Webinar « State of innovation, stakeholder needs, requirements for Key Enabling Technologies and use case selection »

Jean-Baptiste Coget, VEDECOM

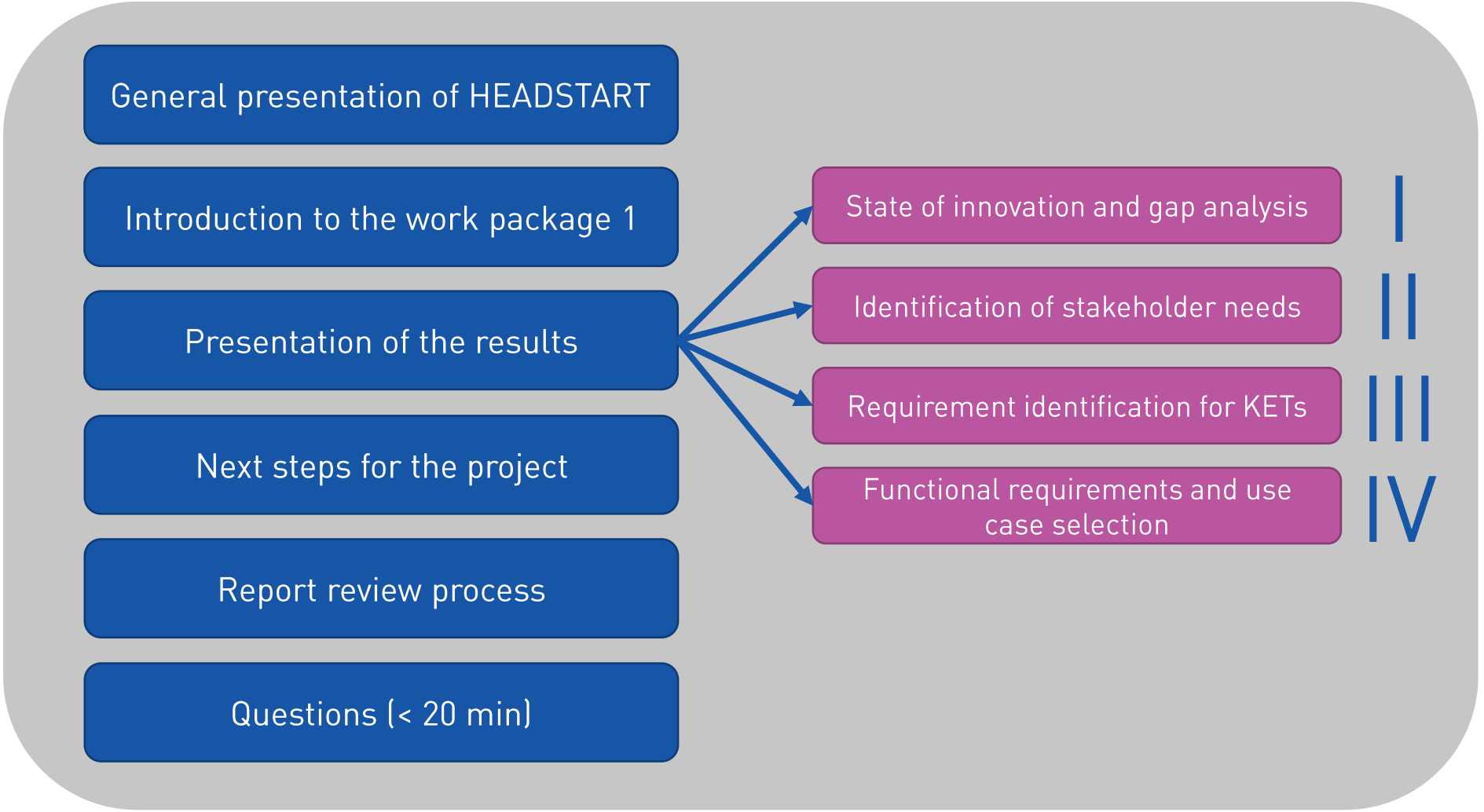
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824309.

INSTITUT VEDECOM
DU VÉHICULE DÉCARBONÉ ET COMMUNICANT ET DE SA MOBILITÉ

General information and rules

- ✓ **Duration :** 40 min presentation + 20 min open questions
- ✓ This webinar will be recorded and will be published later on the Website https://www.headstart-project.eu/
- ✓ **Any question about the presentation ?** Please type it in the "Question bar" with the slide number, it will be answered at the end.
- ✓ **Any technical issue ?** Tell us in the chat box
- ✓ For any other specific request to the project coordinator, please send us an email at : info@headstart-project.eu

Plan of the presentation



HEADSTART project facts

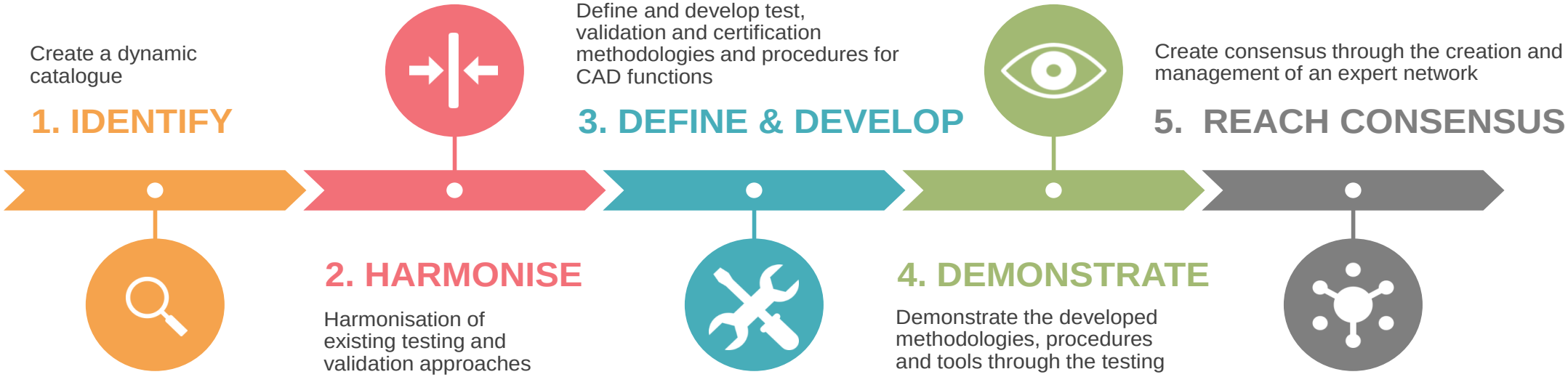
- ✓ **Call identifier:** ART-01-2018
- ✓ **Type:** Research and Innovation Action (RIA)
- ✓ **Duration:** 01.2019 – 12.2021 (36 months)
- ✓ **Budget:** 6M€
- ✓ **Consortium:** 17 partners
- ✓ **Coordinator:** Applus IDIADA, Mr. Álvaro Arrue, Project Manager
- ✓ **Dissemination Manager:** ICCS, Dr. Angelos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

HEADSTART Partners

Project's Objectives

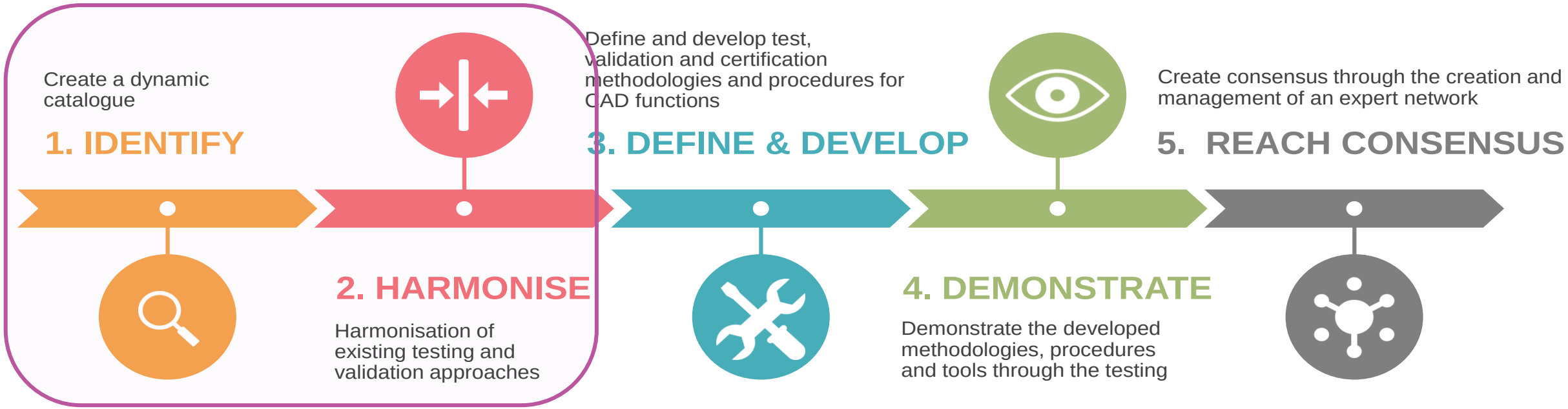
HEADSTART will define testing and validation procedures of CAD functions including:

- its key enabling technologies (i.e. V2X 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)



Use cases and requirements (Work Package 1)

January to September 2019



"State of innovation, stakeholder needs, requirements for Key Enabling Technologies and use case selection"

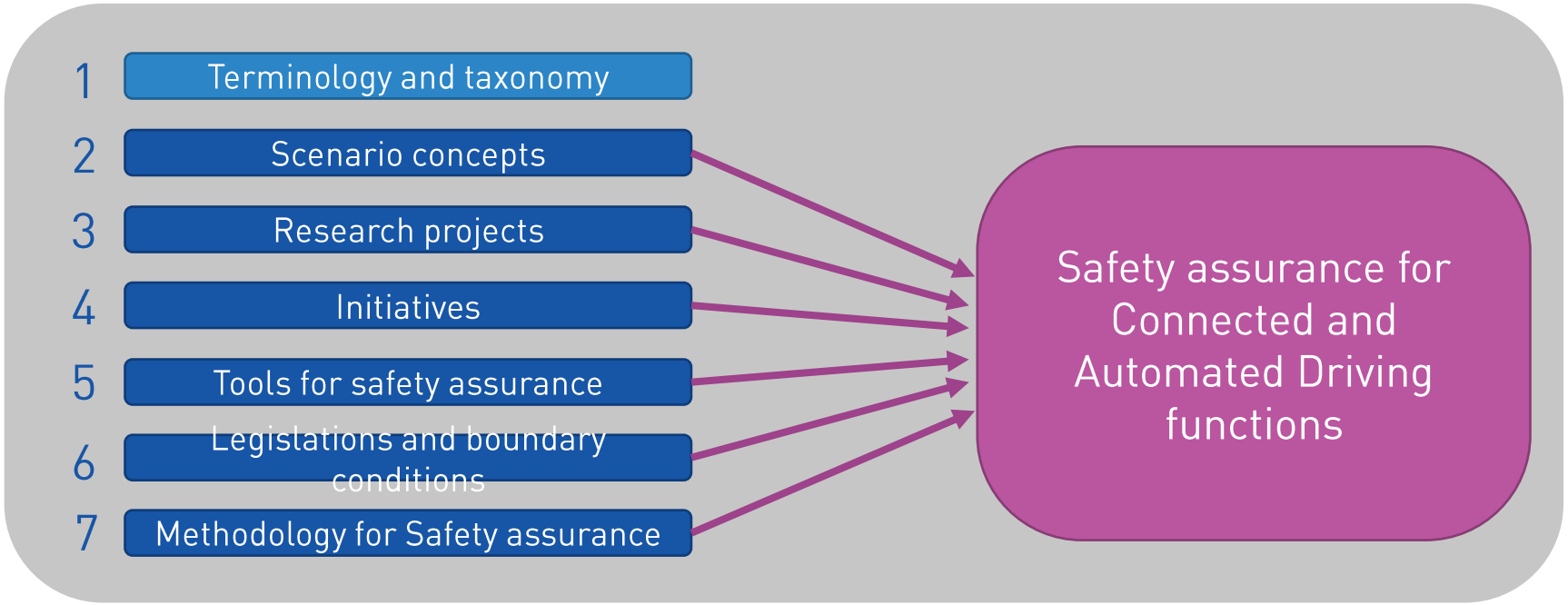
Use cases and requirements (Work Package 1)

Objective : Develop a comprehensive technical analysis and gap analysis on testing and validation methodologies based on ongoing initiatives worldwide and future pilot tests across Europe.

1) Analyse the existing state of the art on validation and testing methodology for CAD
2) Identify the needs of stakeholders and target groups and prioritise the use cases arising.
3) Identify the functional and technical requirements for KETs (Cyber-security, Positioning, Connectivity).
4) Select the most relevant use cases and identify 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
ASTAZERO
Program (SAFER)
BRAVE
CARTRE Coordination of Automated Road Transport Deployment for Europe
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

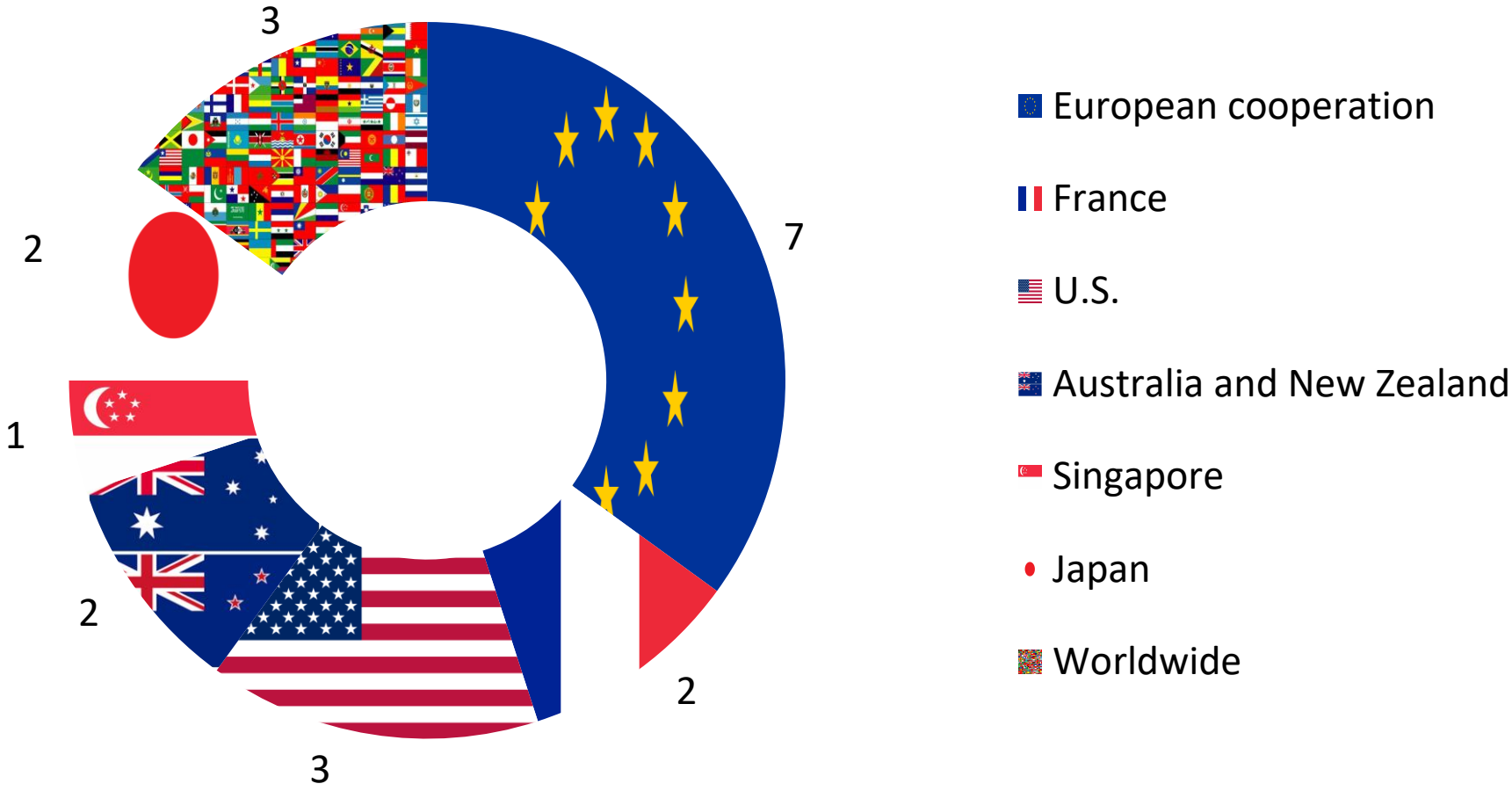
- Euro NCAP – For Safer Cars

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
- 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

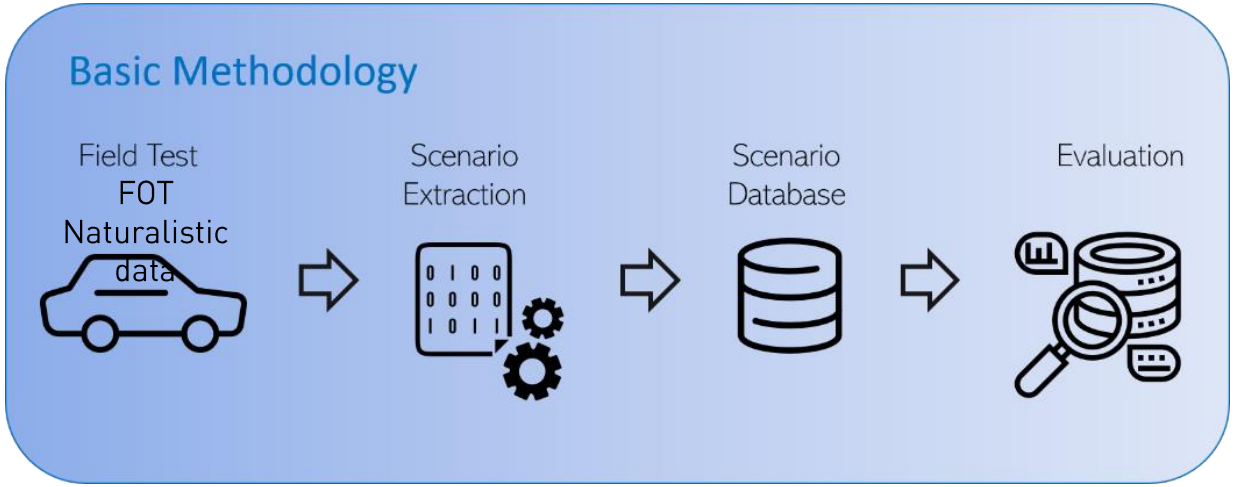
L3Pilot Driving Automation

PEGASUS

MOOVE

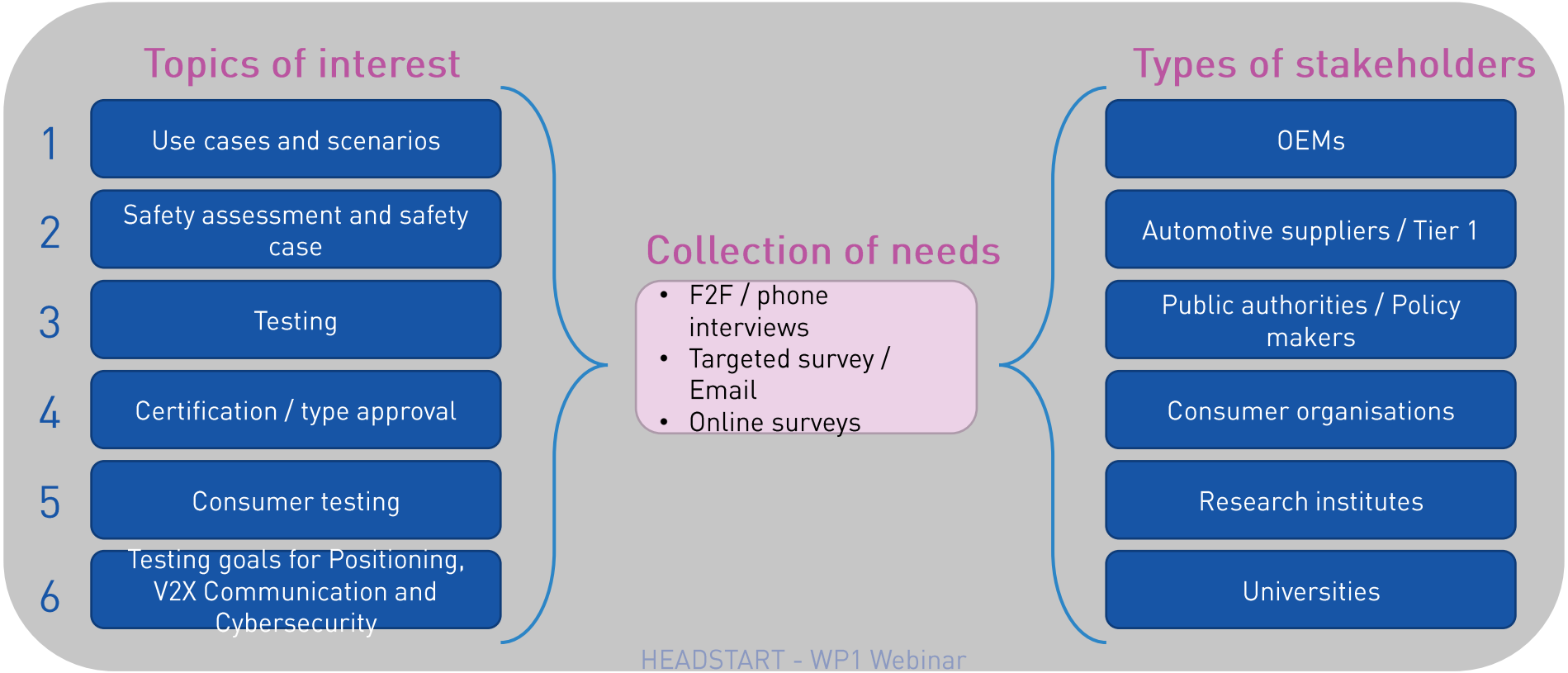
street wise

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

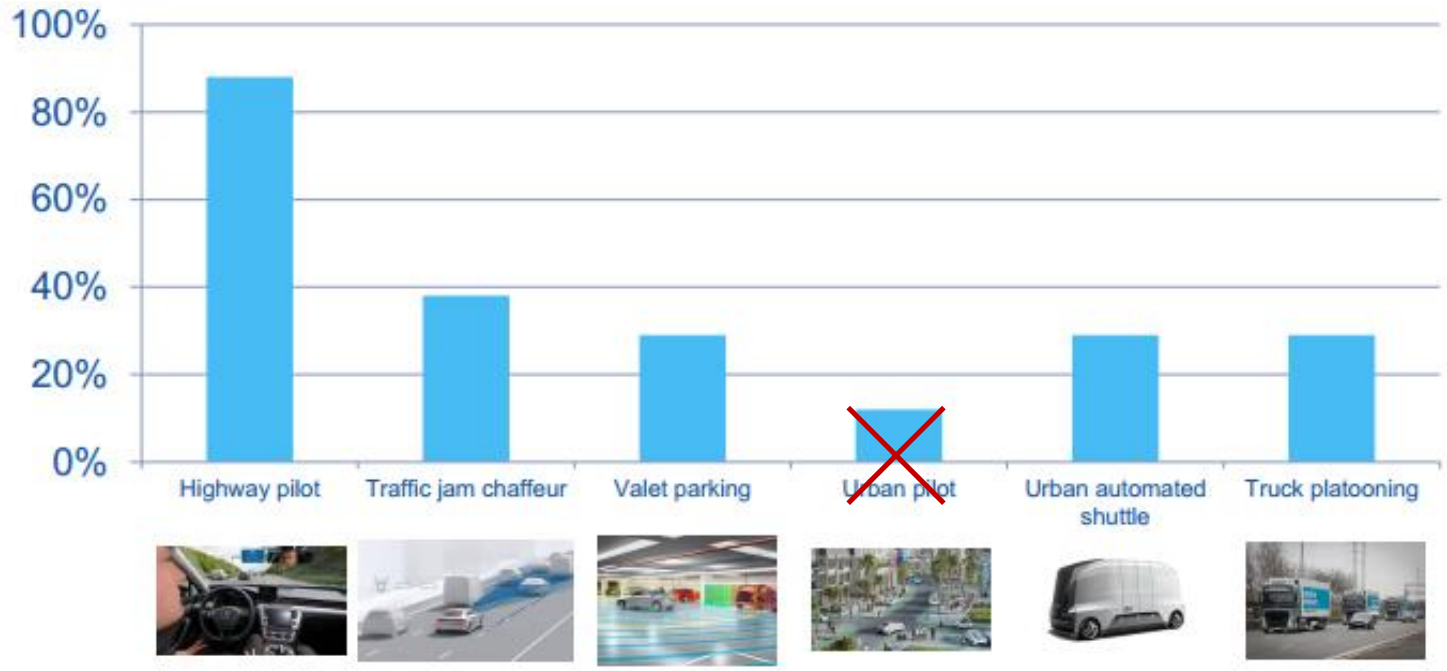
✓ Quantitative results for the 6 interview topics:

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:**

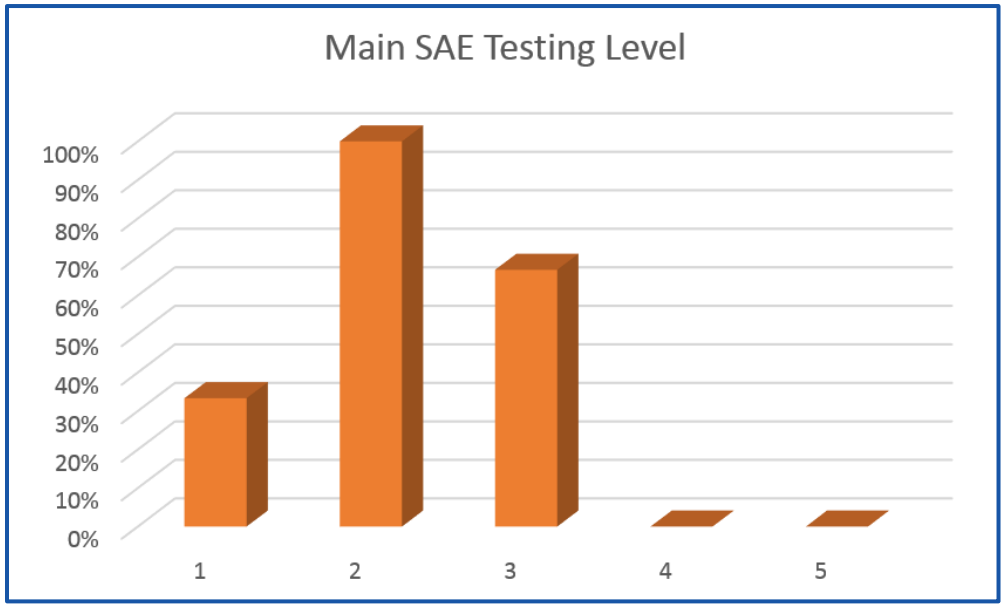
- Misusing the system (ex: no respect of the ODD)
- Encountering an unknown scenario
- Software update and bugs
- Criminal activities / cyber-attack
- Loss of positioning / Connectivity
- ...

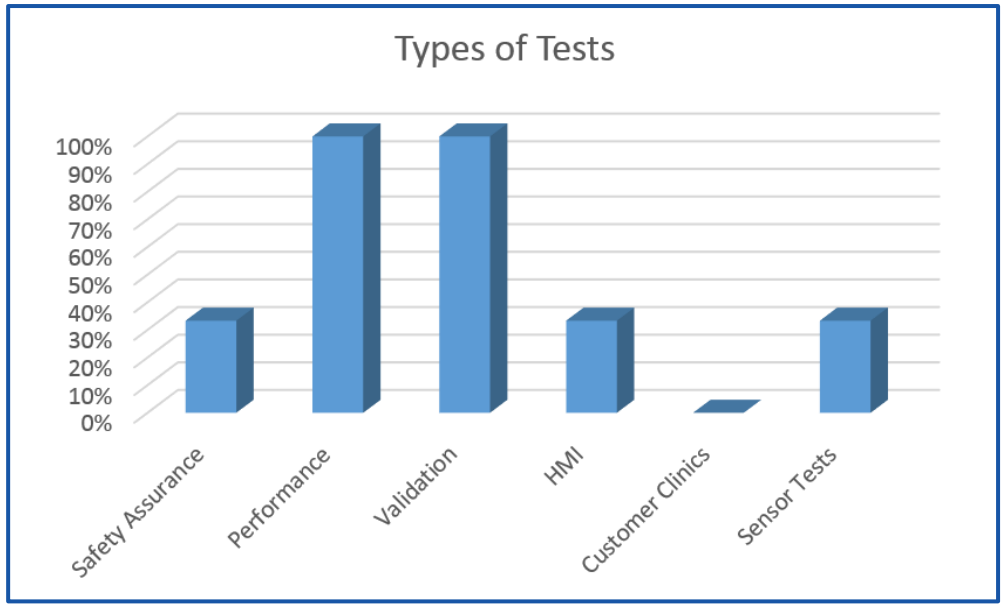
✓ **Best approach to take to ensure safety:**

- 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

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

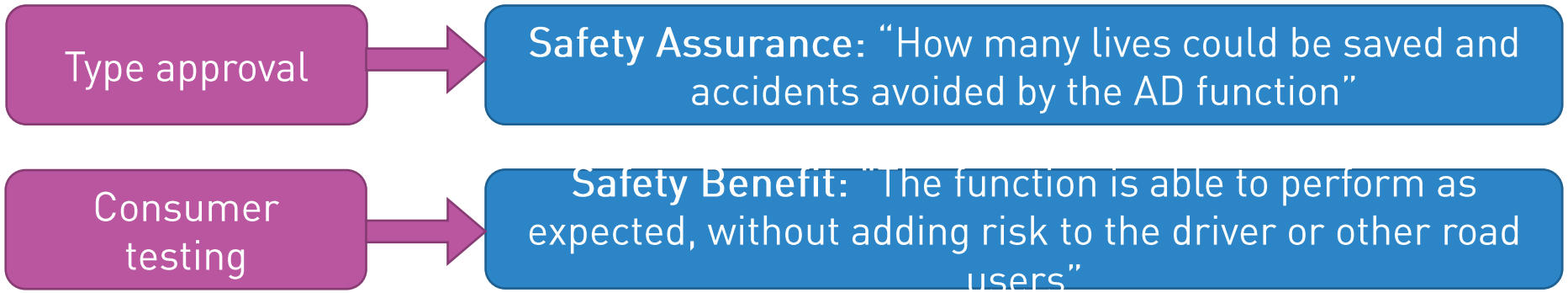
Real World Test Drive

- 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

@OICA

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

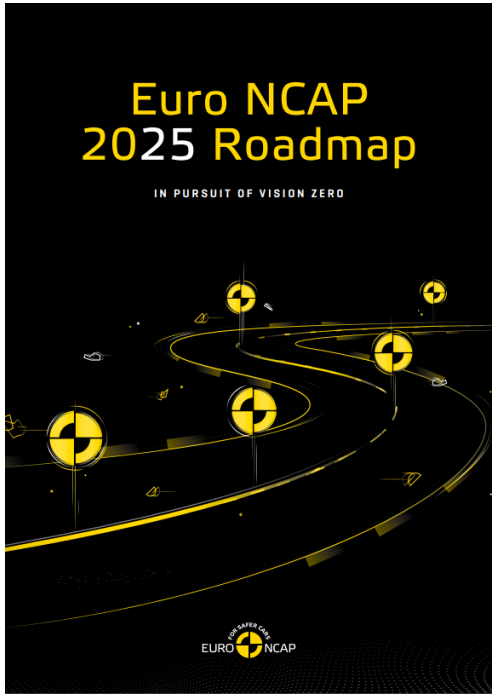
Euro NCAP 2025 https://cdn.euroncap.com/media/30700/euroncap-roadmap-2025-v4.pdf

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)

III- Requirement identification for KETs

- ✓ Topic led by SAFER: SAFER VEHICLE AND TRAFFIC SAFETY CENTRE AT CHALMERS
- ✓ **Objective:** Identify and Compile technical and functional requirements for HEADSTART's Key Enabling Technologies (Positioning, V2X communication, Cyber-security) to achieve safe automated functions.

Analysis of stakeholder needs for KETs

KETs relevant projects from the state of the art analysis

SECREDAS Digital Privacy Safety & Security · SAFER TEC · ENSEMBLE · ICT4CART · (...) · INTER ⇄ ACT · ENABLE-S3 · PRoPART Precise and Robust Positioning for Automated Road Transports

Positioning / V2X communication / Cybersecurity

1) Functional requirements at vehicle level
2) Technical constrains at vehicle component level
3) Safety requirements for road-users
4) Potential physical constrains on test tracks
5) How the technical requirements are expected to be partly verified by computer tools
6) Technical feasibility

Requirements for Positioning

1) **Functional requirements at vehicle level**
   - The system shall be able to provide positioning data at 10 Hz.
   - Detect and evaluate GNSS uncertainty.
   - …
2) **Technical constrains at vehicle component level**
   - The system shall be able to provide longitudinal and lateral positioning with 10 cm accuracy
   - ….
3) **Safety requirements for road-users**
   - The vehicle must be possible to reach a safe state when positioning is degraded or lost
   - …
4) **Potential physical constrains on test tracks**
   - The outdoor test track must allow easy GNSS connection
   - A HD map of the test track area must be available.
   - How to test high-precision absolute navigation with confidence (not to measure GNSS with GNSS)
   - …
5) **How the technical requirements are expected to be partly verified by computer tools**
   - Proper simulation under various weather conditions
   - …

Requirements for V2X communication

1) **Functional requirements at vehicle level**
   - Connected infrastructure, e.g., traffic lights, should be able to communicate through ITS-G5, 4G/LTE, 5G/LTE.
   - The system must support high connection density for congested traffic.
   - …
2) **Technical constrains at vehicle component level**
   - One Road Side Unit shall be able to communicate with up to 200 User Equipment (UE).
   - …
3) **Safety requirements for road-users**
   - A vehicle must be able to reach a safe state if it has a critical failure (engine failure or loss of V2X communication).
   - …
4) **Potential physical constrains on test tracks**
   - If V2X communication testing is carried out in open air, no other radio transmission must influence the testing.
   - If V2X communication testing is carried out in a shielded chamber, no other radio transmission must exist.
   - …
5) **How the technical requirements are expected to be partly verified by computer tools**
   - The tool should be able to define and re-use test sequences of V2X messages
   - …
6) **Technical feasibility**
   - V2X is still in being developed and devices meeting the requested requirements may not be available
   - To ensure safety when testing of non-deterministic algorithms (e.g. High speed Truck Platoon and AI). Some scenarios will be to dangerous to test out with real vehicles.
   - …

Requirements for cyber security

1) **Functional requirements at vehicle level**
   - V2X message reception shall be signed by a trusted third-party (message shall have valid and verified certificate and signature).
   - …
2) **Technical constrains at vehicle component level**
   - Measures should be applied for all components in the system (e.g. vehicles involving network and infrastructure) to ensure an end-to-end cybersecurity.
   - …
3) **Safety requirements for road-users**
   - N.A
4) **Potential physical constrains on test tracks**
   - Potential cyber-attacks shall be dually analysed; from the "Defenders" or "Blue Team" and the "Attackers" or "Red Team" point of view.
   - …
5) **How the technical requirements are expected to be partly verified by computer tools**
   - Performed cyber security testing (e.g. TARA analysis, Penetration testing, Fuzz testing)
   - …
6) **Technical feasibility**
   - The function has been developed following existing best practices for cybersecurity.
   - Sensitive to attack GNSS systems in non-shielded environment.
   - …

IV- Functional requirements and use case selection

- ✓ Topic led by SAFER: SAFER VEHICLE AND TRAFFIC SAFETY CENTRE AT CHALMERS
- ✓ **Objectives:**

1. Compile the requirements for use cases and functionality to demonstrate safe CAD functions
2. Classify use cases, functional requirements and scenarios described in the previous tasks
3. Determine the most important use cases and for each of them, the appropriate CAD functions
   - Description of each preselected use case with representative scenarios,
   - Relevance ranking of the use cases based on a survey

Requirements for selecting use cases

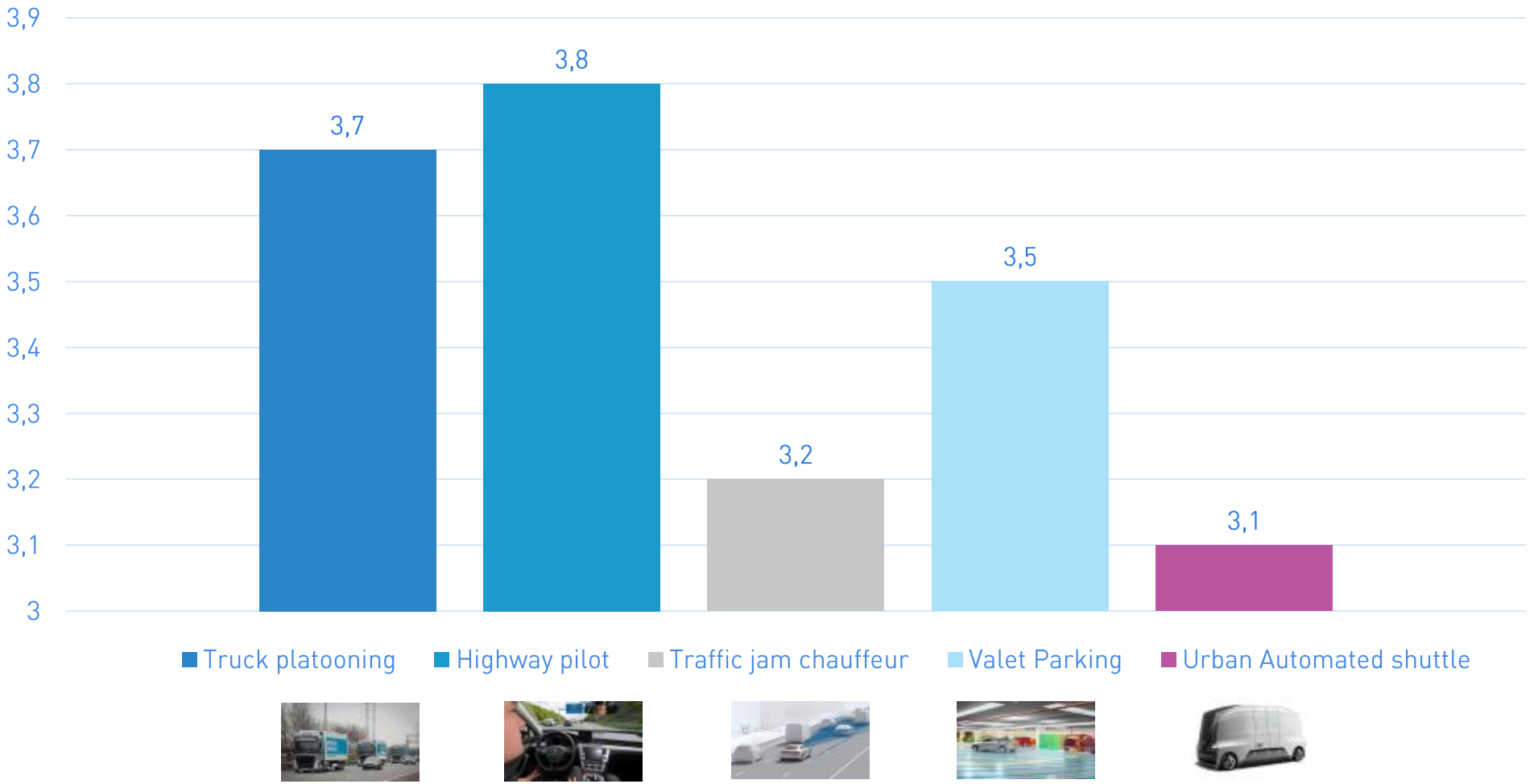
Categories of requirements:

- ✓Requirements on testability of the KETs
  - Positioning
  - V2X Communication
  - Cybersecurity
- ✓Requirements regarding physical testing
  - Proving ground testing
  - Field operational tests
- ✓Requirements regarding model-based testing
- ✓Definition and availability of scenarios
- ✓Requirements on collaboration partners
- ✓Relevance to key user groups
  - OEMs, Tier1s
  - Type approval authorities
  - Consumer Testing

Use case ranking

	Truck Platooning	Highway Pilot	Traffic Jam Chauffeur	Valet Parking	Urban Automated Shuttle
Requirements for testing KETs: 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
Requirements for testing KETs: 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
Requirements for testing KETs: 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 testing: 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
Requirements for testing: 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
Requirements for testing: 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
Requirements for testing: 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 Scenarios: 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
Collaboration partners 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 key user groups: How suitable is the use case to meet the requirements regarding relevance to OEMs andTier1s in HEADSTART.	3,0	4,8	4,5	3,5	3,3
Relevance to key user groups: 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
Relevance to key user groups: 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

Final ranking of use cases



Next steps for the project

January to September 2019

Create a dynamic catalogue

1. IDENTIFY

2. HARMONISE

Harmonisation of existing testing and validation approaches

Define and develop test, validation and certification methodologies and procedures for CAD functions

3. DEFINE & DEVELOP

4. DEMONSTRATE

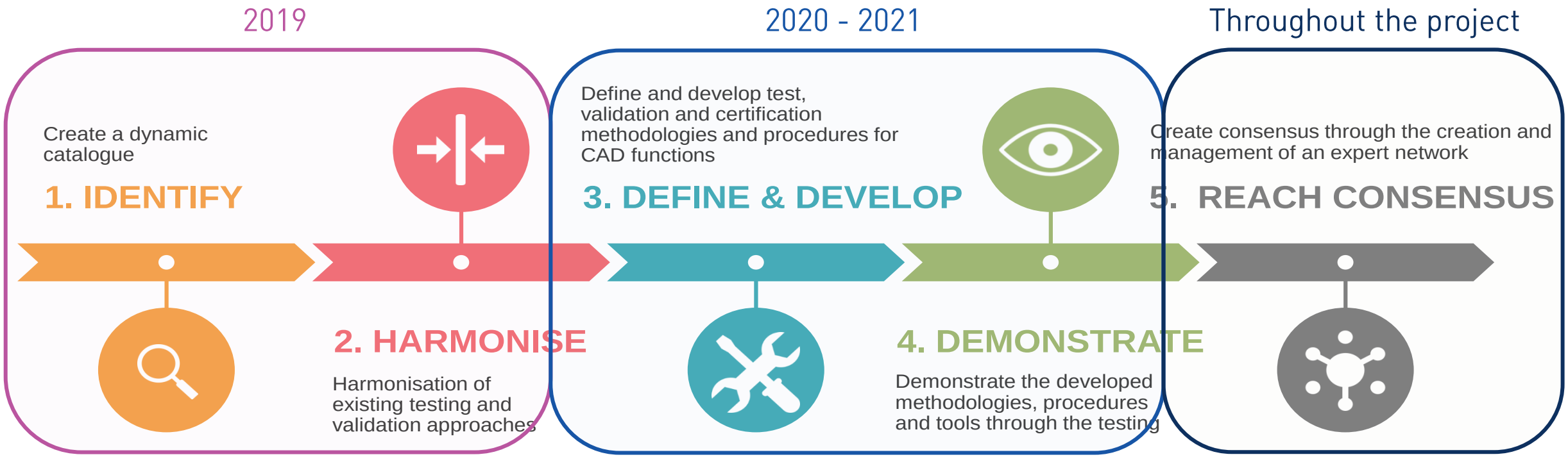
Demonstrate the developed methodologies, procedures and tools through the testing

Create consensus through the creation and management of an expert network

5. REACH CONSENSUS

"State of innovation, stakeholder needs, requirements for Key Enabling Technologies and use case selection"

Next steps for the project



"State of innovation, stakeholder needs, requirements for Key Enabling Technologies and use case selection"

"Methodologies, procedures, demonstrations ..."

"Expert network and international cooperation through Events, Workshops and Webinars"

Next steps: Report review and update

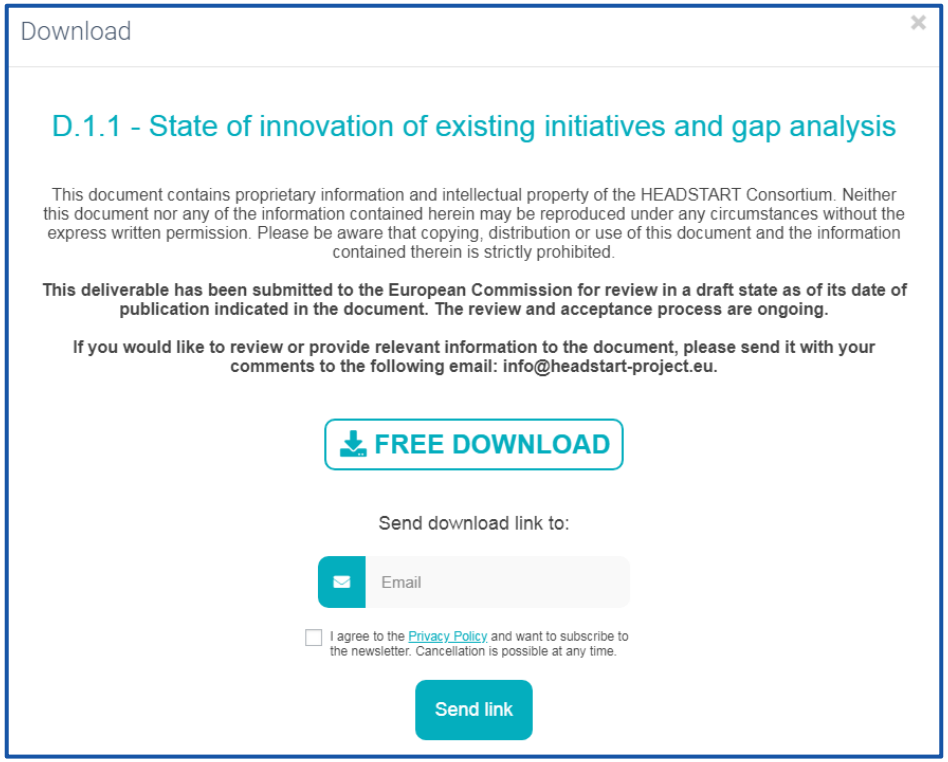
✓ Report review process ➔ Four deliverables written

Number	Title	Dissemination Level	Delivery Date	Download
D1.1	State of innovation of existing initiatives and gap analysis	PU	M6	Download
D1.2	Stakeholders and user group needs	PU	M6	Download
D1.3	Technical and Functional requirements for KETs	PU	M9	Download
D1.4	Functional requirements of selected use cases	PU	M9	Download

1. Download the deliverables : https://www.headstart-project.eu/results-to-date/deliverables/
2. Provide your comments to info@headstart-project.eu

Next steps: Report review and update

1. Download the deliverables : https://www.headstart-project.eu/results-to-date/deliverables/
2. Provide your comments to info@headstart-project.eu



Questions

Questions from the chat (20 min)

Cooperate with HEADSTART project

https://www.headstart-project.eu/get-involved/

EXPERT GROUP PARTICIPATION

- Join as associated partner and our expert group
- Join the discussion group of your interest:
  - Cyber-security
  - Communications (V2X)
  - Positioning
  - Scenario selection
  - Consumer testing (NCAP)
  - Type approval
- Provide needs and requirements and evaluate

JOINT TESTING ACTION

- ✓ Joint cooperation between both projects for testing validation and certification purposes
- ✓ Align your project with the harmonized methodology and tools developed within HEADSTART
- ✓ Become one of our use cases!

Please let us know about your interest and join our distribution list.
Website: **www.headstart-project.eu**
Contact: info@headstart-project.eu

Workshop on new approaches for ´Scenarios selection´ and ´Consumer Testing´

Summary of results

- Overview of initiatives worldwide
  - Euro NCAP, JARI, etc…
- Use case prioritization by stakeholders
- Prioritization of test instances by type of testing needs (development, consumer testing, type approval)
- Discussion on type approval (sub) procedures

Workshop on new approaches for ´Scenarios selection´ and ´Consumer Testing´

Thank you!

Any questions?

Jean-Baptiste Coget

RAMS Engineer at VEDECOM

jean-baptiste.coget@ext.Vedecom.fr

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