Proposal for an Approach to Defining Rules of the Road:
United Kingdom Proposal

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UNECE FRAV 17th Session
27 July 2021

Motivation

FIRST PART: ADS Safety Topics

FRAV DDT Workstream

The ADS should drive safely

1. The ADS should be capable of performing the entire Dynamic Driving Task (DDT)
2. The ADS should recognize the ODD conditions and boundaries of the ODD of its feature(s)
3. The ADS should detect and respond to objects and events relevant for the DDT
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5. The ADS should interact safely with other road users

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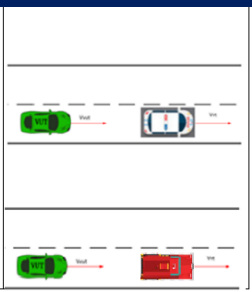
FRAV ORU Workstream

3	**The ADS should respond in line with traffic laws to markings and signals used to identify the functions and authorizations of ORUs.**	● The ADS should respond in accordance with traffic rules upon the operational status or dedicated signals displayed by emergency/enforcement vehicles.	**Scenario/Virtual test/Track test:** ● **Object:** Emergency/Special vehicle with visual signal (flash/painting), ego vehicle; ● **Case:** 2-lane road, an emergency vehicle moves at low speed (in operational state) ahead while test vehicle drives in the same lane.	

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5.1.2. The activated system shall comply with traffic rules relating to the DDT in the country of operation.

UNECE Reg 157

4.1.1. Verification of the function of "The System"

The Type approval authority shall verify "The System" under non-failure conditions by testing on a track a number of selected functions from those described by the manufacturer in paragraph 3.2. above, and by checking the overall behaviour of the system in real driving conditions including the compliance with traffic rules.

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Rules of the Road (for human drivers)

- UK Highway code (for human drivers) rule defines:
  - Doing some behaviour somewhere
  - NOT doing some behaviour somewhere
- Doing/not doing: Behaviour competency library
- Somewhere: ODD instantiation

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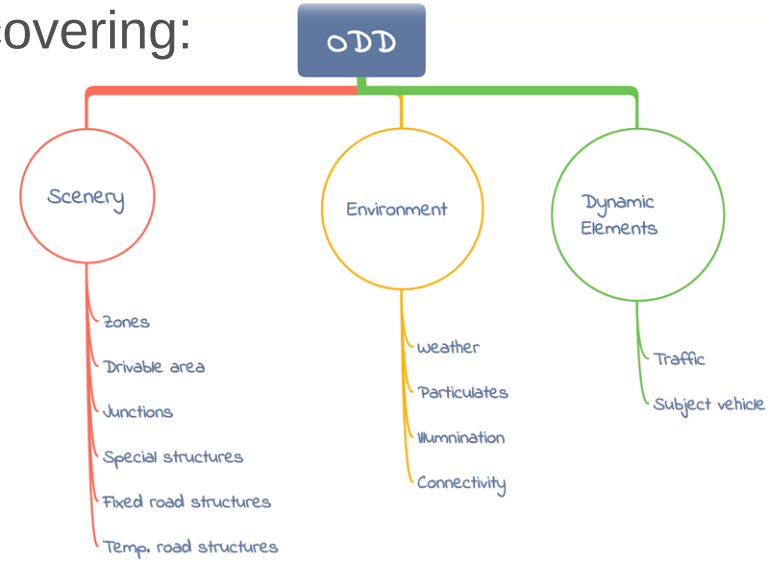
Rules of the Road (for human drivers)

Understanding ODD

- BSI PAS 1883 provides an ODD taxonomy covering:
  - Scenery
  - Environmental conditions
  - Dynamic elements



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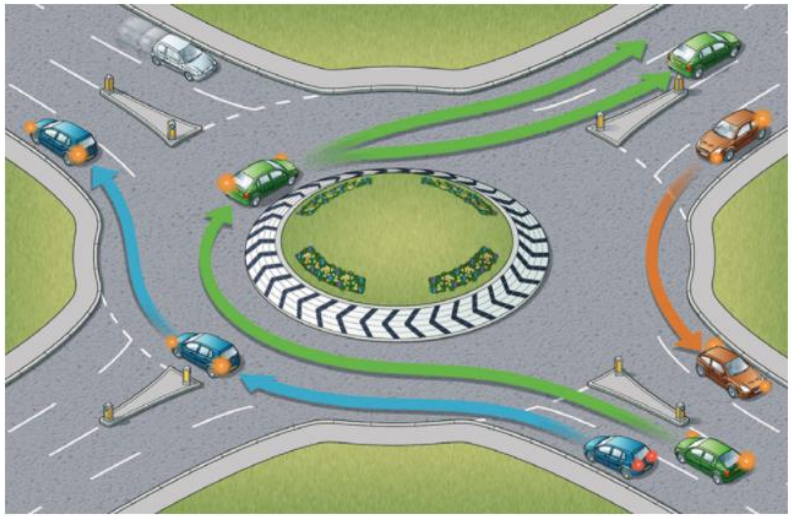
UK Highway Code: Rule 185

When reaching the roundabout you should

- *give priority to traffic approaching from your right, unless directed otherwise by signs, road markings or traffic lights*
- *check whether road markings allow you to enter the roundabout without giving way. If so, proceed, but still look to the right before joining*
- *watch out for all other road users already on the roundabout; be aware they may not be signalling correctly or at all*
- *look forward before moving off to make sure traffic in front has moved off.*



Rule 185: Follow the correct procedure at roundabouts

Behaviour

ODD

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  - Doing some behaviour somewhere
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- **ASSUMPTIONS: by the driver or from the driver**

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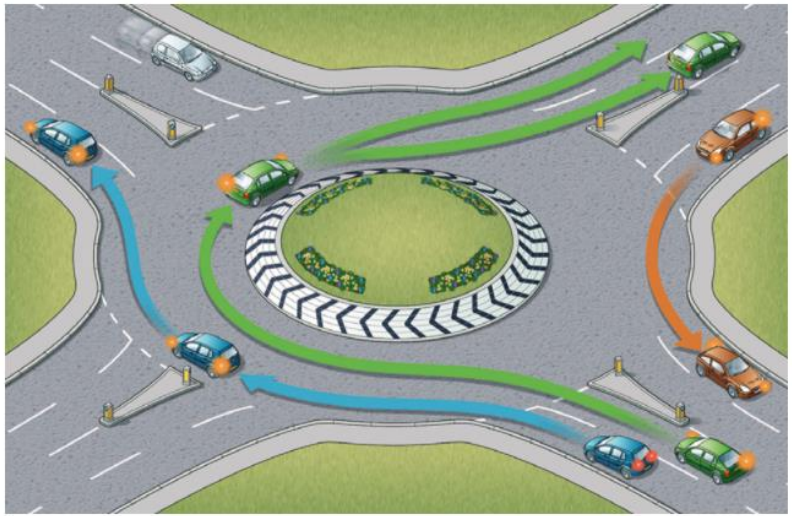

Rule 185: Follow the correct procedure at roundabouts

Weather?

Behaviour | ODD | Assumptions

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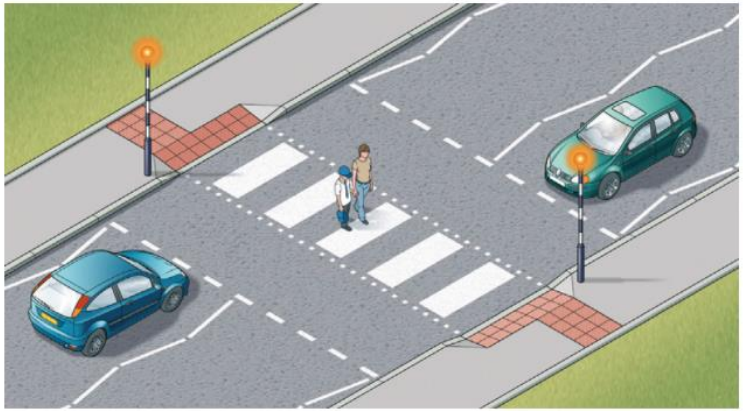
UK Highway Code: Rule 195

"As you approach a zebra crossing: look out for pedestrians waiting to cross and be ready to slow down or stop to let them cross; you MUST give way when a pedestrian has moved onto a crossing"



Rule 19: Zebra crossings have flashing beacons

Behaviour

ODD

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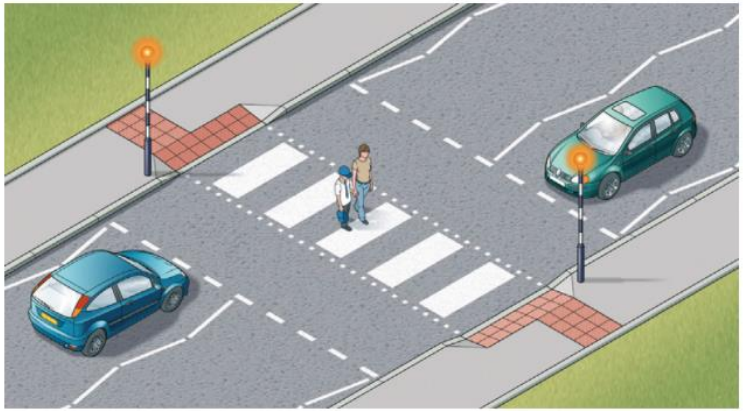

Rule 19: Zebra crossings have flashing beacons

How long to wait?

Behaviour | ODD | Assumptions

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ODD based Codified Rules of the Road

- Doing/not doing: Behaviour competency
  - Possible to create a behaviour competency library (e.g. Singapore, Waymo, NHTSA, WMG etc.)

- Somewhere: ODD instantiation
  - Current highway code (for human drivers) rules **have lot of assumptions** (e.g. weather, connectivity, traffic density, waiting time etc.)
  - These will **need to be reflected explicitly** into a codified rules of the road for ADS

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ODD based Codified Rules of the Road

Current Rules of Road (for human drivers) = *f(Operating condition, Behaviour competency, Assumptions)*

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ODD based Codified Rules of the Road

Current Rules of Road (for human drivers) = *f(Operating condition, Behaviour competency, Assumptions)*

Codified Rule of the Road = *f(Operating condition, behaviour competency, driving characteristics)*

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ODD based Codified Rules of the Road

Steps

- Identification of elements: ODD and Behaviour competency
- Consolidation
- Formalisation to make the “assumptions” explicit

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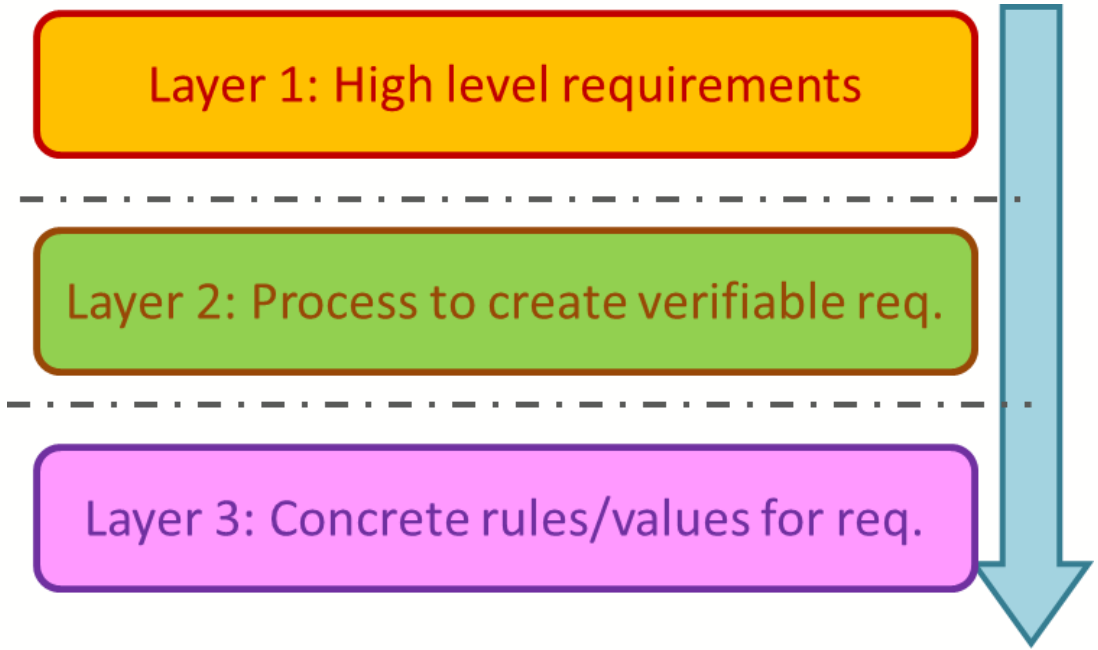
Using Rules of Road in wider Safety Assurance



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Using Rules of Road in wider Safety Assurance

- Layer 1: High Level FRAV requirements (harmonised)

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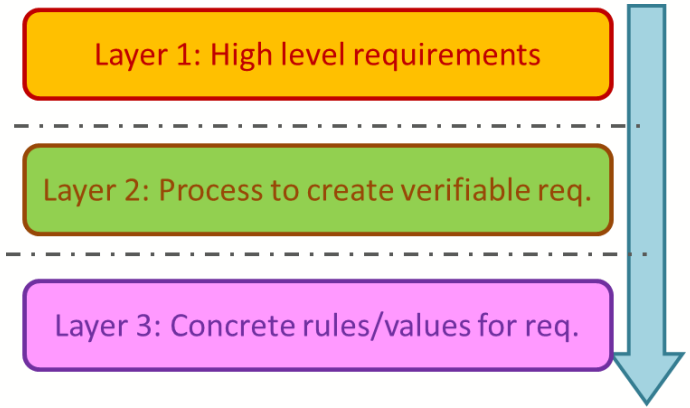

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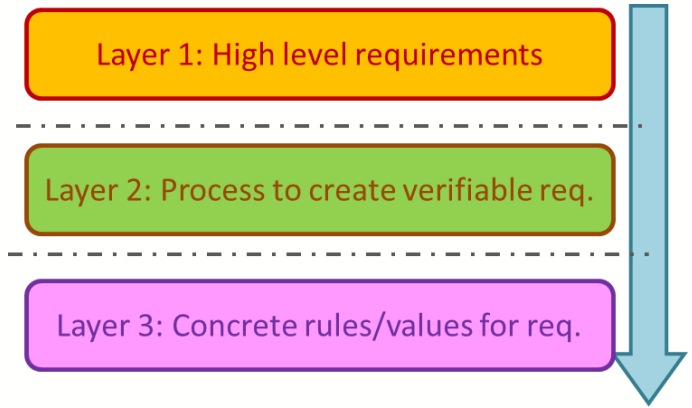

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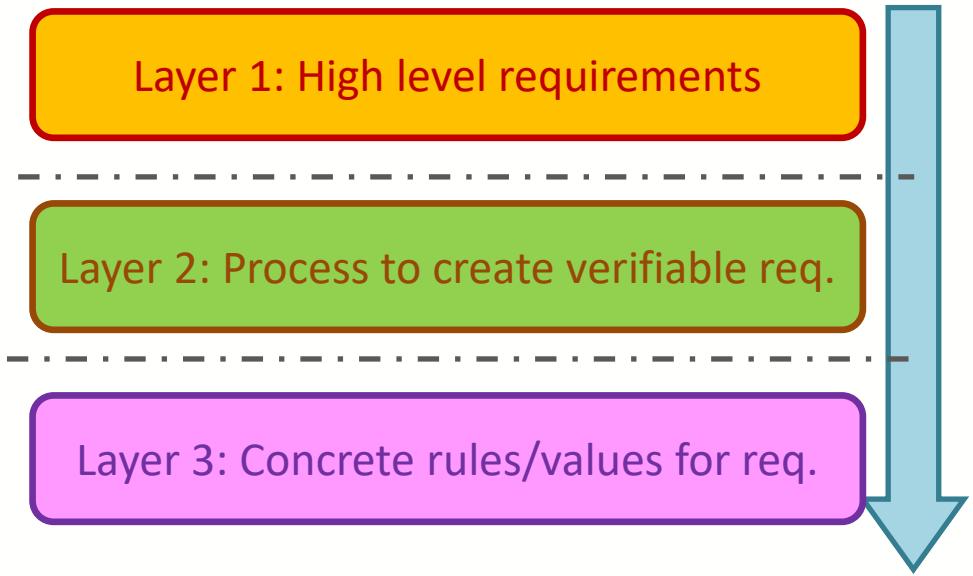
Using Rules of Road in wider Safety Assurance

- **Layer 1:** High Level FRAV requirements (harmonised)
  - DDT
  - DDT relevant safety requirements
  - ORU related general safety requirements
- **Layer 2:** Process for creating detailed verifiable requirements from Layer 1 requirements
  - Proposal to harmonise
- **Layer 3:** Concrete rules or values for requirements
  - May not be harmonised due to diverse ODDs and behaviours



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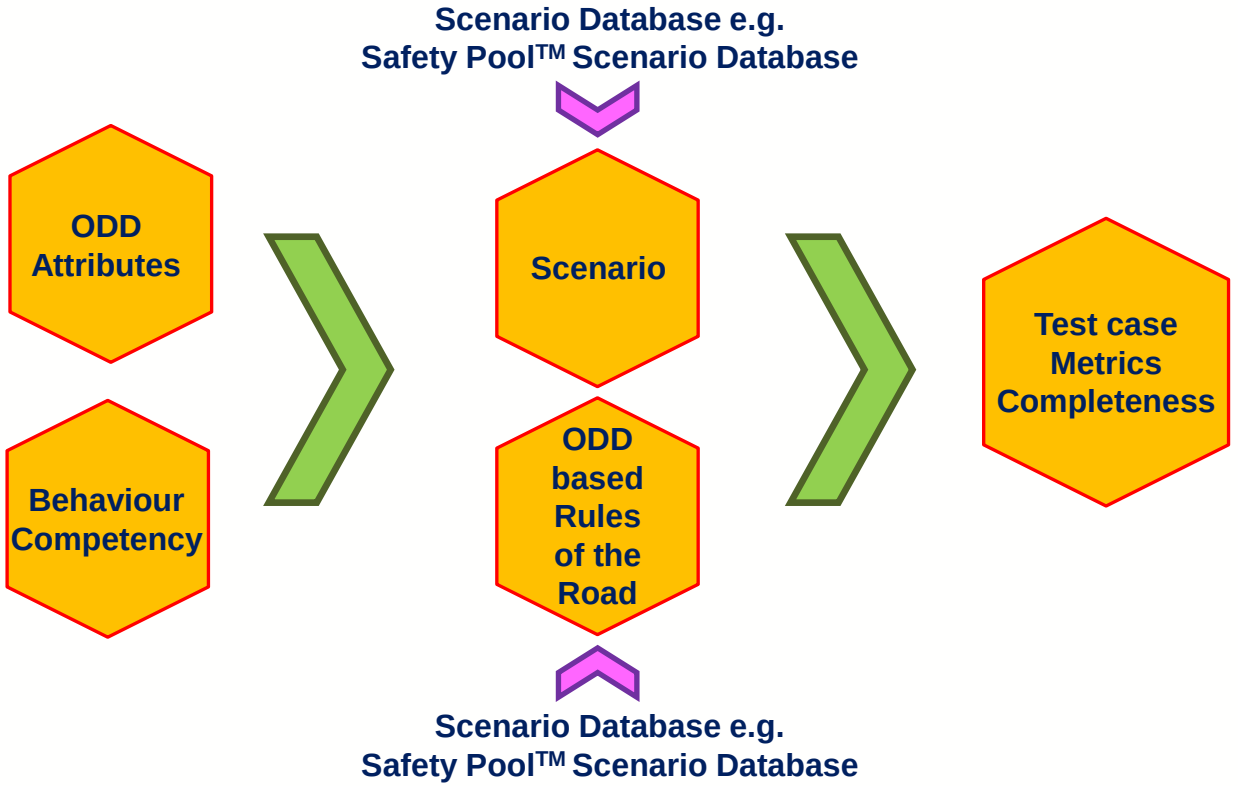

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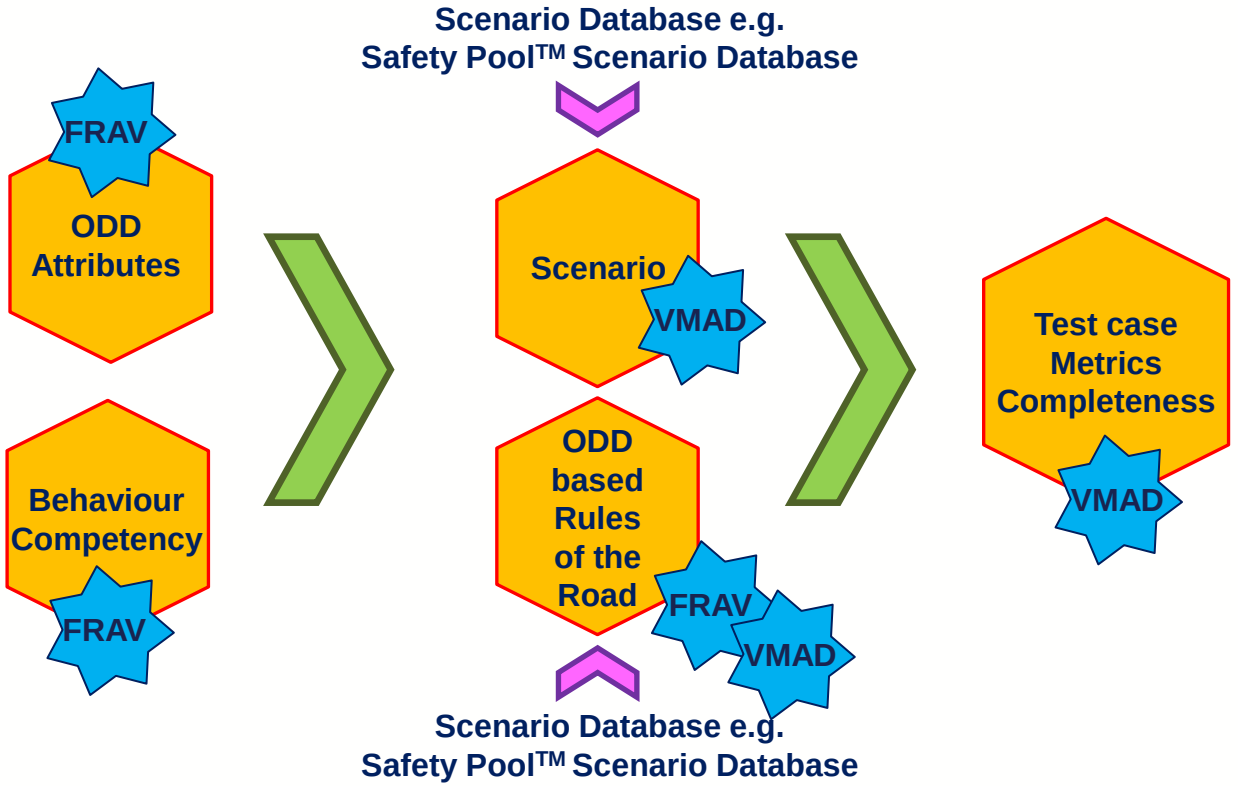

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Advantages of this approach

- Comprehensive approach to define “rules of the road”
  - Rules themselves may differ (depending on country, ODDs, local factors), but the approach for creating the rules can be harmonised
- Guidance on interplay between FRAV and VMAD activities
  - For FRAV: for deriving functional requirements (detailed from rules of road)
  - For VMAD: define pass/fail criteria for scenarios (linking with ODD and behaviour)
- Being an ODD based approach, it is scalable across variety of ODDs
- **The UK would like to make the proposed process (and the outputs) open source with all material openly accessible for all stakeholders**

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Thank you…
Discussions…

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