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WMG Safe Autonomy Research Group

Guidance proposal for AI Dataset Assessment for Automated Driving Systems

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(WP.29/GRVA) Working Party on Automated/Autonomous and Connected Vehicles (23rd session)

22 September 2025

WMG
THE UNIVERSITY OF WARWICK

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Presentation at the views of WMG, University of Warwick, UK.

It doesn't reflect the views of any of the contracting parties or the funder.

Background

- Artificial Intelligence (AI) forms a key building block of current and future Automated Driving Systems (ADS)
- UN Regulation (UNR) and Global Technical Regulation (GTR) on Automated Driving System progressing to meet their mid-2026 timelines
- Both UNR and GTR have limited focus on requirements for AI development and assurance

- New Informal Working Group (IWG) on AI (AI-IWG) initiated: 1st meeting in August 2025
    - Scope for the AI-IWG is broader than automated driving and covers wider AI applications in automotive

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The Challenge

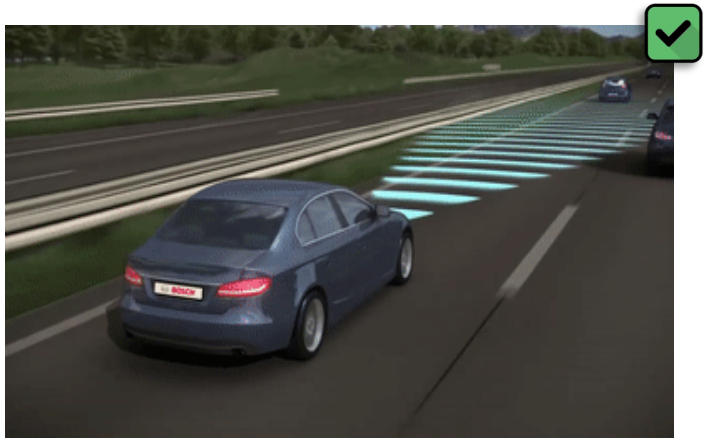
- These activities fall short in providing engineering level guidance or measurable principles for authorities to assess the appropriateness of the AI used in the ADS' performance
- Any guidelines for AI development and assurance need to be technology agnostic
- Every AI-based system will have the following development phases:
    - Model creation
    - Model training
    - Model testing
- Model training and model testing will require the use of "training" data and "testing" data,

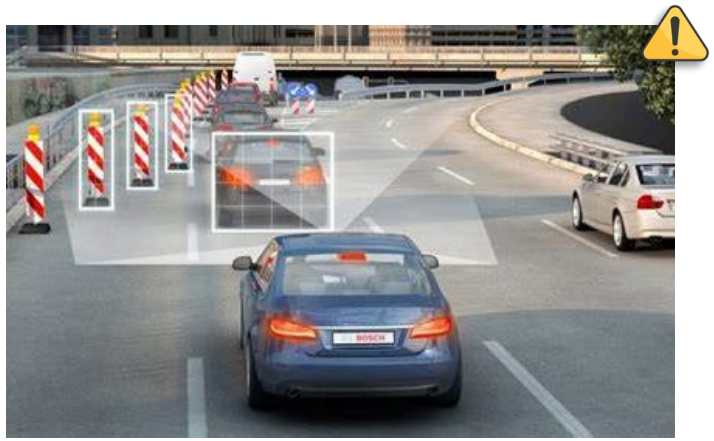
- Focus: Is the training and testing data / scenarios of the AI system sufficient?

Introducing OASISS

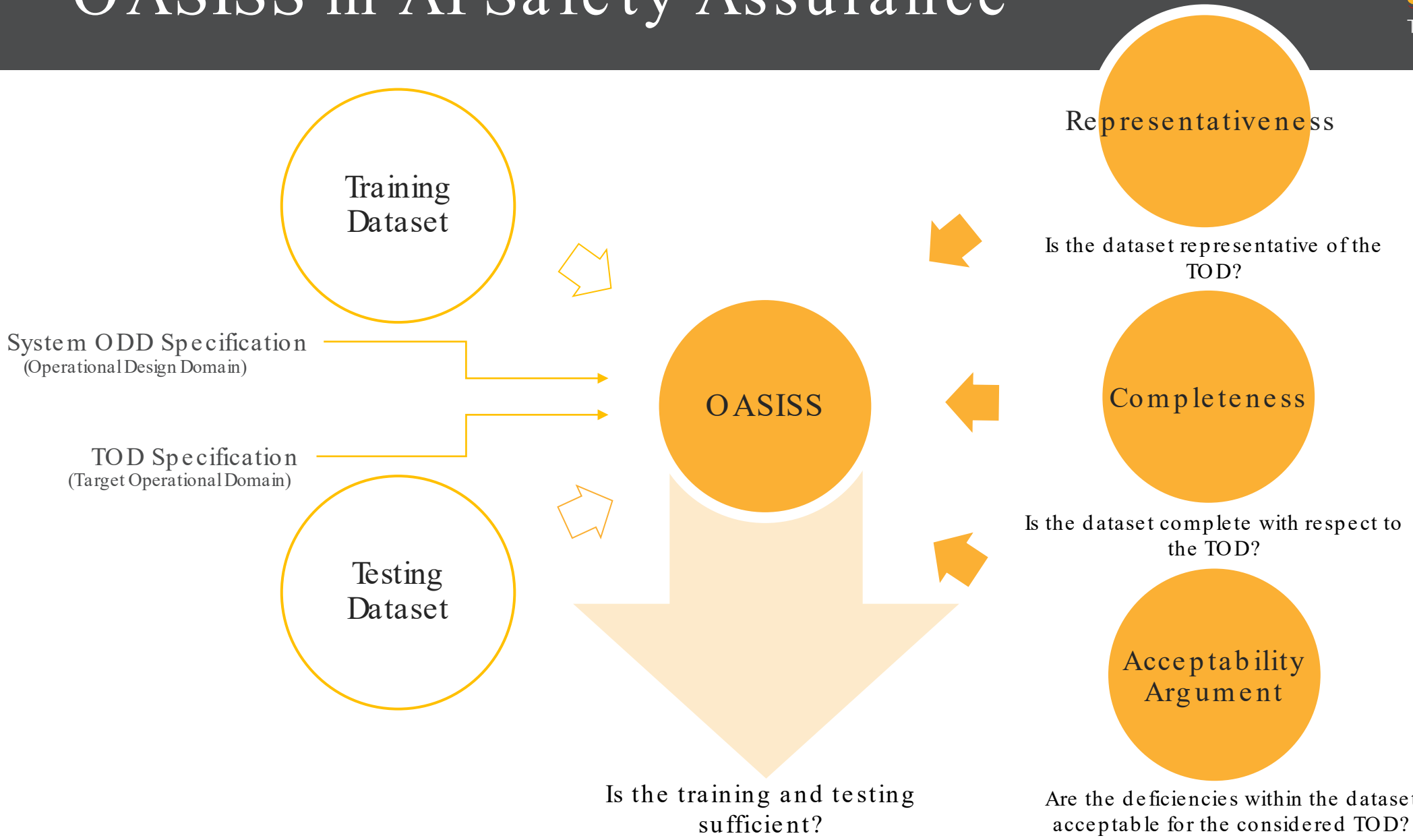
ODD-based AI Safety In autonomouS Systems

A methodology to quantitatively assess the adequacy of the training and testing datasets used on an AI model to ensure its safe deployment into its intended operating environment.

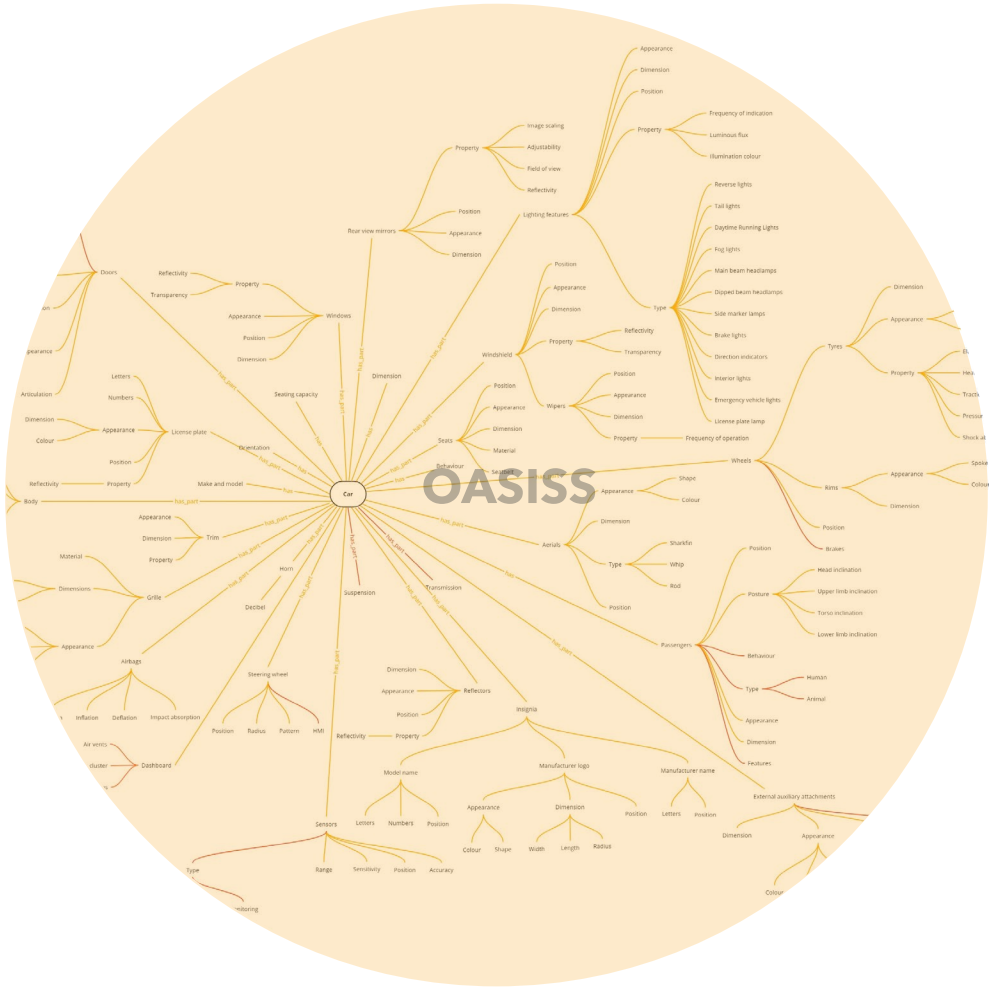




OASISS in AI Safety Assurance



Extended Ontology



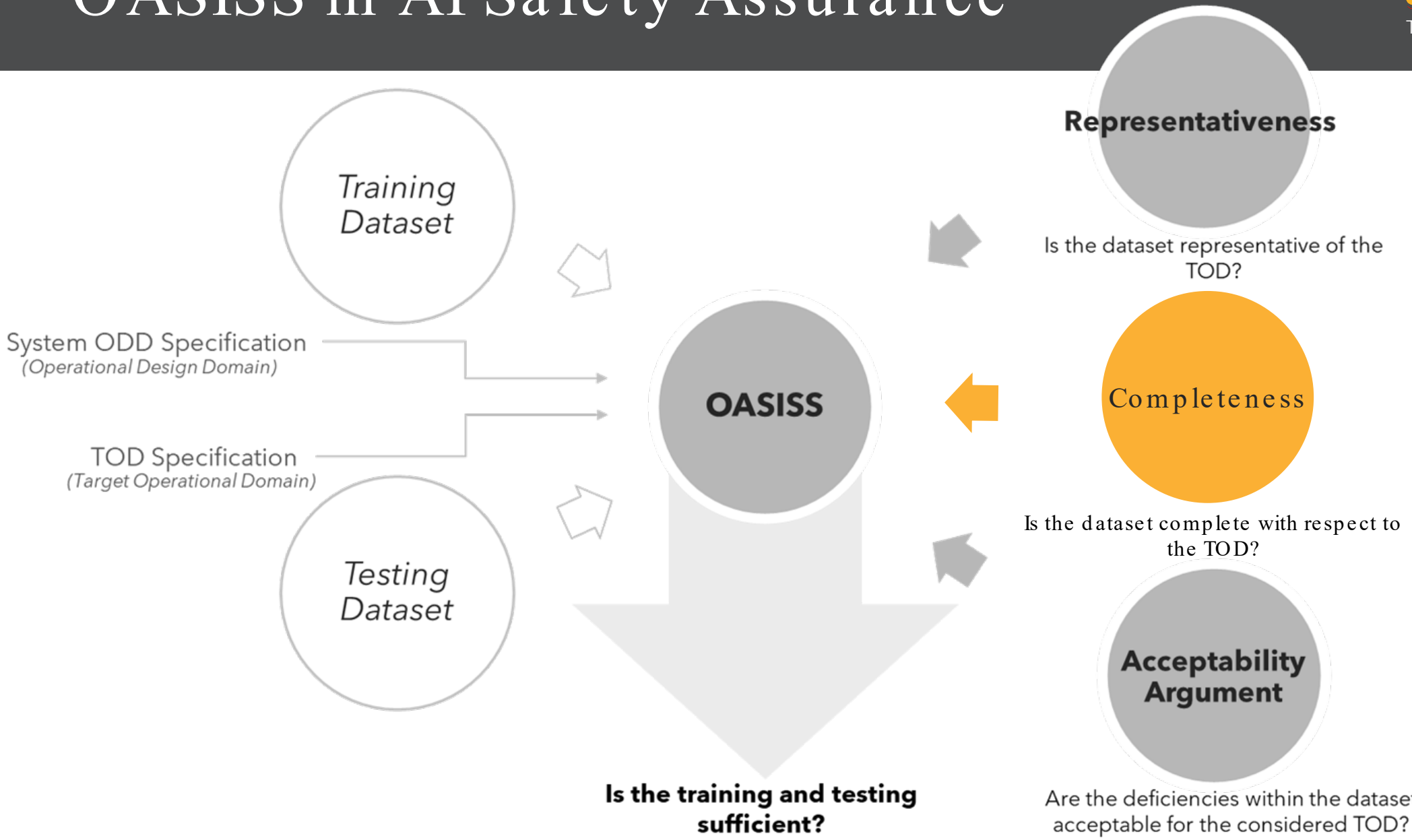
Representativeness

Completeness

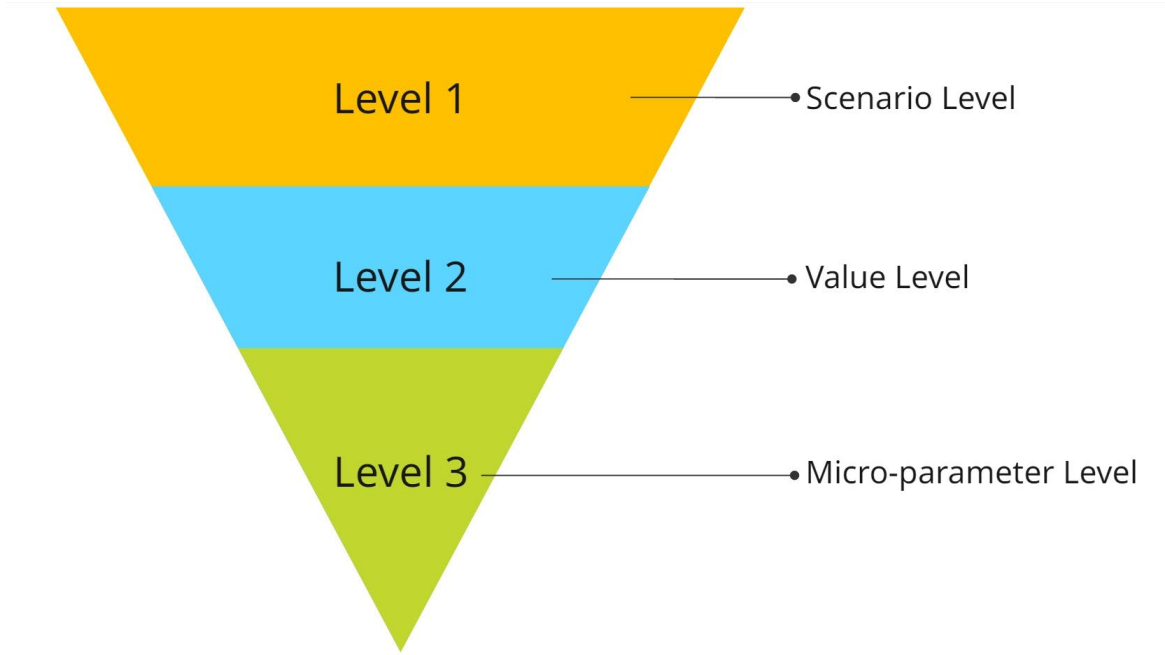
Acceptability Argument

Guidance to the expected level of granularity

OASISS in AI Safety Assurance



Completeness



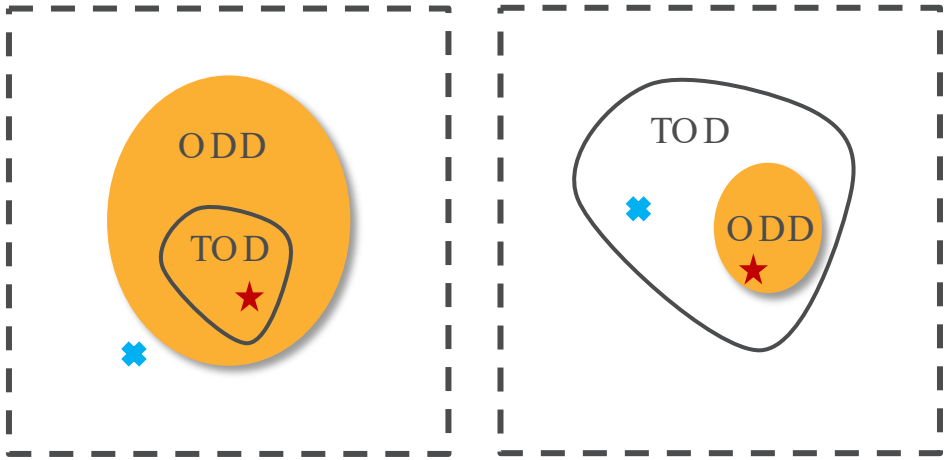
"A scenario suite is complete with respect to the system's area of deployment if it includes all operating conditions as they would occur within that area as well as those conditions that extend beyond the operational capacity of the system."

Completeness

- How would the system perform within its TOD?
- How would the system perform outside its ODD?

Condition	TOD	ODD
1	In	In
2	In	Out
3	Out	In
4	Out	Out

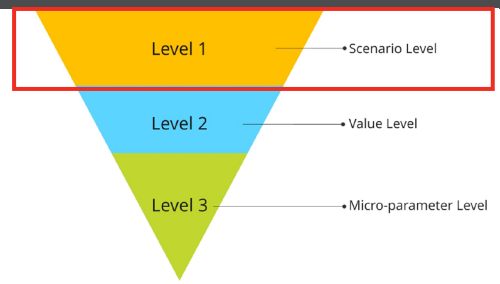
Conditions of interest for Completeness evaluation



★ Conditions which are met by ODD

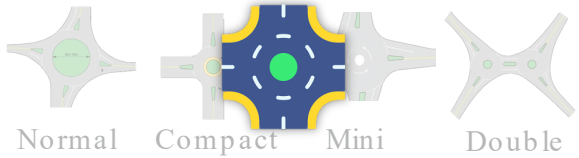
✖ Conditions in which vehicle will need to execute MRM

Scenario Level



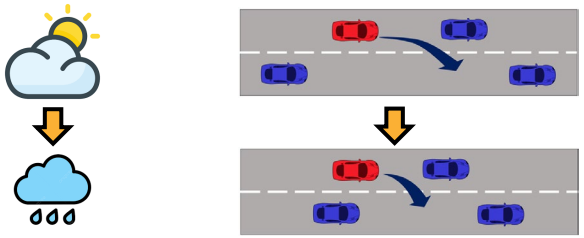
- Within each criteria, assigns a score of 1 if included and 0 if excluded

❑ Element Inclusion:
All parent attributes within TOD

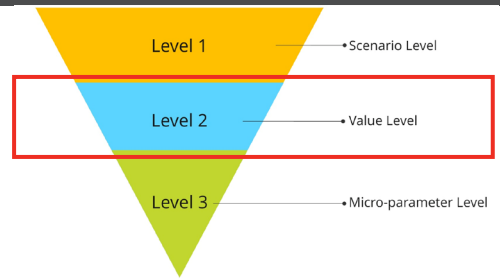


❑ Behaviour Inclusion:
All behaviours

❑ Time Transition Inclusion:
All potential time transitions

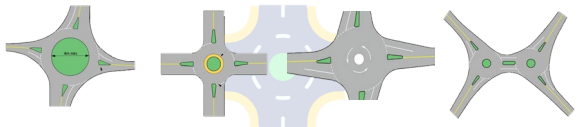


Value Level



- Assigns 1 if both within TOD and outside ODD conditions are met

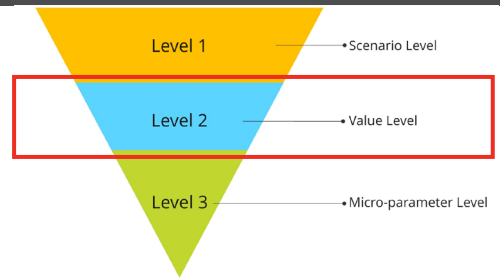
❑ Categorical



❑ Numerical

Amends the score of "Element Inclusion" – an indication that an element cannot be considered complete if its values are not specified

Value Level



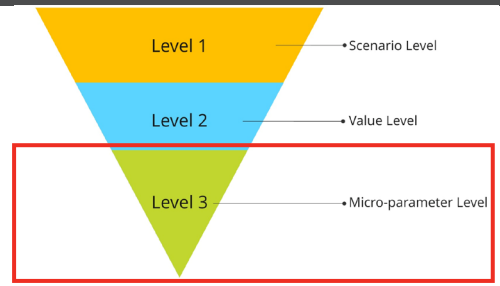
- Assigns 1 if both within TOD and outside ODD conditions are met

Scenario Suite vs TOD

Scenario Suite vs ODD

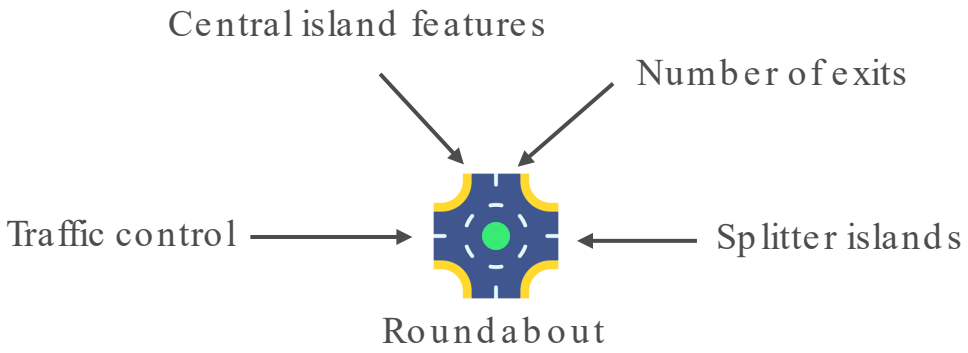
TOD Requirement	ODD Specification	Candidate Scenario Suite Data	Completeness		
			In TOD	Out-of-ODD	In TOD ^ Out-of-ODD
Environmental Conditions					
Wind [0 to 17.1]	Wind [0 to 20.7]	Wind [0 to 24.4]	1	1	1
Scenery Elements					
Drivable Area Type [Motorway]	Drivable Area Type [Motorway]	Drivable Area Type [Motorway]	1	0	0
Special structure [Bridge, Rail crossing, Tunnel]	Special structure [Bridge, Rail crossing]	Special structure [Bridge, Tunnel]	0	1	0
Dynamic Elements					
VRU [Cyclist, Motorcyclist]	VRU [Motorcyclist, Pedestrian]	VRU [Motorcyclist, Pedestrian]	0	0	0

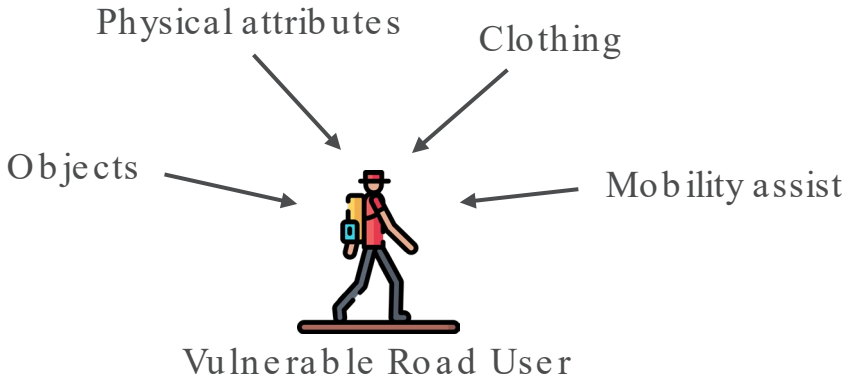
Micro-parameter Level



- Within each element, assigns a score of 1 if associated micro-parameters are included

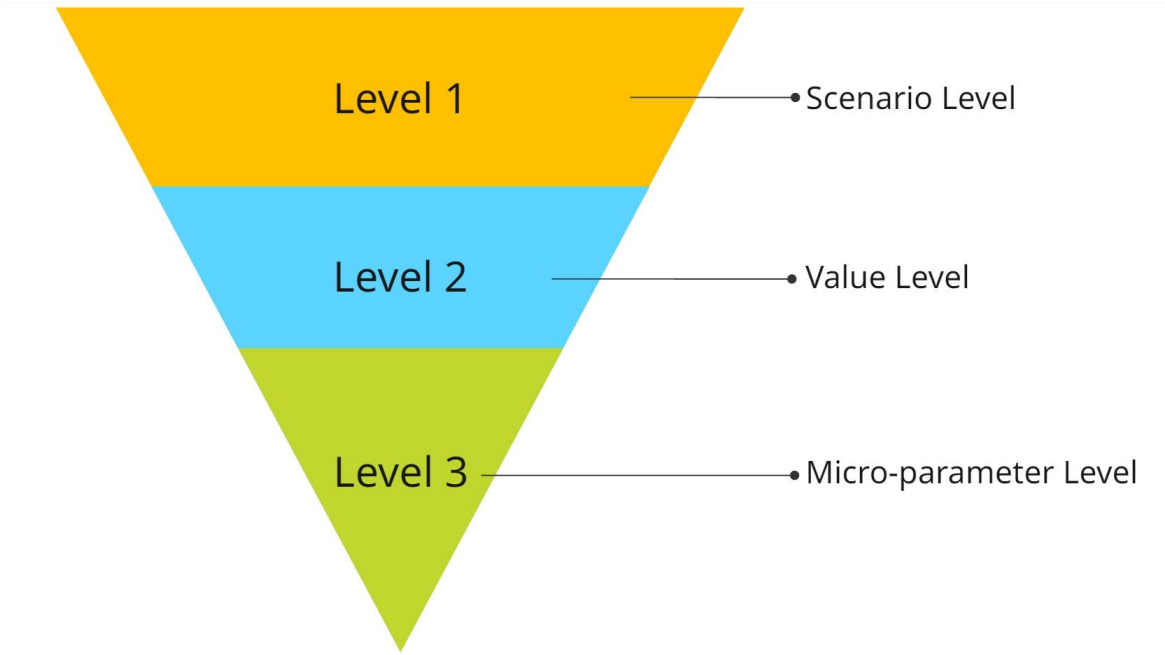
❑ Influential attributes





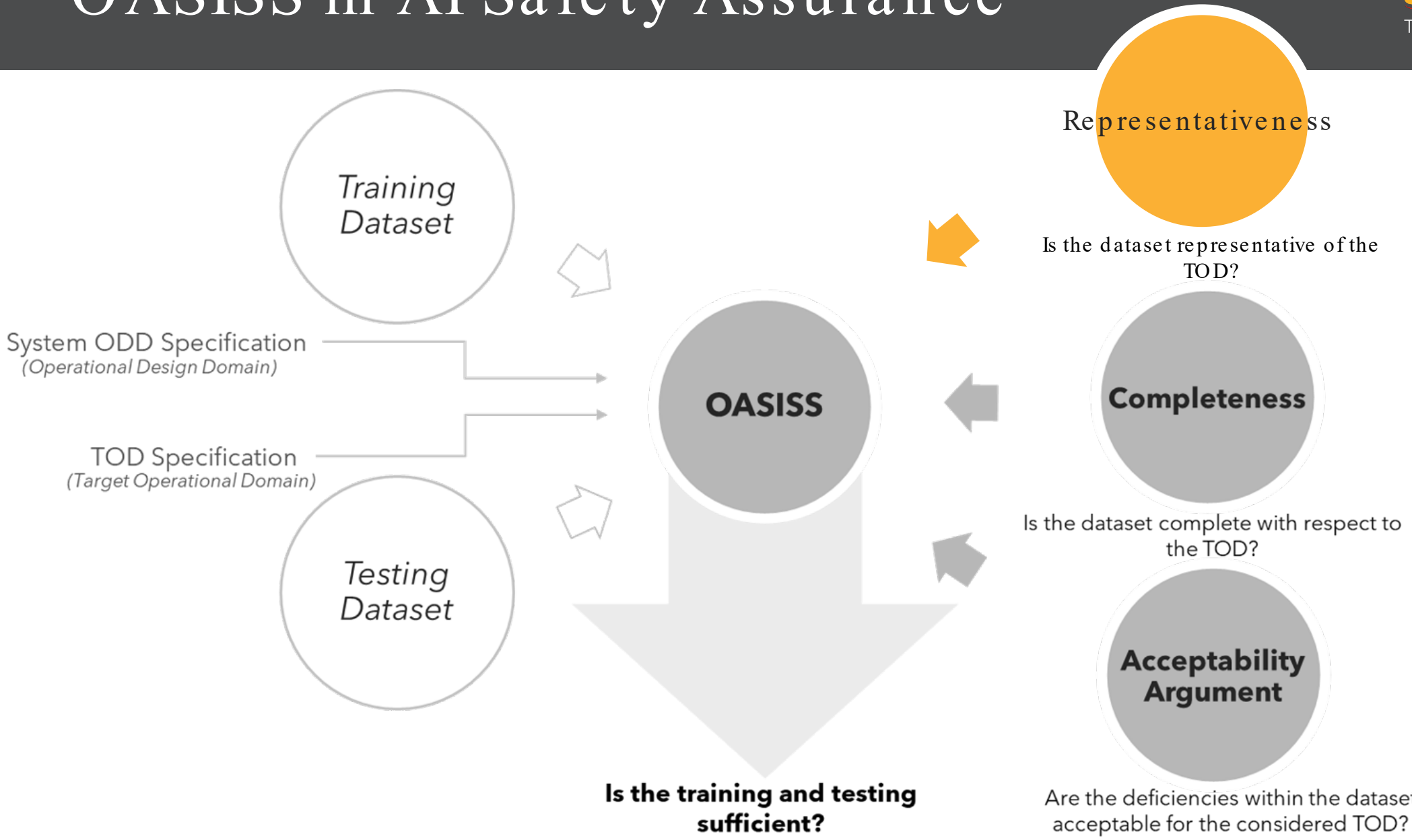
Amends the score of "Element Inclusion" after Value Level evaluation – an indication that an element cannot be considered complete if it its micro-parameters have not been considered

Completeness

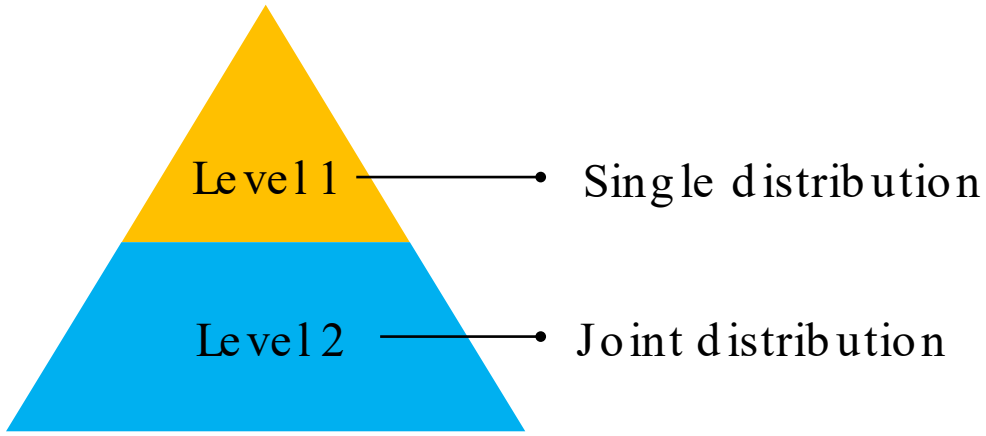


Features	Completeness
In-TOD conditions	✓
Out-of-ODD conditions (in & out-of-TOD)	✓
Occurrence distribution comparison	✗
Micro-parameters	✓

OASISS in AI Safety Assurance



Representativeness



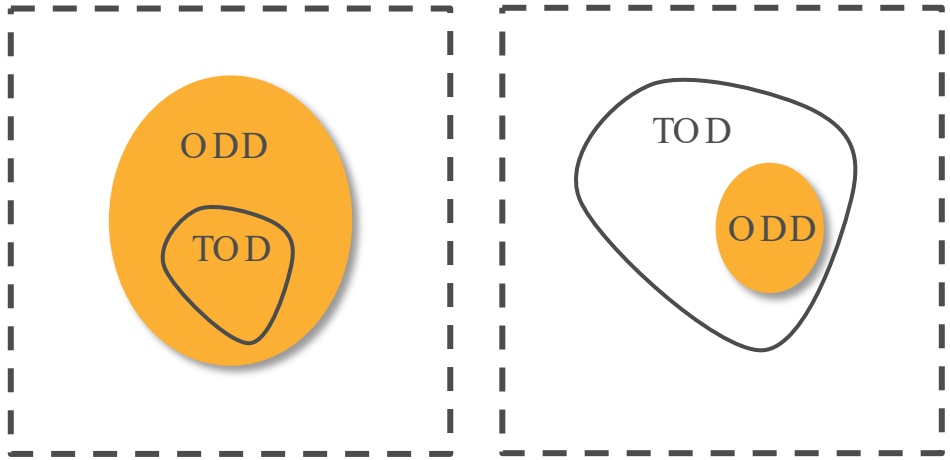
"A scenario suite is representative of the system's area of deployment if the suite exhibits a distribution that is same or similar to that of real-world recorded data from that area at both individual element and joint element levels."

Representativeness

- How well would the system perform within its TOD?

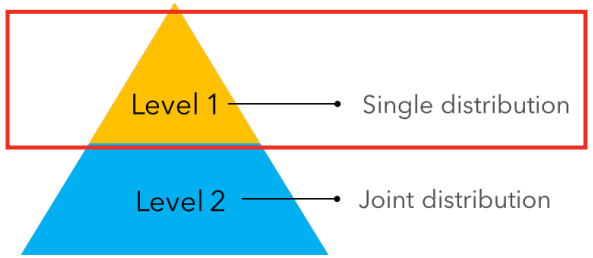
Condition	TOD	ODD
1	In	In
2	In	Out
3	Out	In
4	Out	Out

Conditions of interest for Representativeness evaluation

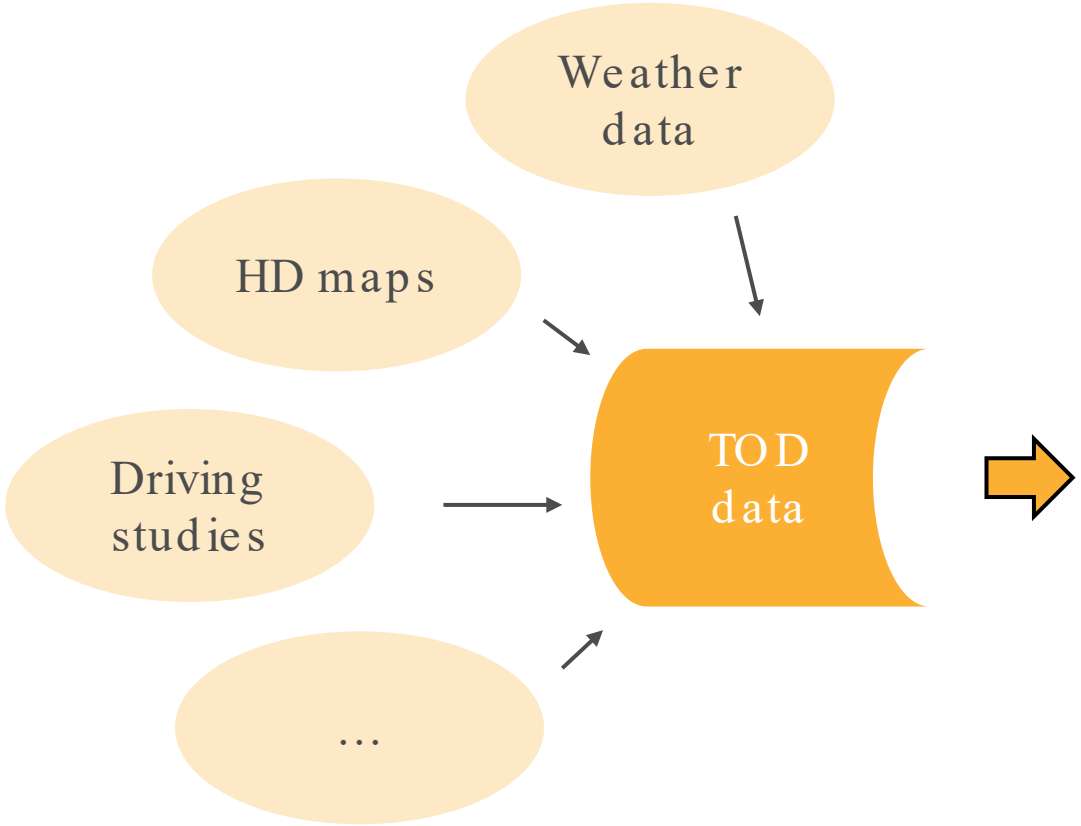


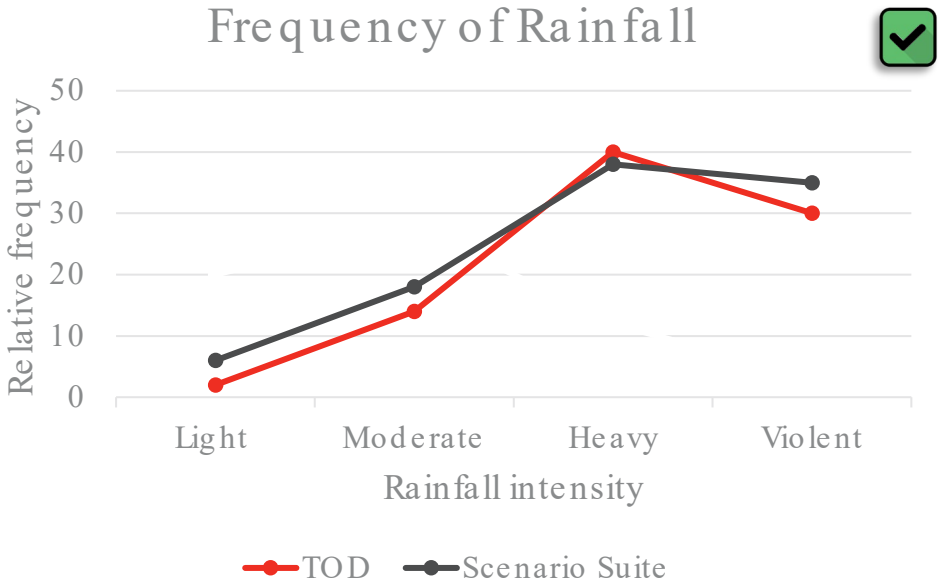
Area of interest for representativeness evaluation

Representativeness: Single distribution

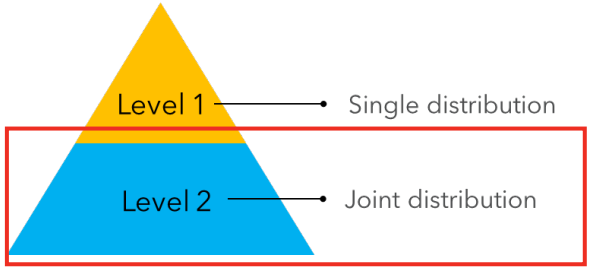


- Frequency of occurrence of individual elements

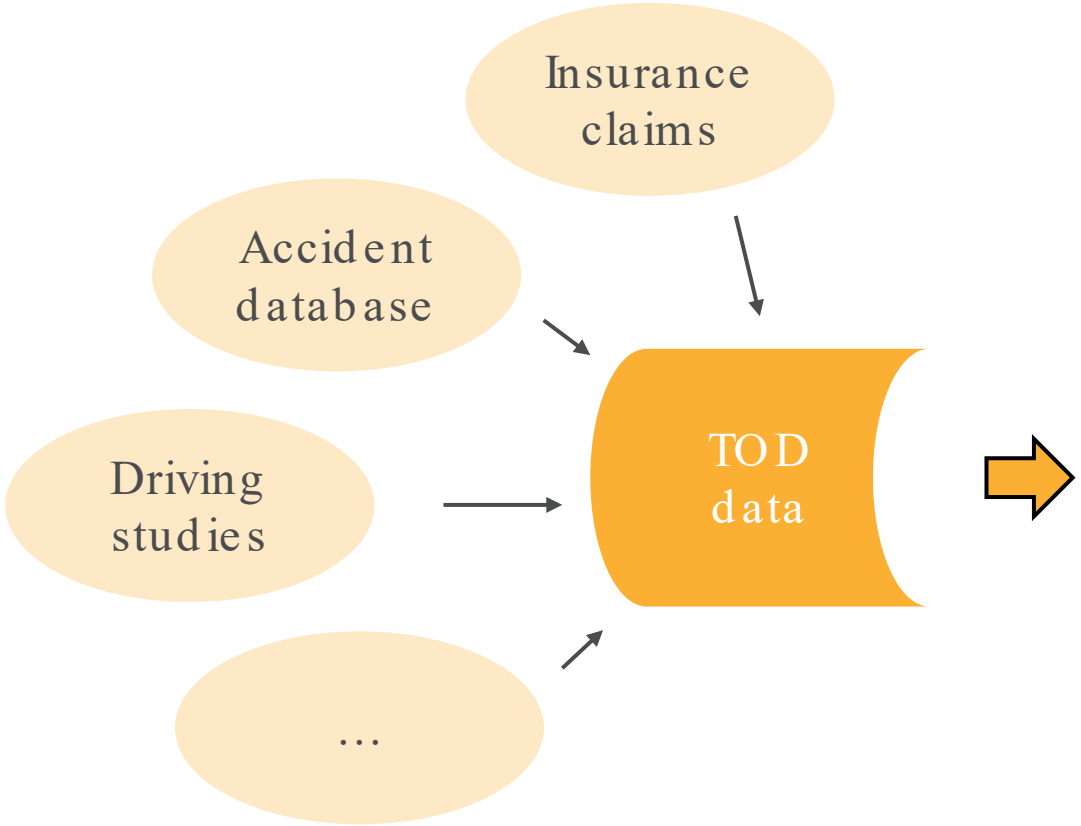


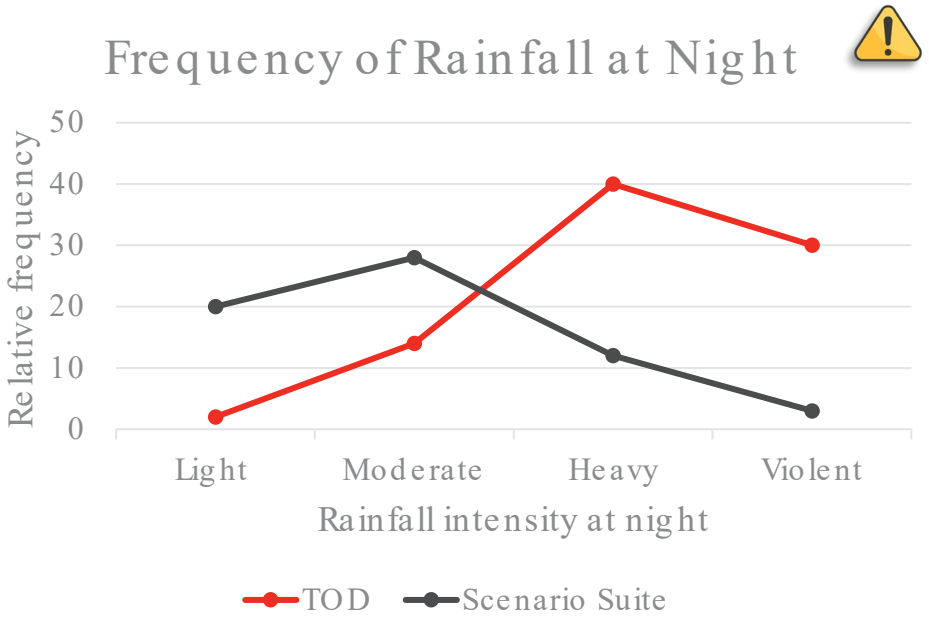


Representativeness: Joint distribution

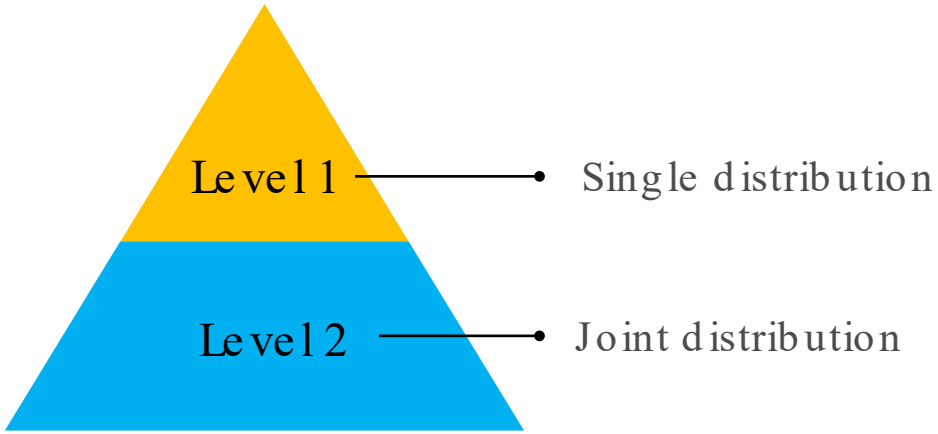


- Frequency of occurrence of elements with respect to other elements



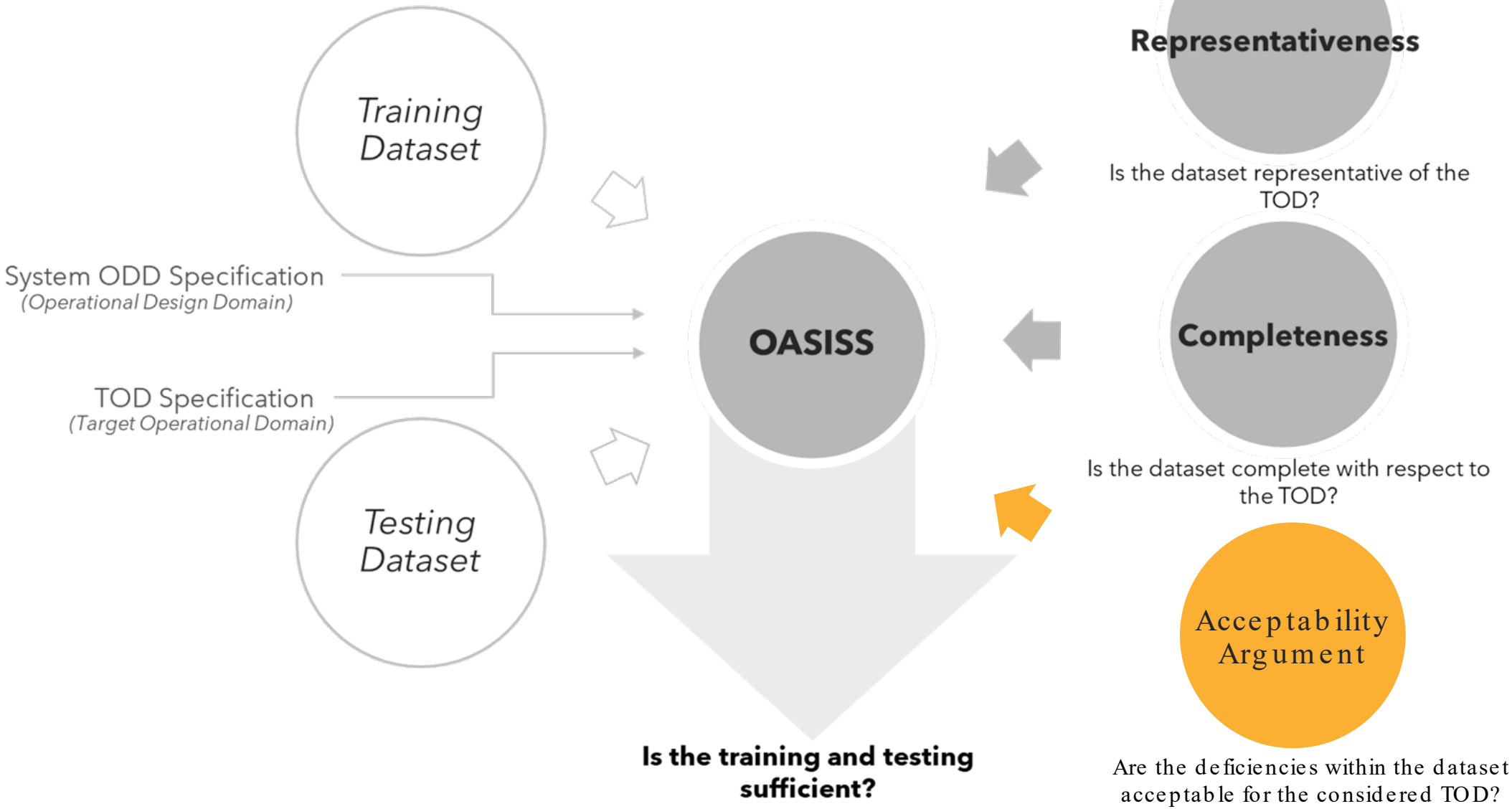


Representativeness



Features	Representativeness
In-TOD conditions	✓
Out-of-ODD conditions (in & out-of-TOD)	✗
Occurrence distribution comparison	✓
Micro-parameters	✓

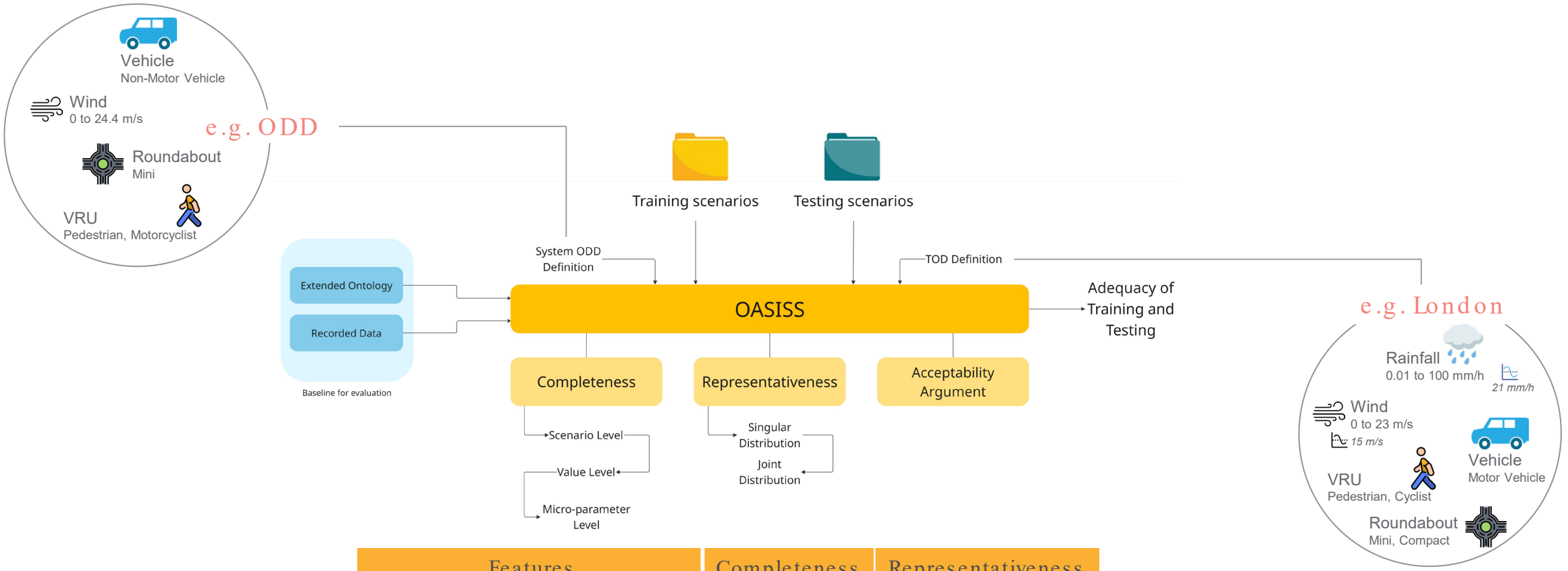
OASISS in AI Safety Assurance



Acceptability Argument

- The evaluation of the acceptability argument is subjective
- As a model-agnostic framework, allows justification of any deficiencies that the Completeness and Representativeness evaluations detect, as what the framework considers as a “gap”, may be non-influential to that specific AI model’s performance - depending on its learning capacity.
- Training scenarios are expected to be more tailored to the AI model’s requirements, which may result in deviations from real-world frequency occurrence distributions. This would automatically result in a lower representativeness score.

Summary of the Concepts



Features	Completeness	Representativeness
In-TOD conditions	✓	✓
Out-of-ODD conditions (in & out-of-TOD)	✓	✗
Occurrence distribution comparison	✗	✓
Micro-parameters	✓	✓

OASISS Compliance with ISO PAS 8800

- OASISS framework aligns with ISO PAS 8800 by covering the following properties to address data insufficiencies:

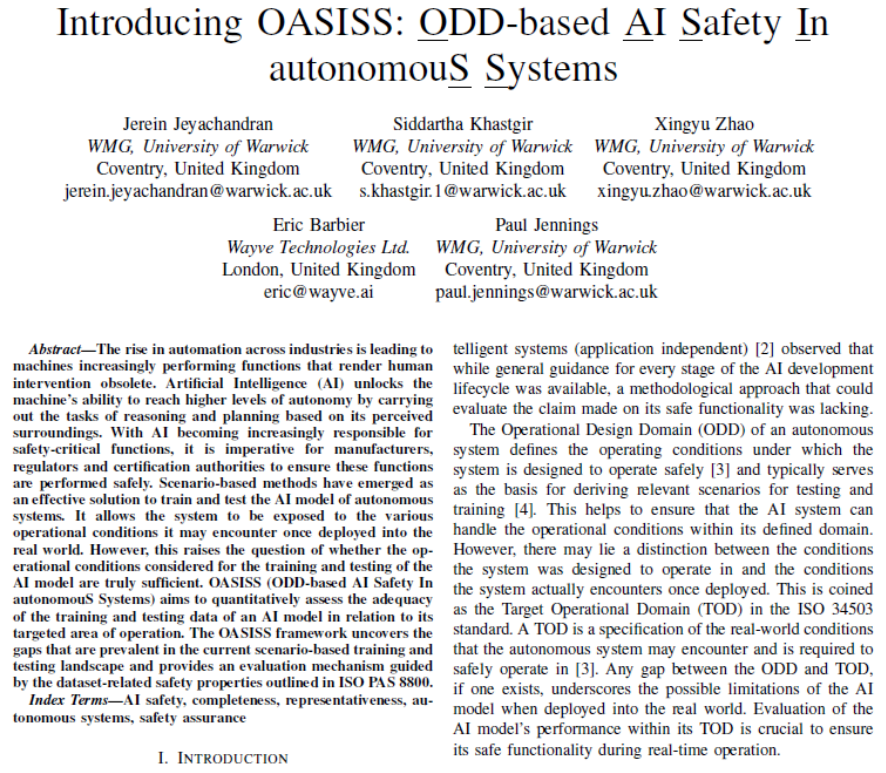
ISO PAS 8800	OASISS
Input dataset-related properties	Scenario suite-related properties
Accuracy	✓
Completeness	✓
Correctness	✓
Independence of datasets	-
Integrity	-
Representativeness	✓
Temporality	✓
Traceability	✓
Verifiability	✓

Current status

- **Paper on OASISS accepted at IEEE ITSC 2025**
  A paper detailing the proposed framework has been peer-reviewed and accepted for publication

- **Tool in Development:**
  Actively developing a software tool to implement the framework in a usable and scalable form

- **Real-World Application:**
  The tool will be used on a real-world system to demonstrate its working



Introducing OASISS: ODD-based AI Safety In autonomouS Systems

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***Abstract*—The rise in automation across industries is leading to machines increasingly performing functions that render human intervention obsolete. Artificial Intelligence (AI) unlocks the machine's ability to reach higher levels of autonomy by carrying out the tasks of reasoning and planning based on its perceived surroundings. With AI becoming increasingly responsible for safety-critical functions, it is imperative for manufacturers, regulators and certification authorities to ensure these functions are performed safely. Scenario-based methods have emerged as an effective solution to train and test the AI model of autonomous systems. It allows the system to be exposed to the various operational conditions it may encounter once deployed into the real world. However, this raises the question of whether the operational conditions considered for the training and testing of the AI model are truly sufficient. OASISS (ODD-based AI Safety In autonomouS Systems) aims to quantitatively assess the adequacy of the training and testing data of an AI model in relation to its targeted area of operation. The OASISS framework uncovers the gaps that are prevalent in the current scenario-based training and testing landscape and provides an evaluation mechanism guided by the dataset-related safety properties outlined in ISO PAS 8800.**

***Index Terms*—AI safety, completeness, representativeness, autonomous systems, safety assurance**

I. Introduction

telligent systems (application independent) [2] observed that while general guidance for every stage of the AI development lifecycle was available, a methodological approach that could evaluate the claim made on its safe functionality was lacking.

The Operational Design Domain (ODD) of an autonomous system defines the operating conditions under which the system is designed to operate safely [3] and typically serves as the basis for deriving relevant scenarios for testing and training [4]. This helps to ensure that the AI system can handle the operational conditions within its defined domain. However, there may lie a distinction between the conditions the system was designed to operate in and the conditions the system actually encounters once deployed. This is coined as the Target Operational Domain (TOD) in the ISO 34503 standard. A TOD is a specification of the real-world conditions that the autonomous system may encounter and is required to safely operate in [3]. Any gap between the ODD and TOD, if one exists, underscores the possible limitations of the AI model when deployed into the real world. Evaluation of the AI model's performance within its TOD is crucial to ensure its safe functionality during real-time operation.

Citation: Jeyachandran et. al. (2025) Introducing OASISS : ODD-based AI Safety In autonomouS Systems. In: The IEEE International Conference on Intelligent Transportation Systems (ITSC), Gold Coast, Australia, 18-21 Nov 2025 (In Press)

Paper Open Access: https://wrap.warwick.ac.uk/id/eprint/192034/

Next steps…

- For AI model evaluation and assurance, it is key to undertake a dataset assessment for the training and testing data used as part of AI model development
- Two key properties for assessment: Completeness and Representativeness of the dataset (with respect to TOD and ODD of the system)
- UNR and GTR on Automated Driving System don't cover such requirements at an engineering implementation level or measuring guidance for authorities
- Need to consider the concepts of: Completeness; Representativeness and Acceptability Argument, as additional guidance for AI dataset assessment

- OASISS provides a framework for engineering level guidance for developers and authorities providing quantified insights into the system's trustworthiness for operation within that area

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