

PUBLIC

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Module Type Package

Automation Engineering of Modular Process Plants

Mario Hoernicke/Katharina Stark, ABB Corporate Research



Automation Engineering of Modular Process Plants

AutomationML – The Industrial Cookbook

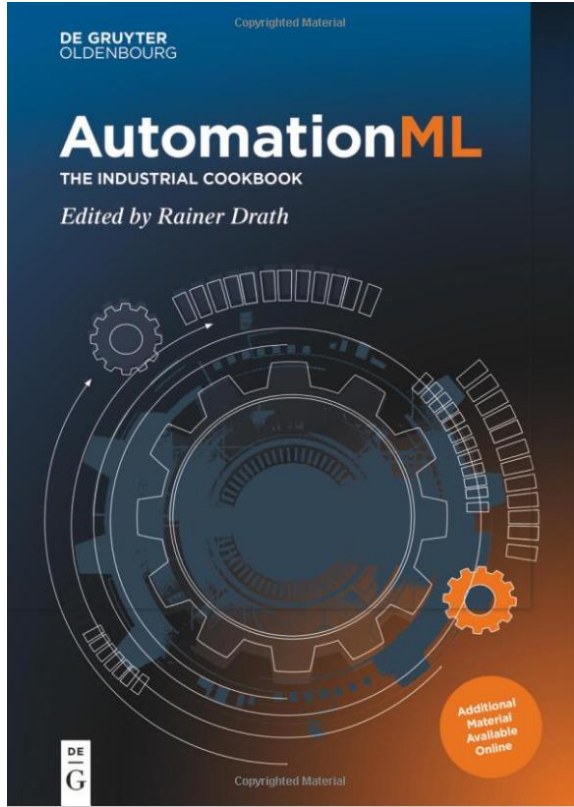


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Mario Hoernicke, Dipl.-Ing. (FH)
Senior Principal Scientist
ABB AG Corporate Research Center Germany
Wallstadter Straße 59
68526 Ladenburg, Germany
E-Mail: mario.hoernicke@de.abb.com
Mario Hoernicke (born 1984) studied electrical engineering and automation science at University of Applied Science in Darmstadt. After the completion with the degree Dipl.-Ing. (FH) in 2008, he started at ABB Corporate Research as a scientist. Since 2018, he is Senior Principal Scientist with the focus on Automation Engineering.



Katharina Stark, M.Sc.
Senior Scientist
ABB Corporate Research Germany
Wallstadter Straße 59
68526 Ladenburg, Germany
E-Mail: katharina.stark@de.abb.com
Katharina Stark (née Gohr) studied automation engineering, later followed by a master course in Mannheim, Germany. She joined ABB Corporate Research in 2002 and became a Senior Scientist for Automation Engineering in 2018. From 2007 to 2010, she was an expatriate at strategic research for oil and gas in Oslo, Norway. Her research interests are workflows and tools in the area of automation engineering.



Prof. Dr.-Ing. Leon Urbas
Chair of Process Control Systems & Head of Process Systems Engineering Group
TU Dresden
Helmholtzstr. 10
01069 Dresden, Germany
E-Mail: leon.urbas@tu-dresden.de
Leon Urbas studied computational engineering science at TU Berlin. He earned his doctorate in process systems engineering for his research on operator training systems with Prof. G. Wozny and became a full professor at TU Dresden after several years of industrial work experience in process optimization, automation and digitalization. He is one of the founding fathers of the module type package.

Mario Hoernicke, Katharina Stark, Leon Urbas

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Automation Engineering of Modular Process Plants

Background

Market situation:

- Highly competitive
- Volatile markets
- Shorter product lifecycle requires faster time-to-market

Conventional production plants:

- World-scale are efficient, but inflexible
- Multi-purpose batch plants are flexible, but inefficient
- Both have high investment cost

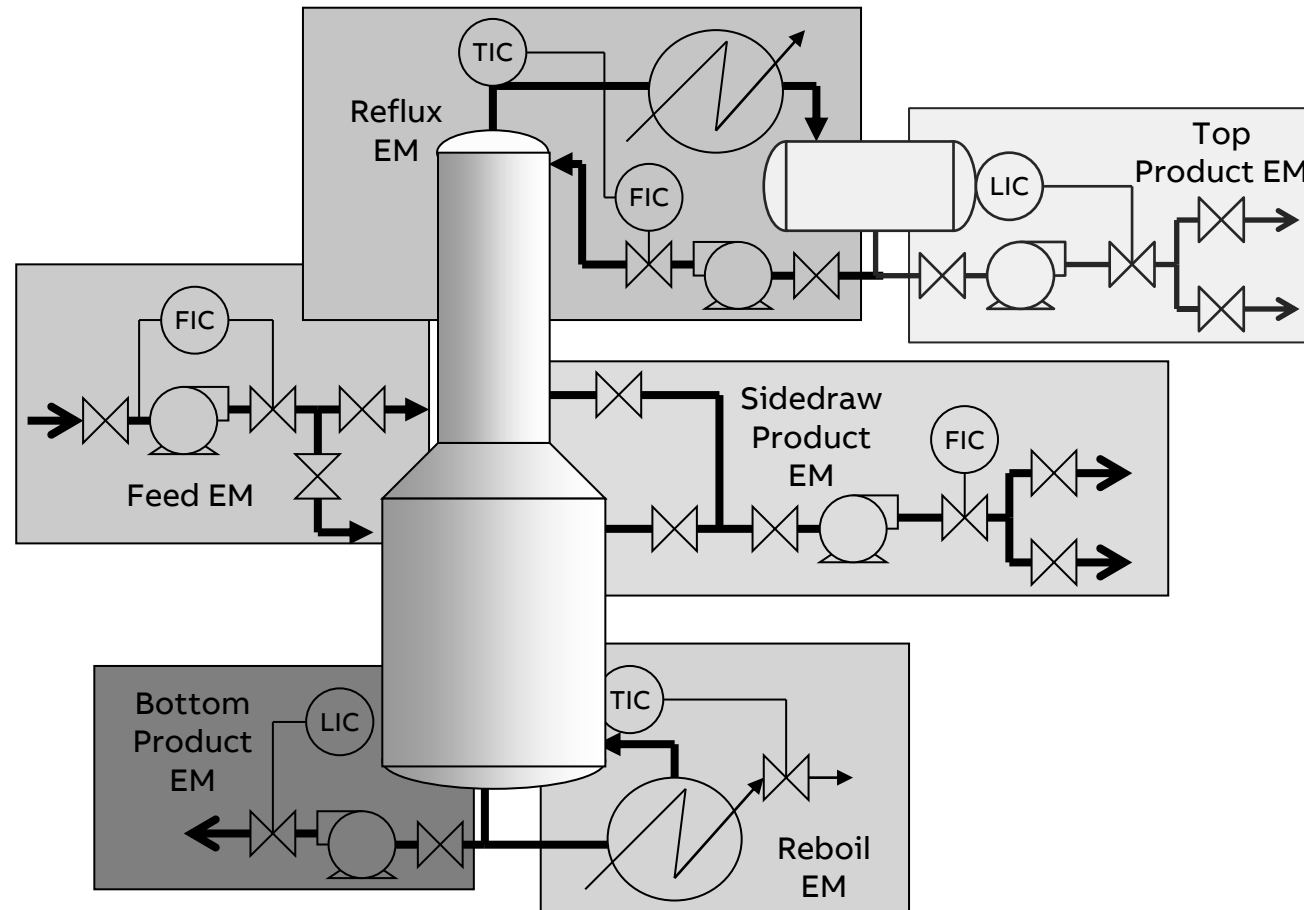
Challenges in process industries:

- Flexible, but efficient, modular plant concepts
- Short time span between development and production
- Numbering-up instead of scale-up



Automation Engineering of Modular Process Plants

Vision – plug & produce of process plants



Automation Engineering of Modular Process Plants

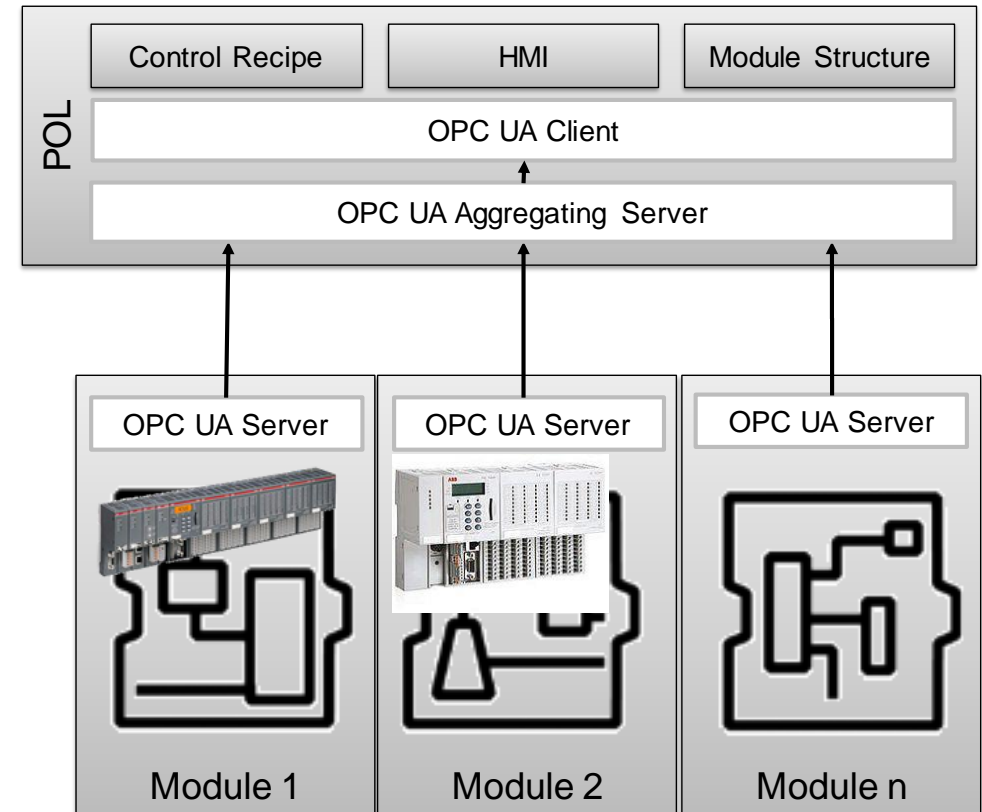
Automation architecture

Every module ...

- serves one or several specific process functions
- contains all automation functions for the process function
- is encapsulated, intrinsic save part of the process
- has an own intelligence (e.g. PLC, embedded controller)
- communicates using an OPC UA server

Plant ...

- aggregates all module OPC UA servers
- has a supervisory system (process orchestration layer, POL) that acts as OPC UA client
- implements operations (HMIs), module structures, control recipes/strategy

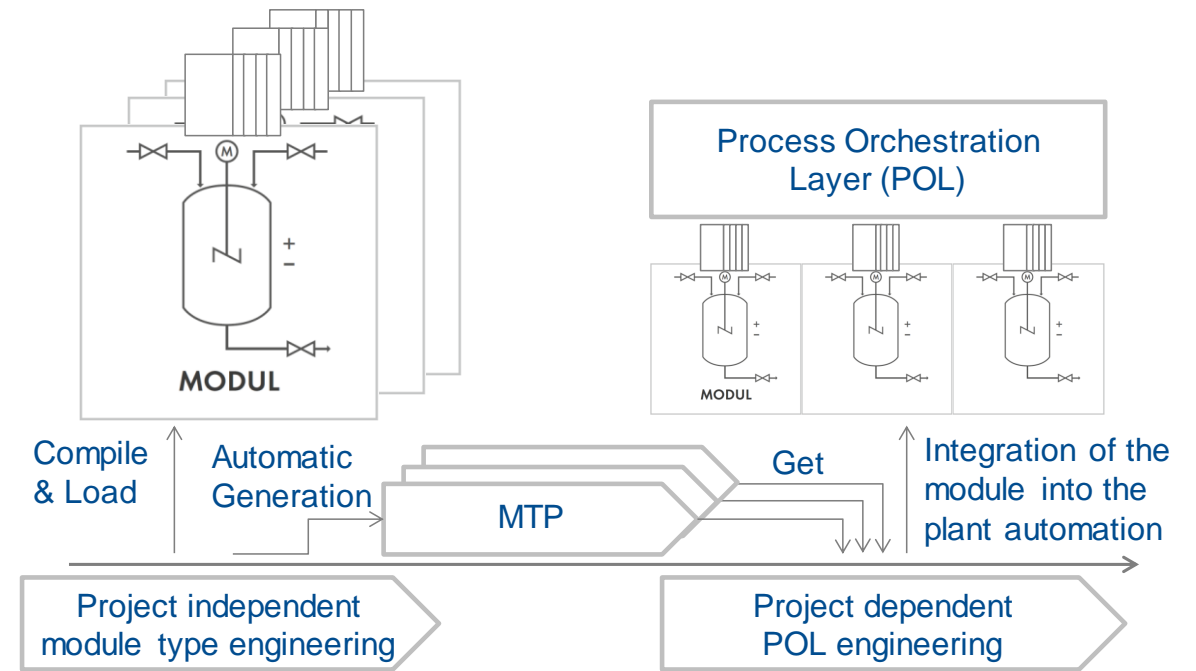


Automation Engineering of Modular Process Plants

Engineering workflow

Engineering is divided in two parts:

- a) Module type engineering
 - Instrumentation, control and electrical engineering
 - I/O marshaling, physical installation
 - Factory acceptance testing (FAT) and module commissioning
 - ...
- b) POL engineering
 - Module instantiation and staging, plant engineering
 - Site acceptance testing (SAT) and plant commissioning
 - ...



Module Type Package is THE interface between module and plant

Automation Engineering of Modular Process Plants

State of the art - Modularization in process industries - Excerpt

Related standards

- ISA 88^[ISA88] / 106^[ISA106]
- ISA TR88.00.02^[ISA88TR]
- IEC: 62714^[IEC62714], 62424, 61131^[IEC61131]
- NE 148^[NE148]
- VDI 2776^[VDI2776]

MTP^[BE16] projects

- F3 Factory^[F3]
- [ORCA](#)
- [BaSys 4.2](#)
- [DIMA](#)

Related technology

- State-based control^[HU09]
- Service oriented architecture^[BL16]

MTP community

- Namur working groups
- ZVEI working groups
- VDI/VDE GMA WG 5.16
- [IEC TC65 WG14](#)

Focus of
the
chapter

Related activities

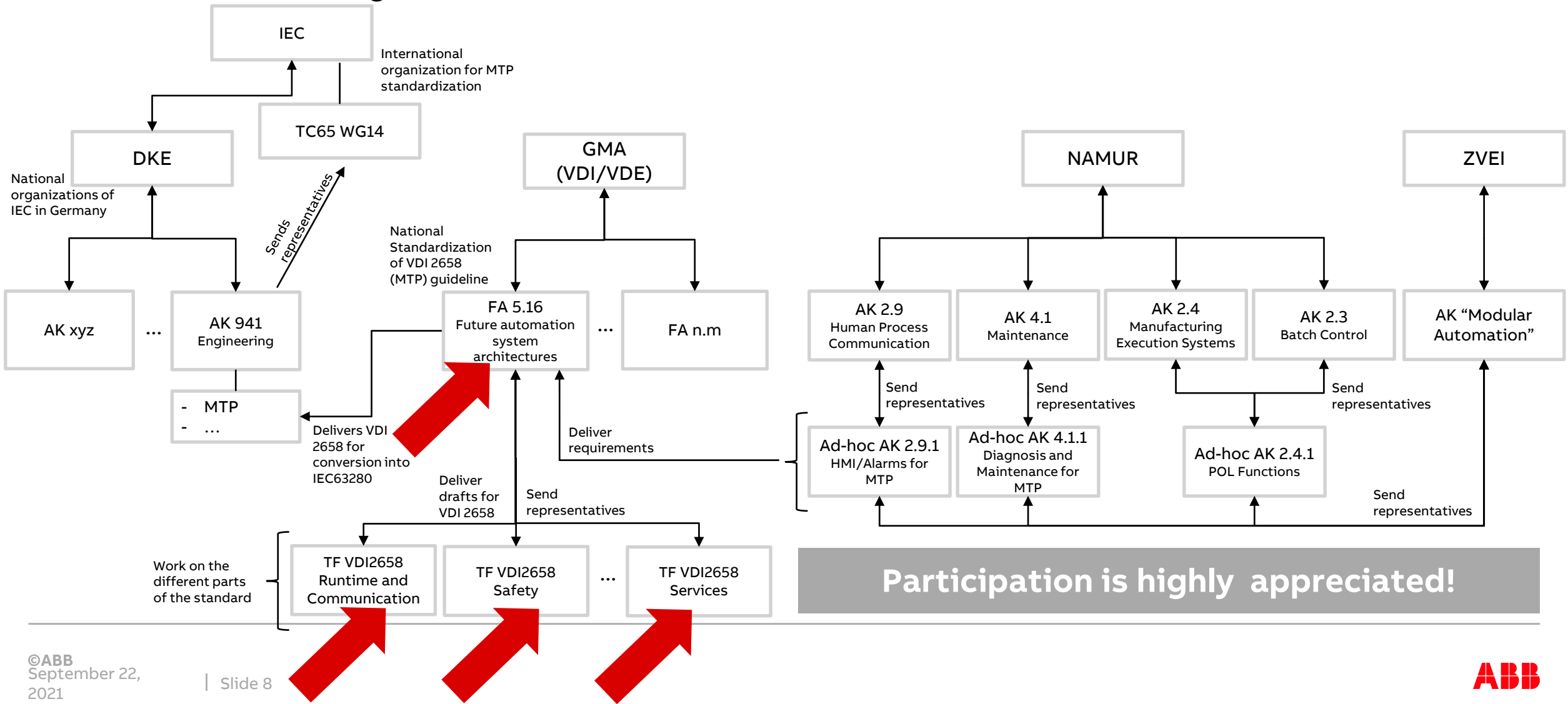
- [Open Process Automation Forum](#)
- [O-PAS Standard](#)
- [“It Just Happens 2.0”](#)

MTP standardization

- VDI/VDE 2658^[VDI2658]
- Parts 1-3 final versions
- Parts 4, 6, 7 draft print
- Parts 5, 5.1, 7.1 in preparation
- [IEC 63280 ED1 ACD](#)

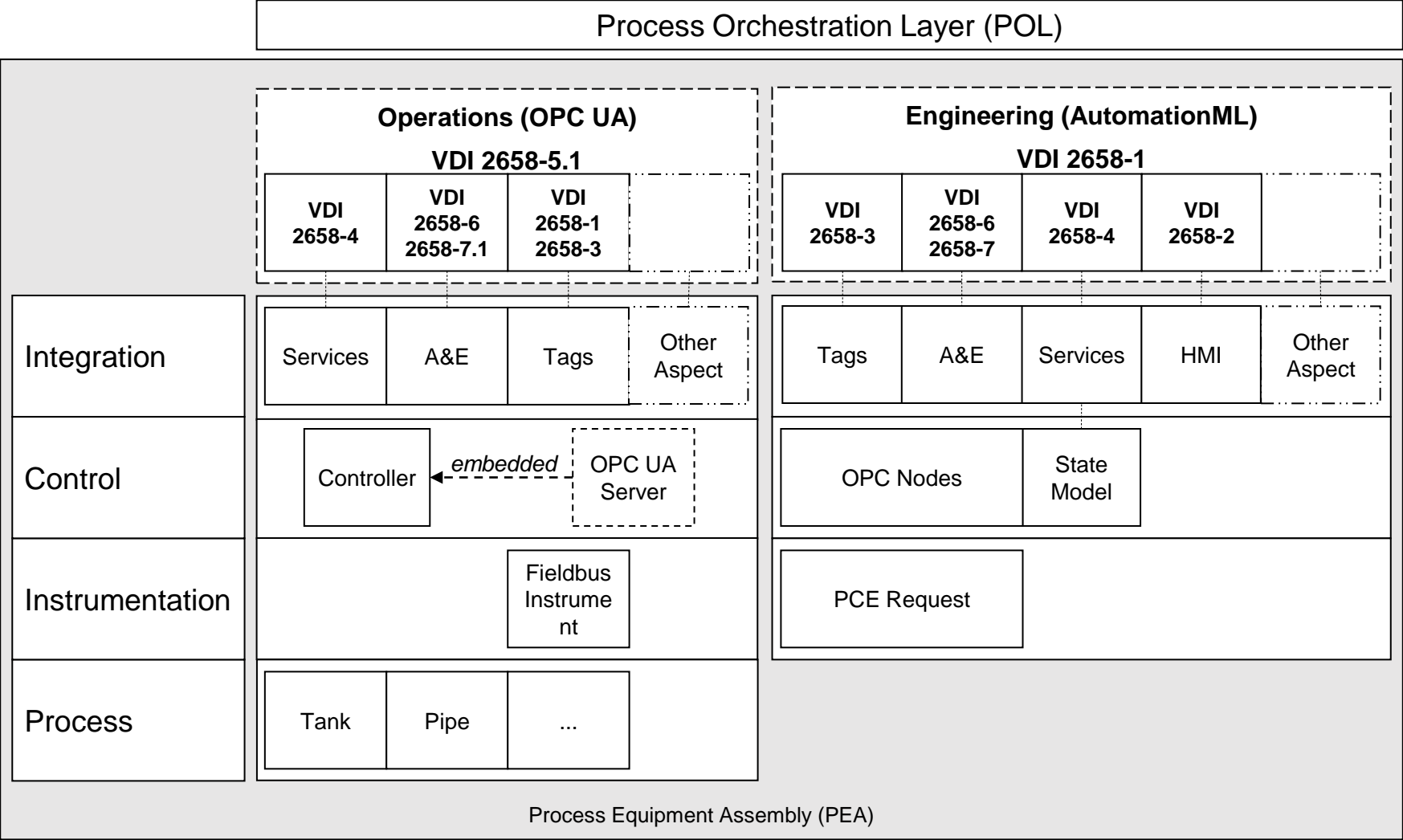
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MTP Standardization Organization



Automation Engineering of Modular Process Plants

Used Technologies



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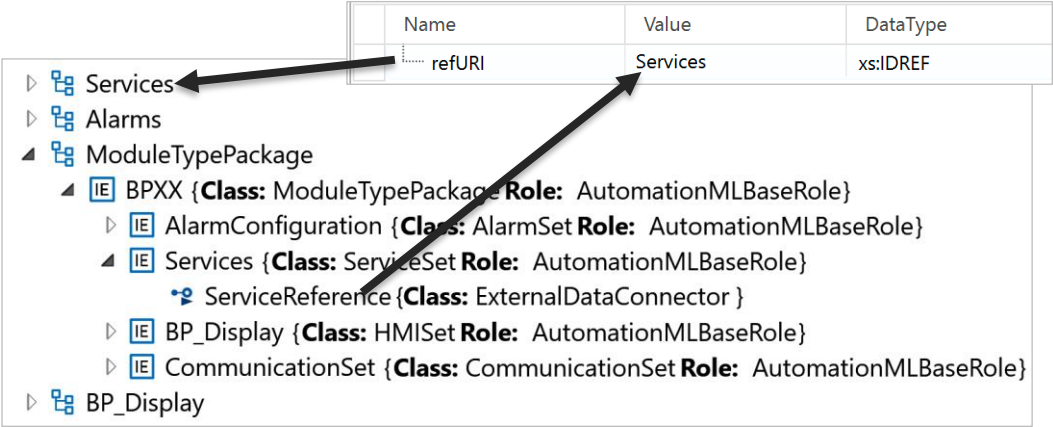
AutomationML Classes

SystemUnitClassLib	Parts of the standard	Where to find instances in the MTP-file?	Important/Example SystemUnitClasses
MTPSUCLib	Part 1 Part 5	Below InstanceHierarchy ModuleTypePackage	LinkedObject, MTPSet, CommunicationSet, ModuleTypePackage, ModuleTypePackageEx
MTPCommunicationSU CLib	Part 1 Part 5 Part 5.1	Below 'ModuleTypePackage/ CommunicationSet/ SourceList'	OPCUAServer, ServerProfile
MTPHMISUCLib	Part 2	Within reference to HMISet	Connection, PortObject, Junction, VisualObject, HMISet, Picture
MTPDataObjectSUCLib	Mainly Part 3, extended by part 4, 5 and 7	Below 'ModuleTypePackage/ CommunicationSet/ InstanceList'	ActiveElement, OperationElement, InputElement, IndicatorElement, ServiceControl, AlarmView
MTPServiceSUCLib	Part 4	Within reference to ServiceSet	Service, ServiceProcedure, ServiceParameter
MTPTextSUCLib	Currently only used in part 4 and 7	Within reference to TextSet	ServiceInteraction, Text, EnumDefinition
MTPAlarmSUCLib	Part 7	Within reference to AlarmSet	Alarm, AlarmGroup, AlarmSet

InterfaceClassLib	Parts of the standard	Where to find instances in the MTP-file?	Contained InterfaceClasses
MTPCommunication- ICLib	Part 1 Part 5 Part 5.1	Below 'ModuleTypePackage/ CommunicationSet/ SourceList/OPCUAServer'	DataItem, OPCUAItem, MethodItem, ObjectItem
MTPHMIInterfaceLib	Part 2	Within reference to HMISet	InformationFlowConn ector, MassFlowConnector
AlarmICLib	Part 7	Within reference to AlarmSet	AlarmRelation
AutomationMLInterfa ceClassLib	Part 1	Below 'ModuleTypePackage/MT PSet'	ExternalDataConnect or

Automation Engineering of Modular Process Plants

Modelling Example: Table of Content^[VDI2658-1]



Automation Engineering of Modular Process Plants

Modelling Example: Tags^[VDI2658-1]

IE CommunicationSet {Class: CommunicationSet Role: AutomationMLBaseRole}

IE SourceList {Class: SourceList Role: AutomationMLBaseRole}

IE OPCUA {Class: OPCUAServer Role: AutomationMLBaseRole}

IE InstanceList {Class: InstanceList Role: AutomationMLBaseRole}

IE Y0001 {Class: MonAnaVlv Role: AutomationMLBaseRole}

IE T0009 {Class: AnaMon Role: AutomationMLBaseRole}

Endpoint

Access

Identifier

Namespace

RefID

TagDescription

TagName

V

VAHAct

VAHEn

VAHLim

VALAct

VALEn

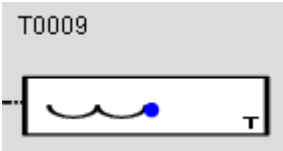
Name	Value	Default	Unit	DataType
Endpoint	opc.tcp://192.168.0.1:48050			xs:string

Name	Value	Default	Unit	DataType
Access	3			xs:byte
Identifier	T0009_IN			xs:string
Namespace	opcda://localhost/Freelance2000OPCServer.23.1			xs:string

Name	Value	Default	Unit	DataType
RefID	5f7579b1-1c20-444f-a036-1caf60c6faaf			xs:ID
TagDescription	0	0		xs:string
TagName	T0009			xs:string
V	d13d9dd5-018e-4bad-a185-f2c722988dff	0		xs:IDREF
VAHAct	36597ac2-c314-4a8a-87b1-eee4be55a0a3	False		xs:IDREF
VAHEn	true	true		xs:boolean
VAHLim	d91c6acf-769a-4924-8abb-843a756cbfa5	45.0		xs:IDREF
VALAct	09598d58-0961-4f89-b1d9-8480f08ead96	False		xs:IDREF
VALEn	true	true		xs:boolean

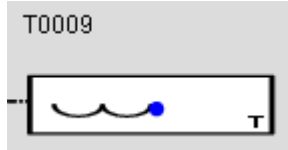
Static Attribute

Dynamic Attribute



Automation Engineering of Modular Process Plants

Modelling Example: OPC UA Access Description^[VDI2658-1]



▲ IE InstanceList {**Class:** InstanceList **Role:** AutomationMLBaseRole}

▶ IE T0009 {**Class:** VisualObject **Role:** AutomationMLBaseRole}

Name	Value	Default	Unit	DataType
RefID	5f7579b1-1c20-444f-a036-1caf60c6faaf			xs:ID
TagDescription	0	0		xs:string
TagName	T0009			xs:string
V	d13d9dd5-018e-4bad-a185-f2c722988dff	0		xs:IDREF
VAHAct	36597ac2-c314-4a8a-87b1-eee4be55a0a3	False		xs:IDREF
VAHEn	true	true		xs:boolean
VAHLim	d91c6acf-769a-4924-8abb-843a756cbfa5	45.0		xs:IDREF

▲ IE SourceList {**Class:** SourceList **Role:** AutomationMLBaseRole}

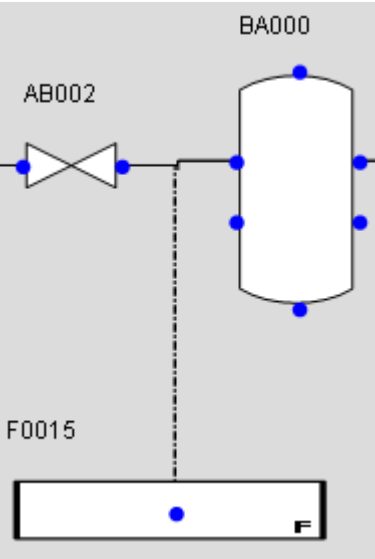
▶ IE OPCUA {**Class:** OPCUAServer **Role:** AutomationMLBaseRole}

- T0009VAHLim {**Class:** OPCUAltItem}
- T0009VAHAct {**Class:** OPCUAltItem}
- T0009V {**Class:** OPCUAltItem}

Identification	
ID	d13d9dd5-018e-4bad-a185-f2c722988dff
Name	T0009V

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Modelling Example: HMI^[VDI2658-2]



- BP_Display
 - BP Display {Class: Picture Role: AutomationMLBaseRole}
 - F0015 {Class: VisualObject Role: AutomationMLBaseRole}
 - BA000 {Class: VisualObject Role: AutomationMLBaseRole}
 - AB002 {Class: VisualObject Role: AutomationMLBaseRole}

Name	Value	Def	DataType
RefID	1cd87d7b-4fc8-4912-9eaf-87cf7f732c0a		xs:ID
Width	115		xs:integer
Height	25		xs:integer
X	181		xs:integer
Y	275		xs:integer
ZIndex			xs:integer
Rotation	0		xs:integer
eClassVersion	0.1		xs:string
eClassClassificationClass			xs:string
eClassRDI			xs:string

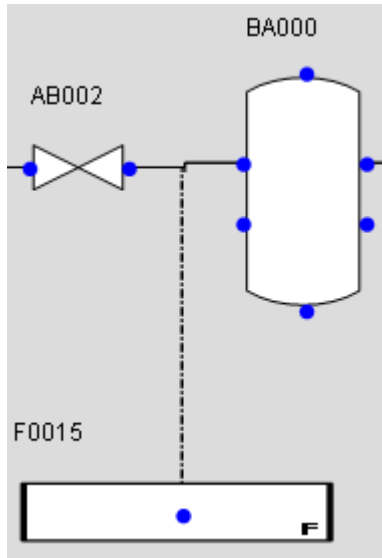
Name	Value	Def	DataType
RefID			xs:ID
Width	44		xs:integer
Height	79		xs:integer
X	258		xs:integer
Y	140		xs:integer
ZIndex			xs:integer
Rotation	0		xs:integer
eClassVersion	0.1		xs:string
eClassClassificationClass	36030101		xs:string
eClassRDI			xs:string

- InstanceList {Class: InstanceList Role: AutomationMLBaseRole}
 - F0015 {Class: AnaMon Role: AutomationMLBaseRole}

Name	Value	Default	Unit	DataType
RefID	1cd87d7b-4fc8-4912-9eaf-87cf7f732c0a			xs:ID
TagDescription	0	0		xs:string
TagName	F0015			xs:string
V	374a8b7e-77d1-43ad-b33e-134f08490c90	0		xs:IDREF

Automation Engineering of Modular Process Plants

Modelling Example: HMI^[VDI2658-2]



Automation Engineering of Modular Process Plants

Take a look into the book to get the rest ...

- How to model services
- How to model alarms
- How all parts work together
- How to model tags
- How to model ...

Automation Engineering of Modular Process Plants

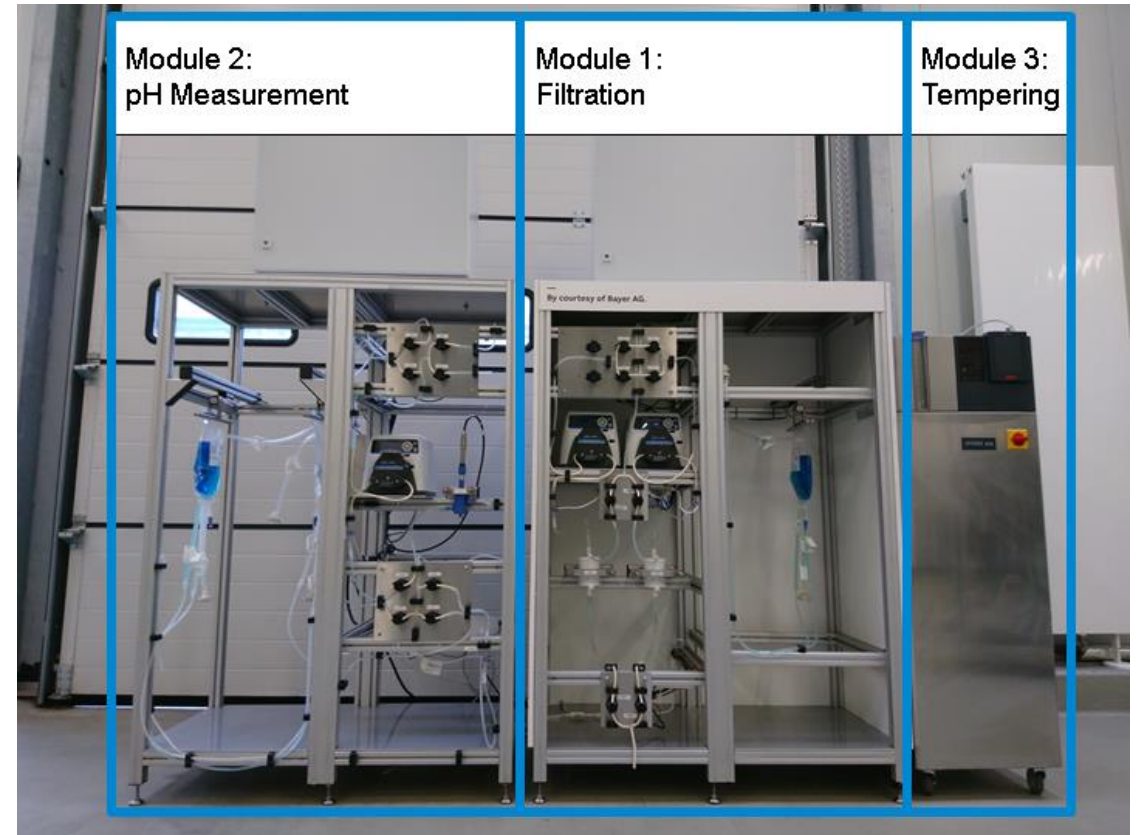
Pilot application

Module	Services	Automation
Filtration	Vent filter line a/b Filtration a/b Clear a/b	ABB Freelance AC700F
pH Measurement	Vent the measurement line Measure pH Calibrate sensor	ABB Freelance AC700F
Tempering	Circulation Tempering	Embedded

Supervisory control:

- ABB System 800xA + AC800M controller

On-site commissioning reduced from 40h to 0.5h





Automation Engineering of Modular Process Plants

Further Activities

Plug & Produce auf dem Sprung in den Markt

Neuerungen in Spezifikation und Implementierung des MTP

Modulare Automatisierung wird als eine der Schlüsseltechnologien zur Erhöhung der Flexibilität von Produktionsanlagen angesehen. Zugleich kann durch eine durchgängige Modularisierung von Produktionsanlagen und die Verwendung von Standards der Engineeringaufwand erheblich reduziert werden. Um dieses Ziel zu erreichen, arbeiten Namur (Interessengemeinschaft Automatisierungstechnik der Prozessindustrie) und der ZVEI (Zentralverband Elektrotechnik und Elektronikindustrie) seit 2015 gemeinsam an der Spezifikation einer funktionalen, herstellerunabhängigen Beschreibung von Prozessmodulfunktionen, die aus dem Automatisierungsengineering eines Moduls herausgewonnen werden kann. Durch den Import eines Module Type Packages (MTP) in eine übergeordnete Automatisierungsebene können dort die Modulfunktionen automatisch bereitgestellt werden. Durch die Kooperation mit dem Fachausschuss 5.16 der VDI/VDE-Gesellschaft Mess- und Automatisierungstechnik (GMA) sind Teile der gemeinsamen Spezifikationen in die Richtlinienreihe VDI/VDE/Namur 2858 überführt worden. Diese bilden nun die Grundlage zur Entwicklung entsprechender Werkzeuge auf Seiten der Automatisierungshersteller, die bereits in Pilotprojekten erprobt wurden. Der Artikel stellt den Fortschritt bei der Spezifikation und Standardisierung des MTP dar und zeigt Ergebnisse aus Pilotprojekten, die den Nutzen des MTP und die damit einhergehende praxistaugliche Realisierung von Plug & Produce-Konzepten nachweisen.

SCHLAGWÖRTER: Modulare Prozessautomation / Standardisierung / MTP-basiertes Engineering

Plug & produce nears market readiness – Progress in the specification and implementation of MTPs
Modular automation is a key technology for increasing the flexibility of production facilities. At the same time, the continuous modularization of production facilities and the use of standards can significantly reduce the engineering requirements. To achieve this goal, Namur and ZVEI have been working together since 2015 on the specification of a functional, manufacturer-independent description of process module functions, which can be obtained from the module's automation engineering. By importing this module type package into a higher automation level, all functions can be provided there automatically. Due to the cooperation with the GMA 5.16, parts of the common specifications have been transferred to VDI/VDE/Namur 2858 series of standards. These now provide the basis for the development of appropriate tools by the automation manufacturers. The results from pilot projects are presented.

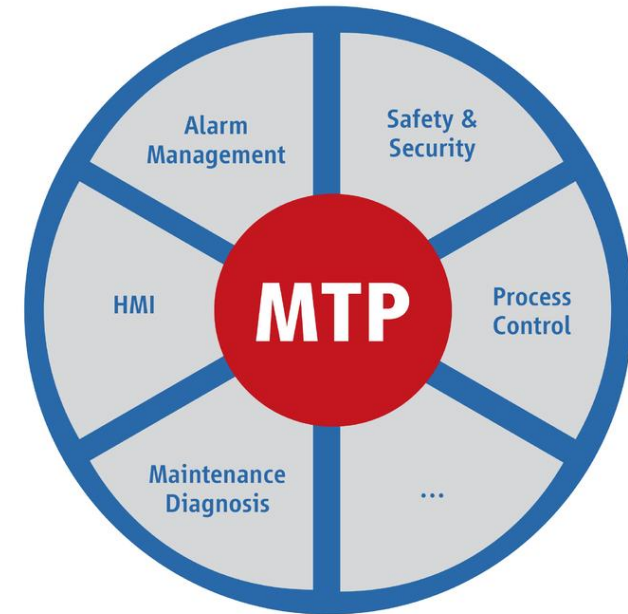
KEYWORDS: Modular process automation / standardization / MTP based engineering

Owner	References	Scale	# modules	Automation Suppliers
ABB Namur Case Study			6	POL: ABB PEA: ABB, B&R
TU Dortmund (Distillation)	[BI20-1]	Lab	5	POL: ABB PEA: Wago, embedded, RasPi
Bayer (API production)	[HO20]	Tech center	3	POL: ABB PEA: ABB, embedded
Merck (Distillation)		Tech center	1	POL: ABB, B&R PEA: B&R
Evonik (Membrane Test 1)	[BE19]	Lab	1	POL: ABB PEA: Wago
Evonik (Membrane Test 2)	[BI20-2]	Tech Center	3	POL: ABB PEA: Wago
Evonik (Reaction)		Tech Center	6	POL: ABB PEA: Phoenix Contact

Automation Engineering of Modular Process Plants

Findings

- First time application requires some effort
- Integration of MTP-based modules works flawless
- Several pilots have proven the feasibility



→ Massive reduction in engineering and commissioning time, each up to 50%!

ABB

Automation Architecture and Engineering for Modular Process Plants

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