The Age of Modular Production: Standardization of Processes and Interfaces

Frank Stenger, Leon Urbas
Motivation

- Reduces development cycles
- Shorter commissioning time
- Adjustment of production

Increased Competitiveness

- Reduced Time-to-Market
- Increased Flexibility
- Improved Efficiency

- Customized, individualized products
- Reduced product quantities
- Small product quantities

- Productivity, availability
- Resources and energy efficiency
- Sustainability

Modular Production as Key Technology
Development of a Plant Technology, that allows an **Economic** production

of **Any Product** in **Shortest Time**

and at **Any Location** according to the demand.
Approach

- Fast & cost competitive by **Standardization**
- Flexibility & Functionality by **Modularization**

*Fast*  
*Flexible*  
*Cost competitive*
Involved disciplines ...

Automation of Modular Plants: MTP (Modul Type Package)
... companies & associations
Different Aspects of Modularity

Modular Process Technology

Modular Plant Design

Modular Process Automation

Process Module
PT + AT + IT

Container Plants
(Greenfield)

Package Unit
(Brownfield)

Formal Description of Interfaces and Capabilities

Source: Ystral

Source: Invite

Source: Clariant

Modular Process Technology & Plant design

Process Technology (VDI 2776)
- Modular Plant (PEF)
  - Infrastructure (Backbone)
  - PEA

Automation Technology (VDI 2658)
- Process orchestration Layer
  - Process orchestration Layer (Orchestration, Historical Data, Alarm-Event-Logging)

- Module Automation
  - Module Automation (Information Processing, Architecture)

- FEA Intelligence
  - FEA Intelligence (Modeling, Monitoring, ...)
Four Levels for a Modular Process Technology …

**Process Technology (VDI 2776)**

- **Modular Plant (PEF)**
  - Modular Plant
  - Process Equipment Assembly (PEA)
    - Infrastructure (Backbone)
    - PEA
  - Functional Equipment Assembly (FEA)
    - FEA
  - Component
    - Mach, App
    - Piping
    - Fittings
    - Field devices
    - Mechanik

**Automation Technology (VDI 2658)**

- **Process Orchestration Layer**
  - (Orchestration, Historical Data Alarm-/Event-Logging)
- **Module Automation**
  - (Microservice Oriented Architecture)
- **FEA Intelligence**
  - (Frequency converter, Massflow Controllern, …)
- **Inst.- Material**
- **Switch cabinet**
… allow for a new Modular Plant Engineering approach
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- **Participants**
  - BASF, Bayer, BHS, CHT, Clariant, Cryotec, INVITE, Evonik, FHI IFF, Kanzlei Kümmlein, Lanxess, Merck, MicroInnova, Regierungspräsidium Darmstadt, TU Dresden, Westfälische HS, Zeton

- Close cooperation with VDI2658
Automation of Modular Plants with Module Type Package (MTP),
a standardized non-proprietary interface description of process equipment assemblies
Modular Automation Technology

Process Orchestration Layer

Engineering System

Import

Automation of Modular Plants: MTP (Modul Type Package)
Aspect Human Machine Interface
**HMI principles**

**Module Engineering**

- **Modul A**
- **Modul B**

**Plant Engineering**

- **Process Orchestration**
  - **Modul A**
  - **Modul B**
  - **Modul C**
  - **Modul D**

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- Describe proprietary graphics in a standardized way (static & dynamic)

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**Harmonized view**

via customized libraries from the automation supplier!

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**Proprietary view**

of the modules
## MTP HMI Standardization

### VDI/VDE/NAMUR 2658

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Process Control Orchestration - Principles

Module Engineering

Plant Engineering

Service oriented communication:
- Command (e.g. tempering)
- Status (e.g. Running)
- Service properties (e.g. temperature)
- State model (ISA88)
# MTP Process Control Standardization

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Research and Pilot Projects

MODULAR BIOPRODUCTION
Bayer & ABB
- Target: **Multi Purpose Bioproduction** through process adaption by changing the module configuration
- Result: Reduction of Engineering time compared to classical automation approach & flexibility in re-configuration scenarios

SEAMLESS PACKAGE UNIT INTEGRATION
Evonik & Yokogawa / Siemens
- Target: **Package unit** (Chiller) integration into conventional DCS system via the modular MTP concept
- Result: First time demonstration for an efficient package unit implementation in an industrial production environment

MERCK’S “SMART FACTORY”
Merck, B&R & Siemens
- Target: **Modular equipment** for **flexible production**. Multi-stage filtration system, two distillation systems with a modular backbone
- Result: Experience in Module Engineering & POL integration, industrial implementation of interoperable Modules with services.

ENPRO2 ORCA
Merck, Evonik, Siemens, Samson, Sartorius, ABB, WAGO, X-VISUAL, TU Dortmund, TU Dresden
- Target: Defining an efficient **orchestration methodology** and learning for a suitable **authority approval**
- Result: First time demonstration of a fully orchestrated modular plant from different module vendors and automation suppliers
Summary & Outlook

- **Summary**
  - Ongoing standardisation processes connect process technology and automation technology
  - Agile approaches that leverage low-hanging fruits (e.g. Package Unit Integration)
  - First pilots show feasibility and provide feedback to standardisation

- **Next Steps**
  - Internationalisation DKE K 941, IEC 6xxx New Work Item Proposal, The Open Group
  - **Ongoing R&D: BMWi ENPRO2 ORCA, TeiA, SKAMPI, ModulA, MoProLog, KoPPoNa2**
    - Modular Plant Design (TeiA, SKAMPI, KoPPoNA2)
    - Excellerated authority engineering (ORCA)
    - Connecting DEXPI & MTP (ORCA + ModulA)
    - Connecting Process Orchestration and Logistics Orchestration (MoProLog + ORCA)
Thanks for you attention

… Questions?