eVALUE –
Testing and Evaluation Methods for ICT-based Safety Systems

Gothenburg, 4 September 2008

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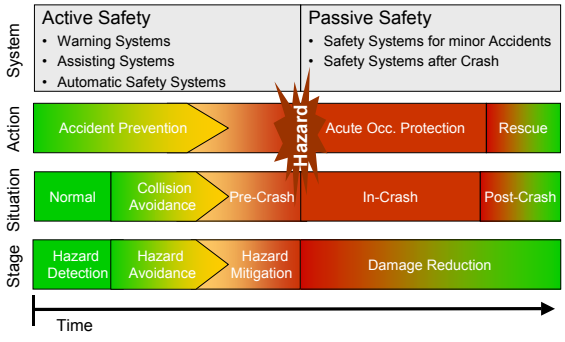
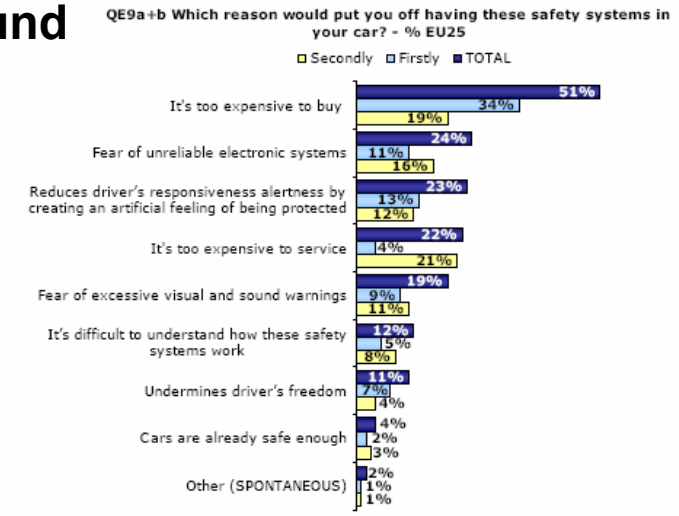


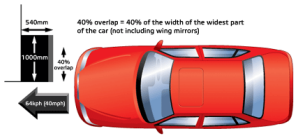
Background

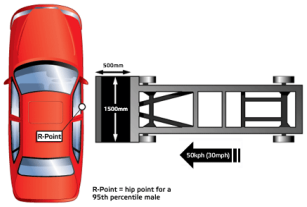


- "Use of Intelligent Systems in vehicles", Eurobarometer 267, Dec 2006

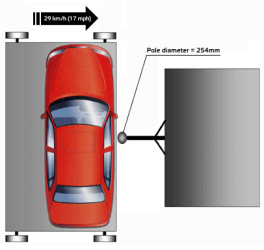
Evaluating passive safety

Frontal impact, side impact, pole impact

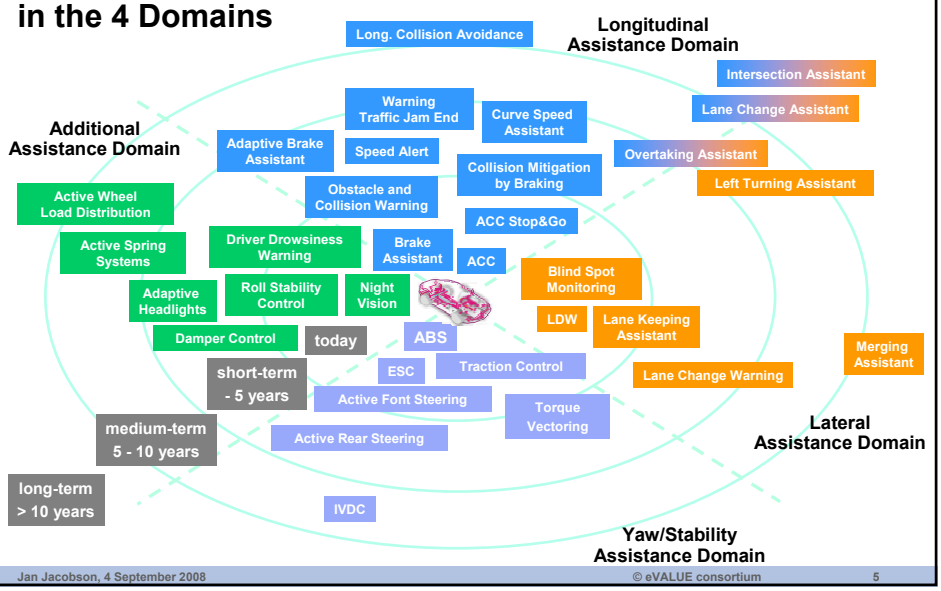




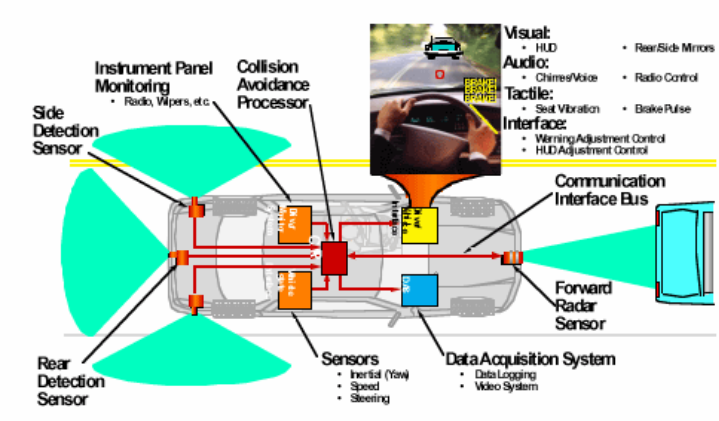
EURO NCAP



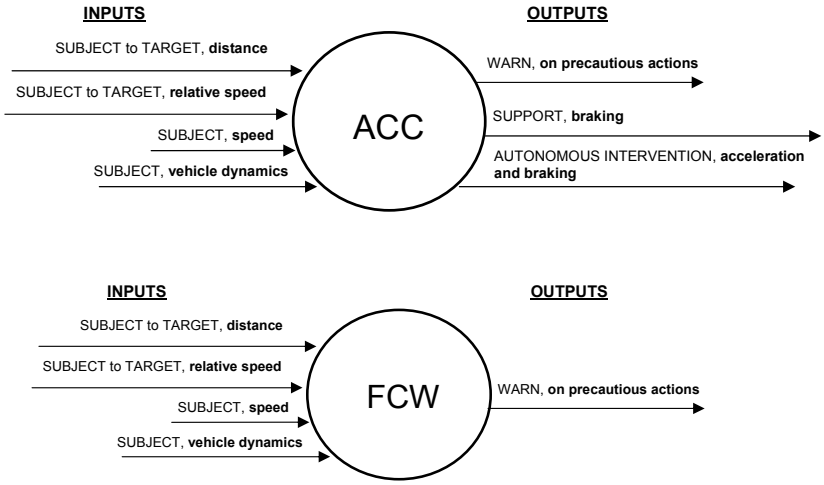
Roadmap – Time Horizon for safety relevant ICT-Systems in the 4 Domains



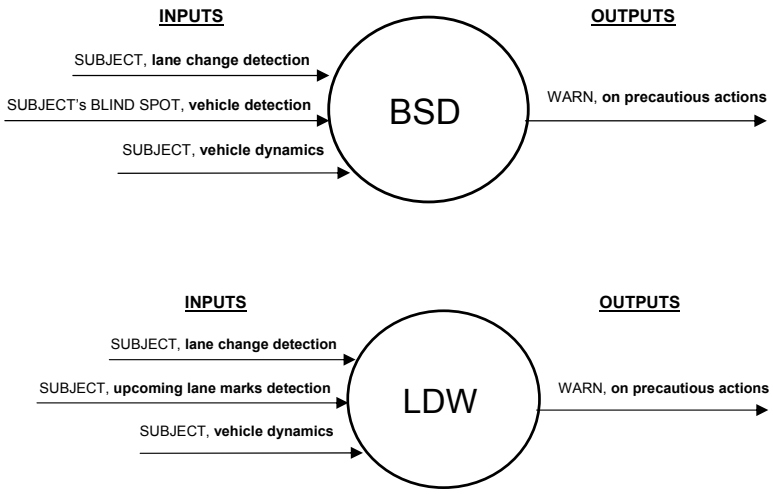
Safety Systems



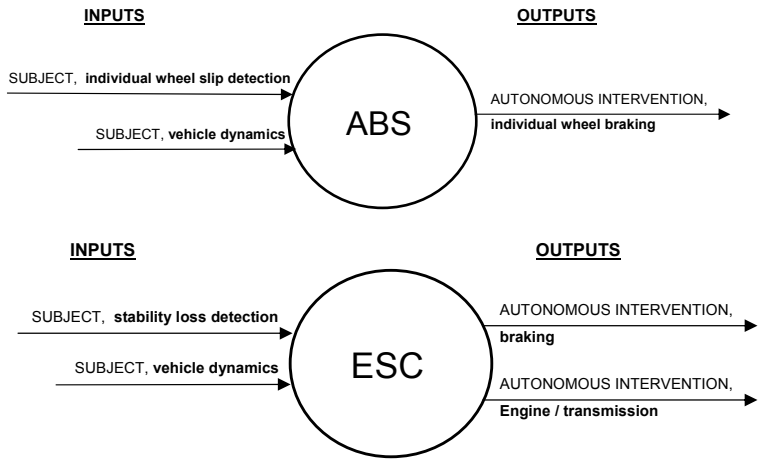
Longitudinal assistance domain



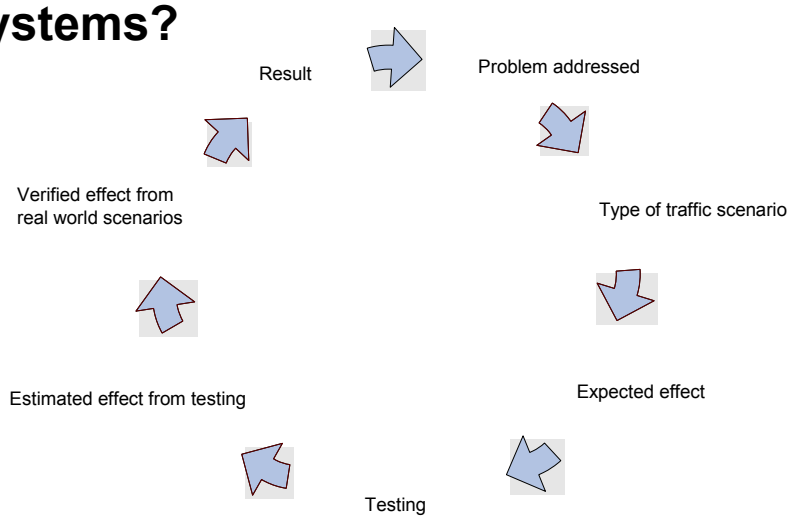
Lateral assistance domain



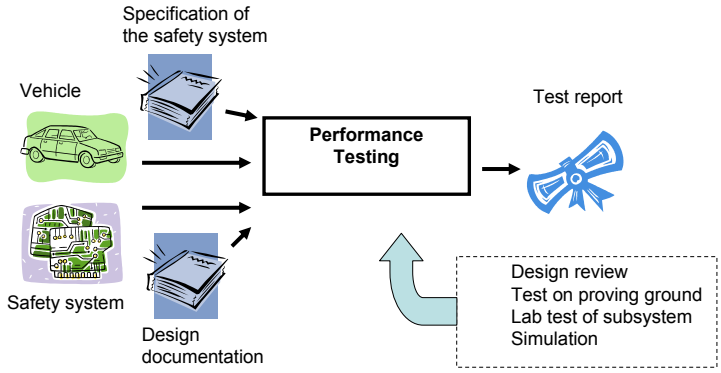
Yaw/Stability domain



How to evaluate ICT-based safety systems?

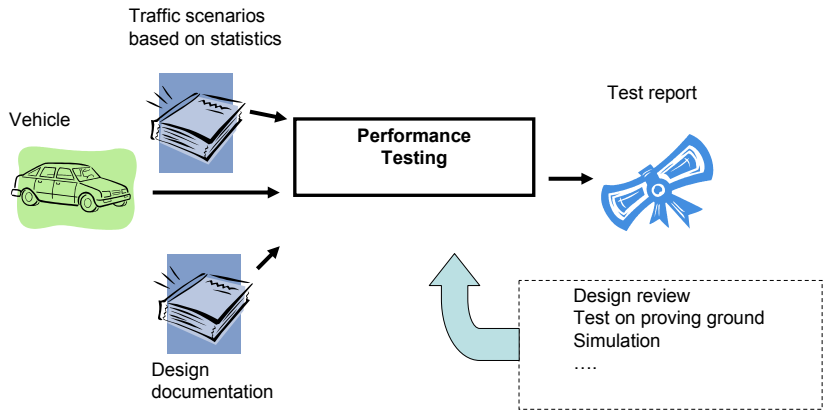


System-based performance Testing



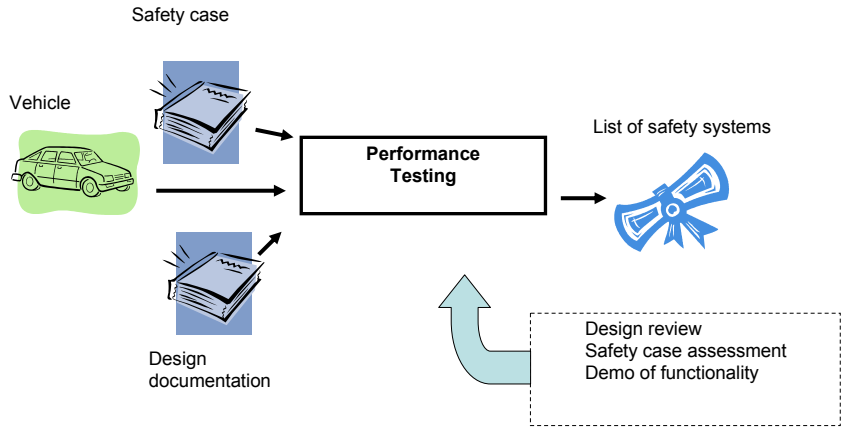
- Test cases derived from specific system capabilities and mapped to traffic scenarios
- Performance of different systems with similar functions but with different layout and technology (by clustering systems)
- As a first step, development of minimum requirements would be required

Scenario-based performance Testing



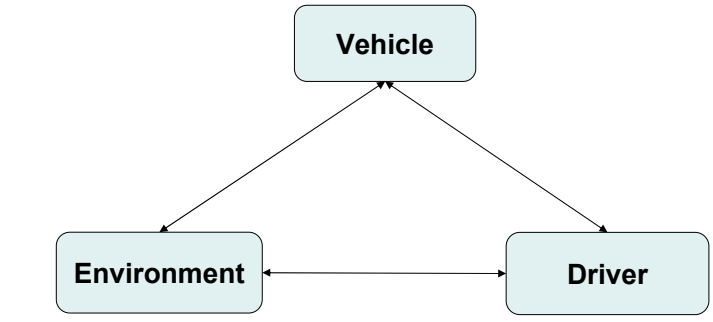
- Test cases derived from traffic scenarios
- Testing on vehicle level- with vehicle as ”black box”
- A limited amount of representative test scenarios are needed to be defined? Possible?

Document-based performance Testing



- Used as complement to physical testing
- In particular valuable for e.g.HMI testing?

A complex problem



Dry/wet road
Day/night
High/middle/low speed
High/middle/low acc.
Straight/curved road

”Normative”

Several standards available for systems

Standard/Report	ACC	FCW	BSD	LKA	LDW	ABS	ESC
ISO/DIS 22178	•						
ISO/DIS 22179	•						
SAE J2399	•						
SAE J2400		•					
SAE J2478				•			
SAE J2536						•	
FMCSA-MCRR-05-005					•		
FMCSA-MCRR-05-007	•	•					
FMVSS 126							•
GRRF-63-26							•

Several standards available for systems

Standard/Report	ACC	FCW	BSD	LKA	LDW	ABS	ESC
ISO 3888-1:1999							•
ISO 3888-2:2002							•
ISO 6597:2005						•	
ISO 7401:2003							•
ISO 7975:2006						•	
ISO 15622:2002	•						
ISO 15623:2002		•					
ISO 17361:2007					•		
ISO/DIS 17387			•	•			
ISO 21994:2007						•	

Examples of test scenarios

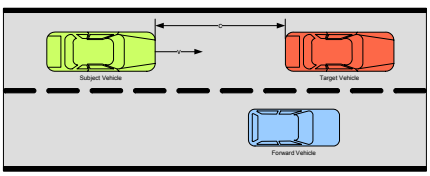
A limited number of test scenarios are needed for performance testing.

A large number of test scenarios are checked by the manufacturer.

Standard ISO 15622: Adaptive Cruise Control

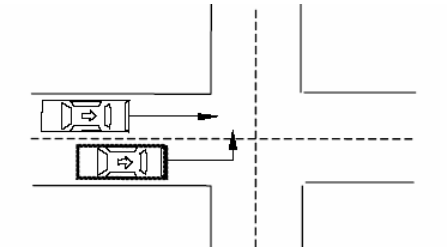
- The requirements in six categories:
- **Basic control strategy**, requirements on e.g. ACC system states and at what velocities the ACC function can be engaged.
- **Functionality**, requirements on e.g. clearance capabilities, following capability, target discrimination, and curve capability (performance classes II - IV).
- **Basic driver interface and intervention capabilities**, requirements on e.g. operation elements and system reactions, display elements, and symbols.
- **Operational limits**, requirements on e.g. minimum set speed as well as maximum deceleration and acceleration rates.
- **Activation of brake lights**, requirements on illumination of brake lights for type 2 ACC systems, i.e. systems with automatic braking.
- **Failure reactions**, requirements on how the system shall react upon the failure of a subsystem (engine, gearbox, sensor, ACC controller).

- Three performance evaluation tests:
- **Detection range test**, the goal of this test is to find out if a test target can be detected between minimum and maximum detection range.
- **Target discrimination test**, the goal of this test is to find out if the subject vehicle under ACC control can follow a target vehicle while passing an identical (to the target vehicle) forward vehicle in an adjacent lane.
- **Curve capability test**, the goal of this test is to find out if the subject vehicle can detect and decelerate when the target vehicle slows down in a constant radius curve..



IVBSS: Crash imminent test scenarios

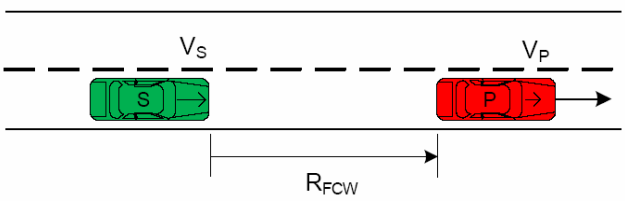
- Example: Lane change crash warning function -
  Light vehicle turns left at 20-40 mph (heavy truck turns right at 15-35 mph) and encroaches on an adjacent vehicle going straight in daylight, clear weather, on straight and level road.



IVBSS: Crash threat scenarios

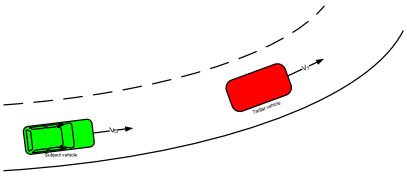
- Example: rear-end crash threat scenario.
  One of the test scenarios is intended to verify the appropriateness of an FCW when a vehicle approaches, from behind, a slower moving vehicle in the center of the same lane. In this test the vehicles are travelling at a constant speed with a speed differential between them of at least 8.9 m/s (20 mph).

P=Principle other vehicle, S=Subject vehicle,
V_S=Subject vehicle speed, V_P=Principle other vehicle speed, R_{FCW}=FCW warning range

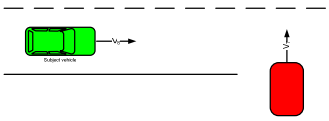


Examples of longitudinal scenarios

- Straight road

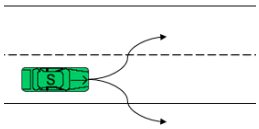


- Curved road

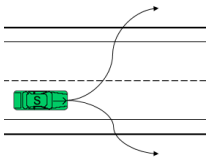


- Transversally moving target

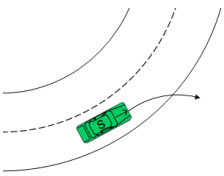
Examples of lateral scenarios



- Lane departure on a straight road

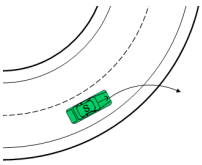


- Road departure on a straight road

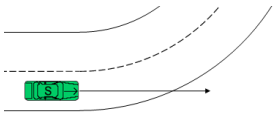


- Lane departure in a curve

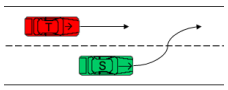
Examples of lateral scenarios



- Road departure in a curve

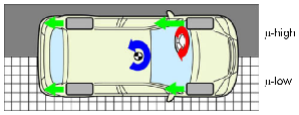


- Lane departure on a straight road just before entering an upcoming curve

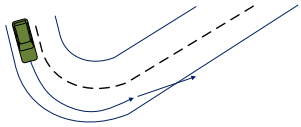


- Lane change collision avoidance in a straight road

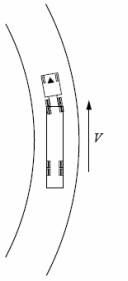
Examples of braking and stability scenarios



- Emergency braking on split μ



- Fast driving into a curve



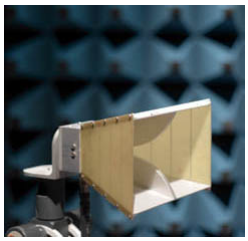
- Roll stability

Performance testing in eVALUE

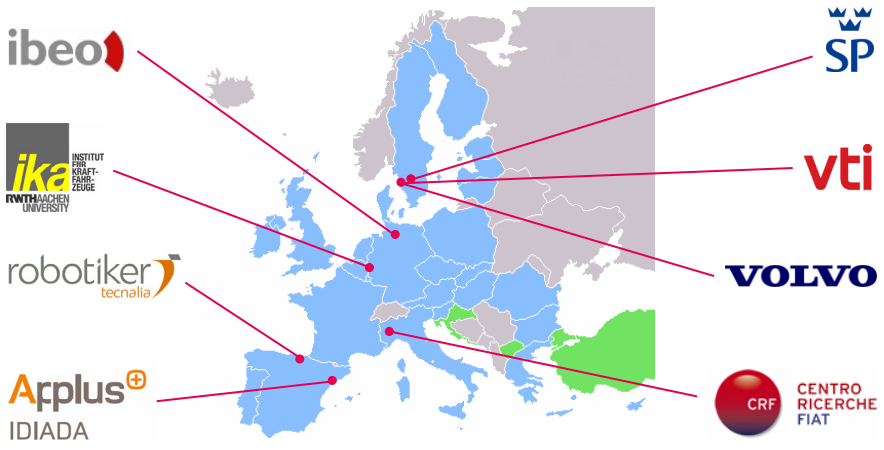
Proving ground tests

Laboratory tests

Design reviews



The eVALUE project



Overall Objectives of the Project

To develop testing and evaluation methods for ICT-based safety systems.

AND thereby

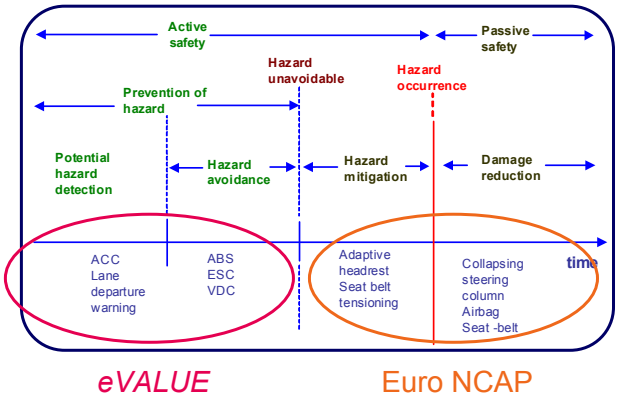
To increase public perception and customer acceptance of ICT-based safety systems.

To support development of ICT-based safety systems at vehicle OEMs and suppliers.

Project Overview

- **Budget**
  - Overall budget: 3,760,442 €
  - EC funding: 2,349,982 €
- **Duration**
  - Start: 1 January 2008
  - End: 31 December 2010
- **Consortium**
  - Coordinator: Micha Lesemann, IKA RWTH Aachen University
  - Partners: SP Sweden, VTI, VTEC, IDIADA, Tecnalia Robotiker, IBEO, CRF

Overall Objectives of eVALUE



eVALUE has a similar goal like Euro NCAP, namely the objective and easy-to-understand assessment of safety systems.

Scope of eVALUE - Chosen Systems

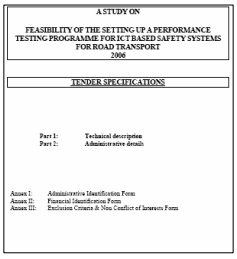
- Systems for automotive preventive safety systems, address at least one domain and available on the market with penetration rates of >50.000 vehicles
- System Cluster 1 (longitudinal assistance)
  - ACC
  - Forward Collision Warning
  - Collision Mitigation, by braking
- System Cluster 2 (lateral assistance):
  - Blind Spot Detection
  - Lane Departure Warning
  - Lane Keeping Assistant
- System Cluster 3 (yaw/stability assistance):
  - ABS
  - ESC
- System Cluster 4 (additional assistance):
  - Not defined at this stage (ICT-based systems becoming available during project duration)

Major Achievements of the Project

- **What we will do:**
  - Define objective evaluation and testing methods and performance criteria
  - Build a de-facto standard
  - Regard current and upcoming active safety systems
  - Consider system interaction and system integration
  - Physical testing, supported by simulation
  - Communication with key stakeholders like OEMs, suppliers, national authorities, customer organisations, ISO working groups etc.
  - Raise public awareness for the topic, e.g. by easy-to-understand benchmarks
- **What we will <u>not</u> do:**
  - Direct standardisation of testing
  - Direct implementation in existing vehicle test programs
  - Define fail/pass criteria for the developed test methods

Further info:
Results of the ASTE Study

- **ASTE - a feasibility study for setting up of a performance testing programme for ICT based safety systems for road transport**
- Aims of the ASTE study
  - Feasibility of setting up an independent performance and conformance testing programme for IVSS
  - Needed methods and principles for V&V of ICT-based safety systems
  - Consensus on the proposed principle
- ASTE partners:
  - Lindholmen Science Park
  - Volvo Car Corporation
  - Volvo Technology
  - SP
  - VTI Swedish National Road and Transport Research Institute


A STUDY ON

FEASIBILITY OF THE SETTING UP A PERFORMANCE TESTING PROGRAMME FOR ICT BASED SAFETY SYSTEMS FOR ROAD TRANSPORT
2006

TENDER SPECIFICATIONS

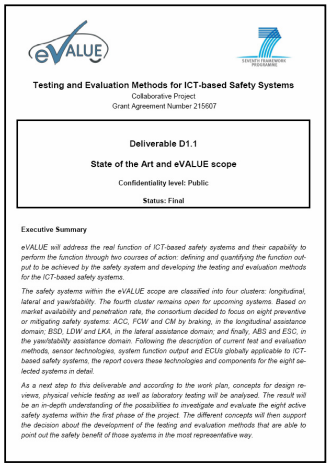
Part I: Technical description
Part 2: Administrative details

Annex I: Administrative Identification Form
Annex II: Financial Identification Form
Annex III: Exclusion Criteria & Non Conflict of Interests Form

http://ec.europa.eu/information_society/newsroom/cf/itemdetail.cfm?item_id=3782

Further information

Download the eVALUE State-of-the-art report
Register for the eVALUE Newsletter



Testing and Evaluation Methods for ICT-based Safety Systems

Collaborative Project
Grant Agreement Number 215607

Deliverable D1.1

State of the Art and eVALUE scope

Confidentiality level: Public

Status: Final

Executive Summary

eVALUE will address the real function of ICT-based safety systems and their capability to perform the function through two courses of action: defining and quantifying the function output to be achieved by the safety system and developing the testing and evaluation methods for the ICT-based safety systems.

The safety systems within the eVALUE scope are classified into four clusters: longitudinal, lateral and yawlstability. The fourth cluster remains open for upcoming systems. Based on market availability and penetration rate, the consortium decided to focus on eight preventive or mitigating safety systems: ACC, FCW and CM by braking, in the longitudinal assistance domain; BSD, LDW and LKA, in the lateral assistance domain; and finally, ABS and ESC, in the yawlstability assistance domain. Following the description of current test and evaluation methods, sensor technologies, system function output and ECUs globally applicable to ICT-based safety systems, the report covers these technologies and components for the eight selected systems in detail.

As a next step to this deliverable and according to the work plan, concepts for design reviews, physical vehicle testing as well as laboratory testing will be analysed. The result will be an in-depth understanding of the possibilities to investigate and evaluate the eight active safety systems within the first phase of the project. The different concepts will then support the decision about the development of the testing and evaluation methods that are able to point out the safety benefit of those systems in the most representative way.

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Visit the IVBSS web
Look for ISO standards

www.evalue-project.eu