FROM INDUSTRY 4.0 TO PHARMA 4.0

Pharma 4.0 Special Interest Group (SIG)
"Plug & Produce" Workgroup

Wolfgang Dedden, Wolfgang Winter

ALLOTROPE CONNECT WORKSHOP

WALDBRONN, 25-APR-2018

Executive Summary Pharma 4.0 „Plug & Produce"

Initiative Summary

- Work group initiated by ISPE DACH Special Interest Group „Pharma 4.0" (approx. 40 active participants)
- Define how „Industrie 4.0" approach, technology and benefits realized in industrial manufacturing can be applied to Pharma → „Pharma 4.0"

Problem Statement

- System integrations in pharma manufacturing (ISA 95 levels 2-3) are struggling with the lack of cross-vendor integration standards, resulting in high complexity and engineering effort for definition, implementation/deployment and validation.

Opportunity Statement

- Enable Quality & Data Integrity by Design by applying current, new and emerging technologies (connectivity and analytics) under a global „Plug & Produce" Standard
- Simplify, increase usability, reduce engineering effort for implementation and integration & enable end-to-end equipment integration, across Manufacturing, Laboratory / Analytical Devices, LIMS, Process Control Systems from the Sensor up to the long term data archive

Next Steps and Focus Areas

- Further assess existing standards and standardization initiatives (NAMUR, MESA, ZVEI, OPC-UA, Allotrope, etc.)
- Foster communication of Plug & Produce concept and status throughout 2018
- Plug & Produce Guidance Document (first white paper planned later in 2018)
- Define and execute Pilot Projects at Pharma organizations to prove the concept and feasibility

OUR VISION

New equipment to expand the production plant!
How to connect this to the existing environment?

Why not like connecting a printer to a computer network? Plug and Produce → a future solution!

PLUG & PRODUCE
WORKING GROUP

Pharma 4.0 – Plug & Produce Workgroup

Co-Chair

Name	Vorname	Firma
Dedden	Wolfgang	Bayer AG
Sauermann	Klaus	Werum IT Solutions GmbH

Core-Team

Name	Vorname	Firma
Buendia	Antonio	Novartis Pharma AG
Eichmann	Thomas	Bioengineering
Herta	Karol	MerckGroup
Krauß	Stefan	Siemens AG
Kritzler	Uwe	F.Hoffmann-La Roche AG
Maurer	Frank	Boehringer Ingelheim Pharma GmbH & Co.KG
Mayer	Martin	evon GmbH
Tapscott	Derrick	Rockwell Automation UK
Trapl	Josef	Takeda Pharmaceutical International AG
Winter	Wolfgang	Agilent Technologies
Wölbeling	Christian	Werum IT Solutions GmbH

Close to 40 active participants
(and growing)

Extended Team

Name	Vorname	Firma
Bahne	Andreas	Boehringer Ingelheim Pharma GmbH & Co.KG
Böhle	Thorsten	F. Hoffmann – La Roche AG
Christmann	Ulrich	Bayer AG
Fossler	Michael	4it
Geiger	Robert	M+W Central Europe GmbH
Günther	Kathrin	Uhlmann Pac-Systeme GmbH & Co. KG
Halfmann	Thomas	HGP
Hanisch	Christian	Robert Bosch GmbH
Hensel	Hartmut	Hochschule Harz
Irmisch	Martin	Rockwell Automation
Kleinpeter	Arne	Bürkert-Contromatic GmbH
Kreutle	Thomas	Uhlmann Pac-Systeme GmbH & Co. KG
Kummli	Dominique	Novartis Pharma AG
Leineke	Ulf	Mediseal GmbH
Liesum	Lorenz	Novartis Pharma AG
Lustig	Gero	ABB Automation GmbH
Meier	Hartmut	Takeda GmbH
Messmer	Jürg	Dividella AG
Moree	Petter	OSI PI
Nagler	Mario	groninger & co. gmbh
Pötter	Thorsten	Bayer AG
Richard	Marc	IN-Pips GmbH
Staudt	Marcel	Bayer AG
Tauchnitz	Thomas	Sanofi Aventis Deutschland GmbH
Zimmer	Thomas	ISPE
Zobel	Joachim	Novartis Pharma AG

ISPE PHARMA 4.0 SIG Workgroups

Holistic Manufacturing Control Strategy

Focused on Product/Quality System with strong relationship to

ICH
harmonisation for better health
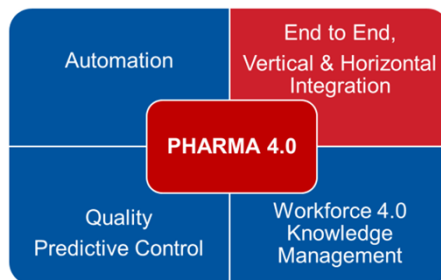
Plug & Produce

Focused on system/equipment integration with strong relationship to

NAMUR ZVEI:

Allotrope

Automation	End to End, Vertical & Horizontal Integration
PHARMA 4.0	
Quality Predictive Control	Workforce 4.0 Knowledge Management

Pharma 4.0 Plug & Produce Workgroup Goals

Business Case

> Minimize equipment integration costs and total lifecycle cost through global Plug & Produce standard (focus on ISA-95 Levels 2-3)

Holistic Solution

> Create global, vendor-independent vertical & horizontal integration standard for ISA-95 L2 to Level 3, based on established standards & proven concepts (e.g. NAMUR, ZVEI, VDI, OPC-UA, MTP, MESA, Allotrope)

> Enable End-to-End Integration from sensor up to long term data archive: Incl equipment from manufacturing, lab devices, LIMS, Process Control (DCS, SCADA, Historians)

> Contribute Pharma & GMP specific requirements and use-cases - Quality & Data Integrity by Design

Plug & Play

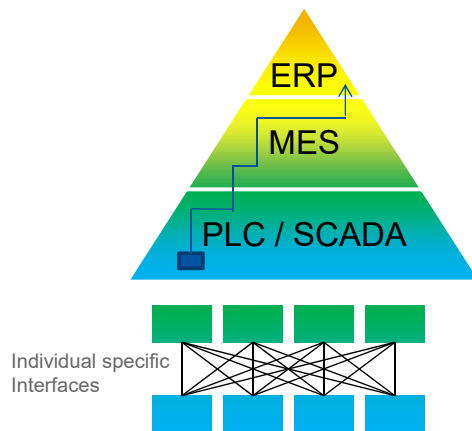> Module certification approach: Suppliers can easily certify new products

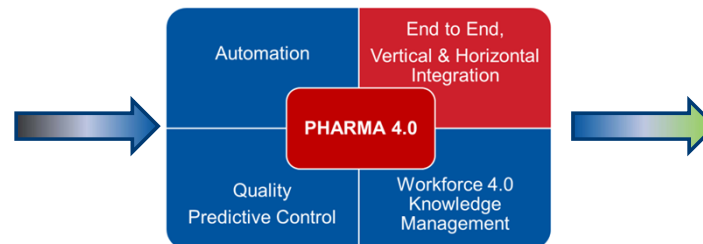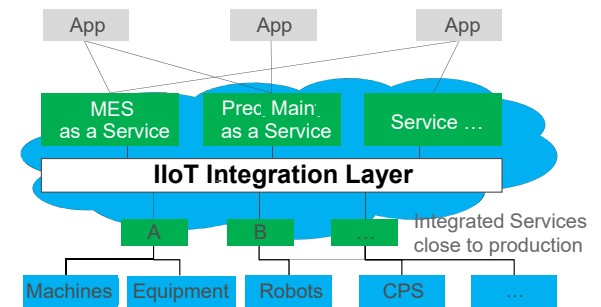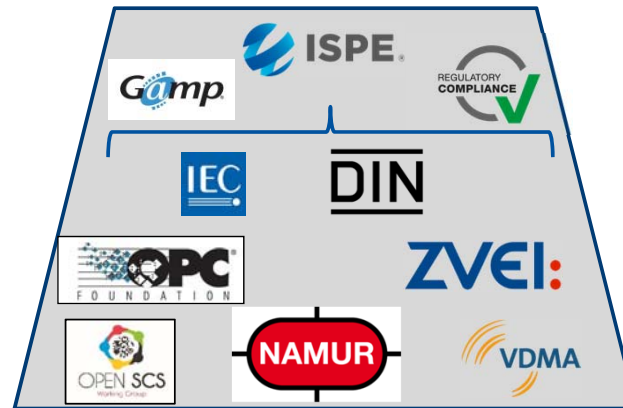White Paper | From White Paper to Best Practice Guide | Plug & Produce

Today:

Tomorrow:

ERP
MES
PLC / SCADA

Individual specific Interfaces

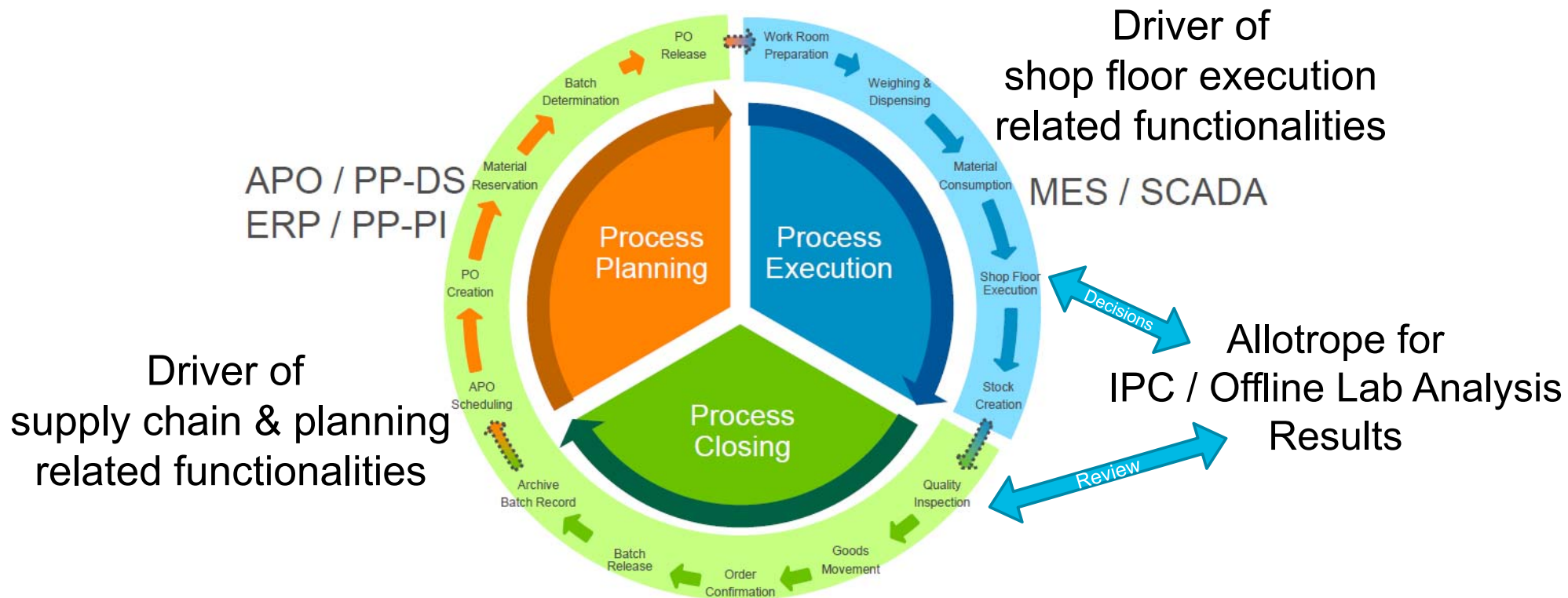Lack of "Plug & Produce" integration scenarios for existing Pharma specific integration standards

Opportunity:
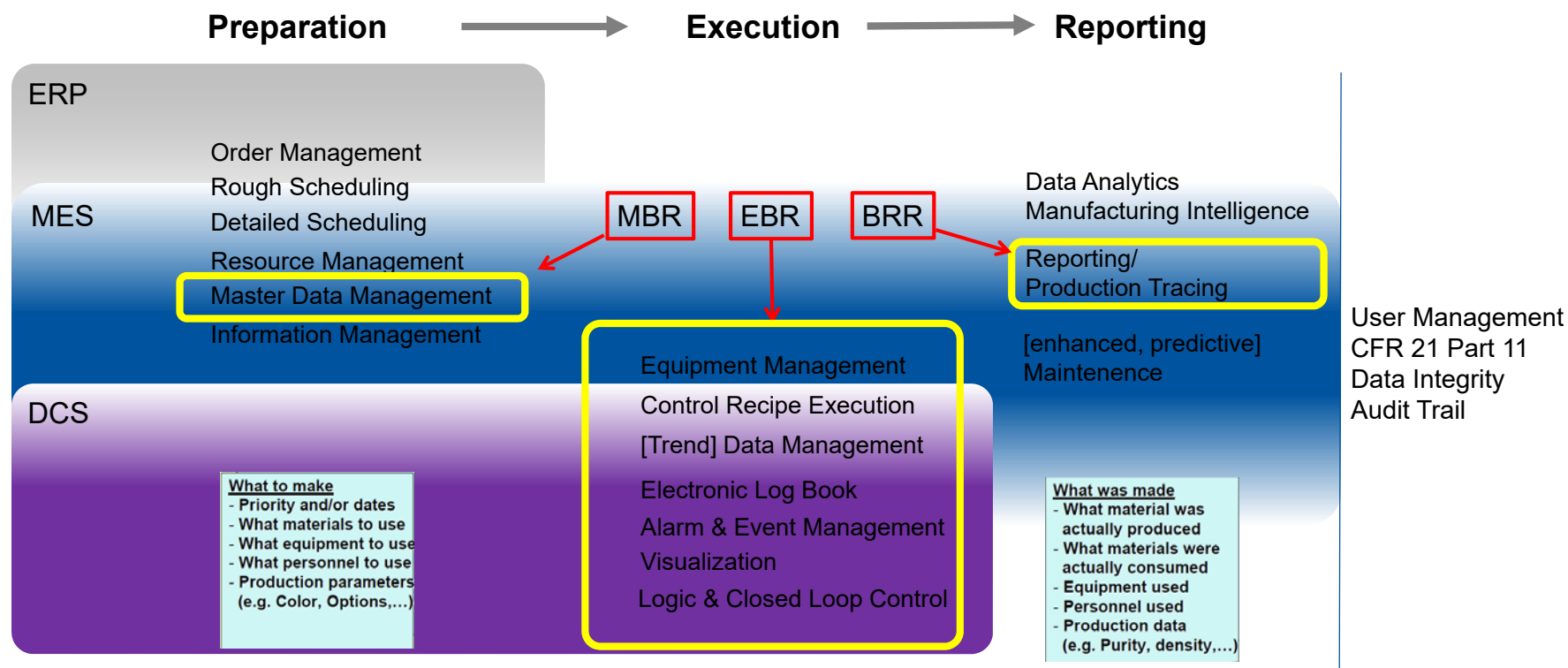**Simplify, increase usability, reduce engineering & validation efforts through "Plug & Produce"**
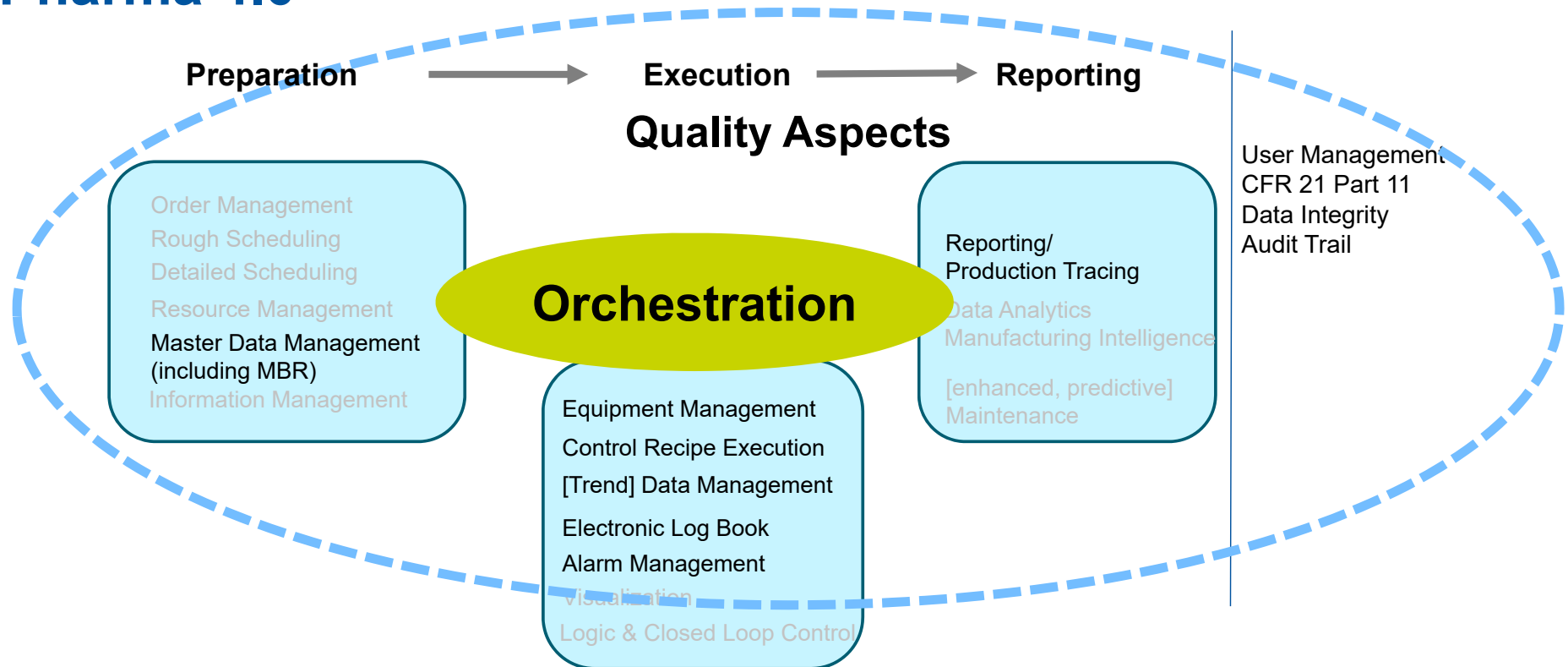
App | App | App

MES as a Service | Prec. Main. as a Service | Service …

IIoT Integration Layer

Integrated Services close to production

A | B | …

Machines | Equipment | Robots | CPS | …

Automation
End to End, Vertical & Horizontal Integration
PHARMA 4.0
Quality Predictive Control
Workforce 4.0 Knowledge Management

PLUG AND PRODUCE WORKGROUP

APPROACH

Status Quo in Pharma Manufacturing:
IT/OT Application-Focus

Driver of
shop floor execution
related functionalities

MES / SCADA

Allotrope for
IPC / Offline Lab Analysis
Results

Driver of
supply chain & planning
related functionalities

APO / PP-DS
ERP / PP-PI

Proposed PnP Approach for Pharma Production 4.0: Focus on Functions, not Applications!

Preparation → **Execution** → **Reporting**

ERP

Order Management
Rough Scheduling

MES

Detailed Scheduling
Resource Management
Master Data Management
Information Management

MBR EBR BRR

Data Analytics
Manufacturing Intelligence

Reporting/
Production Tracing

[enhanced, predictive]
Maintenence

User Management
CFR 21 Part 11
Data Integrity
Audit Trail

DCS

What to make
- Priority and/or dates
- What materials to use
- What equipment to use
- What personnel to use
- Production parameters
  (e.g. Color, Options,...)

Equipment Management
Control Recipe Execution
[Trend] Data Management
Electronic Log Book
Alarm & Event Management
Visualization
Logic & Closed Loop Control

What was made
- What material was
  actually produced
- What materials were
  actually consumed
- Equipment used
- Personnel used
- Production data
  (e.g. Purity, density,...)

Interfacing the Functions Is Key for Quality by Design in Pharma 4.0

Preparation → Execution → Reporting

Quality Aspects

Orchestration

Order Management
Rough Scheduling
Detailed Scheduling
Resource Management
Master Data Management
(including MBR)
Information Management

Equipment Management

Control Recipe Execution

[Trend] Data Management

Electronic Log Book

Alarm Management

Visualization

Logic & Closed Loop Control

Reporting/
Production Tracing

Data Analytics
Manufacturing Intelligence

[enhanced, predictive]
Maintenance

User Management
CFR 21 Part 11
Data Integrity
Audit Trail

End-to-End Integration for Digitalized Manufacturing Execution

Possible Plug and Produce Concept:
From Data Generation to Report Rendering

Execution Functionality

Reporting (Rendering)
- Advanced Analytics
- Reports & Dashboards
- Data Acquisition (Contextualization)

Reporting Data Static

Data Provision

Storage
- Data Repository

Long Term Archive (single point of truth)

True Copy

Equipment Data Generation
- Technical Data / Measured Values

Dynamic Raw Data
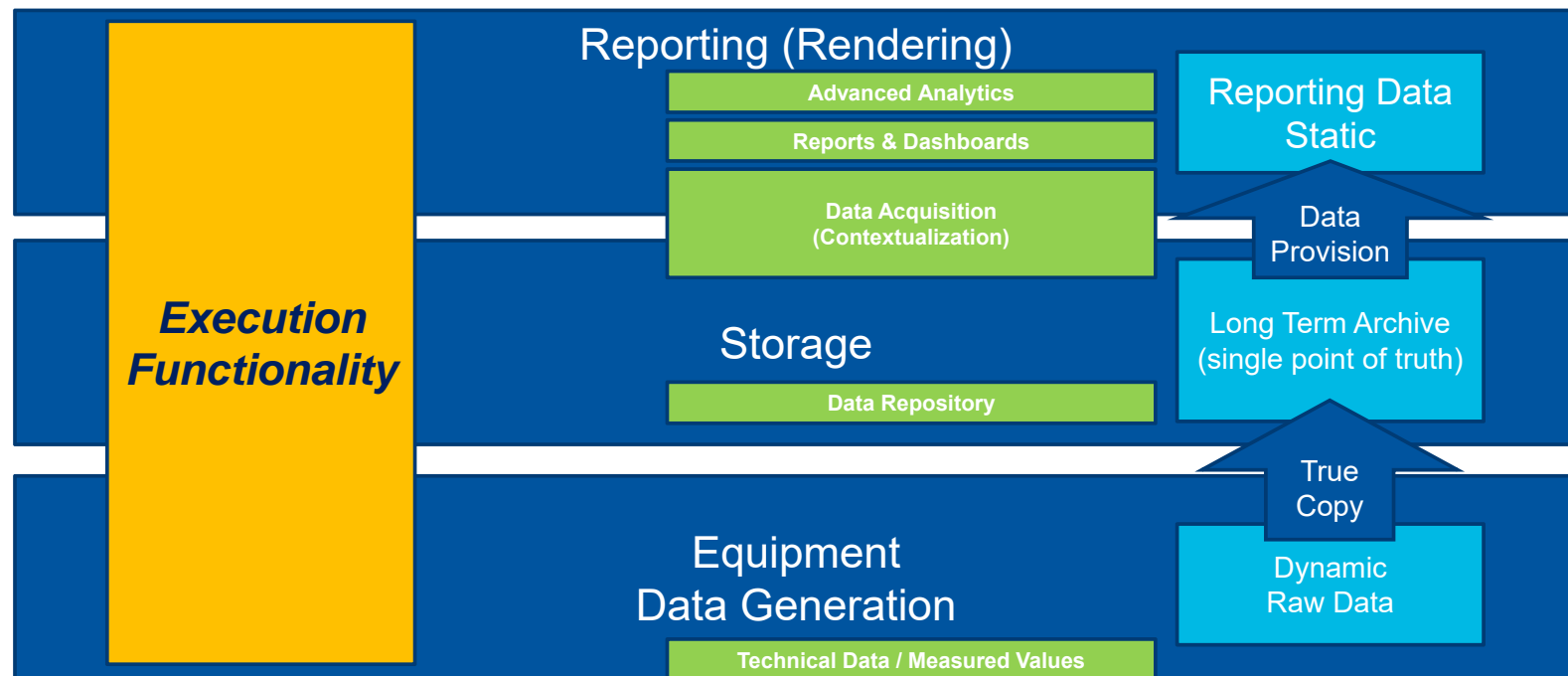
Use Case Example:
EBR execution on a Package Unit

Example Formulation Use Case Tableting
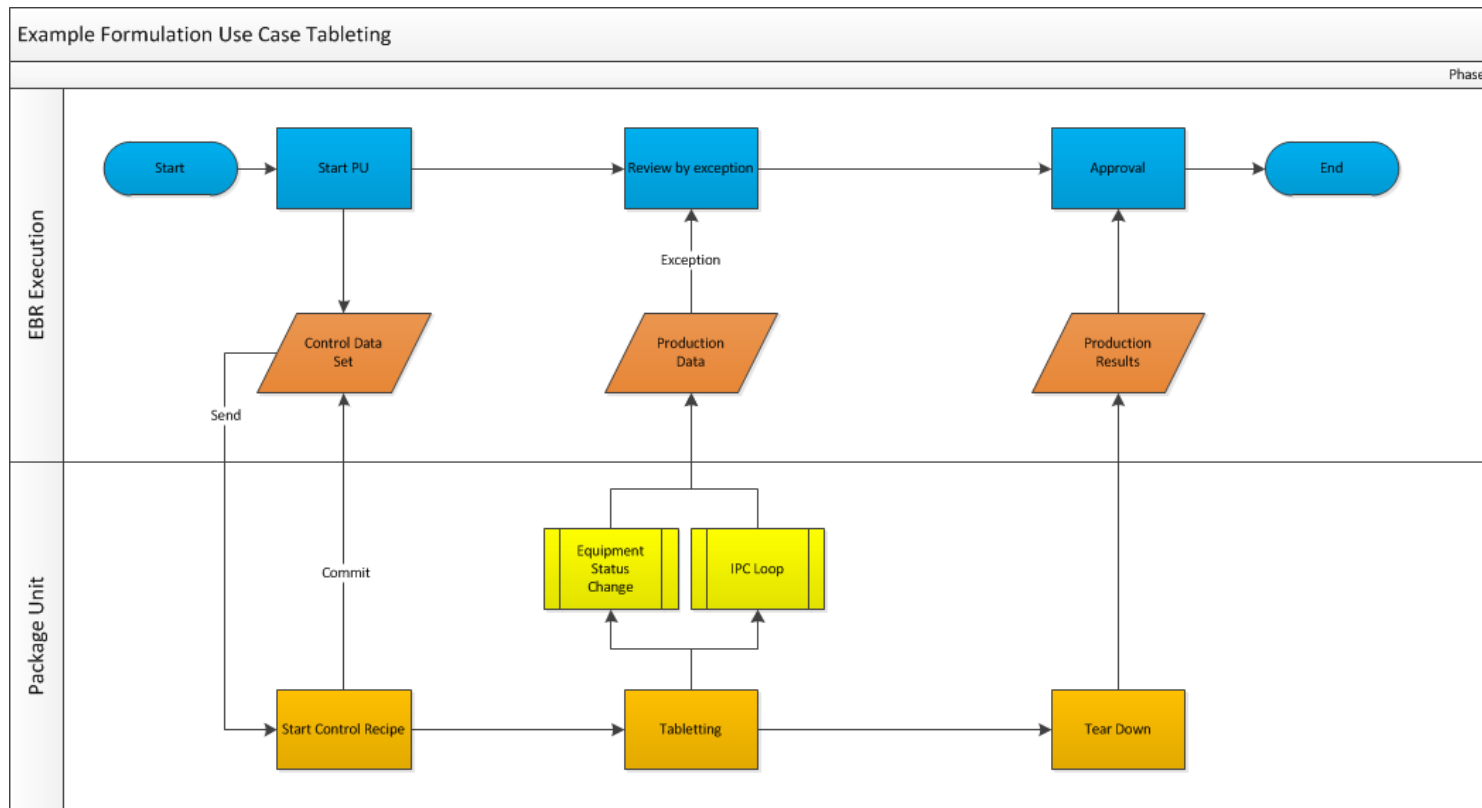
Collaboration with Other Initiatives

Organization	Initiative	Description	ISPE Contribution	More Information
NAMUR	Namur Open Architecture (NOA)	Unlock Industry 4.0 potential for process industry	Pharma & GxP specific definitions, requirements and use cases	Namur-WG 2.8 Automation Networks and Services
ZVEI and NAMUR	Modular Automation (MA) Workgroup	MODULE TYPE PACKAGE (MTP) Service oriented interface for process control	Pharma & GxP specific definitions, requirements and use cases	MTP Whitepaper From ZVEI, Automation Division seibl@zvei.org
The Open Group	Open Process Automation (OPA)	Develop standards-based, open, secure, interoperable process control architecture	Alignment	http://www.opengroup.org/
Allotrope Foundation	Allotrope Framework, Allotrope Partner Network	Standardized format, taxonomies, ontologies, data models, API for scientific data	Alignment – extend concept to include analytical device data in EBR	Allotrope publications and case studies
BPOG	Plug & Play	Standardized format, data models for BioTech productions	Pharma & GxP specific definitions, requirements and use cases	BPOG Plug and Play Whitepaper
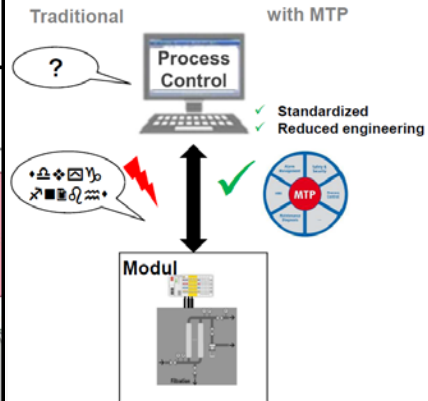
Leverage and Synergy on technical layer integration

Leverage and Synergy on functional layer integration

Fundamentals of a measurement workflow

Addressing the root causes

EBR relevant data interface requirements needed
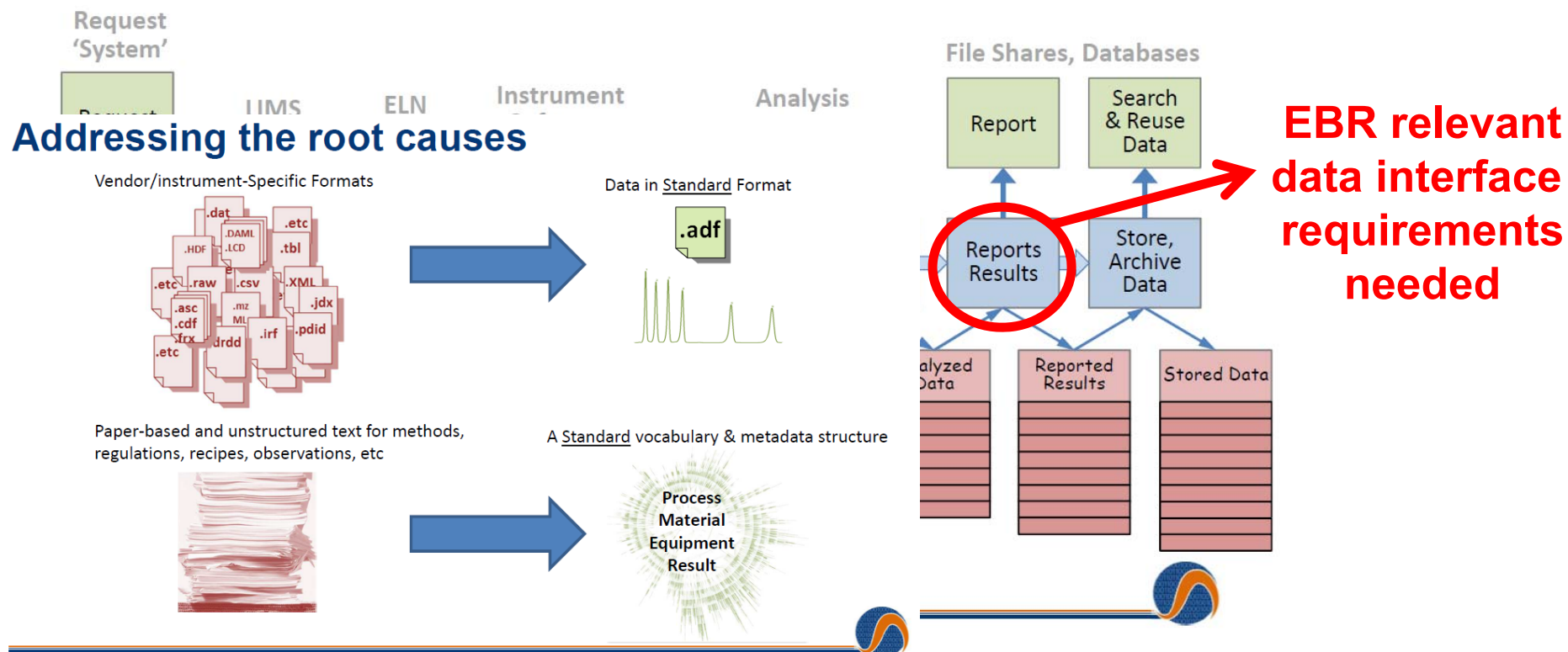
SUMMARY

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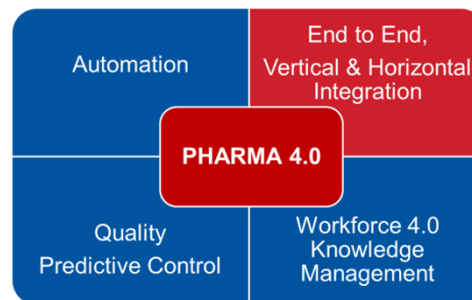
Next Steps: Best Practice Guide to Enable Pharma 4.0 based on existing standards
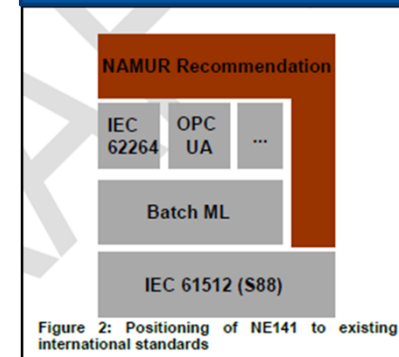
White Paper → From White Paper to Best Practice Guide → Plug & Produce

Opportunity:
Simplify, increase usability, reduce engineering & validation efforts through "Plug & Produce"


ISPE Integration Guideline

ISPE Pharma 4.0 Plug and Produce Workgroup

Motivation:
The application of Industry 4.0 in the pharma context will enable the vision of "A maximally efficient, agile, flexible pharmaceutical sector that reliably produces high quality products and services by a digitized, integrated & connected end to end supply chain." This is what we call "Pharma 4.0". The mission of "Pharma 4.0" is to "manufacture pharmaceutical products with maximum product & process understanding, data integrity by design, efficiency and optimal resource allocation on the basis of full digital data transparency - to the benefit of the patient."
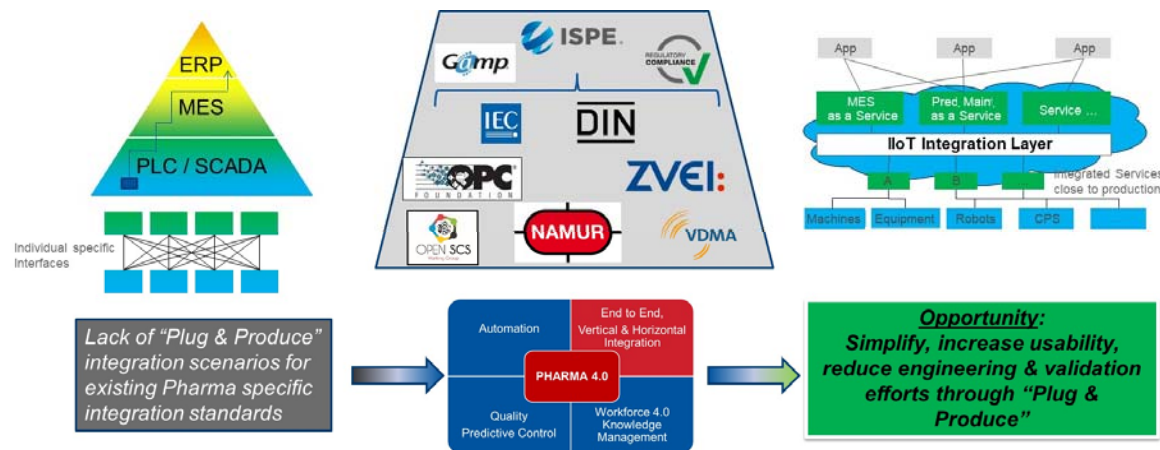
What Is Plug and Produce About?

Plug and Produce contributes pharma-specific requirements to Industry- 4.0-related initiatives in order to define the necessary enablements for end-to-end integration, QbD and Data Integrity by Design → Pharma 4.0

Key Considerations

- System and access security
- Data integrity by design
- Traceability from the raw data up to the approved batch specific released data
- Meeting regulatory expectations to provide batch record reports and performing annual product reviews

Next Steps

- Win further subject matter experts from industry, suppliers and consulting firms to volunteer for the working group
- Liaise with and assess existing standardization initiatives (NAMUR, MESA, ZVEI, OPC-UA, Allotrope, etc.)
- Socialize ideas and concepts for Plug and Produce with broader audience
- Presentations at industry conferences (ISPE. Allotrope Connect)
- Publish a first Plug & Produce Guidance Document in 2018
- Pilot Project at Pharma organizations to prove the concept and feasibility

Plug and Produce Chair:

Klaus Sauermann, Werum IT Solutions GmbH

Wolfgang Dedden, Bayer AG

Synergies and Collaborations

The Plug and Produce workgroup is planning to create a global, supplier independent vertical & horizontal integration standard for ISA-95 Level 2-3, based on already established standards & proven technologies & concepts such as NOA, MTP, OPC-UA, MESA, leveraging activities already undertaken or underway by NAMUR, ZVEI, VDI, OPC Foundation and the Allotrope Foundation.

Summary

The intent is to simplify and increase usability significantly, while reducing engineering effort for implementation and integration & enable end-to-end equipment integration, across Manufacturing, Laboratory / Analytical Devices, LIMS, Process Control Systems. The vision is to achieve horizontal and vertical integration from the sensor/device up to the long-term data archive to realize the full potential of "Pharma 4.0".

Plug and Produce Core Team

Antonio Buendia, Novartis Pharma AG / Thomas Eichmann, Bioengineering / Karol Herta, Merck KGaA / Stefan Krauß, Siemens AG / Uwe Kritzler, F.Hoffmann-La Roche AG / Frank Maurer, Boehringer Ingelheim Pharma GmbH & Co.KG / Martin Mayer, evon GmbH / Derrick Tapscott, Rockwell Automation UK / Josef Trapl, Takeda Pharmaceutical International AG / Wolfgang Winter, Agilent Technologies / Christian Wölbeling, Werum IT Solutions GmbH

Questions?
Thank you for your attention!
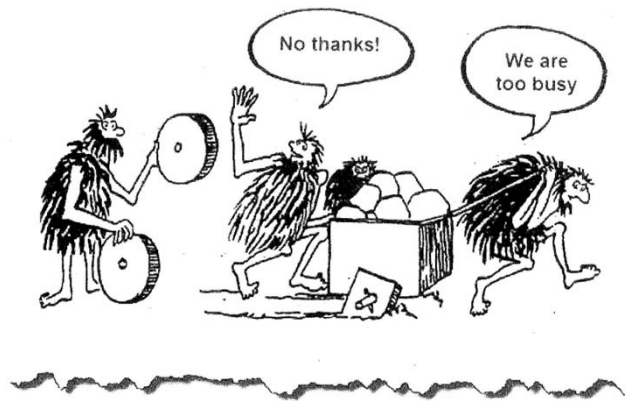
ISPE Special Interest Group
"PHARMA 4.0"

Working Group:

"Plug & Produce"

Co-Chair:

Wolfgang Dedden <wolfgang.dedden@bayer.com>

Klaus Sauermann <klaus.sauermann@werum.com>

ISPE Plug & Produce Allotrope Contact:
Wolfgang Winter <wolfgang.winter@agilent.com>