

**VERIFICATION
VALIDATION
METHODS**

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VV-Methods

Towards a comprehensive framework for AD safety assurance

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Supported by:



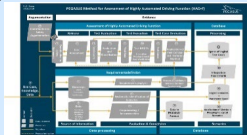
on the basis of a decision
by the German Bundestag

- ▶ The **PEGASUS Family** -publicly-funded projects in Germany focuses on development / testing methods and tools for AD systems on highways and in urban environments

PEGASUS

<https://www.pegasusprojekt.de/en/home>

- Scope: **Basic methodological framework**
- Use-Case: L3/4 on highways
- Partners: 17



VV-Methods



- Scope: **Methods, toolchains, specifications for technical assurance**
- Use-Case: L>=3 in urban environments
- Partners: 23 partners
- Timeline: 07/2019 – 06/2023



SET Level



- Scope: **Simulation platform, toolchains, definitions for simulation-based testing**

2016

2019

Time →

Goals - more close



Goal IV – Argumentation

- ▶ Explainable Compliance

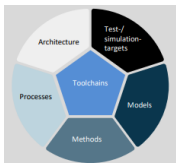


Goal I Systematic control of test space

- ▶ Understand relevant hazardous phenomena
- ▶ Involve traffic-law perspective
- ▶ Identify a target behavior & ODD

Goal II Consistent interfaces

- ▶ Systematic breakdown of technical contracts, requirements & tests
- ▶ Common interfaces for component exchange



Feasibility



Efficiency

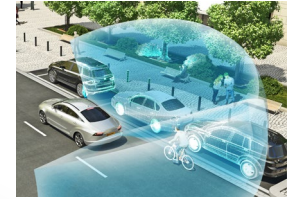
Control of ODD

System Decomposition

V&V Distribution & Generation

Goal III Shift to simulation

- ▶ Seamless use of virtual and real artefacts
- ▶ Efficient integration of simulation into the test-infrastructure



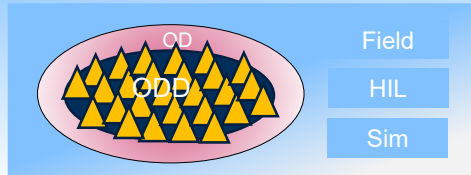
Changeability

Main Approach

Classic

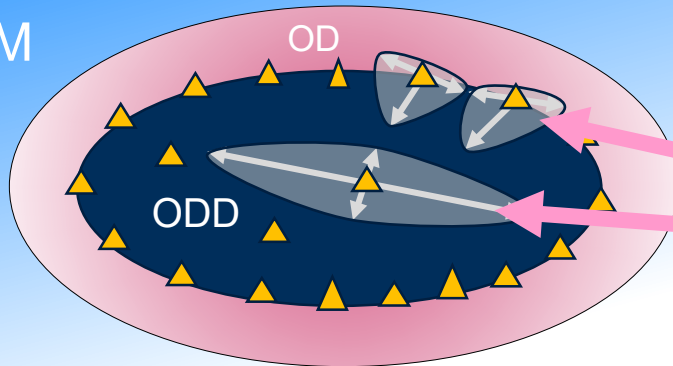
▶ Brute force: x million miles

Pegasus



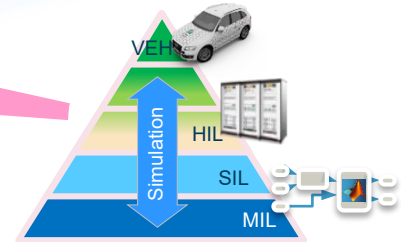
▶ ODD decomposition & initial argumentation

VVM



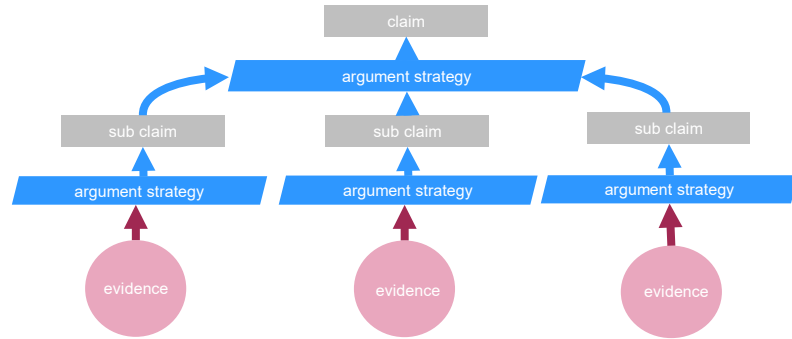
▶ ODD more complex
▶ Systematic argumentation of coverage

Argumentation



▲ full system test

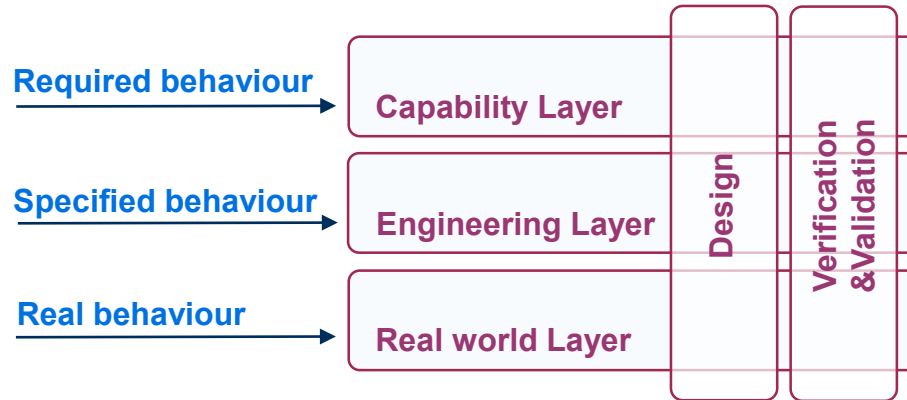
Assurance Argumentation & Framework



Assurance Argumentation

- Enabler for traceable decomposition of claims and thus for explainable compliance.

Perspective of assurance argumentation

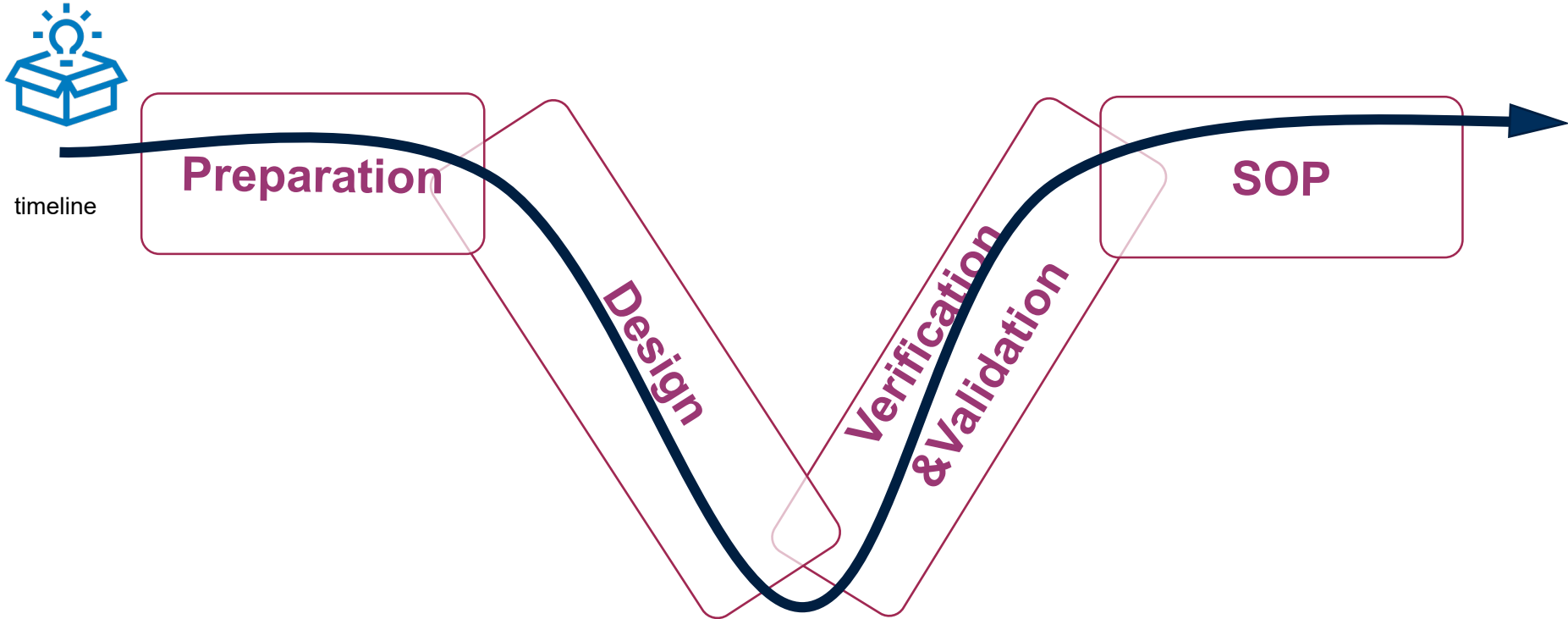


Argumentation Framework

- Structure the elements of Development & Operation with Design and V&V so that a consistent assurance argumentation based on **different perspectives** is possible.

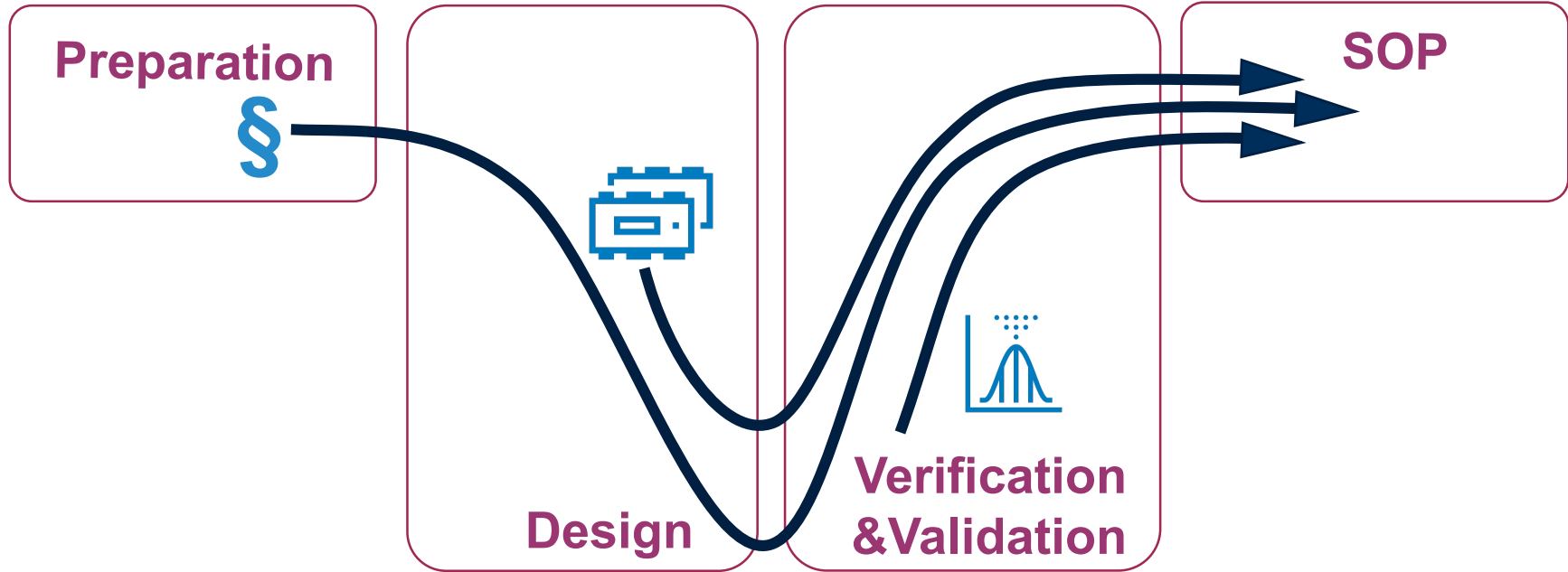
Rational Changeability

- Status Quo V-Modell: optimized for single SOP, less changes





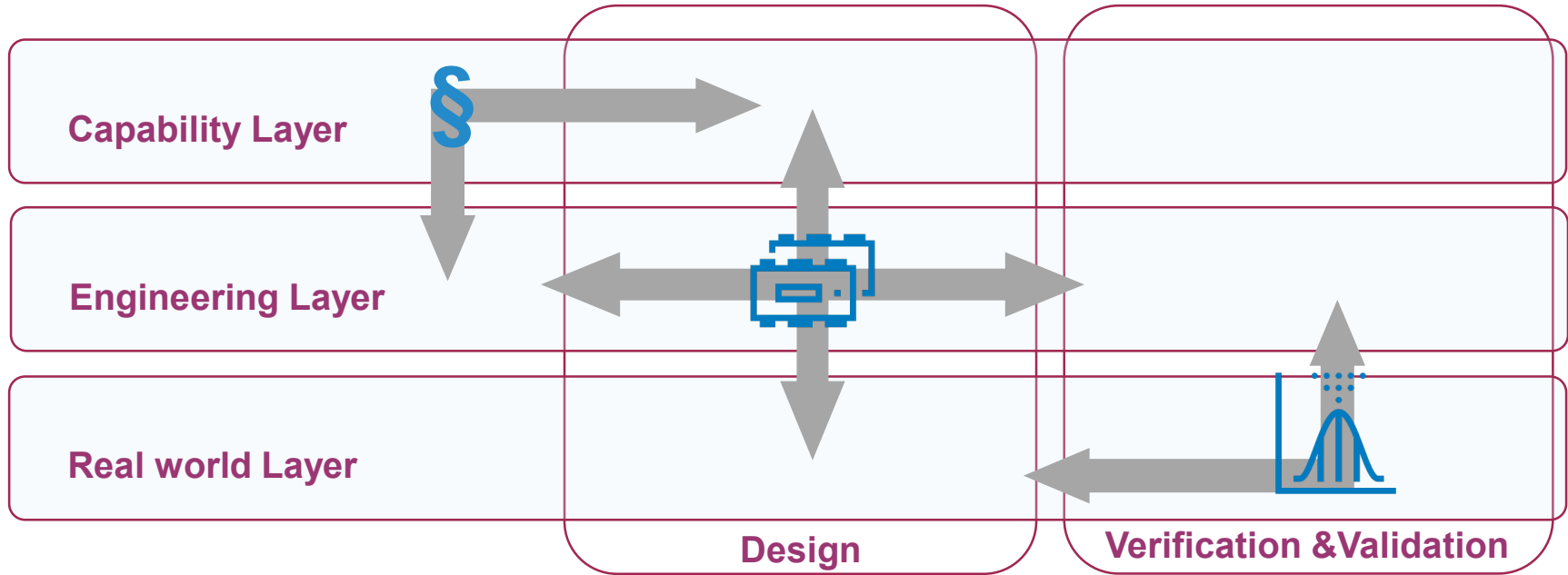
Rational Changeability

► How to ensure consistency of safety argumentation and efficient workflow for changes ?



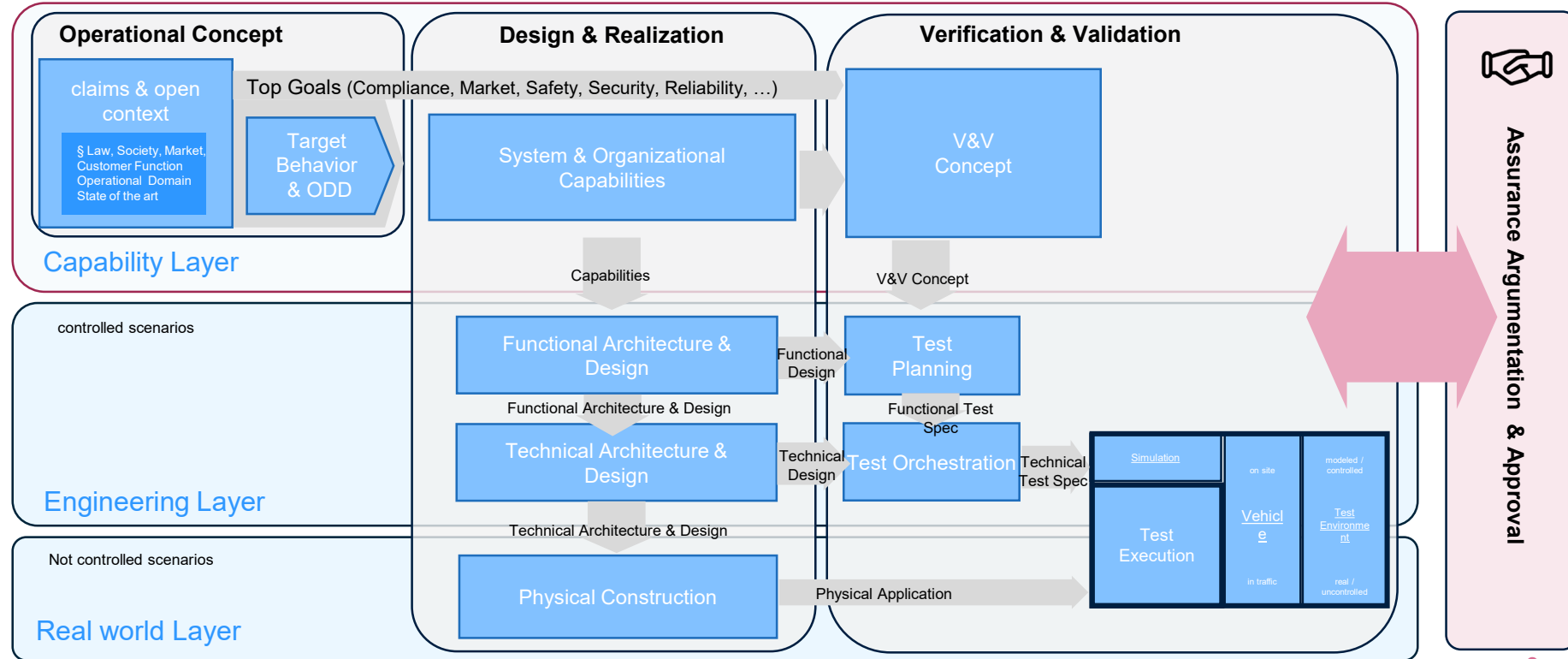
Rational Changeability

- ▶ Harmonized interfaces will support both:
 - ▶ Efficient workflow for changes in development and operation 
 - ▶ Consistency of Safety argumentation 



Assurance Framework

► Synchronisation of interfaces between Argumentation / DevOp/ Design and V&V.



- ▶ An **assurance argumentation** enables **explainable compliance** by consistent and traceable decomposition from claims down to verification & validation.



- ▶ The **assurance framework** delivers the evidences according to the argumentation by connecting results of methods via defined interfaces.





**Thank you for your attention!
Time for Questions.**

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Federal Ministry
for Economic Affairs
and Energy