

Multicoloured Measurement Trains - Developments in Unattended Geometry Measurement Systems (UGMS)

Steve Pearson

Simpler.
Better.
Greener.

Agenda

Particular differences between attended and unattended systems

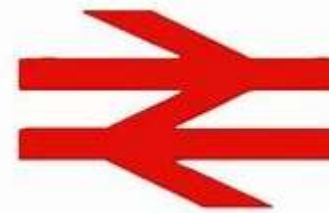
Validation process for a UGMS train

UGMS Implementation stages

Application and benefits to date

Emerging challenges

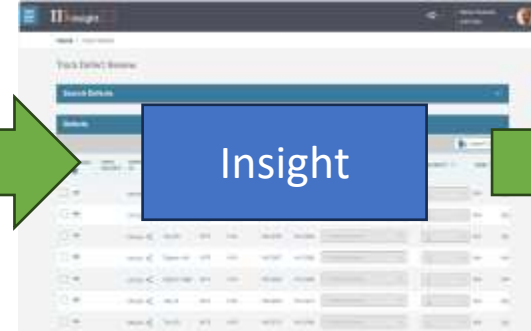
What's next?



Spot the trains..

Attended vs Unattended Geometry Measurement Systems

Attended



Attended vs Unattended Geometry Measurement Systems

Attended



**Immediate Action
Limit Faults**

Attended vs Unattended Geometry Measurement Systems

Attended



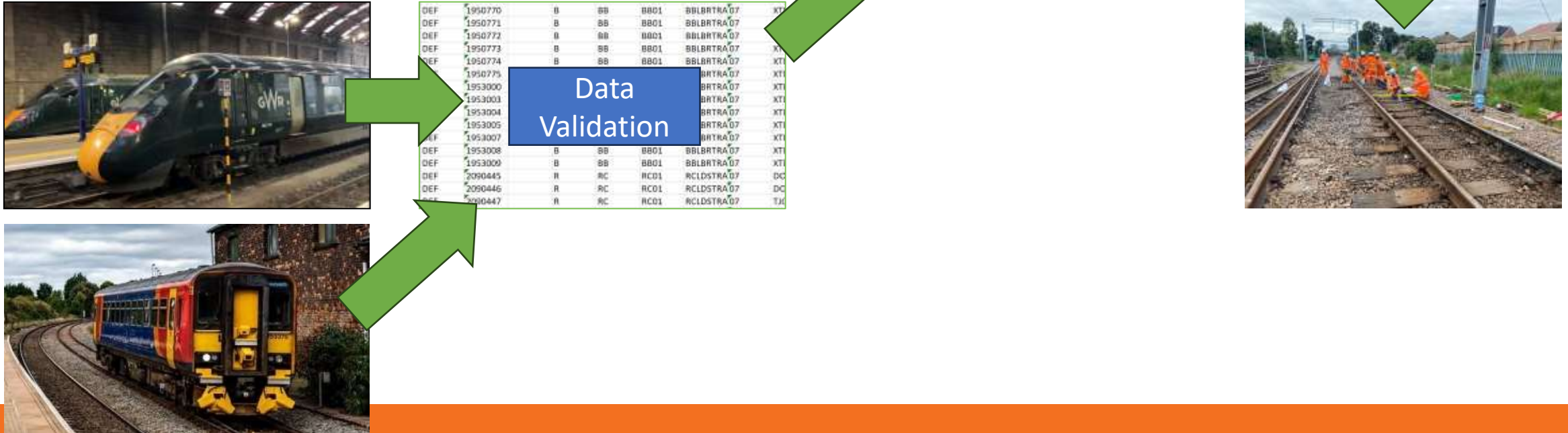
**Immediate Action
Limit Faults**

Attended vs Unattended Geometry Measurement Systems

Attended



Unattended



Train validation

Virtual test track including characteristics such as
Good and poor track, reverse curves, high cant, station or
slow section

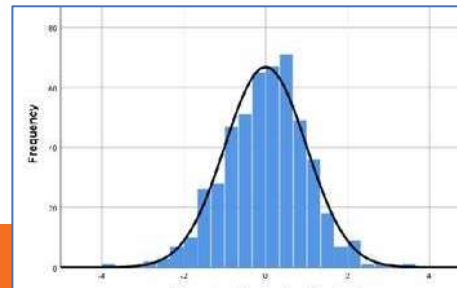
Train operation at different speeds, direction and orientation

Run on run comparison against NR calibrated 'yellow train',
statistical analysis

UGMS systems present future opportunity for continuous
assurance rather than annual calibration.



Photo credit – Avanti West Coast



Comparability

Comparability - Train A vs Train B vs Train C



<Direction; <Orientation; 20mph; Same Day; Day



<Direction; >Orientation; 30mph; Next Day; Night



<Direction; <Orientation: 40mph; Next Week; Day

Reproducibility

Reproducibility - Train A vs Train A vs Train A



<Direction; <Orientation; 20mph; Same Day; Day



<Direction; >Orientation; 30mph; Same Day; Night



<Direction; <Orientation: 40mph; Next Day; Day

Repeatability

Repeatability - Train A vs Train A vs Train A



<Direction; <Orientation; 20mph; Same Day; Day



<Direction; <Orientation; 20mph; Same Day; Day



<Direction; <Orientation; 20mph; Same Day; Day

Three UGMS implementation stages

Stage 1

Ad hoc or targeted application to specific sites, complementing planned 'yellow train' Infrastructure Monitoring

Stage 2

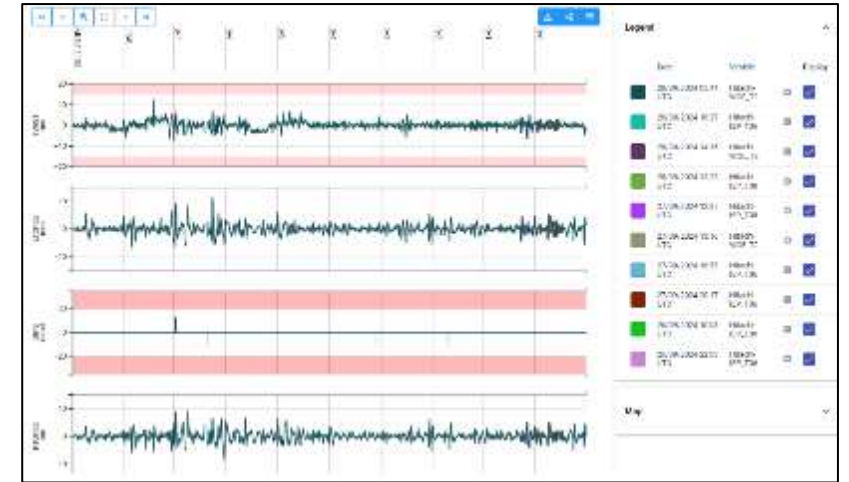
Infill or additional recordings to supplement or replace planned 'yellow train' Infrastructure Monitoring

Stage 3

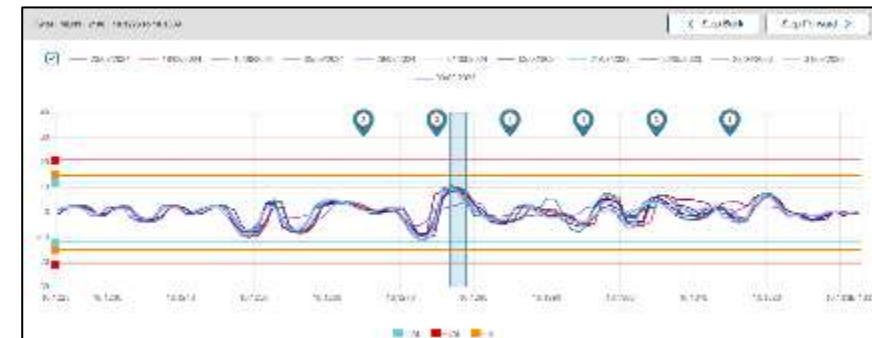
Next generation Risk Based Maintenance through the Insight tool, taking advantage of high frequency recording to improve forecasting accuracy.



Photo credit – Nelso Silva



Example UGMS visualisation system



Network Rail Insight tool

UGMS Stage 1 application and benefits

Validation of cyclic top repairs allowing earlier removal of mitigating speed restrictions (TR116863 against NR/TRK/L2/038)

Verifying resilience of other repairs and maintenance activity

Incident investigation e.g. bump reports, broken rail/fishplates or identifying risk

Feedback on renewals sites including assurance for higher speed opening

Evidence to support temporary variations such as a mitigation for lost recordings

Soil Moisture Deficit mitigation

Non track assets including embankment risk or underbridge/culvert faults



Photo credit – Merseyrail

Emerging challenges (1)

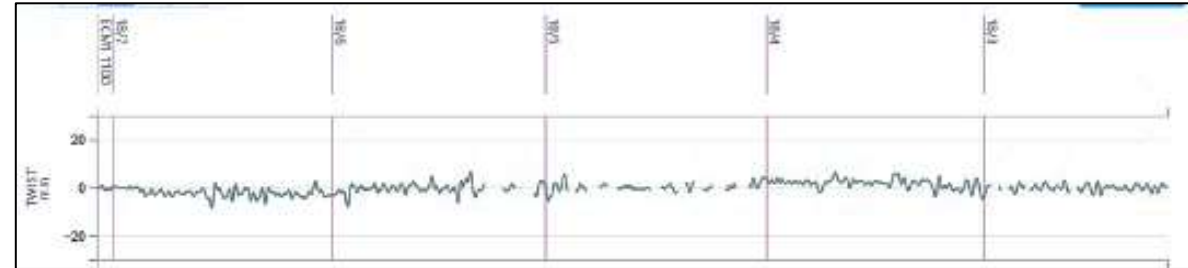
Data drop out – constructing a “Frankenstein file”.

Various reasons for drop out including

- Slow recording speed
- Data transmission
- Dirty UGMS sensors



Photo credit – LNER



		Location															
Train 01		From	00000	00200	00400	00600	00800	01000	01200	01400	01600	01800	02000	02200	02400	02600	02800
Run	Train	To	00200	00400	00600	00800	01000	01200	01400	01600	01800	02000	02200	02400	02600	02800	03000
1	T01	06:00	86	88	84	75	60		85	84	90	85			87	87	85
2	T01	09:00		89	88		76	86	77	86	85				88	85	
3	T01	12:00		85	85				86	85	88			83	84		
T01 Frankenstein			86	89	88			86	86	86	90	85		83	87	87	85

		Location															
Train 02		From	00000	01000	02000	03000	04000	05000	06000	07000	08000	09000	10000	11000	12000	13000	14000
Run	Train	To	01000	02000	03000	04000	05000	06000	07000	08000	09000	10000	11000	12000	13000	14000	15000
1	T02	07:00	84	89	90	89	72		55	72	68	84			88	86	85
2	T02	11:00	83	87							70	68		87	85	85	84
3	T02	14:00		88	85	79	80			83	77				85	85	85
T02 Frankenstein			84	89	90	80	80			83		84		87	88	86	86

		Location															
Frankenstein		From	00000	01000	02000	03000	04000	05000	06000	07000	08000	09000	10000	11000	12000	13000	14000
			01000	02000	03000	04000	05000	06000	07000	08000	09000	10000	11000	12000	13000	14000	15000
			86	89	90	80	80	86	86	86	90	85		87	88	87	86

Quality Categories

- ■ Good quality data - Meets all validation criteria
- ■ Suspect quality - Partially meets criteria but requires caution
- ■ Unusable quality - Fails validation criteria
- ■ No recording data - Gaps in measurement
- ■ Frankenstein data - Composite data from multiple runs

Emerging challenges (2)

P-F curve sensitivity and forecasting accuracy



Cyclic top prediction accuracy, including weather effects.

Traditional systems rely on threshold-based detection, which often miss evolving patterns and leads to sudden risk transitions.

4 to 6 readings per month optimum?

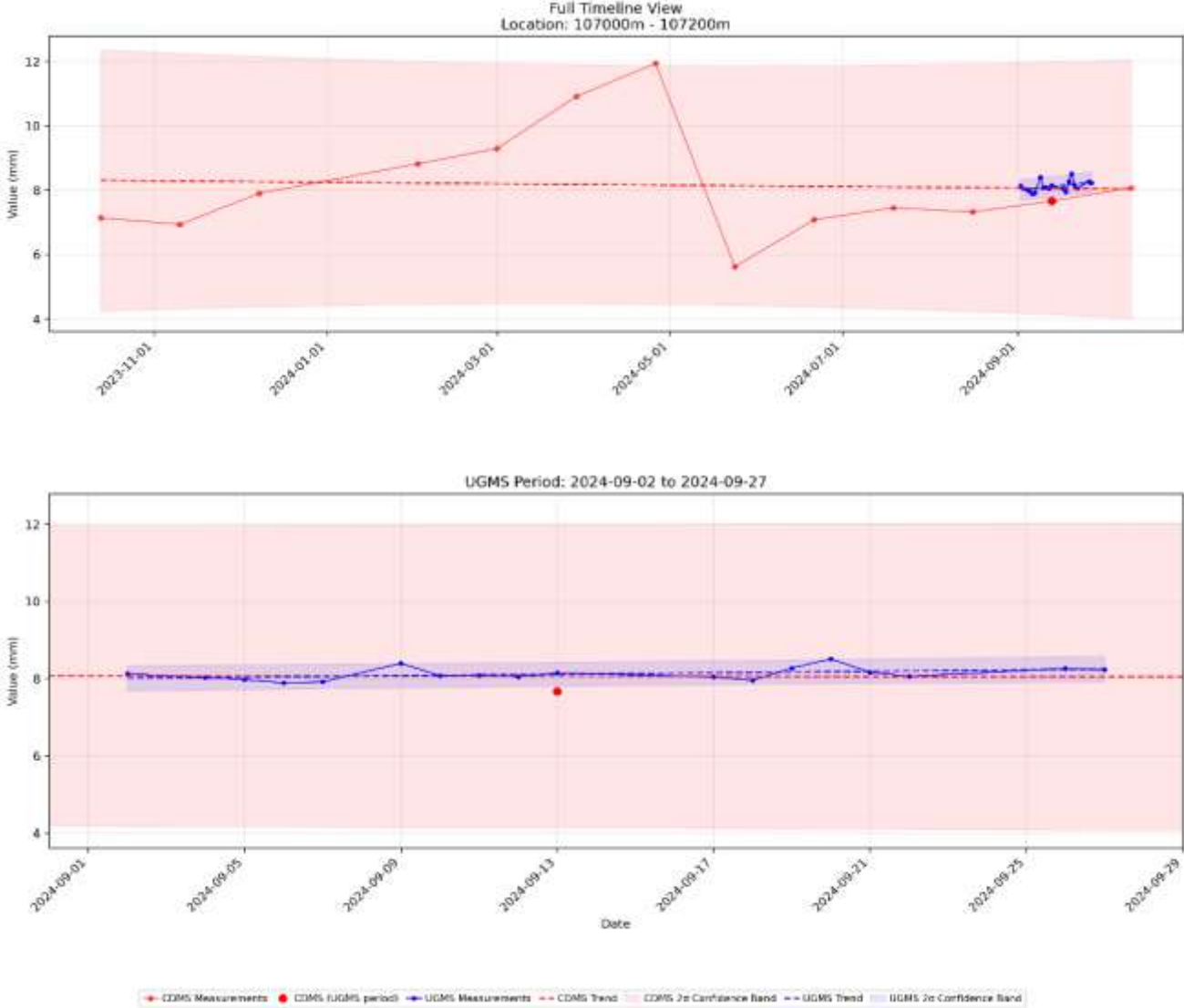
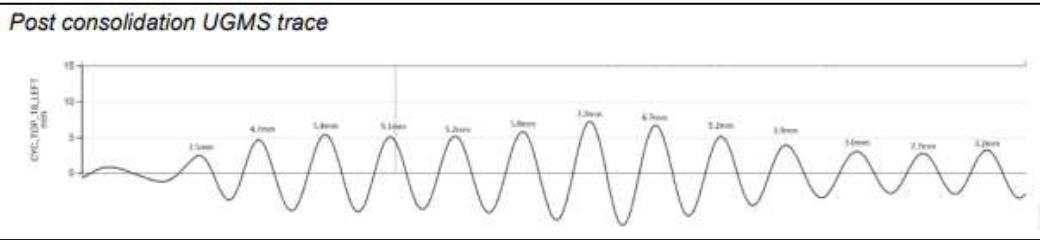


Photo credit – Avanti West Coast
A simpler, better, greener railway.

What's next?

Continue with planned fitments to Class 80Xs on Eastern, TPE and Wales & Western

Refine operation and maintenance regimes

Establish data flows and governance

Develop Stage 1 use cases

Exploit complementary benefits such as acceleration data

Prove the engineering for core application

Develop the business case



Photo credit - Alex6nt via Wikimedia Commons

What's next?

System Safety

Reminder that current compliant track recording has an on board technician who can immediately report urgent faults needing safety critical interventions

Five variations affecting two track standards to facilitate trial for NR UGMS data processing and management to –

- Verify turnaround of data (processing and distribution)
- Test resource demand or alternative methods
- Evidence the business case

Application of Common Safety Method

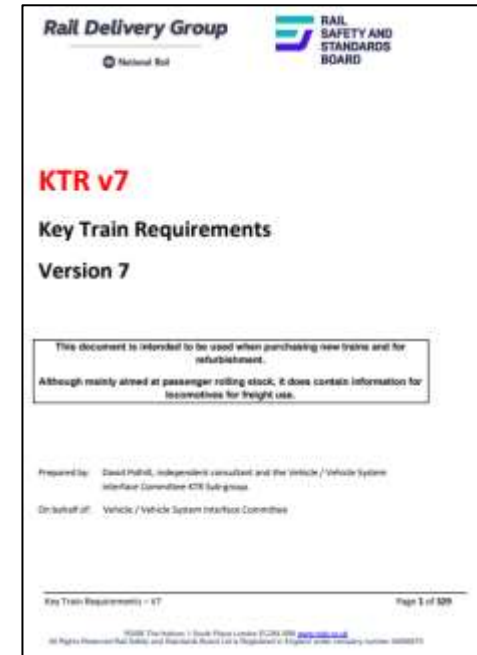


What's next?

Outlook

'Key Train Requirements' published by Rail Delivery Group, RSSB and DfT
Train Technical Specification include provision of UGMS

NR tendering of Infrastructure Monitoring includes provision for In Service Monitoring.



UGMS. The Future's Bright. The Future's Multicoloured..