# Migration towards AutomationML based Tool Chains

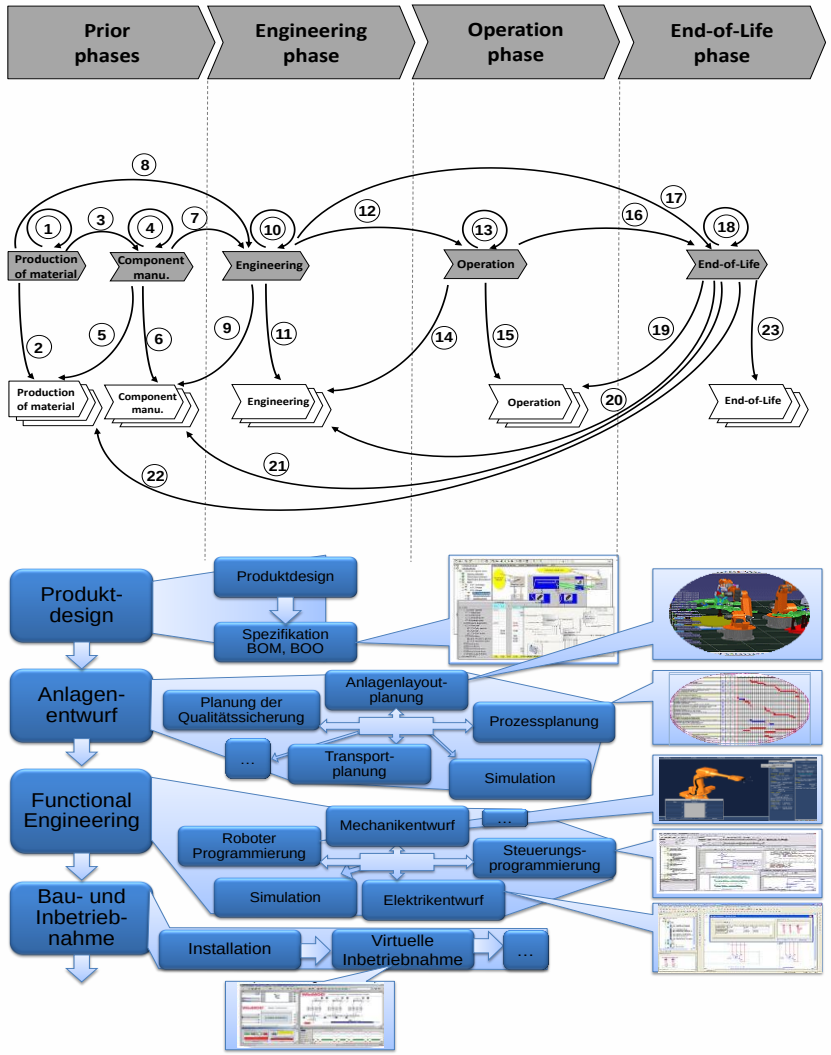
## How to incrementally overcome challenges within engineering networks

**Arndt Lüder**, Johanna-Lisa Pauly, Konstantin Kirchheim
Otto-von-Guericke University Magdeburg

Stefan Biffl, Felix Rinker
Technical University Vienna

# Problem

- Complex Structures of data generation and use along the production system life cycle
  - multidisciplinary approach
  - several engineers of several disciplines with several tools
  - complex data exchange networks including data reuse of other life cycles



# Network structures

Discipline A: Data source

*.xml
*.csv
*.pdf

Discipline B: Data source

*.xml
*.csv
*.pdf

Transport,
Transform,
Select, and
Combine Data

Discipline C: Data sink

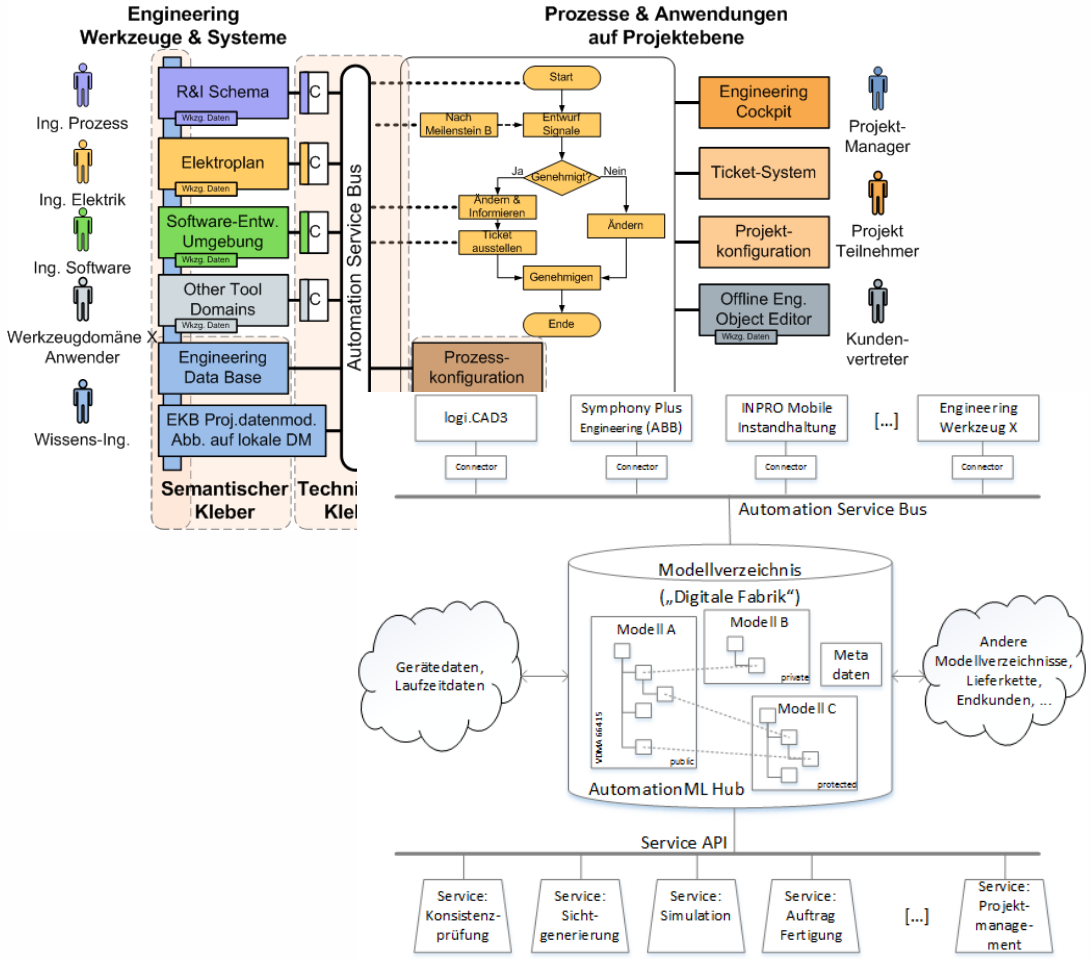
*.xml
*.csv
*.pdf

*.xml
*.csv
*.pdf

Discipline D: Data sink

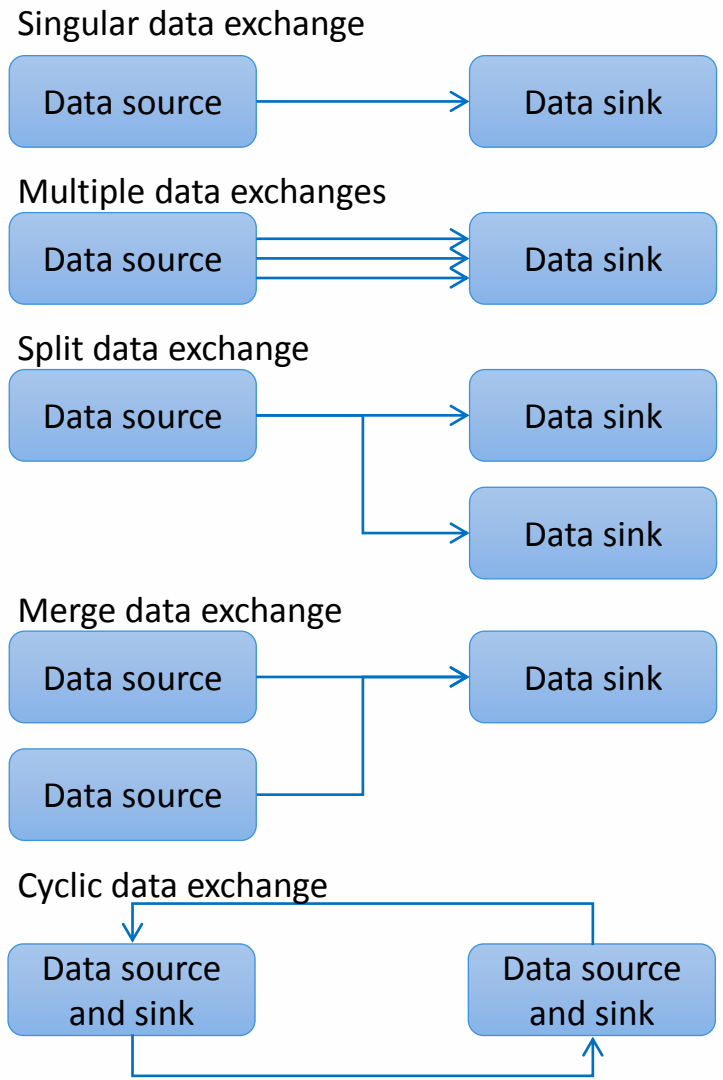
# Lessons learned

- Existing data exchange networks act document based exploiting file formats like *.pdf, *.xml, and *.csv
- A central data storage requires the configuration / design of a common data model spanning all involved discipline specific data structures
- Data integration is based on tool specific connectors
- Existing AutomationML profiles cover only parts of the overall game



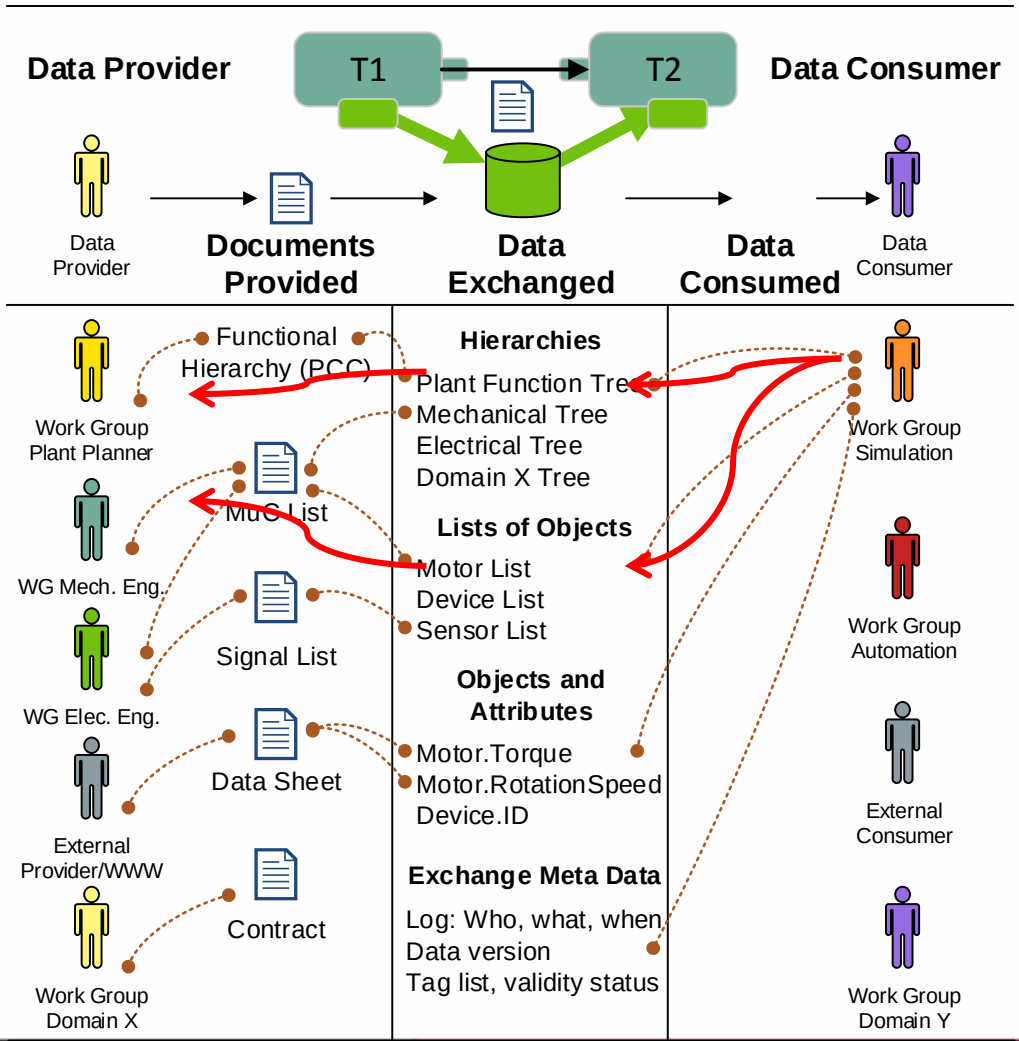
# Challenges

- Engineering habit – keep used tools, information models, and engineering methods unchanged
- Tool diversity – different, partially incompatible concepts and data structures of involved engineering tools, partially predefined AutomationML dialects
- Change management - exchange of intermediate results of different degree of maturity
- Completeness management - identify missed data
- Consistency management – ensure semantical correctness
- Extensibility / Migration - Stepwise reorganization of existing engineering data exchange structure without repetitive software redesign

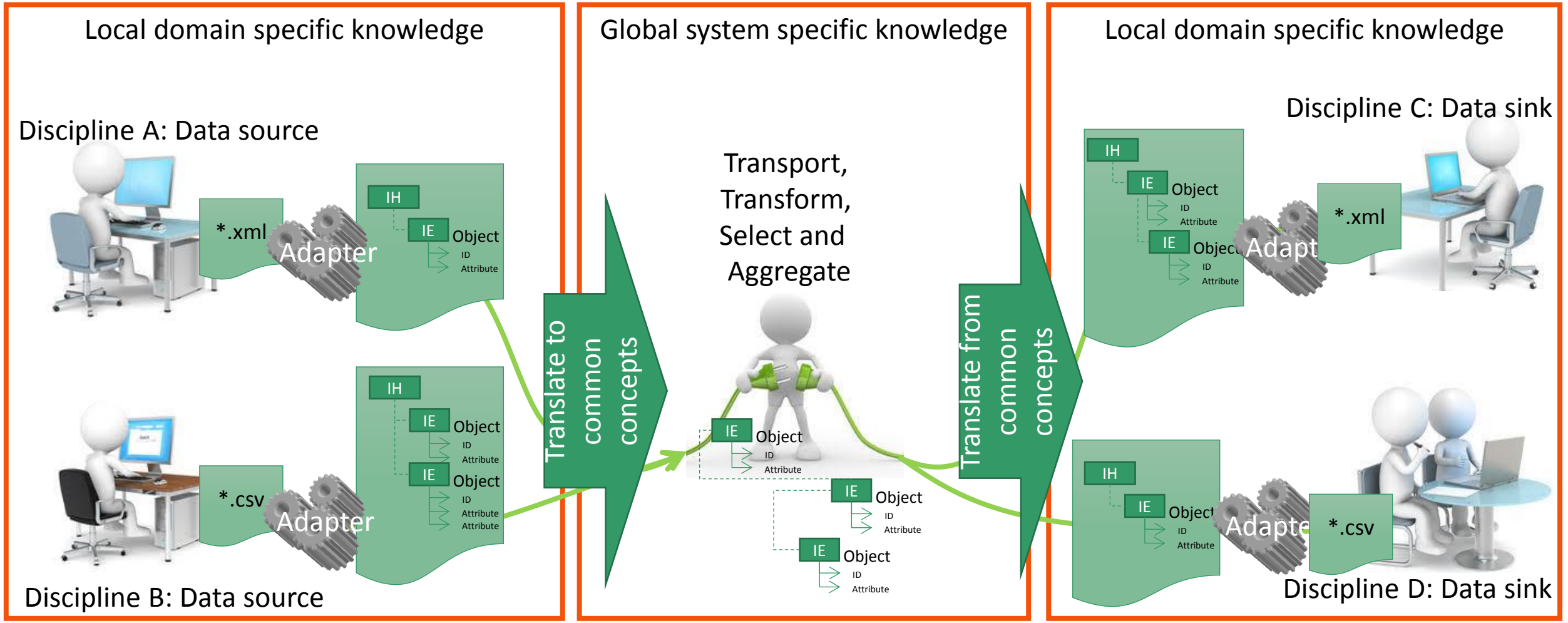


# Basic approach

- Data logistics
  - Replace the existing document based data exchange by information demand driven data exchange
    - Data consumers shall not be forced to collect required data out of a big data set
- Challenge
  - Identification of demands of data consumers related to the required information
  - Definition of technical data access paths to information
  - Efficient data extraction out of existing data source

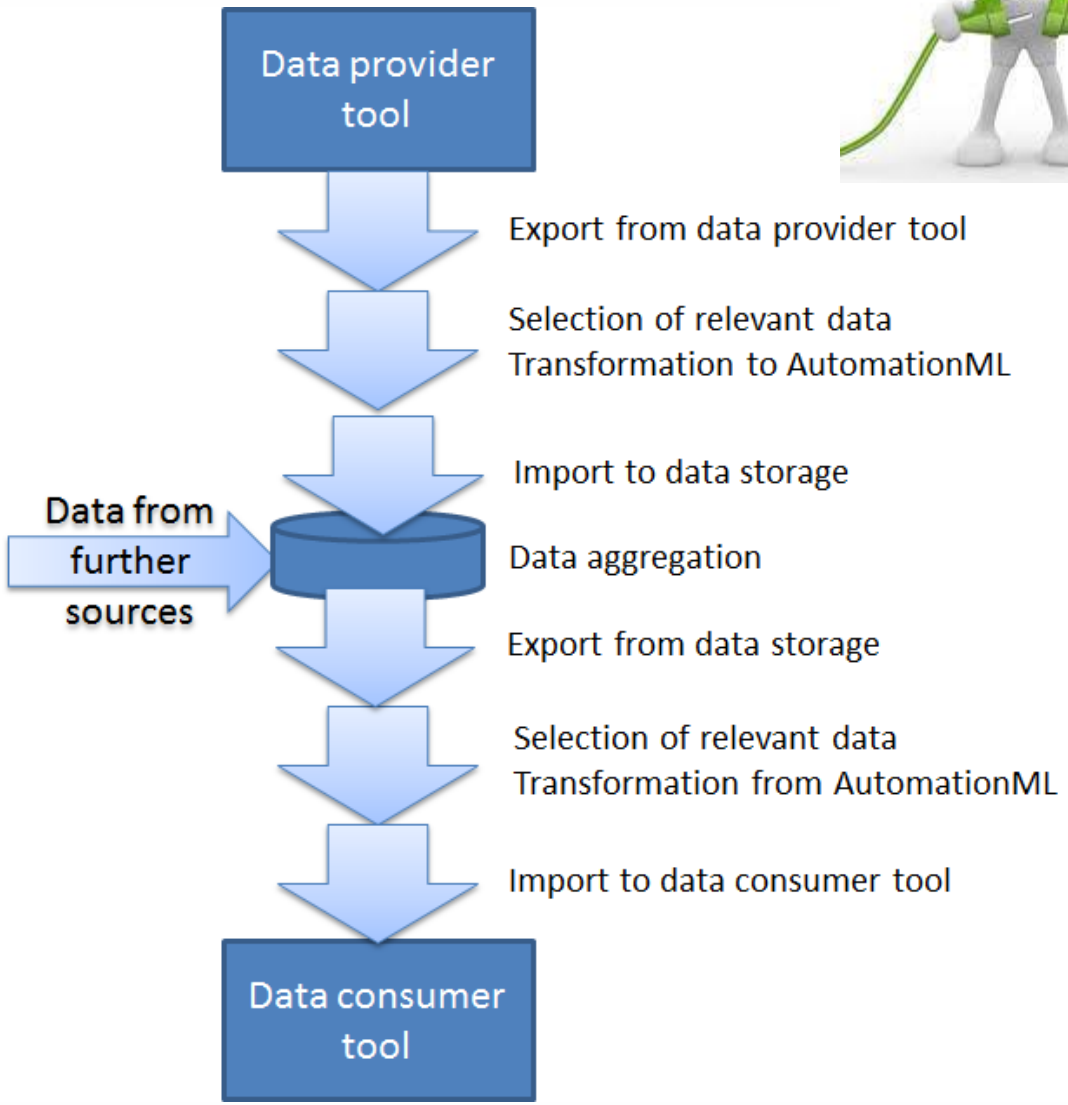


# Basic system architecture



# Necessary transformations

- Bordering conditions
  - NO changes within the used methodologies and tools of the different involved disciplines
  - Complete control of data by the involved engineers
  - Enable the discipline crossing understanding of engineering data
- Preconditions
  - Identification and description of discipline crossing common concepts
  - Each data exchange step can be validated at any time

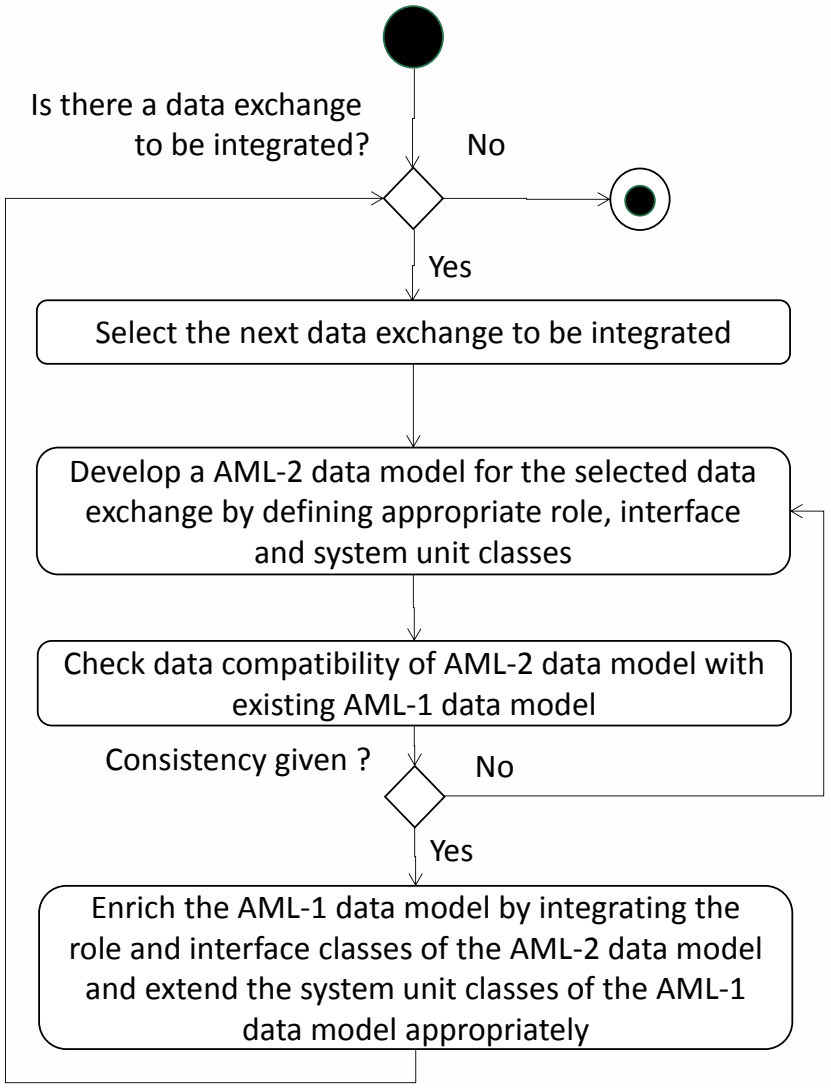


# Distinction of two types of AutomationML models

- AML-1 – common data model used in the background
  - Modelling of production system engineering data within data logistics
  - Mapping of *ALL RELEVANT* properties and concepts of the complete engineering process
  - Not visible for users
- AML-2 – interface models for involved partners
  - View (discipline) and thereby user role related
  - Mapping of relevant concepts and properties of the considered discipline
  - Consideration of  existing AutomationML dialacts
  - Visible for users

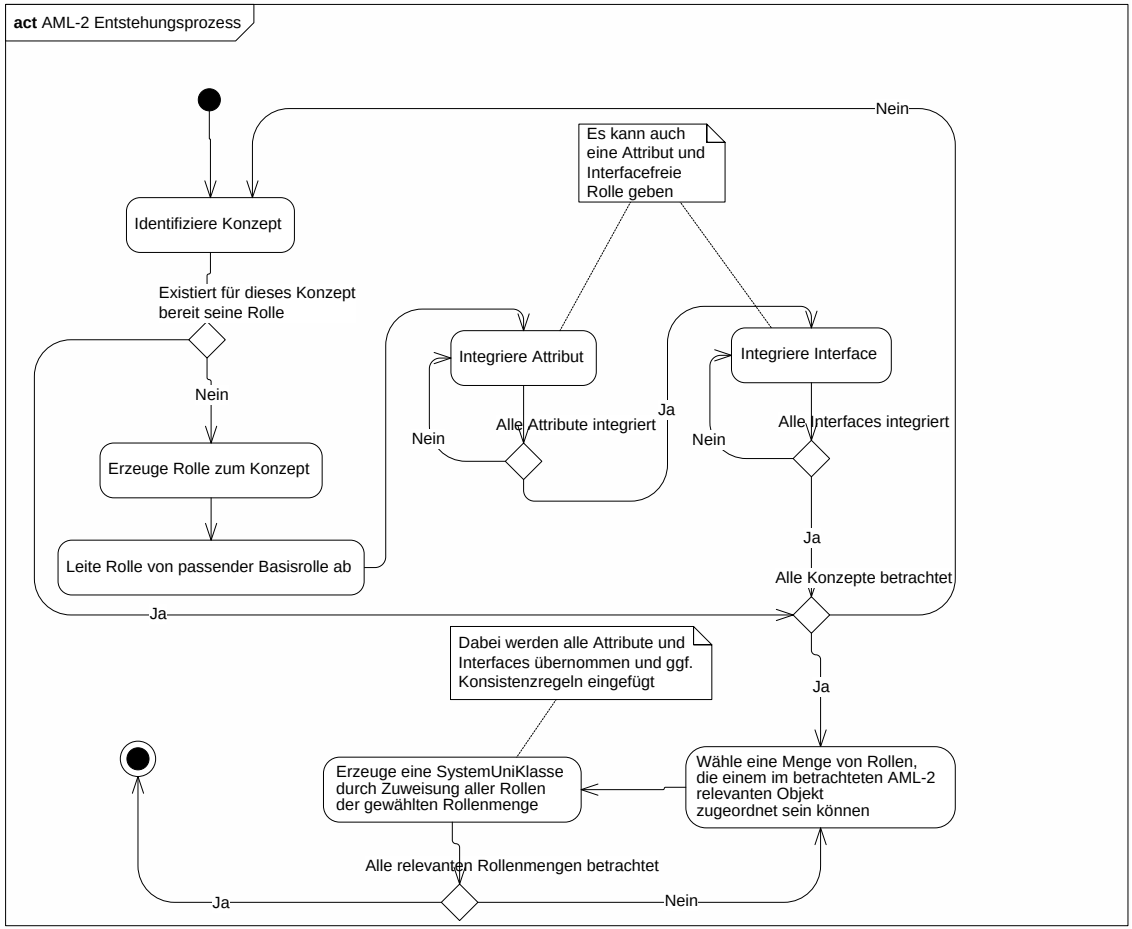
# Stepwise design process of AutomationML models

- For each tool acting as data source and/or data sink
  - Develop an AML-2 data model based on the main concepts of the related tool
  - Integration of AML-2 model in the common AML-1 data model by concept mapping



# AML-2 Models – Interface models for involved partners

- Direct translation of domain specific views to AutomationML models
- Based on
  - Identification of relevant concepts and their properties and relations within one discipline
  - Translation to role and interface classes and their application in system unit classes as templates for transformation

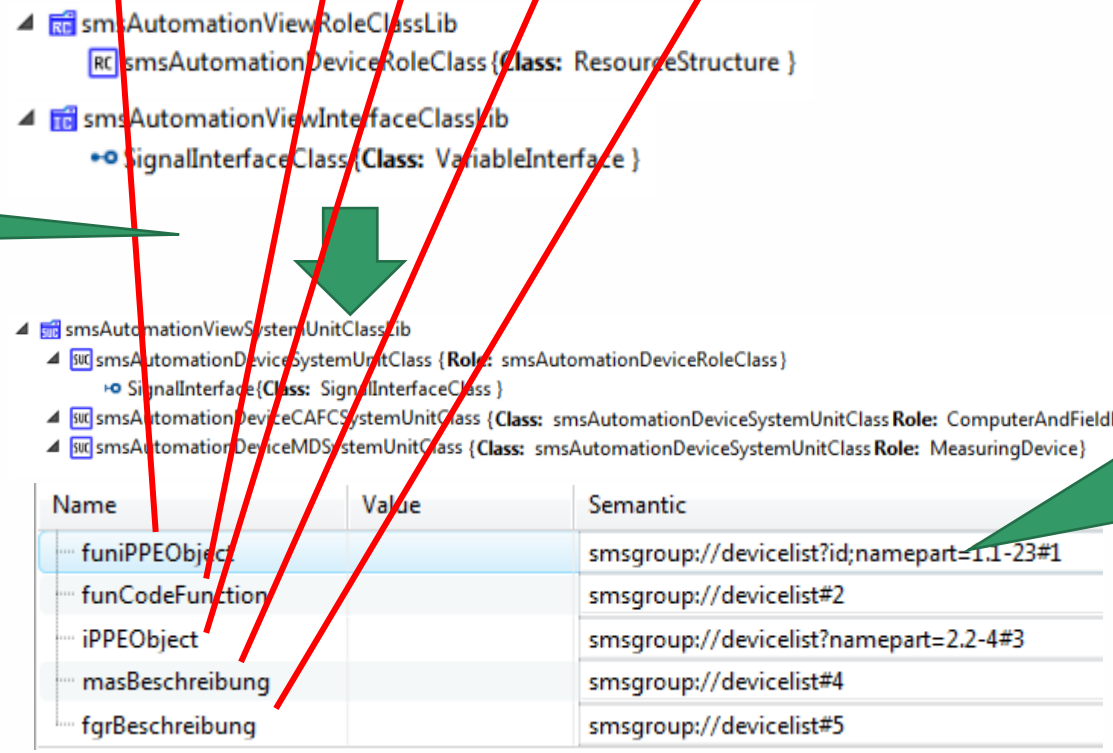


# AML-2 Models – Interface models for involved partners

Concept identification and modelling

Reference source and sink data structure

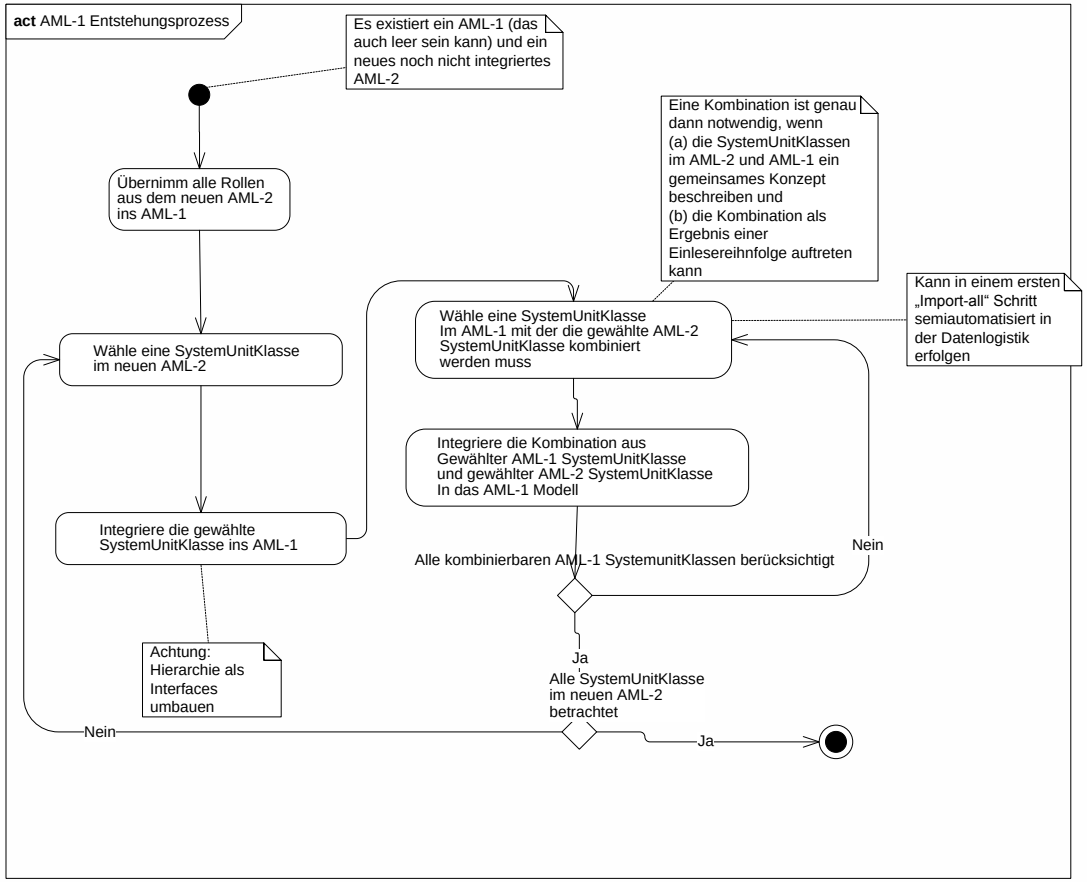
| FUN_iPPE-Objekt | FUN_Code Funktion | iPPE-Objekt | MAS_Beschreibung | FGR_Beschreibung |
|---|---|---|---|---|
| A01130_580_K_13_BE010_M | M | M001 | Drivecontroler | Drivechain |
| A01130_580_K_13_BE010_S | S | S001 | Sensor | Drivechain |
| A01130_580_K_13_BE020_M | M | M002 | Drivecontroler | Drivechain |
| A01130_580_K_13_BE020_S | S | S002 | Sensor | Drivechain |



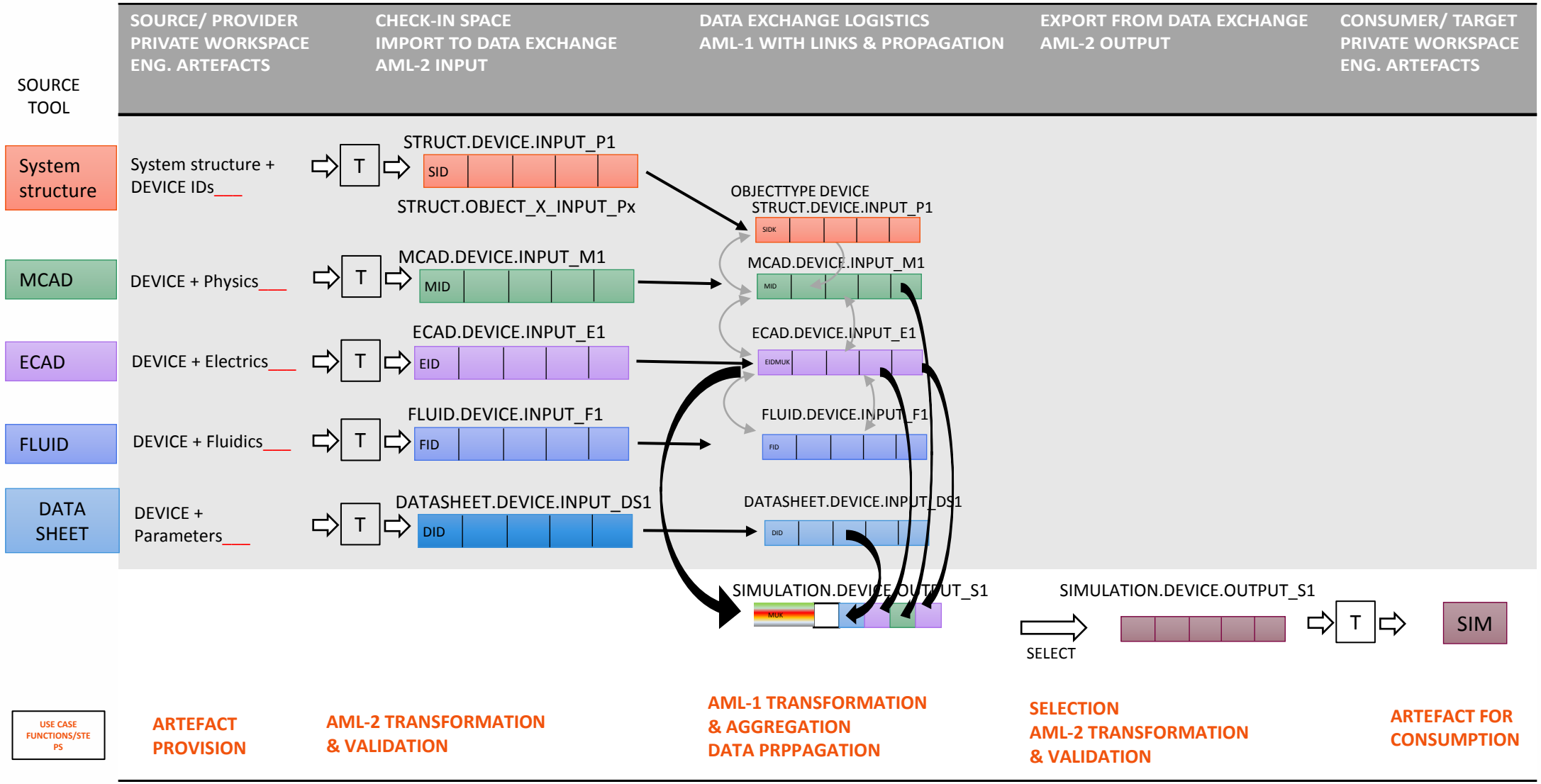

Enable stepwise extension of exchanged data by simple configuration of adapter models

# AML-1 data model as common data model

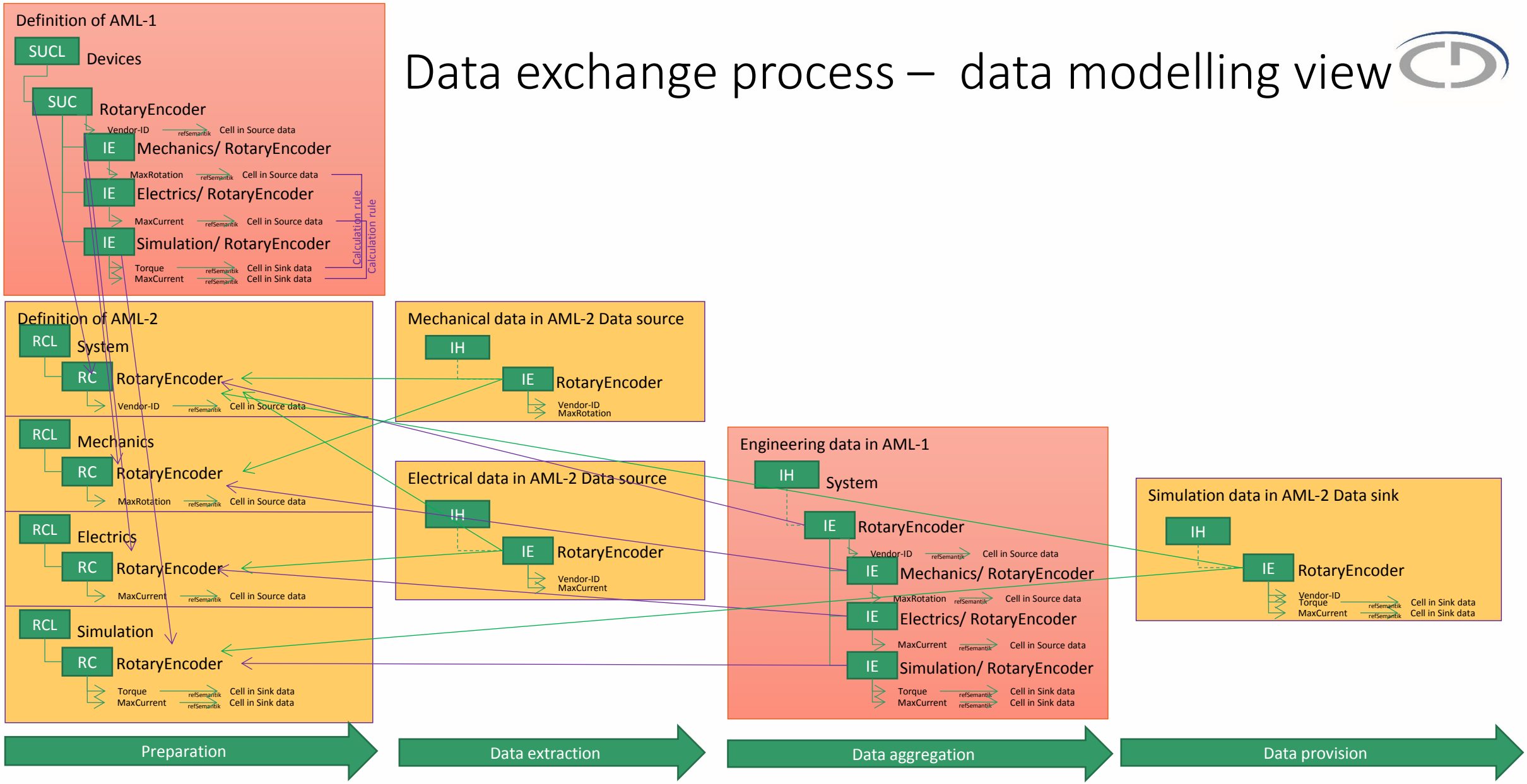
- Integration of different discipline specific views in one AutomationML Model
- Based on
  - Identification of relevant common concepts with relevant properties and relations by integrating AML RoleClasses and InterfaceClasses
  - Design SystemUnitClasses as data ingeration templates



# Data exchange process – Data flow view

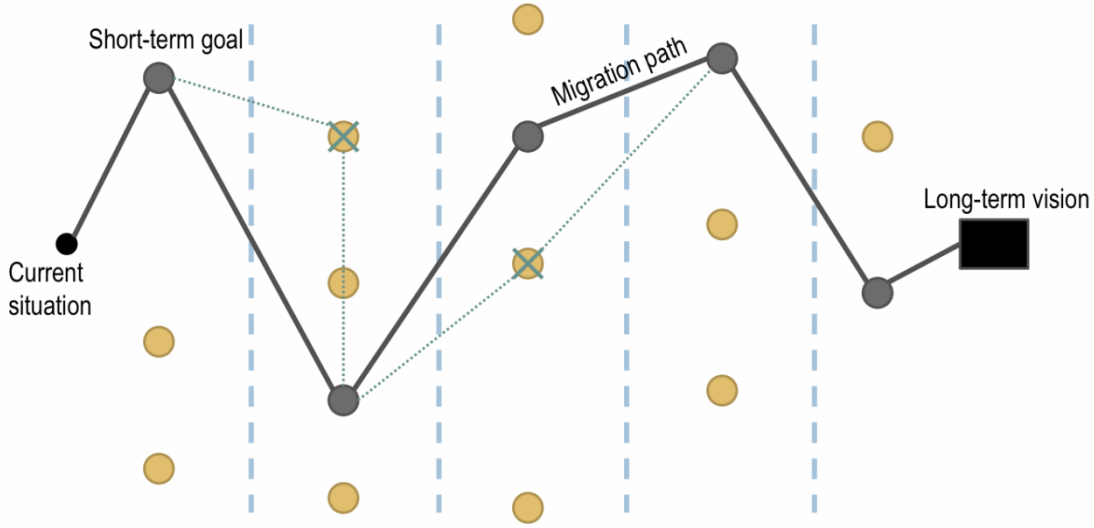


# Data exchange process – data modelling view



# Migration process

- clear distinction between long-term vision of the migration process, i.e. its improvement, and the short-term goals covering possible improvement steps
- Stepwise process of identification and realisation of best short term goal
  - Options investigation phase collects different migration solutions like integration of new tool or new management function
  - Design phase details selected solution option and tests feasibility
  - Implementation phase is realizing designed solution
  - Deployment phase validates improved engineering data logistics



# Reached results

- Definition of a general **architecture for the data logistics**
  - Transformation and data management components with relevant behavior
  - Sketch migration path *towards an* **AutomationML based information logistics**
  - Consideration of discipline specific data models (AML-2) and discipline crossing data models (AML-1) to ensure **maximal utilization of expert knowledge**
  - Ensure minimal impact on engineering habits in parallel with increase of utilization of benefits related to **data validation, data consistency, and data completeness**
- **Prototypical implementation of transformations**
  - Realization of **Data transformation to AML-2** for excel lists
    Realization of **Data transformation and integration in AML-1**
- Prove of concepts of **Basic architecture** was successful!

# Thanks for your interest