ADScene

A path to a European scenarios database for ADS and ADAS specification, validation, and homologation

V&V Methods Mid-Term Event – 2022, March 16th

Stéphane Geronimi (Stellantis) & Emmanuel Arnoux (Renault)

ADScene Project

ADScene

Towards an industrial scenarios database ot design, validate and homologate Driving Assistance Systems

Stéphane Geronimi (Stellantis) & Emmanuel Arnoux (Renault)

ADS & ADAS design, validation & homologation are based on SCENARIOS

ADScene

Our objective is to contribute to establish the new European standard for ADS Design, Validation & Homologation

Benefits :

- Safety & Compliance demonstrations
- Design & V&V cost reduction

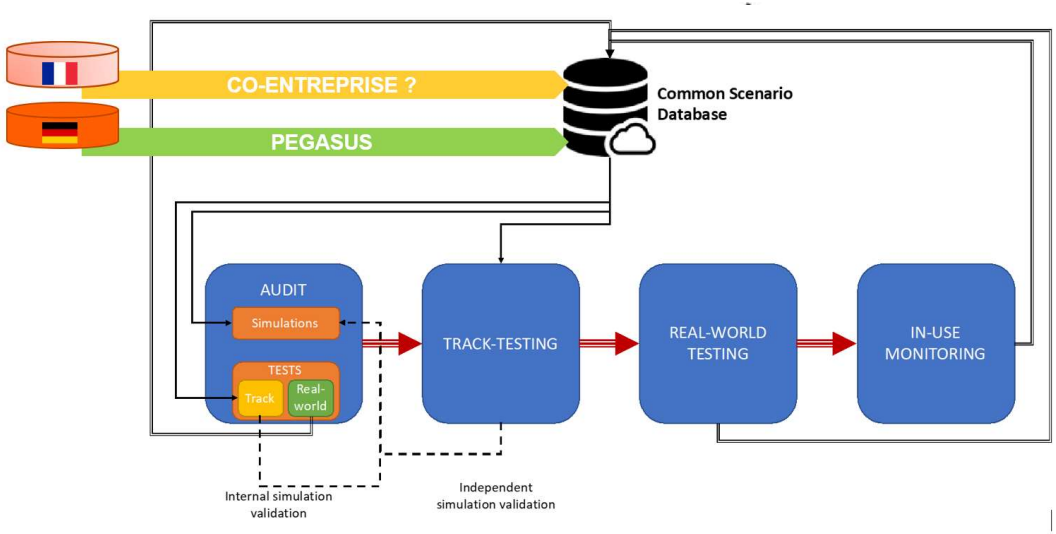


Fig.1 – Common Scenario database in the multi-pillar approach for the certification of automated driving systems

ADSCENE initiative is an answer to requirements coming from French Law (LOM law), regulations (e.g. EC, and UNECE) and standardisations (e.g. ISO SOTIF) about the use of scenarios

Database content & feeding : multi-source approach

ADScene

Scenario types & driving events	Data input type	Data processing
1 Real-world driving data + corner cases	> Real-world driving data > Corner cases	> Detection algorithms + high level parameters calculation + statistics > 2.5 million concrete scenarios / 80 logical classes / **parameter statistics**
2 Incidents	> **Real-world driving data** from Moove > Identification of **Safety Critical Events**	> **Workplan still in progress** > Definition of EU **threshold**
3 Accidents	> Reports on ac**cidents involving bodily injuries on French highways** in 2012	> **Modelling of accidents** in concrete scenarios > 279 scenarios / 50 logical classes
4 Expertise & Regulation / NCAP	> OEM expert views and knowledge on **critical driving situations** > **Regulations / NCAP scenarios**	> **Logical scenarios with parameter value ranges, but no statistics** > **Logical/Concrete scenarios from Regulation & NCAP**

ADScene

COMMON SCENARIO DATABASE
Functional Scenarios
Logical Scenarios &
Parameter Space

DATABASE OF SIMULABLE SCENARIOS

Usage:
> Scenarios for Design & Validation
> Scenarios for Simulation
> Scenarios for Homologation
> Scenario for physical testing improvement

Background

More than 1 M Km of driving data collected since 2016 by MOOVE project

ADScene
INSTITUT VEDECOM
DU VÉHICULE DÉCARBONÉ ET COMMUNICANT ET DE SA MOBILITÉ

First campaign : 2016 - 2019

Area	km
Paris area	436873
France	232983
Germany	115311
United Kingdom	23530
Italy	44749
Spain	48814
Netherlands	4920
Austria	16861
Portugal	12565
Belgium	8205
Switzerland	5291
Sweden	21396
Denmark	12821
Norway	2853
Luxembourg	1679
Ireland	6030
France-Germany Corridor	2519

>550.000km
20.000 < 100.000km
0 < 10.000km
0km

>1 Million Km
France + West EU

6 EQUIPED C4 fleet

New campaign 2020

East EU by C4 fleet

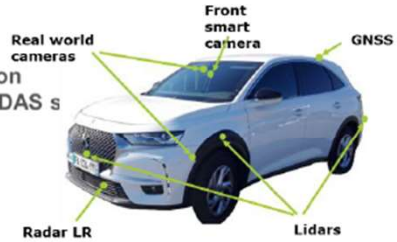
To cover more territories, various infrastructures, climatic contexts and driving usages.

+

3 EQUIPED DS7 fleet

360° Vehicles perception by the most relevant ADAS s

- 4 Lidars Scala
- 1 Long range radar front
- 1 Mobileye Q4 Front
- 1 GNSS RTK receiver
- IMU
- CAN vehicle information

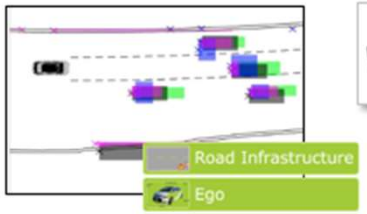


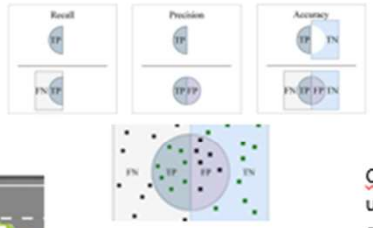
To enrich MOOVE database with more accurate data and deliver usable safety scenarios to our partners

Real driving, Common & Remarkable scenarios, by Moove @ VEDECOM

ADScene

Data collection → Data processing → Coding → Concrete Cases Identification → Formating → Pre-Validation → Validation





360°
Vehicles perception
- 4 Lidars Scala
- 1 Long range radar front
- 1 Mobileye Q4 Front
- 1 GNSS RTK receiver
- IMU
- CAN vehicle information

9 vehicles fleet
1 million km collected in West EU area.
15000 driving hours by professional drivers.
700 signals acquired, 350 To stored.

Data cleaning and filtering.
Multi-sensors fusion.
Object classification and tracking.

Real world modelization by
- 75 high level parameters
- 4 logical layers

Automatic identification of
- 25 Events
- 9 ego-vehicle Actions.

Expert rules encoding to automatically identify 28 scenario major classes.

Attributes computation to precise scenario conditions and fine sorting within 80 scenario detailed classes.

Performance KPI evaluation on a sample annotated dataset.

Computation propagation to the full collect data base.

Identification and classification of 3,3 millions of interest temporal sequences.

Concret cases are put under the "MOOVE" container in ADSCENE.

The scenario is filled with the sequence of steps and its associated parameters

Verifying scenario format:

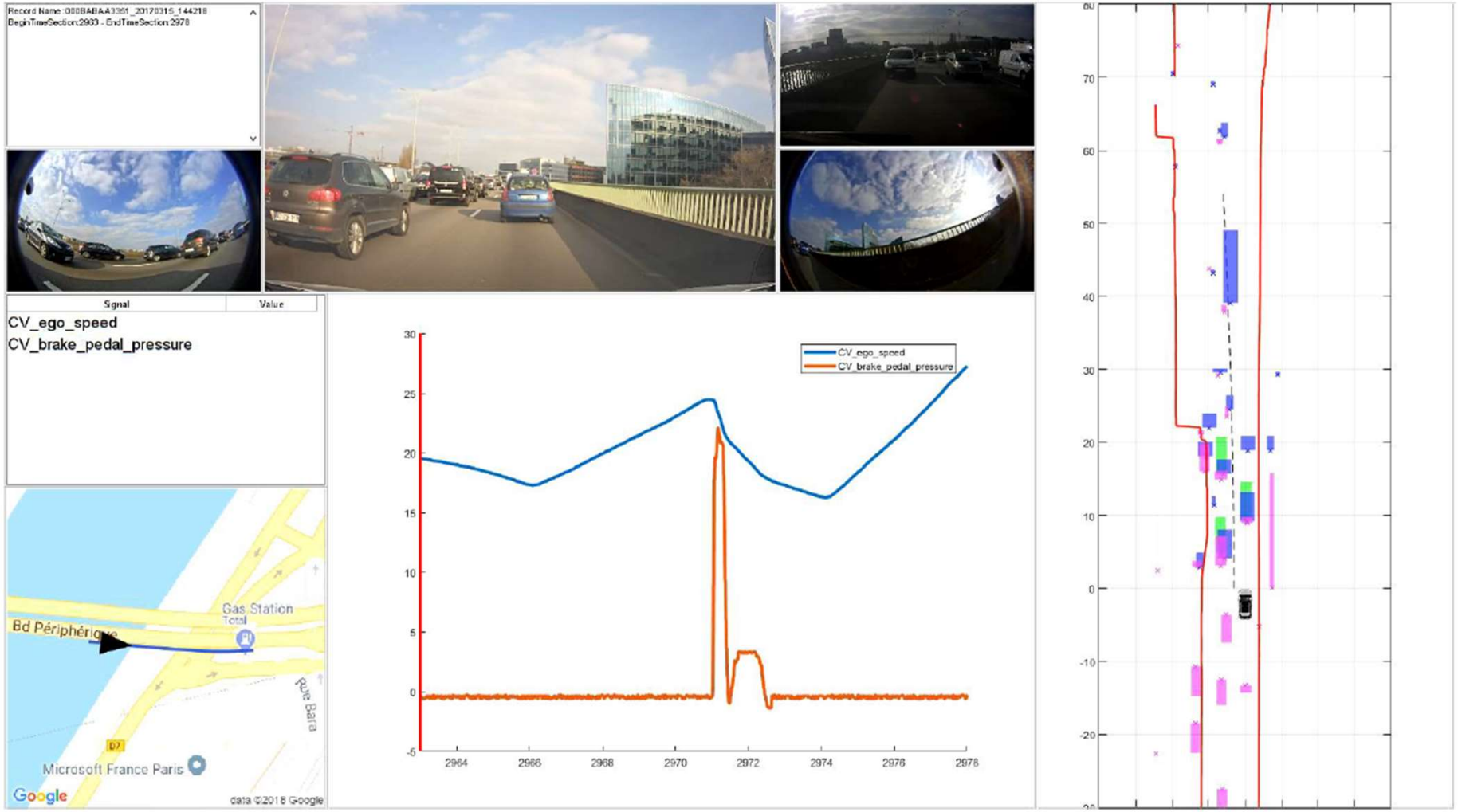
NOk → Modifications required (previous step)

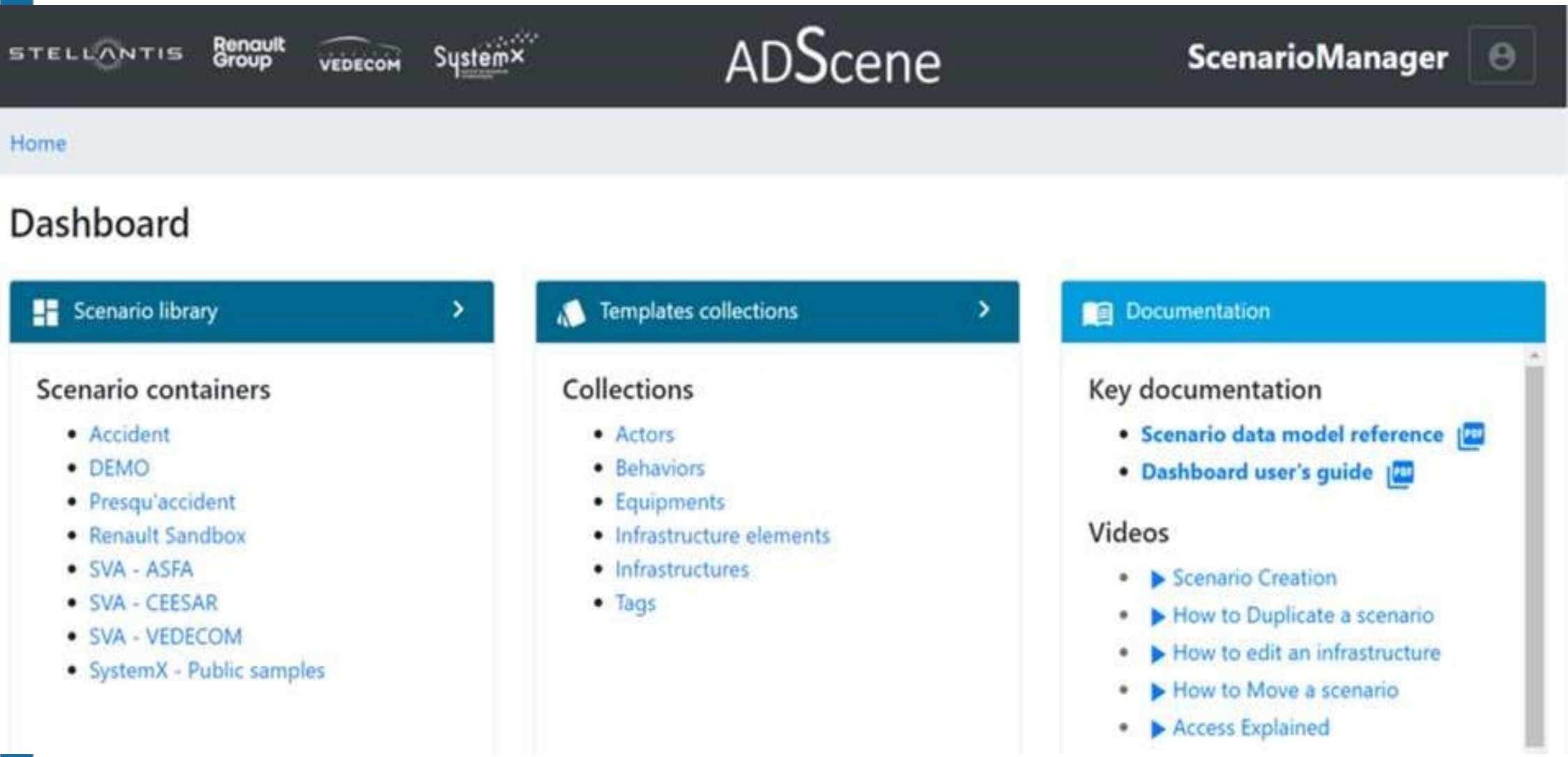
OK → The concrete scenario is placed under its logical scenario

Senarios are validated by the dedicated team.

Concrete scenario example : Cut-in in Traffic Jam

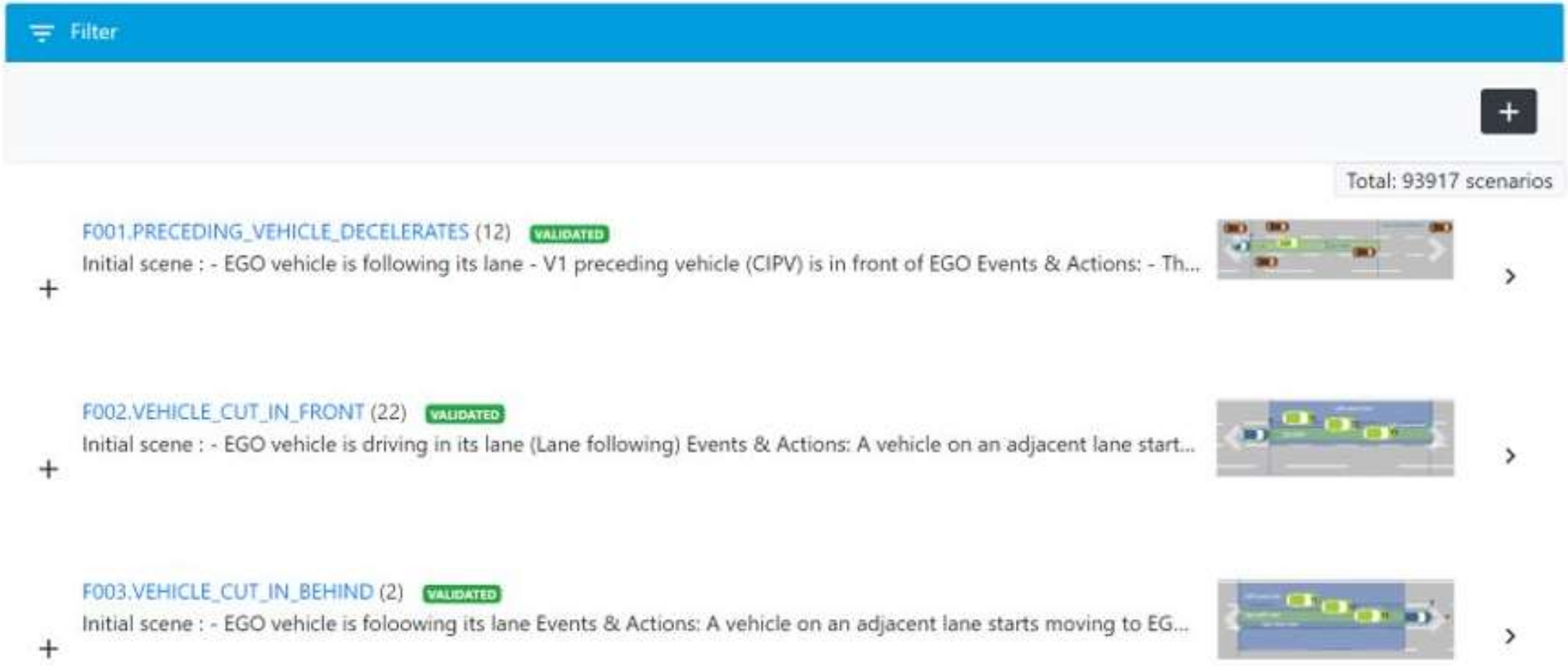
ADScene




STELLANTIS
Renault Group
VEDECOM
SystemX
ADScene
ScenarioManager
Home
Dashboard
Scenario library
Scenario containers
Accident
DEMO
Presqu'accident
Renault Sandbox
SVA - ASFA
SVA - CEESAR
SVA - VEDECOM
SystemX - Public samples
Templates collections
Collections
Actors
Behaviors
Equipments
Infrastructure elements
Infrastructures
Tags
Documentation
Key documentation
Scenario data model reference
Dashboard user's guide
Videos
Scenario Creation
How to Duplicate a scenario
How to edit an infrastructure
How to Move a scenario
Access Explained

ADScene

COMMON FUNCTIONAL SCENARIOS : examples

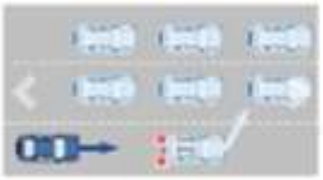


ADScene

COMMON LOGICAL SCENARIOS : examples

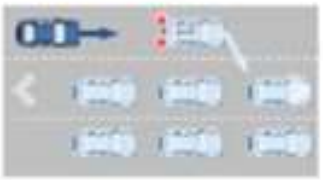
L001.002.01.L.CIPV_brakes_lane_change_to_left_busy_lane (240) VALIDATED

This scenario has many actors and characterized by: Initial scene: - The @EGO vehicle and the @V1 (CIPV) driv...



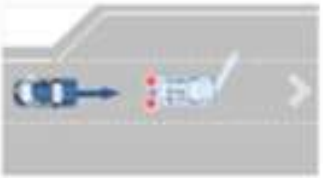
L001.002.01.R.CIPV_brakes_lane_change_to_right_busy_lane (296) VALIDATED

This scenario has many actors and characterized by: Initial scene: - The @EGO vehicle and the @V1 (CIPV) driv...



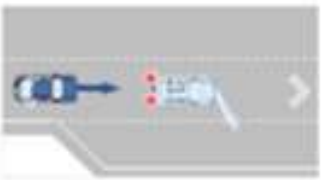
L001.003.01.L.CIPV_brakes_to_exit_to_left VALIDATED

This scenario has 1 actor and an Exit lane infrastructure. Initial scene: - The @EGO vehicle and the @V1 (CIPV) ...



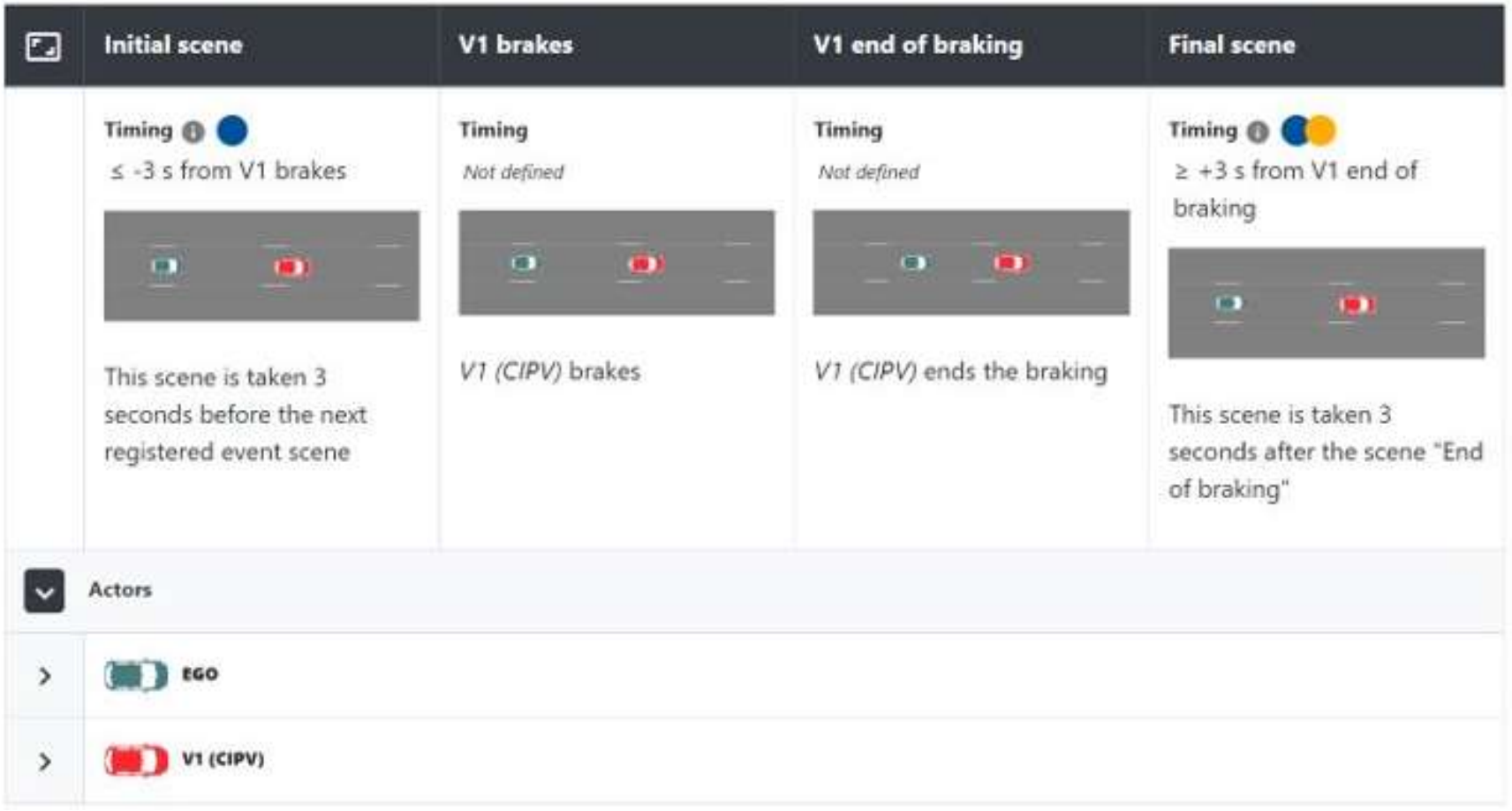
L001.003.01.R.CIPV_brakes_to_exit_to_right VALIDATED

This scenario has 1 actor and an Exit lane infrastructure. Initial scene: - The @EGO vehicle and the @V1 (CIPV) ...



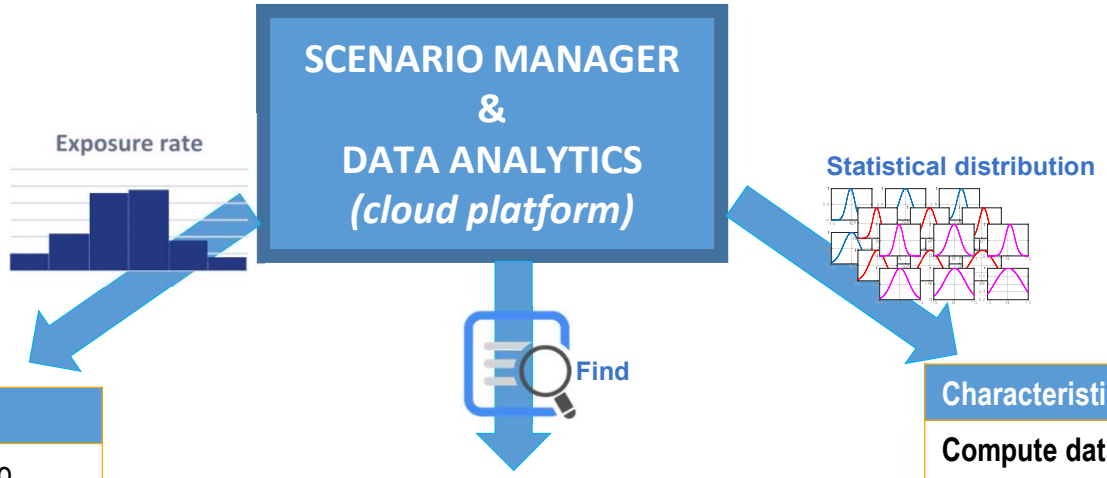
ADScene

COMMON LOGICAL SCENARIOS : example



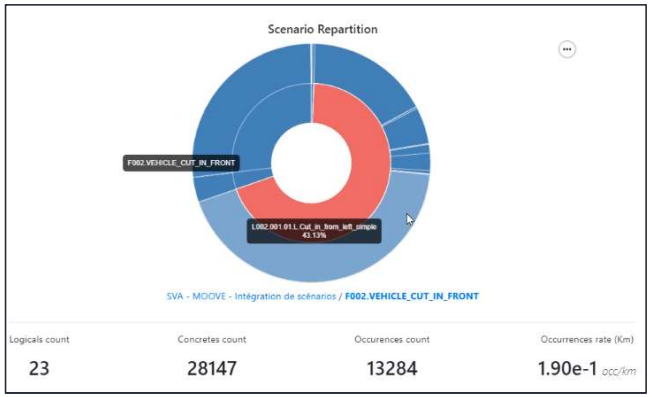
COMMON LOGICAL SCENARIOS : examples of statistics

ADScene



Scenario Occurrence statistics

- Evaluate the occurrence of a given scenario (exposure rate), or its Severity
- Occurrence of cut-ins in 3 lanes ways



Search and filter

Search scenarios according to defined criteria:

- Select all lane change scenarios
- Show only scenarios with ego speed >80 kph
- Select the scenarios from specific container or source (accidents, private container,…)

Select scenarios for the ADAS under test:

- e.g selection LxA homologation scenarios
- e.g selection AEB €ncap scenarios

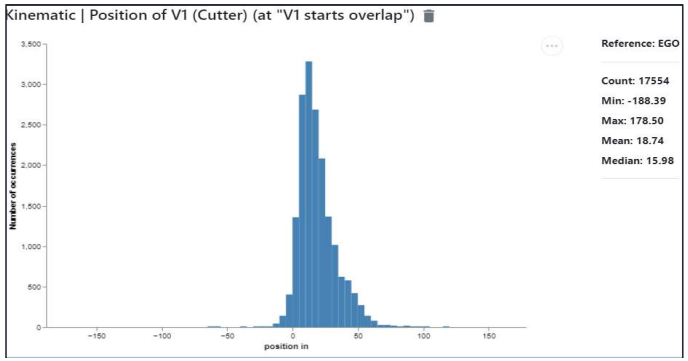
Characteristic parameters statistics

Compute data base characteristic statistics:

- e.g. amount of driving hours with a lead vehicle.

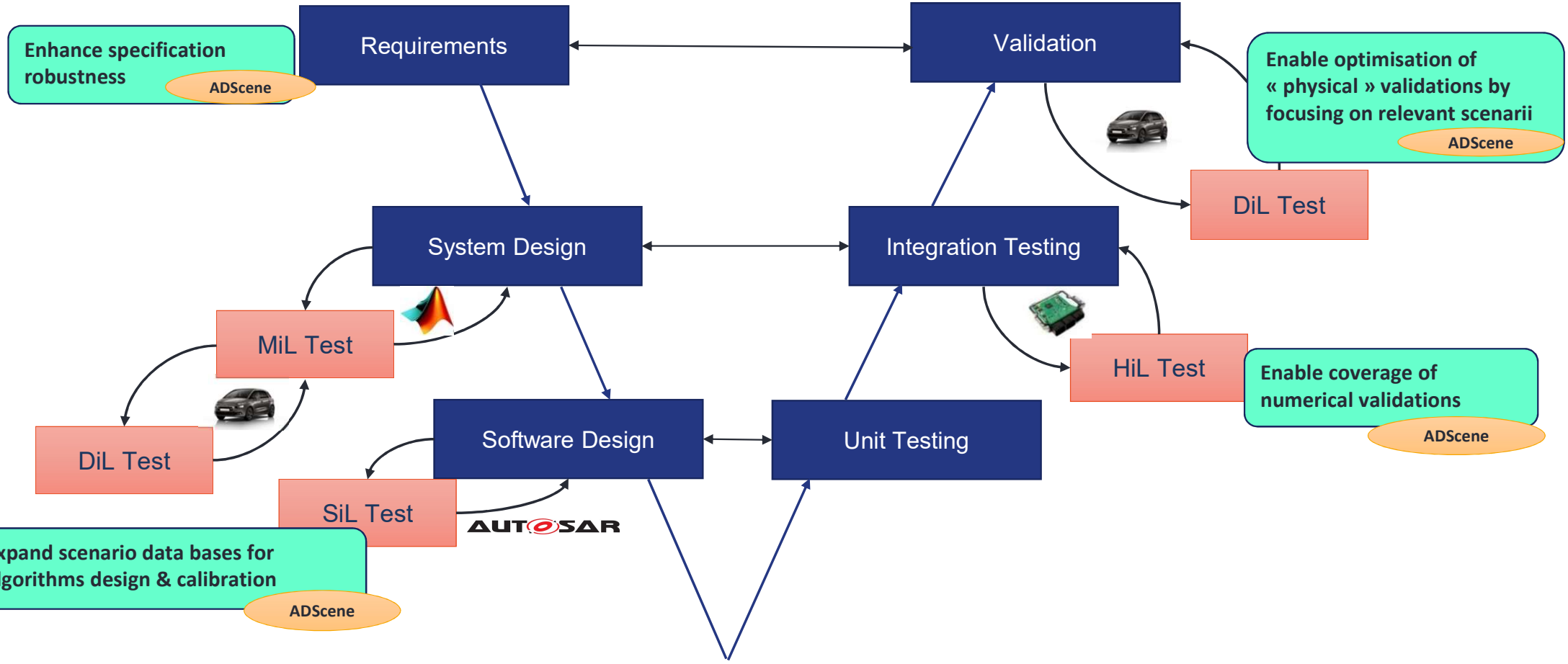
Characterize scenarios using parameters statistics

- Distribution of the distance in cutting-in scenarios.
- Distribution of the headway time.



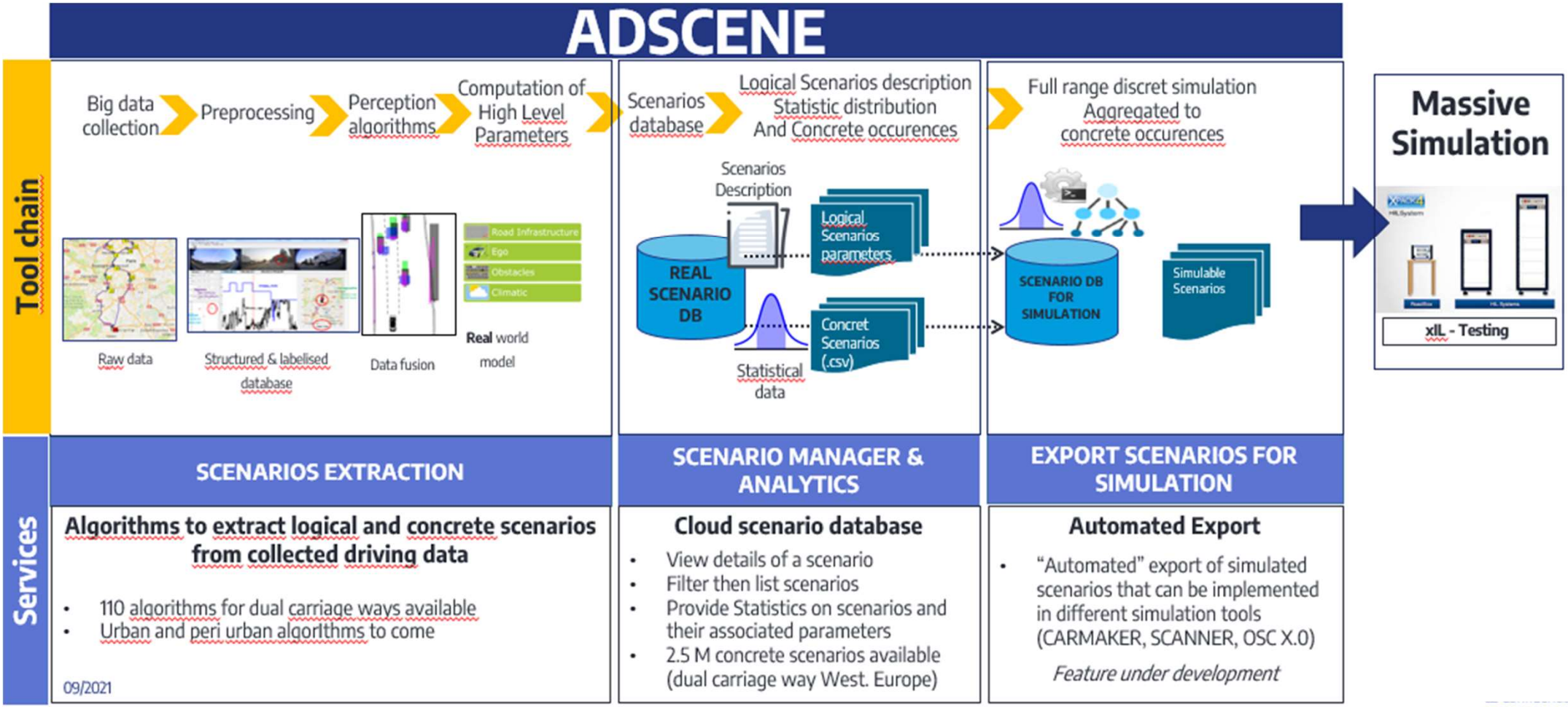
ADScene plateform : a unique scenarios database used along the V cycle

ADScene



SYNTHESIS

ADScene



CONCLUSION

ADScene

- **2021 : grouping of first partners to industrialize the scenarios library and associated toolchain = ADScene project.**
- **Answering the question of ADS safety and validation, not only SAE level 3, but also 1 & 2, requires enriching a scenario library from multiple sources**
  - With different driving operational domains
  - Considering multiple cultural expertise
  - With accidentology sufficient cover and notable incidents
  - With sufficient observation time
- **And establish a "common reference" in a unique structured library, with open export format to initialize the combinatory for exhaustive simulation**
- **"ADScene scenarios library" is supported by French government to become French scenarios library for ADAS, ADS, ARTS, and AGTS safety validation.**

PERSPECTIVES:
International harmonization in terms of methodologies & toolchains

Way to define the different scene of a scenario , to be able to share scenarios more easily

Scenario detection algorithms

Driving Data format & content (to extract scenarios)

Scenarios database coverage for a particular ADS

Audit items for a scenarios database (Quality requirements ?)

Use/Promote ADScene library to store your scenarios

PERSPECTIVES:
Proposals towards VVMethods

ADScene

How to share :

- driving data and
- scenarios

to contributre to interoperability, standardisation and globally the safety of Automated Driving Sytems ?

It is also possible to expand exchanges out of the scope of scenarios …to other topics of French Automated Vehicle Program like : safety approach ? Safety demonstation ? Quantitative safety target ? …