Welcome to
SUNRISE Webinar

SUNRISE
SAFETY ASSURANCE FRAMEWORK FOR CONNECTED, AUTOMATED MOBILITY SYSTEMS

Scenario-based testing methodologies for safety assurance of Connected and Automated Mobility Systems

13 December 2023

13:00-14:00 CET

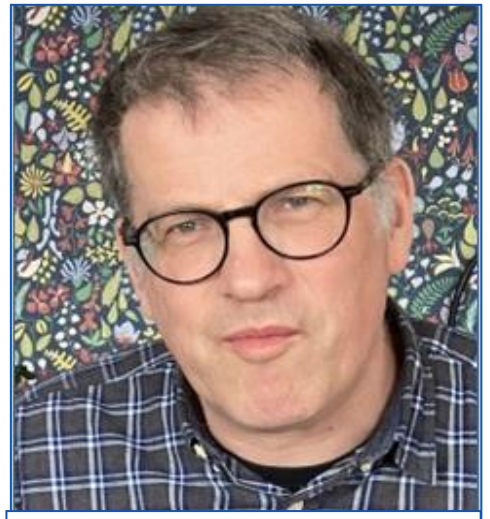
Funded by
the European Union

Speakers

Agenda

- SUNRISE project introduction
- CCAM V&V Methodology for Safety Assurance
- Baseline analysis of existing methodologies
- Q&A

Daniel Beckers
RWTH Aachen
University



Anders Thorsén
RISE Research
Institutes of Sweden AB

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SAFETY ASSURANCE FRAMEWORK FOR CONNECTED, AUTOMATED MOBILITY SYSTEMS

SUNRISE project introduction

Daniel Becker – RWTH Aachen University
Institute for Automotive Engineering

Funded by
the European Union

Vision

Goal: Develop a harmonized **CCAM* Safety Assurance Framework**

Run time	Sep 2022 – Aug 2025
Budget	13.455.866,25 €

Tool Developers
How can I make my tools fit those of others?

Researchers
How do I compare my automated vehicle test results to those of others?

Citizens
What to look for, when I buy an automated vehicle?

Certifiers
How should I assess the safety of automated vehicles?

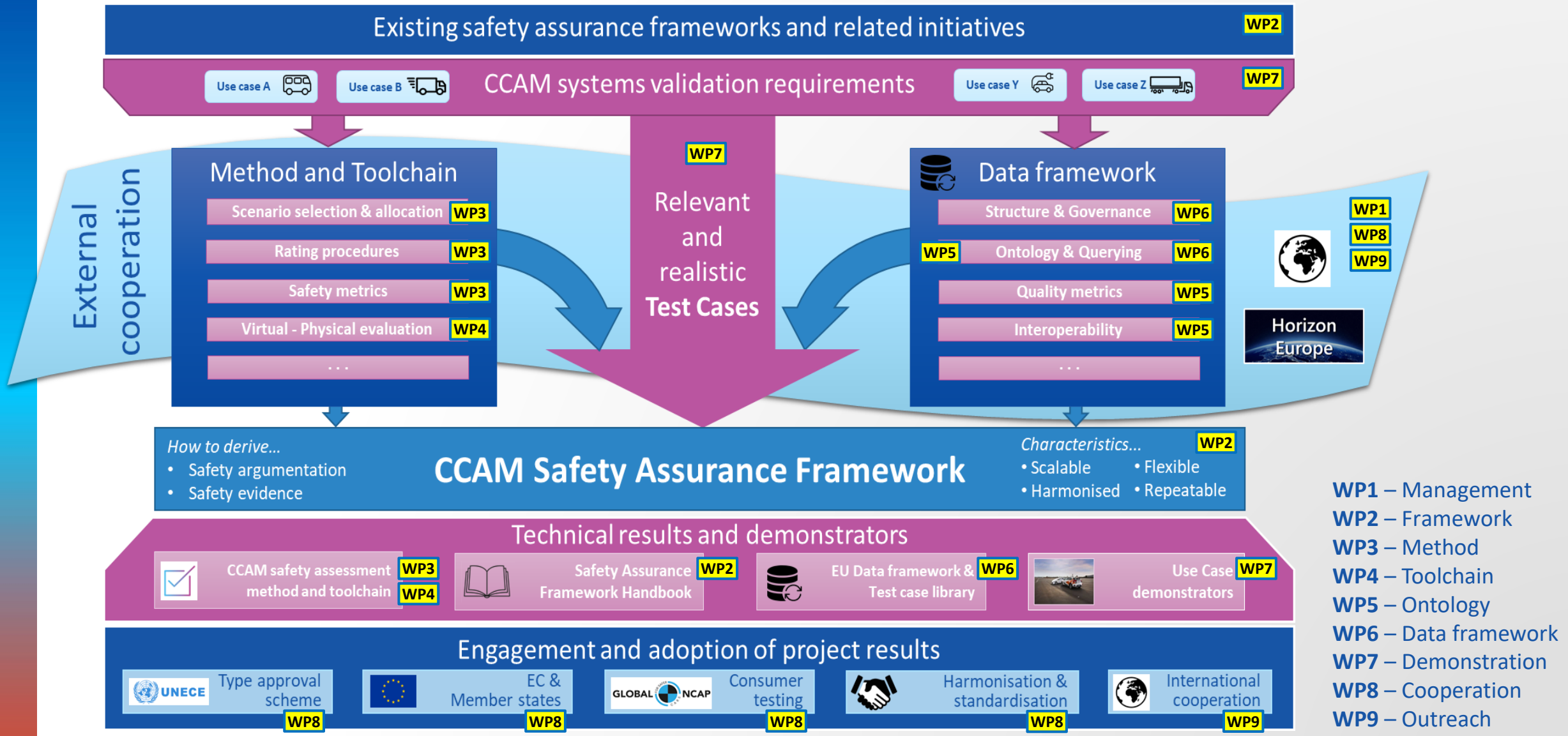
Vehicle Developers
What scenarios should I test my automated vehicles for?

SUNRISE Safety Assurance Framework for Connected and Automated Mobility Systems

Funded by the European Union
Project No. 101069573

* CCAM = Cooperative, Connected and Automated Mobility

Workplan



WP1 – Management
WP2 – Framework
WP3 – Method
WP4 – Toolchain
WP5 – Ontology
WP6 – Data framework
WP7 – Demonstration
WP8 – Cooperation
WP9 – Outreach

Partners

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TNO innovation for life

SIEMENS

WMG THE UNIVERSITY OF WARWICK

ERTICO ITS EUROPE

TOYOTA

TOYOTA MOTOR EUROPE

INSTITUT VEDECOM DU VÉHICULE DÉCARBONÉ ET COMMUNICANT ET DE SA MOBILITÉ

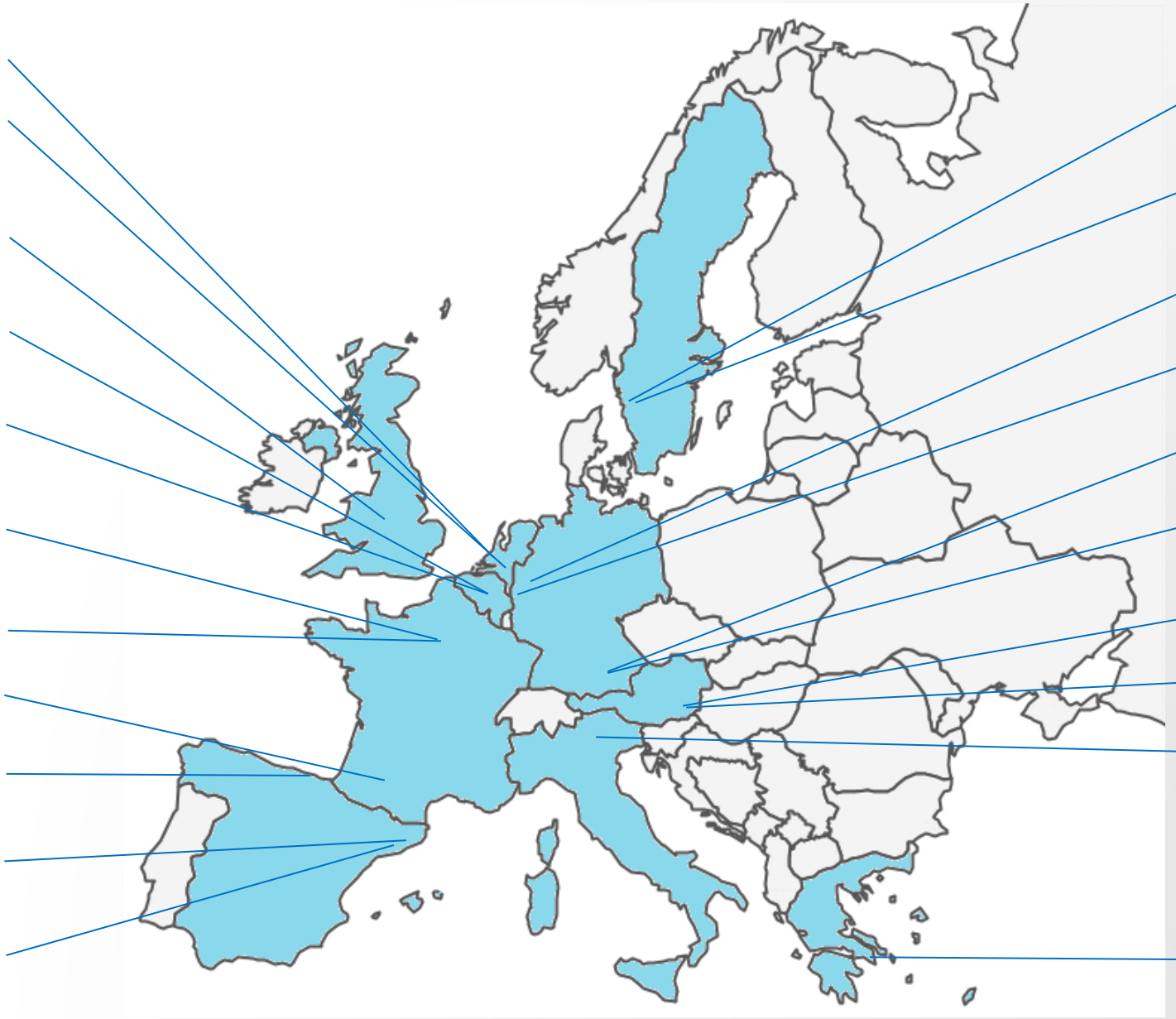
GROUPE RENAULT

Continental

vicomtech your R&D partner for smart digital solutions

CVC Centre de Visió per Computador

Applus IDIADA



CHALMERS UNIVERSITY OF TECHNOLOGY

RI.SE

bast

ika | RWTH AACHEN UNIVERSITY

deepen

infineon

AVL

virtual vehicle

UNIVERSITÀ DI TRENTO

ICCS

Team

SUNRISE team members
General Assembly Athens Sep 2023

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SAFETY ASSURANCE FRAMEWORK FOR CONNECTED, AUTOMATED MOBILITY SYSTEMS

CCAM V&V Methodology for Safety Assurance

Daniel Becker – RWTH Aachen University
Institute for Automotive Engineering

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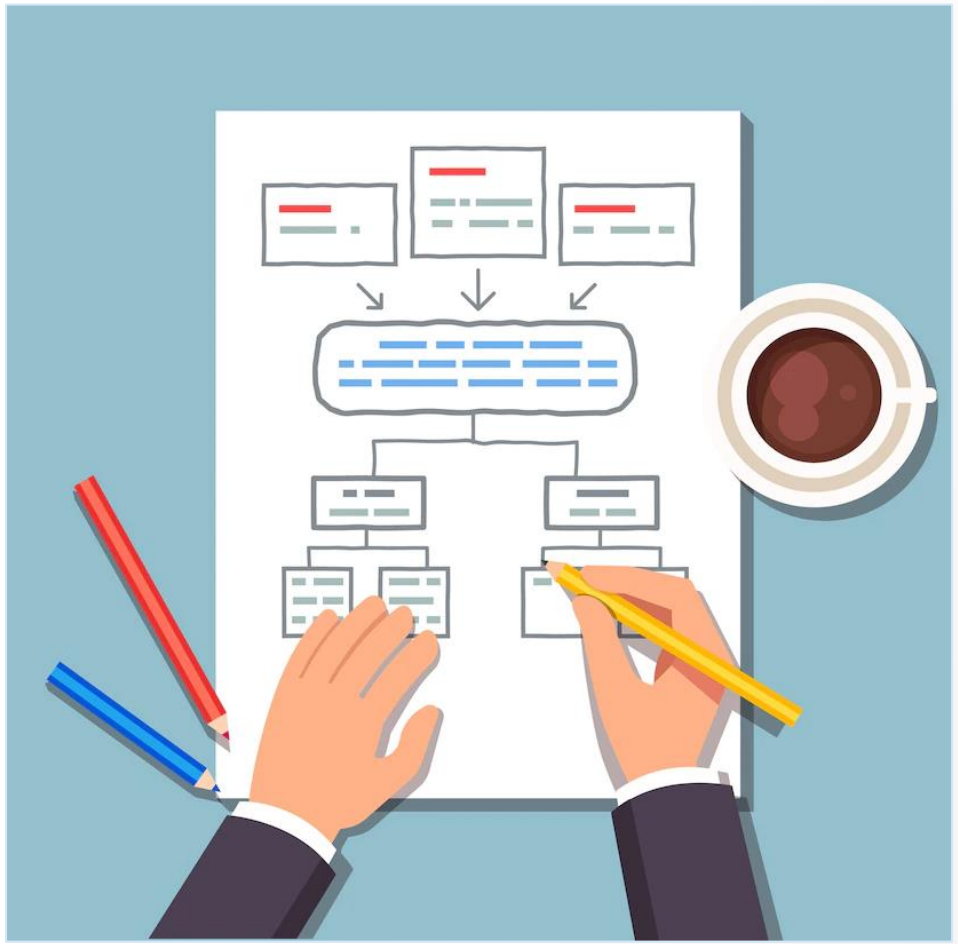
Work Package descriptions

WP3 – Method

Effort
227 PM's (14%)

Full title: CCAM V&V Methodology for Safety Assurance



Objectives

1. **Define** overall **methodology**
2. **Define** function-based **method** for **selection** of **scenarios** and **parameter space**
3. **Define** and implement **mechanisms** for **scenario allocation** to test toolchain
4. **Define** comprehensive verification, validation and **rating procedures**
5. **Define safety metrics** including **pass/fail criteria**

Main contact: Daniel Becker- daniel.becker@ika.rwth-aachen.de

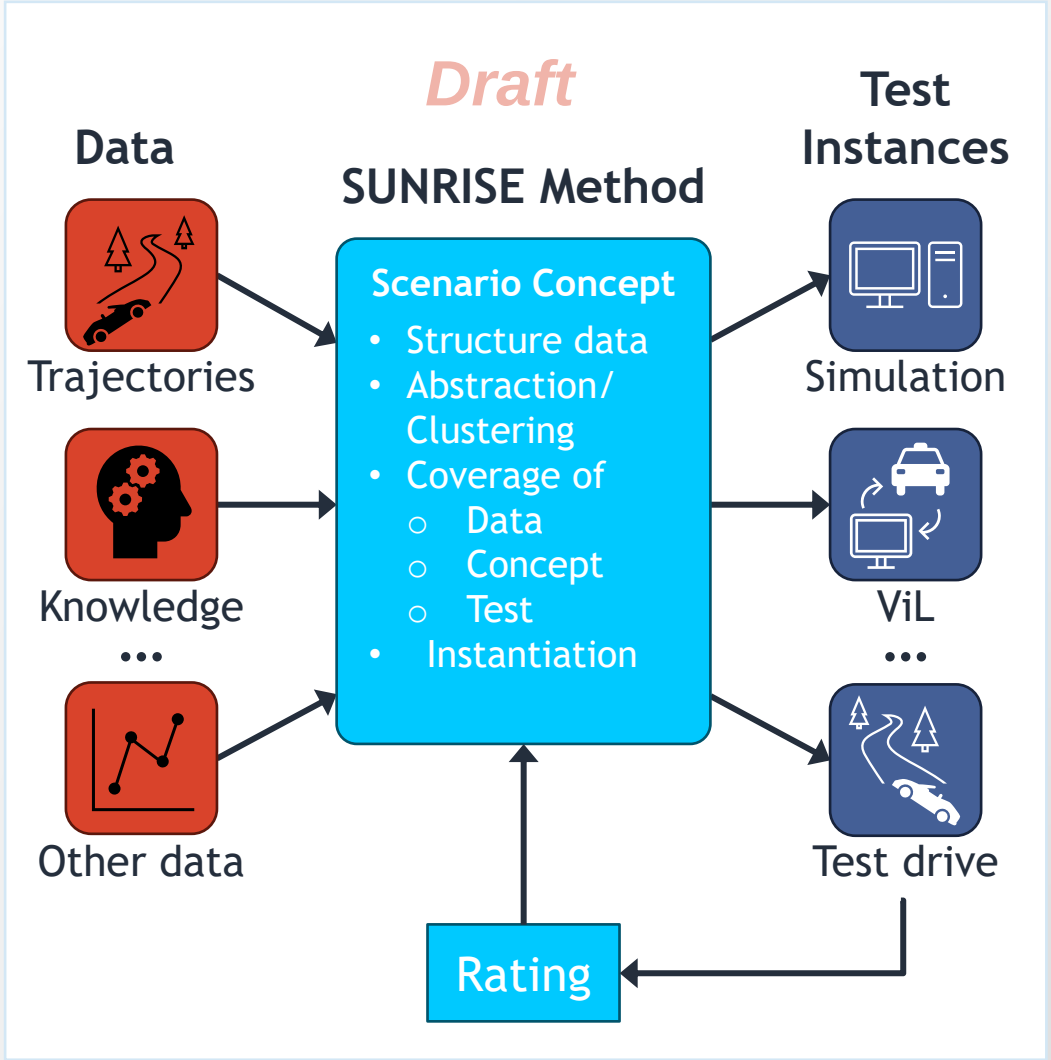
1 Page summary

WP3 – Method

Main Results

- **Submission** of Deliverable 3.1 about *other* scenario-based methodologies (task T3.1)
- Contribution to **high-level SAF**[1] (task T2.2) as input for **SUNRISE methodology** developed in WP3
- Definition of **requirements** for **scenarios** and **SAF interfaces** (task T3.2)
- Gather **knowledge** from project partners regarding **scenario clustering** (subspaces) and **test instances** (tasks T3.3 and T3.4)

Figure – Draft of SUNRISE Method



1. SAF = Safety Assurance Framework

Objectives and achievements

WP3 – Method

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Achievements

- **Obj. 1:** Foundation laid for methodology based on comparison to existing methods for safety assurance (treated in deliverable D3.1)
- **Obj. 2:** Requirements created in T3.2 on:
  - scenario concept
  - scenario parameters
  - parameter spaces
- **Obj. 3+4:** Partner presentations to form a common knowledge base among project members

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SAFETY ASSURANCE FRAMEWORK FOR CONNECTED, AUTOMATED MOBILITY SYSTEMS

Baseline analysis of existing methodology

Anders Thorsén – RISE Research Institutes of Sweden

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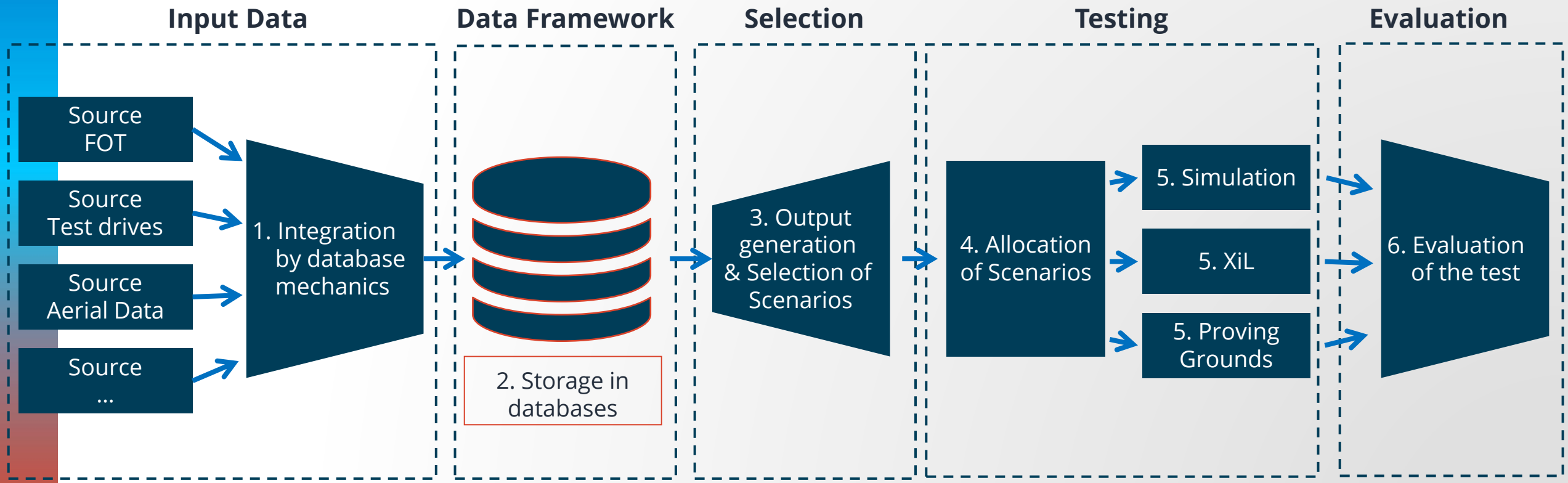
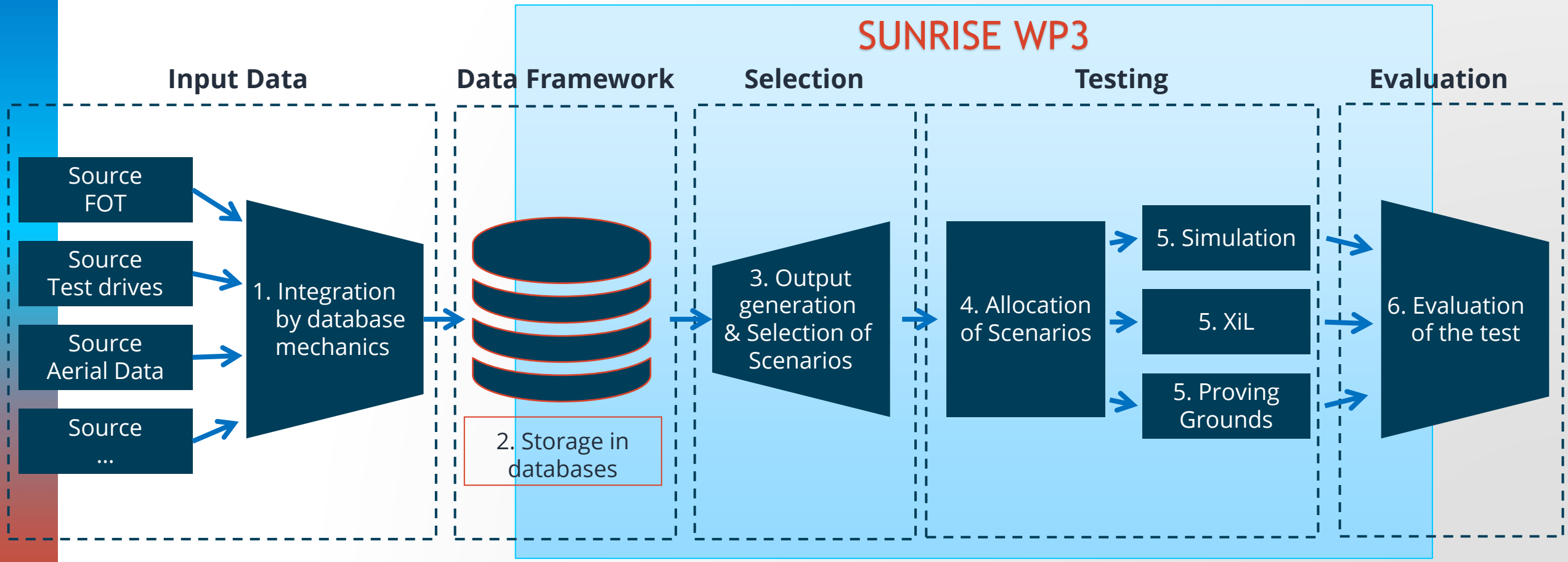
Scenario-based testing – a generic overview



From HEADSTART Final Event

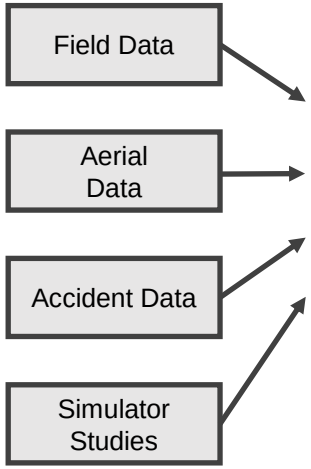
Scenario-based testing – a generic overview



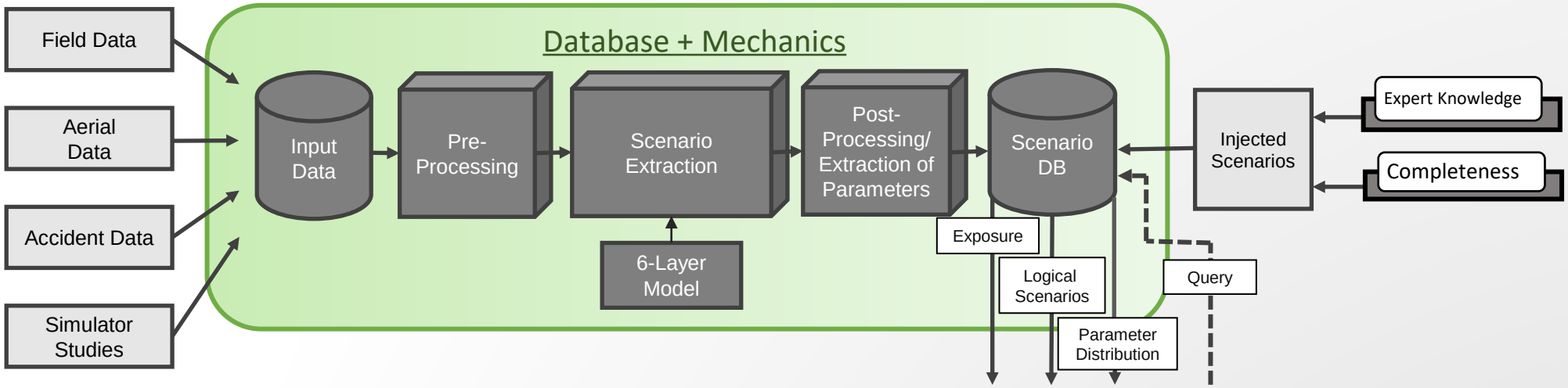
From HEADSTART Final Event

The HEADSTART methodology

The HEADSTART methodology



The HEADSTART methodology



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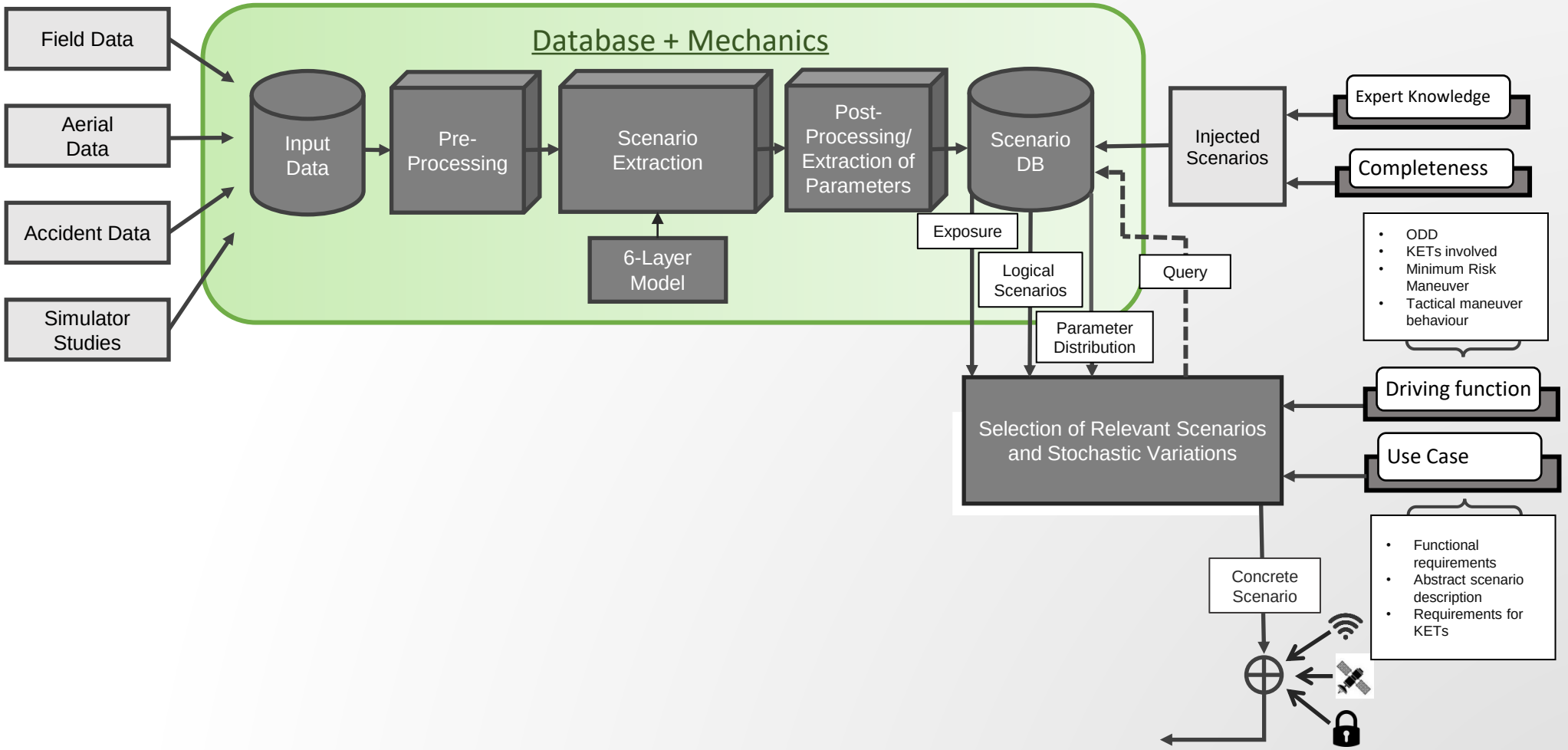

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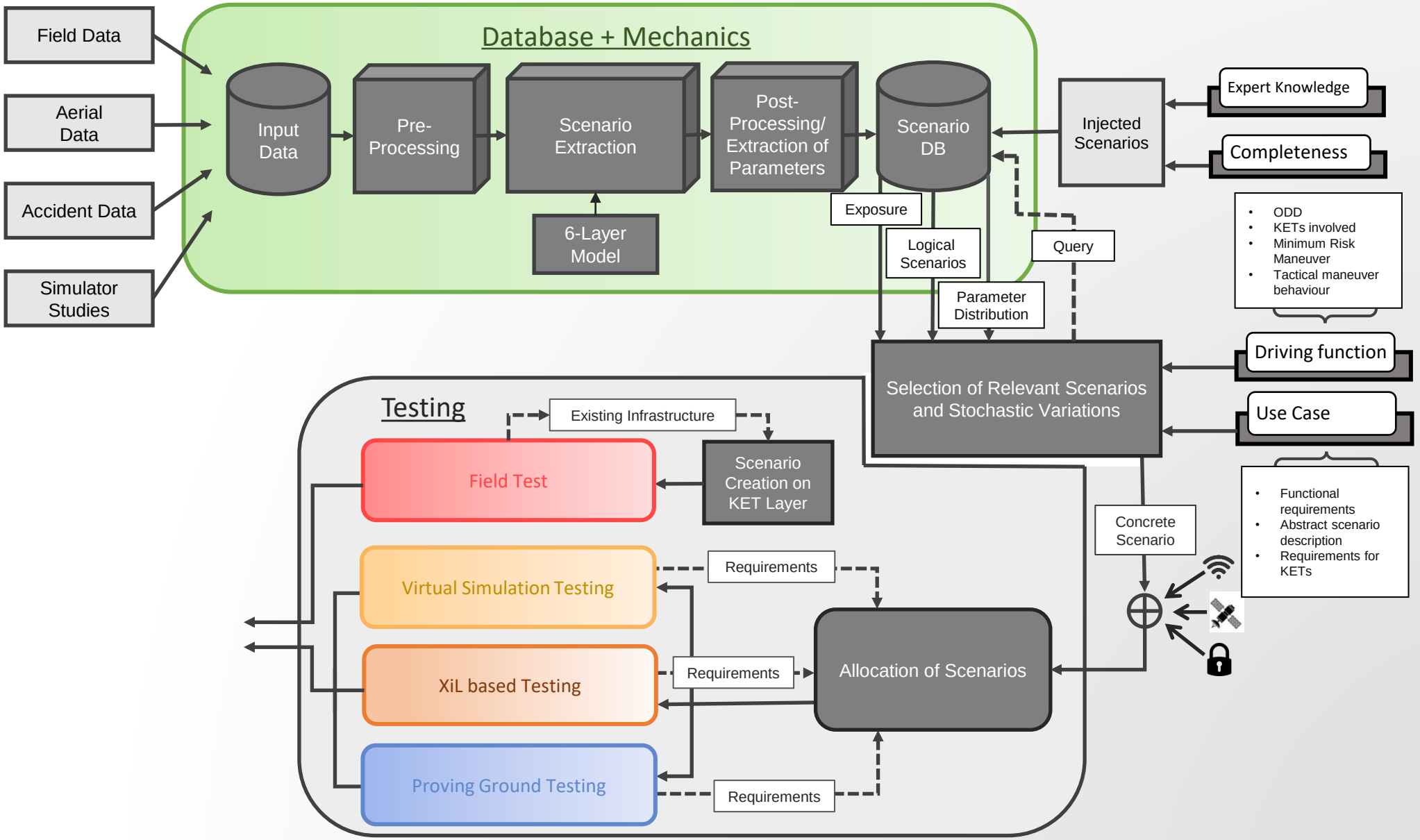

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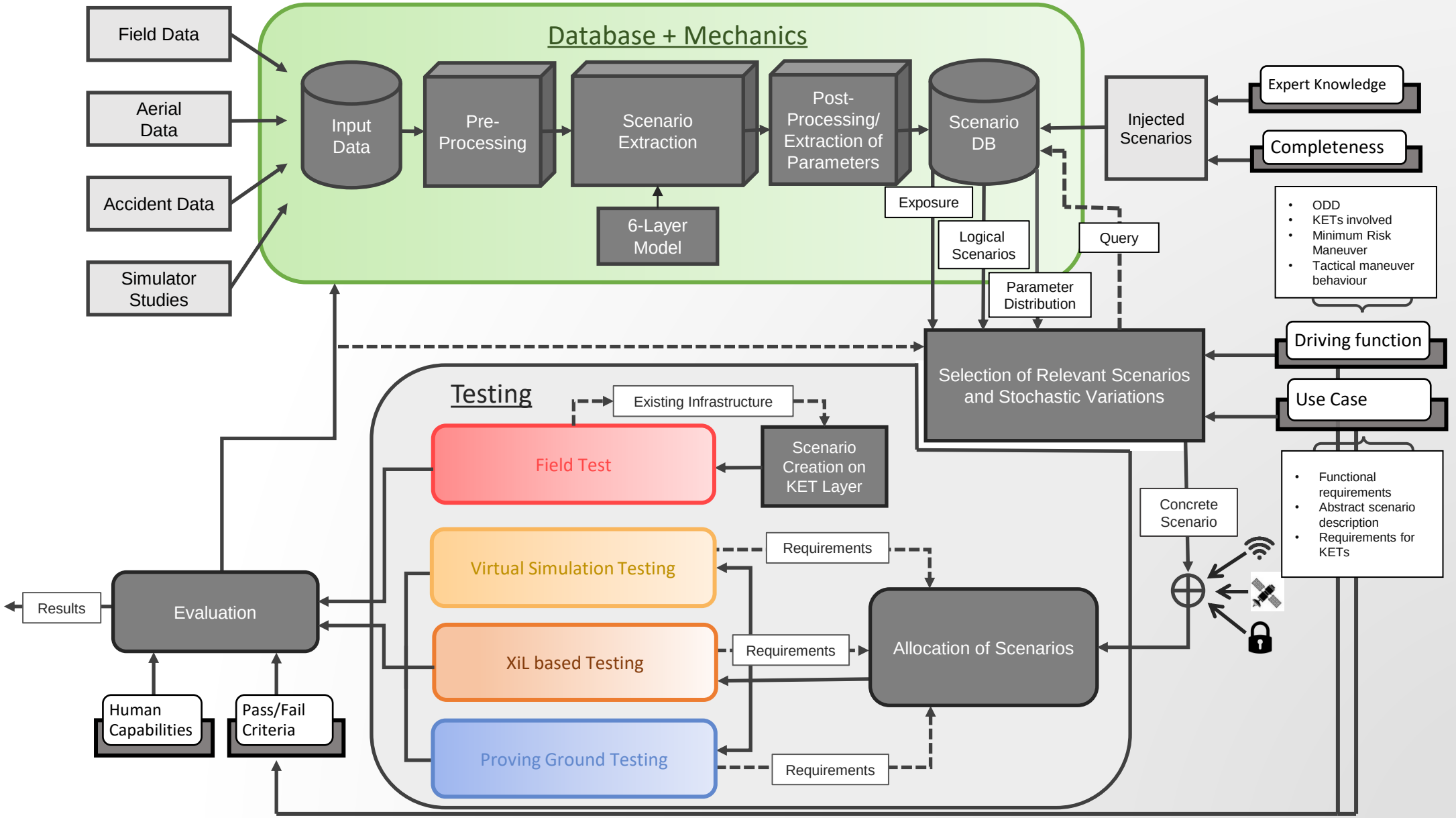

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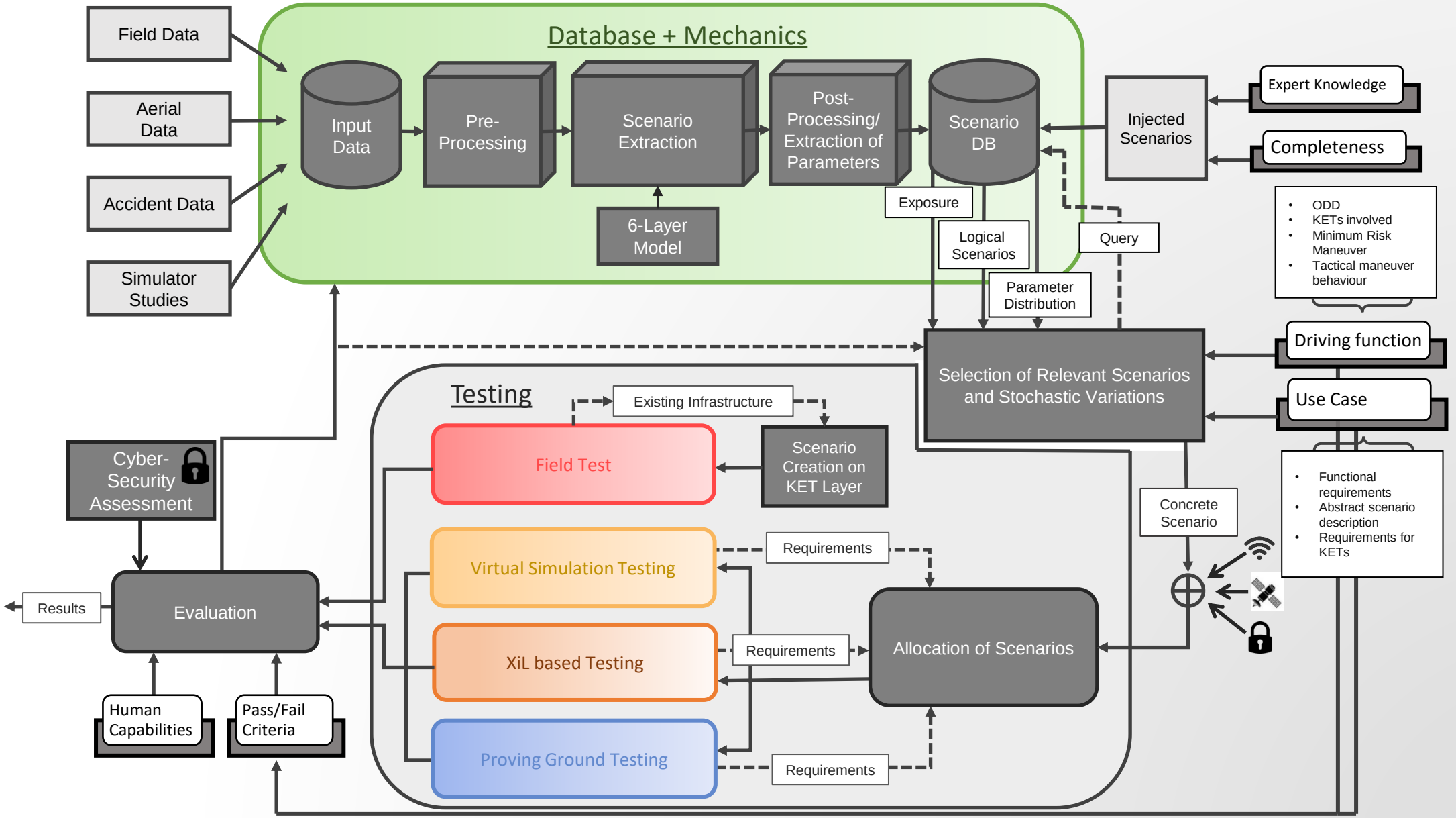

The baseline analysis

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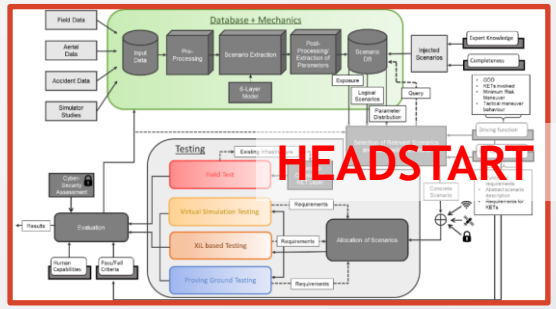
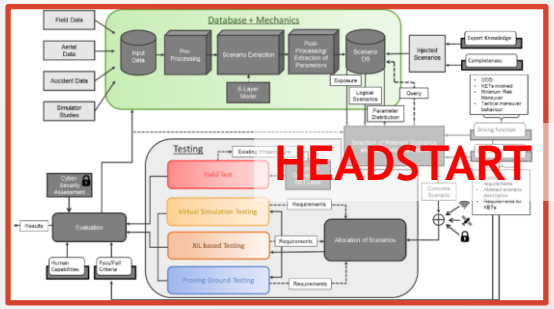


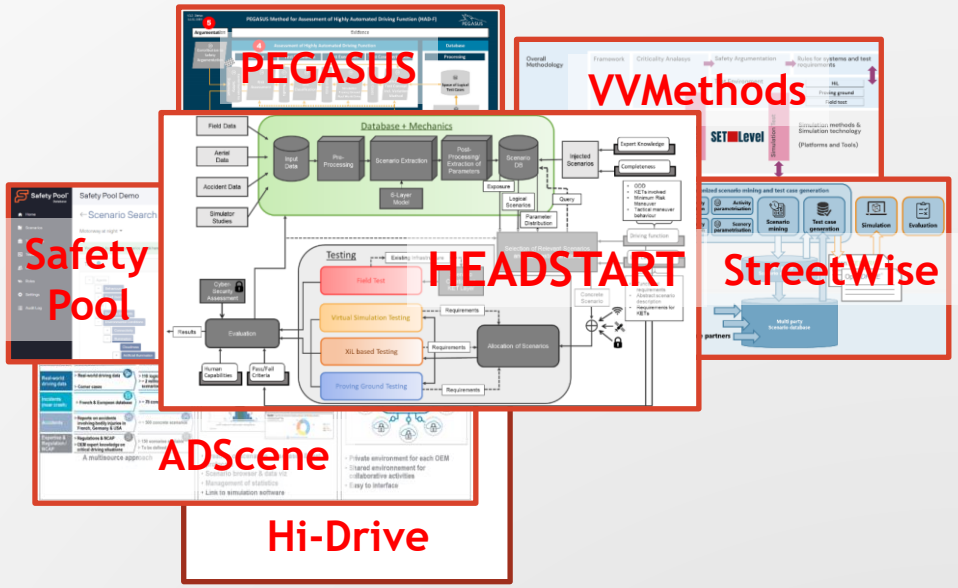
The baseline analysis

- Scenario concepts, parameter sets and descriptions
- Scenario sources and scenario generation
- Scenario database
- Selection of test scenarios
- Test scenario allocation concepts and metrics
- Test scenario execution
- AV assessment



The baseline analysis

- Other existing scenario-based methodologies
  - PEGASUS Project Family
  - StreetWise
  - Safety Pool
  - ADScene
  - Hi-Drive
  - SAKURA
  - CETRAN
  - CATARC
  - U.S. DOT



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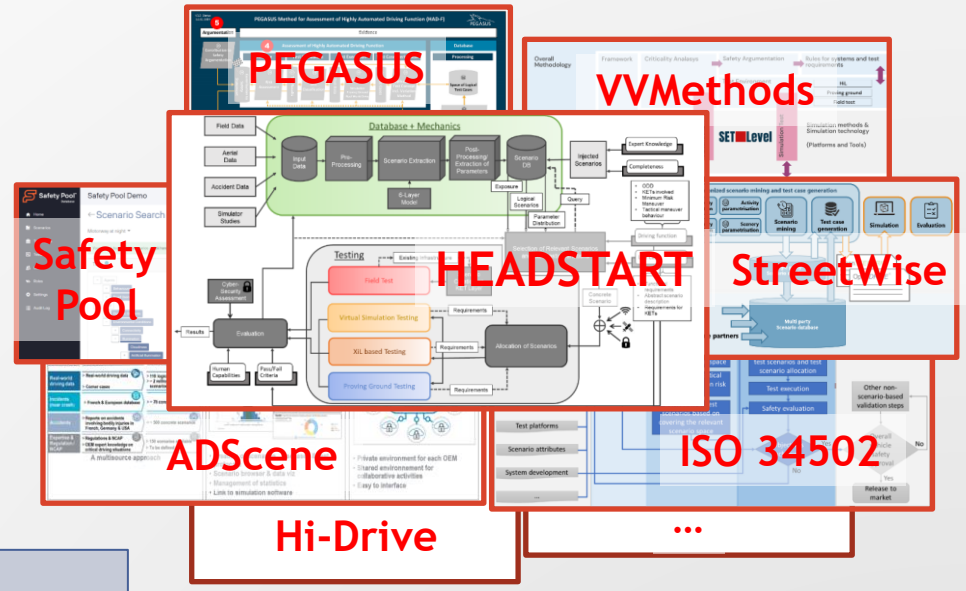

- Standardisation
  - ISO 3450x Test scenarios for automated driving systems
  - ISO 21448 SOTIF
  - ASAM OpenX Standards
- Other related initatives
  - Euro NCAP
  - UNECE
  - Other academic works
- SUNRISE D2.1 gap analysis

The baseline analysis

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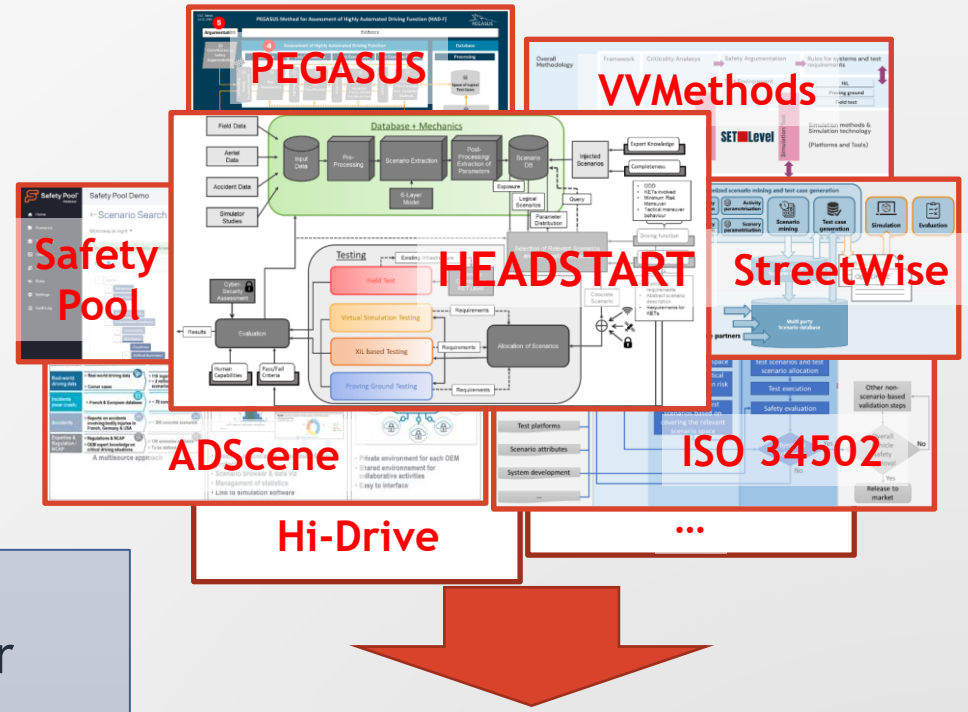

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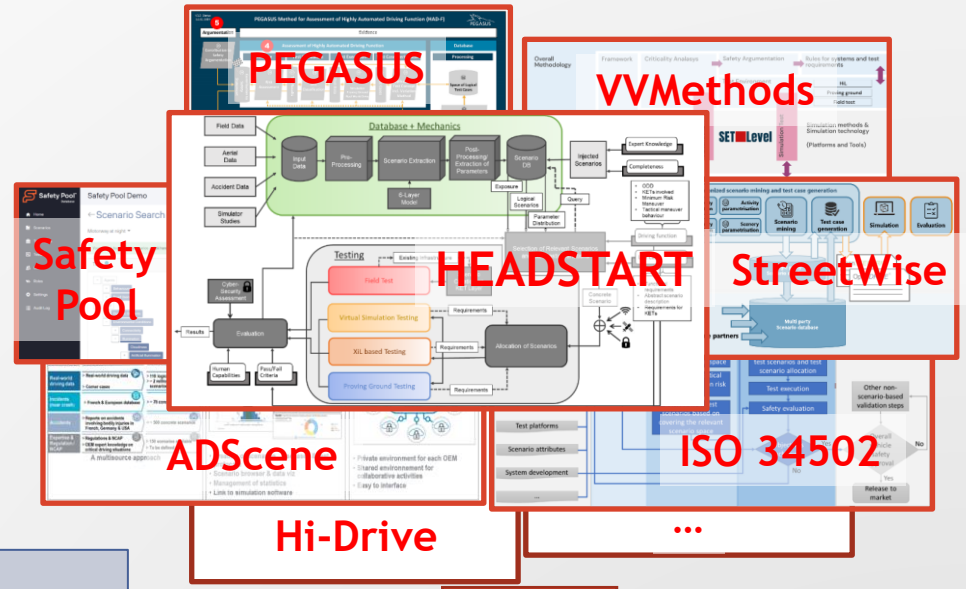

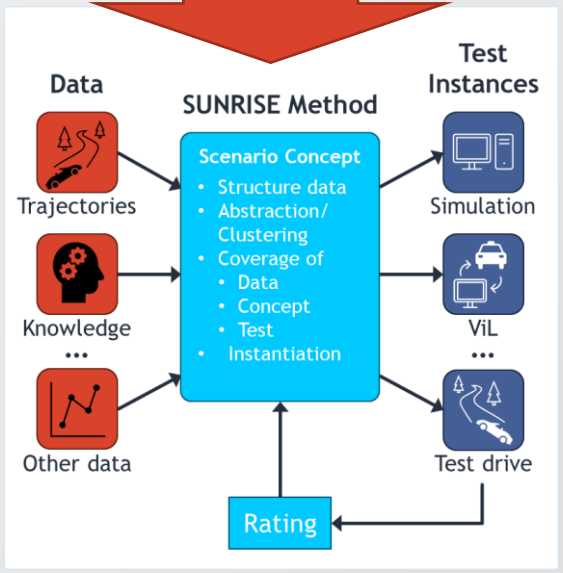

Expanding the HEADSTART method

1. A draft scenario definition for SUNRISE is proposed jointly with Task 3.2.
2. The scenario concept should be versatile and able to support different approaches
3. Like HEADSTART, SUNRISE targets multiple data sources and relies on external scenario databases.
4. HEADSTART's scenario selection process should be suitable to SUNRISE
5. SUNRISE's test scenario allocation process and metrics can be based on HEADSTART's process
6. SUNRISE should include mechanisms for identifying unknown scenarios.
7. The HEADSTART methodology does not explicitly include a systematic risk assessment element.

Expanding the HEADSTART method

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1. A draft scenario definition for SUNRISE is proposed jointly with Task 3.2

(A simplified version of the HEADSTART definition):

A scenario is a

*"**description of temporal and spatial traffic constellation**".*

The definition will be further refined in later tasks in SUNRISE.

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2. The scenario concept should be versatile and able to support different approaches

- HEADSTART's scenario concept is an embryo (compatible with, e.g., PEGASUS, StreetWise, and ADScene).
- Extend to support other methods like the ODD and behaviour model used in Safety Pool.
- Ensure it is flexible and easily adaptable to new concepts in the future.

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3. Like HEADSTART, SUNRISE targets multiple data sources and relies on external scenario databases.
   - Analysed databases* together cover multiple data sources including, real-world data from, e.g., vehicles, roadside units and drones, incident reports, accident reports, expert knowledge/regulations, and from simulations.
   - Qualitative and quantitative metrics to determine the completeness for a given ODD of the federated scenario database are missing and need to be developed.

* Includes PEGASUS family, StreetWise, Safety Pool, ADScene, Hi-Drive.

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4. HEADSTART's scenario selection process should be suitable to SUNRISE

- Requires that proper queries for scenario searches can be defined
- Metrics are needed for the quality evaluation of the selected scenarios
- Methods needed to further structure and limit the number of scenarios using, e.g. subspace creation techniques based on works done in, e.g., VVMethods and by WMG for Safety Pool.

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5. SUNRISE's test scenario allocation process and metrics can be based on HEADSTART's process:
   - First, the capabilities of each test method are analysed and then the test scenarios are allocated to suitable test methods.
   - Assuming proper queries for scenario searches can be solved, the test scenario allocation process should be compatible with all supported scenario databases.

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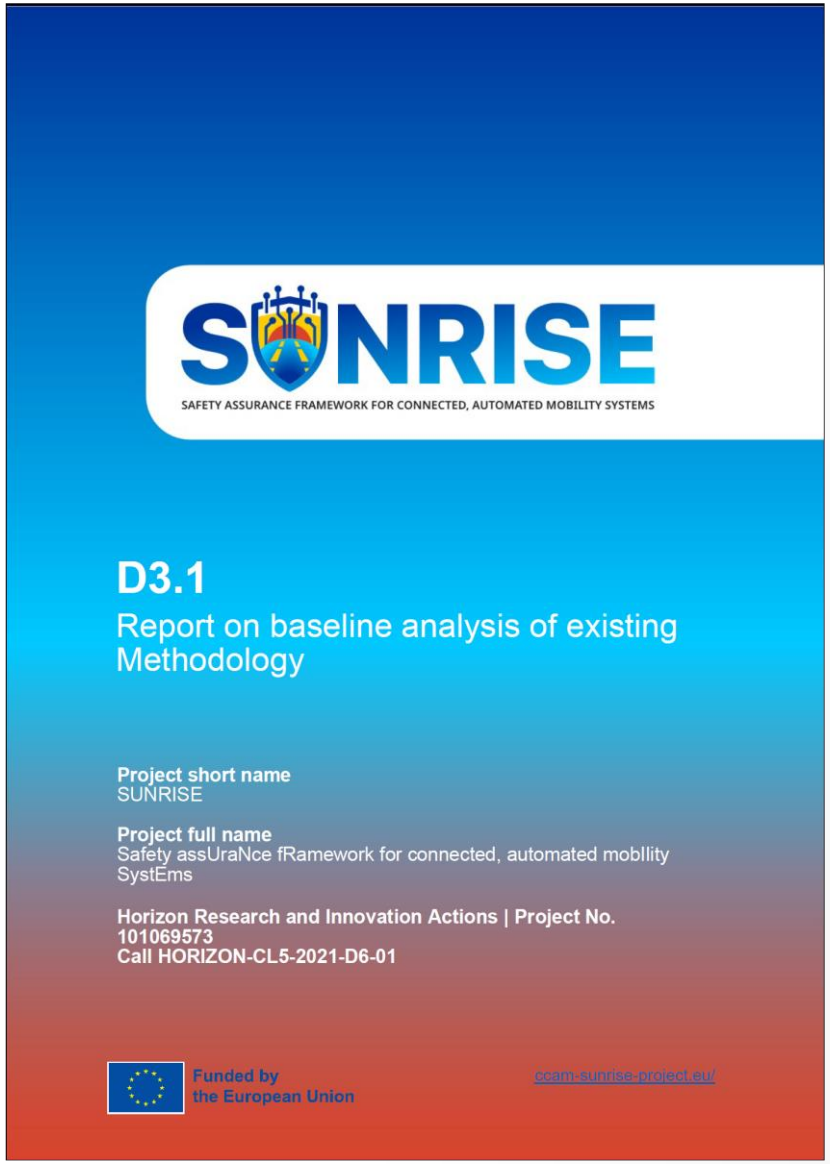
   - For SUNRISE, it is crucial to incorporate support for identification and risk evaluation of potential hazardous scenarios.
   - This should involve thoroughly analysing the scenario space, including identified unknown scenarios (see previous slide), within the context of a specified SUT, ODD, and DDT.

D3.1
Report on baseline analysis of existing Methodology



- Draft version available on (Pending approval):
- https://ccam-sunrise-project.eu/deliverable/d3-1-report-on-baseline-analysis-of-existing-methodology/

Questions from audience

SUNRISE

SAFETY ASSURANCE FRAMEWORK FOR CONNECTED, AUTOMATED MOBILITY SYSTEMS

Thank you for your attention!

Next webinar:

22 January 2024

13:00-14:00 CET

Relevant subsystems to validate CCAM systems

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