



International Regulation

- VMAD UN-ECEs WP.29 Validation Methods for Automated Driving
 - Supported by NHTSA, Canada, Japan, UK, EU, Korea, OICA...
 - Mandated to devise validation methods to achieve
 - ".. shall not cause any traffic accidents resulting in injury or death that are reasonably foreseeable and preventable.."
 - Automated Lane Keeping (ALKS) could become a prototype and is expected to complete March 2020
- Design Processes many groups working on updating design processes for AV development
 - SOTIF, UL4600, BSI, Self Assessment packs
 - The V diagram is broken, how do we check that everything is covered?
- Acceptable Risk Who should take responsibility for defining acceptable risk?
 - Driving is not zero risk
 - How should traffic flow be balanced with accident risk

Multi Tier Validation



Audit

Function Safety Strategy. FMEAs...

Design, development, testing, manufacturing processes

Virtual Testing

Road/scenario DB Driver models Vehicle models

Testing

Knowns

- Objects
- Movement
- Vehicle drives as per model
 Perception limited

Measurements

 Against test criteria of knowns

Tracks Testing

Specific scenarios testing

Testing

Known

- Objects
- Movement
- Real vehicle motion
 Perception edge case possible

Measurements

- Against test criteria of knowns
- Perception consistency

Real World Testing

Safety driver controlled use, wide verity of scenarios with diversity of conditions

Testing

- Few external knowns
- Disengagements
- Testers notes

Measurements

- Perception consistency
- Planning accuracy
- Driving accuracy

In Service

Significant increase in miles driven.
Limited or no driver interventions

Measurements

- Perception consistency
- Planning accuracy
- Driving accuracy
- Near misses
- Accident reports

Testing Testing Testing Deploy

Refine Refine Refine Refine Refine



First Step- A Measure of Safety

- Implementation agnostic The measurement system should be outcome based and not impose a design on the developers of the AV.
- Open standard The measurement system must be an open standard that all OEMs can work with
- Extendable The number of potentially unsafe driving scenarios is unlimited and so any measurement system must be able to be extended to account for new incidents.
- Efficient The time taken for an OEM to react to an incident (understand fix validate) may need to be weeks or months but not years. Estimates for testing by public roads driving have suggested 1 billion miles would be needed. This is neither practical or desirable.
- **High fidelity** Recording accidents is not sufficient, as humans we learn from near misses where accidents are avoided by drivers taking evasive action or the luck of timing.
- Continuous Safety needs to be measured by all vehicles both in development and deployment.
- Objectivity Measured data must provide clear guidance to decision making so that assessments are objective and fair to all.