SAFETY ASSURANCE BASED ON AN OBJECTIVE IDENTIFICATION OF SCENARIOS

One Approach of the PEGASUS-Project

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PEGASUS Project

Project for Establishing Generally Accepted quality criteria, tools and methods as well as Scenarios And Situations for approval of **highly automated driving functions**

PEGASUS

42 Month 2016 January 1st – 2019 June 20th

17 Partners

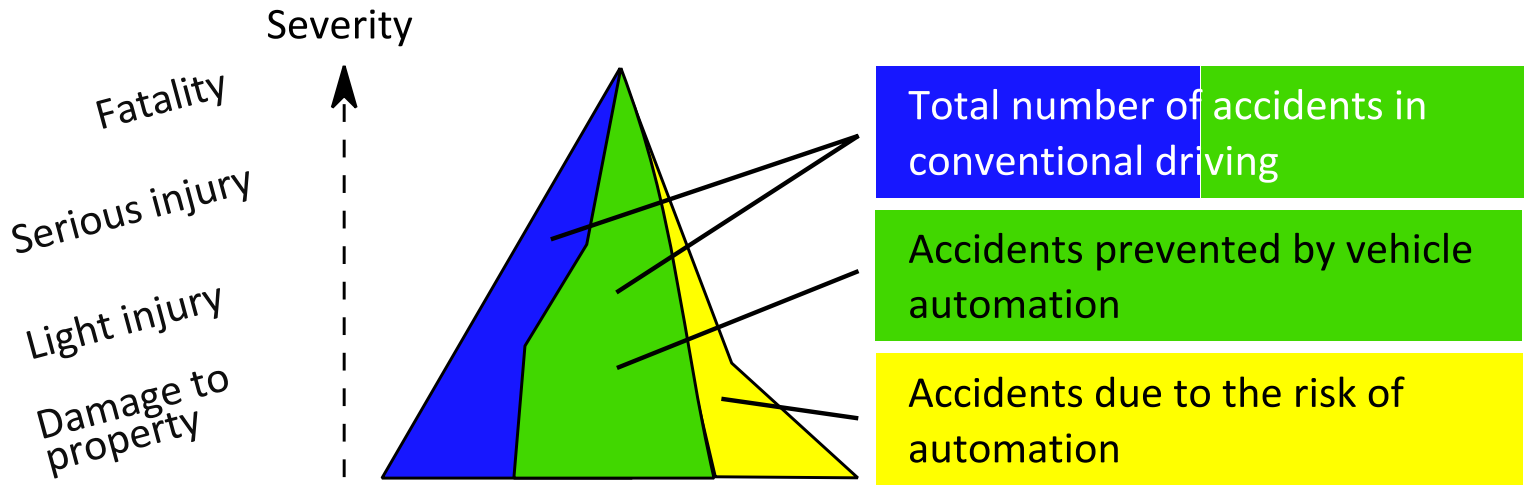
Audi, BMW, Daimler, Opel, Volkswagen, Bosch, Continental, TÜV SÜD, fka, iMAR, IPG Automotive, QTronic Simulation for Engineering, tracetronic, VIRES Simulationstechnologie GmbH, DLR, Technische Universität Darmstadt

12 Subcontractors i.a. IFR, ika, OFFIS

Projects budget ca. 34.5 m. EUR, funding 16.3 m. EUR

Personnel planning ca. 1,791 person month that is 149 person years

Safety Challenge for **HAD** (SAE level 3)



[1]

- Which change in numbers due to highly automated driving will occur?
- Do we need to predict the change for all level of severity?

The proof of safety for the top of severity is economically not possible by a solely stochastic approach of real world driving. [1-4]

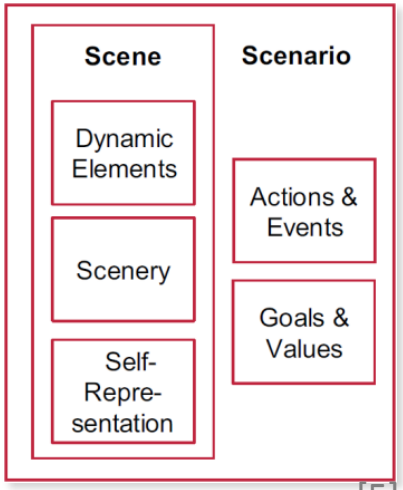
→The Approval-Trap asks for hundred millions or even billions of test kilometers.

Scenario Based Approach

- If we want to reduce the kilometers of real world driving, we have to identify relevant scenarios for alternative approaches!

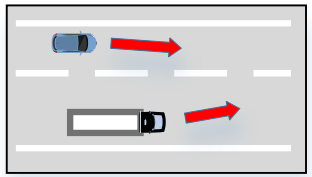
Scenario:

- "A **scenario** describes the **temporal development** between several scenes in a sequence of scenes. Every scenario starts with an **initial scene**. **Actions & events** as well as **goals & values** may be specified to characterize this temporal development in a scenario. Other than a scene, **a scenario spans a certain amount of time**."



[5]

- A **concrete scenario** is a series of subjective or objective scenes, including **specific movement trajectories** of one or more vehicles, and the concrete description of **the environment**.



- A **logical scenario** is a **configurable representation** of the traffic with parameter distributions. Substituting individual parameter combinations concrete scenarios can be derived.

Method to Identify Scenarios and Assess Relevance

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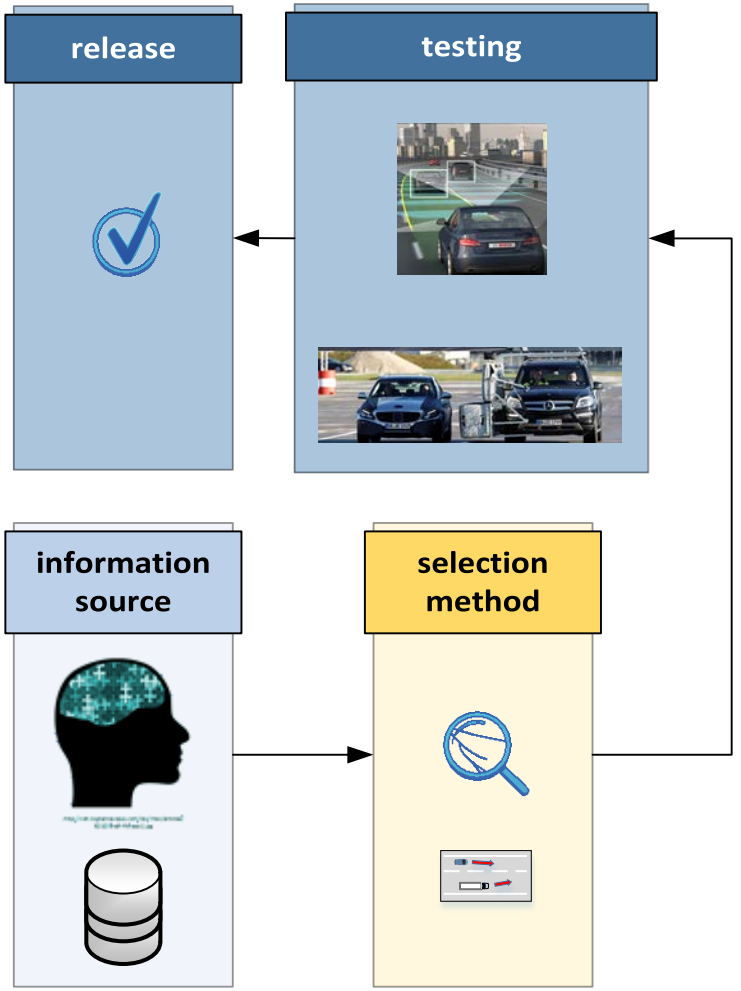
Let‘s start simple:



- The goal is to bring **HAD** to the users.
- The process seems straight forward.
- But every step needs a decision of an engineer/manager → human.

➢ To establish objective decisions, metrics should be identified and established.

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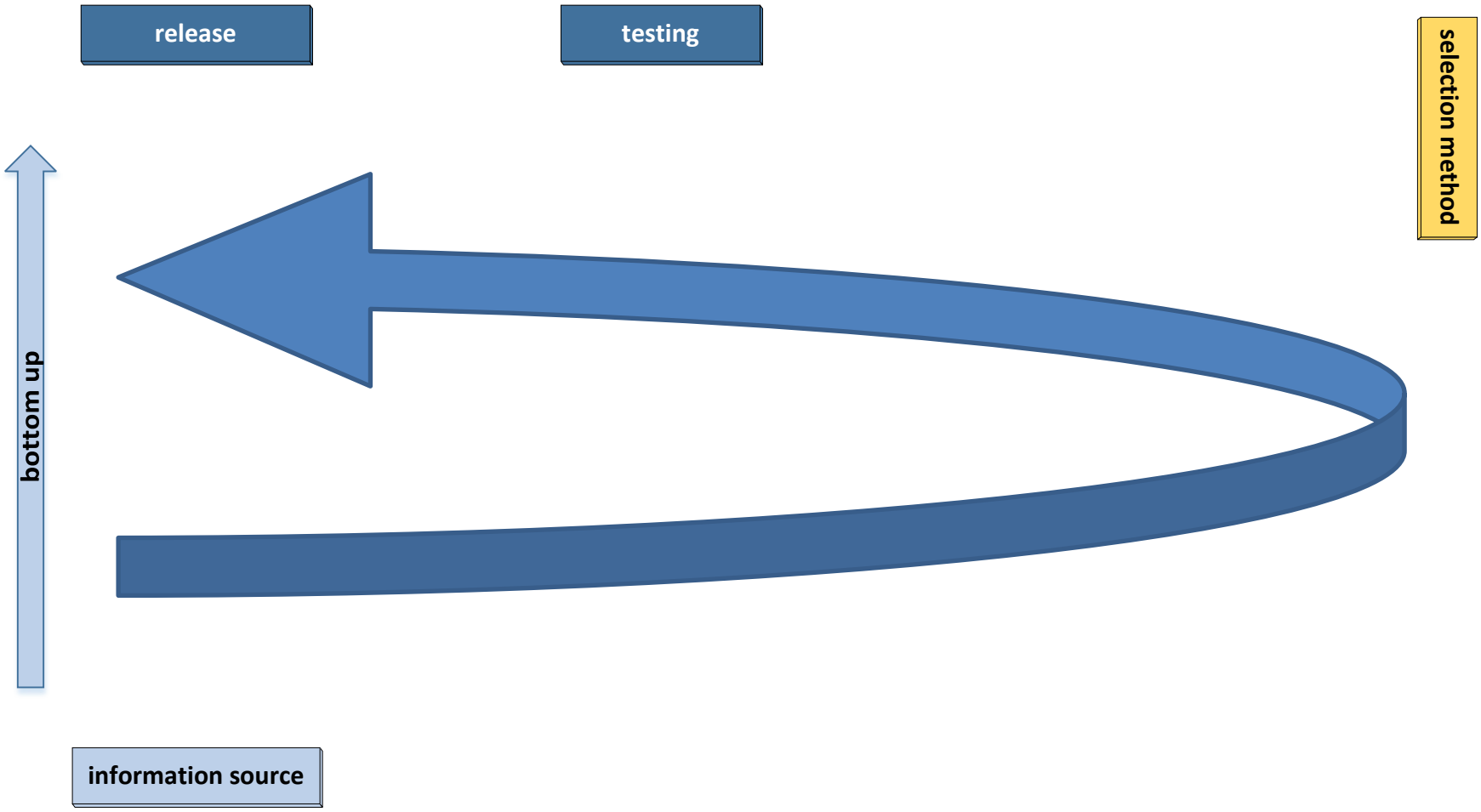

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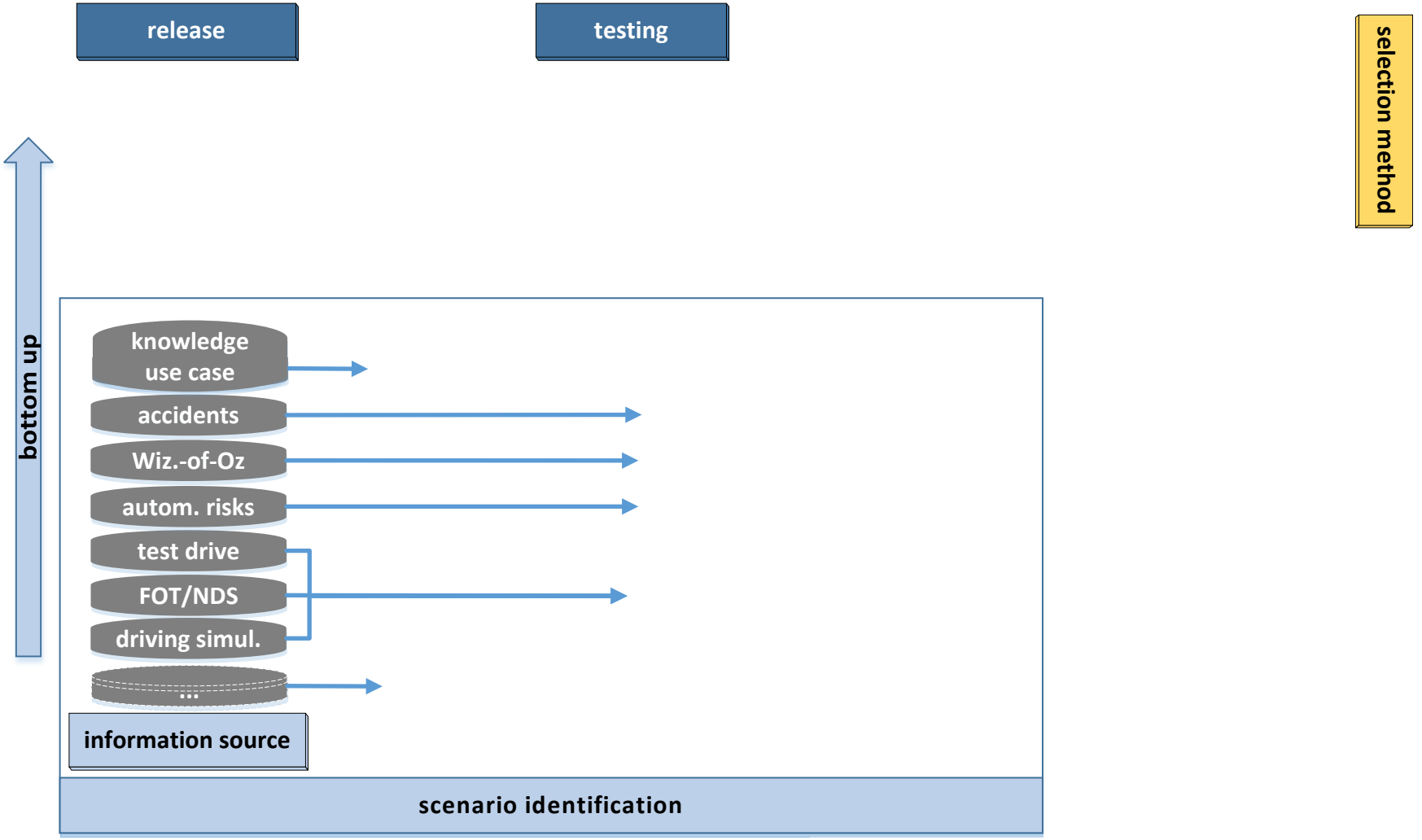

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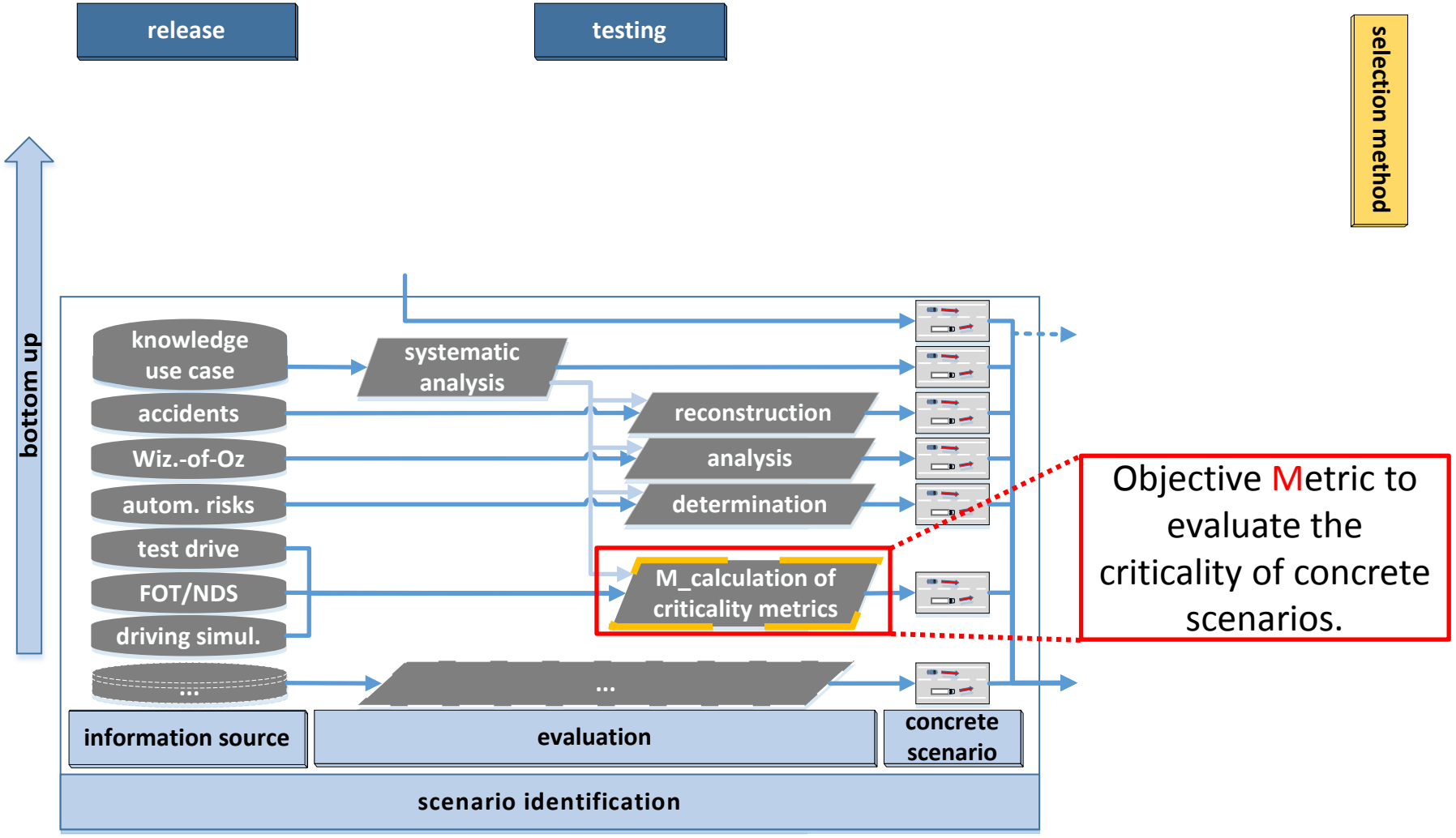

Metrics to Evaluate Information Sources

- calculation of criticality metrics -

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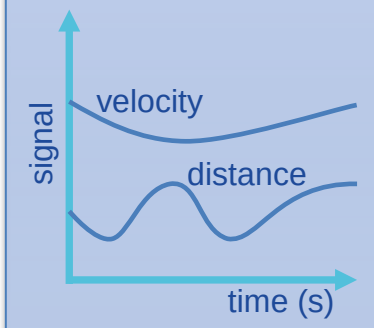
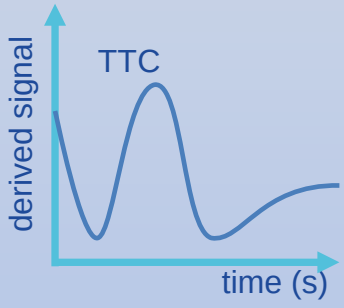
Step 1
Collect measurement signals from:

- simulations
- accident analysis
- test site measures
- FOT data
- …



Step 2
Derive additional signals in a coherent way e.g.:

- time-to-collision
- time-headway
- …



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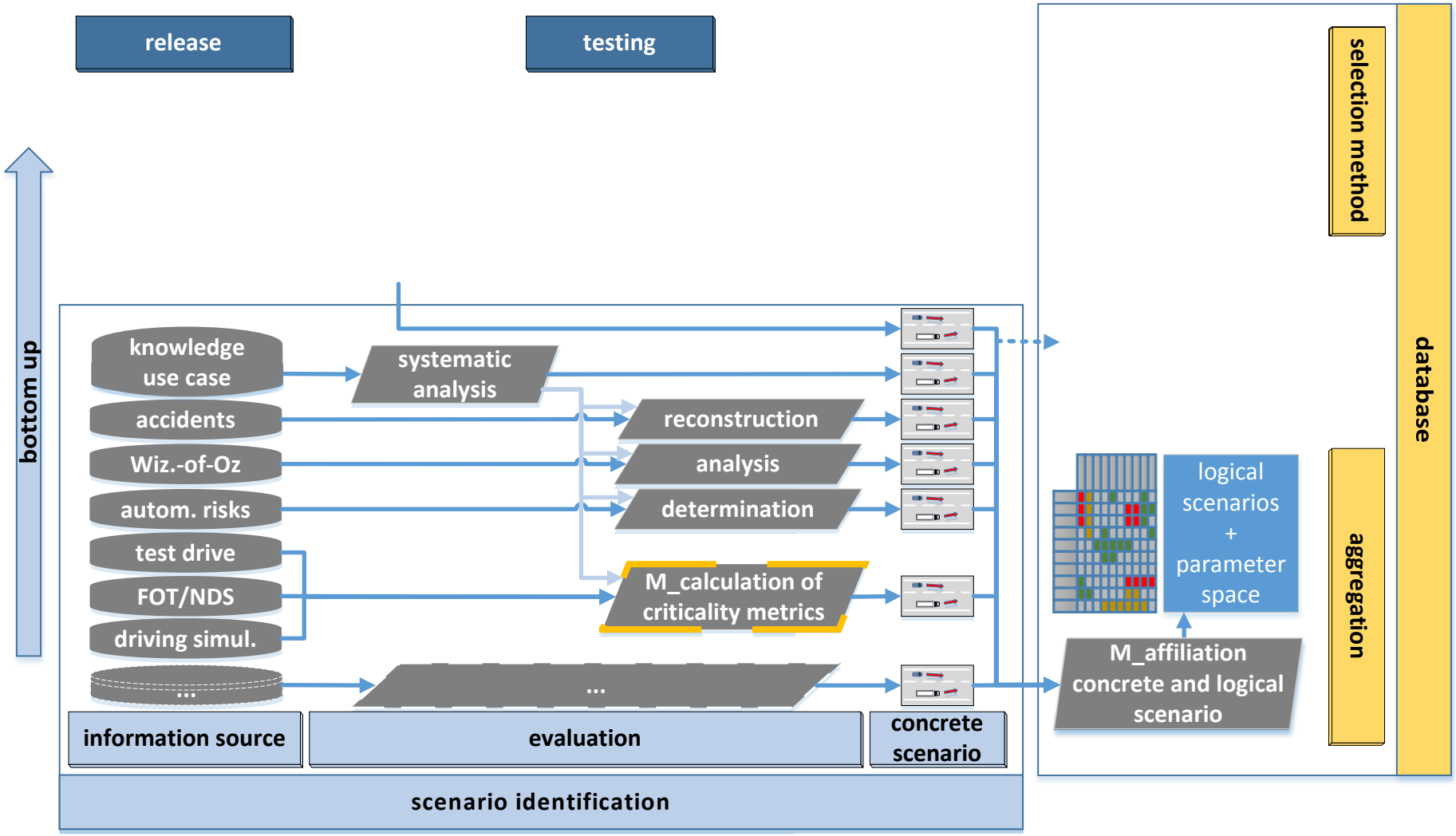

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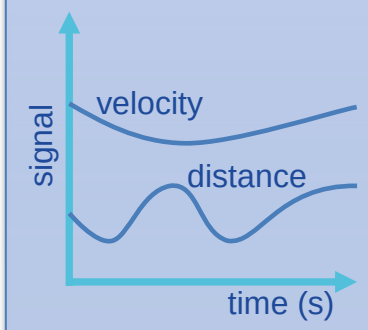

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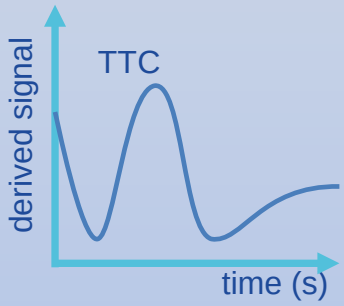
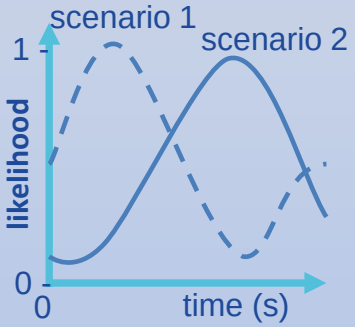


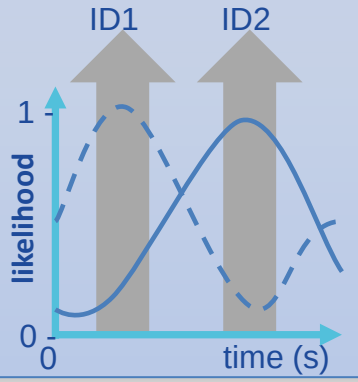
Step 3
Calculate scenario likelihood e.g.:

- lane change
- acceleration
- cut in
- …



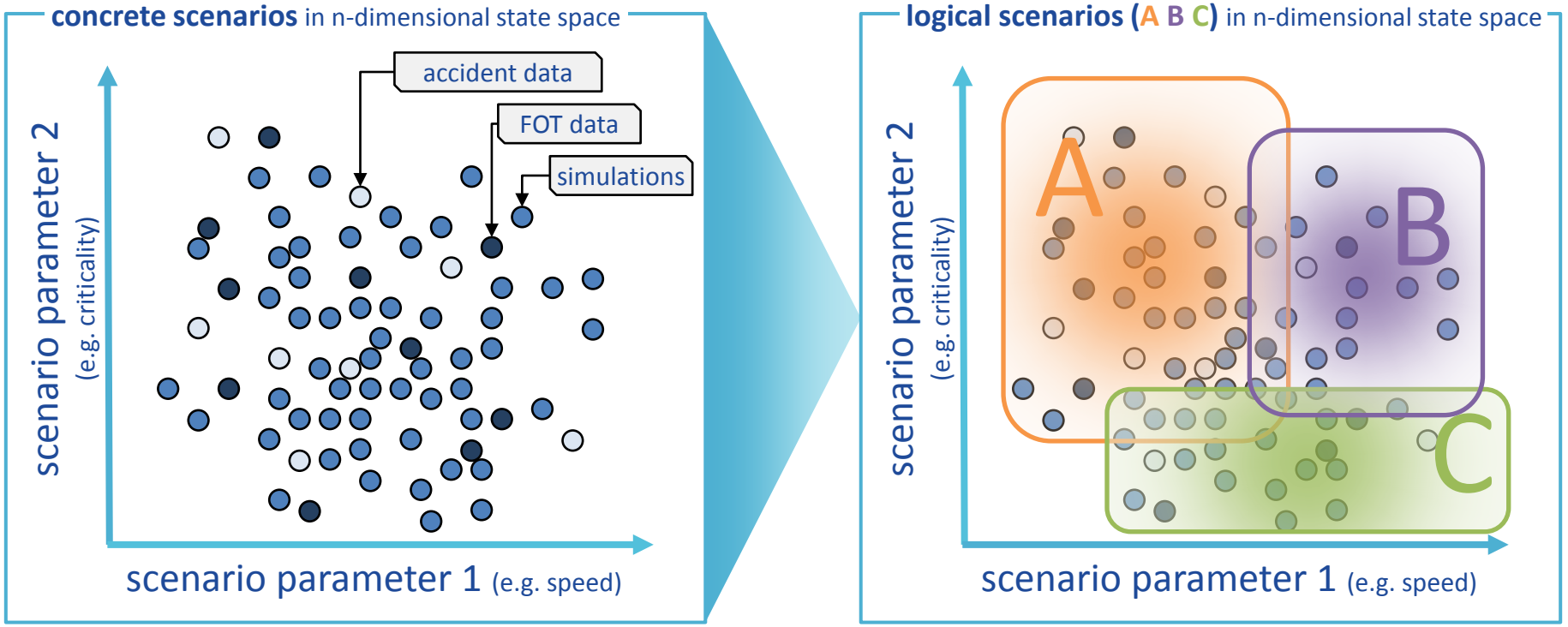
Step 4
Extract scenarios and derive indicators e.g.:

- maximum speed
- minimum TTC
- max. criticality
- …

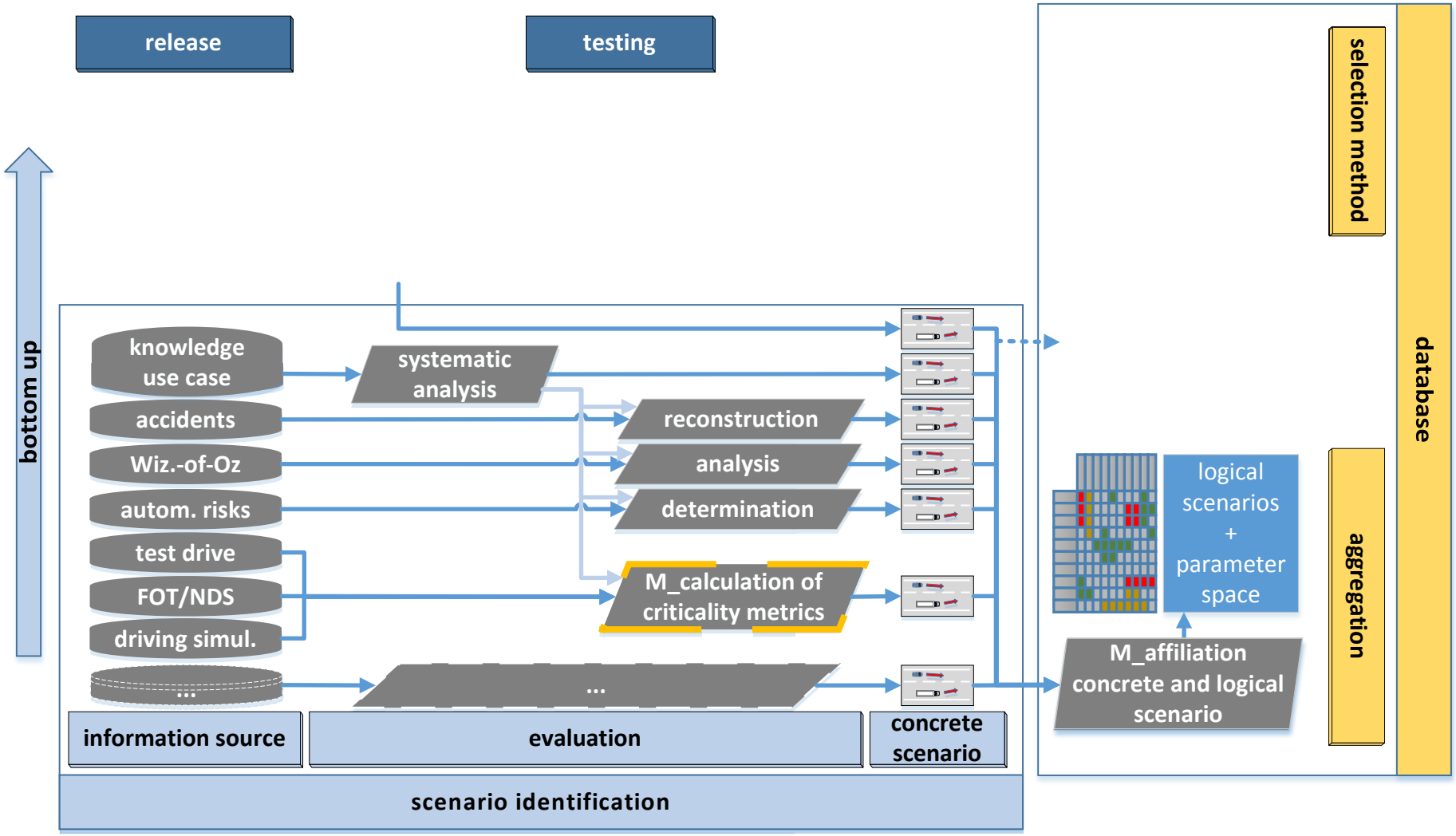


Metrics to Cluster Scenarios

- affiliation concrete and logical scenario -



Method to Identify Scenarios and Assess Relevance



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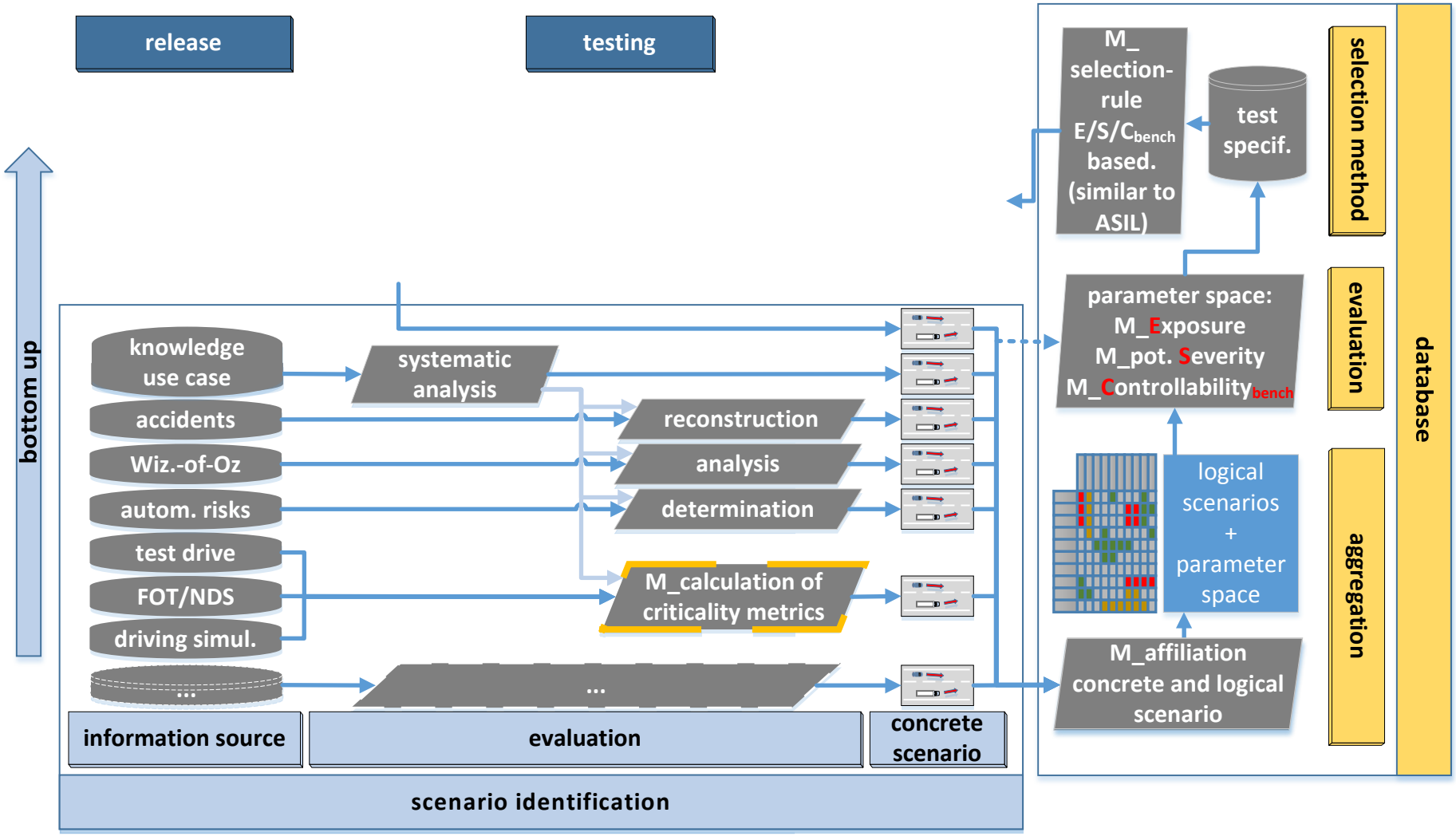

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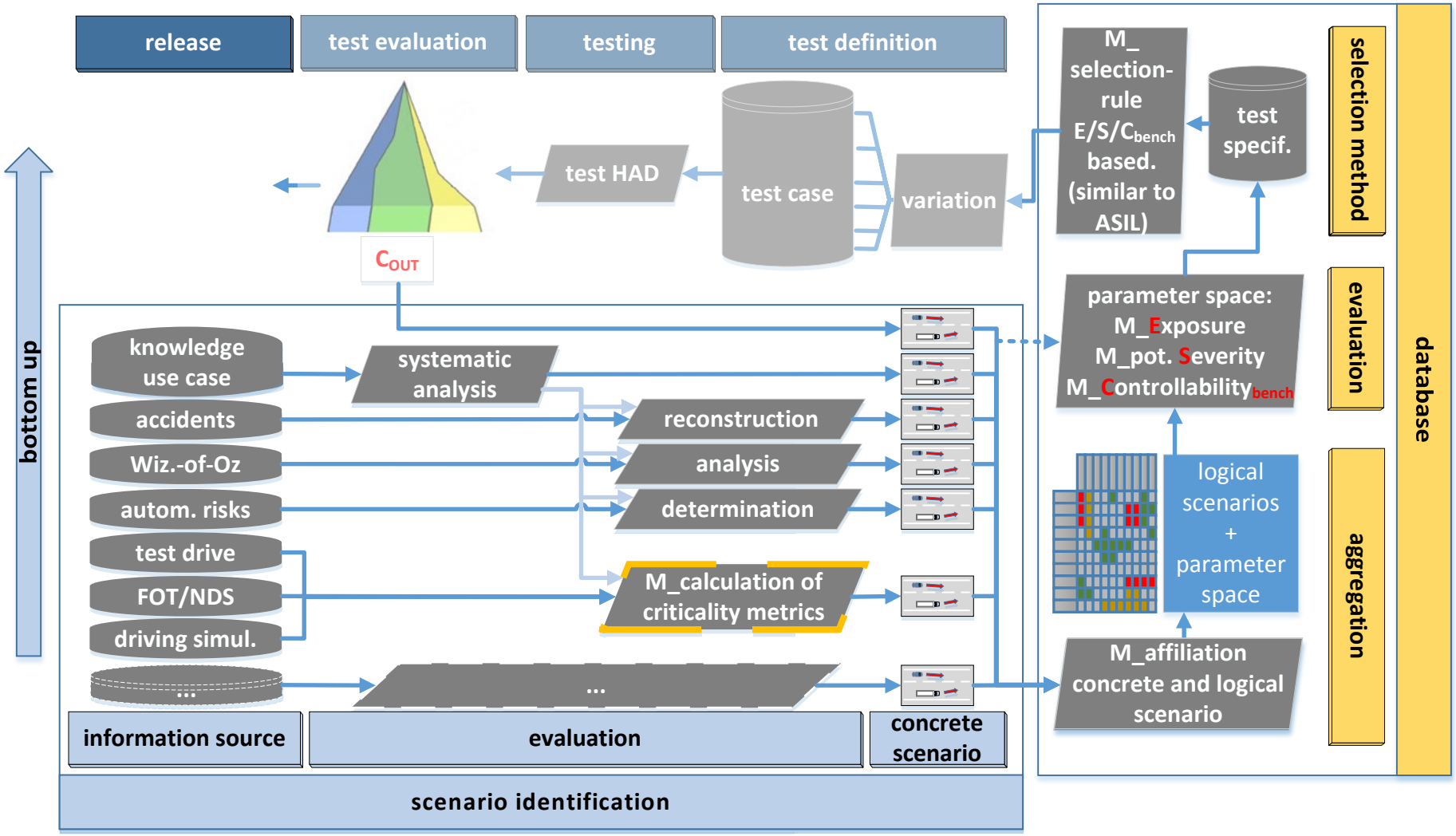

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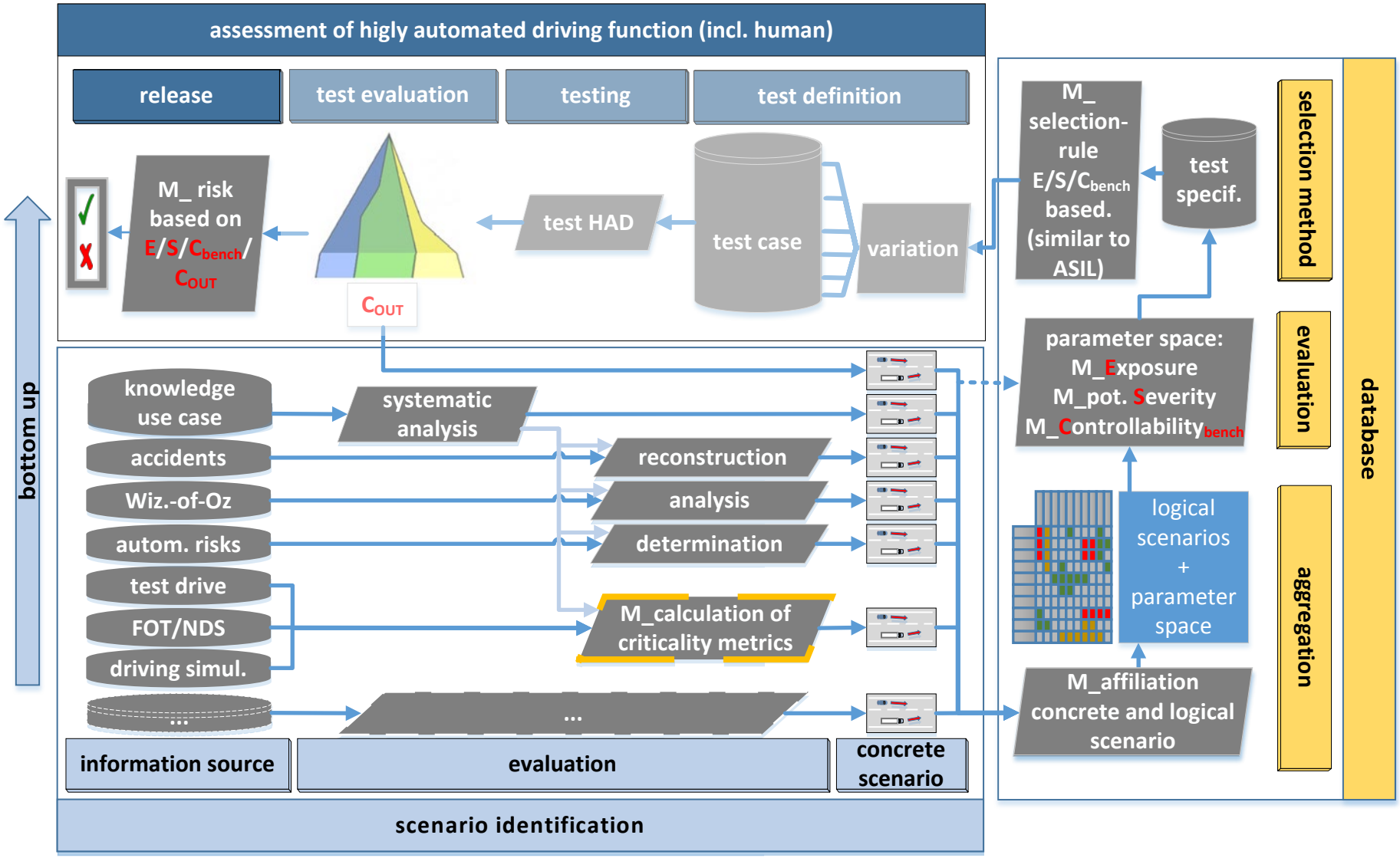

Method to Identify Scenarios and Assess Relevance

Challenges:

- The amount and representativeness of data
- How to define a logical scenario to represent the relevant reality in a consistent way?
- How to demonstrate the validity of this approach?

➢ An uncertainty on HAD's safety will remain for the first introduction.
➢ The goal is to reduce this uncertainty to the best of today's knowledge.

- Transferability to different use cases of HAD

➢ PEGASUS starts with HAD on highways/Autobahn.
➢ The transferability to further use cases will be studied within PEGASUS in the second step.

Conclusion

- The definition of a common method to identify scenarios is urgent.
- An approach has been proposed: the metric perspective
- The PEGASUS partners further work on this need.
- The final goal is a common scenario database as a transparent tool for collaboration
- The next steps are:
  - Further concretize the metrics
  - Gather information sources
  - Filling up the database

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