Challenges of vehicle automation
A human factors perspective
Potentials of automated driving

**Increased safety**
- Reduction of human error / weaknesses
- Faster and stronger reactions

**Increased comfort**
- More efficient use of time
- Release of attentional resources
Ironies of Automation (Bainbridge, 1983)

The more complex an automated system is, the more important the role of the human operator becomes.

Automation takes over tasks that humans find annoying or are bad at.

- But: Operator has to monitor if the systems is doing the right thing

The more reliable the automated system, the lesser the human has to intervene and correct the automation.

- But: The lesser the human has to intervene, the harder it will be
# Possible side effects

<table>
<thead>
<tr>
<th>Altered driver state</th>
<th>System understanding</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Drowsiness</td>
<td>• Mode confusion</td>
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<tr>
<td>• Reduced situation awareness</td>
<td>• Mental model</td>
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<table>
<thead>
<tr>
<th>• Overreliance</th>
<th>• Loss of skills</th>
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<tr>
<td>• Misuse</td>
<td>• Behavioural adaptation</td>
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### Inappropriate trust in Automation
- Long term effects
Crucial aspect:
Transitions of control between automation and driver

As long as there are no fully autonomous systems, systems always have to interact with humans at different times and to different degrees.

Goal: Safe and efficient transitions
Goal: Human-centered design

- Finding suitable strategies to hand back vehicle control to the driver
- Prevention of automation surprises in order to:
  - Increase system understanding
  - Increase reliance
  - Increase acceptance

Positive automation effects will only affect traffic safety if the automation is actually used.
Human-vehicle integration: Key Research questions in AdaptIVe

**Driver in the loop**
- Situation awareness
- Mode awareness

**Controllability**
- Managing system limits/failures

**Driver attention state**
- Drowsiness
- Secondary-task engagement

**Transitions**
- System- and driver-initiated

**Shared control**
- Driver and automation act in parallel

**Interface design**
- Modality and timing of information
"Quality" of automation

Situational demands

Driver state

Integrated research approach

High-priority T-O-R*

Low-priority T-O-R*

Monitoring request

* Take-Over-Request
Human-vehicle integration

Functional requirements and design guidelines

Use Cases

State of the Art of Human Factors research

Research questions

Experiments

// General subproject objectives
Use Cases

„Description of a specific sequence of interaction between the user and the system to achieve a specific goal. “

April 2014: Use-Case-Workshop at DLR Braunschweig

Results: Definition of first set of use cases
## Examples of defined Use Cases

<table>
<thead>
<tr>
<th>Close distance maneuvers</th>
<th>Urban scenarios</th>
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<tbody>
<tr>
<td>• Activation/Deactivation with/without driver in car</td>
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<td>• Parking in/out</td>
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<tr>
<td>• Drive to parking lot</td>
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<td>• Pass through construction site</td>
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<tr>
<td>• Activation/Deactivation</td>
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<tr>
<td>• In lane lateral and longitudinal control</td>
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<tr>
<td>• Lane change (driver/system initiated)</td>
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<tr>
<td>• Handling of traffic lights/intersections/roundabouts</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Highway scenarios</th>
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<tbody>
<tr>
<td>• Activation/Deactivation</td>
<td></td>
</tr>
<tr>
<td>• Lane Following</td>
<td></td>
</tr>
<tr>
<td>• Lane Change</td>
<td></td>
</tr>
<tr>
<td>• Enter/exit motorway</td>
<td></td>
</tr>
<tr>
<td>• Cooperative Use Cases (using C2X-Technology)</td>
<td></td>
</tr>
<tr>
<td>• Driver State</td>
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</tbody>
</table>
// Use Case Example: Lane Change

Demonstrator: SP6
Use-Case: lane change

Main Flow: driver initiated lane change

- lane change is possible
- conducts lane change
- lane change done

- actuator shall change lane
- feedback in display
- feedback visible for driver
- initiate lane change
- time

- environment
- vehicle
- automation
- HMI
- steering wheel
- gas pedal
- brake pedal
- Display
- kinetics
- Lever / Button
- driver

Challenges of vehicle automation, Helsinki
//Next steps: Experiments

Leeds driving simulator

DLR driving simulator

WIVW driving simulator

FORD fixed based simulator

AB Volvo truck simulator

VCC fixed based simulator

DLR FASCar
Thank you.

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