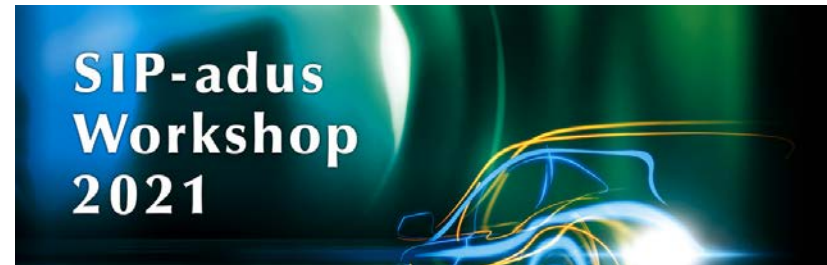


Roland Galbas, Coordinator of VVM

Senior Manager System Development Robert Bosch GmbH
Coordinator of research projects

A contribution to SIP-adus Workshop 2021 by the German
Verification and Validation Methods project (VVM)



VV-METHODS PEGASUS family – Publicly-funded projects in Germany

- ▶ The **PEGASUS Family** 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 \geq 3 in urban environments
- Partners: 23 partners
- Timeline: 07/2019 – 06/2023

SET Level



- Scope: **Simulation platform, toolchains, definitions for simulation-based testing**
- Use-Case urban environments
- Partners: 20 partners
- Timeline: 03/2019 – 08/2022

+ future projects of the PEGASUS Family

2016

2019

Time →

2

VV-METHODS – Project setup

- ▶ **Funded by** Ministry of Economics and Technology (BMWi)
- ▶ **Start, Runtime** 07/2019, 4 years
- ▶ **Budget total** 47M€
- ▶ **Partners**

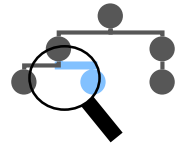
OEM	
Tier-1	
Tech	
Eval	
Science	



Thanks to Federal
Ministry for Economic
Affairs and Energy of
Germany.

Approach

- ▶ **Objective – methodological framework – release**
 - ▶ Consider all relevant **societal claims** as laws/standards & **market proposition** in a **common process**.
 - ▶ Focus on **resilience** in **open context** over the complete **life cycle** (development & operation).
- ▶ **Strategy**
 - ▶ Use **different perspectives** and **appropriate levels of abstraction**.
 - ▶ Combine **development & operation** with Design, Verification&Validation via an **assurance argumentation**.
 - ▶ An **assurance argumentation** enable **consistency and traceability**, prepared for **changes** over life cycle.

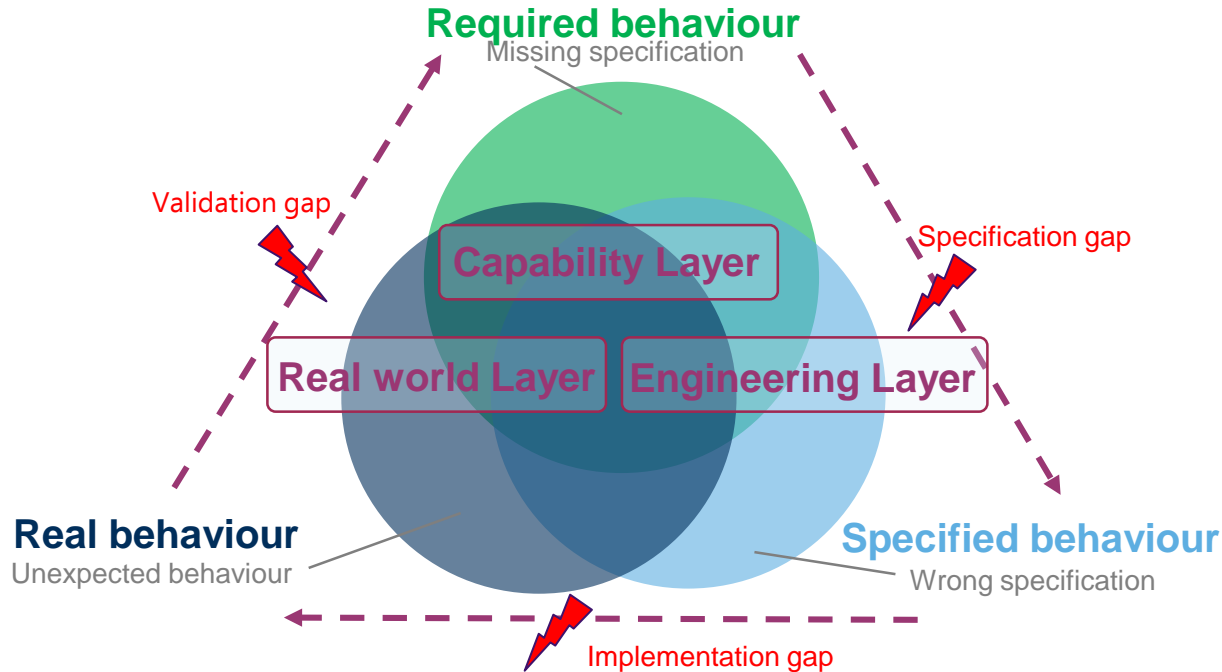


Approach - Argumentation Framework - perspectives

- Use different perspectives and appropriate levels of abstraction.

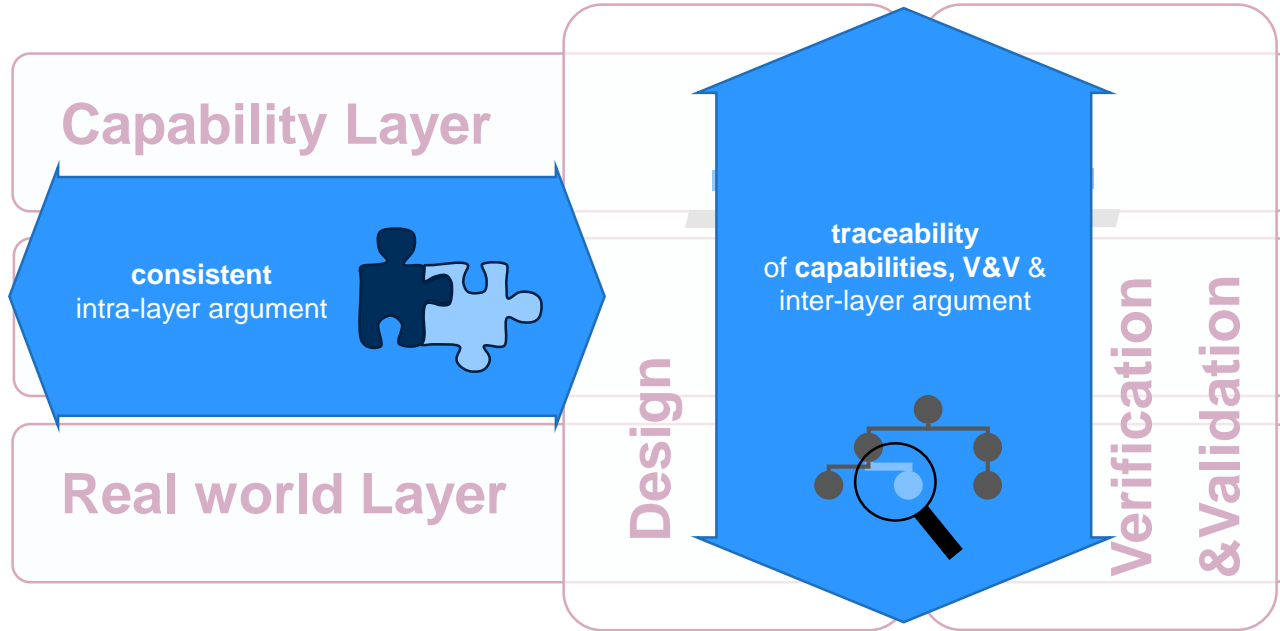


perspectives



Argumentation Framework

- ▶ Use different perspectives and **appropriate levels (layers) of abstraction**.
- ▶ Combine **development & operation** with Design, Verification & Validation via an **assurance argumentation**.
- ▶ Assign process interfaces **prepared for changes**



perspectives



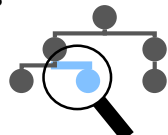
assurance argumentation



changes



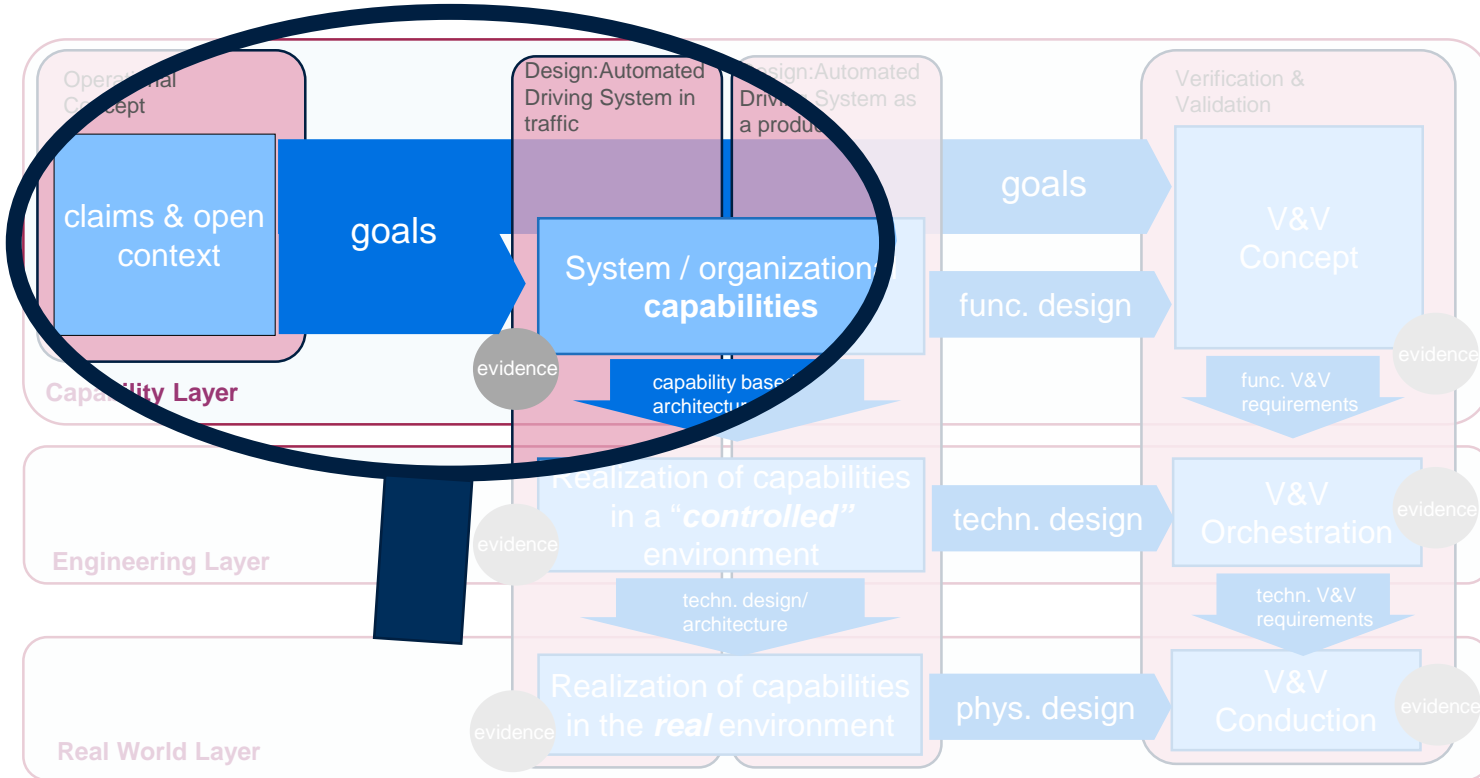
consistency



traceability

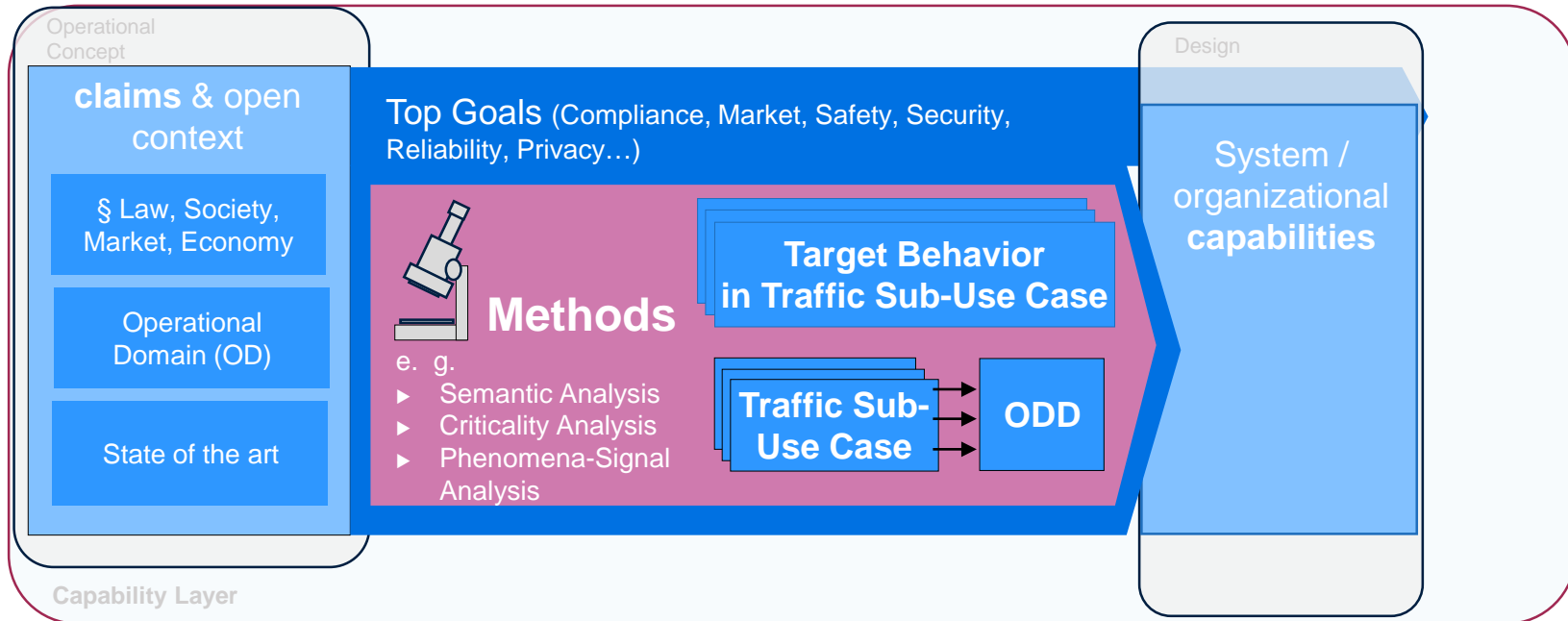
Argumentation Framework - Elements

- ▶ Layers and domains interact.
- ▶ Iterative steps enable convergence of elements.

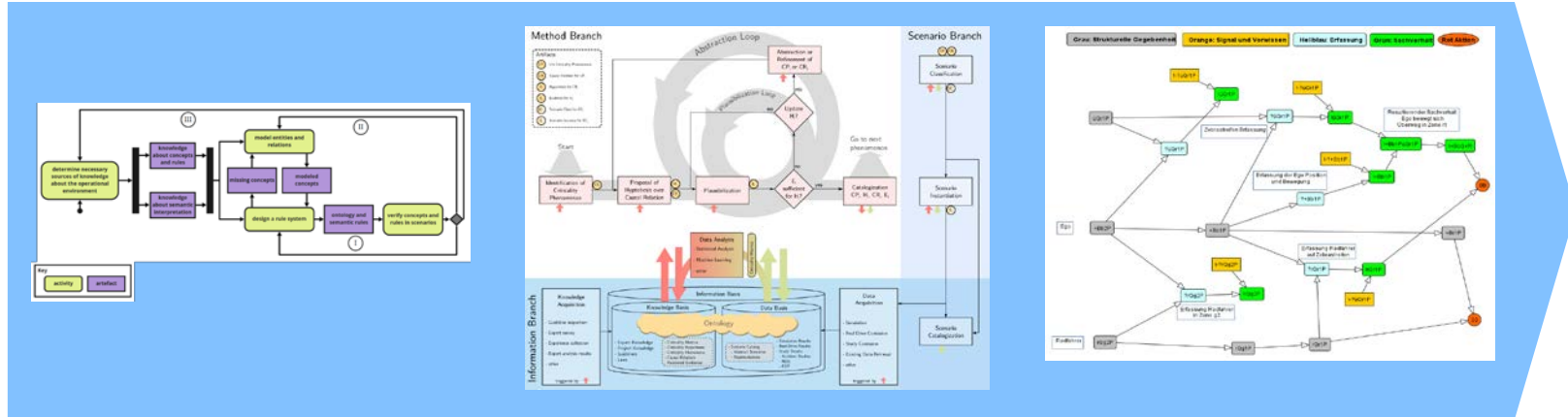
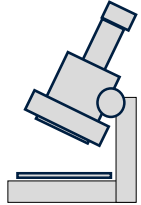


From claims to capabilities

- ▶ Exemplary flow: Target Behavior / Sub use cases / ODD are steps to define capabilities.
- ▶ New methods for analysis have been developed.



► Exemplary Analysis Methods



► Semantic Analysis

understand the perspective of law concerning scenarios and their ontology.

► Criticality Analysis

Identification and causal analysis of traffic phenomena associated with criticality.

► Phenomena-Signal Analysis

understand and assess the interexchange of traffic by decisions, sequences, law and traffic-phenomena based on the information flow.

- ▶ **Enabler for consideration of societal /market claims and resilience in open context**
 - ▶ **Argumentation Framework** enables **iterative development** and thus convergence of results from different **perspectives**.
 - ▶ The **Assurance Argumentation** builds a backbone for **traceable decomposition** of claims. This enables efficient **post-release** when changes appear in the **open context**.
 - ▶ The abstract **capability-based architecture** combines **system and organization** to achieve a **consistent argumentation**.
 - ▶ Developed **methods** comply to **relevant industry standards**.
- ▶ **Next Steps**
 - ▶ Exemplary application of the methodical chain.
 - ▶ Further development of new methods and integration of existing methods.
 - ▶ Getting feedback and harmonization with existing approaches.