



Great Britain Automated Vehicle Approval  
**Framework for In-Use Safety Monitoring and Reporting**

May 2022

# Disclaimer



*This work has been funded by the Department for Transport  
And is pre-regulatory research into the possible options for an in-use monitoring framework.*

*The findings and recommendations do not necessarily reflect the views of the Department for  
Transport and will not necessarily be implemented in future approval requirements.*

# GB Approval context

- Low-speed automated driving (scalable to higher speeds in the future)
- Operation of goods and passenger services
- New vehicle designs (i.e. no traditional human controls)

## Manufacturer

- Responsible for a safe system
- Collect data about vehicle performance
- Share safety data with the regulator

## Service Operators

- Responsible for safe operation of the service
- Safe operation of the vehicle in line with manufacturer user reqs.

## In-Use Regulator

- Assess continued compliance during use
- Report on GB AV safety performance
- Investigate issues and intervene to maintain safety

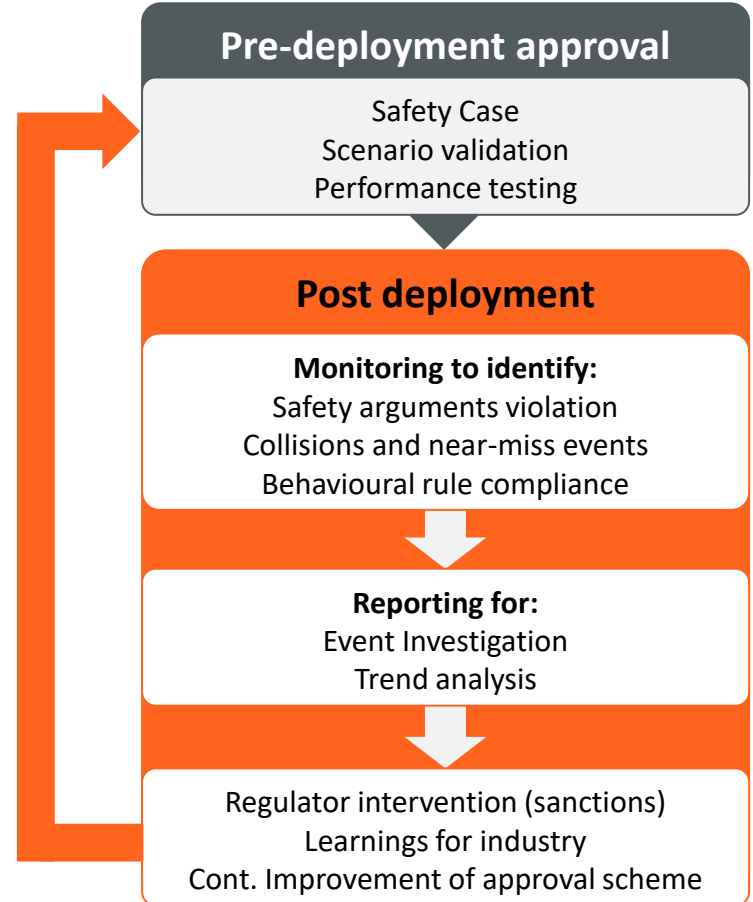
## Independent Investigator

- Blame-free investigations for safety learnings

# GB Approval: In-Use Safety Monitoring & Reporting

A practical method of in-use monitoring to support and extend vehicle approval post-deployment

1. Provide continued validation of the safety of the automated vehicle during its deployment lifetime
2. Monitor violations defined behavioural rules
3. Identify potential safety hazards prior to any harm arising
4. Collect data to support the investigation of incidents
5. Support continual learning for the industry



# Event Identification (Leading and Lagging Measures)

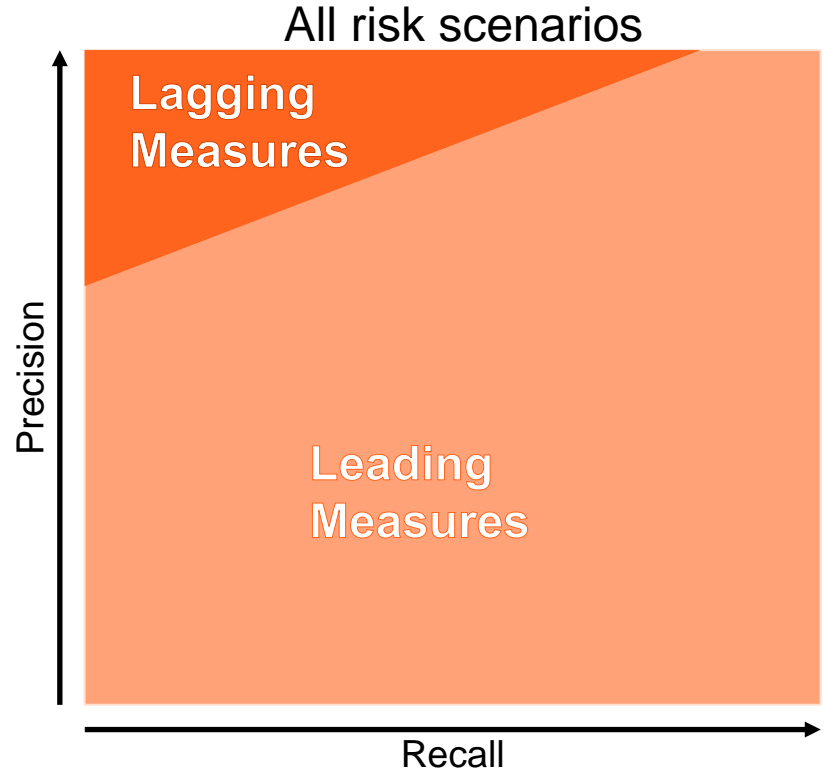
DATA → METRICS → THRESHOLDS

## Lagging measures

Strong indicators of the occurrence of actualised risk events

## Leading Measures

Proxies indicative of potential risk



# Proposed Leading and Lagging Measures

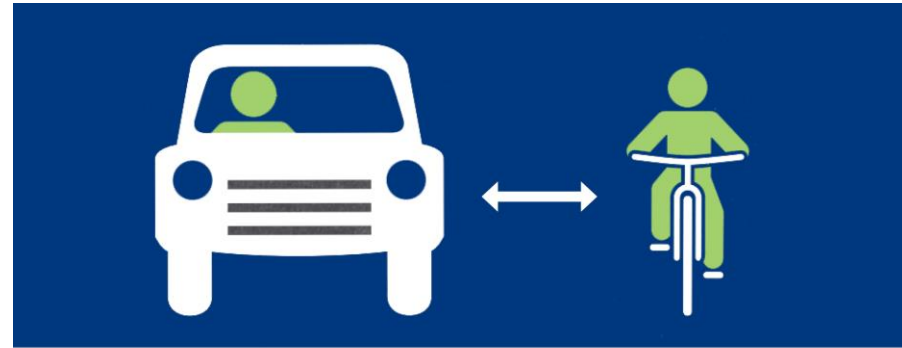
Lagging measures	Leading measures
VRU impact detection system activation triggers	Infraction Measurement – excess speed (Limit)
Occupant rollover system triggers	Infraction Measurement – excess speed (Safe)
MRM activation	Safety Envelope – proximity
System triggers of “wake-up” occupant protection systems	Driving style – longitudinal jerk
Battery / under vehicle impact protection trigger	Driving style – lateral jerk
Vehicle door release when in motion	ODD exit
Safety Envelope - proximity	MRM Triggers
Passenger emergency or remote operator control override mechanism	Hazard Identification, reaction and risk perception
ODD exit	Safety pre trigger events – e.g. ABS pre-charge, Forward Collision warning
Vehicle dynamics beyond expected ranges (e.g. over max speed, or harsh events beyond design range)	
Unavailable or disabled autonomous sensor or control, fault triggers	

# Selection of Thresholds - Findings

Measures can be both leading and lagging by selection of appropriate thresholds

Chosen thresholds delineate between acceptably safe and unacceptably safe AV performance

- Set in relation to domestic traffic rules
- Context and ODD dependent and relate actual risk
- Simulation needed to set thresholds prior to deployment
- Continuous evaluation of their predictive value



minimum safe  
passing distance  
**1 metre**



minimum safe  
passing distance  
**1.5 metres**



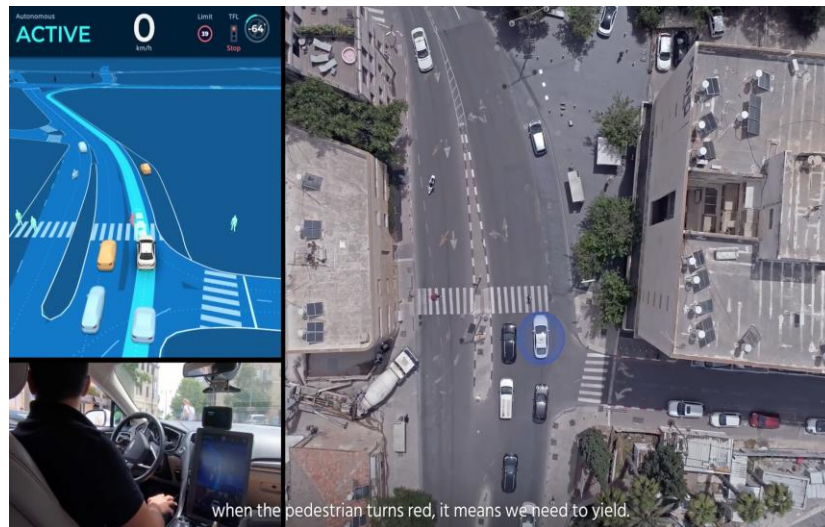
minimum safe  
passing distance  
**2 metres**

<https://www.northants.police.uk/>

# Monitoring traffic rule compliance - Findings

Extracting perception data can help interrogate compliance with road rules:

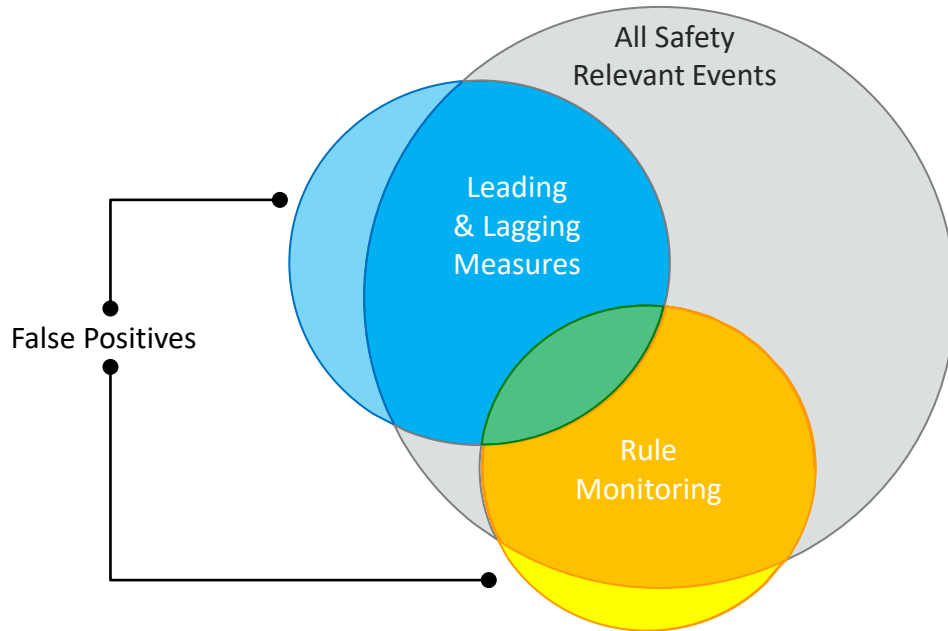
- Spatial and temporal data of objects and static elements in a scene (world model data) extracted prior input to AV planning module – processed output (not raw sensor data)
- Data is processed to compare actual outcome against desired behaviour (can be on-board or off-board, real-time or after the fact)
- Real-time on-board processing can serve as a trigger for comprehensive data capture.
- Same data required for scenario generation and collision reconstruction – feedback to improve scenario set



Intel Mobileye 3D-world model data  
[https://youtu.be/kJD5R\\_yQ9aw?t=252](https://youtu.be/kJD5R_yQ9aw?t=252)

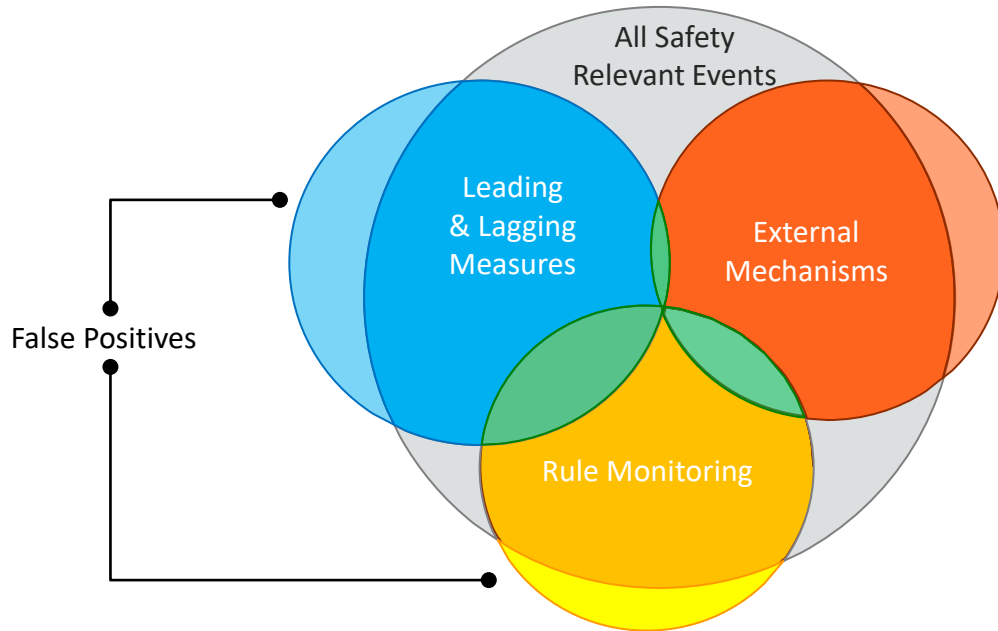


# Coverage of risk events



- In-vehicle measurement not possible for all risk events
- Perception failures are difficult to identify
- External mechanisms for reporting required

# Coverage of risk events



## External mechanisms:

Police reports and traffic infrastructure (e.g speed cameras)

Public reports (operator required to set up suitable mechanism)

## Operator processes:

- Daily vehicle checks
- Maintenance
- Passenger feedback

# Data Sharing to Regulator

Data to be reported to the regulator periodically (6-12 months), or immediately following a collision, or as soon the safety case/approval may be invalidated

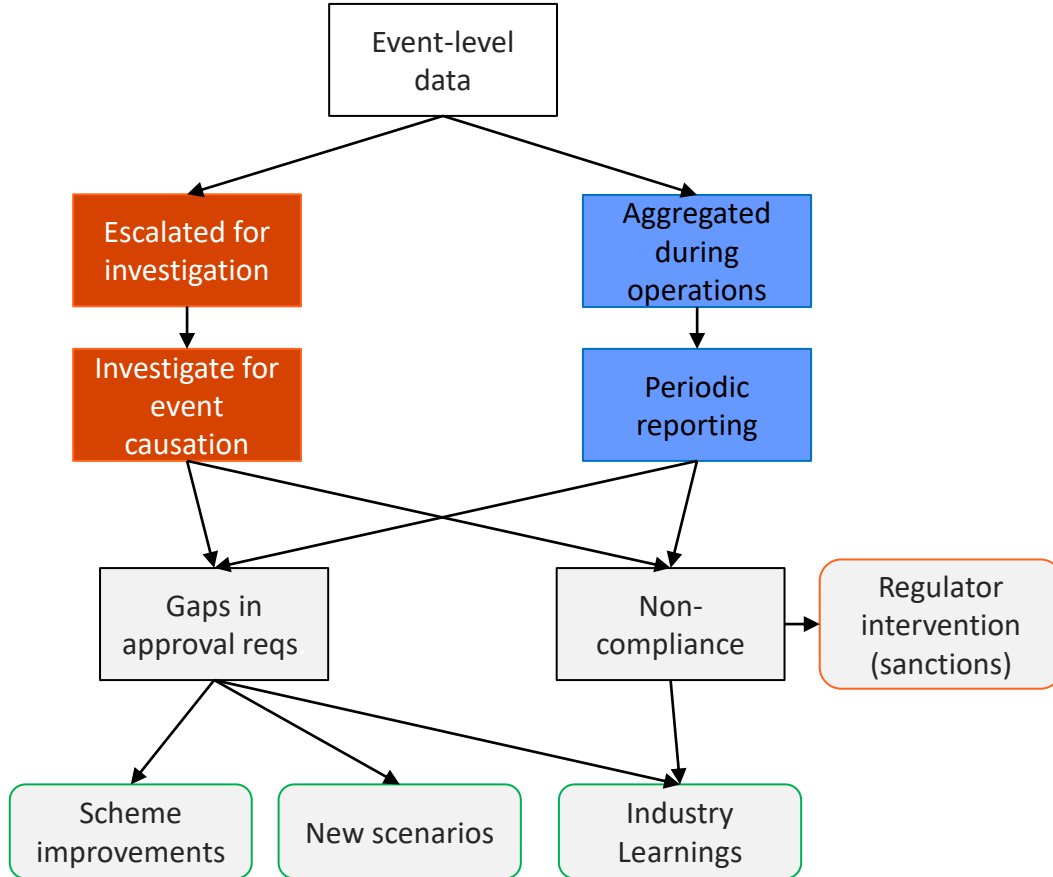
## Event Investigation:

- Investigation for all collisions involving automated vehicles initially. Greater emphasis on trend analysis over time
- Any other events requested by the regulator (e.g. new event, potentially highly severe near miss)
- AV collision investigations led regulator or independent investigator
- Processes required for interfacing with police investigators

## Trend Analysis:

- Aggregated event data
- Measure rate of occurrences of events (e.g. collisions, near misses, traffic infractions)
- Capture of exposure data (miles travelled, number of pedestrian interactions) for normalisation
- Segmented by variables that impact risk exposure (ODD, event type, road users, etc.)

# Data Sharing to Regulator



## Sanctions:

1. Informal and formal warnings
2. Fines
3. Redress orders
4. Compliance orders
5. Suspension of authorisation
6. Withdrawal of authorisation
7. Attendance at a restorative conference.

**Thank You**

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