Mehr Wert.
Mehr Vertrauen.

Add value.
Inspire trust.

Homologation of ADAS/AD - challenges and how to tackle them

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AUTONOMOUS DRIVING

How Long is the Way to Go?

A lot of progress concerning the

TECHNOLOGY

is visible, but:

"The critical path to introduce autonomous driving vehicles will not be the technology but the development of a metric which empowers for an approval"

Prof. Dr. rer. nat. H. Winner, November 2013

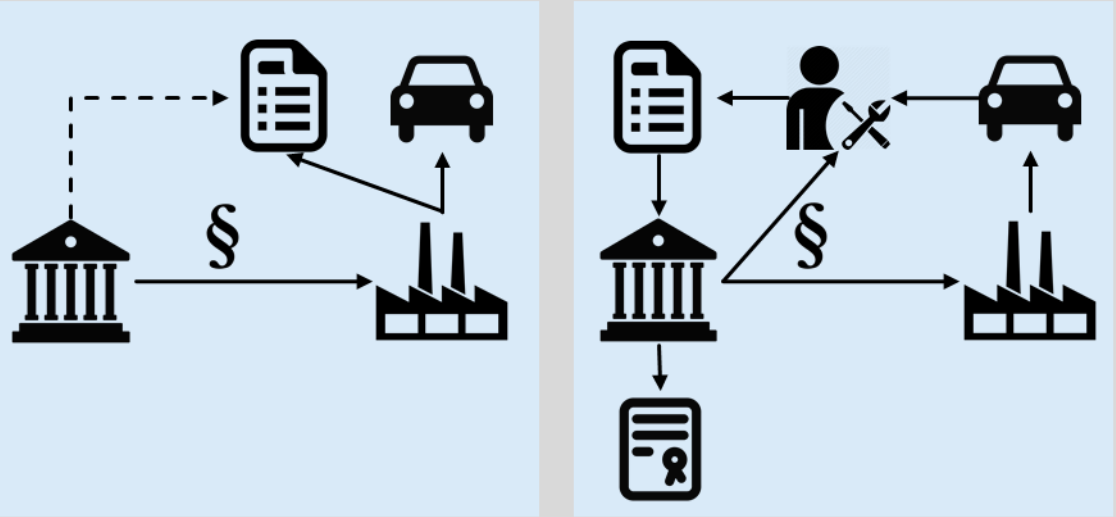
… so what do we need to master and overcome this critical path?

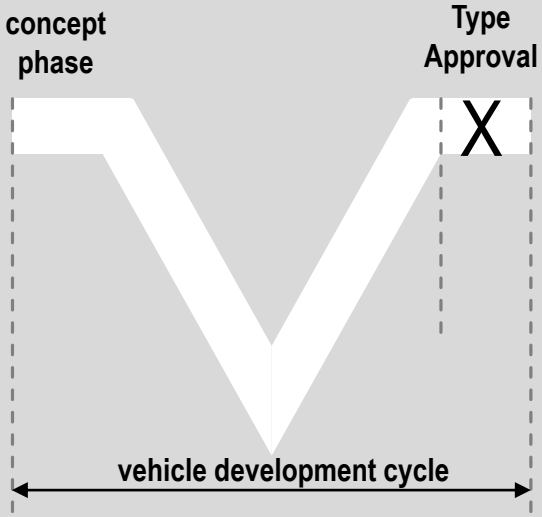
HOMOLOGATION Qu'est-ce que c'est?

Definition
Homologation refers to the certification process of a product (vehicle) granting that it complies with all local standards and legal regulations such as safety and environmental regulation.

No homologation → No CoC → No sales

Self certification vs. type approval 3rd party principle





Type Approval in vehicle development

- Last step of development
- Accomplishment of the v-cycle
- legal and technical approval of the concept

- European Union: Directive 2007/46/EC Type approval, tests are based on United Nations Economic Commission for Europe (UN/ECE) procedures;
- North America: Federal Motor Vehicle Safety Standards (FMVSS) regulations released by the NHTSA;
- Australian Design Rules (ADR) regulations;
- Japan follows UN/ECE regulations and their own Test Requirements and Instructions for Automobile Standards (TRIAS) regulations;
- Other countries that accept or base their own regulation on those mentioned above, following the latest release or previous versions of the regulations.

What CHANGES with Automation?

"device, having a unique purpose, that augments or replaces human or animal effort for the accomplishment of physical tasks"

Encyclopedia brittanica

Machine

The car is turning into a

Cyber Physical System

"A cyber-physical system (CPS) is a mechanism that is controlled or monitored by computer-based algorithms, tightly integrated with the Internet and its users"

Wikipedia

unique purpose

augmenting / replacing

accomplish

physical tasks

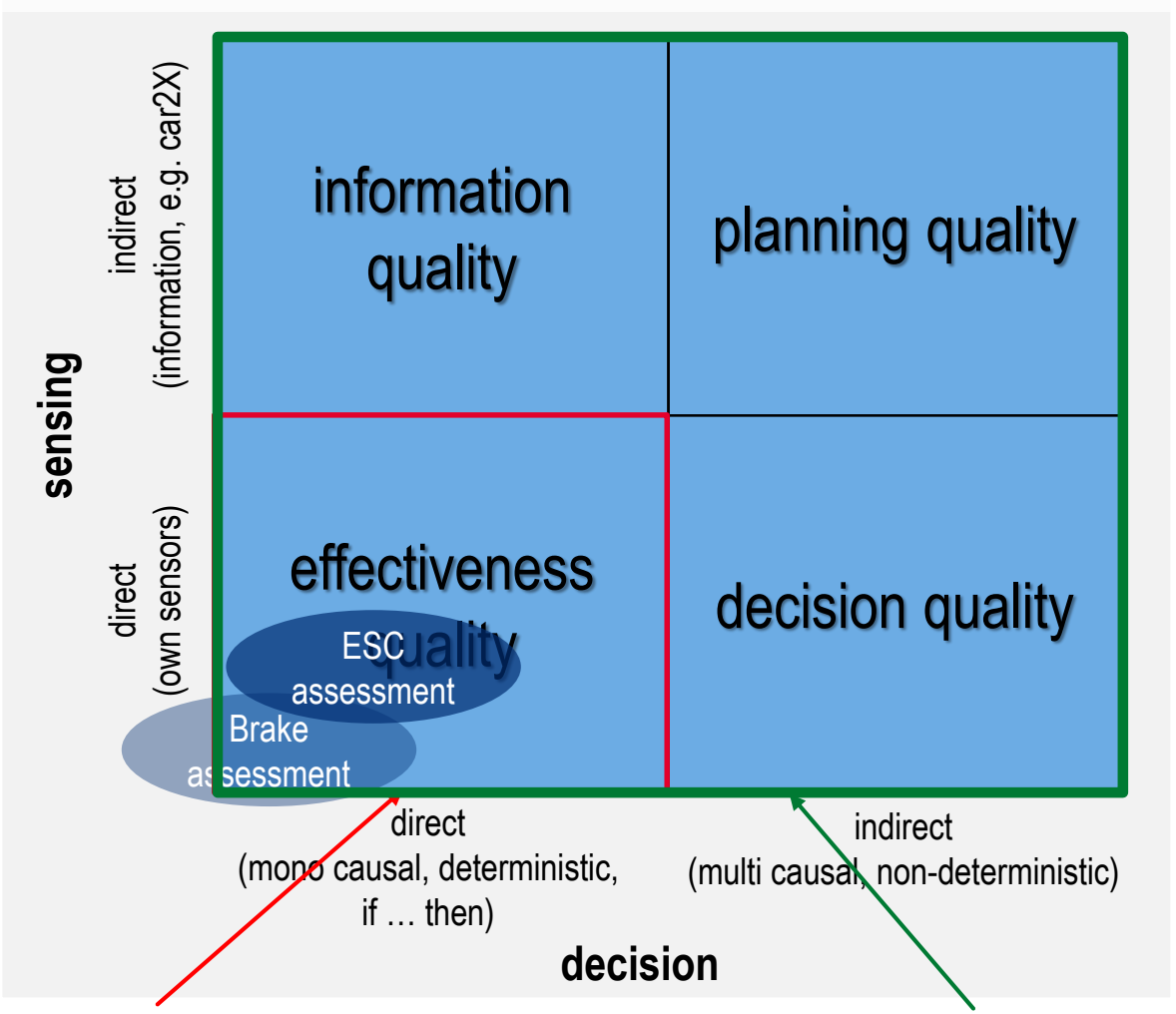
controlled / monitored

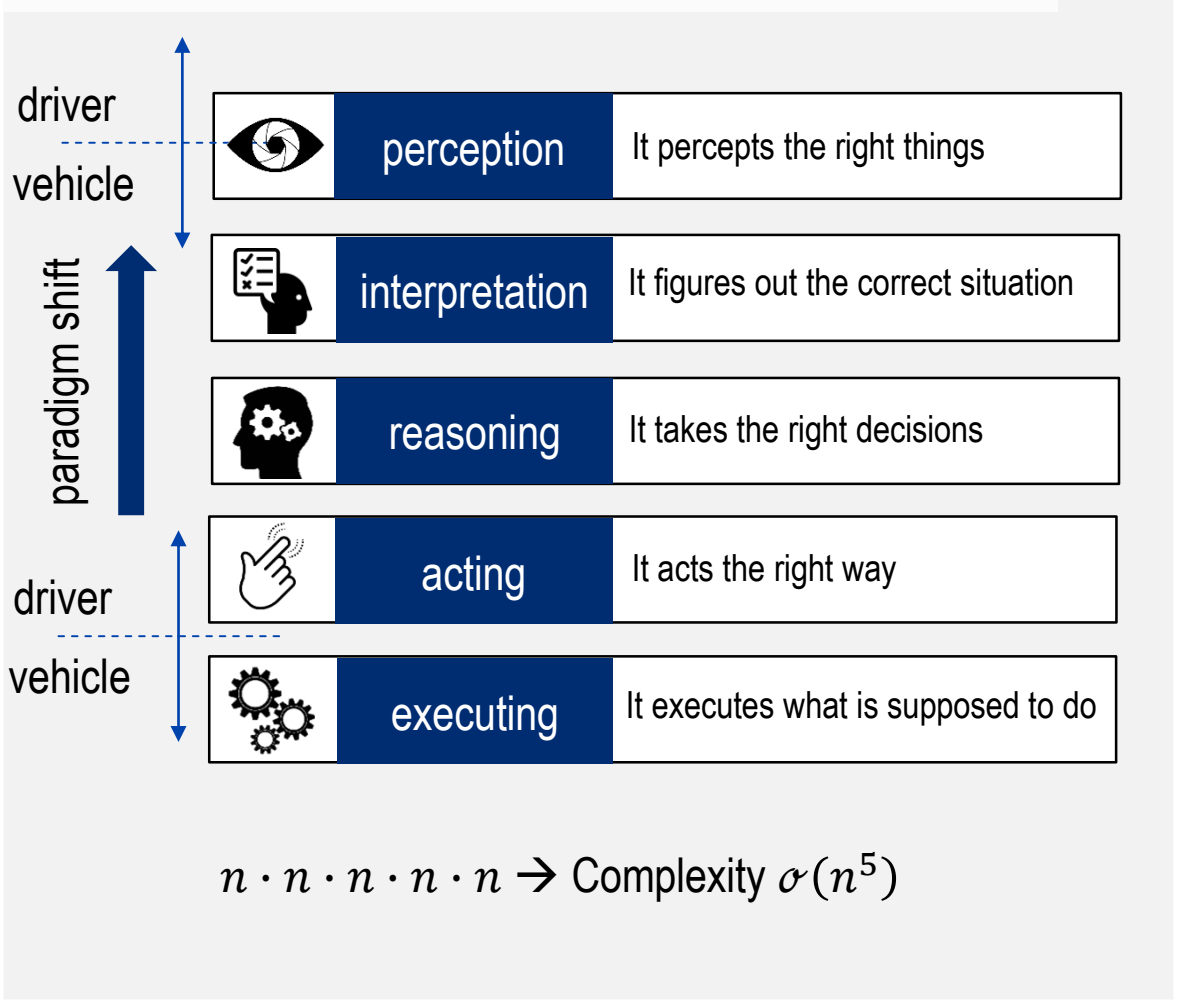
Computer and algorithms

Internet

users

Cyber Physical Systems and COMPLEXITY

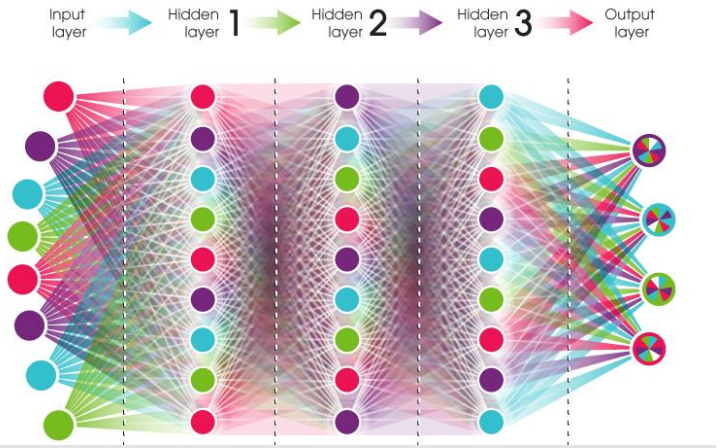




$n \cdot n \cdot n \cdot n \cdot n \rightarrow$ Complexity $\sigma(n^5)$

Is AI (Artificial Intelligence) safe?

Explainability

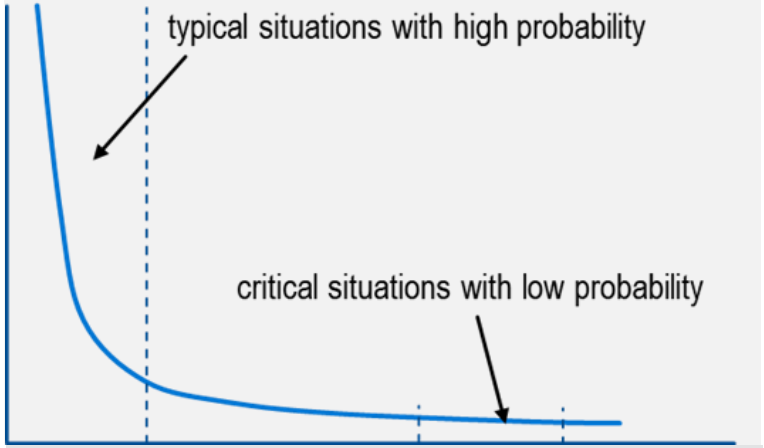


- The behavior of deep nets and deep learning are basically non explainable: it is like a human brain, we know it does work somehow but no one can exactly explain why ….

Forgetfulness

- You know how to get on a plane to fly on vacation. There you might collect new impressions and information. You still though know how to get on a plane to travel back home. A deep net might not. He might unlearn this after all the impressions newly collected …

Learning Critical Situations



- Critical situations are just too diverse and too rare to constantly learn from them …

Take a SIMPLE IDEA …

Maneuver / scenario data base
- description
- parameters
- fail/pass criteria (KPI)

subset for physical testing

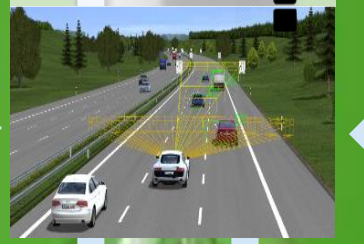
subset for homologation

subset for simulation testing

test track

real vehicle

simulation



virtual vehicle

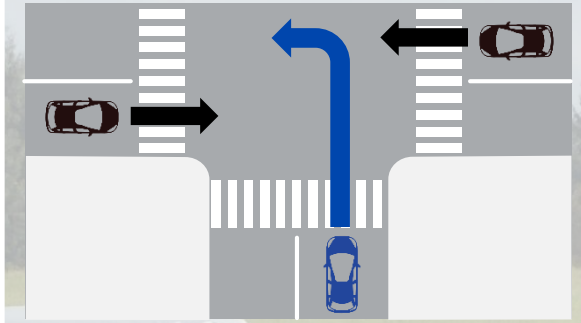
results: *m* vehicle variants X *n* scenario variants X …

A 6 Points Approach to realize this Idea to empower for Approval

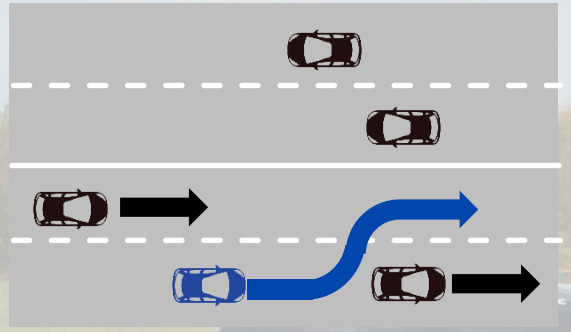
1 Establish SCENARIO-BASED TESTING as State of the Art

A scenario is a description of a driving situation

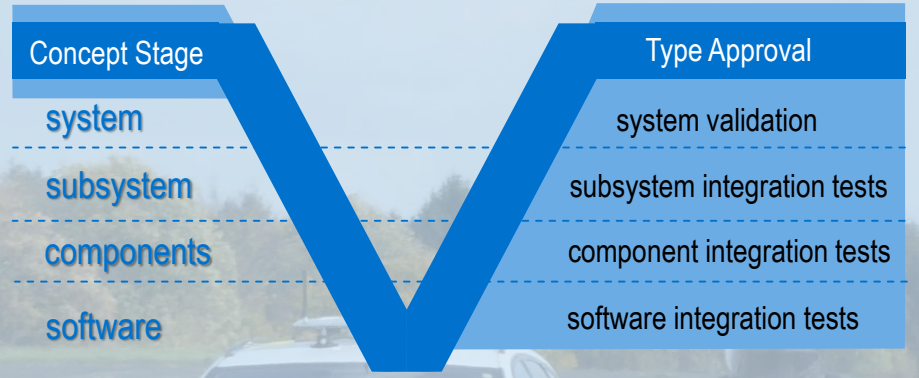
a) Left turn in road junction



b) Overtaking on a dual carriageway



Using scenarios from concept to approval



2

Show Me The

Data Base!!

Scenario Definition

- A uniform definition of scenarios and their respective abstraction layers is needed
- A universal scenario description should be provided and supervised

Availability and access

- Data base should be hosted by a neutral instance and made accessible by public (by everyone!)

Pass/Fail Criteria

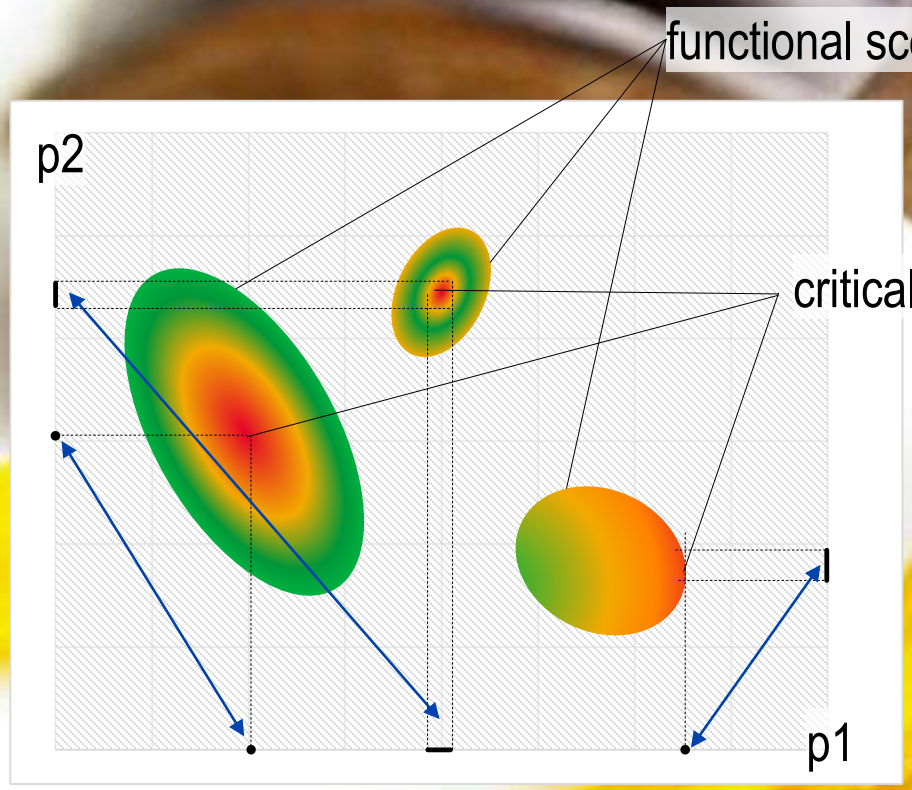
- Multiple criteria to be defined and associated to each scenario
- Relevance of pass/fail criteria to be defined by the use case (safety, comfort, customer experience, country & cultural relevance)

Monitoring and Supervision

- A committee and/or organization is to be defined that is responsible for updating and grooming the data base: increase, precise, delete, correct scenarios and pass/fail criteria

What is enough?

3 The CRITICALITY COVEARGE



Criticality Metrics

- A uniform definition of criticality metrics with respect to pass/fail criteria and the respective use case
- What are the most critical scenarios?

Criticality Coverage

- Define a criticality selection method
- Define a criticality threshold for validation and for verification

4 Use SIMULATION for Approval

Using simulation

- Enable the use of simulation in the homologation process, e.g.
  - UN/ECE R140 for the approval of Electronic Stability Control
  - UN/ECE R79 (new Release) for the approval of (automatic) steering
  - Next?
- Extend the purpose of simulation use to more then just variants verification to enable scale-out effects

Using the right simulation

- Obligate the validation of simulation tool and its trustworthiness as an integral part of the homologation process
- Define how to demonstrate the trustworthiness in
  - Perception (e.g. Sensor simulation)
  - Interpretation (e.g. sensor fusion)
  - Reasoning (e.g. decision algorithms)
  - Acting (e.g. E/E and control algorithms)
  - Executing (e.g. Vehicle Dynamics)
- Enforce standards for simulation and simulation interfaces, enforce affordable and/or open-source solution

5

Consider

FUNCTIONAL SAFETY Assessment

Industry					
International Standards	DO-178B/C	EN 50128 EN 50129	ISO 26262	IEC 62304	IEC 60880
Mandatory Submission of Documents to Regulator					
			Change This!		

Applying Functional Safety to AI


DO-178B/C


EN 50128
EN 50129


ISO 26262


IEC 62304


IEC 60880

Current standards of functional safety exclude explicitly non deterministic algorithms for being non adequate to control technical systems

Deep nets can adopt functional safety if the following principles hold:

- Exactness: algorithms should behave exactly as intended
- Traceability: all algorithms are well documented and traceable such that all errors can traced
- Quantitative predictability, e.g.
  - Critical system failure should be proven to happen just once in 1140 Years (!)

Make AI Verifiable and Certifiable

AI will be the enabling technology for SAE level 4 & 5 driving

framework for AI regulation, verification and certification is necessary

verification of AI is an unsolved challenge today

openGENESIS

Collaboration platform for assessment and certification of AI for autonomous driving – “TÜV for AI”

Mission

- Provide knowledge and tools for the assessment of AI
- Prove AI to be safe and roadworthy before deployed to public road

Added Value

- Lean collaboration platform for leveraging knowledge among members
- Establishes strong global exchange between industry, research and regulators

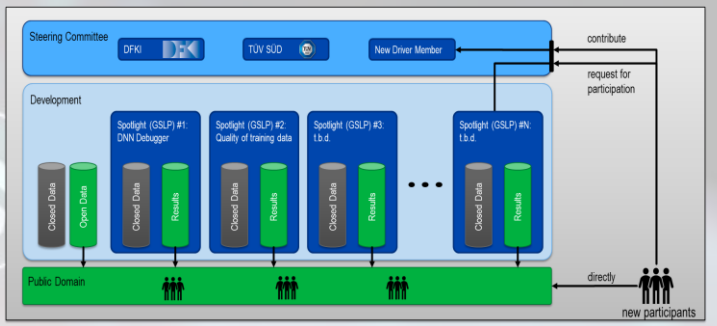
Current Status

- Founding process with Eclipse Foundation ongoing
- Charta released and approved.

Next steps

- First openGENESIS Face-to-Face Meeting (30th of April 2019)
- Start more technical projects (Spotlight Projects) and become productive

Structure



Potential Partners

German Research Center for Artificial Intelligence

ECLIPSE FOUNDATION

AUTONOMOUS INTELLIGENT DRIVING

iMotion.ai

The MathWorks

AMOTIVE

Close the Loop by

6 REAL-WORLD DRIVING

Event Data Recorder

- Obligate the integration of Event Data Recorder in automated vehicles
- Define the set of necessary data to be logged for safety monitoring and accident reconstruction

Real-World Driving (Field Tests)

- Define categories, e.g. highway, city center, suburbs, rural areas, etc..
- Manufacturers conduct supervised/witnessed real-world driving tests

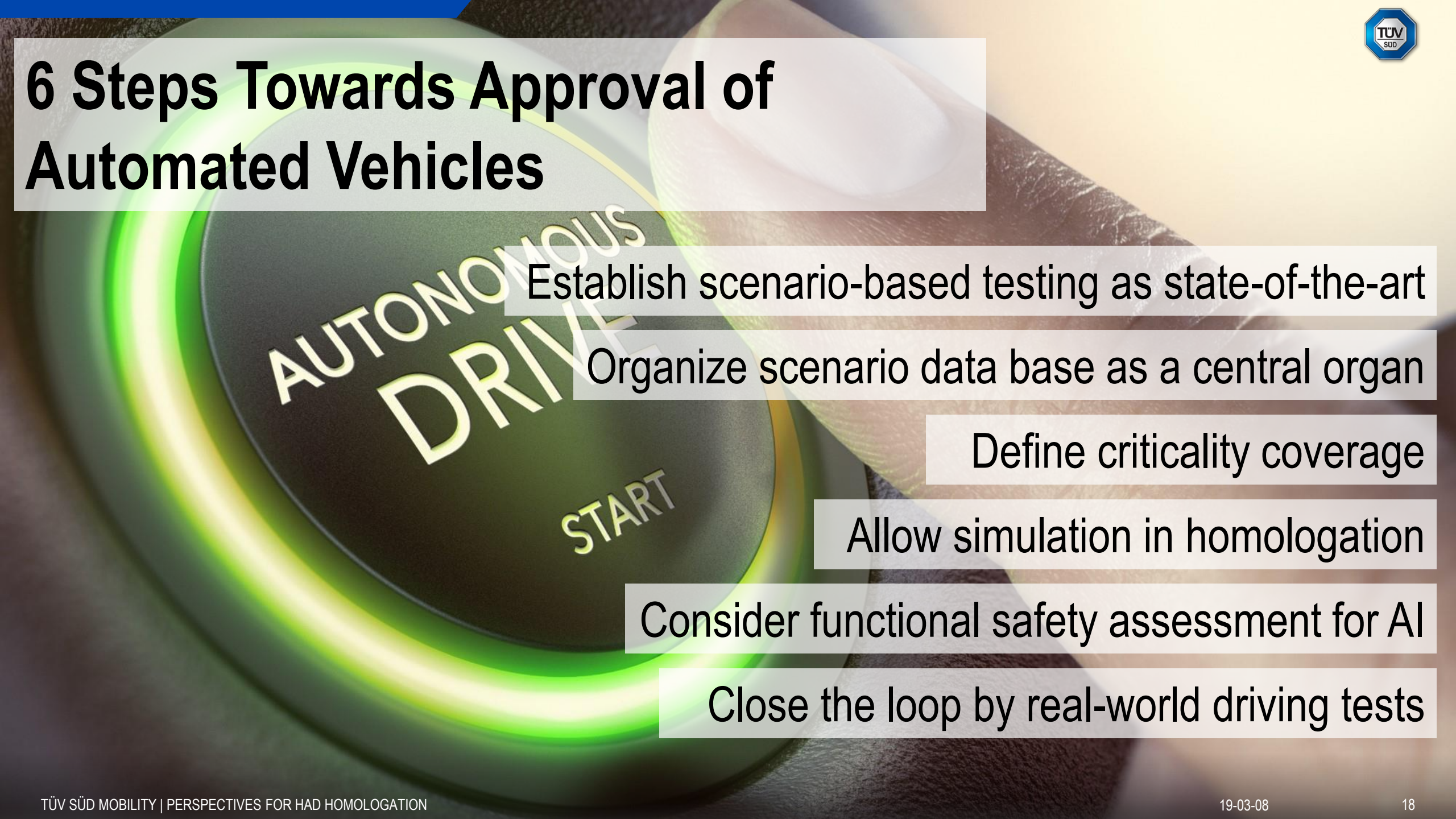
Feedback into Homologation

- All approval related and relevant field tests to be documented and to be submitted with logged data
- Submit data to scenario supervision committee (see Point 1)

Critical Issues

- In case of critical issue, consider this in the product correction
- Provide proof of consideration with test results, e.g. simulation, real vehicle testing

6 Steps Towards Approval of Automated Vehicles



Establish scenario-based testing as state-of-the-art

Organize scenario data base as a central organ

Define criticality coverage

Allow simulation in homologation

Consider functional safety assessment for AI

Close the loop by real-world driving tests

… and we can skip plan B

Source: https://de.upost.info/31383037343032393936