interactIVe

Accident avoidance by active intervention for Intelligent Vehicles

Lessons Learned From Evaluation of the interactIVe Project and next steps towards the evaluation of automated driving

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Content

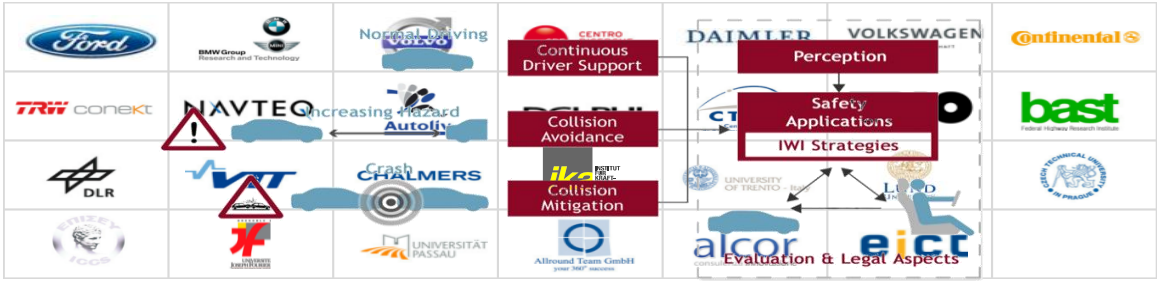
- Overview interactIVe
- Evaluation in interactIVe
- Result of interactIVe
- Lessons learned from the evaluation
- Evaluation of automated driving

interactIVe – Overview Project

The interactIVe vision:
Accident-free traffic and active safety systems in all vehicles

- Facts:
  - Duration: 48 months
    (January 2010 – November 2013)
  - 29 partners of 10 countries
  - Budget: 30 Million €
    (European Commission funding: 17 Million €)

- Objectives:
  - Create an innovative model and platform perception
  - Extend range of possible scenarios and usability of ADAS by multiple integrated functions and active interventions
  - Improve decision strategies for active safety
  - Develop solutions for collision mitigation for lower-class vehicle segments
  - Further encourage the application of standard methodologies for the evaluation of ADAS



interactIVe - Overview Functions

Driver Support

- Continuous Support
- Curve Speed Control
- Enhanced Dynamic Pass Predictor
- Safe Cruise

Collision Avoidance

- Lane Change Collis. Avoid.
- Oncoming Vehicle Collis. Avoidance/Mitigation
- Rear End Collis. Avoidance
- Side Impact Avoidance
- Run-off Road Prevention

Collision Mitigation

- Emergency Steer Assist
- Collision Mitigation







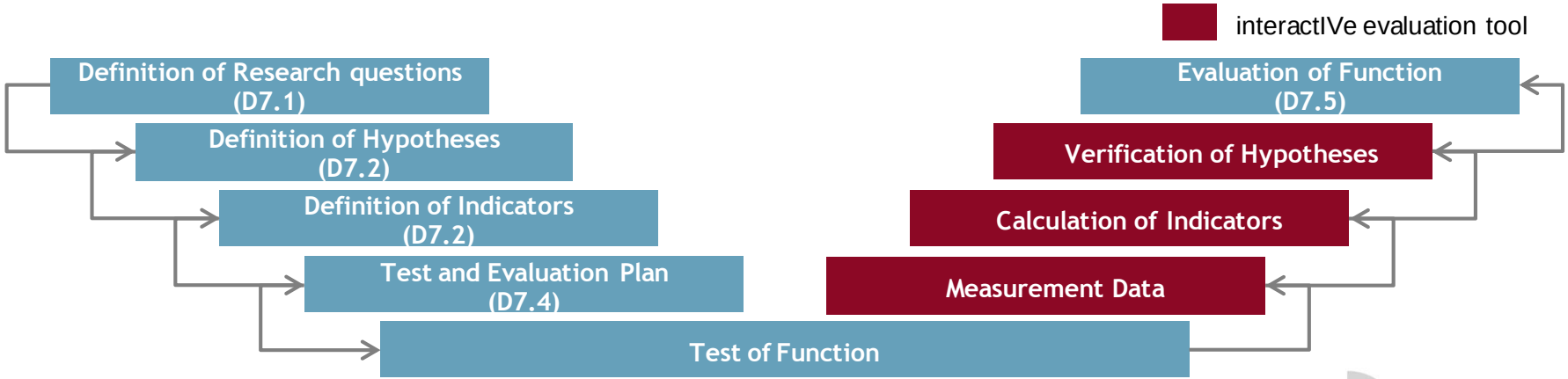
interactIVe - SP “Evaluation and legal aspects”

Role in interactIVe:

- Definition of a test and evaluation framework
- Development of test scenarios, procedures and evaluation methods
- Provision of tools (e.g. equipment, test catalogues, questionnaires or software) and test support
- Definition of test and evaluation criteria

Evaluation divided into:

- Technical assessment (on function level)
- User-related assessment
- Impact assessment
- Legal aspects

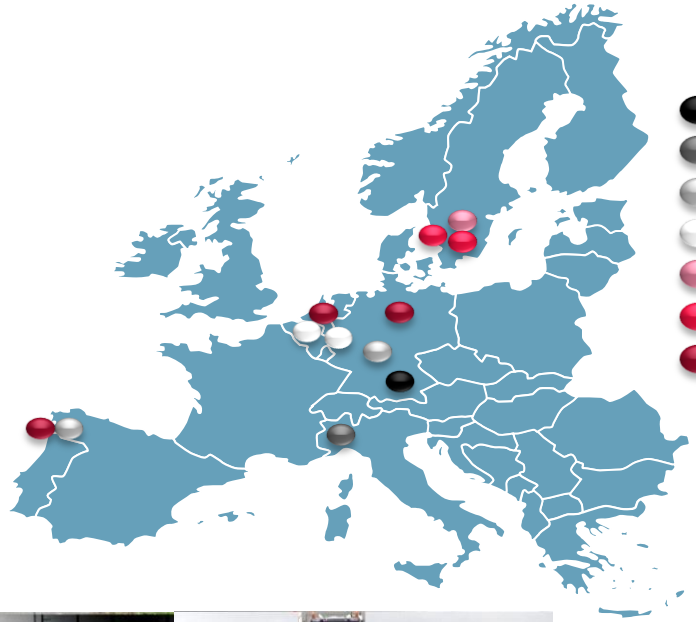


Techncial Assessment – Evaluation and Test Design

Facts

- Tested conflict types:
  - Rear-end, Head-on, Blind spot, Road Departure, Crossing Traffic, VRU, Excessive Speed, Traffic Rule Violation

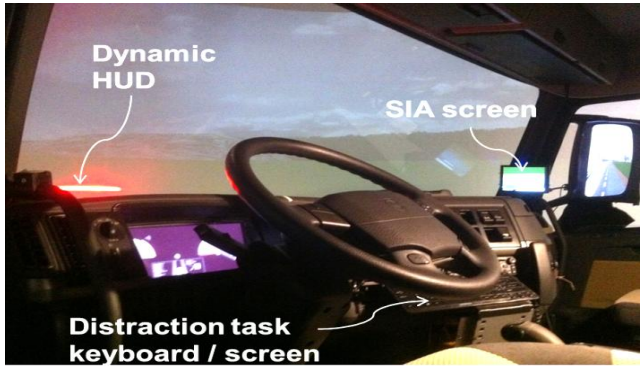
- In total over 900 test runs
- 30 general hypotheses (for all functions)
- 63 specific hypotheses



User-related Assessment – Evaluation and Test Design

- 9 studies with 263 test persons have been conducted
- Method chosen depending on the criticality of the system under investigation
  - Small field test
  - Focus group studies
  - Test on a test track
  - Driving simulator studies

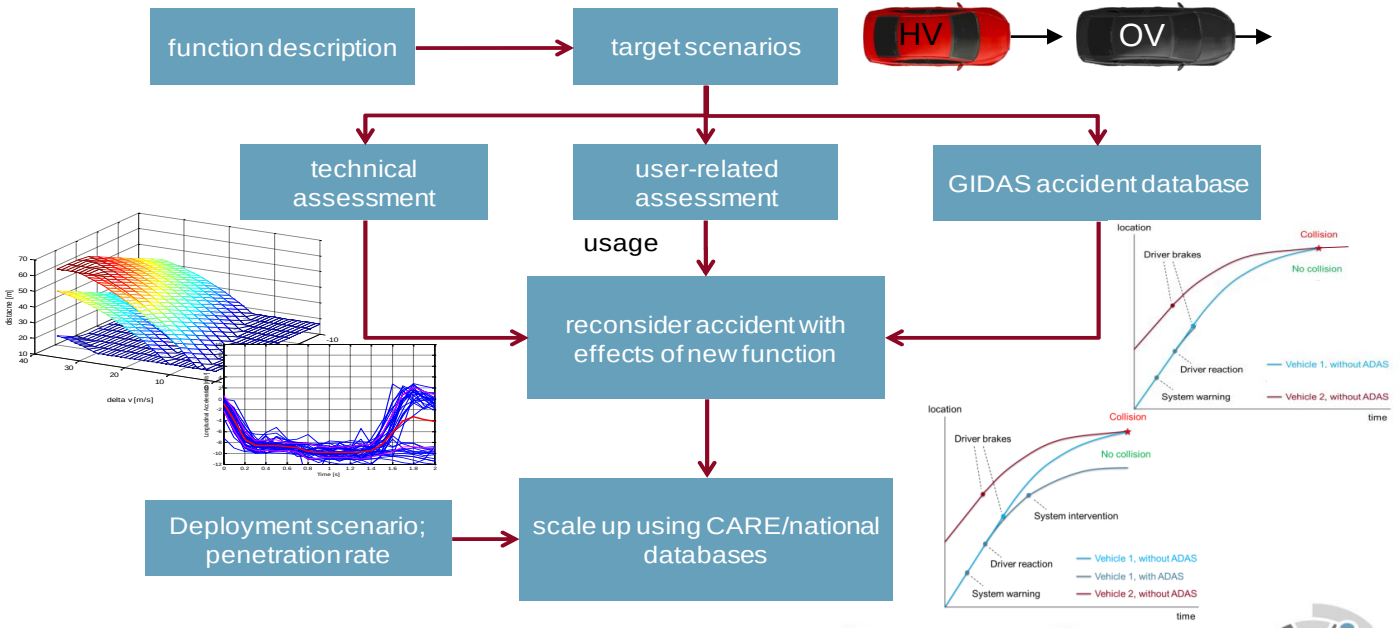
Source: Ford



Source: VTEC

Safety Impact Assessment – Methodology

- Approach for safety impact assessment
  - Safety Mechanisms (direct effects by means of accident re-simulation)

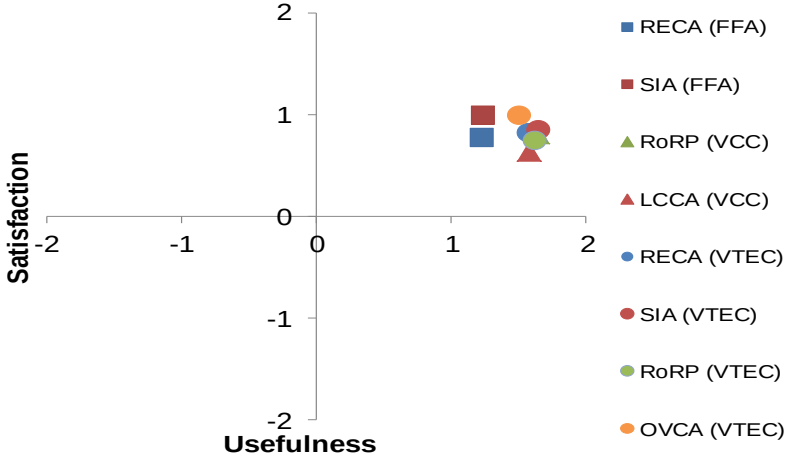


Result of interactIVe I

- Technical Assessment
  - The interactIVe functions behaved as intended and showed overall positive results
  - Differences in the maturity of the functions were observed during the analysis of the false activation behavior

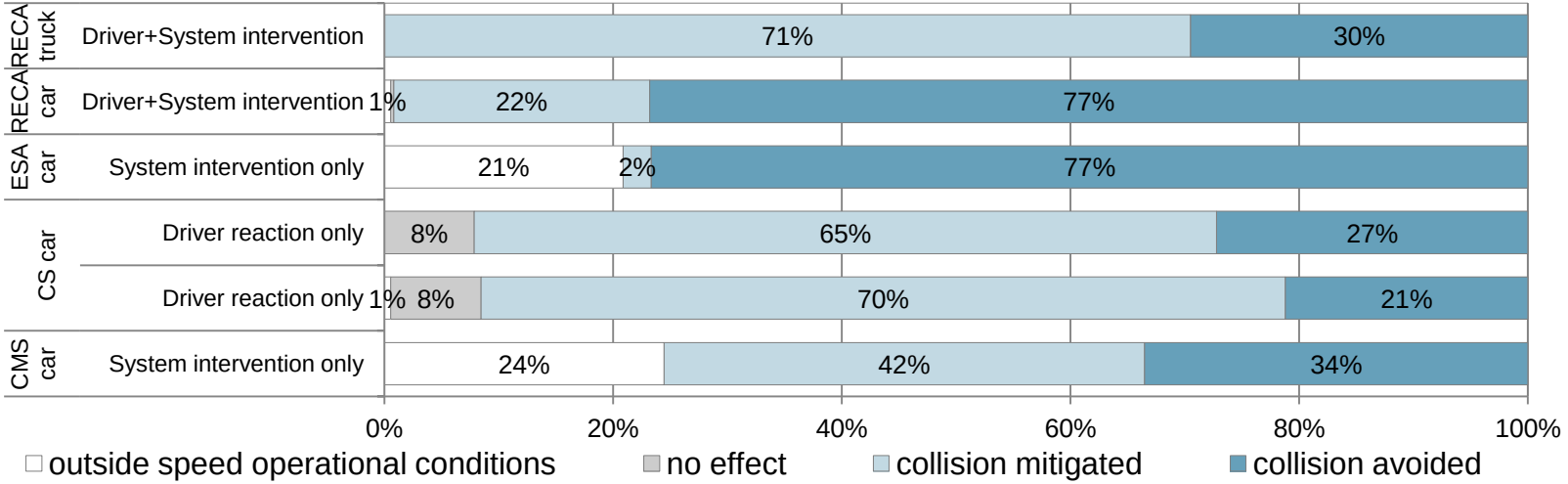
- User-related Assessment
  - In general it can be concluded that the test persons found all assessed interactIVe functions useful
  - The mean values of the test persons' willingness to pay are higher than 500 € for most of the functions
  - Tested persons are willing to pay more for functions that intervene

Acceptance – van der Laan scale



Result of interactIVe II

- Safety Impact Assessment



- 364 in-depth accident cases analysed
- Relevant for 4 functions
- Varying results: 21% - 77% rear ends *potentially* avoided, others mitigated
- This holds for selection of GIDAS scenarios

Lessons Learned I

- General:
  - The evaluation was affected by delays in the function development. This required a close cooperation between the responsible partners.
  - Trade-off between tests amount and information required for the evaluation.

- Technical Assessment
  - Results are hardly comparable and cannot be harmonized, if boundary conditions are not in the same range and show high variations.
  - Rear-end scenarios are quite well described and test tools are sufficiently available, e.g. Euro NCAP.
  - The lateral conflict test cases (blind-spot and run-off road) are difficult to perform and hardly standardized. Oncoming and crossing conflict scenarios a standardization and appropriated test tools is missing.

Lessons Learned II

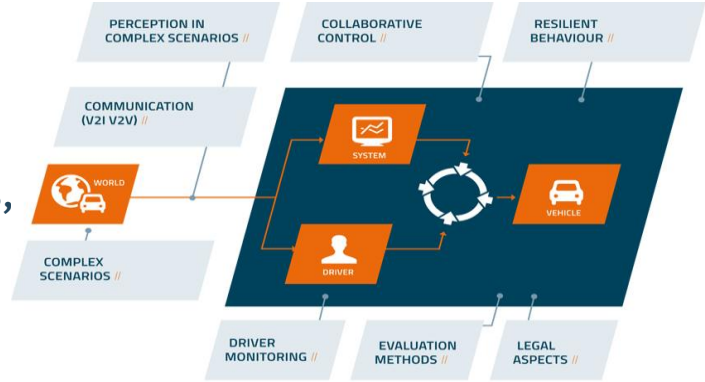
- User-related assessment:
  - The assessment was mainly affected by the restrictions on the permission to drive the test vehicles. In many cases naïve test persons were not allowed to drive the test vehicles.

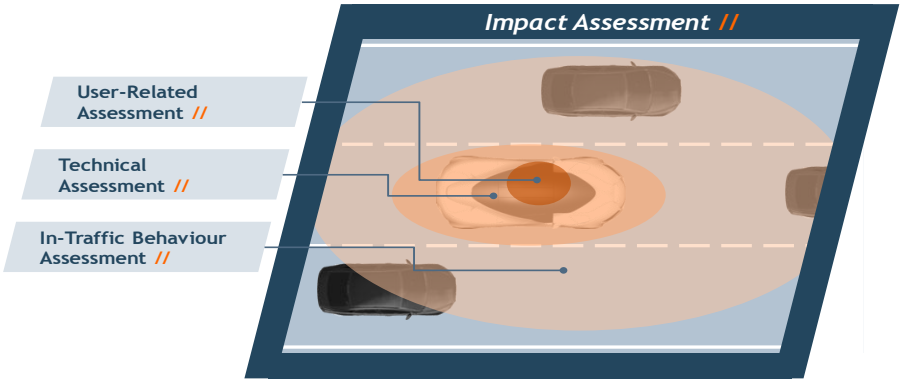
- Impact Assessment
  - The main issue for the safety impact assessment is the availability of adequate accident data, that allow a detailed reconstruction respectively re-simulation of the accident (→ lateral conflicts).

- Open Issues:
  - Investigation of long term effects for the user interaction.
  - Bundles of functions in demonstrator → interference effect in case two functions addressing the same use case (e.g. a warning and an intervening function).
  - Finally, additional research on the evaluation methodology is necessary, if the function affects not only certain scenarios but also the whole traffic as it is the case for automated driving functions.

// Evaluation of automated driving - AdaptIVe Automated Driving

- **Duration:** January 1, 2014 – June 30, 2017
- **Coordinator:** Volkswagen Group Research
- **Consortium:** 29 partners from 8 countries – France, Germany, Greece, Italy, Spain, Sweden, The Netherlands, United Kingdom; including 11 OEMs,4 suppliers, 11 research institutes and universities, and 3 SMEs
- **Research Budget:** EUR 25 million





- **SP Evaluation**
  - **Assessments:** Technical, User-related, In-traffic, Impact
  - **Lead:** ika
  - **Partners:** BAST, BMW, CTAG, CRF, Lund University, TNO

// Evaluation Approach

Classification of automated driving functions:

- **Event based operating**
  - Function that is only active for a short period in time (typically vehicle stands still at the end or the automated driving ends)
  - Examples: Parking, Minimum Risk Manoeuvres

- **Continuously operating**
  - Function that is active for a longer period in time (typically vehicle is still moving at the end of an manoeuvre respectively automated driving is continued)
  - Example: Highway Pilot

// Summary

- interactIVe project developed ADAS related to active safety
- Technical, user-related and safety impact assessment has been conducted for the interactIVe function
- Results of the assessments as well as the lessons learned have been presented
- Next step is evaluation of automated driving function, on which it will be concentrated in the project AdaptIVe

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Automated Driving Applications and Technologies for Intelligent Vehicles

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Thank you.