OPC DAY FINLAND 2016

TUESDAY, OCTOBER 18TH 2016 @BECKHOFF, HAKAKALLIONTIE 2, HYVINKÄÄ

Combining AutomationML and OPC UA

Dr.-Ing. Miriam Schleipen

Agenda

- Motivation
- Plug-and-work principles
- Goals
  - Mapping of AutomationML and OPC UA
  - Access to the AutomationML model in OPC UA
- Examples
- Conclusion and Outlook

Motivation - Changes

- Continuous changes of production systems → reconfiguration of hardware and software components
- Objects to change within a manufacturing enterprise
  - Products
  - Technological or logistical processes
  - Parts of the manufacturing facilities
  - Software systems
  - Company's organization
- → interoperability and seamless semantic integration necessary

Initial situation - ‚Babylon' on the shopfloor

Visualization / SCADA
Production Monitoring & Control

?

Ωασχημοδυ
Τροχκενμοδυλ
Τεμπερατυρ
Γεσχηωινδιγκειτ

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Image sources: MOC Danner, KUKA, MAG, Schunk

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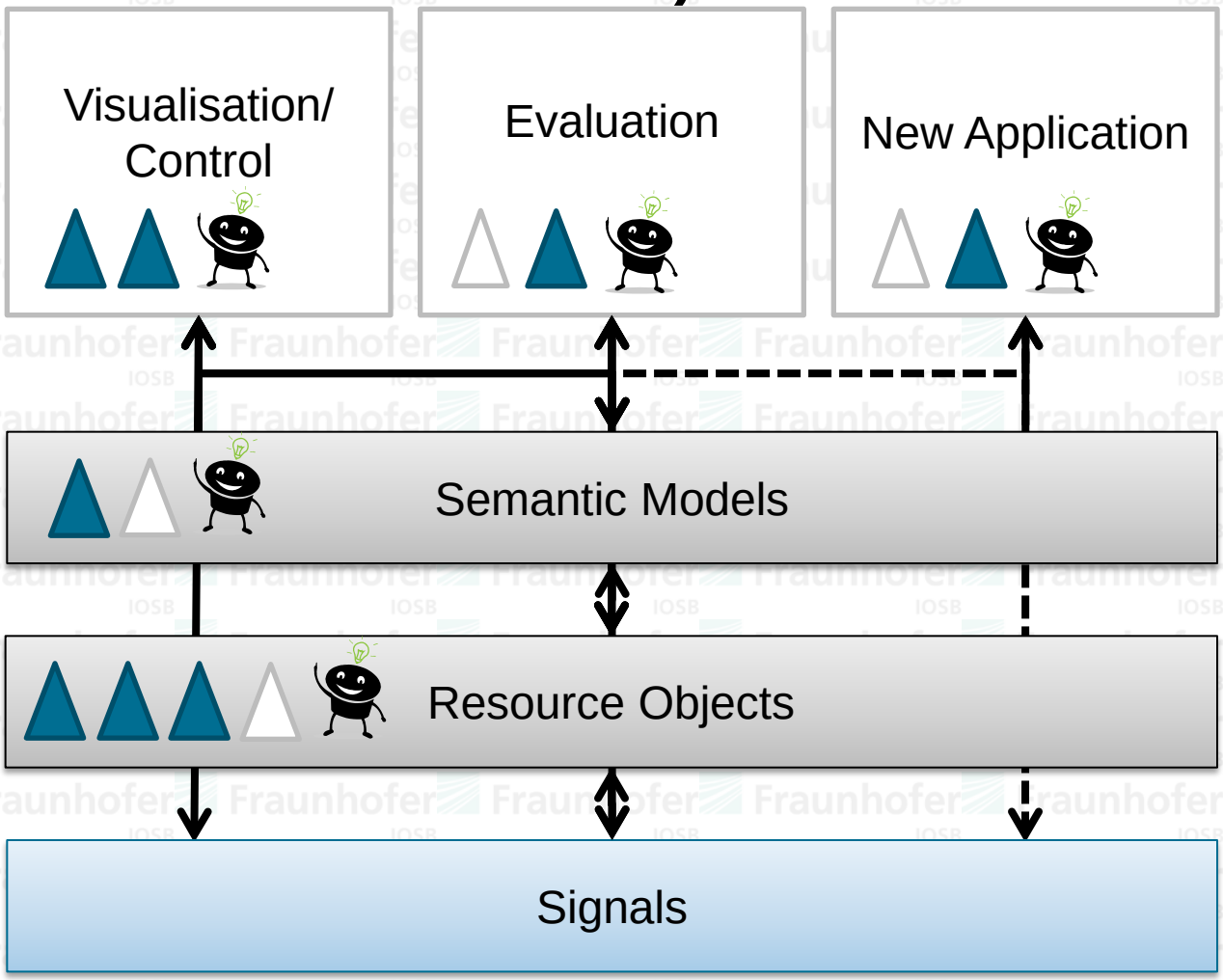
Plug-and-work

- Term definition:
  - setting up, modification or termination of interoperation between two or more involved parties with minimal effort
  - **Note 1**: The interoperability of those involved is assumed.
  - **Note 2:** The minimum effort can vary depending on the state of the art.
  - **Note 3**: Plug & play and plug & produce are synonyms or similar terms.

Source: I4.0 Glossary of the VDI GMA technical committee 7.21 »Industrie 4.0«

Unique Datamodels (yesterday-Level 1, today-Level 2, tomorrow-Industrie 4.0)



Function

Knowhow/Meaning
(„Industry 4.0“)

Information
(Level 2)

Data
(Level 1)

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Plug-and-work

IOSB Plug-and-work hardware and software

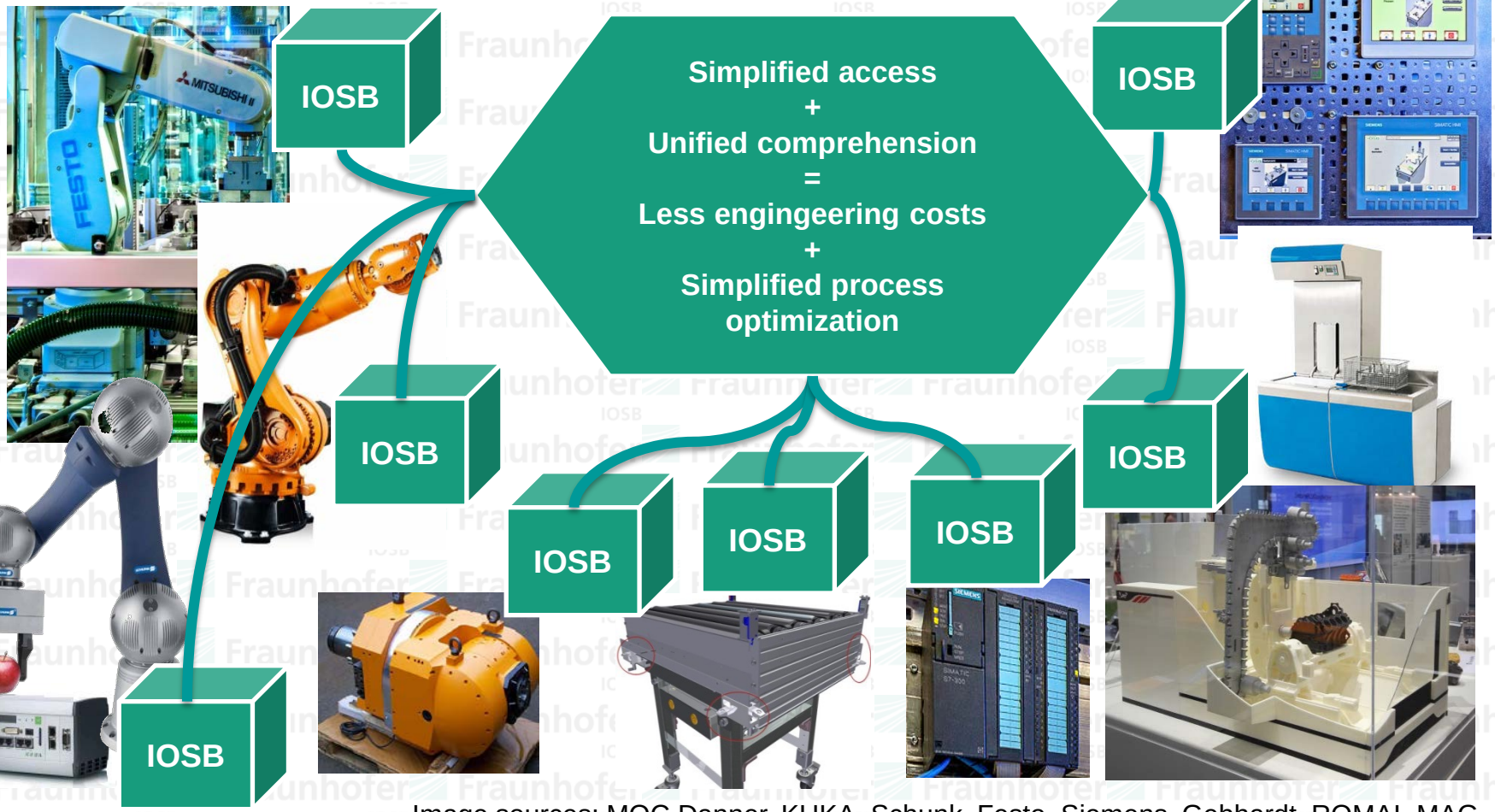

Image sources: MOC Danner, KUKA, Schunk, Festo, Siemens, Gebhardt, ROMAI, MAG

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Requirements for plug-and-work

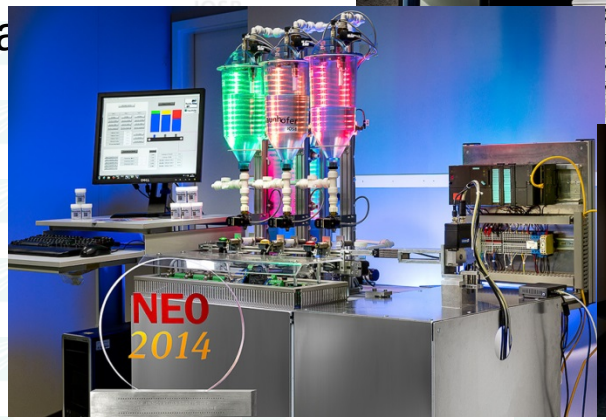
- Component description
- Component selection
- Component access
- Component control

Miriam Schleipen, Arndt Lüder, Olaf Sauer, Holger Flatt, Jürgen Jasperneite: Requirements and concept for Plug-and-Work - Flexibility in the context of Industry 4.0 (Anforderungen und Konzept for Plug-and-Work – Flexibilität im Kontext von Industrie 4.0). at - Automatisierungstechnik. Band 63, Heft 10, Seiten 801–820, ISSN (Online) 2196-677X, ISSN (Print) 0178-2312, DOI: 10.1515/auto-2015-0015, October 2015

Plug-and-work principles

- (Self-)Description via AutomationML (IEC 62714)
- Assistant-Functions and Accumulation/Fusion
- Communication/ Data-Management/ Identification/ Validation via OPC UA (IEC 62541)
- Combination with Middleware, Fieldbus-Technologies, IT-Security-Components, Hardwa
- Test/Realization of Components/Systems of industrial partners and accordingly inhouse demo systems

NEO2014
DER INNOVATIONSPREIS DER TECHNOLOGIEREGION KARLSRUHE



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(Self-)Description of Components, Machines and Plants

1. Production system components and their skills (function-oriented descriptions)
2. Function-oriented descriptions of production tasks
3. Methods for an automatic matching/comparison
4. Description of the access path to the functions

What?

<AutomationML/>

Semantic description of production plant

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Communication, Data Exchange of Components, Machines, Plants and IT-Systems

1. Standardized interfaces for the access to components
2. Universal combination of components to production systems
3. Modular and self-adapting information and control structures
4. Self-parametrisation of the structures possible

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Communication and management of data models including security

How?

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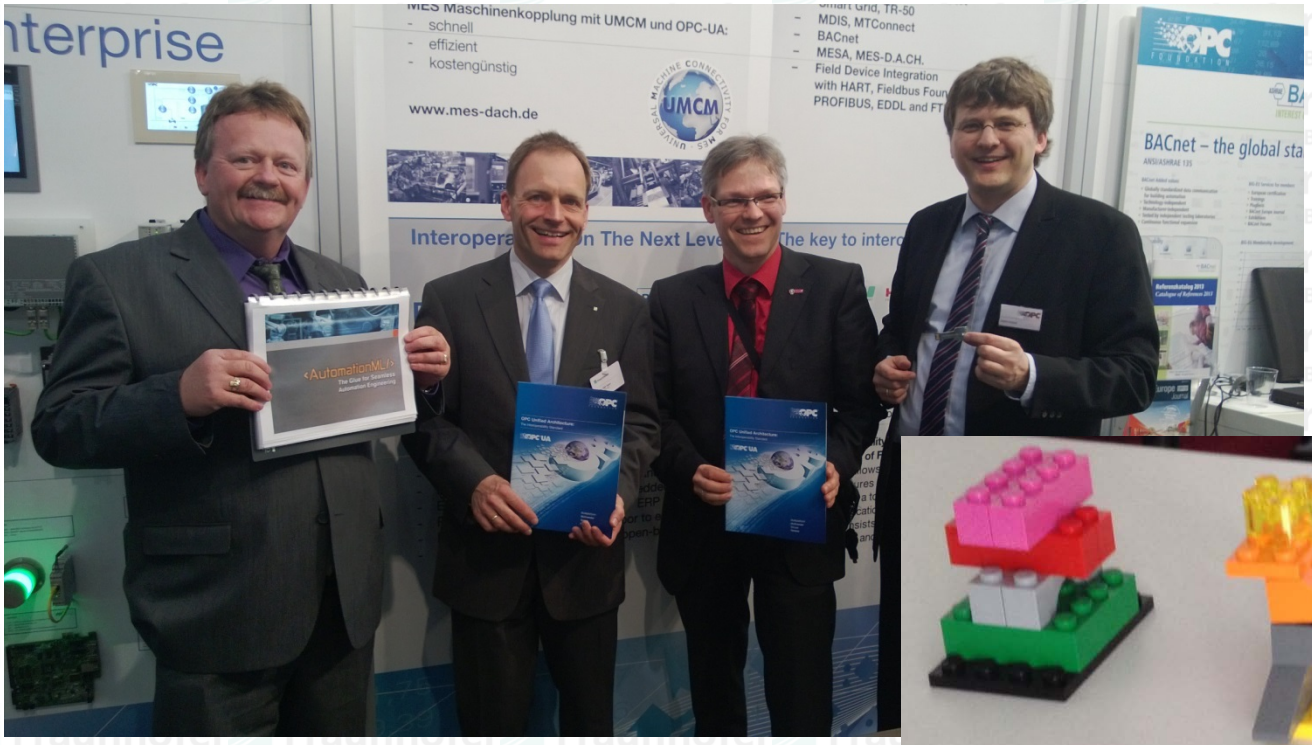
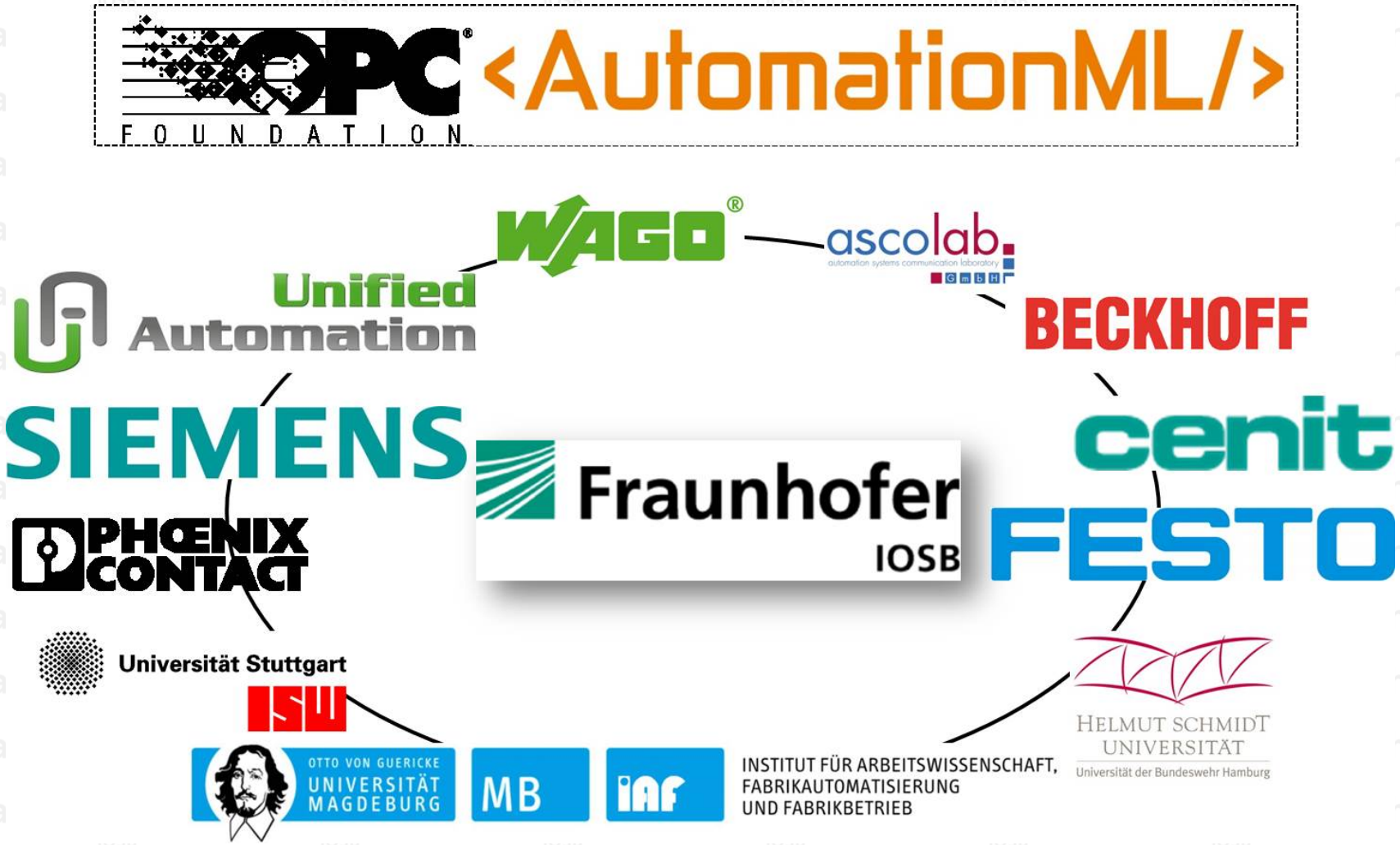
Start of cooperation at SPS/IPC/Drives 2013 (AutomationML e.V. and OPC Foundation)



Work group members



Companion Specification „AutomationML for OPC UA“ 02/2016

DIN SPEC 16592 „Combining AML and OPC Unified Architecture“ Coming soon (2016)

OPC UA™

Communication and management of data models including security

How?

What?

<AutomationML/>

Semantic description of production plant

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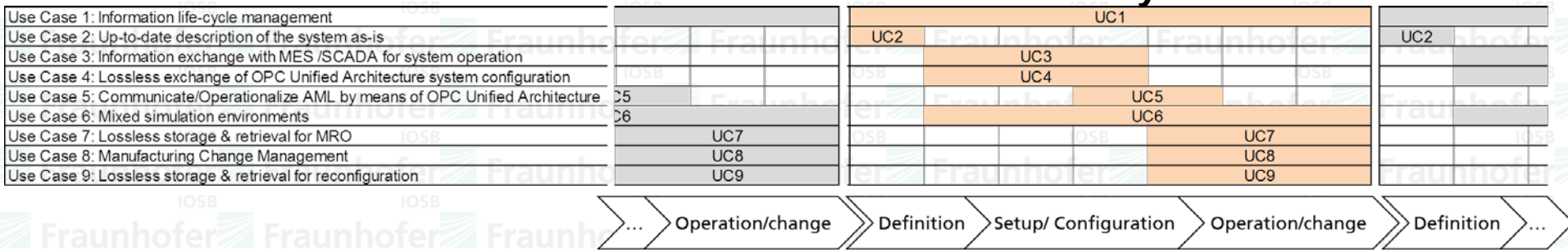
Relations between use cases over the lifecycle



Actors and related use cases

DIN SPEC 16592 Annex A – Industrial application

	Use Case 1: Information life-cycle management	Use Case 2: Up-to-date description of the system as-is	Use Case 3: Information exchange (e.g. asset information, quality information, diagnostic data, etc.) with MES or SCADA system for system operation	Use Case 4: Lossless exchange of OPC Unified Architecture system configuration	Use Case 5: Communicate/Operationalize AML by means of OPC Unified Architecture	Use Case 6: Mixed simulation environments	Use Case 7: Lossless storage and retrieval of system engineering information for system maintenance, repair, overhaul (MRO)	Use Case 8: Manufacturing Change Management	Use Case 9 : Lossless storage and retrieval of system engineering information for manufacturing system reconfiguration
Mechanical engineer	x	x		x	x		x	x	x
Electrical engineer	x	x		x	x		x	x	x
Software developer (PLC, HMI, Robot, distributed control system (DCS), network, etc.)	x	x		x	x	x	x	x	x
Plant operator	x		x	x		x	x	x	
SCADA system/MES provider, IT integrator			x	x				x	
Maintenance personnel					x		x	x	
Commissioner	x	x			x			x	
Plant/Factory Planner	x							x	

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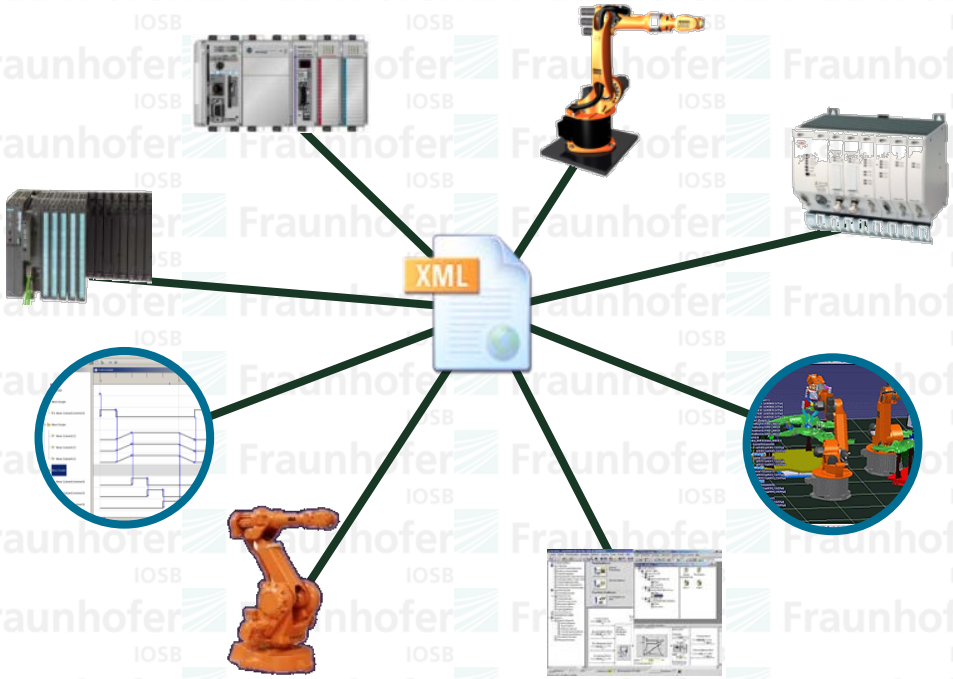
Goals and benefits (1)



- AutomationML integration in OPC UA
- Goal: Communicate and operationalize AutomationML by means of OPC UA
- OPC UA server includes functional view on production
  → information model
- Result: AutomationML models can be exchanged via OPC UA
- Benefit: simplify the creation of OPC UA information models based on existing AutomationML data
- Application: re-engineering and maintenance use cases where the AutomationML model evolves over time

Use Cases

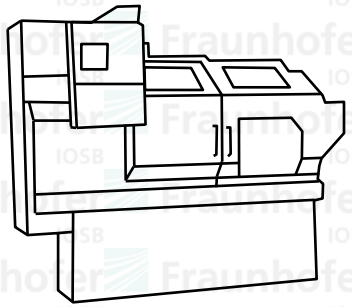
- Information life-cycle management
- Up-to-date description of the system as-is
- Information exchange (e.g. asset information, quality information, diagnostic data, etc.) with MES or SCADA system for system operation
- Communicate/Operationalize AML by means of OPC Unified Architecture
- Lossless storage and retrieval of system engineering information for system maintenance, repair, overhaul (MRO)
- Lossless storage and retrieval of system engineering information for manufacturing system reconfiguration

PLUG & WORK – Online/Operation: Data usage of operation phase

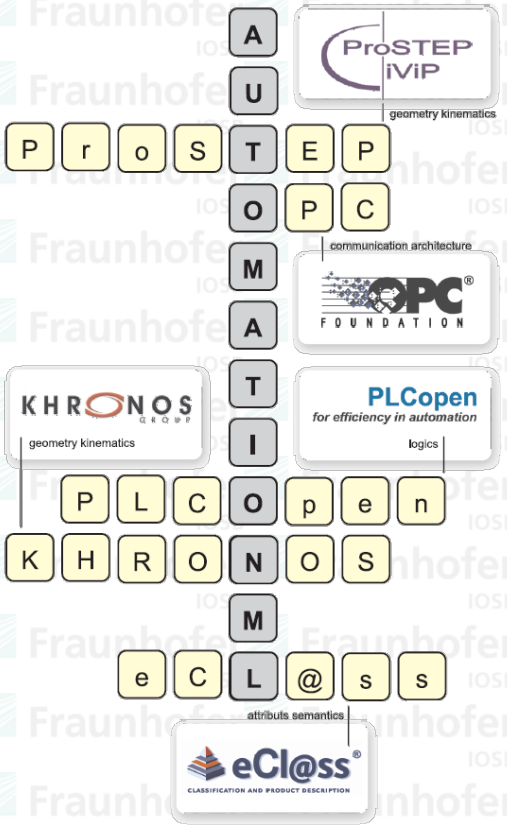
- Use Case „Lossless storage and retrieval of system engineering information for system maintenance, repair, overhaul (MRO)”
- Benefits and usage
  - More exact failure forecast (based on operational data)
  - Predictive maintenance (based on operational data)
  - Easy and safe maintenace and connection (at customer site → network)
  - Longer guarantee/warranty of components (based on operational data)
  - Log/history for components (persistent storage)

Machine vendor

Machine operator



Goals and benefits (2)



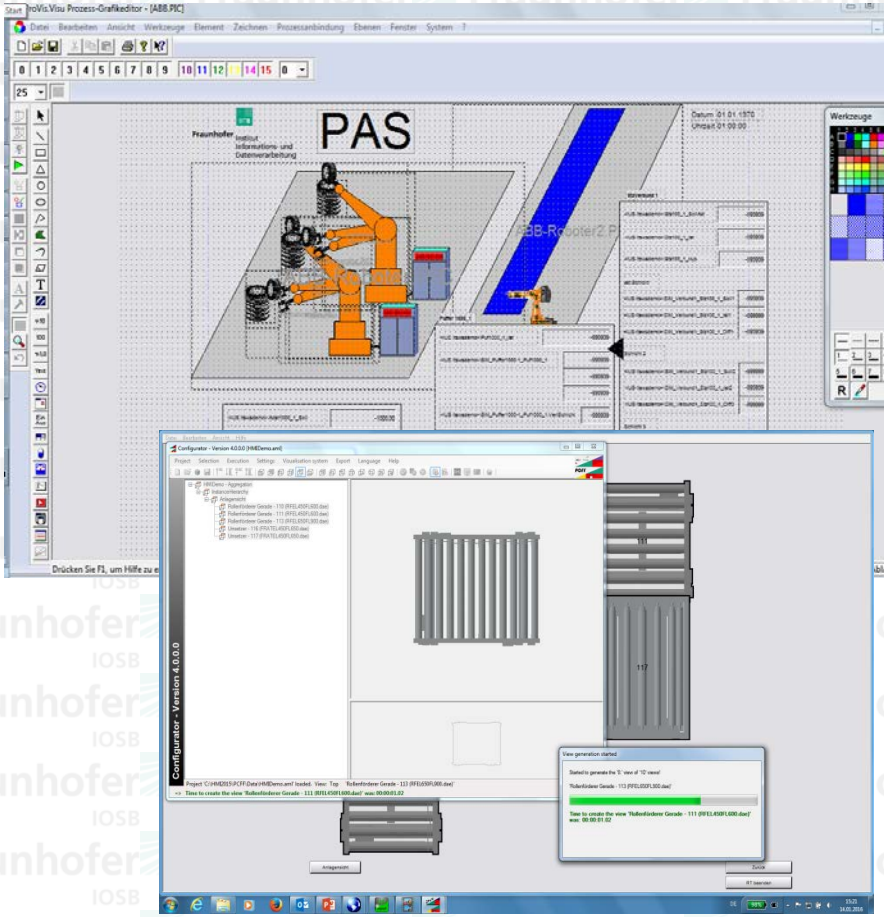
- OPC UA integration in AutomationML
- Goal: Lossless exchange of OPC UA system configuration within AutomationML models
- Result: Parameters to set up OPC UA communication between tools can be exchanged using AutomationML
- Benefit: simplify the configuration of OPC UA client connections to an OPC UA server (reduce manual configuration effort)
- Application: configuration of communication networks based on description of network configuration and structure (including communication components of sensors and actuators with respect to communication system parameters, network structure and wiring, quality of service, etc.)

Use Case

- Lossless exchange of OPC Unified Architecture system configuration
- Mixed simulation environments
- Manufacturing change management

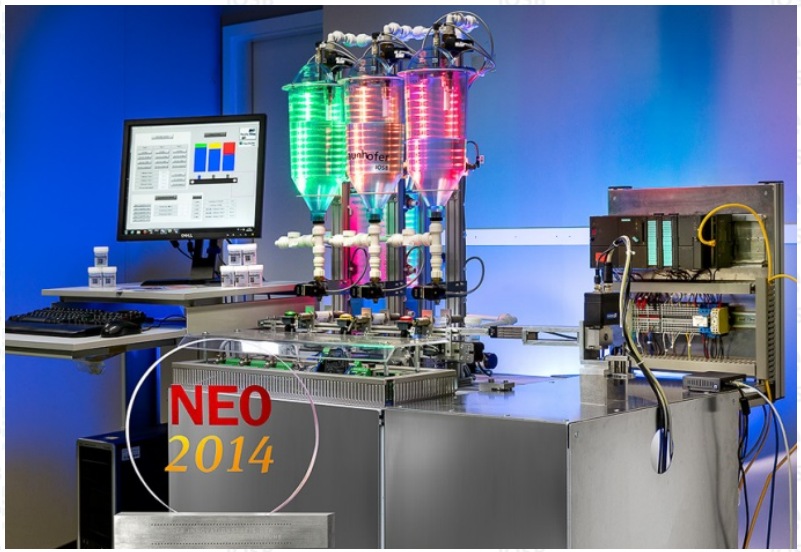
PLUG & WORK – Offline/Engineering: Data usage for configuration

- Use case „Lossless exchange of OPC Unified Architecture system configuration”
  - Benefits and usage
    - Faster startup
    - Integrated documentation for components
    - Usage of existing data for engineering of MES and visu



Example: Demo available in Karlsruhe

- Demo plant: each module/ controller equipped with OPC UA server
- Aggregating OPC UA server based on Unified Automation C++ SDK
- AutomationML model of plant
- Trafo tool: AML2UA
- AML model = information model of aggregating server with connection to OPC UA server of controllers
- View on aggregating server with AML-UA-information model via different clients



Past and present research in this area

- BMBF, SecurePLUGandWORK, 02PJ2590 ff, 2013-2016, http://www.secureplugandwork.de
- BMWi, PCFF – Plug & Control for flexible transport equipment, ZIM KF2074712KM2, 2013-2015, http://www.zim-pcff.de/
- EU, SkillPro - Skill-based Propagation of "Plug&Produce"-Devices in Reconfigurable Production Systems by AML, FP7-2012-NMP-ICT-FoF (Grant 314247), 2012-2015, http://www.skillpro-project.eu
- EU, EIT Digital, EIT CPS High Impact Initiative – Industrie 4.0 Powering Europe, 2015, http://www.eitcpshii.eu/

DIN SPEC 91345 – RAMI4.0


April 2016

DIN SPEC 91345

DIN

ICS 03.100.01; 25.040.01; 35.240.50

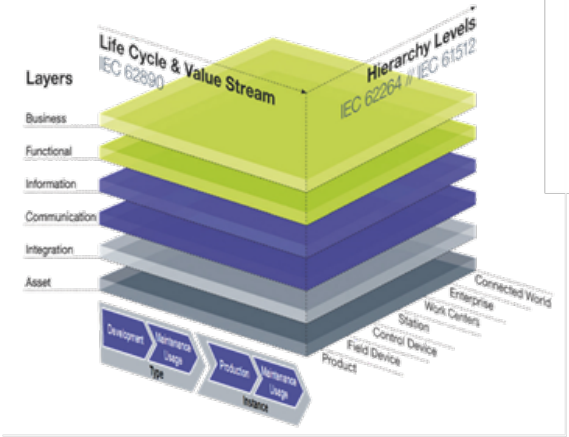
Referenzarchitekturmodell Industrie 4.0 (RAMI4.0)

Reference Architecture Model Industrie 4.0 (RAMI4.0)

Modèle de référence de l'architecture de l'industrie 4.0 (RAMI4.0)

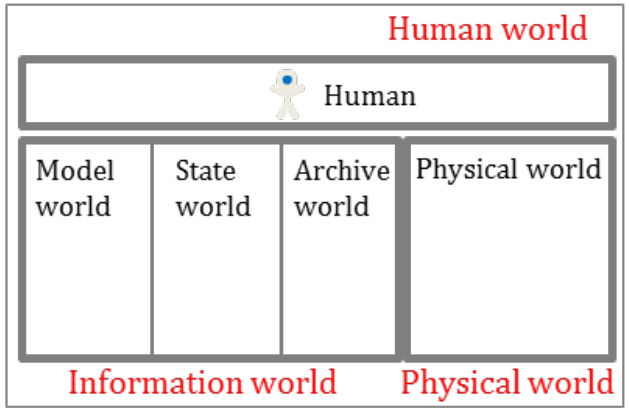
Zur Erstellung einer DIN SPEC können verschiedene Verfahrenswege herangezogen werden. Das vorliegende Dokument wurde nach den Verfahrensregeln einer PAS erstellt.

DIN SPEC 91345 describes …

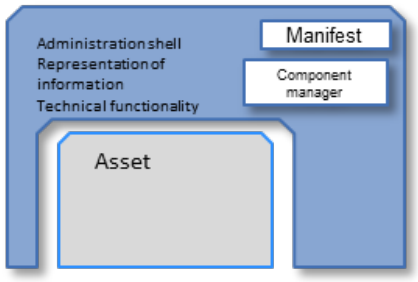


… are structured and …

Reference architecture model Industrie 4.0



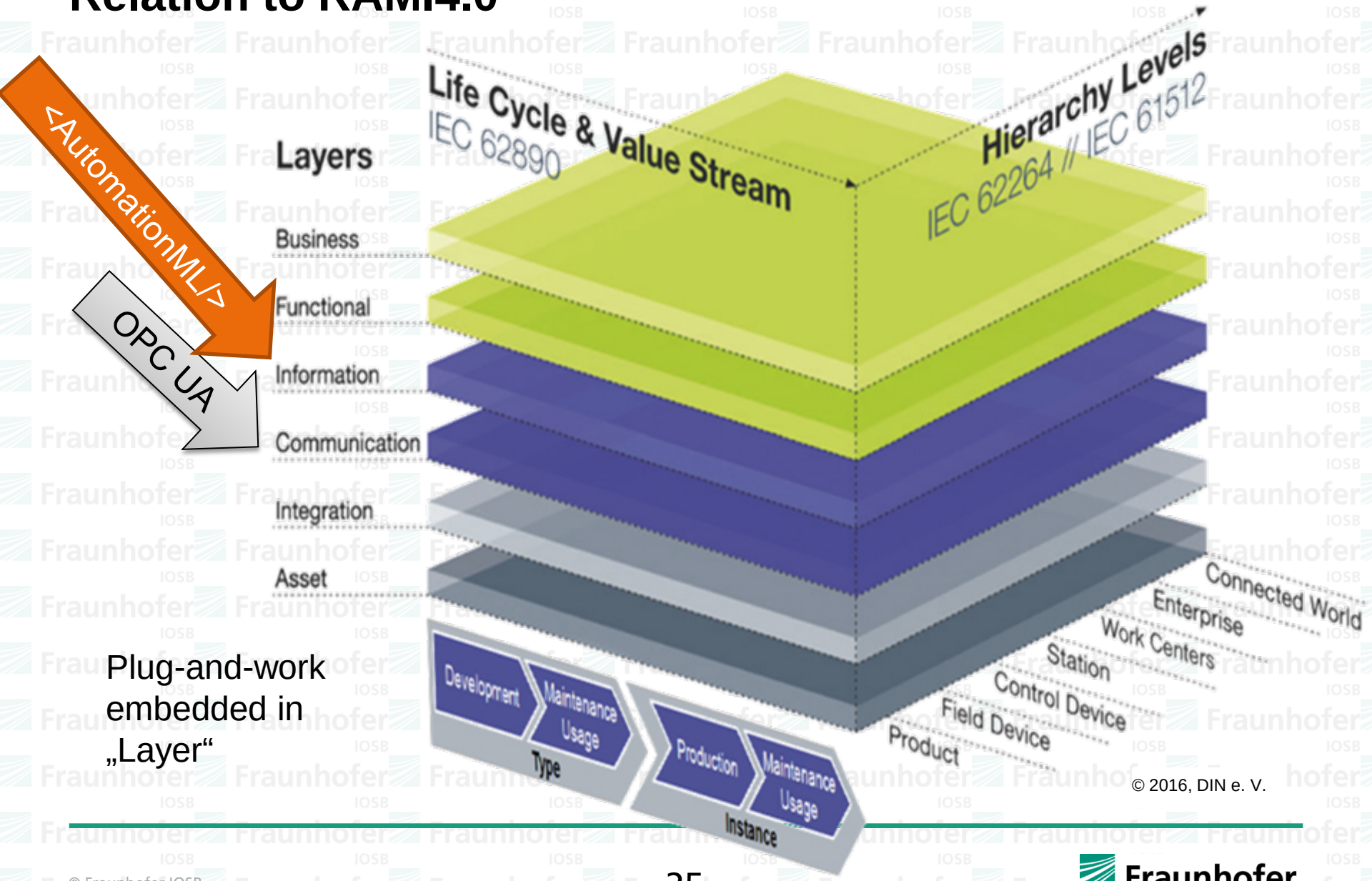
… how technical assets …



Industrie 4.0 component

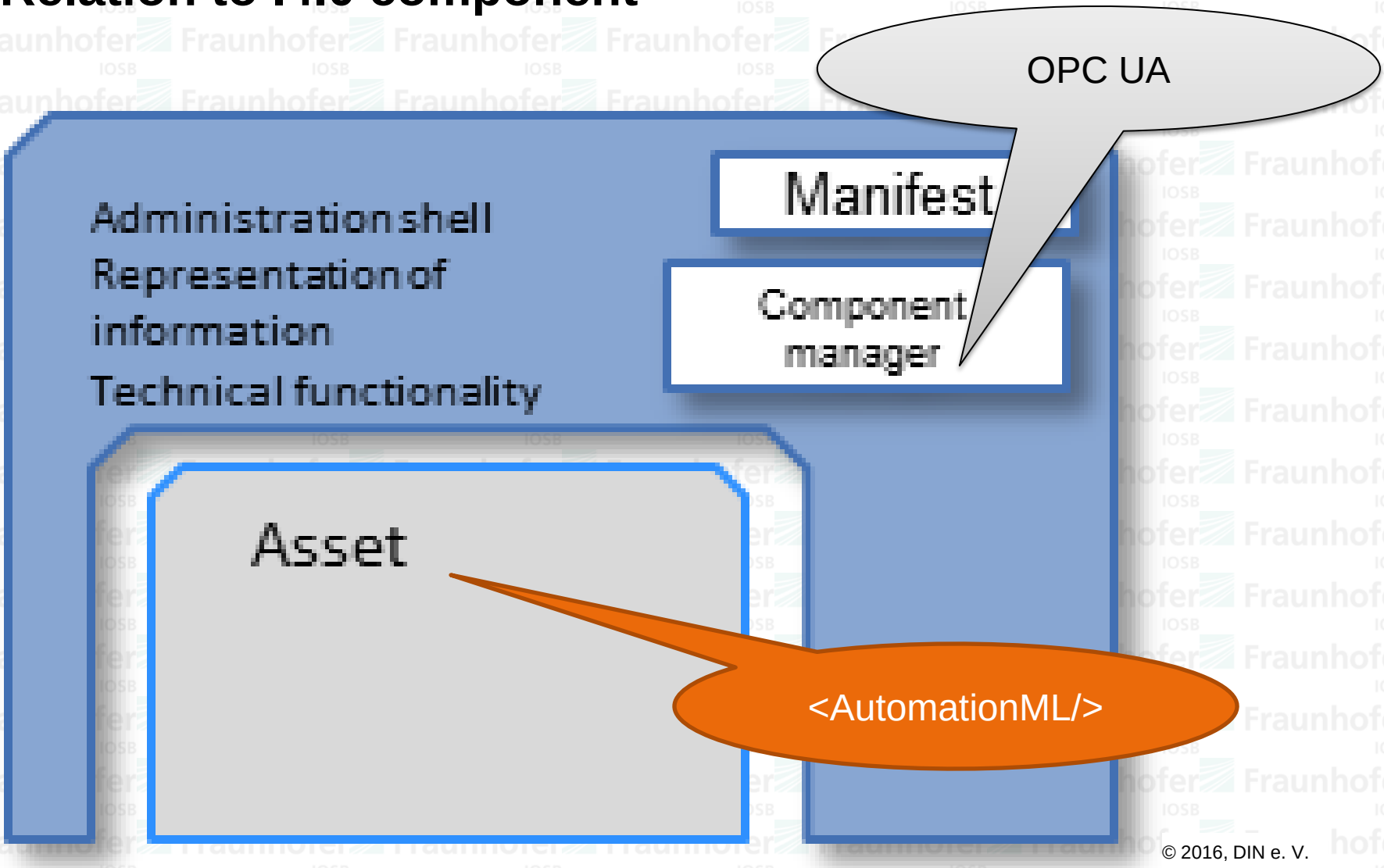
… made available for the information world!

Relation to RAMI4.0



Plug-and-work embedded in „Layer“

Relation to I4.0 component



Conclusion and Outlook

- Plug-and-work based on standards for I4.0 components
- February 2016: Companion Specification „AutomationML for OPC UA“: general explanation, mapping rules, and definition of organizing nodes and AutomationML standard libraries
- Coming soon (2016): DIN SPEC 16592 – Combining AML and OPC Unified Architecture
  - Extended mapping rules, integration of OPC UA configuration data in AutomationML, relation to other standards and specifications, and use cases for industrial application
- Current work of joint working group
  - AML BPR - DataVariable concept: Integration of OPC UA configuration data in AutomationML
  - Harmonization with other companion specs: OPC UA for devices, OPC UA for IEC62264 (ISA95), OPC UA for FDI, OPC UA for IEC61131-3 (PLCOpen)
- Current status via AutomationML/OPC-F website or http://www.iosb.fraunhofer.de/?opcuaaml

Thank you!

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Impressum

http://www.iosb.fraunhofer.de/?factory+and+tools

Combining AutomationML and OPC UA

Finland, October 2016

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