

VIRTUAL DEVELOPMENT AND TESTING FOR SAFETY ASSURANCE

A Keynote by Henning Mosebach, DLR-TS (Institute of Transportation Systems)

2024-04-22



Longterm GER/JPN collaboration on safety assurance



German-Japanese Symposium on Safety Assurance for Connected and Automated Driving

safeCAD-DJ Symposium 2022

Keynotes on V&V Methods

Methodologies

Scenarios

Sensors, data

Test metrics

Half-time event of R&D-project VIVID

Networking

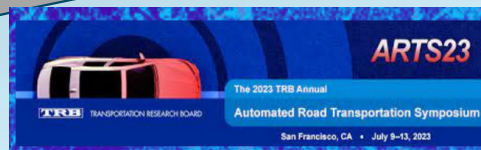
Breakout sessions

Plenary talks

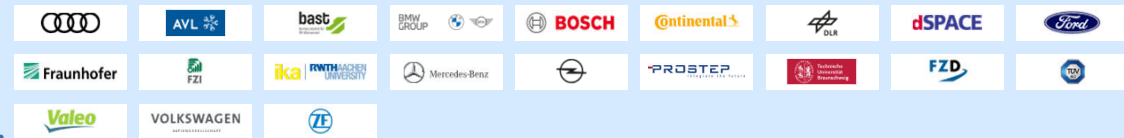
Logos: National Ministry of Education and Research, National Ministry of Economy and Technology, Cabinet Office, VERIFICATION VALIDATION METHODS, SET Level, Vi, DIVP, PEGASUS FAMILY, DLR, Thüringer Innovationszentrum MOBILITÄT, TECHNISCHE UNIVERSITÄT ILMENAU

Project Events 2023

Logos: Vi, DIVP, SET Level, VERIFICATION VALIDATION METHODS

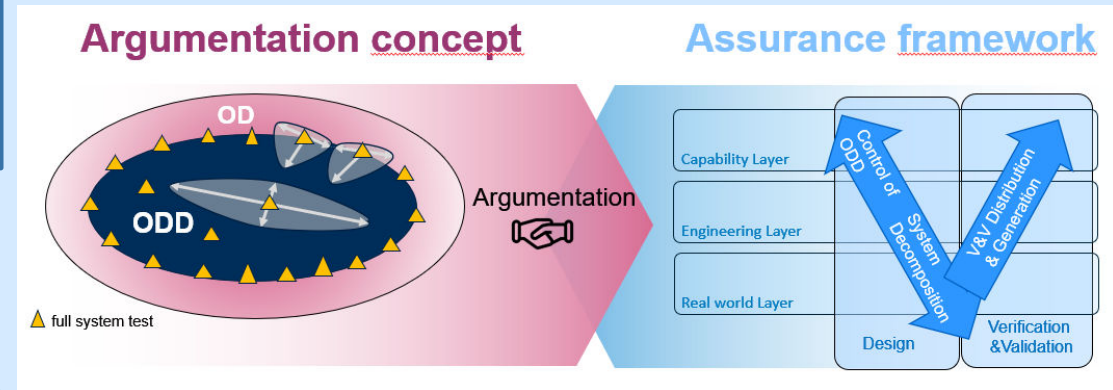


The PEGASUS project family



2019 - 2023
**VERIFICATION
 VALIDATION
 METHODS**
<https://www.vvm-projekt.de/en/>

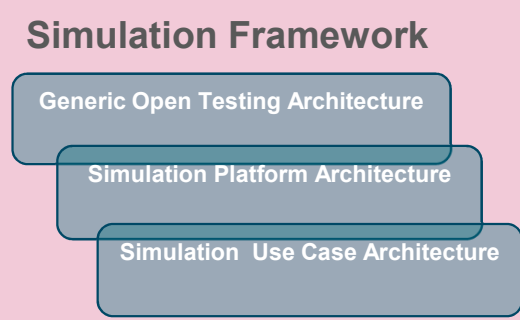
Overall safety case methodology linking safety argumentation and corresponding R&D and V&V processes



2019 - 2023
PEGASUS
Scenario based testing basic methodology
<https://www.pegasusprojekt.de/en>

2019 - 2022
SET Level
<https://setlevel.de/en>

Ready to use configured simulation toolchain and framework



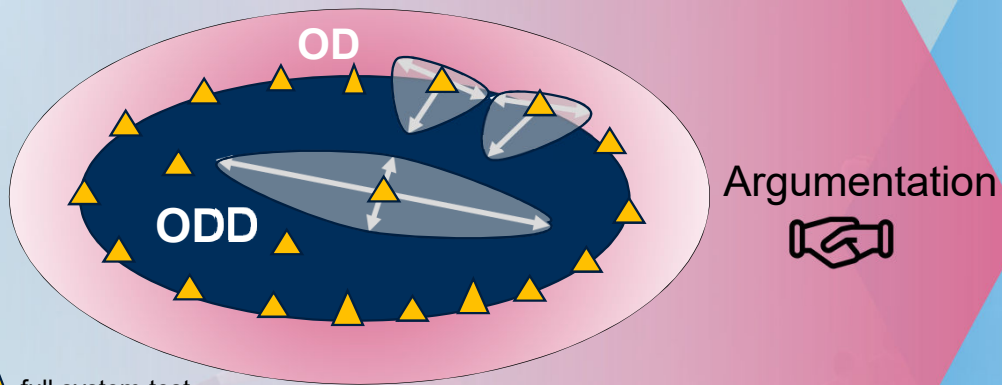
Final Event October 2022

Final Event November 2023

The VV Methods safety case approach

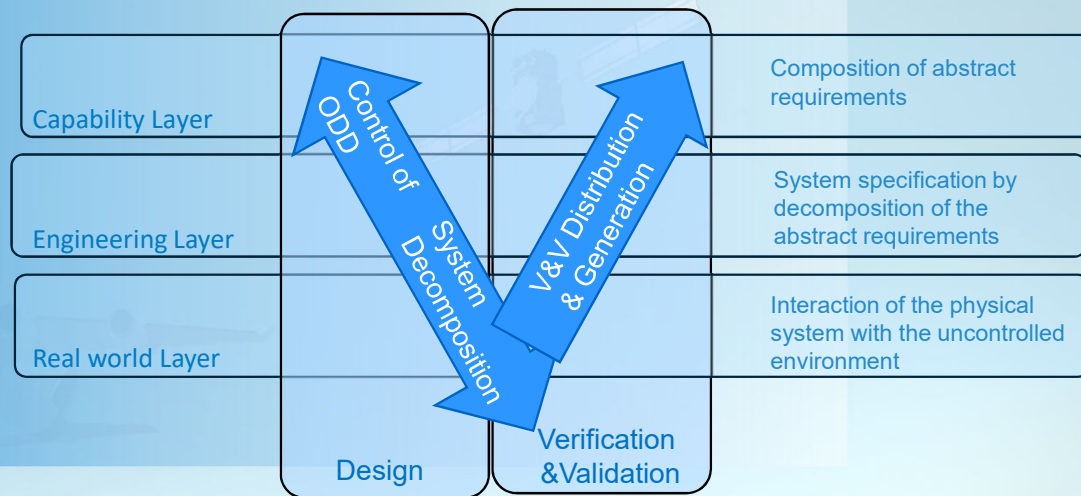


Argumentation concept

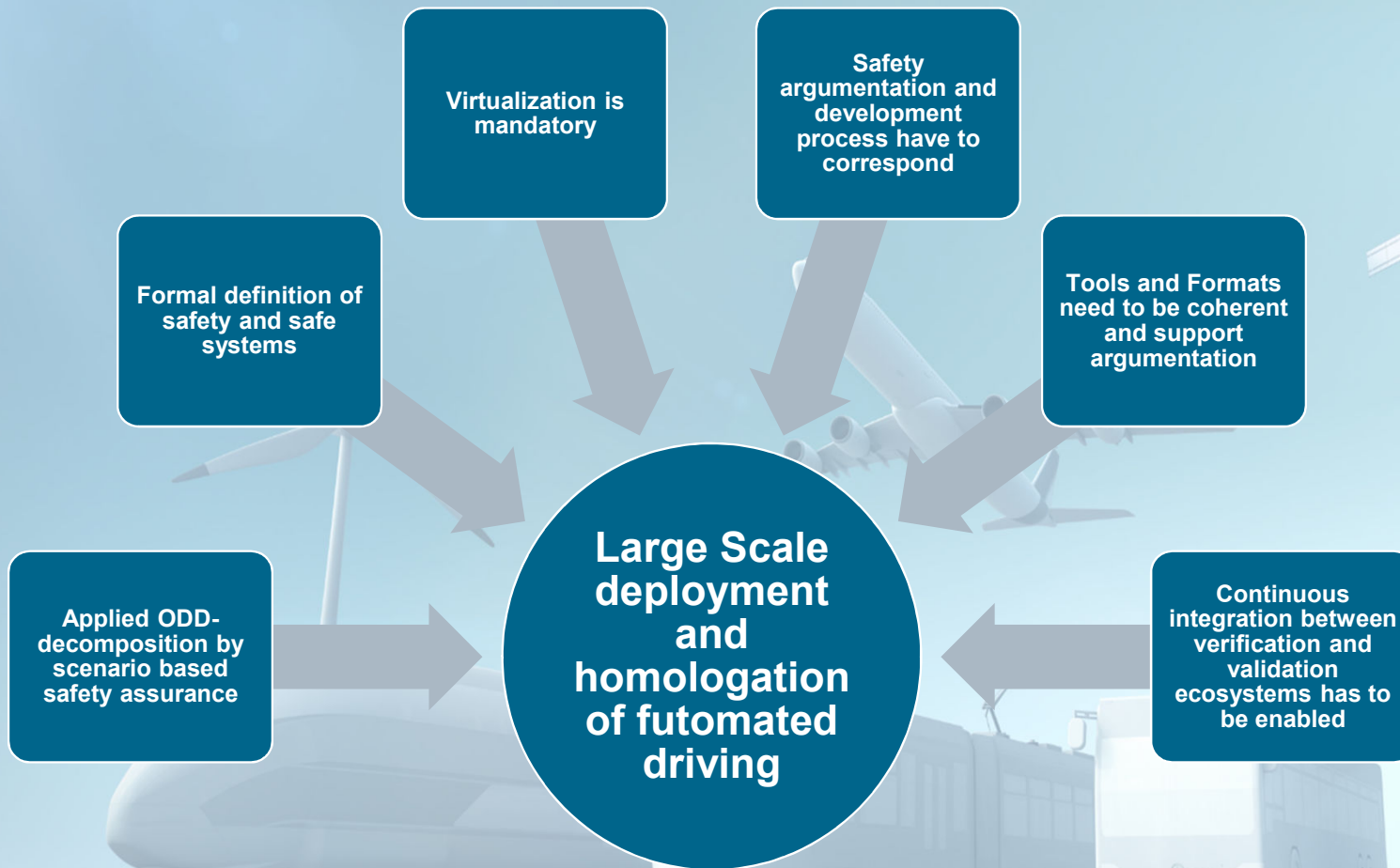


▲ full system test

Assurance framework



Results and (still) remaining challenges



Safety assurance at post SIP-adus symposium 2023



Reality abstraction

Scenario based testing platforms

Innovative data- and service ecosystems

The safety case for deployment of AD

Shaping continuous integration architectures and pipelines of data, models and test facilities

Development topics for collaboration



Reality abstraction

Systematic transformation of reality into versatile virtual elements
Strategies for modelling sensors and environments and its calibration/verification procedures
High precise maps e.g. including materials for multi-channel perception

Scenario based testing platforms

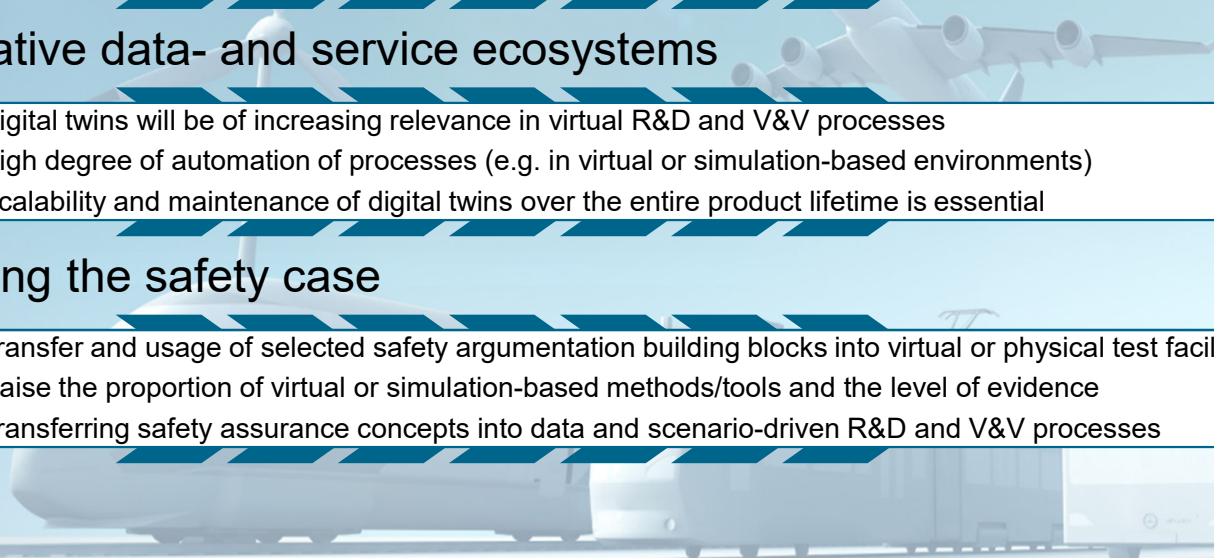
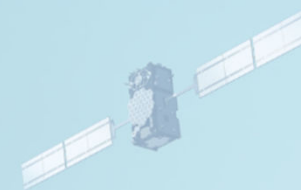
Complementary use of scenario databases and its models, data and scenarios
Simulation validation: How to validate simulation results
Systematically linking data and scenario marketplaces to targeted ODDs

Innovative data- and service ecosystems

Digital twins will be of increasing relevance in virtual R&D and V&V processes
High degree of automation of processes (e.g. in virtual or simulation-based environments)
Scalability and maintenance of digital twins over the entire product lifetime is essential

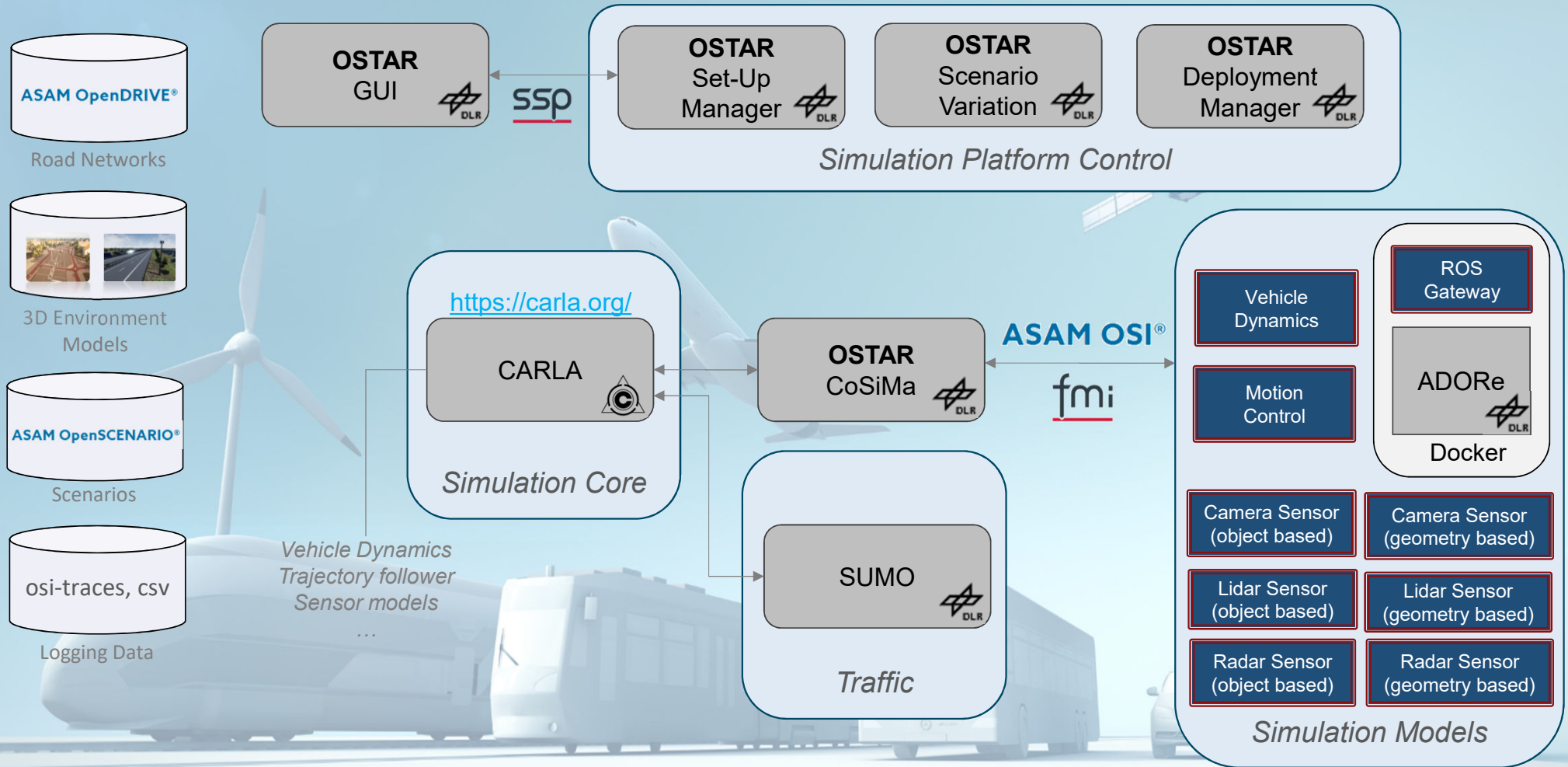
Applying the safety case

Transfer and usage of selected safety argumentation building blocks into virtual or physical test facilities
Raise the proportion of virtual or simulation-based methods/tools and the level of evidence
Transferring safety assurance concepts into data and scenario-driven R&D and V&V processes



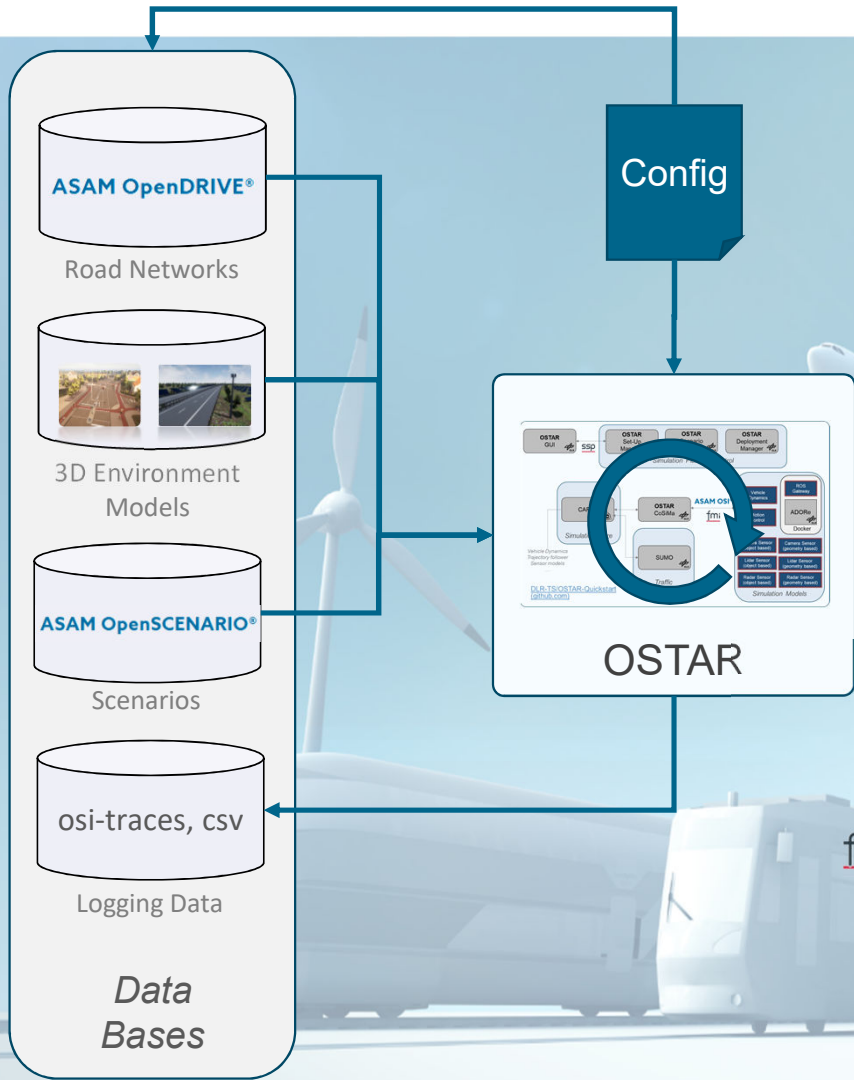
One example – DLR MiL/SiL simulation toolchain „OSTAR“

OSTAR (Open Source Toolchain for Automotive Research)



OSTAR – Key Features

Data Driven Scenario Generation



- Open Source
- Modular Simulation Set-up
- Automated Execution
- Generic Architecture based on simulation standards
 - OpenDRIVE
 - OpenSCENARIO
 - SSP
 - FMI
 - OSI
- Gaia-X Connector Service
 - in preperation

Related projects

SET Level

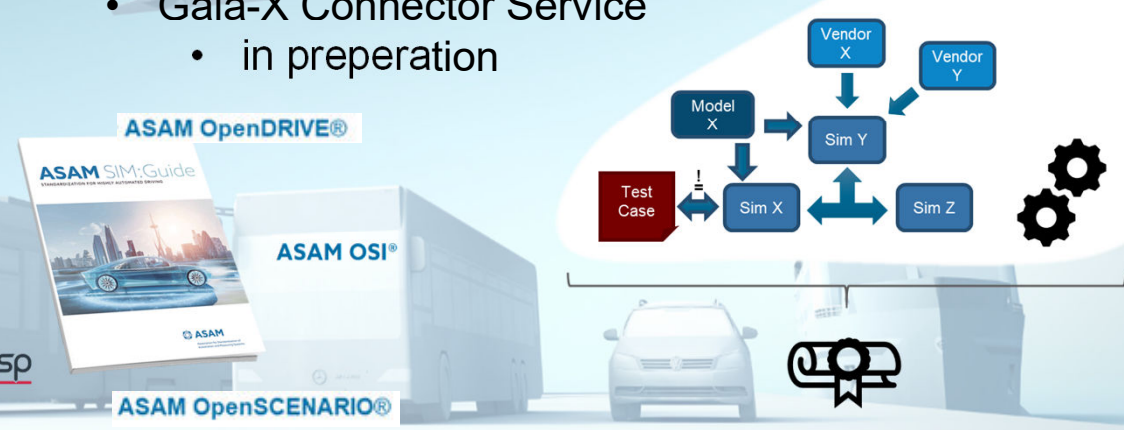
<https://setlevel.de/>

VVM VERIFICATION
VALIDATION
METHODS

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

GAIA-X 4 PLC-AAD

<https://www.gaia-x4plcaad.info/>



The continuous integration story



Shaping a continuous integration story

Future goals

- Application of **VVM methodological steps and building blocks** to the operated safety case
- Connecting the VVM assurance framework process to **open data- and scenario marketplaces**
- Stimulating **continuous integration chains** e.g. by linking assurance process steps with product development and V&V processes
- Identification of needs, gaps, hurdles, **future perspectives** applying the safety case

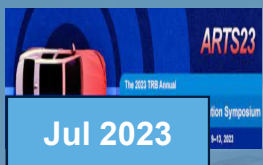
May 2023



Nov 2023



Jul 2023



Nov 2023

