

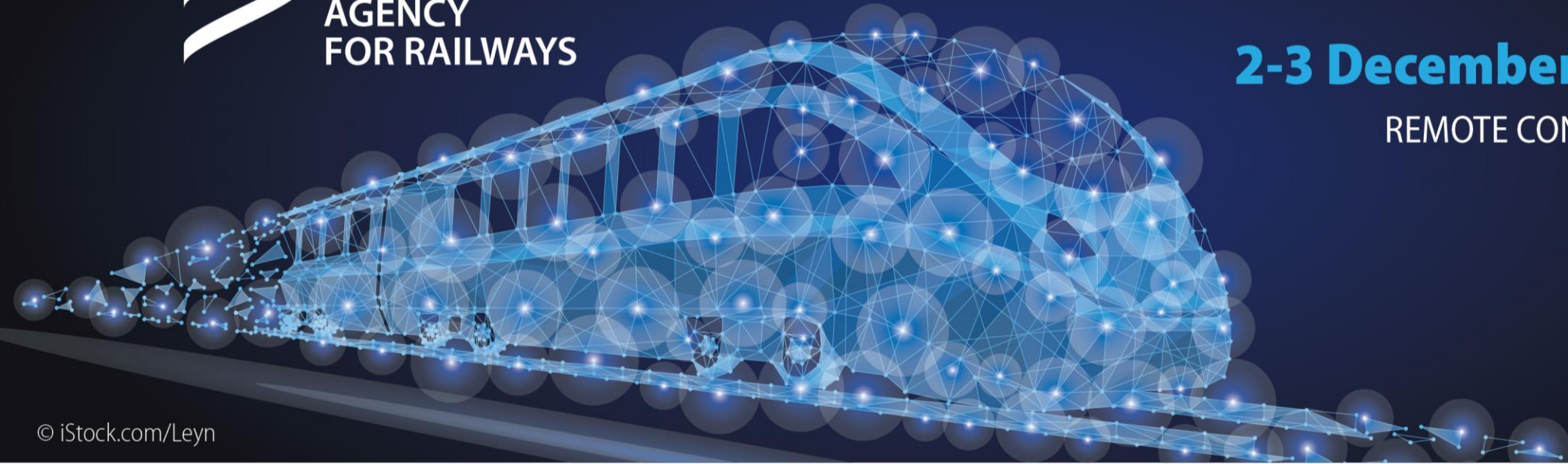


EUROPEAN
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Integration of Human and Organisational Factors in Railway Automation

2-3 December 2020

REMOTE CONFERENCE



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Railway automation: Learning from incidents

Dr Mark Young, NIB UK

RAILWAY AUTOMATION: LEARNING FROM INCIDENTS

Dr Mark Young

Rail Accident Investigation Branch, UK



Rail Accident Investigation Branch

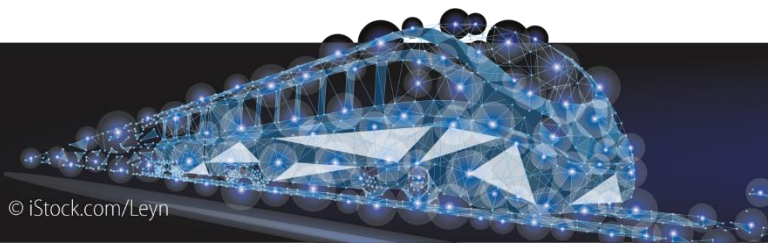
Integration of Human and Organisational Factors in Railway Automation

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Dr Mark Young, Rail Accident Investigation Branch, UK

Mark Young is an Inspector with the Rail Accident Investigation Branch (RAIB) and leads the Branch's work on human factors. Before joining RAIB in 2012, he worked in academia, researching and teaching in human factors, with a focus on transport safety and vehicle automation. Mark has around 25 years' experience working in human factors, and holds a degree in Psychology and a PhD in Human Factors, both from the University of Southampton. He is also a Visiting Professor at Loughborough University's Design School.





Rail Accident Investigation Branch

Railway automation: Learning from incidents

Integration of HOF in railway automation remote conference

Mark Young

Inspector, RAIB

3 December 2020

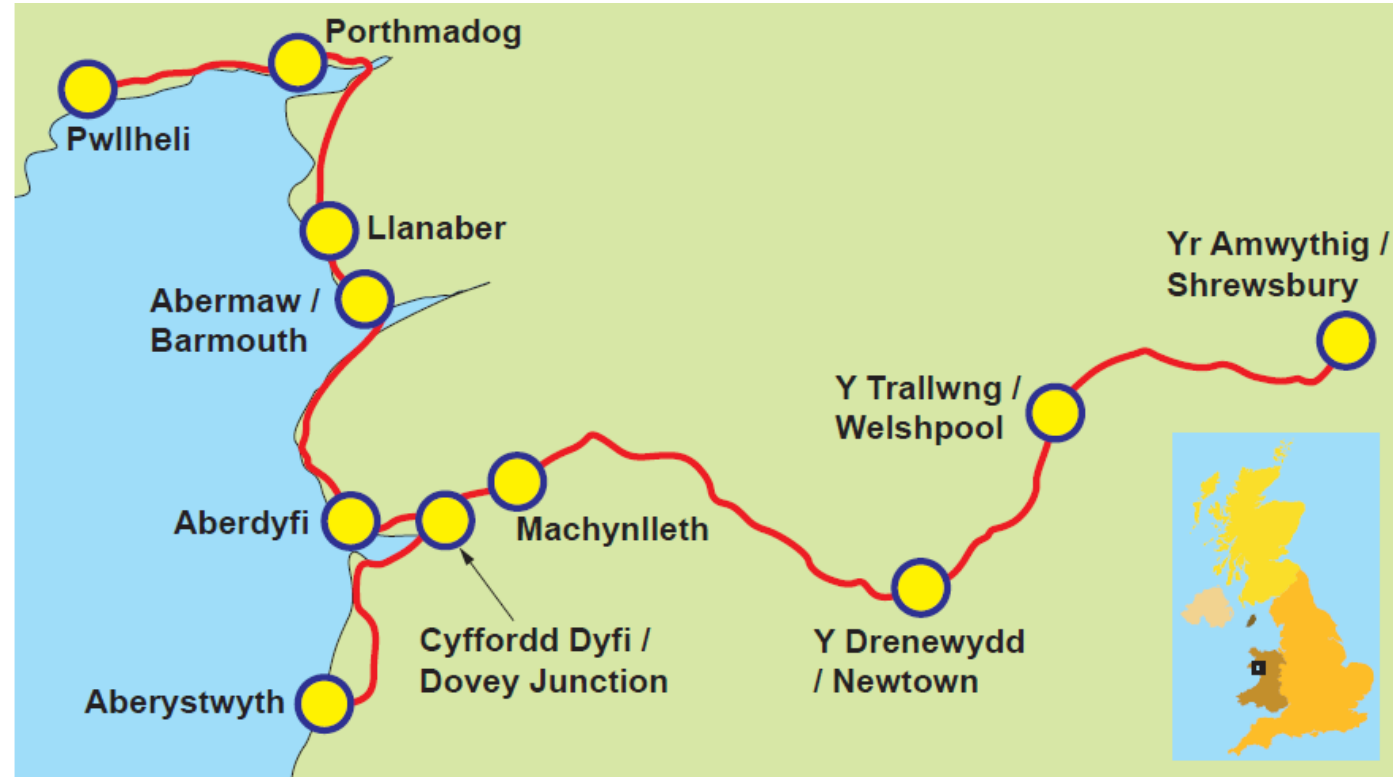
Background

- Rapid growth in railway automation
 - ATO and driverless common on metro
 - One article¹ suggested widespread driverless operation on mainline is realistic between 2030 and 2040
- Automation promises many benefits, but these are not always realised – and it sometimes causes new problems
- IEC 62267 defines Grades of Automation (GOA):
 - Grade 0: on-sight train operation
 - Grade 1: Non-automated (speed supervision)
 - Grade 2: Semi-automated (controls driving)
 - Grade 3: Driverless (prevents collisions)
 - Grade 4: Unattended
- The balance of control shifts to the system at Grade 2
- Until Grade 4, humans still play some part in monitoring the system or taking over manual control if necessary

¹Jones, B. (2017). Automated operation is approaching... . *Rail*, 883, 58-59.

ERTMS on the Cambrian lines

- Shrewsbury to Dovey Junction and Aberystwyth (Cambrian Main Line) / Pwllheli (Cambrian Coast Line)
- Controlled from Machynlleth
- Pilot ERTMS scheme for GB mainline network; commissioned in March 2011



Source: RAIB (2019)

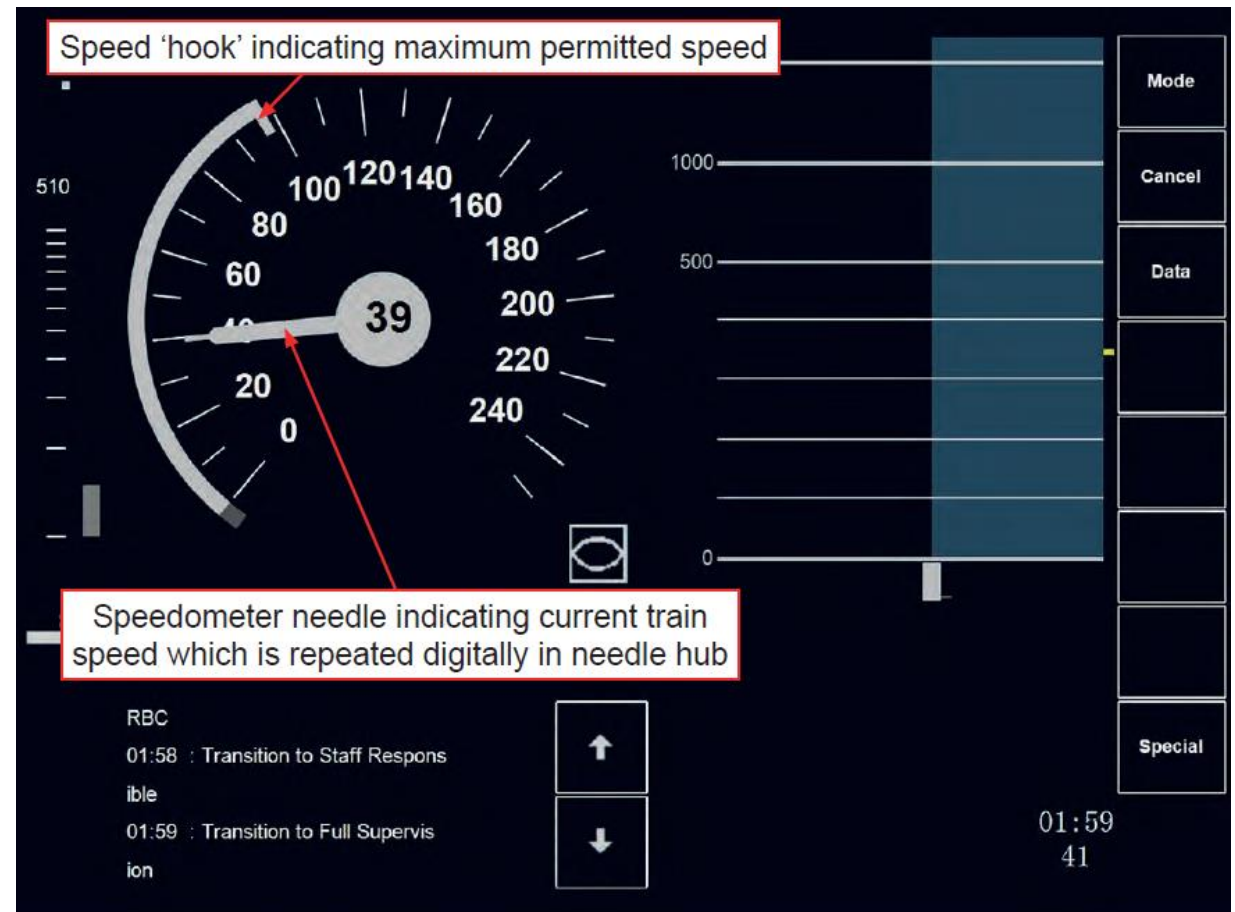
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 - Some trackside signs (marker boards, speed signs for degraded modes)



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 - Speed and movement authority on the DMI (sent as radio messages from control centre)



Source: RAIB (2019)

Case study: Llanbadarn, 19 June 2011

- Train ran on to a level crossing with the barriers raised
- Crossing is automatic – the train strikes-in to activate the crossing sequence
- Crossing is 'locally monitored' – the driver has to check a signal to ensure the crossing is operating correctly



Source: RAIB (2012)

Case study: Llanbadarn, 19 June 2011

- Train ran on to a level crossing with the barriers raised
- Crossing is automatic – the train strikes-in to activate the crossing sequence
- Crossing is ‘locally monitored’ – the driver has to check a signal to ensure the crossing is operating correctly
- Driver presses a plunger at Aberystwyth station to get priority over the nearby heritage rail crossing (10-minute timer)
- ETCS monitors speed and warns of approaching crossing, but no other protection; driver must still check the signal and a movement authority can be granted even if the crossing is open



Source: RAIB (2012)

Case study: Llanbadarn, 19 June 2011

- Train was running late and departed Aberystwyth in SR mode (problems changing ends)
- 10-minute timer had expired by the time the train approached, so crossing did not activate
- Driver was monitoring DMI as it transitioned to FS mode, and also closely watching the speed
- Driver did not notice the signal until it was too late to stop



Source: RAIB (2012)

Case study: Llanbadarn, 19 June 2011

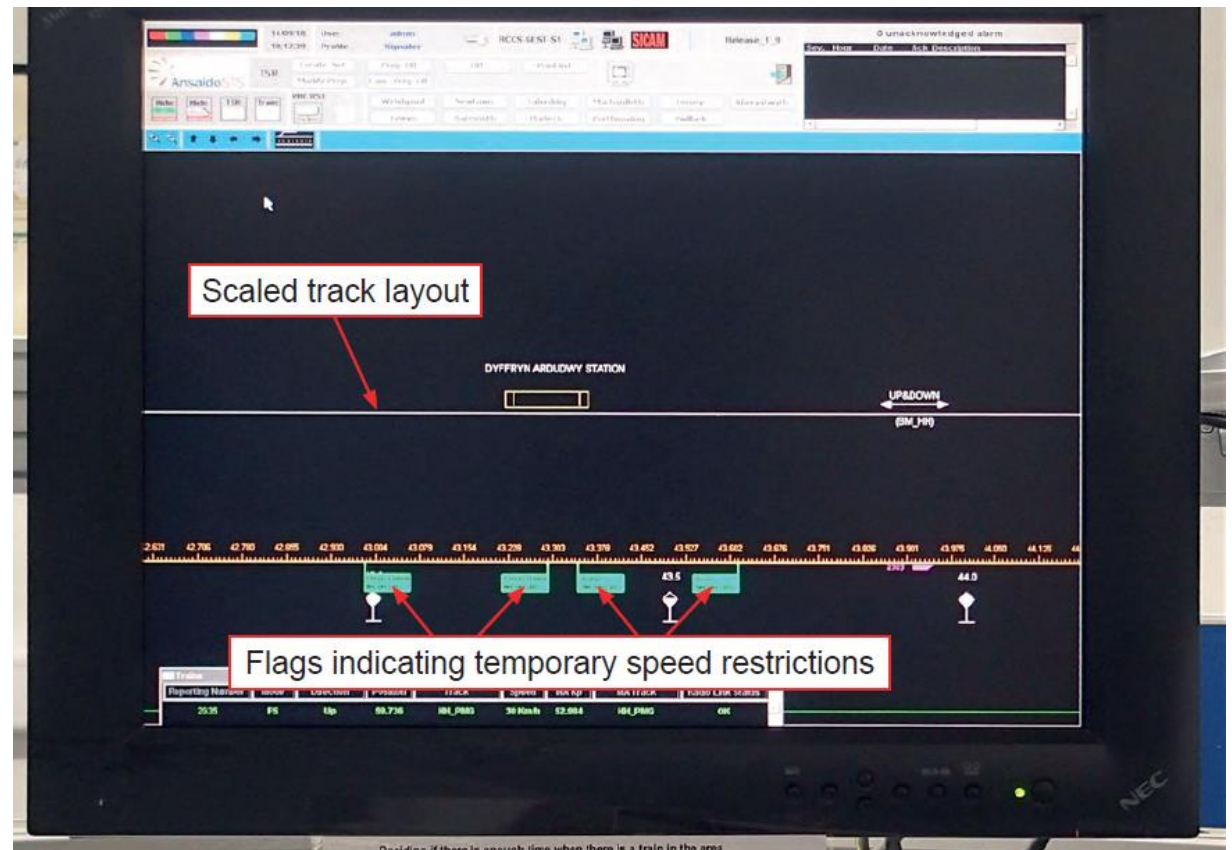
- Causal factor: driver workload
 - Driver's attention was focused on DMI; higher demand of SR departure
- Underlying factor: No interface between ETCS and Cambrian automatic crossings
 - Costs deemed to outweigh benefits
 - No HF analysis in risk assessments
- Recommendations:
 - Engineered safeguards to reduce risk of ERTMS trains passing over automatic crossings (including HF risk assessment)
 - HF analysis and risk assessment of workload departing Aberystwyth



Source: RAIB (2012)

Case study: Cambrian Coast line, 20 October 2017

- Loss of safety-critical signalling data (temporary speed restrictions)
- TSR data was not uploaded during an automated overnight computer restart, due to a database fault
- But signallers' display incorrectly showed the restrictions as being loaded, because it was holding previous data
- Investigation focused on software design, validation and acceptance
- However, the incident highlights users' (drivers and signallers) trust in, and mental models of, systems



Source: RAIB (2019)

Case study: Cambrian Coast line, 20 October 2017

- Thron (2020) MSc thesis examined this incident using STAMP
- Noted that the observation skills of signallers can be an asset to system resilience in noticing detail problems
- But there have been few studies focusing on how signallers, due to their central role in this complex system, are most impacted by automation
- There is also a need to understand whether rapid digitisation of railways raises new sociotechnical risks (ie, not just individual performance)



Source: RAIB (2019)

Case study: Notting Hill Gate (London Underground), 31 January 2018

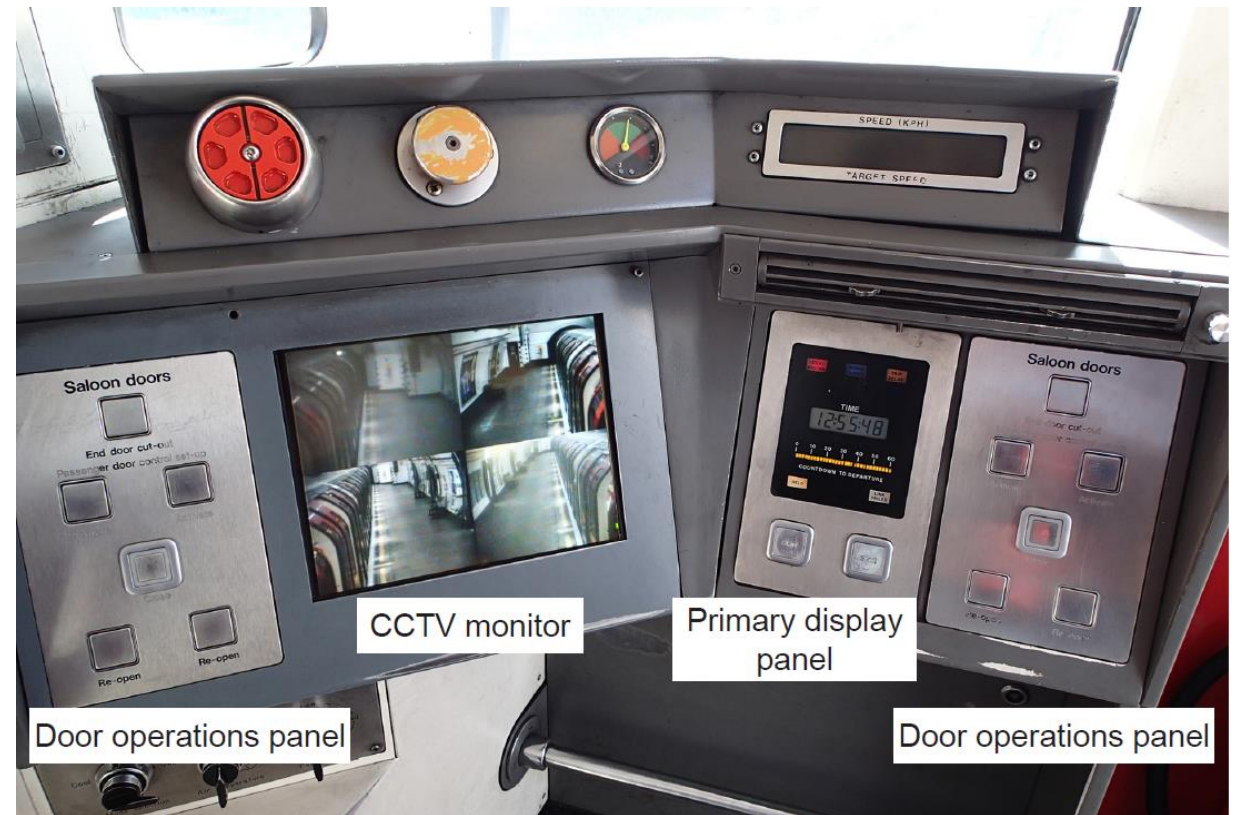
- Passenger's shopping bag became trapped in the closing train doors as she attempted to board
- Passenger was dragged 75m along platform and 15m into tunnel at speeds up to 35km/h, suffering serious injuries
- Emergency brakes applied about 10s after train started moving



Source: RAIB (2018)

Case study: Notting Hill Gate (London Underground), 31 January 2018

- Train is controlled by ATO; train operator is responsible for station duties (including doors) and starting the train
- Train operator scans platform-train interface using in-cab CCTV monitor
- Instruments also include a countdown indicator and door interlock light
- Train operator did not perceive the passenger on CCTV because:
 - Low task workload / repetitive actions leading to automatic responding
 - Some reliance on interlock light / countdown
 - Inattention blindness in visual search for rare targets



Source: RAIB (2018)

Case study: Notting Hill Gate (London Underground), 31 January 2018

- Conspicuity of the image



Source: RAIB (2018)

Case study: Notting Hill Gate (London Underground), 31 January 2018

- Conspicuity of the image
 - Possible obscuration



Source: RAIB (2018)

Case study: Notting Hill Gate (London Underground), 31 January 2018

- Conspicuity of the image
 - Possible obscuration
- Underlying factor: training
 - Visual scanning / divided attention
 - Awareness of interlock limitations
 - Vigilance and non-technical skills
- Investigation recommended implementing task design strategies to help maintain attention and awareness (eg interspersing periods of manual driving)



Source: RAIB (2018)

Lessons learned

- Automation is not a panacea for ‘human error’; it can create new problems
- The implementation of automation should consider the impacts on the user from the outset (human-centred design)
 - Mental models
 - Trust / reliance
 - Workload
- This issues should be designed out where possible, and supported with training
- Automation adds complexity to an already complex system, with unanticipated consequences



Source: RAIB (2018)

Q & A

In the next 20 minutes Mark will reply live to your questions.

- You may wish to write your question in the Teams Live chat, or
- Receive a detailed reply after this conference: use the link provided on the event webpage.

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