ARTHUR D LITTLE

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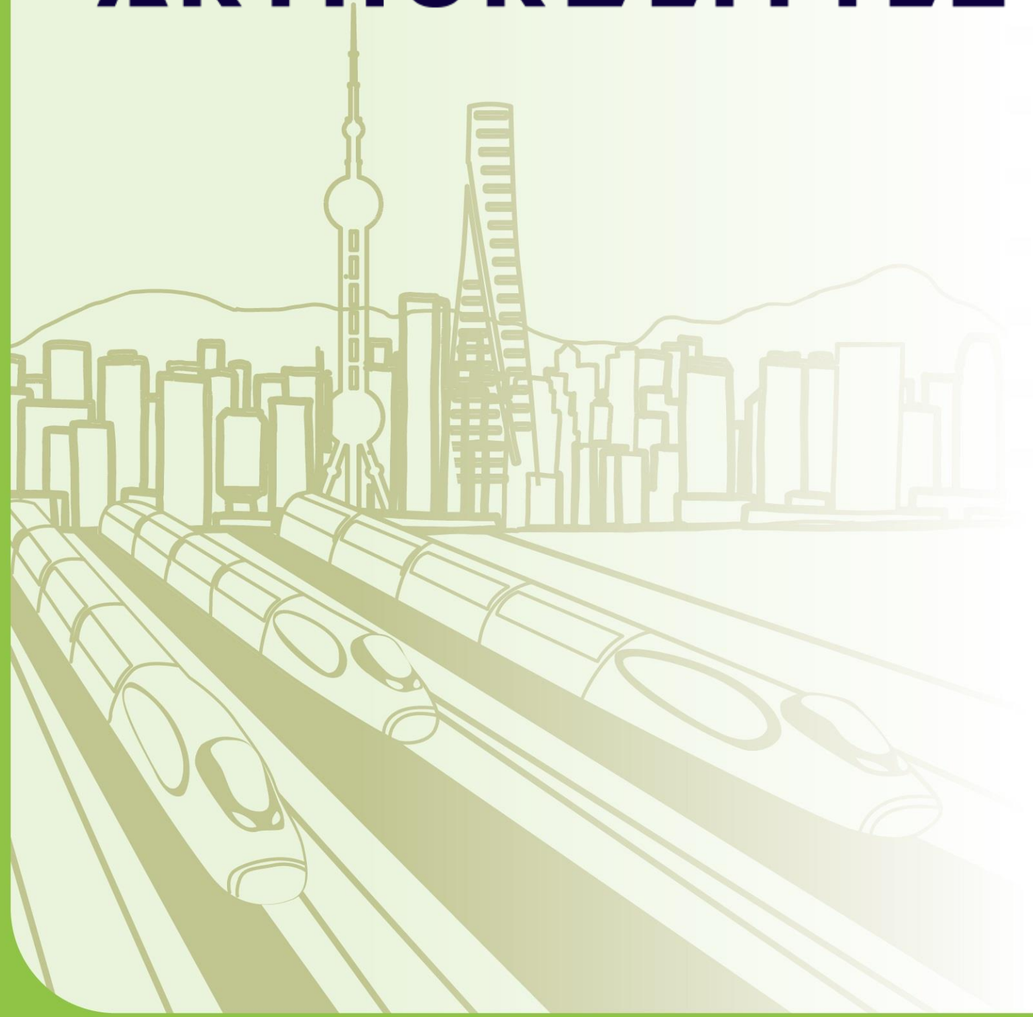


IRSC 2025

Advancing Railway Safety through Innovations and Collaborations

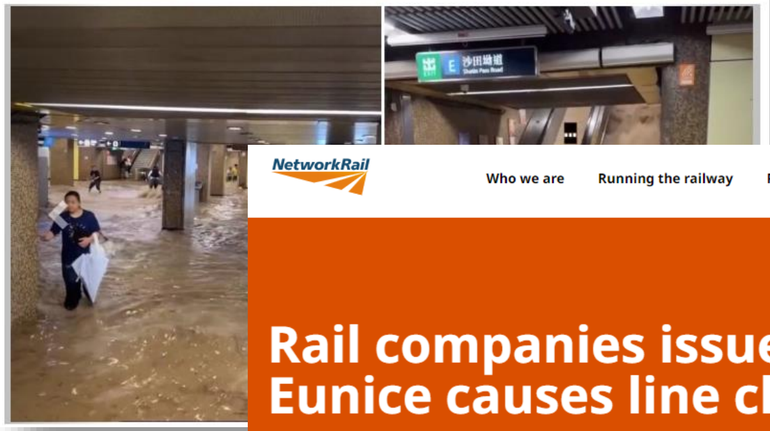
Hong Kong, China 25th - 30th November 2025

Risk Targeted Speed Restrictions

Marcus Beard
Partner
Arthur D Little

(Video) HK hit with record-breaking rainfall in 139 years, traffic halts as roads turn into rivers

Local | 8 Sep 2023 1:28 am



Network Rail doubles spending on adapting to climate risks

Rail owner admits that vital infrastructure will deteriorate over 2024-29 despite new investments

NetworkRail

Who we are | Running the railway | Putting passengers first | Communities | Industry & commercial | Media | Search

Rail companies issue 'do not travel' warning as storm Eunice causes line closures

Transport systems are facing severe and increasing threats from **extreme weather**...

Carmont derailment 2020

3 fatalities

Prosecution of Network Rail and fine of £6.7M

“Failed to inform the driver it was unsafe”

“Failures in construction, inspection + maintenance”

How to manage **safety risk** while keeping the railway moving … affordably?

170,000 earthwork assets

+

10s of millions of trees

- Network Rail investing £500M on mitigating extreme weather events to 2024, with more to come
- Weather-related delay cost in GB railways
  £45M / yr → £ 100M yr → £XXX?
- Emergency weather meetings often apply a **blanket speed restriction** to reduce safety risk….

…but leads to **massive disruption to trains + £Millions**

Gale-force winds can blow trees onto railway
DERAILMENT. DISRUPTION

GUSTO: a web-based decision support tool (GUSTO) developed by ADL + Network Rail:

- Enhance ***operational resilience*** in the face of climate change
- Using ***robust analytics*** in determining the optimal operational response
- ***Balance safety, operational*** and ***cost***

GUSTO

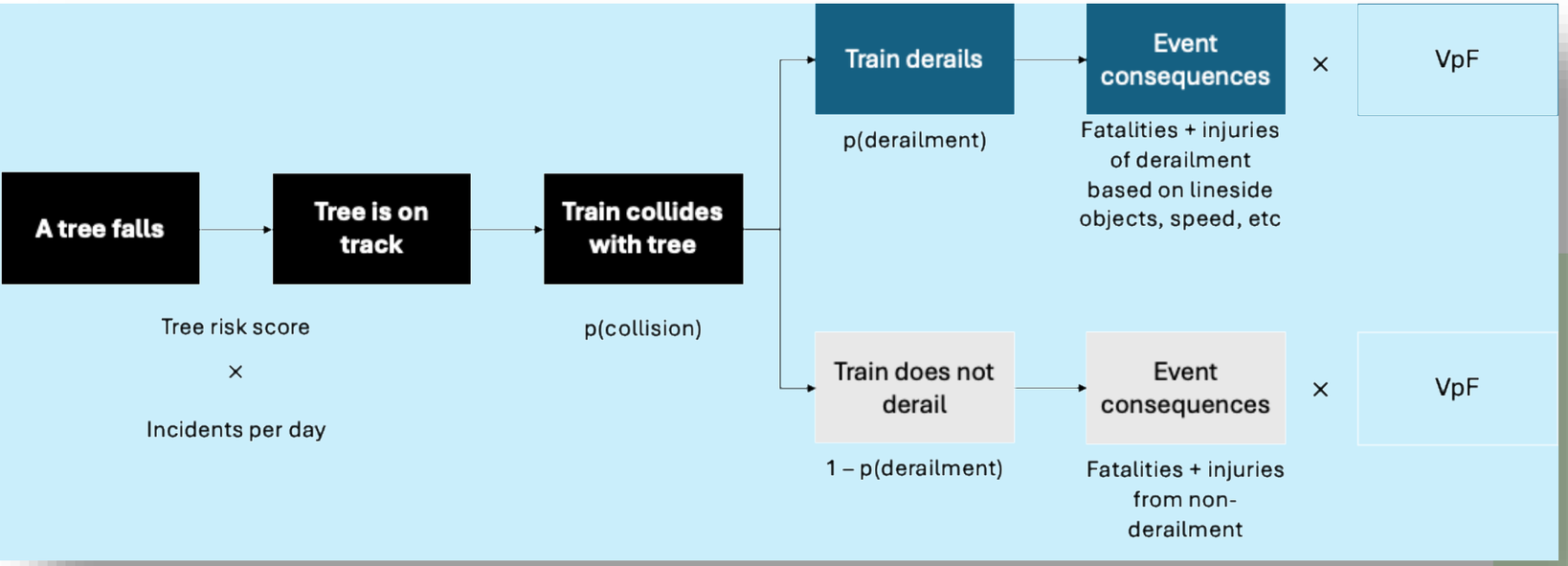
APPROACH

- Web-based risk tool – models gale force winds causing treefalls leading to train accidents
- INPUTS: weather forecast information
- DATA: trees + characteristics, train timetable, operations, lineside assets
- MODEL: tree fall and derailment engine, delay costs

OUTCOME

- Simple web tool and downloadable speed plans
- Suggests speed restrictions targeted on high-risk track sections
- Saving $MILLIONS in train delays when storms hit

The model (super simplified)



- **Train** timetables, train data
- **Derailment** model – includes lineside objects, numbers of tracks
- **Millions of trees** – (geometry, location) scanned by LIDAR
- **Costs** from delays (socio-economic, performance penalties)

GUSTO (Gales - Use of Speed-restrictions Targeted to Operational risk)

An augmented decision support tool for use in assessing the reasonable practicability of applying operational restrictions in the event of adverse wind conditions.

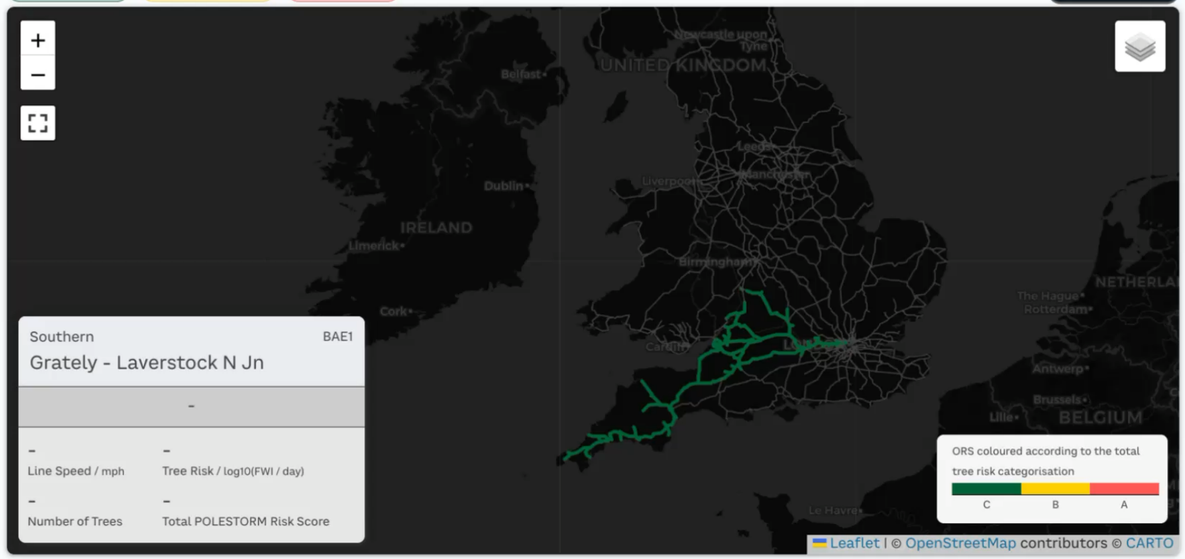
Wind

Rain

Info

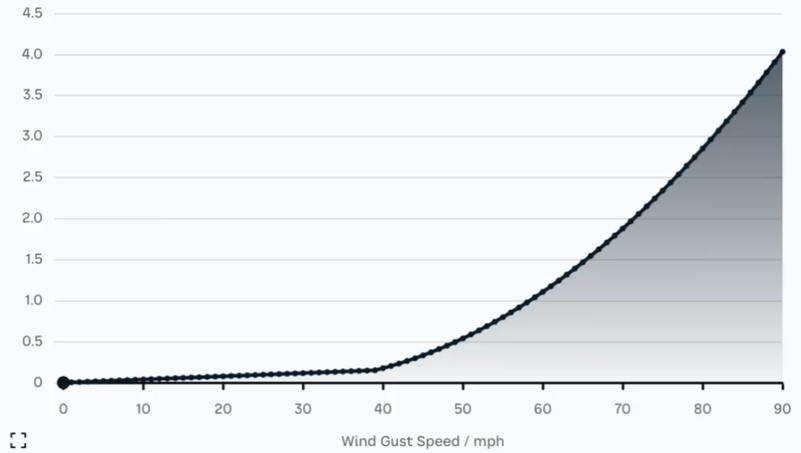
175 Low Risk / C | 0 Medium Risk / B | 0 High Risk / A

Drilldown



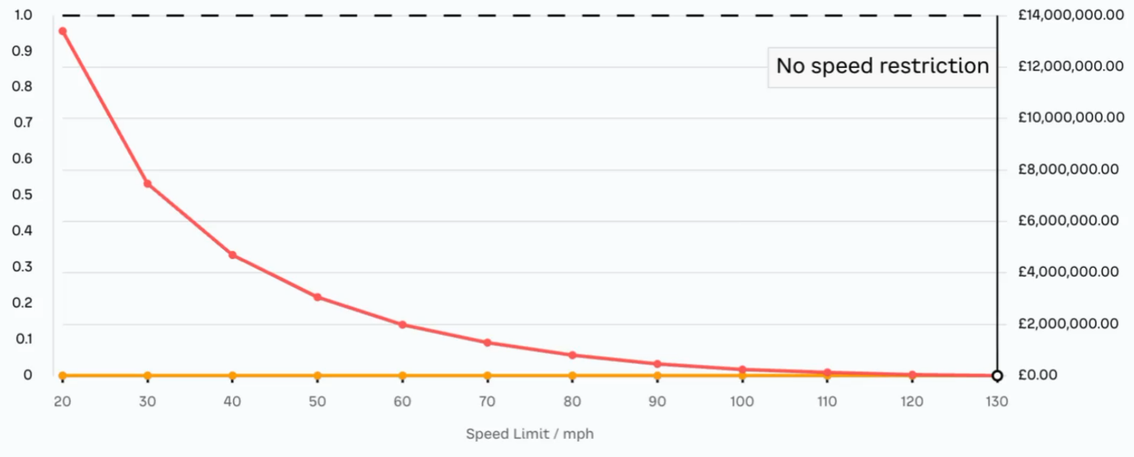
Wind Incidents

Tree failure incidents per day under wind gust conditions



Performance Cost-Benefit

Cost-Benefit analysis of applying speed restrictions



Operator	Service Group ID	Service Group	Performance Value / £ per min	Traffic Proporti
GWR	EF02	London - South Wales	333.36	1
Elizabeth line	EX99	All NR Infra ECS Moves	0	0
Elizabeth line	EX85	All Passenger Services on RfL Infra Only	0	0
Elizabeth line	EX97	All RfL Infra ECS Moves	0	0
Greater Anglia	EB04	Anglia Inter City	75.17	0
Greater Anglia	EB04	Anglia Inter City	75.17	0

1 2 3 4 5 ... 17

Parameters

Colour map by...
Tree & Debris Risk Category

Risk

Line Speed / mph
20 — 130

Wind Gust Speed / mph
0

Wind Direction
SW

Performance

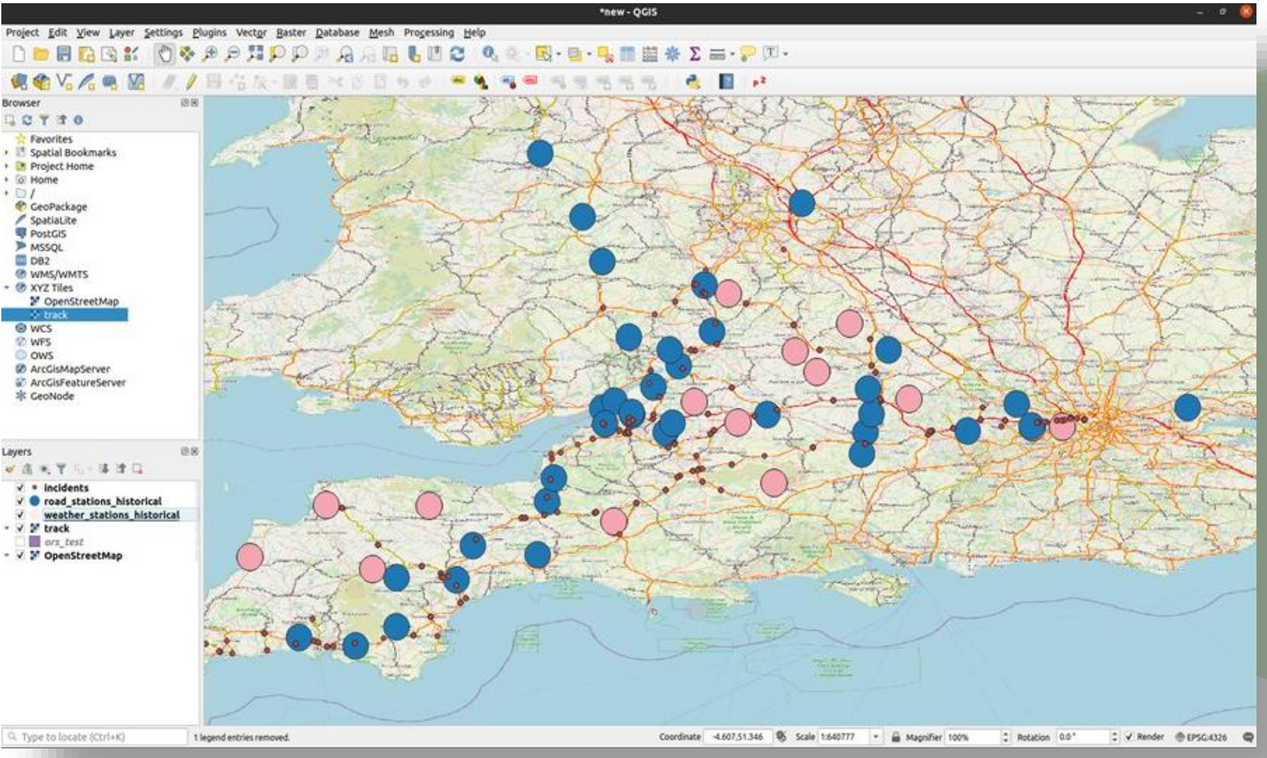
Edit Service Groups

Operational Route Sections
NO PERSR Abbotswoo...
Filton West Jnc - Ha...
+ 169 ...

Restriction Duration / hrs
3

Include Wider Economic Impact

Model built from '**big data sets**' for weather, past incidents, assets & operations



- Model maps past incident data and historical weather station recordings to geospatial coordinates
- 5 years of delay and incident data
- 5 years of weather data from 100+ weather stations
- 50 million wind speed data points

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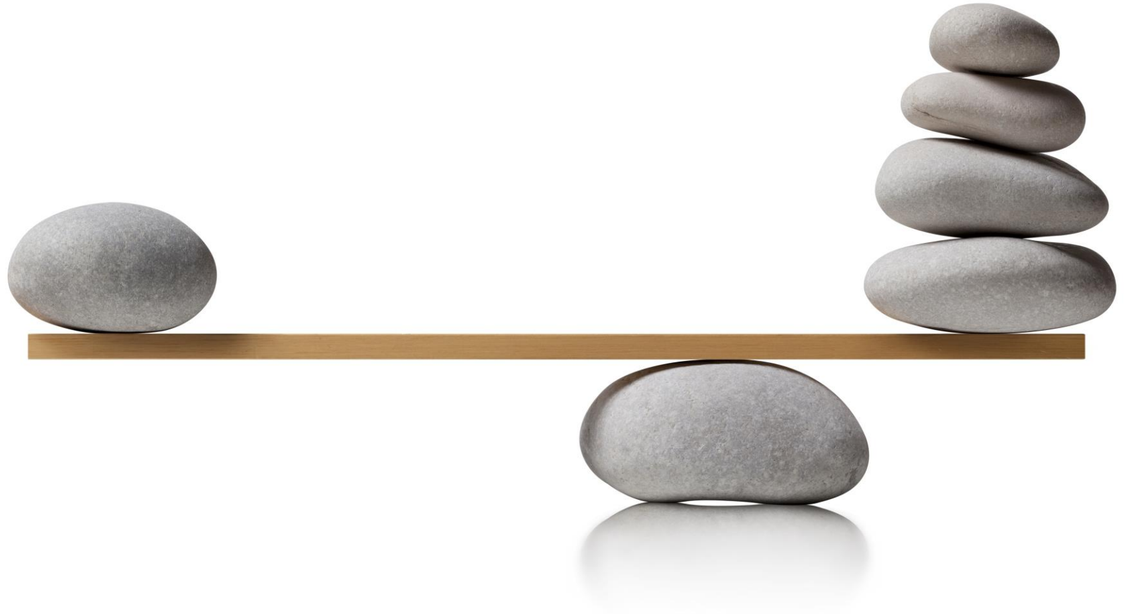
CONCLUSIONS

- Advanced analytics / complex problems can provide **simple tools to help smart people make smarter decisions**
- Railways have huge quantities of **data** which can be used to build **useful insights**
- **Climate impacts on railways** are already significant and will increase. GUSTO is an example of how to intelligently **balance performance and safety**



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