interactIVe – Accident avoidance by active intervention for Intelligent Vehicles

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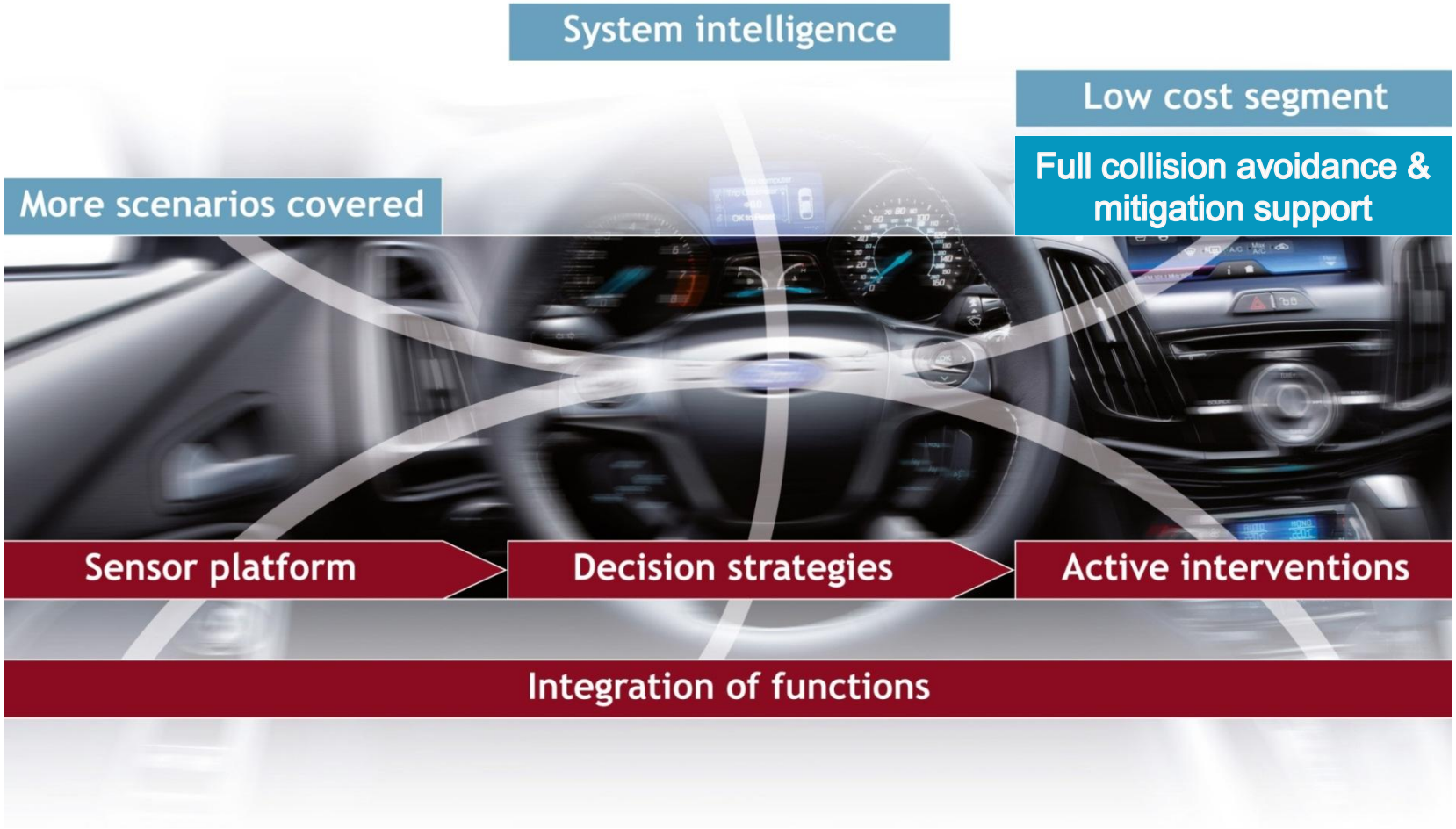
Consortium

interactIVe

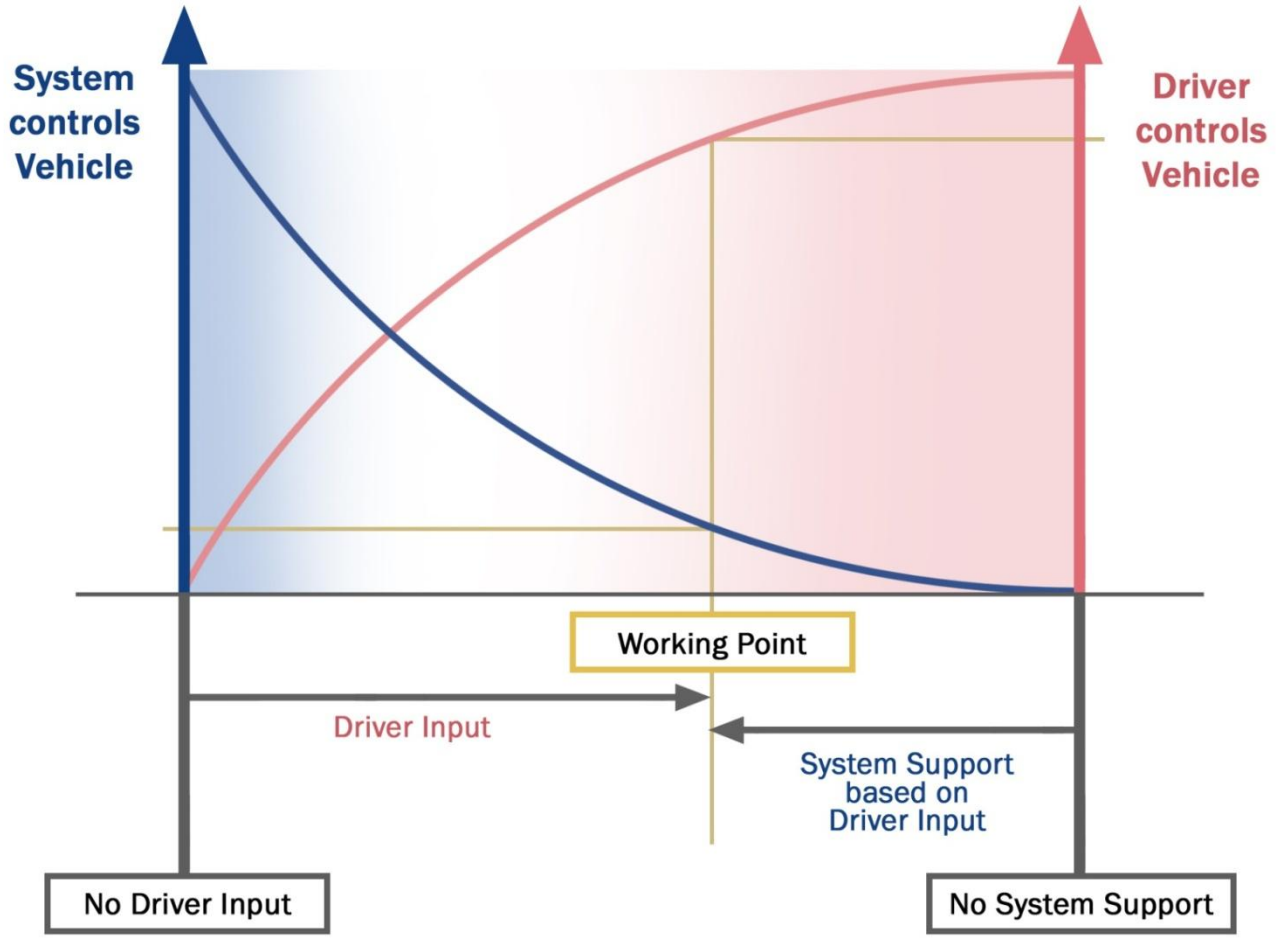
Research concept

SECONDS	INCA	EMIC
Continuous driver support	Collision avoidance support	Collision mitigation support

Objectives


System intelligence
Low cost segment
Full collision avoidance & mitigation support
More scenarios covered
Sensor platform
Decision strategies
Active interventions
Integration of functions

Support: splitting driving task between driver and vehicle



interactIVe Demonstrators – assistance for drivers

SECONDS

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

INCA

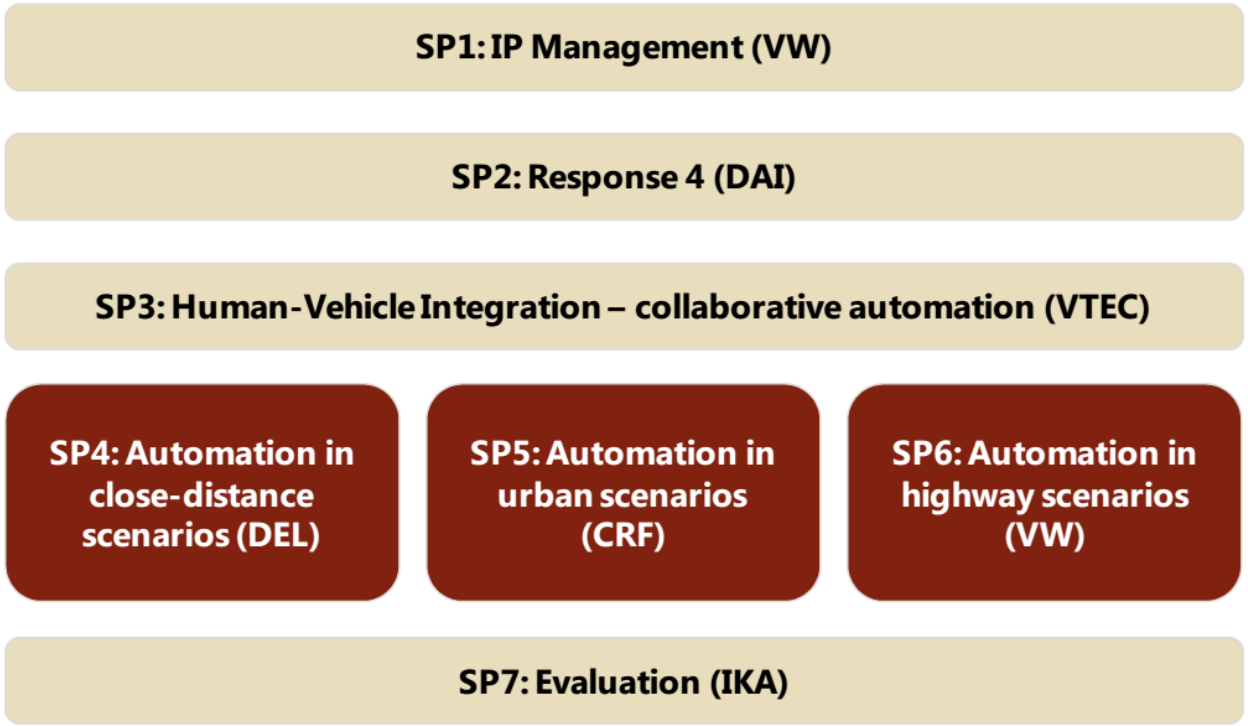
- Lane Change Collis. Avoid.
- Oncoming Vehicle Collis. Avoidance/Mitigation
- Rear End Collis. Avoidance
- Side Impact Avoidance
- Run-off Road Prevention

EMIC

- Emergency Steer Assist
- Collision Mitigation

AdaptIVe

- Automated Driving Applications & Technologies for Intelligent Vehicles
- Duration: 42 months (Start: January 2014)



interactIVe - accident avoidance by active intervention for Intelligent Vehicles

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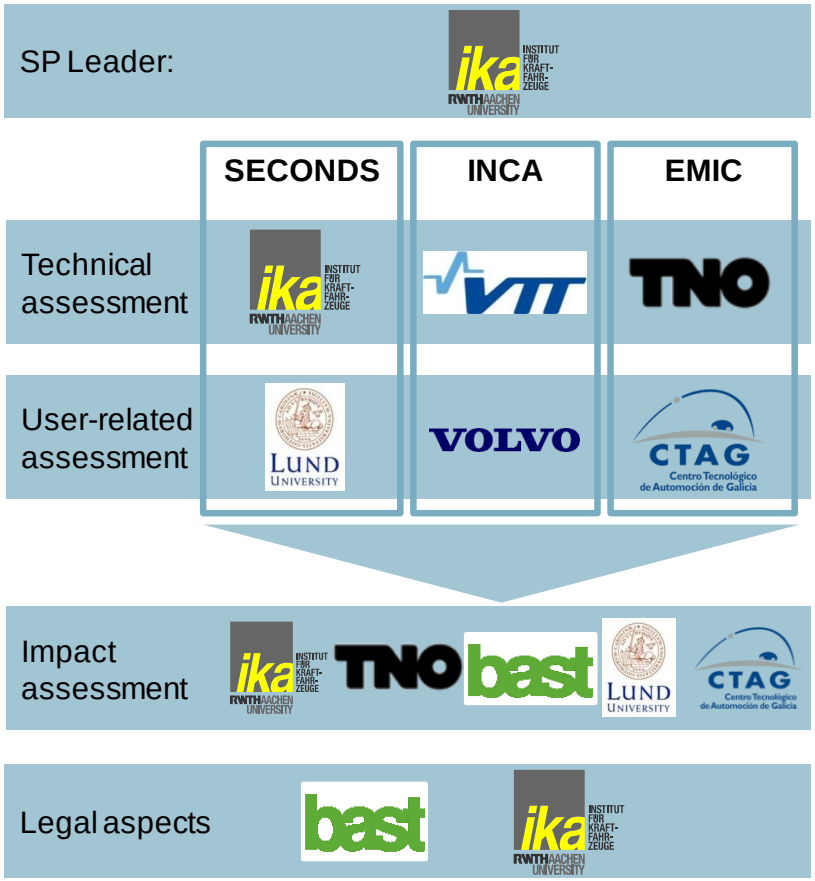
SP7 “Evaluation and legal aspects” - Overview

SP7 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
- Analysis of legal aspects

Evaluation divided into:

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

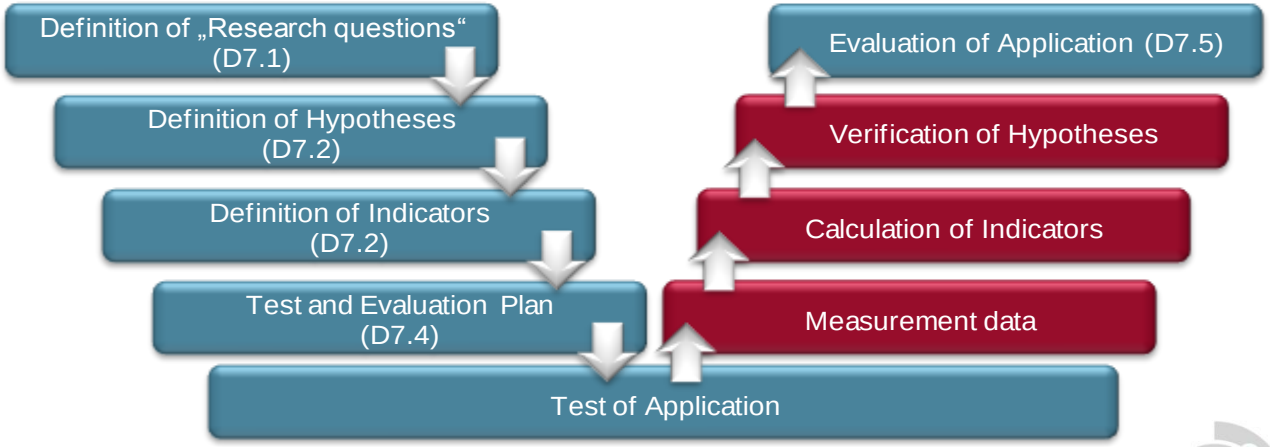


SP7 “Evaluation and legal aspects” - Methodology

Methodology for the evaluation bases mainly on the PReVAL methodology:

- Step 0: System and function description
- Step 1: Expected impact and hypotheses
- Step 2: Test scenario definition
- Step 3: Evaluation method selection
- Step 4: Measurement plan
- Step 5: Test execution and analysis

Adaptation and application of methodology in interactIVe

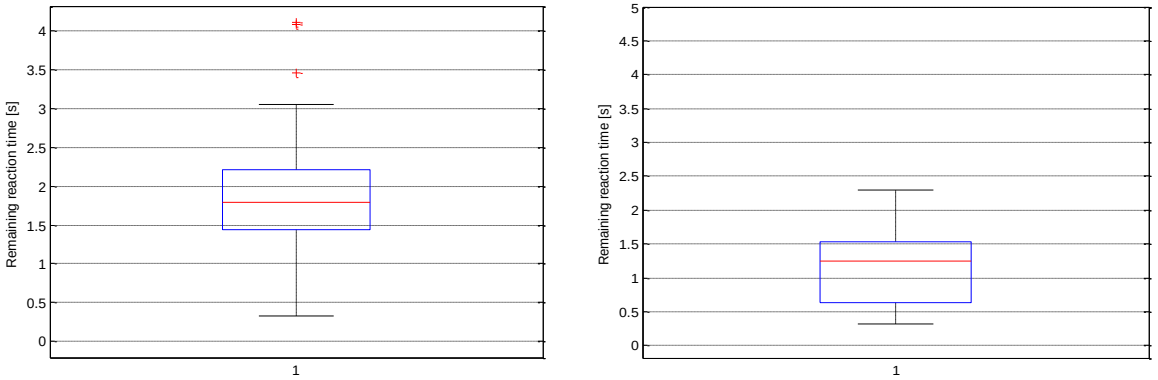


Techncial Assessment – Example Results

- Overall 908 test runs considering 8 accident related test scenarios (e.g. rear-end, blind-spot or run-off road conflicts) were evaluate to analyse the defined hypotheses

- In general the interactIVe functions behave in the intended way

- **Example:**
  Hyp_T_gen_TecU_01: The driver has enough time to react and avoid the accident, when the warning is issued



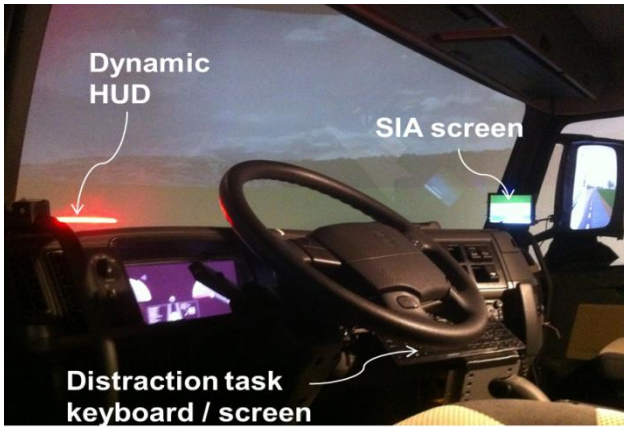
- The remaining reaction time is (TTC @ warning - $t_{Manoeuvre}$) compared to the presumed reaction time
  →Hypothesis is confirmed at significance level of 5 % at a reaction time of $t_{Reaction}$ = 1.2 s in the example on the left
  →Hypothesis is confirmed at significance level of 5 % at a reaction time of $t_{Reaction}$ = 1.0 s in the example on the right

User-related Assessment – Results

- For the user-related assessment 9 studies with 263 test person have been conducted

- Method chosen depending on the criticality of the system under investigation
  - Small field test
  - Focus group studies
  - Tests on a test track
  - Driving simulator studies

Source: Ford

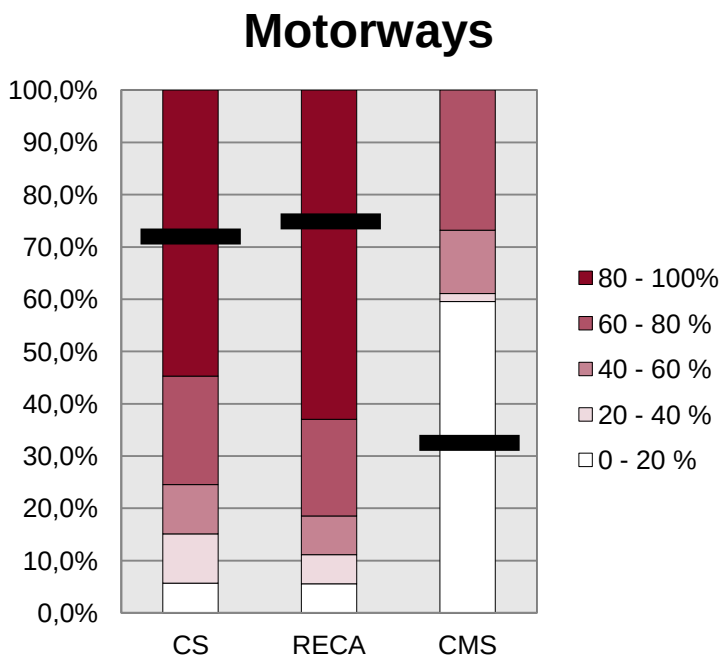


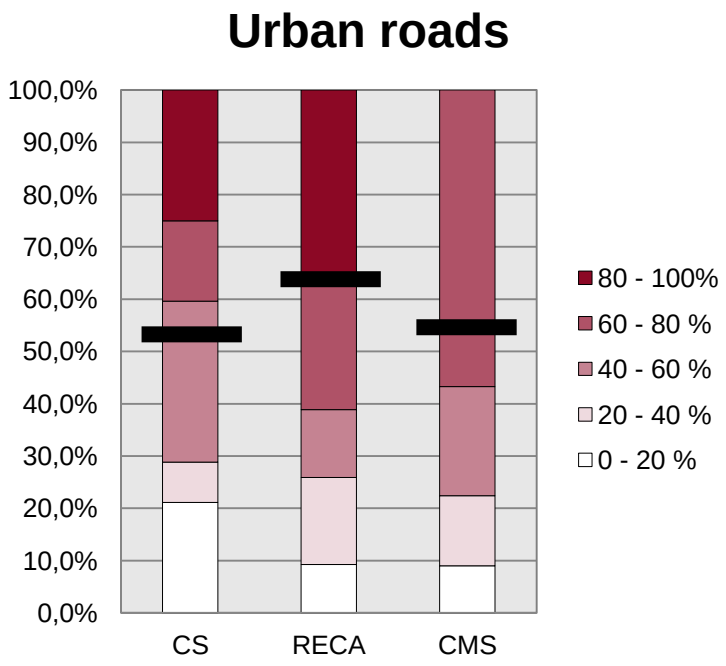
Source: VTEC

User-related Assessment – Example Results

- Intended usage of the functions

CS: Continuous Support
RECA: Rear-end Collision Avoidance
CMS: Collision Mitigation System



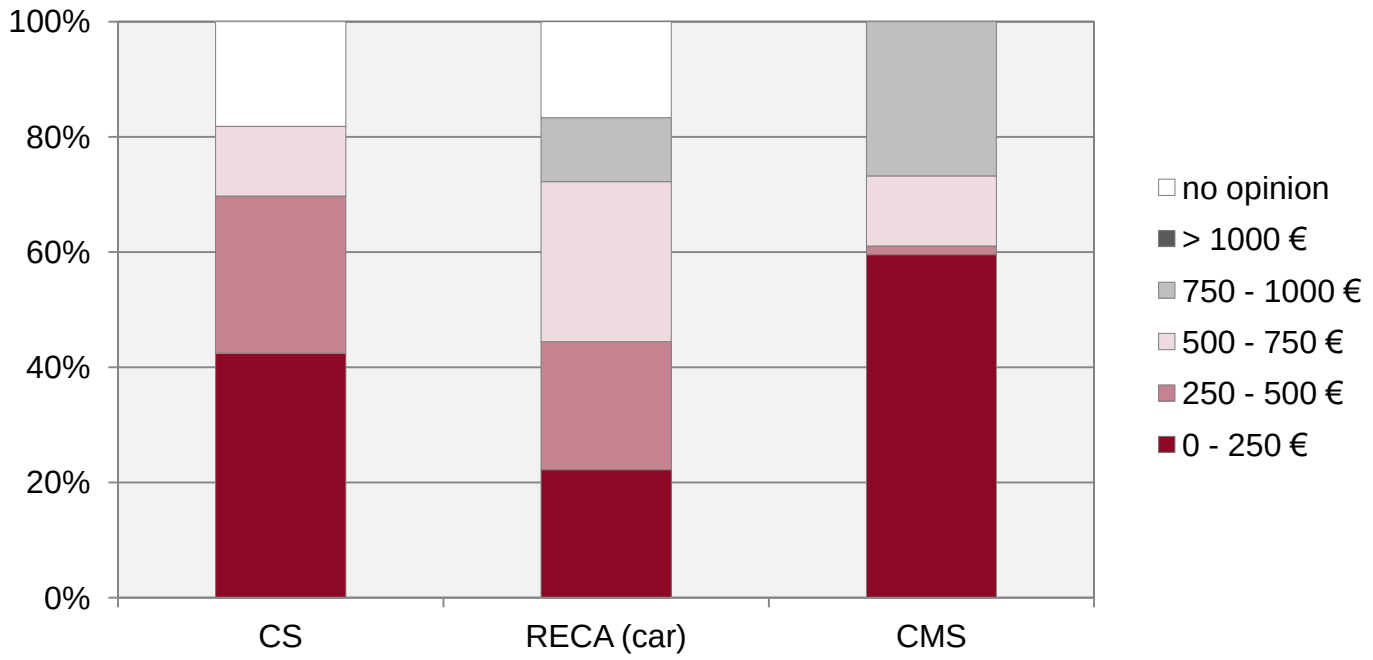


- The test persons would use interactIVe functions frequently
- Drivers would use the function more on motorways and less in urban regions – exception CMS

User-related Assessment – Example Results

- Willingness to pay

CS: Continuous Support
RECA: Rear-end Collision Avoidance
CMS: Collision Mitigation System



- The test persons are not willing to spend much money on active safety functions (< 500 €)
- The test persons are willing to pay more for functions that intervene than for functions which only warn

Safety Impact Assessment – Methodology

- Literature review on impact assessment methodologies:
  - Safety Mechanisms
  - Accident Reconstruction
  - Neural Network
  - FOT – Approach
- Chose appropriate methodology by considering the available data as well as advantage and disadvantages of the methodologies:
  - Nine Safety Mechanisms

- Direct effects
  1. Direct in-car modification of the driving task,
  2. Direct [illegible] modifications,

Only in-car functions

- Indirect effects on user
  3. Indirect modification of user behaviour,
- Effects on non-users
  4. Indirect modification of non-user behaviour,
  5. Modification of interaction between users and non-users,
- Exposure effects
  6. Modification of road user exposure,
  7. Modification of modal choice,
  8. Modification of route choice,

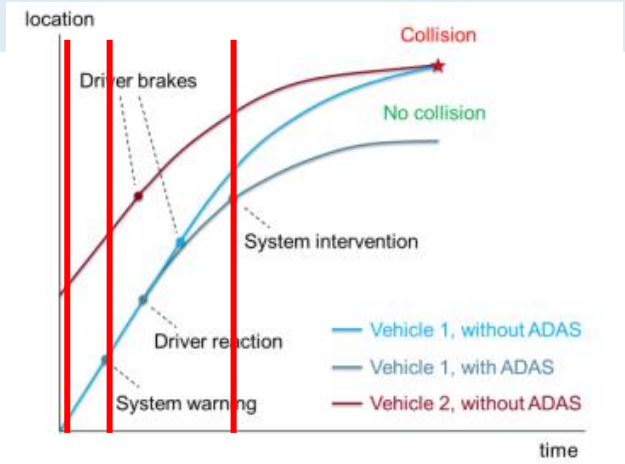
Exposure effects, typically small

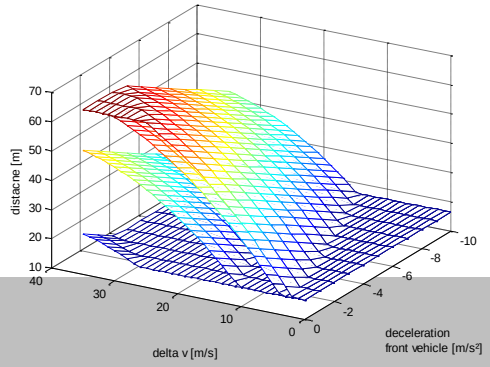
- Effects on post-accident consequence modification
  9. Modification of [illegible]quences.

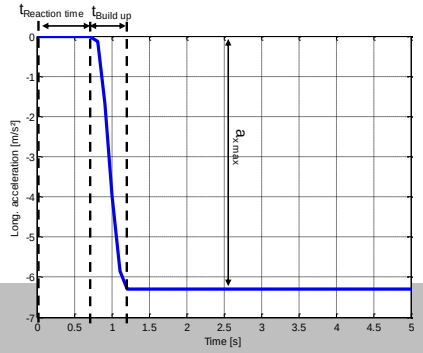
Only post-collision

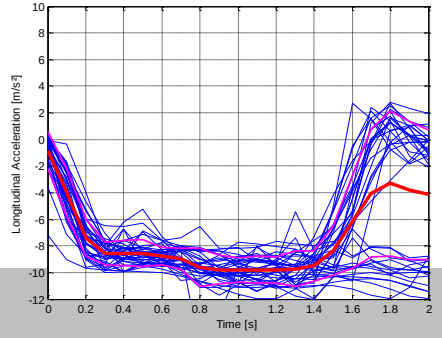
Direct effects – Rear-end scenario (Braking)

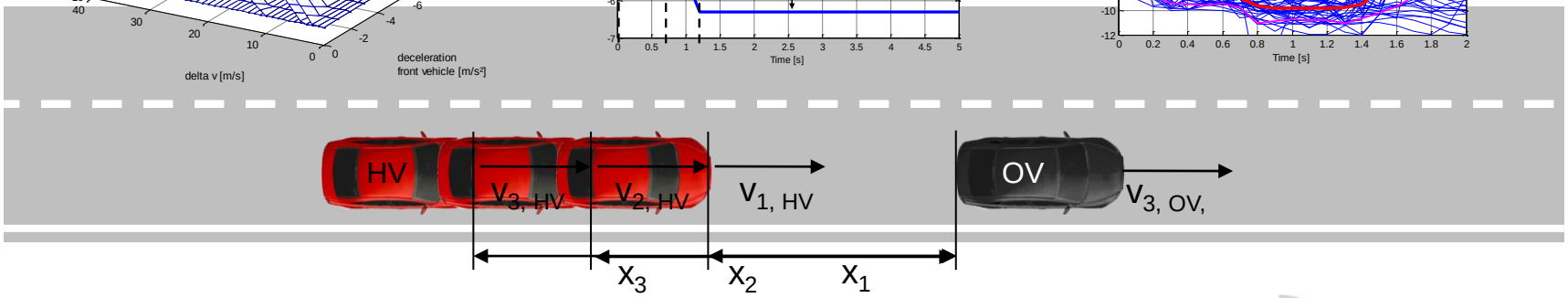
- Initial condition (in-depth accident database)



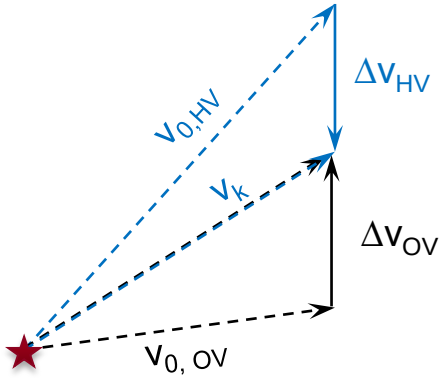




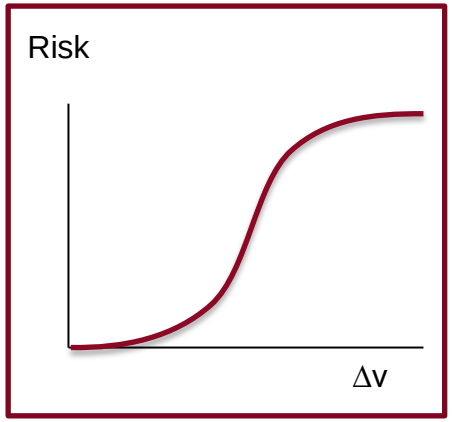




Direct effects – Rear-end (collision mitigation)



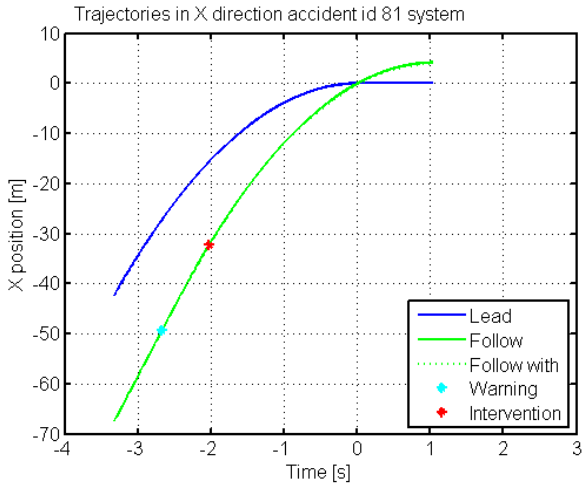
$(m_{HV}+m_{OV})\, v_k = c_k\, (m_{HV}\, v_{0,HV} + m_{OV}\, v_{0,OV})$



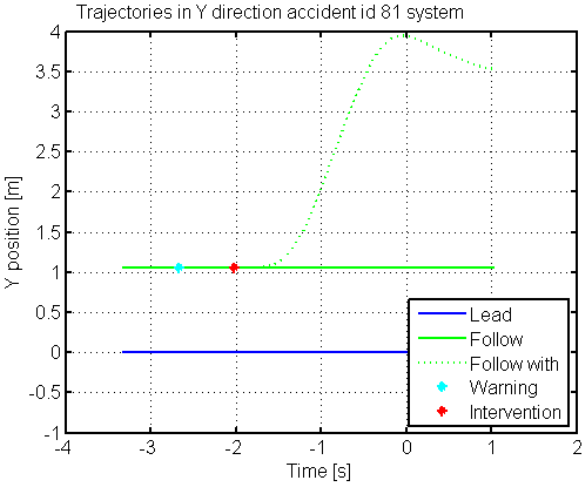
- Speed $v_{0,HV}$ and $v_{0,OV}$ collision are known!
- Derive speed v_k from just after collision based billiard mechanics (correction factor c_k)
- Calculate $\Delta v_{HV} = v_k - v_{0,HV}$ and $\Delta v_{OV} = v_k - v_{0,OV}$, the change of speed at collision for the host and the other vehicle, with and without the system
- Use known relations between Δv in order to calculate injury risk…

Safety Impact Assessment – Example (Preliminary) SP7 Results

- Sample result for a rear-end collision avoidance function:
  - 364 in-depth rear end accident scenarios analyzed
  - 77 % collision avoided
  - 22 % collision mitigated
  - 1 % no effected



- Sample result for a collision mitigation function:
  - 364 in-depth rear end accident scenarios analyzed
  - 34 % collision avoided
  - 42 % collision mitigated
  - 24 % no effected



Summary & Next steps

- interactIVe Vision: Accident-free traffic and active safety systems in all vehicles
- 11 different interactIVe functions were developed
- The interactIVe functions have been tested and evaluated in the technical and user-related assessment
- Based on the results a safety impact assessment of the interactIVe functions were conducted

- **Final Event:**
  - 20-21 November 2013 in Aachen
  - Joint event with eCoMove
  - November 20: Presentations & Exhibition in Aachen
  - November 21: Demo drives on Ford Proving Ground in Lommel
  - Subscription is open at the interactIVe website: http://interactive-ip.eu

interactIVe

Accident avoidance by active intervention for Intelligent Vehicles

Thank you.

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by the European Commission

SEVENTH FRAMEWORK
PROGRAMME