Type approval Webinar

Key note speakers:

Alvaro Arrue, IDIADA (alvaro.arrue@idiada.com)

Carlos Lujan, IDIADA (carlos.lujan@idiada.com)

Oriol Flix, IDIADA (oriol.flix@idiada.com)

Edwin Nas, RDW (ENas@rdw.nl)

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

Welcome!

Meeting etiquette:
- Only the speaker's camera and microphone will be ON.

- There will be a Q&A at the end of all speakers interventions. Please, write down all your questions on the Q&A box.

- The session will be recorded and uploaded in the project's page.

Agenda

- HEADSTART project
- Introduction to type-approval
- UN Regulation No. 157 - Automated Lane Keeping Systems (ALKS)
- Round table

Agenda

- **HEADSTART project**
  - The HEADSTART project
  - The HEADSTART methodology
  - The HEADSTART procedures
  - Conclusions and next steps
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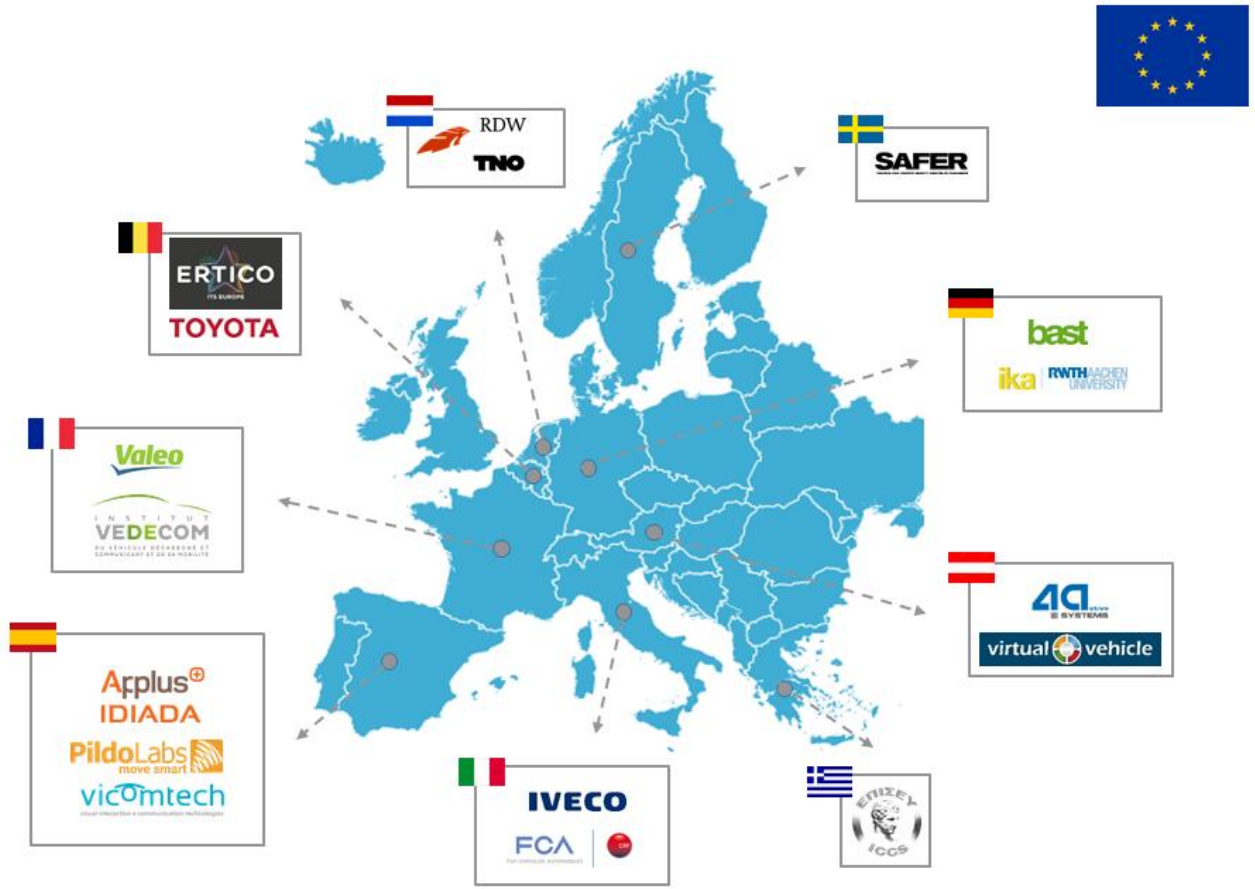
HEADSTART project facts

- ✓ **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

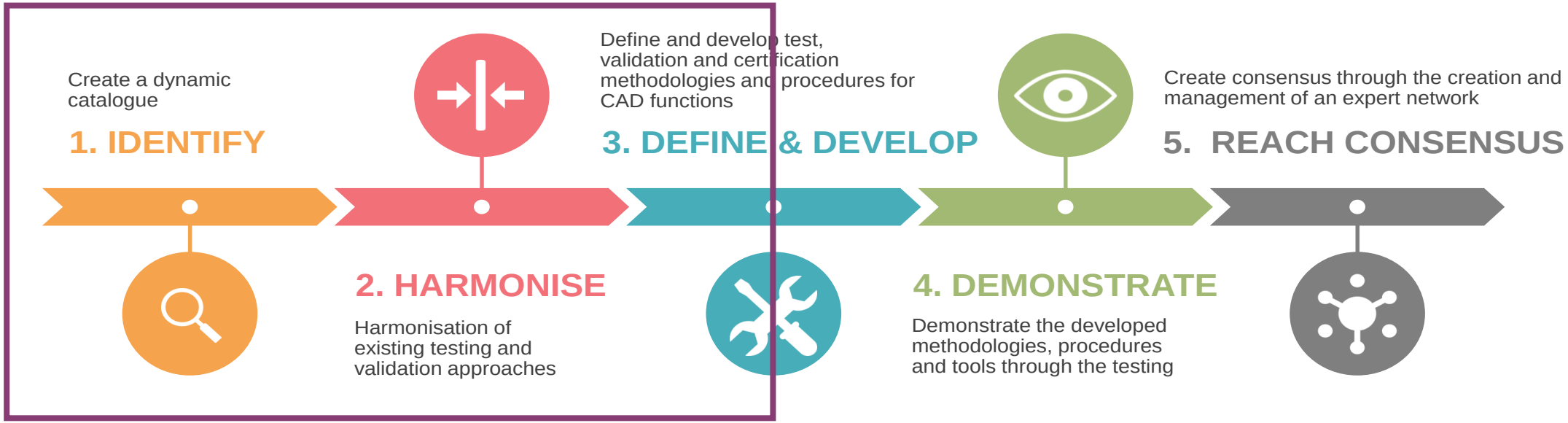
- ✓ 7 research centres
- ✓ 2 Technical services
- ✓ 3 Euro NCAP laboratories
- ✓ 4 OEMs
- ✓ 2 Tier-1s
- ✓ 3 coordinators of H2020 ART calls



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)



Technical Results up to M18

Some key **Deliverables**

Del. #	Deliverable Title	Lead Beneficiary
D1.1	State of innovation of existing initiatives and gap analysis	IKA
D1.2	Stakeholders and user group needs	VEDECOM
D1.3	Technical and functional requirements for KETs	SAFER
D1.4	Functional requirements of selected use cases	SAFER
D2.1	Common methodology for test, validation and certification	IKA
D2.2	Extension of the common methodology for the HEADSTART KETs	CRF
D2.3	Assessment method for the defined use cases	TNO
D3.1	Procedure pipeline definition	Virtual Vehicle
D3.2	Toolchain for mixed validation	Virtual Vehicle

All finished deliverables available in

www.headstart-project.eu

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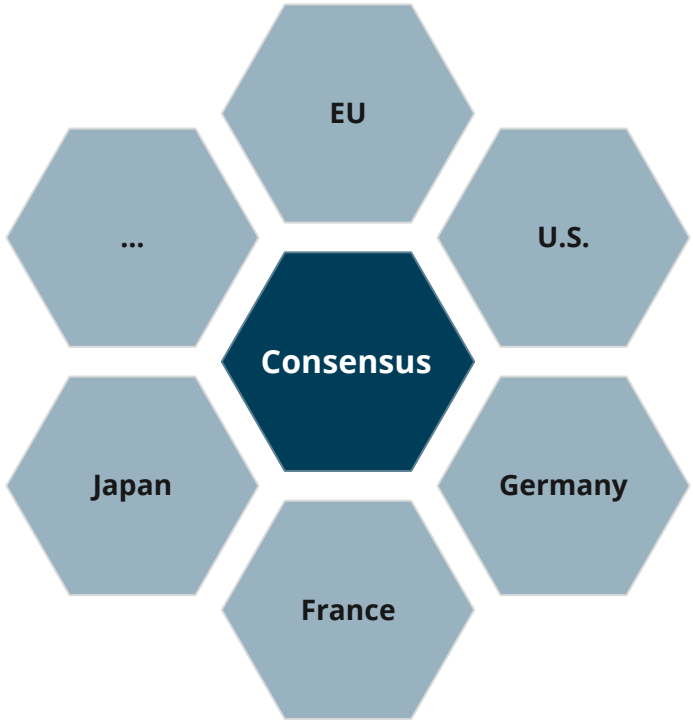
Overall Methdology

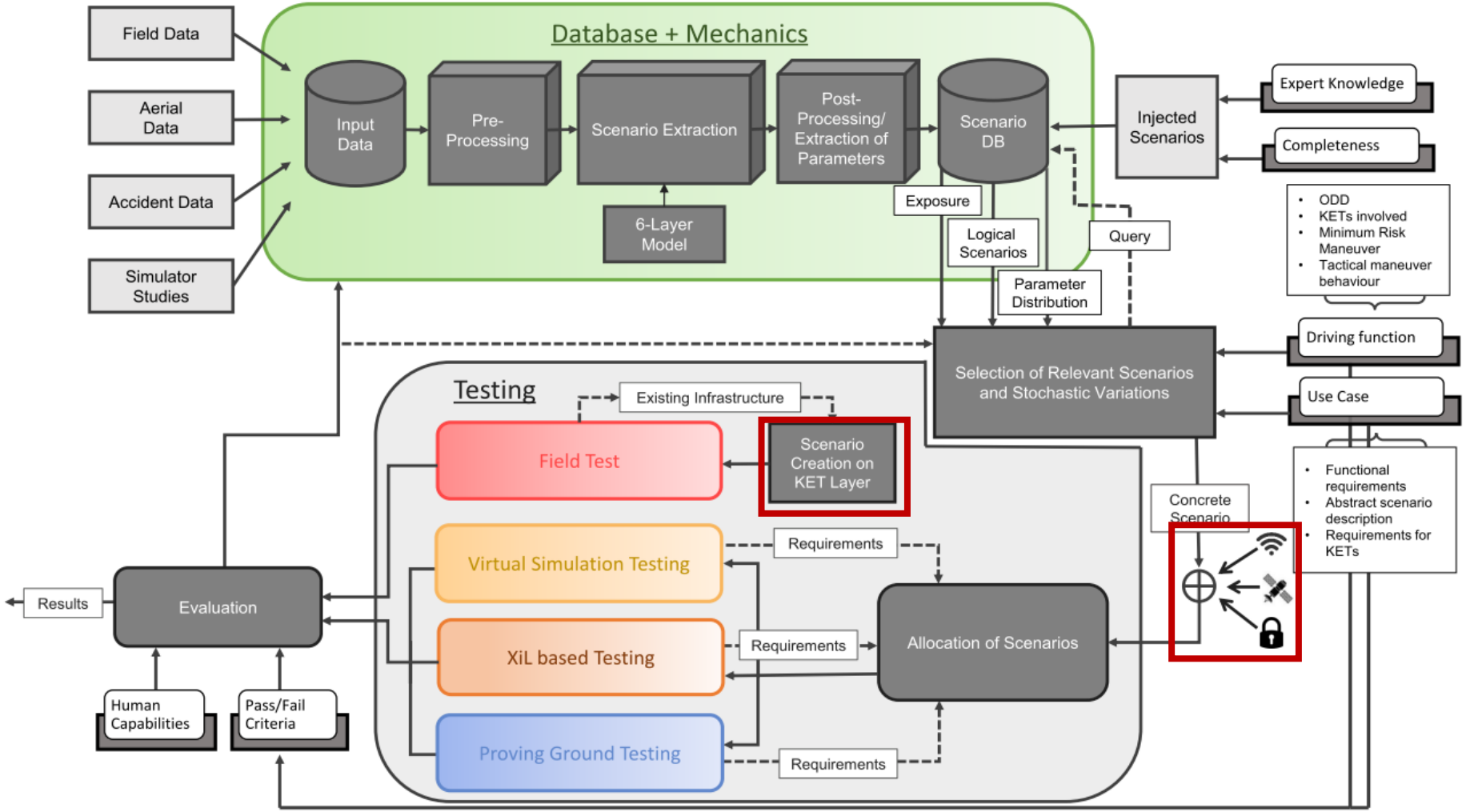
Where does the HEADSTART Methodology come from?

- ✓ 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**

- ✓ **Inputs from:** PEGASUS, MOOVE, SAKURA, STREETWISE, ENABLE-S3 and many other projects…
  - ✓ Can be found in D1.1, D1.2, D1.3 and D1.4
  - ✓ www.headstart-project.eu



KETs within the methodology



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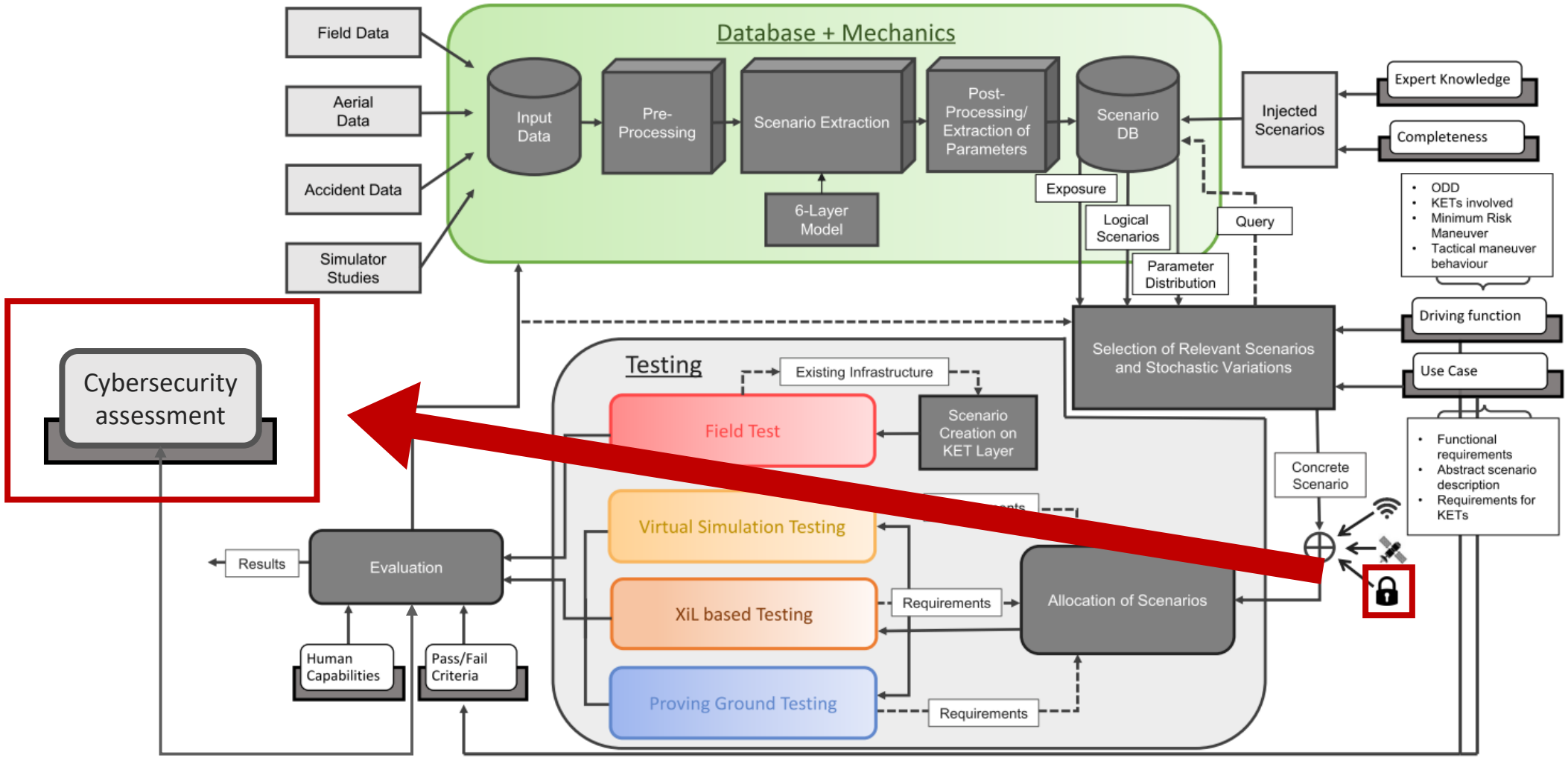

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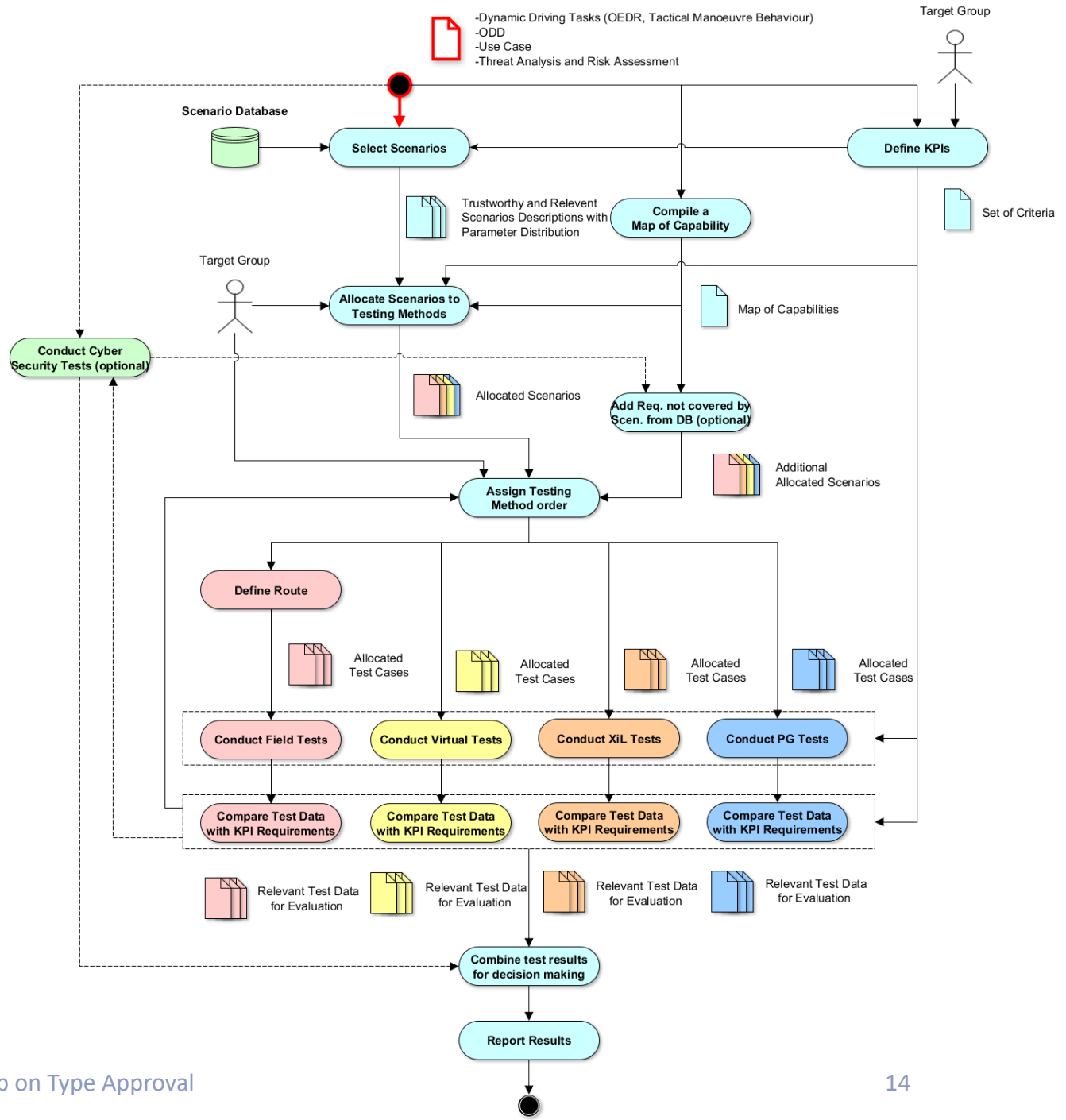
High-Level Process

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



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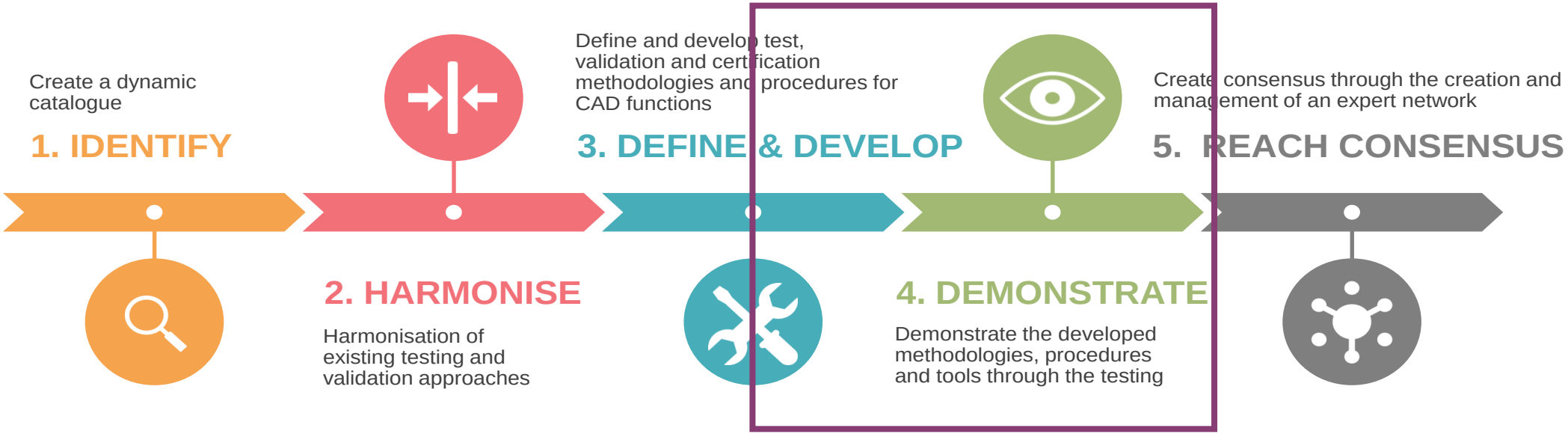
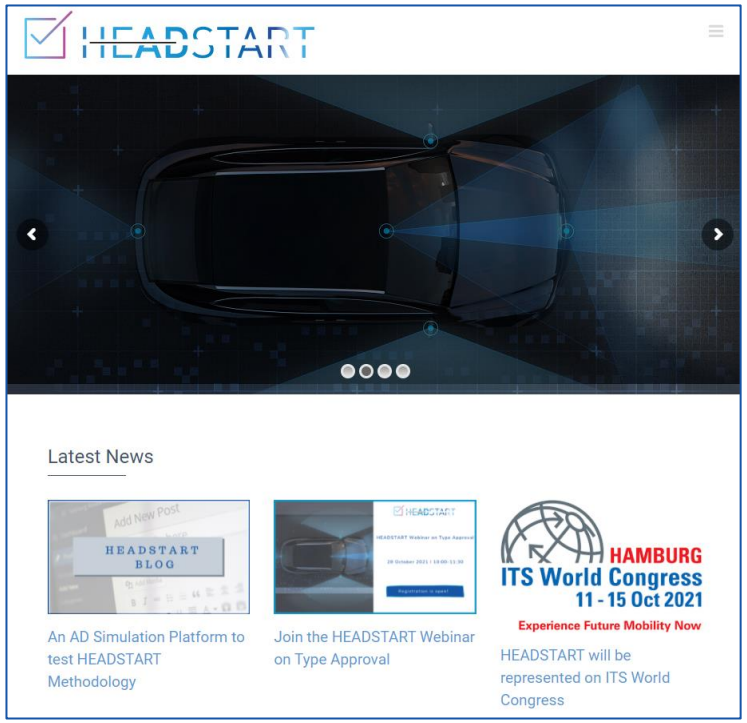


Finished activities

- ✓ There are multiple available deliverables in www.headstart-project.eu
- ✓ Latest activities include:
  - D2.3 - Assessment method for each of the use cases defined
  - D3.2 - Toolchain for mixed validation – integration of simulation, test track testing and field testing
  - D3.3 - Assessment criteria of CAD functionalities in the context of consumer testing and type approval
  - D3.4 - Harmonisation of test results
  - D3.5 - Specification of test procedure for selected use cases
- ✓ And much more: webinars, blog, news and more events



Final event coming soon!

Next Steps

- ✓ Current development of a testing tool chain for the project
  - Including simulation / virtual testing / test track testing / Field tests
  - Harmonization of queries to external DBs
  - Evaluation metrics definition

- ✓ This will be demonstrated next year for the chosen Use Cases:
  - Highway Pilot
  - Traffic Jam Chauffeur
  - Truck platooning

- ✓ Demonstrations planned in second semester of 2021

- ✓ Assessment results in late 2021

Highway pilot

Truck platooning

Traffic jam chauffeur

Conclusions

- ✓ State-of-the-art assessment is publicly available
  - Information from worldwide projects
  - Functional requirements for AD but also KETs
- ✓ The HEADSTART Methodology is a living process
  - Need for expert input to refine the methodology is welcomed
  - KETs have been considered in the whole process
  - Keep the Methodology harmonized and applicable for different databases
- ✓ The procedure allows us to continue with the actual implementation of the whole validation process
  - Some KETS are naturally integrated (V2X + positioning)
  - Some require specific paths (cybersecurity)
  - Cooperation on Open Scenario extension/enhancement is ongoing
- ✓ Currently developing the testing toolchain which will be demonstrated during the project final event
  - Coverage of KETs, end users and test methods
  - Three use cases as demonstrators of the methodology

Stay connected with HEADSTART

✓ Visit HEADSTART website

www.headstart-project.eu

✓ Follow our Social Media:

- @HEADSTART_EU
- HEADSTART-PROJECT
- HEADSTART project (Group)
- @HeadstartEUproject

✓ Reach us via an e-mail:

info@headstart-project.eu

✓ Sign up to our newsletter:

https://lists.iccs.gr/wws/subscribe/headstart-news

✓ Get in touch with our partners

Final event coming soon!

HEADSTART Partners

Agenda

- ✓HEADSTART project
- **Introduction to type-approval**
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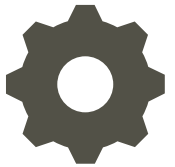
Type-approval

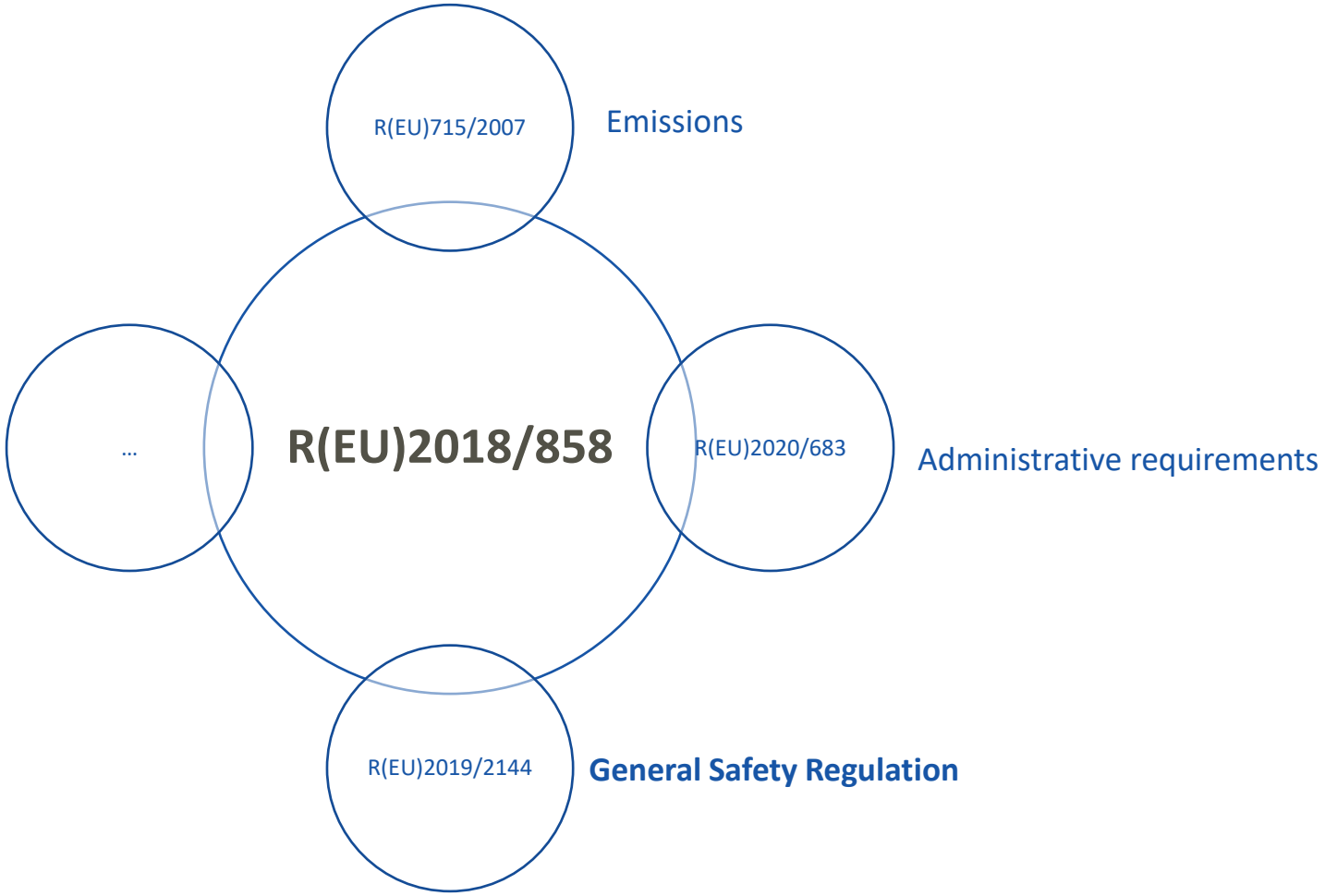
Type-approval means the procedure whereby **an approval authority certifies** that a type of vehicle, system, component or separate technical unit satisfies the relevant **administrative provisions** and **technical requirements**



Type-approval

EU Framework



General safety Regulation

Regulation (EU) 2019/2144

- Repeals and replaces Regulation (EC) 661 / 2009
- Repeals many of the EC Regulations associated to 661/2009, which shall be replaced by new regulations in order to cover the same scope, or even update it, if the state of the art has changed
- Adds some considerations on **“partially automated vehicles” (ADAS) and “Fully automated vehicle” (CAV)**, naming some of the systems that shall be included in the near future (dates defined in the Regulation, starting 2022)

General safety Regulation

Example of functions introduced by GSR2:

- Intelligent Speed Assistance
- Driver Drowsiness and Attention Warning
- Advanced Emergency Braking System
- Emergency Lane Keeping Systems

General safety Regulation

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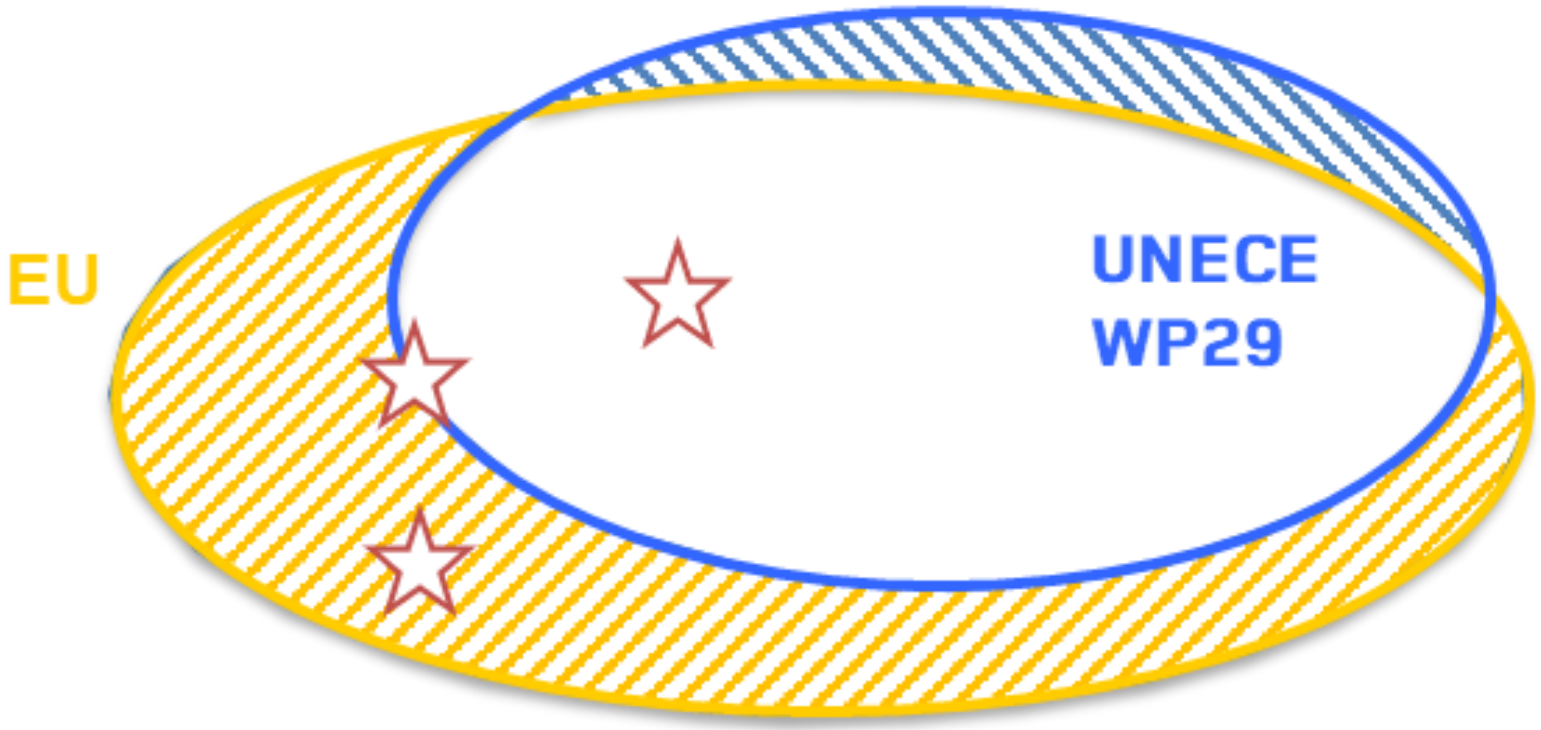
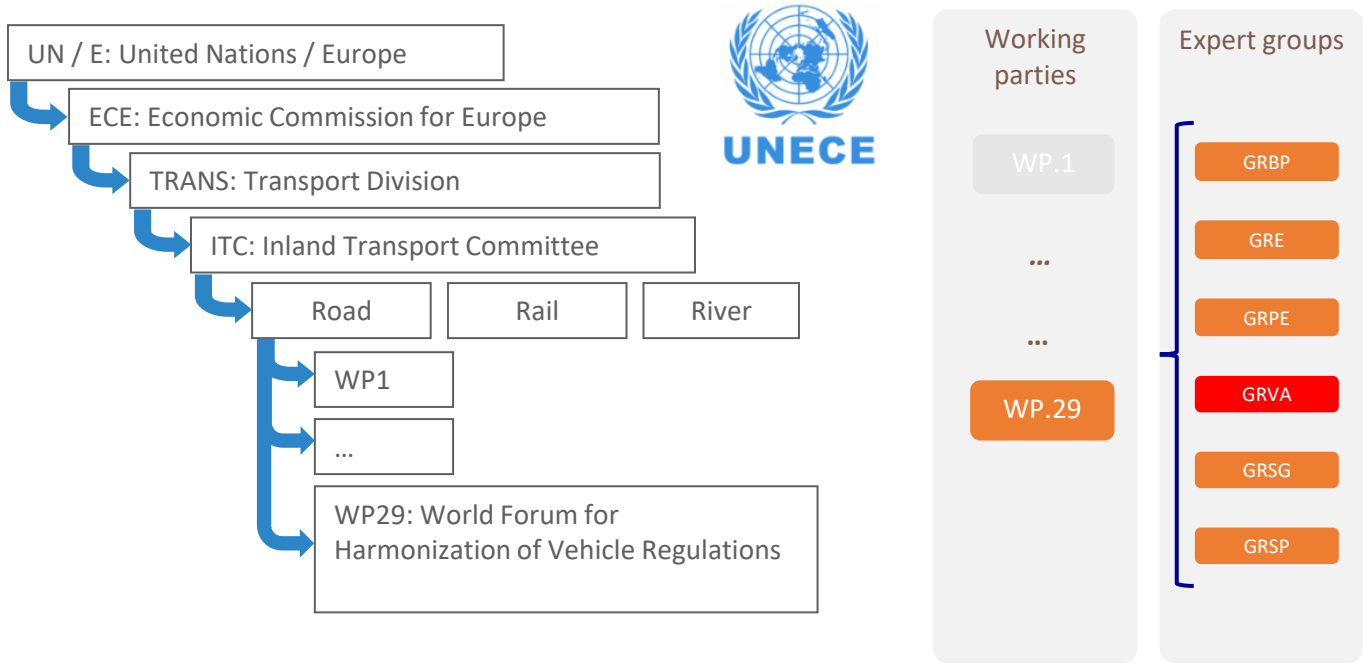
General safety Regulation



UNECE WP29

WP29: World Forum for Harmonization of Vehicle Regulations

Structure:



UNECE WP29

WP29: World Forum for Harmonization of Vehicle Regulations

Framework document:

SYSTEM SAFETY

OBJECT EVENT DETECTION AND RESPONSE (OEDR)

EVENT DATA RECORDER (EDR)

SW UPDATES

VALIDATION FOR SYSTEM SAFETY

HUMAN MACHINE INTERFACE (HMI)

FAILSAFE RESPONSE

CYBERSECURITY

OPERATIONAL DESIGN DOMAIN (ODD)

Agenda

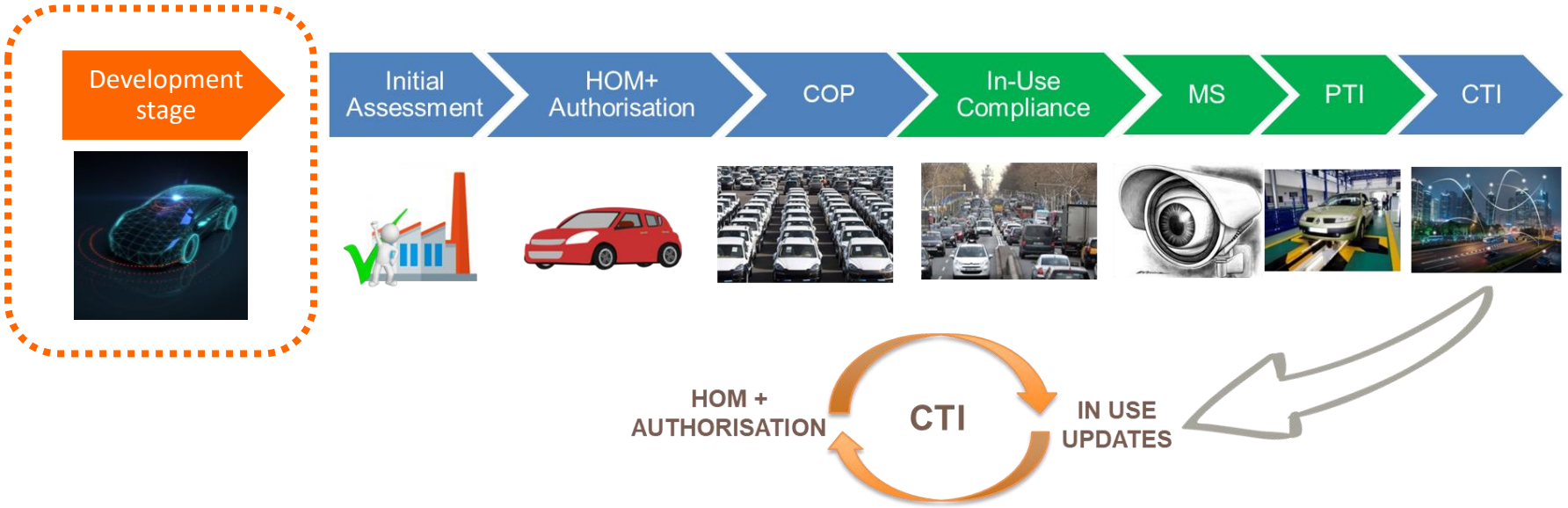
✓HEADSTART project

✓Introduction to type-approval

- **UN Regulation No. 157 - Automated Lane Keeping Systems (ALKS)**
  - **General concepts for testing ALKS**
  - Spanish approach for testing ALKS
  - Dutch approach for testing ALKS
- Round table

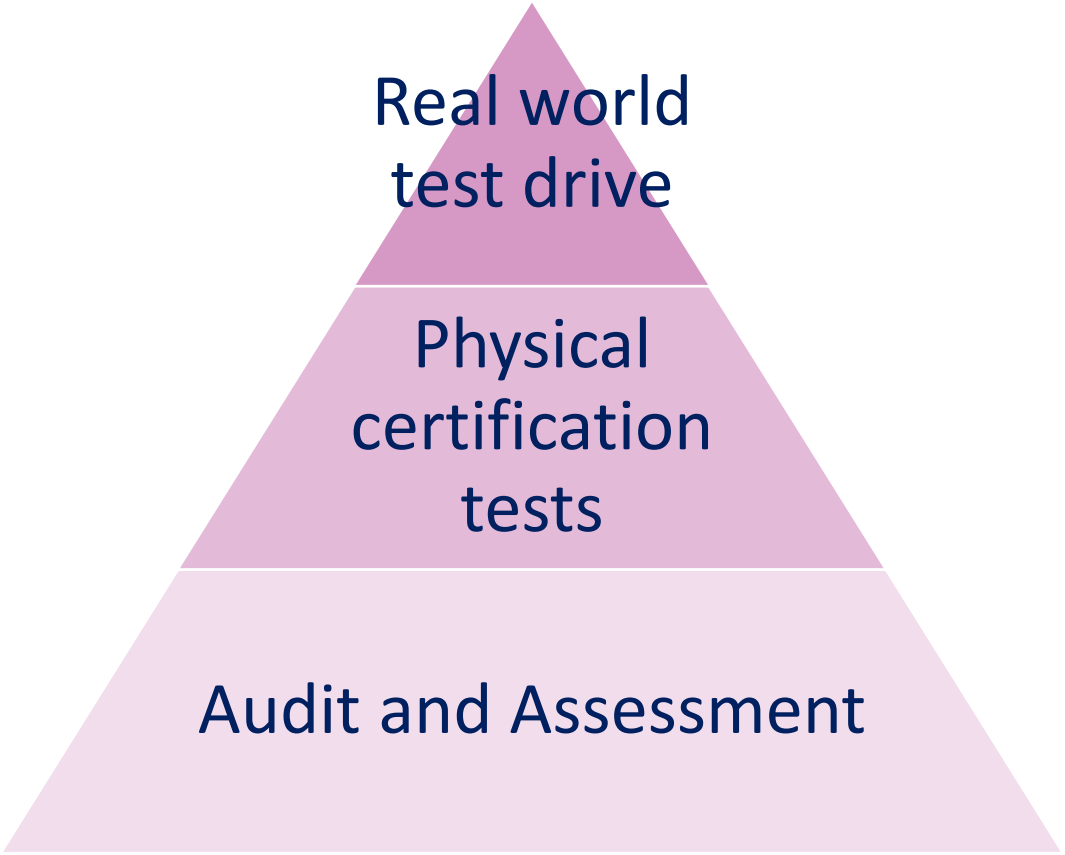
UN Regulation No. 157 – General concepts for testing ALKS

New Homologation procedure



UN Regulation No. 157 – General concepts for testing ALKS

New Homologation procedure- 3 Pillars Approach



- Overall impression of system behavior on public roads
- Assessment of system's ability to cope with real world traffic situations with a standardized checklist
- Driving license test for automated driving system
- Guidance through given set of situations which shall be passed

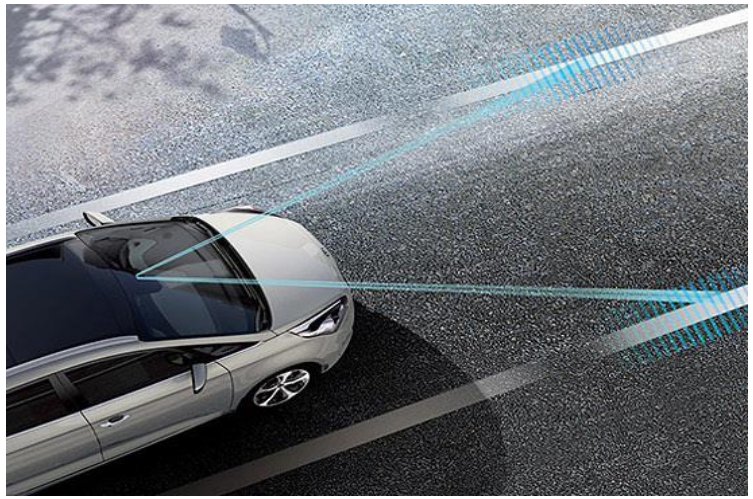
- Matching of audit/assessment results with real world behavior
- Assessment of system behavior in fixed set of challenging cases, which either aren't testable on public roads or cannot be guaranteed to occur during the real-world test drive
- Reproducibility of situations

- Audit of development process (methods, standards)
- Assessment of safety concept (functional safety, safety of use)
- Check of integration of general safety requirements and traffic rules
- Use of simulation results (high mileage approval, capability to cope with critical situations, which aren't testable)
- Assessment of development data/field testing, OEM-self-declaration

UN Regulation No. 157 – General concepts for testing ALKS

Definition and Scope

- A system which is activated by the driver and which keeps the vehicle within its lane when travelling at low speed by controlling the **lateral and longitudinal movements** of the vehicle for extended periods without the need for further driver input.
- M1 vehicles.



BASIC ODD CONSTRAINS
Roads where pedestrians and cyclists are prohibited
Physical separation that divides the traffic moving in opposite directions and prevent traffic from cutting across
Operational speed up to 60 km/h maximum

UN Regulation No. 157 – General concepts for testing ALKS

REQUIREMENTS

Requirements

- Safety and failsafe response
- Human machine interface / operator information
- Object and Event Detection and Response (OEDR)
- Data Storage System for Automated Systems
- Cybersecurity and Software Updates





UN Regulation No. 157 – General concepts for testing ALKS

FUNTIONAL AND OPERATIONAL SAFETY

Complex Electronics System (Annex 4)

Manufacturer Documentation

- Information document (Appendix 2)
- Documentation Package (Item 3)
- Confidential documentation (Item 3.4.4.)

Safety Management System

- Processes
- Methodologies
- Tool are updated and followed throughout the whole product lifecycle (designe, development, production, operation…

Tests/Verifications

- Verification of the function of the system (real driving situations)
- Verification of the safety concept (under failure conditions)

UN Regulation No. 157 – General concepts for testing ALKS

SIMULATIONS

5.2. Dynamic Driving Task

For conditions not specified in paragraphs 5.2.4., 5.2.5. or its subparagraphs, this shall be ensured at least to the level at which a competent and careful human driver could minimize the risks. This shall be demonstrated in the assessment carried out under Annex 4 and by taking guidance from Appendix 3 to Annex 4.

Annex 4 - Appendix 3

Guidance on Traffic disturbance critical scenarios for ALKS

1. General

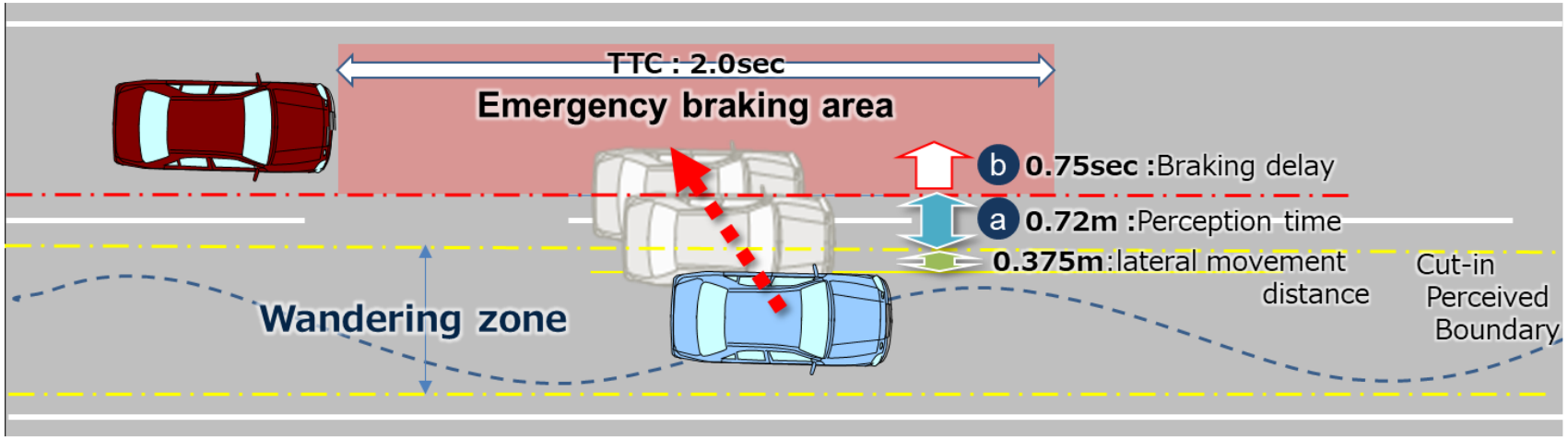
1. This document clarifies derivation process to define conditions under which Automated Lane Keeping Systems (ALKS) shall avoid a collision. Conditions under which ALKS shall avoid a collision are determined by a general simulation program with following attentive human driver performance model and[1] related parameters in the traffic critical disturbance scenarios.

UN Regulation No. 157 – General concepts for testing ALKS

SIMULATIONS

Cut-in scenario

- Other Vehicle suddenly merges in front of the ego vehicle



UN Regulation No. 157 – General concepts for testing ALKS

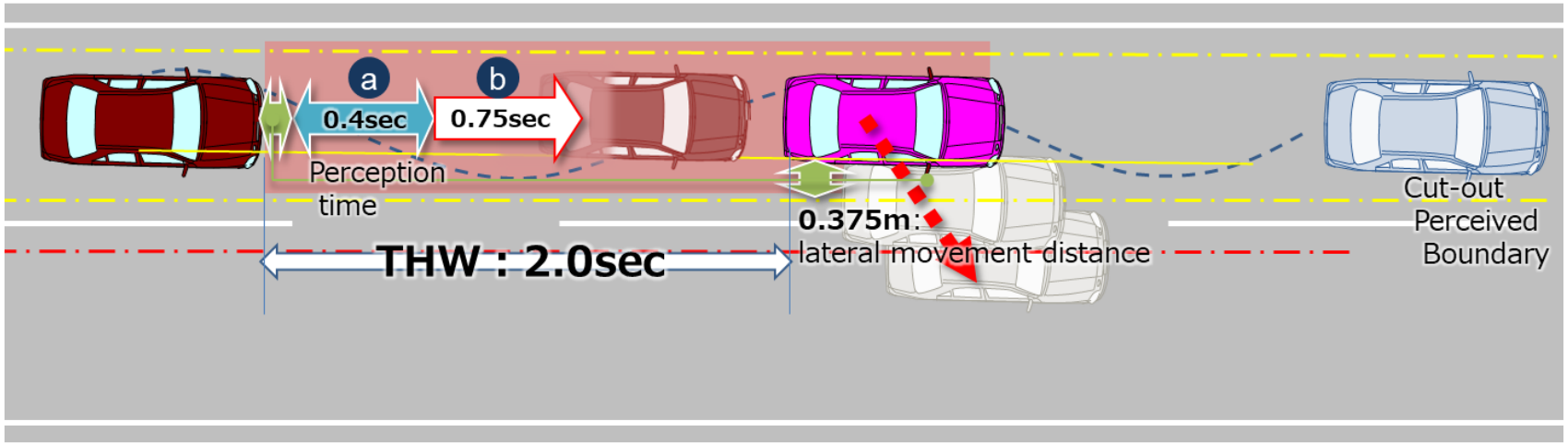
SIMULATIONS

Cut-in scenario

- Other Vehicle suddenly merges in front of the ego vehicle

Cut-out scenario

- Other Vehicle suddenly exits the lane of the ego Vehicle



UN Regulation No. 157 – General concepts for testing ALKS

SIMULATIONS

Cut-in scenario

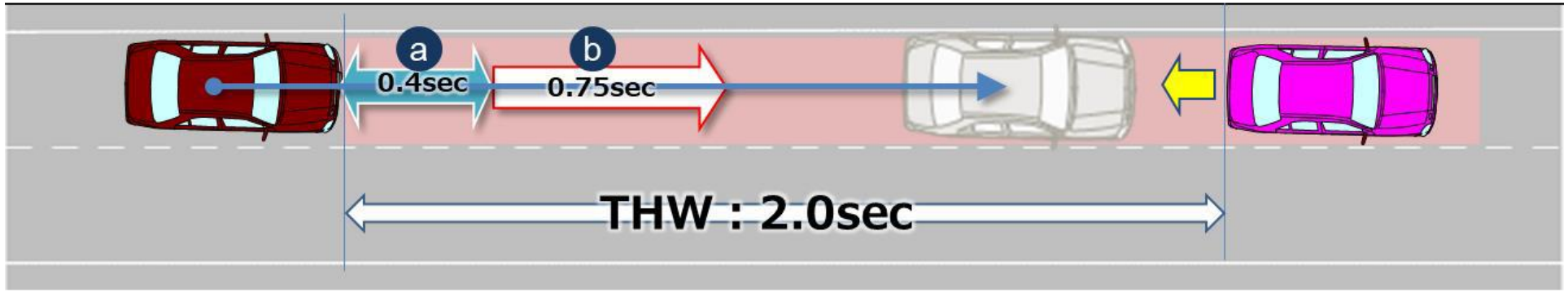
- Other Vehicle suddenly merges in front of the ego vehicle

Cut-out scenario

- Other Vehicle suddenly exits the lane of the ego Vehicle

Deceleration scenario

- Other Vehicle suddenly decelerates in front of the ego Vehicle



UN Regulation No. 157 – General concepts for testing ALKS

Testing – Proving Ground

UN Regulation No. 157 – General concepts for testing ALKS

Testing – Real World

- Prevention of the activation out of the ODD conditions
- No violation of traffic rules
- Response to a planned event
- Response to an unplanned event
- Detection of other users in front and on the sides
- System override
- Vehicle behaviour with regards to other users (cut-in, cut-out,…)

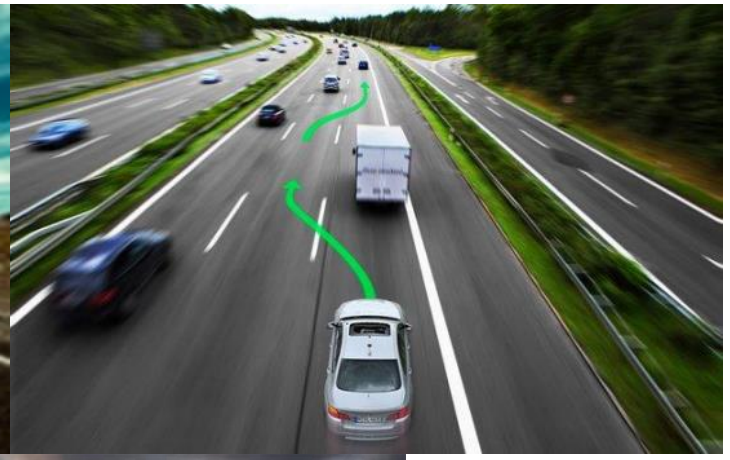
UN Regulation No. 157 – General concepts for testing ALKS

Future Amendments

- Extend to 130 km/h

  +

- Allow the autonomous lane change



- Inclusion of other categories of vehicles (M2, M3, N1, N2 and N3)

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UN Regulation No. 157 – Spanish approach for testing ALKS

Traffic Management Responsible Authority:
Directorate-General for Traffic

Instruction 15/V-113[1]*: Authorization to conduct tests or research trials of automated vehicles on roads that are open to general traffic*

November 2015

November 2020

End of 2021

The instruction suffered some changes[2] (adapting the tests conditions for those vehicles not able to perform the usual tests)

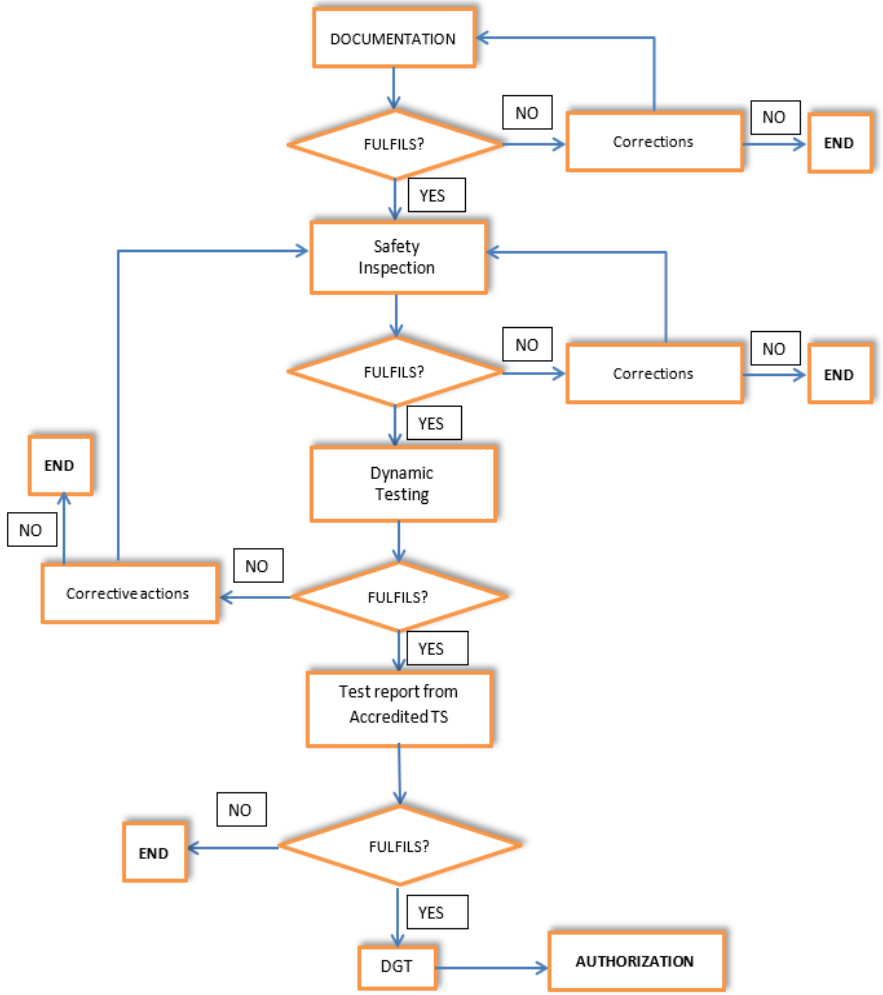
Expected to issue new modification (not affecting test procedure)

In Spain, Real World Tests of UN Reg. 157 will be tested according to the instruction

[1] http://catalonialivinglab.com/wp-content/uploads/2019/06/15v-113-vehiculos-conduccion-automatizada-english.pdf

[2] https://www.dgt.es/Galerias/seguridad-vial/normativa-legislacion/otras-normas/modificaciones/2020/Escrito_Directriz_SGGMT_7_2020_Modificacion_anexo_de_la_Instruccion_DGT_15_V_113.pdf

UN Regulation No. 157 – Spanish approach for testing ALKS



PROCEDURE TO GET THE PERMISSION:

Technical Documentation

- Application form and fee payment
- Test report from a designated Technical Service

Tests in a Designated TS

- Description of the tested functionalities and scenarios
- Technical Specifications of the vehicle
- Vehicle inspection & Safety Checks
- Dynamic Tests according to 15/V-113
- Functional Safety checking (HARA, FMEA,…)

UN Regulation No. 157 – Spanish approach for testing ALKS

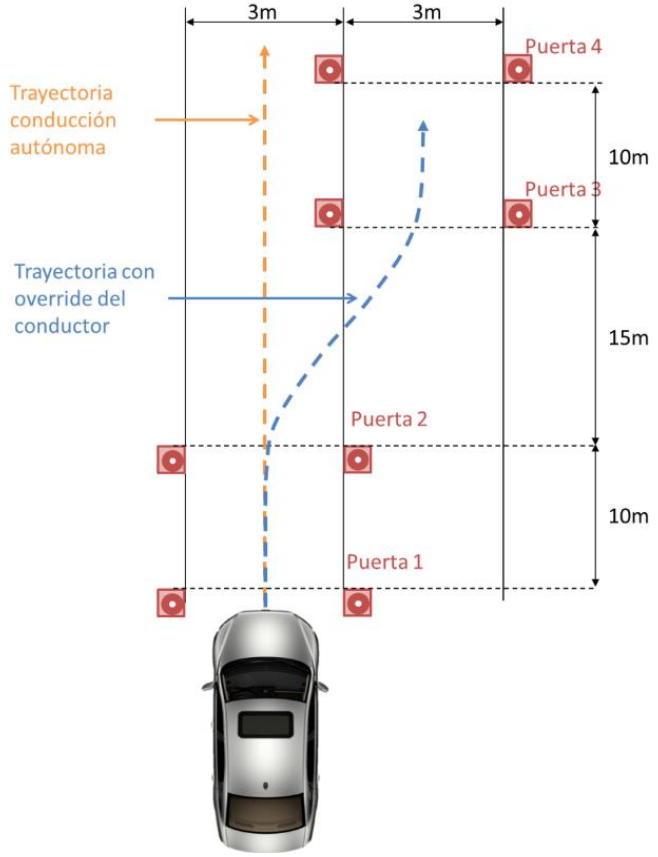
DYNAMIC TESTS

Conventional Driving

- Simple tests to check safety systems of the vehicle:
  - Acceleration, Steering, Braking, Speedometer…

Override Tests

- Steering:
  - Manually override the automated trajectory
- Brake:
  - First drive the vehicle in automated mode
  - Repeat the test applying brakes
- Throttle:
  - First drive the vehicle towards a static target
  - Repeat the test accelerating when vehicle is braking
- Emergency button

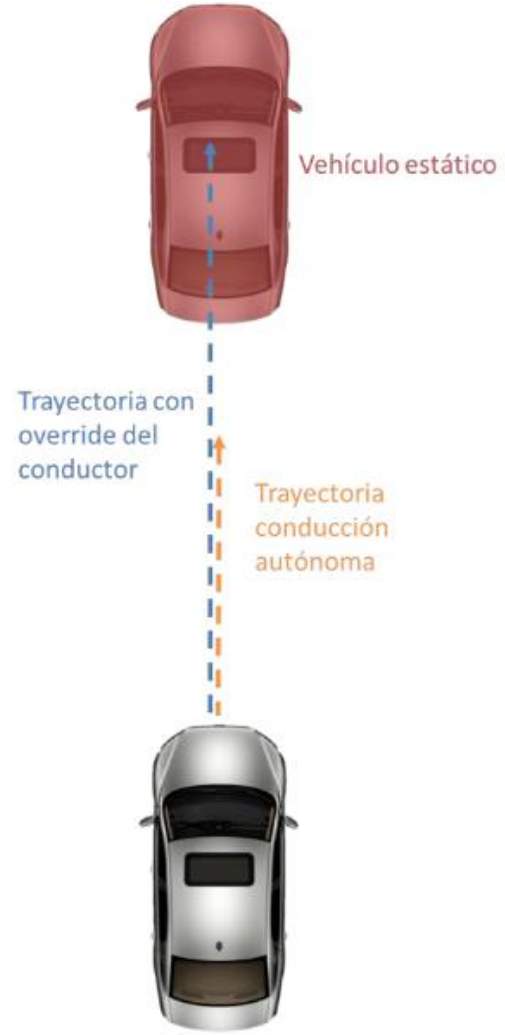


UN Regulation No. 157 – Spanish approach for testing ALKS

DYNAMIC TESTS

Longitudinal Control

- Conventional Brakes (avoided with UN Reg 13/13-H)
  - Type 0 and Type I tests
- Advanced Emergency Brake
  - C2C: Stationary Target 30, 50 & 70 km/h
  - C2C: Moving target 50 & 70 km/h (target @ 20 km/h)
  - C2C: Braking target 50 km/h (braking @4m/s2)
  - C2P: Adult crossing from right (impact at 50% offset)
  - C2P: Child crossing from right (impact at 50% offset)
- Vehicle must avoid impact in all these scenarios



UN Regulation No. 157 – Spanish approach for testing ALKS

DYNAMIC TESTS

Lateral Control

- By means of guidance system (GPS coordinates, line following,…)

The technical Service will agree with the applicant the test method to verify that the vehicle will not cross the lane in the different scenarios

- Lane crossing avoidance or lane centering systems:
  - Scenario 1: Lane crossing avoidance: Vehicle will not cross the line
  - Scenario 2: Lane centering: Vehicle will not leave the lane

UN Regulation No. 157 – Spanish approach for testing ALKS

TESTS CONDITIONS FOR THOSE VEHICLES NOT ABLE TO PERFORM TESTS

- For those vehicles not able to reach the vehicle conditions specified in these tests (e.g.: test speed)
- Technical Service will analyse the specific features of the vehicle
- Technical Service will propose alternative scenarios for dynamic tests in the instruction

UN Regulation No. 157 – Spanish approach for testing ALKS

FUNCTIONAL SAFETY CHECKINGS

- Applicant will provide to Technical Service (TS) the HARA, FMEA (or alternative method) in advance
- The TS will check the provided documentation
- The TS will select some of the risks/mitigations in the analysis and will simulate these conditions to verify that the vehicle's behaviour is according to documentation

ELECTROMAGNETIC COMPATIBILITY

- Applicant will provide to Technical Service documentation proving the system fulfils UN Reg. No 10

CYBERSECURITY

- Applicant will provide documentation proving all the systems have been designed/developed taking into account the appropriate cybersecurity levels

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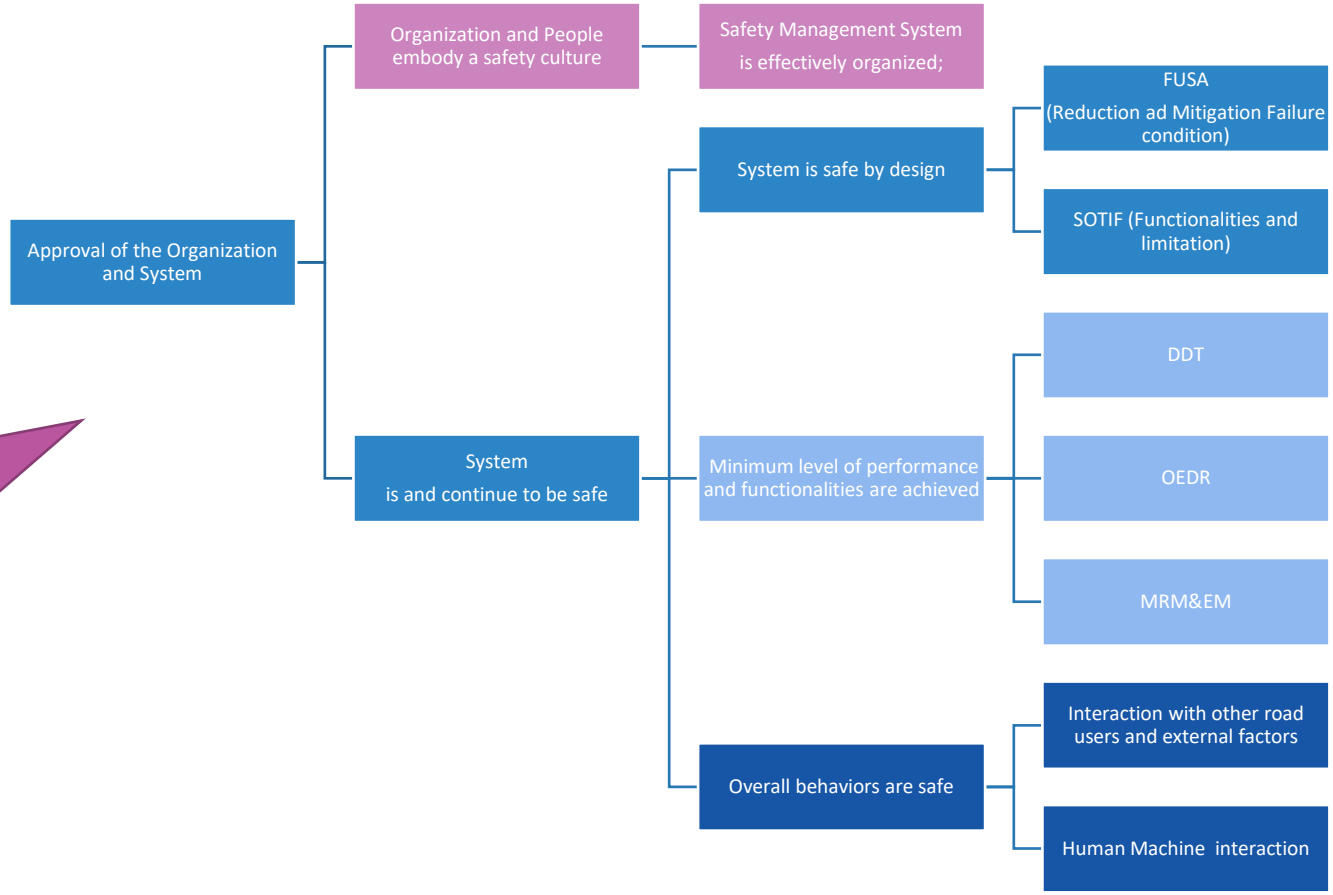
UN Regulation No. 157 – Dutch approach ALKS Type approval Strategy

SMS approval and System approval

This approach will be checked up with FoT and strengthened by sharing experience with authorities in the International Forum



This strategy assure the safety by processes, measurement and thresholds. *Ref. EC/JRC*

UN Regulation No. 157 –
Dutch approach ALKS Type approval - SMS

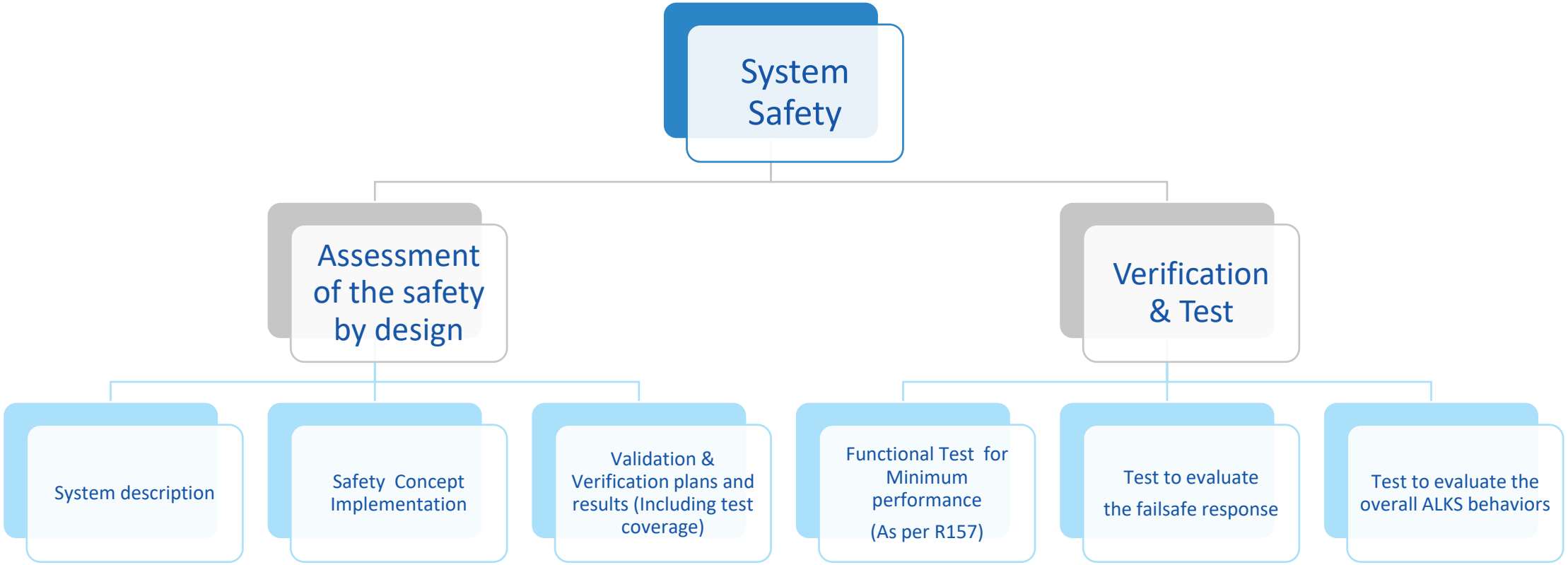
The Safety Management System (SMS) an organized approach - including the necessary organizational structures, accountabilities, policies, and procedures - for the management of safety in order to promote a strong safety culture and achieve good safety performance (adaptation from INSAG, 1999 and ICAO, 2013).

The auditing of SMS is mandatory to assess the robustness of the Organization and *it is preparatory for the assessment and test of the product*.

SMS approval scheme

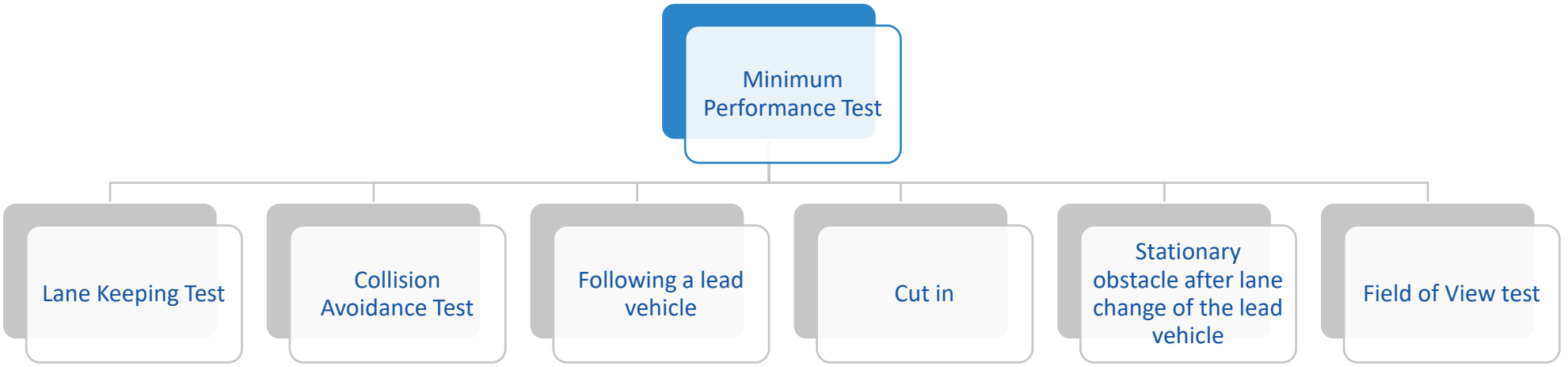
Ref. VSSF

UN Regulation No. 157 – Dutch approach ALKS Type approval – Assessment and Test Strategy – System Safety

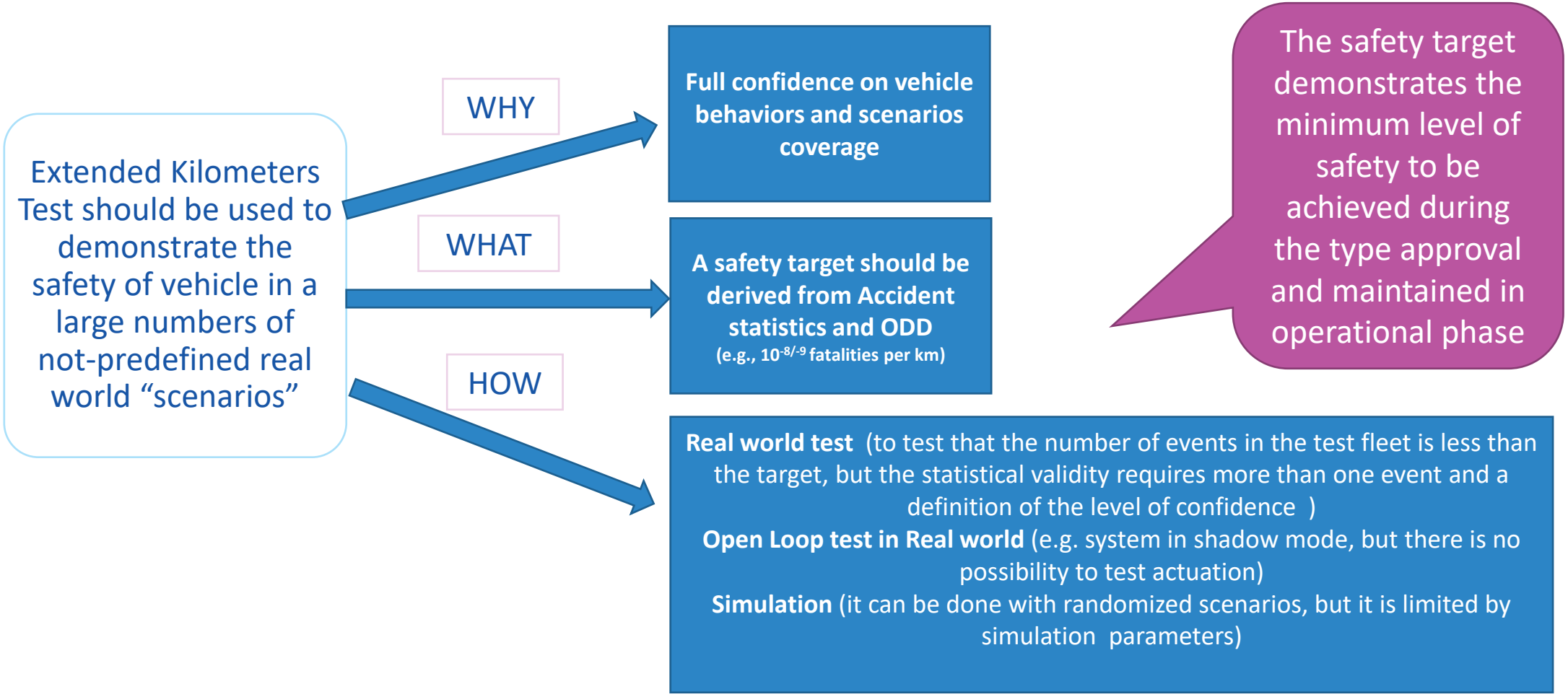


UN Regulation No. 157 – Dutch approach ALKS Type approval – Performance Test as per R157

The test conditions should cover the entire ODD



UN Regulation No. 157 – Dutch approach ALKS Type approval – Test Demonstration of Overall Safety Target



UN Regulation No. 157 – Dutch approach ALKS Type approval – Test

VDLF approach for Assessing the vehicle behavior

Real-world testing should be used to represent general traffic situations with no pre-set conditions on the road.

This tests serve to assess the overall behaviors of the system in a holistic way like the Human Driver competence test.

A Likert scale is used to evaluate the overall behavior of system in respect to traffic scenarios/traffic situations.

Safety aspect are assessed: Safety Cushion
General aspect are assessed: Smoothness of the manoeuvre, Fluency of the manoeuvre, Comfort of the manoeuver.

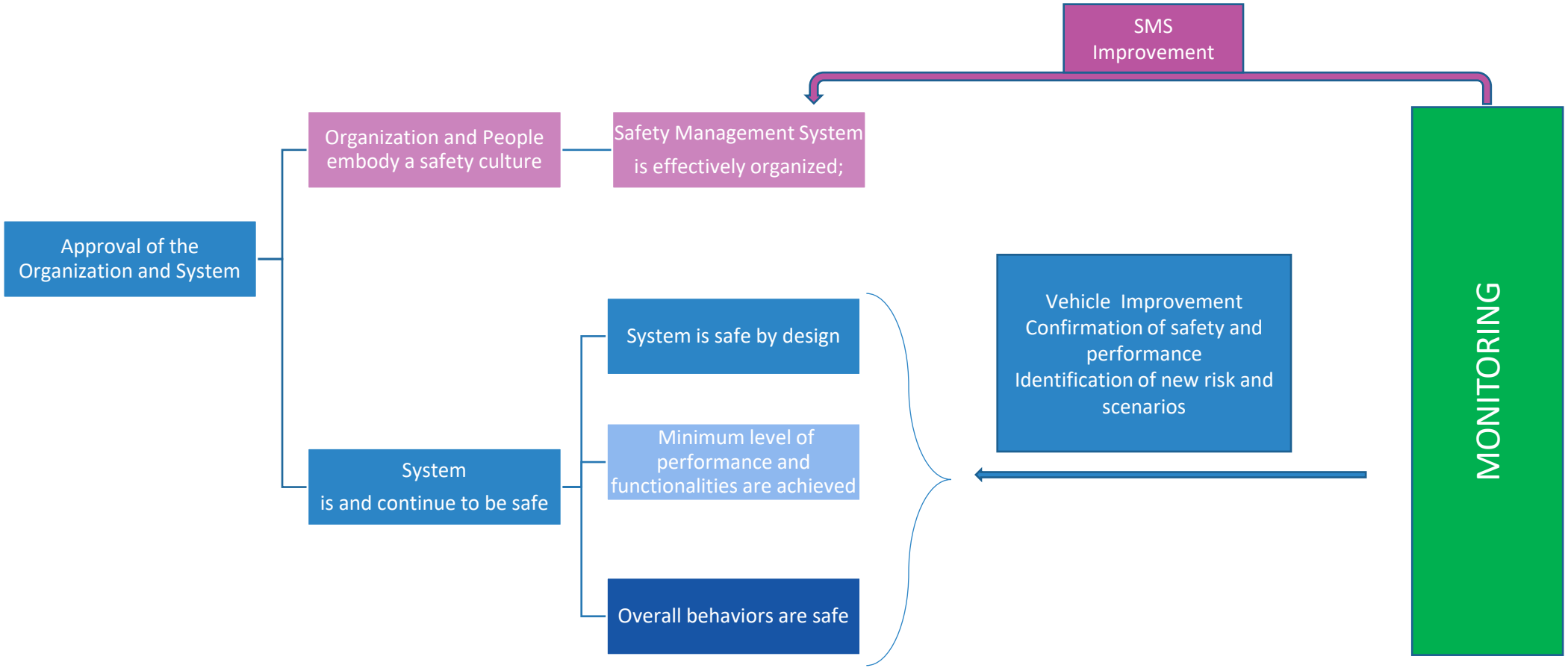
Example Test Matrix:

		Traffic Scenarios / Traffic Situations				
Criteria		Driving on the motorway	Merging	Lane Change	Overtaking	Exiting Motorway
Lane keeping	a. Driving straight	1-7	1-7	1-7	1-7	1-7
	b. Driving curves	1-7	1-7	1-7	1-7	1-7
	c. (…)	1-7	1-7	1-7	1-7	1-7

Ref. VMAD SG4

UN Regulation No. 157 – Dutch approach ALKS Type approval Strategy

Type approval and In use monitoring



Agenda

- ✓HEADSTART project
- ✓Introduction to type-approval
- ✓UN Regulation No. 157 - Automated Lane Keeping Systems (ALKS)
- **Round table**

Round Table

HEADSTART

Thank you!

Applus IDIADA

RDW

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