Autonomous Vehicle's Digital Simulation Challenges

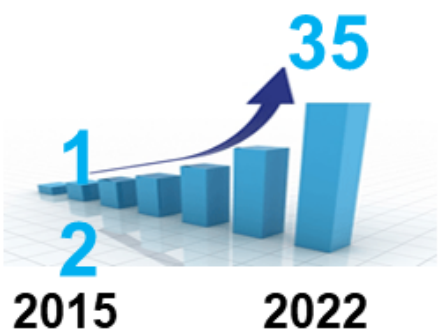
OPAL-RT TECHNOLOGIES

GROUPE RENAULT

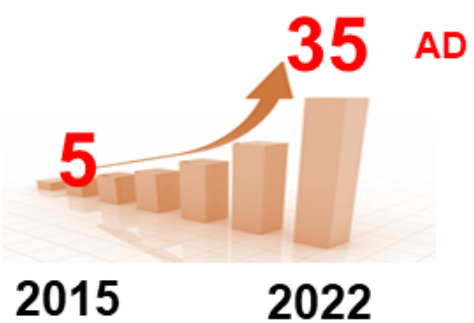
DSA

Autonomous Vehicle's Digital Simulation Challenges

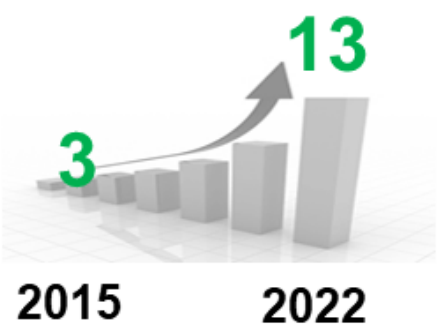
ADAS & AD: ROADMAP



ADAS SYSTEMS



VEHICLE APPLICATIONS



PLANTS & MARKETS

- Increase of AD/ADAS systems

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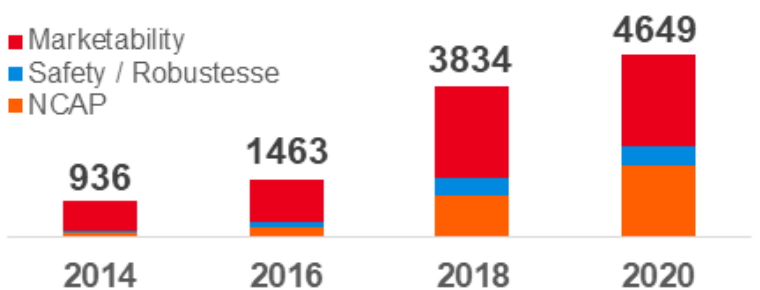
WORKLOAD & COMPLEXITY

TWO MAIN DRIVERS

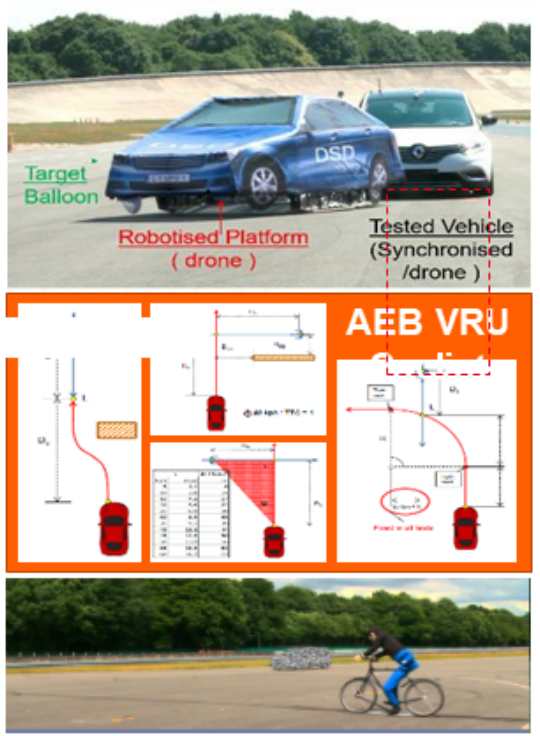
Rating & Regulation

AD System

LEADING TO DRASTIC INCREASE OF TEST CASES



PHYSICAL & DIGITAL TESTING ARE NESTED



- Increase of tuning workload & complexity
- Physical & digital testing are nested

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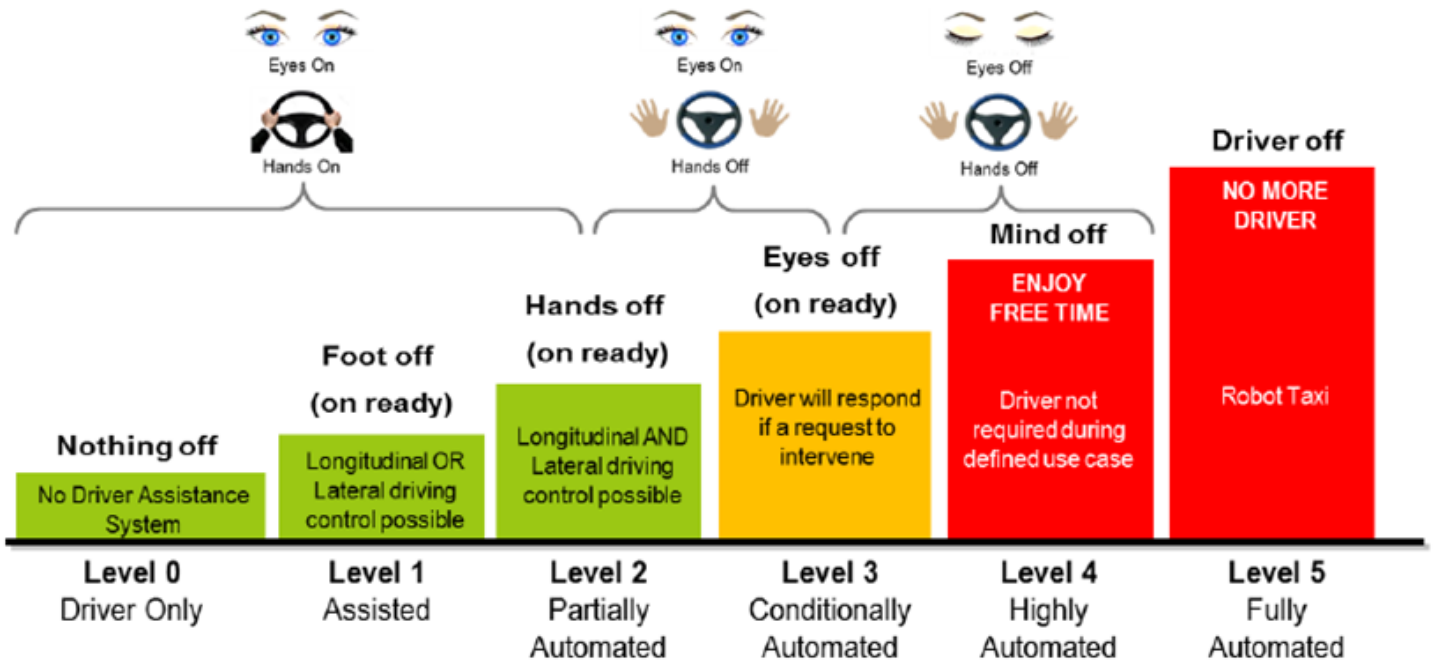
ADAS & AD CHALLENGES



- From driver last resort to system last resort

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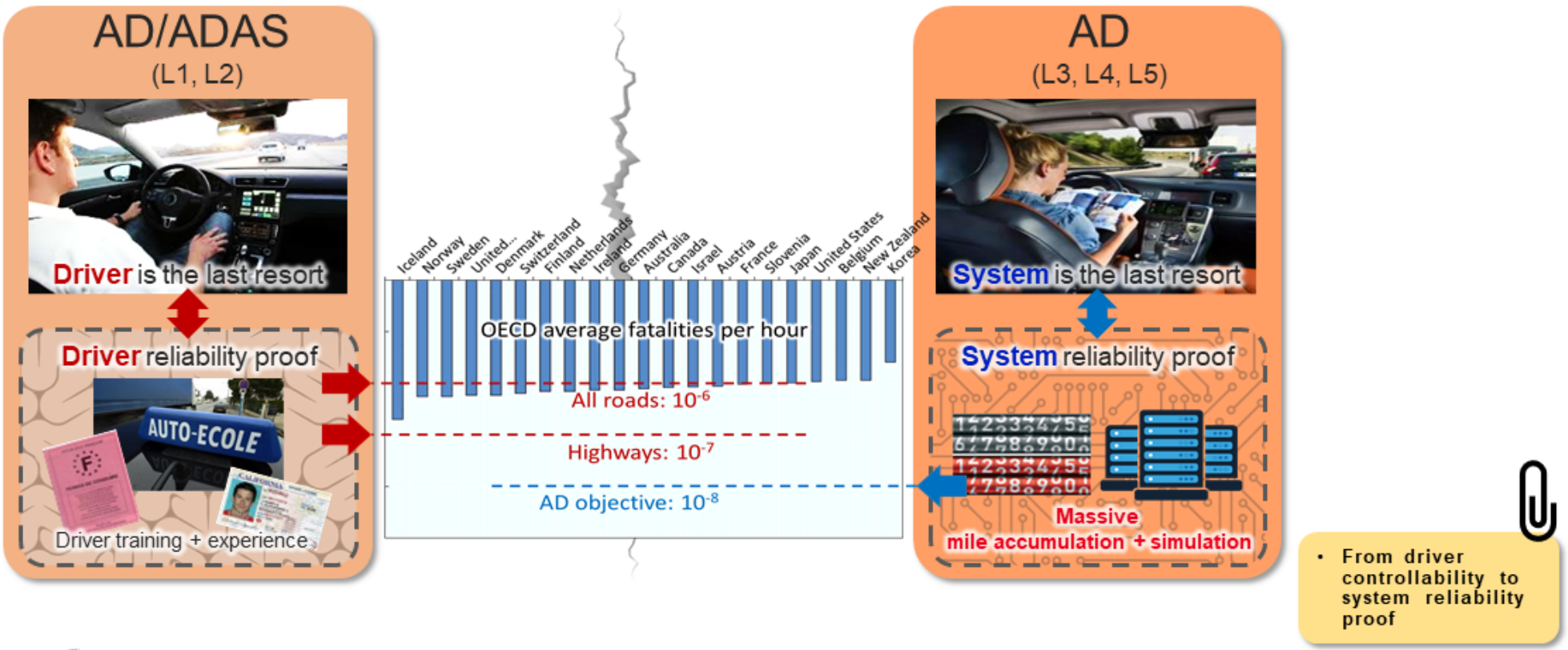
ADAS & AD CHALLENGES



- From driver controllability to system reliability proof

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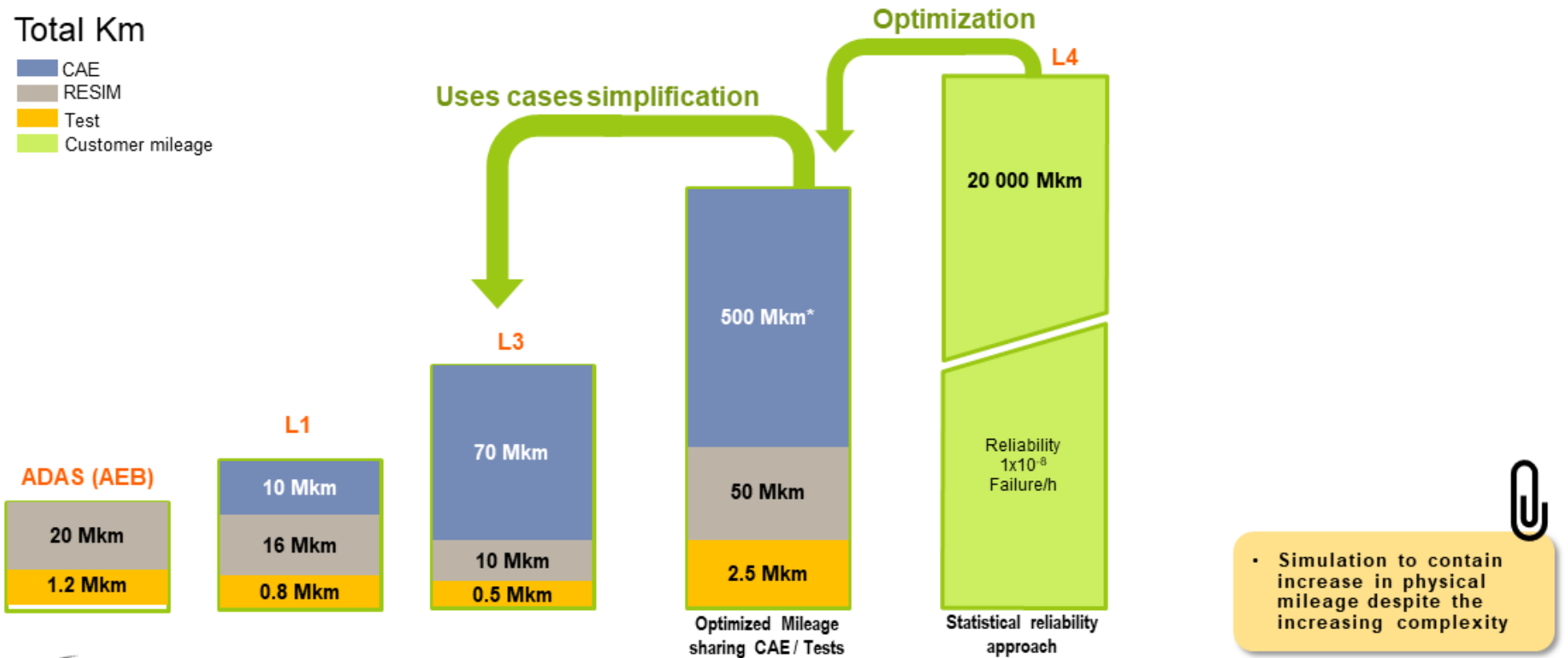
TEST MILEAGE CHALLENGES



- Simulation to contain increase in physical mileage despite the increasing complexity

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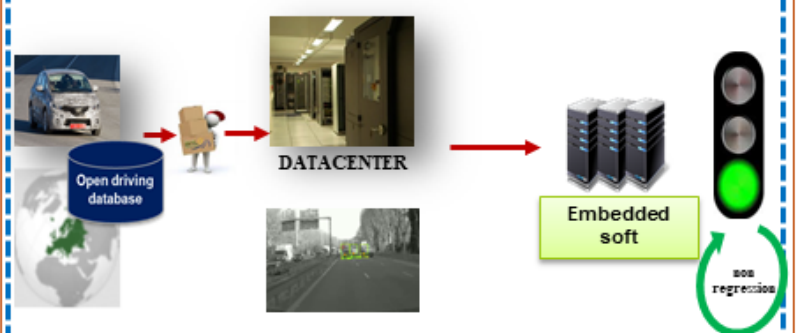
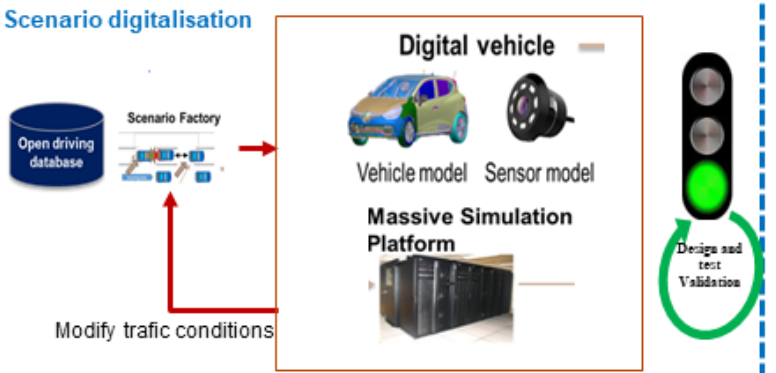
RESIMULATION & SIMULATION

Resimulation



- **USE FOR NON REGRESSION TEST**
- **PHYSICAL SENSOR VALIDATION IN REAL LIFE ENVIRONMENT**
  - ✓ OPEN LOOP
  - ✓ FALSE POSITIVE (false alarm) TRACKING FOR AUTOMATIC TEST

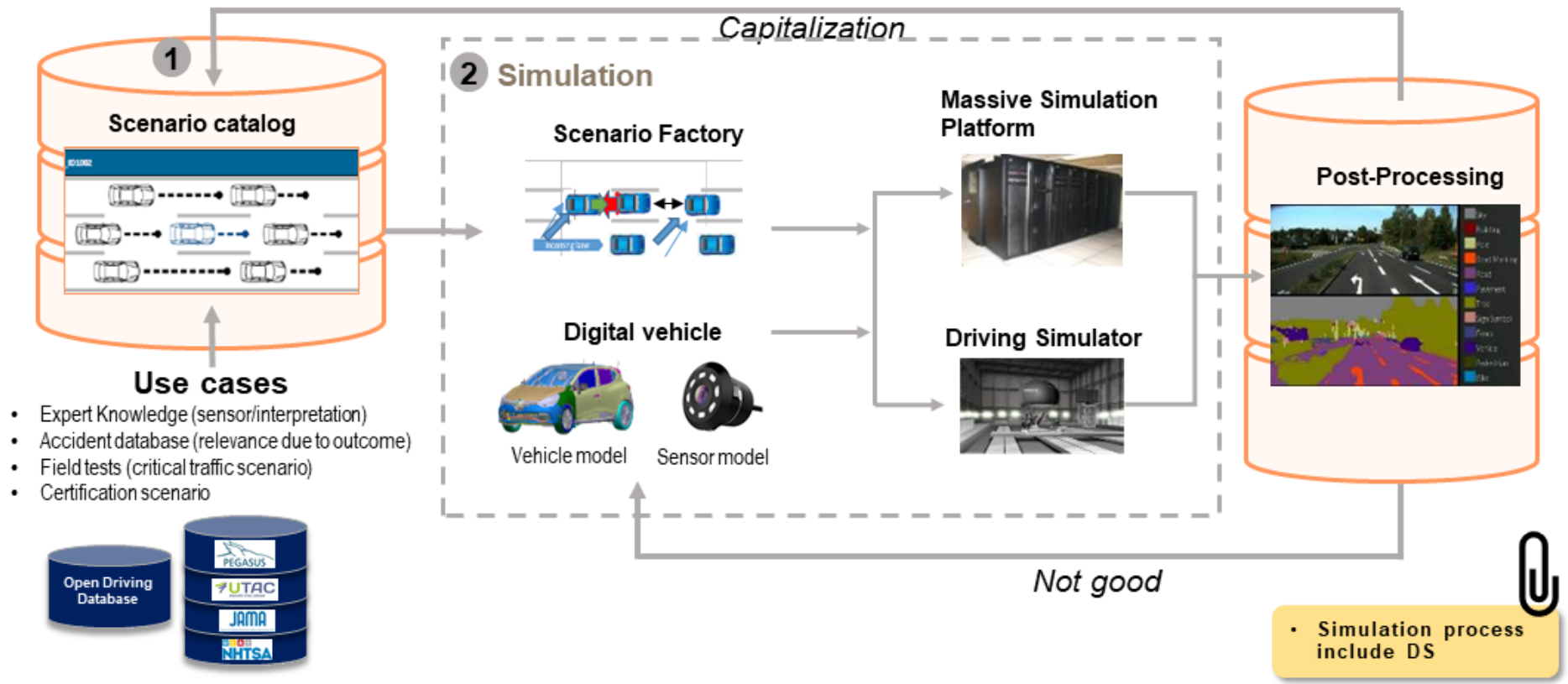
Simulation



- **USE FOR DESIGN AND TEST VALIDATION**
- **BEHAVIORAL MODEL FOR SENSORS**
  - ✓ CLOSED LOOP
  - ✓ FALSE NEGATIVE (non detection) TRACKING FOR AUTOMATIC TEST

- **Simulation & Resimulation are complementary simulation tools**

ADAS & AD VALIDATION PROCESS



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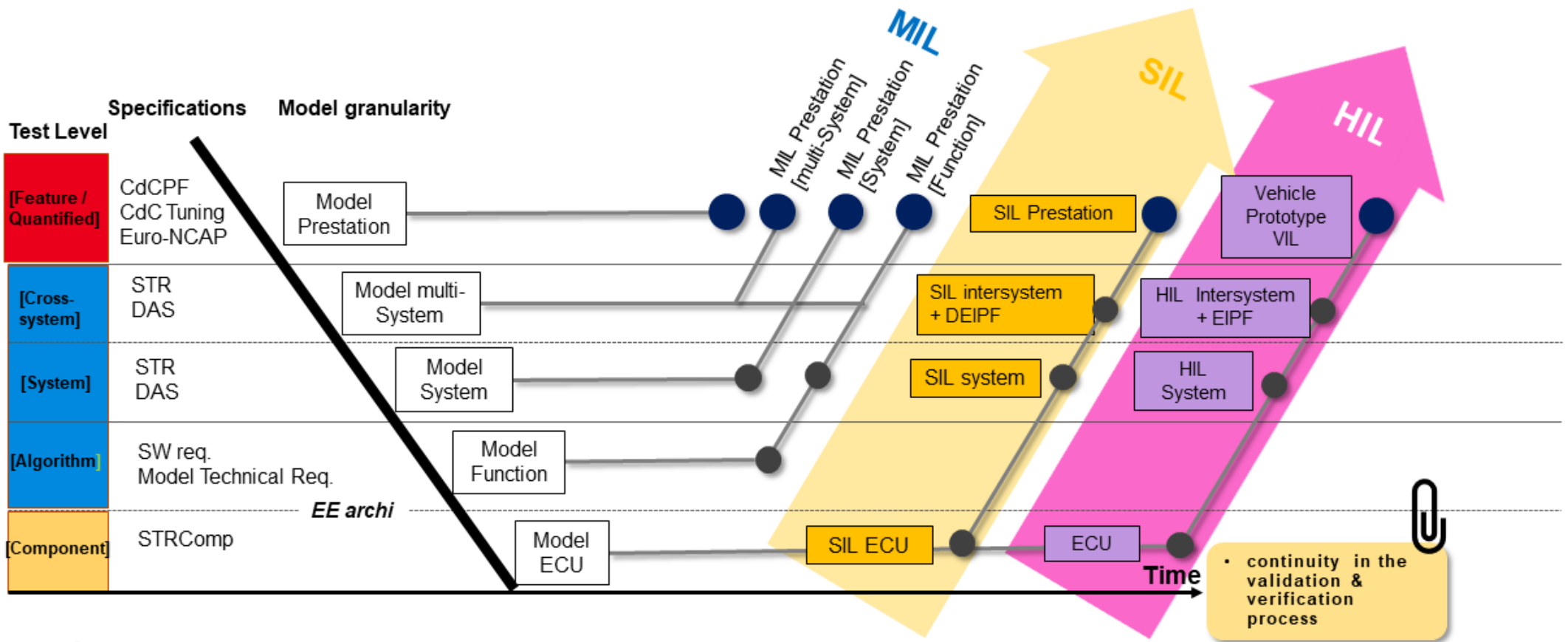
ADAS & AD TEST PROCESS



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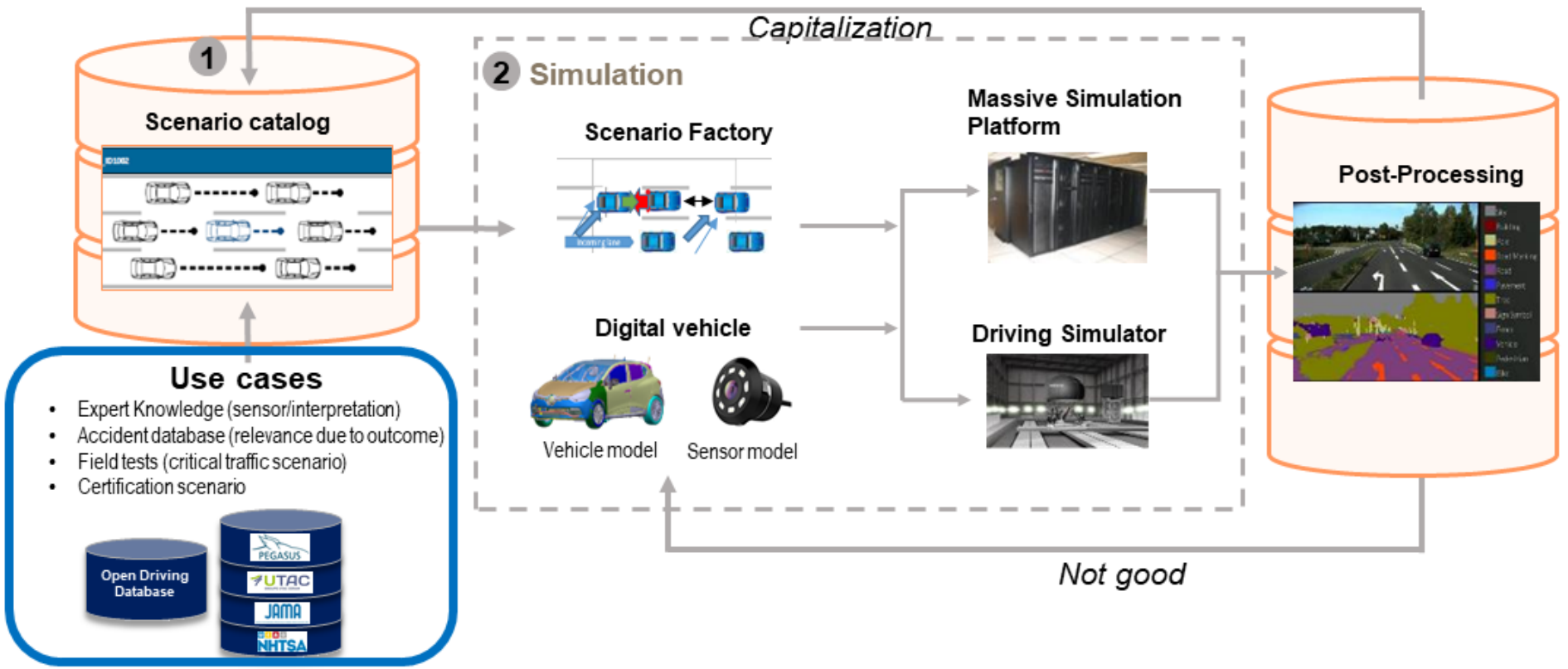
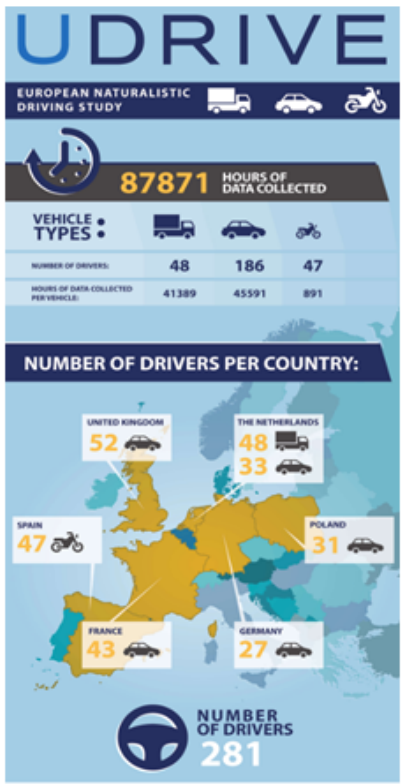
ADAS & AD VALIDATION PROCESS



CRITICAL SCENARIO FROM REAL LIFE : EXAMPLE

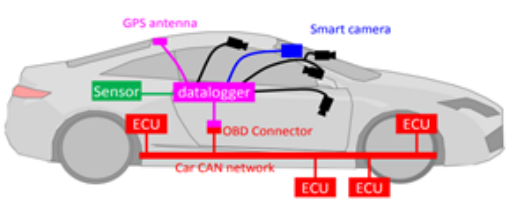


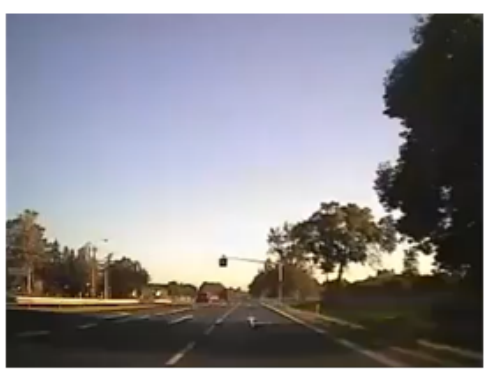
udrive.eu

Udrive project :

European large scale naturalistic driving study

- 6 countries
- 281 drivers
- 2 000 000 km





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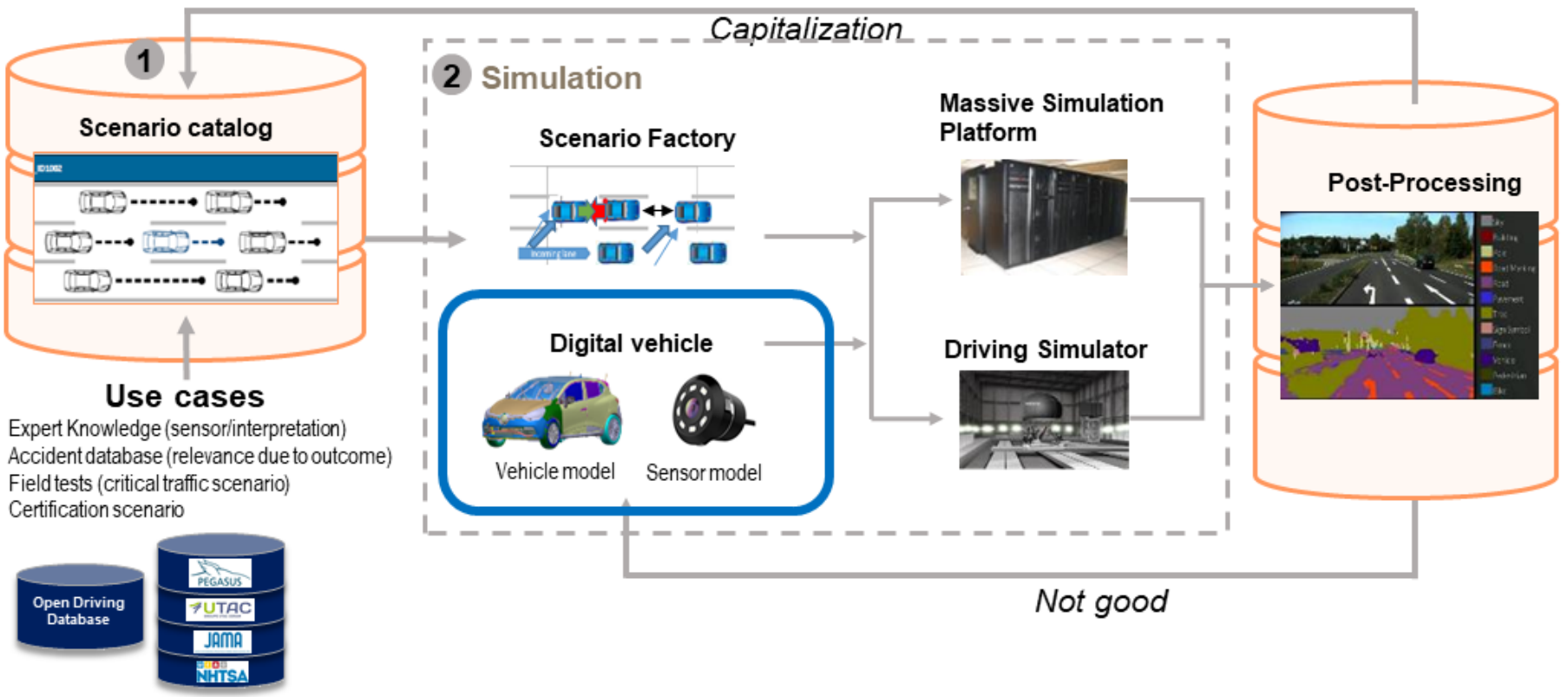
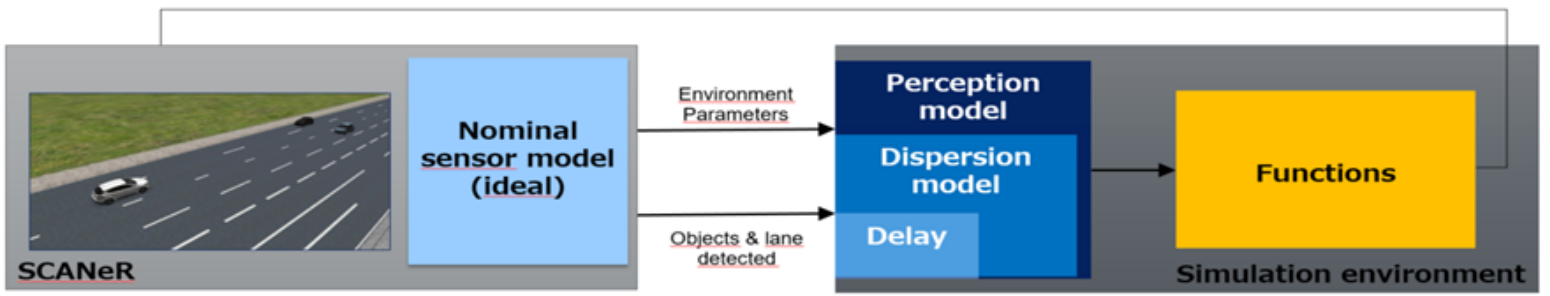
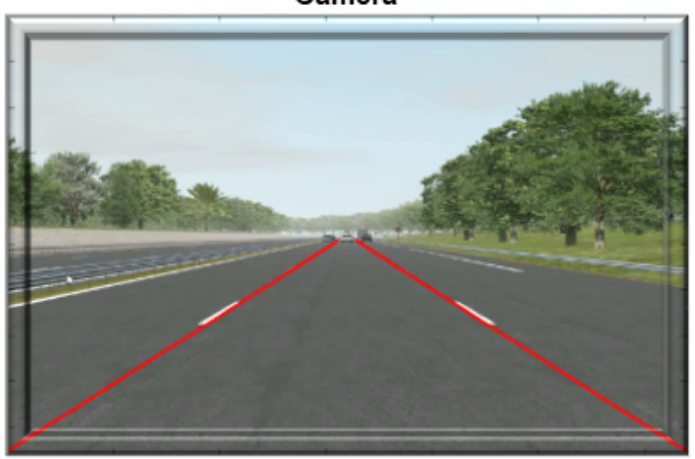
ADAS & AD VALIDATION PROCESS



SENSOR MODELING

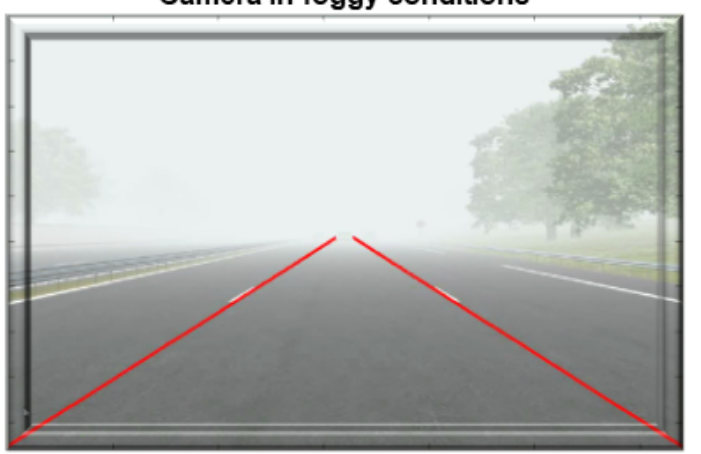


Camera

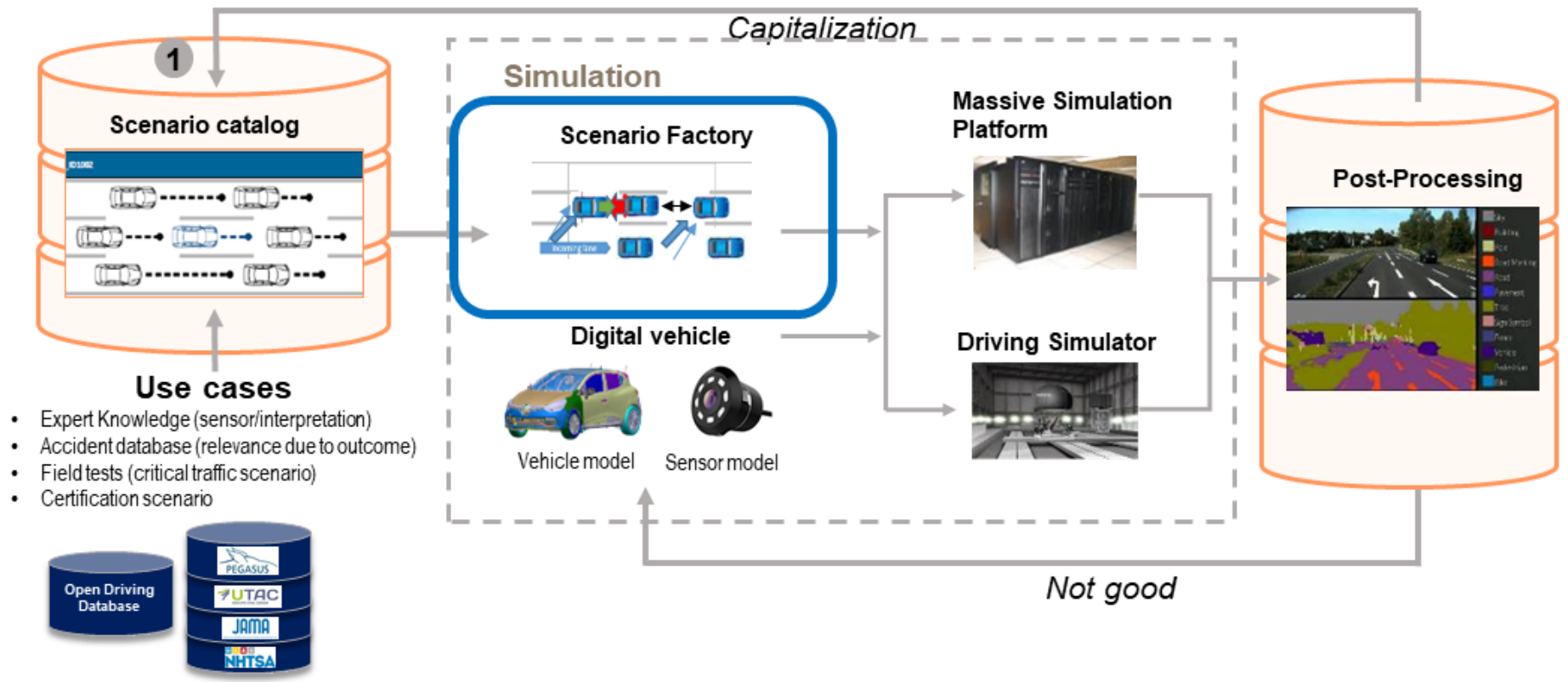


Perception model

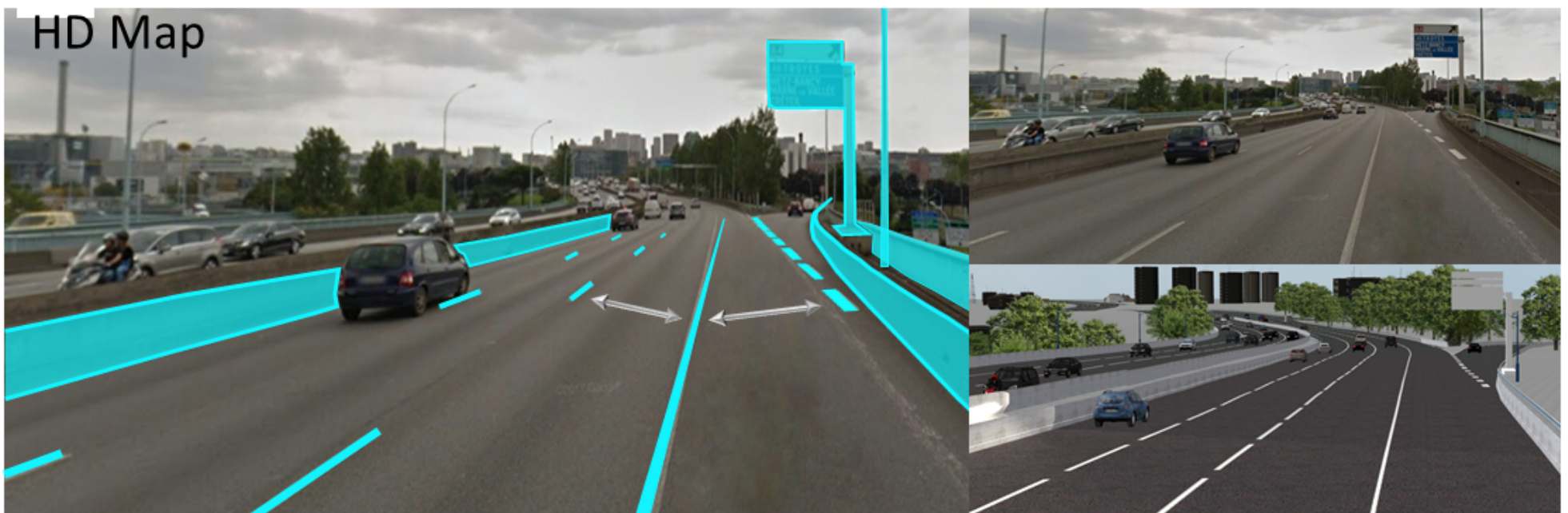
Camera in foggy conditions



ADAS & AD VALIDATION PROCESS



HD MAP AUTO IMPORT TOOL IN SCANER



HD MAP AND TRAFIC MODELISATION FROM REAL DATA

Simulated Scene in SCANeR - *Vision of Fusion Algorithm Data*

Real Scene - *Recorded Video*

GENERATION OF ROBUSTNESS TEST CASES

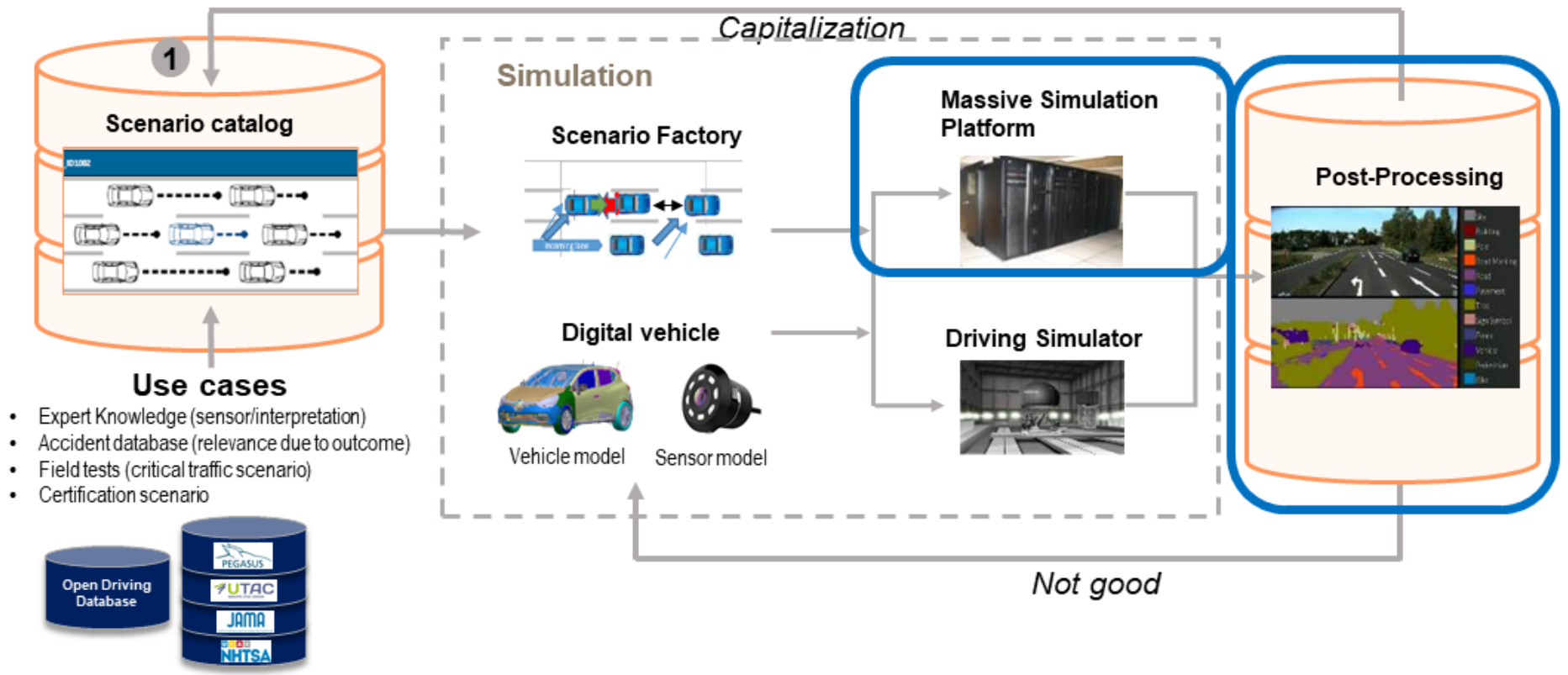
0. Original

Cut-in 1

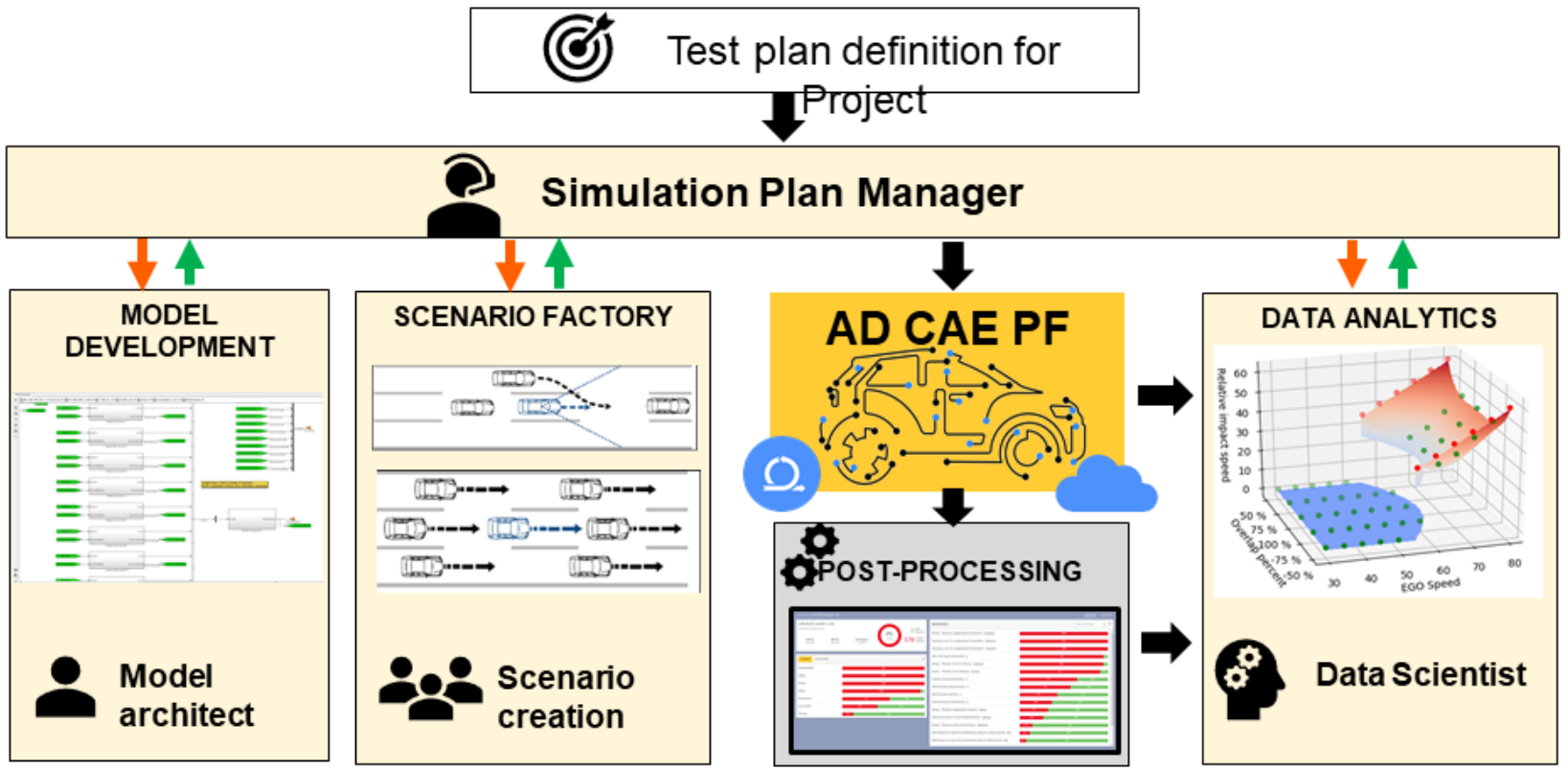
Cut-in 3

Cut-in 2

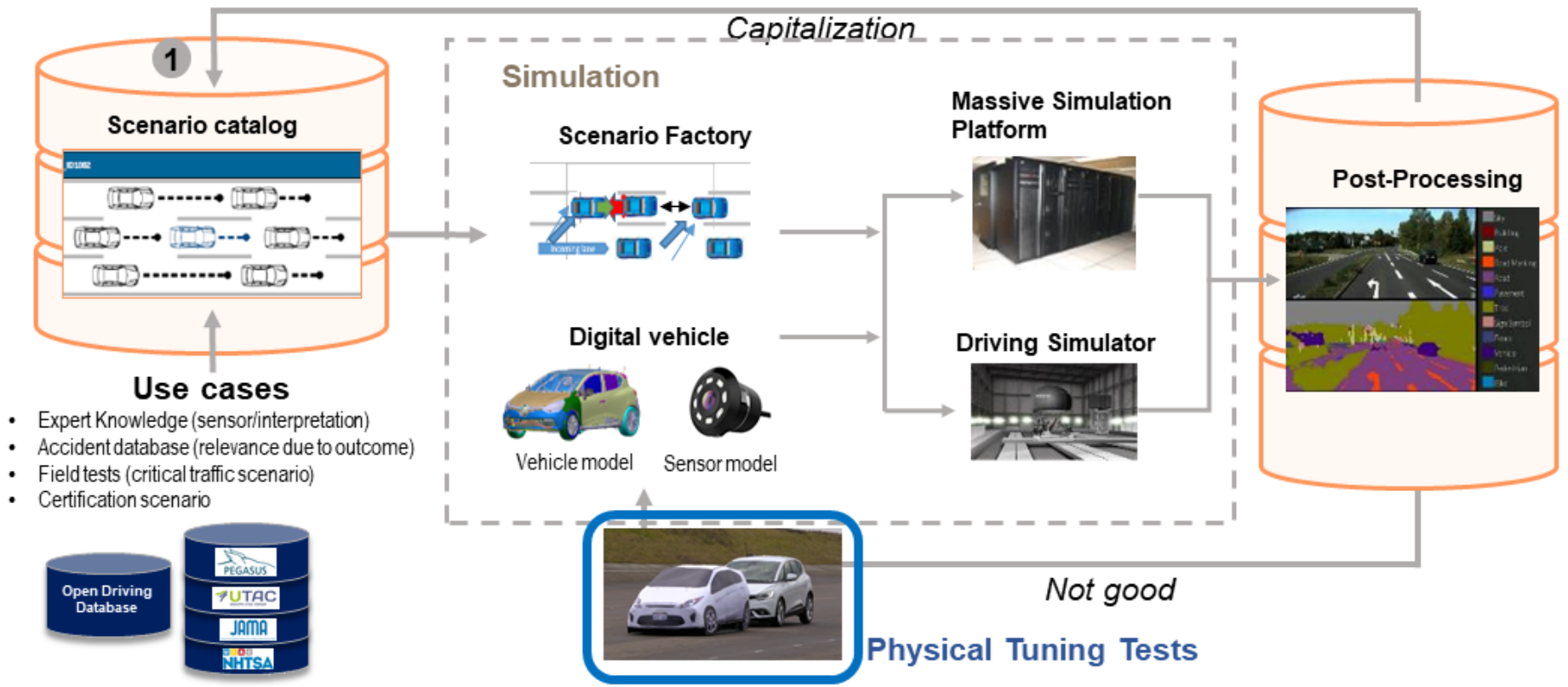
ADAS & AD VALIDATION PROCESS



ROLE DEFINITION IN THE PROCESS FOR DIGITAL VALIDATION



ADAS & AD VALIDATION PROCESS



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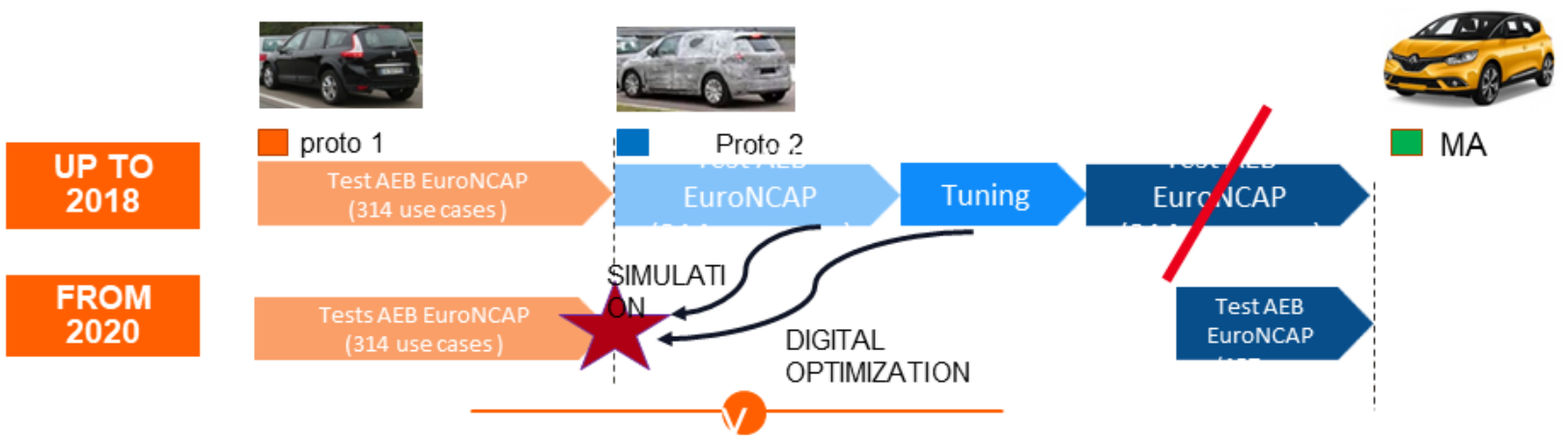
AD/ADAS TESTING ACTIVITIES: DIGITAL APPROACH

Example of Digital approach to reduce testing entry ticket



TARGET : **-50%** physical testing workload for **NCAP AEB** from 2020

✓ Simulation and Resimulation

- **needs to have in parallel prototype and digital vehicle (digital twins) for test campaign efficiency**

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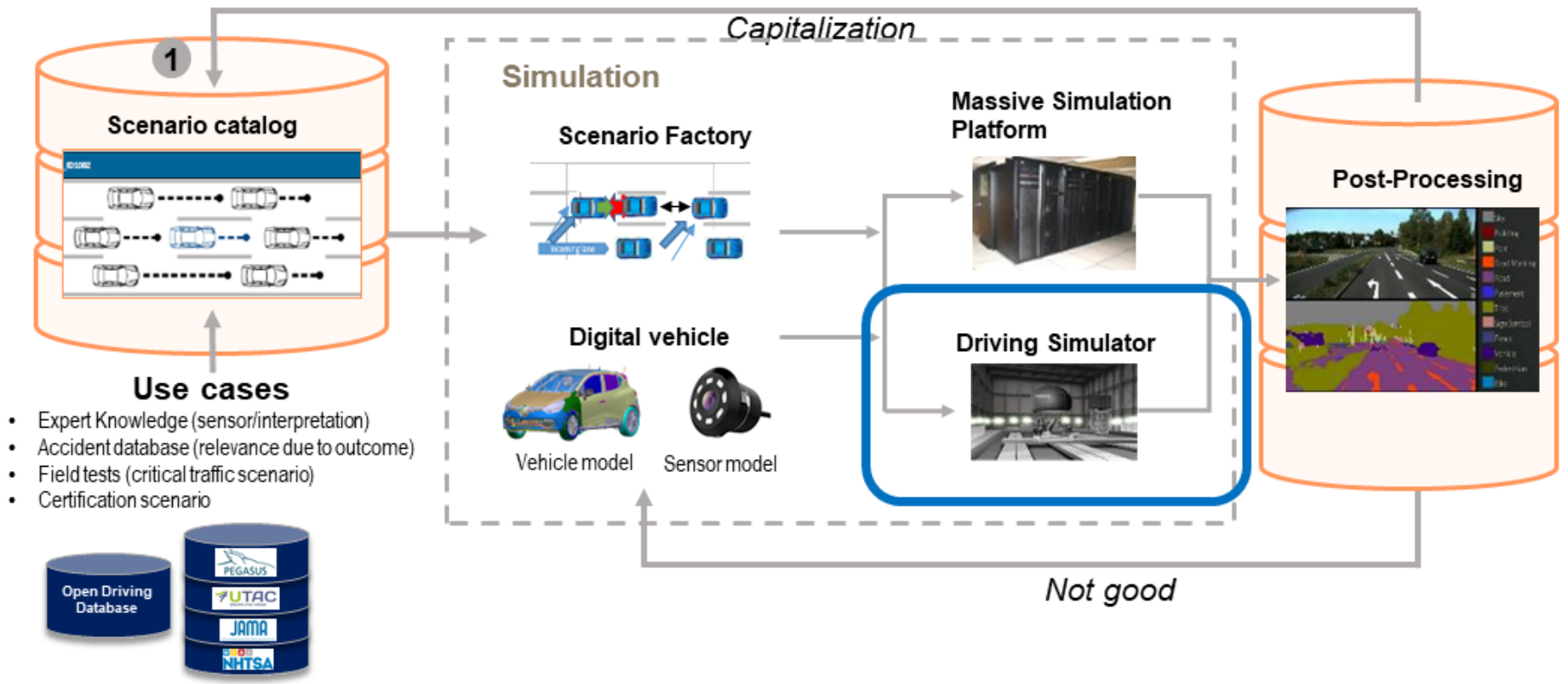
ADAS & AD VALIDATION PROCESS



DRIVING SIMULATOR FOR AD VALIDATION

- Driver acceptance & HMI validation
- Performance definition & pre-tuning
- Functional safety, limit conditions & dangerous situations

NIDS2

ULTIMATE

- Alliance Driving Simulator Interoperabilty

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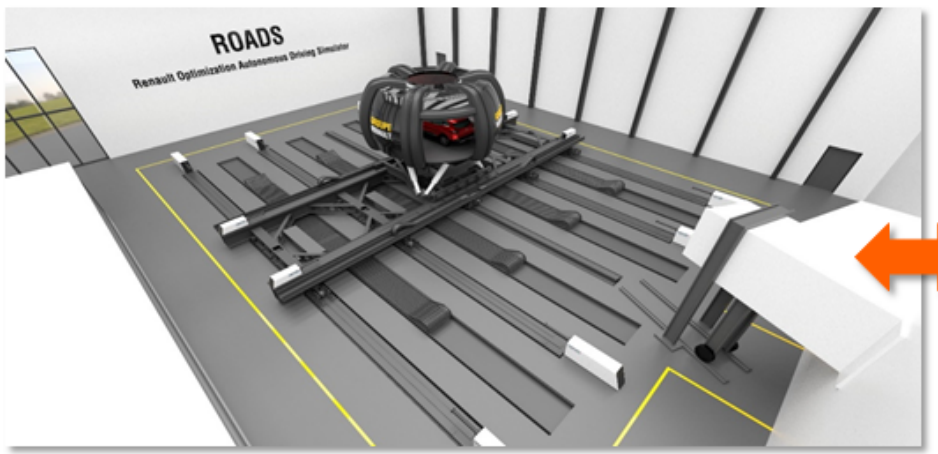
ROADS



High performance dynamic DS :

- Motion system : 1G in X&Y / 15x15m
- Projection system : 360° / 3D
- Immersive quality : Vehicles & eco system
- Delivery : Q2 2020

New building in TCR :

- ~2300m²
- AD/ADAS simulation center

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CONCLUSION

- Tools and simulation process are mature enough to be scaled and used in vehicle project
- Tools are used in agile process with integrated team DESIGN / SIMULATION
- MBSE process should improve efficiency of the loop by keeping tracability and continuity from design to simulation
- Tools will support digital process from upstream to development and tests

ADAS & AD SYNTHESIS VALID