



HEADSTART

SAFE-UP Meeting

HARMONISED EUROPEAN SOLUTIONS FOR TESTING AUTOMATED ROAD TRANSPORT

Álvaro Arrúe – Applus IDIADA





Project coordinator



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824309.

Applus⁺
IDIADA

HEADSTART project facts

- ✓ **Call identifier:** ART-01-2018
- ✓ **Type:** RIA
- ✓ **Duration:** 01.2019 – 12.2021 (36 months)
- ✓ **Budget:** 6M€
- ✓ **Consortium:** 17 partners
- ✓ **Coordinator:** Applus IDIADA, Mr. Álvaro Arrúe, Project Manager
- ✓ **Dissemination Manager:** ICCS, Dr. Angelos Amditis, Research Director
- ✓ **Website:** <https://www.headstart-project.eu>
- ✓ **Social media:**
 -  / HEADSTART_EU
 -  / HEADSTART-PROJECT
 -  / HEADSTART project
 -  / @HeadstartEUproject

HEADSTART Consortium

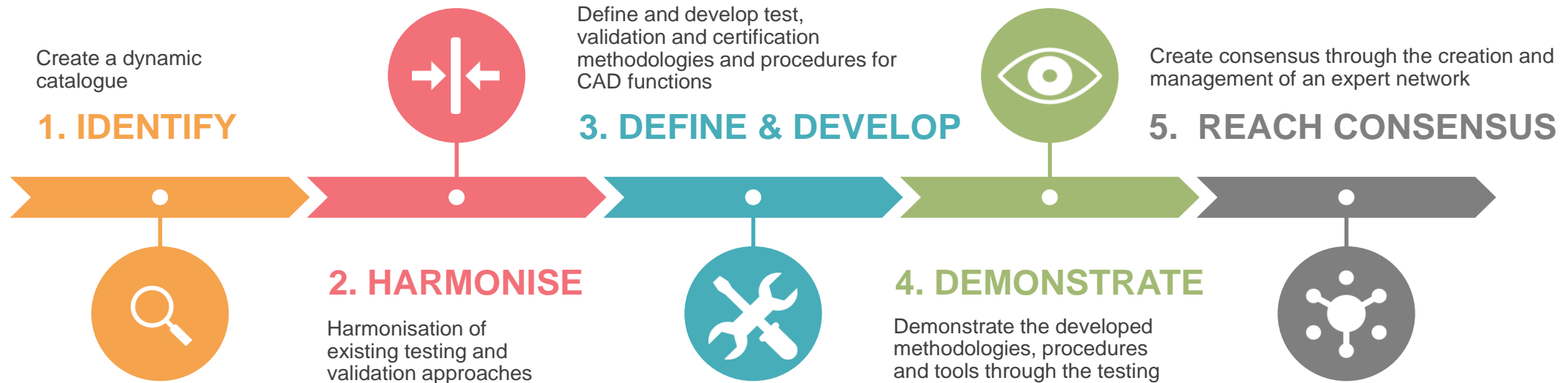
- ✓ 7 research centres
- ✓ 2 Technical services
- ✓ 3 Euro NCAP laboratories
- ✓ 4 OEMs
- ✓ 2 Tier-1s
- ✓ 3 coordinators of H2020 ART calls



Project's Objectives

HEADSTART will define testing and validation procedures of CAD functions including:

- its key enabling technologies (i.e. communication, cyber-security, positioning)
- by cross-linking of all test instances such as simulation, proving ground and real world field tests
- to validate safety and security performance according to the needs of key user groups (technology developers, consumer testing and type approval)



HEADSTART available deliverables

- ✓ Available to be downloaded in www.headstart-project.eu
 - D1.1: State of innovation of existing initiatives and gap analysis
 - D1.2: Stakeholders and user group needs
 - D1.3: Technical and functional requirements for KETs
 - D1.4: Functional requirements of selected use cases
 - D2.1: Common methodology for test, validation and certification
 - D2.2: Criteria to choose optimal scenarios and tests for each KET
 - D2.3: Assessment method for each of the use cases defined
 - D3.1: Guideline of a comprehensive validation and certification procedure to ensure safe CAD systems
 - D5.1: Networking report
 - D6.3: Dissemination and communication strategy
 - D6.5: Dissemination material

www.headstart-project.eu

HEADSTART

Methodology

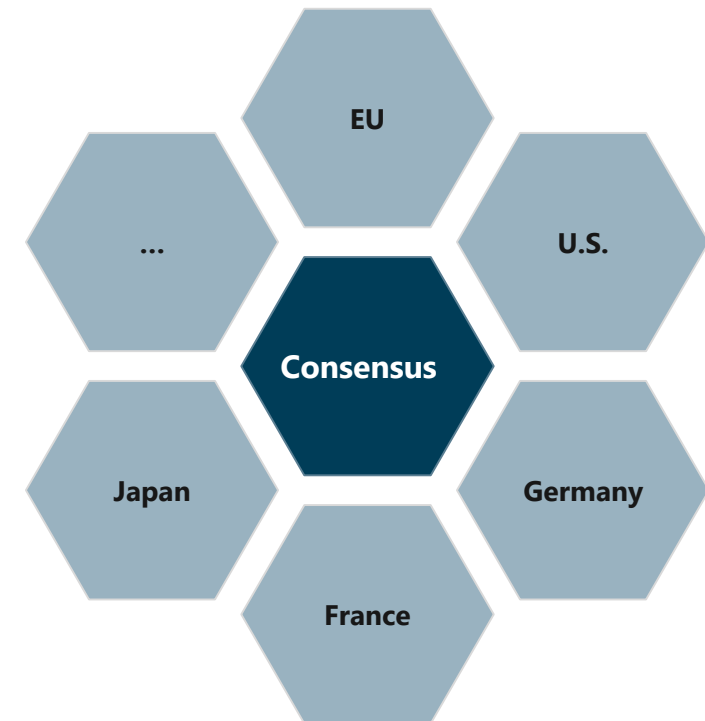
HEADSTART Methodology

Where does the HEADSTART Methodology come from?

Motivation

Where does the HEADSTART Methodology come from?

- ✓ State of the art analysis of international and national projects
- ✓ **Harmonization** of present and past projects
- ✓ Utilizing **common databases** to analyse data
- ✓ Testing of selected **relevant scenarios**



Motivation

Why do we need a scenario-based safety assurance?

Motivation

Why do we need a scenario-based safety assurance?

Safety assurance by test drives?

- Sample calculations ranging **up to billions** of kilometers
- ➔ Not feasible

Safety assurance by expert knowledge?

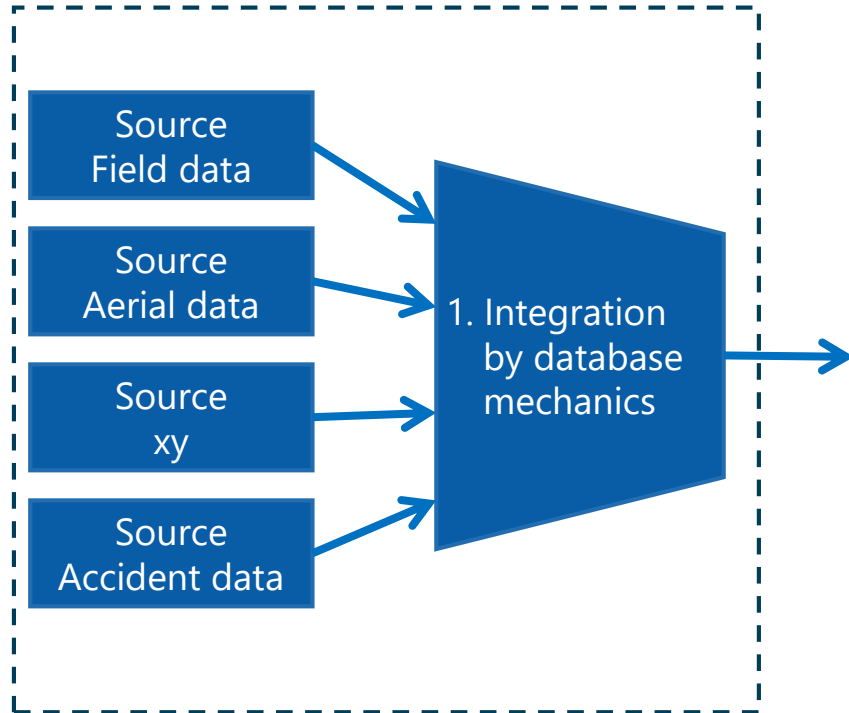
- **No evaluation methodology available** for automated driving (L3+)
- ➔ Not available

Overall Methodology

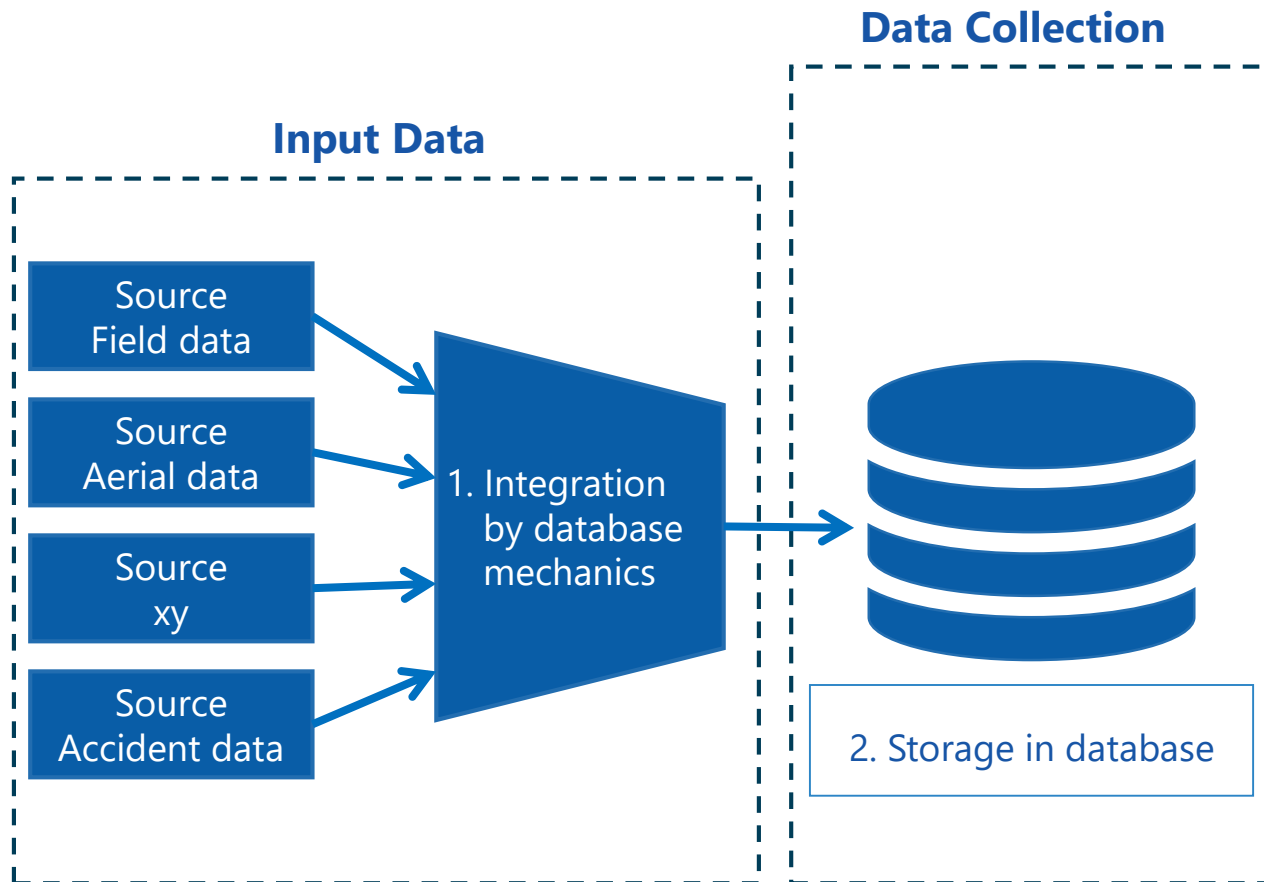
How can such a methodology look like?

Overall Methodology

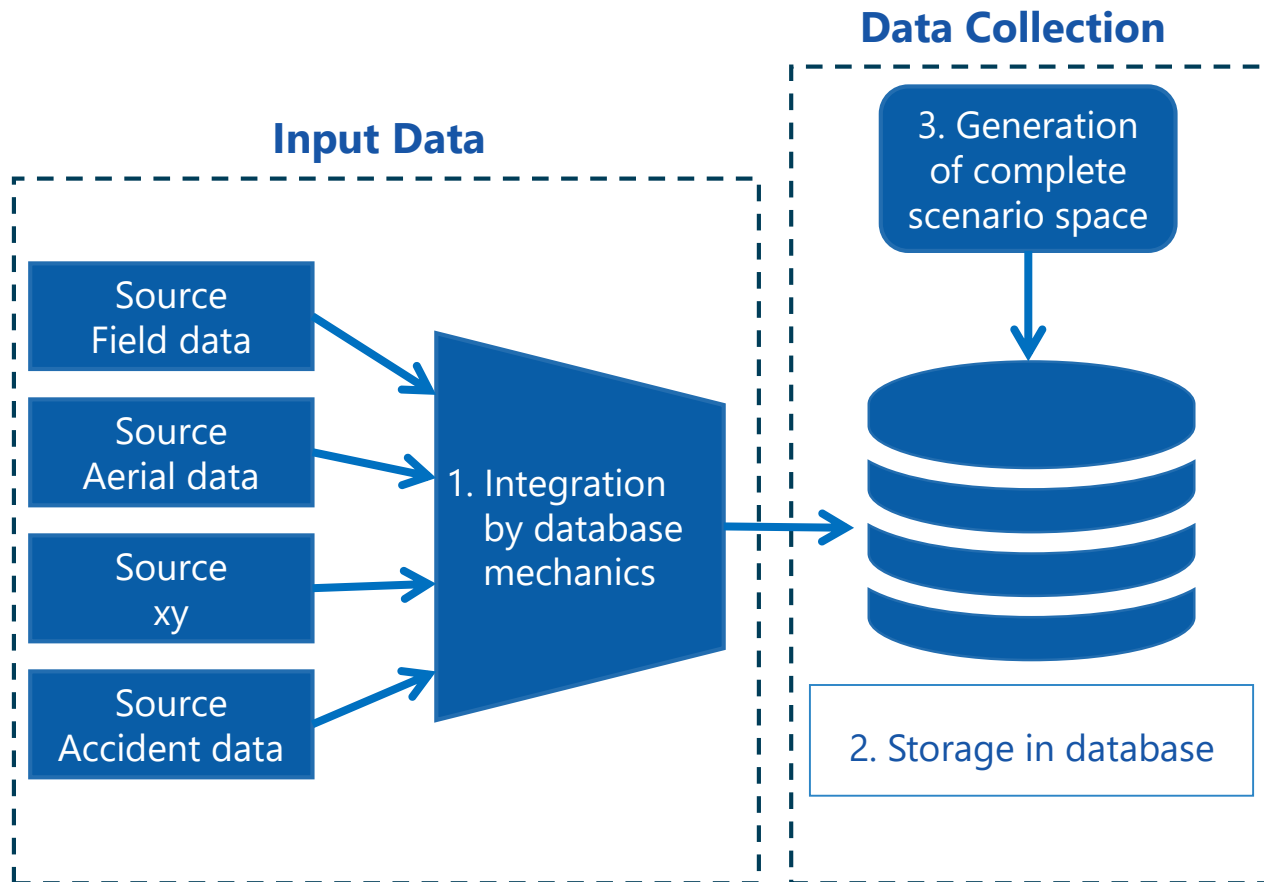
Input Data



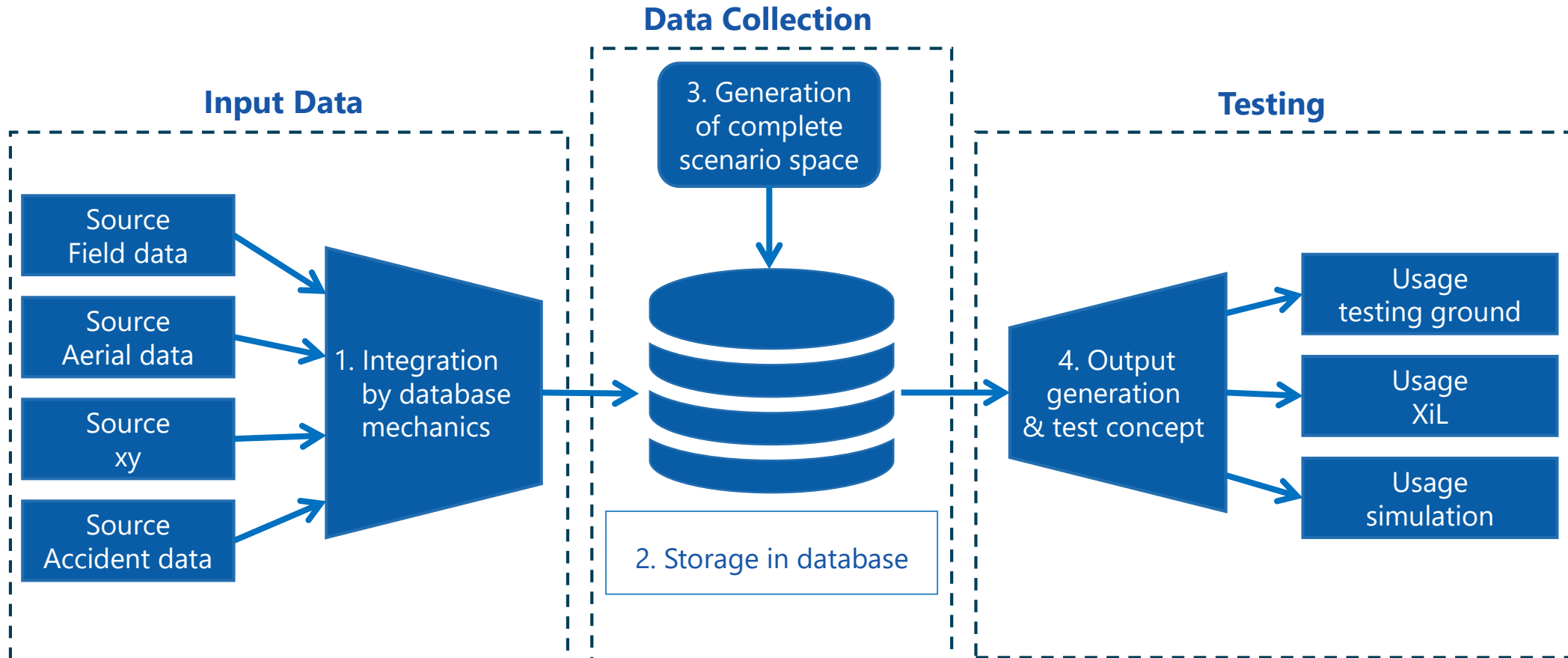
Overall Methodology



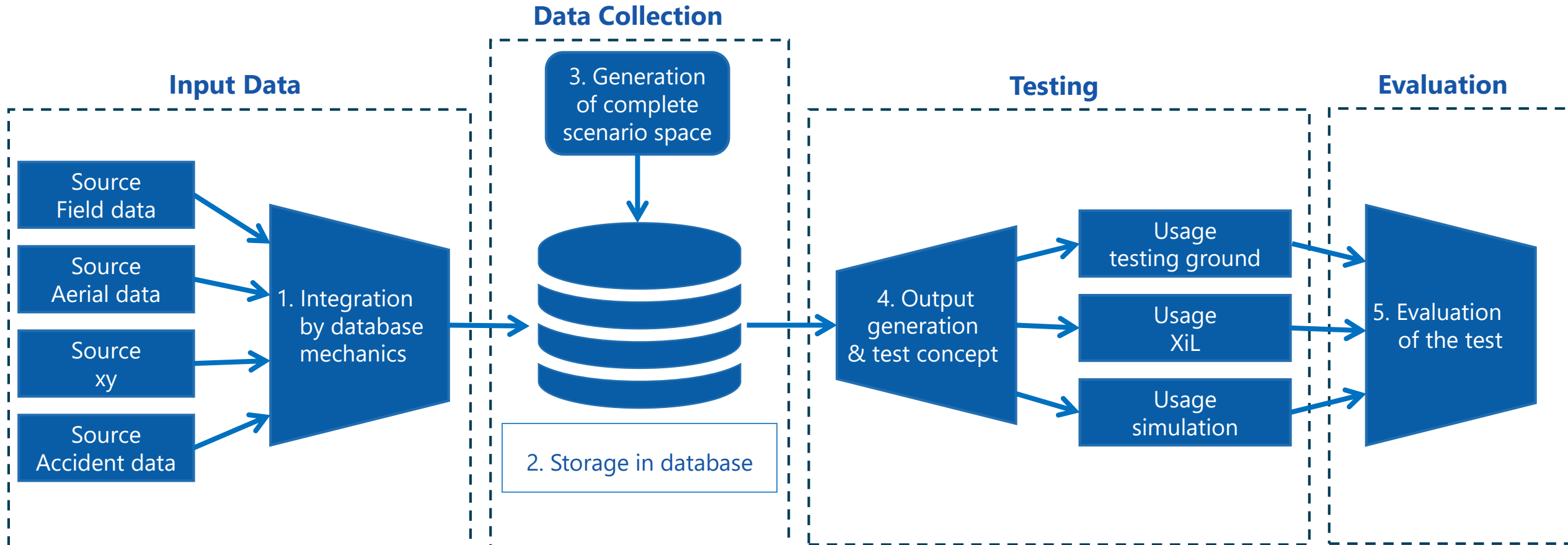
Overall Methodology

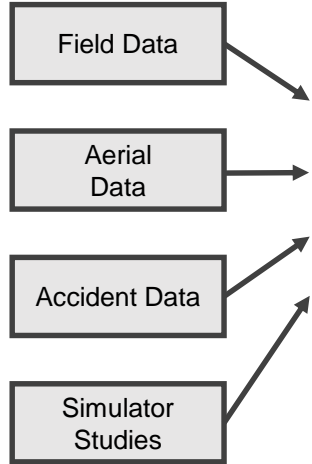


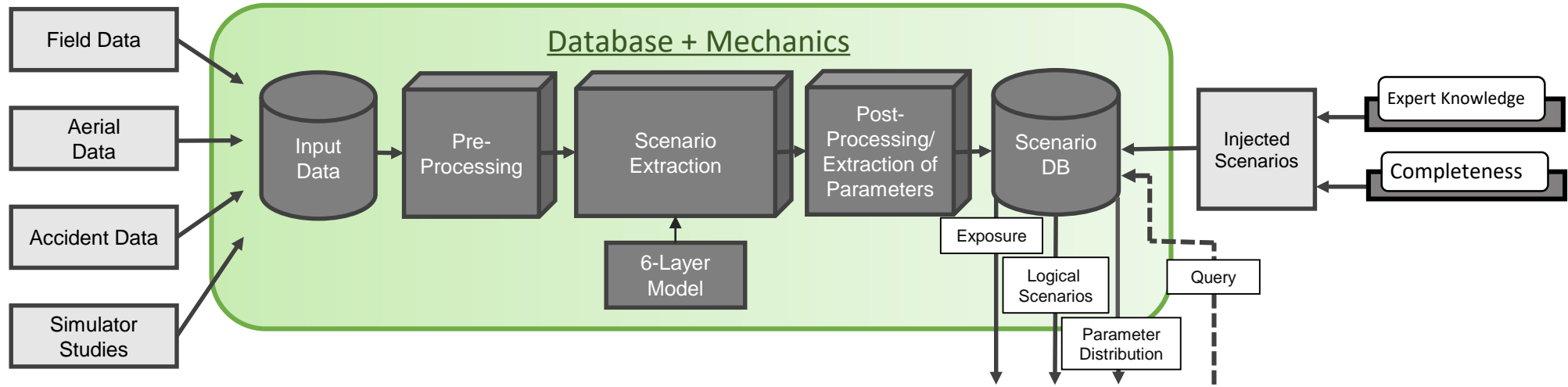
Overall Methodology

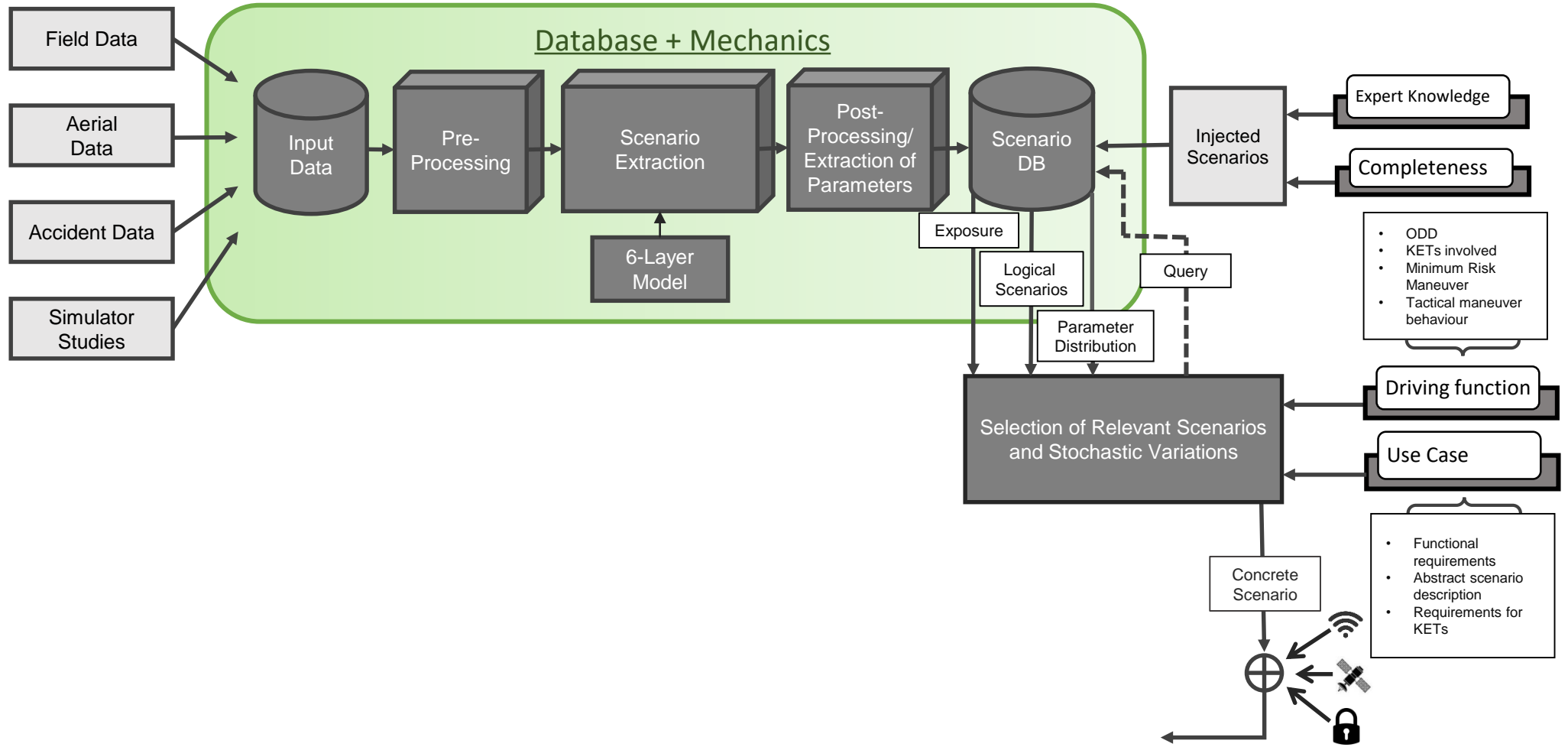


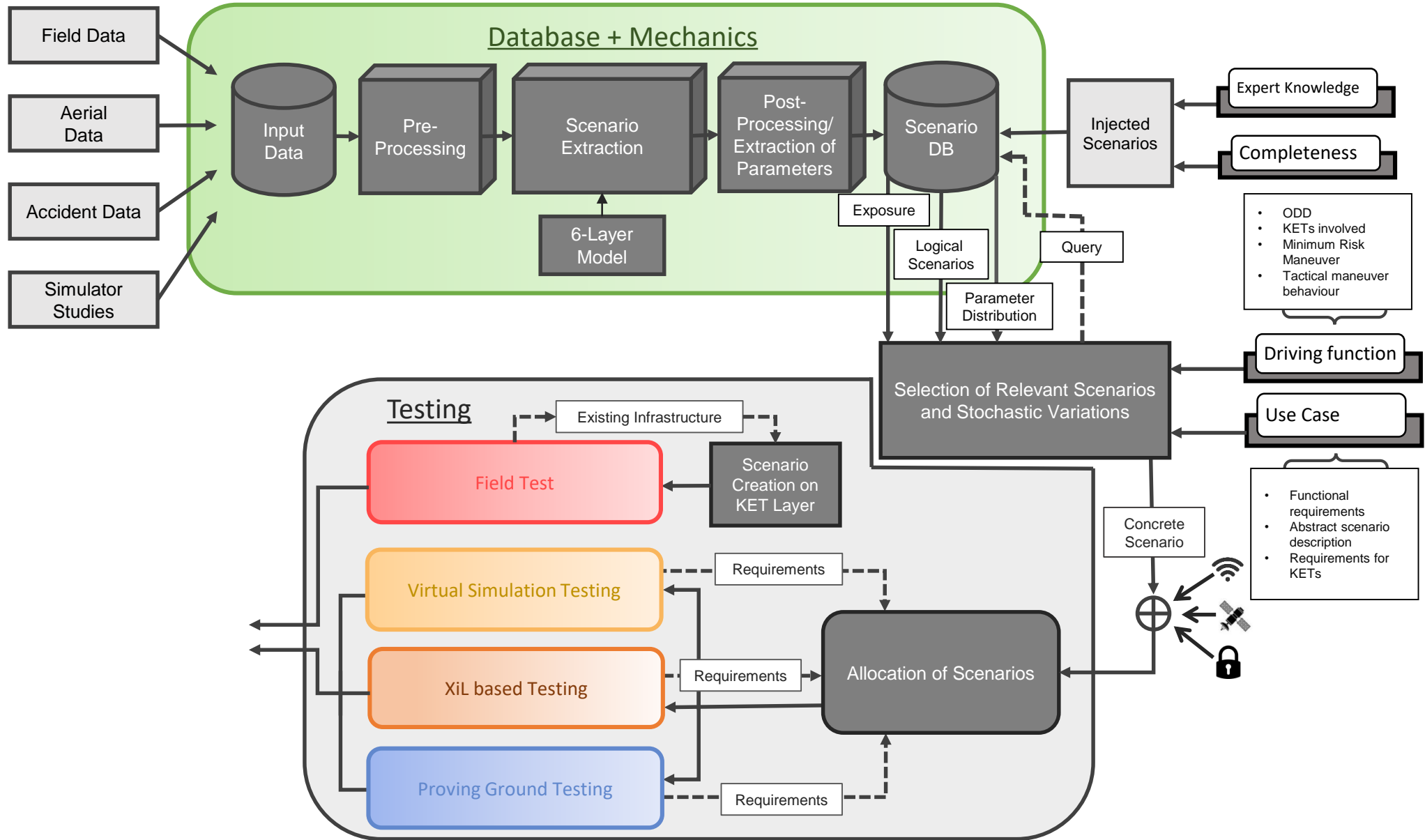
Overall Methodology

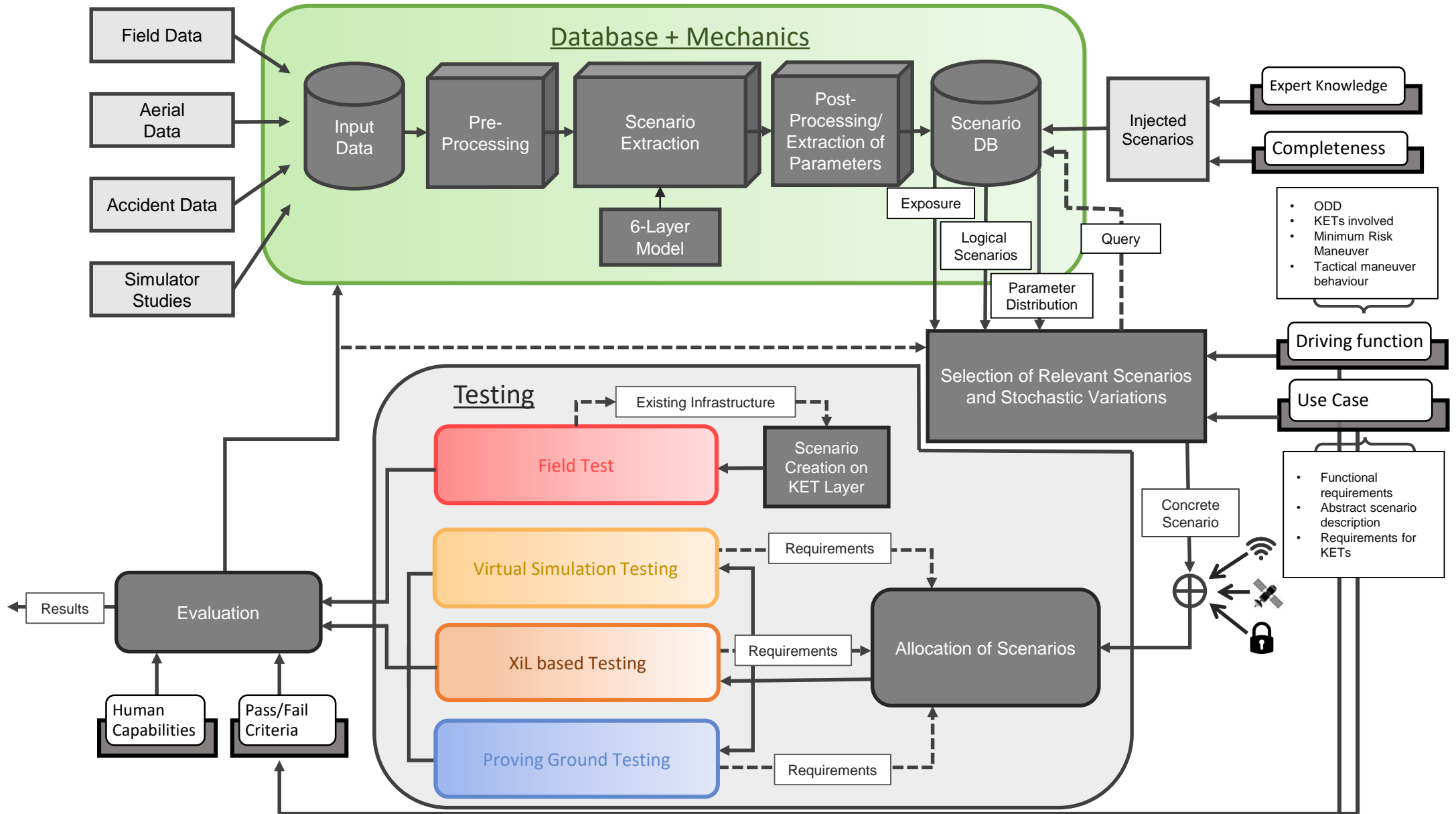


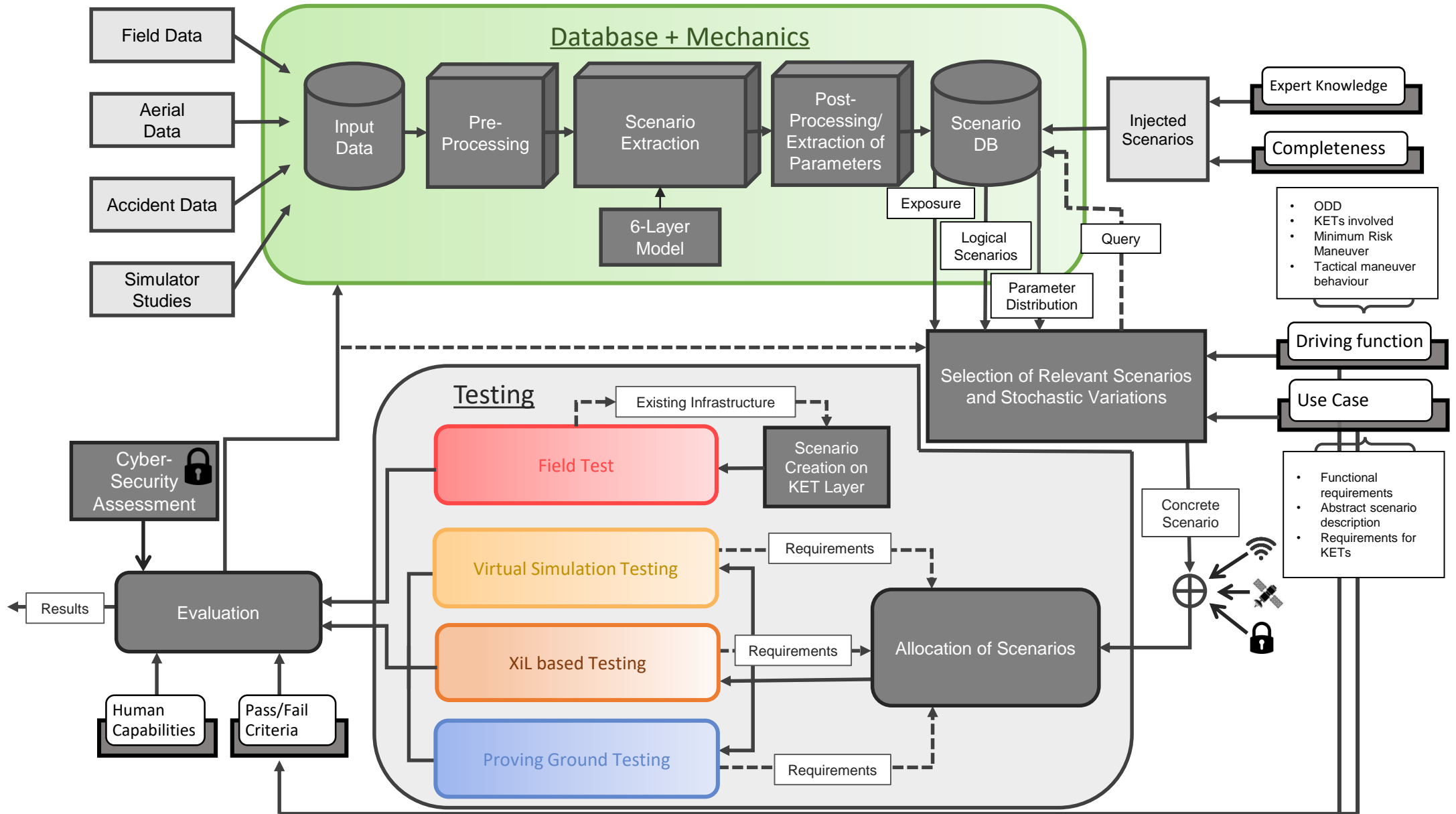




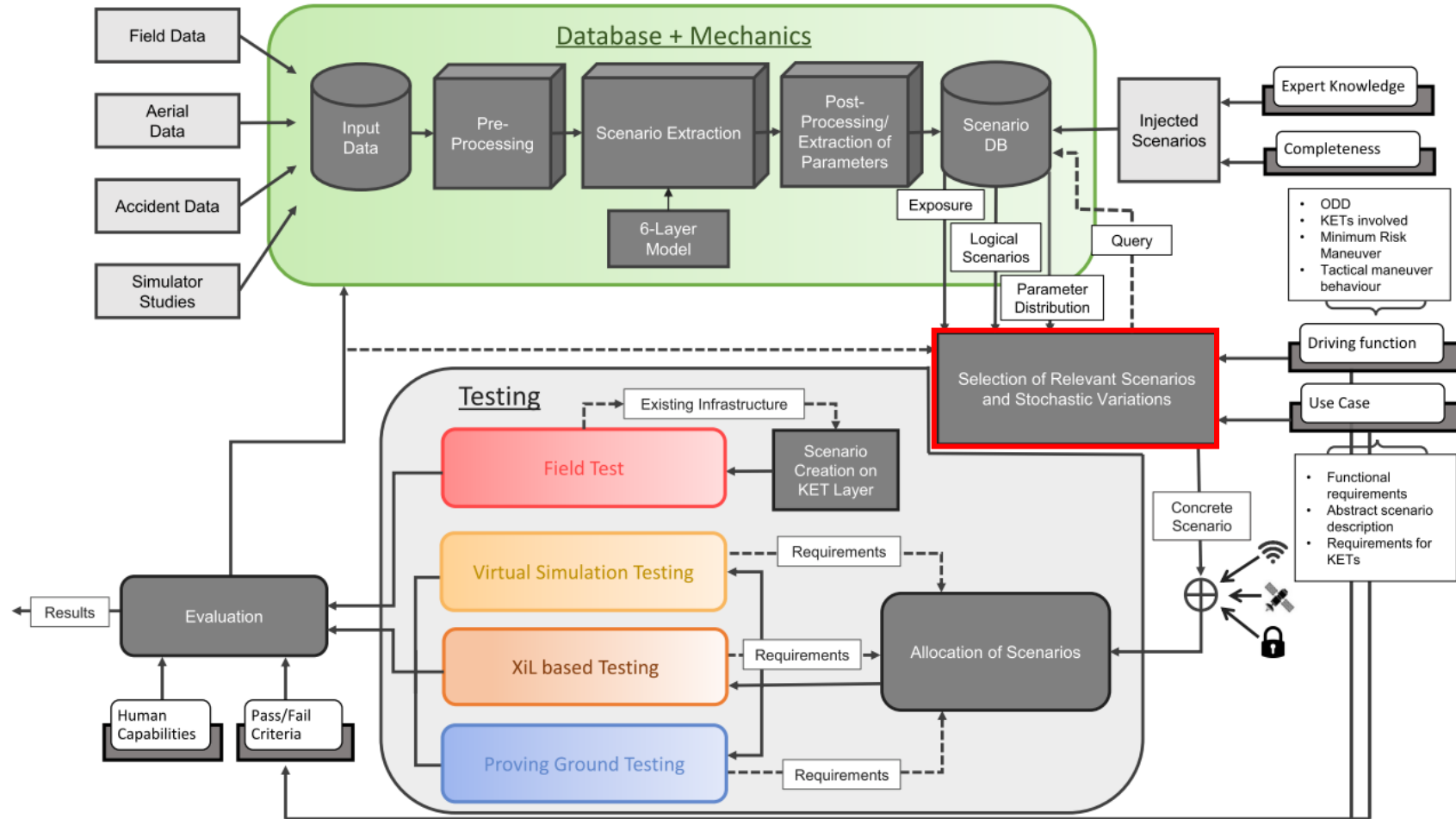








Scenario Selection



Layer Model

Layer 6

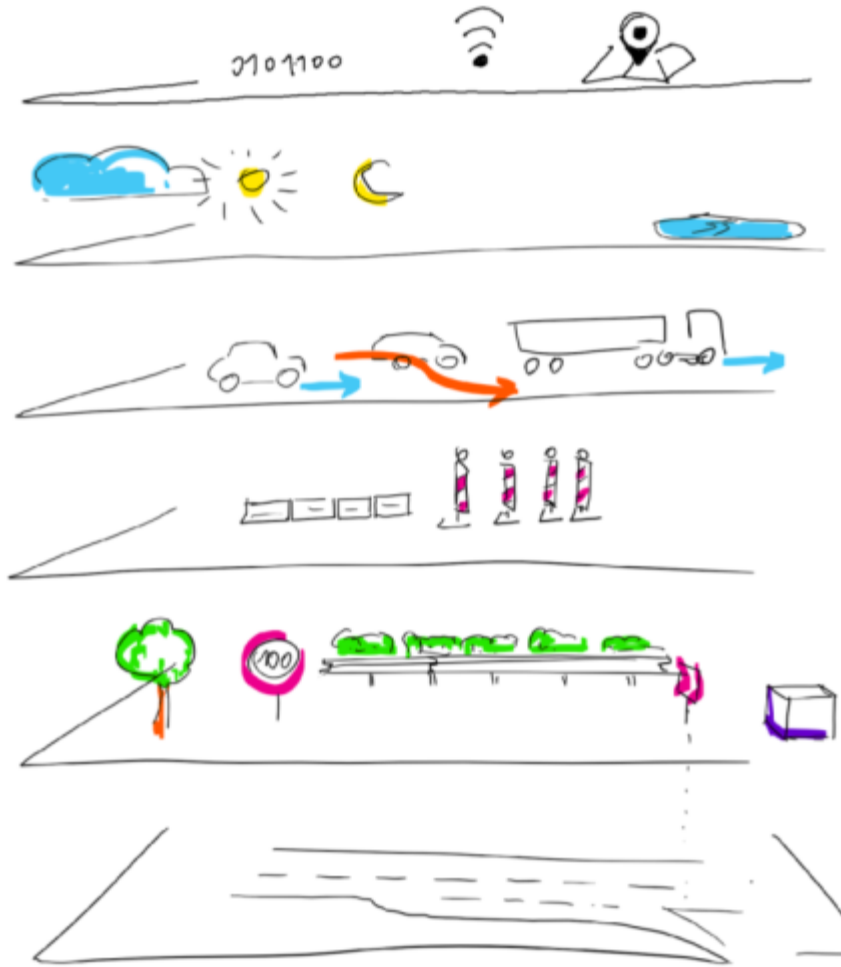
Layer 5

Layer 4

Layer 3

Layer 2

Layer 1



Digital information

e.g. V2X information on traffic signals, digital map data

Environmental conditions

e.g. Light situation, weather (rain, snow, fog)

Moving Objects

e.g. Vehicles, pedestrians, other moving objects

Temporal modifications and events

e.g. Road construction, traffic cones, fallen trees

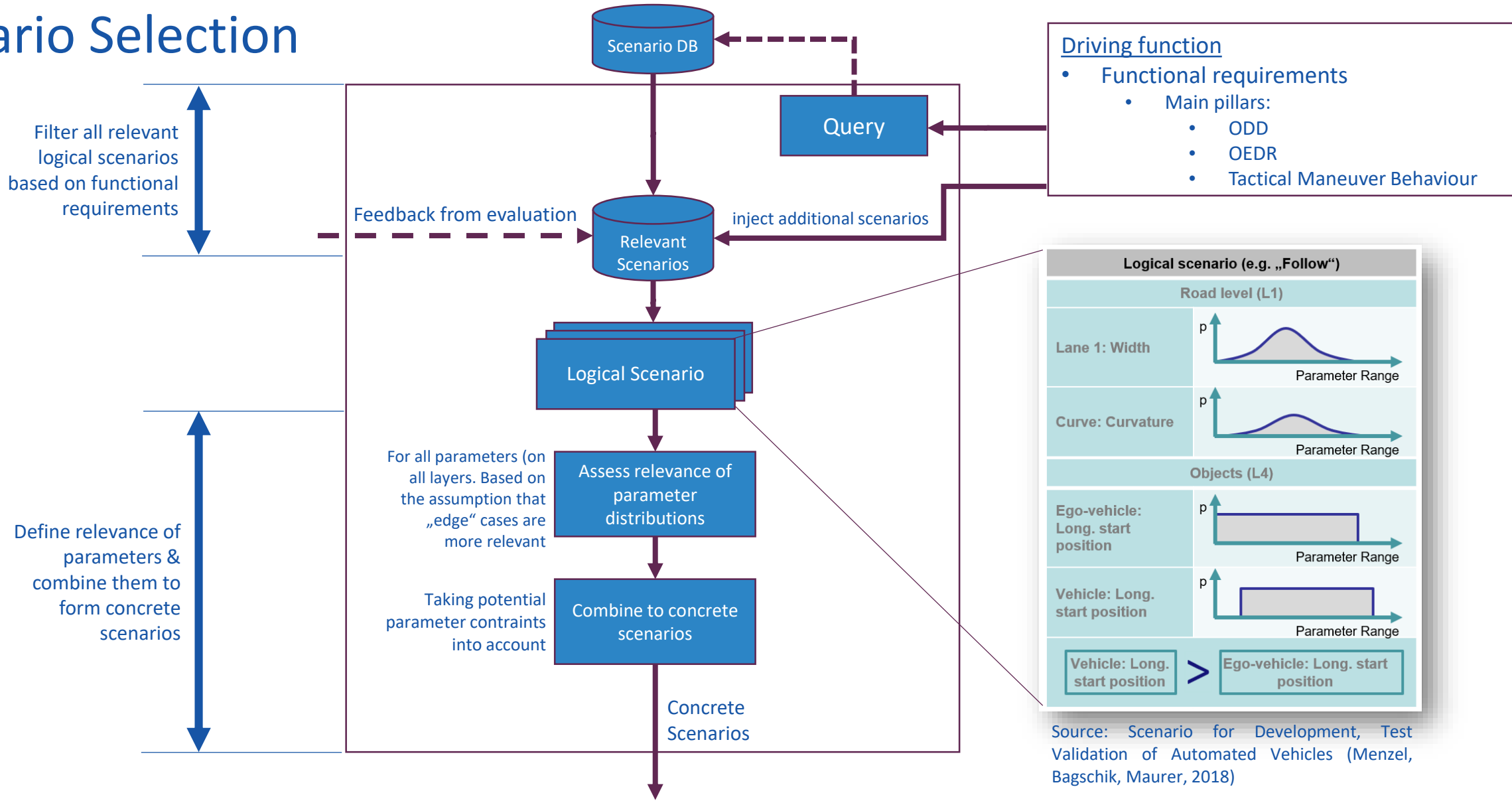
Road furniture and Rules

e.g. Traffic signs, railguards, lane rules, bot dots

Road layer

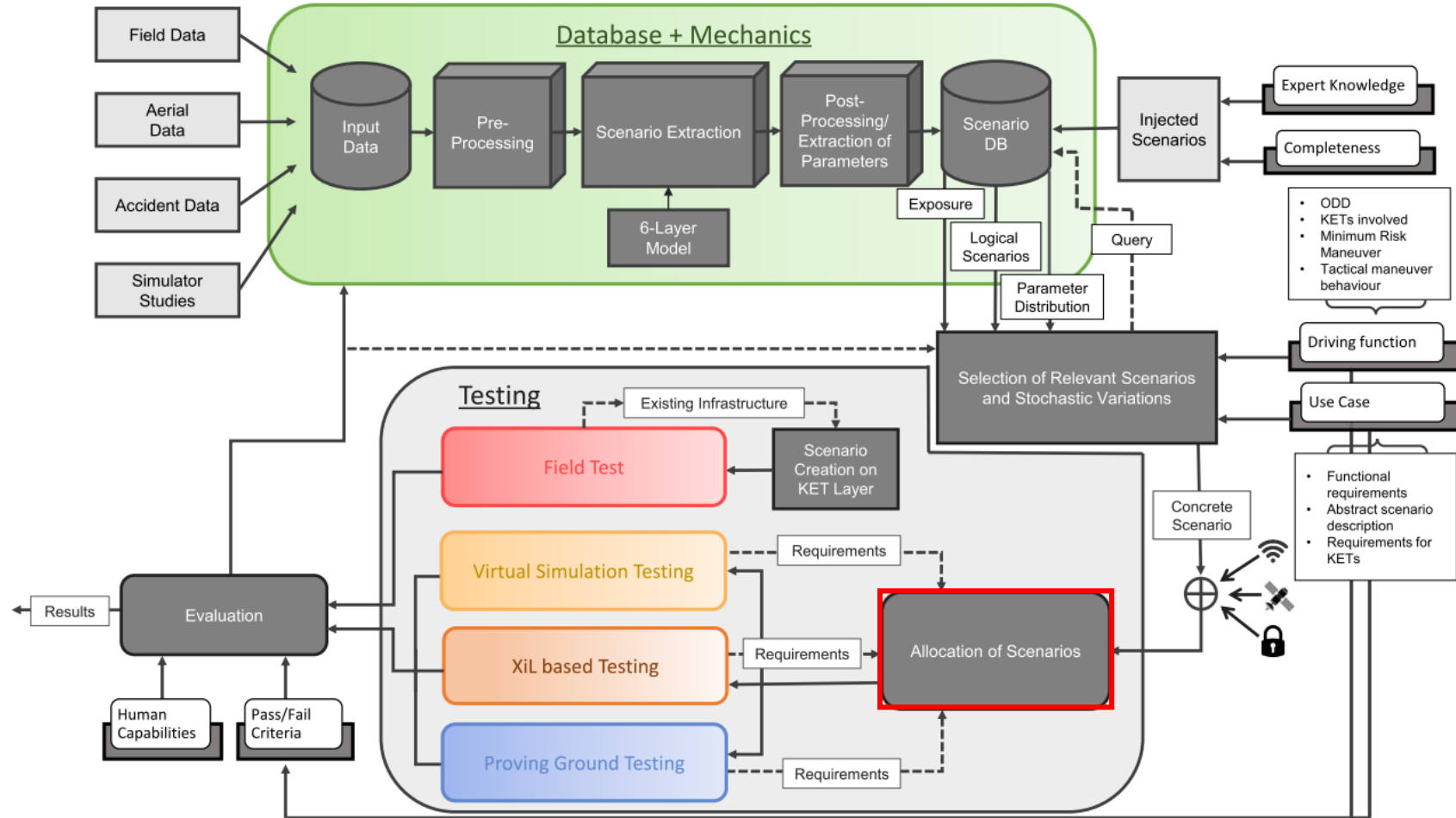
e.g. Road geometry, road unevenness, lane logic

Scenario Selection



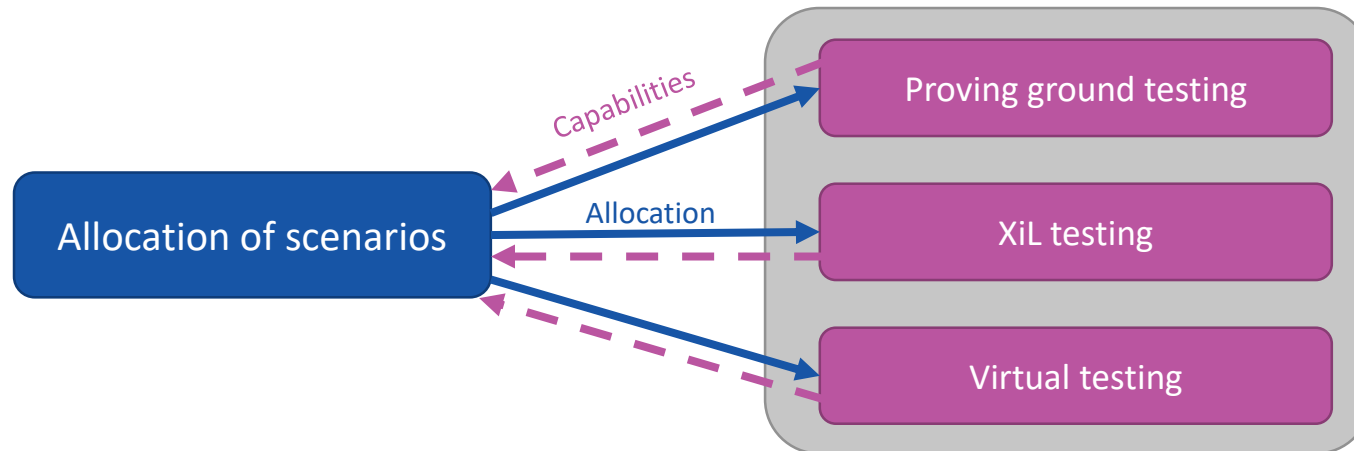
Source: Scenario for Development, Test Validation of Automated Vehicles (Menzel, Bagschik, Maurer, 2018)

Scenario Allocation



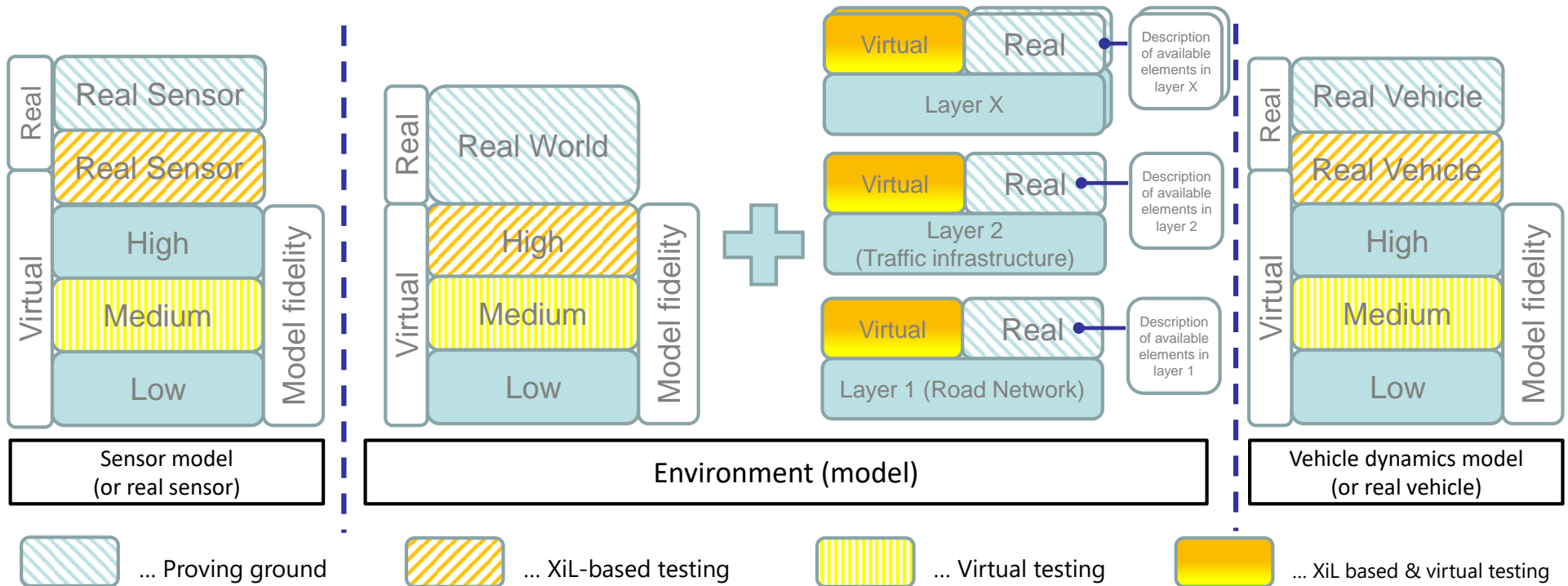
Scenario Allocation

- ✓ Each test instance has its advantages and restrictions
- ✓ Safety, testing cost, testing time and other parameters must be taken into account in the allocation process
- ✓ **Objective** → Define how to allocate the selected concrete scenarios to each test method to find the “best fit”

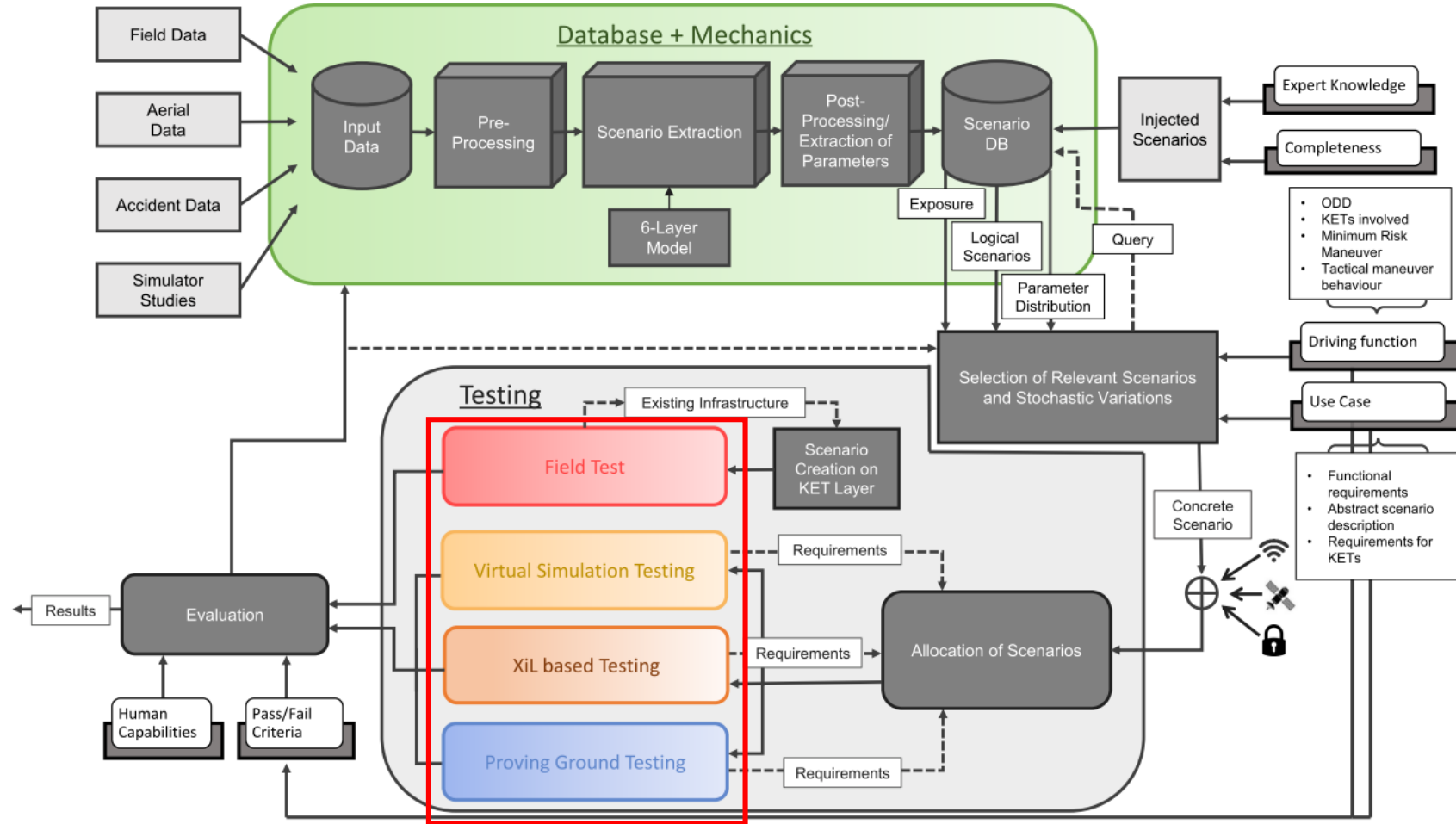


Scenario Allocation

- ✓ Definition of the capabilities for “Sensor”, “Environment” and “Vehicle Dynamics”
- ✓ Use of the map of capabilities:



Test Execution



Scenario Execution

✓ Testing Facilities

- Proving Grounds
- Simulation
- XiL – Based
- Field Operational Tests

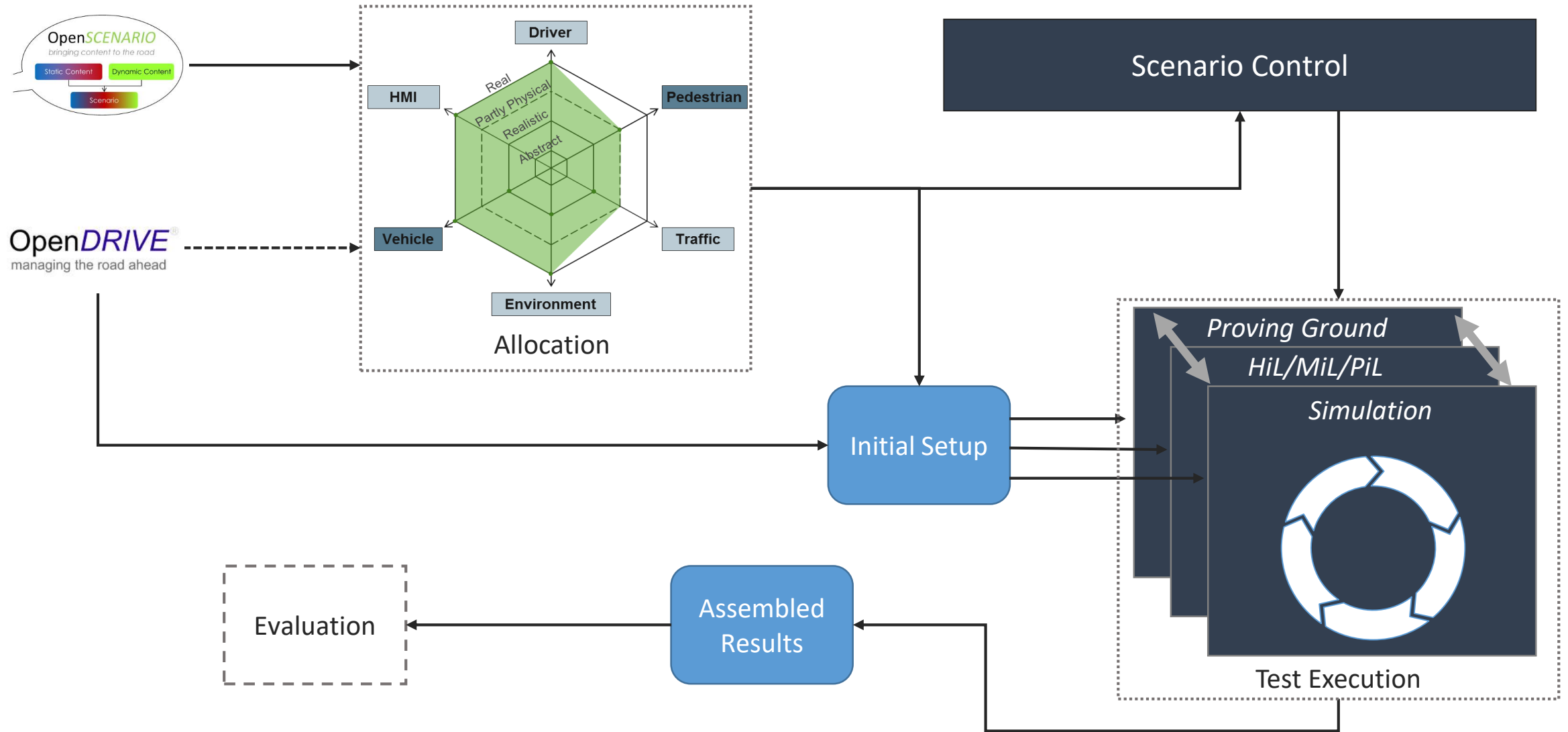
✓ Unified Interfaces

- Open Simulation Interface (OSI)
- Functional Mock-up Interface (FMI)

✓ Open Standards

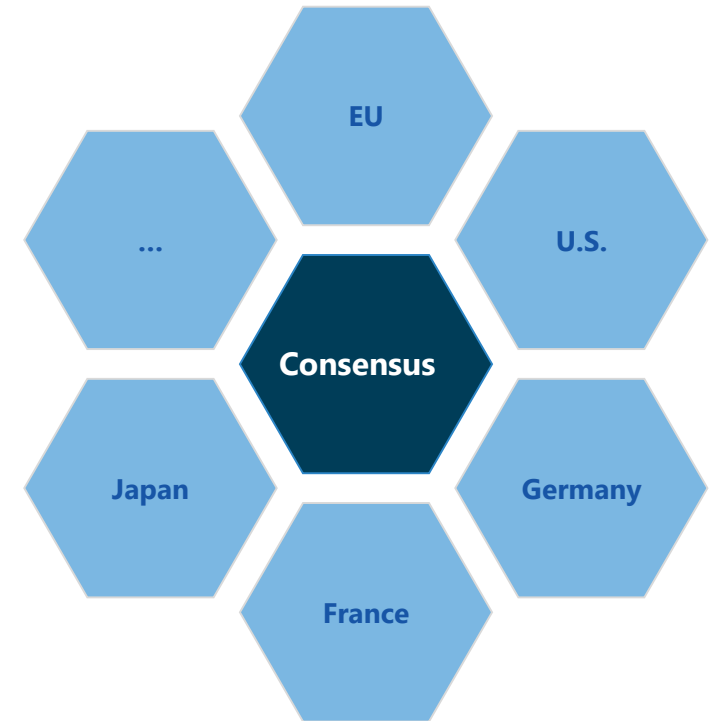
- OpenSCENARIO
- OpenDRIVE
- OpenCRG

XiL-Based Testing



Summary

- ✓ The HEADSTART Methodology is a living process
 - Need for expert input to refine the methodology
- ✓ High effort for safety assurance on **national and international** level
- ✓ HEADSTART tries to **harmonize** different projects and initiatives
- ➔ International **cooperation** is key to safety assurance

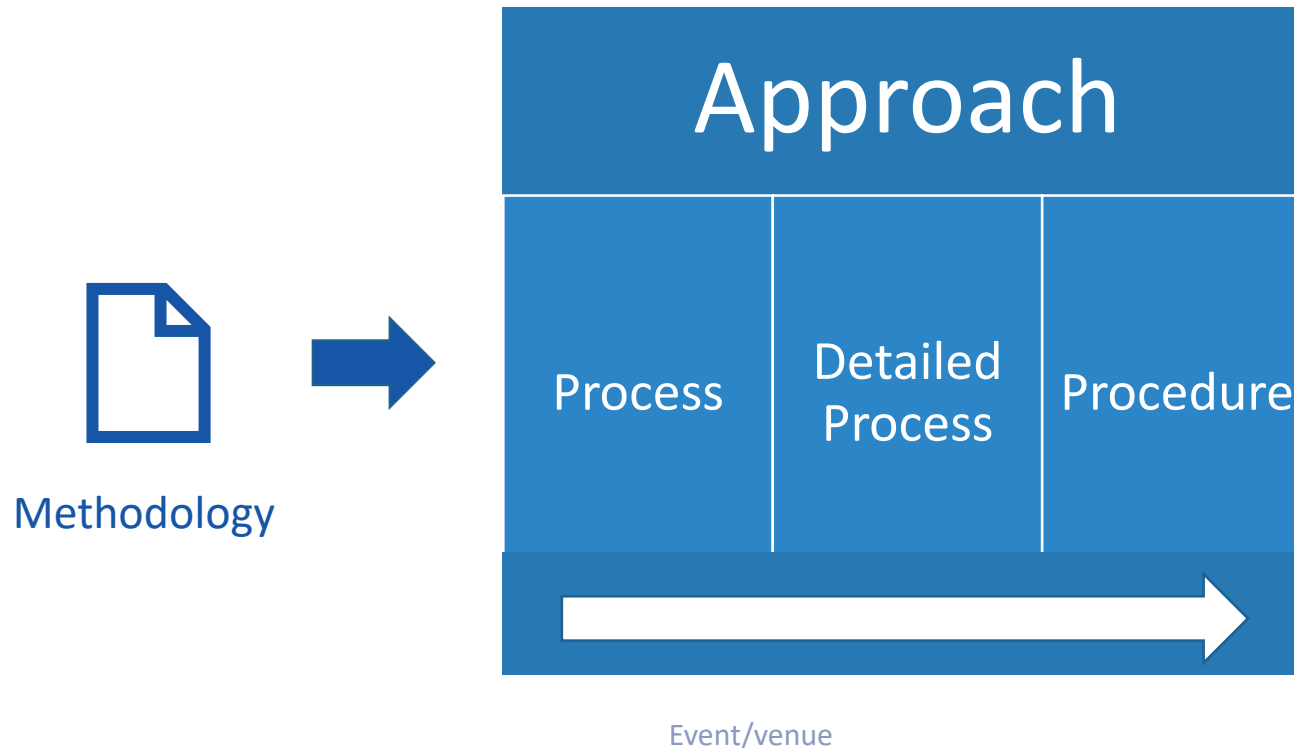


HEADSTART

Procedure

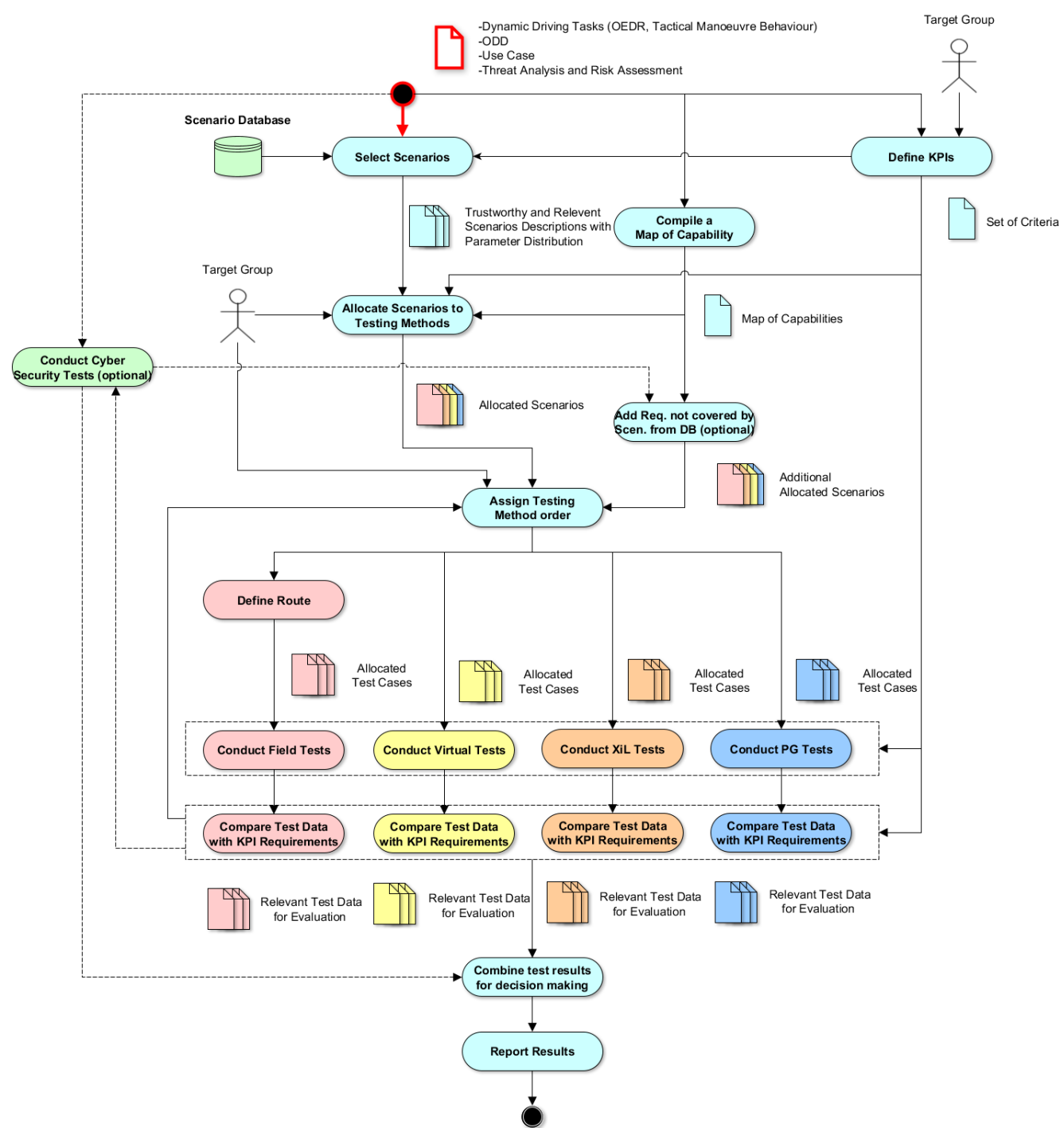
Process vs. Procedure

- ✓ A **process** is a set of interrelated or interacting activities which transforms inputs into outputs. It's about **what to do**.
- ✓ A **procedure** is a specified way to carry out an activity or a process. It's about **how to do it**.



High-Level Process

- ✓ Scenario Selection
- ✓ Scenario Allocation
- ✓ Testing Method Coordination
- ✓ Field Testing
- ✓ Virtual Testing
- ✓ XiL Testing
- ✓ Proving Ground Testing
- ✓ Cyber Security
- ✓ Evaluation



HEADSTART

Use Cases

HEADSTART: WP1 use case overview (October 2019)

	Truck Platooning	Highway Pilot	Traffic Jam Chauffeur	Valet Parking	Urban Automated Shuttle	
Requirements for testing <i>HEADSTART KETS</i>	How suitable is the use case to meet the requirements on testability of positioning in HEADSTART	● 3,8	● 3,6	● 2,6	● 4,3	● 4,5
	How suitable is the use case to meet the requirements on testability of communication in HEADSTART	● 4,8	● 3,4	● 1,9	● 3,5	● 3,5
	How suitable is the use case to meet the requirements of testability of cyber-security in HEADSTART	● 4,5	● 3,1	● 2,4	● 3,7	● 3,7
Requirements for <i>testing methods</i>	How suitable is the use case to meet the requirements regarding physical testing in HEADSTART	● 4,3	● 4,3	● 3,5	● 4,3	● 2,9
	How suitable is the use case to meet the requirements regarding proving-ground testing in HEADSTART	● 4,1	● 3,6	● 3,1	● 3,8	● 2,6
	How suitable is the use case to meet the requirements regarding field operational tests in HEADSTART	● 4,0	● 4,1	● 3,4	● 3,8	● 3,1
	How suitable is the use case to meet the requirements regarding model-based testing in HEADSTART	● 3,9	● 3,6	● 3,6	● 3,9	● 3,6
Availability of usage <i>Scenarios database</i> →	How suitable is the use case to meet the requirements regarding definition and availability of scenarios in HEADSTART	● 3,3	● 3,8	● 3,5	● 3,0	● 2,6
<i>Collaboration partners</i> for this use case →	How suitable is the use case to meet the requirements regarding requirements on collaboration partners in HEADSTART	● 4,0	● 3,7	● 2,9	● 3,3	● 2,6
Relevance to <i>key user groups</i>	How suitable is the use case to meet the requirements regarding relevance to OEMs and Tier1s in HEADSTART.	● 3,0	● 4,8	● 4,5	● 3,5	● 3,3
	How suitable is the use case to meet the requirements regarding relevance to type-approval authorities in HEADSTART	● 3,3	● 4,1	● 3,9	● 2,8	● 2,9
	How suitable is the use case to meet the requirements regarding relevance to consumer testing in HEADSTART	● 1,7	● 3,9	● 3,6	● 2,4	● 1,7
	Total Average Score	3,7	3,8	3,2	3,5	3,1

HEADSTART: selected use cases (April 2020)



Truck platooning



Highway pilot



Traffic jam chauffeur

Role of the HEADSTART use cases

- ✓ For the different use cases HEADSTART will *closely cooperate with 'linked projects'* that will enable us to demonstrate the HEADSTART methodology.

'Linked projects' include:

- [ENSEMBLE](#)
- [MuCCA](#)
- [CAVRide](#) by IDIADA
- [Automated Drive Demonstrator](#) by Virtual Vehicle

- ✓ Focus to:

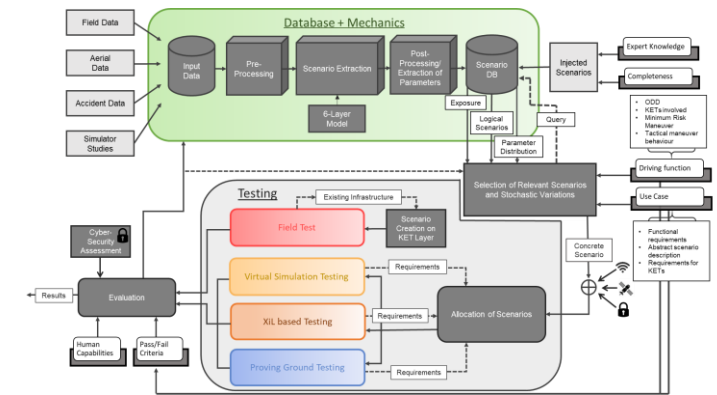
demonstrate HEADSTART methodology

not to demonstrate vehicle/function performance.

Role of the HEADSTART use cases

✓ Important aspects to be covered in the demonstration of the HEADSTART methodology

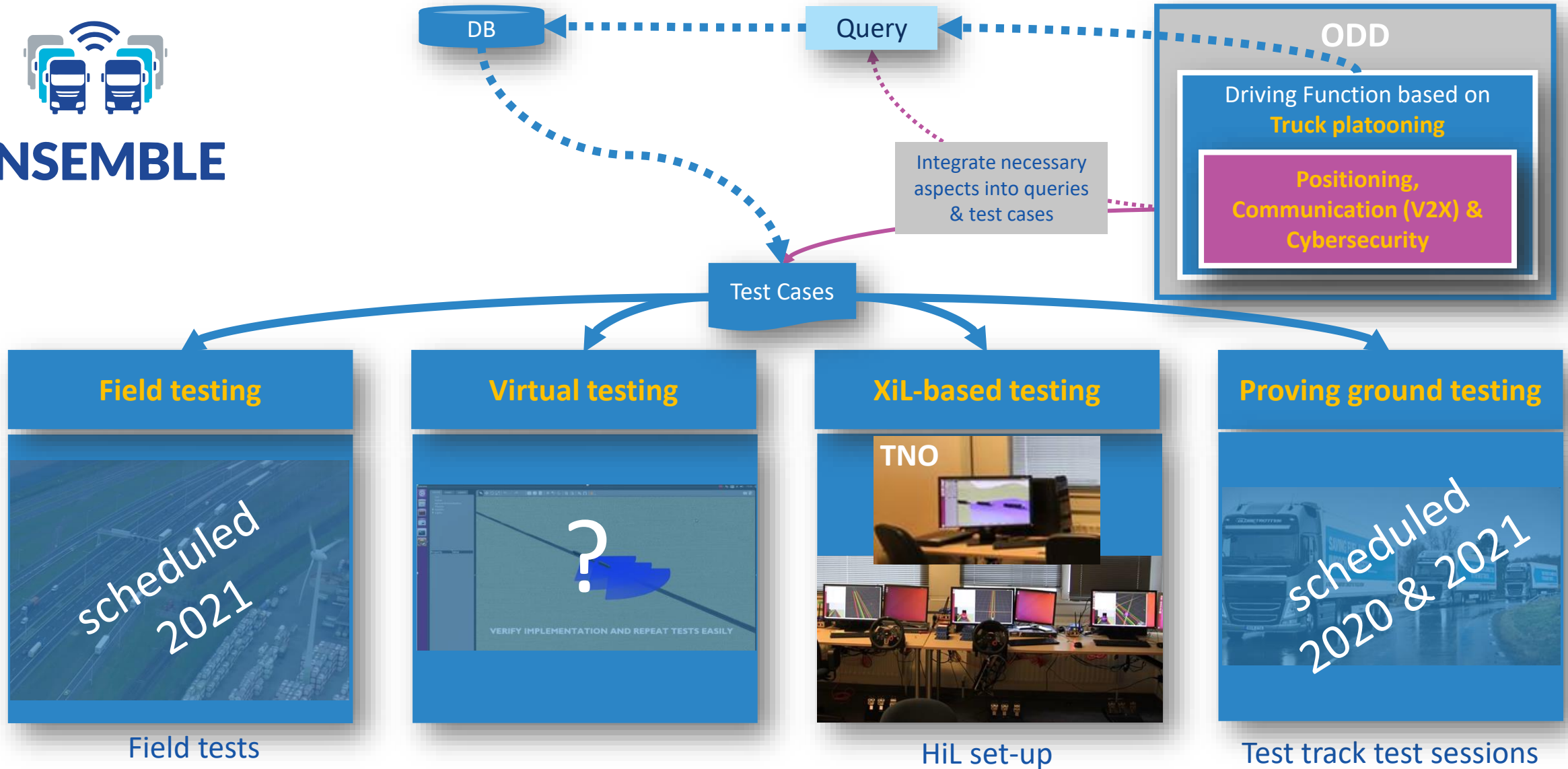
- **Scenario based approach**
 - Scenario database, selection & allocation
- **Testing methods**
 - Field testing, Virtual testing, XiL-based testing & Proving ground testing
- **HEADSTART KETs**
 - Communication V2X, Positioning (GNSS) & Cybersecurity
- **Key user groups**
 - OEMs & TIERS, Type approval authorities & Consumer organisations (like Euro NCAP)

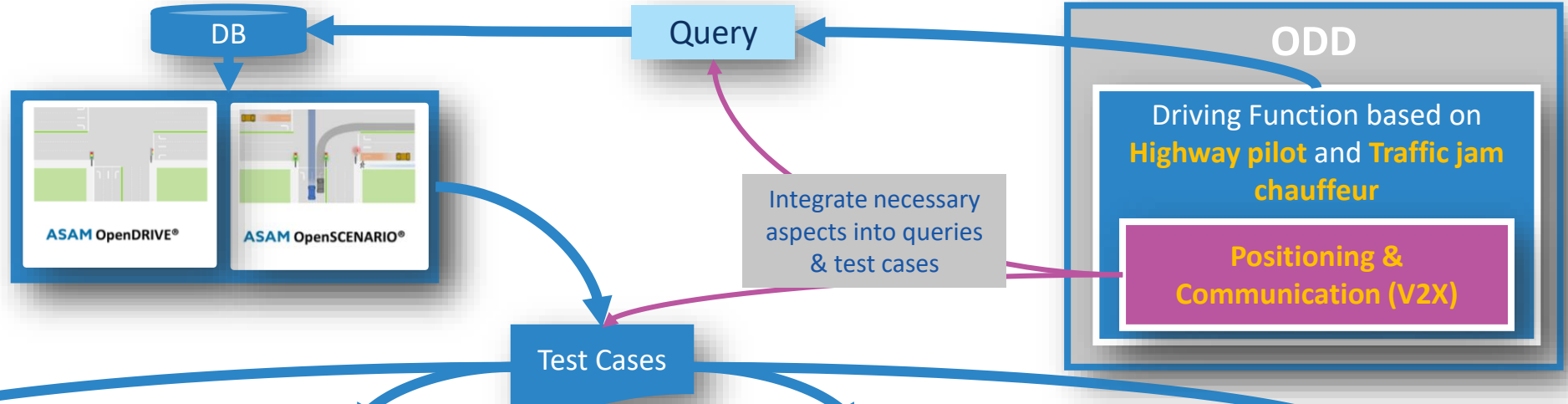


✓ Current 'linked projects' are not able to cover all aspects, but all 'linked projects' together will be able to demonstrate the feasibility of **Scenario based approach**, **Testing methods** and **HEADSTART KETs** and relevance of HEADSTART methodology for the different **Key user groups**



ENSEMBLE



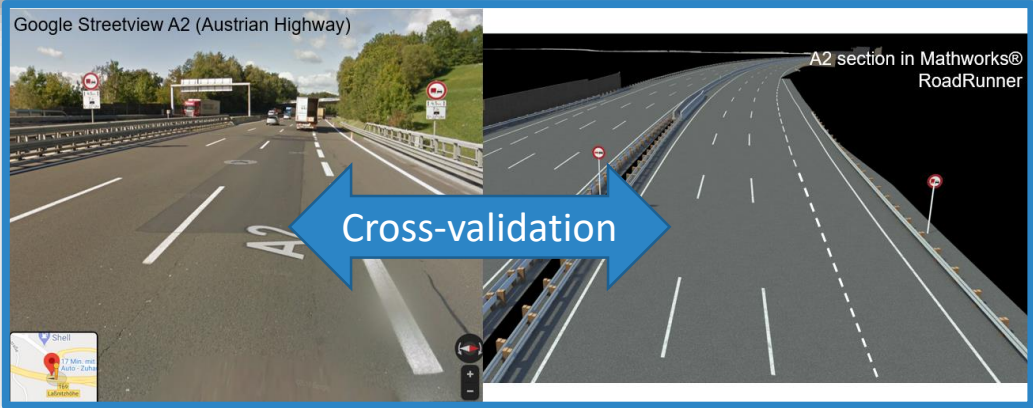


Field testing

Virtual testing

XiL-based testing

Proving ground testing

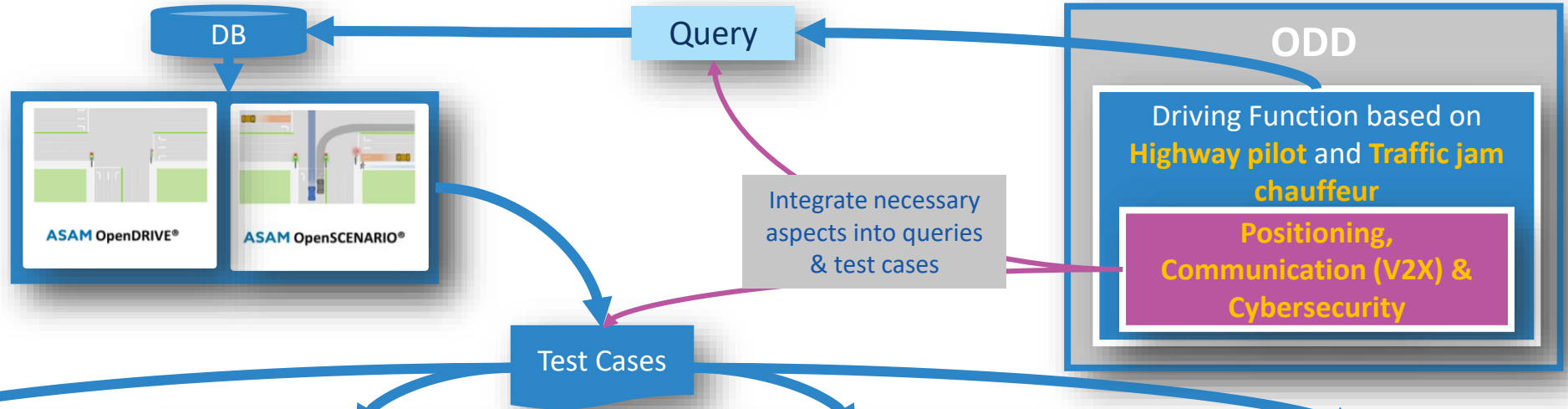


Field tests (permit available)

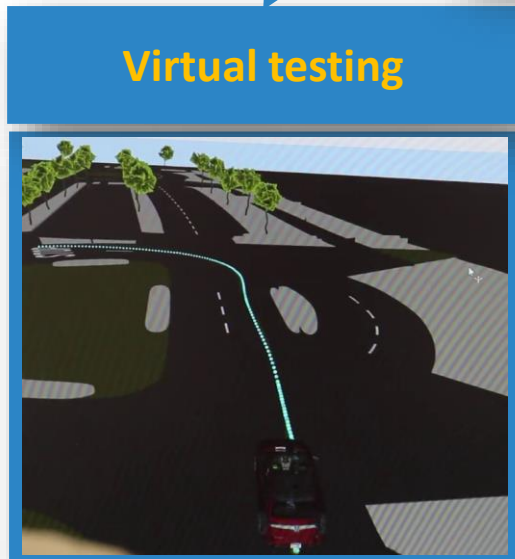
Virtual environments for usage in simulations

Driving simulator

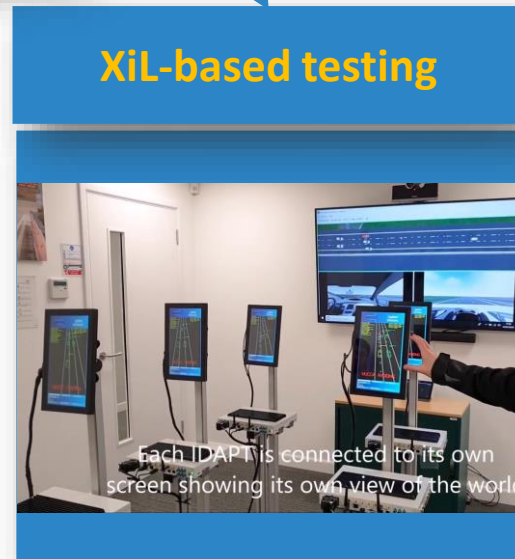
Automated Driving Demonstrator



Field tests (permit available)



Simulations



Vehicle-in-the-Loop testing



Test track testing

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