Industrial Use Cases Drive Data Space Adoption

Technology Talks Austria

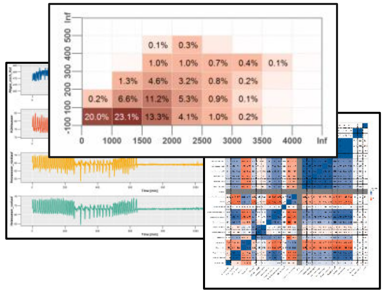
Dr. Bernhard Peischl

Failure Prediction with customer field data

Process when historical in-use data is available

Usage data

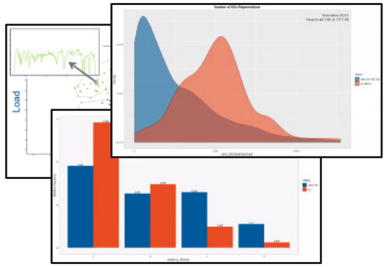
Descriptive Analysis



Histograms, counters, integrals, etc.

KPI's / Features

Descriptive Report



Feature engineering

Feature selection & reduction

Validation

Model selection, training & evaluation

Predictive model to separate between healthy and faulty vehicles

Classifier

VIN	Risk	State
A102	0.87	Faulty
A289	0.12	Healthy
B495	0.95	Faulty

AVL Contributors

- Domain expert
- Data Scientist

Service Data

Observations about failures from field

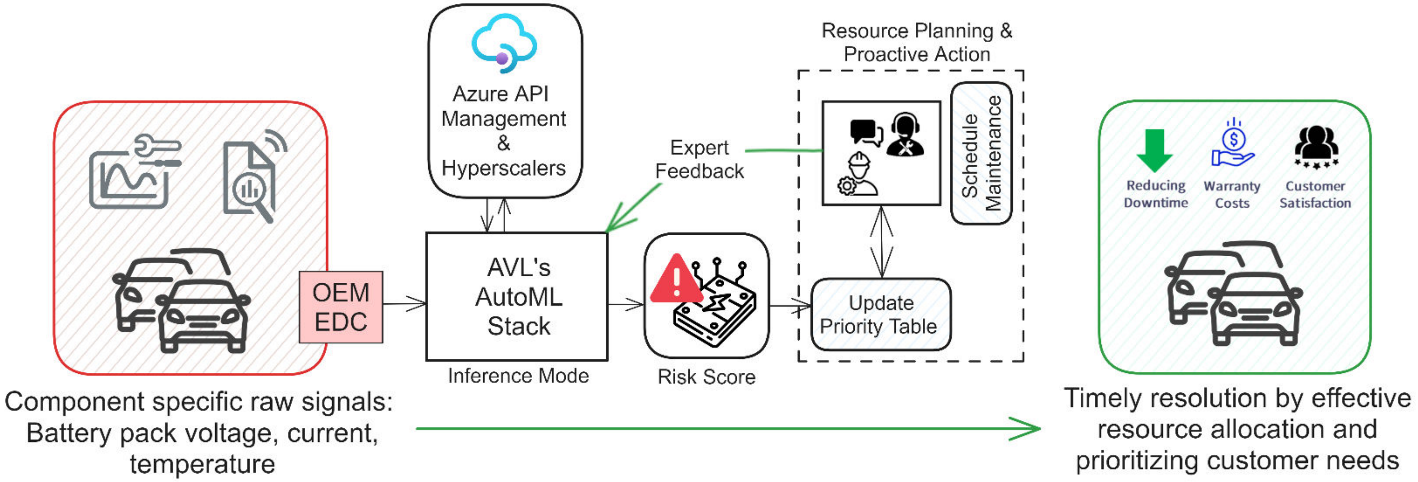
Labels

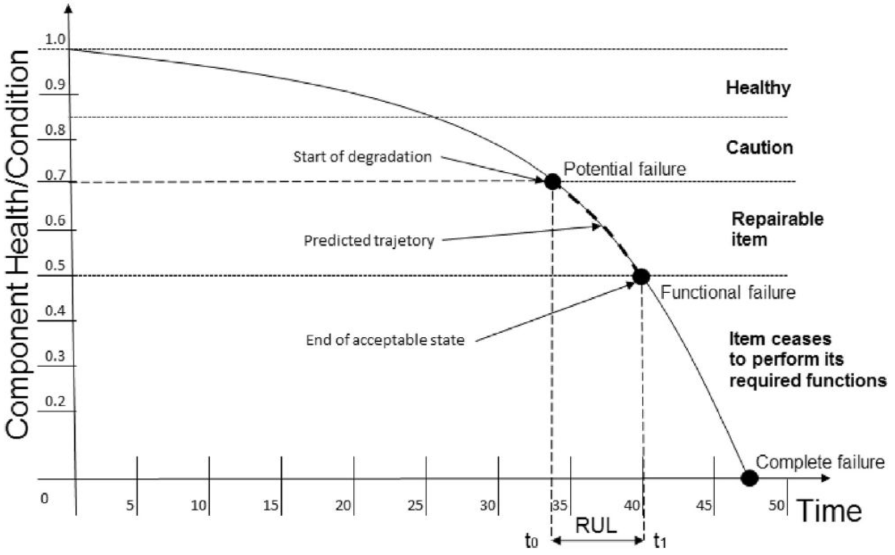
Failure Prediction with customer field data (SaaS)

- Customer Requirements
  - Data-driven solutions for fleets
  - Model development via a dedicated engineering team
  - Data analytics within costumer premises

- Challenges
  - Long and laborious process (acquisition)
  - Customers often unclear about what to receive (model, report, code) and how to use it.
  - Not profitable for AVL

- Engineering Projects -> SaaS
  - Inefficient communication with customers and frequent misunderstandings
  - Customer data: poor quality, delayed, and in numerous formats
  - Time-consuming, regular presentations/reports

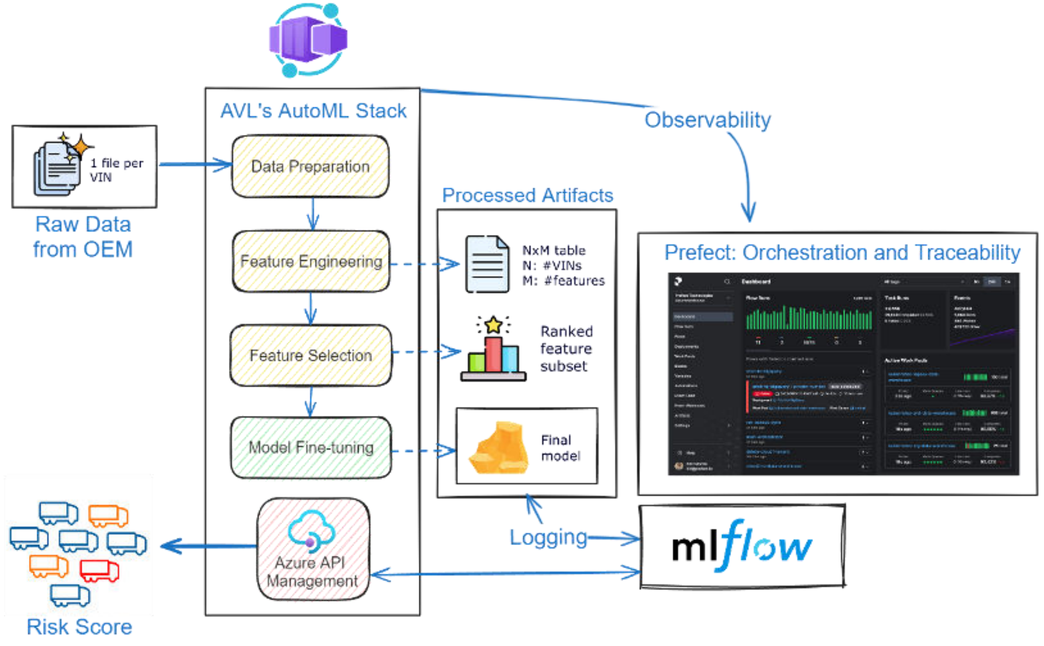


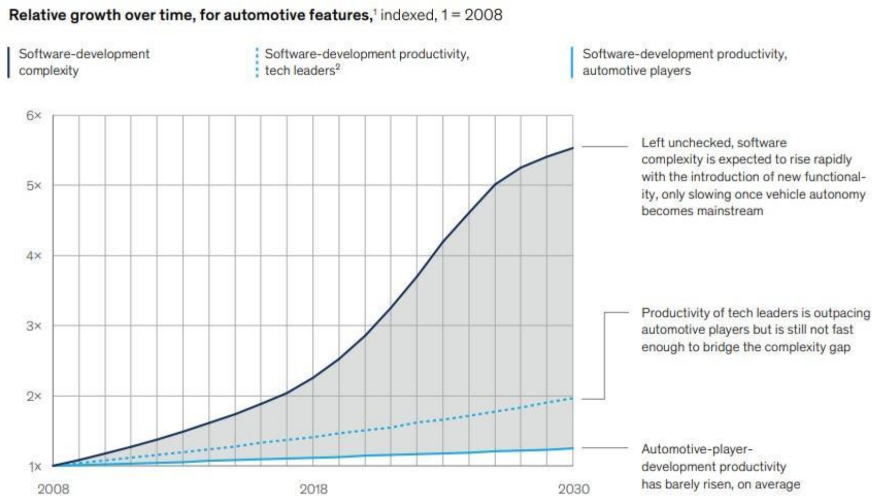


Source: D. L. Nunez, M. Borsato, An ontology-based model for prognostics and health management of machines. Jounral of Industrial Information Integration, 2017, Elsevier.

Robust & trustworthy AI

- Black-Box models
  - Degree of explicability (ML, reasoning)
  - Safe and static specifications vs. unknown specifications
- Nature of the AI component
  (AI model, algorithm, operations, system)
  - Exact guarantees on AI models
  - Approximate guarantees of AI-Ops
  - Assured guarantees of AI critical decision support
  - Textualized guarantees of human critical decision support
- Operational Design Domains (ODD)
  - Verification and Validation methodology wrt. to robustness and dependability
  - Limitation of the operating context for an automated system
  - ODDs to specify where the AI system operates safely



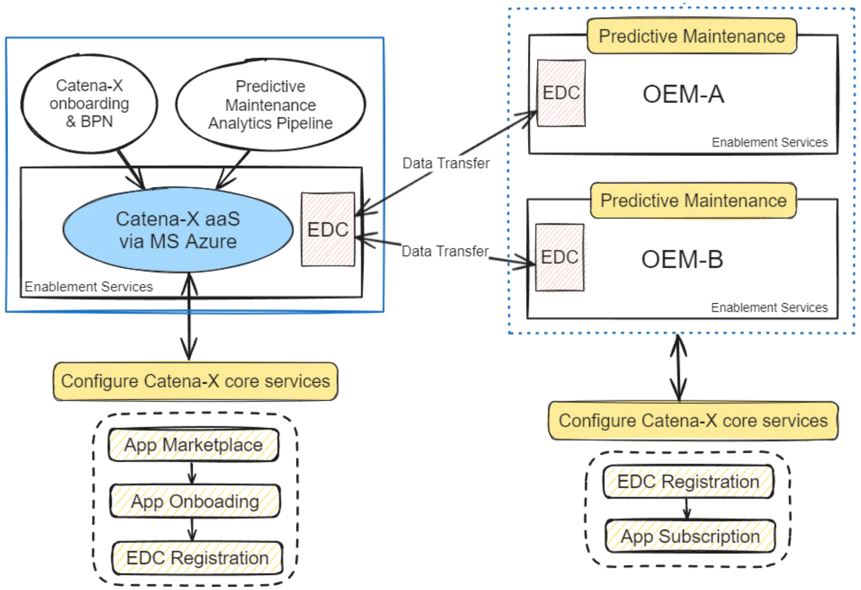


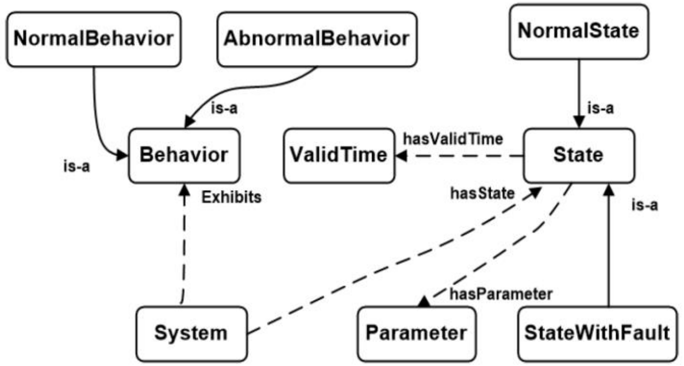
Fletcher, R. et. al, "The case for an end-to-end automotive-software platform," McKinsey & Company, January 16, 2020,

Data quality, fit for purpose

- Historical time-series data
  - Data for >=10 failed target systems* with the same failure mode
  - Data for >=10 healthy target systems
  - Time span >= 3 months
  - Voltage, temperature, state of charge

- Vehicle Metadata
  - Encrypted VIN identifier, Label
  - Label information for "healthy" and "faulty" annotation potentially derived from Diagnostic Trouble Codes (DTCs)
  - Part replacements, warranty claims, service stations
  - Optional data sources: Ambient conditions, manufacturing data

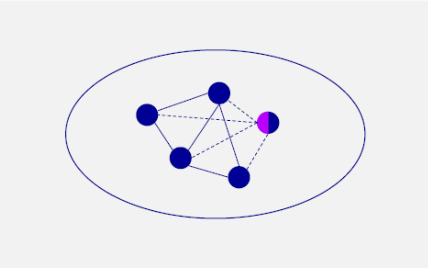




Source: Cao, Qiushi & Zanni-Merk, Cecilia & Reich, Christoph. Towards an Ontological Representation of Condition Monitoring Knowledge in the Manufacturing Domain, IC3K, 2018.

Semantically interlinked digital data out of several sources, systems and services. Machine readable ontologies allow for relating different sensors and lifecycle phases and for automated reasoning.

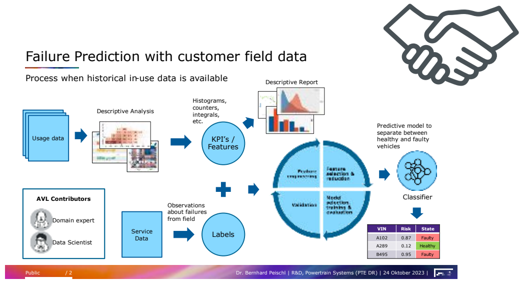
Closed Ecosystem



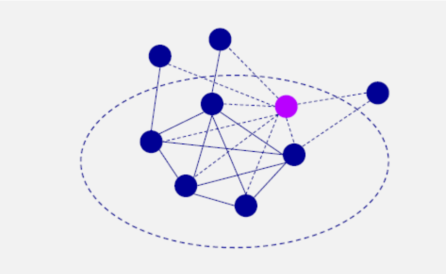
- OEM
  AVL

- Data and meta-data exchange between participants
- Sector-specific standards

Failure prediction with customer field data



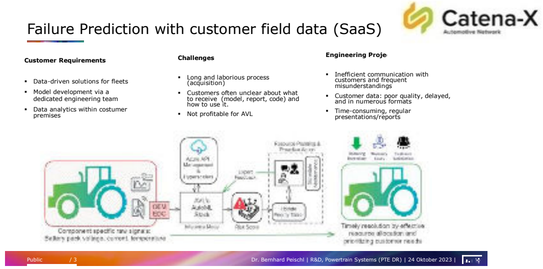
Open Ecosystem



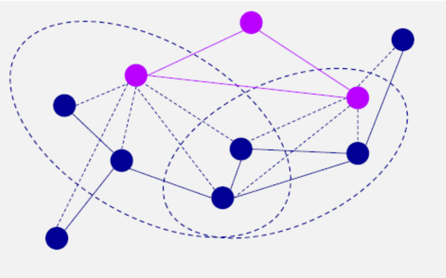
- OEM
  AVL
  Tier-x
- Catana-X

- Meta-data between participants and orchestrator
- Sector specific, open standards

Failure prediction (SaaS) using Auto-ML Stack



Federated Ecosystem



- OEM
  AVL
  Tier-x
- EPC
  Grid
  CPO
- Fleet
  City
  Map
  AVL
- Catana-X
  Mobility-DS
  Energy-DS

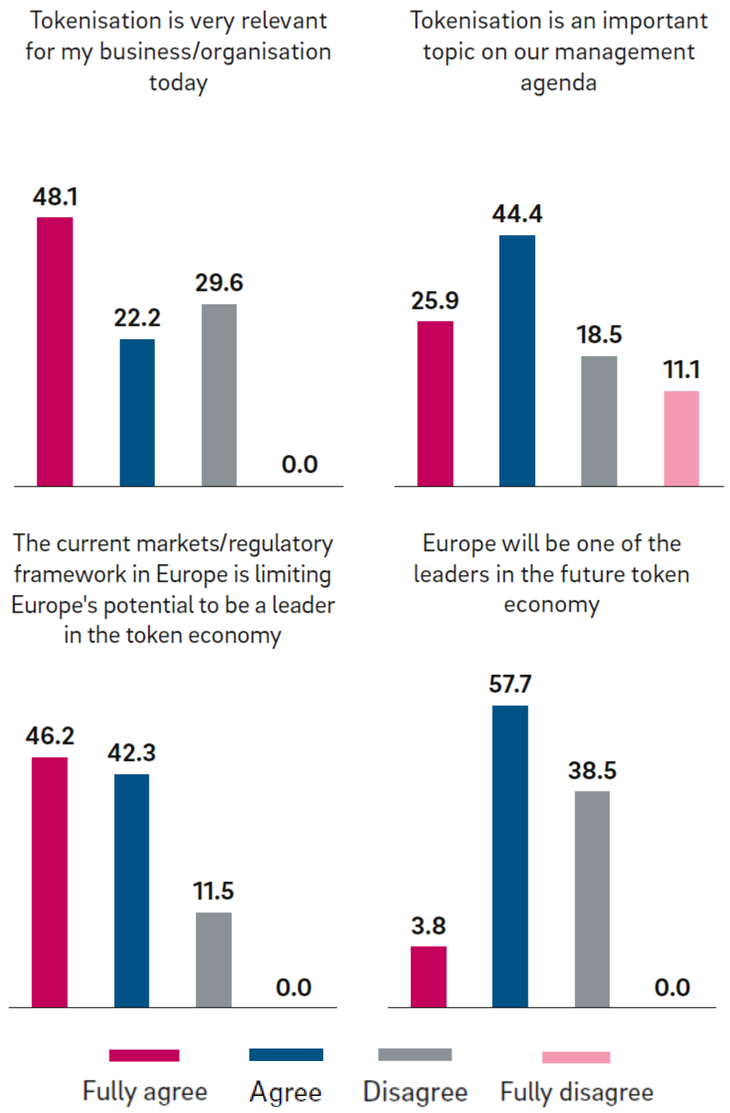
- Meta-data between orchestrators
- Cross-sector, open standards
- Mapping between sector-specific, open standards

Smart Charging
Adaptive Vehicle Controls (BEV, FCV)

Sources: Catena-X Automotive Network , Gaia-X Webinar on Data Spaces, Mobility Data Space, Energy Data Space: Enershare, EnDaSpace.

Tokenized digital assets & autonomous economic agents

- Asset representation and rights in digital form
  - Asset in digital form
    - CBDC, Securities, Stablecoins
    - Digital Twin, Machine IDs (tangible physical assets)
  - Assignable digital rights
  - Programmable and automated
  - Administration, possession and sharing of information (models, data)
  - Identification of attributes for persons (self-sovereign identity) and objects (machine IDs)
  - Cryptographic method, distributed ledger technology
  - Autonomous economic agents
- Tokenization in European verticals
  - Underestimation of the importance of the technology
  - Lack of broader understanding of DLTs among decision makers
  - Diffuse and unclear legal regulatory framework

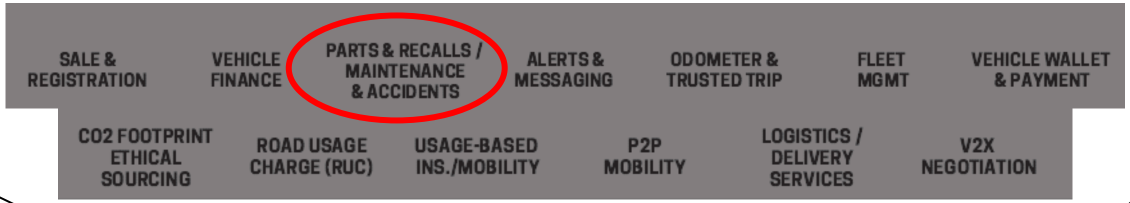


Source: Should Europe Develop Into a Token Economy; Tokenize Europe 2025; Roland Berger GmbH., 2024.

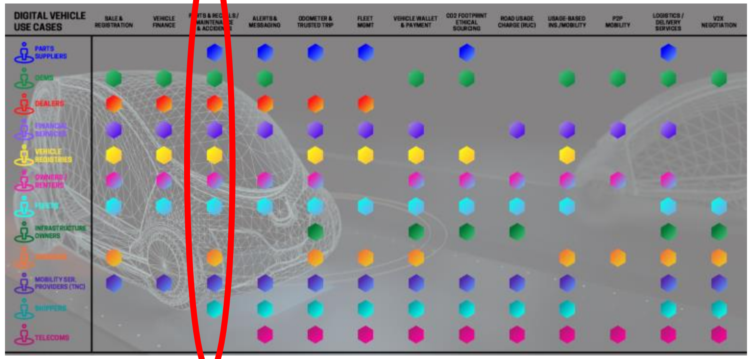
Tokenized digital assets & autonomous economic agents

- Tokenization underpins the very foundations of Industry 4.0
  - Strengthen data sovereignty
  - Enables the fast, secure and automated execution of business process
    - Digital identities: lower transaction costs, higher data availability
  - Digitalization of production and supply chains (connectivity, digital twins)
  - Merge supply chains, production, mobility, finance and logistics into a seamless process
  - Smart contracts enable fractionalized settlement and transfer
  - Spill-over effects for upcoming business models

Use Case



Stakeholder



Source: MOBI VID Standard, Blockchain for Vehicle Identity Business Whitepaper, 2021.

AVL

Failure Prediction with customer field data (SaaS)

Customer Requirements

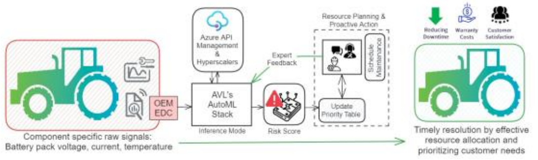
- Data-driven solutions for fleets
- Model development via a dedicated engineering team
- Data analytics within costumer premises

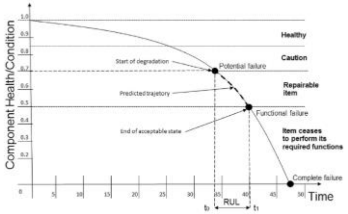
Challenges

- Long and laborious process (acquisition)
- Customers often unclear about what to receive (model, report, code) and how to use it.
- Not profitable for AVL

Engineering Projects -> SaaS

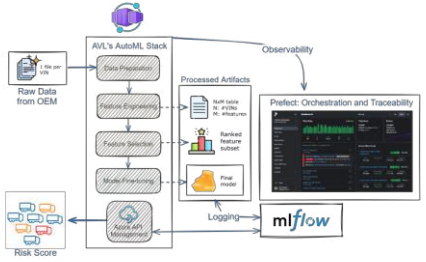
- Inefficient communication with customers and frequent misunderstandings
- Customer data: poor quality, delayed, and in numerous formats
- Time-consuming, regular presentations/reports

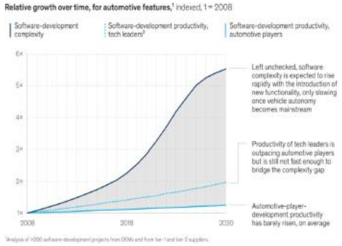




Robust & trustworthy AI

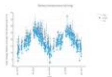
- Black-Box models
  - Degree of explicability (ML, reasoning)
  - Safe and static specifications vs. unknown specifications
- Nature of the AI component (AI model, algorithm, operations, system)
  - Exact guarantees on AI models
  - Approximate guarantees of AI-Ops
  - Assured guarantees of AI critical decision support
  - Textualized guarantees of human critical decision support
- Operational Design Domains (ODD)
  - Verification and Validation methodology wrt. to robustness and dependability
  - Limitation of the operating context for an automated system
  - ODDs to specify where the AI system operates safely



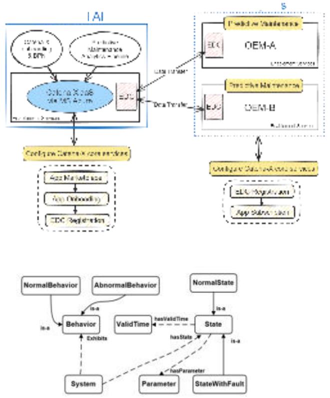


Data quality, fit for purpose

- Historical time-series data
  - Data for >=10 failed target systems* with the same failure mode
  - Data for >=10 healthy target systems
  - Time span >= 3 months
  - Voltage, temperature, state of charge



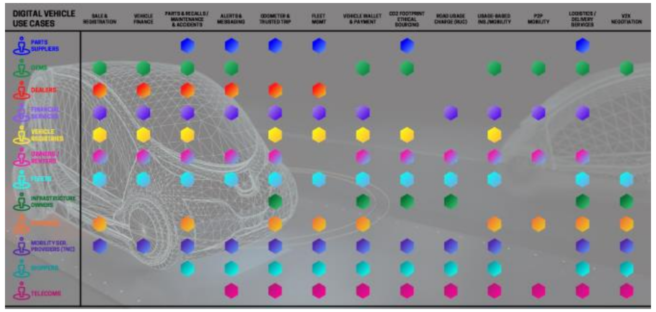
- Vehicle Metadata
  - Encrypted VIN identifier, Label
  - Label information for "healthy" and "faulty" annotation potentially derived from Diagnostic Trouble Codes (DTCs)
  - Part replacements, warranty claims, service stations
  - Optional data sources: Ambient conditions, manufacturing data



Semantically interlinked digital data out of several sources, systems and services. Machine readable ontologies allow for relating different sensors and lifecycle phases and for formal reasoning.

Tokenized digital assets & autonomous economic agents

- Tokenization underpins the very foundations of Industry 4.0
  - Strengthen sovereignty
  - Enables the fast, secure and automated execution of business process
    - Digital identities: lower transaction costs, higher data availability
  - Digitalization of production and supply chains (connectivity, digital twins)
  - Merge supply chains, production, trade, finance and logistics into a seamless process
  - Smart contracts enable fractionalized settlement and transfer
  - Spill-over effects upcoming business models



Public

The work presented herein has been partially supported by SM4RTENANCE and PLIADES project. SM4RTENANCE has received funding from Digital Europe Programme; PLIADES has received funding from Horizon Europe Programme.

AVL

Industrial Use Cases Drive Data Space Adoption

Dr. Bernhard Peischl

Technology Talks Austria, 13/09/2024, mumok Lounge, Vienna