# Research project PEGASUS

EFFECTIVELY ENSURING AUTOMATED DRIVING.

PEGASUS

Supported by:

Federal Ministry
for Economic Affairs
and Energy

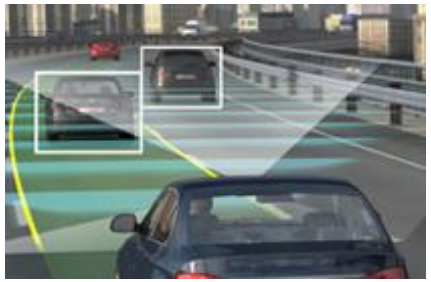
on the basis of a decision
by the German Bundestag

# Key Figures

| | |
|---|---|
| 42 Months Duration | January 1, 2016 – June 30, 2019 |
| 17 Partners | ▪ OEM: Audi, BMW, Daimler, Opel, Volkswagen<br>▪ Tier 1: Automotive Distance Control, Bosch, Continental Teves<br>▪ Test Lab: TÜV SÜD<br>▪ SME: fka, iMAR, IPG, QTronic, TraceTronic, VIRES<br>▪ Scientific institutes: DLR, TU Darmstadt |
| 12 Subcontracts | ▪ i.a. IFR, ika, OFFIS |
| Project Volume | ▪ approx. 34,5 Mio. EUR<br>▪ Funding: 16,3 Mio. EUR |
| Personnel Deployment | ▪ approx. 1.791 man-month or 149 man-years |

# Current State of Development of HAD

## Prototypes

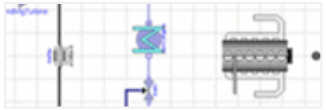





## Lab / Proving Ground

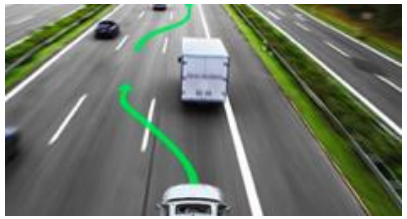







## Products




current status

# Current State of Development of HAD

## Prototypes

- Multitude of prototypes built by OEM with HAD-functionality
- Evidence, that HAD is technologically possible
- Partially tested in real traffic situations
- Test drives involve backup safety driver at all times

## Lab / Proving Ground

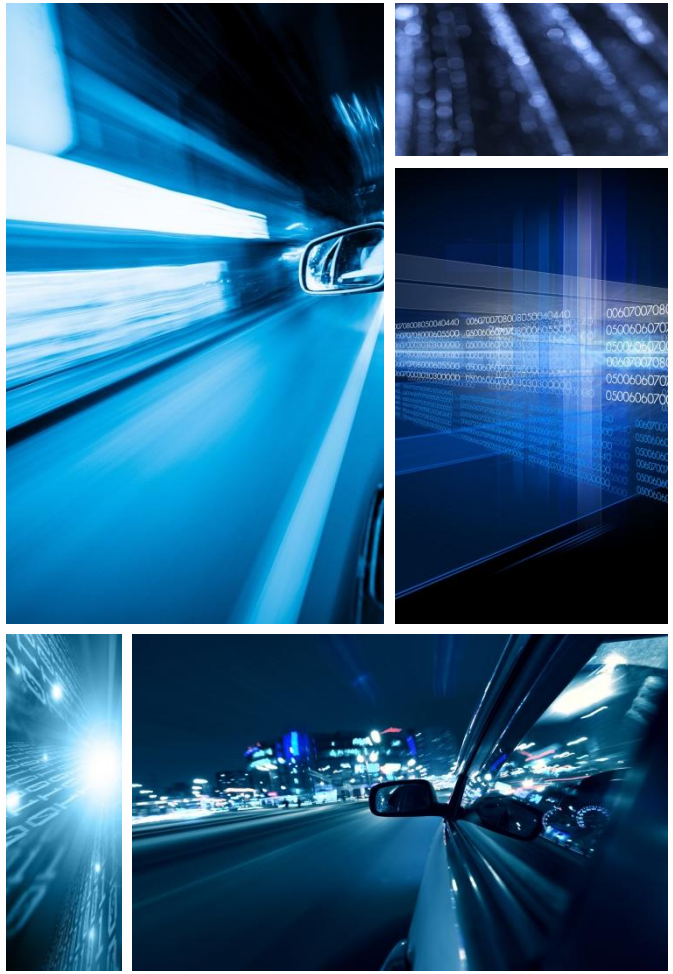
- Individual analyses to optimize prototypes
- Current test methods/ proving grounds do not provide enough test coverage for all HAD features currently in focus
- There is no procedure for adequate testing (particularly performance) of HAD-systems

## Products

- No release or introduction of variety of HAD features without sufficient assurance

# PEGASUS - Selected Goals of the Project

- Development of a procedure for the determination of design criteria and establishment of quality measures.
- Considering the driver in regards to his abilities.
- Design of the development process for the release of highly automated vehicle systems.
- Conceptual design, assembly and demonstration of building blocks for an efficient tool chain for simulation, proving ground and field test.
- Embedding of findings into the industry.
- Distribution and pioneering of standardization.



# Central Issues of the Project

**What level of performance is expected of an automated vehicle?**
**How can we verify that it achieves the desired performance consistently?**

## Scenario Analysis & Quality Measures

- What human capacity does the application require?
- What about technical capacity?
- Is it sufficiently accepted?
- Which criteria and measures can be deducted from it?

## Implementation Process

- Which tools, methods and processes are necessary?

## Testing

- How can complete-ness of relevant test runs be ensured?
- What do the criteria and measures for these test runs look like?
- What can be tested in labs or in simulation? What must be tested on test grounds, what must be tested on the road?

## Reflection of Results & Embedding

- Is the concept sustainable?
- How does the process of embedding work?

# SP 1 Scenario Analysis and Quality Measures

**Deduction of requirements**
based on the accepted measure of quality

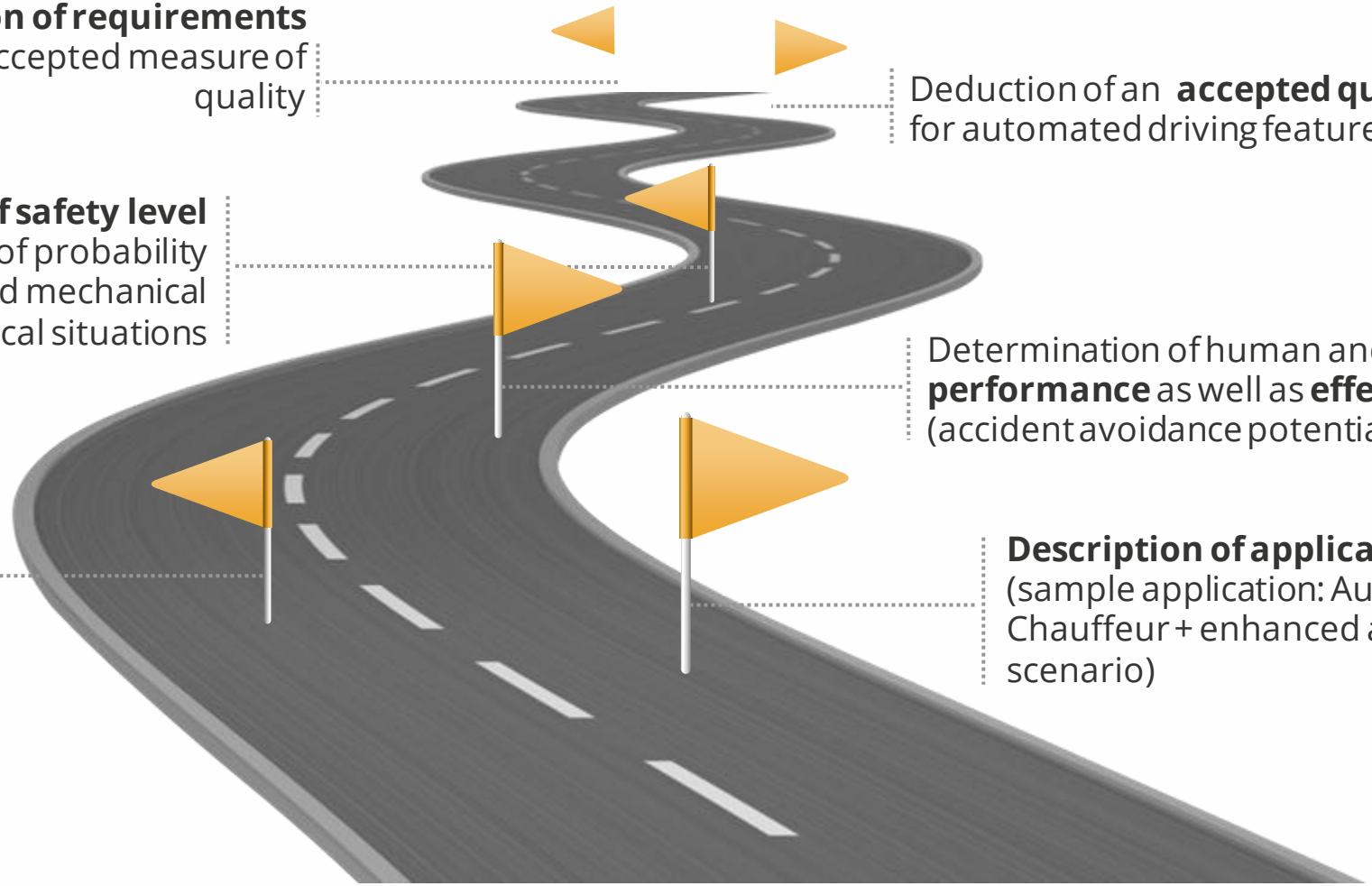
Deduction of an **accepted quality measure** for automated driving features

**Determination of safety level**
through assessment of probability of occurrence and mechanical manageability in critical situations

Determination of human and mechanical **performance** as well as **effectiveness** (accident avoidance potential)

Determination of critical **traffic situations**

**Description of application scenario**
(sample application: Autobahn-Chauffeur + enhanced application scenario)



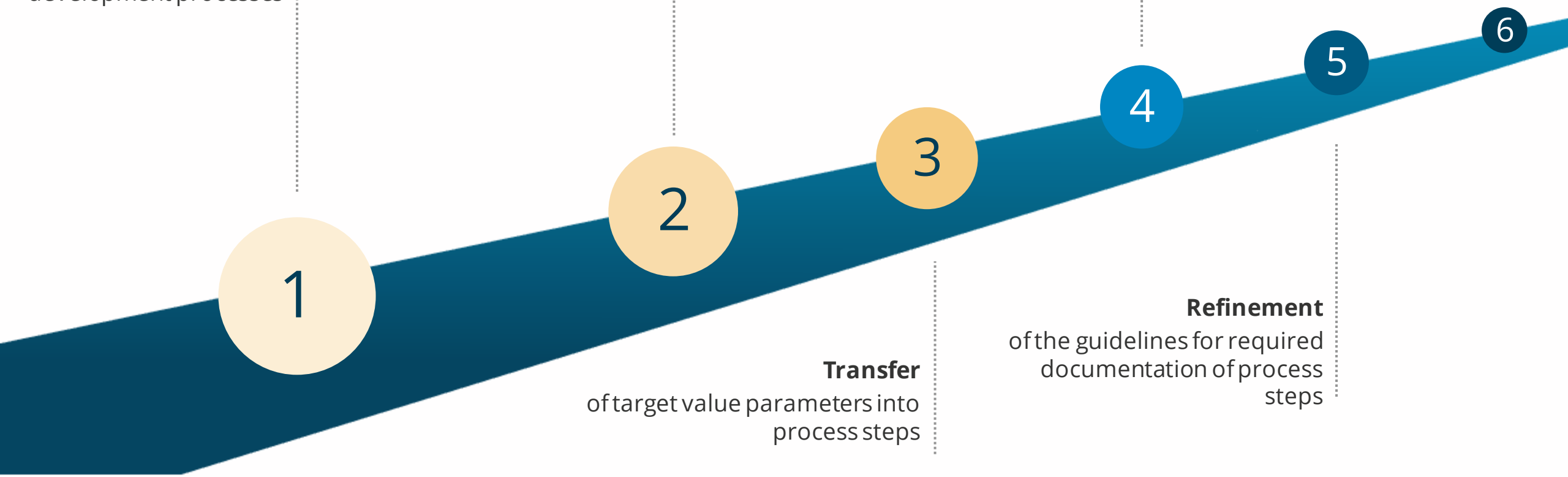
# SP 2 Implementation Process

**Analysis**
of modification needs of existing metrics and automobile series development processes

**Transfer**
of systematic scenario guidelines into process steps in consideration of system classifications and levels of vehicle utilization

**Preparation**
of requirements definition for simulation, lab tests, testing ground and field coverage

**Guidelines and Protocols**
for the documentation of technological state-of-the-art compliance during the development process




**Transfer**
of target value parameters into process steps

**Refinement**
of the guidelines for required documentation of process steps

# SP 3 Testing

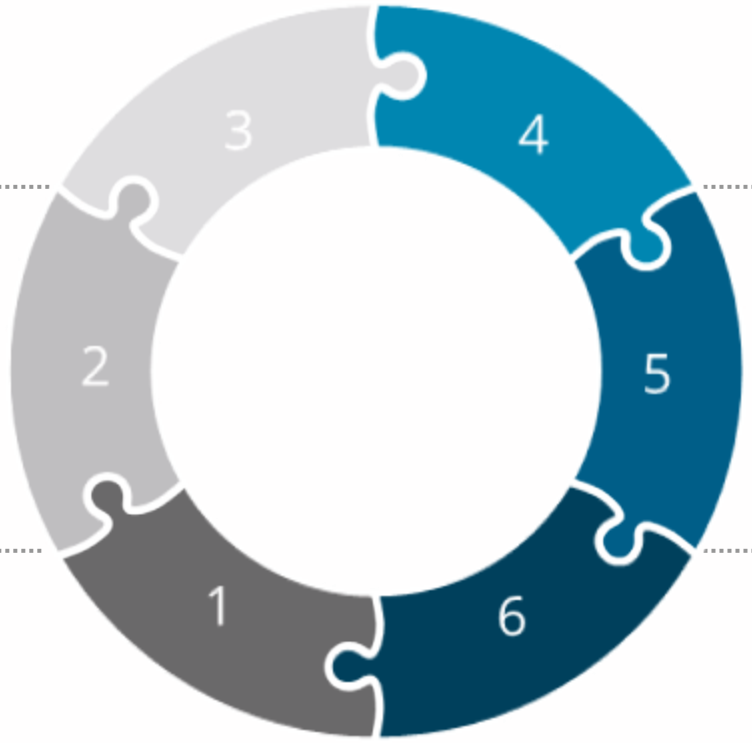
- Detailing and completion of test scenarios of subproject 1, including technical quality measures as well as approval criteria
- Construction and filling of test specification database
- Establishment and verification of testing methods, interfaces, tools in the lab, on testing grounds and in real traffic
- Development and coordination of industrywide established models, tools and interfaces for the simulation
- Compilation of a test catalog and requirements for lab, testing ground and field coverage
- Construction of reference elements for practical testing and demonstration of functions
- Testing in the lab, on proving grounds and on the street

# SP 4 Reflection of Results & Embedding

**Statement**
about the distribution ratio between the applied test methods (from simulation to testing ground to field test)

**Assessment,**
whether the test goal can be achieved with the utilized processes and methods in PEGASUS

**Verification**
of methods to identify relevant situations, quality and criticality measures for the assurance of HAD features




**➔Proof of Concept**

**Assistance**
with embedding of acquired results with our project partners

**Lessons learned**
regarding the implementation of the results in existing corporate structures

# Summary

- Testing and validation of automated vehicles requires new methods and tools for an efficient safeguarding process.
- Core element of the circuit process is a database and a data processing chain for the relevant scenarios.
- Available and known methods and tools can be utilized in the overall circuit process and therefore increase effectiveness.
- The data processing chain needs to be able to process different data sources and heterogeneous data quality in order to provide common test specifications.
- The presented database concept allows an efficient processing of high data volumes by means of a flexible tool chain.

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