



Holistic Approach for
Driver Role Integration and
Automation Allocation for
European Mobility Needs

Improving the Driver Role for Automated Driving:
An Opportunity for advancing Human-Systems Integration

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29. Mar, 2022

www.hadrianproject.eu/



HADRIAN has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 875597

PROJECT

Addresses EU call for research and innovation:

“Solutions need to be developed to ensure both a safe transfer between use cases with different automation levels and that drivers always have a very clear understanding about the degree of automation enabled in each situation.” (DT-ART-03 call text)

- ▶ **Duration:** 42 Months
- ▶ **Start:** Dec 2019
- ▶ **Funding:** 8 Mio EUR

Mar 29, 2022



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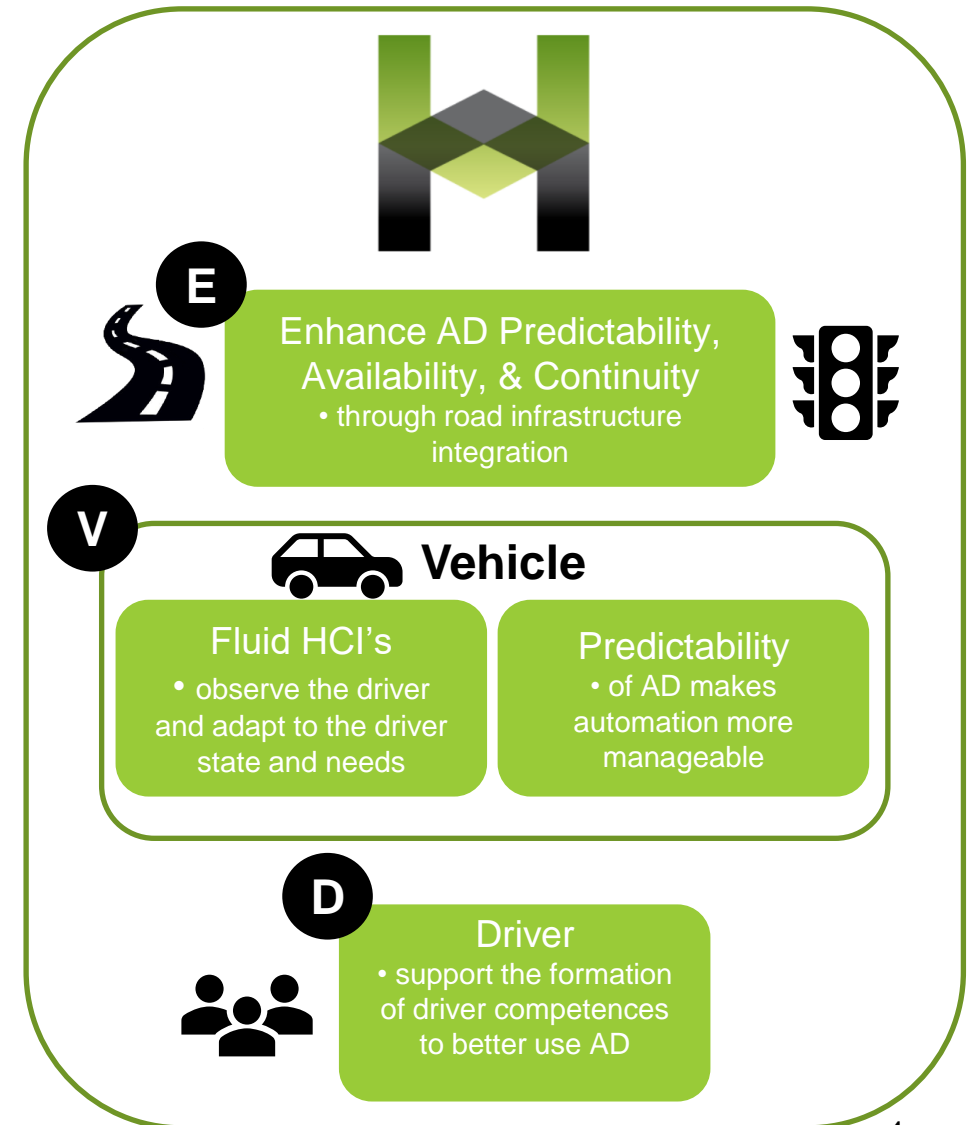
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OBJECTIVES

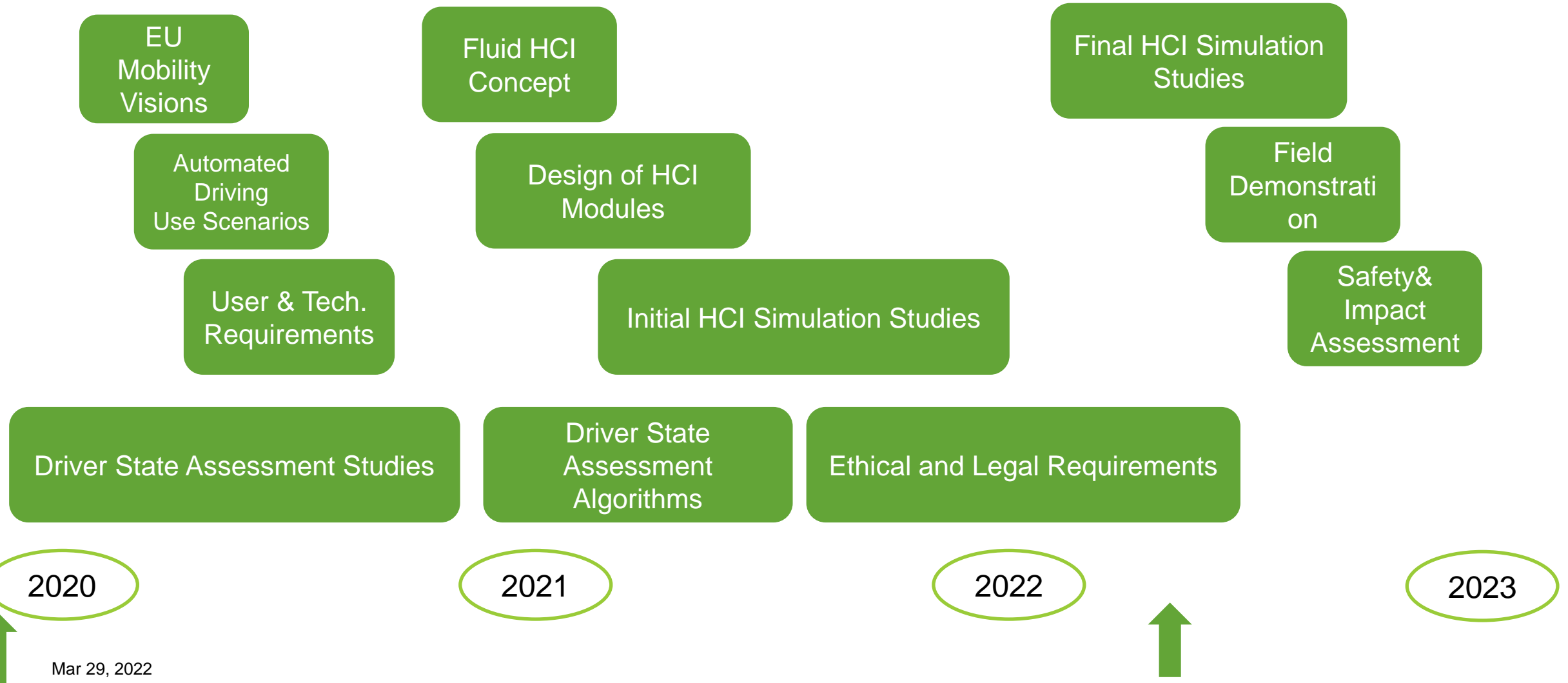
1. Demonstrate how the characterization of novel driver roles based on fluid interaction design leads to 90% **safe AD level transitions** for a set of HADRIAN applications cases e.g. shared and individual mobility and professional freight transport. **WP 1-5**
2. Demonstrate safe AD level transitions for a set of HADRIAN application cases using fluid interaction designs that at least **80% of users find acceptable** **WP 1-5**
3. Demonstrate that at least 80% of users achieve **calibrated trust** in AD and AD level transitions over time when using fluid interaction designs for a set of HADRIAN applications cases. **WP 1-5**
4. Develop **innovative technology bricks** regarding fluid HMI, sensor data-fusion, driver-models, and decision logic **WP 2 & 3**
5. Develop Human-Systems, **integration guidelines & recommendations** around a human-centred methodology to create safe, acceptable as well as usable, and trustworthy AD technologies & AD level transitions. These recommendations and guidelines are intended for infrastructure providers, road operators, and OEM's. **WP 3.4, 6 & 7**

HOLISTIC APPROACH TO ADDRESS ADL 3 CHALLENGES

- ▶ Acceptable, safe AD driver role (E, V, D)
- ▶ Enhance AD Predictability
 - To facilitate getting driver back in the loop
 - Allow better planning for NDRA
 - Enhance availability of RI support for increase availability and continuity
- ▶ Improve the AD Vehicle
 - Add driver monitoring to warn driver in case of incompatible driver state
 - Enhance Human Computer Interactions
 - For predictable transitions and NDRA planning
 - Dynamic “fluid” interactions based on driver state/action
- ▶ Help the AD User / Driver
 - Strengthen competences for AD usage via tutoring
 - Before, during, and after drive
 - Active feedback in case of inconsistent actions
 - Increase understanding of vehicle for calibrated trust formation

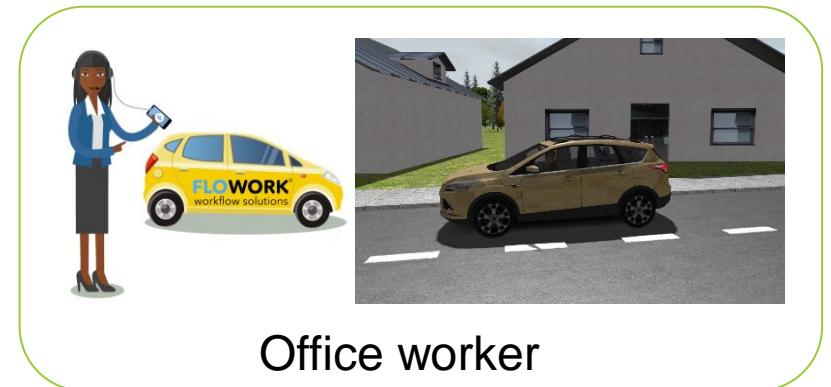
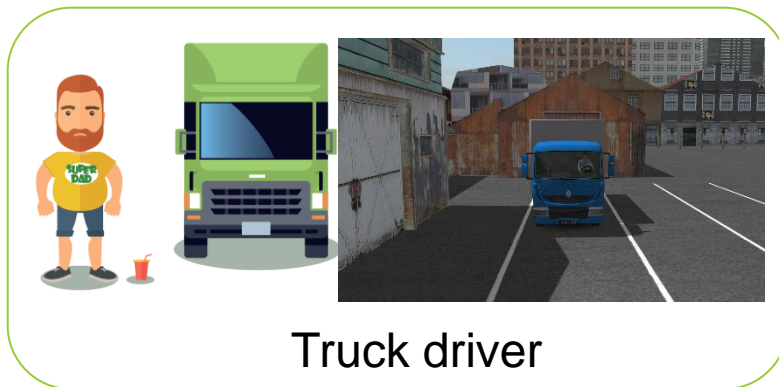
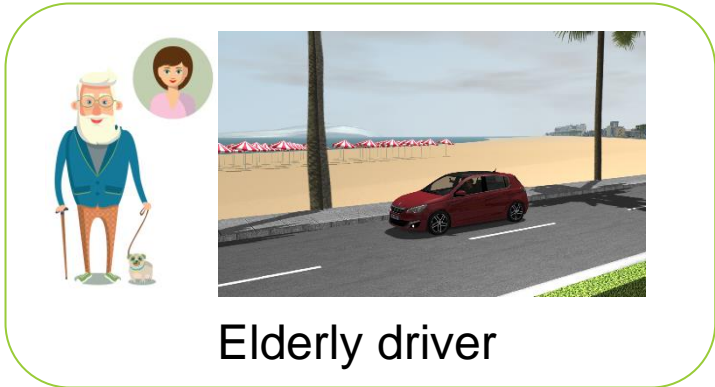


OVERVIEW OF MAIN PROJECT ACTIVITIES IN YEARS 1 AND 2

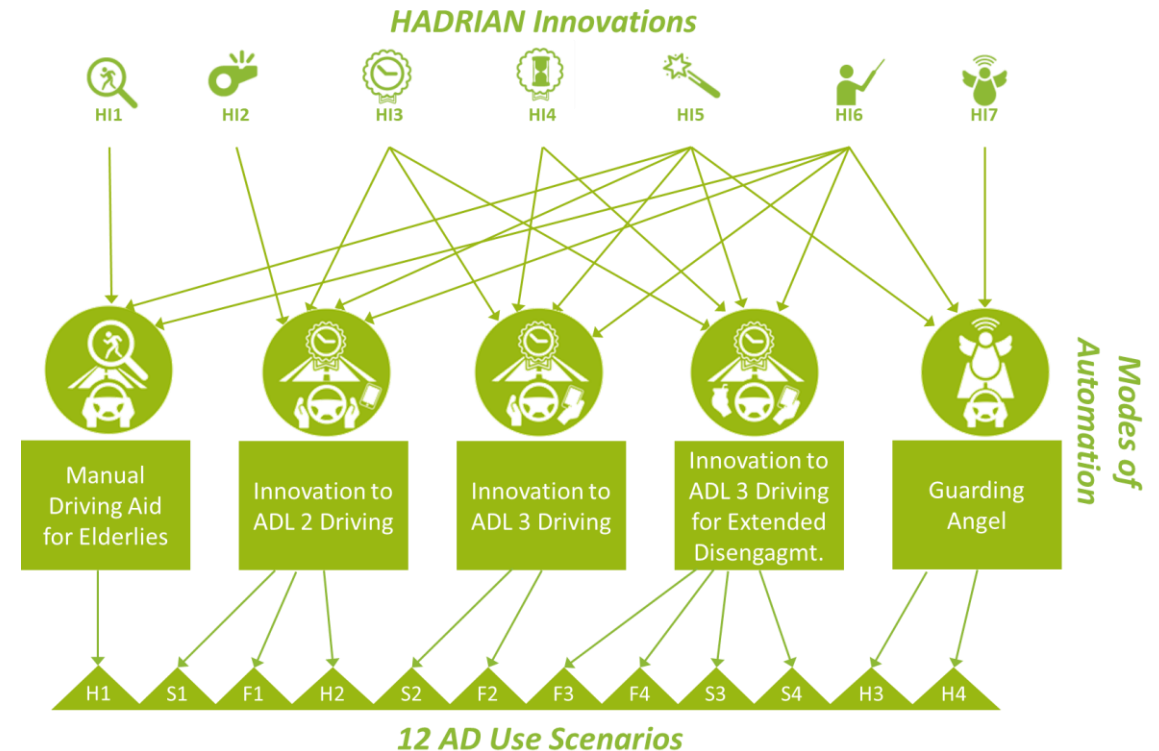


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AUTOMATED DRIVING USE SCENARIOS

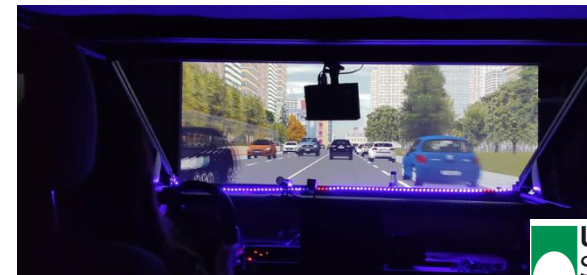


- ▶ Joint definition of 12 AD use scenarios with user needs & constraints, and environment definition
 - Used to derived functional automated driving and interaction requirements
 - Form the basis for specific studies
- ▶ Basis for AD solution identification
- ▶ Translated use scenarios into driving simulation scenarios for use by partners
 - Twelve trips in urban, suburban, highway, and motorway driving
 - Format compatible with OpenScenario

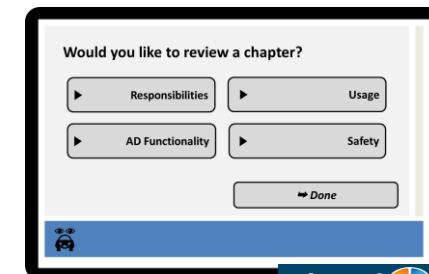


OVERVIEW OF CURRENT RESULTS

- ▶ Over the first 2 years, HADRIAN performed various studies to measure the impact of various innovations to improve the human driver role during automated driving
 - Data from approx. 400 participants in driving simulation studies
 - Here only an excerpt is given
- ▶ Increasing the predictability of the automated drive
 - What AD predictability time horizons would be needed to be helpful?
 - Our partner the German Federal Highway Research Center (BAST) performed two studies
 - Literature review and wizard-of-oz study
 - For ADL2: 5 sec, for ADL 3: 15 sec
 - How helpful is ADL 3 predictability to improve the takeover?
 - Partner ViF performed a simulator study with 41 participants and identified subjective and awareness benefits
- ▶ How could ambient lighting in the vehicle facilitate ADL mode awareness?
 - Partner Plus performed two studies with together 100 participants to identify appropriate colors and arrangements for different alerting modalities for automation and driver engagement
 - Blue and cyan for ADL 2 / 3, red / orange for driver engagement
- ▶ How can a tutoring application help drivers learn to interact with the AD functions
 - Driver state dependent feedback to build competences and mental model

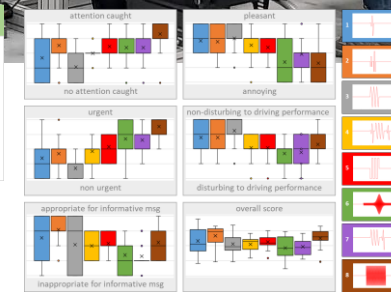
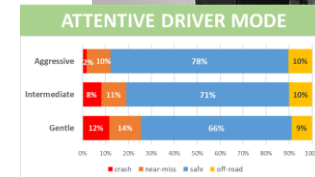
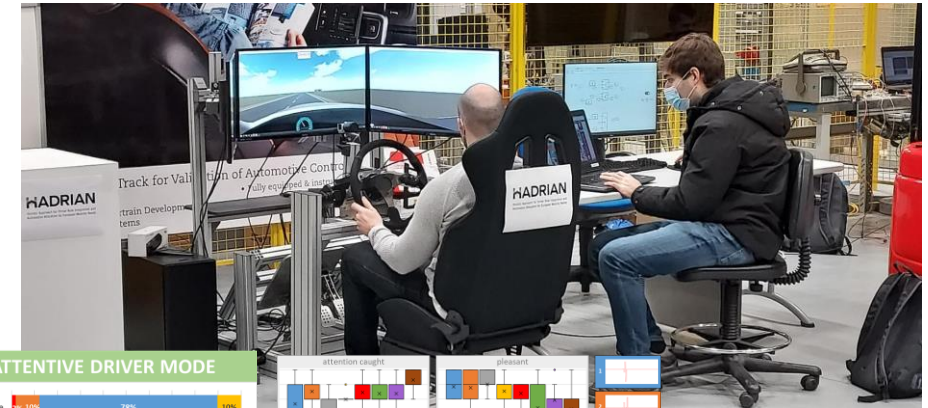


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OVERVIEW OF CURRENT RESULTS

- ▶ Under what conditions can a guarding angel support the safety of manual driving?
 - Safety benefits of sufficiently strong force feedback for attentive drivers (24 drivers)
 - Also identified appropriate haptic icons to identify various AD state transitions (13 drivers)
- ▶ Additional studies addressed
 - Large driver state assessment studies (>120 drivers with various age groups, experience, and gender)
 - Assessment of truck driver preferences concerning automated driving (20 truck drivers)
 - Including optimized AD sound designs
 - Standardizable alerting framework
 - Effectivity of a turning seat to increase AD mode awareness
- ▶ Development of a human reliability calculator
 - Translating methods from human reliability engineering domains into the automotive domain
 - Actively engage with safety communities, SOTIF



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FIELD DEMONSTRATION

► Turkey Field Demonstration



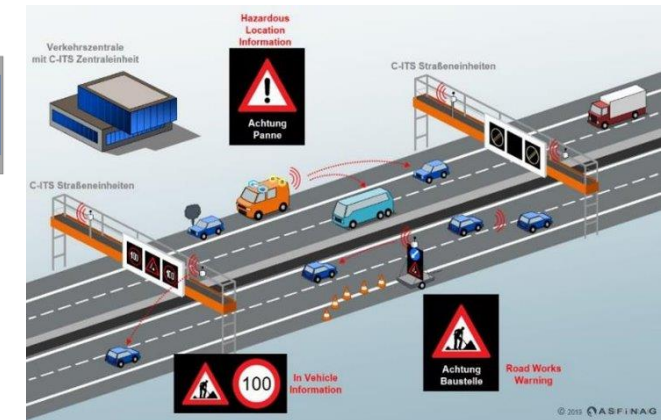
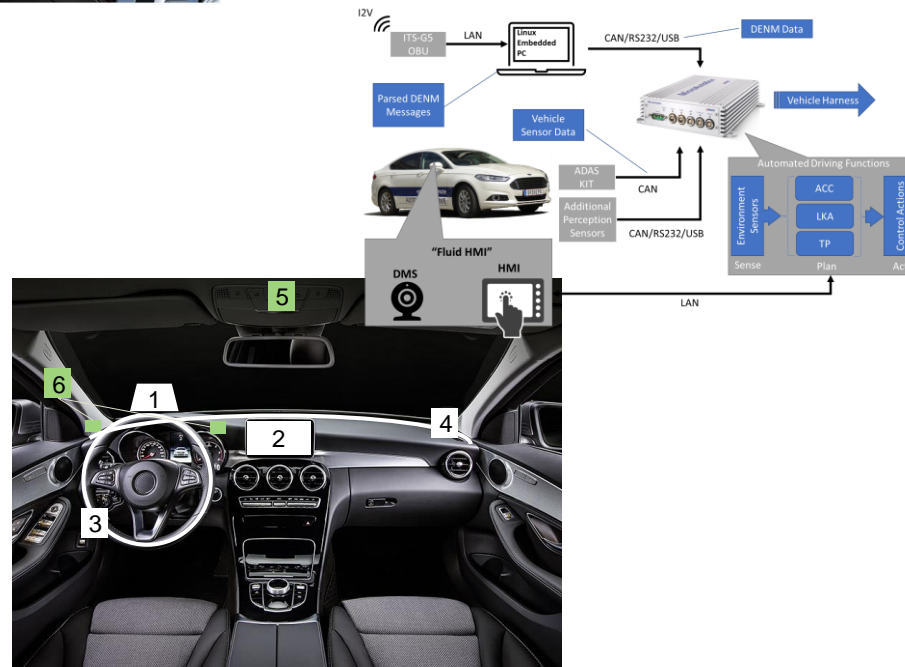
► Austria Field Demonstration



► Spain Field Demonstration



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IMPACT

- ▶ Targeted long term impact **is to improve the safety and acceptance of automated driving solutions in Europe** (and beyond)
- ▶ Help industry to **innovate AD products** for improved (safer, more accepted) driver role
 - Multiple HCI design prototypes, demonstrations, and empirical results
 - Connection with industry
 - Daimler, Toyota Research, Ford
 - Twinning with US and Japanese organizations
 - U.S. transportation research institute, MITRE, AIST
 - International dissemination activities
 - TRB, INCOSE, ACM CHI, EUCAD21, TRA 2022,..
- ▶ Support EU & CCAM decision making through quantifications of innovations (EU, OEM, infrastructure providers, cities)
 - Also bring human reliability assessment methods into ISO TC 22 SC 32 / TS 5083
- ▶ Support widening integration of AD vehicle - road infrastructure systems by providing benefit and feasibility assessments
- ▶ Contribute to improvement European DMS products by providing **open access to annotated datasets of driving state data** for different driver populations under distracted, non-distracted, fatigued, driving conditions, including gaze-and eye-orientation and heart-activity for European DMS research
- ▶ Facilitate a harmonized basis for AD research and development by providing **open access to driving simulation scenarios** and descriptions
- ▶ Enable harmonization and standardization of driver alerting across AD vehicle brands and models in through translating regulations from aviation (CS § 25.1322)
- ▶ Provide concrete recommendations to EU and OEMs to facilitate the development of human-centered automated driving systems for an improved driver role
- ▶ Widen research impact through academic collaborations

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