

AutomationML Java Engine

– initial experiences –

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Motivation

- Free open development environment
- Educational purpose
- Plattform spanning
- Integration into existing java projects at IAF

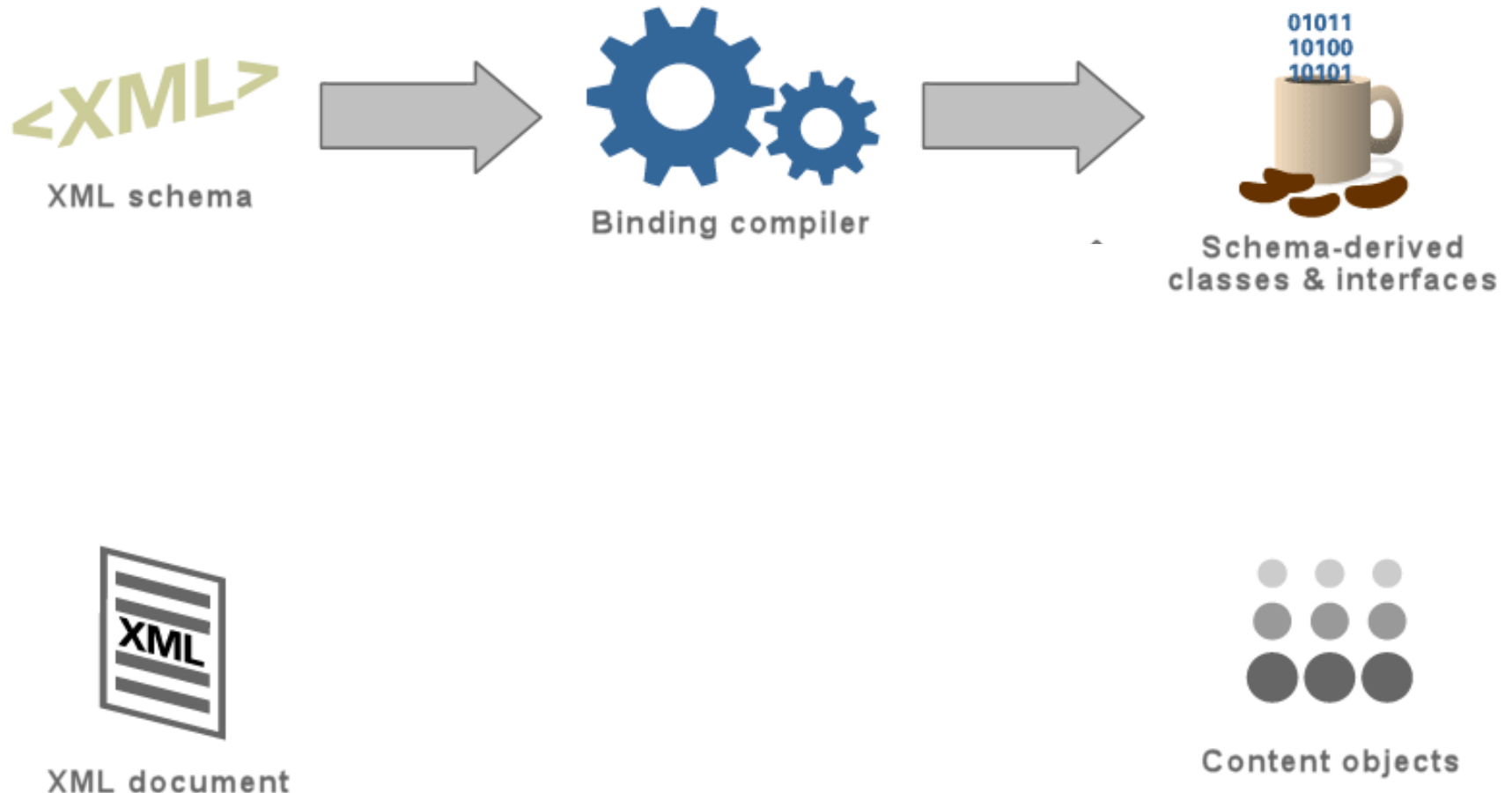
Java Architecture for XML Binding

- Maps Java classes to XML representations
- A special case of persistence
- similar to xsd.exe and XmlSerializer in the .NET
- part of the Java SE platform and one of the APIs in the Java EE platform

https://en.wikipedia.org/wiki/Java_Architecture_for_XML_Binding

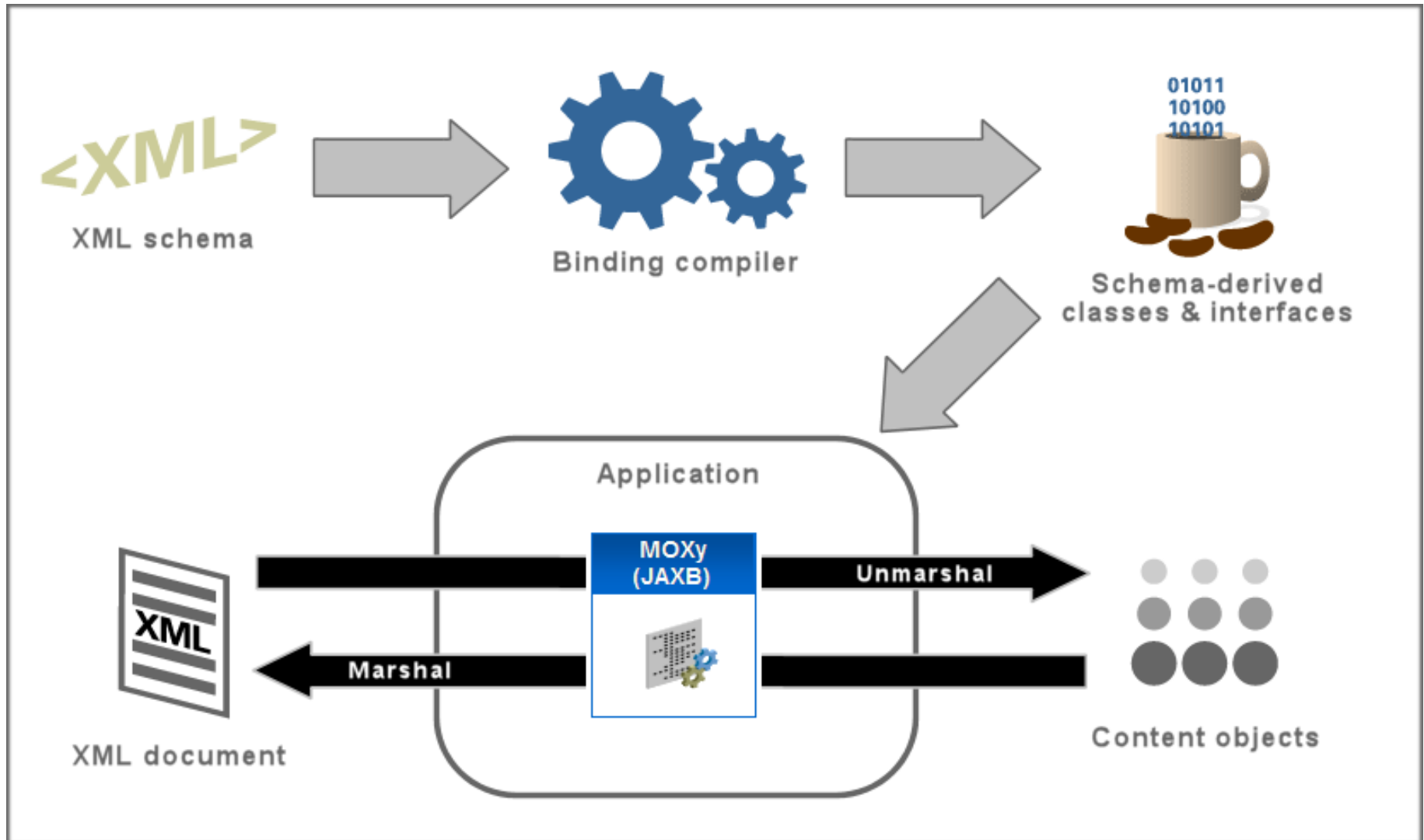
EclipseLink – XML binding compiler

<http://www.eclipse.org/eclipselink/documentation/2.5/concepts/blocks002.htm>



EclipseLink – application integration with MOXy

<http://www.eclipse.org/eclipselink/documentation/2.5/concepts/blocks002.htm>



EclipseLink Pojo vs. Ecore

- Ecore
 - Designed for eclipse framework
 - Massive tool support in the Eclipse family
 - Experiences with running framework at TU Wien
- POJO
 - Need for integration into existing applications at IAF
 - Least dependencies (MOXY as JAXB implementation)
 - Lower entrance level for mechanical engineering students

POJO* models for AutomationML

Full functional object models with xml binding compiled out of the standards *.xsd files.

Objects come with appropriate Getter and Setter functions to have typesafe access.

Models have been built for:

- CAEX v.2.15
- PLCOpenXML v.2.01
- Collada v.1.41

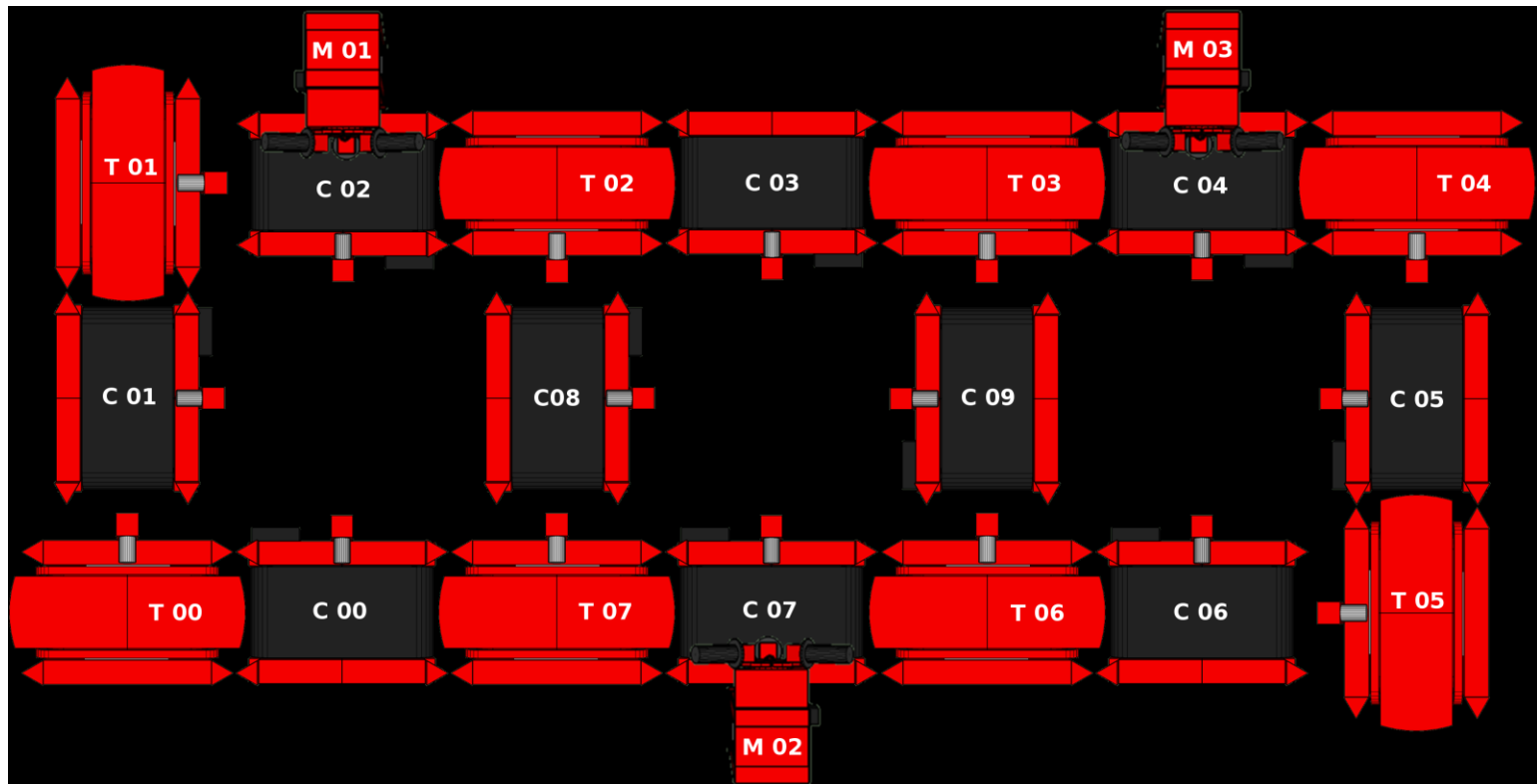
* Plain Old Java Object

Architecture

- The application model was layered
 - View/Edit base models (generic)
 - View/Edit AutomationML model (e.g. IWriterHeader.class)
 - Business models for different use-cases (e.g 2D Plant Layout)
- Avoided implementation of logic to the generated model by implementation of adapter objects which:
 - Adapt base models to application models
 - Fire events on changes (Undo/Redo support)
 - Contain consistency mechanisms
 - Map to view structures (treetable, sourceCode, ..)

Example 2D-Plant Layout

Floor Plan of Fischertechnik Plant Model CVS@IAF



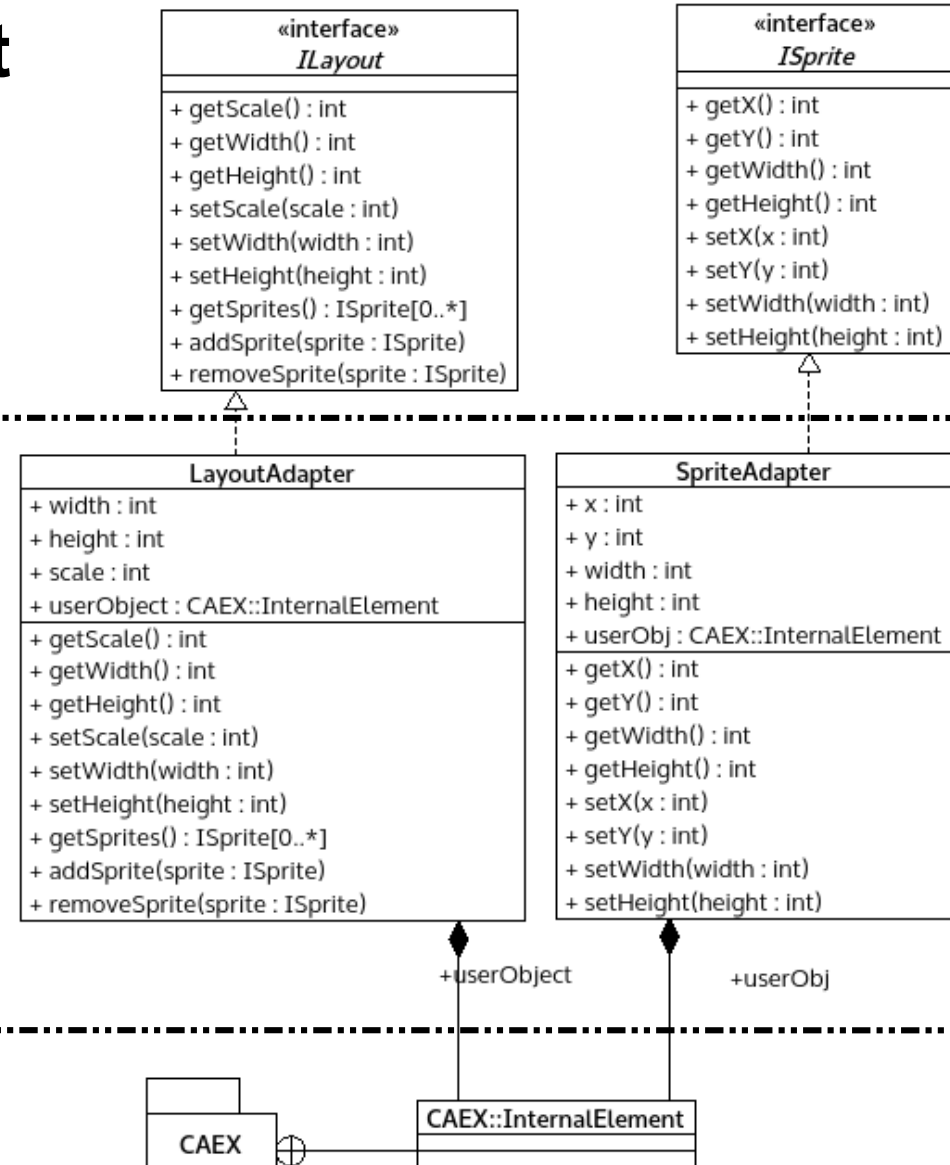
Example 2D-Plant Layout

Engineering tool mockup

Business Object Model

Adapter Packages

Data Model



JAVA AutomationML API specification

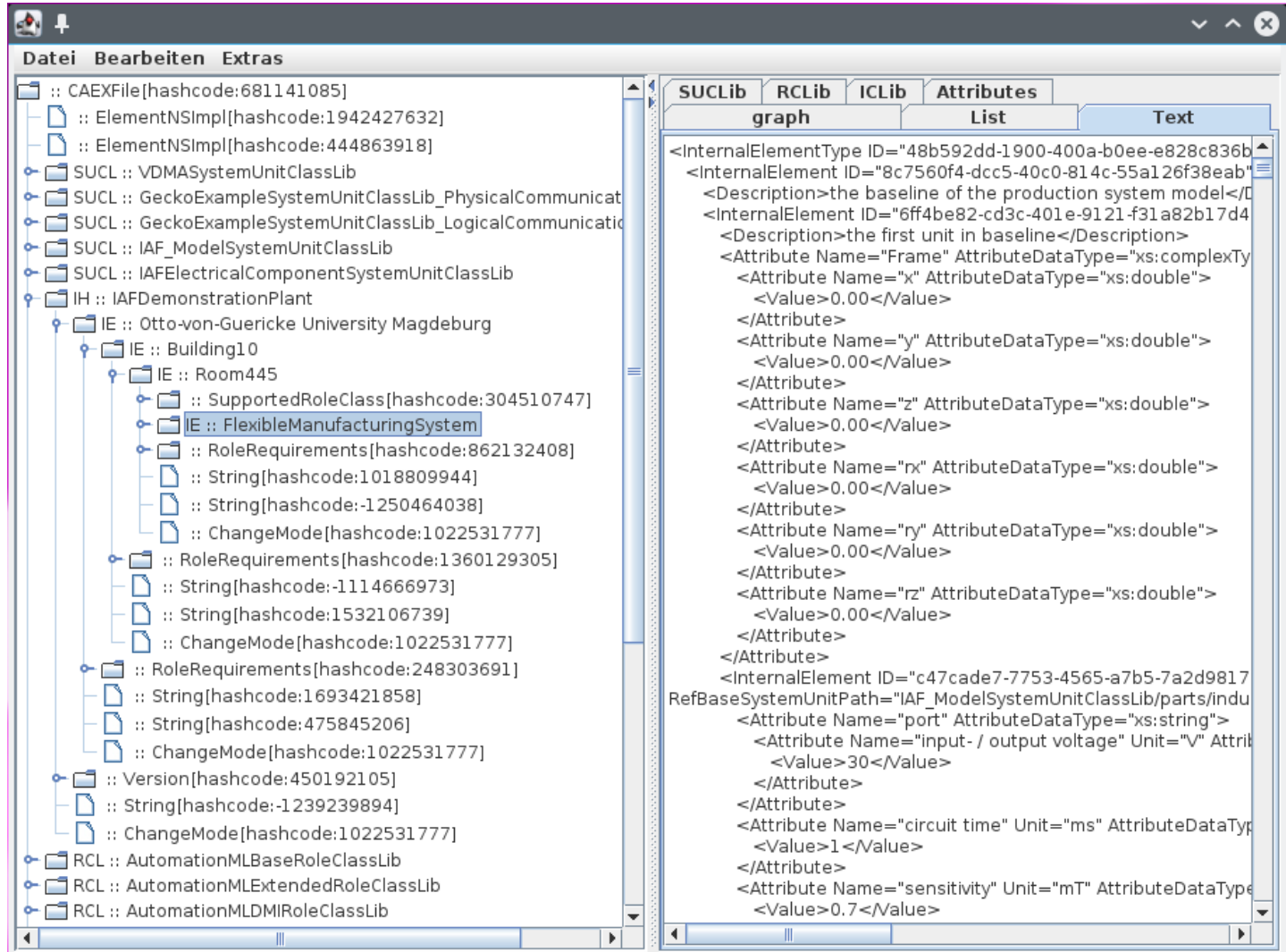
- Go beyond CAEX specification
- e.g. constitute „WriteHeader“ Object
- Allow exchange of engine or parts like GUID algorithm

Java AutomationML Engine and Editing tools

Whats done

- ✓ Read and Write proper AutomationML files
- ✓ .. as well as PLCOpenXML and Collada
- ✓ Generic action framework (create-, delete- New...)
- ✓ Undo/Redo operations
- ✓ Different types of views (tree, table, source)
- ✓ Specialized editors for e.g. batch operations, wiring ..

Java AutomationML Editor



The screenshot displays the Java AutomationML Editor interface. On the left, a project tree shows a hierarchy of files and folders. The selected folder is 'IE :: FlexibleManufacturingSystem'. The right pane shows the XML content of the selected file, with tabs for 'SUCLib', 'RCLib', 'ICLib', and 'Attributes'. The 'Attributes' tab is active, showing a list of attributes for the selected element. The XML content is displayed in a text area, showing the structure of the AutomationML file, including internal elements and attributes.

Project Tree (Left):

- CAEXFile[hashcode:681141085]
 - ElementNSImpl[hashcode:1942427632]
 - ElementNSImpl[hashcode:444863918]
 - SUCL :: VDMASystemUnitClassLib
 - SUCL :: GeckoExampleSystemUnitClassLib_PhysicalCommunicat
 - SUCL :: GeckoExampleSystemUnitClassLib_LogicalCommunicat
 - SUCL :: IAF_ModelSystemUnitClassLib
 - SUCL :: IAFElectricalComponentSystemUnitClassLib
 - IH :: IAFDemonstrationPlant
 - IE :: Otto-von-Guericke University Magdeburg
 - IE :: Building10
 - IE :: Room445
 - SupportedRoleClass[hashcode:304510747]
 - IE :: FlexibleManufacturingSystem**
 - RoleRequirements[hashcode:862132408]
 - String[hashcode:1018809944]
 - String[hashcode:-1250464038]
 - ChangeMode[hashcode:1022531777]
 - RoleRequirements[hashcode:1360129305]
 - String[hashcode:-1114666973]
 - String[hashcode:1532106739]
 - ChangeMode[hashcode:1022531777]
 - RoleRequirements[hashcode:248303691]
 - String[hashcode:1693421858]
 - String[hashcode:475845206]
 - ChangeMode[hashcode:1022531777]
 - Version[hashcode:450192105]
 - String[hashcode:-1239239894]
 - ChangeMode[hashcode:1022531777]

XML Editor (Right):

Attributes tab is active. The XML content shows the structure of the AutomationML file, including internal elements and attributes.

```
<InternalElementType ID="48b592dd-1900-400a-b0ee-e828c836b"
  <InternalElement ID="8c7560f4-dcc5-40c0-814c-55a126f38eab"
    <Description>the baseline of the production system model</D
    <InternalElement ID="6ff4be82-cd3c-401e-9121-f31a82b17d4
      <Description>the first unit in baseline</Description>
      <Attribute Name="Frame" AttributeDataType="xs:complexType
        <Attribute Name="x" AttributeDataType="xs:double">
          <Value>0.00</Value>
        </Attribute>
        <Attribute Name="y" AttributeDataType="xs:double">
          <Value>0.00</Value>
        </Attribute>
        <Attribute Name="z" AttributeDataType="xs:double">
          <Value>0.00</Value>
        </Attribute>
        <Attribute Name="rx" AttributeDataType="xs:double">
          <Value>0.00</Value>
        </Attribute>
        <Attribute Name="ry" AttributeDataType="xs:double">
          <Value>0.00</Value>
        </Attribute>
        <Attribute Name="rz" AttributeDataType="xs:double">
          <Value>0.00</Value>
        </Attribute>
      </InternalElement>
    <InternalElement ID="c47cade7-7753-4565-a7b5-7a2d9817
      RefBaseSystemUnitPath="IAF_ModelSystemUnitClassLib/parts/indu
        <Attribute Name="port" AttributeDataType="xs:string">
          <Attribute Name="input - / output voltage" Unit="V" Attrib
            <Value>30</Value>
          </Attribute>
        </Attribute>
        <Attribute Name="circuit time" Unit="ms" AttributeDataTyp
          <Value>1</Value>
        </Attribute>
        <Attribute Name="sensitivity" Unit="mT" AttributeDataTyp
          <Value>0.7</Value>
```

**Wir suchen das Wissen, das wir
durch Information verloren haben.**

(Thomas Stearns Eliot)