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Accident avoidance by active intervention for Intelligent Vehicles

www.interactIVe-ip.eu

interactIVe - accident avoidance by active intervention for Intelligent Vehicles

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RWTHAACHEN UNIVERSITY

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)
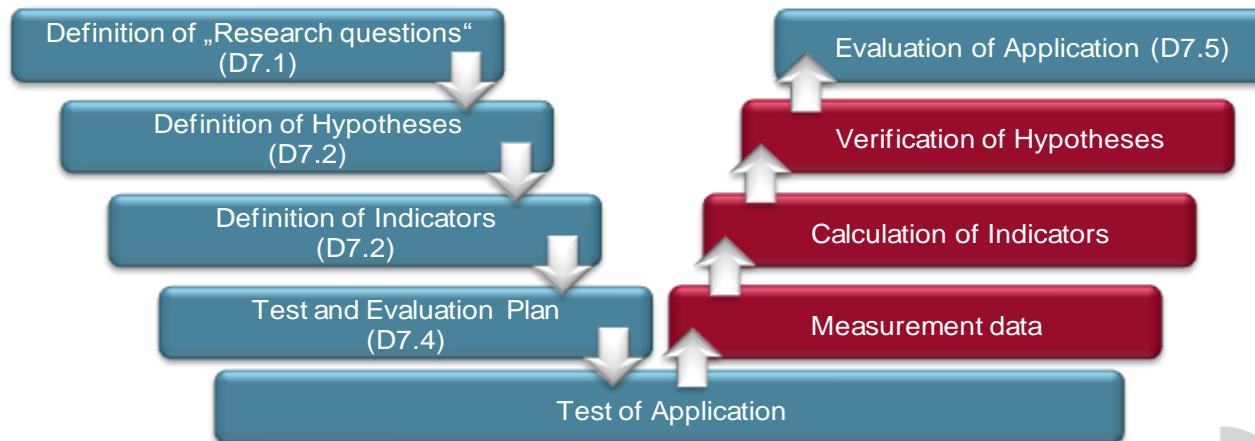- User-related assessment
- Impact assessment
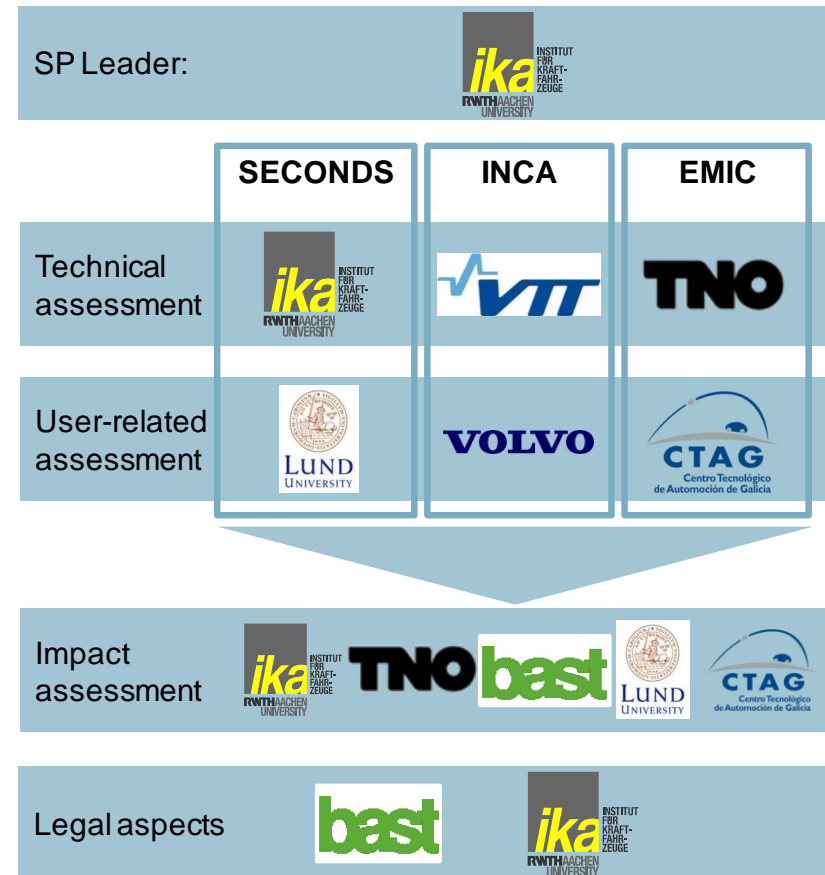
SP7 "Evaluation and legal aspects" - Methodology

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
- Considering the activation behaviour at least some function are still in the research phase
- **Example:**
 **Hyp_T_gen_TecU_01: The driver has enough time to react and avoid the accident, when the warning is issued**
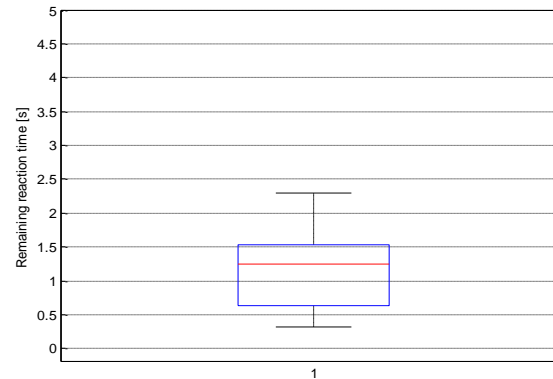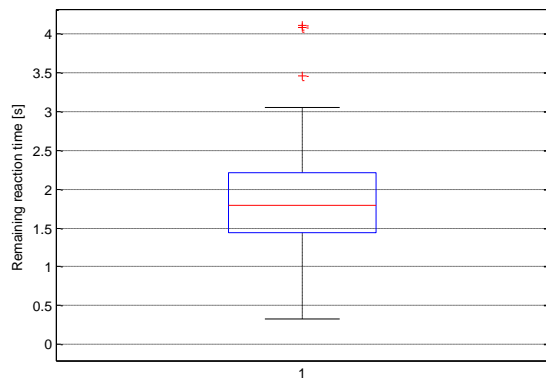
- The remaining reaction time is (TTC @ warning - $t_{Manoeuvre}$) compared to the presumed reaction time s
  →Hypothesis is confirmed at significance level of 5% at a reaction time of $t_{Reaction}$ = 1.2 s in the example on the left
  →Hypothesis is confirmed at significance level of 5% at a reaction time of $t_{Reaction}$ = 1.0 s in the example on the right

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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
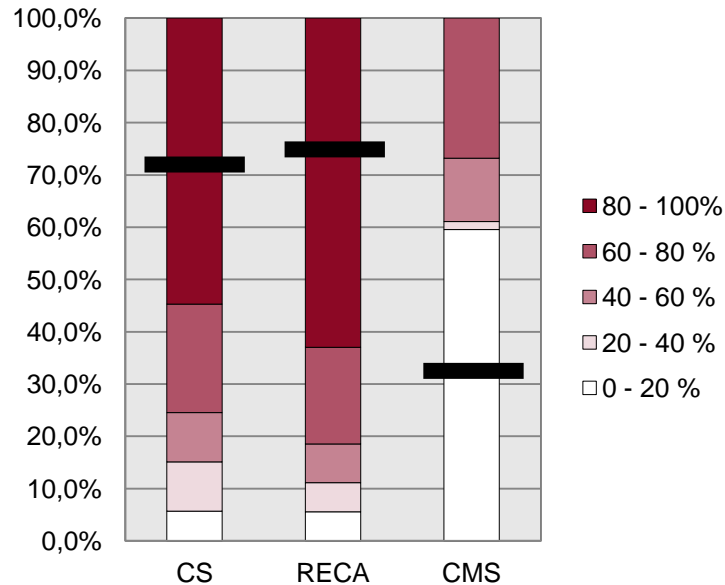 - Driving simulator studies

Source: Ford

Dynamic HUD

SIA screen

Distraction task keyboard / screen
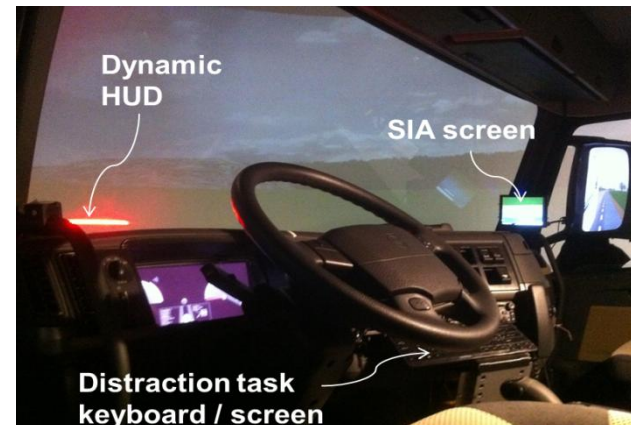
Source: VTEC

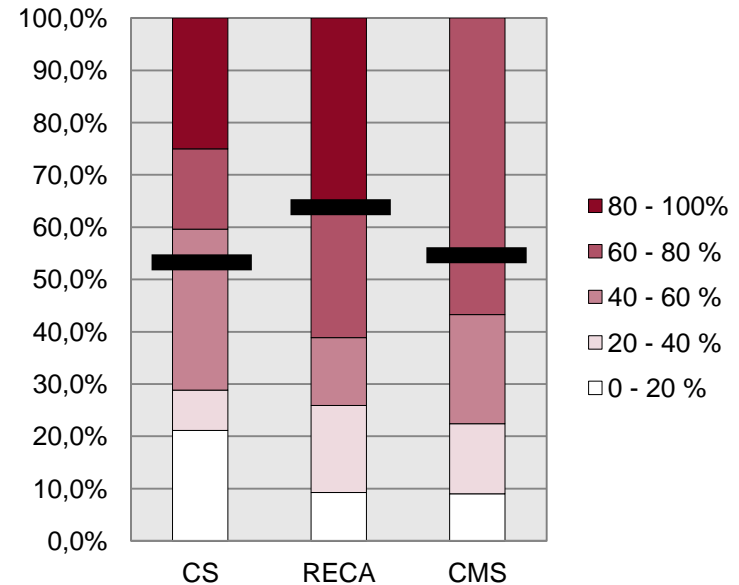interactive

User-related Assessment – Example Results

- Intended usage of the functions

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

Motorways

Urban roads

Legend for both charts:
- 80 - 100%
- 60 - 80 %
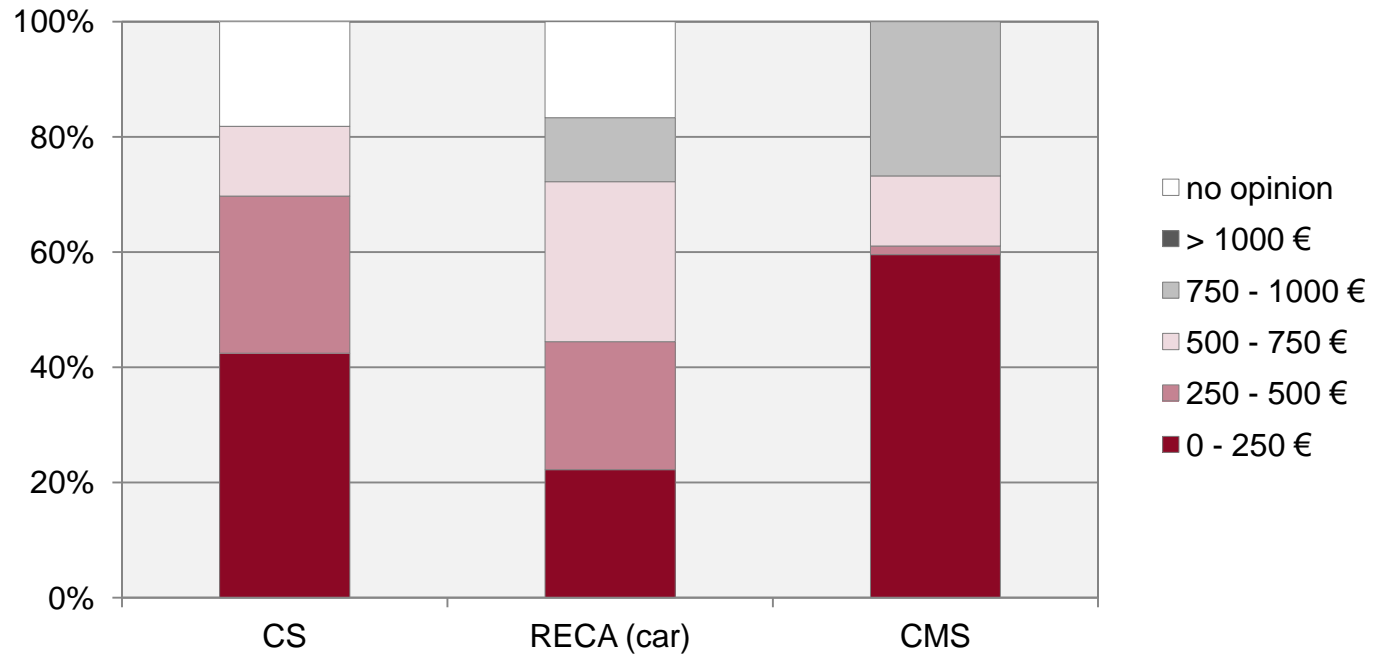- 40 - 60 %
- 20 - 40 %
- 0 - 20 %

- 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

Legend:
- □ no opinion
- ■ > 1000 €
- ■ 750 - 1000 €
- ■ 500 - 750 €
- ■ 250 - 500 €
- ■ 0 - 250 €

X-axis: CS, RECA (car), CMS

- 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

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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. Dire **Only in-car functions** ications,
- 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
  Exposure effects, typically small
  7. Modification of modal choice,
  8. Modification of route choice,
- Effects on post-accident consequence modification
  9. Modi **Only post-collision** quences.

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Direct effects – Rear-end scenario (Braking)
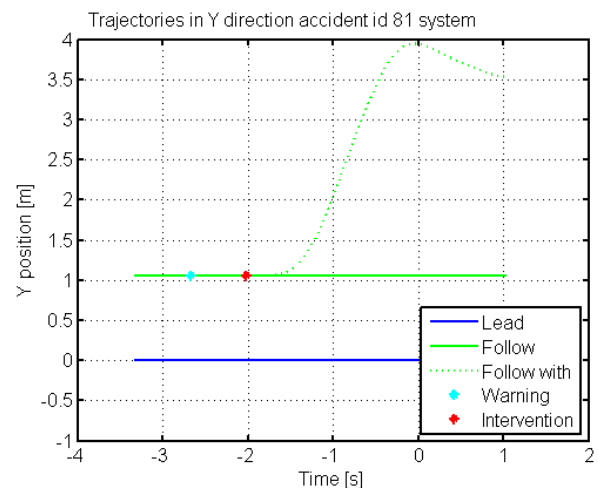
- Initial condition (in-depth accident database)

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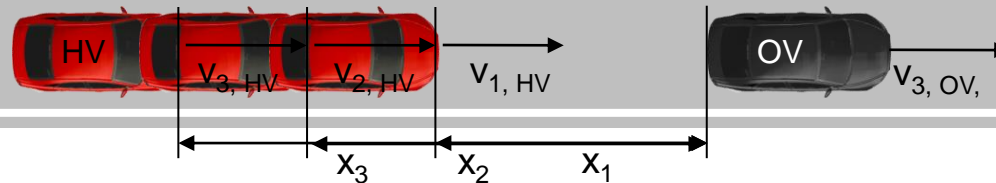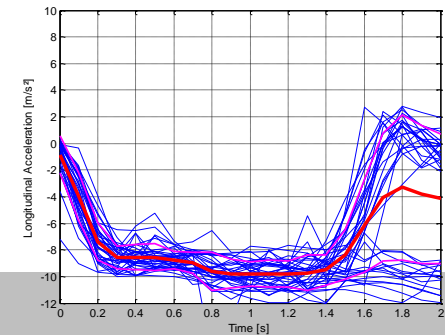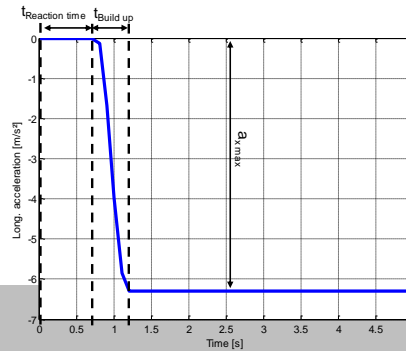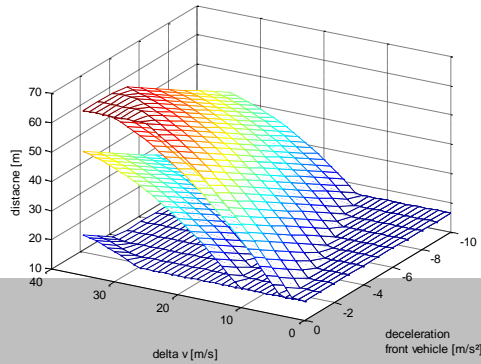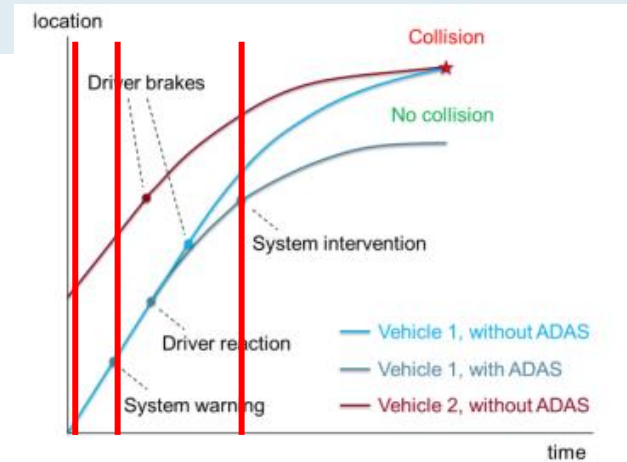
Direct effects – Rear-end (collision mitigation)

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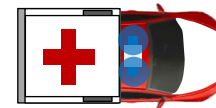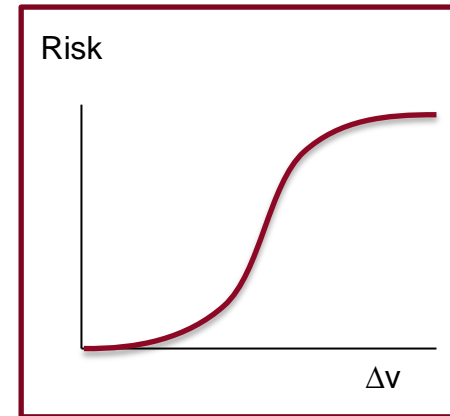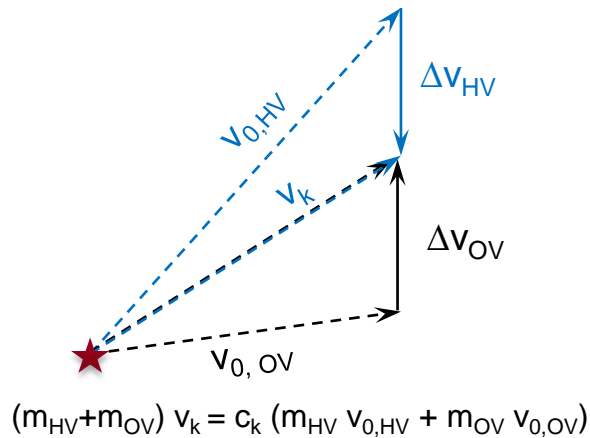
- Speed $v_{0,HV}$ and $v_{0,OV}$ collision are known!
- Derive speed v_k from just after collision based billiard mechanics (corection faktor c_k)
- Calculate $\Delta v_{HV} = v_k - v_{0,HV}$ and $\Delta v_{OV} = v_k - v_{0,OV}$, the change of speed at collision for the host and the other vehicle, with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

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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

Trajectories in X direction accident id 81 system

Trajectories in Y direction accident id 81 system
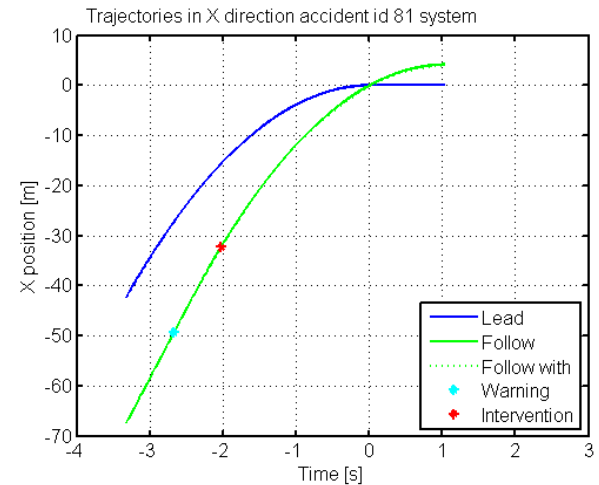
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Summary & Next steps

- A test and evaluation framework was defined, which considers test plans and test methods for all 11 interactIVe functions
- 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

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Thank you.

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by the European Commission

SEVENTH FRAMEWORK
PROGRAMME