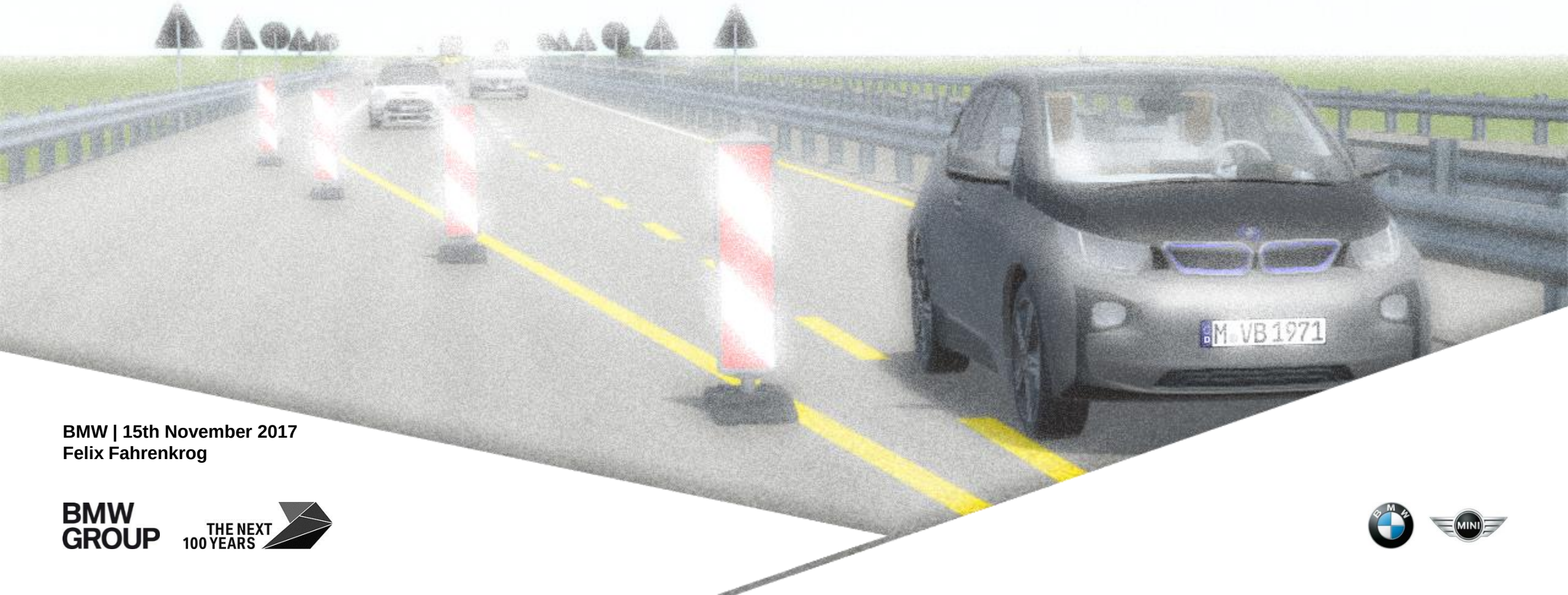
IMPACT ASSESSMENT OF AUTOMATED DRIVING

SIP-ADUS WORKSHOP



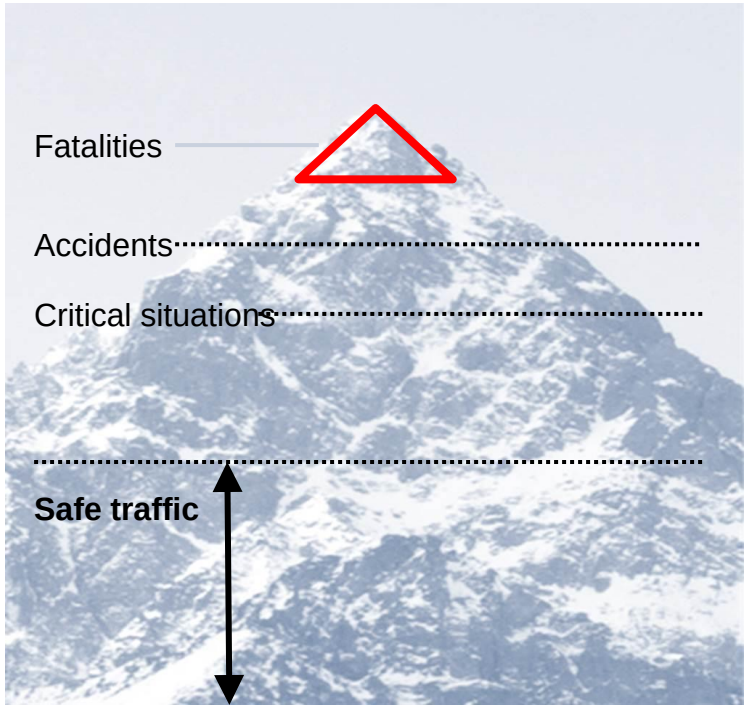
BMW | 15th November 2017
Felix Fahrenkrog

BMW GROUP THE NEXT 100 YEARS

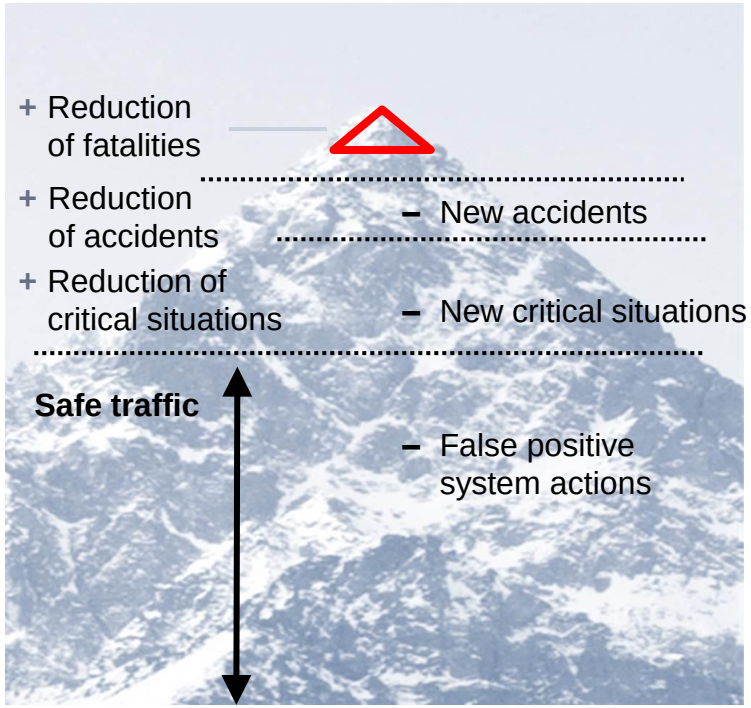
TRAFFIC, ACCIDENTS AND TRAFFIC SAFETY . OBJECTIVES AND REQUIREMENTS.

Automated and connected driving is an ethical imperative if the systems cause fewer accidents than human drivers (positive balance of risk) [Ethics Commission on automated driving 2017]

Traffic (Baseline)



Traffic with technology (Treatment)



The effectiveness evaluation of a function of active safety must …

… consider **variations** in boundary conditions of traffic situations,

… quantify **positive** and **possible negative** effects,

… and so take into account the **sum** of **all effects**.

PROSPECTIVE SAFETY ASSESSMENT. COMPARISON OF APPROACHS.

Proof of positive balance of risk requires an assessment of a technology‘s impact on traffic safety prior to its market introduction!

Analysis of accident data

Only accidents.

No near-accidents, critical driving situations or general HAF-relevant traffic scenarios are considered.

Simulation

Driving situation / traffic simulation.

Investigations of all situations from accident over critical to normal driving situation.

Number of tested driving situations can be scaled as desired

Driving Simulator

Targeted investigation of driver behavior in relevant traffic scenarios.

Controlled and standardized test environment.

Number of tested driving situations is usually scaled over the number of subjects.

Field Operation Test (FOT)

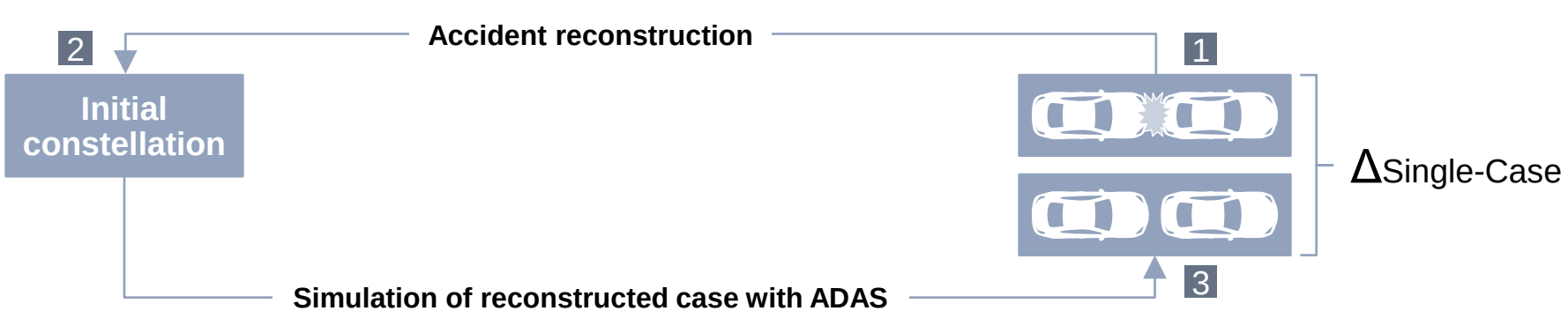
Examination of the function takes place in real traffic.

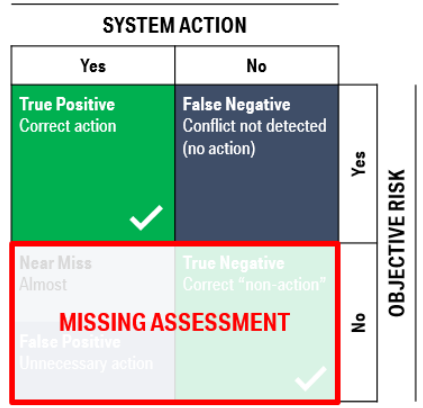
Only critical and normal driving situations are examined.

The number of investigated situations scales over the scope of the experiment

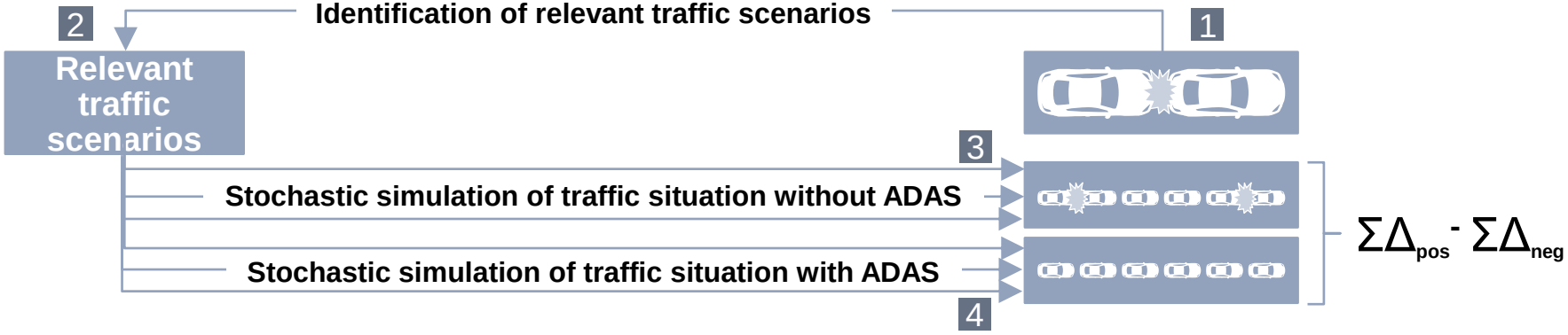
METHODOLOGY.
ACCIDENT- VS. TRAFFIC-BASED APPROACH.

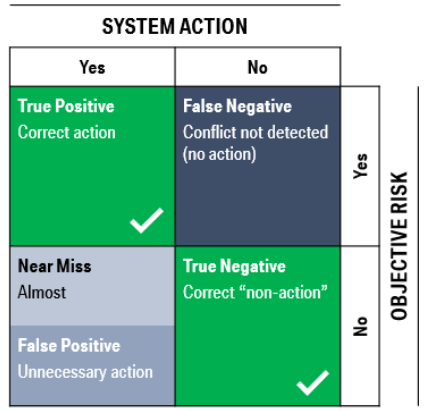
1) Accident-based





2) Traffic-based



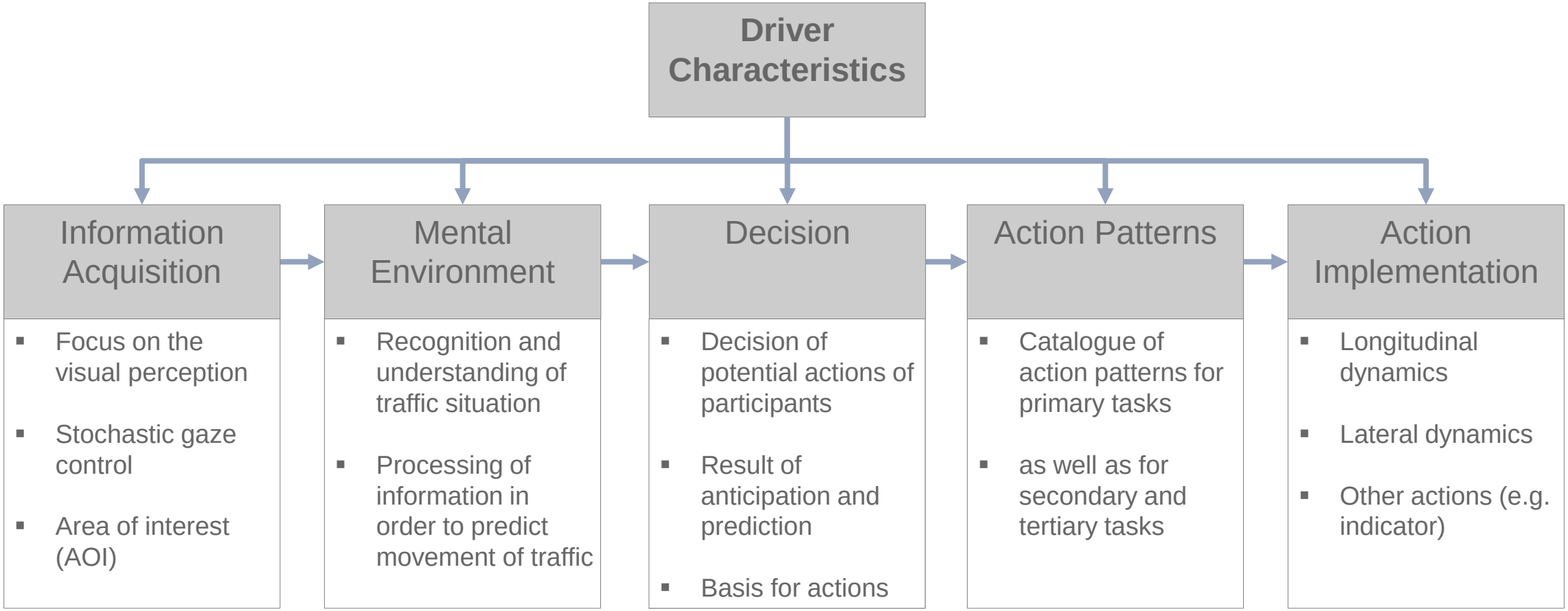


METHODOLOGY.
P.E.A.R.S.

- Representative assessment of **active safety** requires **harmonized methods**.
- Harmonization enables **comparable** and **comprehensible** assessments.
- For simulation: **methods, processes,** and **models** for prospective assessment have to be **harmonized**.
- **Objective** of this open working platform is the **creation of a worldwide standard** for the **evaluation of systems within the pre-crash phase**, which is **created, discussed, and finally accepted by all relevant stakeholders.**
- ISO Technical Report 21934 “Prospective safety performance assessment of pre-crash technology by virtual simulation”

DRIVER BEHAVIOUR MODEL.
STOCHASTIC COGNITIVE MODEL.

Stochastic Cognitive Model (SCM) – driver behavior model for the simulation within the safety assessment



DRIVER BEHAVIOUR MODEL.
STOCHASTIC COGNITIVE MODEL – INFORMATION ACQUISITION.

Objective: realistic implementation of the information acquisition

- Definition of different view area
  - Recognition of the objects in the area towards the driver is looking
- Stochastic view control based scientifically founded distribution matrix
- Integration of both top-down and bottom-up gaze control

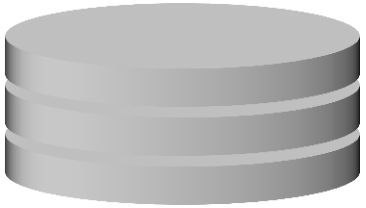
TOOL.
SIMULATION FRAMEWORK OPENPASS.

- OpenPASS is a **new software framework** for simulation and evaluation of ADAS and automated driving
  - **Join initiative of OEMs** (Daimler, VW and BMW) + other Partners (itk) with scope of harmonization of simulation tools
- **Realistic traffic models and simulation** → investigate interaction between different traffic participants
- **Fast and efficient simulation** → consider a high number of situations
- **Open source approach** → generate trust and acceptance by authorities and public
  (**Eclipse project: sim@OpenPASS**)

openPASS

METHODOLOGY.
IDENTIFICATION OF TOP-SCENARIOS FOR AUTOMATED DRIVING.

A

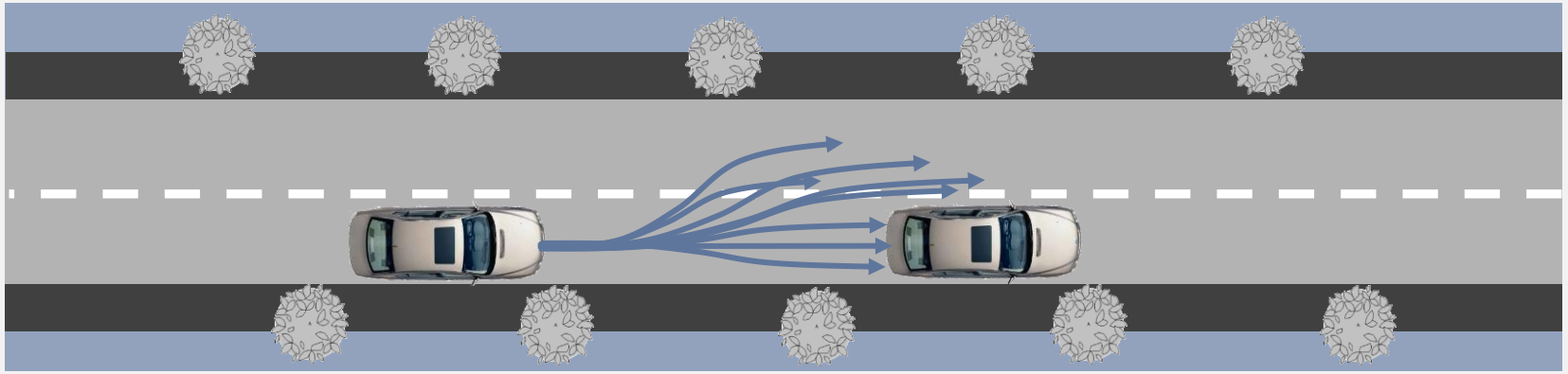


Accident data (e.g. GIDAS) /
Critical situations (FOT)

B

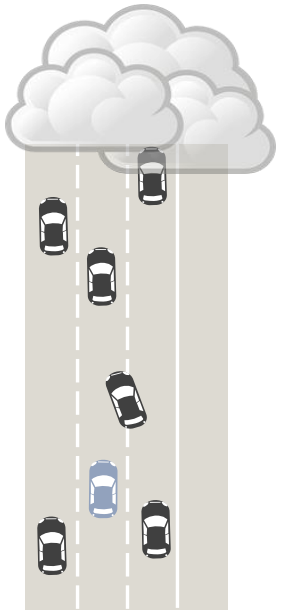
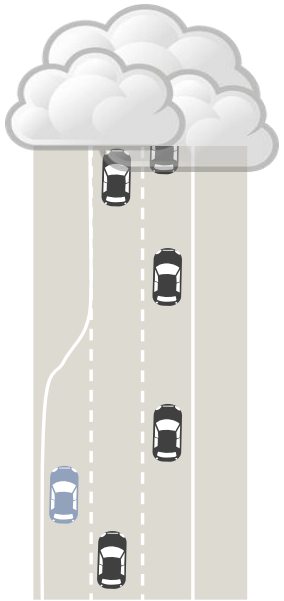
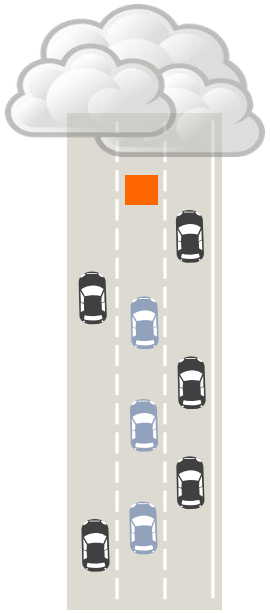
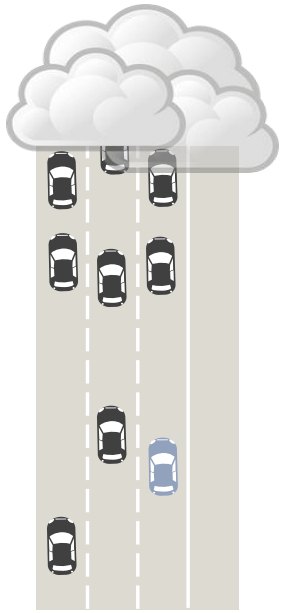
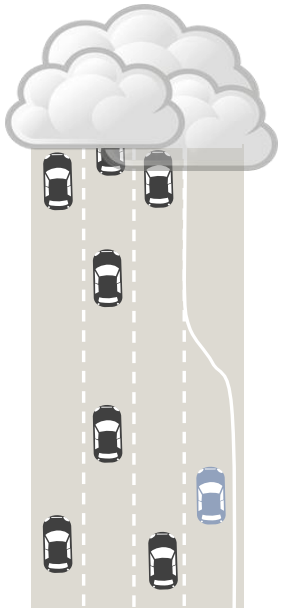
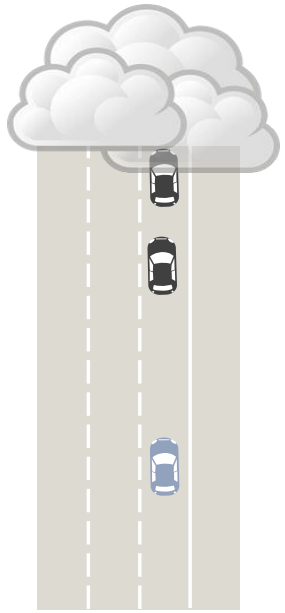
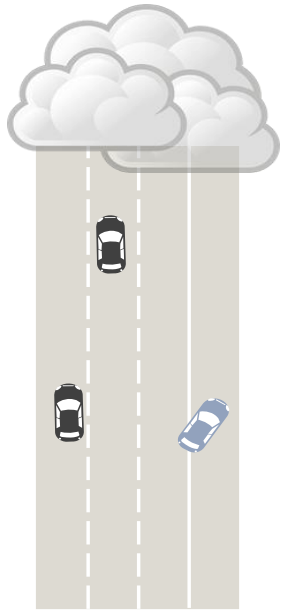
Based on specification
of function

Top Scenarios



Simulation of traffic scenarios

APPLICATION.
TOP 7 SCENARIOS.

Top 1	Top 2	Top 3	Top 4	Top 5	Top 6	Top 7
Cut-In	End of Lane	Obstacle in the lane	Traffic jam	Highway entrance	Rear-end accident	Single driving accident
						

RESULTS.
ADAPTIVE – IMPACT ASSESSMENT.

– Analysis of the AdaptIVe automated driving function:

	Top 1	Top 2	Top 3	Top 4	Top 5	Top 6	Top 7[2]	Not consi-dered
Mean determined effect in the operation	-83%	-14%	-40%	-40%	-49%	-73%	-100%	0%
Accidents within the operation conditions[1]	72% (92%)	67% (83%)	78% (97%)	80% (89%)	95% (95%)	69% (96%)	67% (93%)	0%
Expected change in the accident risk per scenario	-60% (-76%)	-9% (-12%)	-31% (-39%)	-32% (-36%)	-47% (-47%)	-51% (-70%)	-67% (-93%)	0%

– Open Issues for the safety impact assessment in AdaptIVe:

  – Situations (e. g. transition of control) with potentially negative effects are not considered

  – Effects along the penetration rate need to be not considered

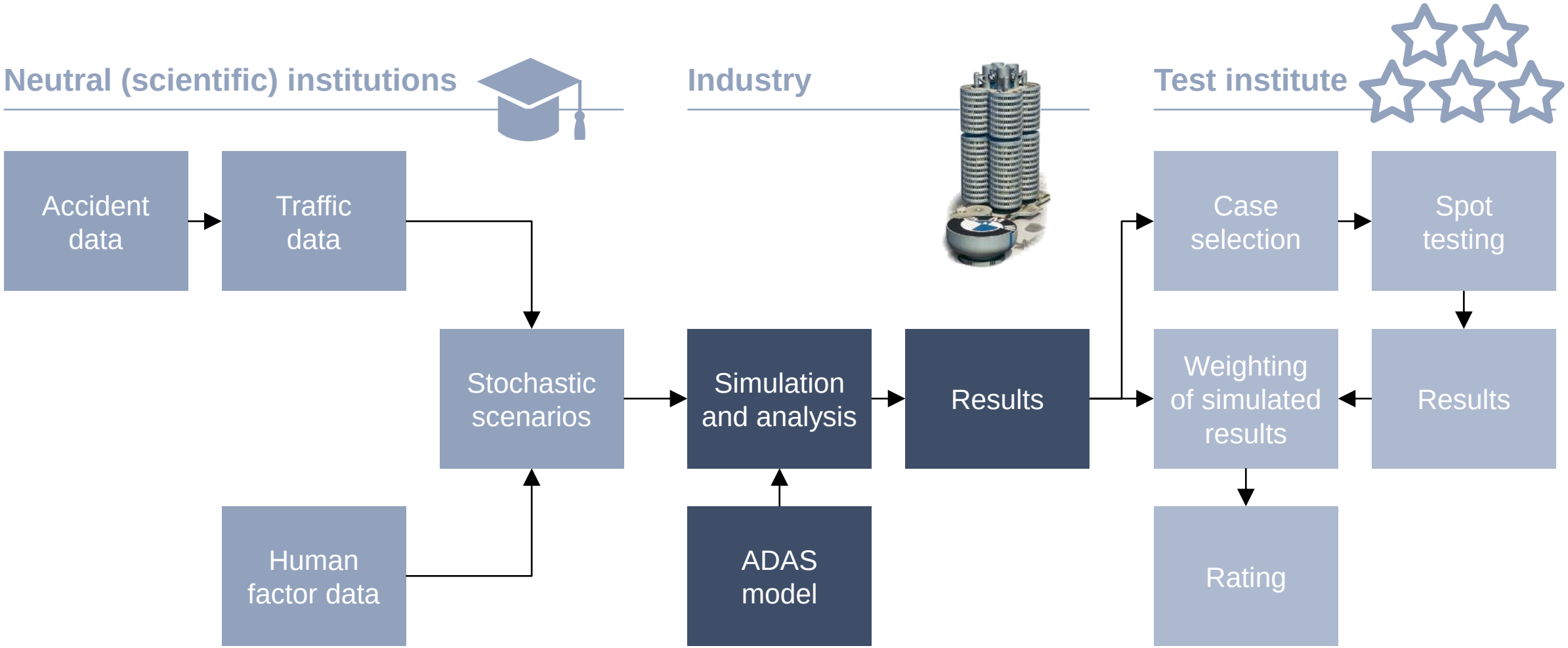
  – Usage is not considered

  – Available data

– Limitation and assumptions of the study (see AdaptIVe Deliverable D7.3) must always be taken into account!

1: Accidents within the operation conditions including accidents at speeds outside operation conditions
2: Determined based on the assumption

PROCESS AND ROLES.
VISION OF ACTIVE SAFETY EVALUATION.



THANK YOU FOR YOUR ATTENTION!