<AutomationML/>

The Glue for Seamless Automation Engineering
In factory automation, engineering is cost driver #1

Analysis of factory automation costs

- Engineering Commissioning: 50%
- Bought-in Parts: 28%
- Assembly: 11%
- Project Management: 3%
- Precommissioning: 3%
- Robot Programming Offline/Online: 5%

Source: Cost structure analysis of robotics and controls, AIDA 2005
Major challenge is the heterogeneous tool landscape in plant engineering

<table>
<thead>
<tr>
<th>Application</th>
<th>Subgroup</th>
<th>Tools (Examples)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAD</td>
<td></td>
<td>CATIA v4, v5, Autocad, UGS, SolidWorks, PTC ProEngineer, MicroStation, Blender, 3d Max, Maya</td>
</tr>
<tr>
<td>Simulation</td>
<td>Material Flow Simulation</td>
<td>Simple++, e-MPlant, Quest, Delmia</td>
</tr>
<tr>
<td>Robot Simulation</td>
<td></td>
<td>Cosimir, IGrip D5, Catia v5 Robotics, Robcad</td>
</tr>
<tr>
<td>Process Simulation</td>
<td></td>
<td>FEM, Ansys</td>
</tr>
<tr>
<td>Electrical Simulation</td>
<td></td>
<td>PSPICE, Electronics Workbench, Multisim</td>
</tr>
<tr>
<td>Office</td>
<td>Text Processing</td>
<td>MS Word, OpenOffice</td>
</tr>
<tr>
<td></td>
<td>Spreadsheet Analysis</td>
<td>MS Excel, OpenOffice</td>
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<td></td>
<td>Presentation</td>
<td>MS Powerpoint, OpenOffice</td>
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<tr>
<td></td>
<td>Databases</td>
<td>Access, Oracle, MS Sql</td>
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<tr>
<td></td>
<td>Communication</td>
<td>Email</td>
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<tr>
<td>Project Management</td>
<td></td>
<td>MS Project, MindManager</td>
</tr>
<tr>
<td>Product Data Management (PDM)</td>
<td></td>
<td>UGS TeamCenter, Dassault Smartteam, Dassault Enovia</td>
</tr>
<tr>
<td>Product Lifecycle Management (PLM)</td>
<td></td>
<td>e-MPlaner, Delmia ES DPE</td>
</tr>
<tr>
<td>Enterprise Resource Planning (ERP)</td>
<td></td>
<td>SAP R3, Oracle Peoplesoft, MS Navision</td>
</tr>
</tbody>
</table>

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</thead>
<tbody>
<tr>
<td>Reporting</td>
<td></td>
<td>Cognos, Crystal Reports, Eclipse BIRT</td>
</tr>
<tr>
<td>Visualization</td>
<td>Mock-up</td>
<td>e-MPlaner, many others</td>
</tr>
<tr>
<td>Plant Visualization</td>
<td></td>
<td>JViz, OpenGT, OpenFlight</td>
</tr>
<tr>
<td>HMI</td>
<td></td>
<td>WinCC / WinCC Flexible, intouch</td>
</tr>
<tr>
<td>Control Programming</td>
<td>PLC</td>
<td>STEP 7, RSLogix, RSLinx, CoDeSys, iMap, ...</td>
</tr>
<tr>
<td></td>
<td>Robot Control</td>
<td>ABB Robotstudio, KUKA SIM, Dürr 3D Onsite</td>
</tr>
<tr>
<td>CAE</td>
<td></td>
<td>Ruplan, ePlan, Eagle, Target 3001</td>
</tr>
<tr>
<td></td>
<td>Process configuration</td>
<td>3D Onsite, Robotstudio, Robscan Design/Control, Bos 6000</td>
</tr>
<tr>
<td>Facility Management</td>
<td></td>
<td>Bentley Microstation, Speedycon, Triplan, Autocad Architectural</td>
</tr>
<tr>
<td>Computerized Maintenance Management System (CMMS)</td>
<td></td>
<td>Maximo, Datastream7i, API Pro</td>
</tr>
<tr>
<td>Authoring</td>
<td></td>
<td>Adobe Acrobat, Illustrator, Wiki, Excel, Sharepoint, MacroMedia</td>
</tr>
<tr>
<td>Functional Engineering</td>
<td></td>
<td>AutomationDesigner based on Comos, Automation Framework</td>
</tr>
</tbody>
</table>
Many gaps and breaks in tool chains lead to using the “paper interface”
Our goal and claim

Get rid of the paper interface!

www.automationml.org
Vision of the AutomationML

AutomationML becomes the “Glue for Seamless Automation Engineering” through

- Interoperability between software tools
- in all engineering phases,
- seamless and scalable,
- as open and standardized data format.
AutomationML describes plants and components with all aspects:

- Topology
- Geometry
- Kinematic
- Motion Paths
- Logic/Behavior
- ...
AutomationML is free and open

- **Openness**
  - Open, documented format free of charge
  - Manufacturer independent
  - Without proprietary interfaces and libraries

- **Extensible**
  - Standardized description based on XML
  - Scalable from single components up to complete plants
  - Prepared for future extensions

- **Support of engineering processes**
  - Multi document architecture
  - Access protection (via XML encryption)
  - Support for change and versioning processes
History

- Sep 2006: Kick-off, start of joint development as industry cooperation
- Apr 2007: First press workshop to announce AutomationML
- Apr 2008: Release of AutomationML 1.0
  Release of COLLADA 1.5
  Start of standardization within IEC/DKE
- Nov 2008: Release of PLCopen XML 2.0
- Apr 2009: Foundation of the AutomationML Organization
  Release of AutomationML 1.1
## Planned standard series

**AutomationML: Planned IEC standard series**

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part I: Architecture*</td>
<td>Definitions, basic concepts, top-level architecture, usage of CAEX (IEC 62424)</td>
</tr>
<tr>
<td>Part II: Libraries</td>
<td>Role library, industry specific libraries</td>
</tr>
<tr>
<td>Part III: Geometry</td>
<td>Usage of COLLADA, CAEX interfaces to COLLADA</td>
</tr>
<tr>
<td>Part IV: Logic</td>
<td>Concepts, interlocking, usage of PLCopen XML, CAEX interfaces to PLCopen XML, extensions</td>
</tr>
<tr>
<td>Part V: ...</td>
<td>...</td>
</tr>
</tbody>
</table>

*) Version 1.1 released as Whitepaper at Hannover Messe 2009
The top-level architecture describes topology information and linking to other formats.

CAEX IEC 62424
Top level format

Plant topology information
• Plants
• Cells
• Components
• Attributes
• Interfaces
• Relations
• References

AutomationML
Engineering data

Object A

Object A₁

Object A₂

...

Object Aₙ

COLLADA
Geometry
Kinematics

PLCopen XML
Behaviour
Sequencing

Further XML Standard format
Further aspects of engineering information

Further aspects of engineering information

Init

Step 1

End
The topology description is based on CAEX (IEC 62424)

Example

<table>
<thead>
<tr>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core Concepts:</td>
</tr>
<tr>
<td>▪ Class Libraries</td>
</tr>
<tr>
<td>▪ „Template“ for objects</td>
</tr>
<tr>
<td>▪ Object oriented approach</td>
</tr>
<tr>
<td>▪ Instance Hierarchy</td>
</tr>
<tr>
<td>▪ Topology information</td>
</tr>
<tr>
<td>▪ Object properties</td>
</tr>
<tr>
<td>▪ Roles</td>
</tr>
<tr>
<td>▪ Abstract concepts to describe objects</td>
</tr>
<tr>
<td>▪ Examples are „robot“, „controller“, etc</td>
</tr>
<tr>
<td>▪ Interfaces and Relations</td>
</tr>
<tr>
<td>▪ The „Glue“ between objects</td>
</tr>
<tr>
<td>▪ The „Glue“ between topology, geometry, kinematics and logics information</td>
</tr>
</tbody>
</table>
A manufacturing cell in the AutomationML Editor
The geometry part describes fully kinematic-enabled scenes with COLLADA 1.5

- **Geometry**
  - Precise or tessellated for performance-optimized display
  - Different levels of detail

- **Surfaces**
  - Material
  - Shader

- **Kinematics**
  - Joints
  - Kinematic constraints
  - Dynamic constraints
  - Articulated systems

- **Kinematic-enabled scenes**
  - Links between geometry and kinematics
  - Parameterization
Complete cells can be transformed to leading tools via AutomationML

Delmia V5  Acrobat / PDF  COLLADA

VGR  JT2Go  Robcad
The logic part of AutomationML covers all engineering phases:

- **Product Design**
- **Plant Planning**
- **Mech. Constr.**
- **Electr. Constr.**
- **PLC Progr.**
- **Robot Progr.**
- **HMI Progr.**
- **Virtual Comm.**

**Planning**
- Gantt Chart
- Pert Chart

**Control System Behavior**
- Impulse diagram

**Interlocking**
- Logical Networks

**Control System Implementation**
- SFC

**Component Behavior**
- State Charts
- SFC
AutomationML maps important logic models to PLCopen XML

Gantt Chart

Impulse Diagram

Pert Chart

Sequential Function Chart

State Chart

Function Block
Software tools supporting AutomationML (realized or announced)

SIEMENS
SIMATIC Automation Designer based on Comos

ABB
RobotStudio

KUKA
KUKA.Sim

Development Services

Conditioner Pipeline Framework

Logic-CPF (Batch Tool)

Transformation to AutomationML

Transformation to AutomationML Logic

CPF (Batch Tool)

AutomationML Editor AutomationML Logic Viewer
Why become a member?

- **Influence**
  - Further direction of the AutomationML
  - Prioritization of own business cases

- **Collaboration**
  - Foundation of new working groups, e.g. devices, electrical planning, …
  - Contribution of own solutions to make them a standard

- **Ahead of competition**
  - Early access to specifications
  - Validation of own solutions before release of the next version of the standard
  - Early communication of new topics within the group
Join AutomationML!

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