Properties and the Asset Administration Shell as information backbone
How can true interoperability be achieved along the entire Industrie 4.0 value chain

→ Industrie 4.0
→ Digital Twins & Administration shells
→ Current developments
→ Recommendations

eCl@ss Congress
18 SEP 2019

Dr. Michael Hoffmeister
Festo AG & Co. KG
Festo provides (linear) motion for endless applications of factory and process automation

- **FA+PA**: 3.1 b€
- **300,000** customers
- **20,500** staff
- **62** companies
- **30,000** products
- **8%** R&D

Software + business models are crucial
Which are the goals of Smart manufacturing?

- Basic-Function: No accidents
- No information of and for drivers
- Rigid traffic flows

- Networking: Traffic lights adapt to traffic situation
- Adaption: Your car can choose a different route
- Energy efficiency: Your car brakes optimally
- Business Model: What would you pay for your green wave?
Plattform Industrie 4.0 unifies global companies as well as SMEs along the complete value chain. Plattform Industrie 4.0 is one of the worldwide largest networks for smart manufacturing with more than 350 pioneering companies. ... and many more.
Business case | Smartenance in Festo GPC Scharnhausen

- 15 years of paper history digitised
- schematics, maintenance schedules, repair instructions digitally available
- massive reduction of walking times, office space, tool kit preparation
- saving 1 week per year per machine
- ROI < 6 months, OEE increased
The RAMI4.0 model gives the logical frame of reference
Overall goal: integration across all system boundaries

RAMI 4.0 Architecture

<table>
<thead>
<tr>
<th>Digital World</th>
<th>Real World</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business models</td>
<td>Physical assets</td>
</tr>
<tr>
<td>Function</td>
<td></td>
</tr>
<tr>
<td>Information</td>
<td></td>
</tr>
<tr>
<td>Communication</td>
<td></td>
</tr>
<tr>
<td>Digitalisation</td>
<td></td>
</tr>
</tbody>
</table>

Interoperability along all added value chains

Source: Plattform Industrie 4.0, Bosch Rexroth, Festo AG & Co. KG
One core concept of Smart manufacturing is the versatile Administration Shell

With intelligent and networked components, we are establishing our products in the digital world.

The Administration Shell provides information and added values.

The digital worlds reflects the specific features of the asset.

All components require an Administration Shell to be part of Industrie 4.0 and smart manufacturing.

Source: Plattform Industrie 4.0, Dr. Michael Hoffmeister, Festo AG & Co. KG
Versatile and diverse information and functions need to be interoperable for new business models.

**Simplify engineering with component offers**
- dimensions
- conditions
- materials, lubrication
- certificates
- documentation

- Lower infrastructure costs
- Increase productivity

**System services for machine builders**
- dimensioning
- validation
- application planning
- special variants

- Extend portfolio north-wise
- Gain new competences

**Explore new life-cycle phases for business**
- energy saving
- condition monitoring
- analyse IoT Data
- availability
- quality

- Safeguard operation
- Increase profitability

**Approach: make business models feasible**
The real innovation:
We're giving each information an agreed meaning (semantics)!

14.0 compliant communication

**Submodels of the AAS**
- identification
- positioning
- safety (SIL)
- 3D model
- energy efficiency
- purchasing
- condition Monit.
- .. many further

**Submodel Positioning**
- Endpos. left [mm] 5
- Endpos. right [mm] 200
- Max. velocity [mm/s] 15
- Max. acceleration [mm/s²] 33
- No of completed jobs [1] 4634
- Avg. pos. lag. [mm] 4.5

= worldwide identification, if possible standardized as well: secure identities

- Identifier (1) *IRDI (International Registration Data Identifier)* in IEC 61360, ISO 13584
- Identifier (2) *URI / URL* (as in web)
Semantic IDs create for all assets and applications an **unambiguous understanding about the meaning of fundamental data**.

This understanding is achieved by enriching simple data with machine- and human readable descriptions.

**Property**

<table>
<thead>
<tr>
<th>Property</th>
<th>0173-1#02-BAA120#007 Max. rotation speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data type</td>
<td>INTEGER_MEASURE</td>
</tr>
<tr>
<td>Unit of measure</td>
<td>1/min</td>
</tr>
<tr>
<td>Definition</td>
<td>Greatest possible rotation speed with which the motor or feeding unit may be operated</td>
</tr>
</tbody>
</table>

2000 = Max. rotation speed (1/min)
Data formats nearly clarified: Specification series: "Details of the Administration Shell"

Part 1 - Information model for the AAS for the exchange of information between partners in the value chain

Part 2 - Interfaces and API for using a single AAS information model described in Part 1 (access, modify, query and execute information and active functionality)

Part 3 - Infrastructure, which hosts and interconnects multiple AAS together (registry, discovery, endpoint handling)
Asset Administration Shell as information backbone of Industrie 4.0

- suppliers of materials
- technology providers
- machine builders
- integrators
- factory operators
- service providers

engaging in:
- unified information models
- strong information security
- new business models

Remark: exemplary systems
For each industrial domain, we want to have **exactly one** submodel providing a dependable set of **minimal required information**

<table>
<thead>
<tr>
<th>Domäne</th>
<th>mögl. Kandidaten</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identification (FA? PA?)</td>
<td>Admin shell in practice (DE), PA-DIM, ..</td>
</tr>
<tr>
<td>Documentation</td>
<td>VDI 2770</td>
</tr>
<tr>
<td>Asset classification</td>
<td>eCl@ss classification</td>
</tr>
<tr>
<td>Technical data</td>
<td>eCl@ss properties</td>
</tr>
<tr>
<td>Fluidics</td>
<td>VDMA WG Fluidtechnics I4.0</td>
</tr>
<tr>
<td>Modules process autom.</td>
<td>NAMUR MTP</td>
</tr>
<tr>
<td>Sensors PA</td>
<td>NAMUR Core Parameter</td>
</tr>
<tr>
<td>Sensors FA</td>
<td>ZVEI WG Sensorik</td>
</tr>
<tr>
<td>Electrical drives</td>
<td>ZVEI &amp; VDMA WG El. Drives</td>
</tr>
<tr>
<td>Software modules</td>
<td>ZVEI WG Software</td>
</tr>
<tr>
<td>Machine state</td>
<td>40 x Companions-Specs of VDMA</td>
</tr>
<tr>
<td>Condition Monitoring</td>
<td>VDMA 24582</td>
</tr>
<tr>
<td>Spare parts</td>
<td>multiple WGs</td>
</tr>
<tr>
<td>Maintenance manuals</td>
<td>Impulse from AASX examples</td>
</tr>
<tr>
<td>3D models (M-CAD)</td>
<td>Impulse from AASX examples</td>
</tr>
<tr>
<td>schematics (E-CAD)</td>
<td>Impulse from AASX examples</td>
</tr>
</tbody>
</table>
Asset Administration Shell in international context

**Trilateral Cooperation (FR, IT, DE)**

- **Alliance Industrie du Futur**
- **PIANO INDUSTRIA 4.0**
- **INDUSTRIE 4.0**
- **DIGITISING EUROPEAN INDUSTRY**

Advanced & Interoperable Digital B2B Platforms for Smart Factories and Energy

**Industrial Internet Consortium (IIC)**

- **Dec '17**
  - 1st joint whitepaper

- **Nov '19**
  - 2nd joint whitepaper

**synergies**

- **IIRA**
- **RAMI 4.0**
- **Digital Twin**
- **VWS**

**and many further cooperations**

- ISO/IEC JWG 21
- IEC TC65 WG23
- ISO TC184 WG15

Source: Bosch
Livedemo | AASX Package Explorer | Semantically enriched information
Livedemo | AASX Package Explorer | Access on embedded documents
The technologies and prototypes are ready to be prototyped

- demonstrators on fairs and exhibitions
- recurring test labs
- best practice recommendations
- open source libraries
- editors and tools
- research platforms
We're building an eco-system around smart manufacturing!

**Component supplier**
- Delivers Industrie 4.0-Components
- Provides new Industrie 4.0-Services
- Continuously improves his products and services

**Machine builder**
- Uses accelerated engineering
- Builds reconfigurable machines
- Integrates into customers' supply chain

**Factory operator**
- Develops products digitally
- Designs in parallel product, process, equipment
- Optimizes production (lotsize 1 and mass production)
- Joins real & virtual worlds (as design, as built, as operated)

Many further partners (IT, consultancy, engineering, maintenance, services) can flexibly integrate with this eco-system!
Thank you!
Questions?