VERIFICATION
VALIDATION
METHODS

Mid-Term Presentation 15 / 16 March 2022

Using Ontologies for the Formalization, Recognition, and Analysis of Criticality

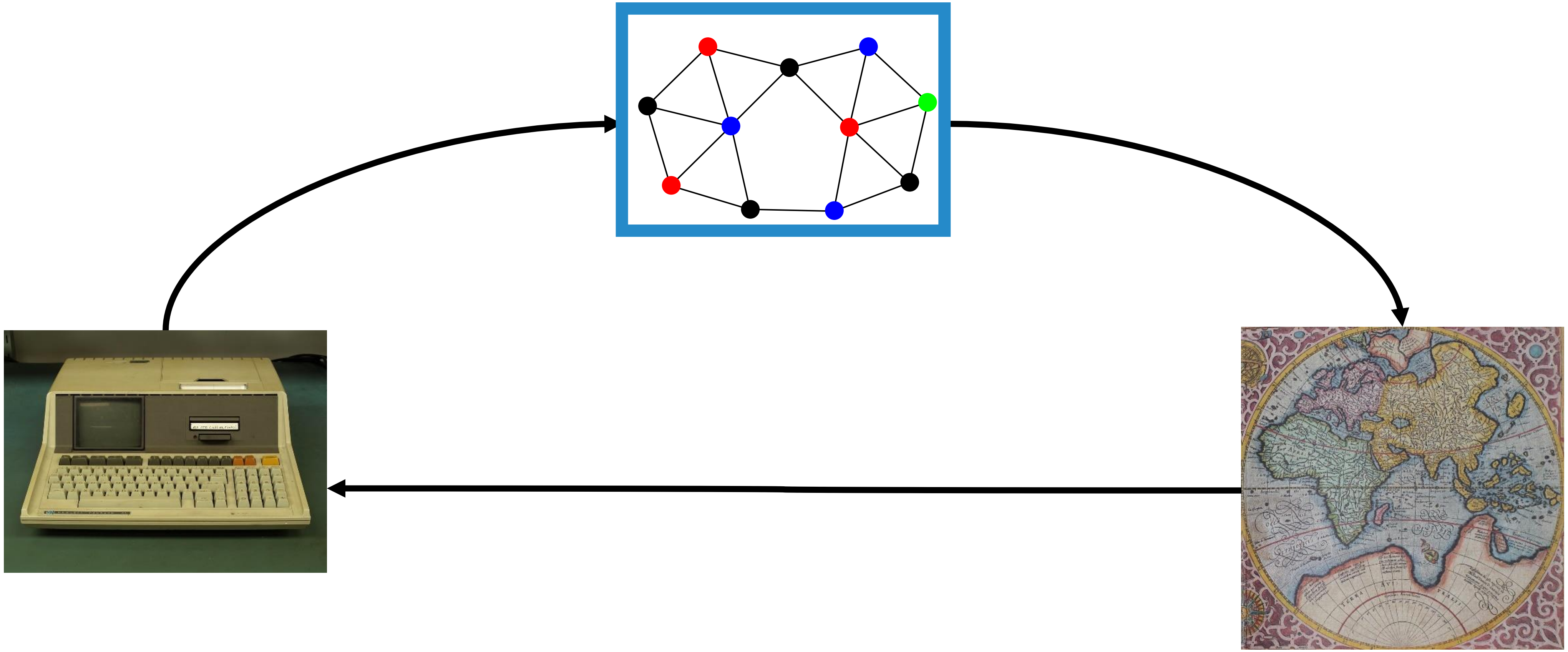
Lukas Westhofen, German Aerospace Center (DLR)

Supported by:
Federal Ministry for Economic Affairs and Climate Action
on the basis of a decision by the German Bundestag

The Complex and Open Context

VERIFICATION
VALIDATION
METHODS

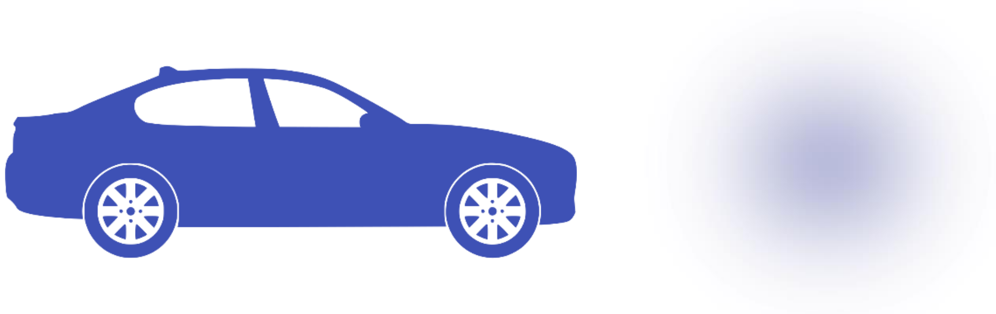
Ontologies to Formalize Conceptualizations



Ontologies within a Safety Case

Designer: ‚My ODD shall not contain `fog`‘

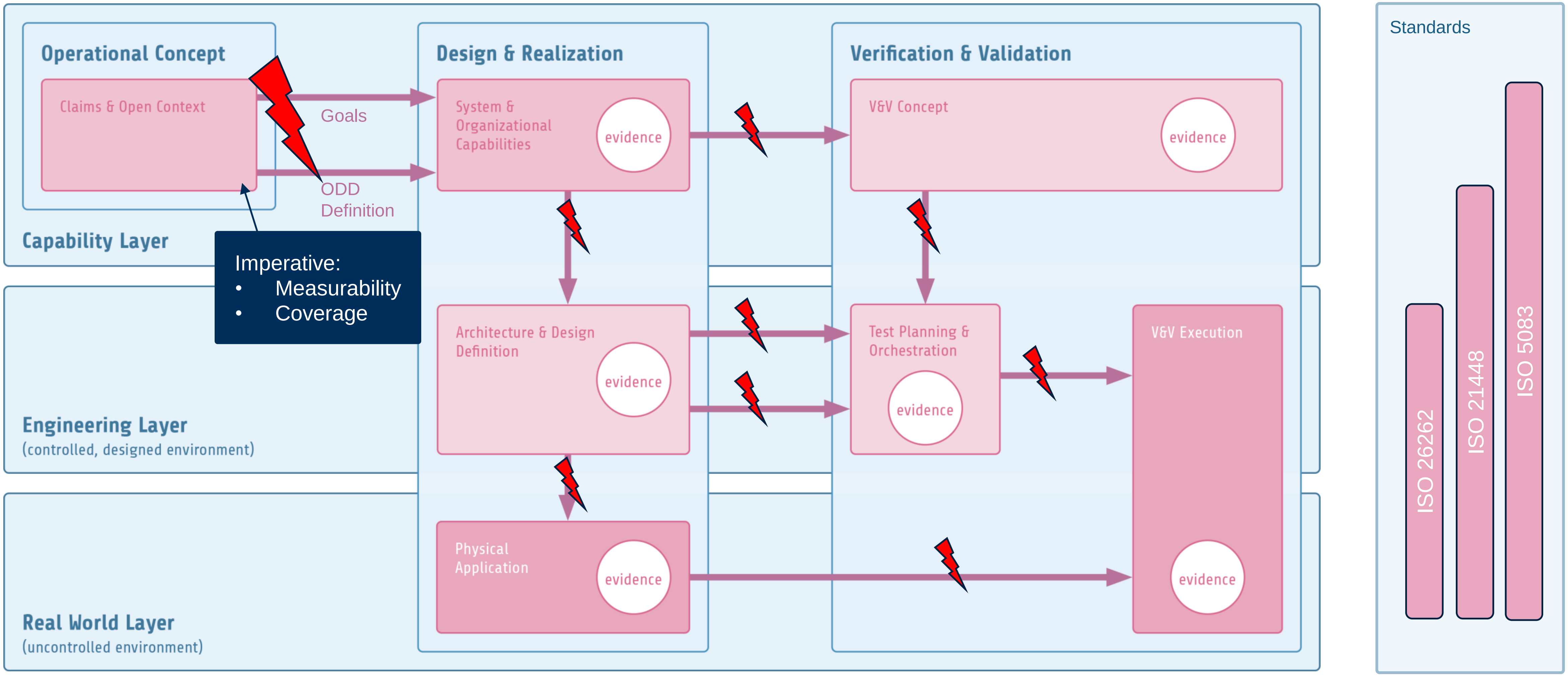
Developer: ‚Ensure that system detects ODD boundary `fog`‘



Issues:

- What is `fog`? Does spray classify as `fog`?
- What is the difference to `mist`? Same, just another symbol?
- Where does `fog` end and `rain` start?
- How do we agree on a suitable definition? How do we organize knowledge?
- …

Ontologies within a Safety Case



Criticality Phenomena as an Ontological Basis

VERIFICATION
VALIDATION
METHODS

Fog , Occluded Bicyclist, Heavy Rain, Low Coeffi… …on, Glare, Highly Reflective Materi… …on Intersection … …tholes, N… …cial Traffic Signs, Storm, E… …nstructions Site, Icy Road, Wild Animal C…ing, …

Catalog of ~300 CPs already identified

Formalization

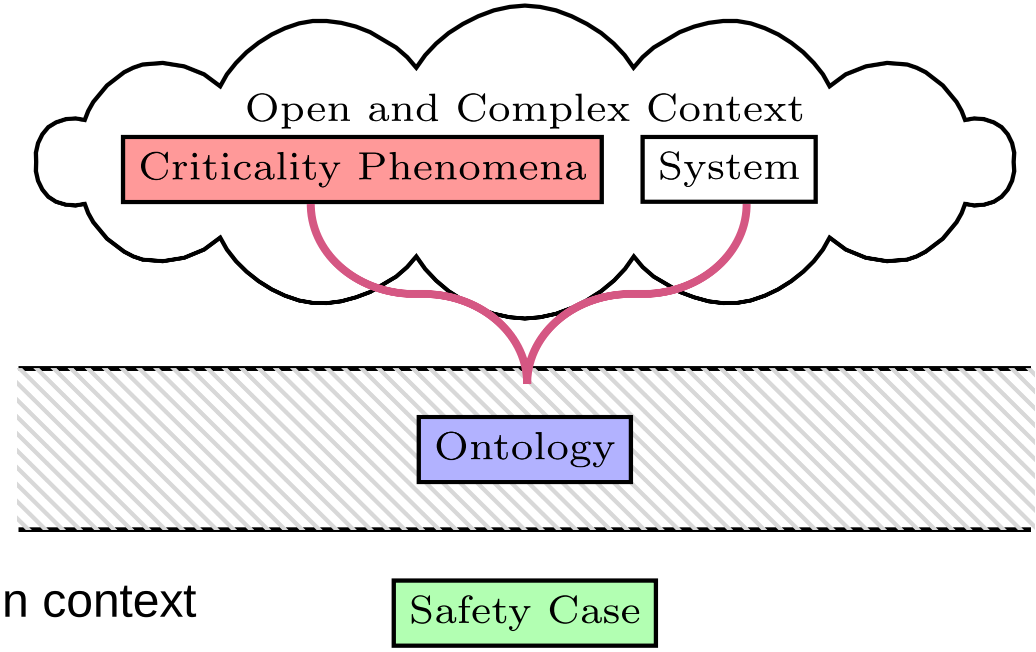
1. Construct ontology from criticality phenomena (CPs)

Recognition

2. Ontology-based recognition of criticality phenomena in context

Analysis

3. Usage of criticality phenomena inference in safety case



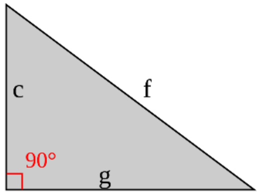
Creating an Ontology from Criticality Phenomena

Formalization

Recognition

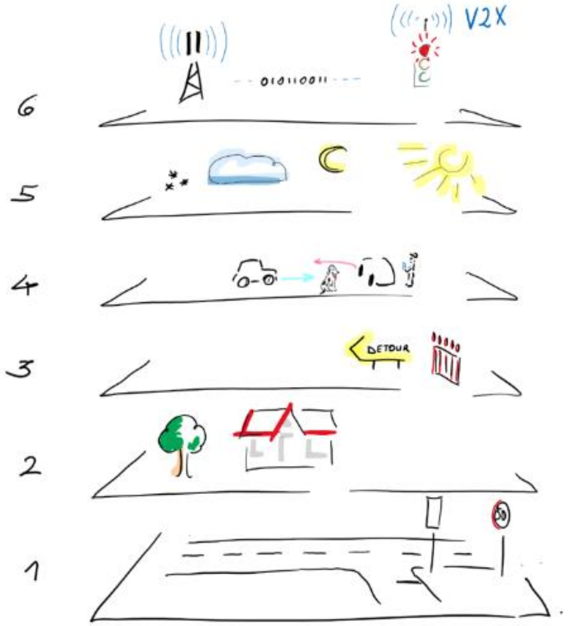
Analysis

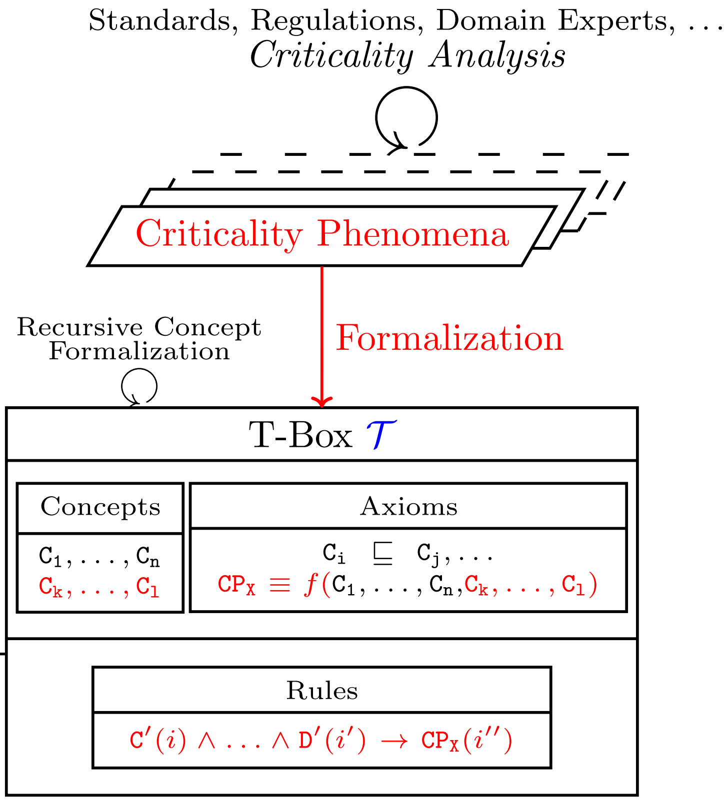
Related Ontologies



⋮

6-Layer Model





Automotive Urban Traffic Ontology (A.U.T.O.)

https://ieeexplore.ieee.org/document/9400833

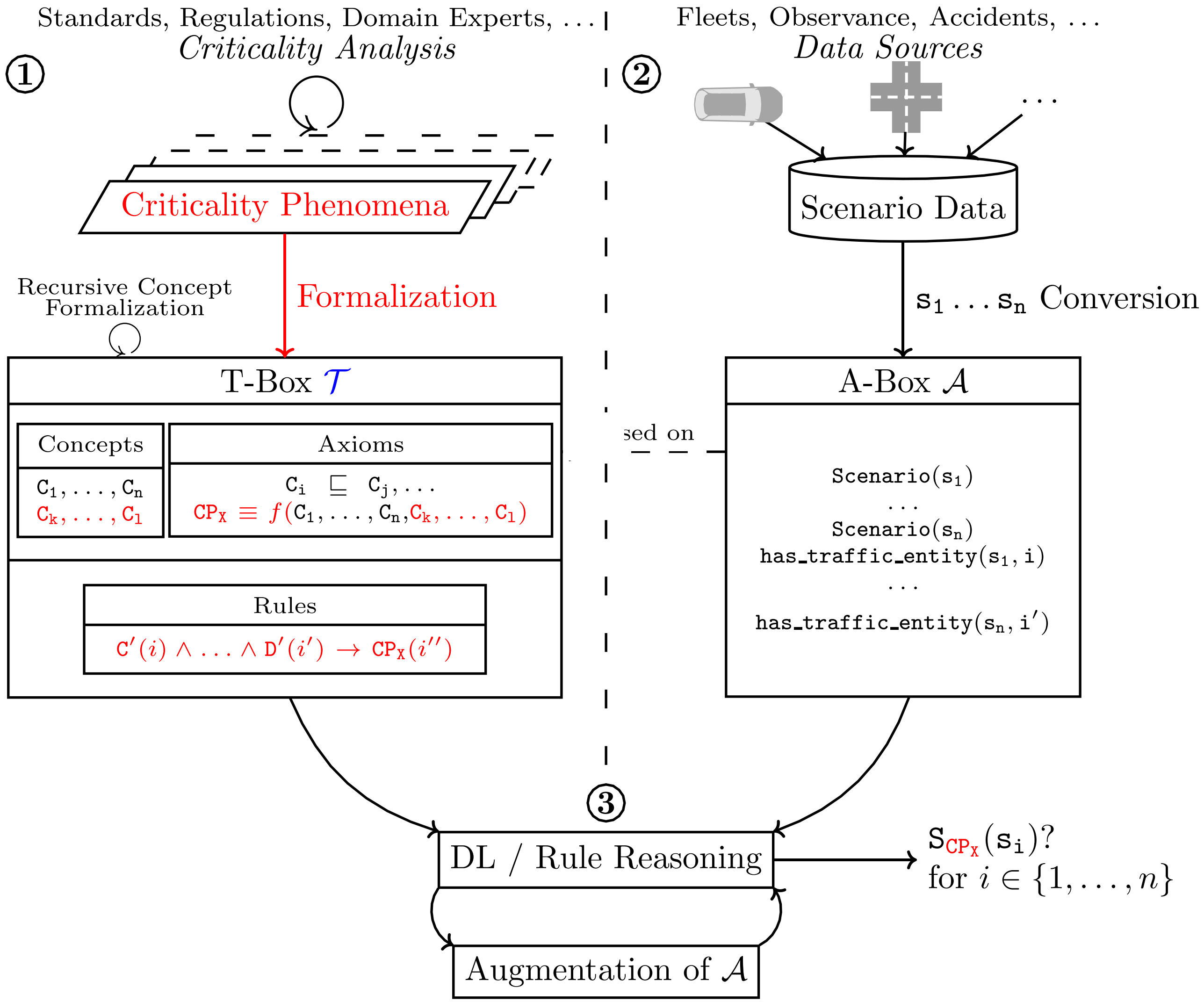
Find our ontology @GitHub: https://github.com/lu-w/auto

Ontology-based Recognition of Criticality Phenomena

Formalization

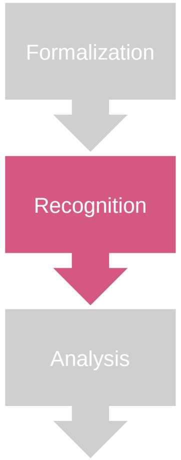
Recognition

Analysis



VERIFICATION VALIDATION METHODS

Tool Demo



Pellet DL Reasoner

Owlready: Ontology-oriented programming in Python with automatic classification and high level constructs for biomedical ontologies

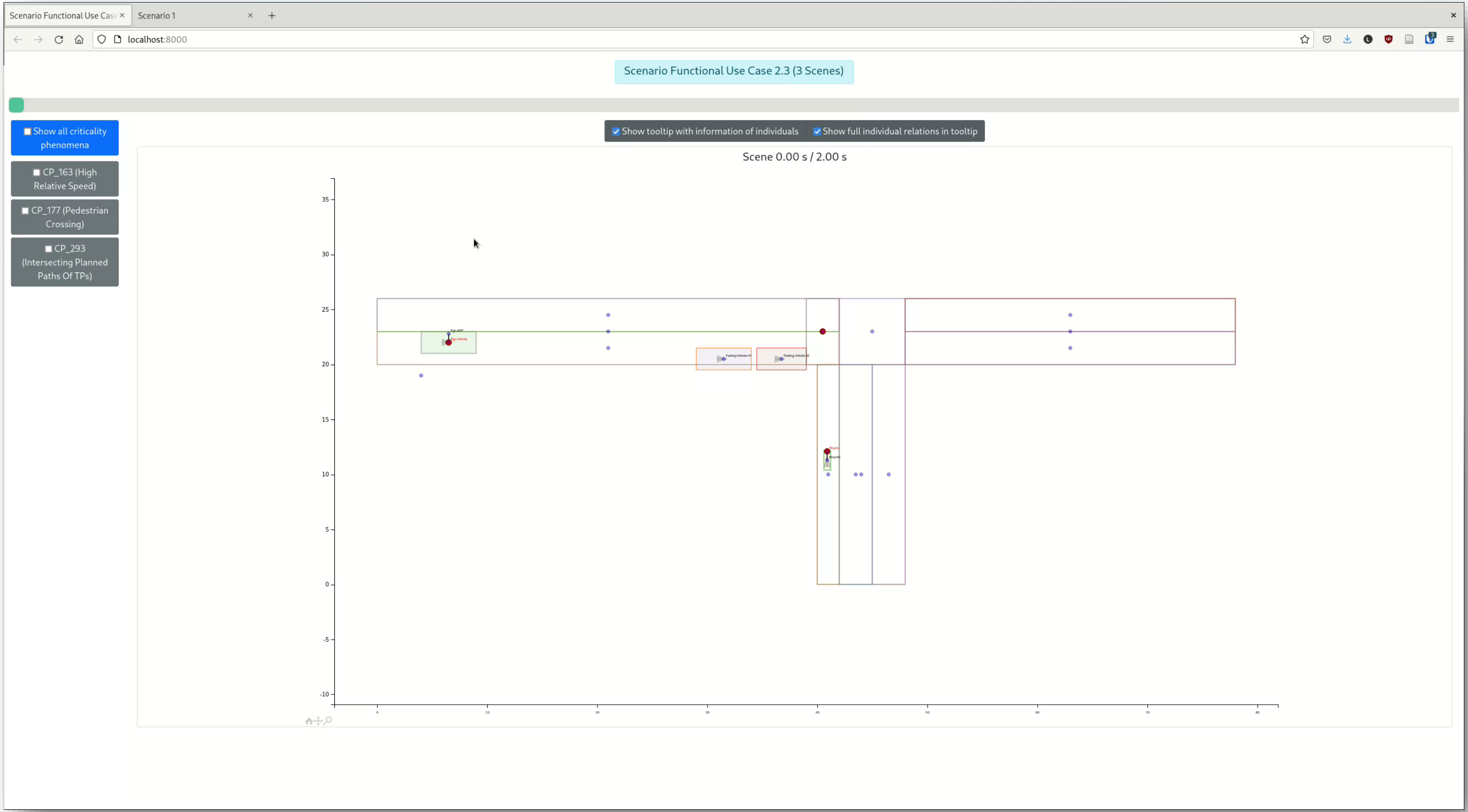
Jean-Baptiste Lamy[a,*]

[a]LIMICS, Université Paris 13, Sorbonne Paris Cité, 93017 Bobigny, France, INSERM UMRS 1142, UPMC Université Paris 6, Sorbonne Universités, Paris, France

Find our ontology-based tooling @GitHub: https://github.com/lu-w/criticality-recognition

Tool Demonstration

VERIFICATION
VALIDATION
METHODS



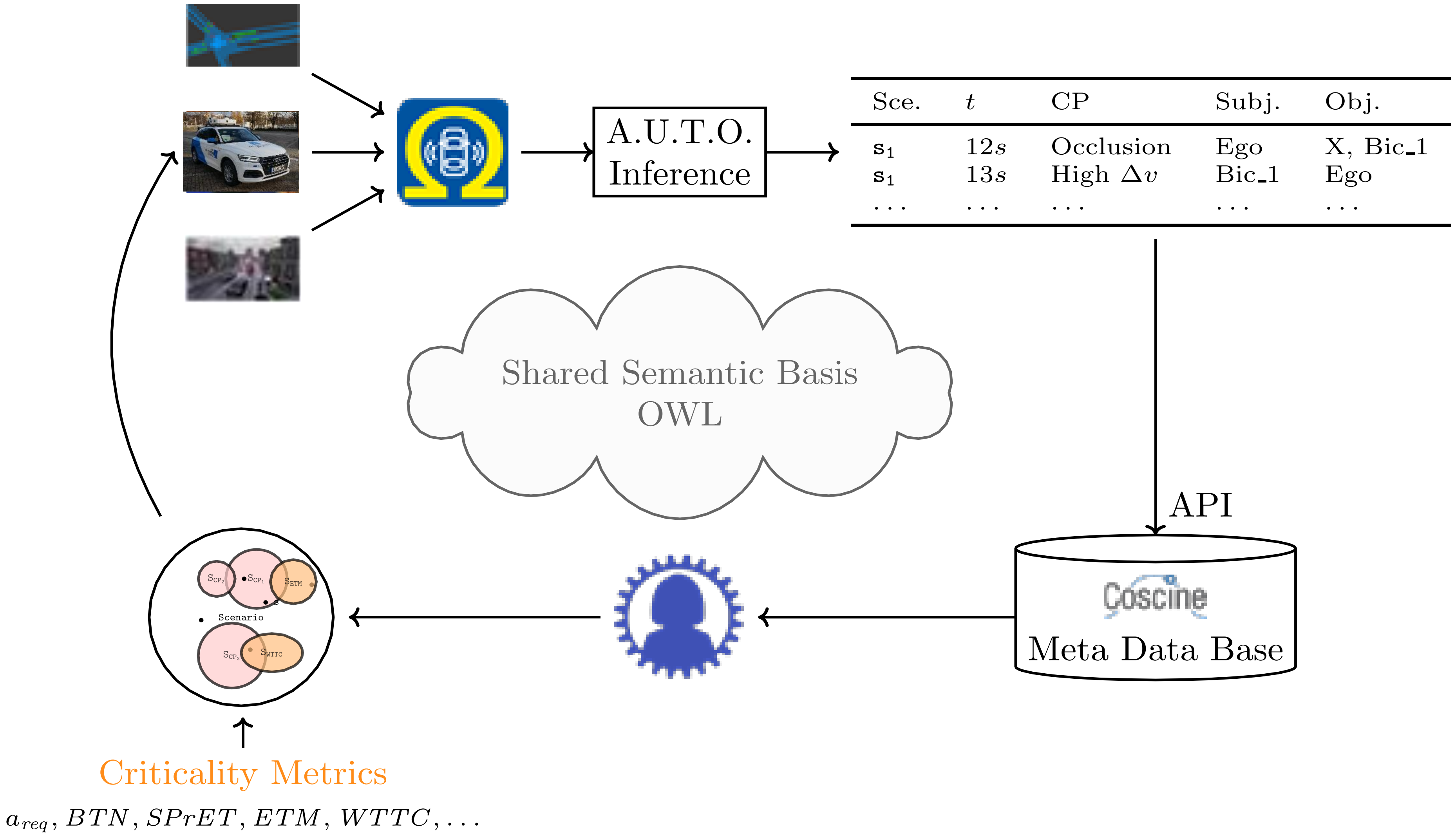
Wrap-Up: Usage of Results in a Safety Case

VERIFICATION VALIDATION METHODS

Formalization

Recognition

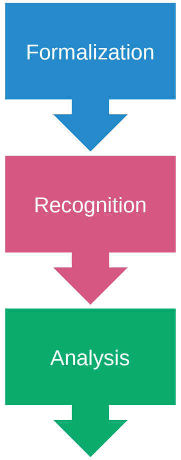
Analysis

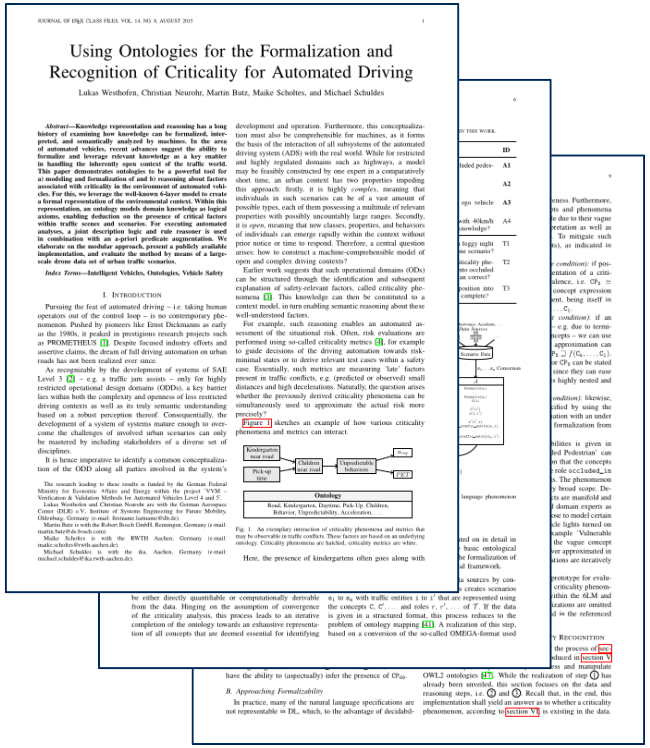


Interested? Publication Submission Upcoming!

VERIFICATION
VALIDATION
METHODS

‚Using Ontologies for the Formalization and Recognition of Criticality for Automated Driving‘





Using Ontologies for the Formalization and Recognition of Criticality for Automated Driving

Lukas Westhofen, Christian Neurohr, Martin Butz, Maike Scholtes, and Michael Schuldes

Find our ontology @GitHub: https://github.com/lu-w/auto

Find our ontology-based tooling @GitHub: https://github.com/lu-w/criticality-recognition

Find our 6-Layer Model publication @IEEE: https://ieeexplore.ieee.org/document/9400833

Thank you!

Lukas Westhofen, DLR

VERIFICATION VALIDATION METHODS

PROJECT of the PEGASUS FAMILY

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