

# SIS 19

“Tools and methods  
for validation and  
deployment of  
automated driving”

## Hall B6 – Room 2 - 14:00 – 15:30

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## Session SIS 19 – Main thesis

**“One important step enabling large scale homologation and deployment of automated driving is a shift from real world tests into virtual testing procedures and environments. Harmonized simulation toolchains, a common understanding of scenario descriptions and its metrics as well as an assessable safety argumentation including formal descriptions are essential to reach this goal.”**

**“This session combines speakers from all around the world who are tackling this challenge by providing tools, methodologies, concepts, architectures, specifications and taxonomies to transfer real and virtual tests into assessable metrics and to share proof of concepts for verification and validation of automated vehicle functionalities”**

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# Session SIS 19 – Speakers and presentations

**Frank Köster, DLR - Simulation-Based Testing of Automated Driving Functions – selected Results of the SET-Level Project to enable Simulation as a Service**

**Roland Galbas, Bosch: VVM - Towards a comprehensive framework for AD safety assurance**

**Satoshi Taniguchi, JAMA - Sakura database to enhance automated driving safety and development speed (Video presentation)**

**Adrian Zlopcki, ika - Sharing scenario databases for CAD assurance**

**Álvaro Arrúe - HEADSTART - validation procedures and scenario databases for CAD deployment**

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# SIS 19 AGENDA

14:00 – 14:10 Henning Mosebach DLR (GER)

14:10 – 14:20 (+5) Frank Köster DLR (GER)

14:25 – 14:35 (+5) Roland Galbas, Bosch (GER)

14:40 – 14:50 Satoshi Taniguchi, JAMA (JAP)

14:50 – 15:00 (+5) Adrian Zlocki (GER)

15:05 – 15:15 (+5) Álvaro Arrúe, IDIADA (ESP)

15:20 – 15:30 Discussion

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# VVM - Towards a comprehensive framework for AD safety ensurance

2

Roland Galbas

Senior Manager System Development  
Robert Bosch GmbH  
Coordinator of research projects



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# Short text for the online program

Roland Galbas, Bosch: results of VVMMethods (PEGASUS Family) - overall framework and methodology to release and operate highly automated vehicles.

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# Long text for the online program

One important step enabling large scale homologation and deployment of automated driving is a consistent framework of methods mastering the complexity of release and operation of highly automated vehicles within an open context environment.

Such a framework combines design and verification&validation by a safety argumentation, it also enable a shift from real world tests into virtual testing procedures and environments. Harmonized simulation toolchains, a common understanding of scenario descriptions and its metrics.

This session combines speakers from all around the world that are tackling this challenge by providing methodologies, concepts, architectures, specifications and taxonomies to share proof of concepts for verification and validation of automated vehicles.

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# 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: L4/5 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 →



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

OEM	
Tier-1	
Tech	
Eval	
Science	



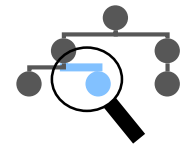
Thanks to Federal Ministry for Economic Affairs and Energy of Germany.

## ▶ 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).

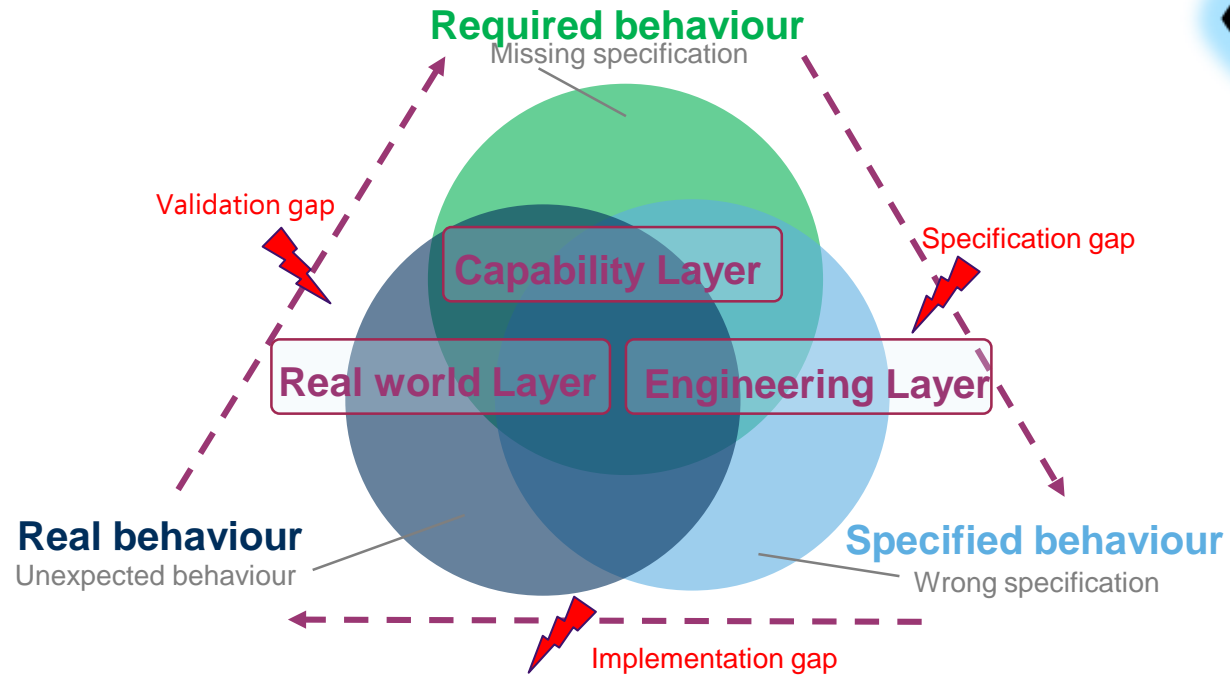
## ▶ Strategy

- ▶ Use **different viewpoints** and **appropriate levels of abstraction**.
- ▶ Combine **development & operation** with Design, Verification&Validation via an **assurance argumentation**.
- ▶ An **assurance argumentation** enable **consistency and traceability** over life cycle.



# Layer structure - viewpoint approach

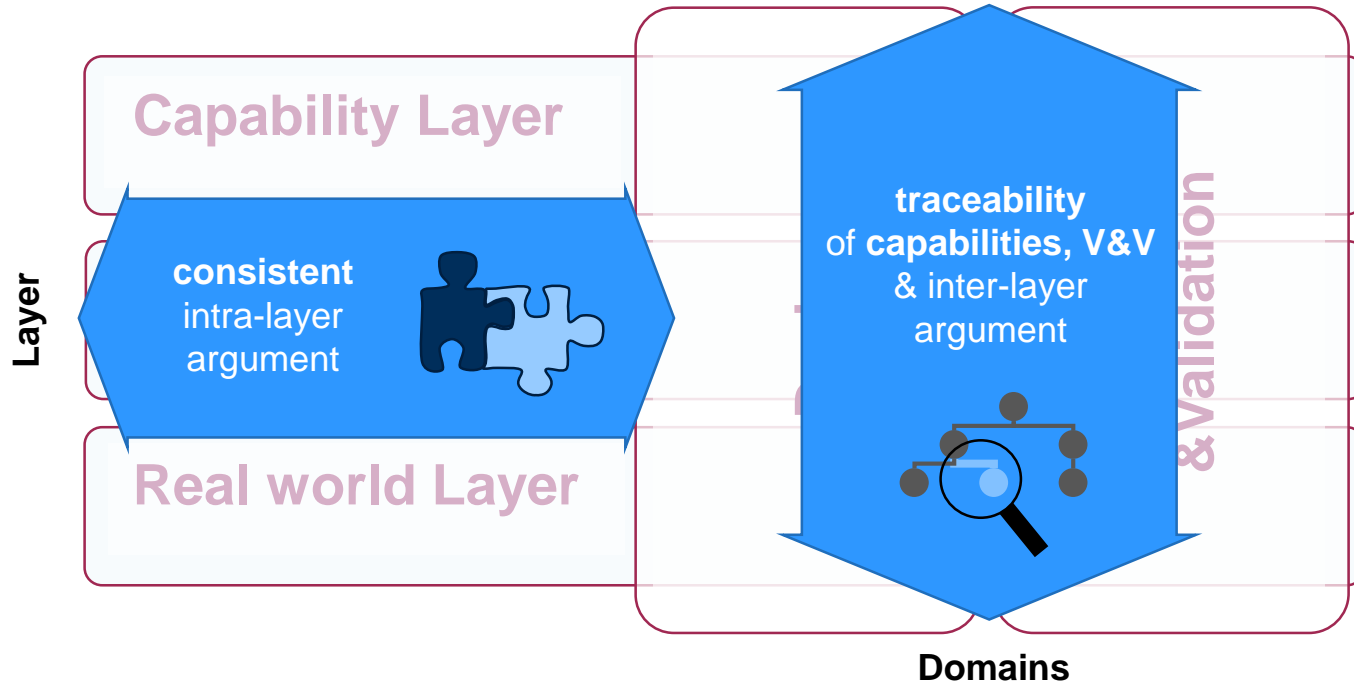
- Use different viewpoints and appropriate levels of abstraction.



(Brade, Stellet 2021 with minor changes)

# Layer structure

- ▶ Use different viewpoints and **appropriate levels of abstraction**.
- ▶ Combine **development & operation** with Design, Verification&Validation via an **assurance argumentation**.



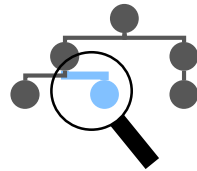
viewpoints



assurance argumentation



consistency

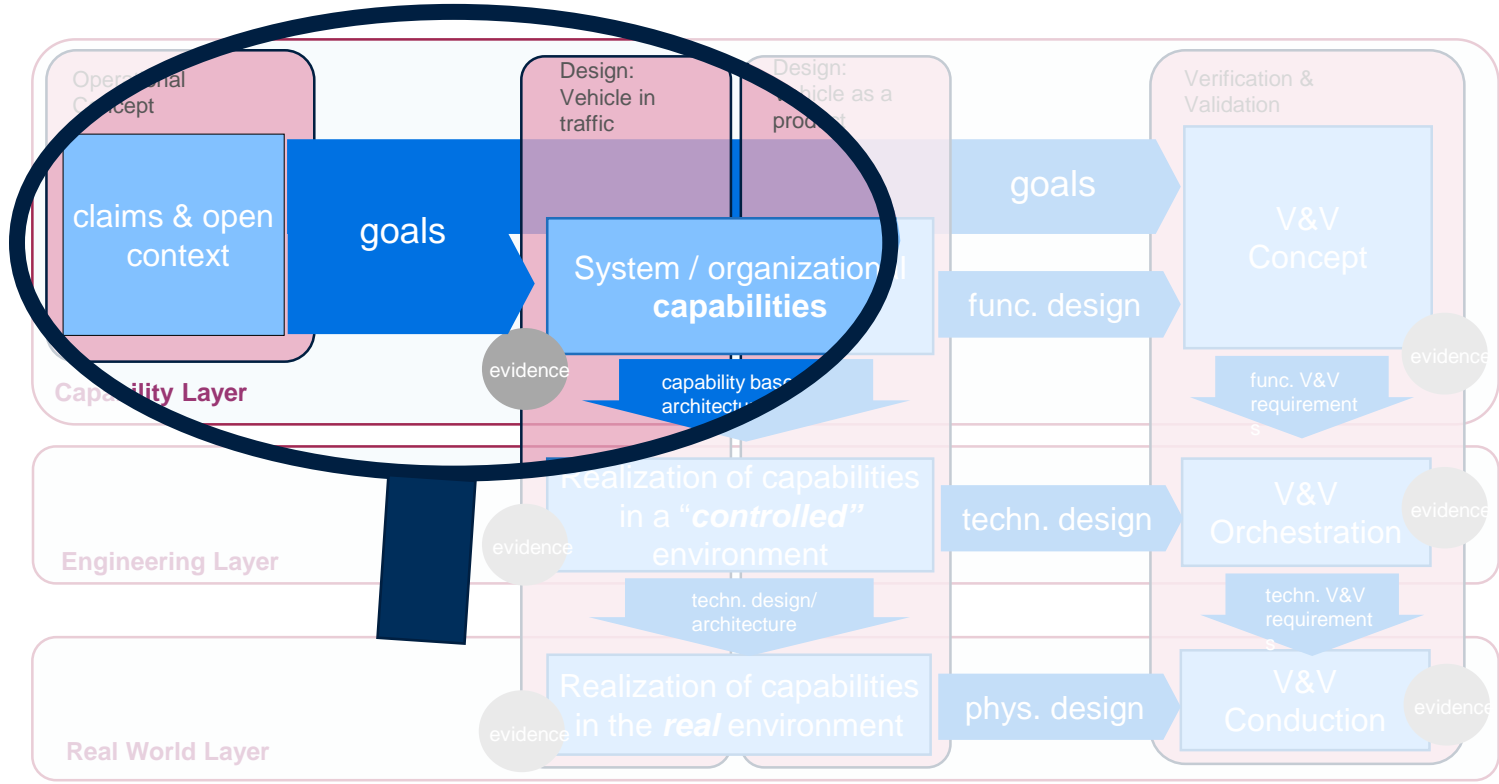


traceability

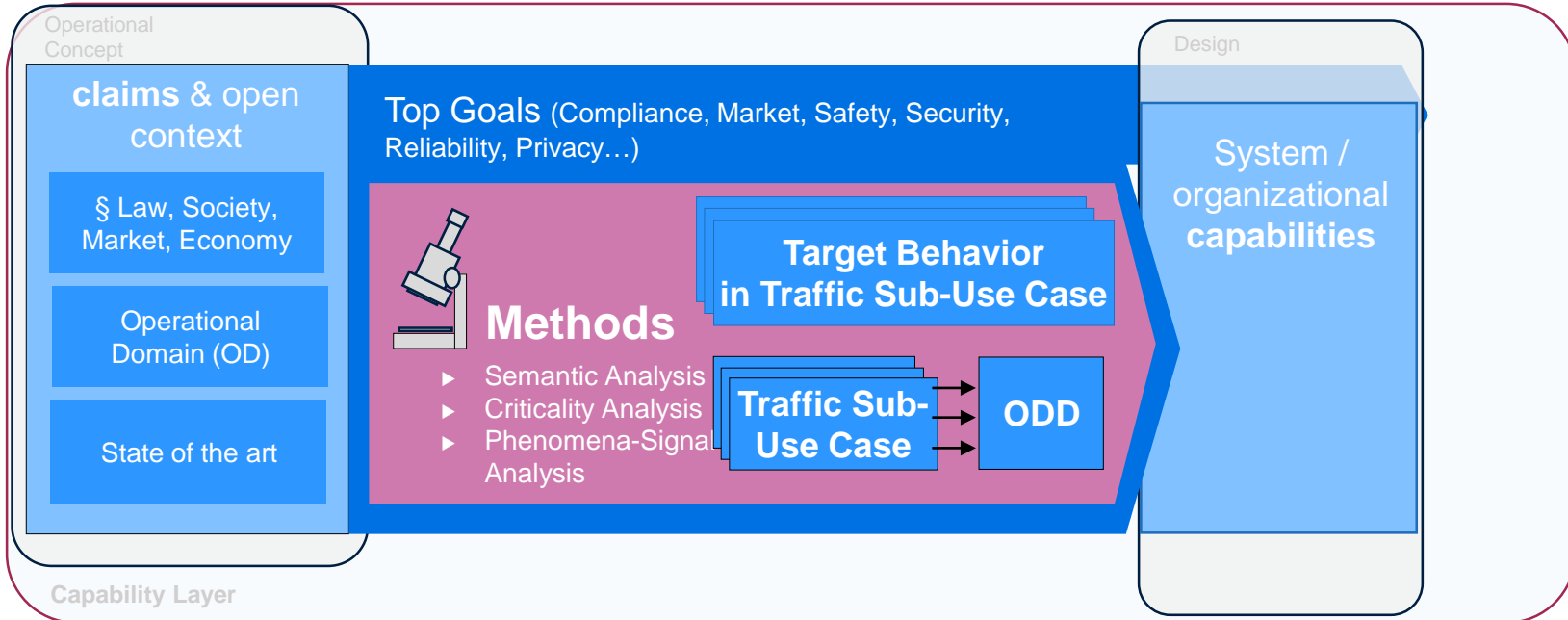


# Layer Structure - Elements

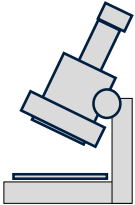
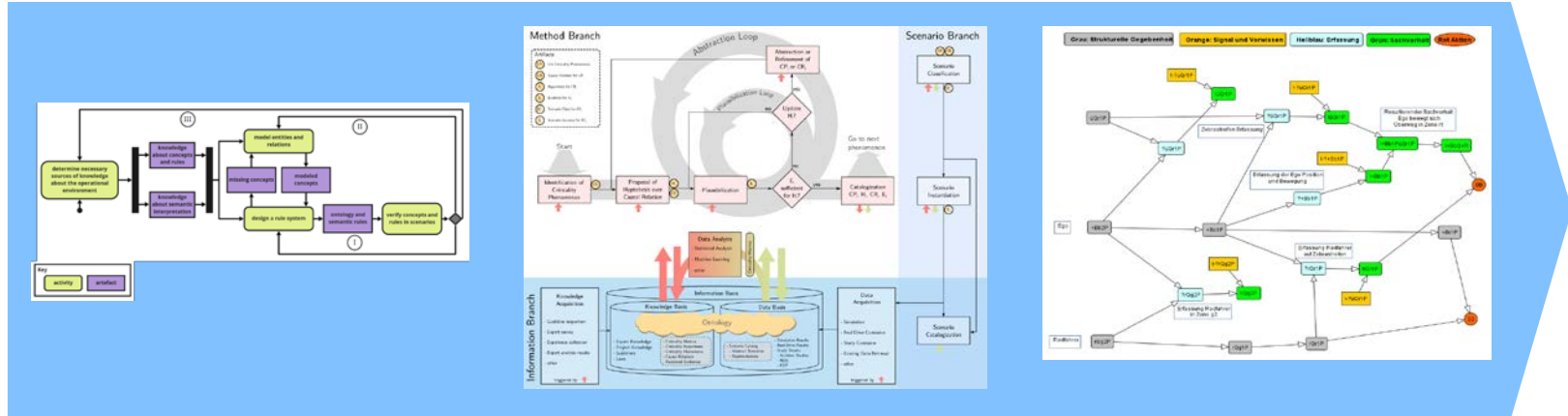
- ▶ Layers and domains interact.
- ▶ Iterative steps enable convergence of elements.



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



## ► Analysis methods



► **Semantic Analysis**  
understand the perspective of law concerning scenarios and their ontology.

► **Criticality Analysis**  
understand and assess the causal-chain of hazards traffic-phenomena.

► **Phenomena-Signal Analysis**  
understand and assess the interexchange of traffic by decisions, timing, law and traffic-phenomena based on the information flow.

## Take Away / Outlook

- ▶ **Enabler for consideration of societal /market claims and resilience in open context:**
  - ▶ **Layer structure** 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.



# 2

## Discussion and Questions

Roland Galbas



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# GET IN TOUCH



**BOSCH**

**Roland Galbas**

Robert Bosch GmbH

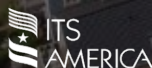
Industrial Cooperation for Enabling  
Automated Driving (XC-AD/PJ-CAD)

[roland.galbas@de.bosch.com](mailto:roland.galbas@de.bosch.com)

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# Preferred questions towards me as speaker

- Why do we need different layers and how is this related to the V-Model?
- How does the assurance argumentation enable the link between all the V&V- and design aspects?
- How does this framework support the use of simulation and the reduction of efforts?

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