VALIDATION OF OPC UA INTERFACES WITHIN THE SCOPE OF DIGITAL PLUG-AND-PRODUCE

Presented by
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Division: Corporate Management
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Competencies of Fraunhofer IPK

Solutions along the production chain – The path to the digital integration

- PRODUCTION TECHNOLOGY
  - Machines und Equipment
  - Tools
  - Operating Resources
  - Processes

- IT-TECHNOLOGY
  - Data
  - Networks
  - Algorithms
  - Interoperability
  - Security

- ENGINEERING-TECHNOLOGY
  - Requirements
  - Engineering
  - Construction
  - Simulation
  - Virtual Validation

- CORPORATE PROCESSES
  - Modelling
  - Steering
  - Monitoring
  - Transformation
  - Quality Assurance

- ORGANIZATION- AND BUSINESS-MODELS
  - Local, regional, global
  - Central, decentral
  - Open, closed Community

- BENEFITS AND RISKS
  - Costs
  - Time
  - Quality
  - Sustainability

- DIGITAL INTEGRATED PRODUCTION
  - agile, focused
  - measure, steer, apply
  - plan, steer, apply
  - specify, test, feel
  - efficient, robust, precise
Production Technology Center

Fraunhofer-Gesellschaft
Institute for
Production Systems and Design Technology (IPK)

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Prof. Dr.-Ing. H. Kohl

Virtual Product Creation
Prof. Dr.-Ing. R. Stark

Production Systems
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Automation Technology
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Joining and Coating Technology
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University of Technology Berlin
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Micro Production Technology
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The Division of Corporate Management works on the development and implementation of innovative concepts for the design of service provision processes and management within and between organizations, as well as on the development of methods and software tools to **support strategic and operational planning and control**.
Integrated Enterprise Modeling and MO²GO

Model based production planning, control and monitoring

Objective
Visualization and design of enterprise systems and processes to understand the appearance, interconnections, dependencies, responsibilities and constraints within the enterprise information.

Brief benefits:
• Enterprise model with consistent information and process model
• Fast consistent model design and analysis
• Easy to understand
• Flexible in terms of application and adaptation (adaptable metamodel)

Model-based Knowledge Management
IT Specification and Implementation
Interoperability and Corporate Network
Factory Planning and Management
Benchmarking
Corporate Strategy Development
Requirements Management
Synchronisation and Harmonisation of Distributed Enterprises and Enterprise Cooperation
Integrated Management Systems
Implementation and Optimization of Business Processes and Organisation Concepts
Enterprise Design
Objective
The aim of "Industry 4.0 out of the box" is to quickly and ad hoc network machines and systems for order-specific scheduling and to be able to track special orders.

Partner Fraunhofer Institutes
IPK (UM, PS), FOKUS (IIoT, SQC)

Industry:
Budatec GmbH

Temporary ad-hoc increase of the maturity concerning digitization, production process analysis and fault detection
Objective
On three workshop days, I4.0 solutions will be prototypically used by SMEs, data will be analyzed and potentials for digital networking will be demonstrated.

Partner Fraunhofer Institutes:
IPK (UM, AUT, VPE), FOKUS (IIoT, DANA, SQO), IZM (R3S)
Industry:
Gebrüder Geisler GmbH

Digitization Kit

Fasten-up, motivation and support of digital transformation of SMEs
**Objective**

Increases the flexibility of manufacturing systems and provides a standardized way to set up manufacturing control on top of the machinery.

**Brief benefits:**

Connects the production system with Shopfloor IT without programming via semi-automated generation of control processes by using enterprise models and provides a common interfaces to heterogeneous production systems using OPC-UA.

- Shopfloor provides services to invoke into a production process,
- Model based production planning, control and monitoring
Project IoT-Test (September 2016 – December 2019)

Objective
Development of methods and technologies (testware) for building test labs for the Internet of Things.

- Test and certify in real environments
- Seamless integration of functions (robustness, interoperability)
- Information security and reliability
- Label, certificate
- Standardized test tools and test labs

The project has been extended with further resources regarding security, performance and usable prototypes

Initial testware and validation software is available.

http://www.iot-t.de/en/

IoT-Testware
Protocol test (compliance, security, performance)
- CoAP
- MQTT
- OPC-UA

Application and Interoperability test OPC-UA
- CPS Validation Adapter
- CPS Emulation
Proposals concerning interoperability of information models using OPC-UA

- Development of a validation approach to test server and clients before the integration into the IT infrastructure by using of the **OPCF XML format** to describe the information model in an executable way.

- Provide **prototypes** of software components supporting the approach

- Need of the development of common information models in terms of standards or **company standards**
IoT-T for Industry especially OPC-UA – Digital Plug-and- Produce

1. Specifications for IT interfaces
   - Plant operator / User
   - Equipment supplier / System integrator
   - OPC-UA Application standard

2. Specification
   - OPC-UA Specification for new plant

3. Development
   - OPC-UA Testing for interoperability

4. Installation / Commissioning
   - Setup in company infrastructure

5. Operation
   - Adjustments / updates of the IT interfaces
Validation approach for the client related to the information model

<table>
<thead>
<tr>
<th>OPC-UA Client</th>
<th>OPC-UA Server</th>
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</thead>
<tbody>
<tr>
<td>➢ Client reads target information model (XML file)</td>
<td>Server provides:</td>
</tr>
<tr>
<td>➢ Client compares node structure in target information model with the node structure found in the server (name search)</td>
<td>➢ Node structure</td>
</tr>
<tr>
<td>➢ Client identifies the corresponding node IDs in the server</td>
<td>➢ Node ID</td>
</tr>
<tr>
<td>➢ Client checks the data in the server information model against the data in the target information model (e.g. data types)</td>
<td>➢ Details of the Information model (e.g. data types)</td>
</tr>
<tr>
<td>➢ Client provides log file with results of the validation (JSON file)</td>
<td></td>
</tr>
</tbody>
</table>

**OPC-UA Server Application**
(e.g. digital interface of facility)

**CPS ValidationAdapter**
Examples of validation purposes

- NodeId do not exist (missing node)
- BrowsName do not exist (missing node)
- Reference is missing
- Additional nodes identified
- ParentNodeID do not correlate
- Attribute set do not correlate
- ...
Software elements

- Test Configuration
- Log File
- Target Information Model (Specification)
- OPC-UA Management
- OPC-UA Calls
- Invocation of OPC-UA Implementations / Services
- OPC-UA Requests
- Information Model
- Server under validation

CPS ValidationAdapter
- OPC UA Java Milo framework of Eclipse foundation
- OPC UA Java framework of OPC Foundation

CPS Emulator (Softing)
Conclusion

Results

• CPSVA and CPSE
• Initial TDL descriptions of validation purposes
• Initial demonstration
• Requirements

Next steps

• Application scenarios and validation purposes
• Easy use of the validation tools
• CPS validation adapter on GitHub
• Concept for automatic execution of application scenarios for OPC UA testing
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