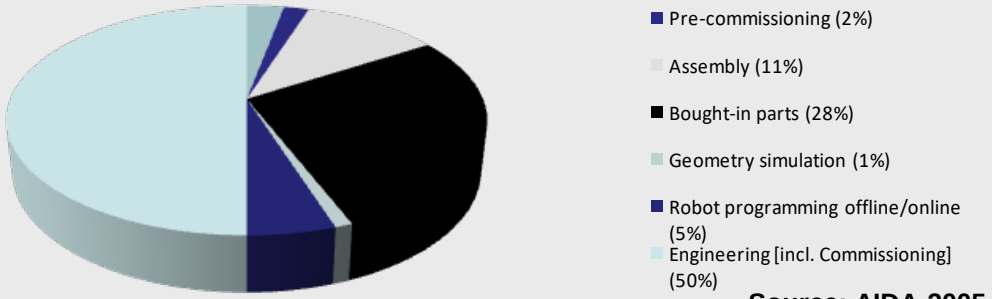
<AutomationML/>

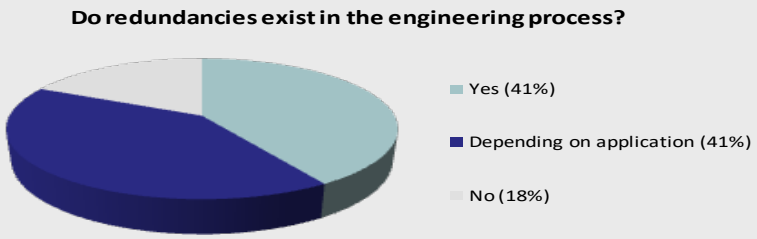
The Glue for Seamless Automation Engineering

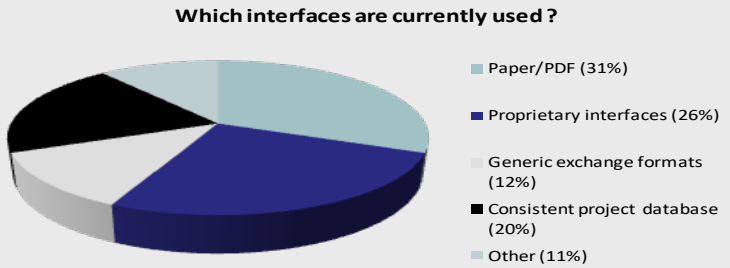
Starting points

- **A significant cost factor of industrial production systems is the engineering process.**
- **A survey revealed:**
  - That 82% of the interviewed experts say that redundancy on planning steps exits.
  - That the pdf/paper interface is the most widespread interface with 31%.
  - That only 12% of the interviewed experts use standardized interfaces.

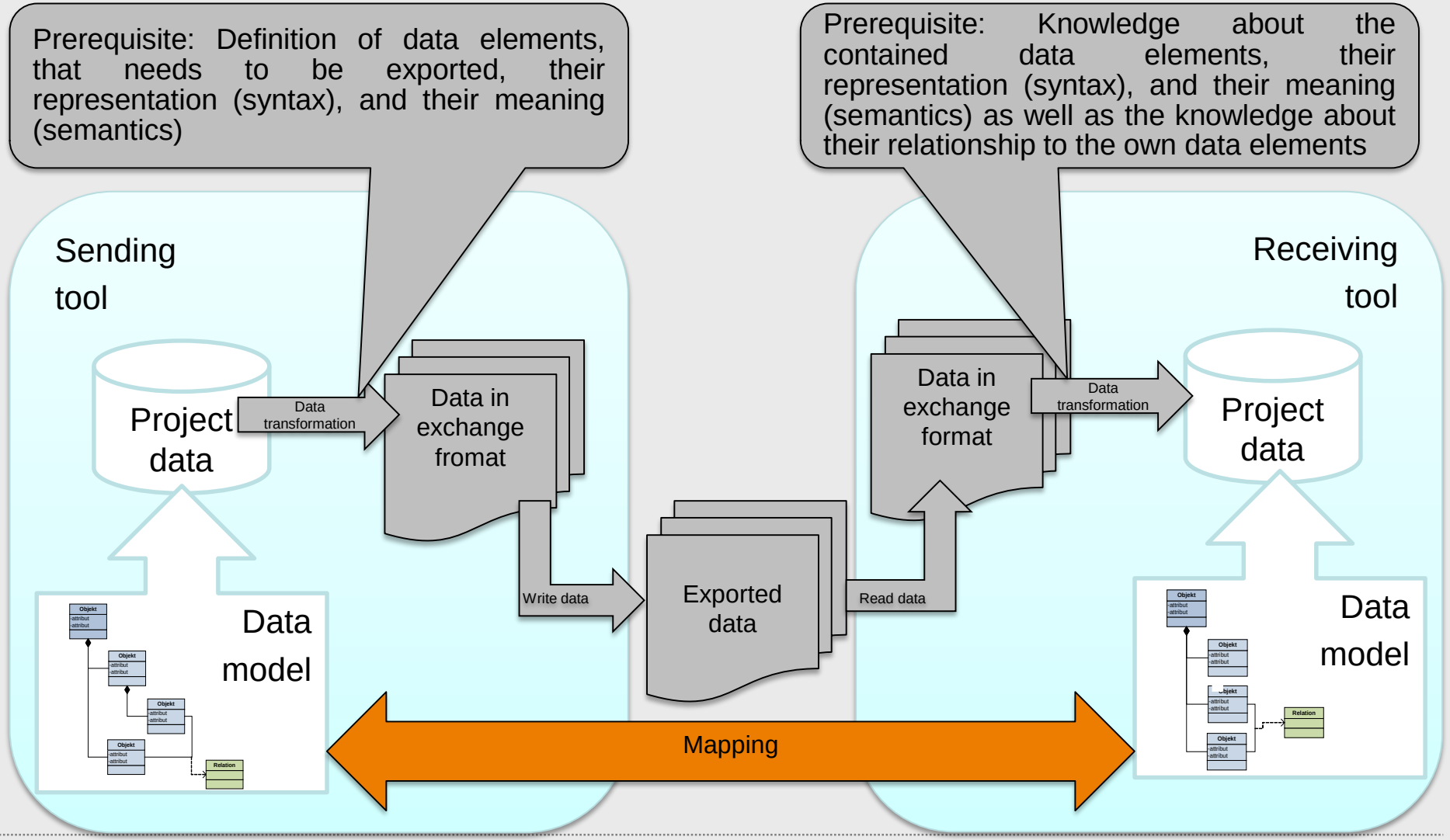


Source: AIDA 2005

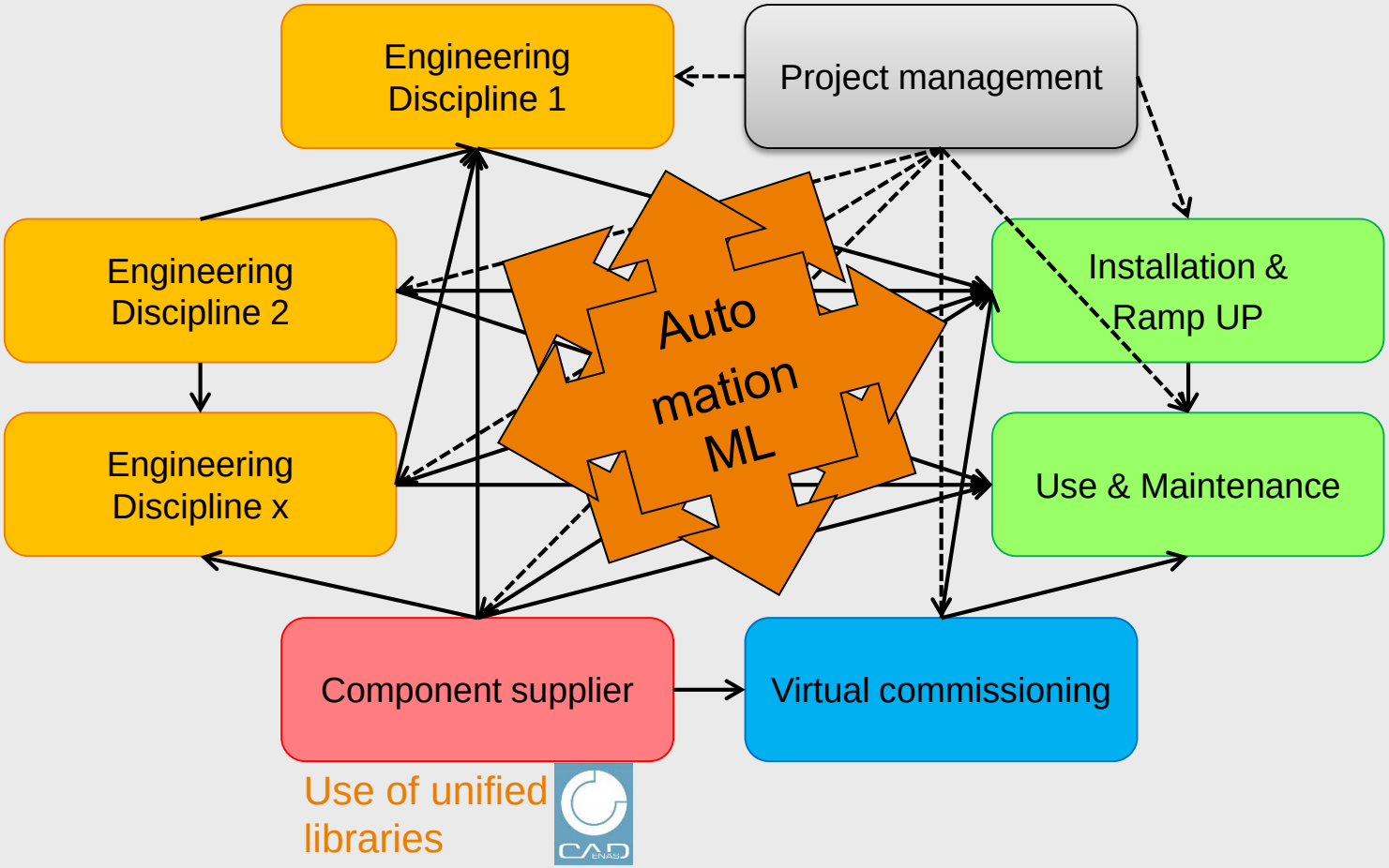




Data exchange problem

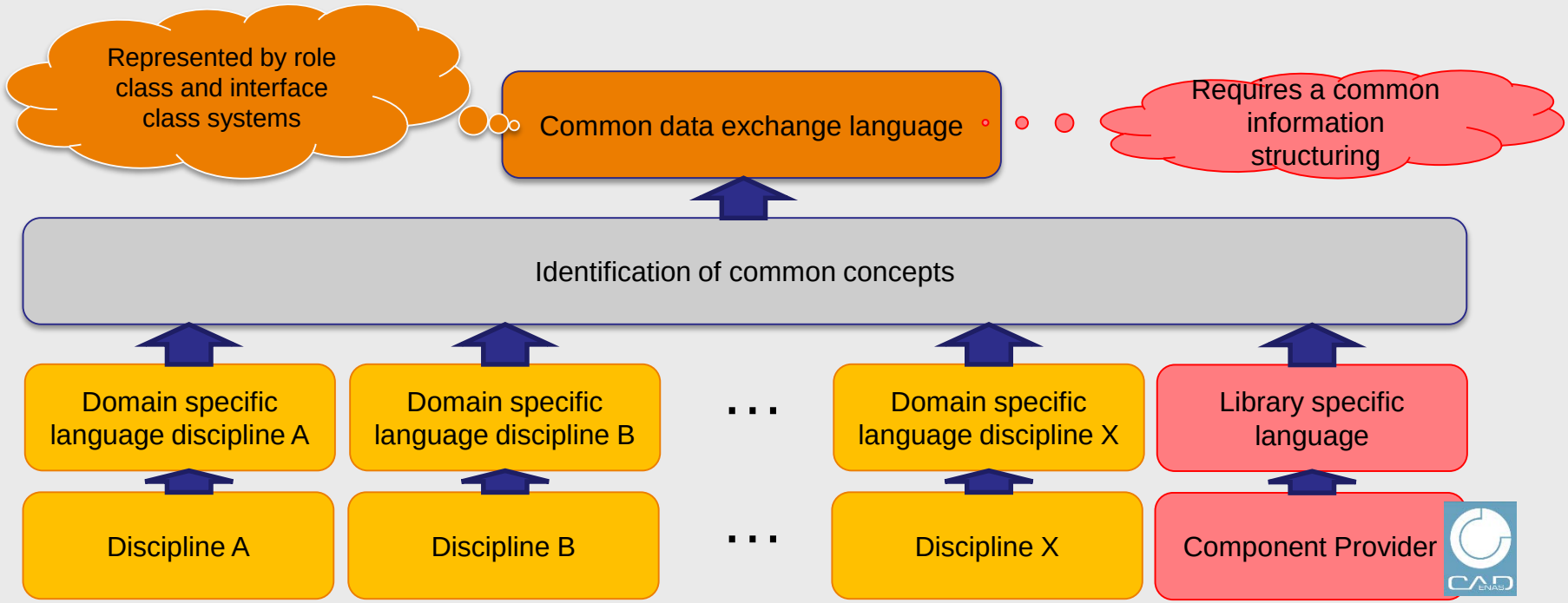


Objectives of AutomationML

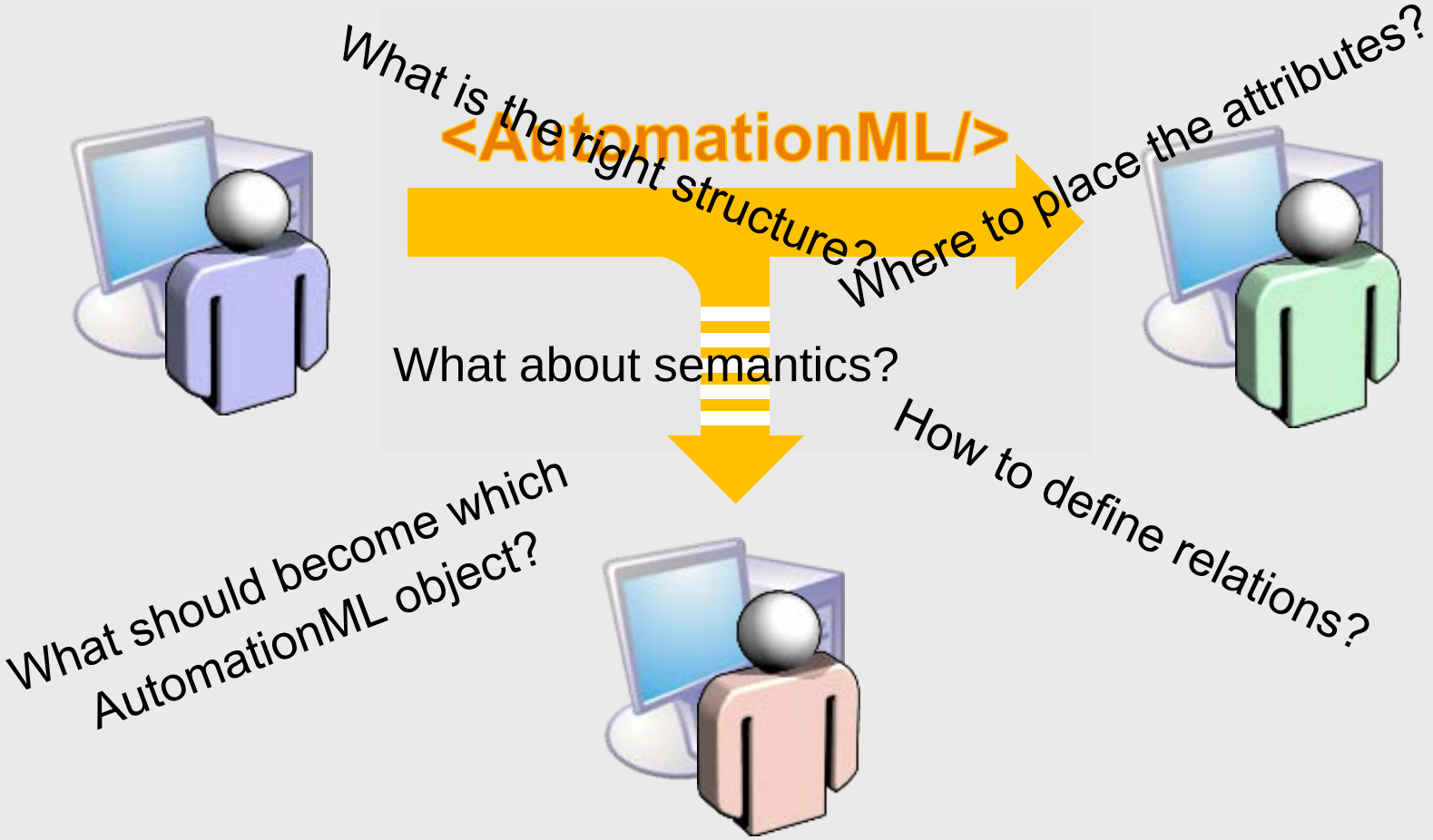


Objectives of AutomationML

- **Ensure a common understanding of exchanged data**
  - ➔ Explicit common semantics for all data to be exchanged

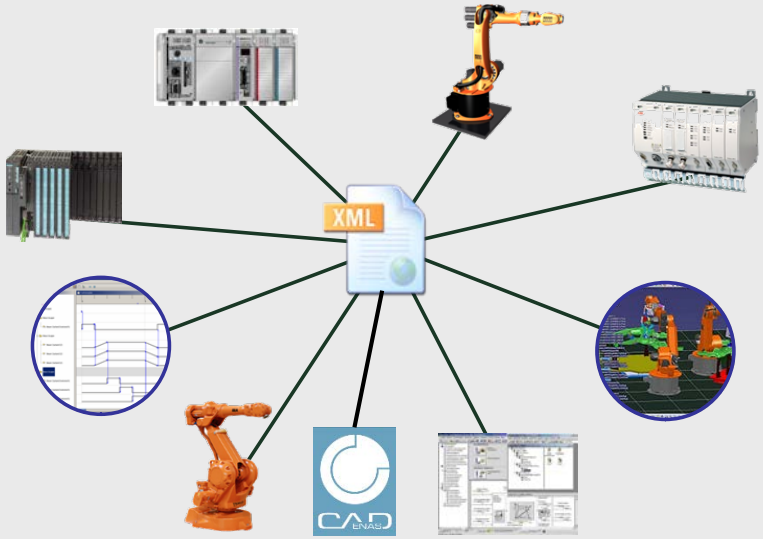


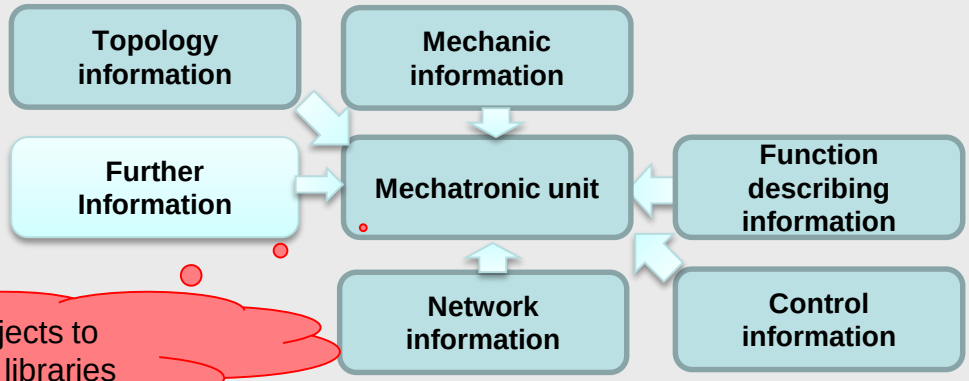
Objectives of AutomationML



Objectives of AutomationML

- AutomationML allows a consistent data exchange among and across different tool chains.
- AutomationML is an XML based human readable data format.
- It is an international standard and free of charge.
- It allows the integration of the world of tools into the digital factory of the future.
- Covers the information sets:

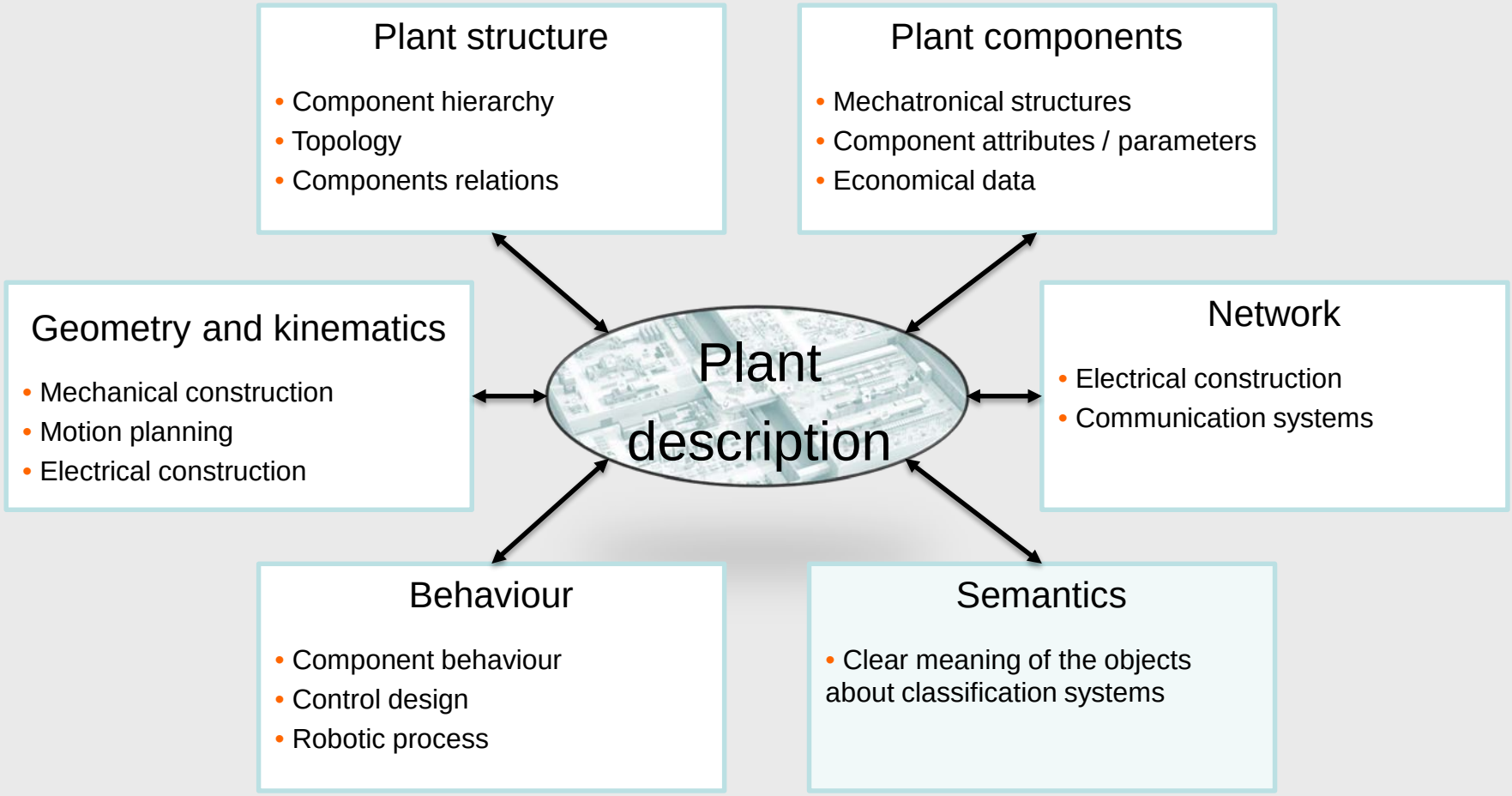




Ranging from simple objects to complex ones storable in libraries

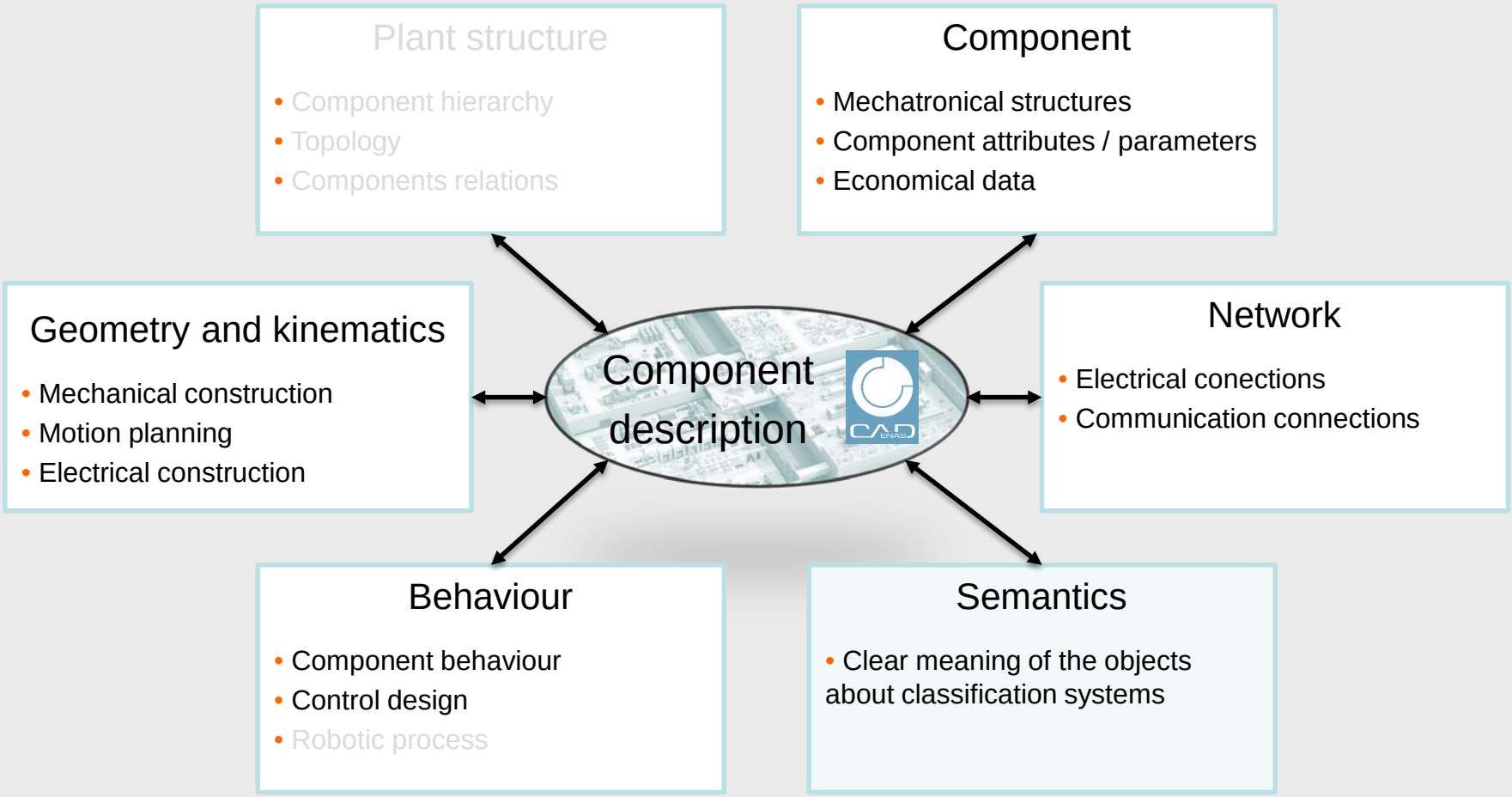
Objectives of AutomationML

- **Which data contents are covered by AutomationML?**



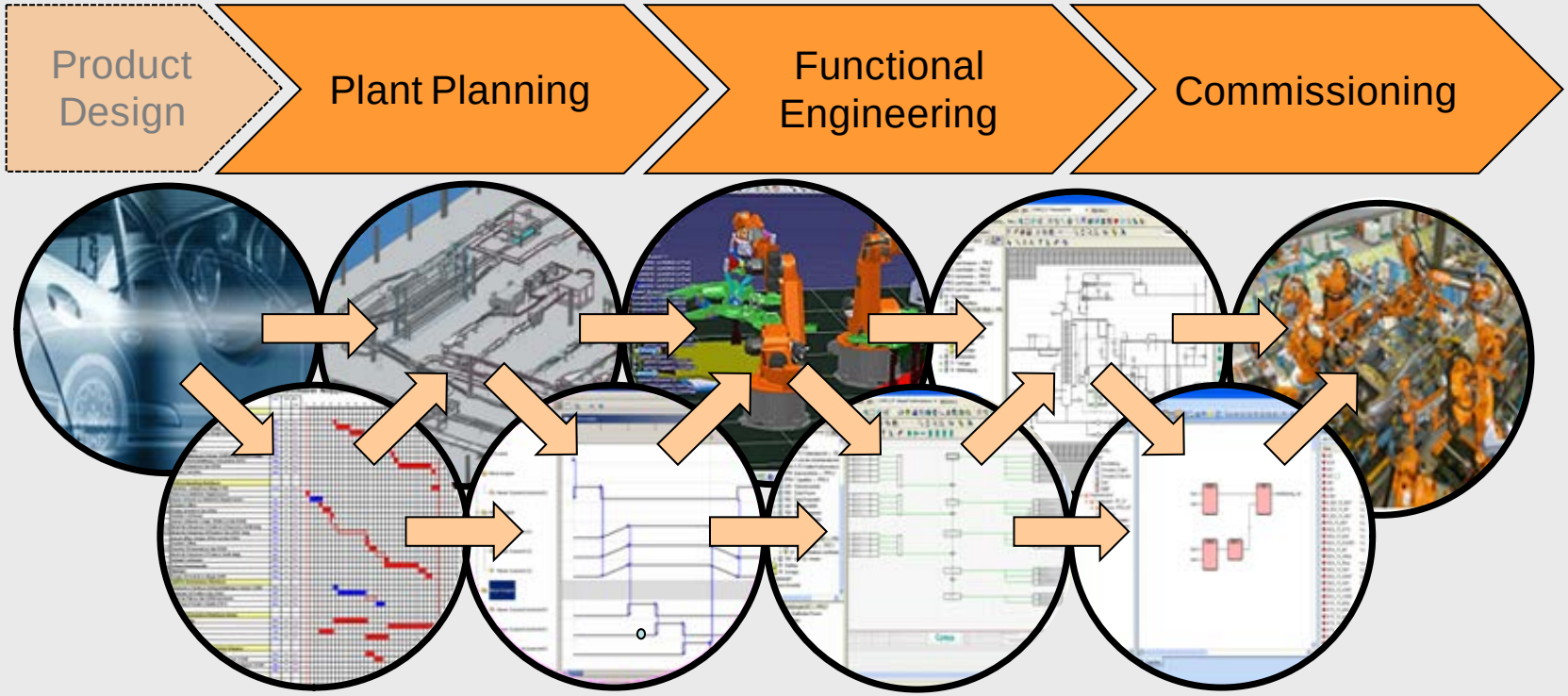
Objectives of AutomationML

- **Which component related data contents are covered?**



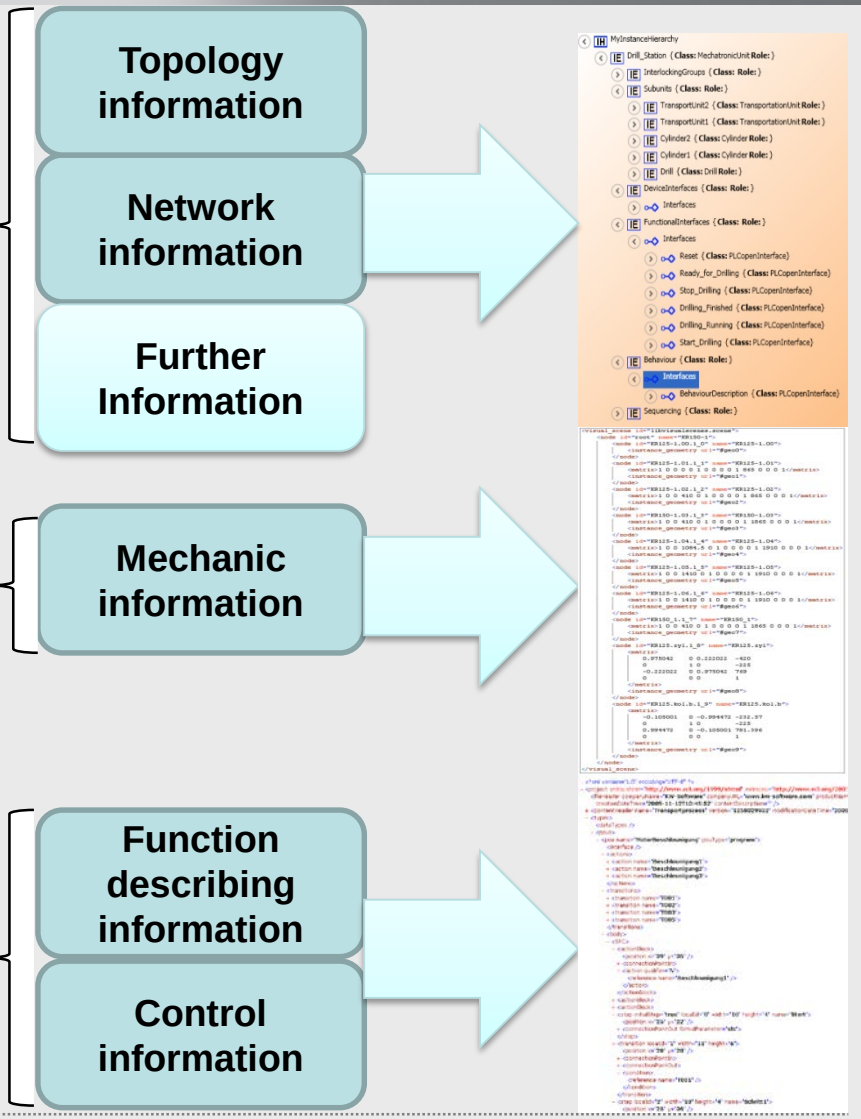
Objectives of AutomationML

- **Where can AutomationML be used?**

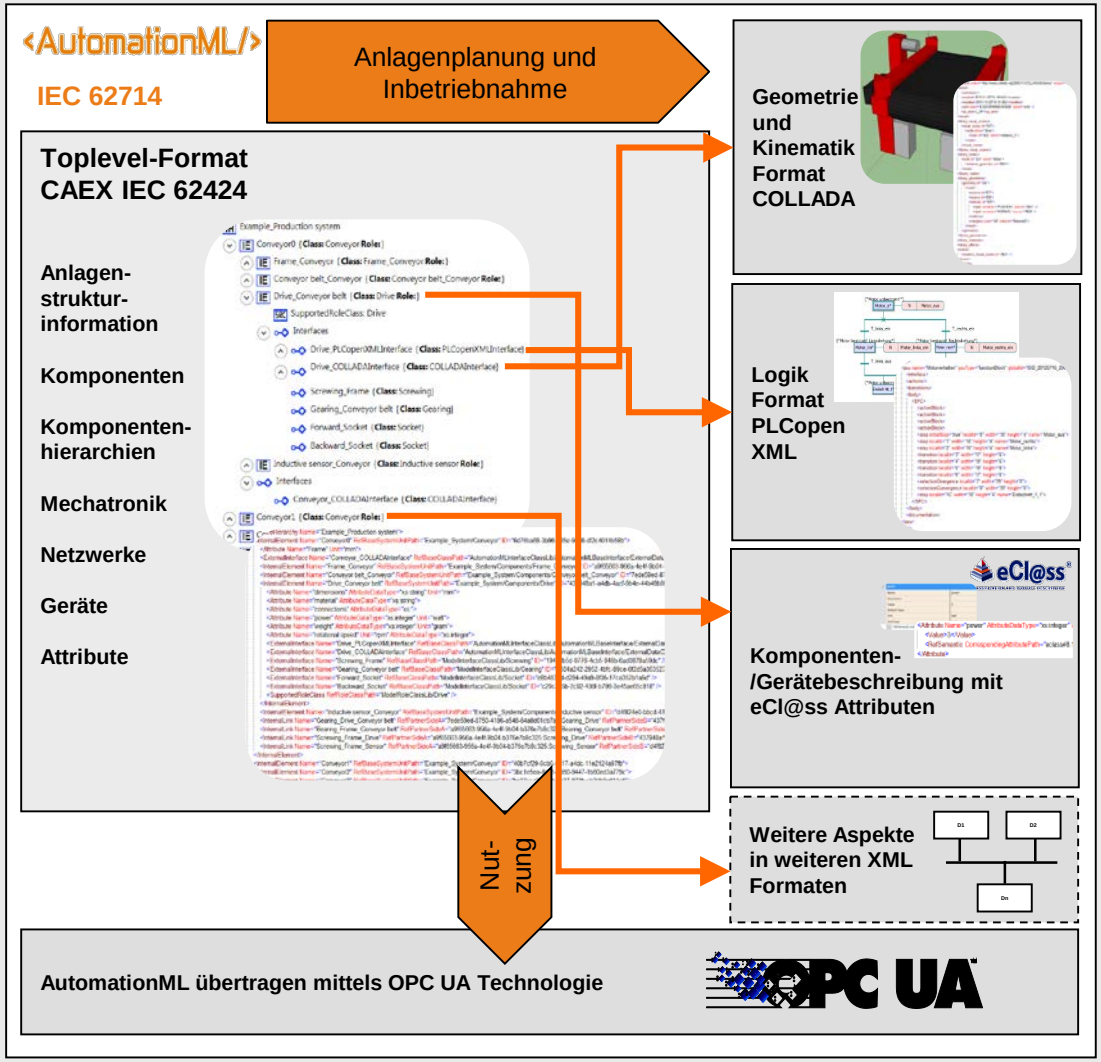


The AutomationML – architecture

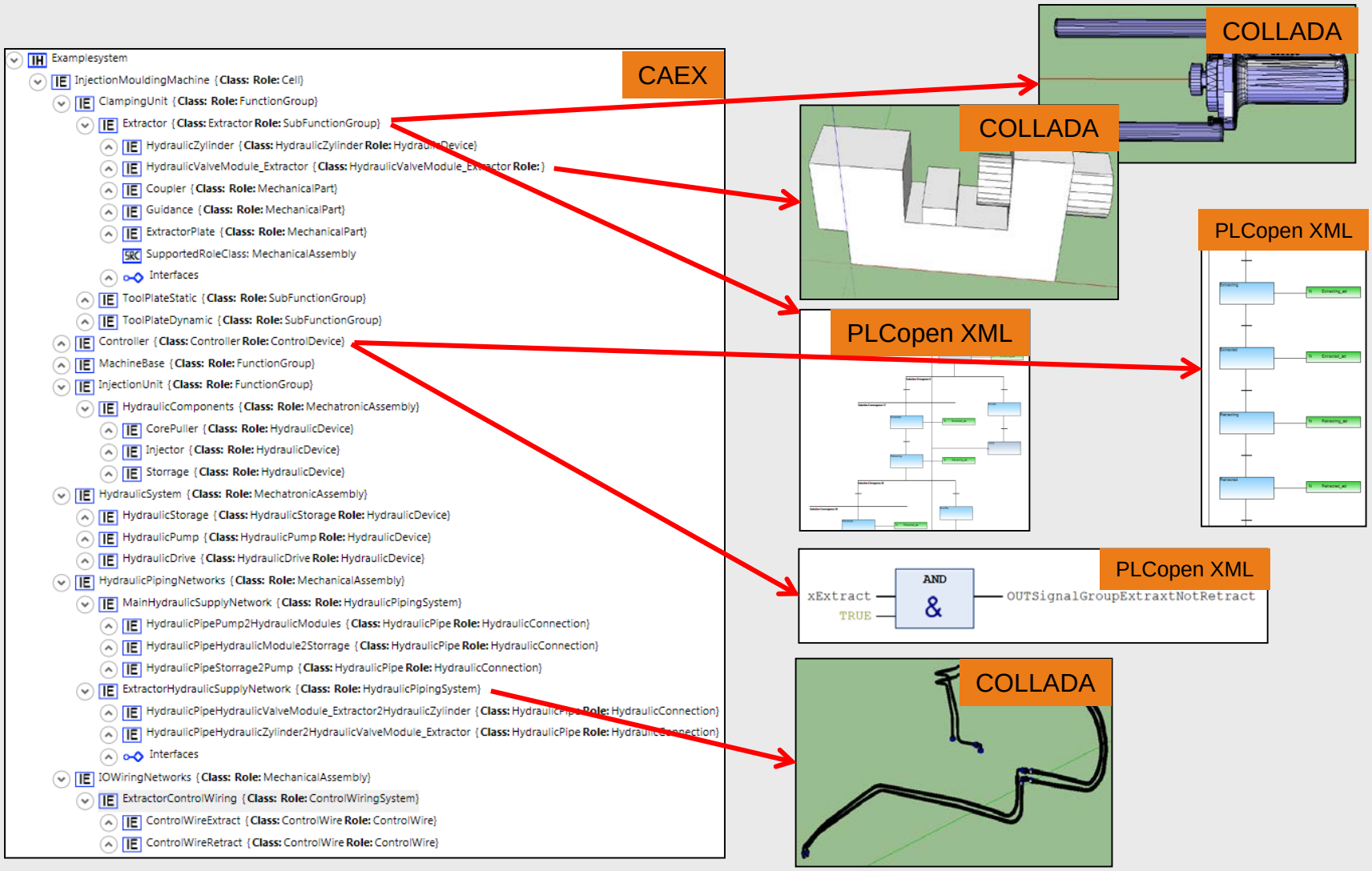
- **AutomationML combines the data formats**
  - CAEX (IEC 62424) to describe system hierarchies as well as attributes for system elements and devices
  - COLLADA (Standard of KHRONOS Group) to describe geometry und kinematic information
  - PLCopen XML (Standard of PLCopen for modelling of IEC 61131 projects) for behavior information modelling



The AutomationML – architecture

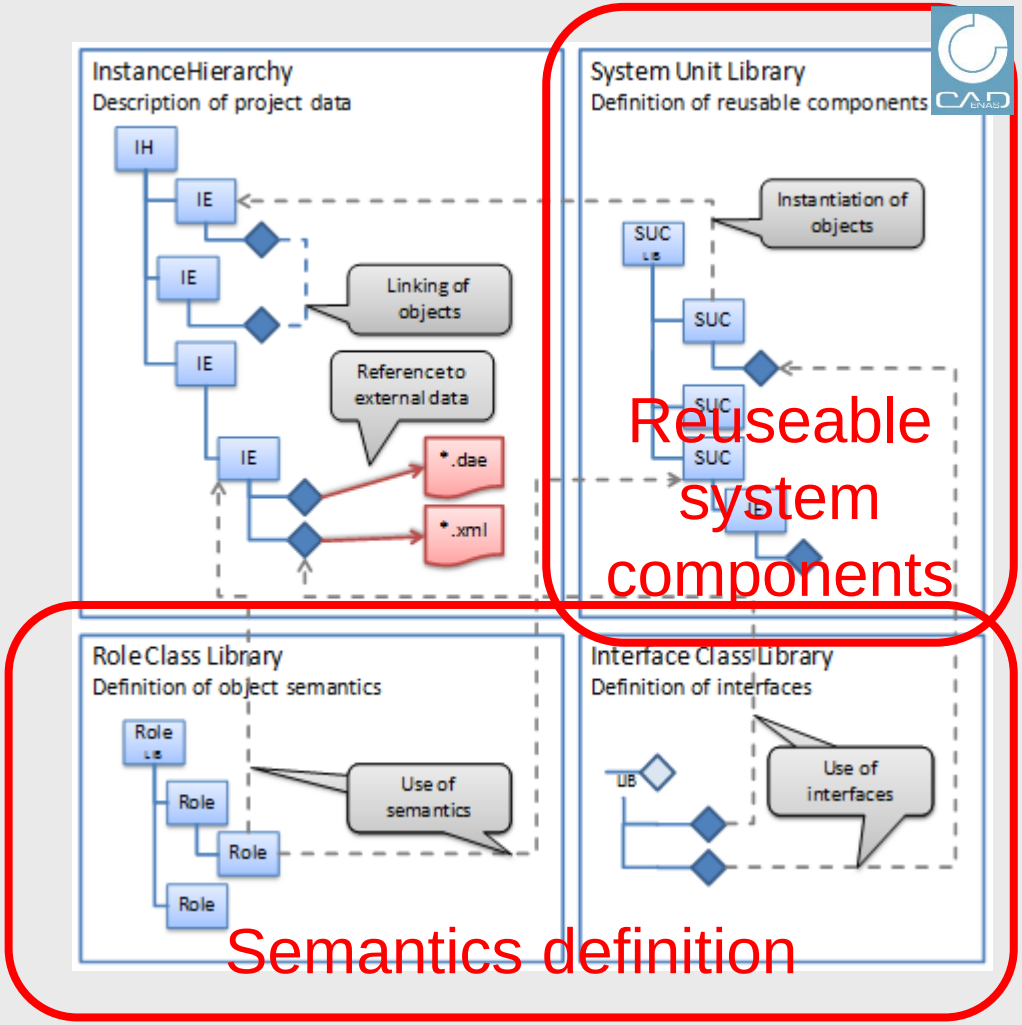


The AutomationML – architecture



Topology description with CAEX

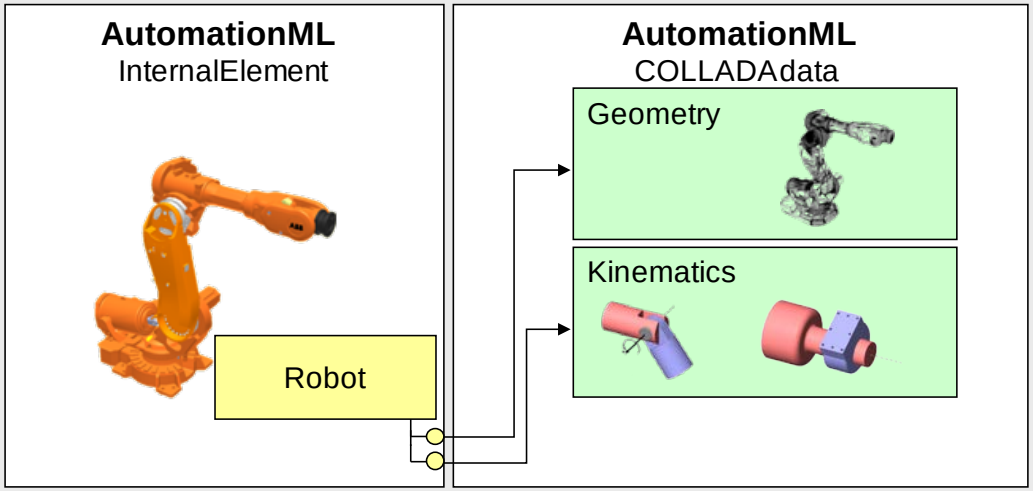
- **Definition of meaning of objects by role classes**
- **Definition of reusable objects for the engineering**
  - Components
  - Interfaces
  - Roles
- **Representation of project data as project tree**
- **Integration of object descriptions as attributes**
- **Relations between objects and references to external documents**

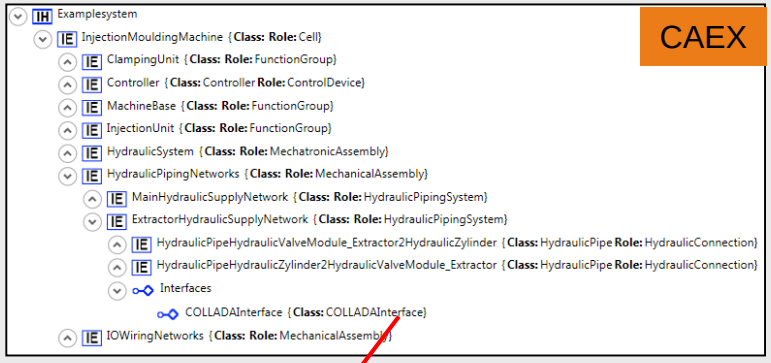


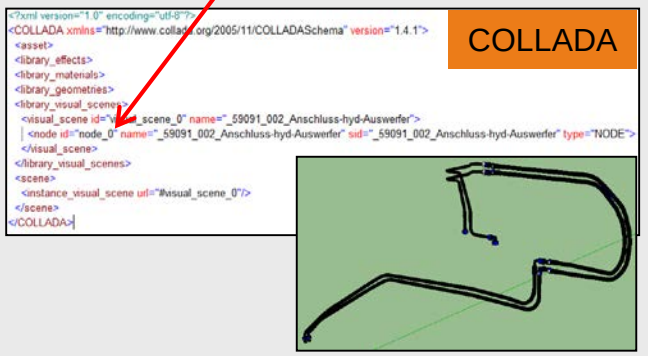
Geometry and kinematics description with COLLADA

<AutomationML/>
The Glue for Seamless Automation Engineering

- **OpenXML – based 3D graphics format including geometry AND kinematics (sinceV1.5) as only file format that enables that**
- **Also used by Google Earth/Sketch Up, Game Engines**
- **COLLADA is standardized as ISO/PAS 17506 by KHRONOS**
- **Originally developed for gaming industry.**
  - Main driver: Sony

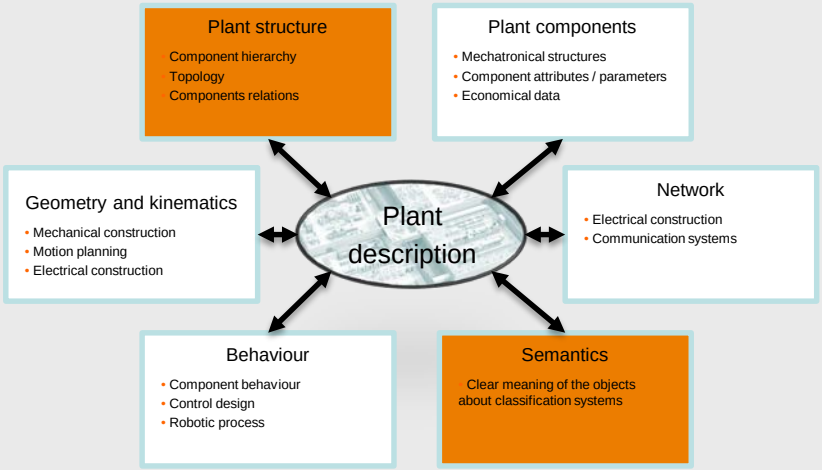


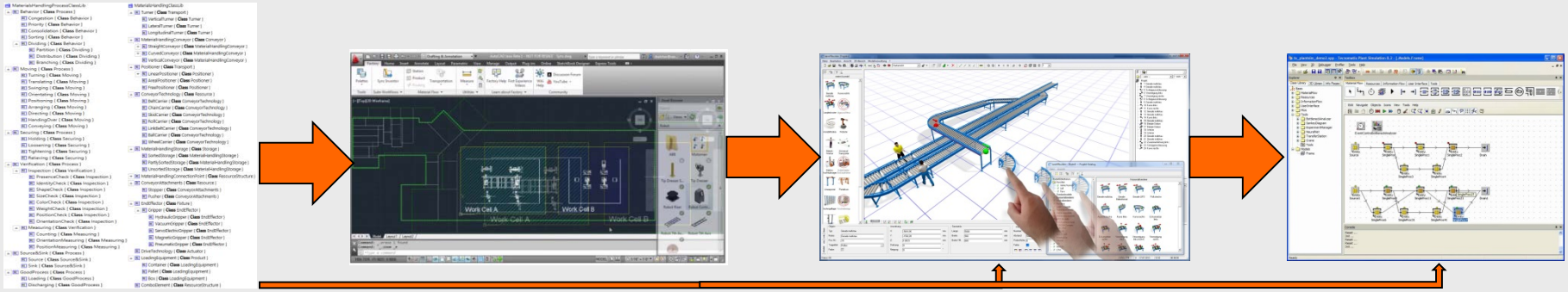




Application examples

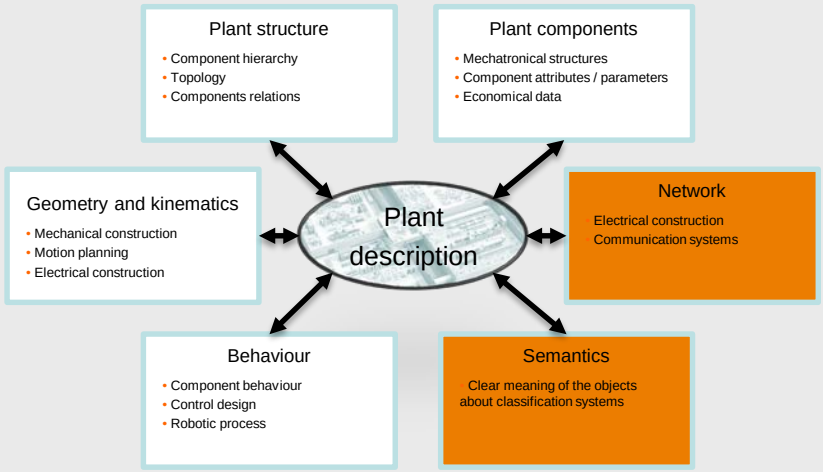
- **Exchange of plant structures**
  - CAD structures of transport systems
    - Example tool chain: AutoCAD (Autodesk) → taraVRbuilder (tarakos) → PlantSimulation (Siemens)
    - Precondition: transport system role library

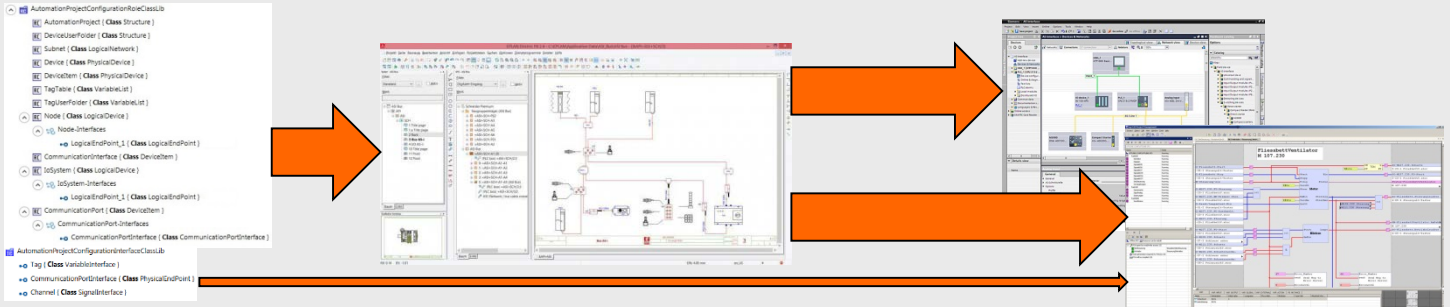




Application examples

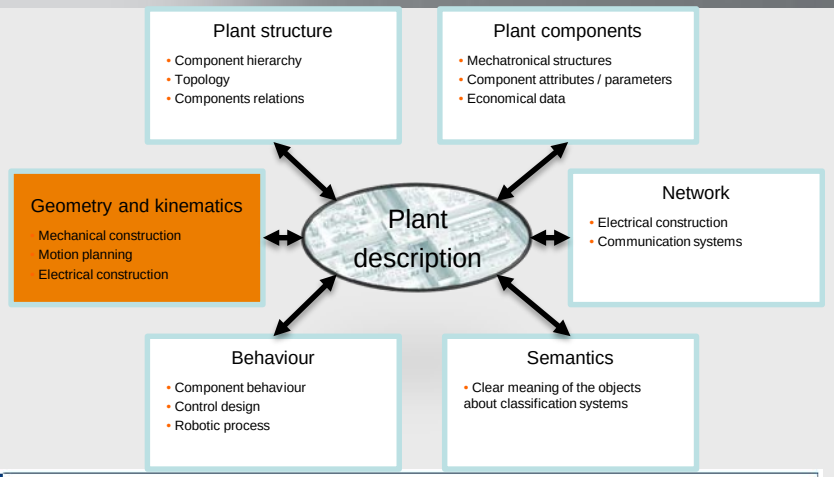
- **Exchange of network structures**
  - Device and wiring structure within automation systems
    - Example tool chain:
      EPlan Electric (Eplan)→ TIA Portal (Siemens)/ logi.CAD (logi.cals)
    - Precondition: Automation system hardware configuration role class system

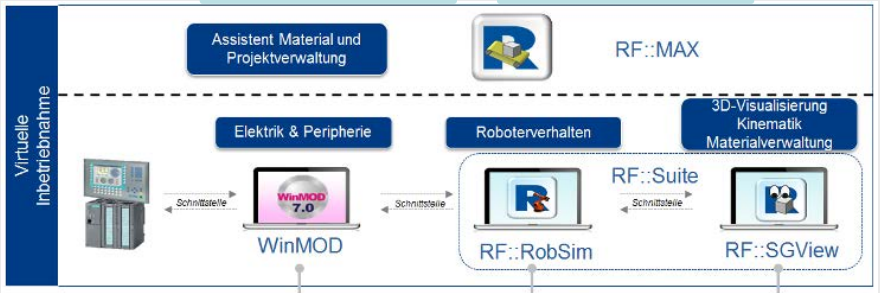


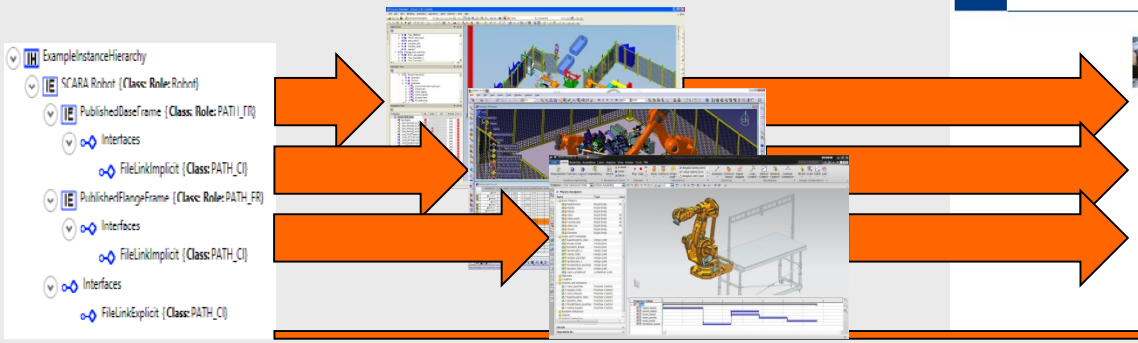


Application example

- **Exchange of kinematics**
  - Structure, geometry und kinematics data for virtual commissioning
    - Example tool chain: Process simulate (Siemens), Delmia (Dassault), NX MCD (Siemens) → RF::Suite (EKS Intec)
    - Preconditions: virtual commissioning related role class systems, COLLADA

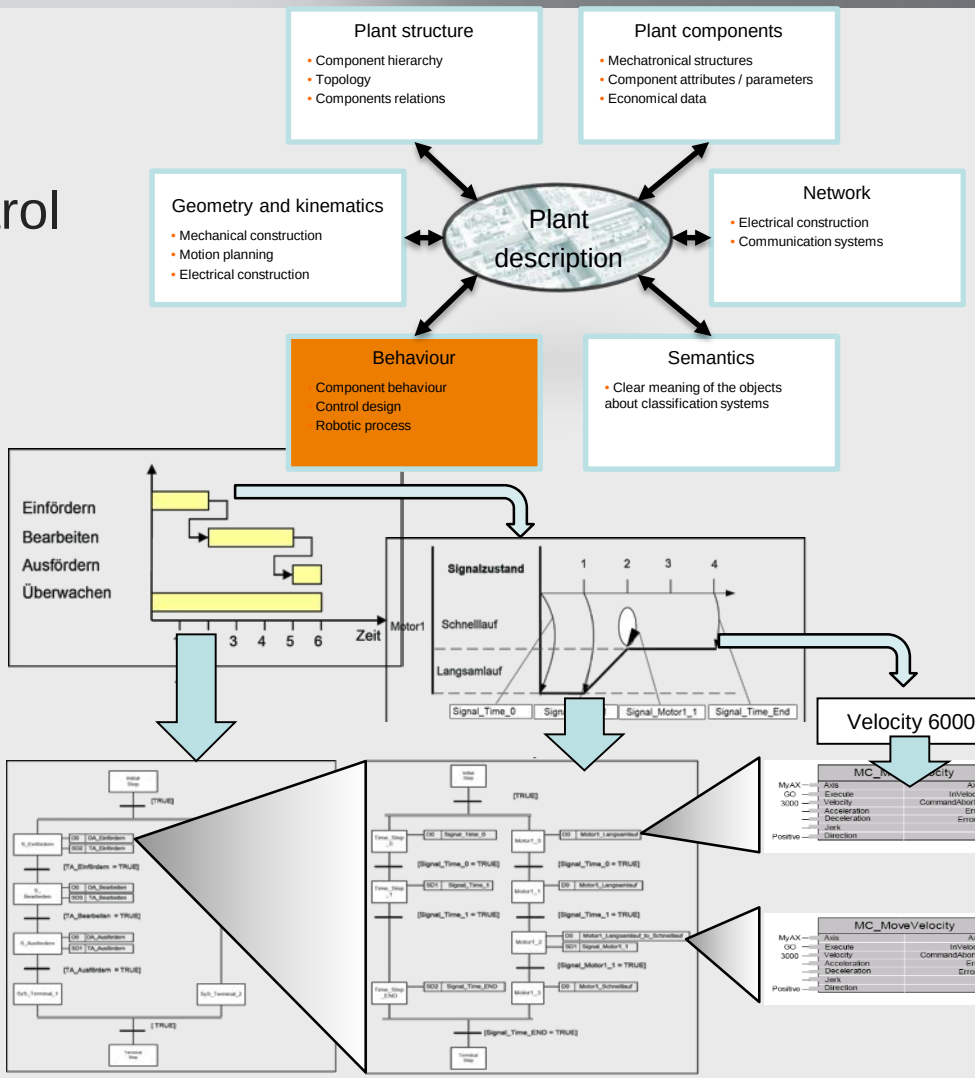


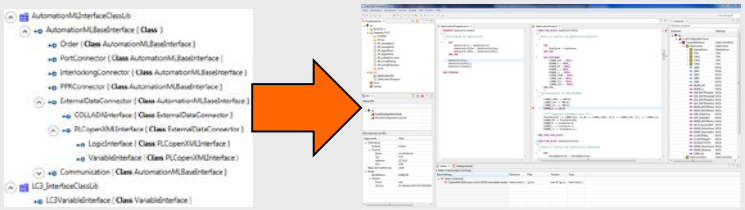




Application example

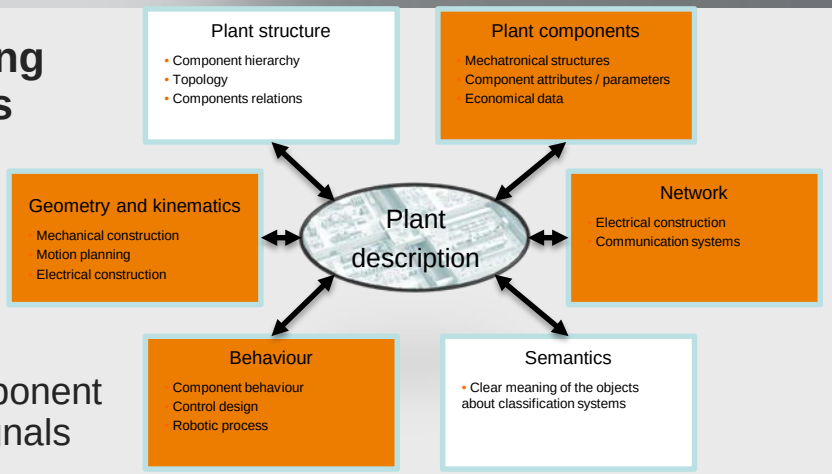
- **Setup of control projects**
  - Model based engineering of positive behavior within control application
    - Example tool chain: logi.CAD (logi.cals)
    - Proconditions: control related role class systems, PLCopen XML



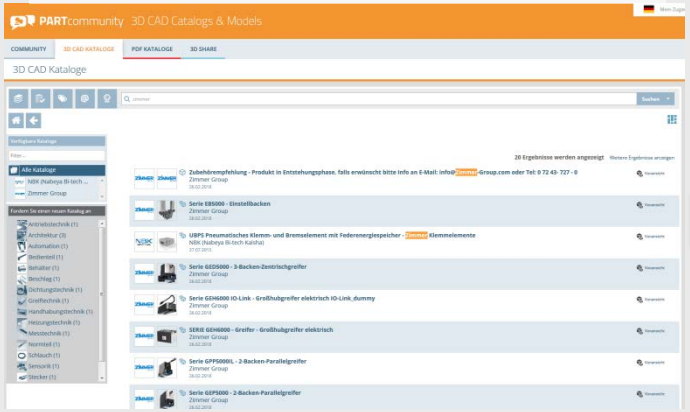


Application example

- **Support of automation and process engineering with intelligent parts from component libraries**
  - CENIT FASTSUITE Edition 2
    - Scalable solution with respect to level of information from component manufacturer
    - Already available is download of Collada files from CADENAS with geometry and kinematics import
    - Will be extended after release of BPR - AML Component covering mechanical and electrical adapter, I/O signals and behavior
    - Components can directly be used to setup a mechatro-nical simulation model for OLP and PLC validation purpose in Fastsuite E2



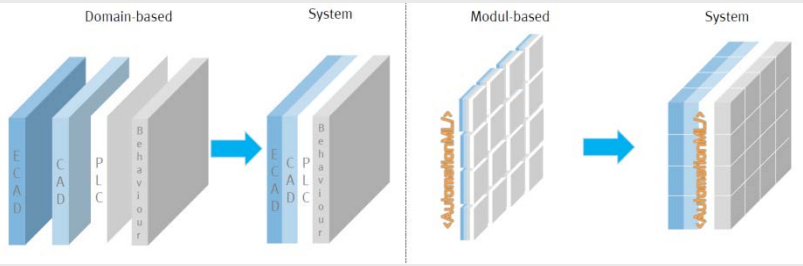
CADENAS https://b2b.partcommunity.com



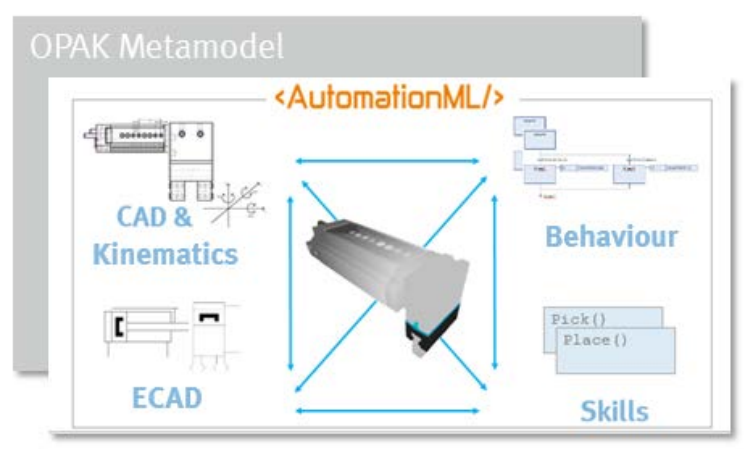
CENIT Fastsuite Edition 2

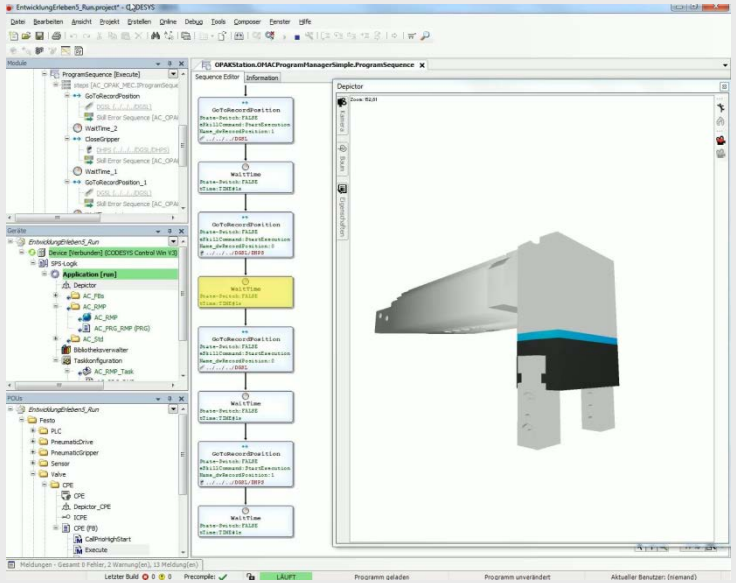
Important support structure

- An very important building block for the extensive use of AutomationML are component libraries
- Example OPAC Project



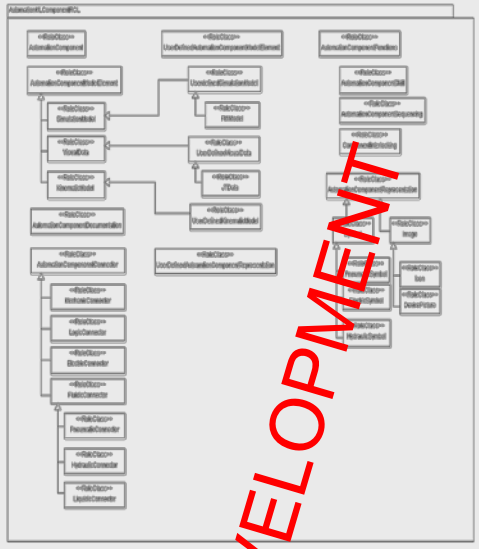
- How can a plant component be modelled by AutomationML?

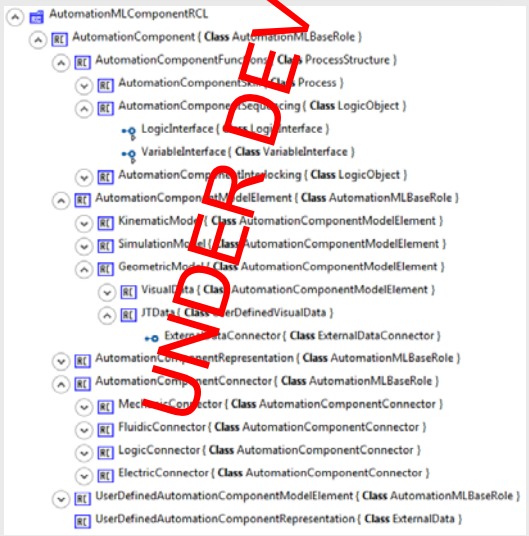




Important support structure

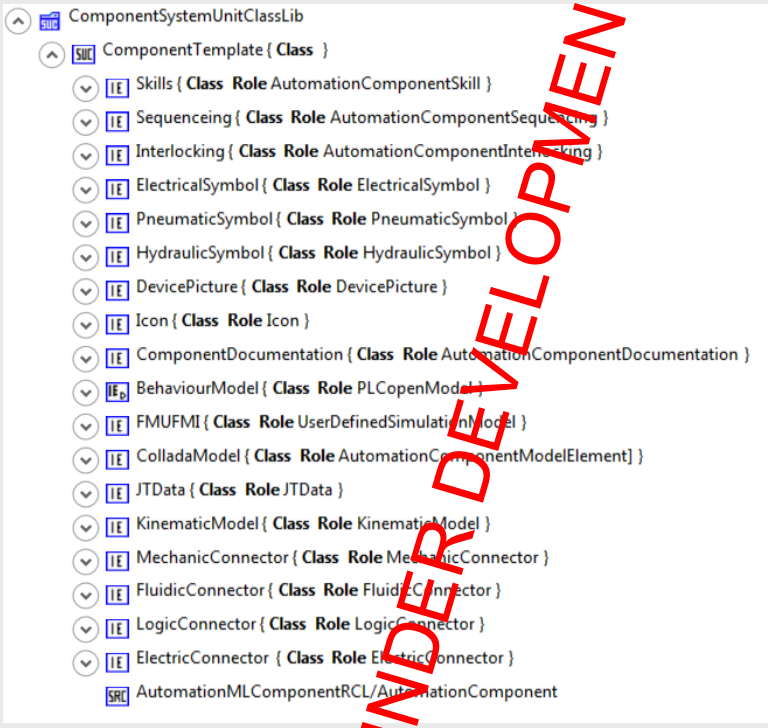
- **Development of component modelling approach**
  - Defines Role Class Lib for AutomationML Component
    - Basic Role Class AutomationComponent
      - Defines basic attributes
      - Identification of elements as „AutomationML automation component“
    - Further Role Classes (examples)
      - AutomationComponentDocumentation – integration of external documentations in different file formats, e.g. PDF
      - AutomationModelElement – integration of addition models like simulation, 3D or kinematic models
      - AutomationComponentConnector – definition of different connector, e.g. electric, pneumatic … are possible





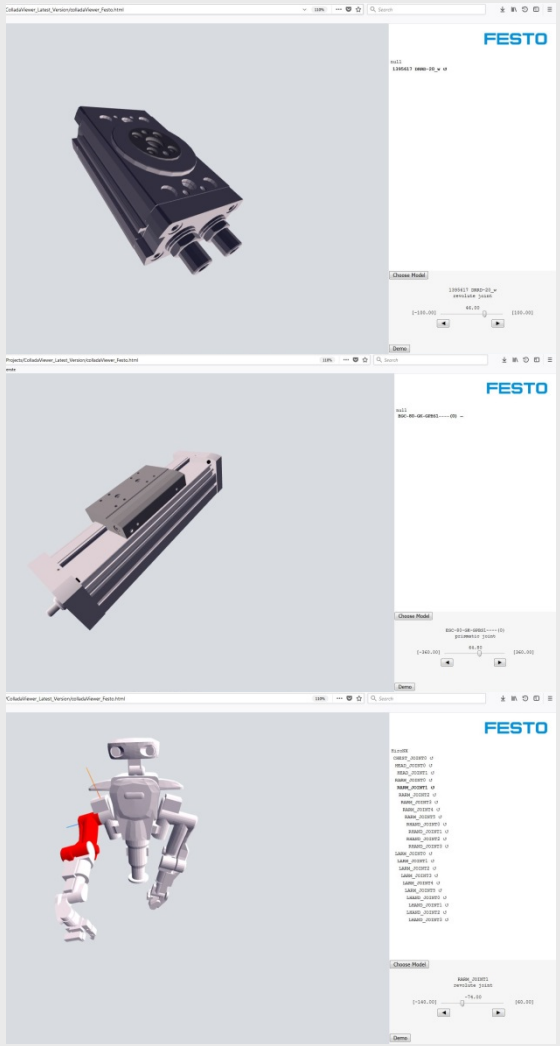
Important support structure

- **Development of component modelling approach**
  - SUC as Template for 100% Component
  - Components are defined by the Supported / RequieredRole Class AutomationComponent
  - Internal Elements with defined Role Classes for all information classes, including the necessary interfaces



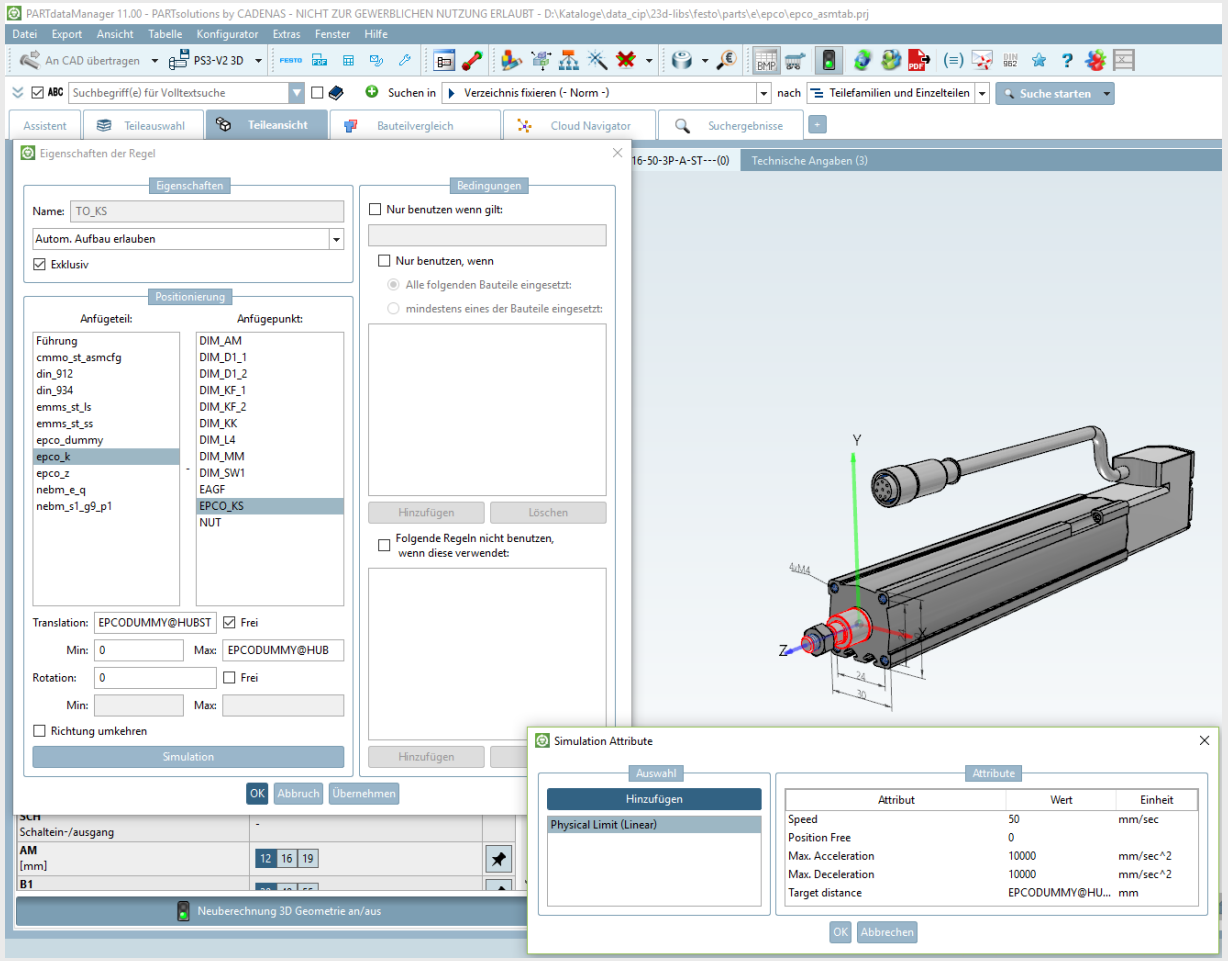
Important support structure example

- **Forerunner within the implementation of the component concept is Festo**
  - At the moment Festo is able to provide Collada 1.4.0 representations for nearly all catalogue products (Collada 1.5.0 will be availabe soon)
  - Provides ColladaWebViewer and AutomationMLEditor Plugin
  - Intention: Provide a stable tool kit for evaluation of geometry and kinematic behavior of components BEFORE purchasing
- **Enables a first step towards integrated component libraries and their use**



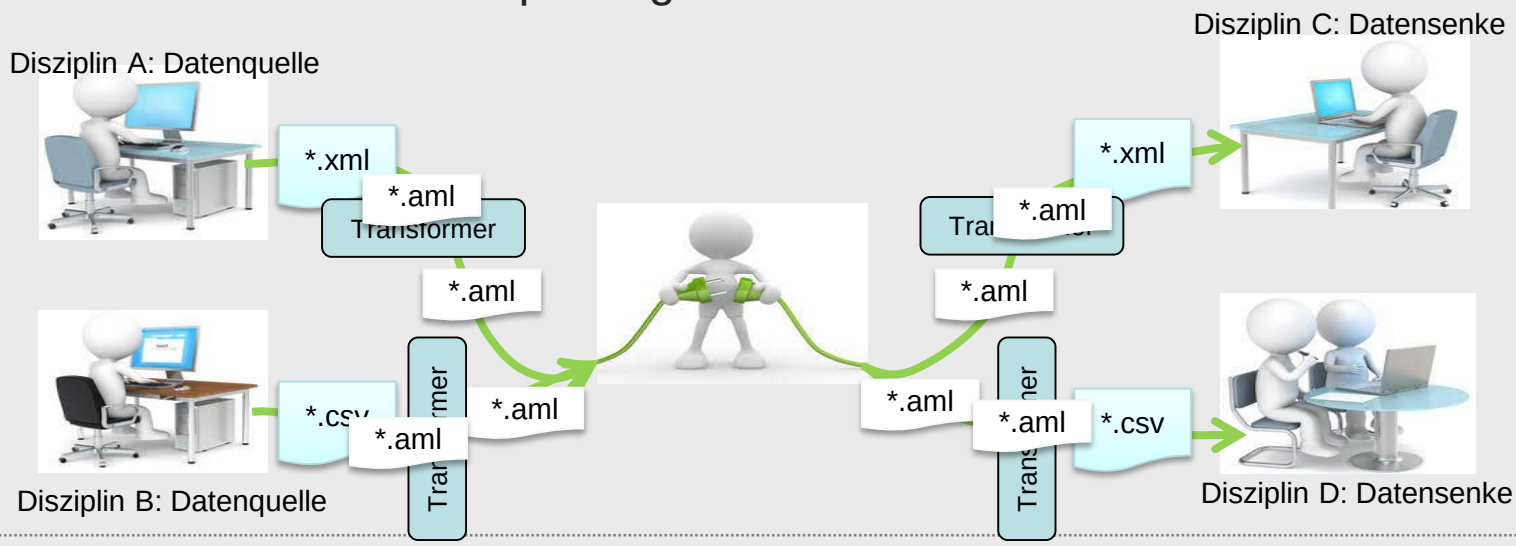
Important support structure example

- **First CADENAS based solutions available**



State of applicability of AutomationML

- **Frequently addressed issue: Is AutomationML mature enough to be applicable ?**
  - Simple answer: YES!
  - More complex answer: There is a possible migration path from existing stable engineering chains towards AutomationML based ones!
    - Problems to be tackled: Convince the user to NOT change their known habit but improving their work.



Cooperations

- **The AutomationML e.V. cooperates with different organizations for the purpose of harmonization of standards and the collaborative development of Best Practice**
- **Liaisons exist with**
  - PLCopen
  - KHRONOS (COLLADA)
  - eCl@ss
  - ProSTEP iViP
  - OPC Foundation
  - IEC
  - FDT
  - VDMA
  - CADENAS

Cooperation with CADENAS

- **Status: Liaison**
- **Technical objective:**
  - Development of a production system component modelling methodology
    - Integration of engineering and purchase relevant information
  - Application of this methodology as export function from CADENAS product catalogs
    - Enhancement of CADENAS PARTsolution product line with AutomationML export
- **Non-technical objectives:**
  - Collaborative promotion / marketing
- **Affected parts of AutomationML**
  - Best Practice Recommendations Description of Automation Components (currently in development)

AutomationML information

- **What else can be found about AutomationML?**

➔ **AutomationML web page on www.automationml.org**

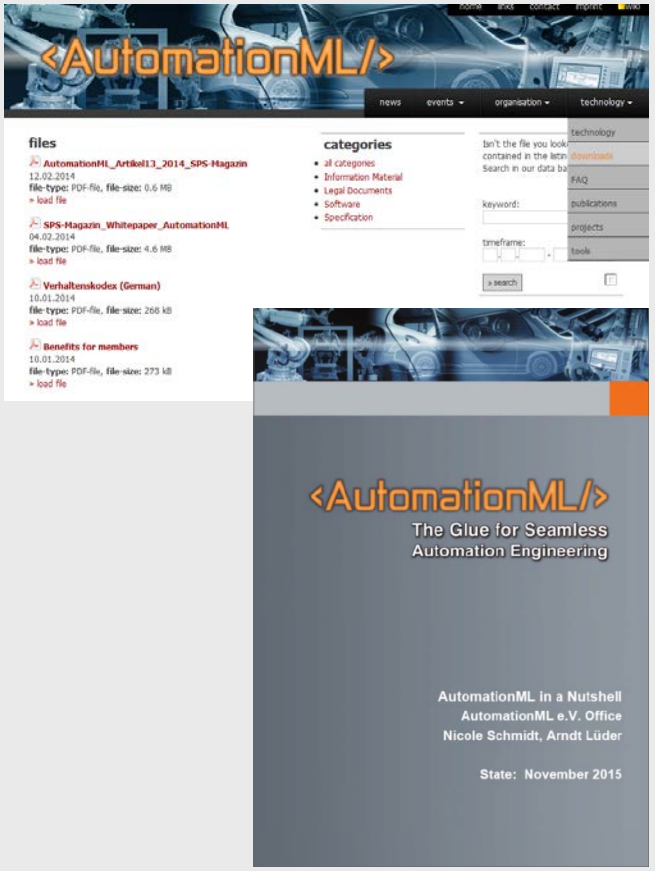
- ➔ Download area with all whitepapers, software, development examples, …
- ➔ Research projects, tools, publications, …

➔ **AutomationML newsletter**

- ➔ Subscription possible on the web page www.automationml.org

➔ **AutomationML in a Nutshell**

- ➔ Downloadable on the web page as well



Join AutomationML!

Eine wirklich gute Idee erkennt man daran, dass ihre Verwirklichung von vorne herein ausgeschlossen erscheint.

Albert Einstein

Topology description with CAEX example

Project

- Produktionsmodell
  - Conveyor0 {Class: Conveyer Role:}
  - Motor_Band_Conveyer {Class: Motor Role:}
    - SupportedRoleClass: Motor
    - Interfaces
      - Verzahnung_Band {Class: Verzahnung}
      - Verschraubung_Gestell {Class: Verschraubung}
      - Vorlauf_Stromanschlussbuchse {Class: Stromanschlussbuchse}
      - Motor_COLLADAInterface {Class: COLLADAInterface}
      - Rücklauf_Stromanschlussbuchse {Class: Stromanschlussbuchse}
      - Motor_PLCopen_LogicInterface {Class: LogicInterface}
  - Induktivsensor_Conveyer {Class: Induktivsensor Role:}
    - SupportedRoleClass: Sensor
    - Interfaces
      - Sensor_COLLADAInterface {Class: COLLADAInterface}
      - Induktivsensor_PLCopen_LogicInterface {Class: LogicInterface}
      - Verschraubung_Gestell {Class: Verschraubung}
      - Signal_Stromanschlussbuchse {Class: Stromanschlussbuchse}
  - Band_Conveyer {Class: Band_Conveyer Role:}
  - Gestell_Conveyer {Class: Gestell Role:}
  - Conveyer1 {Class: Conveyer Role:}
  - Conveyer2 {Class: Conveyer Role:}
  - Conveyer3 {Class: Conveyer Role:}
  - Conveyer4 {Class: Conveyer Role:}
  - Conveyer5 {Class: Conveyer Role:}
  - Conveyer6 {Class: Conveyer Role:}
  - Conveyer7 {Class: Conveyer Role:}
  - Conveyer8 {Class: Conveyer Role:}
  - Conveyer9 {Class: Conveyer Role:}
  - Turntable0 {Class: Turntable Role:}
  - Turntable1 {Class: Turntable Role:}
  - Turntable2 {Class: Turntable Role:}
  - Turntable3 {Class: Turntable Role:}
  - Turntable4 {Class: Turntable Role:}
  - Turntable5 {Class: Turntable Role:}
  - Turntable6 {Class: Turntable Role:}
  - Turntable7 {Class: Turntable Role:}
  - Maschine1 {Class: Maschine Role:}
  - Maschine2 {Class: Maschine Role:}
  - Maschine3 {Class: Maschine Role:}
  - FL_IL_24_BK_BusKoppler {Class: FL_IL_24_BK_BusKoppler Role:}
  - WAGO_750_342_BusKoppler1 {Class: WAGO_750_342_BusKoppler Role:}
  - WAGO_750_342_BusKoppler2 {Class: WAGO_750_342_BusKoppler Role:}
  - Verkabelung {Class: Role:}

Geometrie	
Material	
Anschlüsse	
Leistung	
Name	Leistung
Description	
Value	3
Default Value	
Unit	Watt
DataType	xs:integer
Gewicht	
Name	Gewicht
Description	
Value	140
Default Value	
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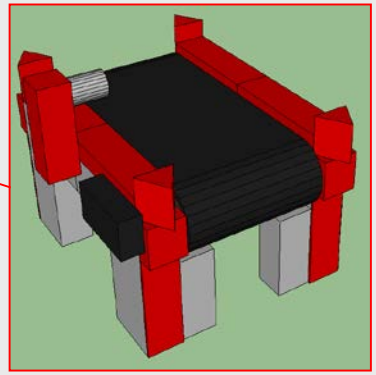
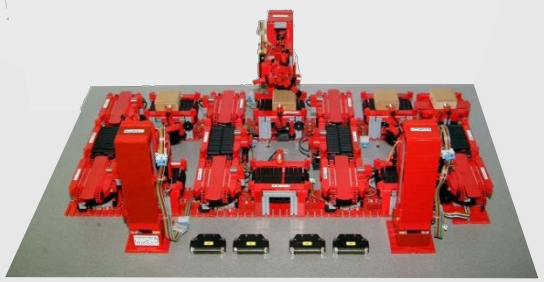
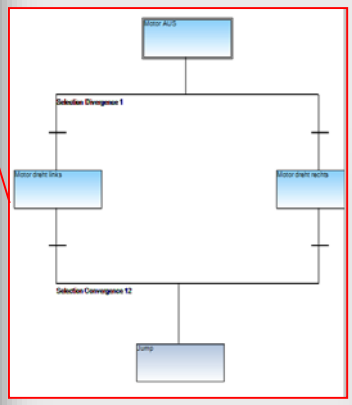






Defined roles as sematic representation

- Modell RoleClassLib
  - Motor {Class: MechatronicAssembly}
  - Sensor {Class: Sensor}
  - Band {Class: BeltConveyor}
  - Gestell {Class: MechanicalAssembly}
  - Untergestell_Turntable {Class: MechanicalAssembly}
  - Obergestell_Turntable {Class: MechanicalAssembly}
  - Ständer {Class: MechanicalPart}
  - Bearbeitungswerkzeug {Class: Tool}
  - Werkzeugträger {Class: MechanicalPart}
  - SPS_Steuerung {Class: PLC}
  - BusKoppler {Class: Communication}
  - Kabel {Class: Communication}
- AutomationMLBaseRoleClassLib
- AutomationMLCSRoleClassLib
- AutomationMLDMIRoleClassLib
- AutomationMLExtendedRoleClassLib

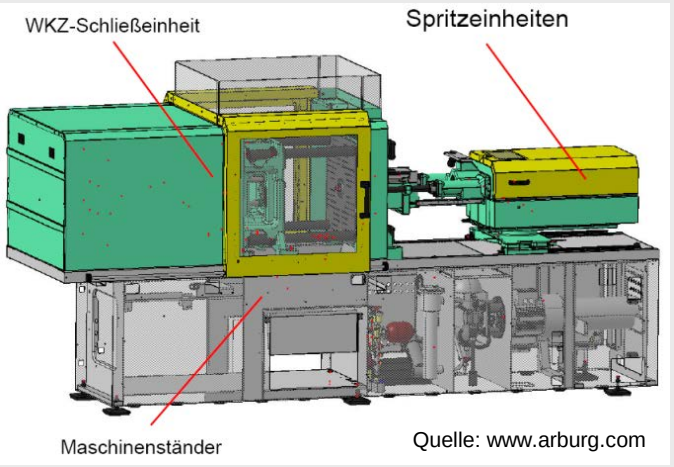
Component library

- FabrikModell
  - Bauteile {Class:}
    - Motor {Class:}
    - Sensor {Class:}
      - Verschraubung_Gestell {Class: Verschraubung}
      - Signal_Stromanschlussbuchse {Class: Stromanschlussbuchse}
      - SupportedRoleClass: Sensor
    - Endlagenschalter {Class: Sensor}
    - Induktivsensor {Class: Sensor}
      - Induktivsensor_PLCopen_LogicInterface {Class: LogicInterface}
      - Sensor_COLLADAInterface {Class: COLLADAInterface}
    - Band_Conveyer {Class:}
    - Gestell {Class:}
    - Untergestell_Turntable {Class:}
    - Obergestell_Turntable {Class:}
    - Ständer {Class:}
    - Bearbeitungswerkzeug {Class:}
    - Werkzeugträger {Class:}
    - SPS_Steuerung {Class:}
    - Kabel {Class: Port}
    - Drehkranz {Class:}
    - WZT_Halterung {Class:}
    - Band_Turntable {Class:}
    - WAGO_750_342_BusKoppler {Class:}
    - FL_IL_24_BK_BusKoppler {Class:}
  - Conveyer {Class:}
  - Turntable {Class:}
  - Maschine {Class:}

Geometry and kinematics example

CAEX

- Examplesystem
  - InjectionMouldingMachine {**Class:** **Role:** Cell}
    - ClampingUnit {**Class:** **Role:** FunctionGroup}
    - Controller {**Class:** Controller **Role:** ControlDevice}
    - MachineBase {**Class:** **Role:** FunctionGroup}
    - InjectionUnit {**Class:** **Role:** FunctionGroup}
    - HydraulicSystem {**Class:** **Role:** MechatronicAssembly}
    - HydraulicPipingNetworks {**Class:** **Role:** MechanicalAssembly}
      - MainHydraulicSupplyNetwork {**Class:** **Role:** HydraulicPipingSystem}
      - ExtractorHydraulicSupplyNetwork {**Class:** **Role:** HydraulicPipingSystem}
        - HydraulicPipeHydraulicValveModule_Extractor2HydraulicZylinder {**Class:** HydraulicPipe **Role:** HydraulicConnection}
        - HydraulicPipeHydraulicZylinder2HydraulicValveModule_Extractor {**Class:** HydraulicPipe **Role:** HydraulicConnection}
        - Interfaces
          - COLLADAInterface {**Class:** COLLADAInterface}
    - IOWiringNetworks {**Class:** **Role:** MechanicalAssembly}



CAEX

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    <Attribute Name="refType" AttributeDataType="xs:string">
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    </Attribute>
    <Attribute Name="refURI" AttributeDataType="xs:anyURI">
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    </Attribute>
  </ExternalInterface>
  <InternalElement Name="HydraulicPipeHydraulicValveModule_Extractor2HydraulicZylinder"
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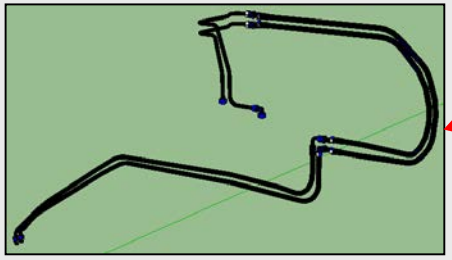

COLLADA

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  <asset>
  <library_effects>
  <library_materials>
  <library_geometries>
  <library_visual_scenes>
    <visual_scene id="visual_scene_0" name="_59091_002_Anschluss-hyd-Auswerfer">
      <node id="node_0" name="_59091_002_Anschluss-hyd-Auswerfer" sid="_59091_002_Anschluss-hyd-Auswerfer" type="NODE">
    </visual_scene>
  </library_visual_scenes>
  <scene>
    <instance_visual_scene url="#visual_scene_0"/>
  </scene>
</COLLADA>
```