10.1 | Overview - Behavior Specification, Behavioral Safety Concept, Capability Analysis and ODD Tailoring

Nayel Fabian Salem, Christian Lalitsch-Schneider, Marcus Nolte, Daniel Hillen

What to expect from this booth?

In this booth we focus on aspects that support safety assurance through analyses on the operational level. Thus, the presented approaches do not consider a specific automated driving system but rather take a system-of-systems perspective. The approaches presented in this booth include

- a method to explicitly specify target behavior in scenarios based on stakeholder needs [1],
- a model to formally represent target behavior [2],
- a method to refine the specified target behavior as part of the safety lifecycle [3],
- a method to derive and analyze required system capabilities, and
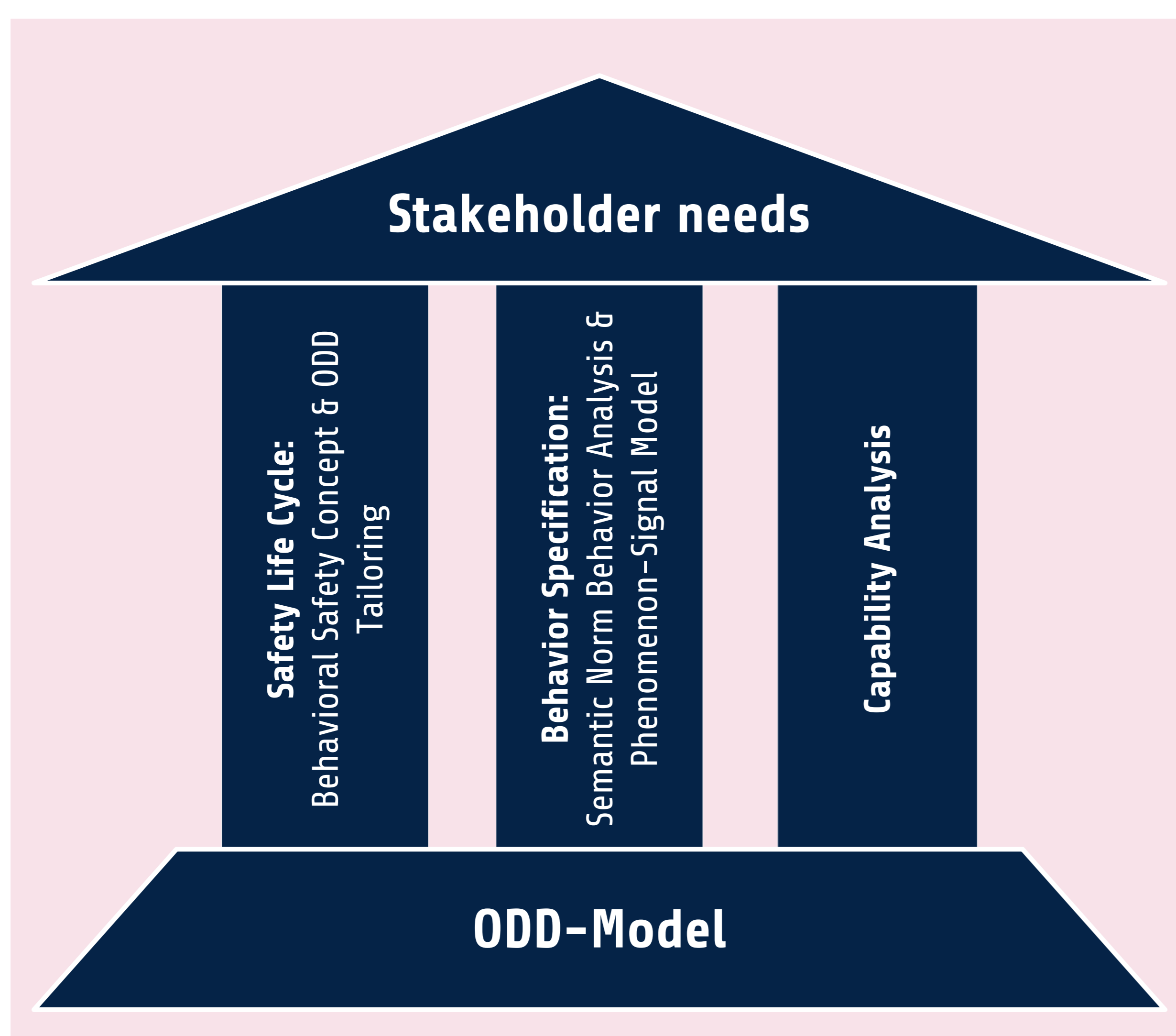- a method to support tailoring of an ODD-Ontology based on safety analyses [4].

Figure 1: Overview of the key topics in this booth

Semantic Norm Behavior Analysis

The Semantic Norm Behavior Analysis [Poster #10.2] is an approach to support the traceability of a behavior specification for automated driving. Based on stakeholder needs with respect to the behavior of an automated vehicle this analysis facilitates an explicit specification of behavioral requirements.

Phenomenon-Signal Model

In VVMethods we developed the Phenomenon-Signal Model [Poster #10.3] in order to formally represent target behavior in a scenario. The formalism is based on facts and rules that lead to the specification of conform maneuver options.

Key Artefacts
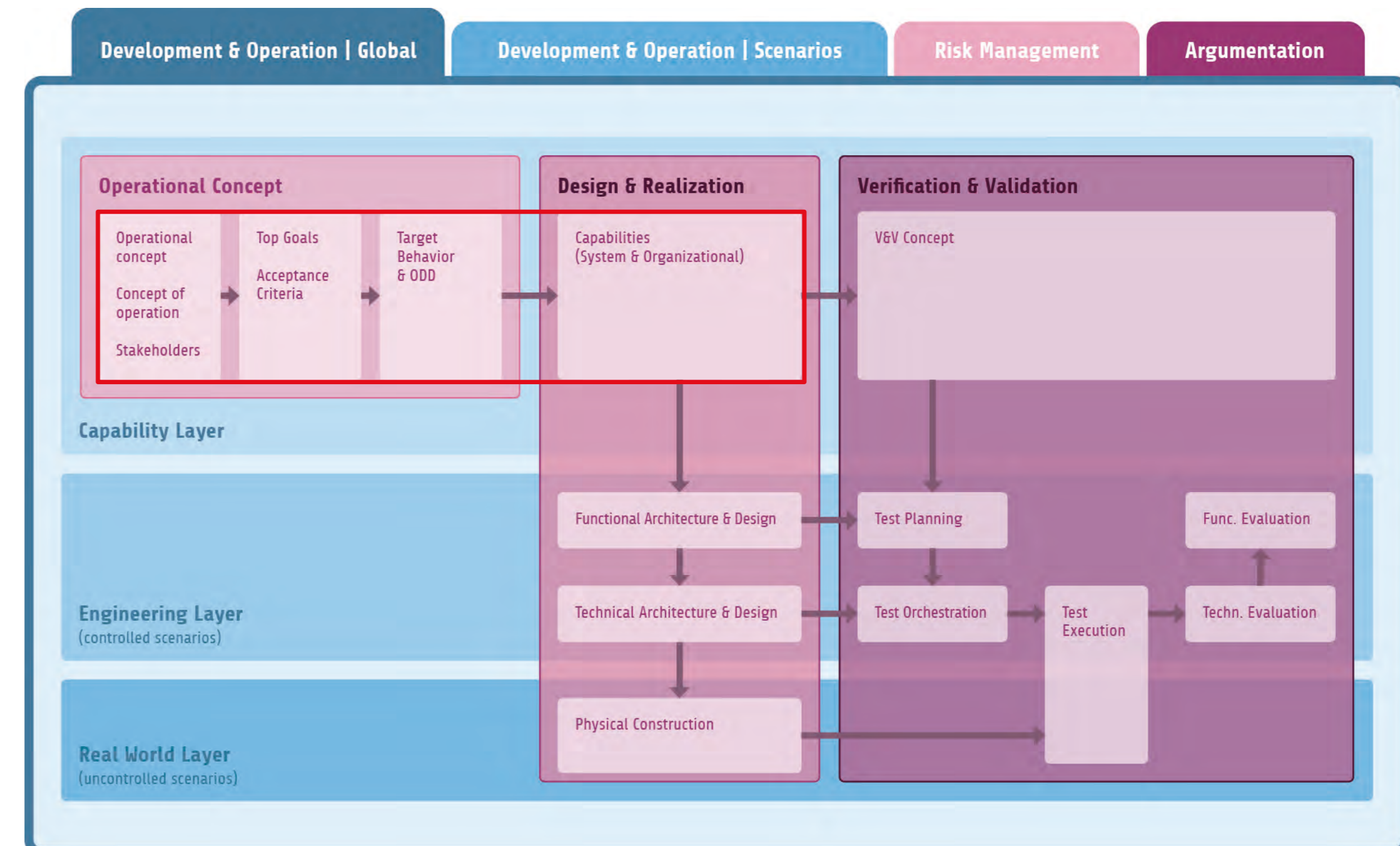
Behavioral Safety Concept

Based on a given specification of target behavior we need to analyze its emerging risks and specify safety measures to ensure the safety of the behavior specification. The Risk Management Core provides a framework that we applied to the behavior specification in order to compile a behavioral safety concept [Poster #10.4] that satisfies the safety goals.

Capability Analysis

The approaches we present to specify the behavior of an automated driving system lead to (semi-)formal representations of norm behavior and target behavior. In order to utilize these representations as part of downstream Systems Engineering activities, we present SysML-based representations of target behavior. Furthermore, the system capabilities that are required for a system to exhibit target behavior are analyzed and captured in a SysML-model [Posters #10.6, 10.7].

Guideword-based ODD-Tailoring

Many different stakeholders who work with the Operational Design Domain (ODD) have their own unique needs for what information they require and how detailed it should be. To address this, we propose using a guideword-based method to customize both the ontology and the ODD to fit each stakeholder's specific preferences and requirements [Poster #10.5].

References:

[1] N. F. Salem et al., "Ein Beitrag zur durchgängigen, formalen Verhaltensspezifikation automatisierter Straßenfahrzeuge." arXiv, Sep. 15, 2022. doi: 10.48550/arXiv.2209.07204. (English publication upcoming)

[2] H. N. Beck, N. F. Salem, V. Haber, M. Rauschenbach, and J. Reich, "Phenomenon-Signal Model: Formalisation, Graph and Application." arXiv, Jul. 20, 2022. doi: 10.48550/arXiv.2207.09996.

[3] N. F. Salem et al., "Risk Management Core –– Towards an Explicit Representation of Risk in Automated Driving." arXiv, Feb. 15, 2023. doi: 10.48550/arXiv.2302.07715.

[4] D. Hillen and J. Reich, "A pledge for safety-aware operational environment analysis," in SAFECOMP 2023, Position Paper, Toulouse, France, Sep. 2023. Accessed: Sep. 15, 2023. [Online]. Available: https://hal.science/hal-04191761

For more information contact:

salem@ifr.ing.tu-bs.de
christian.lalitsch-schneider@zf.com
nolte@ifr.ing.tu-bs.de
daniel.hillen@iese.fraunhofer.de