# Data Management approach for scenario-based validation of autonomous driving functions
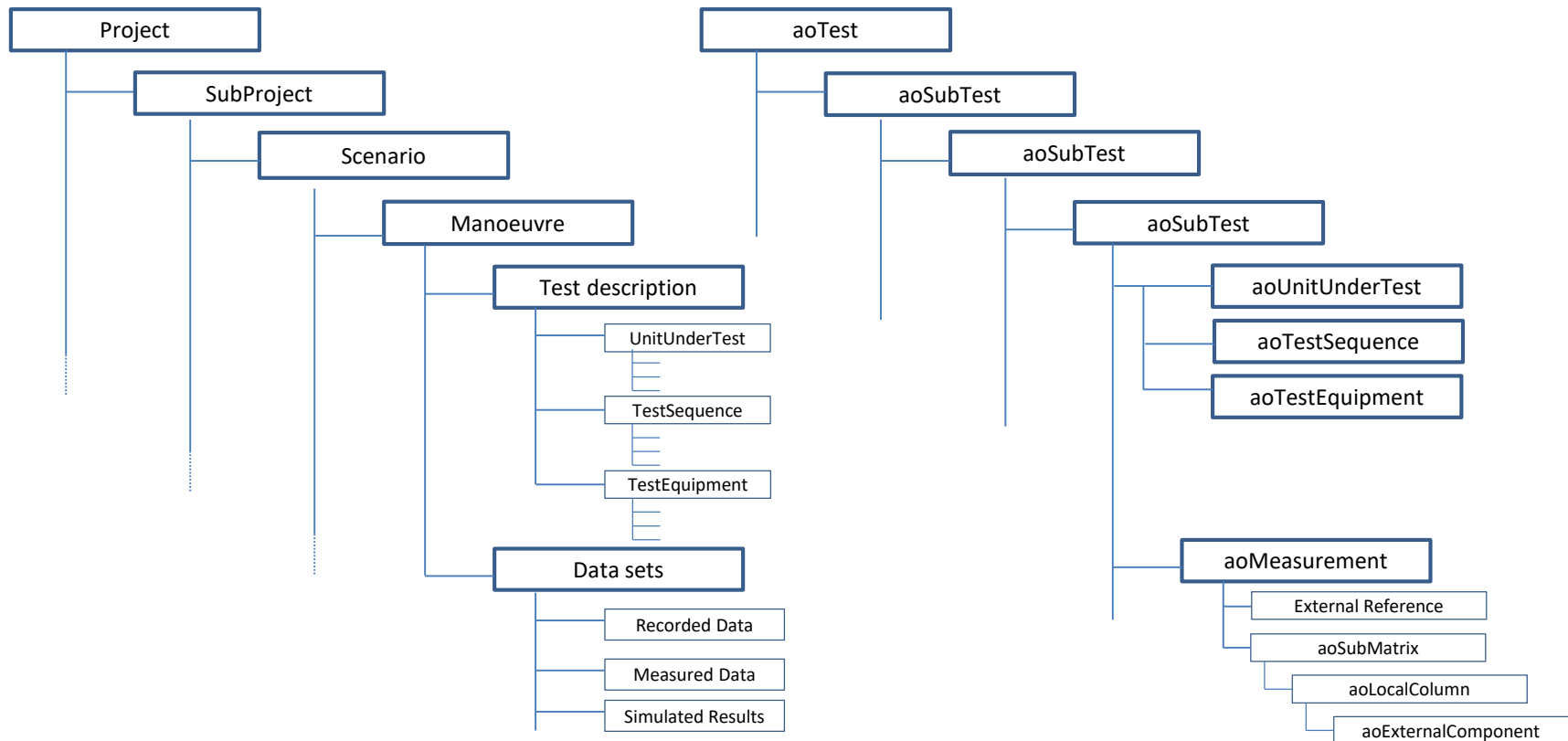
December 2nd, 2019

## Challenges

- **Management of the lifecycle of the diverse datasets for the validation of autonomous driving functions by a appropriate data model**

- **Managed datasets:**
  - **Recorded or generated traffic situations (e.g. scenarios)**
  - **Target values (e.g. expected behavior of an assisent function)**
  - **Measured data (e.g. vehicle status information from CAN, FlexRay)**
  - **Simulated results (e.g. derived test cases)**
  - **Meta data (e.g. vehicle setup and ECU software versions)**

- **Challenge: Different, proprietary descriptions and data formats**

# Best Practice

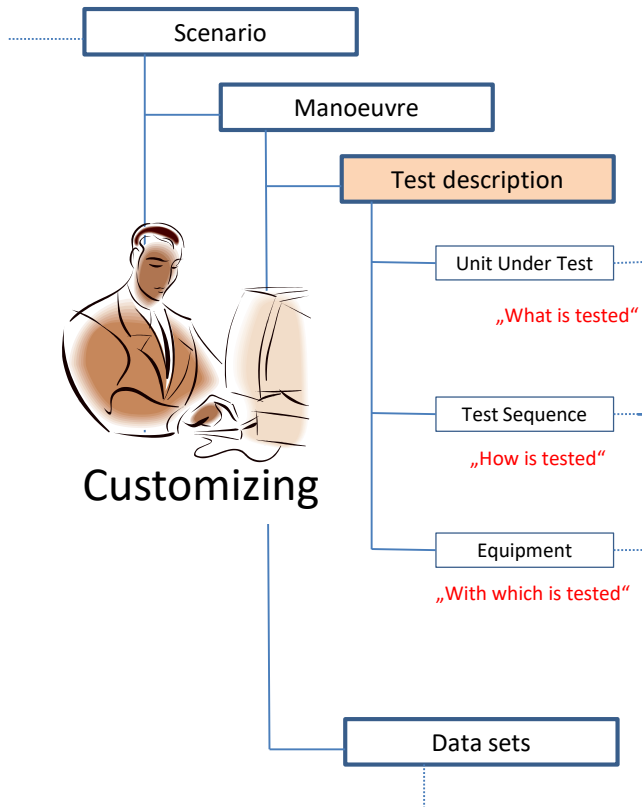**Overview**



Recorded data (e.g. video) → Varied data formats → Processing Labeling

Scenario generation → Test Case Definition → Simulation

Meta Data, Scenarios, Test Cases
Target Values, Measured Data, Simulation results

# openMDM®

**Administration**

Application model: ASAM ODS compliant test data storage

# openMDM®

**Administration**

Definition of metadata by customizing



Customizing

- Scenario
- Manoeuvre
- Test description
- Unit Under Test — „What is tested"
- Test Sequence — „How is tested"
- Equipment — „With which is tested"
- Data sets



Navigator — Default ▾ | Details | MDM Suche

- MDM_ADAS
  - Records
  - Scenario
    - Braking_Test
      - Template_Nr_1_Sheer_out
      - Template_Nr_3_Pedestrian
      - Template_Nr_4_Switch_Lane
        - BT_SWL_001_20191009105113
        - BT_SWL_002_20191009105304
        - BT_SWL_003_20191009105306
        - Documentation_20191009105113
    - Radar
    - Sensor_Connect
  - Simulation

General  Prüfling  **Testablauf**  Messgerät  Sensoren

**Fahrgeschwindigkeiten_Phase_1**

| Name | Beauftragt |
| --- | --- |
| Geschwindigkeit_Ego | 80.0 |
| Geschwindigkeit_Target1 | 70.0 |
| Geschwindigkeit_Target2 | |
| MimeType | application/x-asam. |
| Name | Fahrgeschwindigkei |

**Header**

Manoever_Phase_1

**Versuchsumfeld**

| Name | Beauftragt |
| --- | --- |
| Anzahl_Spuren | 3 |
| Niederschlag | heavy rain |
| Lichtverhaeltnisse | |
| Umfeld_Kommentar | |
| Pruefstrecke | freeway |
| MimeType | application/x-asam |
| Name | Versuchsumfeld |
| Fahrbahnbelag | asphalt |
| Pruefgelaende | |
| Sichtbedingungen | foggy |
| Fahrbahnzustand | soiled |
| Bewoelkung | |
| Sonnenstand | |

# openMDM®

## Searching Scenarios by meta data

☑ Erweiterte Suche  [+]  [✎]  [💾]  [✖]                                        [✎]  [⌄]

**Globale Suchattribute**

| Project | Name | = ▾ | Wert | ✖ |
|---|---|---|---|---|
| Test | Name | = ▾ | Wert | ✖ |
| TestStep | Name | = ▾ | Wert | ✖ |
| Ego_Fahrzeug | Fahrzeug_Typ | = ▾ | Wert | ✖ |
| Fahrgeschwindigkeiten | Geschwindigkeit_Ego | > ▾ | 40 | ✖ |
| Versuchsumfeld | Fahrbahnzustand | = ▾ | soiled ✖ | ✖ |
| Versuchsumfeld | Niederschlag | = ▾ | heavy rain ✖ | ✖ |

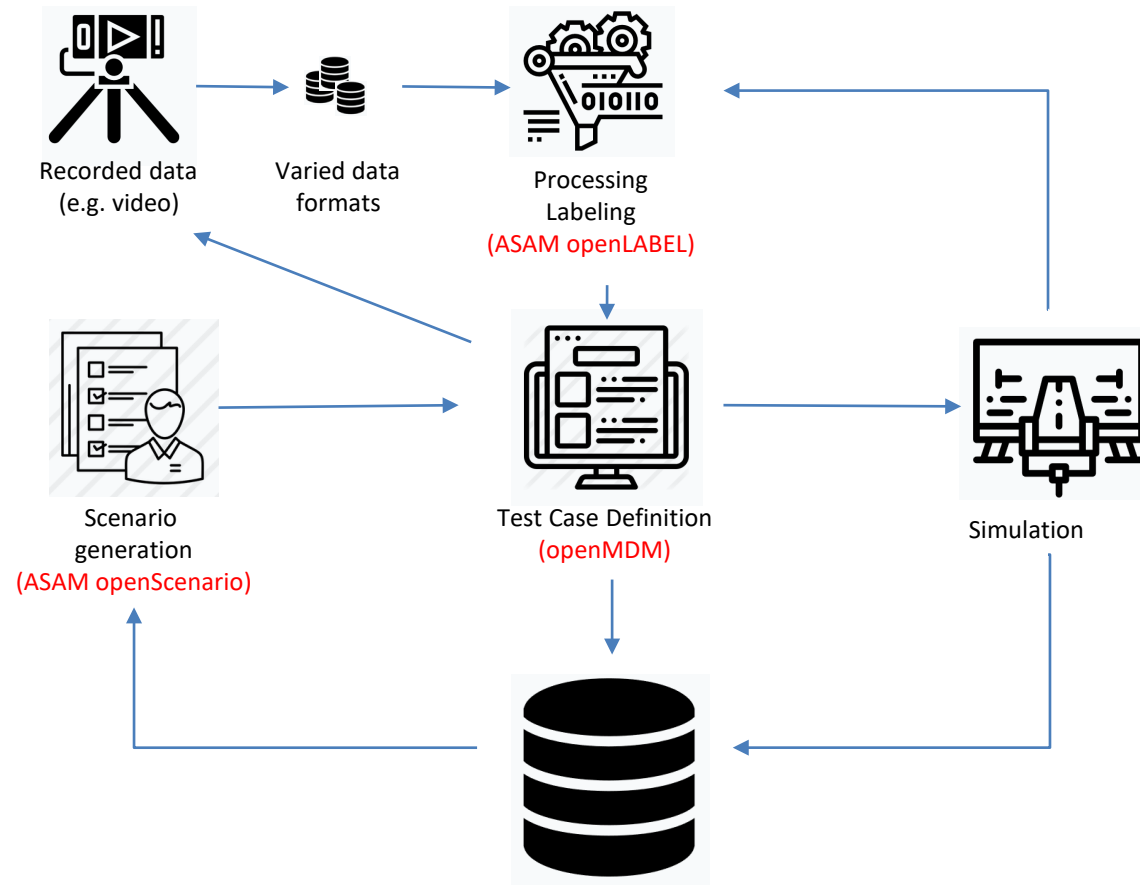Ergebnisse  [Demo_Results ▾]  [+]  [✎]  [💾]  [✖]                    3  [✎]  [🛒]  [⌄]

| ☐ | | | Project Name ⇕ | Test Name ⇕ | TestStep Name ⇕ | Fahrgeschwindigkeiten Geschwindigkeit_Ego ⇕ | Versuchsumfeld Fahrbahnzustand ⇕ | Versuchsumfeld Niederschlag ⇕ | Versuchsumfeld Pruefstrecke ⇕ |
|---|---|---|---|---|---|---|---|---|---|
| ☐ | 🗗 | 🛒 | Scenario | Template_Nr_4_Switch_Lane | BT_SWL_001_20191009105113 | 80.0 | soiled | heavy rain | freeway |
| ☐ | 🗗 | 🛒 | Records | Overtake_Car_Highway | SwLa_Highway_20191126135345 | 90.0 | soiled | heavy rain | highway |
| ☐ | 🗗 | 🛒 | Simulation | Break_before_Overtake | Sim_Overtake_20191126135803 | 90.0 | soiled | heavy rain | highway |

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# Solution proposal

**Overview**



Recorded data
(e.g. video)

Varied data
formats

Processing
Labeling
(ASAM openLABEL)

Scenario
generation
(ASAM openScenario)

Test Case Definition
(openMDM)

Simulation

Meta Data, Scenarios, Test Cases
Target Values, Measured Data, Simulation results
(ASAM ODS)

# Call for action

- **Building Working group to develop use cases**

- **Exchange ideas and knowledge with Eclipse OpenMDM , eclipse OpenADx, etc.  working group**

- **Obvious benefits (a few) of using ODS and openMDM for managing data from the field of ADAS validation**

  - ODS is a proven and widely used standard for exchangeability and interpretability in the long-term

  - The ODS data model allows the flexible definition of storage structures, descriptive attributes, and relationships for different datasets

  - ODS offers several possibilities to store data (as external reference, in MDF files, or in the database)

  - The currently upcoming Big Data capabilities of ODS further extend storing possibilities by JSON, Parquet and Avro

  - Additionally, openMDM provides a freely available REST API that simplifies the complexity and details of the ODS interface

# Thank you!

Alexander Haßler, Consultant Software Engineer Peak Solution
a.hassler@peak-solution.de