Mid-term Event - 22/10/2020

Scenario based validation for CAD: Initiatives, projects and state of the art

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INSTITUT VEDECOM
DU VÉHICULE DÉCARBONÉ ET COMMUNICANT ET DE SA MOBILITÉ

Use cases and requirements (Work Package 1)

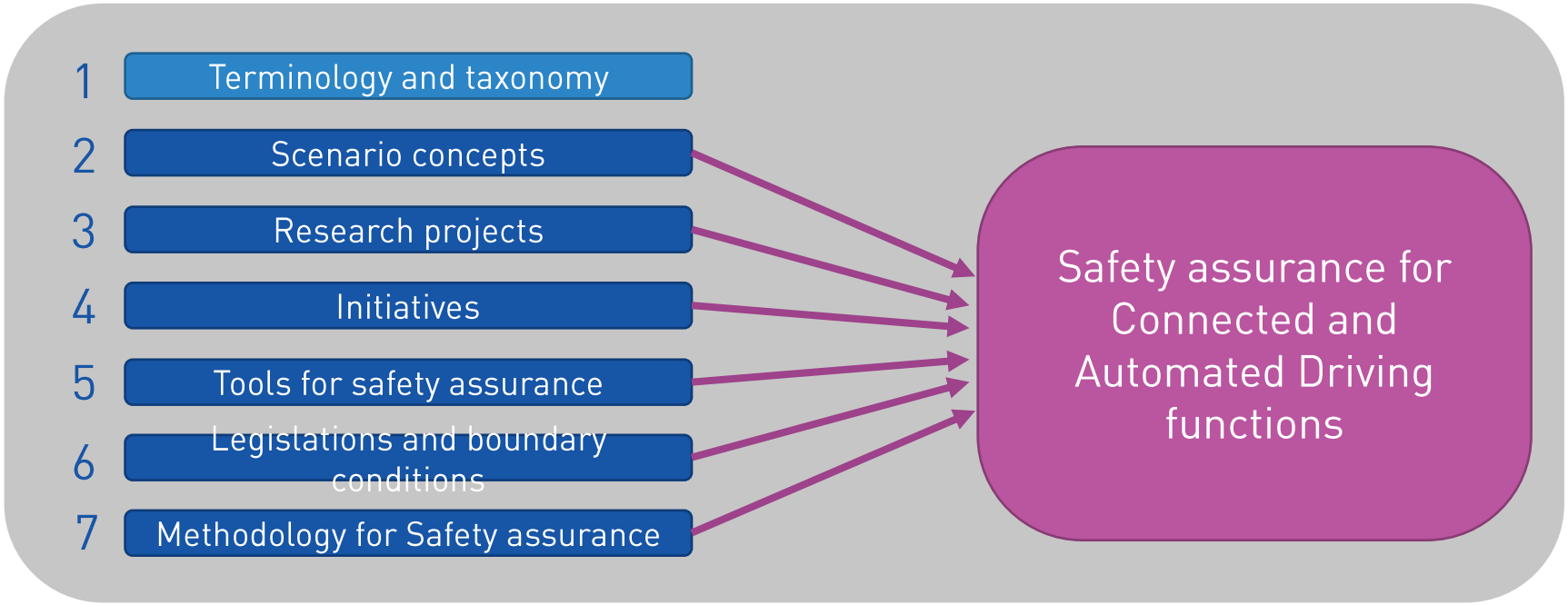
Timeline : From January to September 2019

Objectives :

1) Develop a comprehensive technical analysis and gap analysis on testing and validation methodologies based on ongoing initiatives worldwide.
2) Identify the needs of stakeholders and target groups and prioritise the use cases arising.
3) Identify the functional and technical requirements for Key Enabling Technologies (Cyber-security, Positioning, Connectivity).
4) Select the most relevant use cases in various traffic scenarios and detail their functional requirements.

I- State of innovation and gap analysis

- ✓ Topic led by IKA: INSTITUT FÜR KRAFTFAHRZEUGE ika | RWTH AACHEN UNIVERSITY
- ✓ **Objective:** Provide a detailed analysis of the existing state of the art on validation and testing methodology for CAD and identify the main gaps based on the available results.
- ✓ 7 aspects of the state of innovation.



1- Terminology and taxonomy

Terminology:

- ✓ **Project analysis :** list the terms linked to CAD from 28 projects and standards (DIN-SAE Spec 91381; ISO/PAS 21448 …)
- ✓ **Selection** of the most representative terms.
  - Some terms have multiple meanings
  - The same concept is expressed with different terms
- ✓ Criteria for selecting terms and definition :
  - Relevance to the scope of HEADSTART
  - Generality and representativeness
  - Clarity and conciseness
- ✓ A unified and unambiguous glossary has been defined with ~45 terms

Taxonomy for automation levels:

- ✓ Most projects follow the SAE - J3016 taxonomy
- ✓ Other model found : BASt and NHTSA

Level	SAE - J3016	BASt	NHTSA
0	No Automation	Driver Only	No Automation
1	Driver Assistance	Assisted	Function Specific Automation
2	Partial Automation	Partly Automated	Combined Function Automation
3	Conditional Automation	Highly Automated	Limited Self-Driving Automation
4	High Automation	Fully Automated	Full Self-Driving Automation
5	Full Automation	/	/

2- Scenario concepts

- ✓ Objective : Definition of driving scenarios
- ✓ Scenario concepts detailed form several research projects :

PEGASUS

MOOVE

street wise

L3Pilot Driving Automation

SAKURA Safety Assurance KUdos for Reliable Autonomous Vehicles

3- Research projects

- ✓ Objective : Identify CAD research projects of interest for HEADSTART
- ✓ 38 projects identified
- ✓ Focus on HEADSTART's Key Enabling Technologies
  - V2X communication ➔ 9 projects
  - Cyber security ➔ 7 projects
  - Positioning ➔ 8 projects
- ✓ Focus on CAD-Test-definition &Testing-activities ➔ 22 projects

3- Research projects

AUTOPILOT
MOOVE
PEGASUS
L3Pilot Driving Automation
GALILEO FOR MOBILITY
Robust SENSE
INFRAMIX
ENABLE-S3
PROPART Precise and Robust Positioning for Automated Road Transports
ENSEMBLE
InDrive Automotive EGNSS Receiver for High Integrity Applications on the Drive
ICT4CART
AutoSec
TRUSTVEHICLE
SAFER TEC
street wise
AdaptIVe Automated Driving
VI-DAS
SECREDAS Digital Privacy Safety & Security
inLane Lane Navigation Technology
CONCORDA
Scout
INTER ⇄ ACT
CloudLSVA Large Scale Video Analysis
PRYSTINE
BRAVE
CARTRE Coordination of Automated Road Transport Deployment for Europe
ASTAZERO
Program (SAFER)
ESPLANADE
SAKURA Safety Assurance KUdos for Reliable Autonomous Vehicles
gcdc i-GAME Grand Cooperative Driving Challenge

Other projects:

- ✓ HoliSec
- ✓ MuCCA
- ✓ PROSPECT
- ✓ ESCAPE
- ✓ Cooperative driving at traffic intersections
- ✓ Grand Cooperative Driving Challenge
- ✓ Coordination of CAVs over 5G
- ✓ ADAS & me

4- Initiatives

- ✓ Objective: Identify CAD initiatives of interest for HEADSTART
- ✓ 22 relevant initiatives found
- ✓ Classification into several topics:

Manufacturers associations

- JAMA – Japan Automobile Manufacturers Association, Inc.
- ACEA – European Automobile Manufacturers Association
- PFA – Filière Automobile & Mobilités
- @OICA

Public authorities

- Department of Transportation United States of America
- National Transport Commission
- UNECE

KETs

- 5GAA Automotive Association
- CAR 2 CAR Communication Consortium

Consumer testing

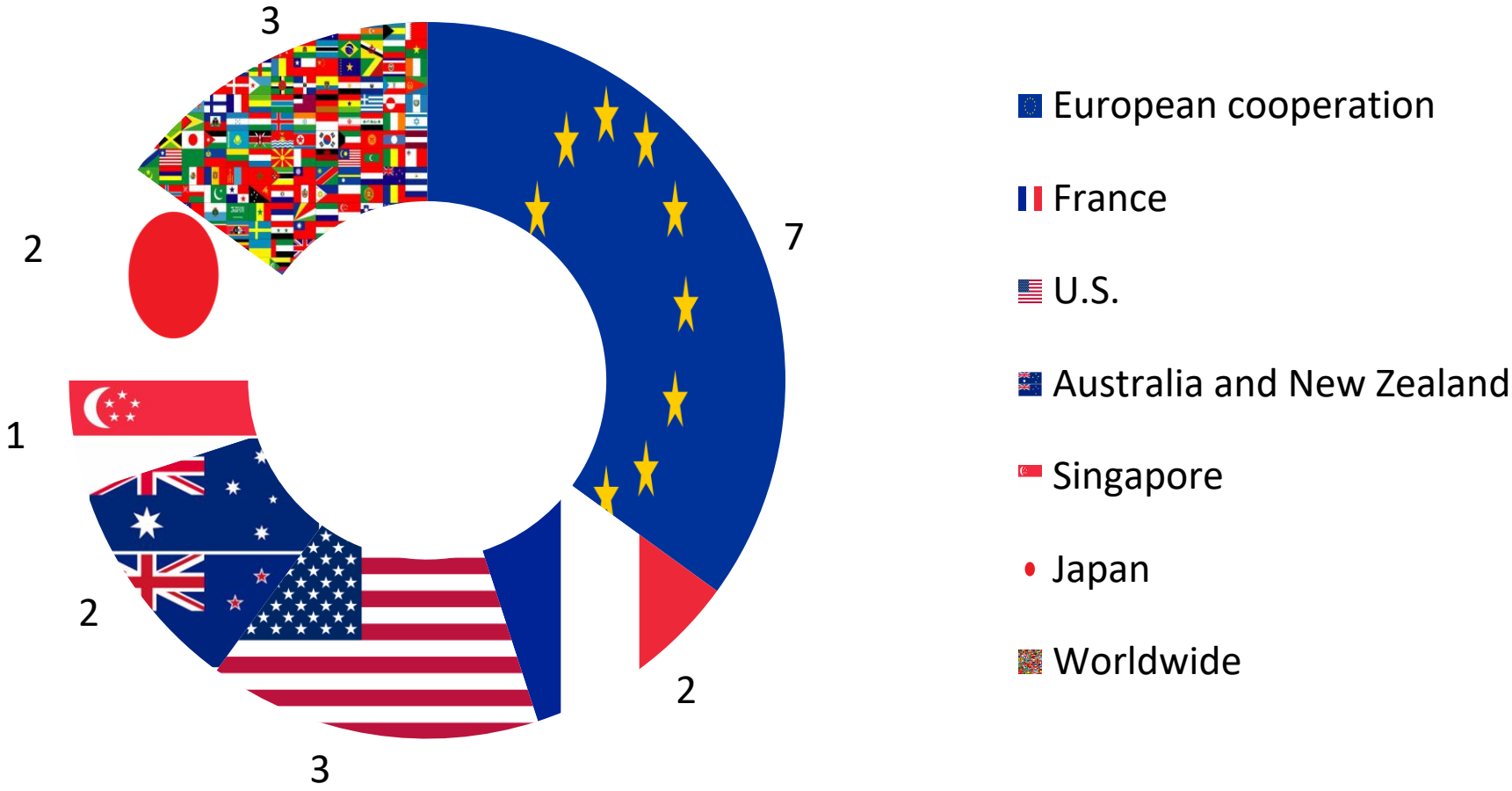
- Euro NCAP – For Safer Cars

Other relevant initiatives

- M city – University of Michigan
- PEARS – Prospective Effectiveness Assessment for Road Safety
- EATA – European Automotive and Telecom Alliance
- ECSEL JU
- EGVI – European Green Vehicles Initiative
- ANDVI – Australia & New Zealand Driverless Vehicle Initiative
- CETRAN
- ERTRAC
- European Truck Platooning
- SIP – 戦略的イノベーション創造プログラム
- American Center for Mobility – Connected. Automated. Validated.
- Nouvelle France Industrielle (NFI)

4- Initiatives

Localisation of the Initiatives



5- Tools for safety assurance

- ✓ **Objective :** List the main tools relevant for HEADSTART
- ✓ Four categories of tools of interest for HEADSTART:

Annotation tools
Addition of relevant metadata

- Video Annotation tools
- Annotation tools for 3D content
- Web platforms offering data annotation services
- Annotation tools from initiatives
- …

Recording tools
Synchronous raw data acquisition

- RTMaps
- Polysync Core
- IDIADA IDAPT
- LogicBricks logiRECORDER 3.0
- …

Simulation tools

- NVIDIA DRIVE
- Microsoft AirSim
- Simcenter Prescan
- CARLA
- IPG Carmaker
- rFpro
- VIRES VTD
- …

Dummies

- Global Vehicle Target (GVT)
- Pedestrian Target (PT)
- Bicyclist Target (BT)
- …

Software to control dummies

- Robot Operating System (ROS)
- Automotive Data and Time-Triggered Framework (ADTF)
- …

6- Legislations and boundary conditions

- ✓ **Objective:** Assess the current legislation on type approval for CAD functions, identify the relevant legislations for HEADSTART.
- ✓ 56 document reviewed from European and non-European Legislation, National Legislation, Standards and Guidelines

7- Methodology for Safety assurance

- ✓ **Objective:** Define the methodologies for safety assurance of automated driving functions

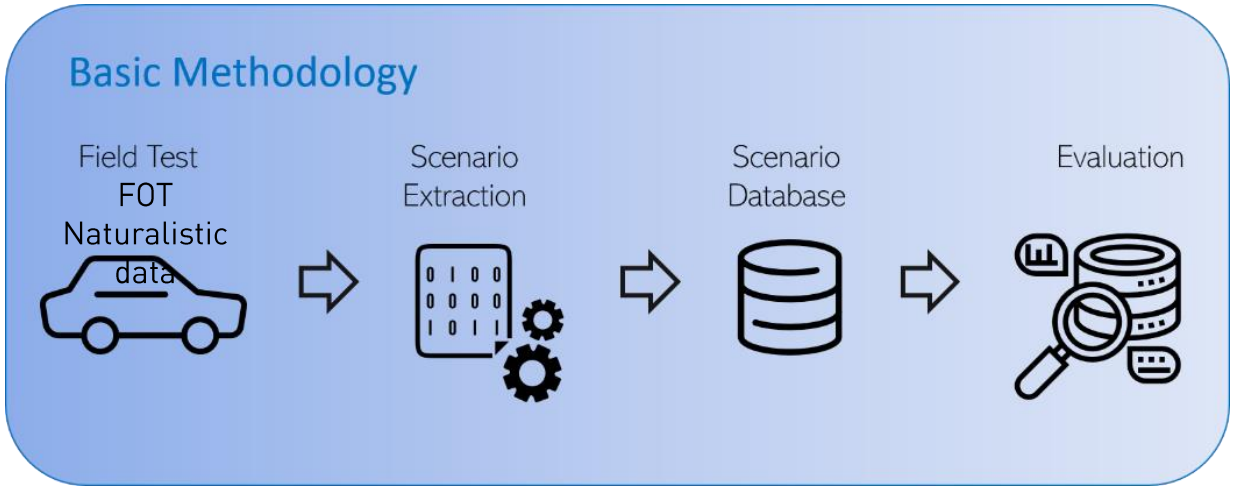
L3Pilot Driving Automation

PEGASUS

MOOVE

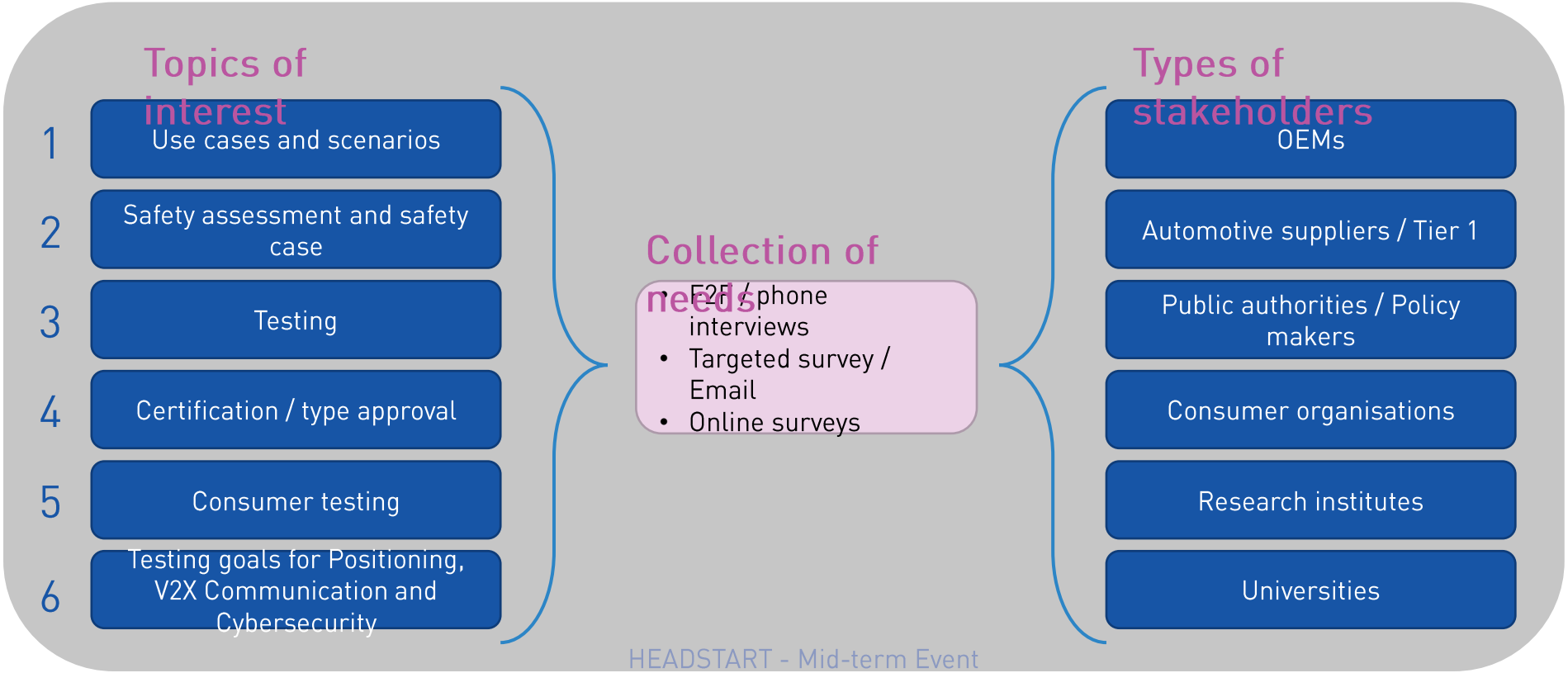
street wise

SAKURA Safety Assurance KUdos for Reliable Autonomous Vehicles



II- Identification of stakeholder needs

- ✓ Topic led by VEDECOM: INSTITUT VEDECOM
- ✓ **Objective:** Identify the needs on methodologies and procedures (demonstrations, certifications), tools and standards from the viewpoint of different stakeholders and user groups.



II- Identification of stakeholder needs

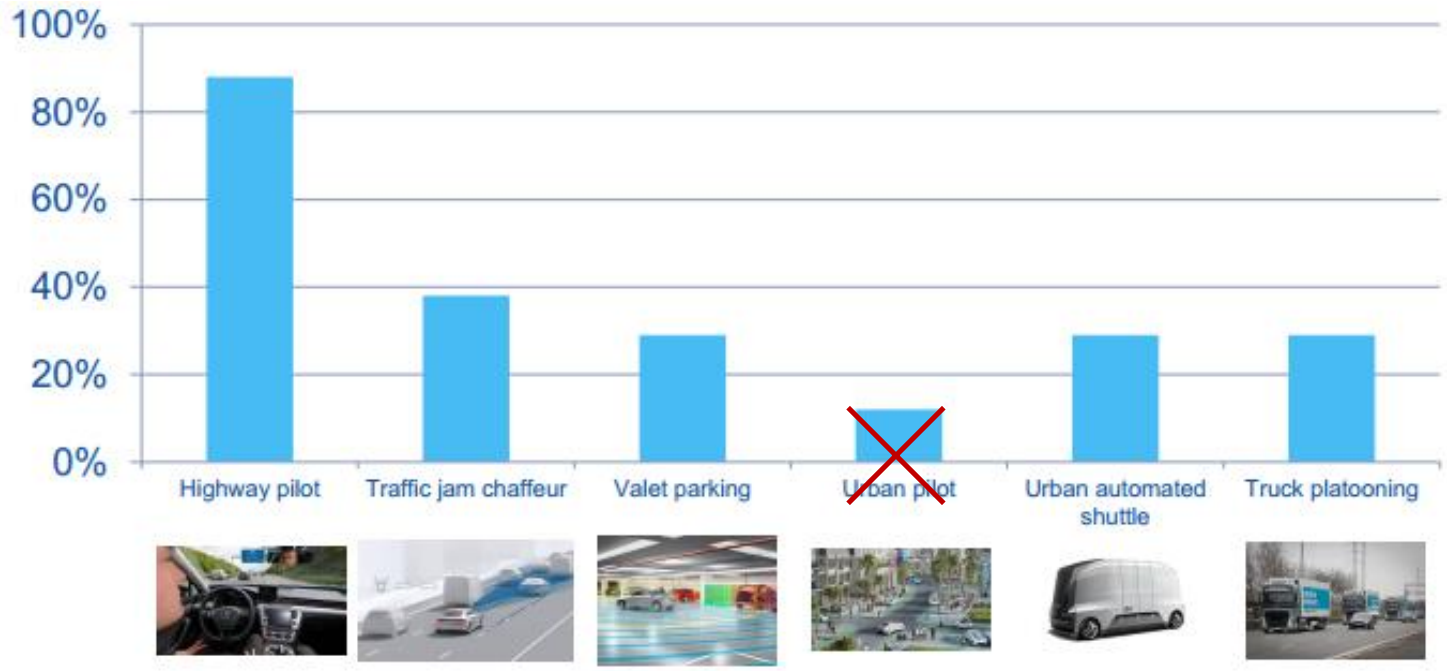
✓ Quantitative results for the 6 interview topics:

Type of stakeholder	F2F / phone interviews	Targeted survey / Email	Total
OEMs	5	3	8
Automotive suppliers / Tier 1	1	2	3
Public authorities / Policy makers	3	1	4
Consumer organisations	0	1	1
Research institutes	11	16	27
Universities	0	1	1
Total	20	24	44

✓ +14 online surveys answered

1- Use cases and scenarios

- ✓ **Objective:** Identify the priority use cases for stakeholders
- ✓ Survey results for use cases:
  - User groups needs on use cases have been presented at an expert workshop in Eindhoven in June 2019
  - The open discussions with the stakeholders confirmed that « urban pilot » is not a priority for them.



2-Safety assessment and safety case

✓ **Objective:** Identify the main risks introduced by CAD functions and the means to improve safety

✓ **Main risks introduced by CAD functions:**

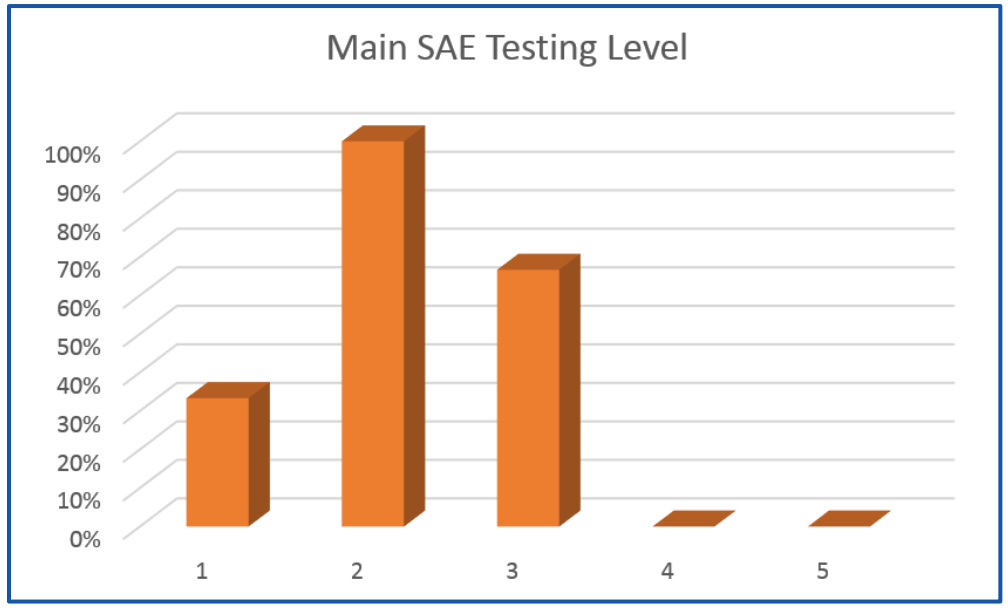
- Misusing the system (ex: no respect of the ODD)
- Encountering an unknown scenario
- Software update and bugs
- Criminal activities / cyber-attack
- Loss of positioning / Connectivity
- …

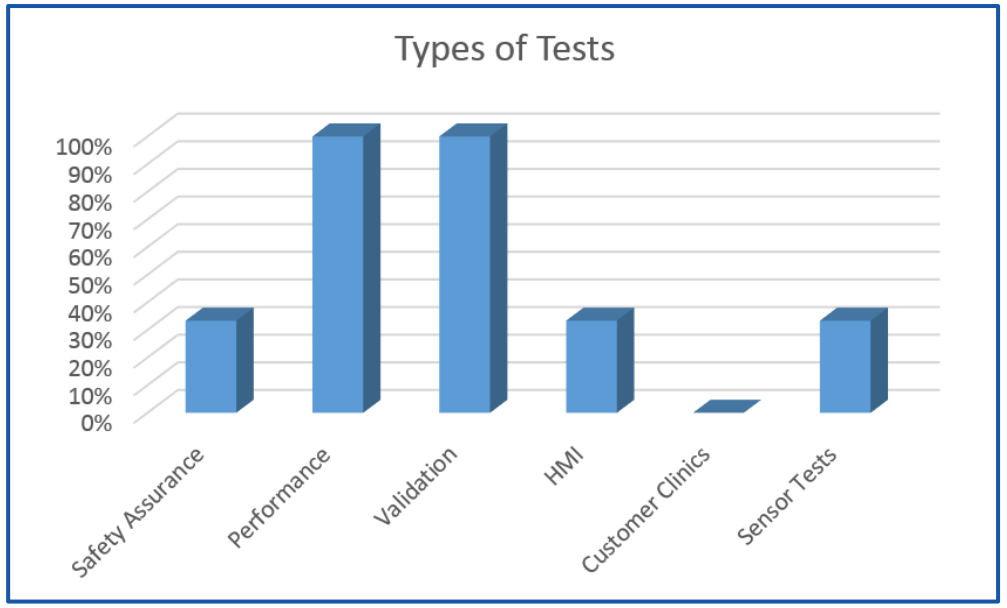
✓ **Best approach to take to ensure safety:**

- Scenario-based approach
- Validation ➔ Combination of different test instances (e.g. simulation, test track, open road)
- Procedure and tools ➔ Safety Of The Intended Functionality (ISO/PAS 21448) + ISO 26262
- No current legislation for the safety of CAD functions of level 3+

3- Testing

- ✓ **Objective:** Identify the needs on testing CAD functions
  - Most of the testing is taking place on SAE levels 2 and 3 but will soon evolve to SAE level 3+
  - Testing organisations are focusing on performance and validation tests.





  - No fixed methodologies stated except from protocols like EuroNCAP
  - Need for a common methodology and protocol

4- Certification & type approval

- ✓ **Objective:** Identifying the type approval needs for testing
- ✓ e.g. International Organization of Motor Vehicle Manufacturers (OICA) 3 pillars concept for certification

@OICA

Audit/Assessment Simulation

- Understand the system to be certified
- Assess that the applied processes and design/test methods for the overall system development (HW and SW) are effective, complete and consistent
- Assess system's strategies/test performance to address (multiple) fault-conditions and disturbances due to deteriorating external influences; vehicle behavior in variations of critical scenarios
- Simulation: Test parameter variations (e.g. distances, speeds) of scenarios and edge-cases that are difficult to test entirely on a test track

Physical Certification Tests

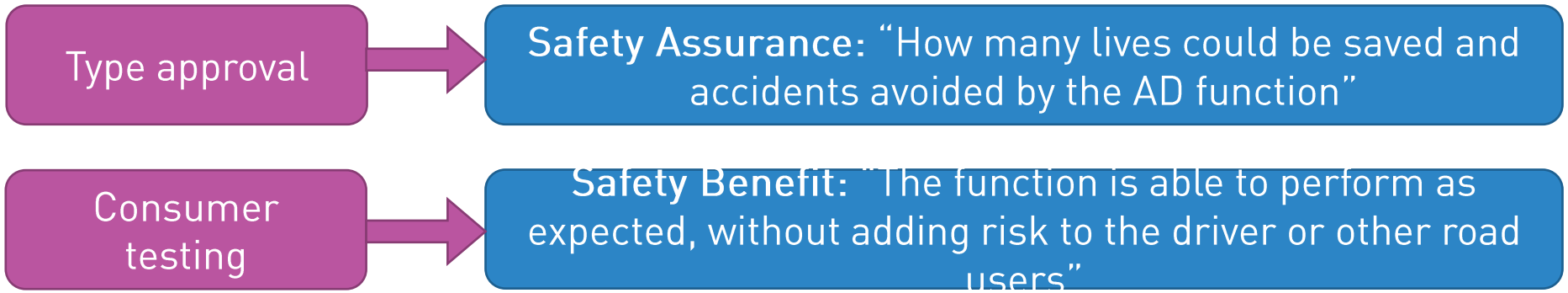
- Assess critical scenarios that are technically difficult for the system to cope with, have a high injury severity (in case the system would not cope with such a scenario) and are representative for real traffic
- Compare with critical test cases derived from simulation and validate simulation tools

Real World Test Drive

- Assess the overall system capabilities and behavior in non-simulated traffic on public roads and show that the system has not been optimized on specific test scenarios
- Assess system safety requirements like e.g. HMI and ODD
- Assess that the system achieves a performance comparable to an experienced driver

5- Needs on consumer testing

- ✓ Consumer testing ➔ one final user of the HEADSTART methodology.
- ✓ Strictly focus on functions that are already available on the market (SAE level 2)
- ✓ Goal for consumer associations ➔ Correctly communicate the capabilities and limitations of the functions to the final customer.



5- Needs on consumer testing

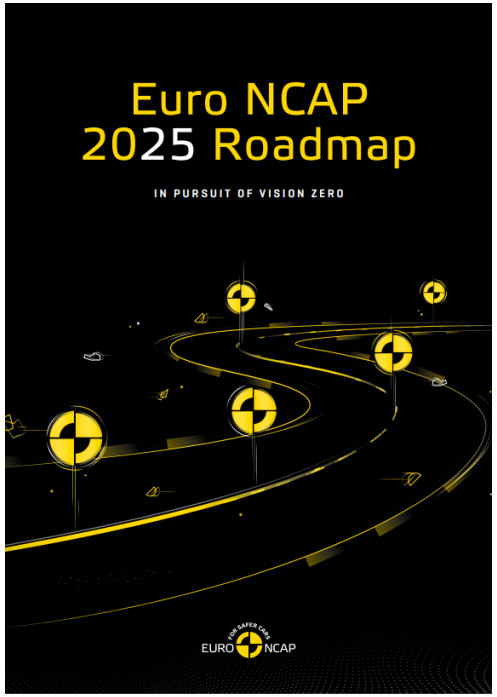
Euro NCAP 2025 https://cdn.euroncap.com/media/30700/euroncap-roadmap-2025-v4.pdf

New features to be tested in Euro NCAP:

- Driver Monitoring (2020)
- Automatic Emergency Steering (2020, 2022)
- Autonomous Emergency Braking (2020, 2022)
- V2x (2024) 10SECONDARY SAFETY
- Whiplash/Rear-end Crash Protection (2020)
- Pedestrian and Cyclist Safety (2022)
- Tertiary Safety
- Rescue, Extrication and Safety (2020)
- Child Presence Detection (2022)

Other Features:

- Automated Driving
- Cyber Security
- Trucks and Powered two-wheelers



6- Needs on testing Key Enabling Technologies

- ✓ Objectives:
  1. Identification of the best use cases to test Key Enabling Technologies
  2. Identification of specific testing needs for KETs
- ✓ Main use cases for testing KETs identified :

Highway Pilot (Level 4)
Urban and Suburban Pilot (Level 4)
Highly automated freight vehicles in Fully Automated Urban Vehicles (Level 5)
Automated PRT/Shuttles on dedicated roads (Level 4)
Automated Bus Chauffeur (Level 3)

Autonomous private vehicles on public roads (Level 5)
Automated Truck Platooning (Level 2)
Highly automated freight vehicles in Hub-to-Hub operation (Level 4)
Urban and Suburban Pilot (Level 4)
Traffic Jam Chauffeur (Level 3)

Thank you!

Any questions?

Jean-Baptiste COGET

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