EARPA Active Safety Workshop

eVALUE – A Test Programme for Active Safety

Aachen, 4 October 2010

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Agenda

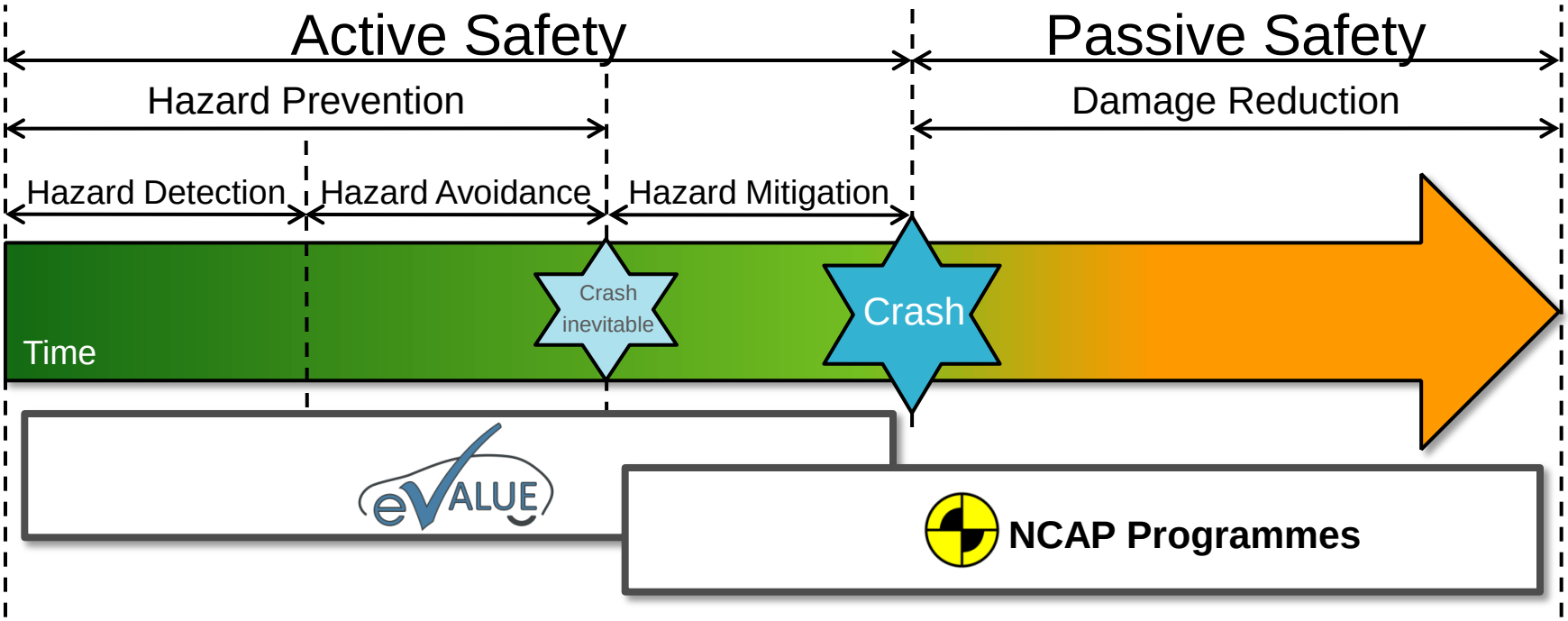
- Project Overview
  - Introduction
  - Motivation
  - Approach
- Testing Protocols
  - Details
  - Validation Efforts
- Summary & Outlook

Project Overview
Introduction

- Active safety is a key measure when it comes to decreasing traffic accidents, injuries and deaths.
- Advanced driver assistance systems are massively introduced into new vehicles, and many of them also contribute with active safety functionality.
- However, and in opposition to passive safety, the car buyer cannot judge the performance of a vehicle's active safety based on objective measures.
- Every vehicle OEM is promoting active safety, but mainly on system functionality rather than on safety impact.

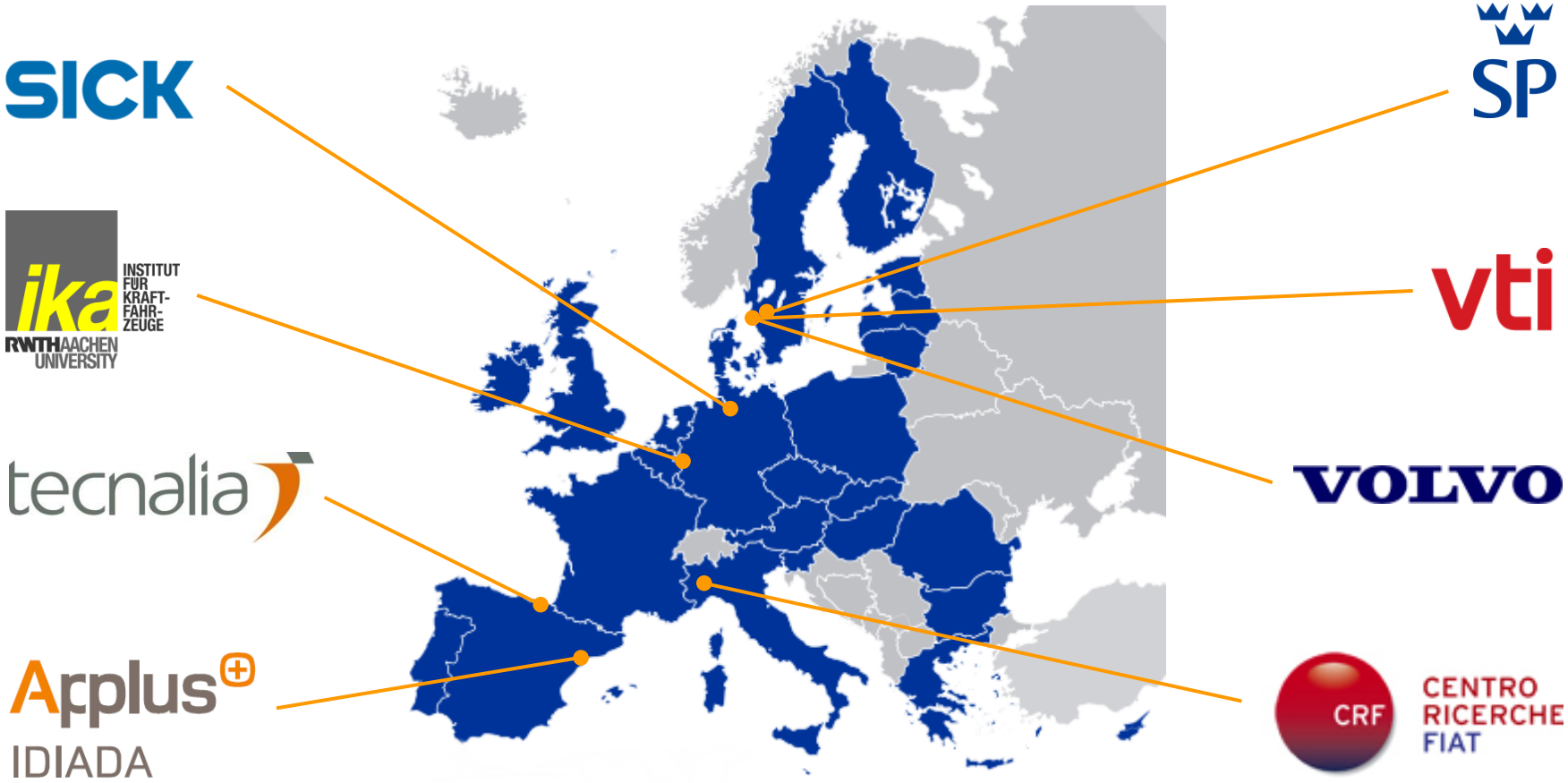
Need for objective test methods for active safety!

Project Overview
Motivation

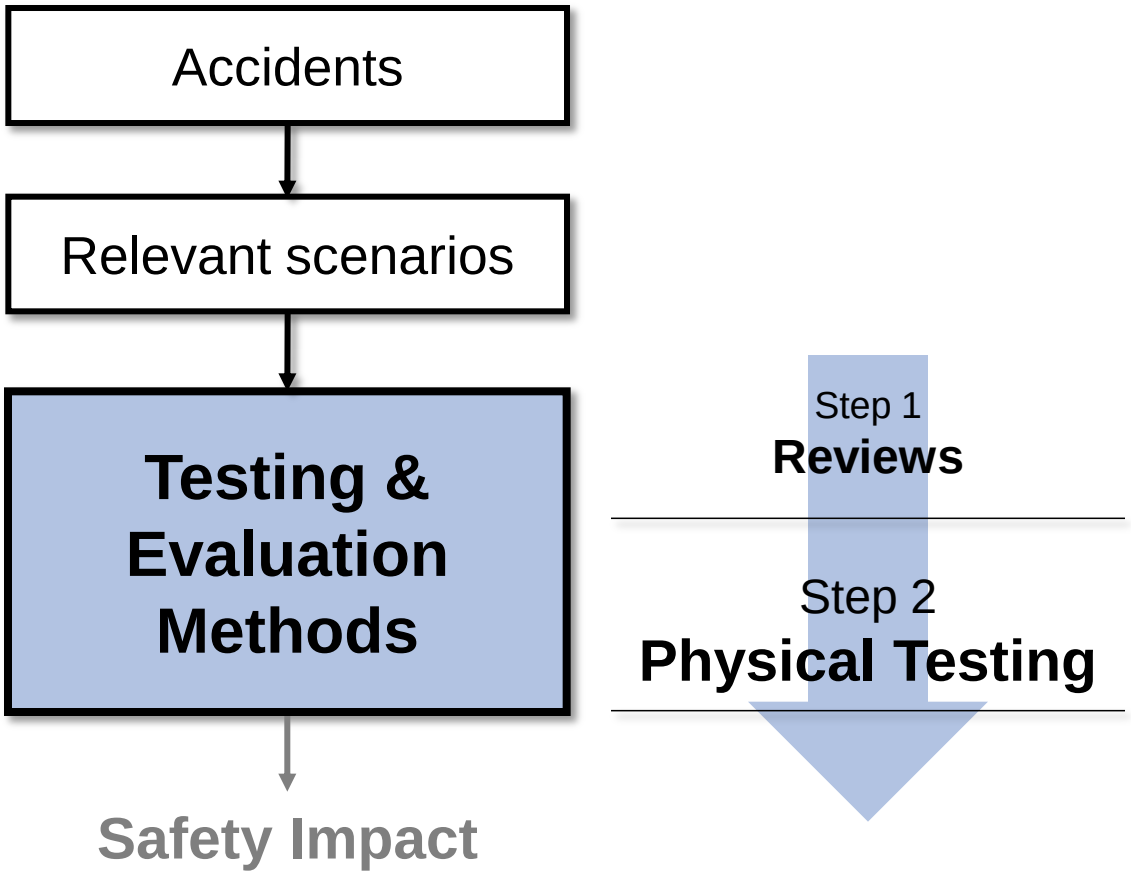


Active safety performance on full vehicle rather than on system level.

Introduction
Partners



Approach



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- **Testing Protocols**
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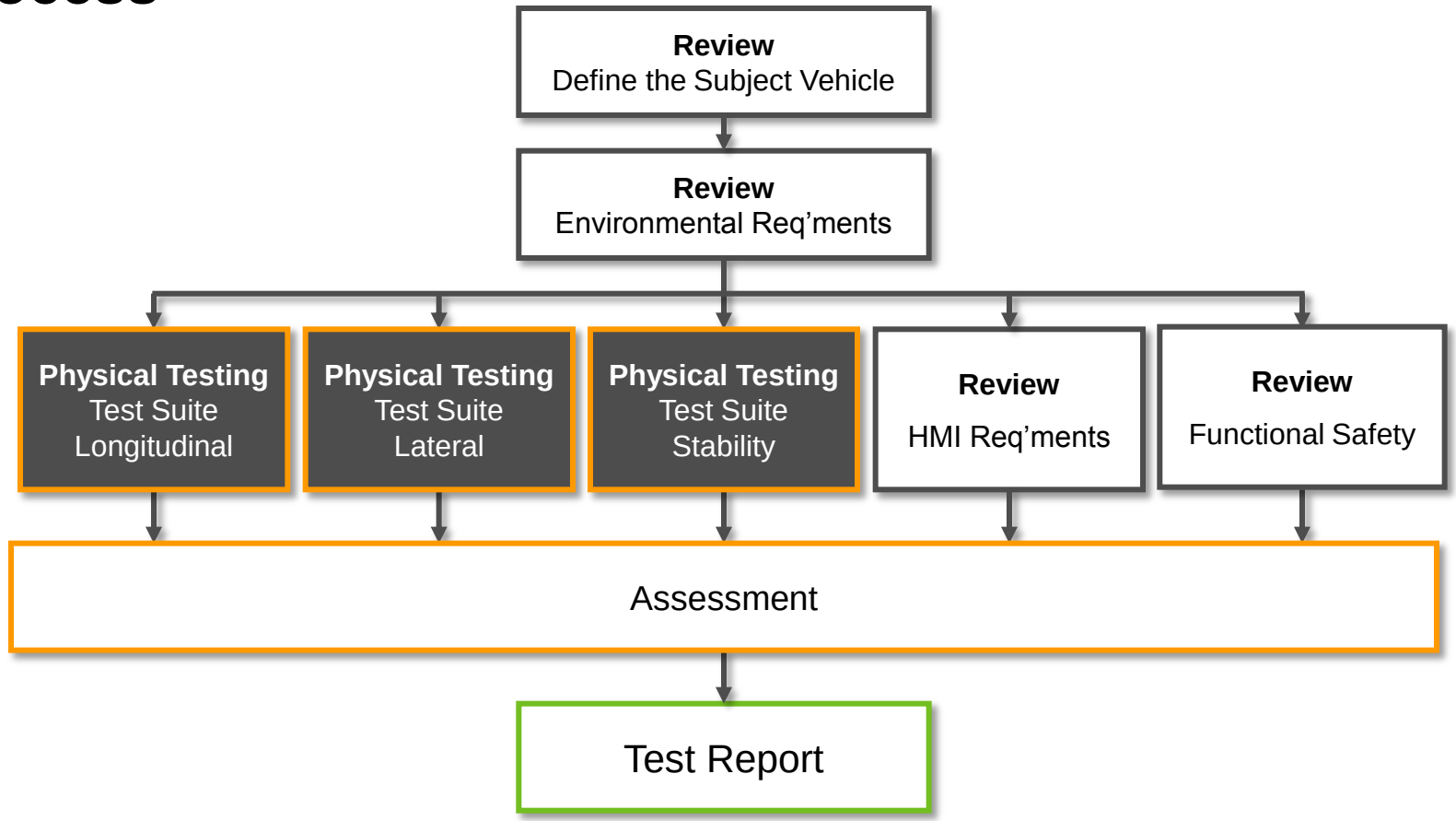
Testing Protocols
Details

- The eVALUE test methodology consists of two measures:
  - Reviews of the considered vehicle
  - Physical testing based on relevant scenarios
- Since the beginning of the project, draft review and testing protocols have been developed.
- Both are currently under validation.

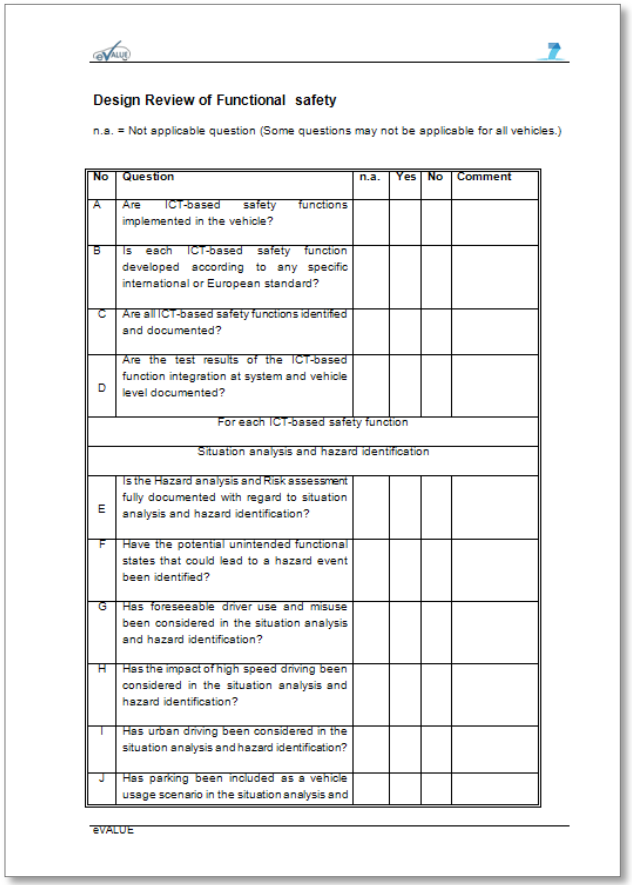
Testing Protocols Process



eVALUE does not define fail or pass criteria!

Testing Protocols
Reviews

- A review is based on simple questions and basic data.
- It may require information provided by the OEM, but is mainly based on the vehicle itself and its standard documentation.
- Requirements or limitations as stated in the vehicle documentation will be taken into account as input for physical testing.
- HMI and functional safety assessment will be based on reviews only.



Design Review of Functional safety

n.a. = Not applicable question (Some questions may not be applicable for all vehicles.)

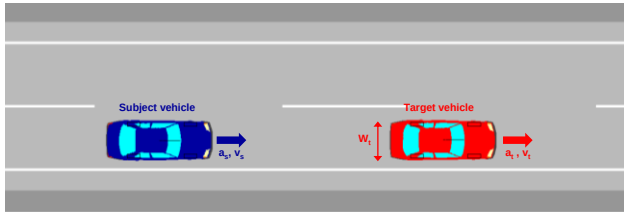
No	Question	n.a.	Yes	No	Comment
A	Are ICT-based safety functions implemented in the vehicle?				
B	Is each ICT-based safety function developed according to any specific international or European standard?				
C	Are all ICT-based safety functions identified and documented?				
D	Are the test results of the ICT-based function integration at system and vehicle level documented?				
	For each ICT-based safety function				
	Situation analysis and hazard identification				
E	Is the Hazard analysis and Risk assessment fully documented with regard to situation analysis and hazard identification?				
F	Have the potential unintended functional states that could lead to a hazard event been identified?				
G	Has foreseeable driver use and misuse been considered in the situation analysis and hazard identification?				
H	Has the impact of high speed driving been considered in the situation analysis and hazard identification?				
I	Has urban driving been considered in the situation analysis and hazard identification?				
J	Has parking been included as a vehicle usage scenario in the situation analysis and				

eVALUE

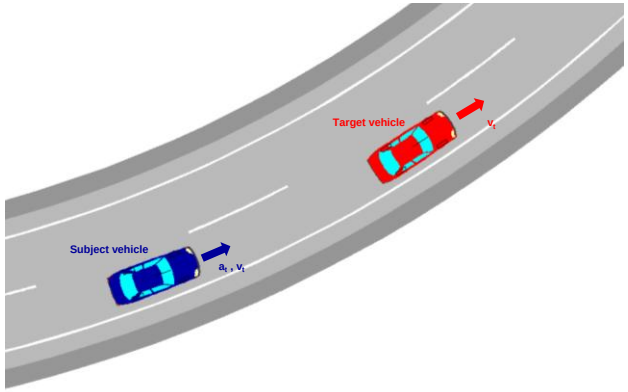
Testing Protocols
Physical Testing

- The protocols for physical testing are based on relevant traffic scenarios, which have been analysed in the beginning of the project.
- They are separated in three clusters that represent different functionality: longitudinal, lateral and stability.
- Each protocol follows a standardised format and contains instructions for:
  - Test principle
  - Objectives
  - Drivers
  - Equipment
  - Environment
  - Required input
  - Vehicle preparation
  - Test procedure
  - Data processing
  - Uncertainties
  - Result generation
  - etc.

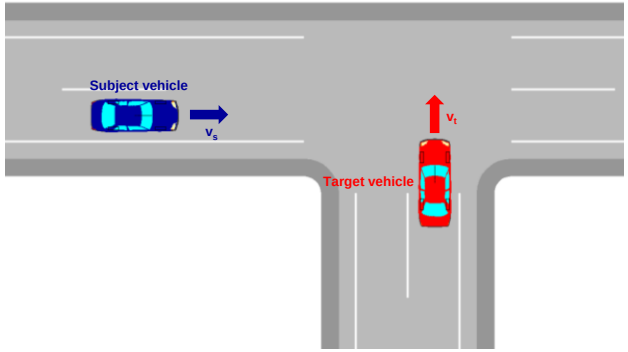
Testing Protocols
Scenarios for Longitudinal Functionality



Straight road

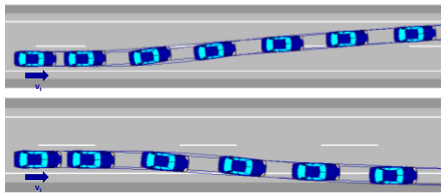


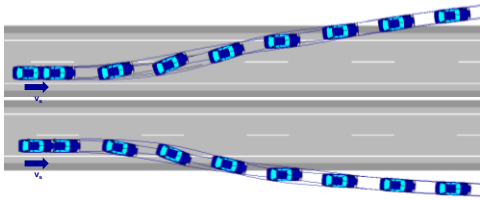
Curved road



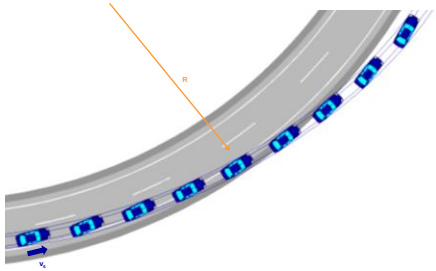
Transversally moving target

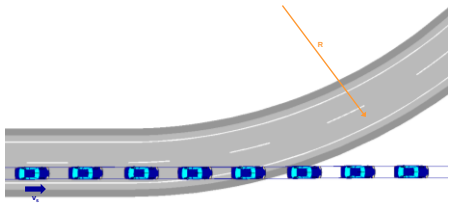
Testing Protocols
Scenarios for Lateral Functionality



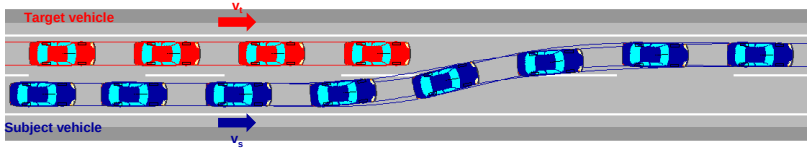


Lane and road departure on a straight road



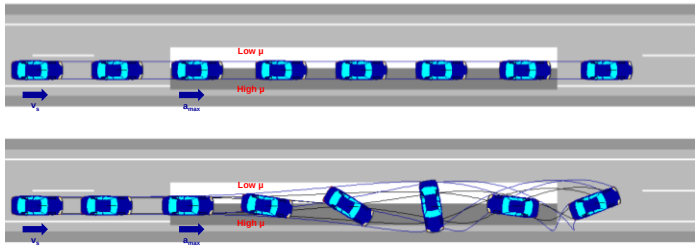


Lane and road departure on curve / on a straight road just before a curve

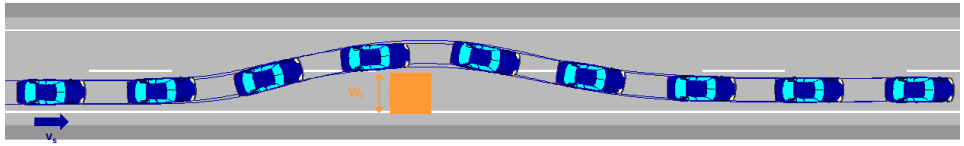


Lane change collision

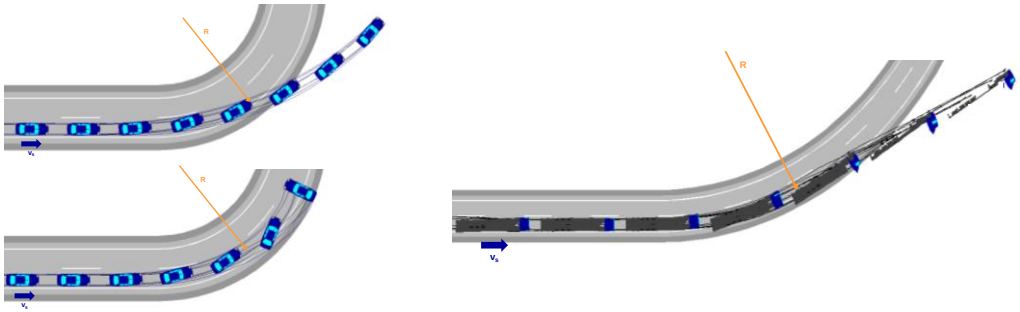
Testing Protocols
Scenarios for Stability Functionality



Emergency breaking on μ-split



Driver collision avoidance



Fast driving into a curve / roll stability

Testing Protocols
Intended Safety Indicators

Longitudinal Functionality

- Collision Speed
- Time of Warning or Intervention

Lateral Functionality

- Collision Speed
- Lane Keeping Performance

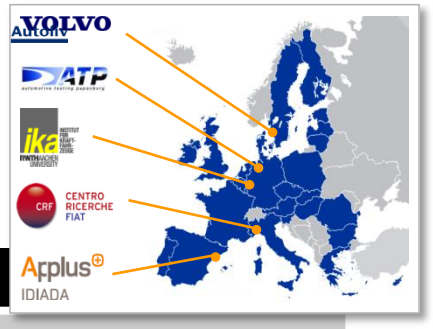
Stability Functionality

- Performance of the Vehicle
- Level of Driver Input Required
- Driver Intention Following
- Stability

Testing Protocols Under Review

- Eight testing protocols are currently under internal and external review:
  - Avoidance of rear end collision (open loop)
  - Avoidance of collision with transversally moving target (open loop)
  - Avoidance of lane departure
  - Avoidance of lane change collision on a straight road
  - Emergency braking on a μ-split (open loop)
  - Emergency braking on a μ-split (closed loop)
  - Obstacle avoidance (sine with dwell)
  - Fast driving into a curve (highway exit)
- All feedback on the circulated drafts will be taken into account when compiling the final testing protocol versions.

Testing Protocols
Validation Efforts



Partner	Test location	Duration	Test runs	Scenarios tested
VTI/SP/VTEC	Hällered Vårgårda Gothenburg Stora Holm	10 days	500	FCW static target/moving target/intersection LDW (open loop) Lane change collision Highway exit (open loop)
VTEC	Hällered	4 days	200	LDW (open loop)
IDIADA/Tecnalia	L'Albornar	10 days	60	LDW (open, closed loop)
CRF	Balocco	15 days	500	Mu-split braking (open, closed loop)
IDIADA/VTEC	L'Albornar	10 days	40	Lane change collision
IDIADA	L'Albornar	15 days	350	Mu-split braking (open, closed loop) Collision avoidance stability Highway exit (open loop)
IKA/SICK	Aachen	2 days	50	FCW static target/moving target
VTI	Papenburg	5 days	100	Mu-split braking (open loop) Highway exit (open loop)
Sum		**71 days**	**1,800**	

Testing Protocols
Validation Efforts – Examples

IDIADA and Tecnalia tested at IDIADA

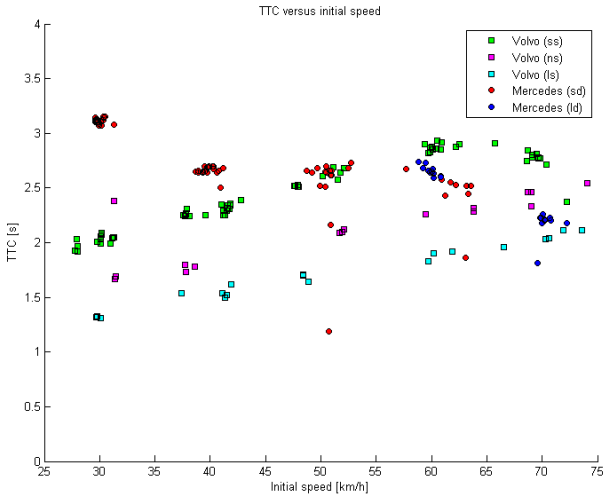
Volvo XC60
- LDW
- steering robot (closed loop)

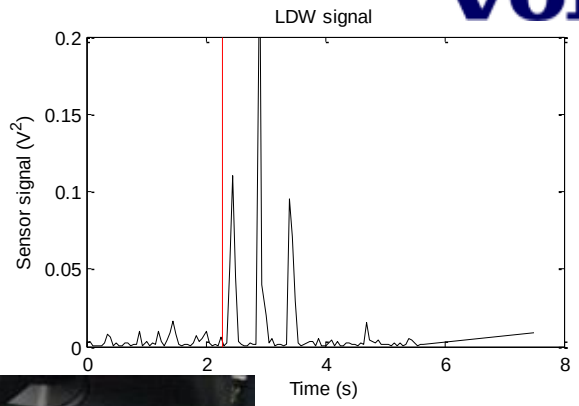
CLUSTER 2 – Scenarios 1 – 6a, closed loop

Test case	Subject vehicle velocity (kph)	Lane drift direction	Lateral velocity (sharp/flat lane drift)	Driving robot implementation		Curvature	repetitions	comments
				Open loop: Path following control	Closed loop: Steering angle control			
1	70	Right	0,1 - 0,3 updated to 0.6 – 0.8 m/s ("Flat")	X		Straight	5	Line detected
2	70	Left	0,6 - 0,8 updated to 1,4 – 1,6 m/s ("Sharp")	X		Straight	5	Line detected
3	90	Right	0,6 - 0,8 updated to 1,4 – 1,6 m/s ("Sharp")	X		Straight	5	Line detected
4	60 updated to 70	Left	0,1 - 0,3 updated to 0.6 – 0.8 m/s ("Flat")	X		Straight	5	Line detected
9	70	"Swaying driving inside the file" (False alarm)[1]	Technical approach definition: "slalom" inside the lane , max lateral acceleration 0,6 m/s²	X		Straight	5	Correct response

Testing Protocols
Validation Efforts – Examples

VTI, SP and VTEC tested in Sweden

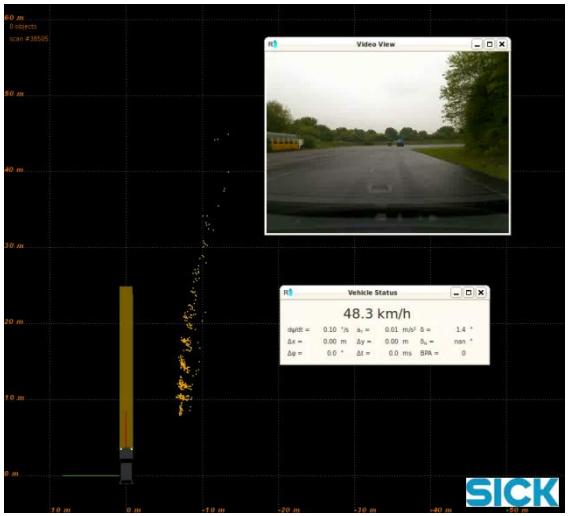


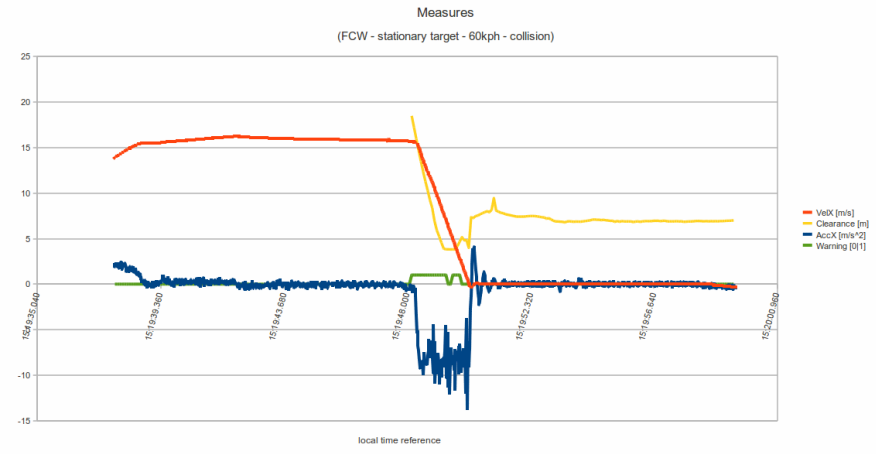


Testing Protocols
Validation Efforts – Examples

IKA and SICK tested in Aachen

- Rear-end collision with decelerating, slower and static target on straight and curved road
- 2 testing days
  - 5 runs / velocity
  - 30-80 km/h





Next Steps

- Validation of the draft test protocols remains the main task until the close of the project.
- This concerns to a very large extent extended physical testing as input for the improvement and sharpening of test methods.
- The eligibility and quality of the intended safety indicators is further elaborated.
- The current status of the project is discussed with those who might be concerned: OEMs, suppliers, authorities etc.

- The final demonstration event will take place on 24-25 November 2010 here at IDIADA's proving ground.

Summary

- Objective test methods for active safety performance are highly needed and currently under development by different stakeholders.
- The eVALUE project presents a broad approach for the assessment of vehicles based on traffic scenarios and derived test methods.
- Major efforts need to be invested into every single test procedure in order to reach acceptance by all involved stakeholders. ASSESS is showing a strong approach in this direction.
- Further research is needed especially for the derivation of true safety indicators based on accident statistics.
- Discussion of the existing approaches should be open and free for all interested parties. The Support Action ActiveTest will take over this task once the eVALUE project is closed.

Outlook
ActiveTest Support Action

The ActiveTest initiative has three main objectives:

- **maintaining an active dialogue with key stakeholder groups**
- **three dedicated workshops on longitudinal, lateral and stability**
- **compiling an outlook for future research need**

It is driven by:

Lifetime: 2011-2012

Thank you for your kind attention!

www.evalue-project.eu

Contact

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