ASAM OpenODD:
New Standard Development

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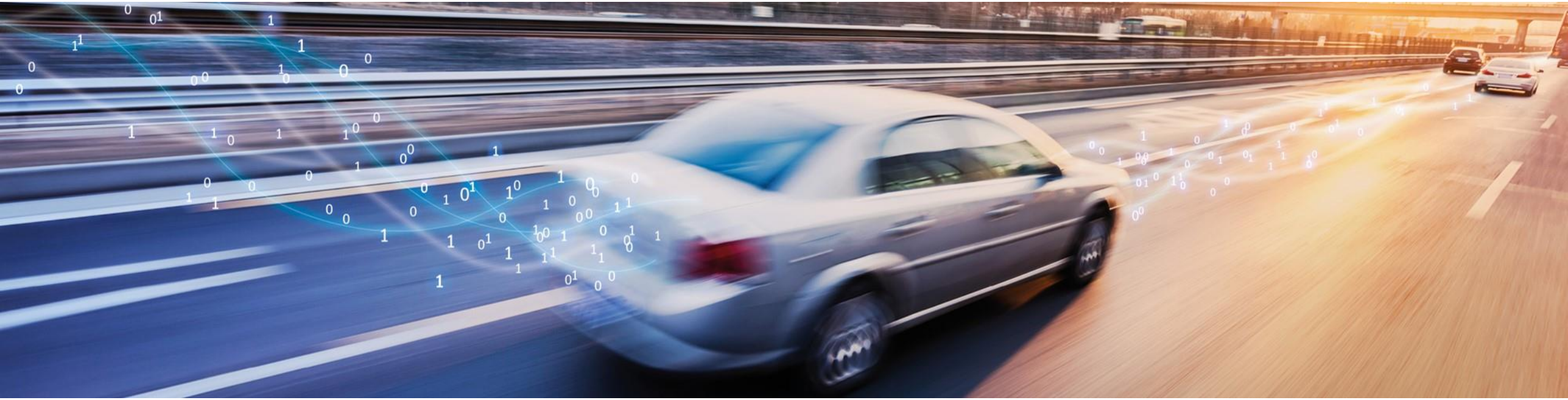
ASAM OpenODD Concept Project Lead

28 April 2022

Online

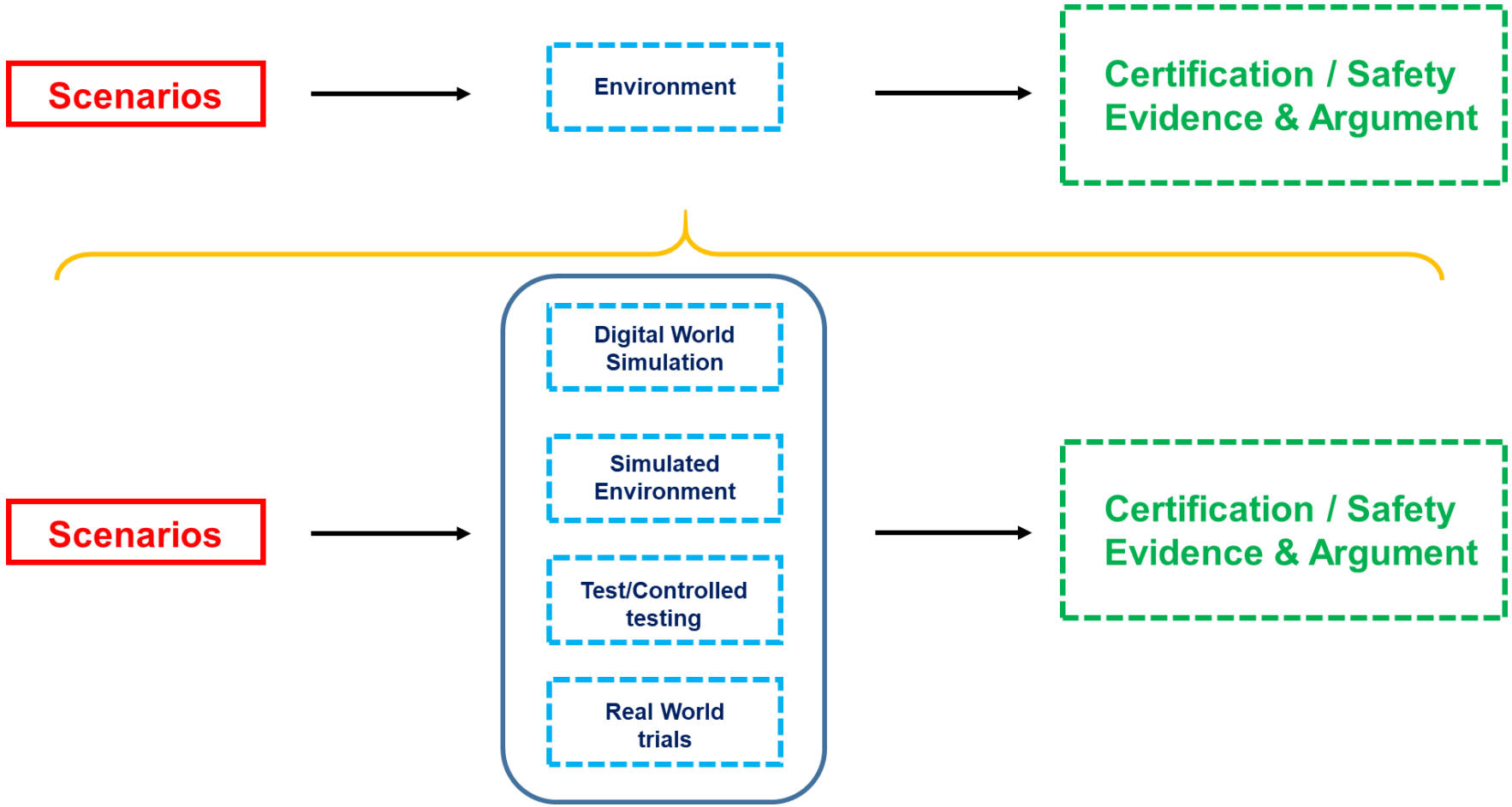


ASAM Association for Standardization of Automation and Measuring Systems

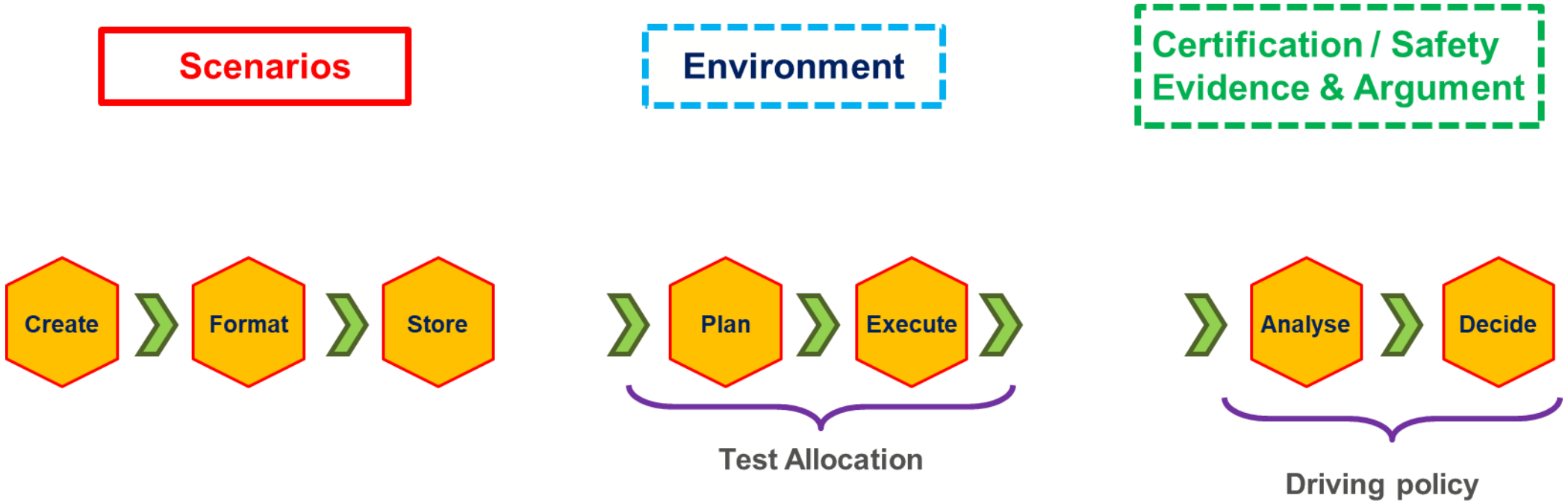
ASAM OpenODD Motivation

Evaluation Continuum

Evaluation Continuum



Evaluation Continuum



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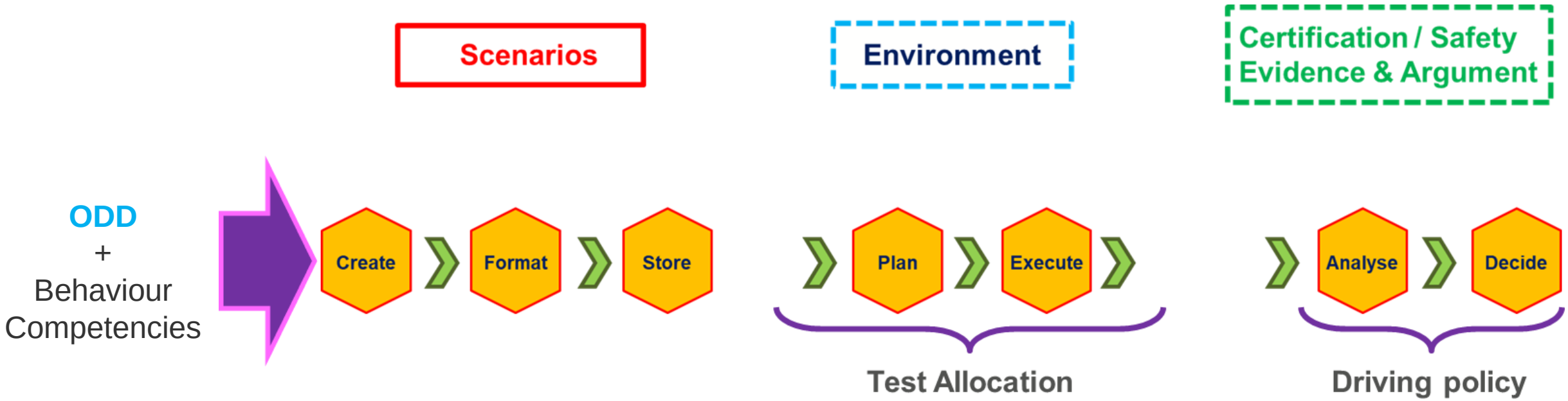
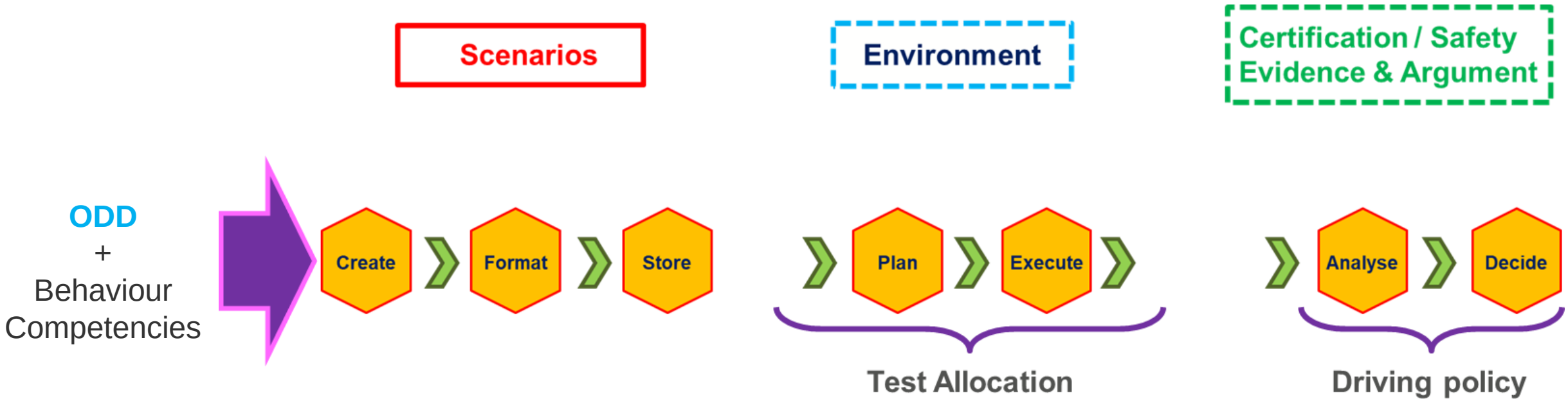
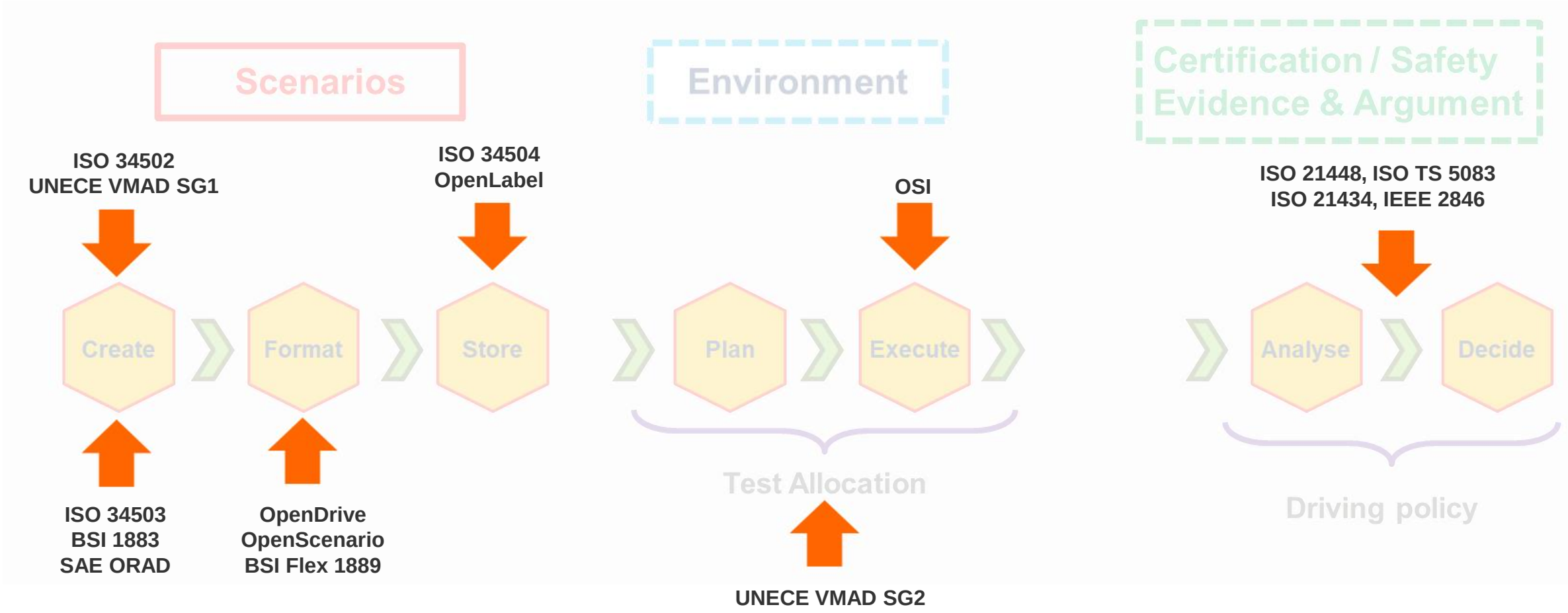


Evaluation Continuum

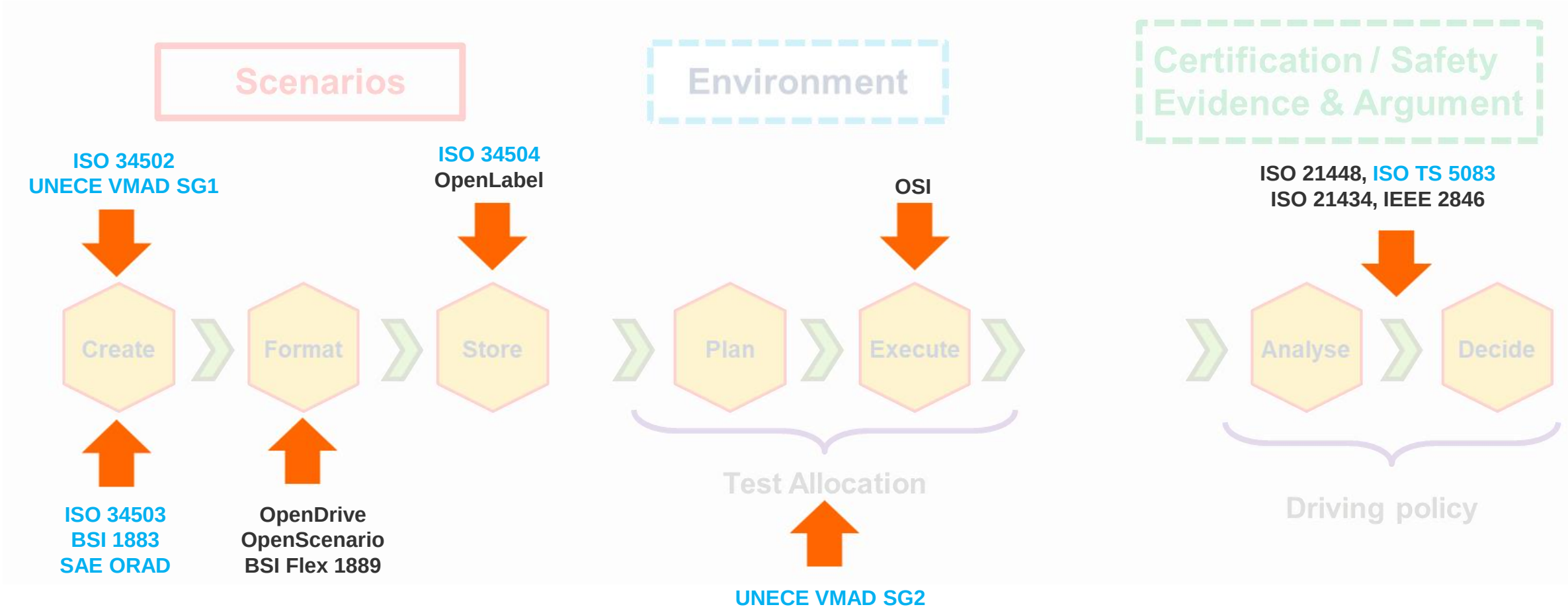


Standards and Tools!

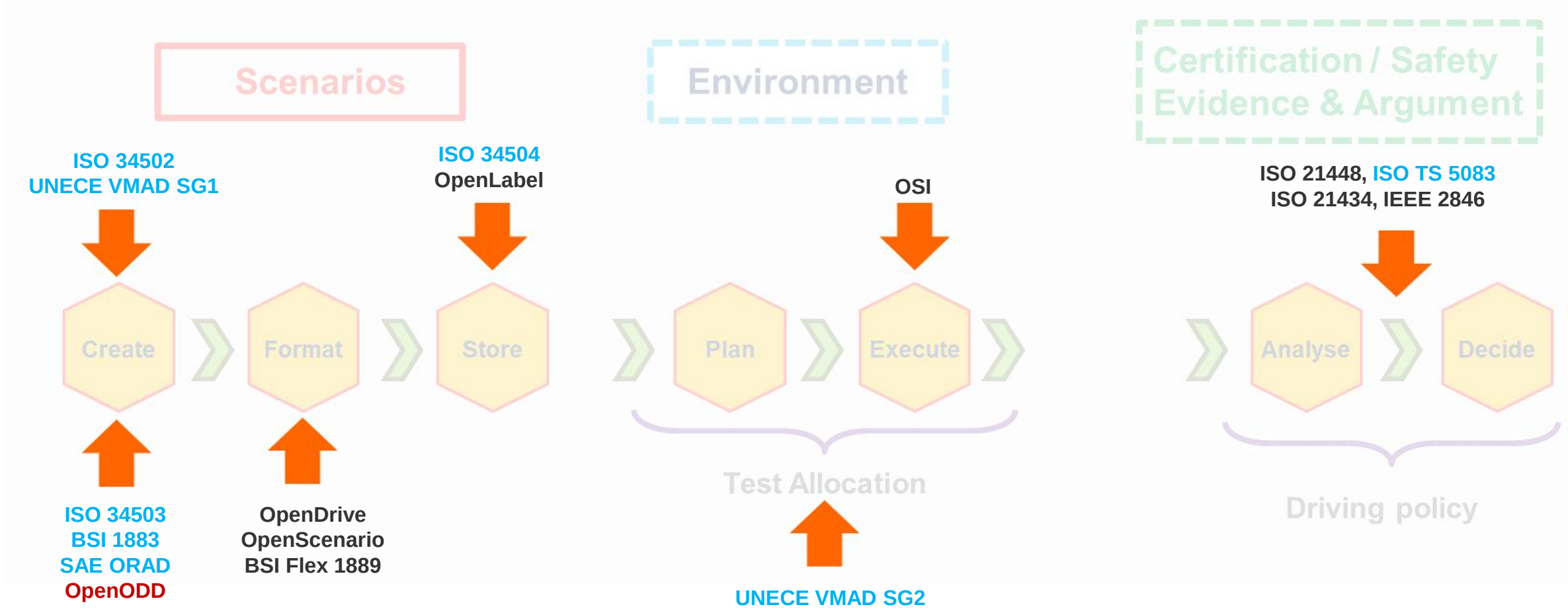
Evaluation Continuum



Evaluation Continuum



Evaluation Continuum



Why is ODD important?

- Number of miles driven?
- Types of scenarios experienced?

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Why is ODD important?

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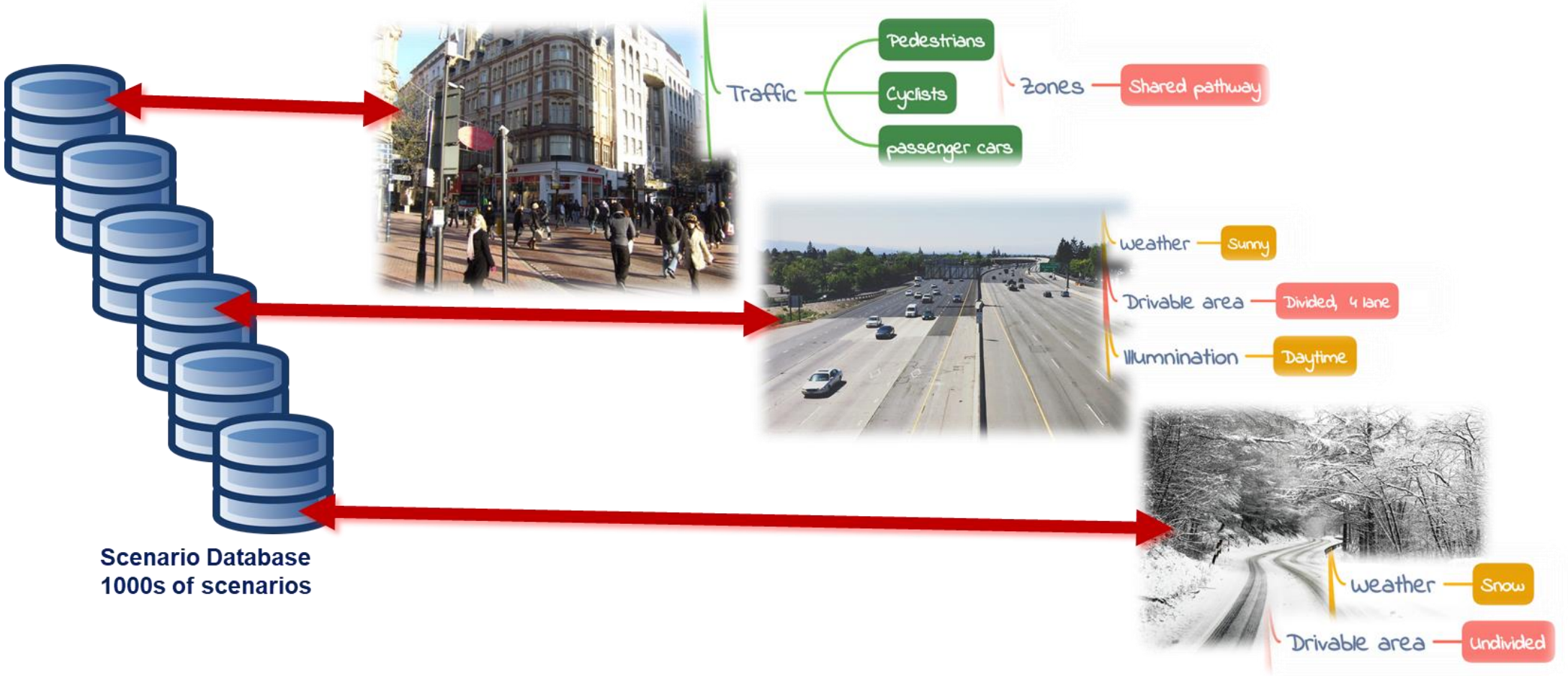
Scenario mapping to ODD



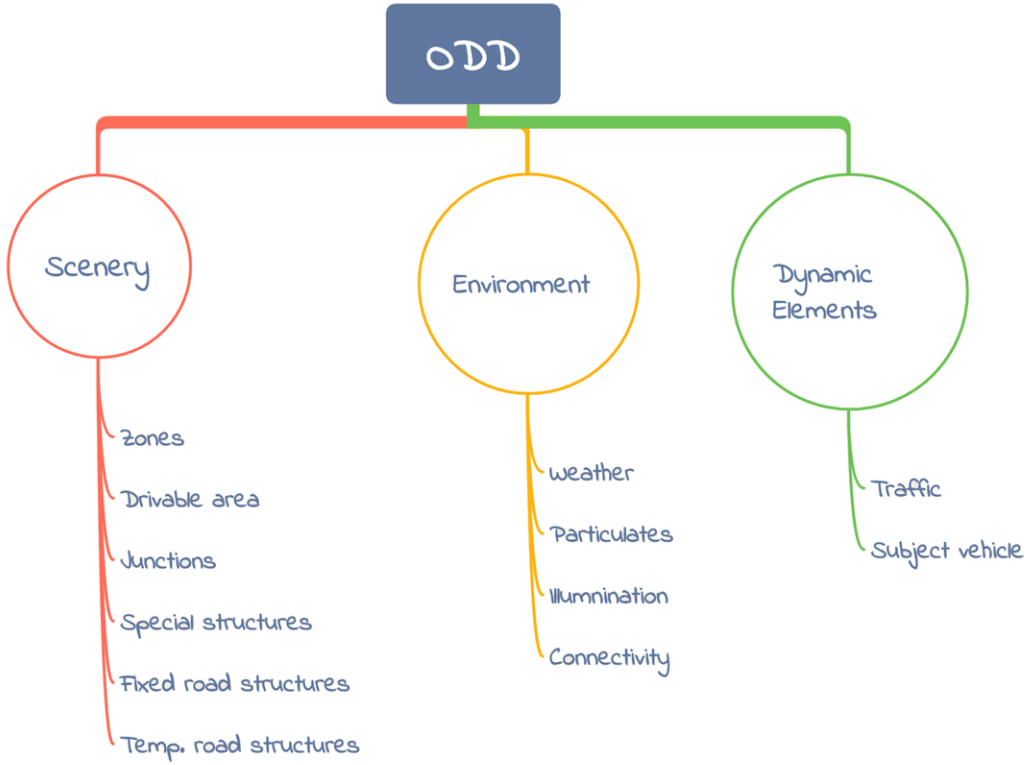
Understanding ODD

What is an ODD?

"Operating conditions under which a given driving automation system or feature thereof is specifically designed to function, including, but not limited to, environmental, geographical, and time-of-day restrictions, and/or the requisite presence or absence of certain traffic or roadway characteristics."

- SAE J3016 (2021)

What is an ODD?



ODD Taxonomy as per BSI PAS 1883

Other standardization activities

- Need for common understanding
- Need for collaboration
- Crowded landscape

Major activities

- BSI (UK): PAS 1883: ODD Taxonomy
- SAE: ORAD (J3259), AVSC: ODD Lexicon
- ISO: ISO 34503: ODD Taxonomy and definition format
- ASAM: OpenX family of standards

ASAM OpenODD Concept Project
Scope and Outcomes

ASAM OpenODD Concept Project: Scope

The aim is to provide a format that is capable of representing a defined Operational Design Domain for connected automated vehicles (CAV) for ***simulation based testing***.

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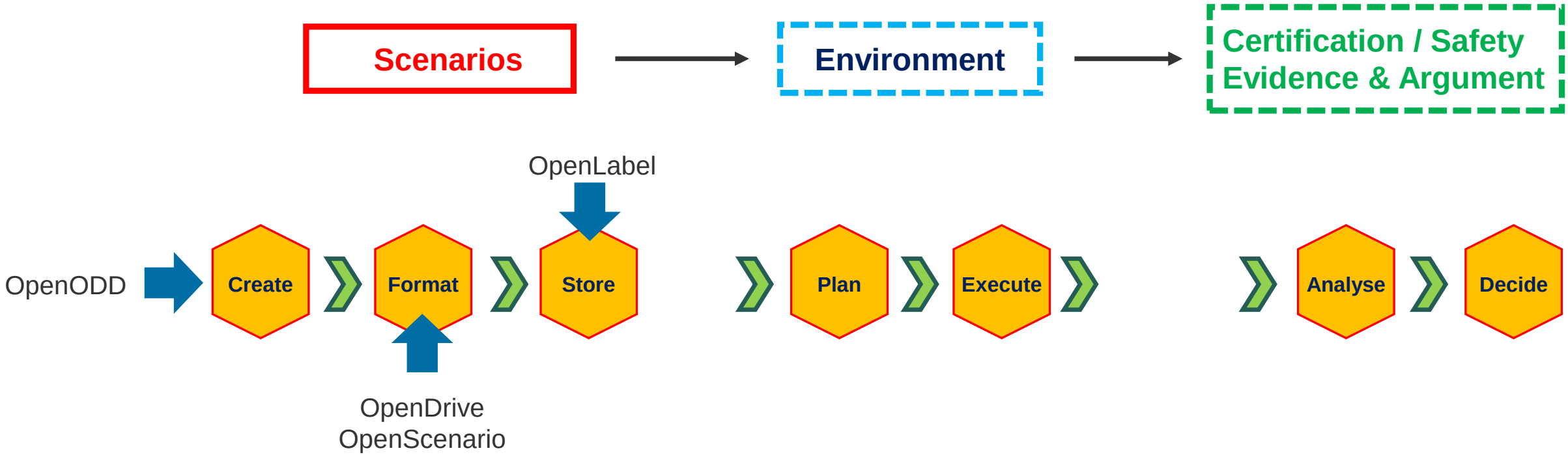
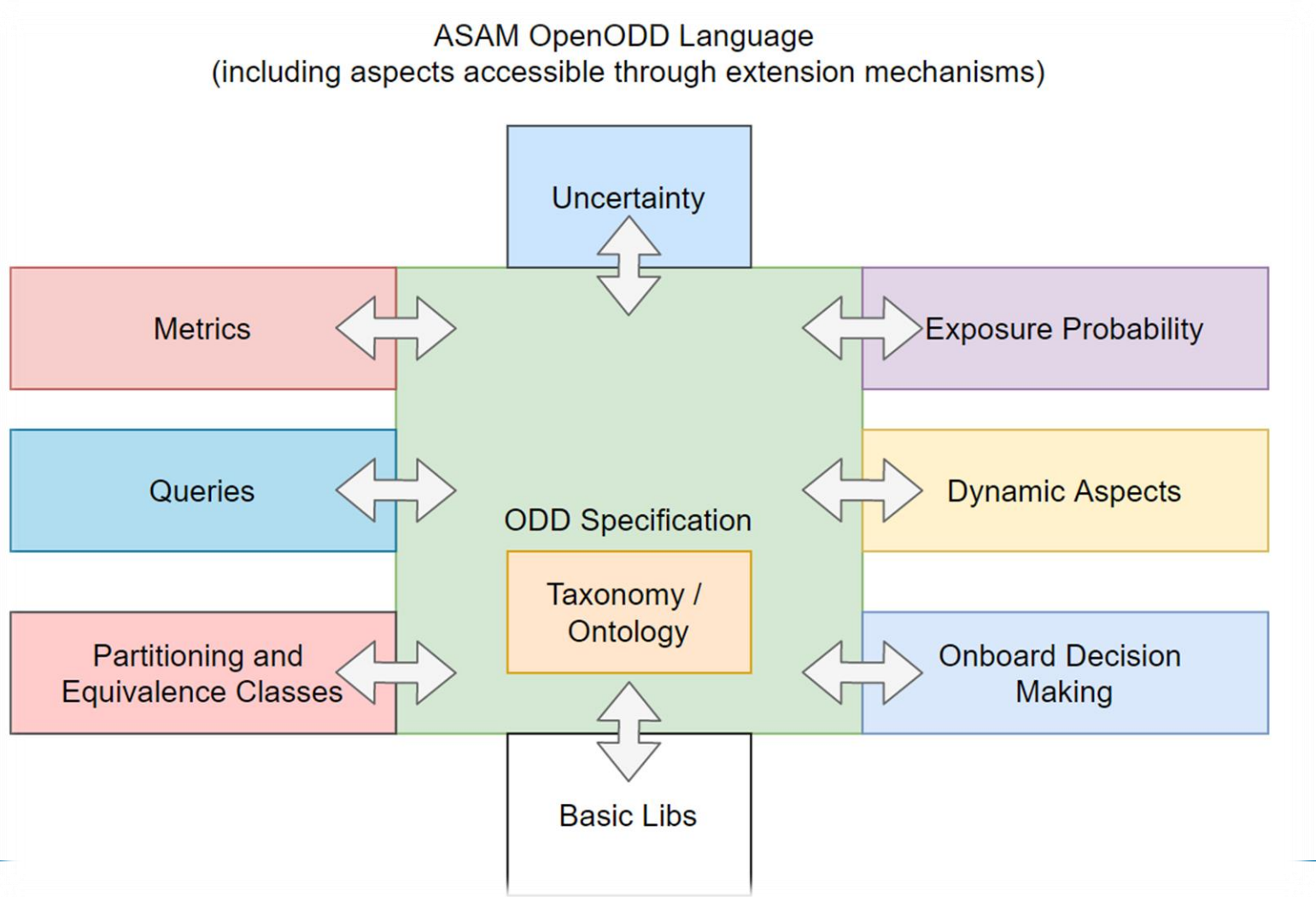


ASAM OpenODD Concept Project: Scope



ASAM OpenODD Concept Project: work packages

- Four work packages

- **Work Package 1:** Attributes:
  - Ensure alignment with BSI PAS 1883, ISO 34503, and the ongoing ASAM OpenXOntology Project

- **Work Package 2:** Specification/format
  - Describe the semantic and syntactic description of the ODD description for format for simulation execution

- **Work Package 3:** Metrics / Measurement
  - Define and describes Metrics associated with ODD

- **Work Package 4:** Uncertainty
  - Define and describes uncertainty attributes associated with ODD

ASAM OpenODD Concept Project: Outcomes

REQUIREMENT: Human and machine readability

Example Use case:

An example ODD states that motorway is only suitable when there is no rain, up slope is not suitable as the vertical geometry.

Syntax 1

```
keep(road_type == motorway => odd_5.weather.rain == none)
keep(geometry.vertical != up_slope)
```

Syntax 2

```
SUITABLE Motorway EXCEPT WHEN Rain
UNSUITABLE Up_slope
```

Deliverables OpenODD Concept project.

What was Released

Concept Paper

- Documentation
- Illustration in 2 example syntaxes

ASAM

ASAM OpenODD: Concept Paper

Version 1.0, 01.10.2021

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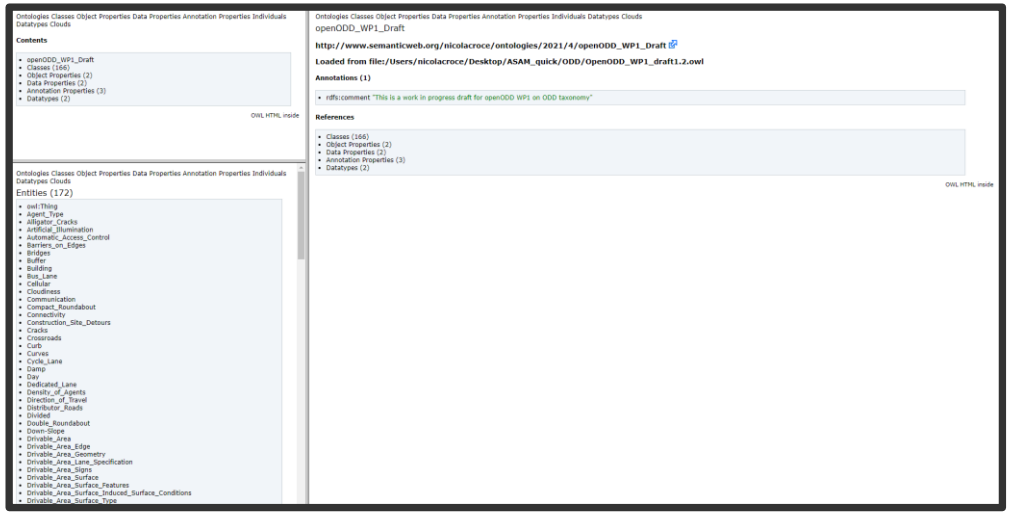
1. Foreword

Association for Standardization of Automation and Measuring Systems (ASAM) is a non-profit organization that promotes standardization for tool chains in automotive development and testing. Our members are international car manufacturers, suppliers, tool vendors, engineering service providers and research institutes. ASAM standards are developed in work groups, composed of experts from our member companies. Our standards enable easy exchange of data or tools within a tool chain. ASAM is the legal owner of these standards and responsible for their development, maintenance, distribution and marketing.

ASAM standards focus on defining data models, file formats, communication APIs, software component APIs, and communication protocols for the data exchange between research, development, and validation systems. ASAM standardization seeks to incorporate requirements from many different global viewpoints and produce an efficient interface.

Ontology Web App

- Online portal with detailed ODD attributes and their ontological relationships



Ontologies Classes Object Properties Data Properties Annotation Properties Individuals Datatypes Clouds

Contents

- openODD_WP1_Draft
- Classes (166)
- Object Properties (2)
- Data Properties (2)
- Annotation Properties (3)
- Datatypes (2)

OWL HTML inside

Ontologies Classes Object Properties Data Properties Annotation Properties Individuals Datatypes Clouds

openODD_WP1_Draft

http://www.semanticweb.org/nicolacroce/ontologies/2021/4/openODD_WP1_Draft

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Annotations (1)

- rdfs:comment "This is a work in progress draft for openODD WP1 on ODD taxonomy"

References

- Classes (166)
- Object Properties (2)
- Data Properties (2)
- Annotation Properties (3)
- Datatypes (2)

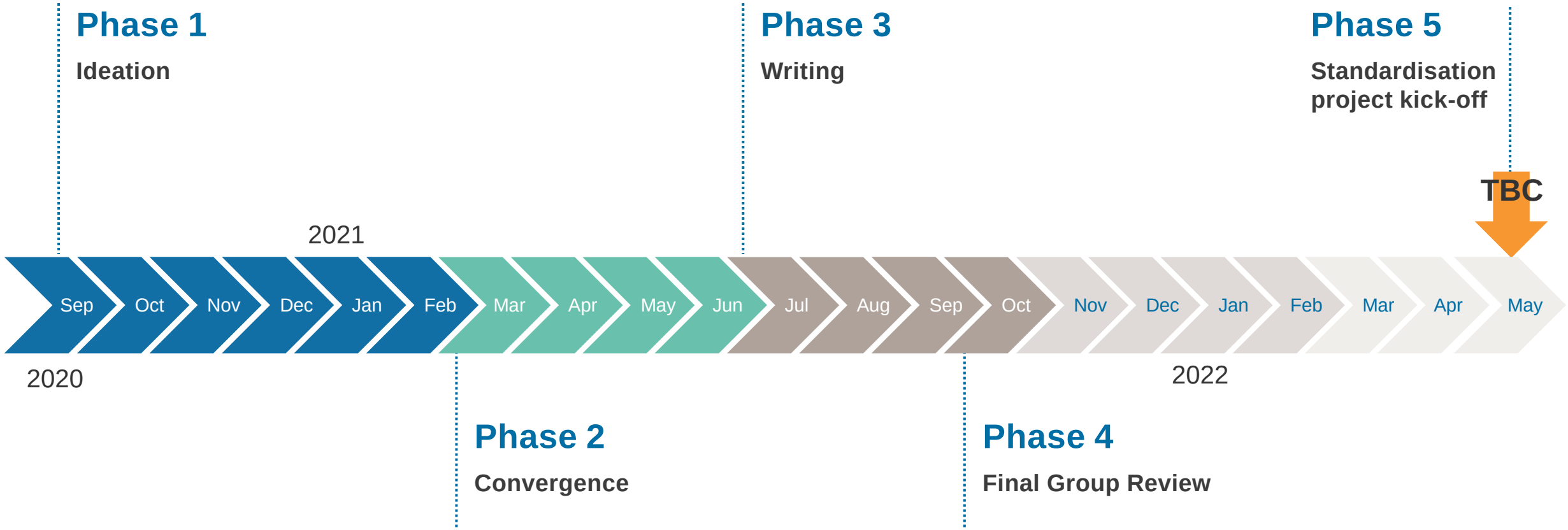
OWL HTML inside

Ontologies Classes Object Properties Data Properties Annotation Properties Individuals Datatypes Clouds

Entities (172)

- owl:Thing
- Agent_Type
- Alligator_Cracks
- Artificial_Illumination
- Automatic_Access_Control
- Barriers_on_Edges
- Bridges
- Buffer
- Building
- Bus_Lane
- Cellular
- Cloudiness
- Communication
- Compact_Roundabout
- Connectivity
- Construction_Site_Detours
- Cracks
- Crossroads
- Curb
- Curves
- Cycle_Lane
- Damp
- Day
- Dedicated_Lane
- Density_of_Agents
- Direction_of_Travel
- Distributor_Roads
- Divided
- Double_Roundabout
- Down-Slope
- Drivable_Area
- Drivable_Area_Edge
- Drivable_Area_Geometry
- Drivable_Area_Lane_Specification
- Drivable_Area_Signs
- Drivable_Area_Surface
- Drivable_Area_Surface_Features
- Drivable_Area_Surface_Induced_Surface_Conditions
- Drivable_Area_Surface_Type

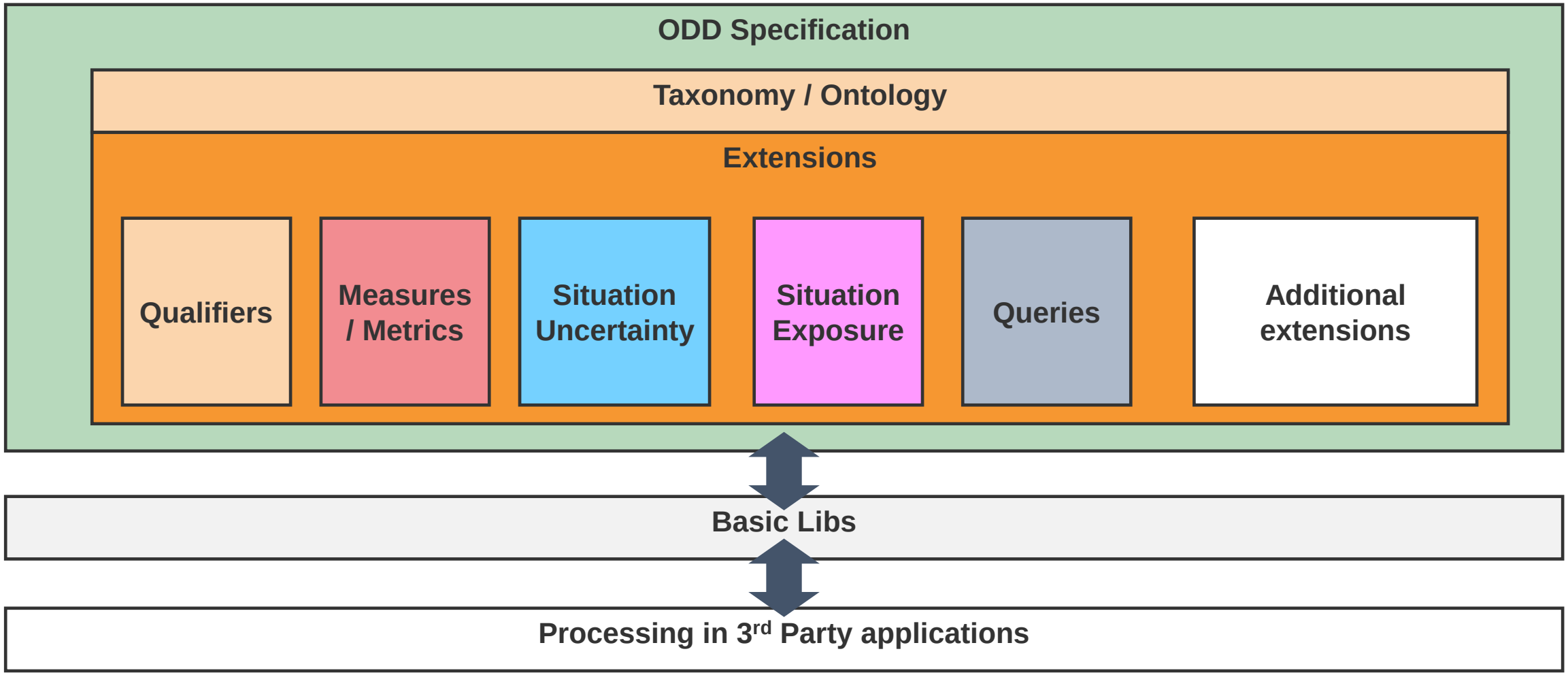
ASAM OpenODD Concept Project Timeline



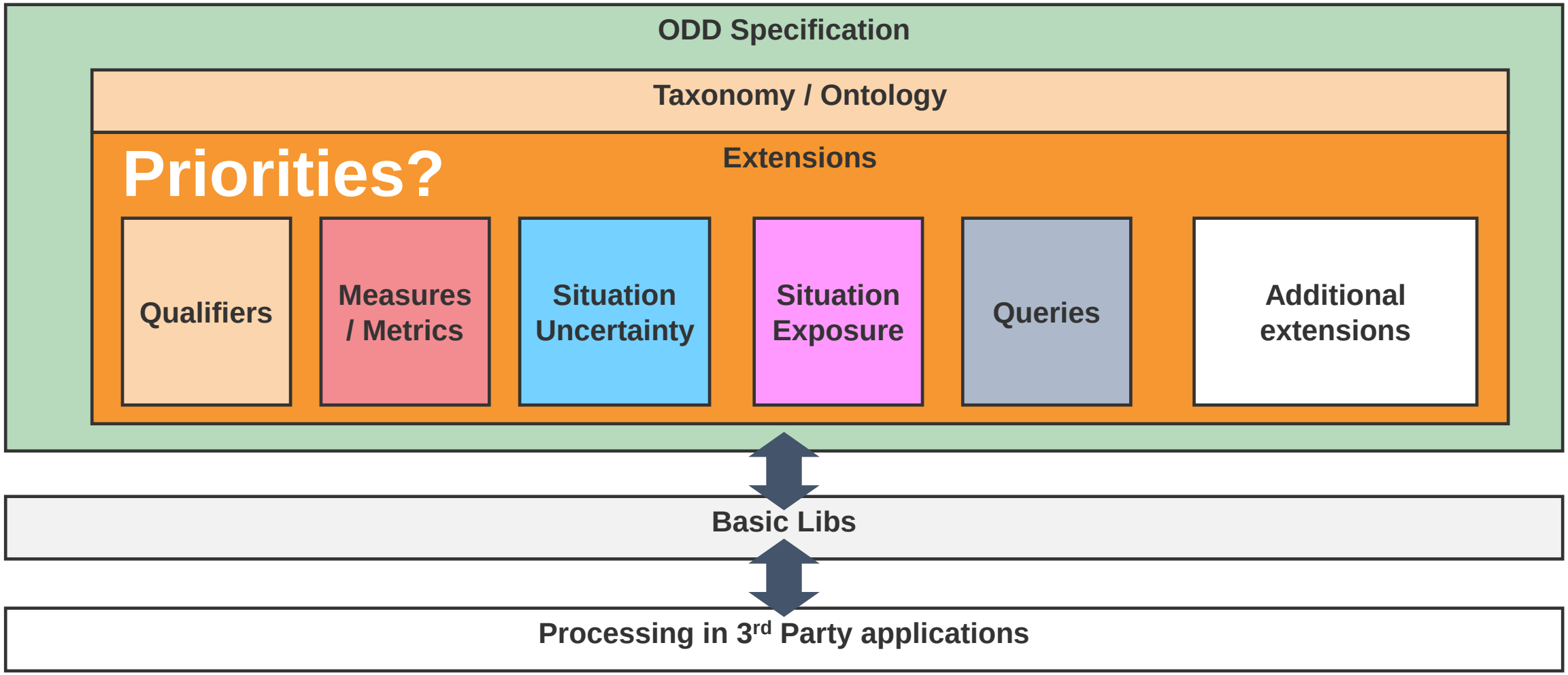
ASAM OpenODD V1.0.0 Standardisation Project

Key Next steps

ASAM OpenODD V1.0.0 Standardisation Scope



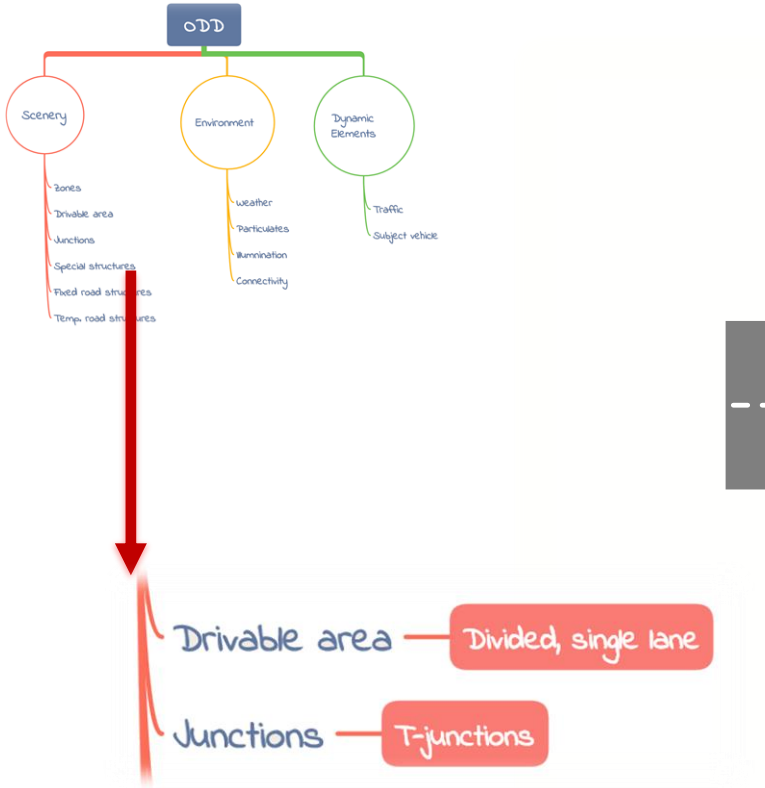
ASAM OpenODD V1.0.0 Standardisation Scope



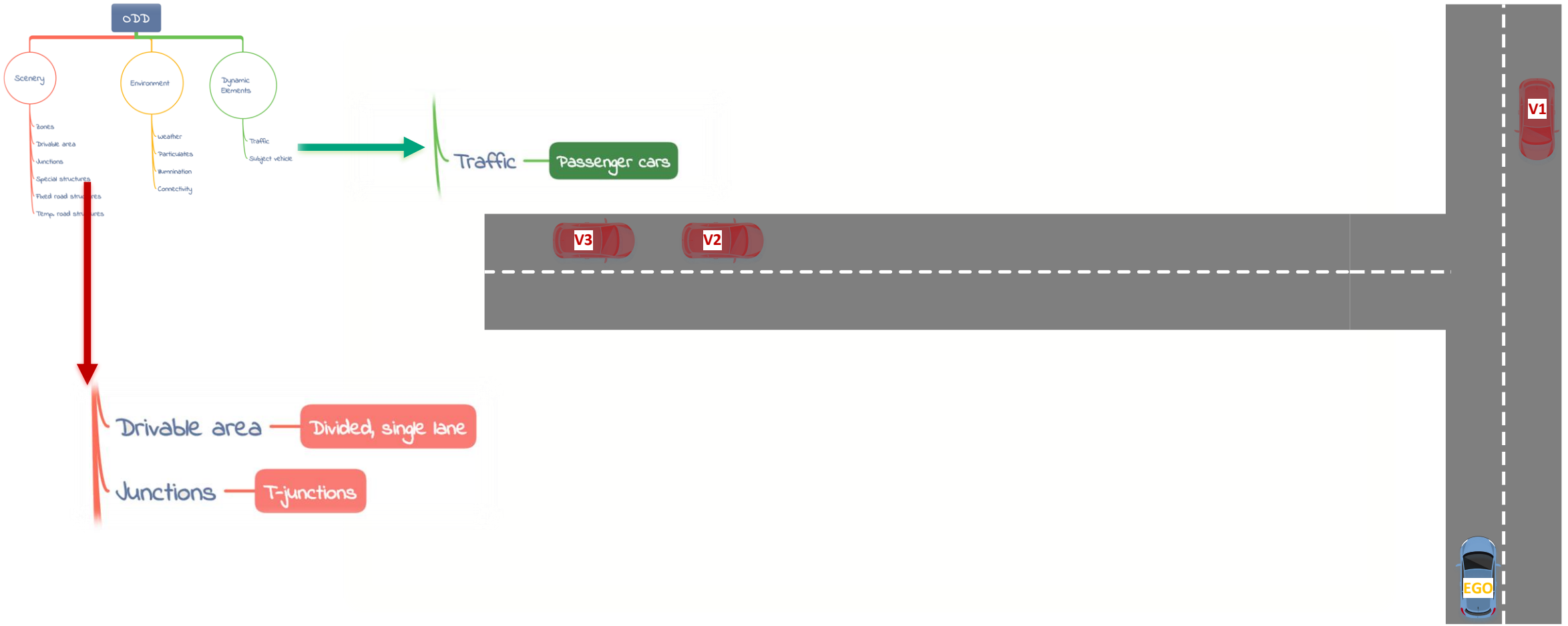
ASAM OpenODD V1.0.0 Standardisation Project: Proposed Work Packages

- **Work Package 1:** Scope Refinement
  - Bringing project team up to speed
  - Ranking for extensions

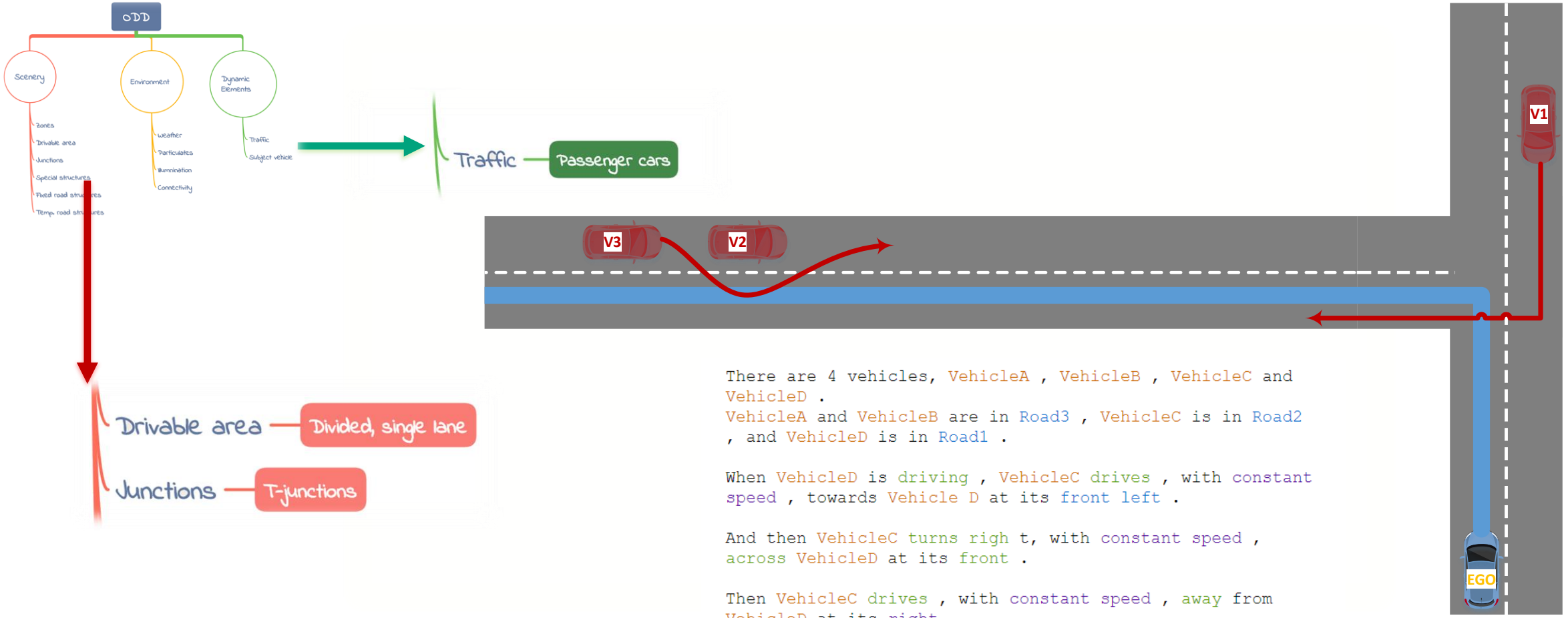
ODD and Scenario



ODD and Scenario



ODD and Scenario



There are 4 vehicles, VehicleA , VehicleB , VehicleC and VehicleD .
VehicleA and VehicleB are in Road3 , VehicleC is in Road2 , and VehicleD is in Road1 .

When VehicleD is driving , VehicleC drives , with constant speed , towards Vehicle D at its front left .

And then VehicleC turns righ t, with constant speed , across VehicleD at its front .

Then VehicleC drives , with constant speed , away from VehicleD at its right .

ODD attributes awareness - Rainfall

- What does rainfall rate mean?
- How do we measure rainfall rate?
- Can the CAV measure it via on-board sensing only?
- How do we address local variability issues?

For more on Curious case of ODD: https://bit.ly/CuriousCaseODD

ASAM OpenODD V1.0.0 Standardisation Project: Proposed Work Packages

- **Work Package 1:** Scope Refinement
  - Bringing project team up to speed
  - Ranking for extensions
- **Work Package 2:** Language (syntax and semantics)
- **Work Package 3:** Extensions
- **Work Package 4:** Case Studies

ASAM OpenODD V1.0.0 Standardisation Project: Additional Details

- 18 months duration
- Summer 2022 Kick-off

Thank you for your attention!

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