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Automotive Solution Center for Simulation

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RESEARCH CLUSTER

AI & Data-driven Simulation ~~Supply Chain~~ Ecosystem

Quantifying Simulation Quality

September 11, 2024
Hochschule Duesseldorf

Hosted by:

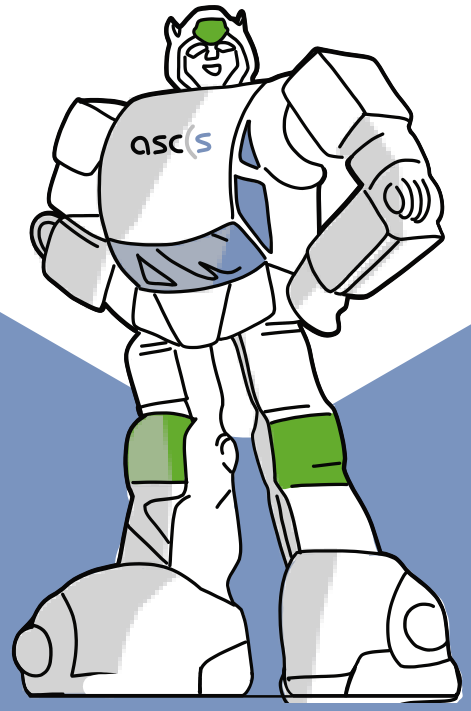
Hochschule Düsseldorf
University of Applied Sciences
HSD | ASAM

ASCS AT A GLANCE

The association **Automotive Solution Center for Simulation** brings together and represents stakeholders in the cutting-edge technology fields

- **Computer Simulation**
- **Artificial Intelligence**
- **High-Performance Computing**

for automotive and mobility solutions.



founded 2008

50+ members

application-oriented research

technology transfer

innovation

further education

VISION

Simulation is THE key for mobility.
Simulation gives mobility a future.

OUTLINE

Automotive Solution Center for Simulation

1. THE NEED FOR DATA
2. DATA SUPPLY CHAIN VS. DATA ECOSYSTEM
3. HOW TO SECURE QUALITY IN A SIMULATION DATA ECOSYSTEM
4. OUR COMMUNITY APPROACH: ENVITED-X DATA SPACE
5. Q&A

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THE NEED FOR DATA: DIGITAL TWINS FOR ADAS AND AD

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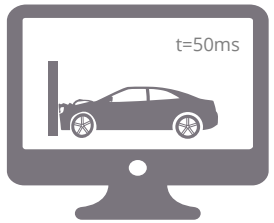
Automated driving (AD) functions rely heavily on environment perception to fulfil their function.

CONVENTIONAL CAE VS. REALITY

Example: CAE Crash



abstract environment

limited sphere of influence

VIRTUAL TEST DRIVE VS. REALITY

Example: Sensor Simulation

digital twin

large, dynamic range of influence

The virtual testing and validation of automated vehicle functions requires the integration of all real-world influencing objects into simulation environments, leading to **application-oriented digital twins**.

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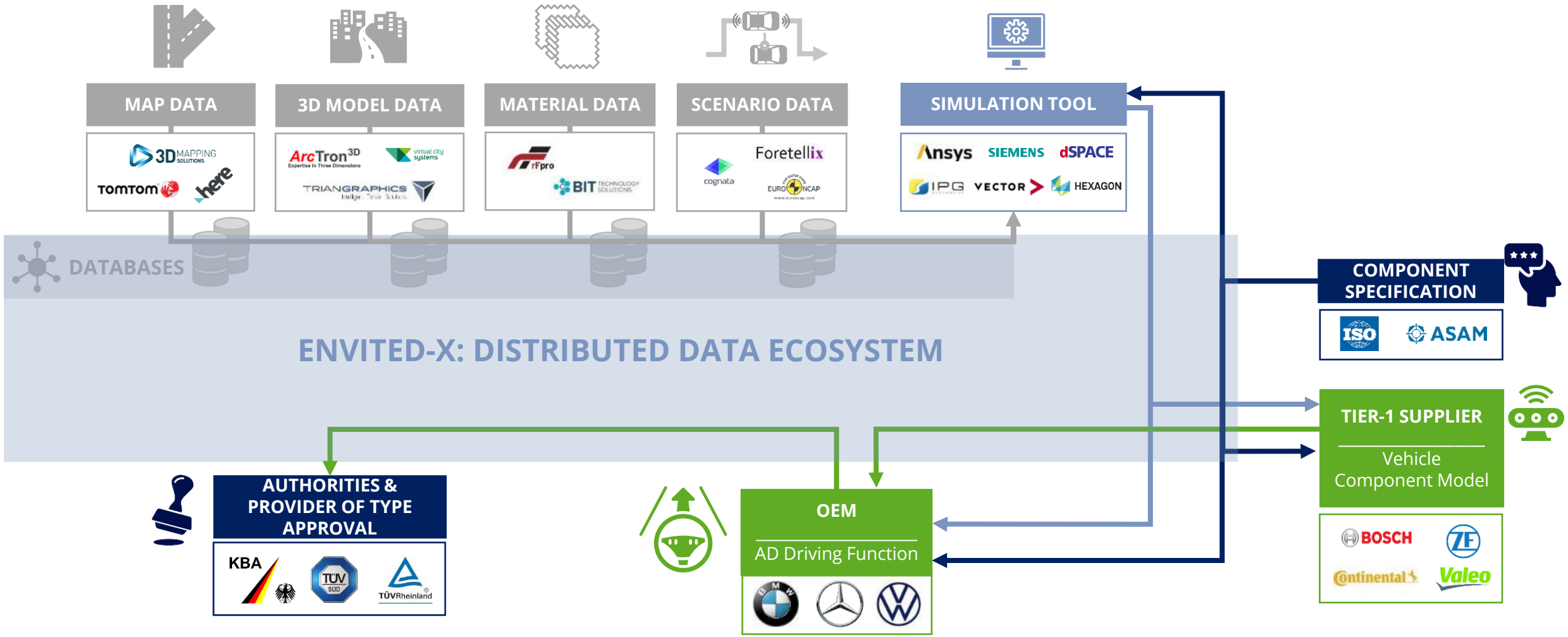
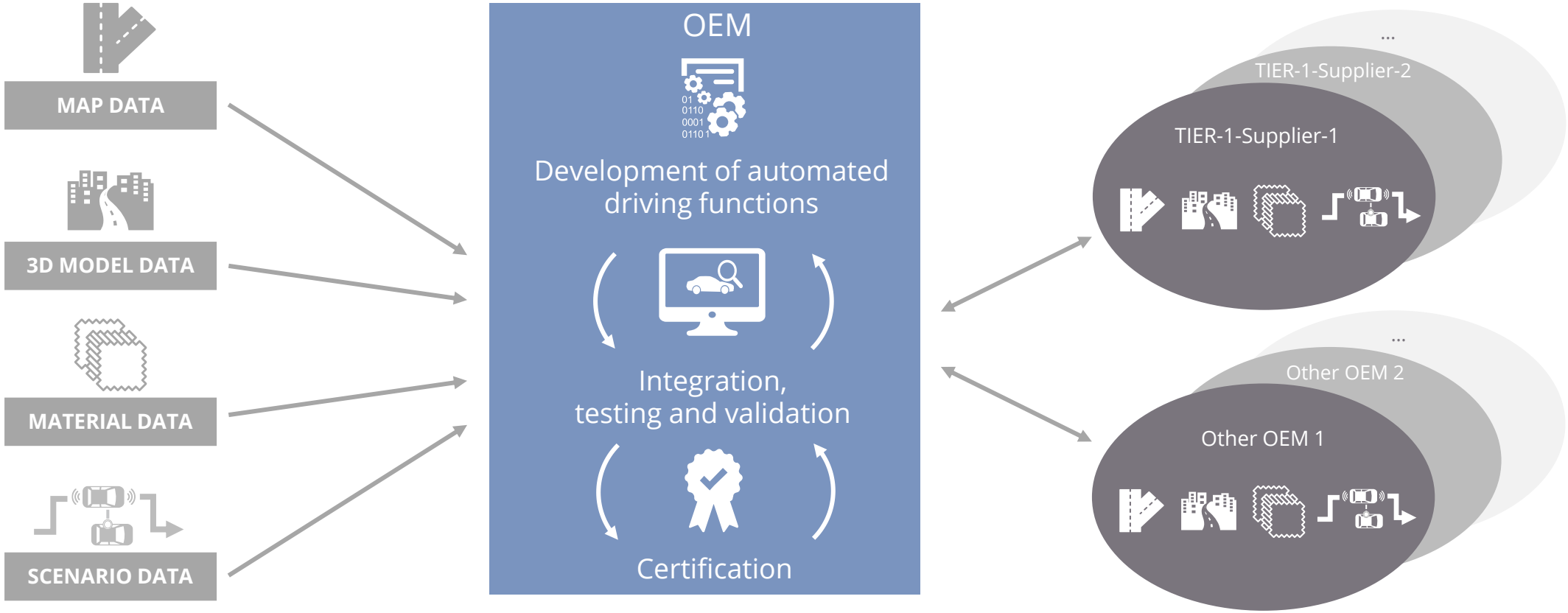
THE NEED FOR DATA: COMPLEX SIMULATION DATA SUPPLY CHAIN



all companies mentioned are for illustrative purposes only

THE NEED FOR DATA GREATLY EXCEEDS THE AVAILABILITY OF DATA



Development, (virtual) testing and certification of autonomous and connected driving functions requires more data (HD maps, scenarios, ...) than any OEM (or system supplier) alone can produce/procure in a limited amount of time and in an economically viable way.

DATA SUPPLY CHAIN VS DATA ECOSYSTEM

	SUPPLY CHAIN	ECOSYSTEM
FOCUS	Primarily focused on the movement of a **customized data set** from **supplier to consumer.**	Focused on the **exchange** and **monetization of data**. The ecosystem allows for the sharing, selling, or trading of data between **multiple parties**. It emphasizes **collaboration**, **data value creation**, and **innovation**.
PARTICIPANTS	The **roles are clearly defined**, with each participant playing a specific part in the flow of data.	**Roles can be more fluid**, and participants may switch between being data consumers and producers.
FLOW OF DATA	The flow is generally **one-directional**. Data is collected in silos from various sources.	Data can flow in **multiple directions**. Data producers and consumers interact more dynamically, and data can be **used and reused across different participants**.

DATA SUPPLY CHAIN VS DATA ECOSYSTEM

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	SUPPLY CHAIN	ECOSYSTEM
VALUE CREATION	The value chain is **typically linear**, with each step adding incremental value.	Data itself becomes more valuable as it is **combined, analyzed, and enriched** by various stakeholders.
MONETIZATION	Revenue comes from the **sale of data**. Each stage of the supply chain has its own pricing, margins, and costs.	Data can be **monetized in various ways**, such as selling (raw) data, providing insights or analytics, or through subscription models. The marketplace enables data providers to sell or share data with **multiple consumers**, allowing for diverse pricing models based on data value, quality, or usage.
COLLABORATION VS. COMPETITION	Generally competitive, with companies focusing on optimizing their own supply chain to **outperform competitors**.	Encourages more collaboration, with participants sharing data to **co-create value**. Marketplaces promote a more open environment where participants contribute to and **benefit from shared data resources**.

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DATA SUPPLY CHAIN VS DATA ECOSYSTEM

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	SUPPLY CHAIN	ECOSYSTEM
QUALITY OF DATA	Defined and controlled by a limited amount of **supply chain partners**.	**Continuous quality control , feedback and enhancement** by multiple stakeholders.

To become data-driven organizations, companies need to invest more in simulation data ecosystems.

We need a change in mindset from traditional supply chains to more dynamic and collaborative data ecosystems.

This is the only way to fully exploit AI and data-driven simulation for future-proofed product development.

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HOW TO SECURE QUALITY IN A SIMULATION DATA ECOSYSTEM

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1

Digital Identities

2

Domain Specific Metadata

3

Quality Checks & Labels

4

Traceability & Access Control

5

Governance

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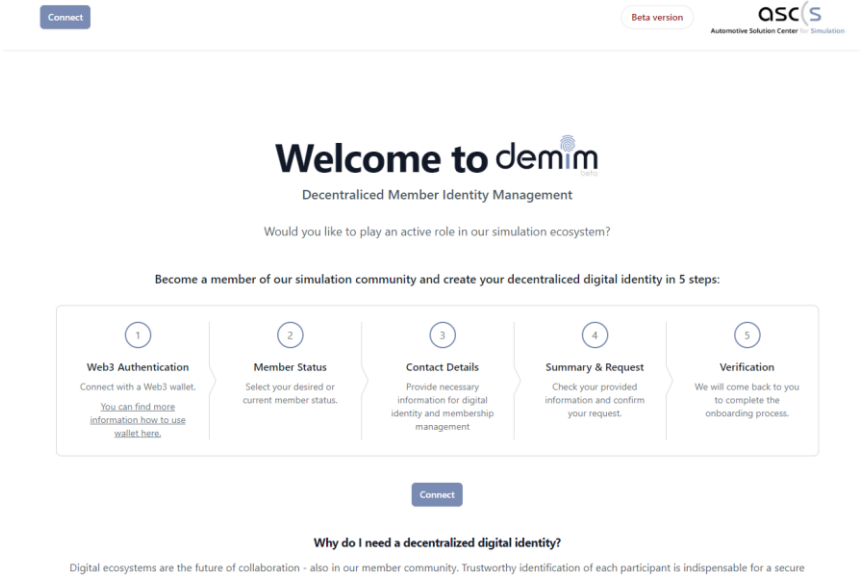
ENVITED-X DATA SPACE

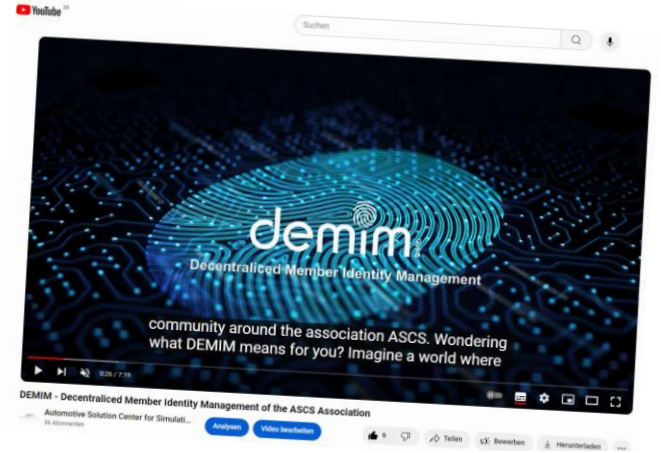
1. DIGITAL IDENTITIES

DEMIM is a digital identity verification service that establishes a chain of trust for a member community.

- multi-level onboarding process
- digitally signed certificates -> verified credentials
- registered in revocation registry
- based on established industry standards in digital identities
- inherently cryptographically secure, privacy-preserving and machine-verifiable



Beta-Version



Tutorial Video

2. DOMAIN-SPECIFIC META DATA

- key to ensuring interoperability and enhancing data usability
- efficient search and comparison across diverse datasets
  - custom ontologies, and associated SHACL shapes
    - HDMap,
    - Environment Model
    - Scenarios
    - OSItrace
    - Surface Model
    - CRG
    - Sensors
    - Services
    - Checks

GitHub Ontology Management Base

- enable precise, automated asset and service registration (for the ENVITED-X data space)

Shape	Property prefix	Property	MinCount	MaxCount	Description	Datatype/NodeKind	Filename
HdMapShape	hdmap	general	1	1			hdmap_shacl.ttl
HdMapShape	hdmap	format	1	1			hdmap_shacl.ttl
HdMapShape	hdmap	content	1	1			hdmap_shacl.ttl
HdMapShape	hdmap	quantity	1	1	Structure		hdmap_shacl.ttl
HdMapShape	hdmap	quality	1	1			hdmap_shacl.ttl
HdMapShape	hdmap	dataSource	1	1			hdmap_shacl.ttl
HdMapShape	hdmap	georeference	1	1			hdmap_shacl.ttl
ContentShape	hdmap	roadTypes			Covered/used road types, defined over ODR element t_road_type, see ODR spec section 8.3	http://www.w3.org/2001/XMLSchema	hdmap_shacl.ttl
ContentShape	hdmap	laneTypes			Covered lane types, see ODR spec section 9.5.3.	http://www.w3.org/2001/XMLSchema	hdmap_shacl.ttl
ContentShape	hdmap	levelOfDetail			Covered object classes, see ODR spec section 11	http://www.w3.org/2001/XMLSchema	hdmap_shacl.ttl

ASAM OpenDrive

www.gaia-x4plcaad.info

3. QUALITY CHECKS AND LABELS

- ensuring quality assessment for seamless data integration preventing time delays or costly errors

Some examples:

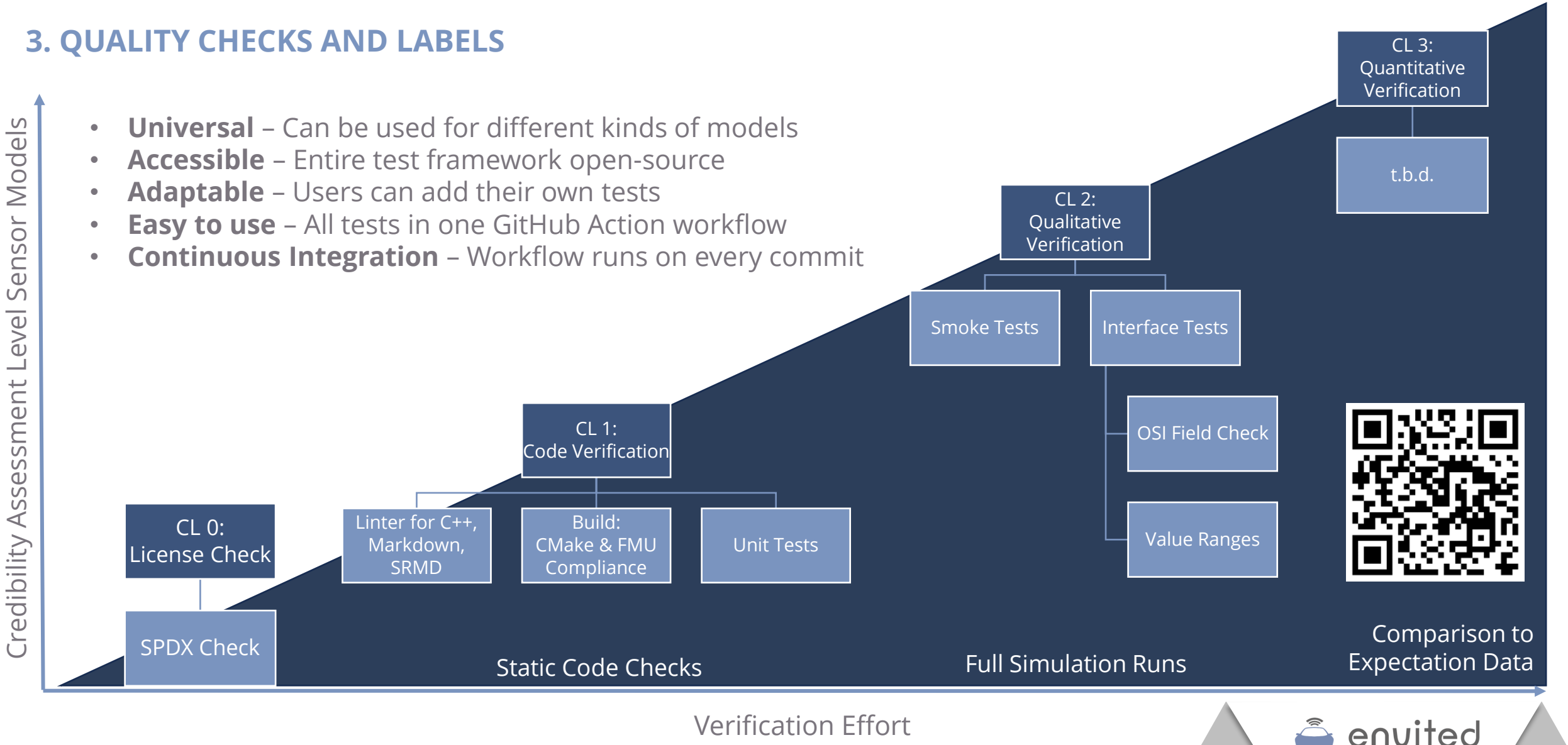
- Schema validation: checking the standard compliance of syntax and structure of the file on data and metadata level
- Content validation: checking the plausibility, consistency, logical coherence, realism, completeness and unambiguity of the data in the file.
- Dynamic validation: run simulation, observe behavior and constantly check the behavior against specific rules
- Tool compatibility: Demonstrate the error-free processability of the data set with certain tools
- Reference visualization: showing how the data shall be rendered
- Statistics: providing statistical data about what kind of data, features and attributes are contained in the file.
- Definition of credibility levels

Quality Checker Framework

OpenMSL Persival asc(s) Automotive Solution Center for Simulation

3. QUALITY CHECKS AND LABELS

- **Universal** – Can be used for different kinds of models
- **Accessible** – Entire test framework open-source
- **Adaptable** – Users can add their own tests
- **Easy to use** – All tests in one GitHub Action workflow
- **Continuous Integration** – Workflow runs on every commit



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4. TRACEABILITY AND ACCESS CONTROL – SENSOR MODEL TOKENIZATION

Distributed Ledger for tokenization using Tezos

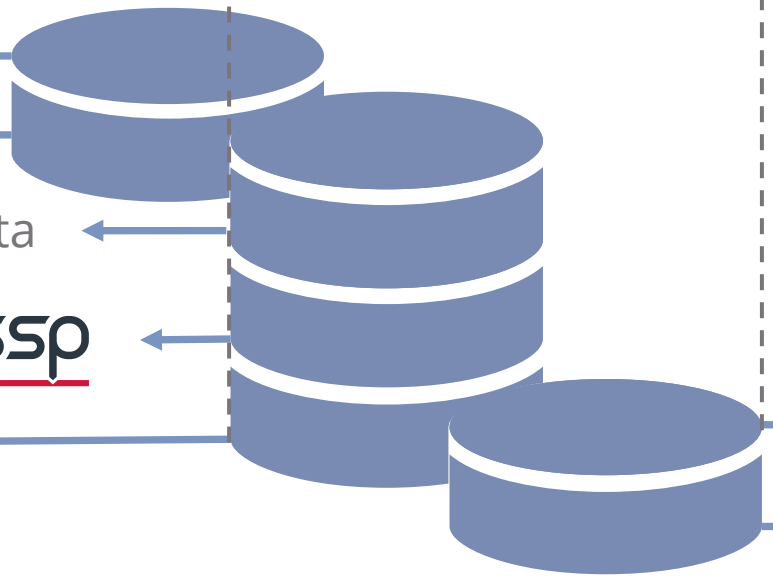
TZIP-12 /-16: Token interface & contract metadata

TZIP-21: Token metadata

SSP Traceability from SSP

SRMD: Model metadata defined in SET Level

Distributed Data Storage with IPFS



- Public infrastructure
- Open APIs
- Open Source Tools
- Open Source Libraries
- Open Specifications
- Open Standards

OSMP: Container using FMI Functional Mock-up Interface

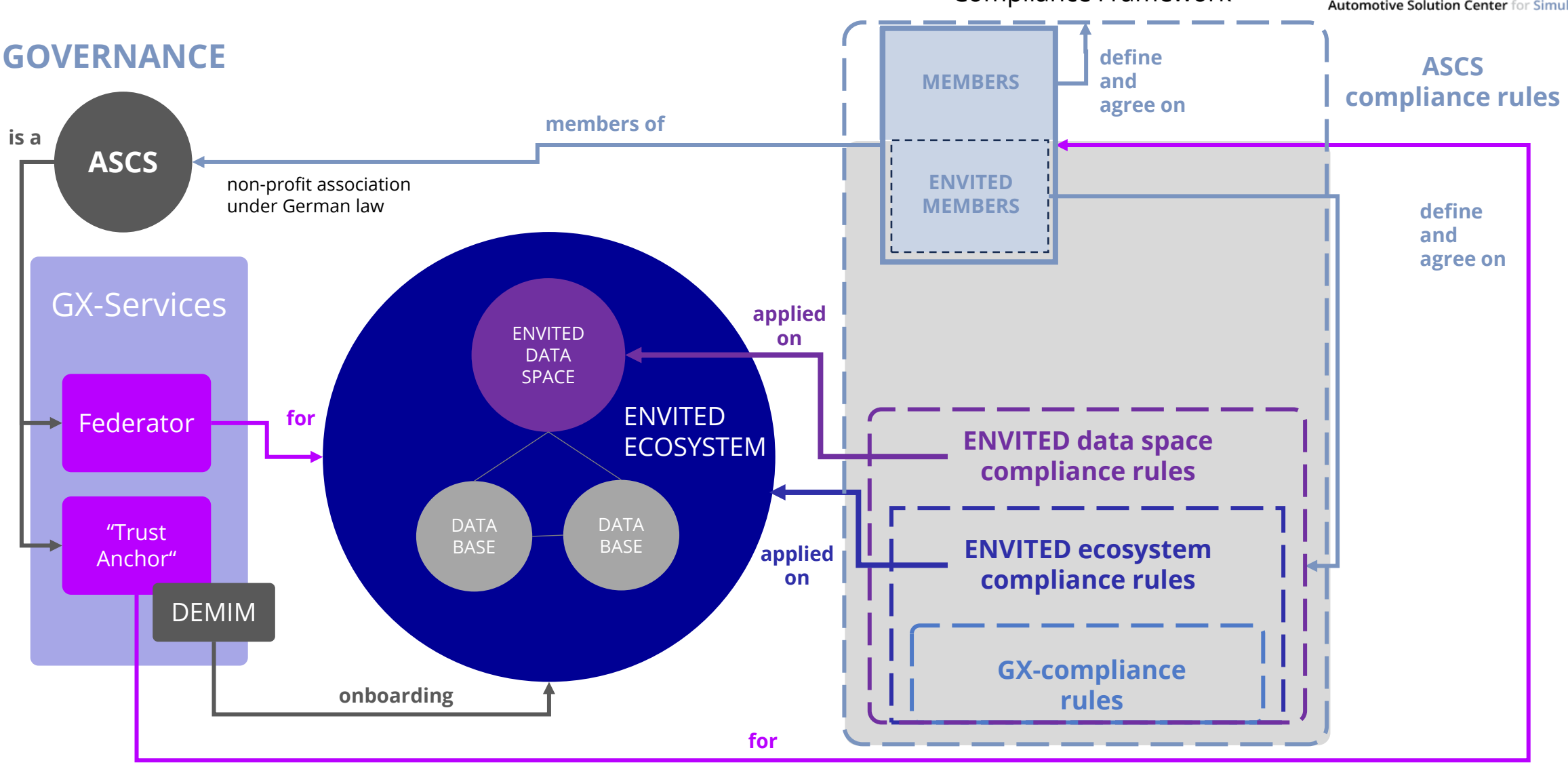
OSI: OS Sensor Model using Google protobuf

ASAM

https://github.com/AlgedonicLoop/SMSIWTDemo/tree/develop/demo

ENVITED-X DATA SPACE

5. GOVERNANCE



QUESTIONS

- What quality checks, lables and assessment methods would you like to see in such an ecosystem?
- Which simulation data could benefit from such an ecosystem?
- What data services would you like to see in such an ecosystem?

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