NAMUR

PROCESSNET
EINE INITIATIVE VON DECHEMA UND VDI-GVC

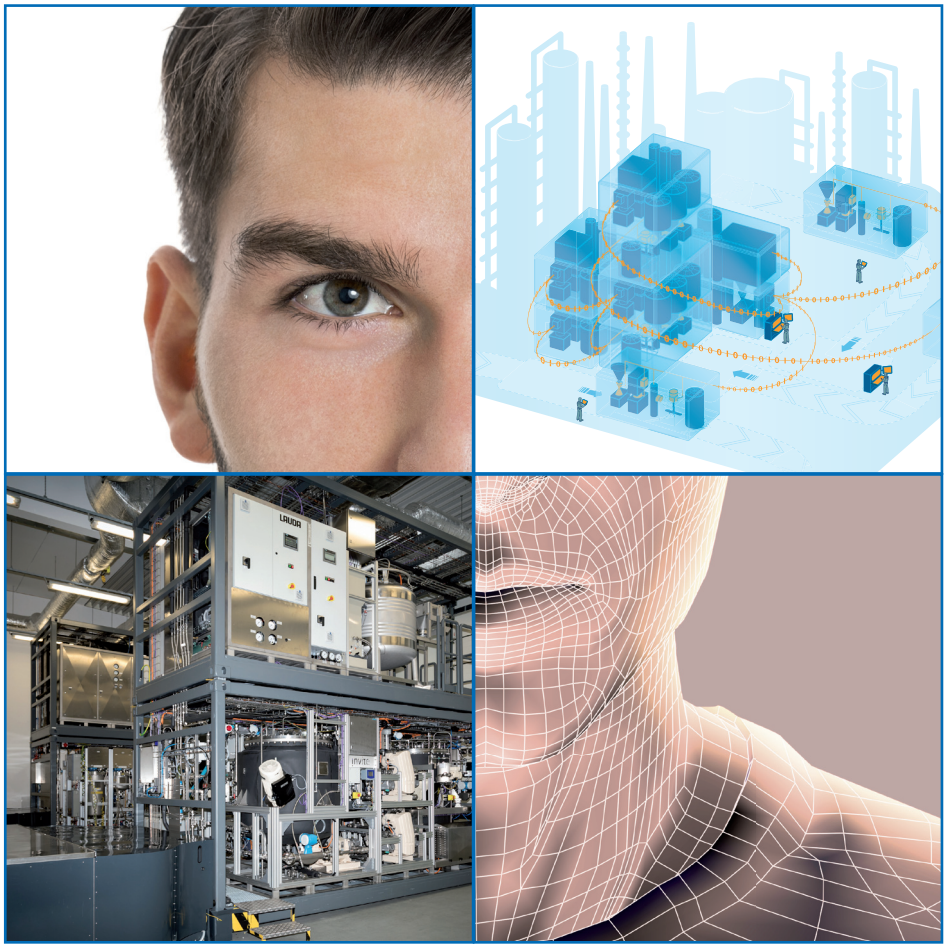
VDMA
Verfahrenstechnische
Maschinen und Apparate

ZVEI: Die Elektroindustrie

Status Report

Process INDUSTRIE 4.0: The Age of Modular Production

On the doorstep to market launch



Process INDUSTRIE 4.0:
The Age of Modular Production

Published by:
ZVEI - Zentralverband
Elektrotechnik-
und Elektronikindustrie e. V.
ZVEI - German Electrical and
Electronic Manufacturers'
Association
Automation Division
Lyoner Strasse 9
60528 Frankfurt am Main,
Germany

Responsible: Felix Seibl
Phone: +49 69 6302-451
E-mail: seibl@zvei.org

www.zvei.org
March 2019

NAMUR –
Interessengemeinschaft
Automatisierungstechnik der
Prozessindustrie e.V.
www.namur.net
Press contact:
Heinrich Engelhard
Phone: +49 175 3039323
E-mail:
heinrich.engelhard@bayer.com

ProcessNet
www.processnet.org
Press contact:
Dr. Alexander Möller
Phone: + 49 69 7564-125
E-mail:
alexander.moeller@dechema.de

VDMA Verfahrenstechnische
Maschinen und Apparate
Press contact:
Dr. Frank Wohnsland
Phone: +49 69 6603-1399
E-mail:
frank.wohnsland@vdma.org
http://vtma.vdma.org

Content

1. Introduction 4
   1.1 Motivation 4
   1.2 The Challenges from NE 148 and ProcessNet 5

2. Value Proposition 6
   2.1 Value Proposition of the Different Stakeholders 6
      2.1.1 Plant Owner 6
      2.1.2 Module Vendor/OEM 7
      2.1.3 System Integrators 7
      2.1.4 Automation Vendors 8
   2.2 Market Potential 8

3. Concept and Current Status 9
   3.1 Concept for a Modular Plant Engineering and Operation 9
   3.2 Structure of a Modular Production Plant 10
      3.2.1 Process Technology 10
      3.2.2 Concept for Module Automation 11
   3.3 Development Guidelines for the Successful Application of Modular Plants 12

4. Results from Pilot Projects 14
   4.1 Modular Plant for Leather Industry 14
   4.2 Merck's Smart Manufacturing Initiative 15
   4.3 Modular Automation for Biopharmaceutical Application 16
   4.4 Seamless Package Unit Integration for Brown- and Greenfield Applications 17

5. Outlook, Next Steps (2019/2020) 18

1. Introduction

1.1 Motivation

The fourth industrial revolution (Industrie 4.0) opens new possibilities for production in the process industry. On the one hand, advancing digitalisation renders the process industry significantly more volatile. Processes must be reliable, repeatable and error-free, and it must be possible to adapt on the fly and quickly ramp output up or down to match sudden changes in demand. The market is moving faster than ever, and manufacturers must move with it, combining the flexibility of production with high efficiency and low costs. This is because new digital opportunities strongly diversify product ranges as the individual products become more customer-orientated. Shorter product life cycles and smaller product volumes are the consequence of this transition. On the other hand, novel concepts for the engineering and operation of chemical plants will change the asset life cycle in a previously unimaginable way. In addition, the European industry as a whole is facing competitors, especially from Asia, that are catching up technologically at undiminished pace but with significantly reduced cost structures (e.g. for human resources). Thus, European industry must retain a technological edge by adapting new ideas and concepts to stay competitive.

Novel process technologies therefore need to meet three requirements, in particular (Figure 1).

Fig. 1: Key benefits: Modular production helps to master the challenges in process industries

Source: NAMUR, ProcessNet, ZVEI

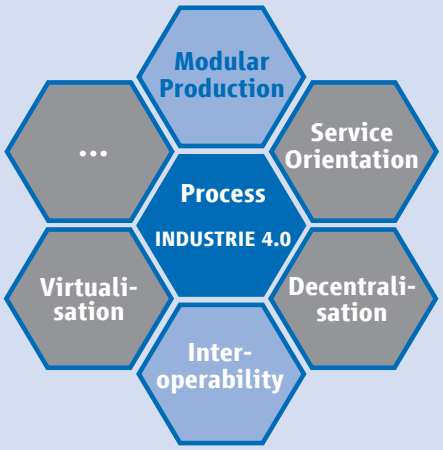
Reduced time-to-market: With shorter product life cycles, the time of market entry defines the value of a product far more than before.
Increased flexibility: Ever smaller product volumes increase the need of higher flexibility to produce more than one product with the available assets. While this is already widely applied in batch processes, having multipurpose production plants in continuous mode is usually still a significant challenge.
Improved efficiency: Efficiency can be increased by re-utilising not only engineering work but also physical equipment. This can lead to significantly reduced engineering efforts and costs and easier re-arrangement of assets. Combining these effects can leverage the cost efficiency of a process tremendously.

Figure 2 shows several important prospects that advanced digitalisation holds for the process industry. Among other things, applying modularisation will be one key perspective for a process industry that is facing the above-mentioned transformations. Modularisation can increase flexibility in terms of

- capacity (e.g. by numbering-up or parallelisation)
- product mix (e.g. by exchanging reaction or downstream processing modules in accordance a plug-and-produce concept)
- feedstock and site (e.g. mobility of modules)

The idea of modularisation of production in process industries has been successfully evaluated in the European research project F3 (Fast, Flexible, Future) Factory and the German ENPRO Initiative. These results revealed that the concept of modularisation need to be based on the standardisation of interfaces and certain parts of the process equipment.

Fig. 2: Opportunities of Industrie 4.0 in the process



Source: NAMUR, ProcessNet, ZVEI

1.2 The Challenges from NE 148 and ProcessNet

Over recent years, several papers have been published by NAMUR, ZVEI and ProcessNet, on the topic of modularisation: the NAMUR recommendation NE 148, published in 2013, was followed by the ZVEI and ProcessNet white papers in 2015 and 2016, respectively. All three papers strongly focused on the need to standardise various aspects of future production in process industries. NAMUR initiated the "Module Type Package" (MTP), "a standardised non-proprietary description of modules for the Process Automation" and ZVEI worked out recommendations on how to implement this MTP into the software of system providers. The ProcessNet white paper defined a common language for the nomenclature of modules. White shortcomings were defined by all three publications and those have been addressed in various collaborative actions. Over the years these organisations have joined forces to address the need for modularisation and standardisation. First standards (VDI/VDE/NAMUR 2658) that focused strongly on "Modular Automation" were published in 2017 and more are on the way (VDI 2776).

Public awareness was raised by several stands at the Hannover Fair (2017, 2018) and the ACHEMA (2018). VDI, which is planning to intensify the collaboration with the other organisations, also participated at ACHEMA.

Since the publications of the NAMUR recommendation and the white papers, a lot has been accomplished and many steps have been taken. Thus, this report provides an update on the status of modular production. It will give an overview on the current status of modular production in the process industry, highlight the opportunities and challenges of the individual stakeholder groups and provide a detailed outlook on the steps to be taken to widely implement the concept of modularisation. The update is a joint effort between the working groups in NAMUR, ProcessNet, VDI, VDMA and ZVEI.

2. Value Proposition

As already stated, production needs to become more flexible to meet the changing market demands. This increased flexibility leads to challenges but also significant opportunities for the various stakeholders in process industry. The most important benefits in process-encapsulated, reusable modules are summarised in Table 1:

2.1 Value Proposition of the Different Stakeholders

Table 1: Matrix of the most important benefits for modularisation in brown- and greenfield production sites

	Brownfield Sites	Greenfield Sites
Facilitated replacement, re-arrangement and integration of production equipment	X	X
Less downtime		X
Less capital expenditure	X	
Less life cycle management		X
Facilitated modernisation/innovation	X	
Faster time-to-market	X	
Faster rearrangement of production equipment	X	X
Reduced engineering effort	X	X

Source: NAMUR, ProcessNet, ZVEI

2.1.1 Plant Owner

Challenge	Opportunity	Benefit
Increase flexibility	Quick response to product variants and shorter product life cycles	Increased production flexibility through fast reconfiguration of production plants using modules with standardised design and automation Market share, new products, customer satisfaction
Reduce cost and risk	Specific production applications defined as packaged services Preassembly of modules in workshops.	Module supplier delivers exactly what is needed. Module is simply integrated into process automation system via MTP. Intellectual property remains with end user. Upscaling is also easier, as entire pre-tested control sub-system programs can be dropped into other controllers. This is clearly far quicker than writing new code from scratch. No or minimal influence on the production environment during the installation of new process steps using modules.

Challenge	Opportunity	Benefit
	If a fault occurs, problems can be narrowed down to affected module (maintenance) Decoupling of maintenance and operating site Maintenance teams hold instant spares for critical modules.	Quickly diagnosed and fixed with less disruption – in some cases while production continues. Shorter downtimes and overhaul times
Reduce time-to-market	Planning, reuse and application of modules with standardised design, interfaces and automation Partnership with module vendors Modular automation offers the required flexibility	Module-based planning approach allows a substantial reduction in development time and engineering effort. It is an essential factor for an increase in engineering efficiency. Easy scaling and numbering up, by simply ordering another module Faster delivery of tailored products

Source: NAMUR, ProcessNet, ZVEI

2.1.2 Module Vendor/OEM

Challenge	Opportunity	Benefit
Reduce cost, risk and schedule by standardising control solutions	MTP allows integration into any process orchestration level	Low risk of integrating module at any modular-capable site
Develop customer relationships and business growth	Business scope is increased as automation can be added to modules	With regular customer contact, it is possible to gain a better understanding of customer processes and add more services such as fleet management
Increase automation expertise as intellectual property resides within modules and not with end user	Rather than being a supplier of valves and pumps, a vendor can offer services that are embedded within modules	Individual modules control the hardware, so an understanding of how the entire process works is not necessary. Intellectual property of a process plant, or specific process recipes, remains with the end user.

Source: NAMUR, ProcessNet, ZVEI

2.1.3 System Integrators

Challenge	Opportunity	Benefit
Reduce cost, risk and schedule	Non-standard interfaces can be reduced by converging to one interface	Engineering design, installation and commissioning is quicker for intelligent modules
Reduce cost, risk and schedule	Commissioning time can be reduced as module is complete	MTPs can be sent ahead for virtual commissioning to simulate integration on the process orchestration level.

Source: NAMUR, ProcessNet, ZVEI

2.1.4 Automation Vendors

Challenge	Opportunity	Benefit
Increase automation	More automation products can be integrated into production units and plant	More automation products can be offered in new market areas
Achieve open interfaces and interoperability	Data exchange is increased and analytics and optimisation are improved	New solution and business models can be offered

Source: NAMUR, ProcessNet, ZVEI

2.2 Market Potential

There are several end user sectors which could strongly benefit from implementing modular production and automation:

- The chemical industry. Within the chemical sector, the fine and special chemicals can particularly benefit
- The pharmaceutical industry
- The energy sector
- The food & beverage industry
- The marine sector

The chemical and pharmaceutical industry

According to a CEFIC prognosis, 212.8 billion euros were invested globally by the chemical and pharmaceutical industry in 2016. If we assume that 3 % is invested in modular plants and of this 3 % is for automation equipment, there was a market potential of approx. 200 million euros for modular automation equipment. The further estimate assumes that in 2030, approx. 25 percent of engineering plants, machines and appliances will have a modular structure and the global investment will be approx. 280 billion euros. At the moment, automation typically makes up approx. 3 % of investments. For module-based process plants, the proportion of automation will shift in the future. We assume an average of five percent automation, because modular-based plant design needs information of an increasingly high quality (for example predictive maintenance, many small PLCs, more sensors). There will therefore be an estimated market volume of approx. 3.5 billion euros for modular measurement and process automation equipment in 2030.

Year	Global Investment (bn €)	Modular Plant	Automation	bn €
2016	212.80	3 %	3 %	0.2
2030	280.79	25 %	5 %	3.5

Source: CEFIC report, ZVEI estimates

The energy sector

Year	Global Investment (bn €) oil & gas only	Modular Plant Share	Automation Equipment Share	bn €
2017	650	1 %	3 %	0.2
2030	720	25 %	5 %	9.0

Source: IEA Monthly Oil Report and the IEA World Energy Outlook, ZVEI estimates

The food & beverage industry and the marine sector where evaluates but currently no meaningful market data found.

Adding together the market volume for three of the five target sectors, a world market volume of more than 12 billion euros is estimated for automation equipment in 2030.

This market volume, in turn, makes up only a part of the overall potential in market volume or engineering savings that the modularisation concept promises for the other stakeholders such as system integrators, plant and equipment manufacturers and end users.

For instance, it is estimated that a large part of the engineering and logistics costs can be saved (estimation up to 60 %).

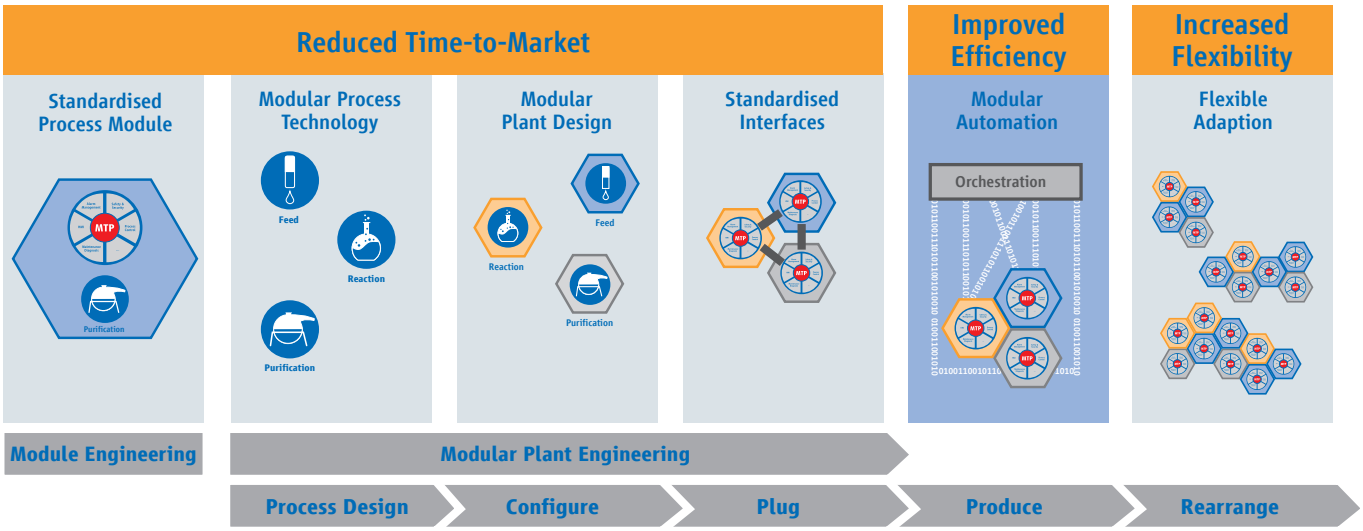
3. Concept and Current Status

3.1 Concept for a Modular Plant Engineering and Operation

All the parties involved jointly drafted the following concept for modular plant engineering, implementation and operation.

Figure 3 shows the concept for modular process development and plant implementation along the asset life cycle including the above-mentioned benefits (time-to-market, improved efficiency, increased flexibility). Module automation plays a crucial role within the engineering and implementation process for modular plants.

Fig. 3: Concept for modular plant engineering



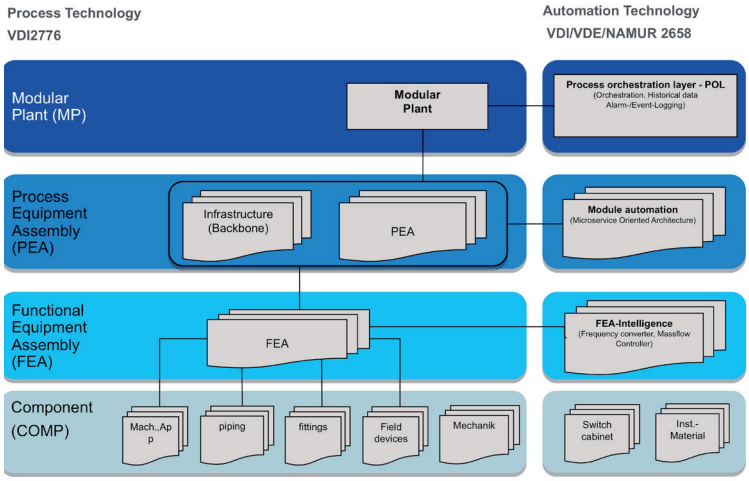
Source: NAMUR, ProcessNet, ZVEI

In the final stage of modular production, standardised process modules (Module Engineering) are already pre-engineered, pre-automated and pre-fabricated, thus can be delivered with standardised interfaces (mechanical, automation = MTP) and decentralised intelligence by the module supplier at short notice. The process development phase (Process Design) starts with the development of single unit operation steps (e.g. feed, reaction, purification) that use pre-engineered standardised process modules (Module Engineering). These have to be configured to the relevant process conditions (Configure) by exchanging relevant sub-modules. As a result, single unit operations can be quickly and easily arranged to form a complete process (Plug). Due to the decentralised intelligence of the modules in terms of automation, the modules simply need to be orchestrated by a process leading unit (Produce). The above-described procedure and interfaces also allow for a flexible, fast and efficient adaption of the complete process (Rearrange) in a later stage.

3.2 Structure of a Modular Production Plant

The technology in modular plants engineering and operation is linked to the structure of modular plants. In principle one can distinguish between process and automation technology on four different levels (Figure 4).

Fig. 4: Structure of modular plants



Source: NAMUR, ProcessNet, ZVEI

3.2.1 Process Technology

The base hierarchical layer for a modular plant consists of Components like machines, piping, fitThe base hierarchical layer for a modular plant consists of Components like machines, piping, fittings, etc. As in conventional plants, this is the smallest unit. The components are characterised by their functionality and operating ranges. If larger operating ranges are required, special series can be applied. At this modular plant layer, components for automation technology are switch cabinets and installation material.

Equipment and machines form the core of the process technology for the next modular plant layer, which is called Functional Equipment Assembly (FEA). Within FEAs, components are grouped that form a special process function (like a pump consisting of pumping head, motor, fittings, piping, etc.). A functional equipment assembly can have its own automation intelligence (e.g. intelligent mass flow controllers).

The next layer is called Process Equipment Assembly (PEA). It consists of at least one FEA and forms a dedicated process step (like feed, reaction, downstream, etc.). The operational range of a PEA can be altered by exchanging single FEAs (e.g. a pumping unit). An essential feature of the PEA is its own automation intelligence that provides all the necessary functions for safe decentralised operation. The data exchange between the PEAs is realised via a supplier-independent standardised interface MTP (Module Type Package).

To guarantee a simple exchange of FEAs and PEAs, both follow clear design and construction guidelines that are described in VDI/VDE/NAMUR 2658 and VDI 2776 respectively.

In the top layer, several PEAs are connected to a Modular Plant (MP). Connections are realised via mechanical as well as data interfaces. The decentralised automation of the different PEAs is integrated in a Process Orchestration Layer (POL).

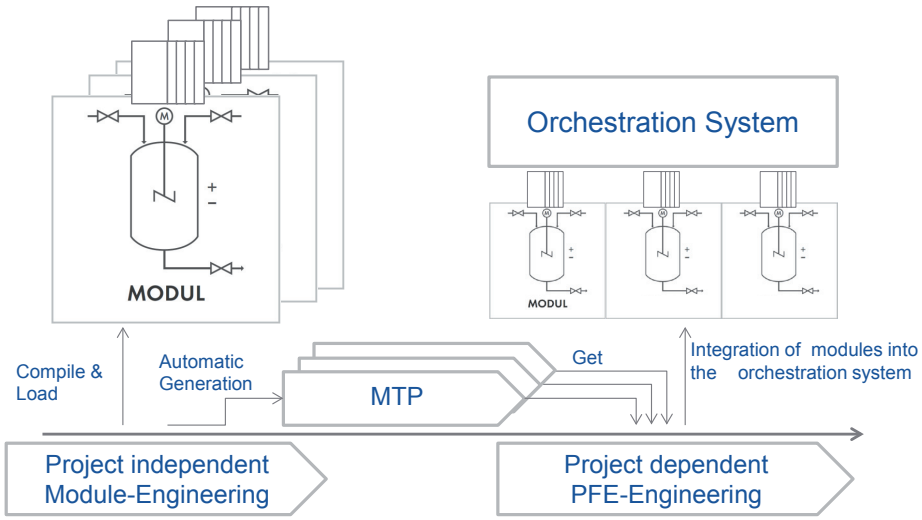
The modular concept is complemented by a suitable infrastructure in which the MPs can be integrated and operated. This infrastructure supplies the MP with the required material and energy streams, e.g. via a standardised backbone interface. Material and energy streams for supply to and removal from the modular system are e.g. compressed air, nitrogen, common raw materials as well as process air, process water, waste water and exhaust air streams. Also included are power supply and data connections.

The above-mentioned concept originates from the F3 Factory project (2009 – 2013) where seven owner operators demonstrated the feasibility and applicability of the concept for a wide range of chemical applications. In the following years the concept was further developed to reach its current state and is applied in several showcases at the different owner operators.

3.2.2 Concept for Module Automation

The key to efficient plug-and-produce is a digital, vendor-independent description of the information needed to integrate a module. For this, the data generated during the engineering of a module are provided by the module manufacturer in an XML-file called a Module Type Package (MTP) (Figure 5 and 6, project-independent module engineering).

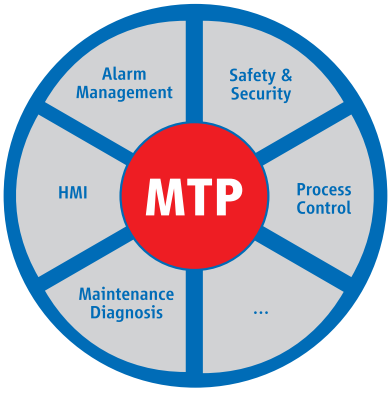
Fig. 5: Exchange of information between project-independent module engineering and project-specific plant engineering through a Module Type Package (MTP)



Source: NAMUR, ProcessNet, ZVEI, TU Dresden

During engineering of the process control concepts for the modular plant (Figure 4 and 5, project-related plant engineering), the PEA is integrated into a Process Orchestration Layer (POL), that is, the description available as an MTP is consumed by the POL and the necessary configuration is generated. In addition, the coordination strategy of all the PEAs is configured in the POL. For this purpose, the process-related behaviour of the PEAs is defined by calling and parameterising predefined services. The result is a procedure control for the timely retrieval and monitoring of the PEA services. The information required for these integration steps, the data provided by a PEA, the process flows necessary for orchestration, services for process control as well as the associated operating screens are provided as aspects in the MTP.

Fig. 6: MTP Logo with the segements of the MTP standardisation



Source: NAMUR, ProcessNet, ZVEI

3.3 Development Guidelines for the Successful Application of Modular Plants

A prerequisite for a smooth interaction between distributed heterogeneous systems is the agreement on a common interface standard. The national consensus is elaborated in the VDI/VDE/NAMUR 2658 series of directives see Table 2. Part 1, 2 and 3 regulate the HMI integration aspects, Part 1, 4, 5 and 5.1 provide the essential prerequisites for the orchestration of plant-wide process operation and control strategies.

Table 2: Overview of topics within VDI/VDE/NAMUR 2658 (Status 12/2018)

Part	Title	Status
2658-1	General Concept and Interfaces	White Print
2658-2	Description of Operator Interfaces to Process Equipment Assemblies	Green Print (in preparation)
2658-3	Interfaces and Libraries for Basic Object Types	Green Print in preparation)
2658-4	Services for Process Equipment Assemblies	Task Force First Draft
2658-5	Run Time Aspects and Communication	Task Force founded
2658-5.1	Implementation Guideline Communications w/ OPC UA	-“”-
2658-6	Modular Message and Alarm Management	First Draft (NAMUR AK 2.9.1)
2658-7	Interfaces, Services and Libraries for Messages and Alarms	-“”-
2658-7.1	Implementation Guideline M&A w/ OPC UA	-“”-
2658-8	Safety MTP for Functional Safety	deferred
2658-9	Interfaces, Services and Libraries for Safety MTP	-“”-
2658-9.1	Implementation Guideline Safety MTP w/ OPC UA	-“”-
2658-10	Diagnosis & Maintenance of modular Plants	in preparation (NAMUR AK 4.3.1)
2658-11	Interfaces, Services and Libraries for Diagnosis & Maintenance	-“”-
2658-11.1	Implementation Guideline Diagnosis & Maintenance w/ OPC UA	-“”-
2658-12	Verification, Validation and Commissioning	planned

Source: NAMUR, ProcessNet, ZVEI

In a similar way, VDI 2776 describes guidelines for a successful application of the modular plant concept in the process development as well as engineering and operation phases along the asset life cycle. In this manner VDI 2776 and its subsequent sheets help to foster a common understanding by providing a detailed description of expectations, deliverables and responsibilities for the different players involved throughout the phases described above. It does not define a standard equipment or instrument to be used in the modular plant concept. Table 3 gives an overview of the intended structure and sheets of VDI 2776.

Table 3: Overview of topics within VDI 2776 (Status 12/2018)

Part	Title	Status
2776-1	General Concept	Green Print (in preparation)
2776-2	Design & construction of modular plants	Task force, green print Q4/2019
2776-3	Safety concepts for modular plants	Task force, green print Q4/2019
2776-4	Guideline for authority engineering of modular plants	-""-
2776-5	Operation & maintenance of modular plants	-""-
…	Further topics: Database concept, modular process analytics	-""-

Source: NAMUR, ProcessNet, ZVEI

In summary, the guideline work within VDI creates a national consensus between the partners involved in this topic and is the basis for the intended internationalisation that is already under way in the field of automation: A new work item proposal has already been placed at IEC Automation Forum Plenary Session in October 2018.

4. Results from Pilot Projects

The advances within the work on standardisation can only be achieved through prototypical testing, in order to gain important insights for further coordination. In addition to the prototypical implementations, experience from the practical production is also important in order to create acceptance for these new developments as well as to open up fields of development. First experiences are available, which are described in the following.

4.1 Modular Plant for Leather Industry

INVITE GmbH plans modular plants that correspond to the plant concept of the F³ Factory project. The modules/PEAs have a fixed footprint and are designed so that they can be installed in a container according to ISO standards. In the publicly-funded ReeL project (resource-efficient production of leather chemicals), a modular, decentralised production plant for processing leather residues was planned and built. Project partners are Lanxess Deutschland GmbH and Heller-Leder GmbH & Co. KG. The aim of the plant concept is the closed processing of the product streams in a cycle and the conversion into a retanning agent with the brand name X-Biomers® at the tannery on site. In addition, decentralised production reduces the logistical effort and costs and avoids energy-intensive drying steps, which promotes economic and ecological efficiency. Another special feature of this concept is that production waste from leather production in form of leather shavings can be recycled directly in the tannery, thus significantly improving the focus of sustainability compared to traditional production of retanning materials in central production locations far away from the tanneries.

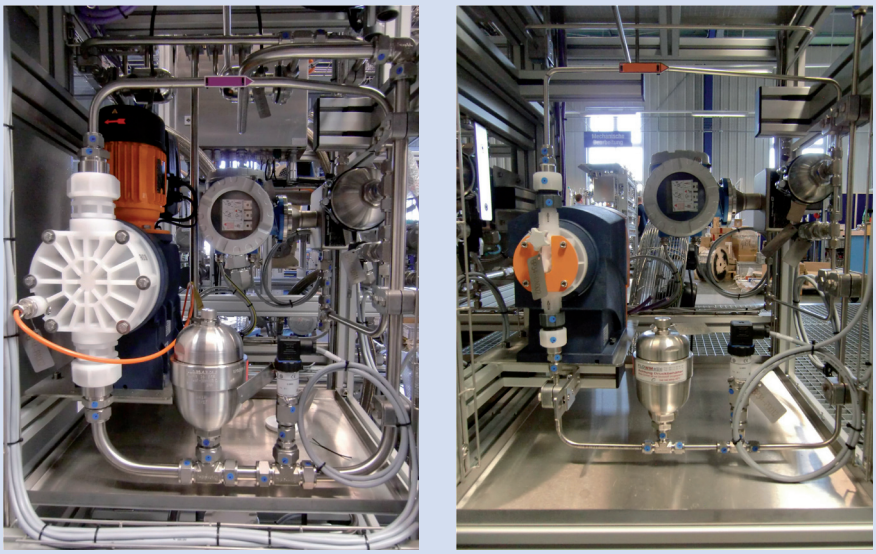
The design of the modular pilot plant is shown in Figure 7. It consists of 18 modules, which are installed in two containers. The lower container consists mainly of two reactor modules, which are equipped with online data control of the filling level, weight, density, temperature, pressure and viscosity. In the first reactor, solid shavings or vegetable biomass are hydrolysed. The hydrolysate can be buffered in storage modules. In the second reactor, the hydrolysate is polymerised to the final liquid X Biomer® product. The upper container holds the modules for temperature control media supply, exhaust air scrubbers and the transfer point of the shaving transport system to the hydrolysis reactor.

Fig. 7: Plant design of the modular pilot plant for production of Biomer®

Source: Lanxess Deutschland GmbH. New sustainability in the tanning process. https://lanxess.com/en/corporate/media/press-releases/trade-technical/2017-00027e/ (accessed 01.03.2019). Lanxess Deutschland GmbH. LANXESS and partners develop innovative technology for tanning leathers. https://lanxess.de/de/corporate/presse/presseinformationen/standorte-national/2017-00084/ (accessed 01.03.2019).

Scalable functional equipment assemblies (FEAs) were used during the planning phase of the ReeL pilot plant. With the FEAs, engineering services can be reused across projects. The basic design of the FEAs is preserved. The pipes or pumps are dimensioned in accordance with requirements, as shown in Figure 8.

Fig. 8: Scalable Functional Equipment Assemblies



Source: INVITE GmbH

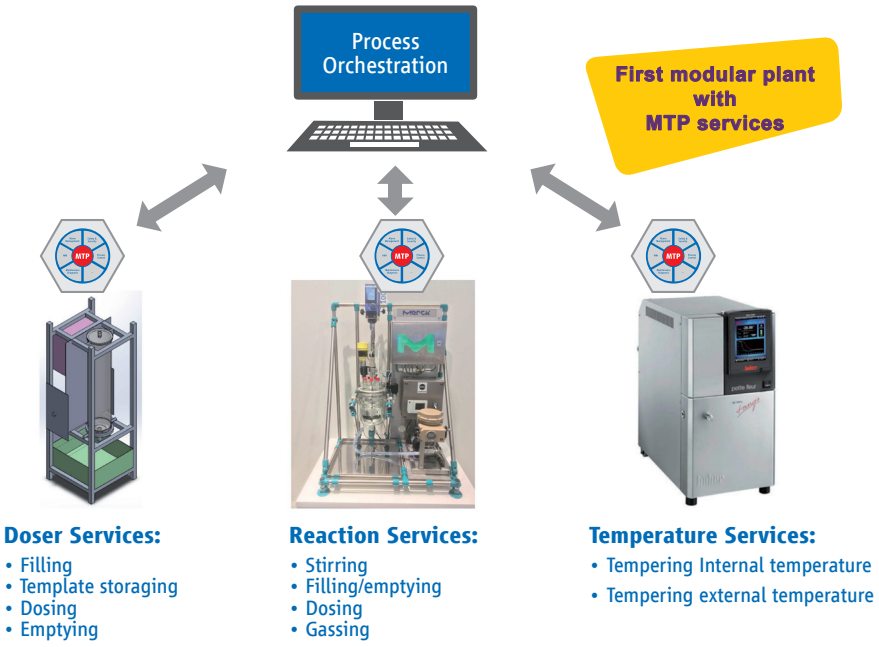
Due to the modular design and the standard interfaces to neighbouring modules and the higher-level control system, modules can be quickly removed from the existing system and, if required, replaced by modules of identical construction. The modules of the pilot plant do not have MTP. Nevertheless, downtimes can be further minimised by this procedure.

The ReeL pilot plant offers the possibility for a remote control. Thus, the status of the plant can be monitored from different locations and errors or mismatches can be clarified with experts.

4.2 Merck's Smart Manufacturing Initiative

The increasing volatility of the markets and the increasing need for customised production lead to ever shorter product life and innovation cycles. To respond to this increasing product and capacity flexibility, modular plant engineering is considered a key technology. As part of the Smart Factory project, Merck wants to take a far-reaching step towards the modular, continuous production of fine and specialty chemicals. Here, the focus is on those topics that currently have the highest development requirements and are essential for the implementation of the smart factory, such as the approval and automation of modular, highly flexible systems. At present, pilot projects with industrial partners are being carried out about the automation of modular systems. In cooperation with Peter Huber Kältemaschinenbau, the "Catalog Module Temperature Control" with MTP is consumed by the process orchestration level for module automation. In addition to the module automation of special systems, the orchestration and the operation of the modular systems in the process orchestration level are being piloted with the manufacturers B & R Industrial Automation and Siemens. The pilot projects will result in a modular infrastructure, a modular multi-stage filtration system and two distillation plants. In addition to the pilot project activities, Merck is also responsible for the work package Approval of Modular Systems in the framework of ENPRO 2.0 ORCA. For demonstrating and evaluating individual work results, several demonstrators will also be produced as part of the project.

Fig. 9: Scheme of smart factory automation setup



Source: Merck KGaA

4.3 Modular Automation for Biopharmaceutical Application

Within a joint project, Bayer, ABB, TU Dresden and HSU Hamburg have built a demonstrator facility to demonstrate the feasibility of modular automation based on the MTP idea in the real world. The plant is based on a modular pilot plant for the continuous processing of biopharmaceutical products. The aim of the original project is to achieve high process flexibility through the interchangeability of process modules. The automation had previously been realised classically. Thus, the process-side flexibility could be found to only a partial degree in the automation.

Within the joint project, the individual process modules were equipped with their own freelance controllers. The original software was broken down to the module level and equipped with its own operating screens and services. The process control level was realised by the process control system 800xA. The MTPs exported from the module software have been integrated into this system. This enabled the visualisation and operation of the modules within the process control system. Implementing services within the modules and making them known through the MTP in the process control system enabled service-based control of the process.

Fig. 10: Demonstrator: Multipurpose use in bio production

Source: Invite GmbH

4.4 Seamless Package Unit Integration for Brown- and Greenfield Applications

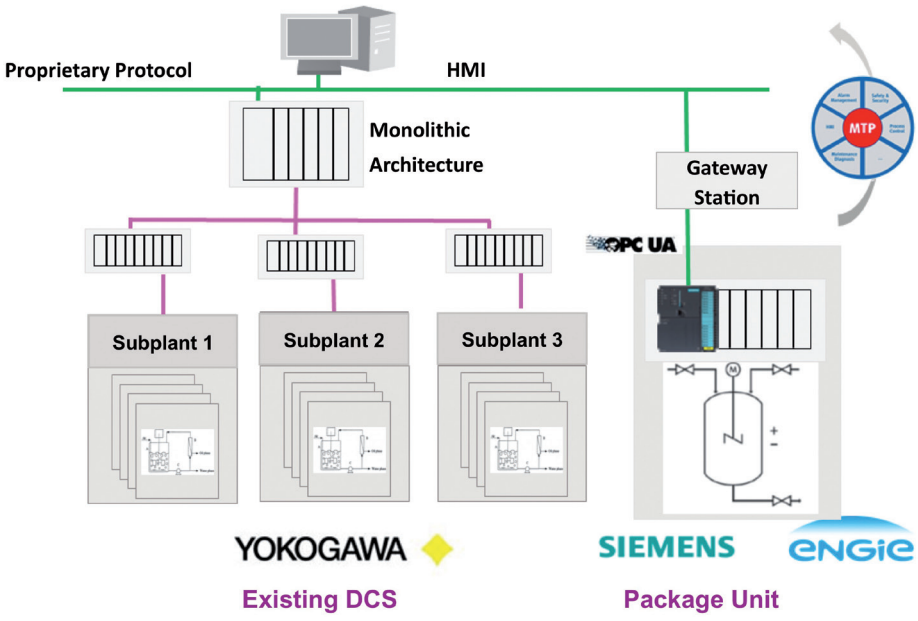
Evonik, Engie, Siemens and Yokogawa are currently working on integrating a chiller package unit into a conventional production plant by means of MTP. This is the first practical application of MTP in an industrial environment. MTP provides a standard description of process modules to ensure efficient integration into a process orchestration level. This concept is considered an enabler for modular production. Nevertheless, package units of non-modular plants have similar complexity in terms of integration. Hence, the same mechanism is useful not just for modular production but also for fast and secure integration of package units into conventional production plants.
In this pilot project, the automation system (Siemens) of the chiller package unit (Engie) was adapted to create an MTP export file containing HMI and communication aspects. This MTP file was consumed by the DCS (Yokogawa) and thus the operating screens and the communication interface were generated automatically.

Technical requirements for the parties are:

- Siemens (PLC supplier for package unit): S7-1500; TIA Portal V15; MTP import tool as VDI/VDE/NAMUR 2658; OPC UA communication
- Yokogawa (DCS supplier): Development of MTP import tool according to VDI/VDE/NAMUR 2658; unified gateway system with OPC UA communication
- Engie (Package Unit supplier) - adaptation of the PLC program with MTP coupling blocks provide by Siemens (or make use of the newest APL library for the PLC configuration)

Commissioning and start up at the Evonik production site are expected in Q1/2019. With this project, it is expected that an MTP information model can be applied for package unit integration. As a result, a reduction in manual effort and thus a saving of time and money is foreseen.

Fig. 11: Integration of a package unit in an existing DCS via MTP



Source: Evonik Technology & Infrastructure GmbH

5. Outlook, Next Steps (2019/2020)

Basic message:

- Although various elements still need to be described or defined in more detail, the experts are convinced that first applications can already be realised today
- Standardisation has reached a sufficient level so that first (modular) products can be launched on the market by 2019 – first requests from customers expected
- Necessary legal framework for modular plants – awareness, based on first experiences with prototypes
- Internationalisation regarding MTP: exchange with OPAF with the objective of achieving an internationally accepted standard – first draft for a New Work Item Proposal (NWIP) on IEC level
- Collaboration between automation companies, process plant users and process plant manufacturers – evaluate potential (new) business models
- Implementation of modular plant engineering on the market is a paradigm shift; hence, this inevitably requires a change in mind-set within the companies involved
- Standardisation of module-related design criteria for modular process plants and equipment. After describing the basic definitions and concept behind modular plants, the subsequent guideline work in VDI 2776 will focus on the description of responsibilities and deliverables for partners that are involved along the asset life cycle of a modular plant. Particular focus will be on module design, modular safety concepts and the operation of modular plants in the coming years. Special attention will be paid to the authority engineering step.
- Further information: Links to the four associations involved

Internationalisation regarding MTP: exchange with OPAF with the objective of achieving an internationally accepted standard – first draft for a New Work Item Proposal (NWIP) on IEC level

The requirements of automation and interfaces of modular process plants will be published in VDI/VDE/NAMUR 2658 as a German standard. For a worldwide acceptance of this concept, an international standard is necessary. Therefore, the ZVEI/NAMUR/ProcessNet/VDMA are striving for an IEC standard. A New Work Item Proposal (NWIP) has already been submitted on IEC level.

At the same time, the US initiative Open Process Automation Forum (OPAF) is developing open interoperable process control architectures. The German and US initiatives agreed on close collaboration and mutual compatibilities of the concepts and technologies. This will support the international acceptance of both the MTP concept and Open Process Automation architecture.

Collaboration between automation companies, process plant users and process plant manufacturers – evaluate potential (new) business models

An agile approach in terms of collaboration between automation suppliers, module manufactures, and owners/operators of process plants is necessary for increased market acceptance. This includes:

- further pilot projects for evaluating the modular process plants concepts
- more mature tools supporting MTP for automation of process modules and on orchestration level
- new business models between module manufacturers and owners/operators of modular process plants (e.g. module manufacturer provides service and maintenance over life cycle)
- in addition to MTP (focus on automation), further essential preconditions need to be developed (module engineering, virtual commissioning of modules, legal aspects of modular plants, etc.)

Verfahrenstechnische
Maschinen und Apparate

NAMUR –
Interessengemeinschaft
Automatisierungstechnik der
Prozessindustrie e.V.
c/o Bayer AG
Building. K 9
51368 Leverkusen, Germany
www.namur.net

ProcessNet -
eine Initiative von DECHEMA
und VDI·GVC
c/o DECHEMA e.V.
Theodor-Heuss-Allee 25
60486 Frankfurt am Main
Germany
www.processnet.org

VDMA
Verfahrenstechnische
Maschinen und Apparate
Lyoner Straße 18
60528 Frankfurt am Main
Germany
http://vtma.vdma.org

ZVEI -
German Electrical and
Electronic Manufacturers'
Association
Lyoner Straße 9
60528 Frankfurt am Main
Germany
www.zvei.org