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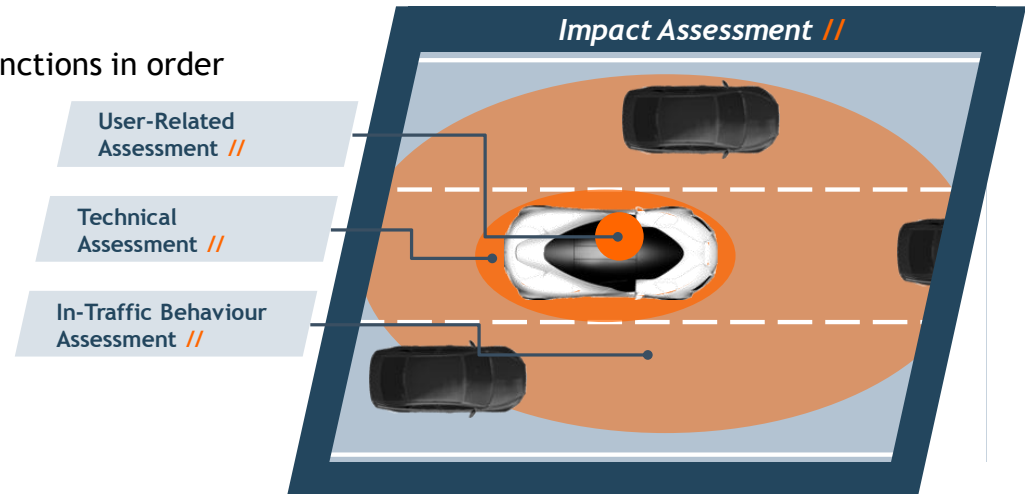
Bordeaux  
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*Adapt*://*Ve - Evaluation*

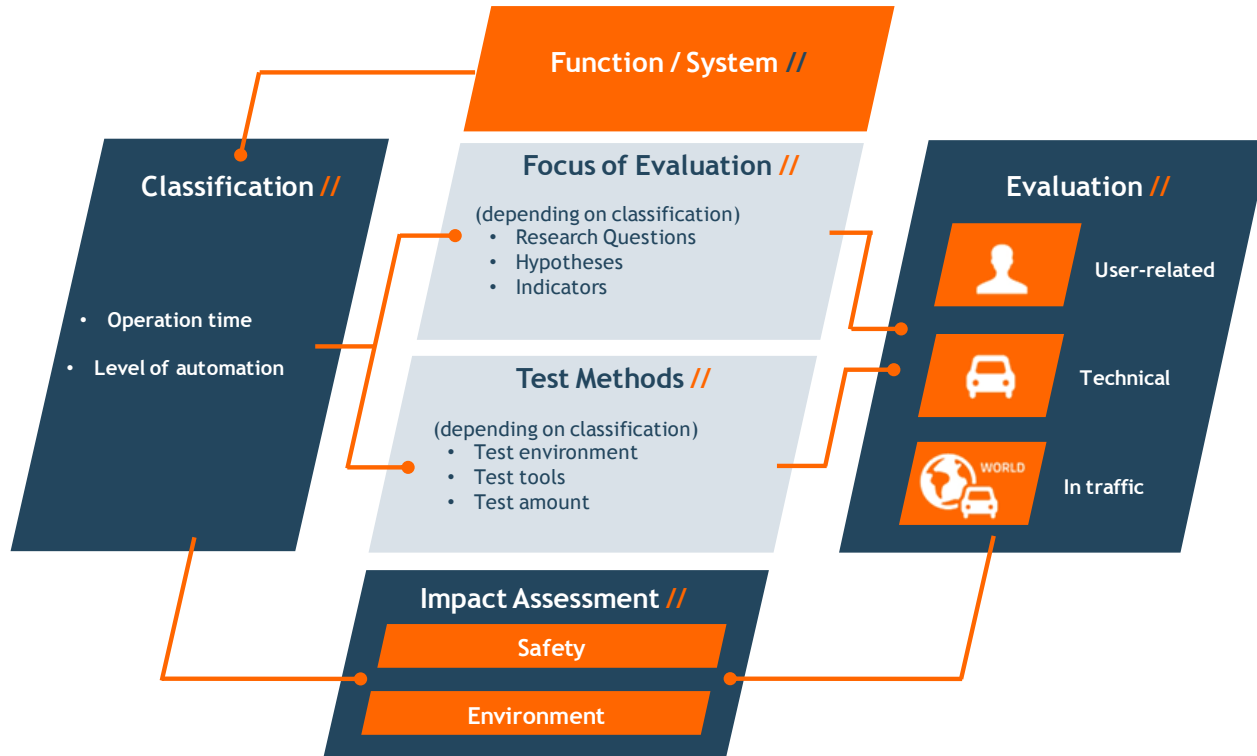


# // Adaptive - SP „Evaluation“

- Main objectives:
  - Development of an evaluation framework for automated driving systems
  - Methodology for impact analysis of automated driving systems
- Detailed objectives:
  - Apply developed methods on selected functions in order to verify the evaluation methods
  - Benefit analysis with focus on safety and environmental impact
    - > Derive first recommendations and results on the impact of automated driving applications
- Partners:
  - ika, BMW, CRF, BASt, TNO, CTAG, Lund



# // Adaptive - Evaluation Approach






# // Classification of automated driving functions for the assessment

- Classification of automated driving functions for the evaluation
  - According to the SAE definition
  - According to the operation time
    - **Event based operating**
      - Function that operates for a short period in time (typically vehicle stands still at the end or the automated driving ends)
    - **Continuously operating**
      - Function that operates for a longer period in time (typically vehicle is still moving at the end of an manoeuvre respectively automated driving is continued)



# // Selection of Evaluation Tools and Methods




- Which tools should be applied for the evaluation of automated driving?

Tool	Application			 WORLD
Field Operational Test	<ul style="list-style-type: none"> <li>Impact assessment in reality</li> <li>Assessment of behaviour/components/systems</li> </ul>	R	R	R
Controlled Field	<ul style="list-style-type: none"> <li>Assessment of components and systems</li> <li>Assessment of driver behaviour</li> </ul>	R	R	R \ V
Dynamic Driving Simulator	<ul style="list-style-type: none"> <li>Assessment of driver behaviour</li> <li>Human machine interaction</li> </ul>	R	V	V
Simulation	<ul style="list-style-type: none"> <li>Virtual layout and assessment</li> <li>Potential impact assessment</li> </ul>	V	V	V

R: Real, V: virtual

## // Selection of Evaluation Tools and Methods

- Which tools should be applied for the evaluation of automated driving?

Tool	Technical	User-related	In-traffic	Impact			
Field Operational Test	Yes Continuously	(Yes)	(Yes)	No	R	R	R
Controlled Field	Yes Event-based	Yes	No	No	R	R	R \ V
Dynamic Driving Simulator	No	Yes	No	No	R	V	V
Simulation	No	No	Yes	Yes	V	V	V

R: Real, V: virtual

## // Scope of evaluation

- **Traffic Scenario:** A traffic scenario describes a larger traffic context, which includes different (not pre-defined) driving scenarios.
- **Driving Scenario:** A driving scenario is the abstraction and the general description of a driving situation without any specification of the parameters of the driving situation.
- **Driving Situation:** A driving situation is a specific driving manoeuvre (e.g. a concrete lane change with defined parameters).

Assesement	Traffic Scenario	Driving Scenario
Technical		X
User-related		X
In-Traffic	(X)	X
Impact	X	X

# // Example: Evaluation Approach in Technical Assessment

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## 1. Defining evaluation scope

- Definition of research questions, hypotheses & indicators

## 2. Planning of assessment

- Analyse system description and adaption of hypotheses
- Planning of test cases
- (Risk assessment)

## 3. Tests in controlled field

- Number of test variations
- Logging of test data

## 4. Assessment of tests

- Analysis of hypotheses based on test data & indicators

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## 1. Defining evaluation scope

- Definition of research questions, hypotheses & indicators

## 2. Planning of assessment

- Analyse system description and adaption of hypotheses
- Planning of test cases and test route
- Definition evaluation criteria (distributions & boundaries)
- Risk assessment

## 3. Pre-/component tests in controlled field

- Basic tests of functionality
- Sensor tests

## 4. Tests in real traffic

- Test route and test amount to be determined

## 5. Assessment of tests

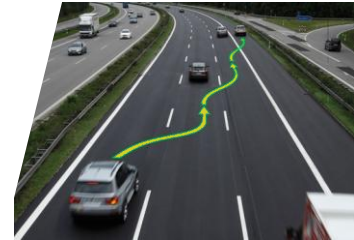
- Analysis of hypotheses based on test data & indicators





# // Safety Impact Assessment

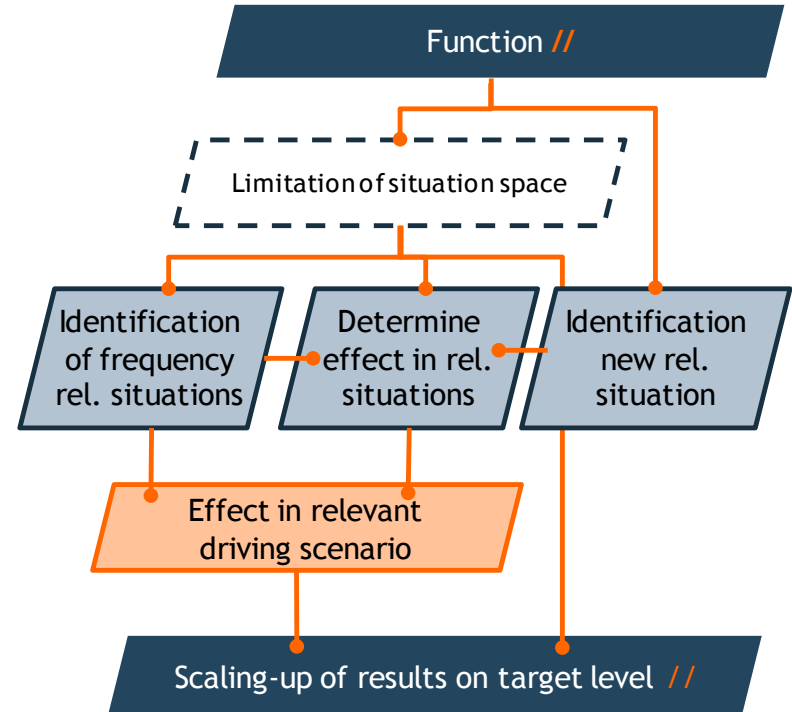
- Classical approach for ADAS
  - Scenario based approach
  - Accident data are analysed
  - Certain accidents are reconstructed and re-simulated accident considering function under study
  - Effect is determined by comparison of accident consequences with and without the function
- Approach for automated driving
  - Open issues
    - Today's accident data do not consider collisions of automated vehicles
    - Automated driving function operated already before a critical situation occurs
  - Consider different driving situations and not only accidents
  - Analyse how the traffic flow is affected by means of simulations
    - Identify (new) critical situations and analyse them



# // Safety Impact Assessment

Safety impact assessment in AdaptIVe bases on three main steps

- 1. Identify relevant situations**
  - Focus on accident and other (relevant) driving situations
  - Use of microscope traffic simulation
- 2. Investigate the relevant situation in detail**
  - Approach is similar to the re-simulation approach
  - Input data from other assessment (technical, user-related, in-traffic assessment) are considered
- 3. Identification of new situations**
  - e.g. transition of control or minimum risk maneuver





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# Adapt//Ve

*Automated Driving Applications and  
Technologies for Intelligent Vehicles*

*Thank you.*

