



SAFETY, SIMULATION AND DATA

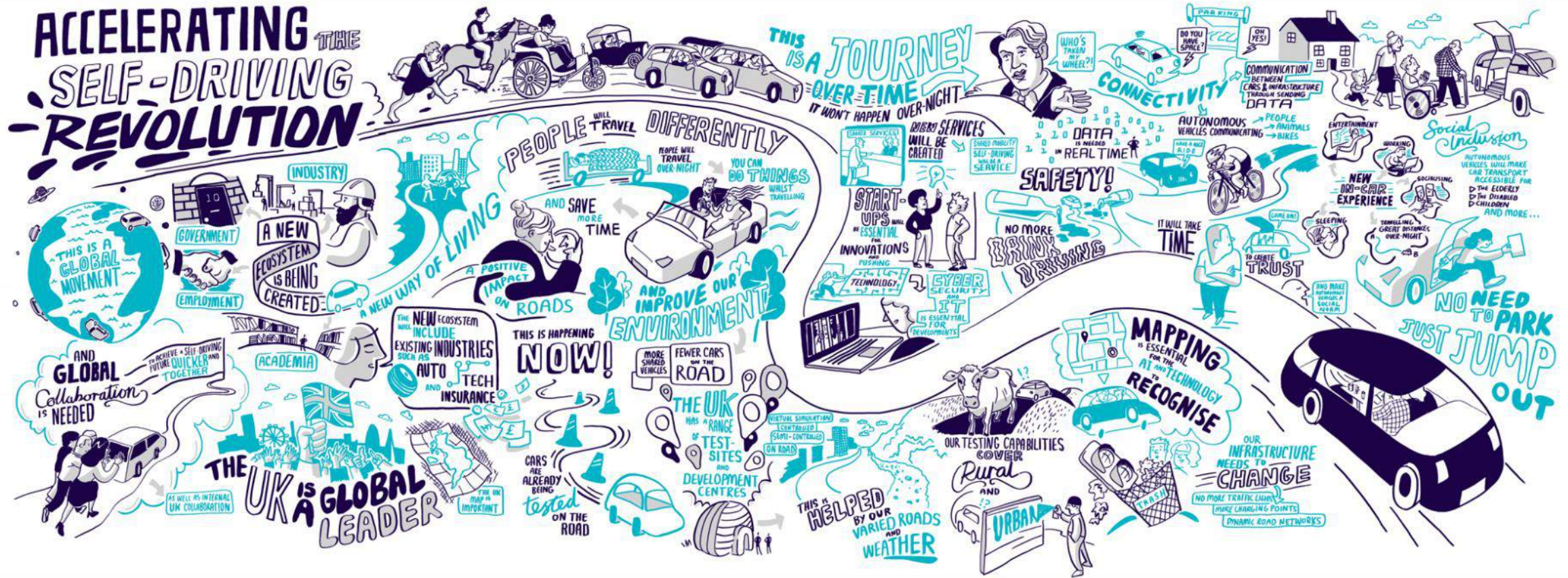
Mili Naik, Zenzic
Michael Orgill, Horiba Mira
Jason Zhang, Warwick Manufacturing Group



MIDLANDS
FUTURE
MOBILITY

ZENZIC⁴

ACCELERATING THE SELF-DRIVING REVOLUTION



Centre for Connected & Autonomous Vehicles

UK CAM Roadmap to 2035: Infrastructure & Data Services

Mili Naik

Technical Delivery Lead

ZENZIC⁴



WHY? **WHAT?** **HOW?**

WHY?



Build Trust & Confidence



Build the UK CAM Supply Chain



Developing and maintaining skills in
the UK



WHY?

01

Real-time decision making

02

Vehicle-to-Vehicle (V2V) and
Vehicle-to-Infrastructure (V2I)
communication

03

Mapping and navigation

04

Monitoring and maintenance

05

Fleet management and
optimisation

06

Data sharing and collaboration





WHY?

WHAT?

HOW?

DATA SERVICES

Data collection
and sensing

Data processing
and analysis

Communication
and
connectivity

Web services
and cloud
computing

Data and
Cybersecurity

Service delivery
and usage

Decision-
making and
control systems

Maintenance
and support

In-vehicle
Infotainment



Infrastructure



Low- Latency
High Bandwidth

High- Latency
Low Bandwidth



WHY?

WHAT?

HOW?

Key Categories Identified

**Data standards
and cooperative
data sharing**

**Federated data
architecture**

**National
coverage plan**

**Digital
infrastructure**

**Physical
infrastructure**

**Skills and
education**

Key priorities for CAM Infrastructure & Data Services to 2035

Identify use cases and stakeholders for data packages

Creation of data standards and data sharing frameworks

Understand the current planned coverage and infrastructure strategy

CAM inclusion in the National Digital Twin programme

Standardisation and maintaining HD-maps in real-time

Collaboration with different stakeholder groups

Identify the gap in skills





Thank you

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Project Harlander

Zenzic Webinar, April 2024

Michael Orgill, *Project Engineer*

April 26, 2024

■ Rapid Intro:

- Who am I?
- What is Project Harlander?

■ HORIBA MIRA's SAE Level 4 Safety Case Lifecycle

■ In-Person Route Review in Belfast | February 2024

■ V&V Testing:

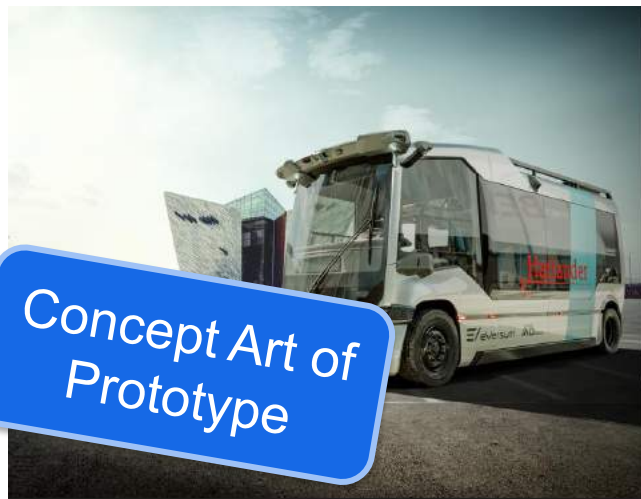
- Simulation
- ASSURED CAV

- 2020: Theoretical Physics MSci, University of Birmingham.
- Ever since: HORIBA MIRA's Connected & Autonomous Vehicles (CAV) team
- Commercial and CR&D Projects including:
 - US & South-East Asian Start-Ups
 - European OEMs
 - Construction & Mining machinery
 - **Innovate UK Consortia**



- **Attended Trial of a Level 4 ADS** around part of the **Belfast Harbour Estate**.
- **~ 2 km route to and from the train station** via,
 - for **commuters:** industrial buildings, workplace
 - for **students:** the local college
 - for **tourists:** the Titanic Museum, the Giants' Ice Hockey Stadium

Trial: Q1 2025
Only halfway through



Harlander



SAE Six Levels of Autonomy | J3016C Taxonomy (2021)



SAE J3016™ LEVELS OF DRIVING AUTOMATION™

Learn more here: [sae.org/standards/content/j3016_202104](https://www.sae.org/standards/content/j3016_202104)

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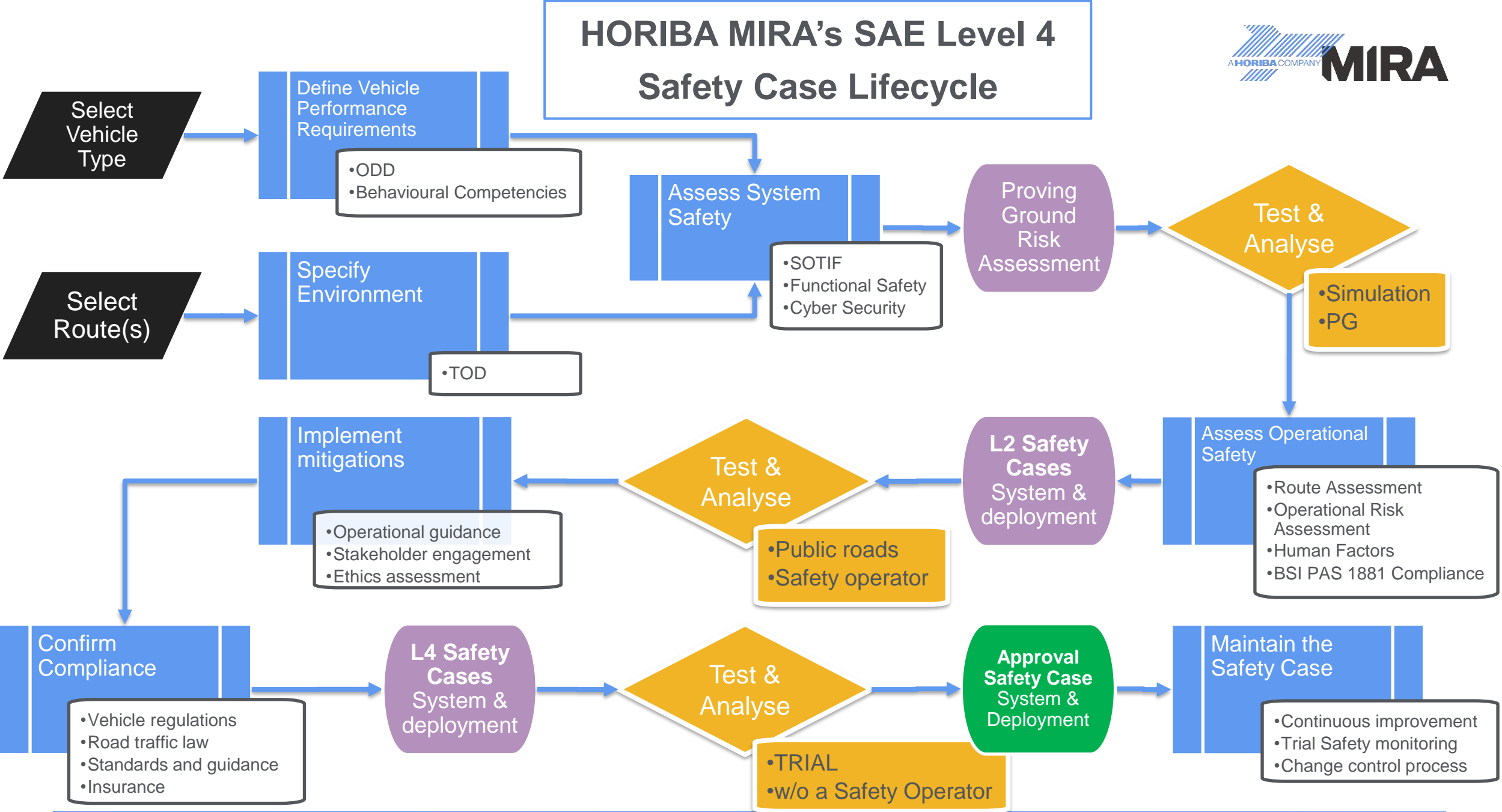
| | SAE LEVEL 0™ | SAE LEVEL 1™ | SAE LEVEL 2™ | SAE LEVEL 3™ | SAE LEVEL 4™ | SAE LEVEL 5™ |
|--|---|--------------|--------------|--|--|--------------|
| What does the human in the driver's seat have to do? | You are driving whenever these driver support features are engaged – even if your feet are off the pedals and you are not steering | | | You are not driving when these automated driving features are engaged – even if you are seated in “the driver's seat” | | |
| | You must constantly supervise these support features; you must steer, brake or accelerate as needed to maintain safety | | | When the feature requests, you must drive | These automated driving features will not require you to take over driving | |

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| | These are driver support features | | | These are automated driving features | | |
|----------------------------|---|---|---|---|--|---|
| What do these features do? | These features are limited to providing warnings and momentary assistance | These features provide steering OR brake/acceleration support to the driver | These features provide steering AND brake/acceleration support to the driver | These features can drive the vehicle under limited conditions and will not operate unless all required conditions are met | This feature can drive the vehicle under all conditions | |
| Example Features | <ul style="list-style-type: none"> • automatic emergency braking • blind spot warning • lane departure warning | <ul style="list-style-type: none"> • lane centering OR • adaptive cruise control | <ul style="list-style-type: none"> • lane centering AND • adaptive cruise control at the same time | <ul style="list-style-type: none"> • traffic jam chauffeur | <ul style="list-style-type: none"> • local driverless taxi • pedals/steering wheel may or may not be installed | <ul style="list-style-type: none"> • same as level 4, but feature can drive everywhere in all conditions |

Source: SAE International, J3016C Taxonomy, 2021, [sae.org/standards/content/j3016_202104](https://www.sae.org/standards/content/j3016_202104)

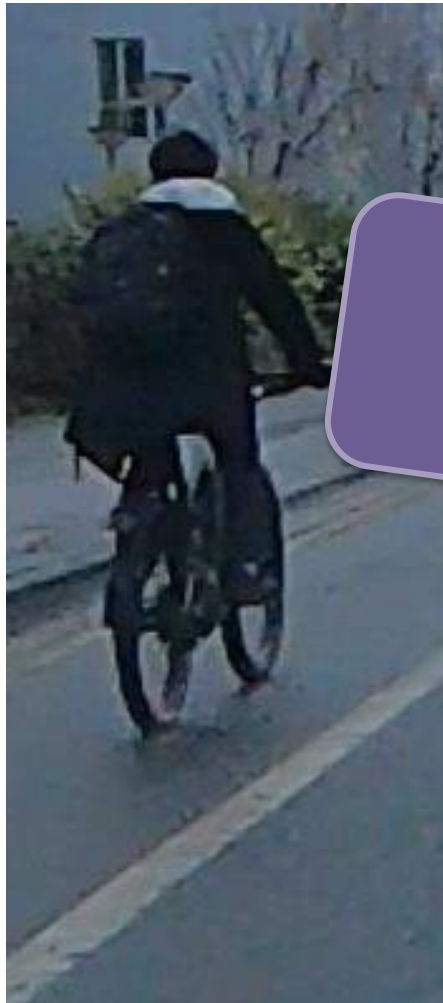
HORIBA MIRA's SAE Level 4 Safety Case Lifecycle



- 3 HORIBA MIRA Engineers
- By car (on road), as well as on foot

Wide Single Lane
Driving Two Abreast





Cyclists

Added to TOD



Examples of Attire inform the Logical Scenario Parameters





Parked or
Queuing
Small
Vehicles
(Cars)



New Functional Scenario
added to Test Programme



Amazon Depot is a unique factor in this TOD

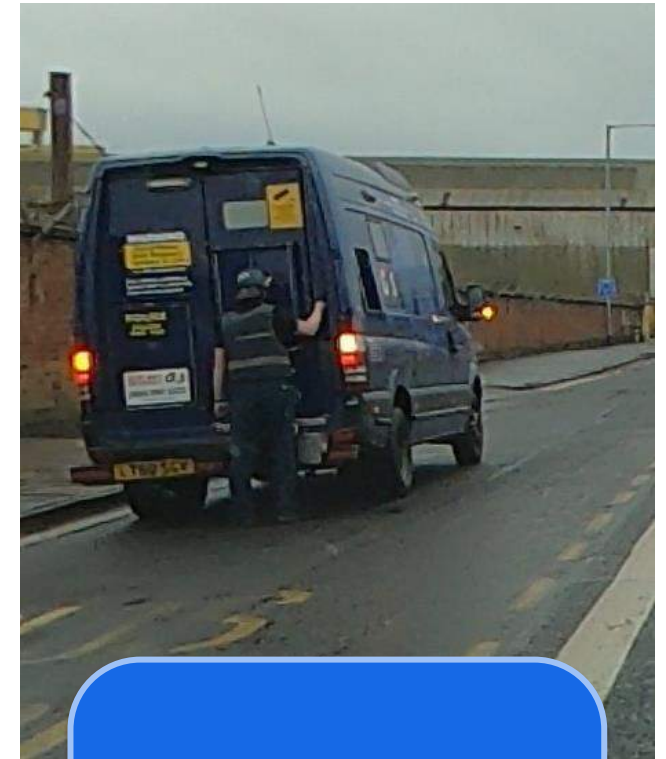
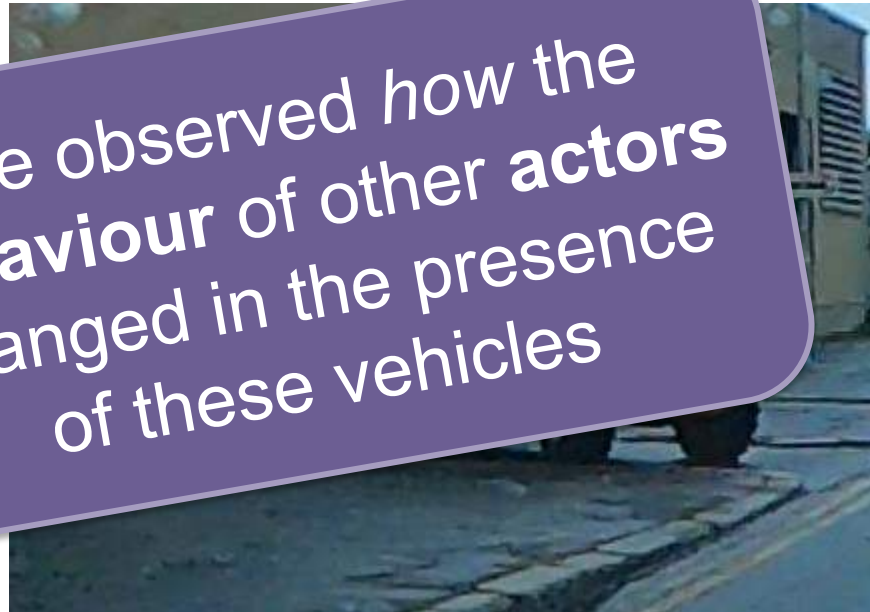


Parked Large Vehicles

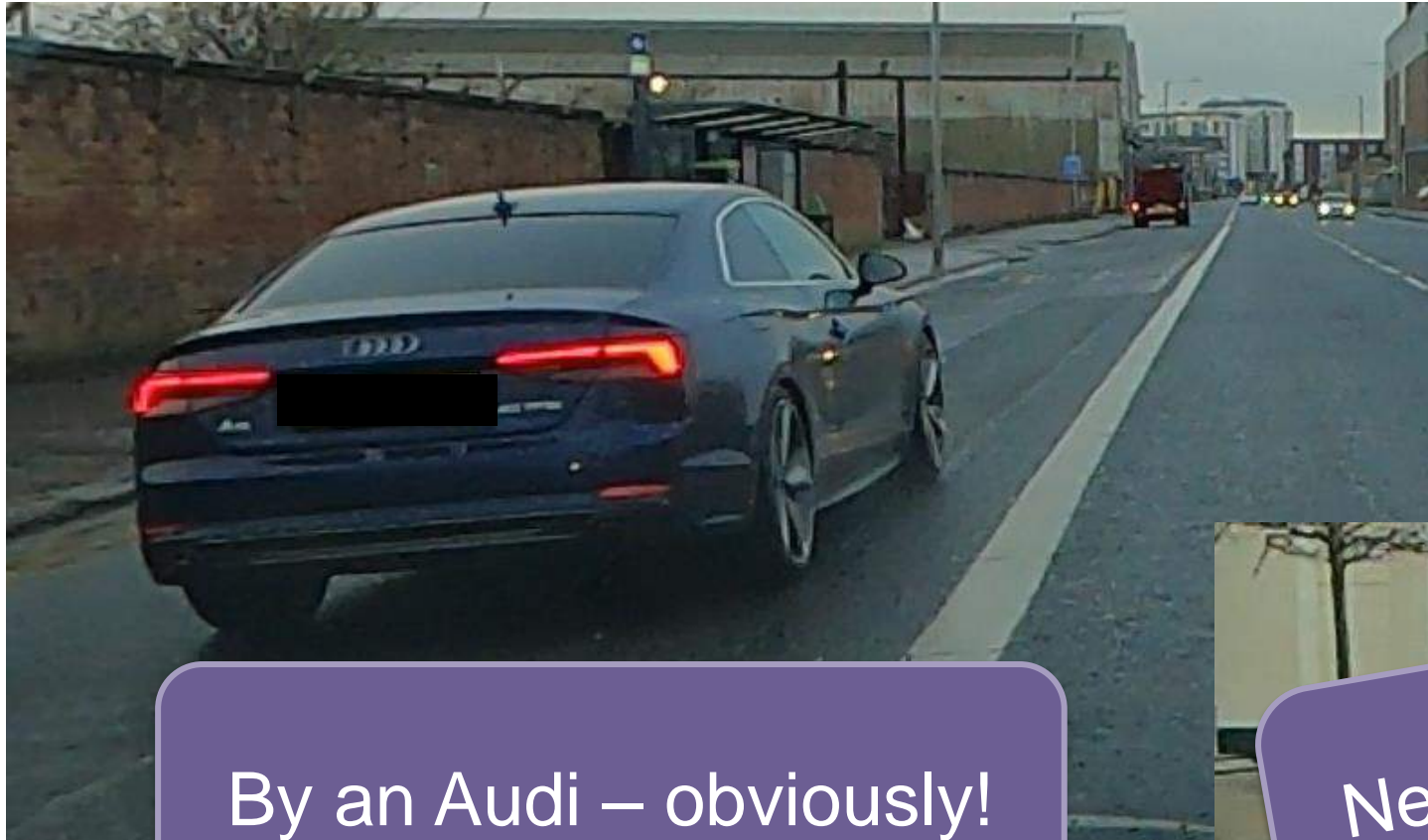




We observed how the **behaviour** of other **actors** changed in the presence of these vehicles



“Unique”
Vehicles



Undertaking
in a Bus Lane

By an Audi – obviously!





New Functional Scenario
added to Test Programme

Late or
abandoned
pulling out
by actors





Examples inform the Logical Scenario Parameters

Added to TOD

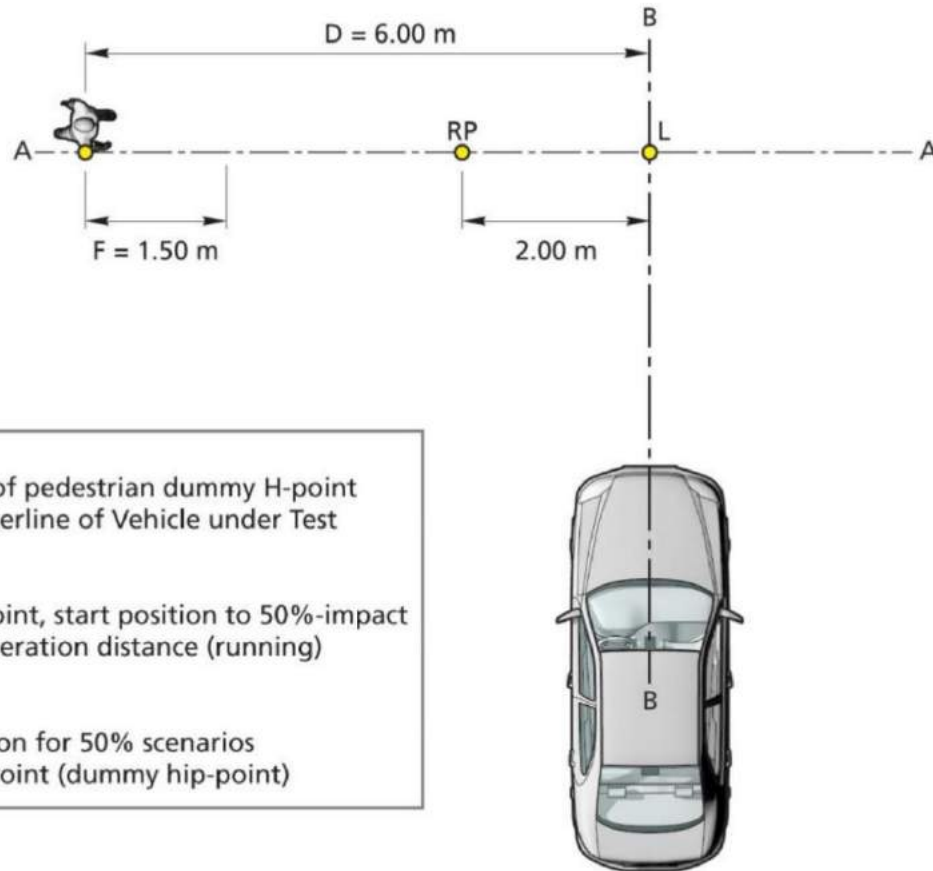
PEDESTRIANS!

New Functional Scenario added to Test Programme

Large or Long Vehicles Turning-in-the-Road





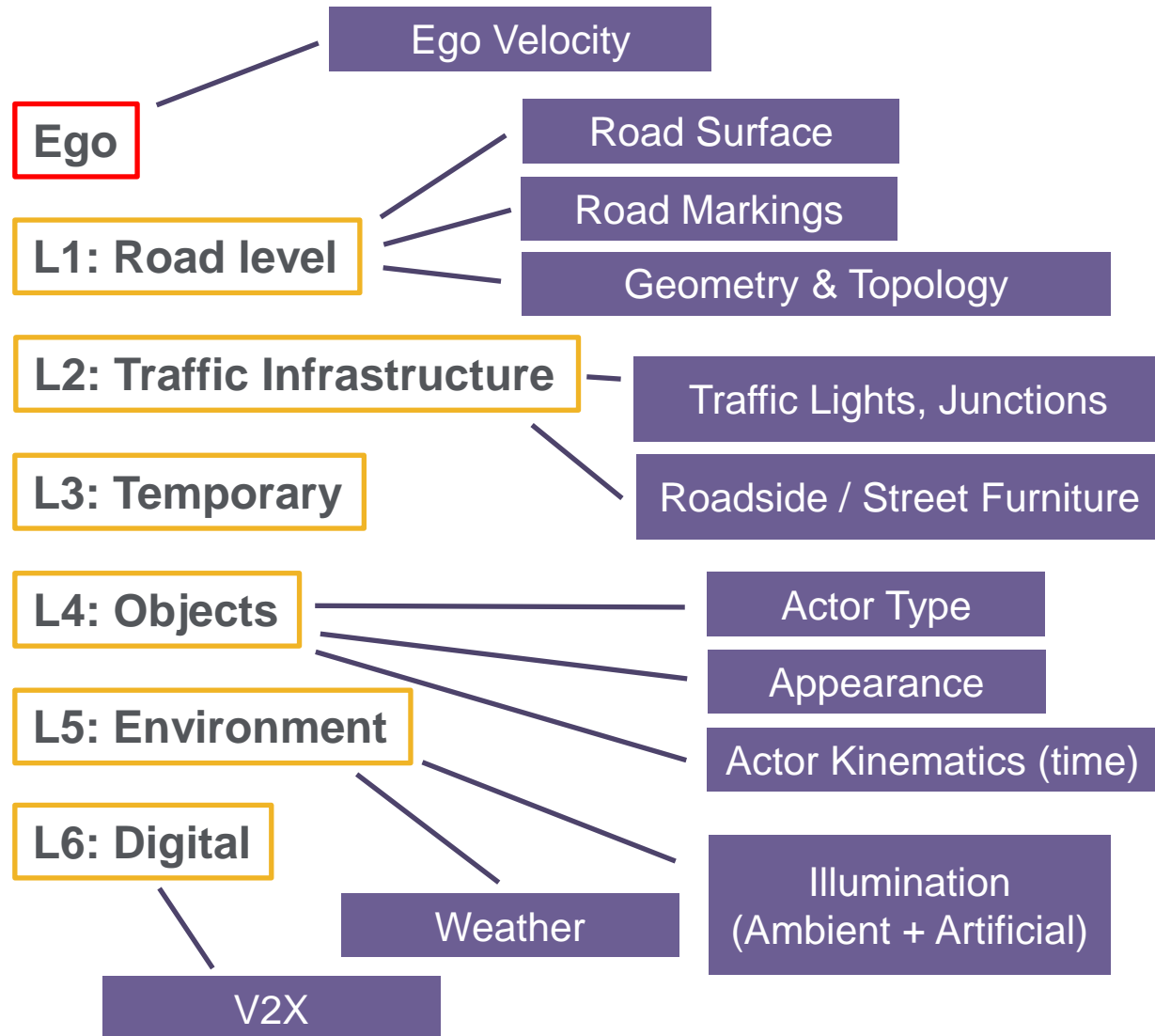


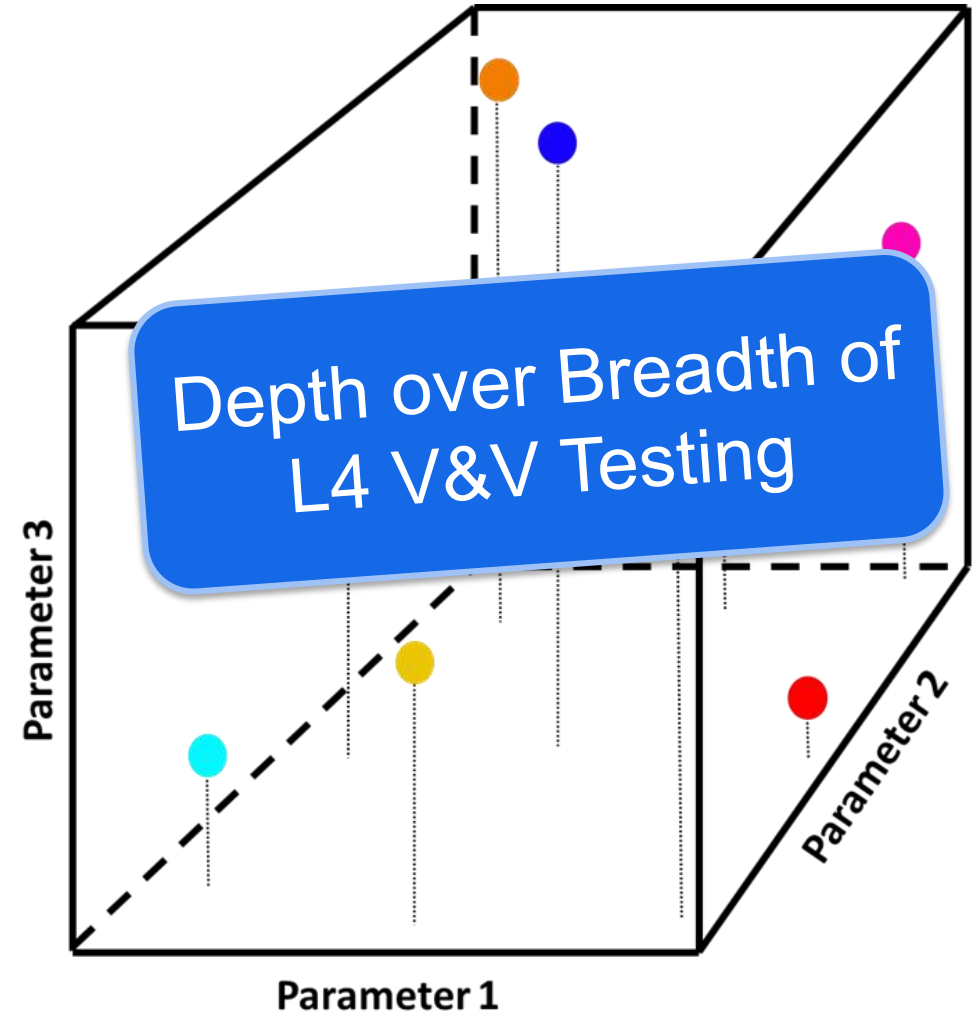
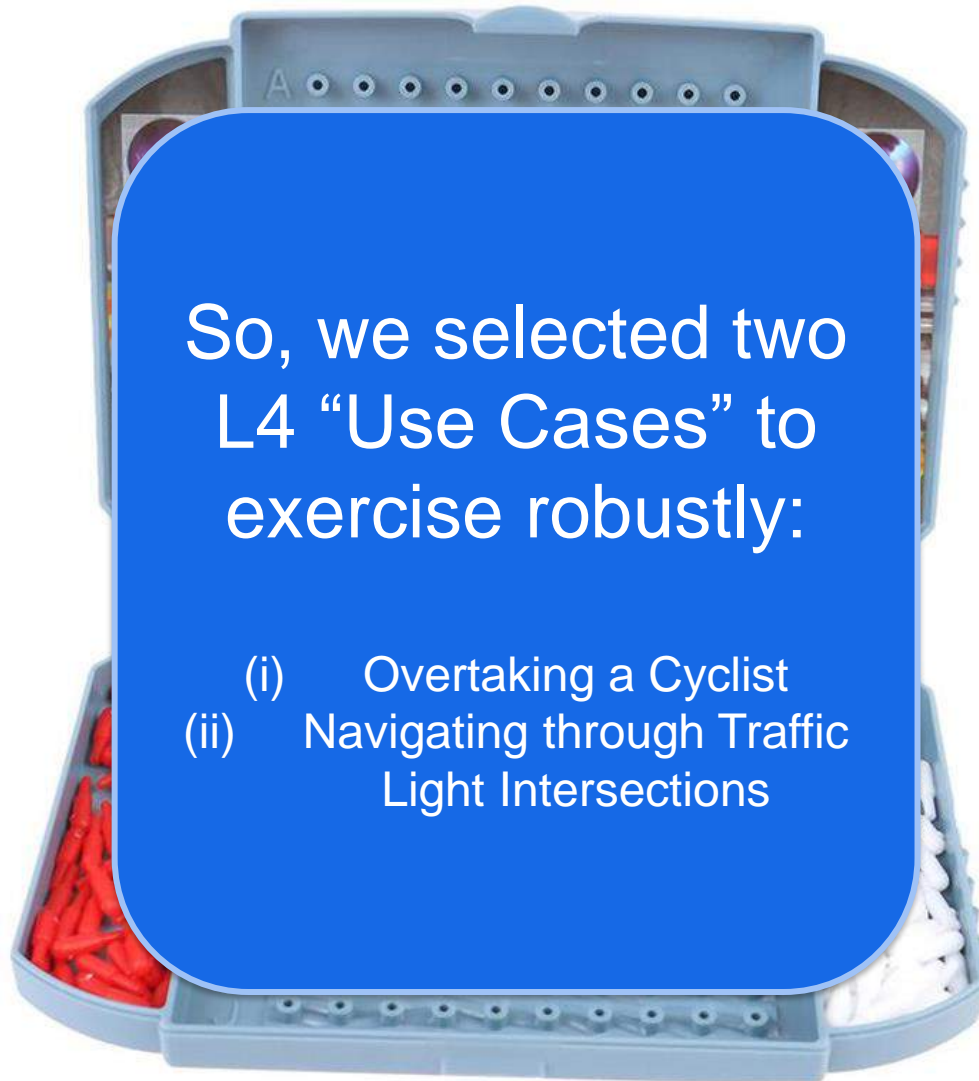
Axes
 AA – Trajectory of pedestrian dummy H-point
 BB – Axis of centerline of Vehicle under Test

Distances
 D – Dummy H-point, start position to 50%-impact
 F – Dummy acceleration distance (running)

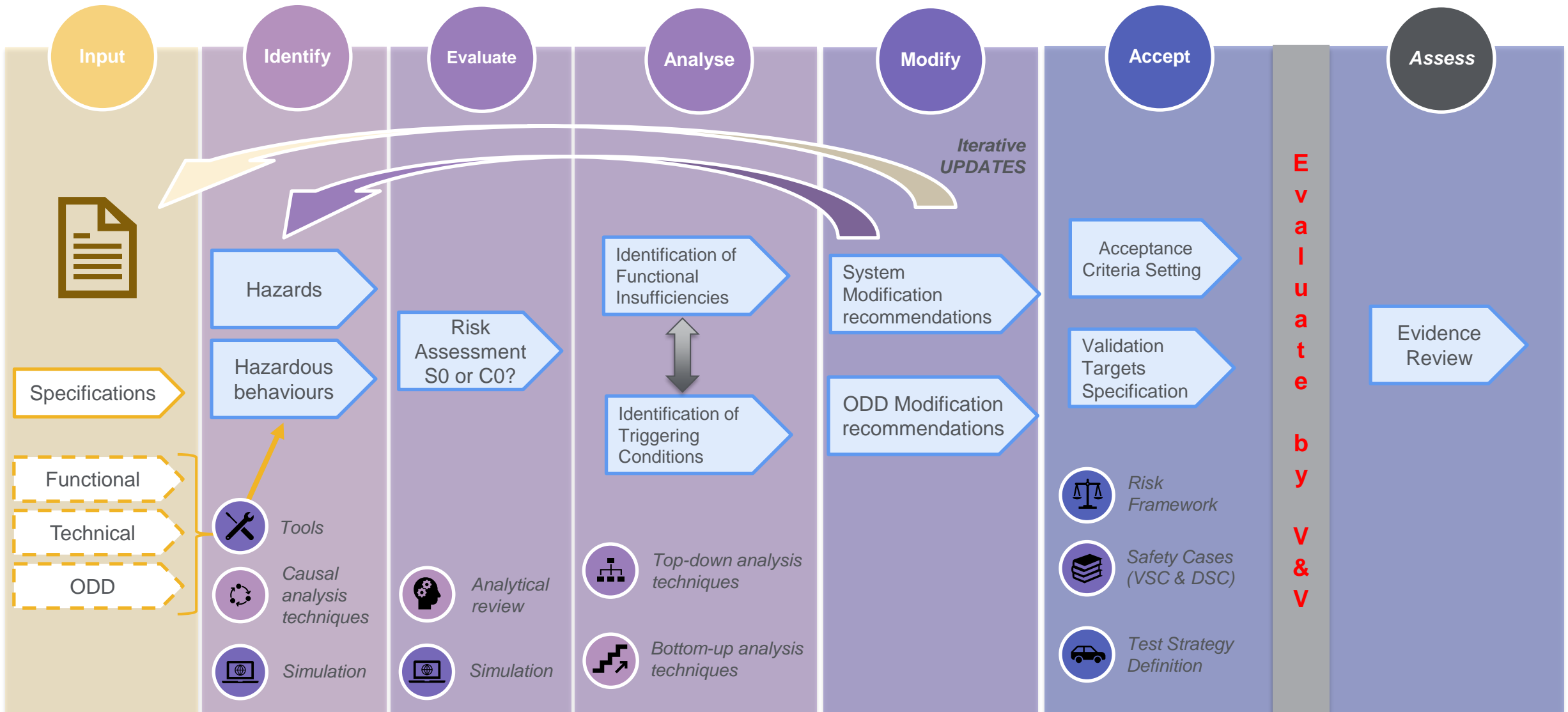
Points
 L – Impact position for 50% scenarios
 RP – Reference Point (dummy hip-point)

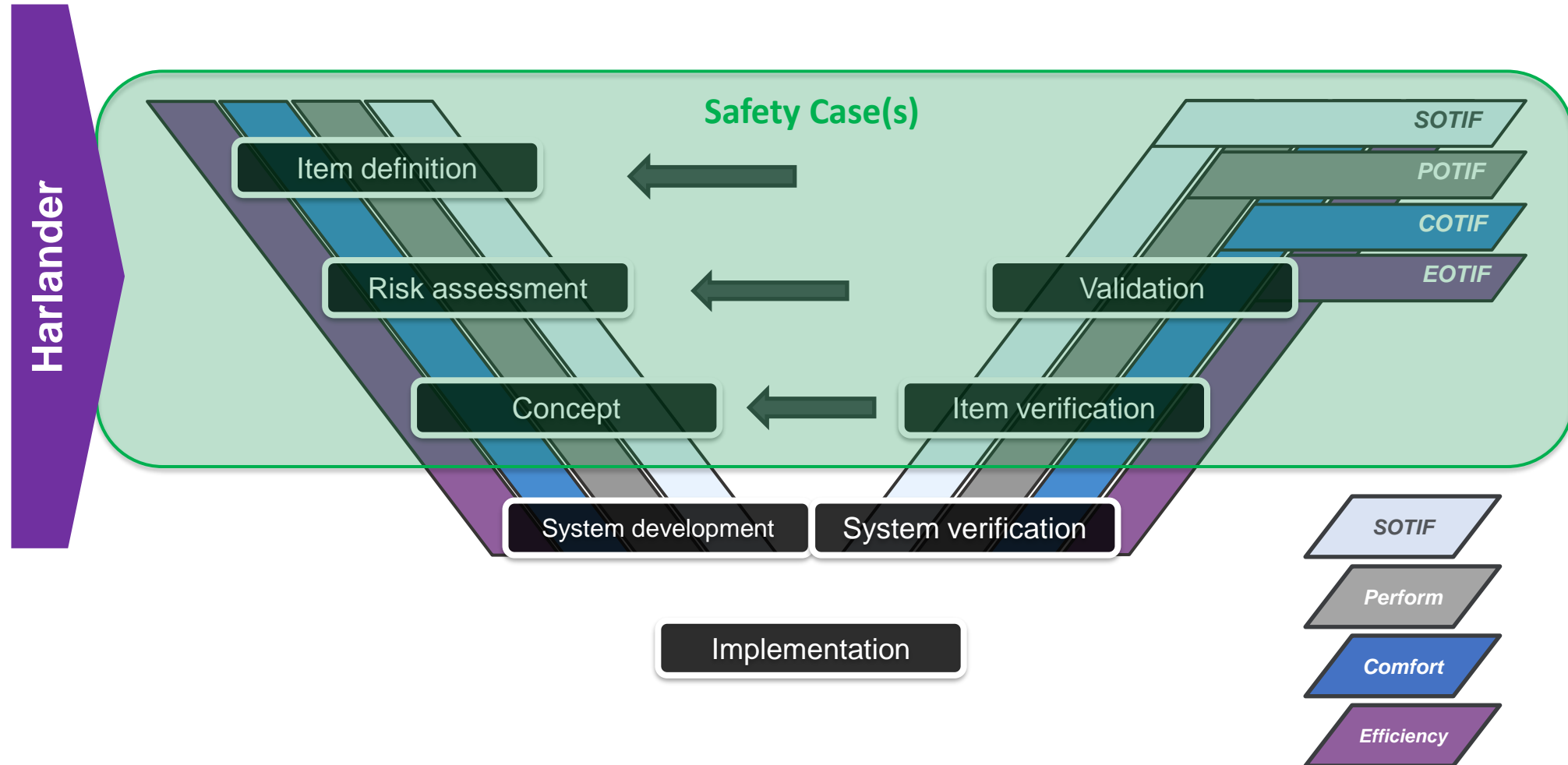
Figure 9a: CPFA-50 scenario, Adult running from Farside



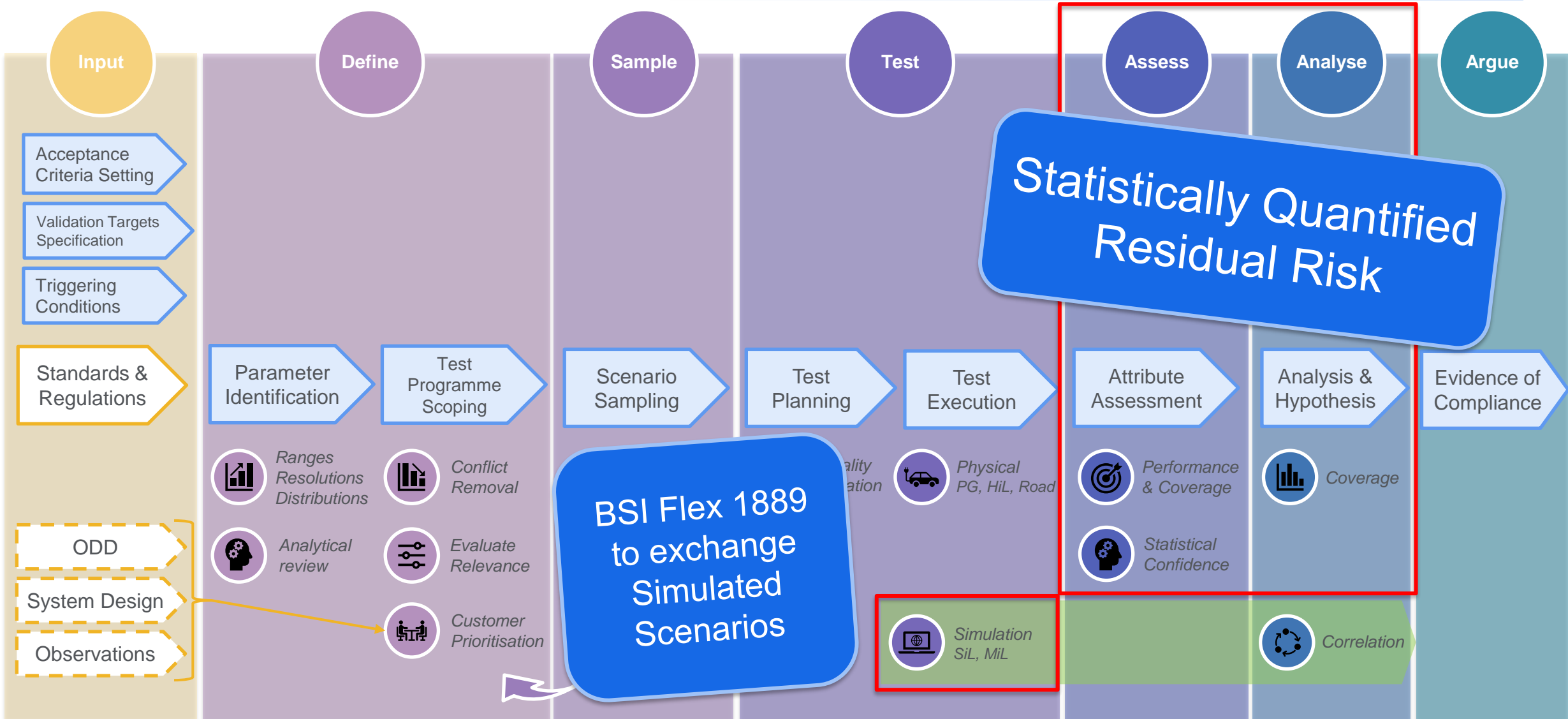


Gearing up for the Safety Case | a Framework





Explore, Justify, Mitigate | the SC Evidence



Questions, Comments & Discussion

5 minutes

Scalable Simulation-based Safety Assurance Framework

Dr Jason Xizhe Zhang
Simulation Lead (Principal Engineer),
Verification & Validation,
WMG, University of Warwick, UK

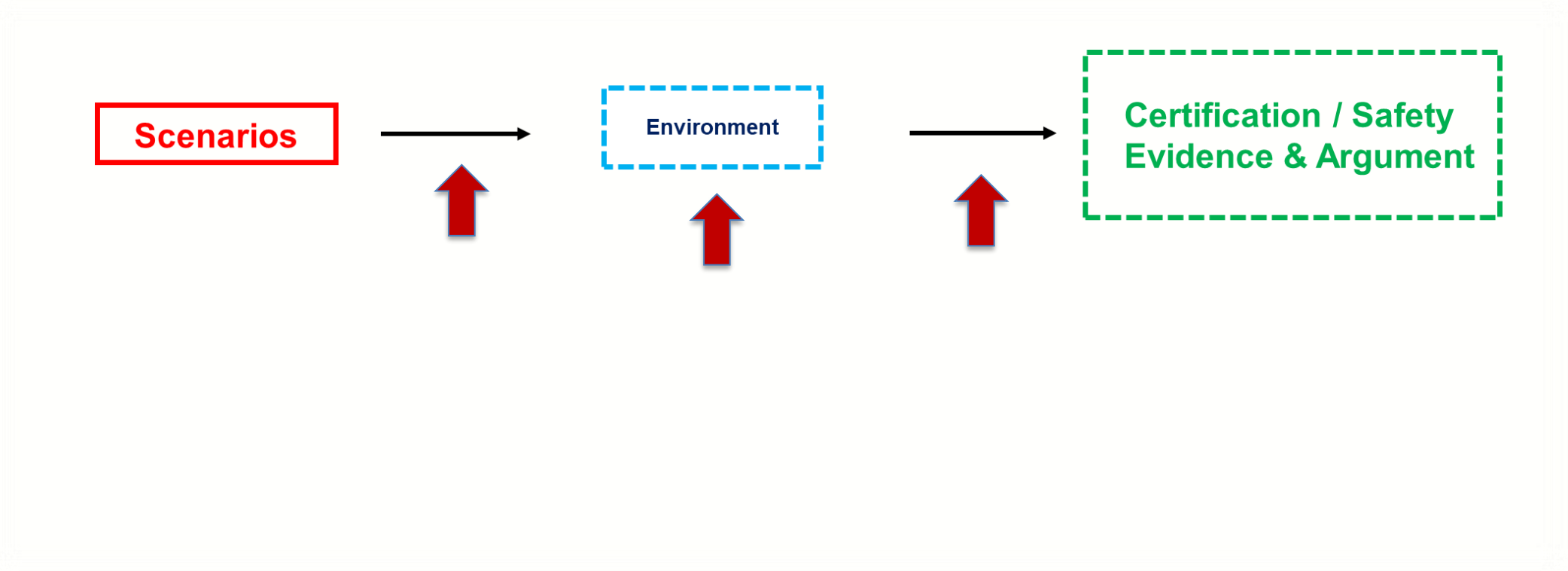
26 April 2024



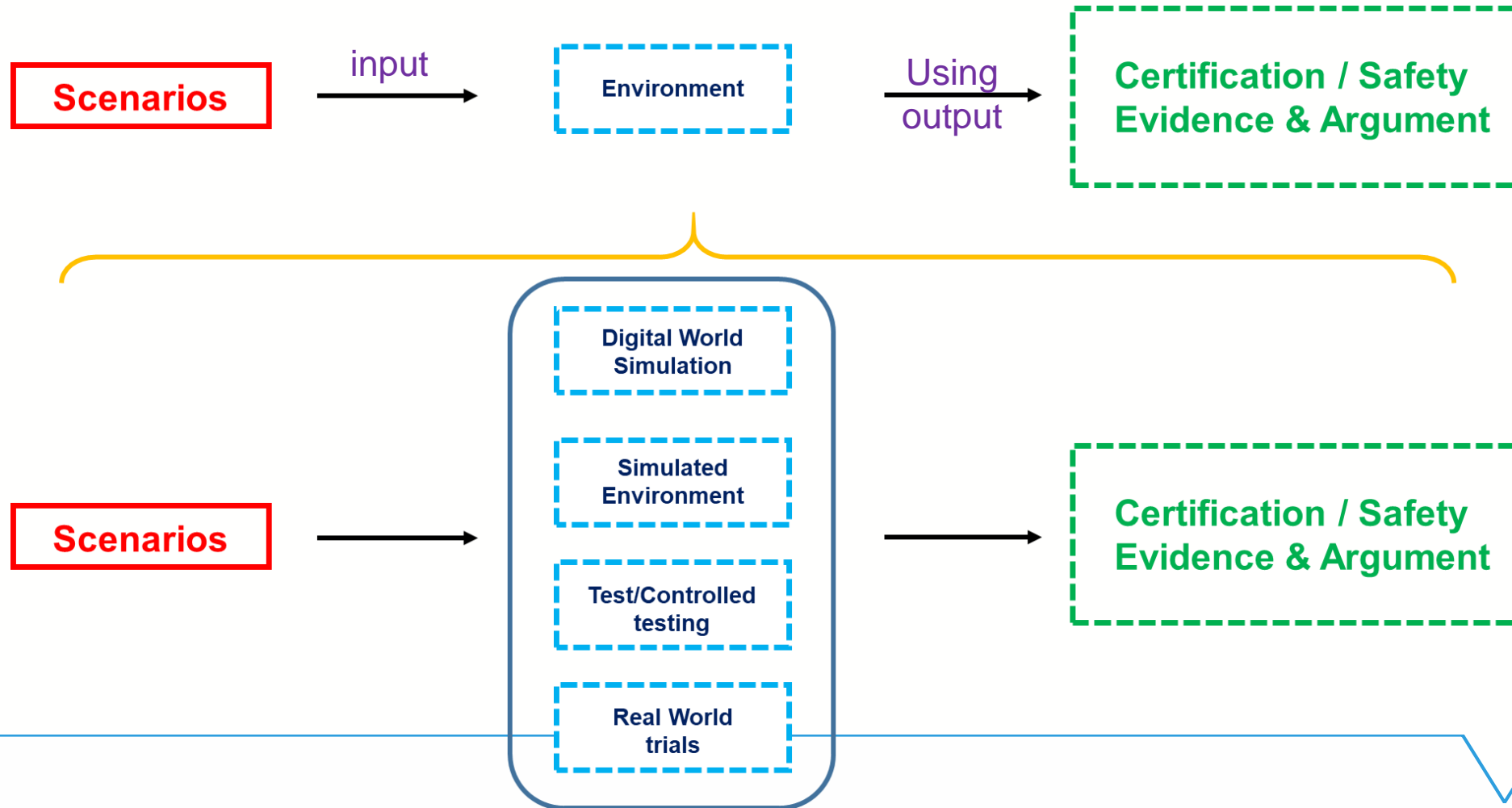
V&V Continuum



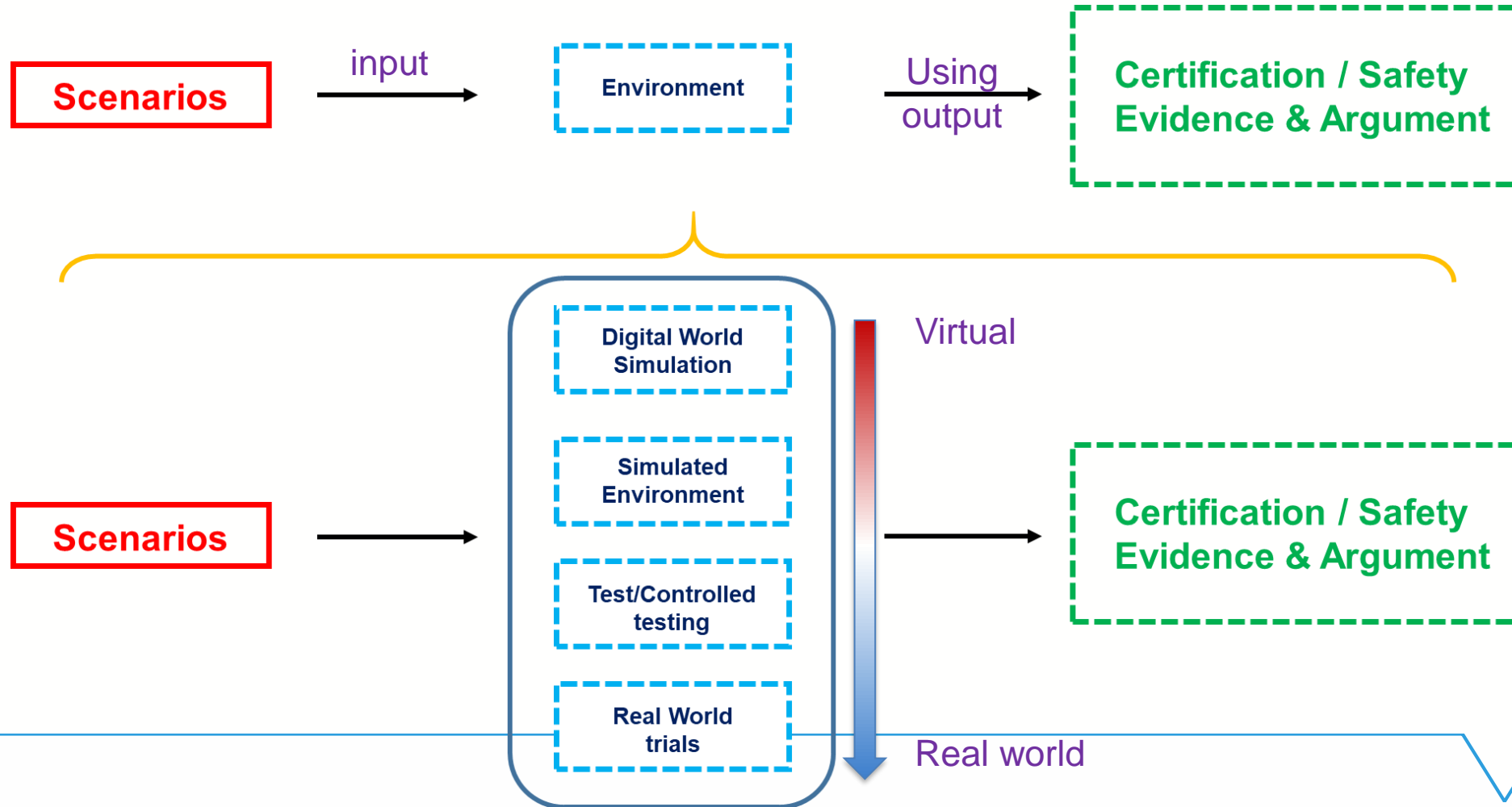
V&V Continuum



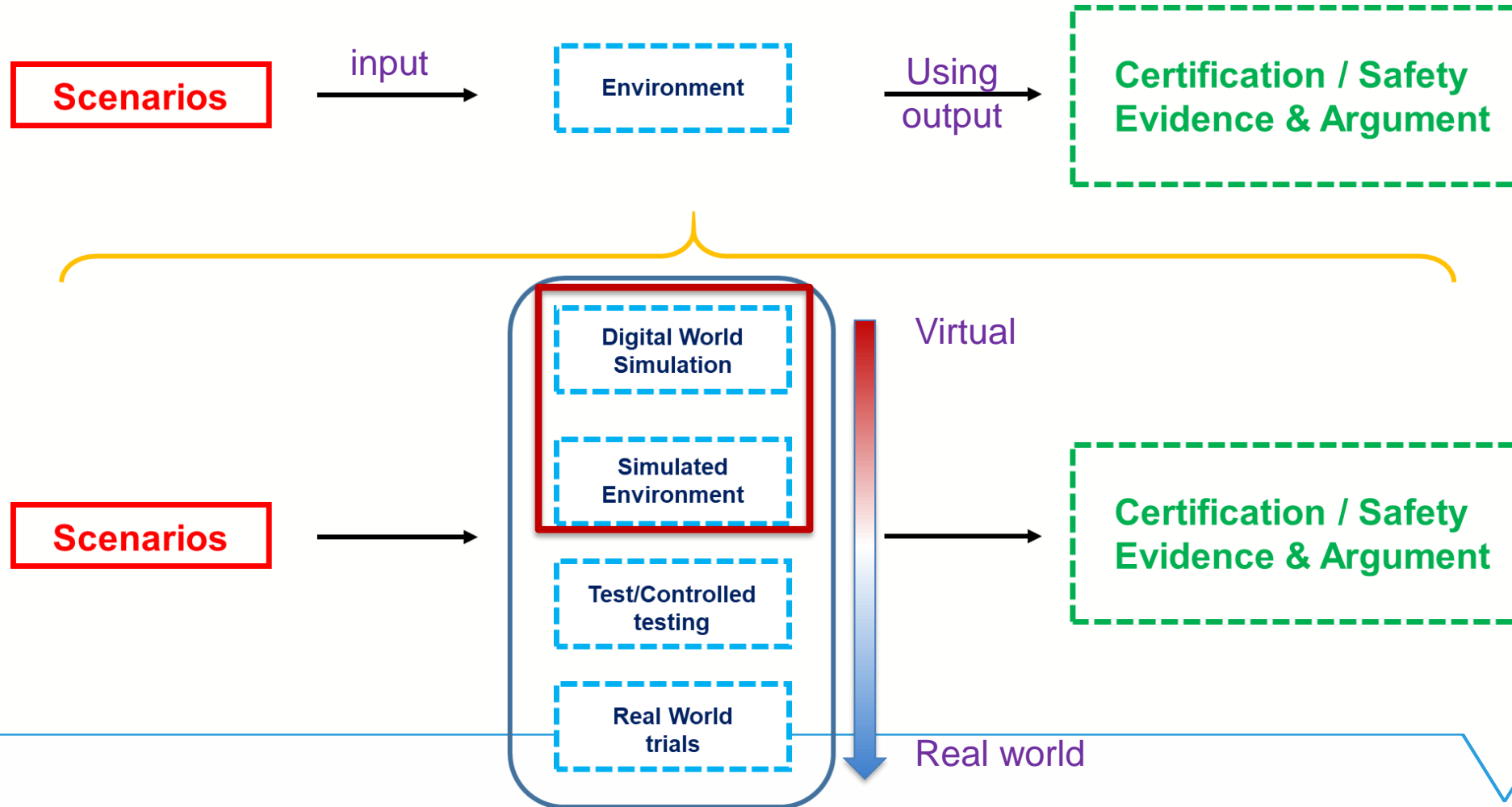
V&V Continuum



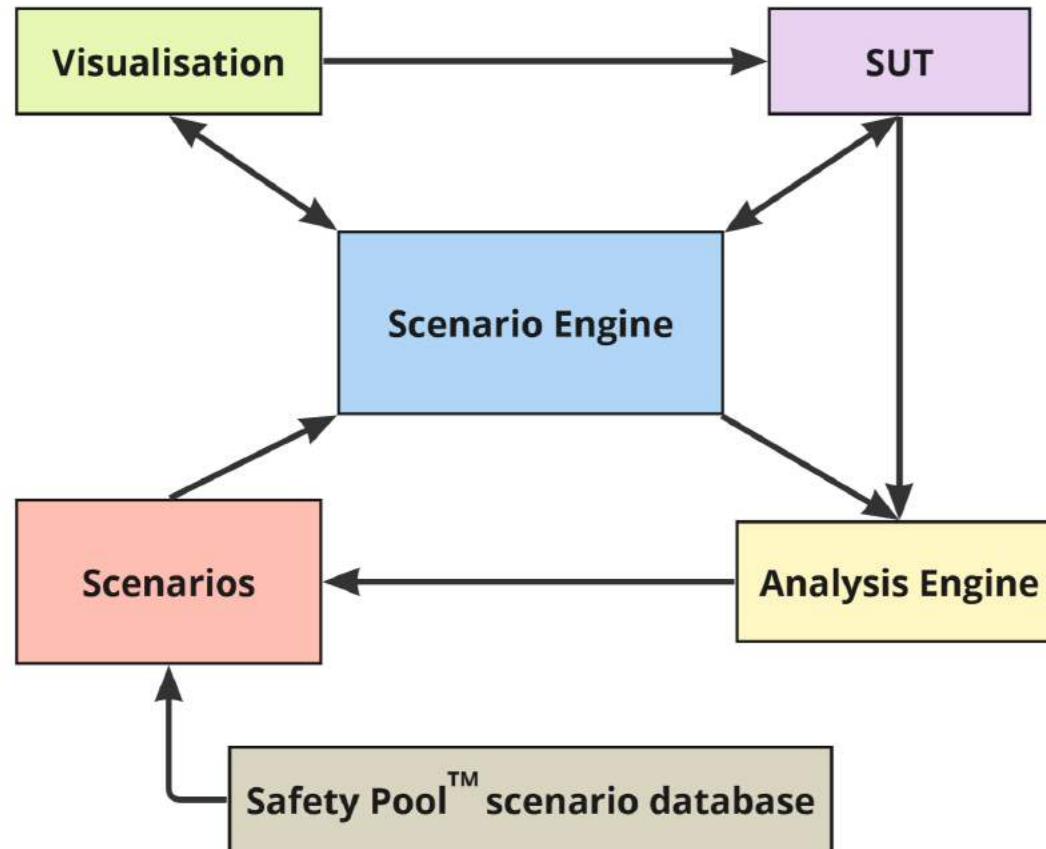
V&V Continuum

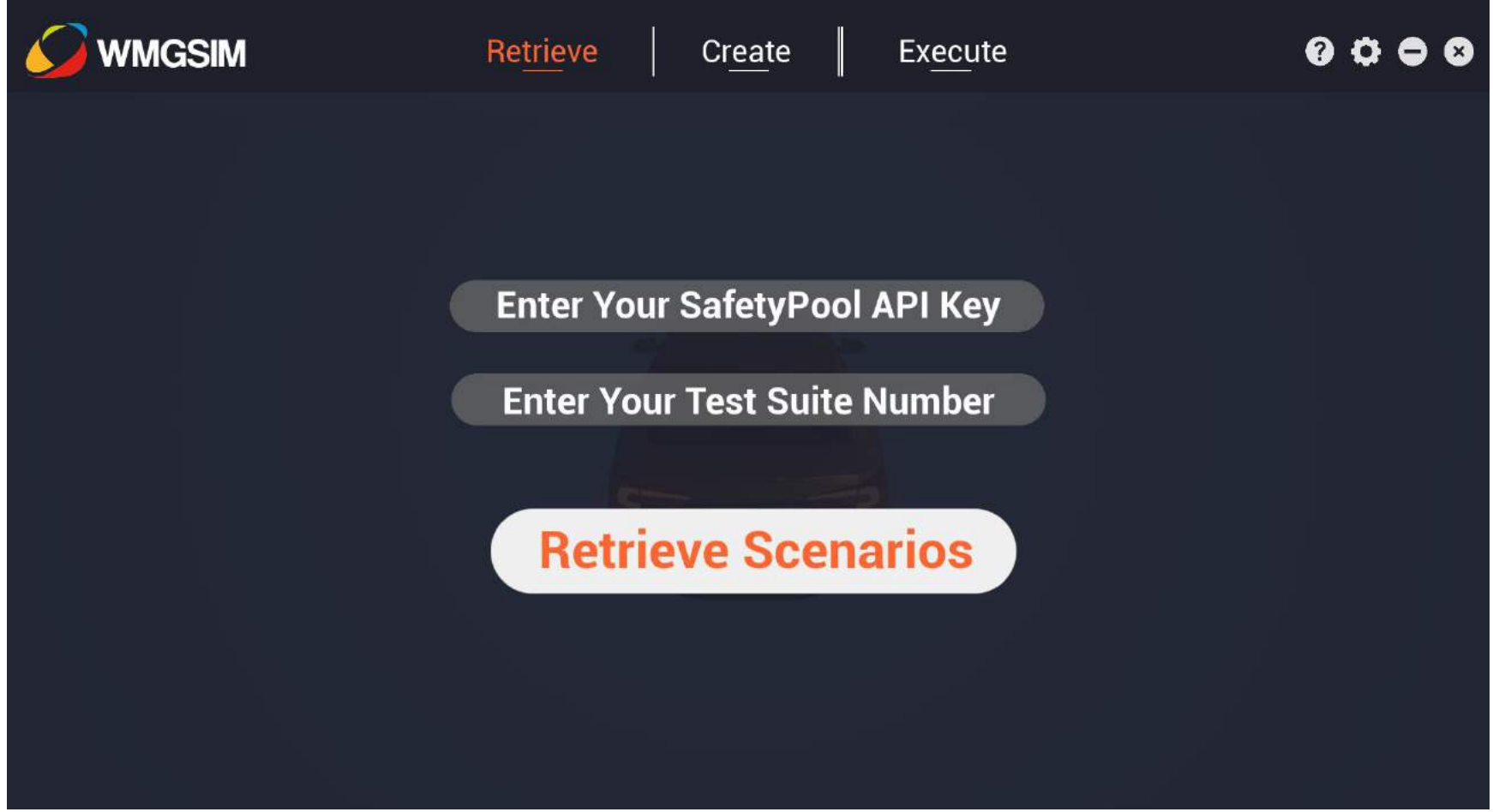


V&V Continuum



Simulation Framework at a Glance

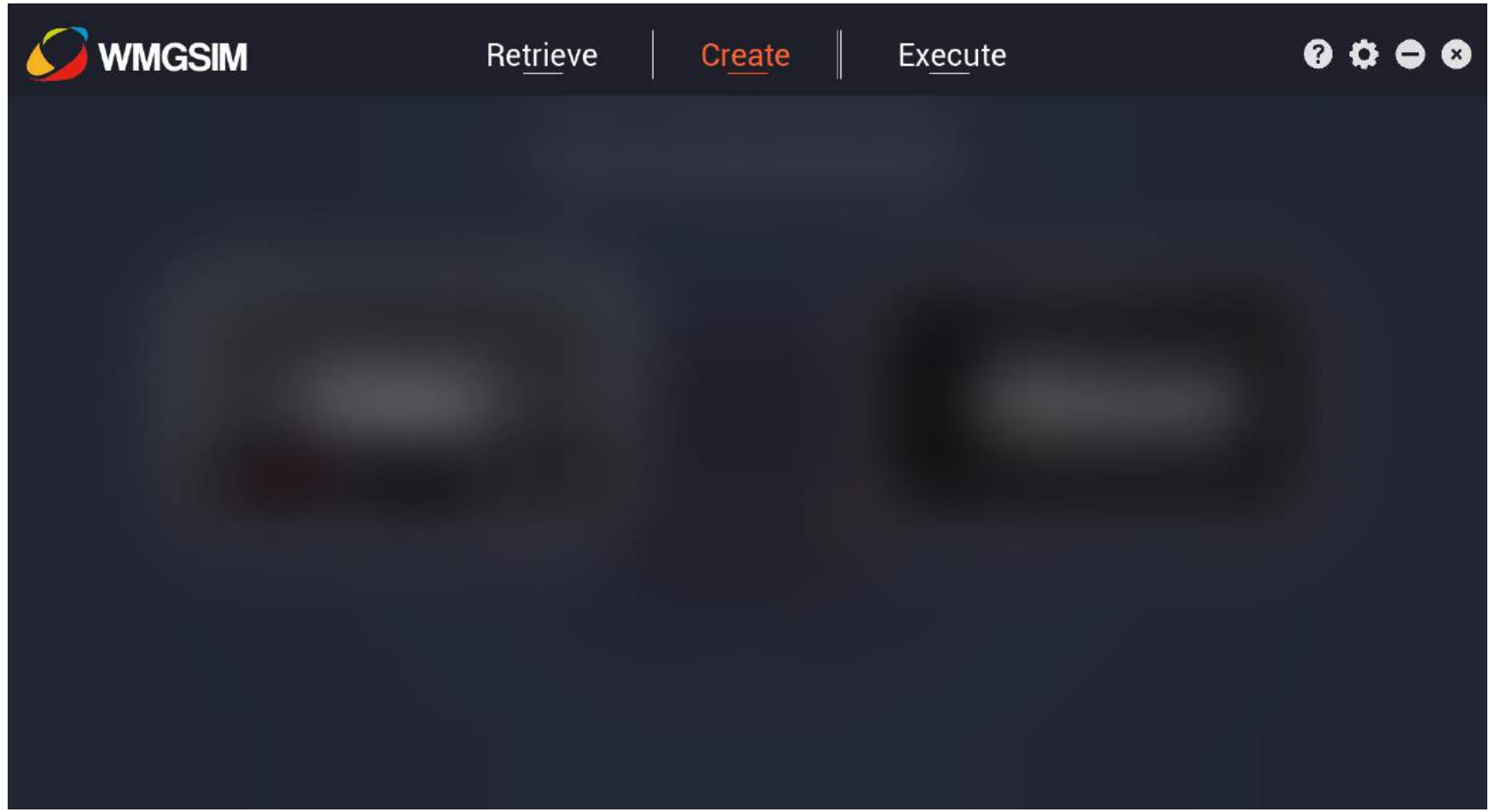


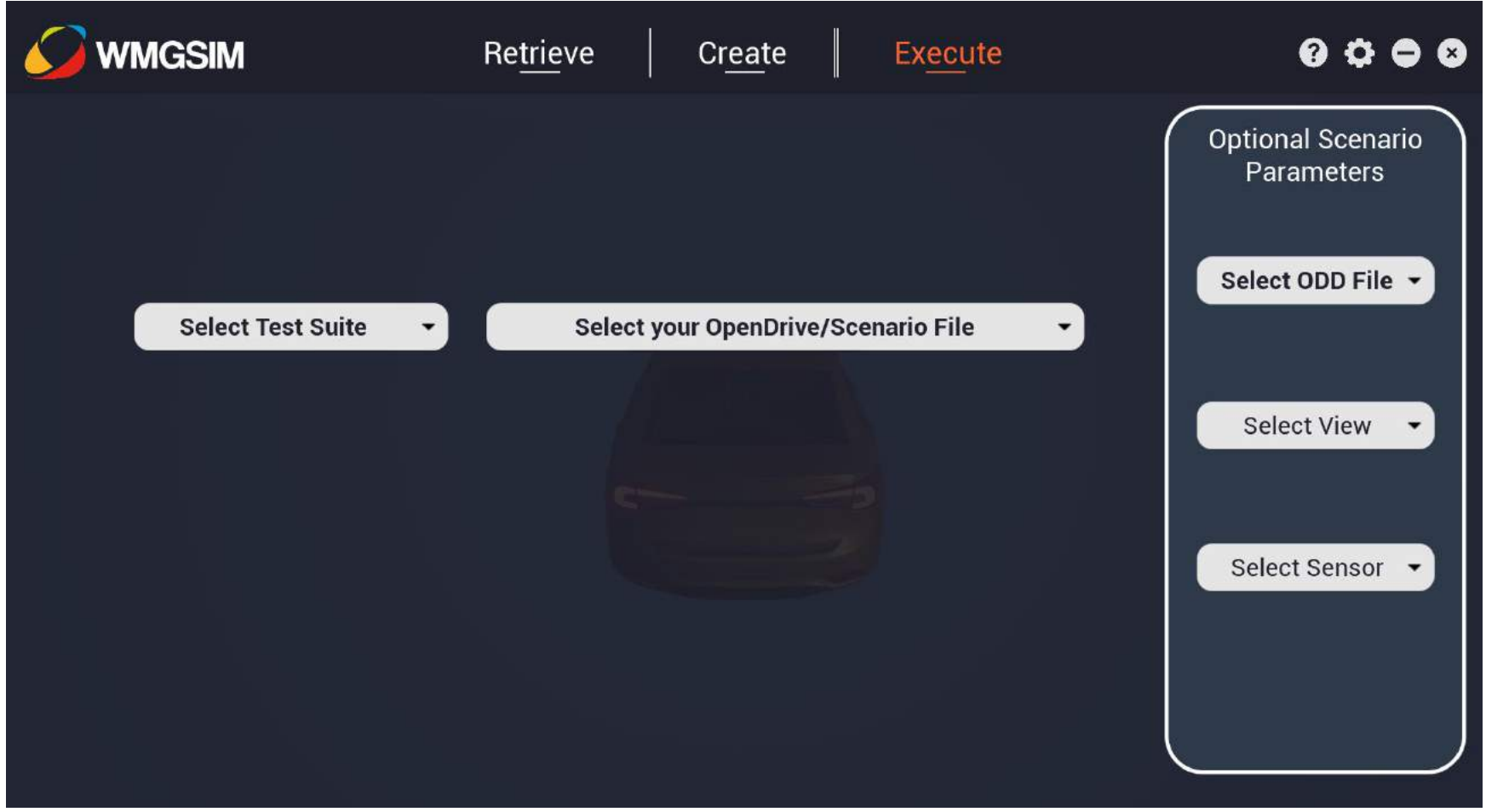


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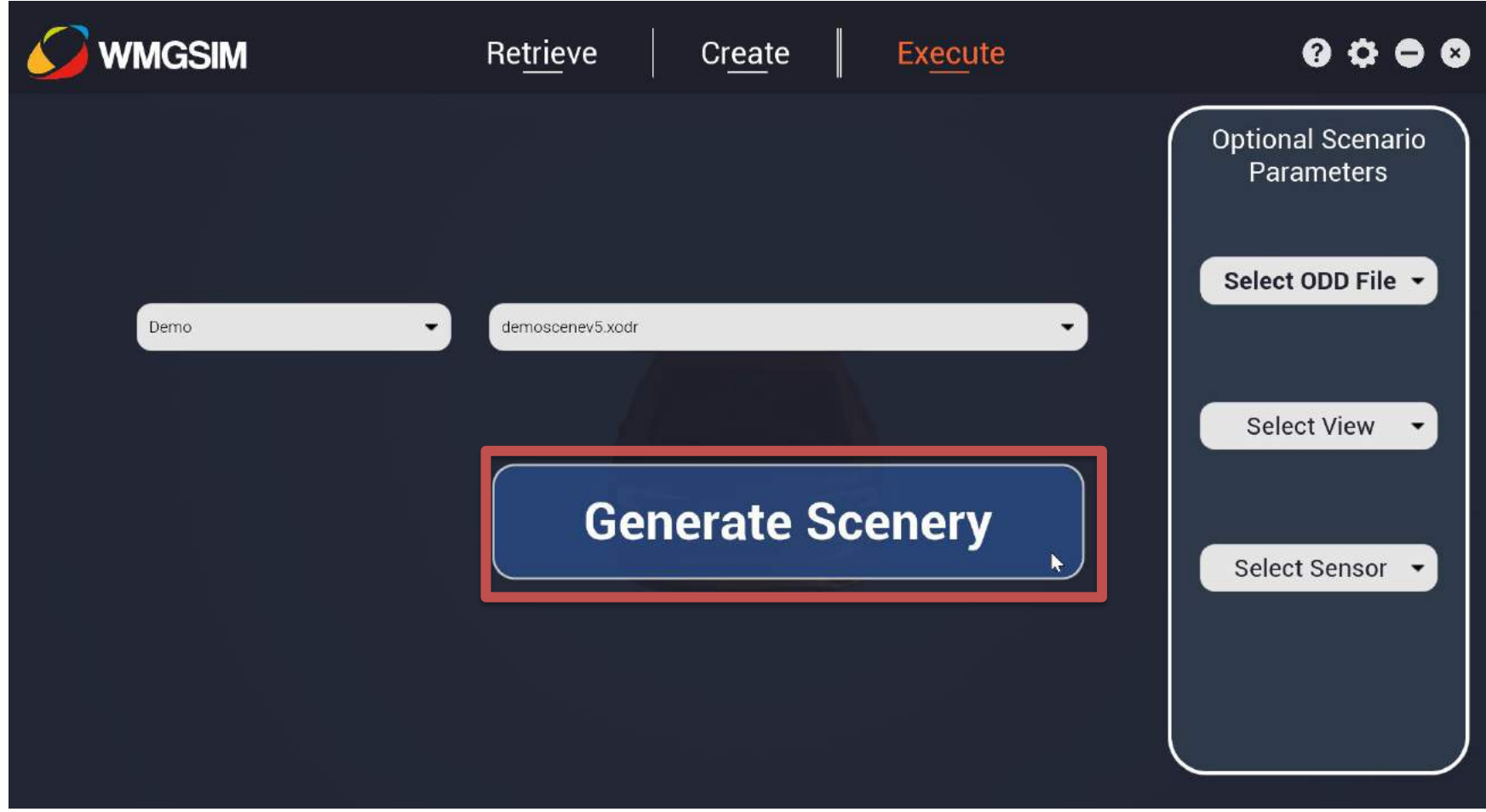
197

Retrieved Scenarios



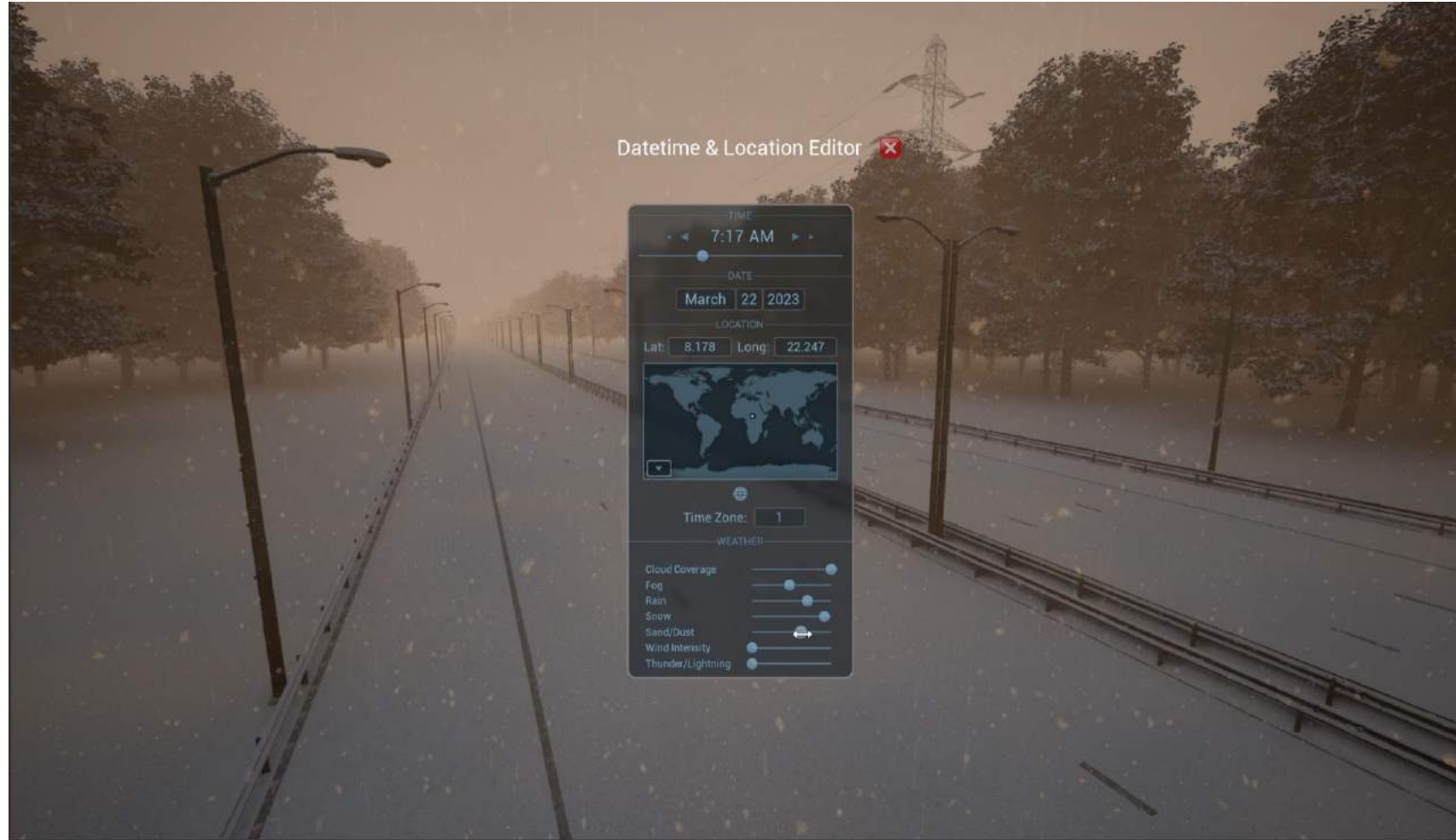


The screenshot shows the WMGSIM web application interface. At the top left is the WMGSIM logo. The top navigation bar contains three tabs: "Retrieve", "Create", and "Execute", with "Execute" highlighted in orange. In the top right corner, there are icons for help, settings, and window management. The main content area features two dropdown menus: the first is set to "Demo" and the second is set to "demoscenev5.xodr". Below these is a large blue button labeled "Generate Scenery". On the right side, a panel titled "Optional Scenario Parameters" contains three dropdown menus: "Select ODD File", "Select View", and "Select Sensor".



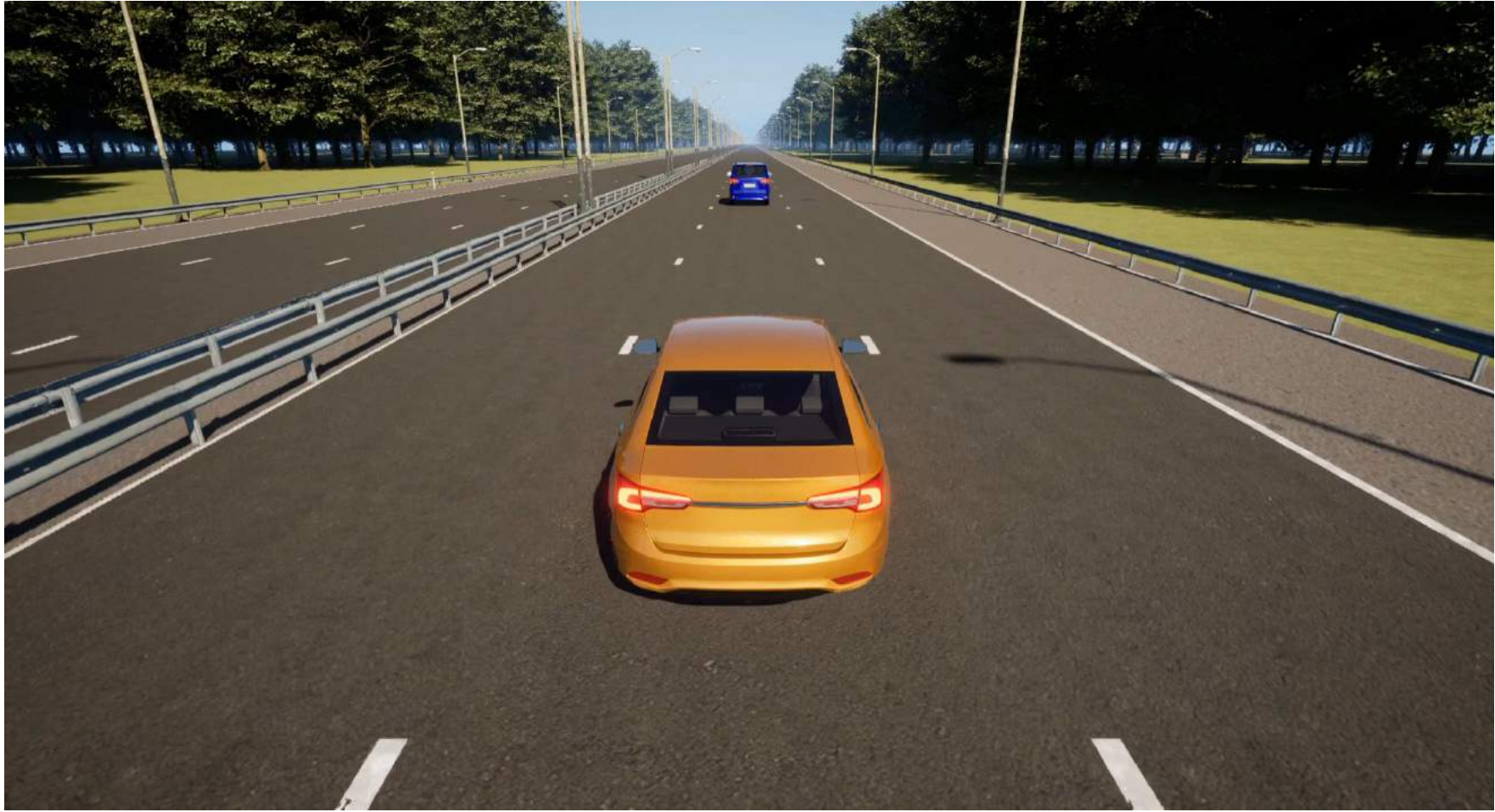






The screenshot displays the WMGSIM software interface. At the top left is the WMGSIM logo. The top navigation bar includes 'Retrieve', 'Create', and 'Execute' (highlighted in orange). On the right side of the top bar are icons for help, settings, and window management. The main area features two dropdown menus: the first is set to 'Demo' and the second to 'demoscenev5day.xosc'. Below these are three 'Execute Scenario' buttons with sub-labels: '(Without Analysis Engine)', '(With Analysis Engine)', and '(With System Under Test)'. A right-hand sidebar titled 'Optional Scenario Parameters' contains three dropdown menus: 'Select ODD File', 'Select View', and 'Select Sensor'.

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Demo

demoscenev5day.xosc

Execute Scenario
(Without Analysis Engine)

Execute Scenario
(With Analysis Engine)

Execute Scenario
(With System Under Test)

Optional Scenario Parameters

Select ODD File

- ODD 1.odd
- ODD 2.odd
- ODD 3.odd
- ODD 4.odd

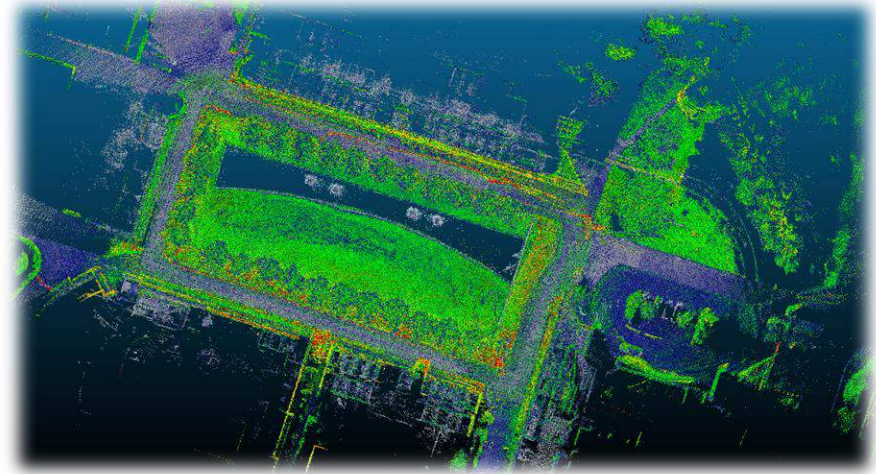
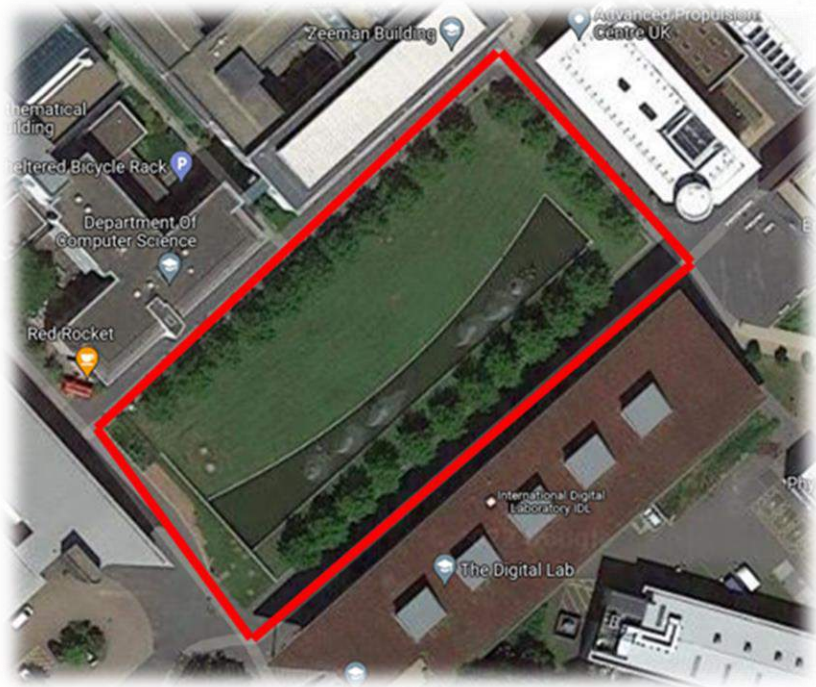
Follow Ego

LiDAR

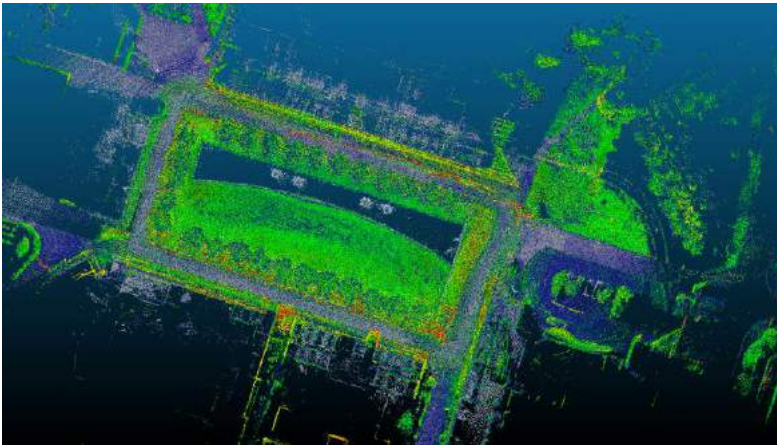
Virtual Testing at Scale (ODD, Risks etc)



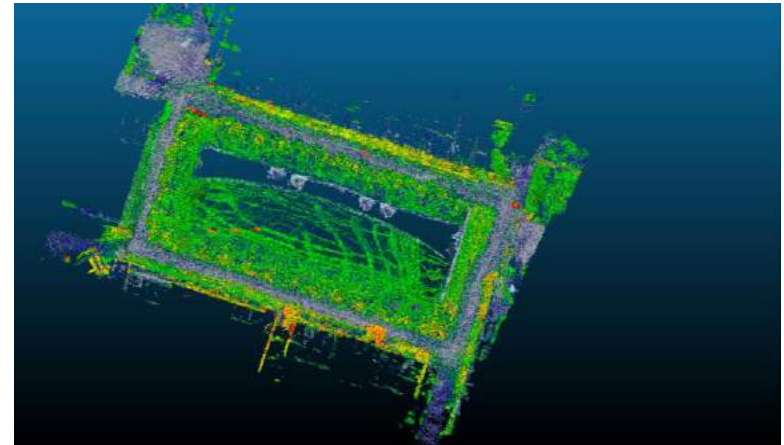
Qualifying Simulation Environment (VTE)



Qualifying Simulation Environment (VTE)

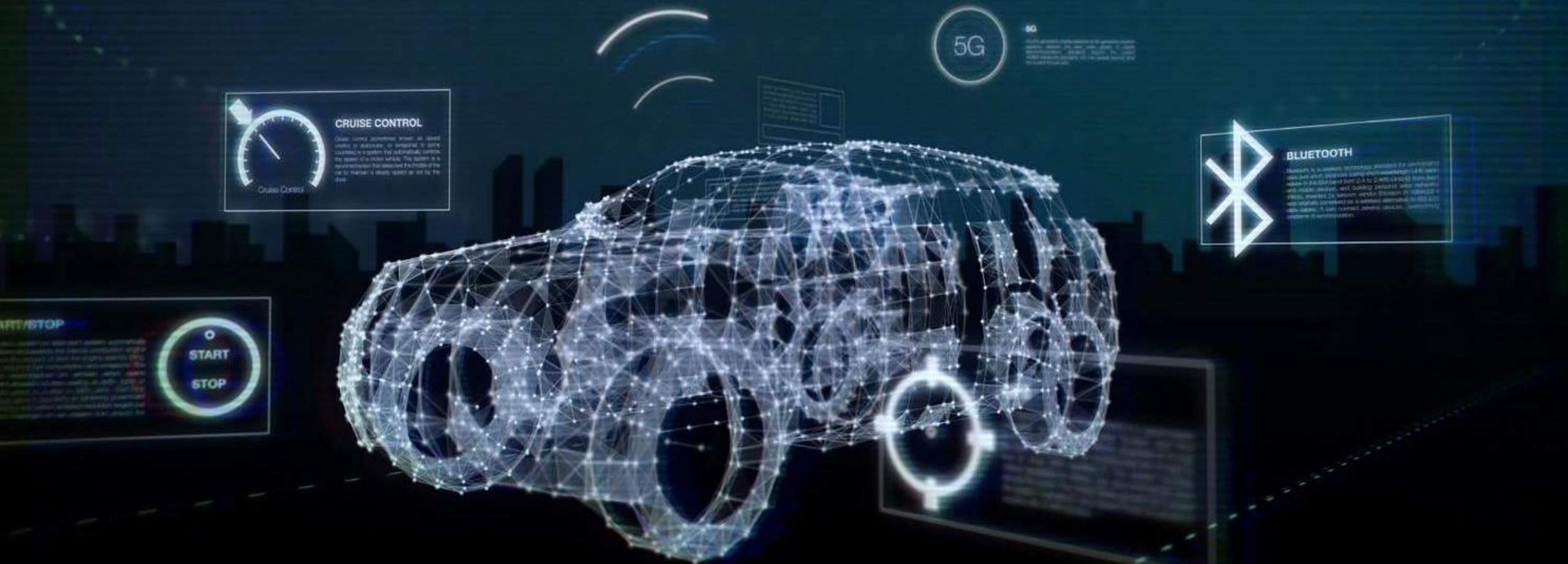


Real LiDAR Sensor Point Cloud



Virtual LiDAR Sensor Point Cloud

Thank you...





Questions?

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