PROJECT of the PEGASUS FAMILY

VERIFICATION VALIDATION METHODS

Final Event 21 / 22 November 2023

Scenario-based Reality Abstraction

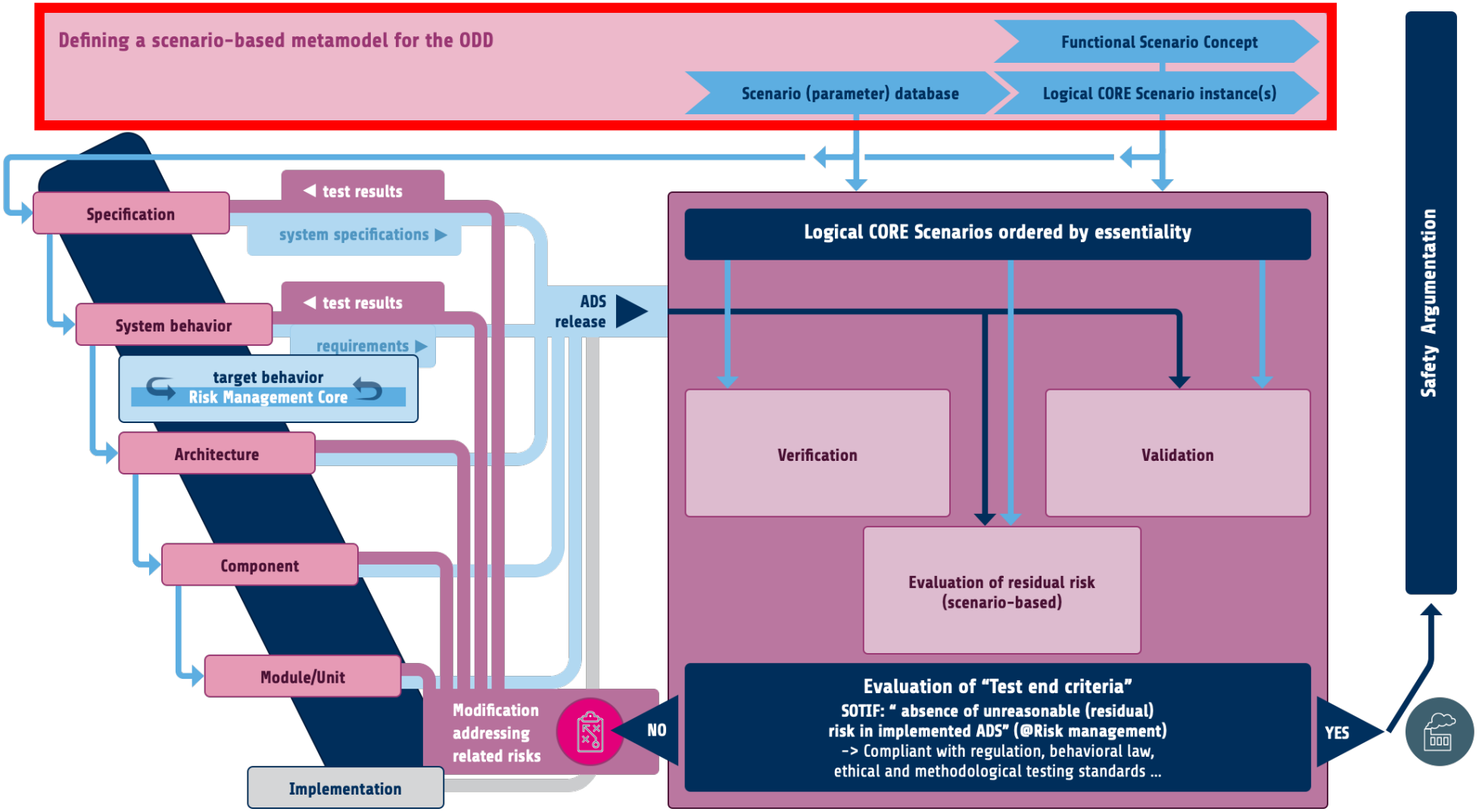
Christoph Glasmacher, ika – RWTH Aachen

Supported by:

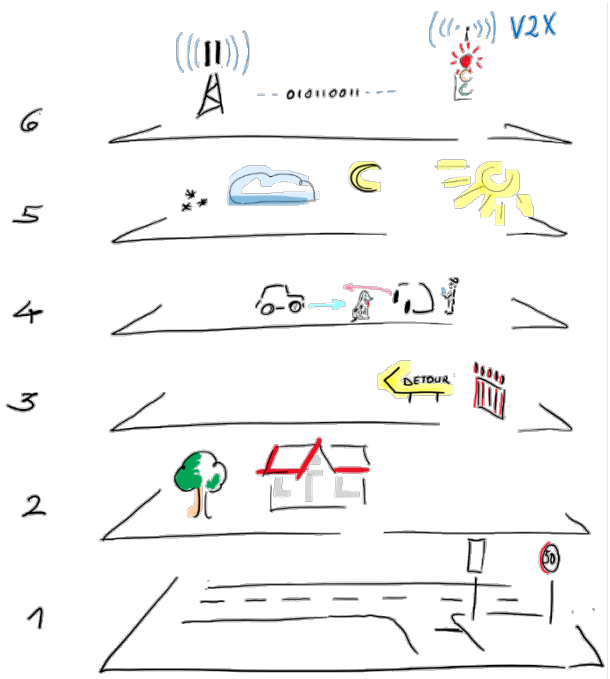
Federal Ministry for Economic Affairs and Climate Action

on the basis of a decision by the German Bundestag

Scenarios within VVM methodology



From ODD to scenarios



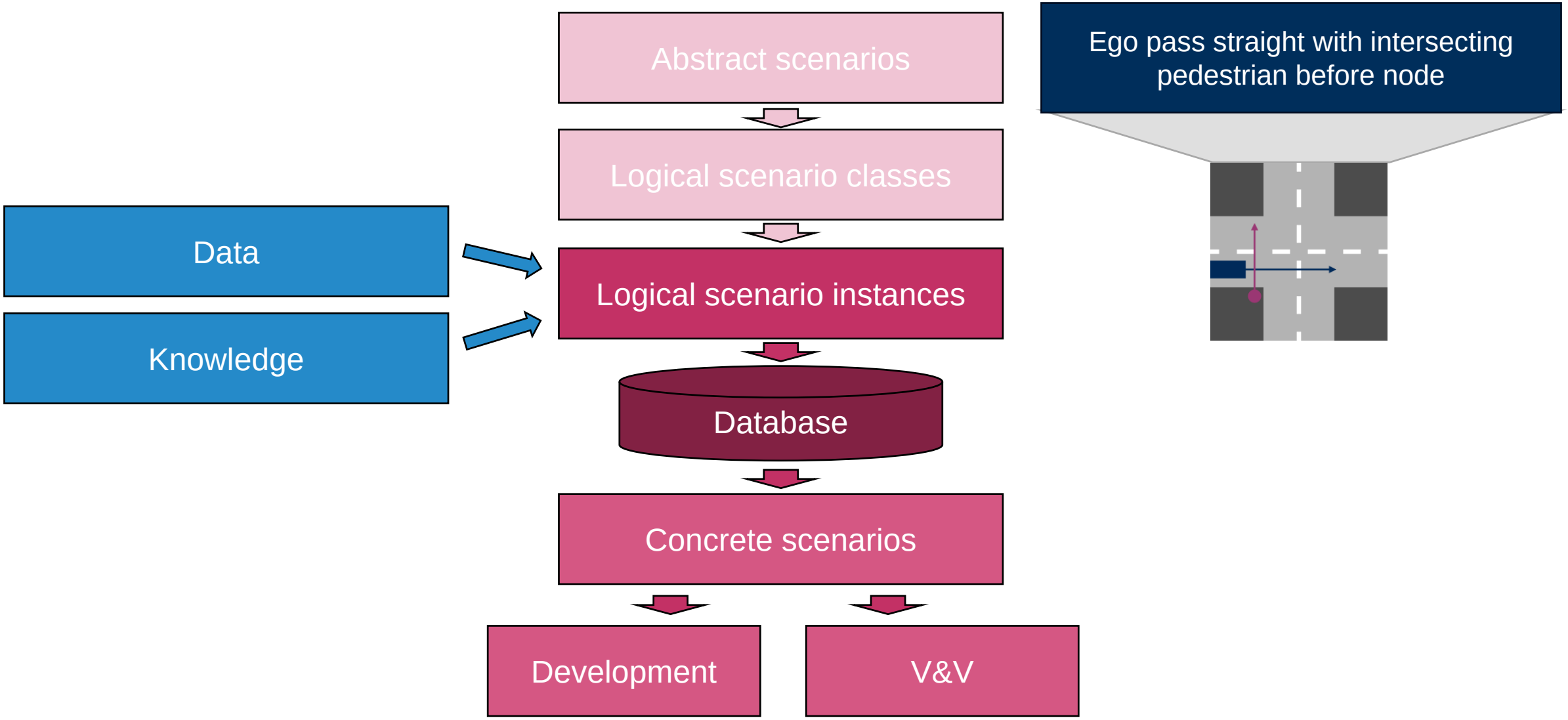
[1]

Scenario concept

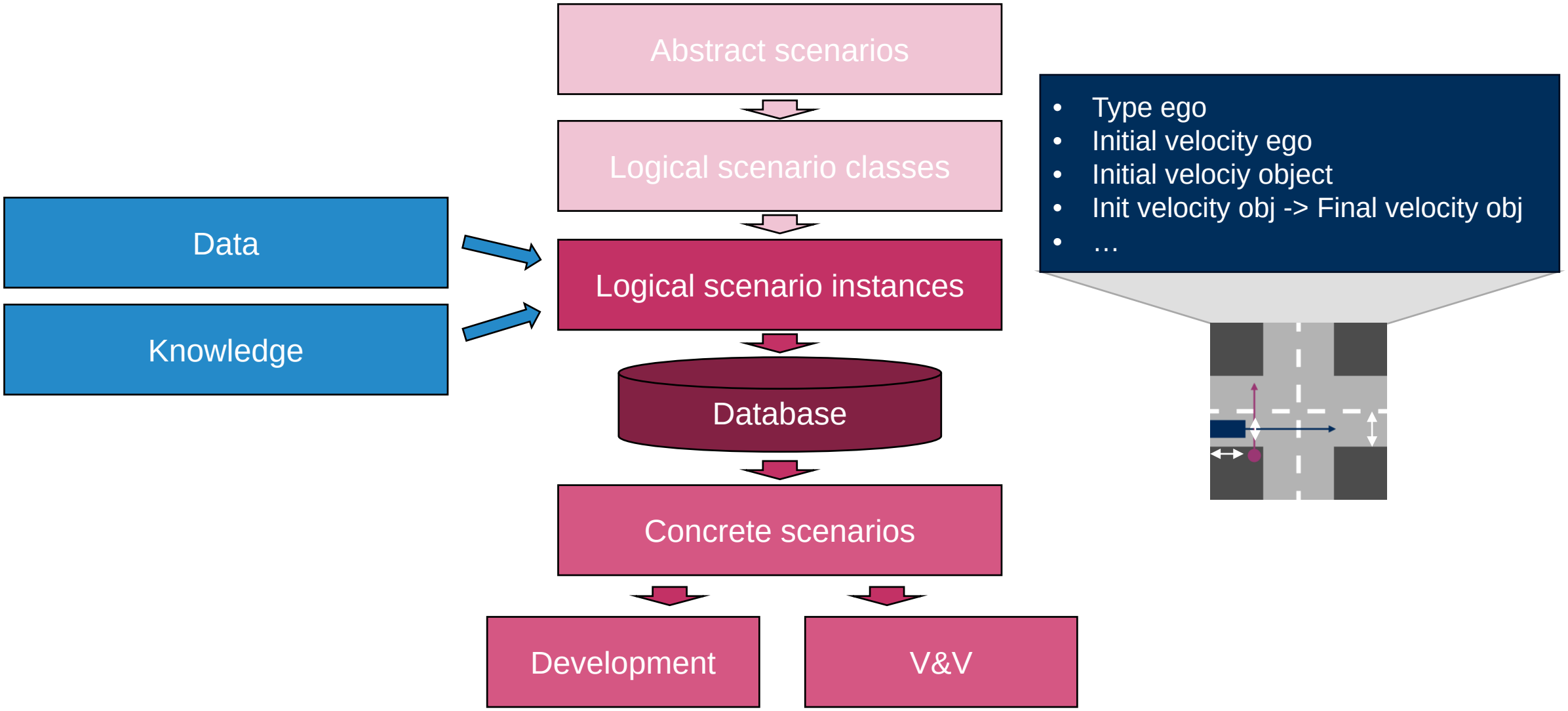
Requirements for scenario concepts

- Sufficient and valid description of scenarios
- Sufficient coverage of real-world scenarios to prove safety
- Formalized and explainable concept to derive scenarios, gain trust and allow argumentability

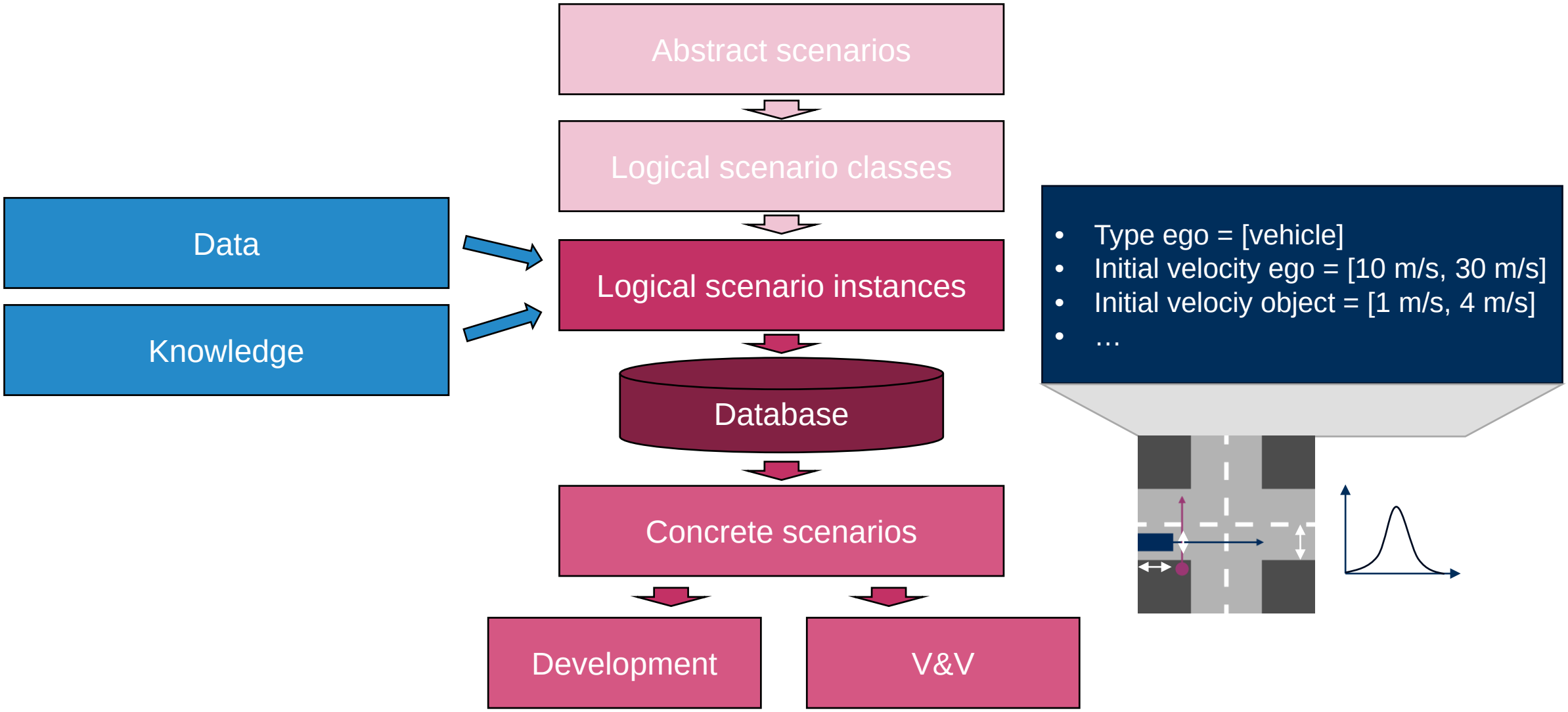
Scenarios in overall methodology



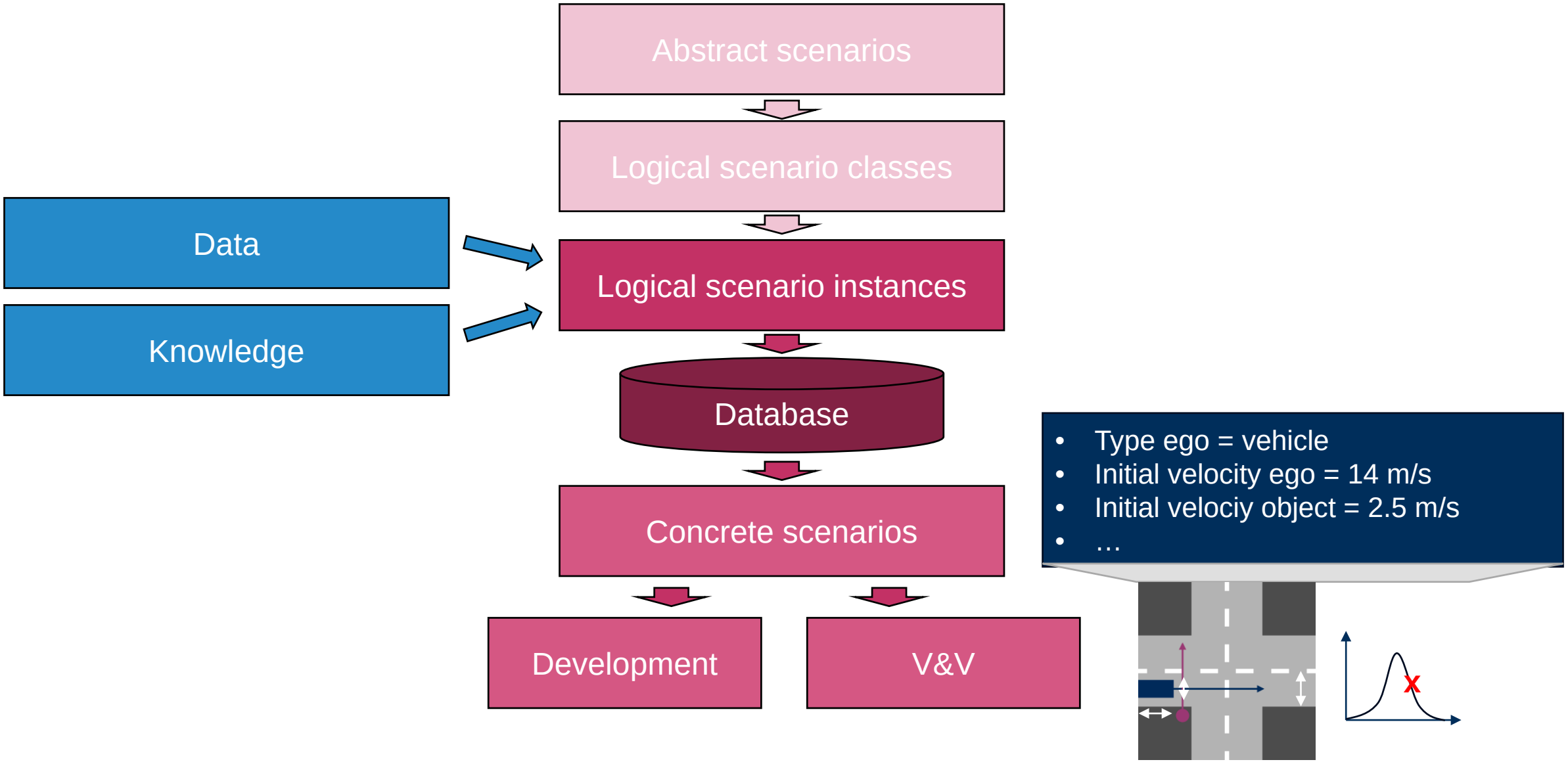
Scenarios in overall methodology



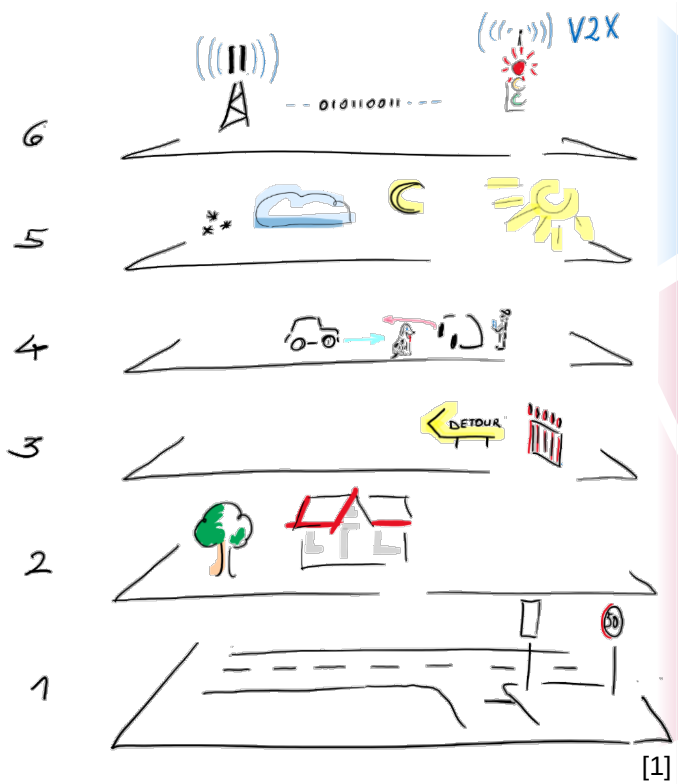
Scenarios in overall methodology



Scenarios in overall methodology



Scenario concept to structure traffic



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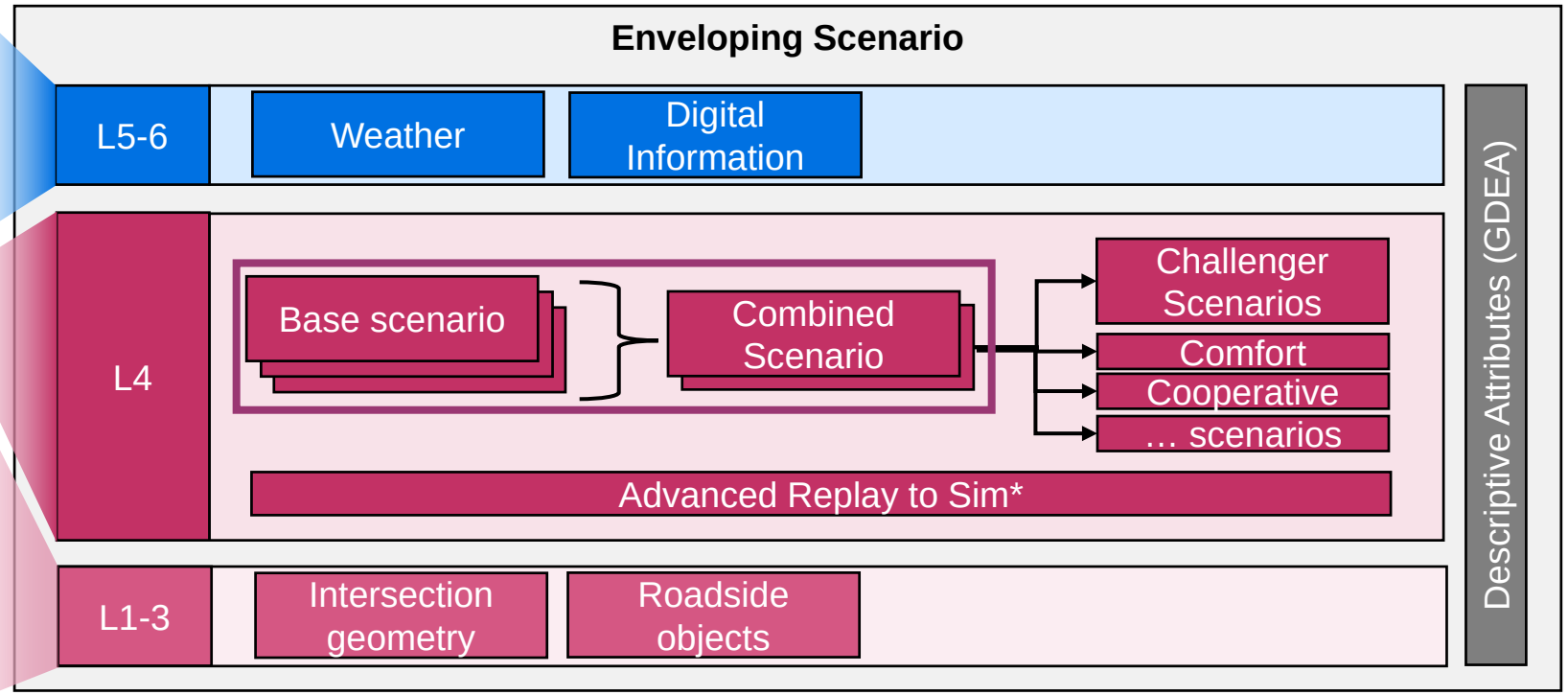


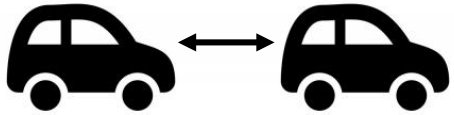
* to be published in VVM Deliverable 13

Dynamic Objects: Abstract concepts

- Concepts describing abstract characteristics of traffic
- Traffic is described in less than 300 base scenarios derived from concepts

Individual concepts

- Road user type
- Intersection maneuver



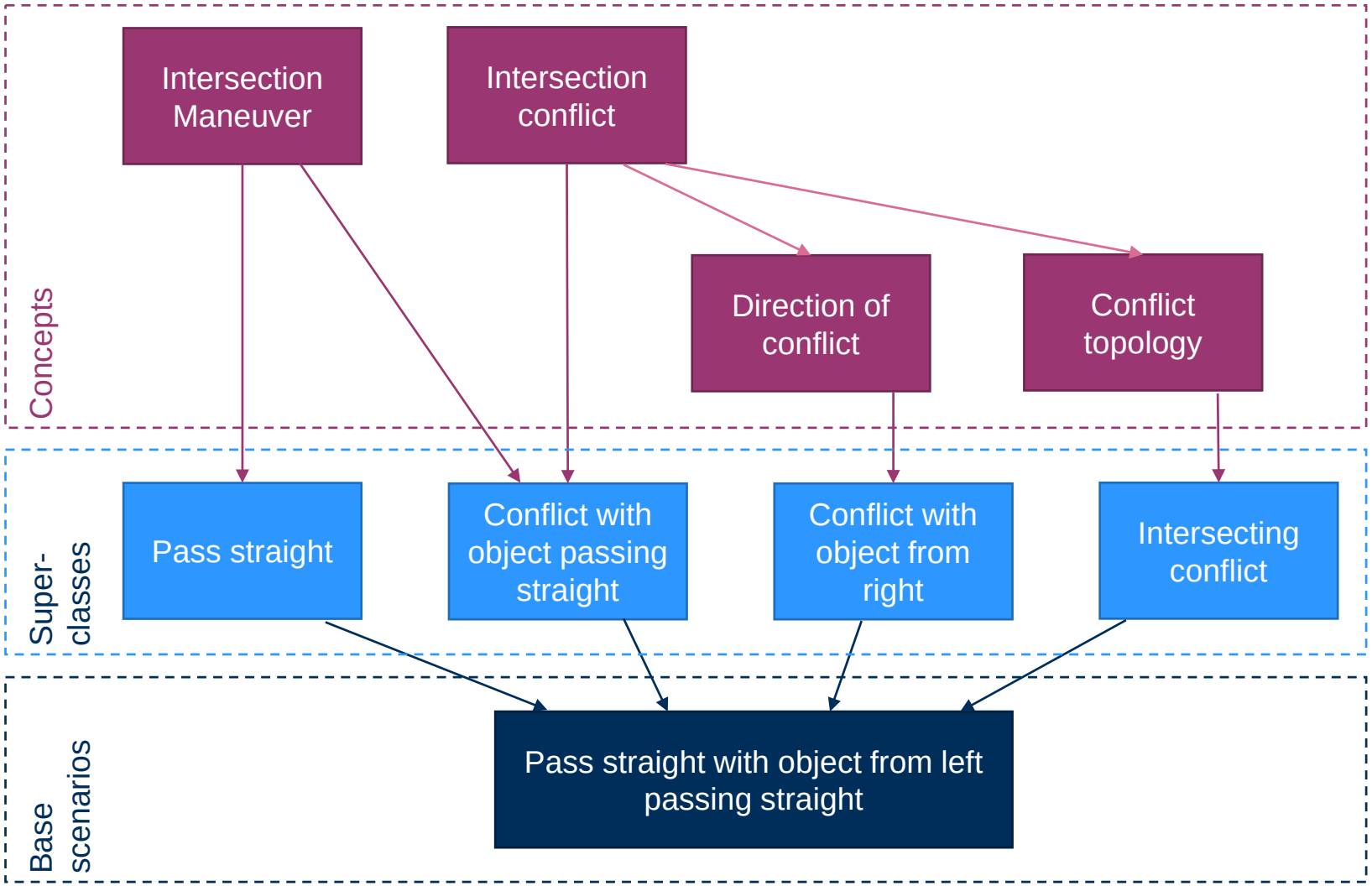
Bilateral concepts

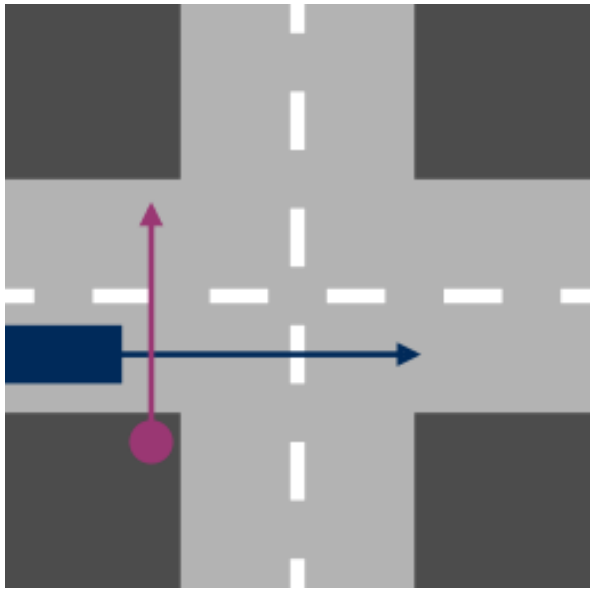
- Longitudinal state
- Intersection conflict
- Relative direction
- Traffic area change

Global concepts

- Traffic flow
- Traffic type

Scenario concept: Application to get Base Scenarios





Scenario concept: Derivation of attributes and parameters

Individual concepts

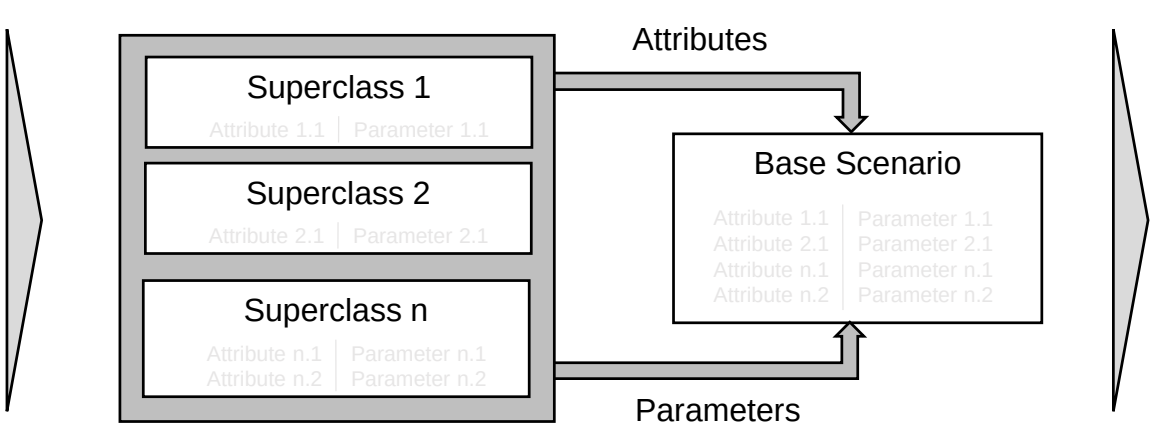
- *Road user type*
- Intersection maneuver

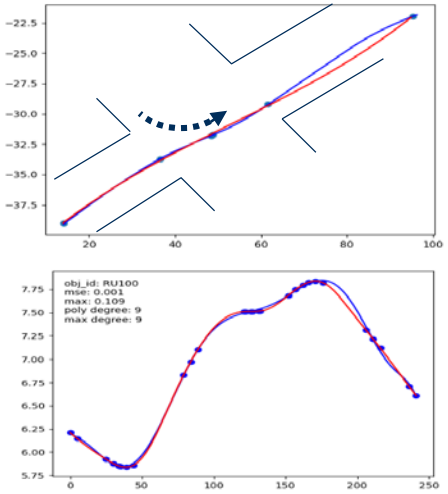
Bilateral concepts

- Longitudinal state
- Intersection conflict
- Relative direction
- Traffic area change

Global concepts

- *Traffic flow*
- *Traffic type*





Example: Derivation of attributes and parameters

VERIFICATION VALIDATION METHODS

Superclasses of Base Scenario

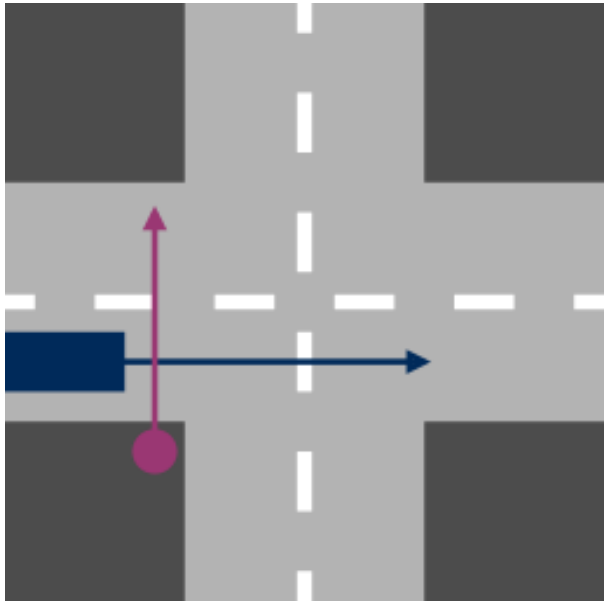
- Pass straight
- Interaction with object from right
- Interaction with object going straight
- Intersecting conflict
- Interaction in same traffic area

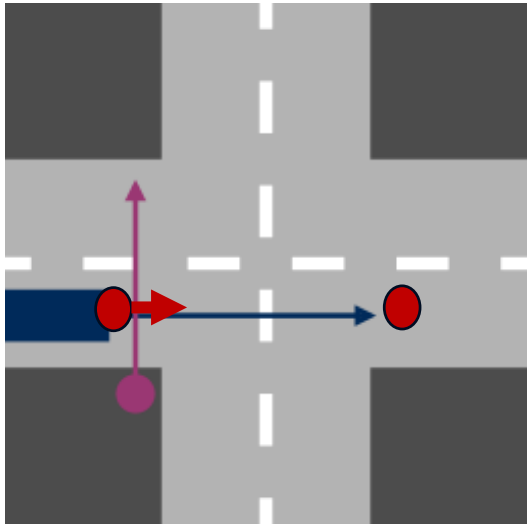
Passing straight

Logical scenario class

description ⇩ ⇩ generation

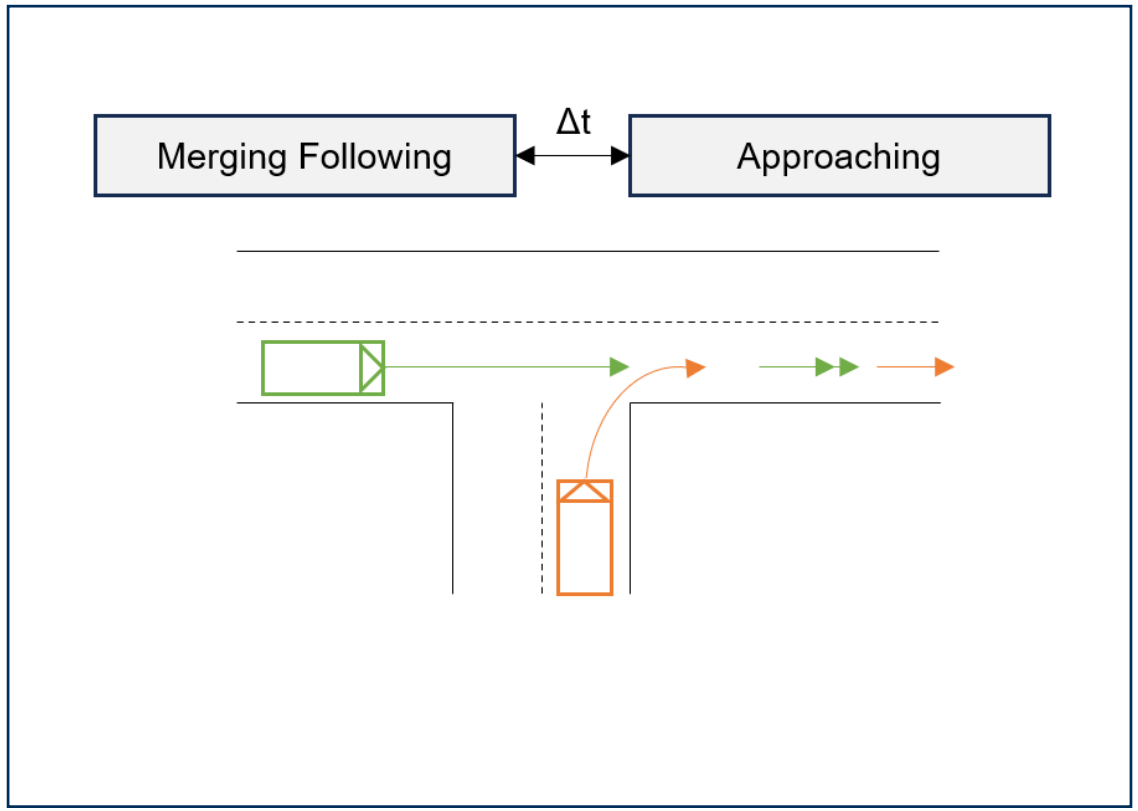
Attribute	Parameter
Pass Straight • Ego Velocity*, Ego lon. acceleration*, …	Pass Straight • Initial ego velocity • Initial ego position (s, t, road, lane) • Ego destination (road, lane)



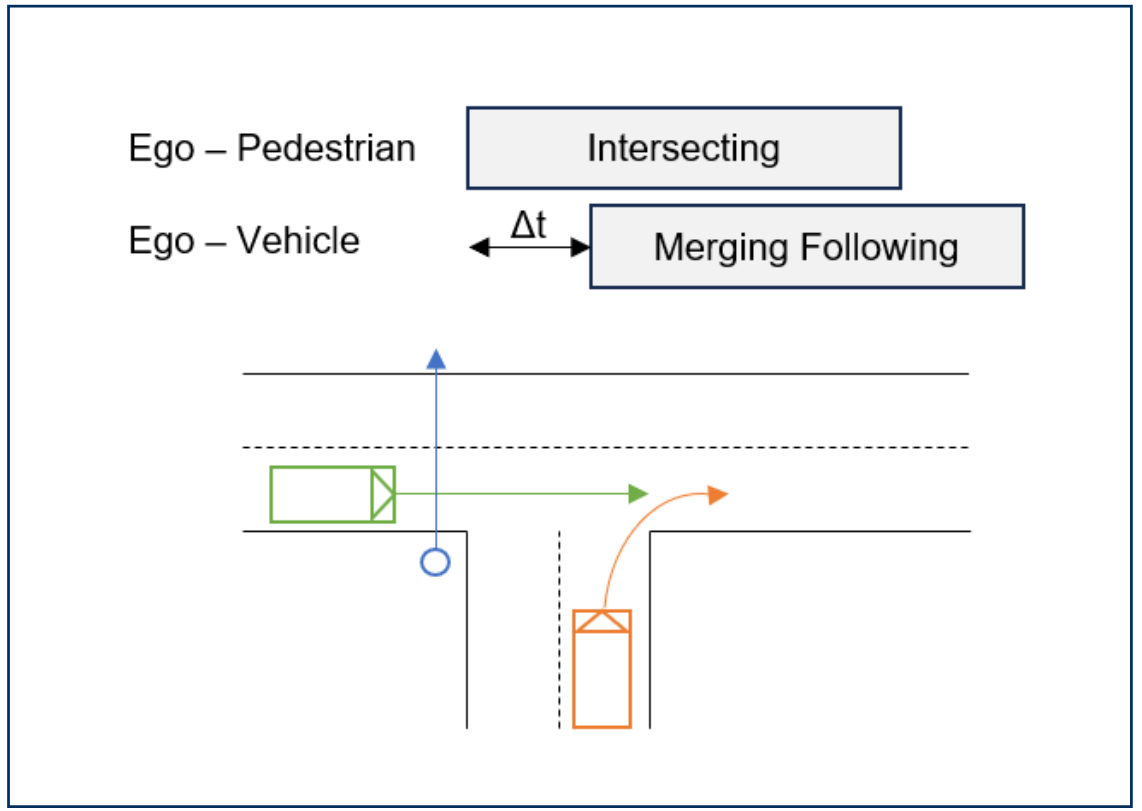


Scenario concept: Combined Scenarios

Sequential combination



Parallel combination



Conclusion

- **Formalized method to describe abstract scenarios**
  - Usage of ontology to get to a reasonable number of base scenarios
- **Formalized method to derive logical scenario classes**
  - Differentiation between attributes and parameters
- **Logical scenario instances can be filled knowledge-based, data-driven or hybrid**
- ***Further presentation: How to prove that the concept is sufficient complete?***

VERIFICATION
VALIDATION
METHODS

Thank you!

Christoph Glasmacher, ika – RWTH Aachen
christoph.glasmacher@ika.rwth-aachen.de

PROJECT of the PEGASUS FAMILY

VDA LEITINITIATIVE

A project developed by the VDA Leitinitiative
autonomous and connected driving

Supported by:

Federal Ministry
for Economic Affairs
and Climate Action

on the basis of a decision
by the German Bundestag

Relevant contributions

[1] M. Scholtes, L. Westhofen, L. Turner, K. Lotto, M. Schuldes, H. Weber, N. Wagener, C. Neurohr, M. Bollmann, F. Körte, J. Hiller, M. Hoss, J. Bock, and L. Eckstein „6-Layer Model for a Structured Description and Categorization of Urban Traffic and Environment“, IEEE Access, 2021.

[2] H. Weber, C. Glasmacher, M. Schuldes, N. Wagener, and L. Eckstein „Holistic Driving Scenario Concept for Urban Traffic“, IEEE Intelligent Vehicles Symposium, 2023.

[3] C. Glasmacher, H. Weber, M. Schuldes, N. Wagener, and L. Eckstein „Generation of Concrete Parameters from Logical Urban Driving Scenarios Based on Hybrid Graphs“, VEHITS, 2023.

[4] C. Glasmacher, M. Schuldes, H. Weber, N. Wagener, and L. Eckstein „Acquire Driving Scenarios Efficiently: A Framework for Prospective Assessment of Cost-Optimal Scenario Acquisition“, IEEE Intelligent Transportation Systems Conference, 2023.