PROJECT of the PEGASUS FAMILY

VERIFICATION VALIDATION METHODS

Final Event 21 / 22 November 2023

Navigating VVM with the Key Process Perspectives

Marco Fistler, IAV contracted by BMW

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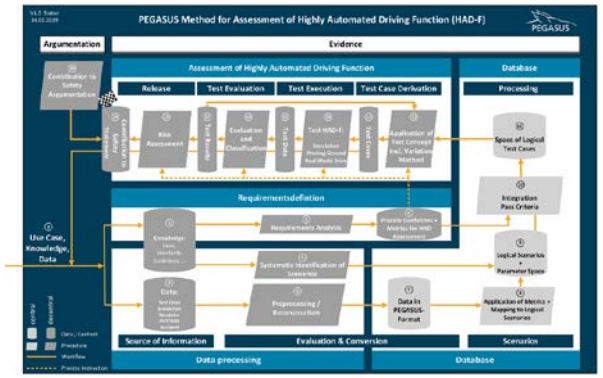
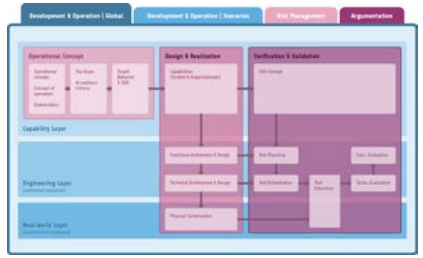
Federal Ministry for Economic Affairs and Climate Action

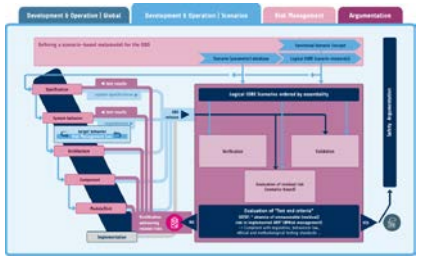
on the basis of a decision by the German Bundestag

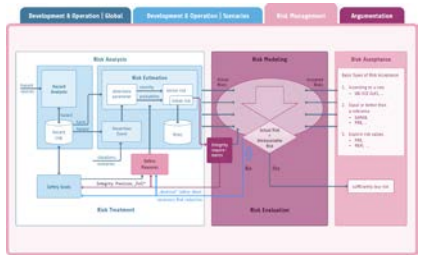
Introduction

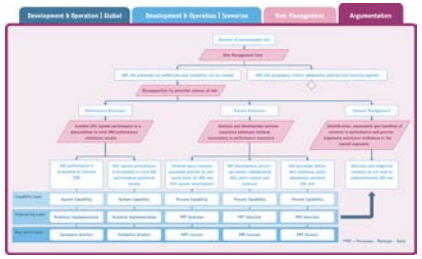
- Developing an ADS is a complex task involving many stakeholders.
- PEGASUS supported the establishment of scenario-based testing over all test levels.
- VVM extended PEGASUS by including the development process, among other things.
- VVM proposes a framework integrating four perspectives to comprehensively develop a safe ADS.











The overall Goal of VVM

Goal

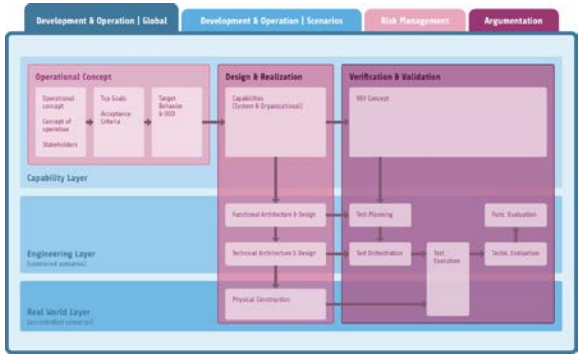
Assurance of a **safe** AD System by demonstrating the **absence of unreasonable risk**

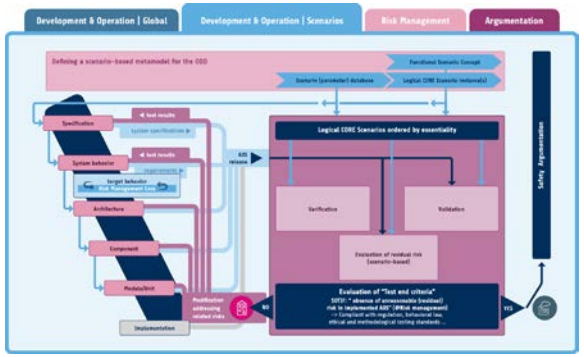
Global Development and V&V

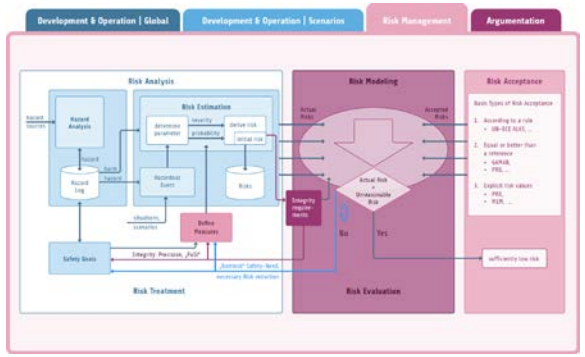
Scenario-based Development and Testing

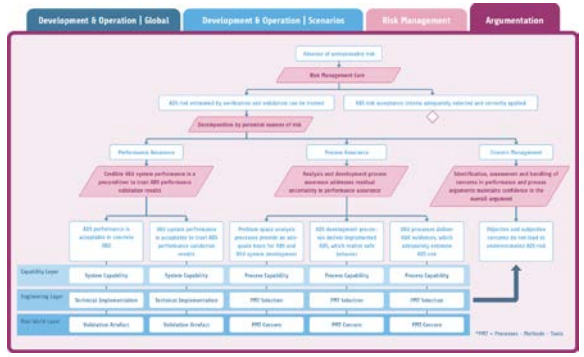
Risk Management

Safety Argumentation



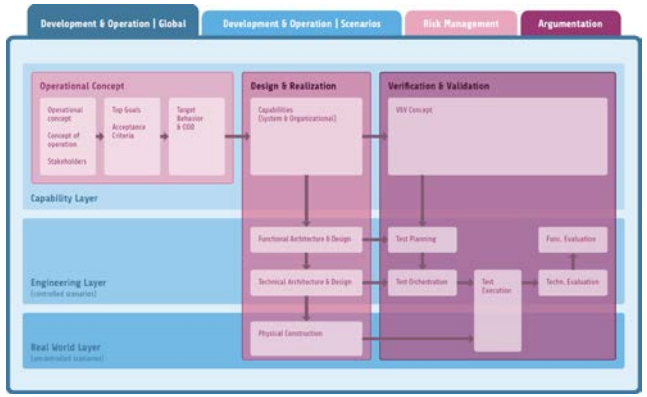






Four key process perspectives – 1/4

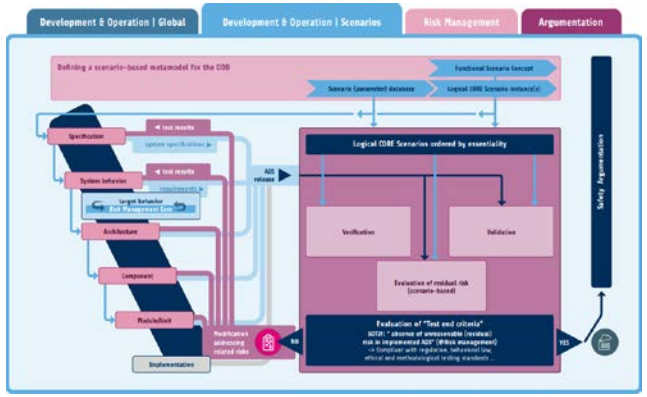
Global Development and V&V



- Ensuring safe behavior in the operational design domain (ODD)
- Systematic integration of safety from the beginning of the design process to qualification incl. field observation
- Three layers of system behavior are considered for the argumentation:
  - the required capability
  - the specified engineering solution
  - the real-world behavior of the integrated AD System
- Framework aims to close the gaps of the layers to argue safe system behavior.
- Explicit differentiation between Concept, AD Design & Realization and V&V processes.

Four key process perspectives – 2/4

Scenario-based
Development and Testing



- Scenarios provide continuously a reference to concrete elements of the open-world context for development and testing.
- Comprise analysis for ODD decomposition, by e.g. criticality analysis
- Consistent usage of the same scenario meta model
- So-called Core Scenarios aim to provide sufficient ODD coverage and play a key role for the safety argumentation.
- They are as well used as filters for the scenario database.

Four key process perspectives – 3/4

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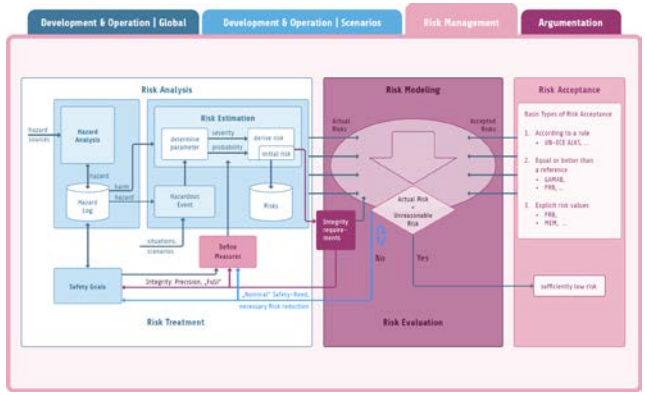
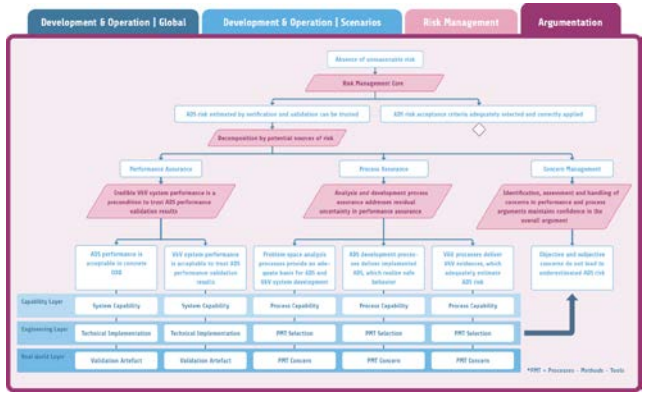
Risk Management



- Explicit Risk Management during development and testing by maintaining associations with overarching risk measures.
- Consideration of multitude of safety contexts (FuSi, Sotif, etc.)
- Generally applicable approach for the assessment and treatment of risks.
- Basis for targeted risk communication and hence improving societal acceptance of ADS.

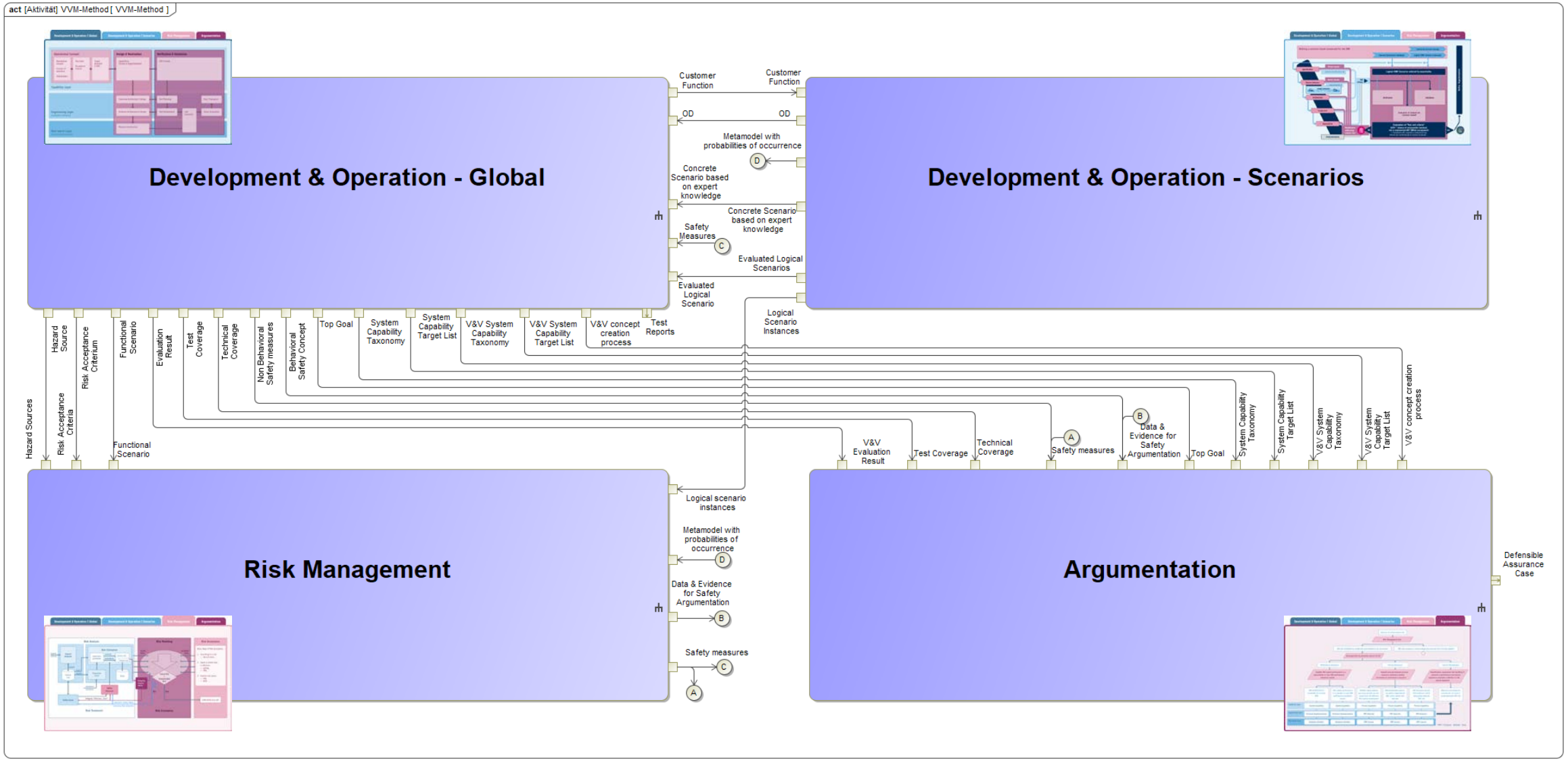
Four key process perspectives – 4/4

Safety Argumentation



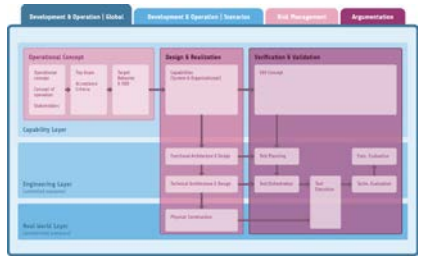
- Structured breakdown of the statement 'absence of unreasonable risk' into specific and actionable sub-statements.
- Incorporation of all top-level VVM elements.
- Special consideration of evidences from the reliability and trustworthiness of the test environment.
- E.g. credibility of virtual test environment included – See project SetLevel.
- Pre- and Post-Deployment aspects are included in the V&V Strategy included.

Connection between Process Perspectives

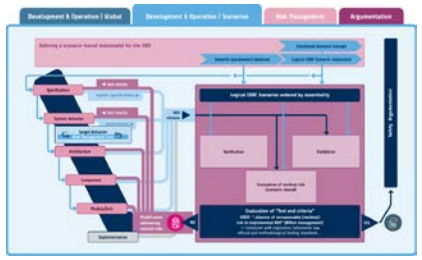


Conclusion

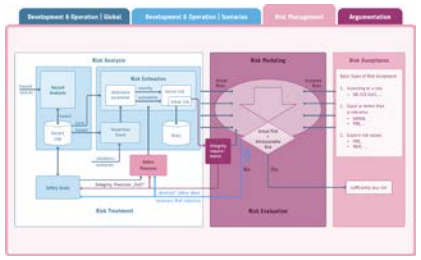
Global Development and V&V



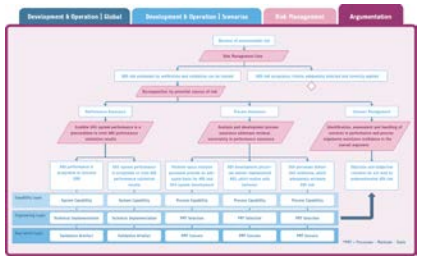
Scenario-based Development and Testing



Risk Management



Safety Argumentation



- VVM overall method consists of four linked processes to ensure the absence of unreasonable risk.
- Scenario-based development and testing is introduced in the existing processes.
- Systematically integrating consideration of an acceptable risk into the development and testing process.
- The VVM Safety Argumentation framework integrates all key VVM components into a unified and thorough argumentation structure.
- Increased transparency on compliance with acceptable risk leads to an increased societal acceptance.

VERIFICATION
VALIDATION
METHODS

Thank you!

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PROJECT of the PEGASUS FAMILY

VDA LEITINITIATIVE

A project developed by the VDA Leitinitiative
autonomous and connected driving

Supported by:

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