Dirk Wisselmann, Project Leader Highly Automated Driving.

EFFECTIVENESS EVALUATION OF ACTIVE SAFETY SYSTEMS.

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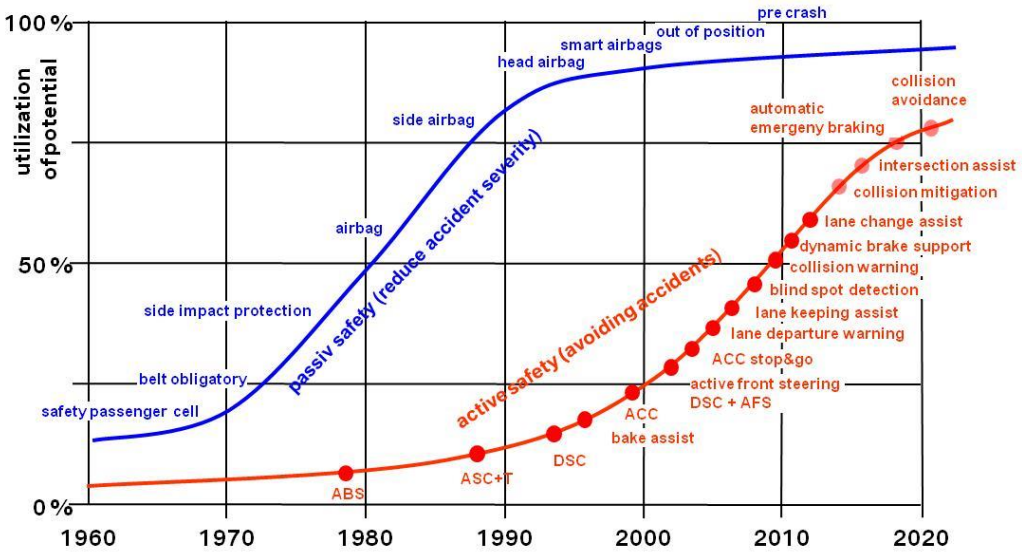
BMW GROUP

THE ROLE OF „VEHICLE SAFETY“.

ACTIVE SAFETY HAS HIGH POTENTIAL.



Developing concepts for increased vehicle safety considering:

- passive safety
- active safety
- functional safety
- operational safety

CURRENT ASSESSMENT OF ACTIVE SAFETY SYSTEMS.

EXAMPLE: AEB PEDESTRIAN FOR EURO NCAP.

Accident cases from accident databases
(e.g. ca. 650 cases in GIDAS*)

Clustering

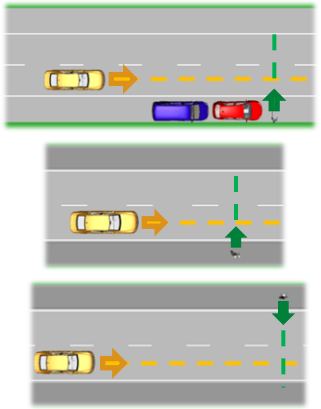
Accident Scenarios
6 cases

Accident Scenarios	Description	Light condition	KSI (84%)	Fatalities (83%)	All (70%)
	Crossing a straight road from near-side; No obstruction	Day Night	**15** **10**	8 15	**16** **7**
	Crossing a straight road from off-side; No obstruction	Day Night	8 12	**7** **23**	9 7
	Crossing at a junction from the near- or off-side with vehicle turning or not across traffic	Day Night	5 3	3 1	4 2
	Crossing a straight road from near-side; With obstruction	Day Night	7 2	1 3	3 1
	Crossing a straight road from off-side; With obstruction	Day Night	5 2	1 2	6 2
	Along the carriageway on a straight road; No obstruction	Day Night	8 7	5 14	9 4
	TOTAL	Day Night	48 36	25 58	47 23

Reduction

in terms of
- represenstability as a test scenario
- reproduceability
- test effort

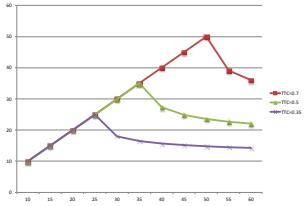
Test scenarios
3 cases



- Development of potential solution concepts
- Development of tests based on existing technical solution concepts

AEB Pedestrian testing

Assessment:
Speed reduction



* *German In-Depth Accident Study*

CURRENT ASSESSMENT METHODOLOGY.

COMPARING PASSIVE AND ACTIVE SAFETY.

- The Passive Safety “laboratory only” approach is not suitable for active safety assessments:
  - Active safety systems can be optimized for specific scenarios. Numerous remaining scenarios not addressed and assessed.
  - Laboratory tests follow precise/well-defined protocols: highly reproducible, comparable, etc.
  - Laboratory tests by nature incorporate a very limited sample of real traffic conditions and contributing factors.
  - An excessive test effort is needed for active safety systems to address all relevant real-world traffic accident scenarios **and** negative side effects (e. g. false positive testing).

reproducibility in test scenarios

vs.

variance in real world traffic scenarios

A “laboratory only” testing approach does not adequately assess the performance of active safety systems in real-world traffic

FUTURE APPROACH TO EVALUATION OF ACTIVE SAFETY.

Accident Data Base

- Causation
- Type of Accidents
- …

Small database, severe accidents

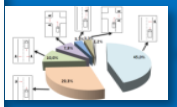
Traffic Data Base

- FOT, NDS, Driving Recs
- Typical, "uncritical Situations
- …

Larger scale data base, less accidents

Scenarios (e.g. Pedestrian Accidents)

- Type of Road
- Visibility
- Driving Direction
- Ped. Moving Direction
- Daytime, Brightness
- …



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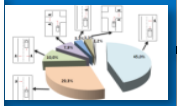
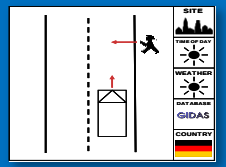


Output

- Focal Points, Scenarios most important
- Parameters, describing the before identified focal points
- Factors that discriminate uncritical from critical situations



Detailed description of safety-relevant scenarios for the effectiveness analysis

Contributing Factors

- Driver reaction
- Pedestrian reaction
- Vehicle performance
- ...

Considering additional basic conditions, e. g. driver's performance

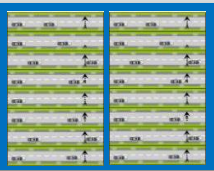
Model of Collision Avoidance System

- Describing parameters of innovations
- Provided by OEM, supplier or others
- Model quality standard req.

Modelling

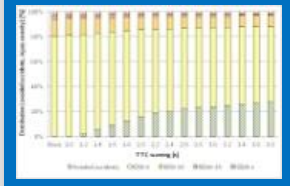
- Stochastic
- Monte Carlo, …

Creation of thousands of artificial, yet representative situations

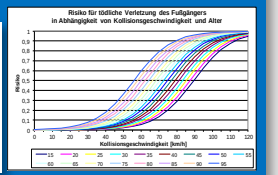


Simulation Model of the ADAS System (OEM) and overall simulation model

Simulation / Evaluation



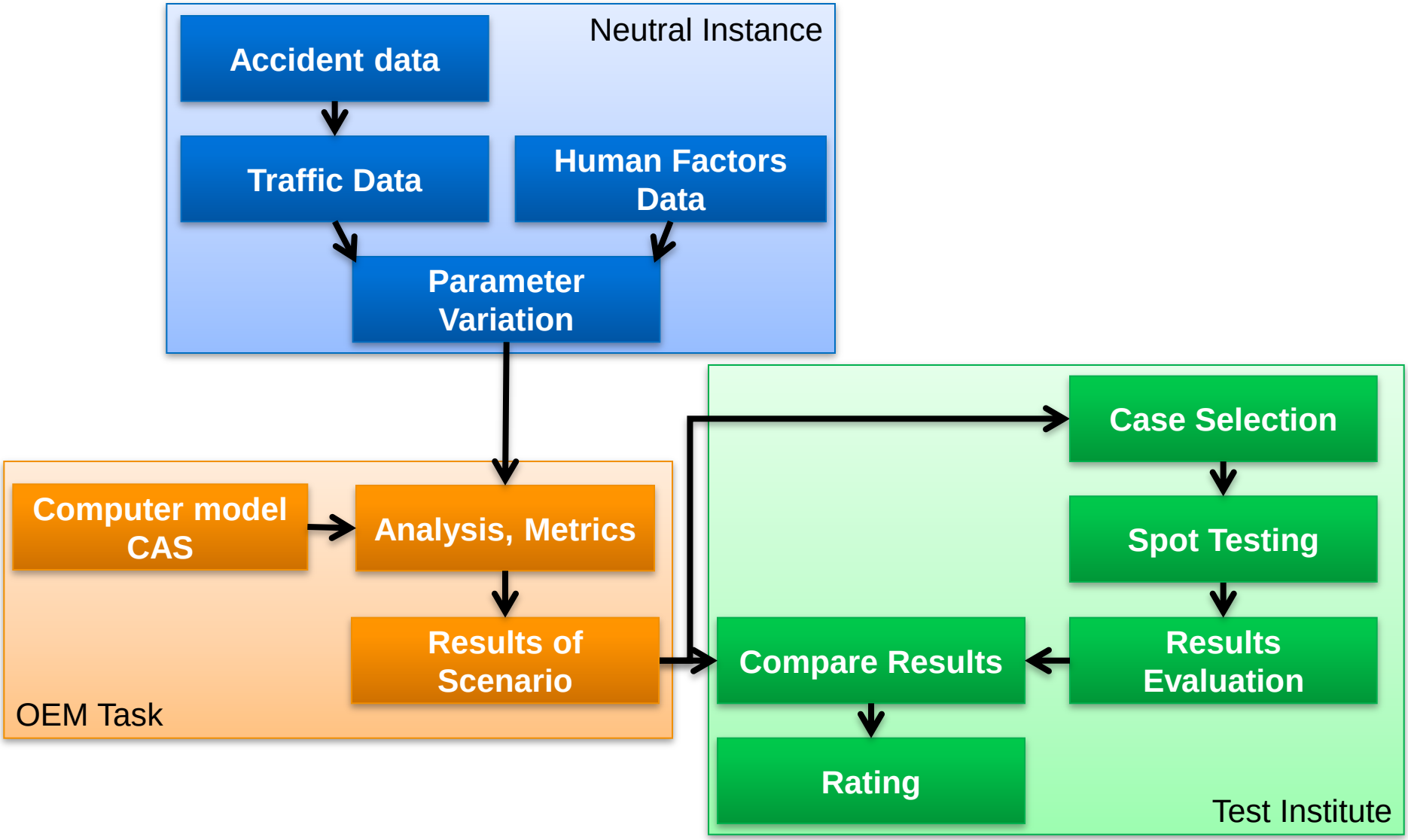
- Evaluation of system benefit
- Calculation of number and severity of unwanted side effects
- prospective effectiveness analysis



Calculation of
-avoided accidents
-mitigated accidents
-<u>newly created accidents</u>

EVALUATION PROCESS FOR ACTIVE SAFETY.

DETAILS.



HARMONIZATION OF EFFECTIVENESS EVALUATION.

OBJECTIVES.

- Representative assessment of **active safety** requires **harmonized methods**.
- For simulation: **methods, processes,** and **models** for prospective assessment have to be harmonized.
- Harmonization enables **comparable** and **comprehensible** assessments.
- **World-wide harmonization / standardization** as primary objective.

- **Open harmonization** initiative was very well received and supported by other OEMs, research institutes and suppliers.

HARMONIZATION OF EFFECTIVENESS EVALUATION.

CURRENT PARTICIPANTS.

CONCLUSION

- Even if Active Safety progresses, Passive Safety remains necessary as backup
- Utilization of drivers abilities provides great benefits
- Development and assessment of Active Safety features require new methods and competencies
- Suggested new approach for evaluation of active safety:
  i. Evaluation via simulation to ensure real world scenarios are adequately addressed
  ii. Verification of simulation results via random hardware tests
- Evaluation approaches to active safety need international harmonization and standardization.

THANK YOU VERY MUCH FOR YOUR ATTENTION!