



DSC 2023 EUROPE VR

Driving Simulation & Virtual Reality Conference & Exhibition



PEGASUS Project Family Perspective – Supporting the release of Automated Driving in Europe

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Antibes

September 6th – 8th 2023



Status and Motivation for PEGASUS Family Projects



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Official Journal of the European Union

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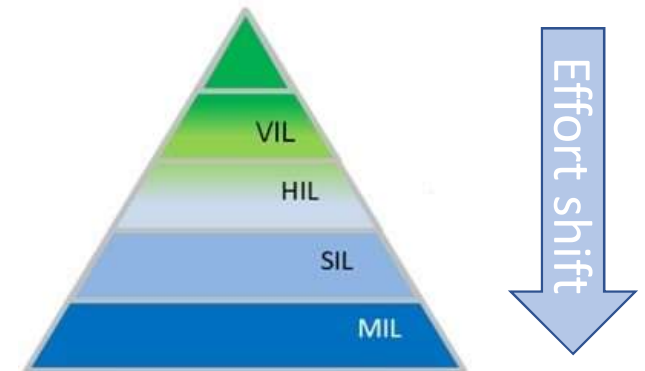


COMMISSION IMPLEMENTING REGULATION (EU) 2022/1426

of 5 August 2022

laying down rules for the application of Regulation (EU) 2019/2144 of the European Parliament and of the Council as regards uniform procedures and technical specifications for the type-approval of the automated driving system (ADS) of fully automated vehicles

- **The European automated driving deployment strategy** requires processes, verification and validation methodologies and technical frameworks for all stakeholders involved in the release process
- Verification and validation of automated driving functions requires a complete and interoperable **formalized safety assurance architecture/framework** with **seamless toolchains**, V&V processes, generation of test scenarios and data on an **international harmonized basis**
- With PEGASUS, SET Level and VV Methods **the PEGASUS Family** projects are defining both – methodologies and frameworks matching the needs of release processes for the scenario based safety case



Goal: Assurance framework covering all needs of the safety case based on balanced virtual elements and real world data





The PEGASUS Family – Main Project Scope



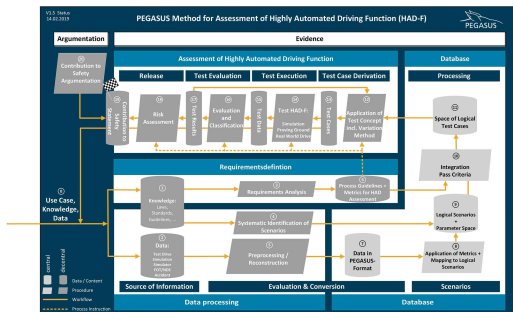
2016 - 2019



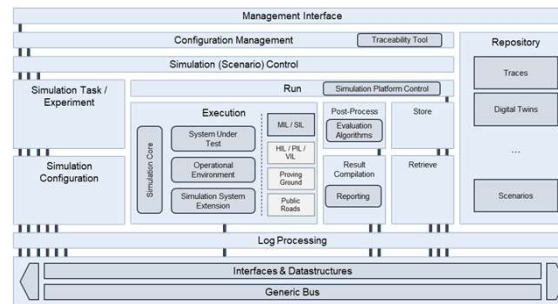
2019 - 2022



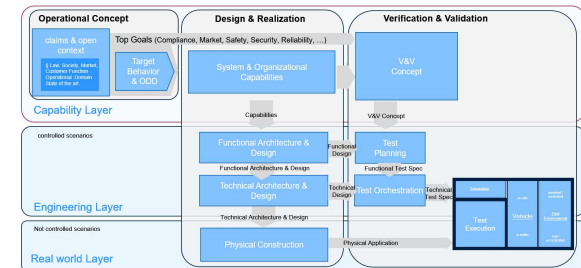
2019 - 2023



Basic methodological framework



Ready to use configured simulation toolchain and framework



Overall methodology for the safety case containing a complete safety argumentation and corresponding processes

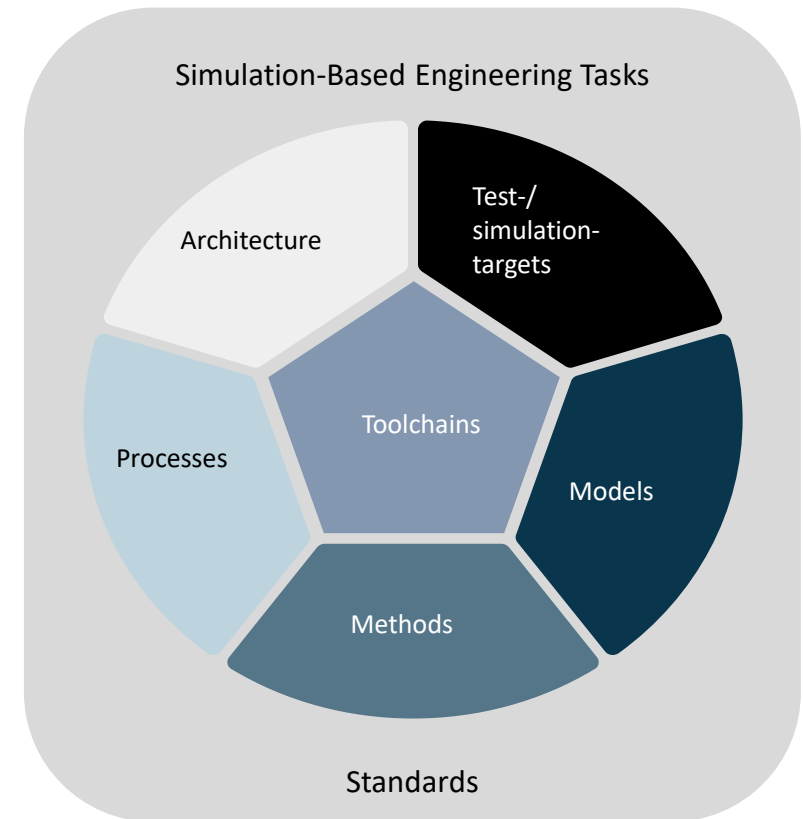


The SET Level Simulation Engineering Framework

- Provides an environment for **simulation-based systems** exploration and understanding as well as verification & validation as a service
- Platform with highly **generic components** – open, flexible and extendable
 - Scenario-based approach
 - Adaption and configuration for special projects with low effort
 - Easy to use / “no experts needed”
- Supports a wide range of **development tasks, assessment & testing**
- Provides insights to support **safeguarding and homologation**
- OEMs, suppliers and IT vendors benefit from **standards** (drafts) / standardization activities initiated



<https://setlevel.de/en>

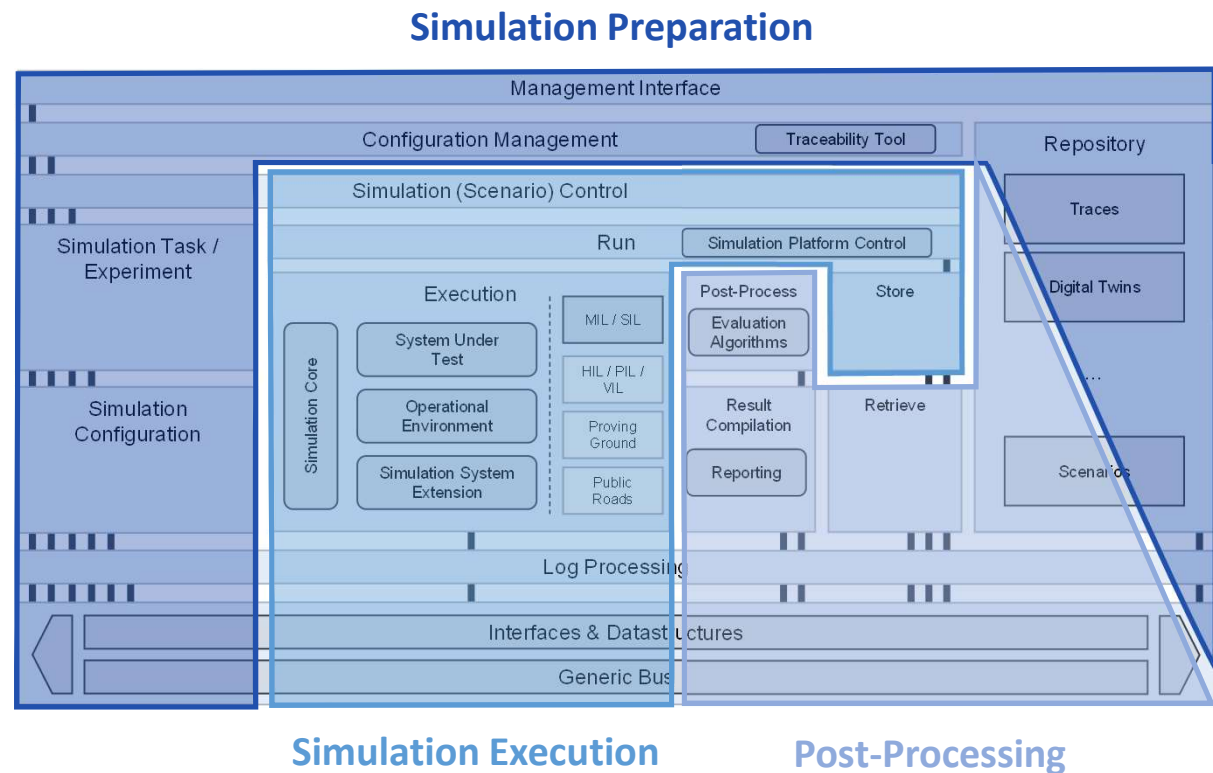




SET Level Generic Open Architecture for Testing and Analysis Tasks

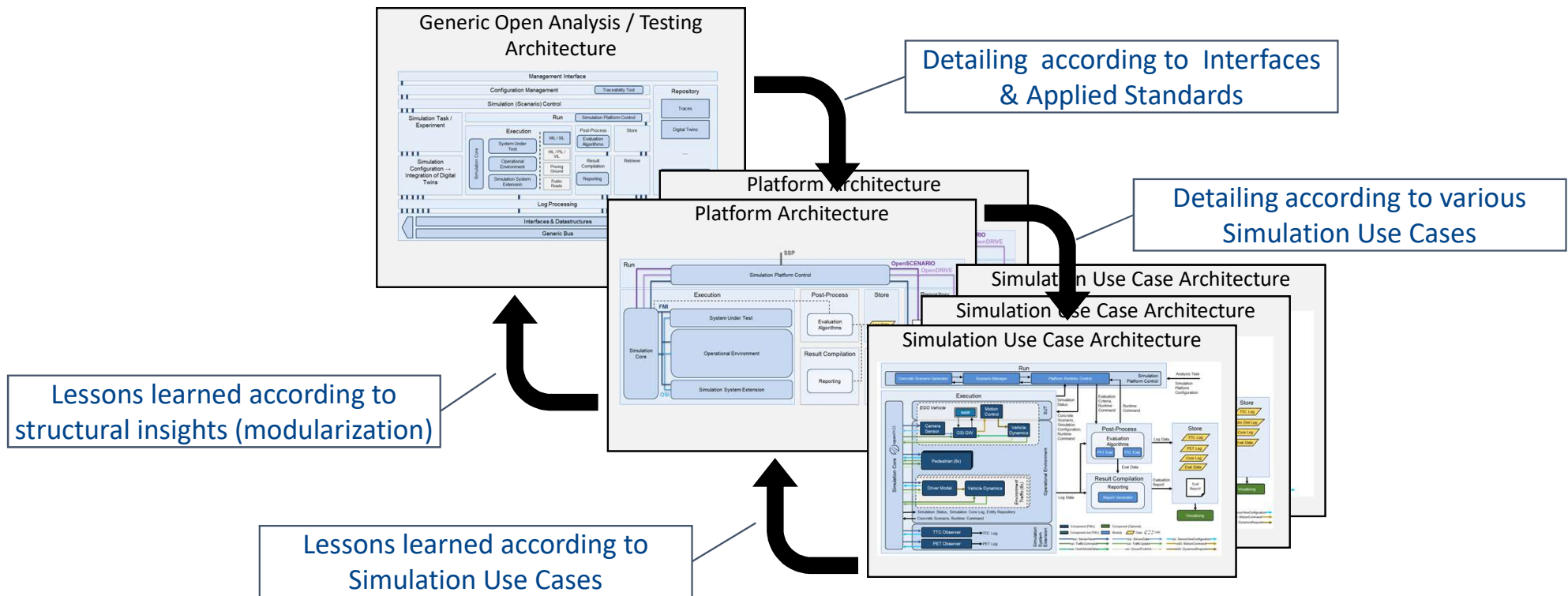
The SET Level architecture shall...

- ... allow for references between **high-level architecture** and **concrete implementations**
- ... apply up-to-date **simulation standards**
- ... support **exchange of separate software modules, models and scenarios**
- ... comprehend a **clear definition of interfaces and modules**





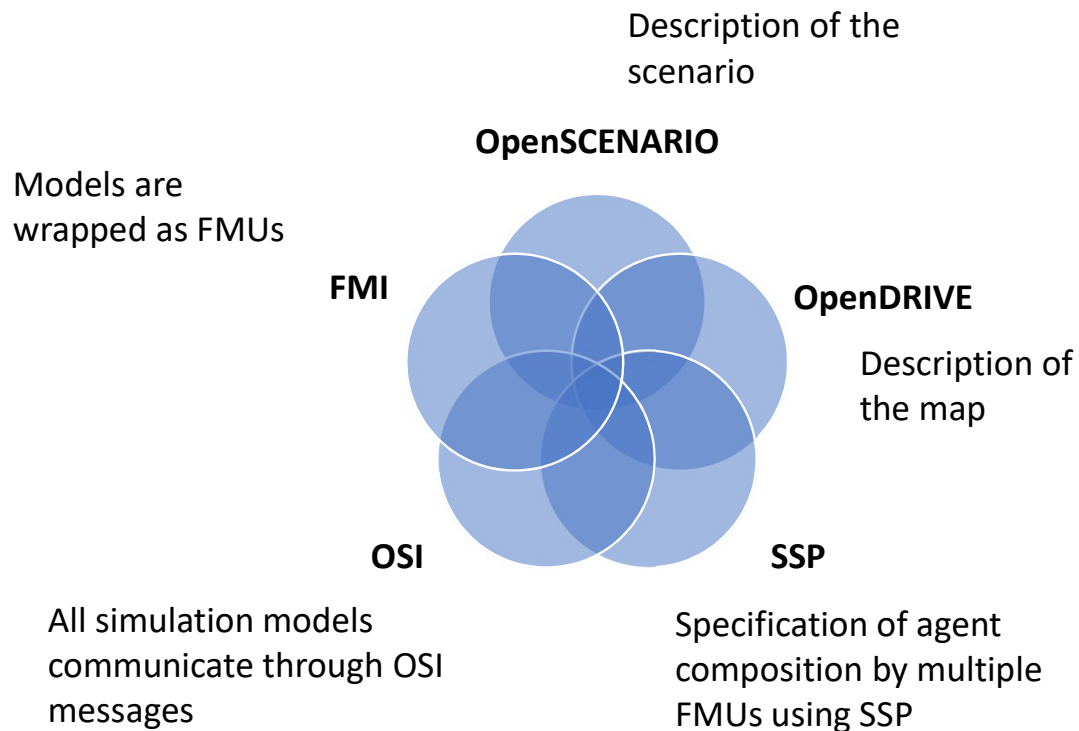
From Generic Open Architecture to Simulation Use Case Architecture





SET Level - Standardization Activities

► Enabler for Modularity and Seamless Integration



Core fields of application for standards

- Simulation configuration (Scenario and map)
- Specification of parameter variation
- Programming interfaces
- Data exchange

Example of simulation model integration
 The integration of various simulation models has been proven to work using OSI messages for communication and wrapping models as FMUs according to the FMI standard.

Contribution to standardization projects
 SET Level not only uses the standards but actively develops further extensions and contributes to the standardization projects (e.g. ASAM, Modelica, SmartSE)

FMI = Functional Mockup Interface, OSI = Open Simulation Interface, SSP = System Structure and Parameterization



VV-Methods Goals



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



Feasibility



Efficiency



Goal III Shift to simulation

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

Goal II Consistent interfaces

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



Control of ODD

System Decomposition

V&V Distribution & Generation



Changeability

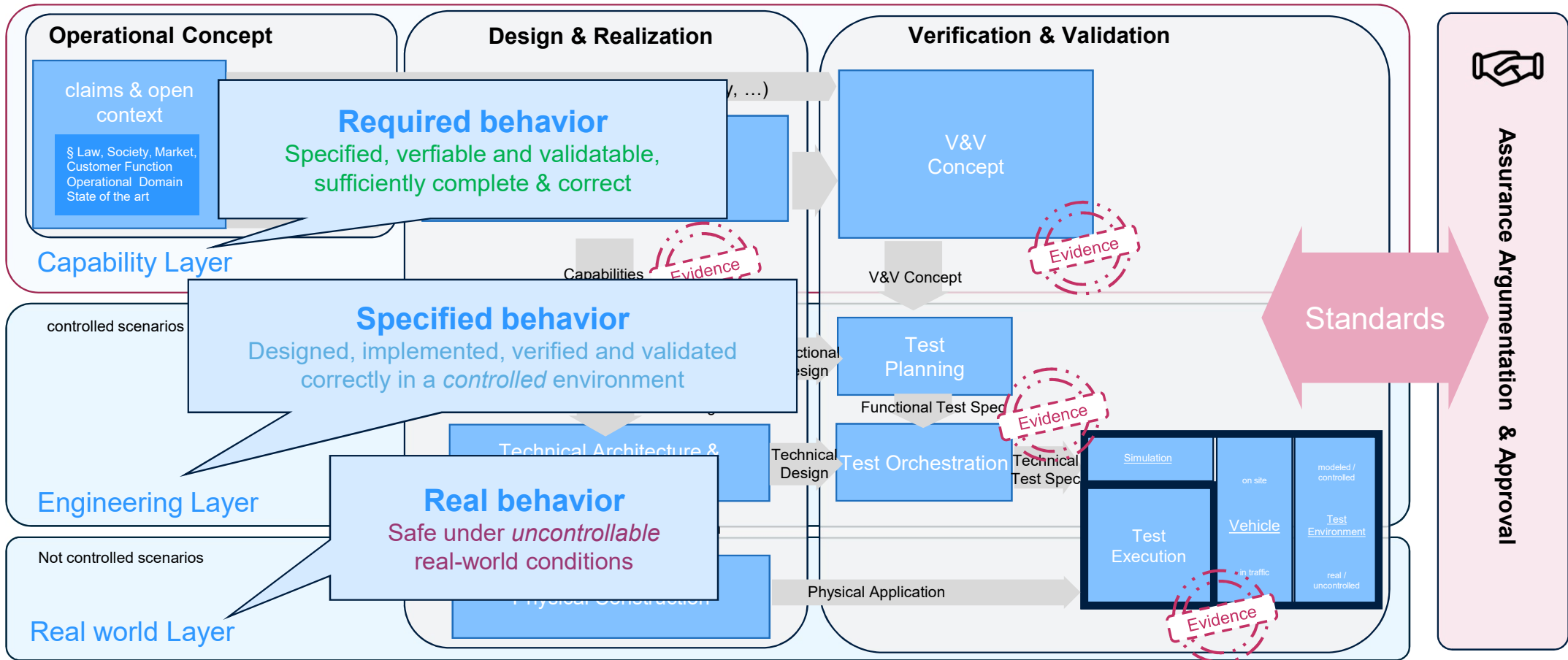


<https://www.vvm-projekt.de/en/>



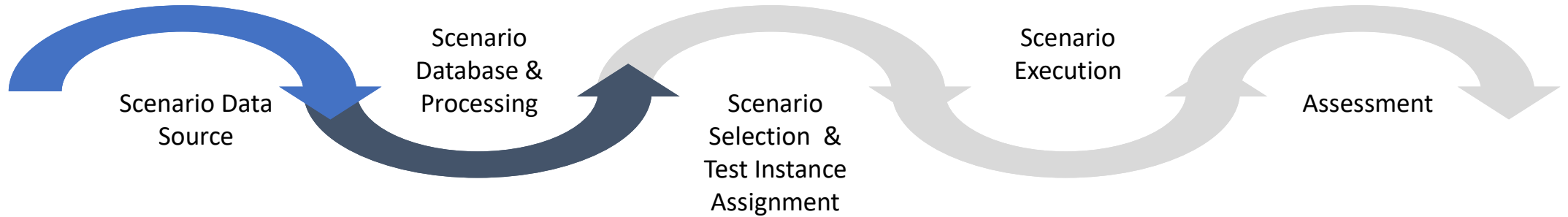
VV Methods Assurance Framework

► Synchronisation between Assurance Argumentation Development/Operation, Design and V&V





VV Methods Databases & International Interoperability

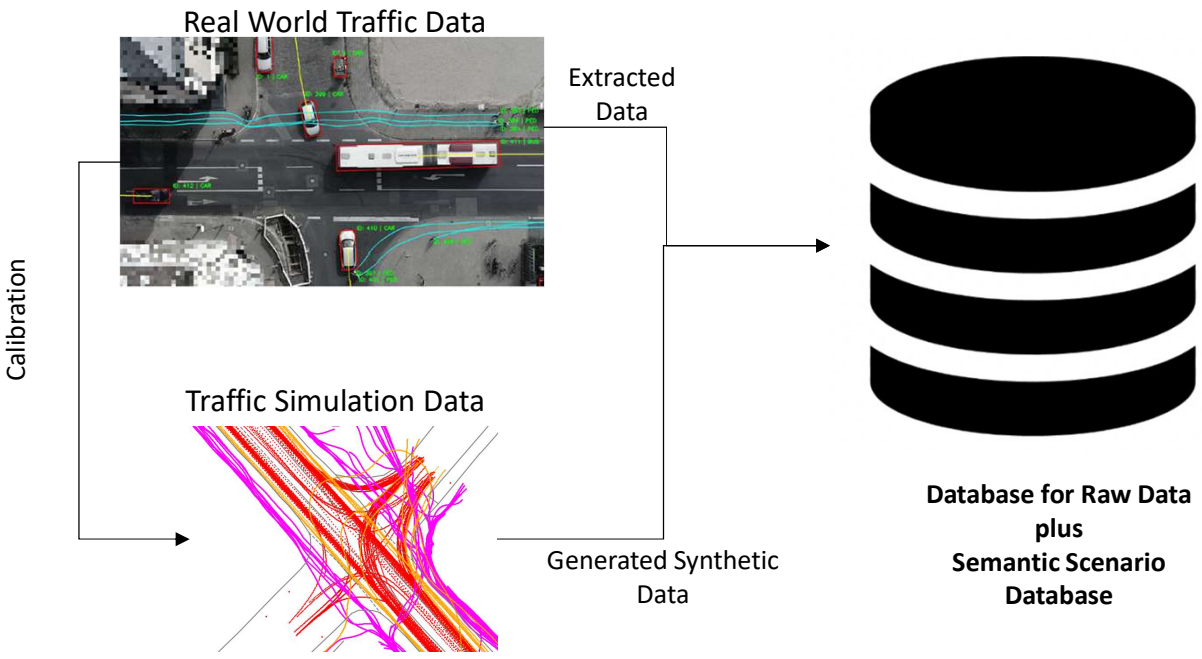


Deployment of Scenario-Based Simulation Platform for Testing Level 3/4/5 ADS

- Focus on innovative test methodologies for the validation and verification of ADS in urban areas
- Real world scenario extraction
- Analysis based scenario generation
- Databases for Raw Data and Semantic Databases
- International Interoperability to be ensured

 Scenarios are the glue!

Enables New Approaches for Development, Training and Validation of Automated Driving

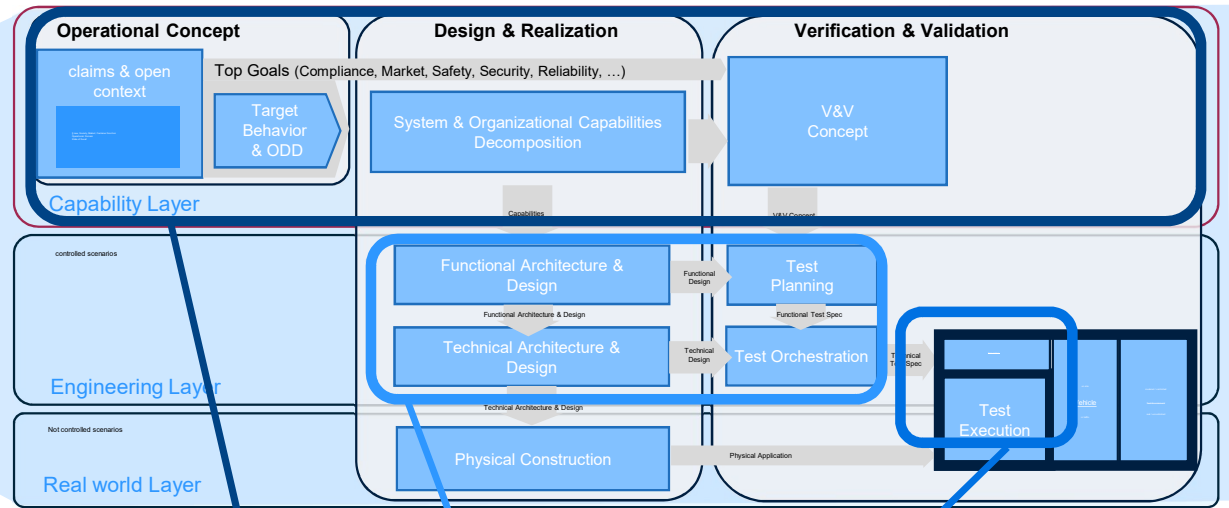




Project Connections



Safety argumentation layer structure



SET Level Simulation-based Engineering Task

The screenshot shows a 'Management Interface' for simulation tasks, including configuration management, execution, and log processing. The circular diagram highlights 'Simulation-based Engineering Tools' such as Architecture, Test/Validation, Models, Methods, and Standards.

Linked projects

Scenario-based V&V



Data and Scenario Marketplaces



Safety Argumentation for AI



Open data and Service Pipeline





PEGASUS, SET Level and VV Methods – what’s next?



Overall methodology for the safety case containing a complete safety argumentation and corresponding processes

Final Event Nov. 2023

Future goals

- Stimulating the **application of VVM building blocks** to product and application driven use cases
- Connecting the VVM assurance framework process to **open data- and scenario marketplaces**
- Stimulating **continuous integration chains** linking assurance process steps with product release management (incorporating risk and law)
- Identification of B2B ecosystems linking **data- and scenario driven approaches** with V&V frameworks
- Identification of needs, gaps, hurdles, **future perspectives** applying the safety case and stimulating innovation projects



Ready to use configured simulation toolchain and framework

Final Event Oct. 2022



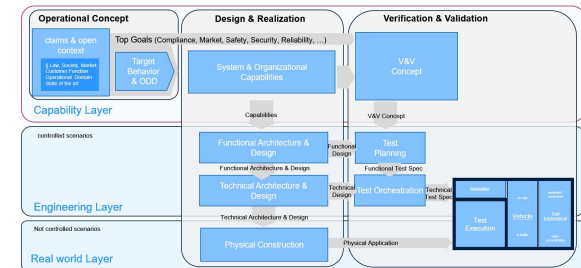
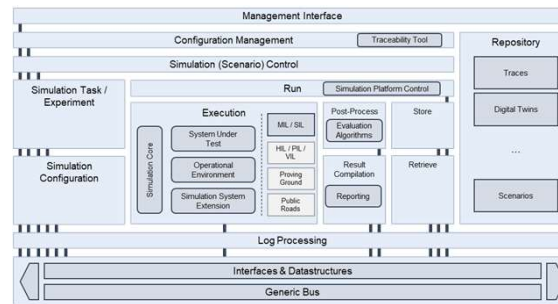
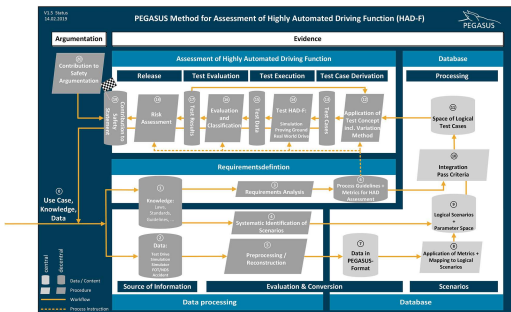
SIS 43 - Automated driving safety assurance – aligning methods, tools and databases

Shaping a continuous integration story



The PEGASUS Family

Contributions towards AD release in Europe



Basic methodological framework

6 layer model, scenario-level definition (functional, logical, concrete)

Ready to use configured simulation toolchain and framework

standards, architecture, simulation framework

Overall methodology for the safety case containing a complete safety argumentation and corresponding processes

Safety argumentation Extended methodological framework



VVM Final Event on 21st and 22nd of November 2023 in Sindelfingen, Germany



- The overall and final V&V Methodology of VVM
- The VVM Safety Assurance Framework
- Deep-Dives covering all layers of the argumentation architecture
- Selected demonstrations applying the methodology to test and simulation
- Panel discussions and links to safety assurance initiative worldwide

SAVE-THE-DATE:
<https://www.vvm-projekt.de/en/>



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THANK YOU



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