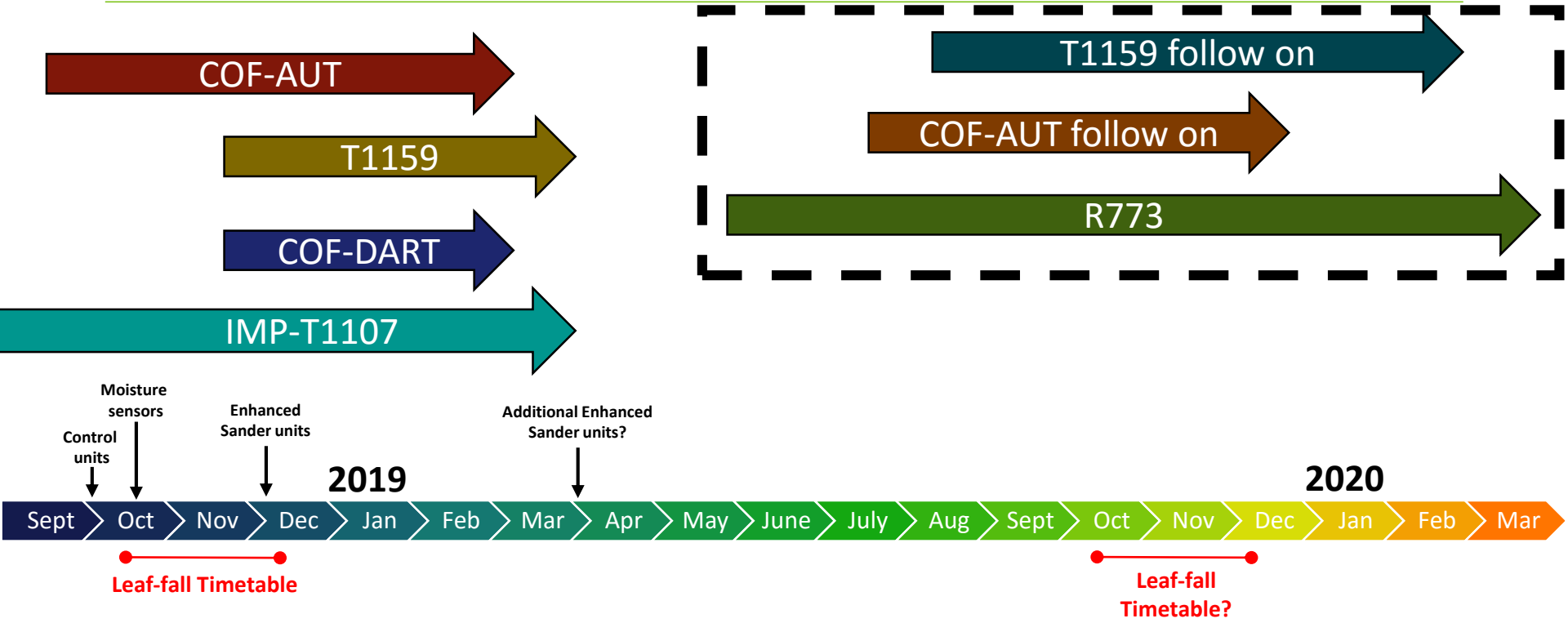
Evaluating variability in train driving under different adhesion conditions

- COF-DART

Quantifying the effects of Railhead Treatments on adhesion

Project timelines

Currently ideas – timeframes TBC pending endorsement



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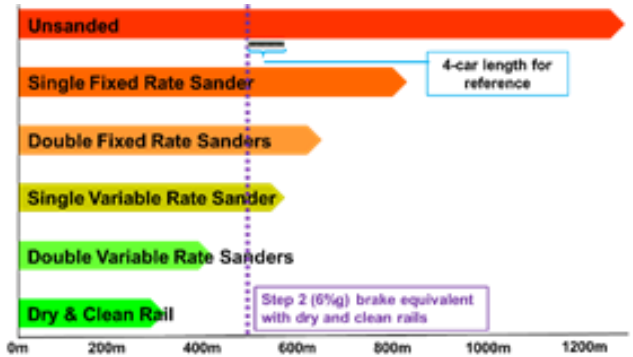
IMP-T1107
Piloting enhanced sanders on the GB Mainline

Background

T1107 delivered conclusive findings of the relative performance of different sander configurations in low adhesion conditions.



As a result, RSSB is co-funding an implementation project with WMT that seeks pilot these variable sanding configurations in a real railway environment.

Why the Cross-City line

The Route

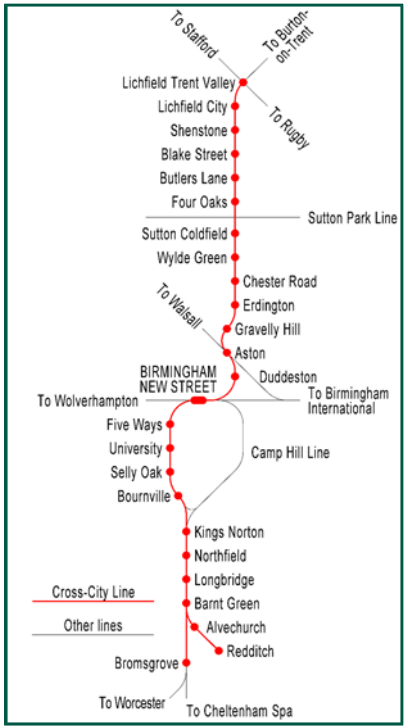
- 32 miles long (>20 stops)
- Intense metro-type service (core 6 tph ↔)
- Operated by class 323 EMUs

Problem

- leafy nature - suffers from low adhesion

Current Mitigation

- ‘Skip-stop’ leaf-fall timetable
- TGAs
- ATUSTs
- RHTTs/MPVs



IMP-T1107
Piloting enhanced sanders on the GB Mainline

Objectives

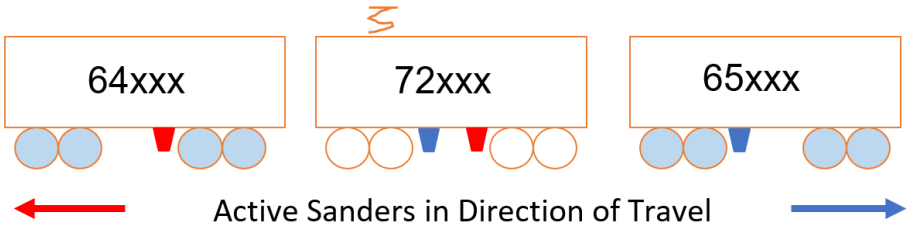
I. Accelerate the roll out of double variable rate sanders by supporting early adopters

II. Demonstrate in-service benefits to the wider industry

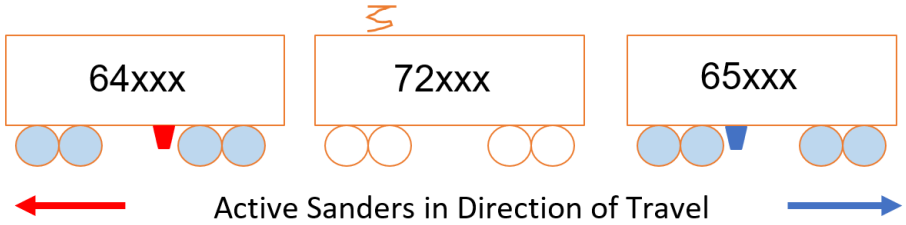
III. Capture in-service data to unlock longer term capacity gains achievable via improved and reliable braking performance

IMP-T1107
Piloting enhanced sanders on the GB Mainline

2 x Modified Enhanced Sander units (+2 units in 2019)



6 (or 4) x Unmodified units



Equipped with Data loggers to monitor braking performance

IMP-T1107
Piloting enhanced sanders on the GB Mainline

Success criteria	Data required
A. Anecdotal evidence from driver and DSM	Collect driver / DSM feedback
B. Reduction / removal station overruns	WMT station overrun data Local low speed test
C. Reduction of reported adhesion issues	reported adhesion issues data
D. Improvement in PPM (or CaSL)	PPM (or CaSL) data
E. Achieved decelerations closer to the demanded brake levels	• Unit deceleration rate (accelerometer & data logger) • Brake demand (Real-time) • Axle 1 & 2 BCP • Sander activity • WSP activity GPS speed and location data
F. Demonstrate 6%g deceleration (if practicable, >6%g demand needed)?	

IMP-T1107
Enhanced sanders on the Cross-City line

Comparing braking performance of
enhanced sander units vs unmodified units

However…..

…..Railhead treatments (TGAs/ATUSTs/RHTTs) may muddle results if “treated” vs “non-treated” rail is are not identified….

…..analysis will need to control for these variables….

….more data required!

IMP-T1107
Enhanced sanders on the Cross-City line

Comparing braking performance of enhanced sander units vs unmodified units

Treatment	Information required
TGAs	Locations, Activity/Operation/Maintenance, 323 fleet unit diagrams
ATUST	treatment sites, Unit number, Operation/Maintenance, 323 fleet unit diagrams,
RHTT/MPVs	Operation, friction modifier treatment sites, 323 fleet unit diagrams

Current Planned Research

- IMP-T1107

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Quantifying the effects of Railhead Treatments on adhesion

COF-DART
Quantifying the effects of Railhead Treatments on adhesion

History of COF-DART

- Anecdotal evidence railhead treatments work - little empirical evidence to corroborate on GB mainline.
  - RHTT - work by ARUP and by Data Alchemist
  - TGAs – work by Liverpool John Moores University
  - ATUST - inconclusive
- Opportunity to utilise IMP-T1107 data to evaluate these treatments in more detail

COF-DART
Quantifying the effects of Railhead Treatments on adhesion

Aim: Use braking data collected in IMP-T1107 to evaluate the effectiveness of Railhead treatment strategies

Key Questions: For TGAs, ATUST units and RHTT/MPVs:

I. What level of braking improvement is generated by the different treatments immediately after their deployment?

II. How resilient is the improvement over time?

III. What is the variability observed in the improvement and what are the key influencing factors?

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Quantifying the effects of Railhead Treatments on adhesion

COF-AUT
Autumnsense: Wet rail monitoring using a network of sensors

Aim

Produce a real time environmental monitoring system to help improve autumn resilience on the railway network by:

I. Focusing on sensing the key element of moisture, the project will translate an existing sensor prototype developed on pilot project COF- TAR- 01;

II. Collecting data over Autumn 2018 so that it can contribute to the RSSB Adhesion Forecasting data sandbox and be considered in the context of the WILAC model and other data analysis driven work that RSSB will carry out or commission as result of joint data collection effort with WMT.

COF-AUT
Autumnsense: Wet rail monitoring using a network of sensors

Objectives

I. Modify the prototype moisture sensor so it is suitable for translation into an operational environment (i.e. adjacent to the rail on dummy rail) and equipped with a battery life to last for the entirety of the IMP-T1107 trials providing data for Autumn 2018;

II. Fitment (by Network Rail) of an agreed number of moisture sensors to a number of agreed sites.

III. Collection of moisture data to demonstrate the feasibility of the low cost moisture sensors applicability to carry out remote monitoring on the GB mainline;

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T1159
Evaluating variability in train driving under different adhesion conditions

Aim: Use on-board train data (& supporting material) to understand changes to driver behaviour variability under different adhesion conditions.

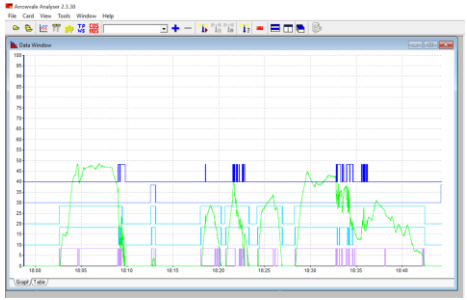
Compare:

I. Traction,
II. Speed &
III. Braking

T1159
Evaluating variability in train driving under different adhesion conditions

Project background

- Anecdotal evidence that driving under low adhesion conditions leads to more driving variability than under ‘good’ adhesion conditions, impacting upon performance and safety. However, little empirical evidence to corroborate on GB mainline.
- Opportunity to utilise Class 323 control unit data from Piloting enhanced sanders on the GB Mainline (IMP-T1107) to evaluate the variability of driving under different adhesion conditions
- Requested by the ADHERE Driver Behaviours workstream subgroup. Endorsed by Adhesion Working Group.

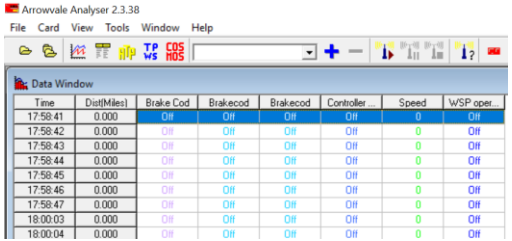


T1159
Evaluating variability in train driving under different adhesion conditions

Premises and hypotheses

I. Driving under low adhesion conditions during the autumn leaf fall period is believed to lead to more driving variability in drivers taking power, permissible line speed/maximum attainable train speed and braking applications than driving under ‘good’ adhesion conditions on a dry day outside of the autumn period

II. Some driving variability is expected, however, significant variability in drivers taking power, permissible line speed/maximum attainable train speed and braking applications would mean that there is an opportunity to seek more consistency to improve performance and safety



T1159
Evaluating variability in train driving under different adhesion conditions

Objectives

I. Establish and compare the extent of driving variability across drivers within the same fleet and route under different adhesion conditions, to assess **how and when drivers take power**

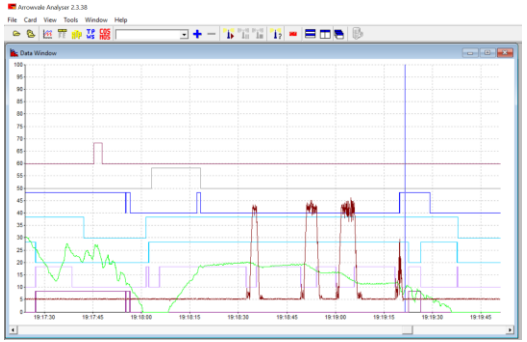
II. Establish and compare the extent of driving variability across drivers within the same fleet and route under different adhesion conditions, to assess **when and how often sanders are manually activated**

III. Establish and compare the extent of driving variability across drivers within the same fleet and route under different adhesion conditions, to assess **what permissible line speed/maximum attainable train speed is reached and maintained**

IV. Establish and compare the extent of driving variability across drivers within the same fleet and route under different adhesion conditions, to assess **when and how often braking applications are undertaken (including when and how often brake testing is undertaken)**

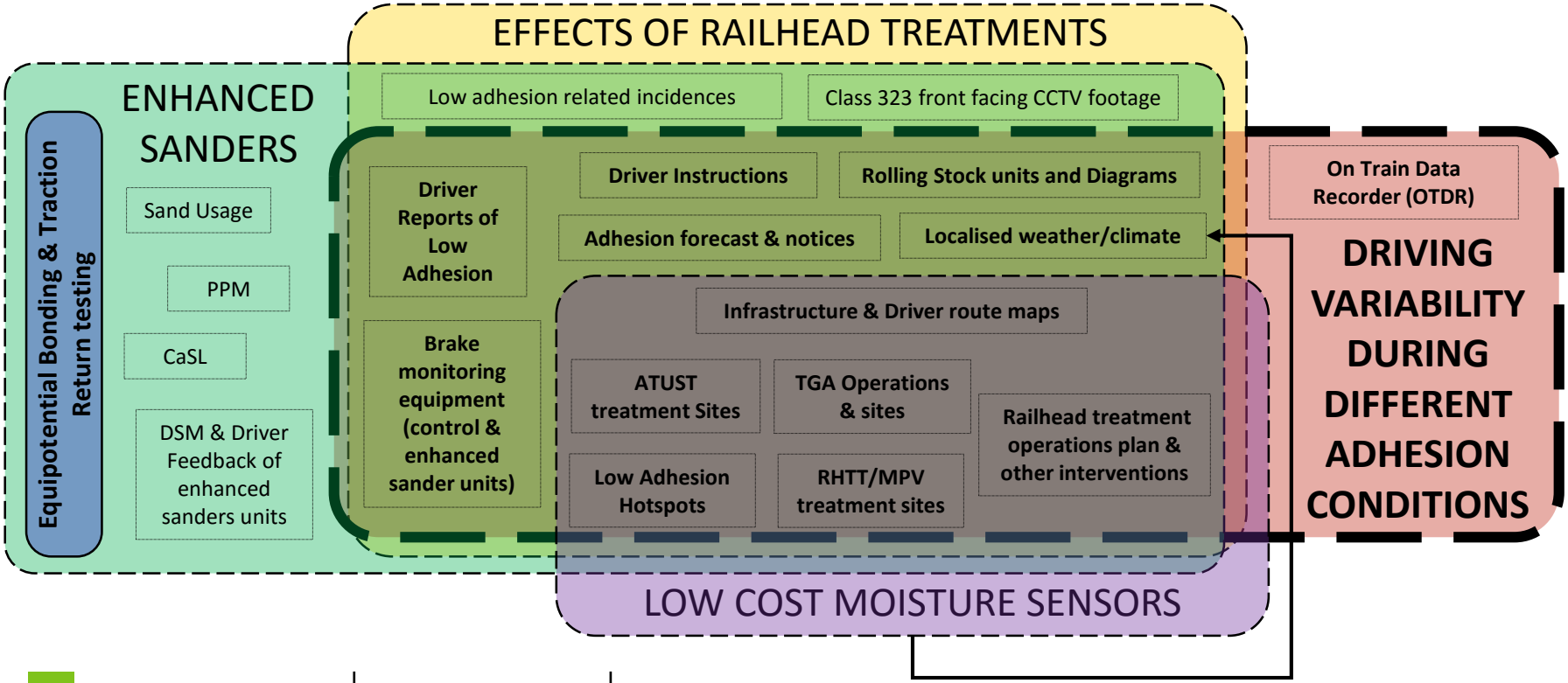
V. Establish **how the extent of driving variability compares to official professional driving policy and braking instructions for autumn**

VI. Identify statistically significant influences that lead to greater driving variability in the presence of low adhesion conditions



T1159 and the data

Projects and relevant data sources



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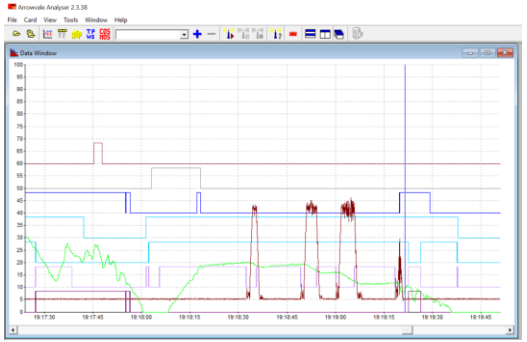

Database

Data to be provided to supplier	Data to be included within database
WMT Class 323 OTDR data (6 control units)	**Control unit OTDR data**
WMT Class 323 OTDR channels list	**Cross-City Line infrastructure**
Class 323 brake train wire coding sequence chart	**Actual rolling stock and train crew diagrams operated**
OTDR download guidance document	**Driver reports of low adhesion**
Monitoring system data (6 control units)	
Cross-City Line driver route maps and sectional appendix	
WMT rolling stock and train crew diagrams	
WMT rolling stock and train crew diagram allocation changes	
WMT professional driving policy documentation	
WMT seasonal briefing documentation	
WMT Adhesion notices	
ATUST TG60 gel application sites (Cross-City Line)	
ATUST data recorded onboard WMT Class 323 units (Cross-City Line)	
Identified low adhesion hotspots (Cross-City Line)	
TGA sites (Cross-City Line)	
TGA data recorded along the Cross-City Line	
Railhead treatment operations plans (Cross-City Line)	
Driver reports of low adhesion (Cross-City Line)	
Moisture sensor locations and data (Cross-City Line)	

Any Questions