

Technology and Asset Management – a Network Rail Perspective

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Network Rail

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Digital innovations help us understanding the real-time health of our assets, which enable timely and efficient maintenance interventions

Background

- COVID-19 had has led to unprecedented levels of innovation in terms of communications and digital technology.
- Our business have had to undergo rapid digitalisation and use this wave of innovation to re-imagine our business model
- In addition, site access changes in our operating model further accelerated the use of technology to reduce time spent by staff on track
- Several case studies are presented here

Case Studies



**Cross-industry efficiency using
in-service train data recording**



Remote Monitoring of S&C



**Class153 S&C Inspection train
and AIVR**

Cross-industry efficiency using in-service train data recording

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Delivering Cross Industry Efficiencies



Main Benefits

Other benefits:

- Incident recovery
- Access planning
- Site familiarization
- Track geometry rectification costs
- Driver pattern analysis to support ETCS deployment



DEPLOYING FFV
NATIONALLY
COULD
POTENTIALLY
REDUCE 100,000
INSPECTIONS
HOURS



USING UGMS
DATA & RE-
DEPLOYING PLPR
NATIONALLY
COULD
POTENTIALLY
REDUCE 200,000
INSPECTION
HOURS AND
REDUCE SAF



DETAILED
MONITORING OF
OLE NATIONALLY
COULD
POTENTIALLY
REDUCE 30,000
INSPECTION
HOURS

Forward Facing Video

Map of FFV with daylight coverage last year (from IM fleet and portable TLC devices)

Capability of most TOC fleets understood, image quality and operational readiness still WIP – this will inform spec for new installs and determine where upgrades are required



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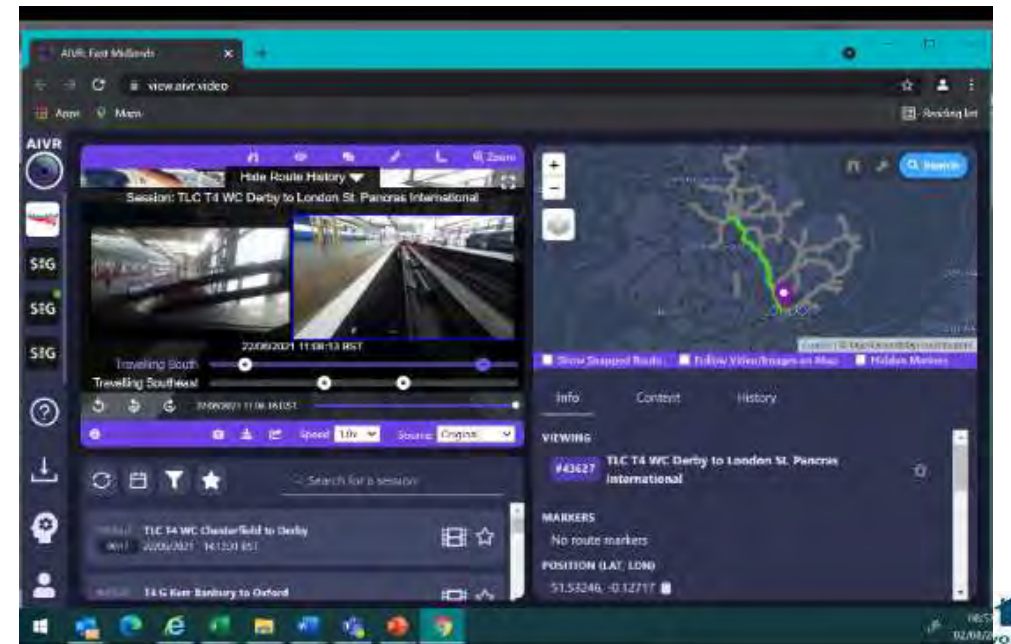
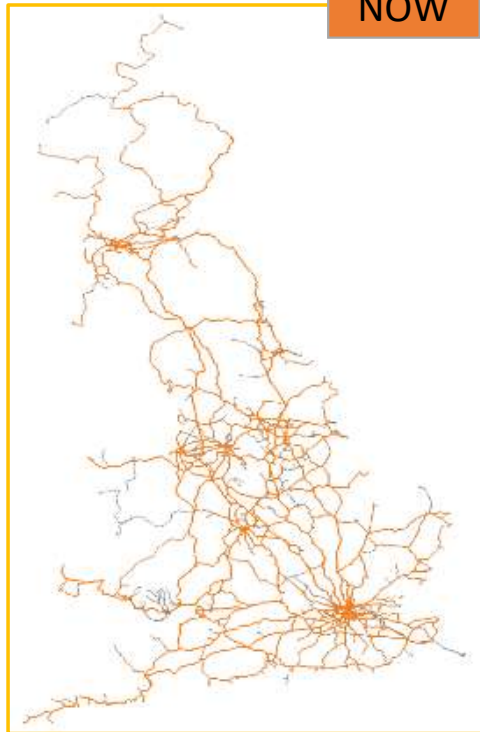
Forward Facing Video

Deploying FFV nationally could improve inspection efficiency, potentially save 100,000 manual inspection hours (boots off ballast)

THEN



NOW



NEST
MANAGE
home safe
every day

OFFICIAL



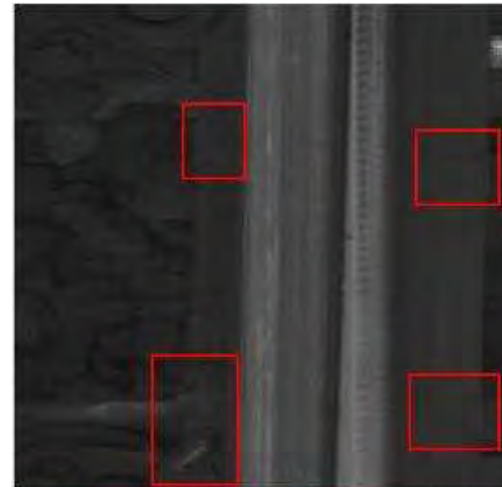
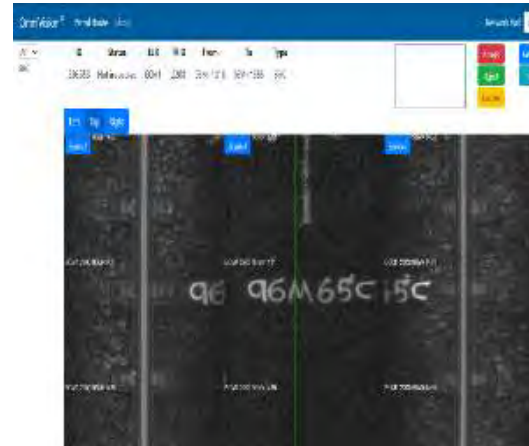
Unattended Geometry Measurement Systems (UGMS) & Plain Line Pattern Recognition (PLPR)

Getting boots off ballast (200k hours)

Great engagement with ROSCOs

Learning by doing

Focus on high-risk areas



1 - PLPR image highlighting the heating clips including the barrel of the heater rods (bottom left)



Unattended Geometry Measurement Systems

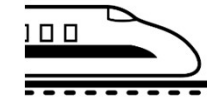
Industry Efficiency summary

Enables re-deployment of IM fleet to lower track cats (where higher risks are)

EMR and GA Class 720 progressing with fitment.



TOC	Fleet	Equipment	Trains Fitted	Status
GWR	800	OBB	5	All fitted
	802		3	1 operational
LNER	800	OBB	6	All fitted 6 operational
TPE	802	OBB	2	All fitted 2 operational
Merseyrail	777	Mermec	3	All fitted
EMR	810	OBB	4	being 'designed in'
GA	720	OBB	tbc	GA progressing
	745/755	tbc	tbc	Potential opportunity



23 trains



3/5 regions



10/14 routes



Late 2022

Shifts

Select ELR



Select TRID



or

Journey

Show deleted shifts ☐

ID  	Vehicle  	Date  	Status  
1191	Hitachi-TPE_002	26/10/2022 03:25 UTC	Uploading complete
1190	Hitachi-HEP_T38	26/10/2022 00:18 UTC	Uploading complete
1189	Hitachi-HEP_T2	26/10/2022 00:04 UTC	Uploading complete
1188	Hitachi-TPE_002	25/10/2022 00:13 UTC	Uploading complete
1187	Hitachi-HEP_T2	25/10/2022 00:02 UTC	Uploading complete
1186	Hitachi-HEP_T2	25/10/2022 00:02 UTC	Uploading complete
1185	Hitachi-HEP_T38	24/10/2022 00:26 UTC	Uploading complete
1184	Hitachi-WOE_T1	24/10/2022 00:03 UTC	Uploading complete
1183	Hitachi-HEP_T2	24/10/2022 00:03 UTC	Uploading complete
1182	Hitachi-TPE_002	24/10/2022 00:02 UTC	Uploading complete

Showing 1 to 10 of 590 shifts

1

2

3

4

5

>

>>



☒ Mileposts ☒ Open Street Map

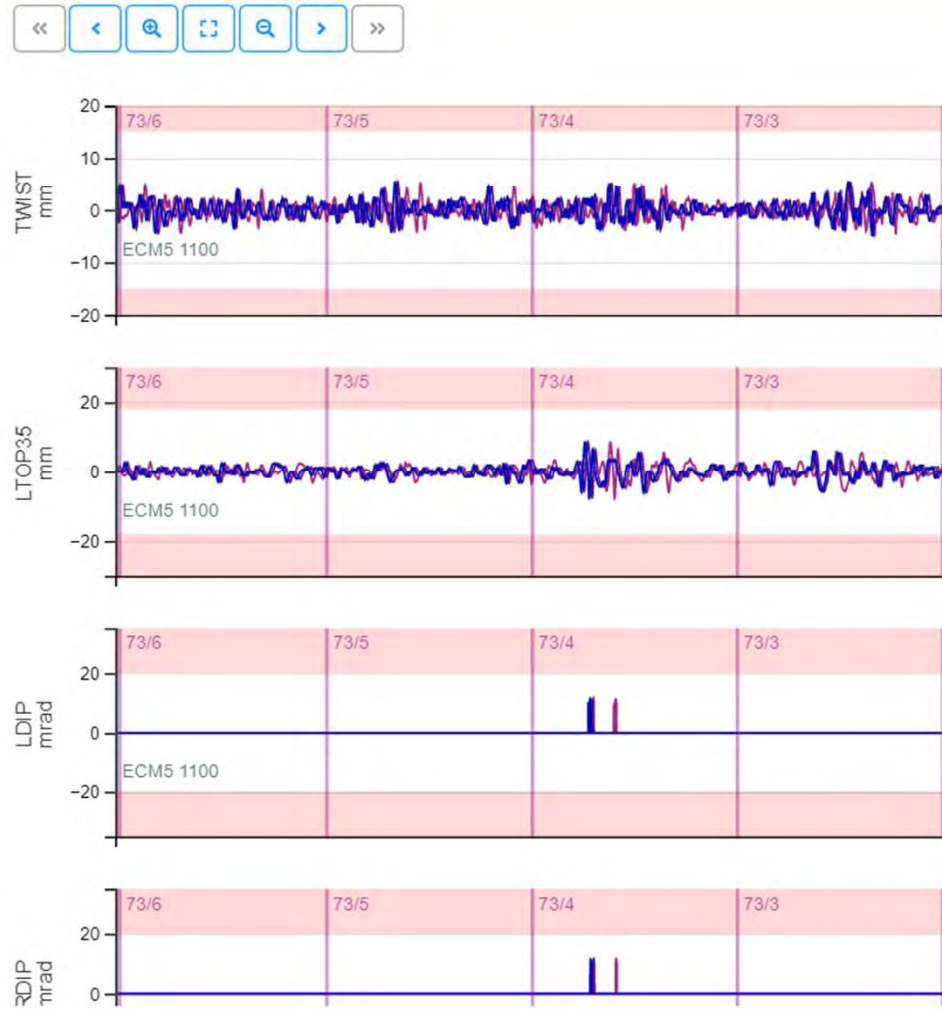
Re-Route



Run Id	Map Version	☒ Show Layer	Start	End	Distance(m)	Direction	Route	Status	Zoom to Run	☒ Active	Save
26198	41.0.0	☒	26/10/2022 03:33 UTC	26/10/2022 06:29 UTC	239717.7	POSITIVE		No route		☒	
26199	41.0.0	☒	26/10/2022 06:29 UTC	26/10/2022 07:05 UTC	50243.1	POSITIVE		No route		☒	Combine with 26198
26200	41.0.0	☒	26/10/2022 07:05 UTC	26/10/2022 07:05 UTC	115.0	POSITIVE		No route		☒	Combine with 26199
26201	41.0.0	☒	26/10/2022 07:54 UTC	26/10/2022 08:32 UTC	50660.3	NEGATIVE		No route		☒	Combine with 26200
26202	41.0.0	☒	26/10/2022 08:46 UTC	26/10/2022 09:55 UTC	83862.4	NEGATIVE		No route		☒	Combine with 26201
26203	41.0.0	☒	26/10/2022 09:55 UTC	26/10/2022 10:14 UTC	30106.2	NEGATIVE		No route		☒	Combine with 26202
26204	41.0.0	☒	26/10/2022 10:14 UTC	26/10/2022 10:18 UTC	11627.8	NEGATIVE		No route		☒	Combine with 26203
26205	41.0.0	☒	26/10/2022	26/10/2022	86911.3	NEGATIVE		No route		☒	Combine with

Previous Runs

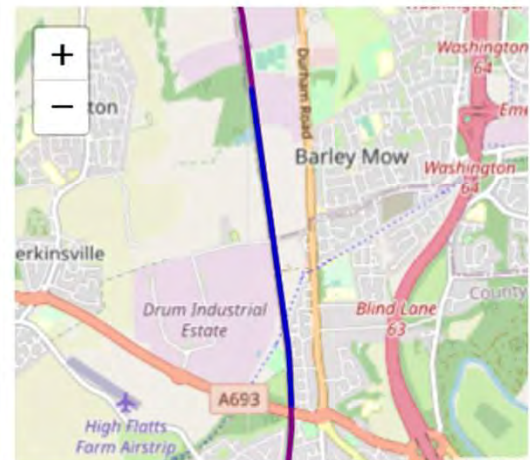
Id	Date	Vehicle
26207	26/10/2022 12:43 UTC	Hitachi-TPE_002
26151	25/10/2022 04:27 UTC	Hitachi-TPE_002
26059	24/10/2022 14:36 UTC	Hitachi-TPE_002
25940	19/10/2022 17:08 UTC	Hitachi-TPE_002
25827	17/10/2022 12:49 UTC	Hitachi-TPE_002
25782	15/10/2022 05:27 UTC	Hitachi-TPE_002
25713	13/10/2022 05:40 UTC	Hitachi-TPE_002
25622	11/10/2022 04:23 UTC	Hitachi-TPE_002
25523	30/09/2022 12:16 UTC	Hitachi-TPE_002
25499	29/09/2022 09:46 UTC	Hitachi-TPE_002



Legend

Date	Vehicle	Display
26/10/2022 03:33 UTC	Hitachi-TPE_002	☒
19/10/2022 17:08 UTC	Hitachi-TPE_002	☒
11/10/2022 04:23 UTC	Hitachi-TPE_002	☒

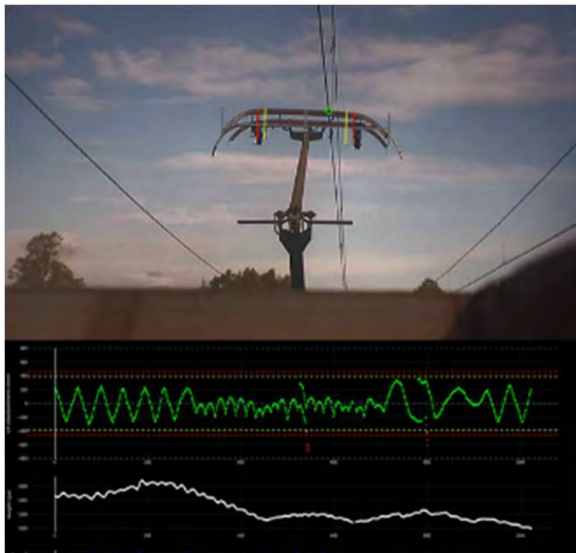
Map



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Opportunities for OLE monitoring

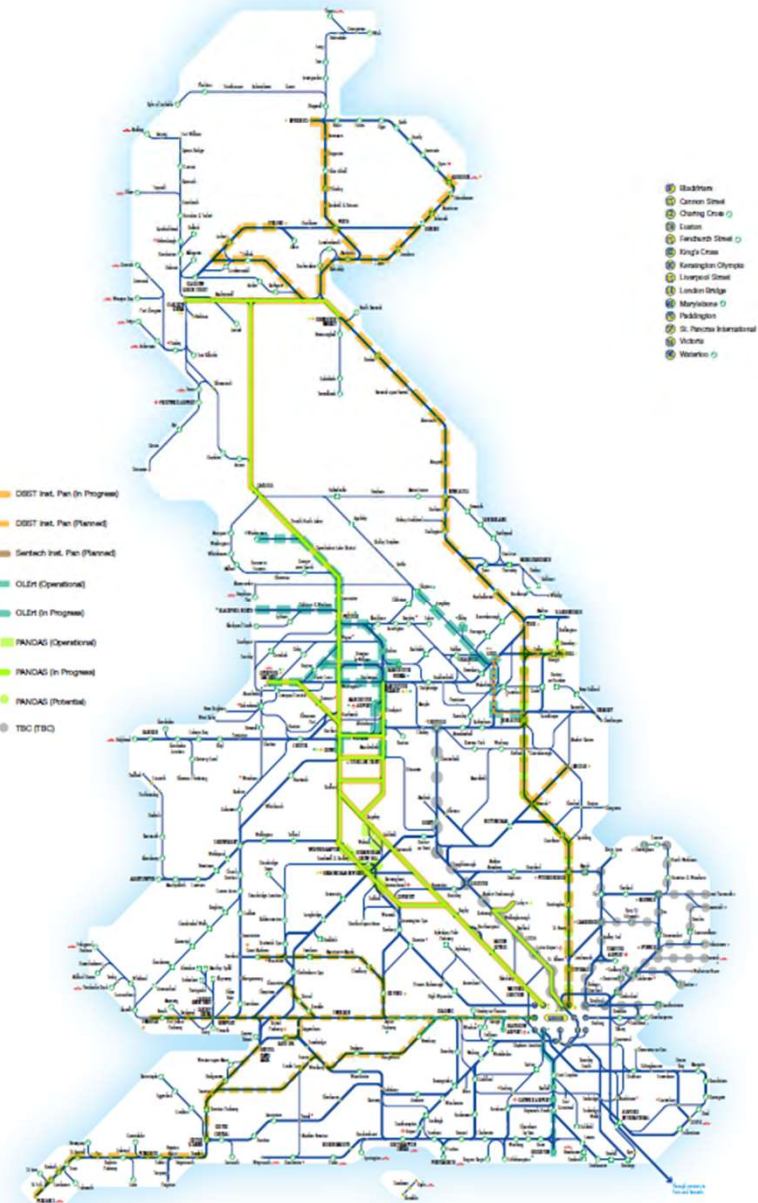
Detailed monitoring of OLE nationally could potentially save 30,000 manual inspection hours and reduce Service Affecting Failures



home safe
every day

Similar opportunities exist for OLE

TOC	Fleet	Equipment	Trains Fitted	Status	Operational
AWC	390	DBST Inst'd Pan	1	In progress	Dec-21
LNER	800	DBST Inst'd Pan	1	Planned	tbc
GWR	800	DBST Inst'd Pan	1	Planned	tbc
EMR	360	Sentech Inst'd Pan	1	In progress	Sep-21
GWR	387	OLErt	4	Operational	N/A
HEX	387	OLErt	2	Operational	N/A
GTR	387	OLErt	1	Operational	N/A
GTR	387	OLErt	3	In progress	tbc
Northern	333	OLErt	1	In progress	tbc
WMT	350	PANDAS	1	Operational	N/A
EMR	360	PANDAS	1	In progress	tbc
AWC	390	PANDAS	1	In progress	tbc
C2C	357	PANDAS	1	In progress	tbc
Hull Trains	802	PANDAS	1	Potential	tbc
MTR	345	OBB TrueOHL	3	tbc	tbc
GA	720	tbc	tbc	GA progressing	tbc
GA	745	tbc	tbc	Passive provision	tbc
GA	755	tbc	tbc	Passive provision	tbc
EMR	810	tbc	tbc		tbc



IMP technology trials to identify optimum solution/mix of solutions

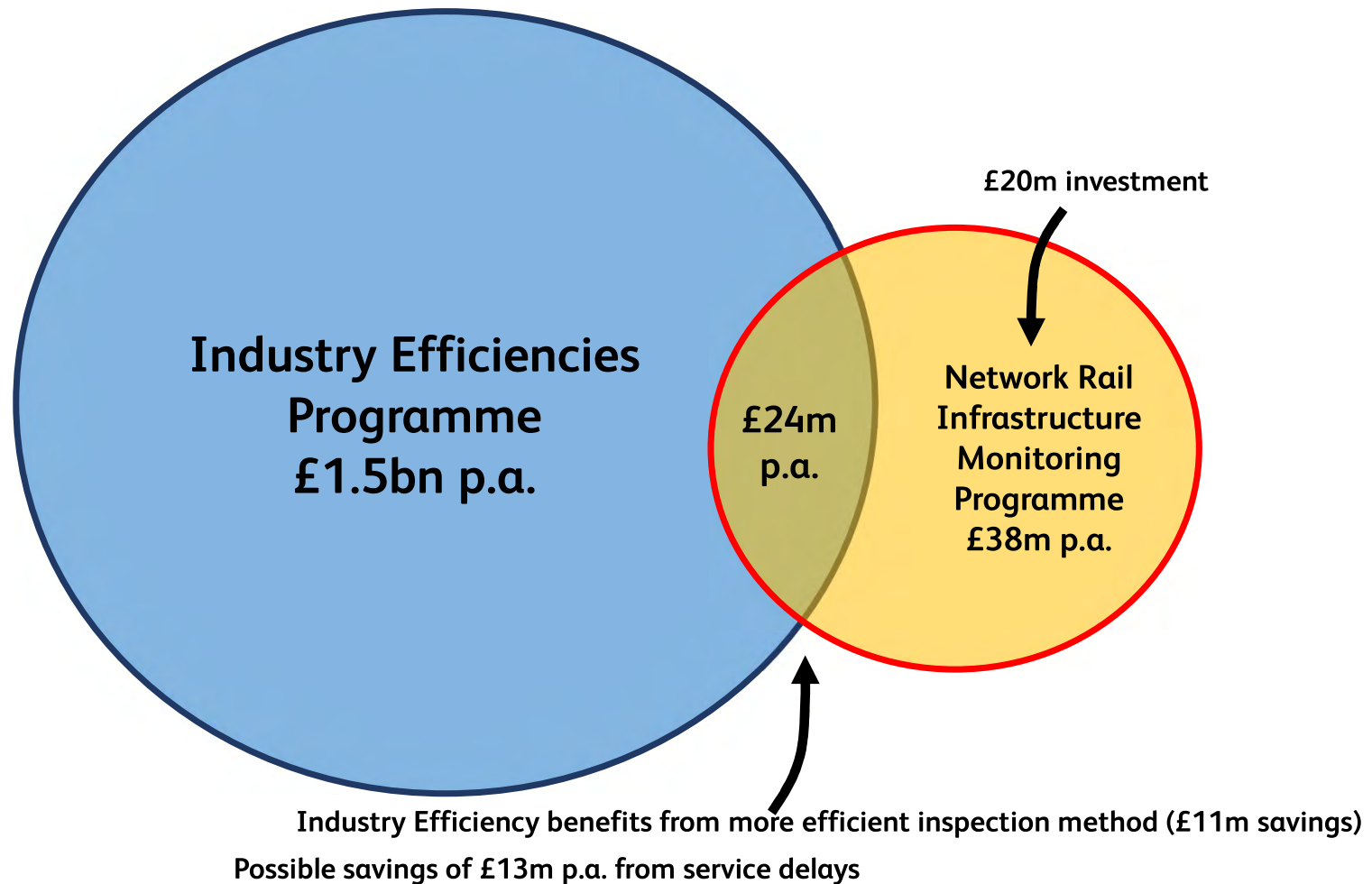


Measuring Efficiencies

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There is a missed opportunity of £2m per period if we don't do this!!



Next Steps

National roll-out

Data available from the 16 UGMS by May 2022

Work with TOCs to confirm frequency of recording for all routes and specific route requirements such as higher definition videos for structural examination

TOCs and NR continued collaboration

Dec 2022 - Class 390s OLE
April 2023 - S&C VIUs
June 2022 - OLE monitoring with Hitachi
Jan 2023 - Anglia trainborne PLPR and geometry
Jan 2023 - Instrumented pantograph on to IETs (LNER and GWR)

Benefits analysis

Monitor the benefits delivered

Capture the benefits from TOCs to establish the full business benefits for the industry

Remote Monitoring of S&C

Which sensors??



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Which sensors??



Case Study – Excessive Vibration of High Speed Switches

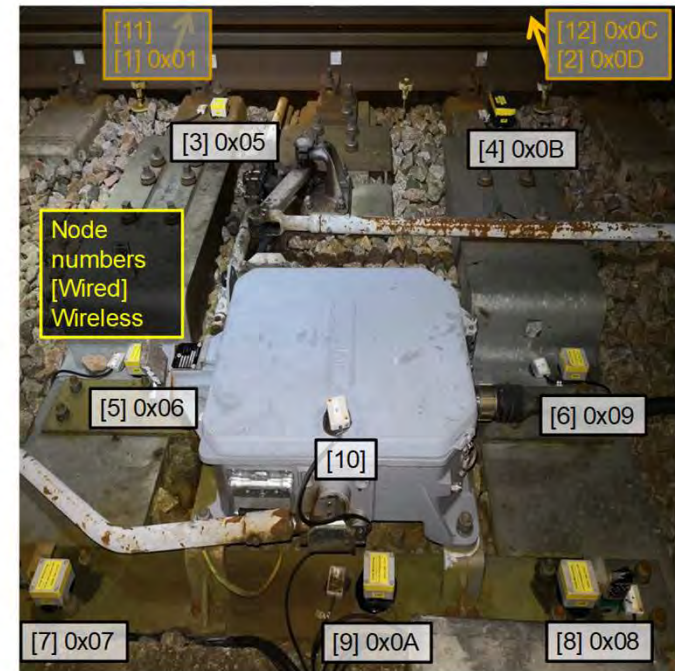
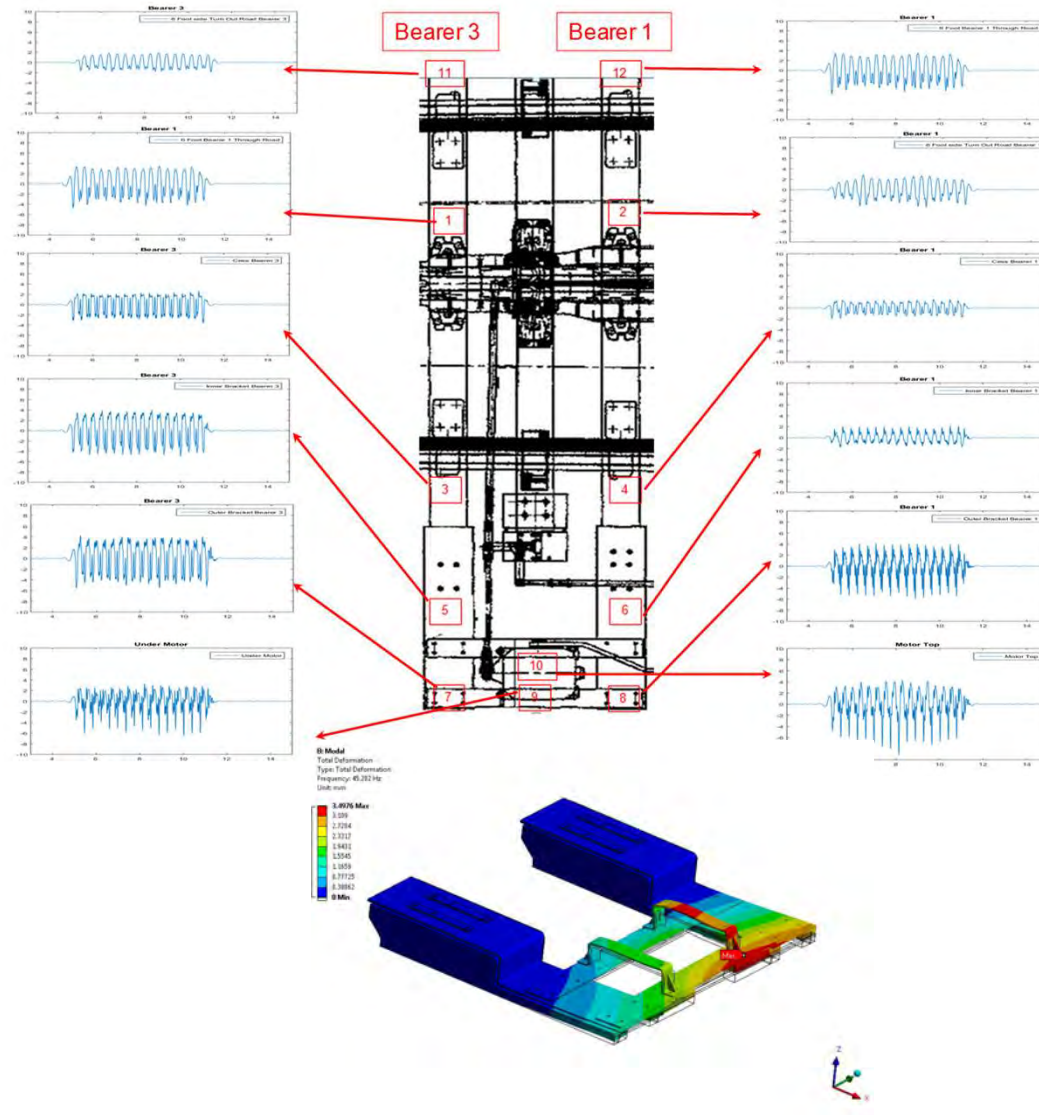




Before

Initial Investigation

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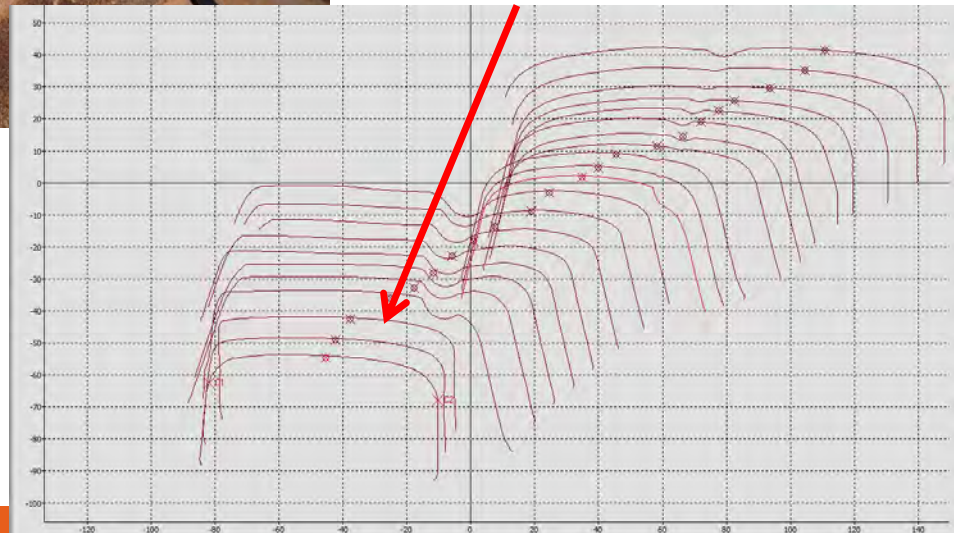


Further Investigation

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1mm dip in rail profile at the weld repaired section





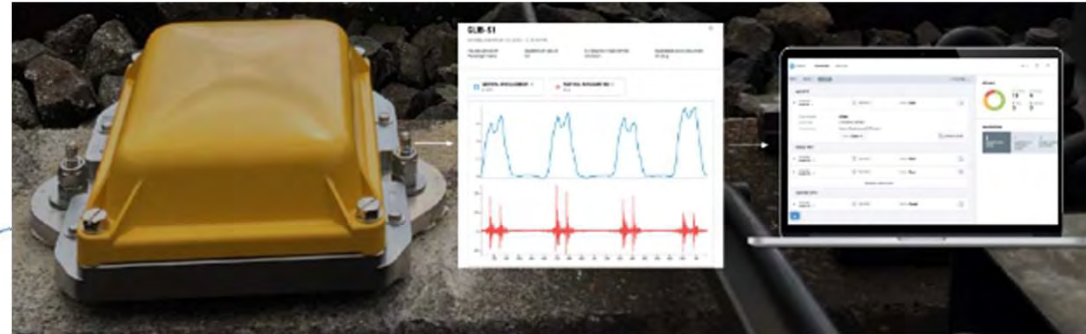
Before



After

Our experience with Konux

All material courtesy of Joshua Chambers



C1800 device tender for East Coast

16 devices installed, Doncaster pilot

8 devices due installation in March for Whitehall flat crossing

64 device request for North and East Route

4 devices installed, Luton pilot . 18 devices offer submitted across East Mids

16 devices, East Coast, Sandy offer submitted

29 IIoT devices, Wessex Route Pilot request

16 devices, Western route pilot request

Network Rail Routes and Regions

- Eastern**
 - 1 East Coast Route
 - 2 North and East Route
 - 3 East Midlands Route
 - 4 Anglia Route
- North West & Central**
 - 5 North West Route
 - 6 Central Route
 - 7 West Coast Mainline South Route
- Scotland's Railway**
 - 8 Scotland Route
- Southern**
 - 9 Kent Route
 - 10 Network Rail High Speed
 - 11 Sussex Route
 - 12 Wessex Route
- Wales & Western**
 - 13 Wales Route
 - 14 Western Route



LA 2282

HEALTH STATUS: 10 10 KONUX LOAD FACTOR: 4.7 IMPORTANCE: ● ● ● WEATHER: 17°C 60%

Switch section: Blade ☐ Frog ☒

Overlay: Temperature ☐ Precipitation ☐ High/Low Range ☐ 7-Day Average ☐ Prediction ☐

Train Speed: 0 km/h to 350 km/h

Train Types: High Speed Trains ☐ Passenger Trains ☐ Cargo Trains ☐ Unknown Trains ☐

VERTICAL DISPLACEMENT
At Frog - in mm

THRESHOLD 3.00MM

TRAIN AVERAGE



MGJ 2457A

HEALTH STATUS: ● ● ● ● ● ● ● ● ●

KONUX LOAD FACTOR: ● ● ● ● ● ● ● ● 3.3

IMPORTANCE: ● ● ● ● ● ● ● ●

WEATHER: 17°C 62%

Switch section

Blade ☐

Frog ☒

Overlay

Temperature ☐

Precipitation ☐

High/Low Range ☐

7-Day Average ☐

Prediction ☐

Train Speed

0 km/h — 350 km/h

Train Types

High Speed Trains ☐

Passenger Trains ☐

Cargo Trains ☐

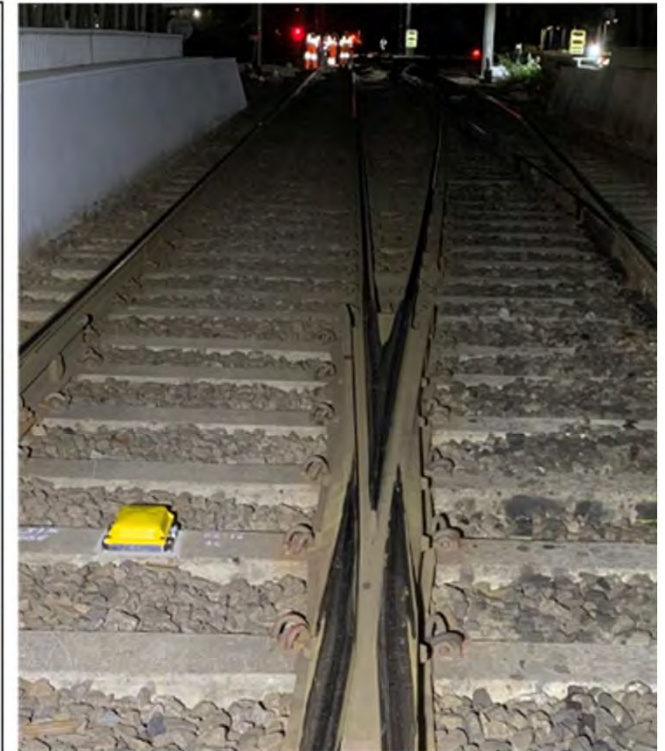
Unknown Trains ☐

VERTICAL DISPLACEMENT ■ ■ ■ ■ ■ ■ ■ ■

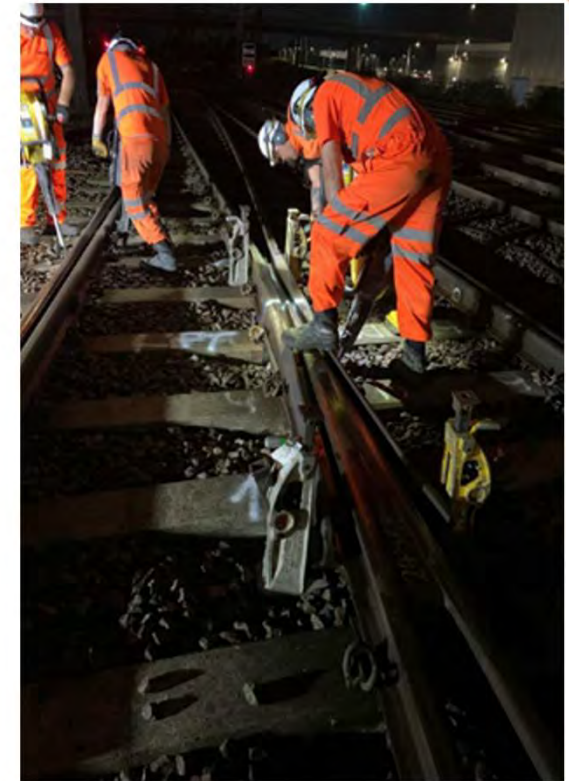
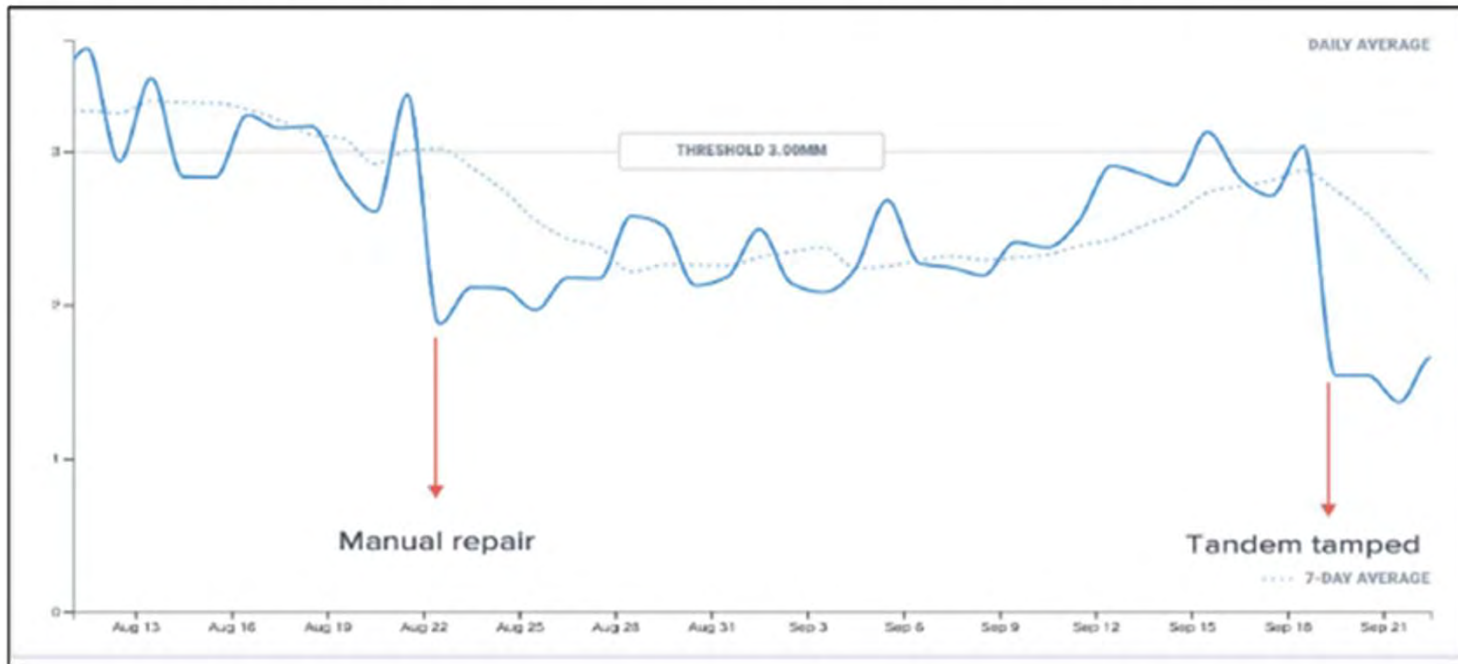
At Frog - in mm

THRESHOLD 3.0MM

TRAIN AVERAGE



- Initial Robel – No Impact
- Lifted throughout with Duff Jacks – Vertical Displacement dropped significantly
- Parallel Tamped through Junction – Vertical Displacement less than 2mm with a predicted downward trend.



Maintenance Effectiveness

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TXF 2221-3B

HEALTH STATUS KUNUX LOAD FACTOR 4.7 IMPORTANCE WEATHER 8°C 85%

Switch section

Blade ☐
Frog ☒

Overlay

Temperature ☐
Precipitation ☐
High/Low Range ☐
7 Day Average ☐
Prediction ☐

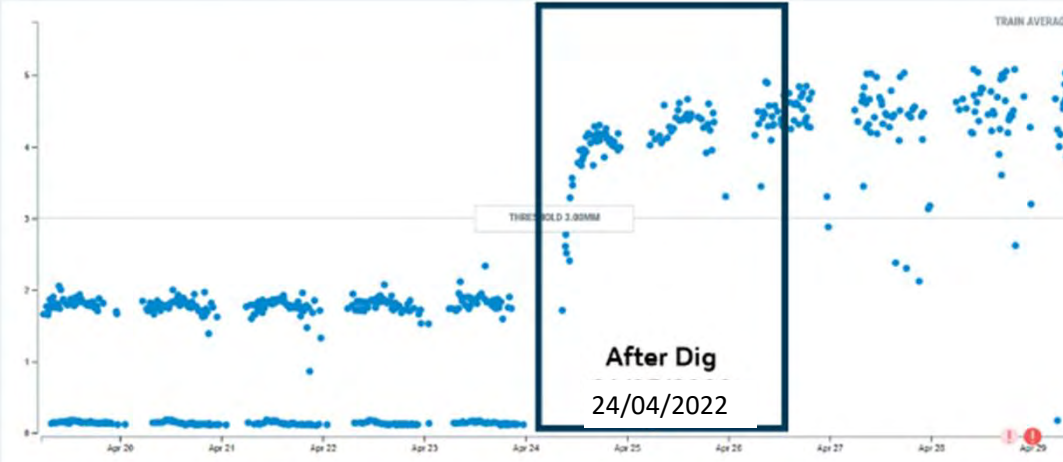
Train Speed

0 km/h 350 km/h

Train Types

High Speed Trains ☐
Passenger Trains ☐
Cargo Trains ☐
Unknown Trains ☐

VERTICAL DISPLACEMENT
At Frog - in mm



TRAIN AVERAGE



TXF 2221-3B

HEALTH STATUS KUNUX LOAD FACTOR 4.7 IMPORTANCE WEATHER 8°C 85%

Switch section

Blade ☐
Frog ☒

Overlay

Temperature ☐
Precipitation ☐
High/Low Range ☐
7 Day Average ☐
Prediction ☐

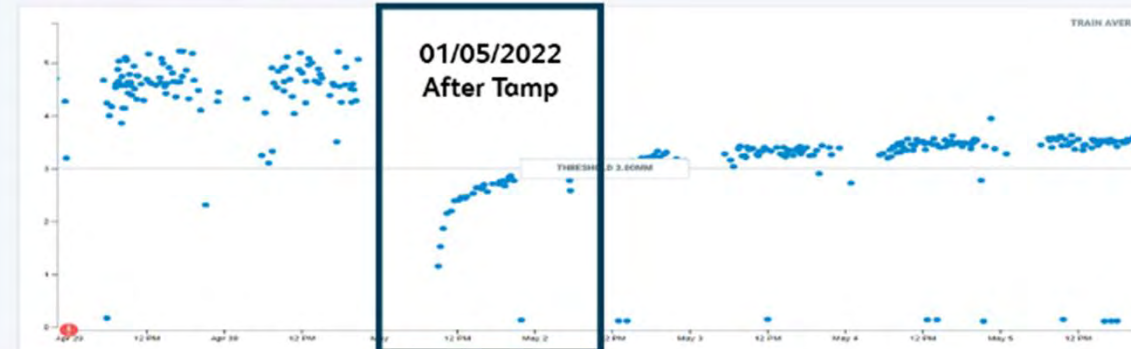
Train Speed

0 km/h 350 km/h

Train Types

High Speed Trains ☐
Passenger Trains ☐
Cargo Trains ☐
Unknown Trains ☐

VERTICAL DISPLACEMENT
At Frog - in mm



TRAIN AVERAGE



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2221 2A following Reballast

TXF 2221-3B

Switch section

Blade

Frog

Overlay

Temperature

Precipitation

High/Low Range

7-Day Average

Prediction

Train Speed



Train Types

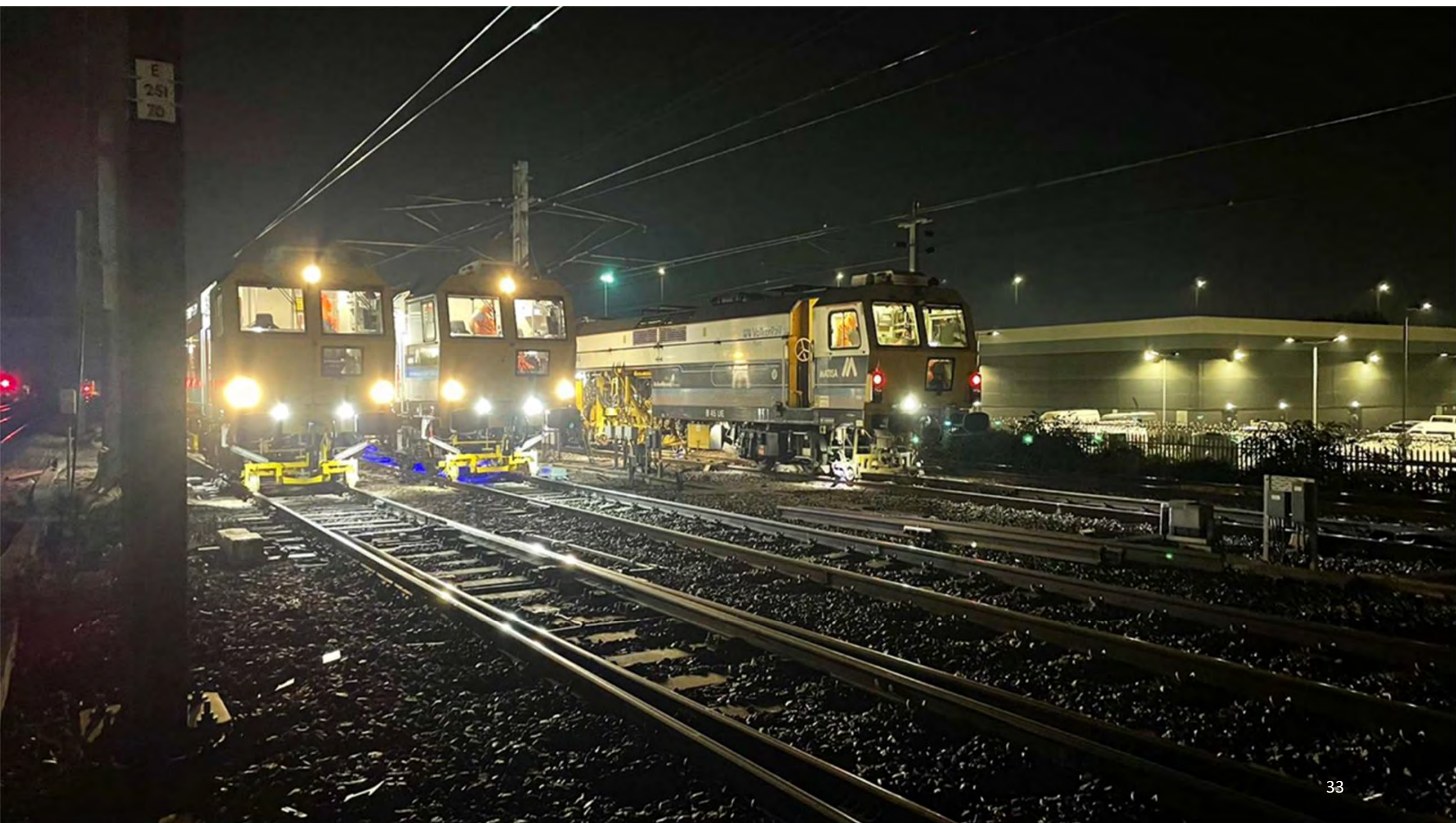
High Speed Trains

Passenger Trains

Cargo Trains

Unknown Trains





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2456B following installation of new crossing nose

MGJ 2456B

11 12 3.8 17°C 62% DETAILS GRAPH

Switch section

Blade

Frog

Overlay

Temperature

Precipitation

High/Low Range

7-Day Average

Prediction

Train Speed



Train Types

High Speed Trains

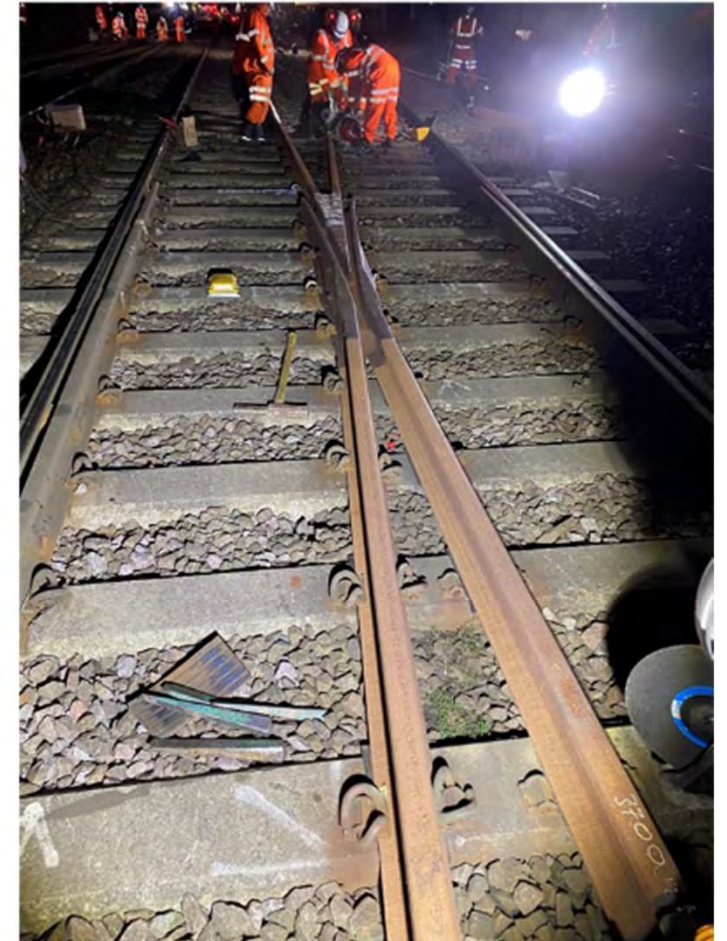
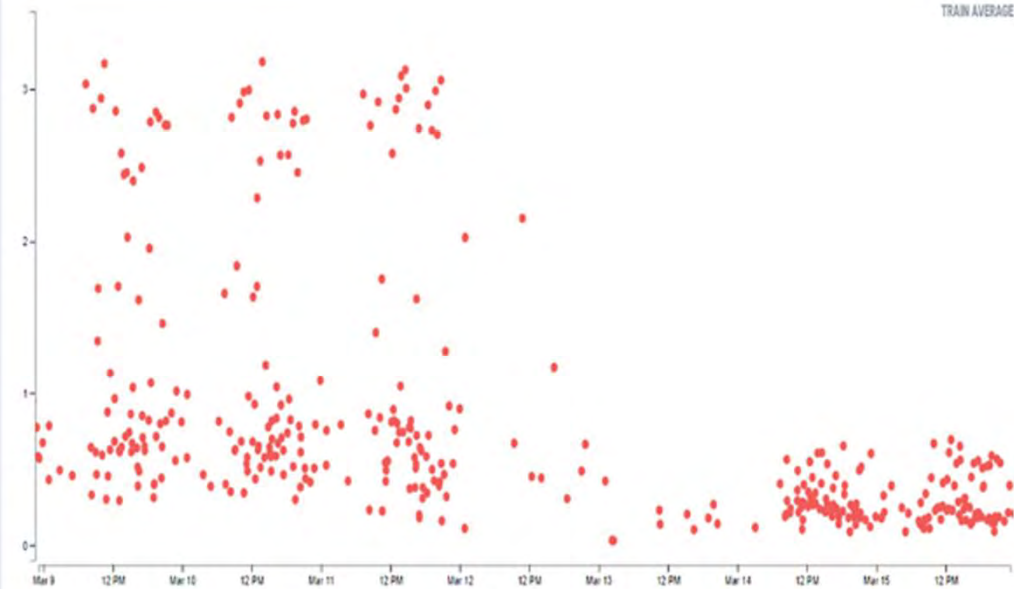
Passenger Trains

Cargo Trains

Unknown Trains

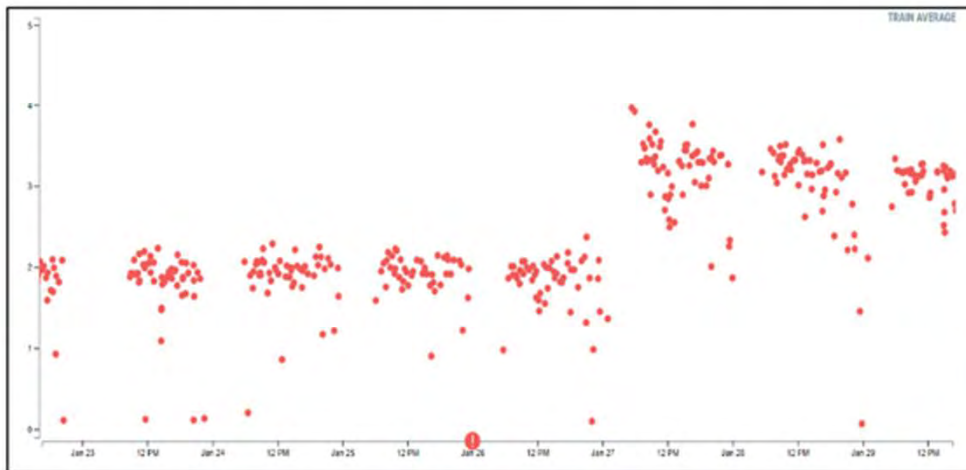
VERTICAL ACCELERATION RMS

At Frog - in g



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2221 2A following weld repair on crossing nose



Estimated Tonnage 2221 2A



Deriving the Benefits

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Understanding the physics of what is being measured



Consistency of measurements

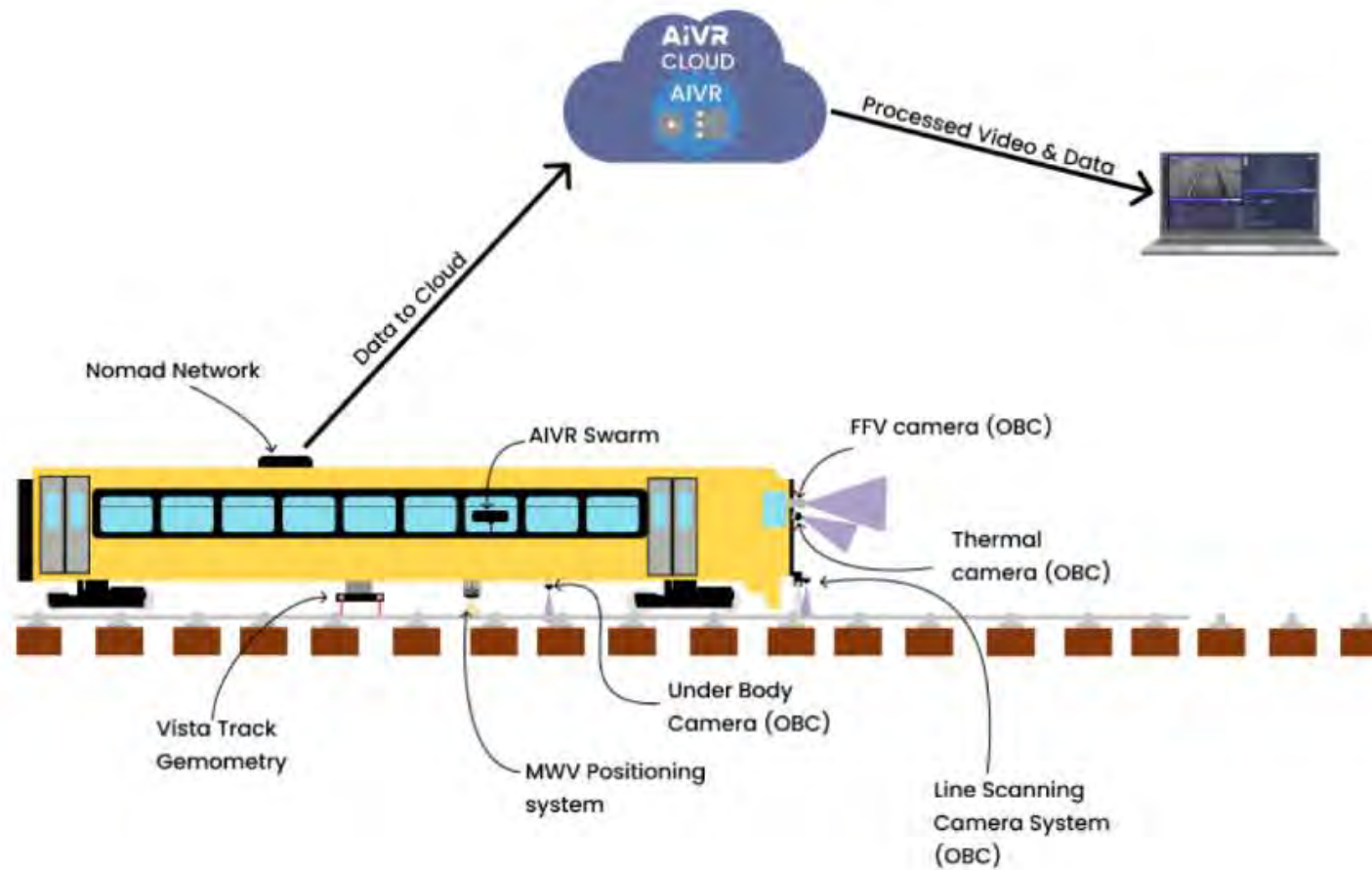


Platform that converts data into useful information



The above are what helps improve efficiency

Class 153 S&C Inspection train



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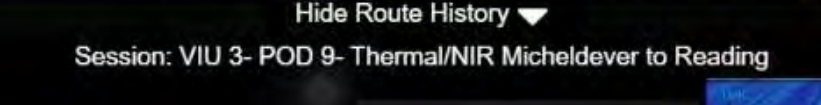


NetworkRail



Hide Route History ▼

Session: VIU 3- POD 9- Thermal/NIR Micheldever to Reading



10/03/2022 23:51:19 GMT

Travelling North

Travelling South

▶ ⏮ ⏭ 10/03/2022 23:51:02 GMT ●

Speed: 1.0x Type: Video

Sessions

Shortcuts

Markup Feed

↺

📅

🔍

★

🔍 Search for a session

#107143

VIU 3- POD 11- 4k Micheldever to Reading

10/03/2022 23:51:02 GMT

00:50

🌙 Night

🔍

🎬

★

#107140

VIU 3- POD 9- Thermal/NIR Micheldever to Reading

10/03/2022 23:50:59 GMT

00:50

🌙 Night

⬅ Backward

🔥 Thermal Hotspot

🔍

🎬

★

The screenshot shows a map application with a snapped route highlighted in green. The route starts near Swindon and Basingstoke, passing through Stockbridge. A purple dot is placed on the route near Stockbridge. The map interface includes a search bar at the top right, zoom controls on the left, and a legend at the bottom. The legend indicates that the green line represents the snapped route, and the purple dot represents a marker.

Info
Session Content
History
Marker Info

VIEWING

#107143

VIU 3- POD 11- 4k Micheldever to Reading

Rail Inspection

▼

ELR (ESTIMATE)

⚙️

ELR:

BML1

MILE:

60

CHAIN:

31

TRACK:

1500

Show more...

▼

SPEED, BEARING & ALTITUDE

0 MPH

North

96m

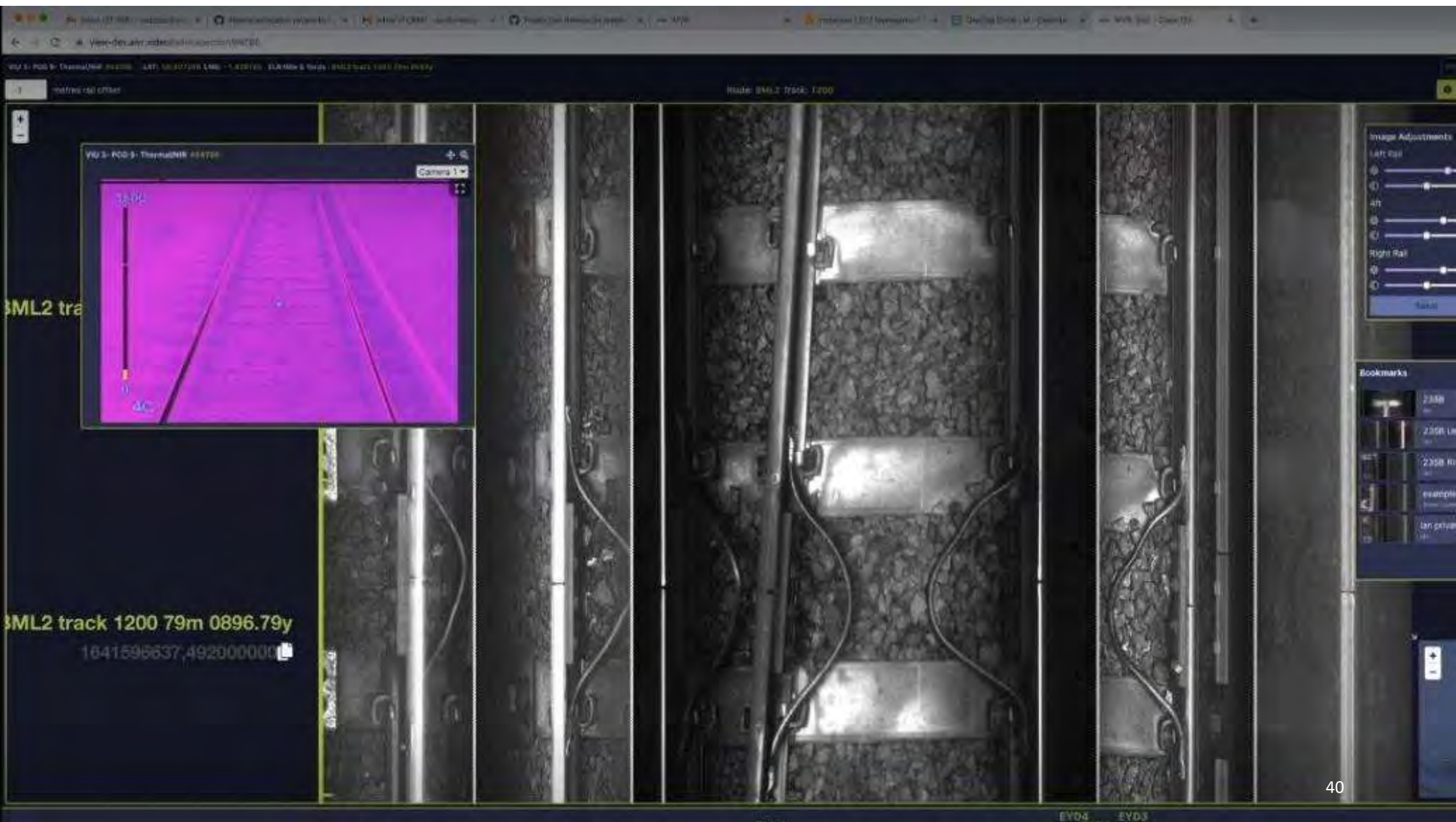
▼

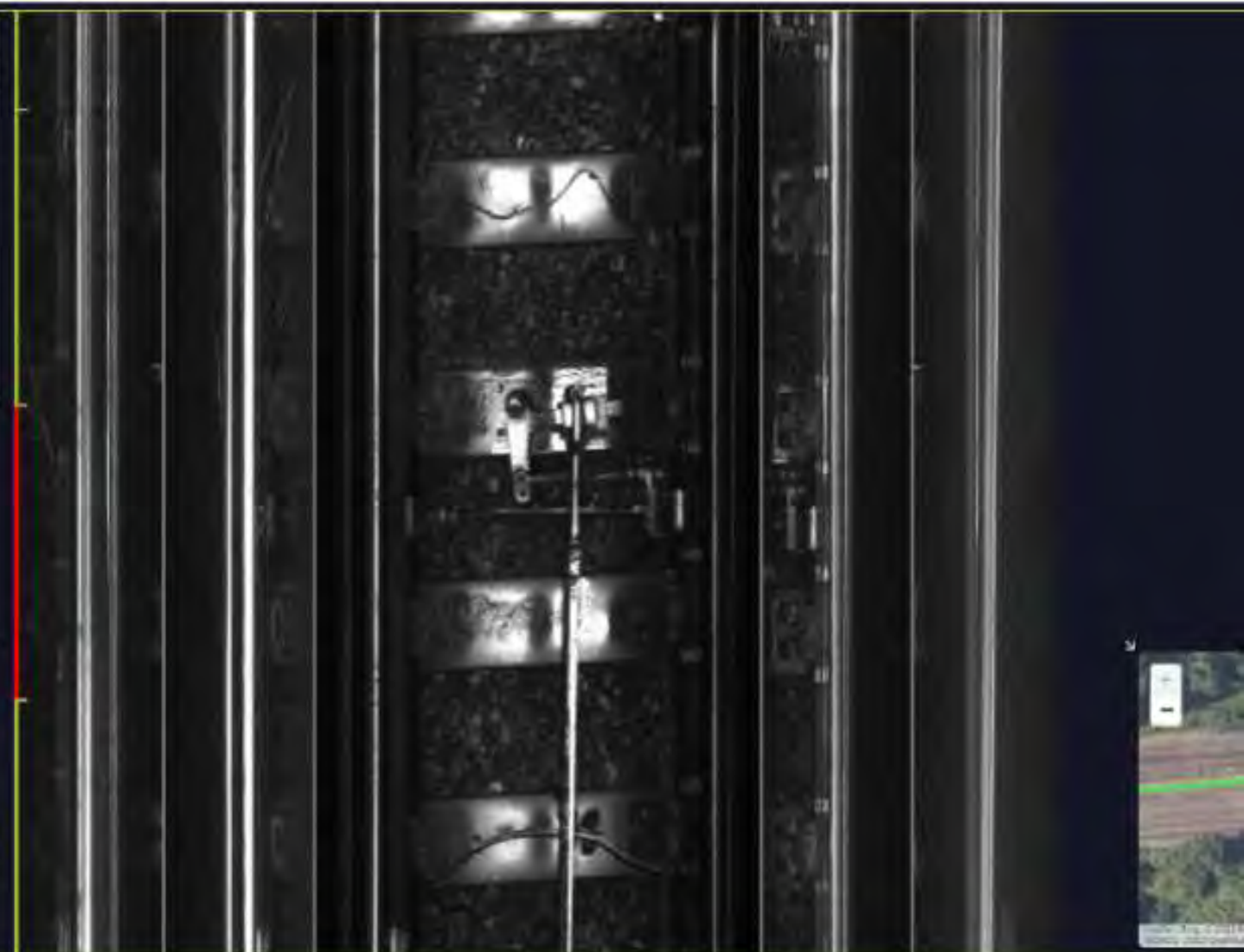
MARKERS

No Route Markers

▼

POSITION





Chrome File Edit View History Bookmarks Profiles Tab Window Help

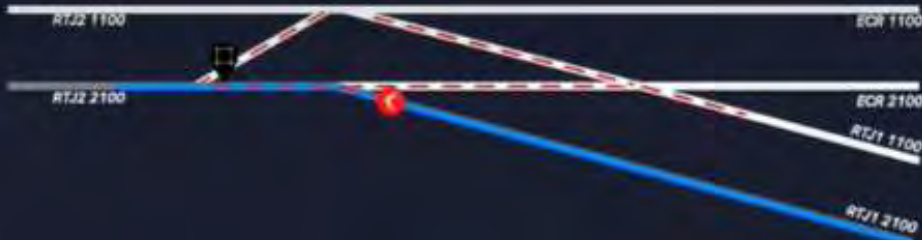
view.avr.video/control/30

ELR Mile & Chain RTJ1 track 2100 18.19 +1m

0% [Reset Progress](#)

Route Patrol Trial Interface - Please Try (VIU3)
16/02/2022 - 30/04/2022

[Start Inspection](#)



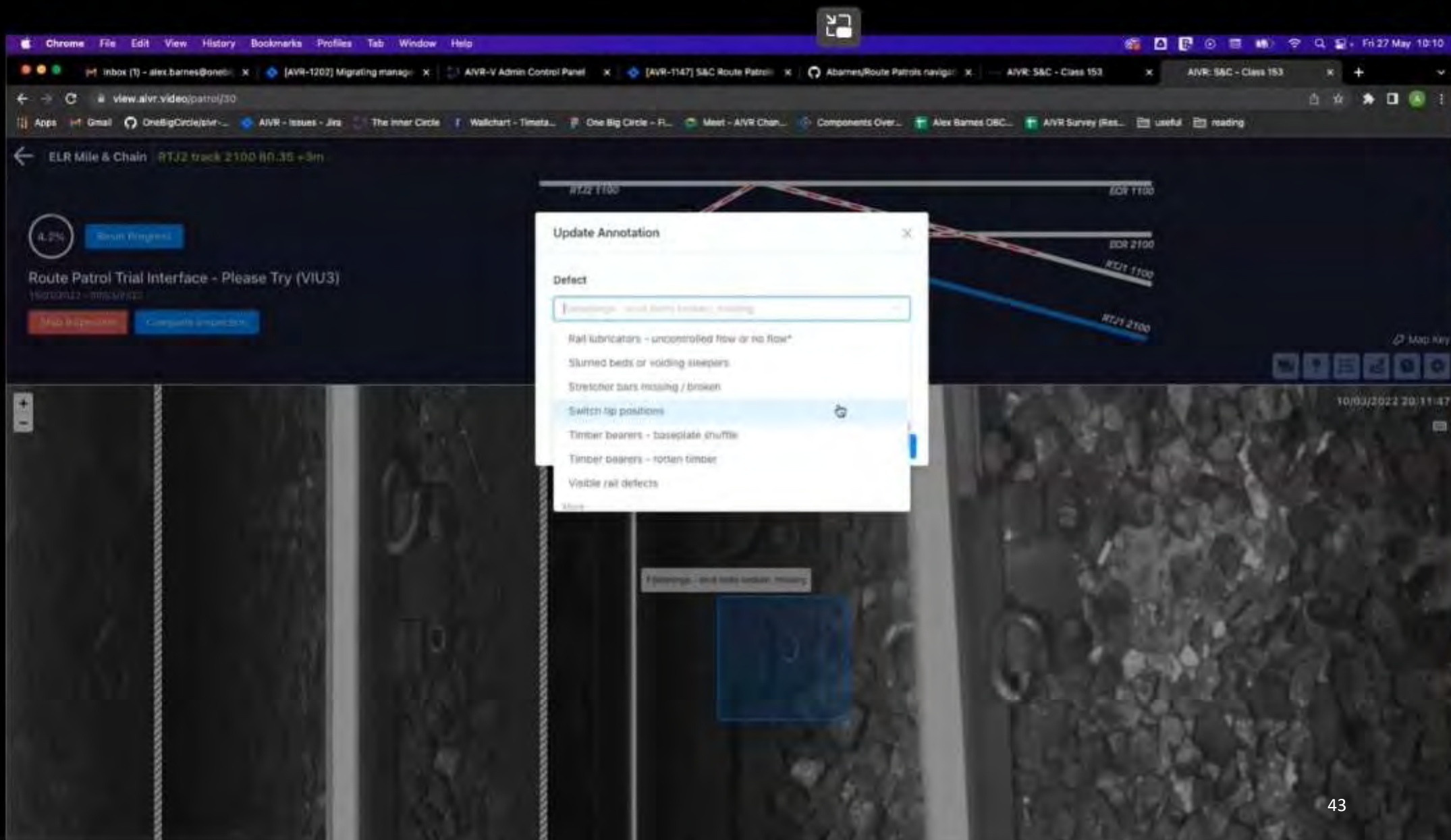
Map Key

10/03/2022 20:11:47

RTJ1 track 2100 18.19 +1m
164234371 43,980000000

RTJ1 track 2100 18.19 +2m
164234371 43,987000000

Play (Alt + K)



Basic Visual Inspection Report

5.1%

Patrol No. Patroller's Name Scheduled Date of Patrol Actual Date of Patrol

Coverage

RTJ2 2100 6433.05 - 6435.47 RTJ2 3700 6433.15 - 6435.67 ECR 2100 6432.15 - 6434.08 RTJ1 1100 1456.62 - 1458.55 RTJ1 2100 1456.46 - 1460.00

Defects

[Add Defect](#)

ELR	Track ID	Position	Defect Type	Description	Urgent	View	Delete
RTJ1	2100	18m 400.10y		Teal	☐	View	
RTJ2	2100	30m 775.62y	Brown Rail	Extra items	☐	View	

Was this patrol fully completed? ☐

[Cancel](#)

[Print Report](#)

R

R



Summary



Understanding the deterioration rate and failure modes and condition of asset so as to identify the most appropriate technologies to improve asset performance and reliability



Utilising in-service trains and appropriate recording and monitoring technologies; this will require working in collaboration with suppliers, universities and Train operating companies



Converting data into useful information that can be understood and utilised by end users and railway maintainers (that's the biggest challenge!)