SAP Connected Manufacturing

Update on SAP Manufacturing Innovations and Roadmap

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March 2016

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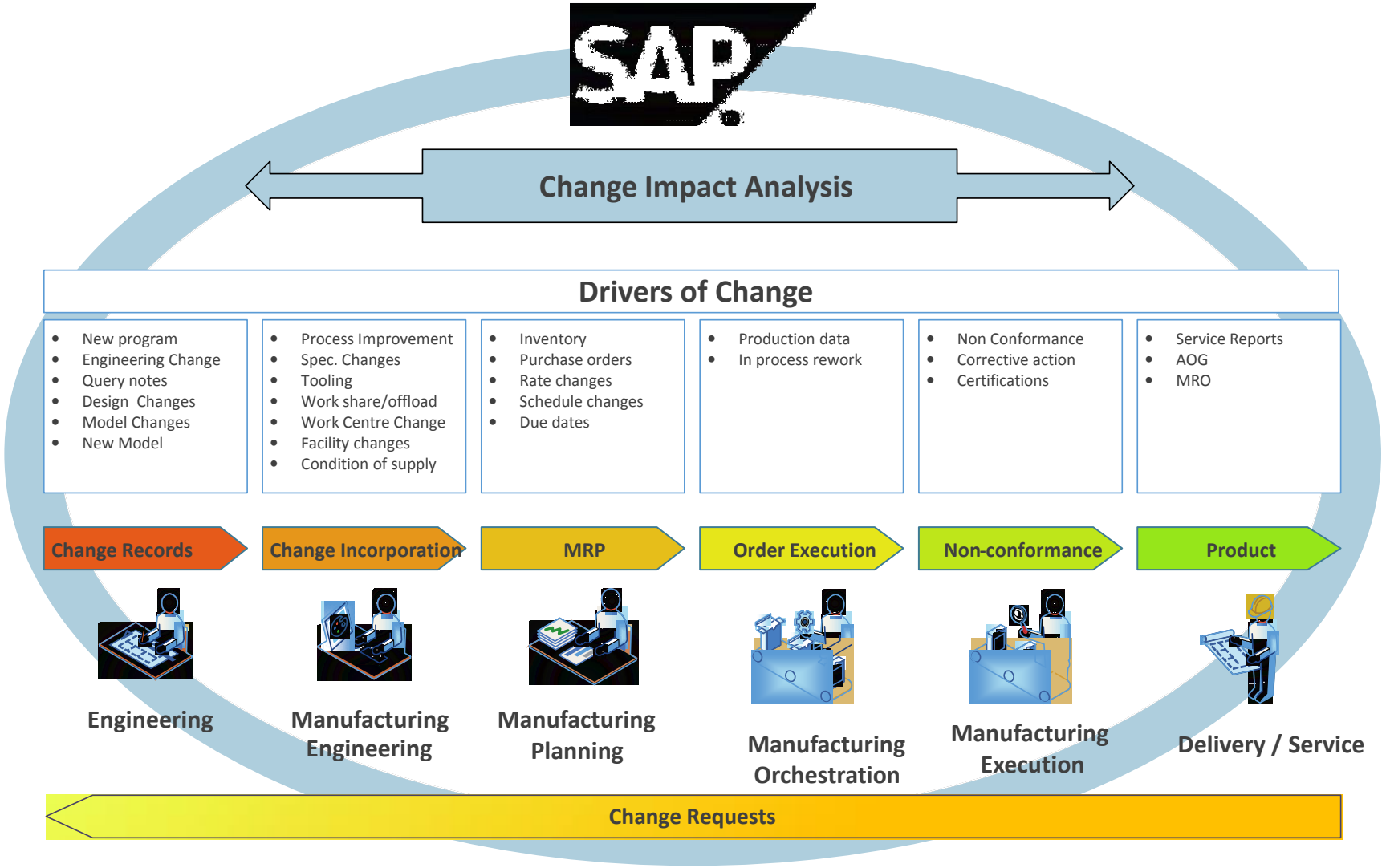
Main Building Blocks Manufacturing



SAP's Manufacturing Execution Suite extends the Digital Core

Business Systems

IBP

ABAP & Fiori

Supply Chain Planning

HCP / Business Networks

ECC or S/4 HANA

Warehouse Management

Quality Management, Plant Maintenance, Costing

R&D | **Sales** | **Manufacturing** | **Delivery** | **Service**

Manufacturing Engineering
Manufacturing Planning (MRP / PP/DS)
Manufacturing Orchestration

ABAP & Fiori

Shop Floor Systems

SAP CAMS
Computer Aided Process Planning
Shop floor Management
Etc,.

TCl/Tk

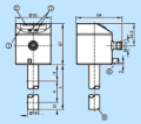
SAP ME / MII
Manufacturing Execution
Manufacturing Integration & Intelligence

NW AS Java

SCADA / HMI

DCS
PLC

Plant
Historian



Sensors

SAP Plant Connectivity

.net

2016 Future Direction of Innovations in Manufacturing

S/4 HANA for Manufacturing

- Manufacturing Engineering
- Production Planning for Discrete (PP)
- Production Planning for Process (PP/PI)
- Material Requirements Planning (MRP)
- Quality Management

SAP Manufacturing Execution Suite

- SAP ME
  - Industry 4.0, HANA Analytics, Integration, Configuration
- SAP MII
  - Industry 4.0, Energy Monitoring, Analytics Content
- SAP PCo
  - Industry 4.0, Configuration, Performance

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Manufacturing Engineering

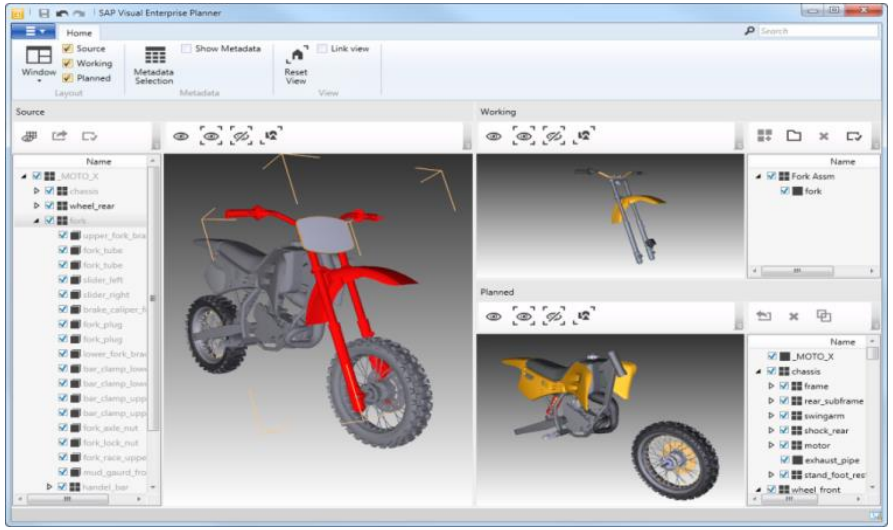
Visual Manufacturing Planner for Handover Engineering to Production

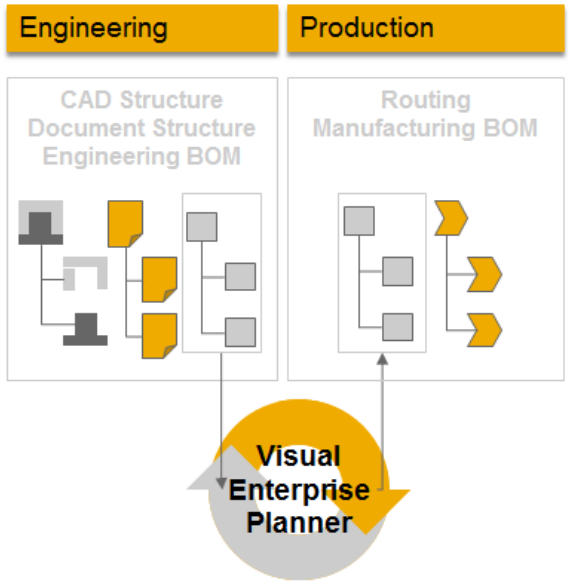
Description

- Create and maintain Material BOMs and routings for Manufacturing from Engineering BOM (Document Structure, Material BOMs or PSM/iPPE)
- Enable easy rearranging of Engineering BOM structures for Manufacturing needs
- User 3D information for visualization

Key Benefits

- Fast processing by visual supported drag & drop
- Support manufacturing planning via 3D visualization
- Fully integrated into SAP ERP
- No system boarder between Engineering and Manufacturing





Prerequisites:

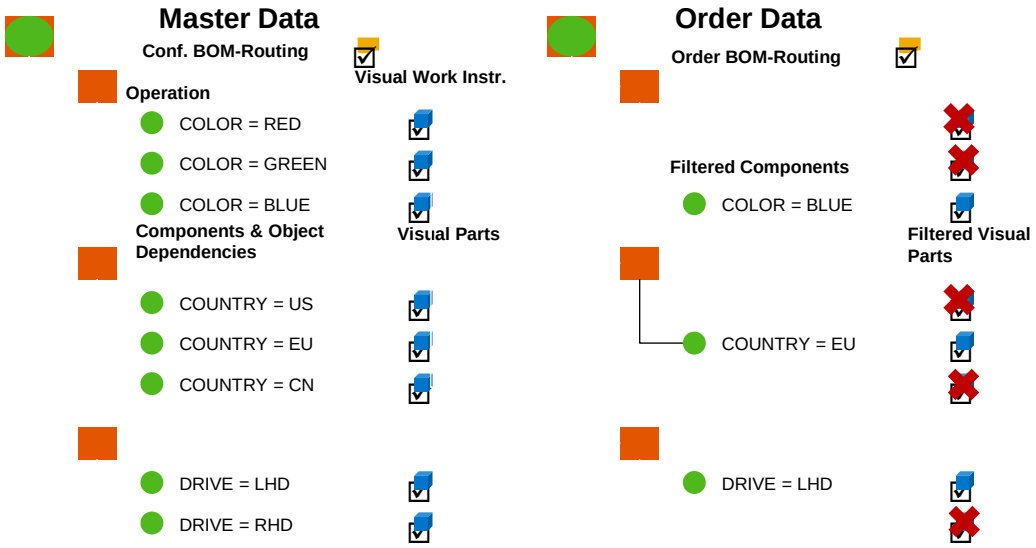
- SAP PLM CAD integration to create the document structure or Visual Data integration (using Visual Enterprise generator)
- Optionally: Visual Enterprise Instance Planner to link visuals to PSM (iPPE)
- Visual Enterprise Generator to create the RH viewing files

Manufacturing Engineering - Planned Innovation

Visual Manufacturing Assembly Planning (Visual Enterprise Manufacturing Planner)

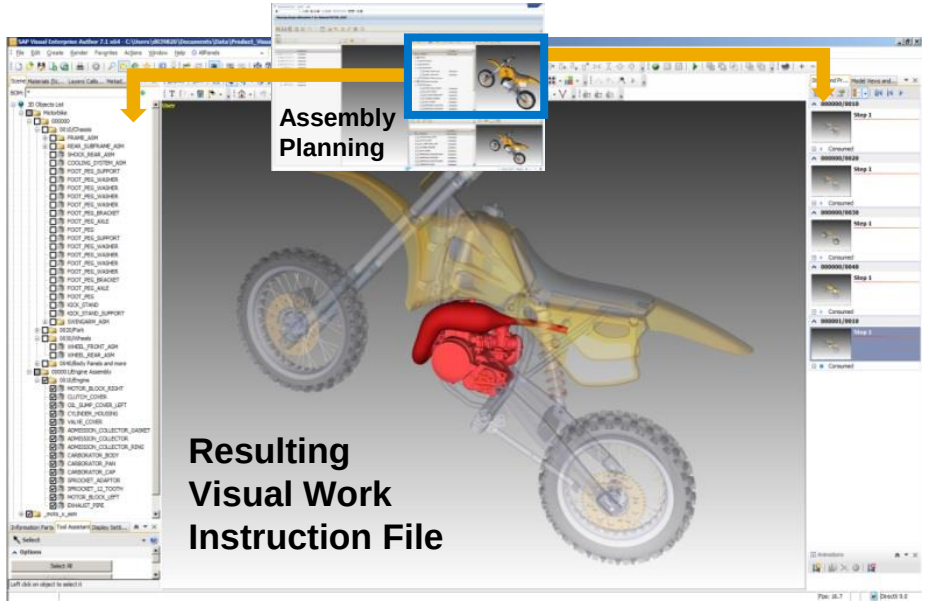
Description

- Configurable Visual Work Instructions
- Visual Enterprise Manufacturing Planner is able to create Visual Work Instruction
- In case the BOM is a variant BOM (150% BOM) the Visual Work Instructions will also contain all possible variants for Visual Work Instructions, i.e. the Visual Work Instructions will be configurable



Key Benefits

- Automatically create Visual Work Instructions according to the BOM and routing structure
- A variant Manufacturing BOM will result in a configurable Visual Work Instruction



Highlights of key business innovations in S/4 HANA

Re-architecting for in-memory platform

Responsive user experience design

Unifying functionality in core

Material Requirements Planning

Inventory Management

Material Valuation

Sales Representative (Order Management & Billing)

Procurement Clerk (Procurement)

Material Planner (Material Requirements Planning)

Available-to-Promise & Backorder Processing

Capacity Planning

Extended Warehouse & Transportation Management

SAP S/4HANA Enterprise Management

Key innovations 1511 mapped to Product Map

Procurement | **Inventory Management** | **Material Valuation** | Material Requirements Planning | Available to Promise | Capacity Planning | Order Mgmt. & Billing | Industry to Core | Accelerated Financial Close | Universal Journal & Central Finance

Use Cases enabled

High volume Backflush (Parallel Production combined postings)

Internet of Things Scenarios (real-time goods movements posting)

Segment of one (Smaller lot sizes passing through logistic operations)

Combined postings from offline devices (Fast parallel postings)

…

Parallel processing of inventory postings

Technical Innovation

…addressing the digital business as digital core

Simplified Data Model (MATDOC = MKPF + MSEG + add. Columns for fast calculations)

No aggregates: On-the-fly aggregation of inventories

Insert only on DB Level, No DB locks anymore.

Insert only on application level- Elimination of standard price (SPREIS) locking (taking rounding differences into account)

One valuation method (Material Ledger) instead of 2 (MM-IM and ML)

Accurate inventory

Business Processes improved

More effective **Inventory Management** like inventory turnover, inventory costs.

More accurate **Material Requirement Planning**

More efficient **Procurement** processes

More accurate **Sales Order Fulfillment** and **Delivery**

More efficient **Production Execution** and Easier implementation of **new processes** (like Just-In-Time, Kanban)

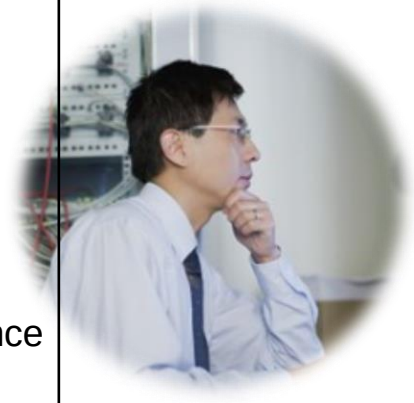
SAP S/4HANA Enterprise Management

Key innovations 1511 mapped to Product Map

Procurement	Inventory Management	Material Valuation	**Material Requirements Planning**	Available to Promise	Capacity Planning	Order Mgmt. & Billing	Industry to Core	Accelerated Financial Close	Universal Journal & Central Finance

Business Challenges

- Increasing customer service
- Low inventory accuracy
- Revenue losses due to stock-outs
- Poor on-time delivery performance
- Missing parts in production



SAP S/4HANA Capabilities

- Prioritized view on material flow issues
- Real-time alerting based on current stock requirements situation
- System-generated solution proposals
- MRP can run as frequently as required (up to 10x faster)
- Demand information is propagated faster through the supply chain

Business Benefits

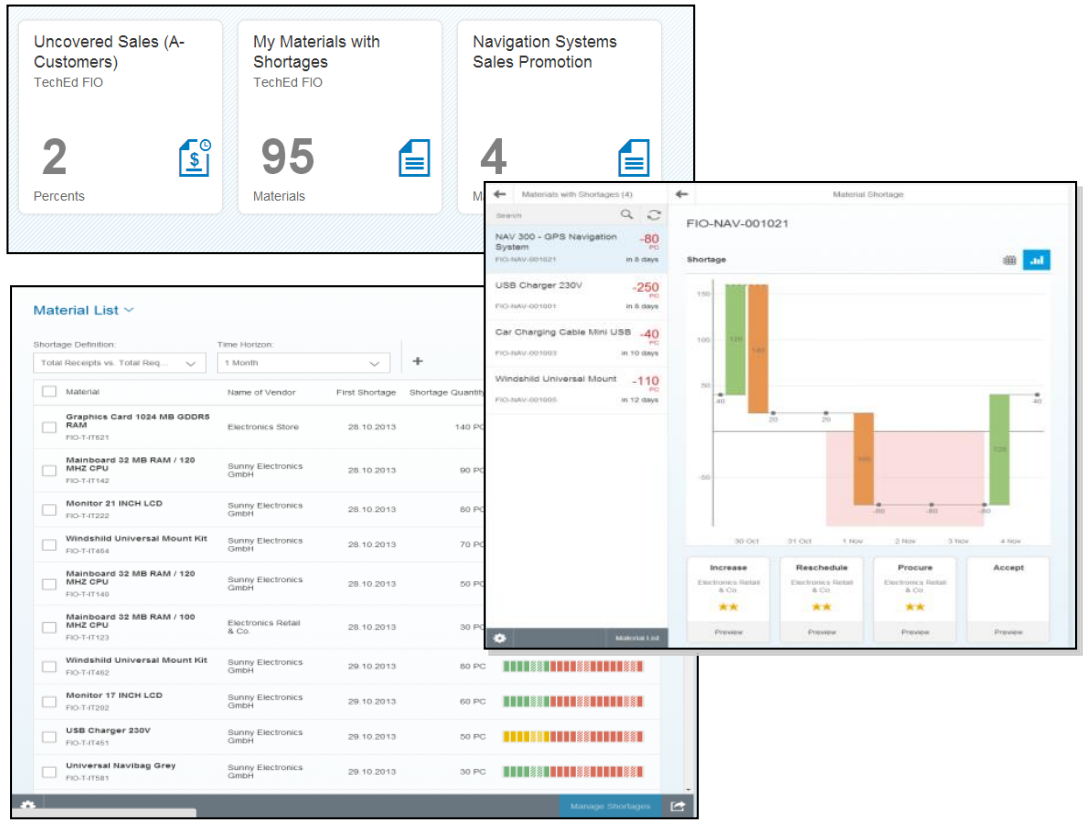
- Clear visibility across the material flow
- Proactive decision making in response to changing demand
- Flexible tailoring of available capacities and receipts to meet required quantities
- Real time inventory monitoring and automating the creation of procurement proposals

Solution Today
MRP Apps

MRP Apps

DemoSP3

DemoSP5



MRP Apps – The new dashboard for the Material Planner.

- Monitor KPIs and alerts
- Identify most urgent and important issues, considering time to action and order values, priorities, and the like
- Choose from a set of pre-evaluated solution proposals
- Instant detection of critical situations in the material flow based on real time data
- Comprehensive impact analysis
- Evaluation of various solution proposals leading to well-founded decisions

Prerequisites:

- SAP EhP7 SP 3
- SAP HANA

SAP S/4HANA Enterprise Management – Key Innovations

Material Requirements Planning

MRP Run

Performance improvement:

- Scenario dependent **up to 10 times faster**
- **Data Storage reduction by 5 times**
- New mode supports procurement and in-house production, delivery schedules and configurable materials
- Classic mode for subcontracting, capacity planning and discontinuation

Step1: Read

Step2: Algorithm (Netting, Lotsizing,..)

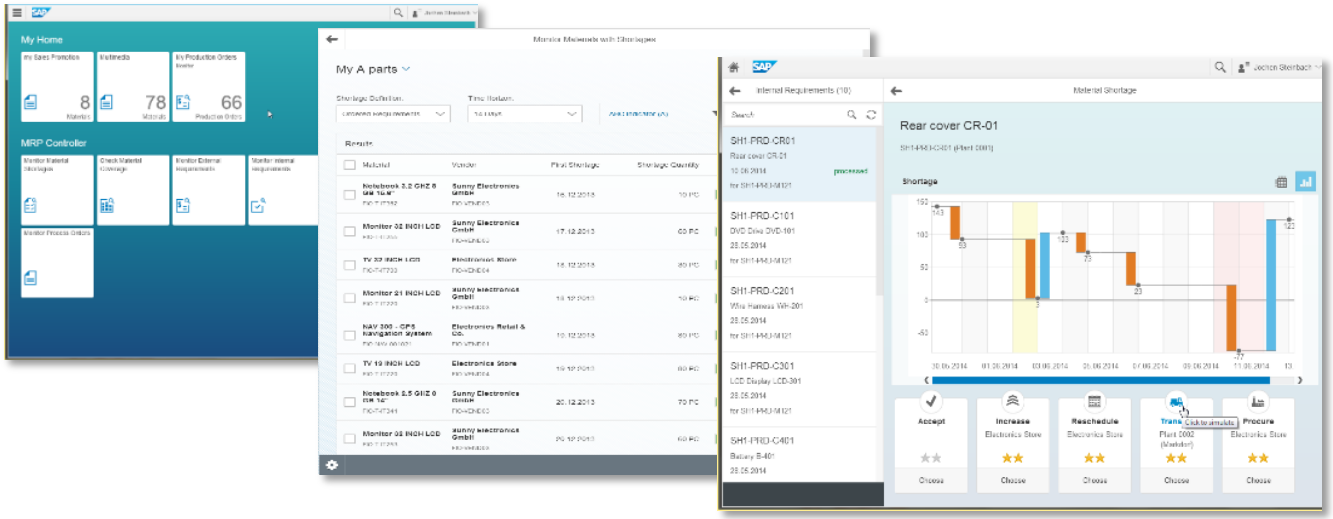
Step3: BOM Explosion/Configuration In-house production, subcontracting

Step4: Write

MRP Analysis

System analyzes material flow of all materials in real time & identifies:

- Disruptions in the material flow
- The impact of these issues
- Solution proposals for decision support
- The remaining time-to-action
- Role based KPI driven entry
- Running on any device
- Adoptable and easy to personalize



Solution Today

SAP S/4HANA Enterprise Management

Key innovations 1511 mapped to Product Map

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Business Challenges

- On-time delivery performance
- Days in inventory
- Revenue loss due to stock-outs
- Adapting to changing plant condition

SAP S/4HANA Capabilities

- PP/DS side-by-side to SAP S/4HANA
- Integrated Production Planning and Detailed Scheduling (PP/DS) in SAP S/4HANA (planned innovations)
  - Advance planning and optimization and production planning and detailed scheduling
  - Live cache-based, finite-capacity planning as an integral part of SAP HANA, requiring just one database to manage
  - Advanced analytics
  - One materials requirements planning
  - Simplified data integration
  - Intuitive maintenance of master data and integration models

Business Benefits

- Fulfill an order on time and in the desired quantity using different kind of checks for different business scenarios
- Perform automatic back-order processing
- Reduce inventory carrying cost

Business process view

Embedded Production Planning and Detailed Scheduling

SAP LABS PREVIEW

Traditional system

SAP Advanced Planning and Optimization – planning and detailed scheduling

Live cache

CIF

ERP

SAP HANA platform

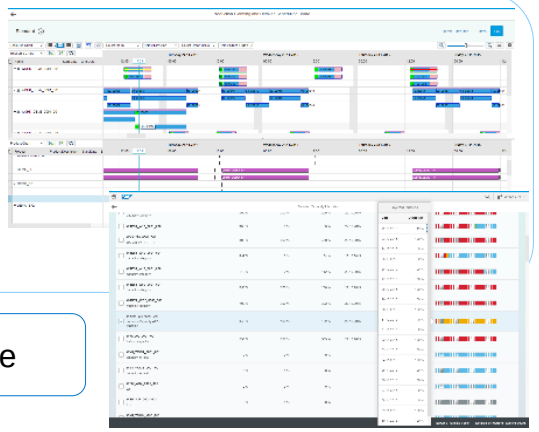
With SAP S/4HANA

ERP

Master data

CIF

Planning and detailed scheduling



SAP HANA platform, including live cache

With traditional system:

- Different master data in scheduling and ERP systems
- Different MRP processes and user tools in scheduling and ERP systems
- Data integration latency and errors

Traditional → **With SAP S/4HANA**

Planning process adoption

With SAP S/4HANA:

Planning and detailed scheduling embedded on ERP system enables:

- UI harmonization
- Data integration (CIF) simplification
- Master data harmonization
- Analytics

2016 Future Direction of Innovations in Manufacturing

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SAP Manufacturing Execution Suite

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- **SAP MII**
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  - **Industry 4.0, Configuration, Performance**

Manufacturing Innovation Roadmap

Manufacturing Execution – Product Landscape

SAP Manufacturing Integration & Intelligence

SAP Manufacturing Execution System

SAP ERP or S/4 HANA	Enterprise	SAP ERP or S/4 HANA
SAP MII	Shop Floor	SAP MII SAP ME

Worker UI

Machine Entry

Range of use

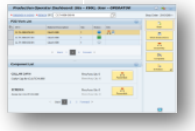
- Integration & Intelligence
- Reporting & Analytics
- Individual Scenarios and Use Cases
- Worker UI - Pre-delivered E2E integrated content delivered with MII to drive Plant Performance Management on the Production Shop floor – covers manual, automatic and semi automatic scenarios

Target Industries

- All Manufacturing Industries

Highlights

- Highly Extensible



ME POD

Machine Entry

Range of use

- Manufacturing Execution System

Target Industries

- Discrete Industries

Highlights

- Tracking & Tracing on SFC / Serial Number
- Non Conformance Handling
- Interlocking
- Production Data Acquisition
- KPIs, Reporting & SPC
- Highly Extensible

SAP Manufacturing Execution - SAP ME

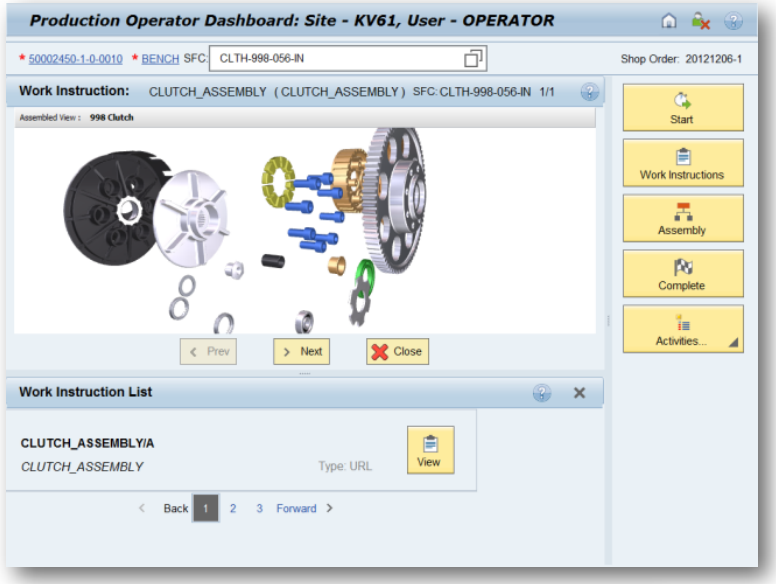
Main Differentiators

SAP ME – What is it?

- Manufacturing Execution System for the **discrete industries**

SAP ME – Main Differentiators

- **ERP Integration** “out of the box”
- **Controls Production** of every single unit (Lot Size 1)
- Easy interaction with shop-floor **automation layer**
- **Unit Level Tracking & Tracing / Genealogy**
  What operation, tool or machine was used, where parts came from, etc.
- Comprehensive **nonconformance management** including in-line sampling and ability for **visual test and repair**
- **Process Interlocking**
- **High Flexibility and Extensibility; pure SOA based architecture**
- **Role specific** access and personalized **dashboards for operators**
- Provides **flexible production process modeling** without additional programming
- Active Community of partners and customers
- **High Usability** with pure Browser Based UIs



SAP Manufacturing Integration and Intelligence (SAP MII)

Main Differentiators

SAP MII – What is it?

- **Extensible** manufacturing platform allowing **rapid adaption** to any manufacturing process

SAP MII – Main Differentiators

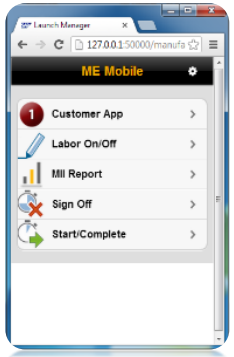
- Integration: Provide **interoperability** (in)between Shop Floor solutions and enterprise ERP (PP, PM, MM, QM)
- Intelligence: Visualize data from any of above sources to provide KPIs. Provide **simple** and **efficient local User Interface and Dashboards**
- Innovation: Powerful SOA-enabled **business logic** to cover for customer specific processes around **Planning, Execution, Maintenance and Quality** now including versioning of any Content
- Allows **Fast prototyping** to achieve fast ROI
- Broad and extensive **Partner Network**
- Applicable to **all Manufacturing Industries and Utilities**

Solution Today – SAP ME

Usability & Mobility

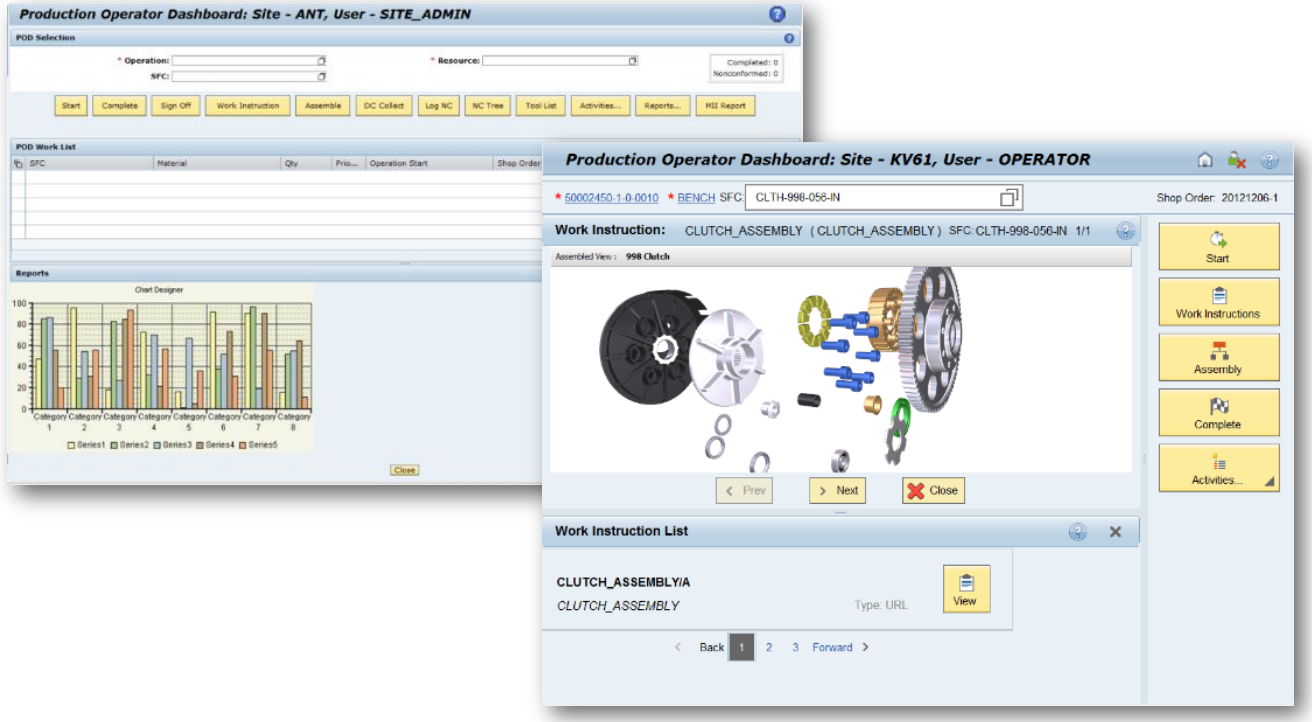
Description

- 3D Models can be embedded in the Production Operator Dashboard (POD) as Work Instructions
  Scenarios: Assembly, Visual Test and Repair
- Visualization of any HTML Pages in a POD plug-in
  E.g. for Display of MII Reports und Dashboards
- Browser-based mobile Apps for shop floor activities; easy extensible



Key Benefits

- Delivers a new user experience for high productivity
- Low training effort



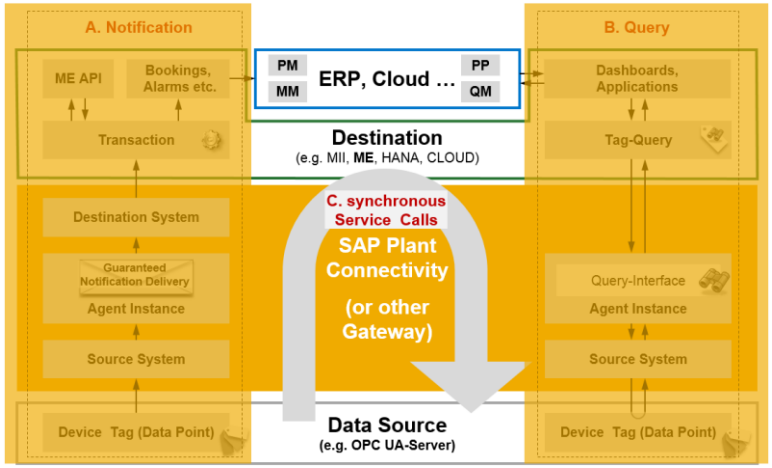
Solution Today

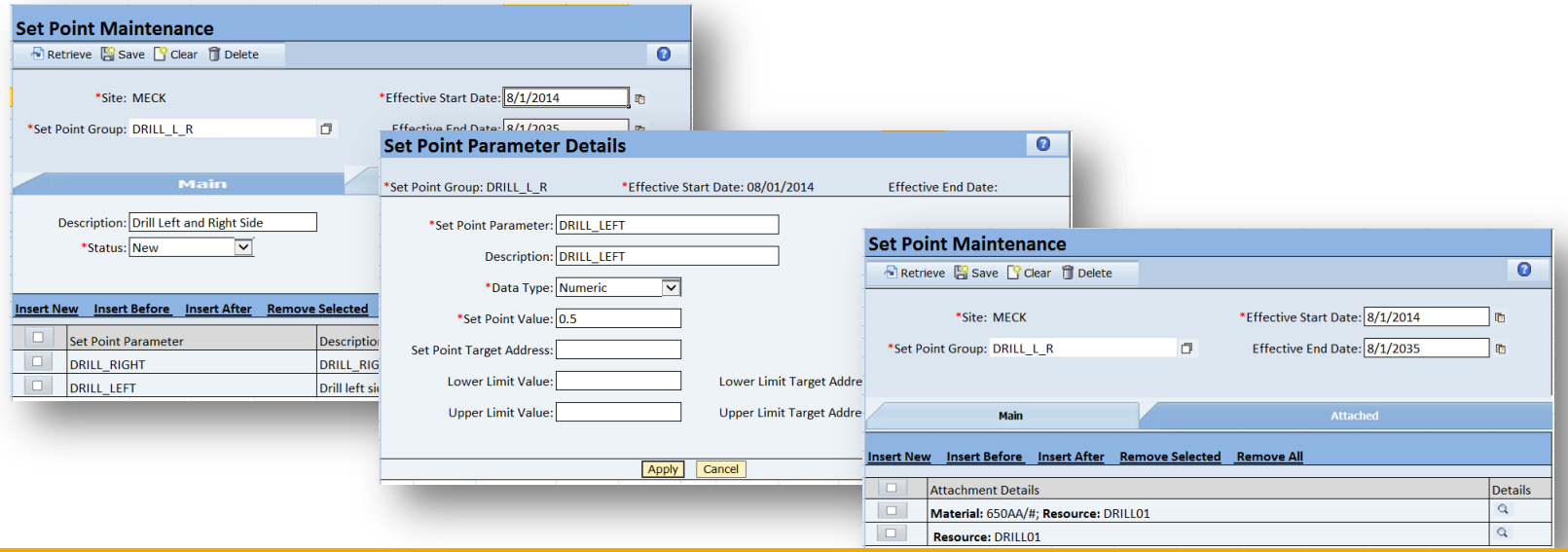
Solution Today – SAP ME

Set Point Object

Description

- A Set Point Parameter is an entity used in Manufacturing and Automation that identifies a value to which a control system will strive to achieve on a particular resource, for a particular material
- A Set Point Group will contain one or more set point parameters, either numeric or string, that are delivered to the shop floor to a specific resource for specific products
- The new functionality will provide PAPIs/Web Services for the master data and run time execution





Key Benefits

- Delivers a solution to define the set point parameters outside the controller and into the execution system for easier maintenance and update
- Provides a concise definition, along with features, without the overhead of Data Collection within SAP ME
- Provides a framework to support configurable product in the future

Solution Today – SAP ME

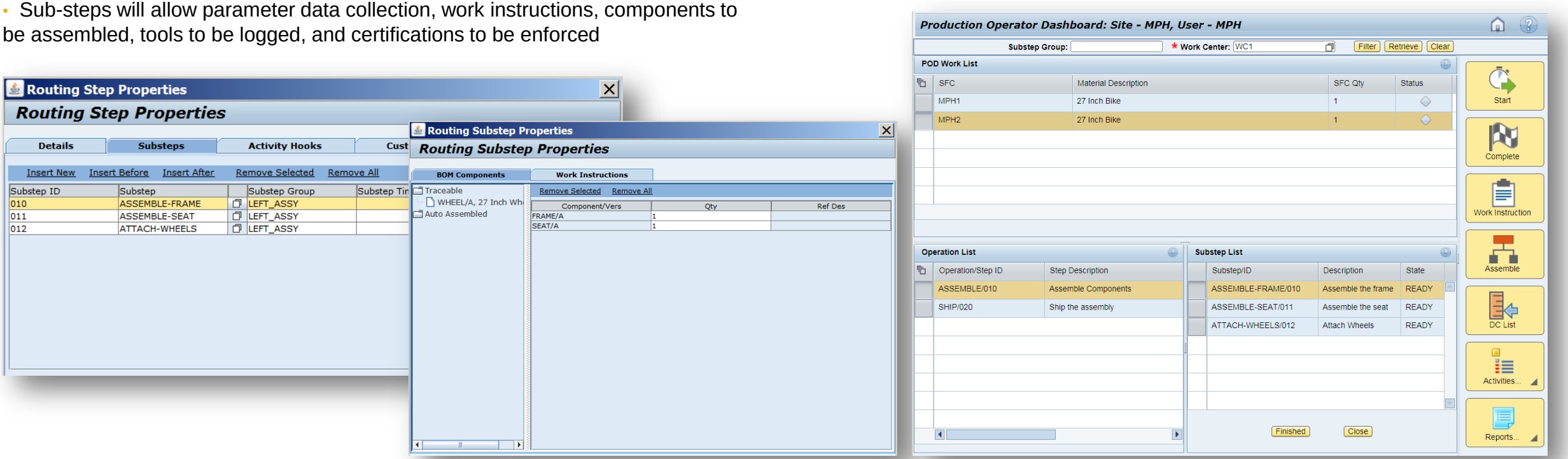
Sub-steps

Description

- Sub-step is a new master data object that is defined under a routing step.
- These sub-steps typically represent a list of tasks or activities that must be performed before a routing step is complete
- Sub-steps will allow parameter data collection, work instructions, components to be assembled, tools to be logged, and certifications to be enforced

Key Benefits

- Allows the definition of sub-steps executed in manufacturing but does not require the shop floor to start and complete at every sub-step
- The goal is to minimize the amount of operator interaction with SAP ME in an operation, yet provide the associated sub-steps that must be acknowledged and tracked



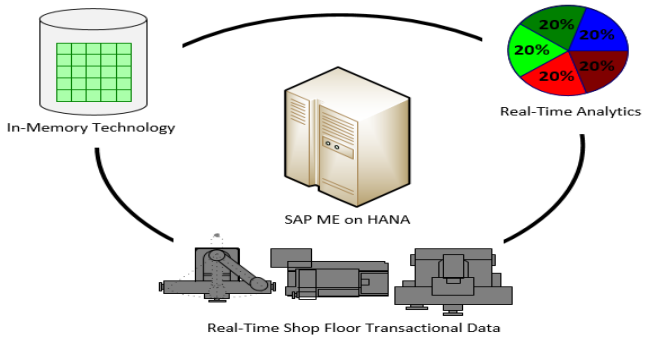
Solution Today

Solution Today – SAP ME

SAP ME on HANA

Description

- Adding support for in memory technology powered by SAP HANA
- Migration support for WIP and Archived data (*1)
- Selected areas for HANA specific performance optimization (*2)
- Consolidation of ODS and WIP on HANA
- Enable use of MII SSCE for real time analytics
- Archiving using the HANA Dynamic Tiering (warm storage/Sybase IQ)



Key Benefits

- High speed real time analytics enablement for SAP ME reporting (*3)
- Data compression with HANA eliminates the need of frequent archiving
- **Simplifies the overall stack** for customers by reducing the maintenance cost of non-HANA database
- Lower TCO solution:

  No separate ODS database required

  ME/MII co-located on NetWeaver & HANA
- Align with customers HANA strategy
- New insights into the shop floor based on trends and predictive analytics with HANA capabilities
- Enables near real time analysis of shop floor data to identify preventive actions

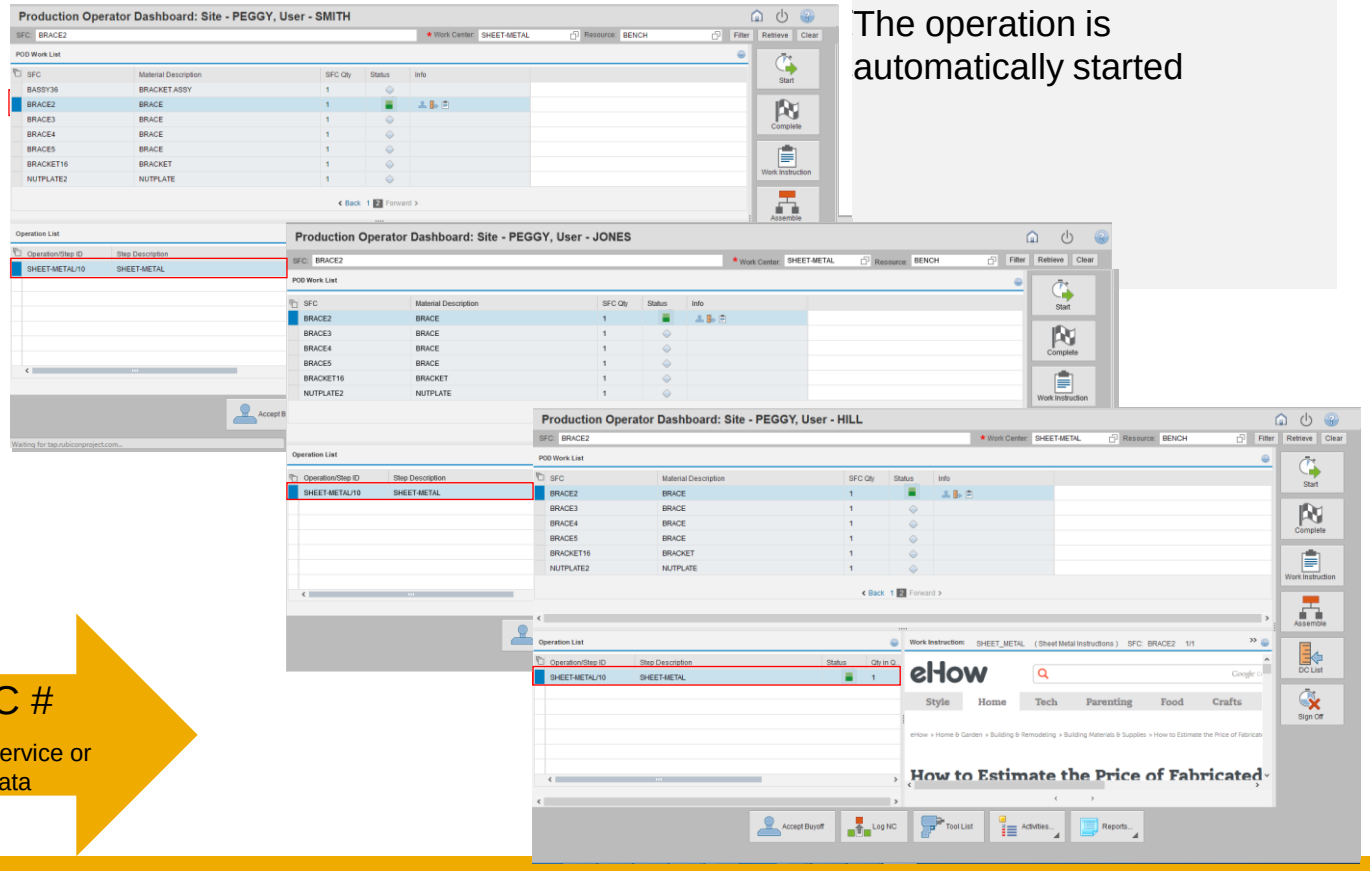
[1]Using Warm storage and Dynamic Tiering
[2]Where performance does not meet requirements
[3]MII SSCE and other reporting tools

Solution Today – SAP ME

Industrie 4.0: Automation Support

Description

- Add out-of-the box POD plug-in auto-refresh capabilities using the message notification framework that refreshes the UI
- Auto start SFC feature



The operation is automatically started

Machine/ Carrier system/ other system

SFC #

Via webservice or OData

Key Benefits

- Minimizes operator interaction w/the system to focus on task at hand
- Critical for more highly automated environments combined w/manual labor

Solution Today – SAP MII

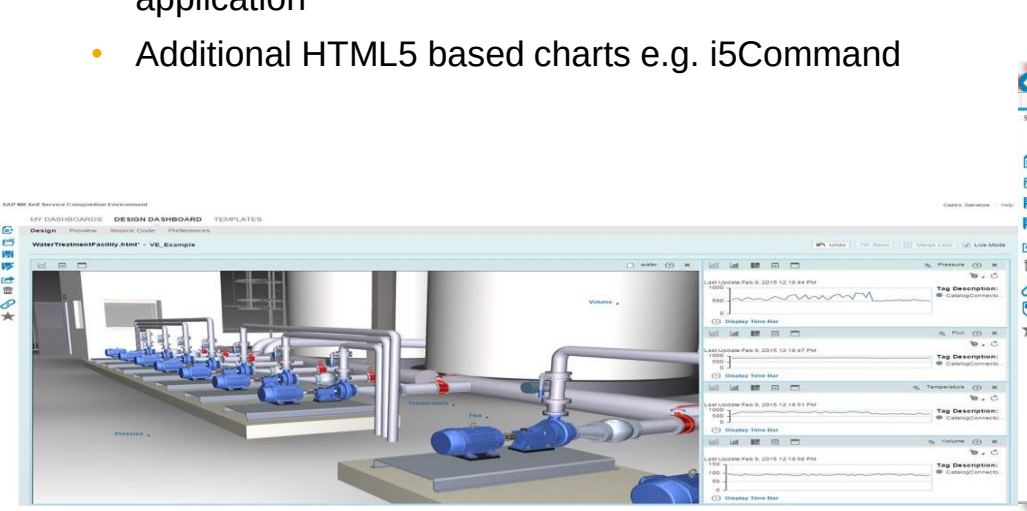
Self-service Composition Environment

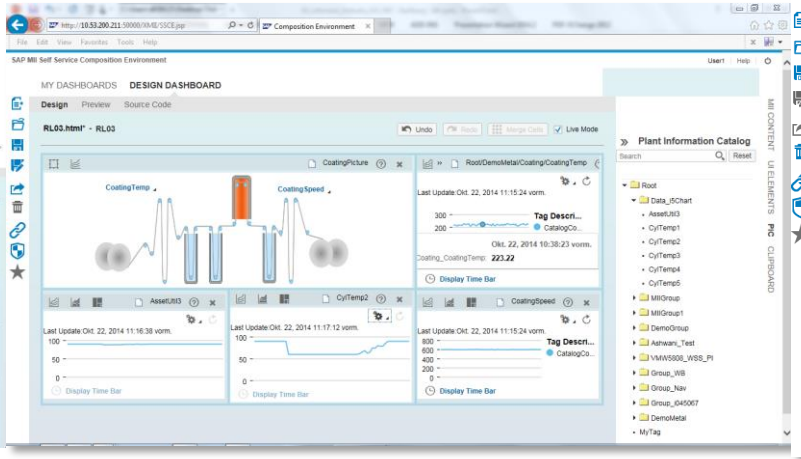
Description

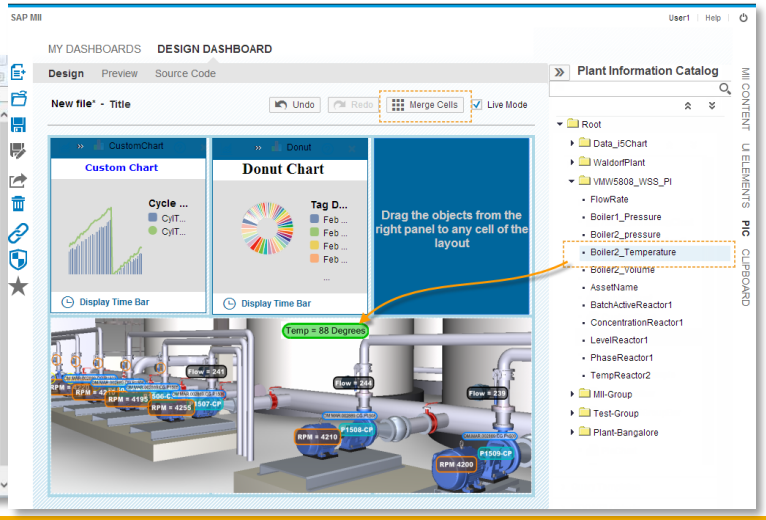
- Browser(HTML5) based design tool for dashboard creation by consuming different MII objects
- WYSIWYG based design
- Integrating tag value changes directly to browser using web socket interface or through catalogue query template
- Source code generation for high sophisticated UIs
- Form based reporting dashboard using UI elements
- 3D file integration and simplified reporting for manufacturing application
- Additional HTML5 based charts e.g. i5Command

Key Benefits

- Simplified interface for dashboard creation.
- A tool which can be used by business users also along with IT developers.
- Reduce the time required for dashboard creation
- Dashboard accessibility from mobile devices
- Remove the dependency on JRE required on each of the machine
- Build reporting application without any coding







Solution Today – SAP MII

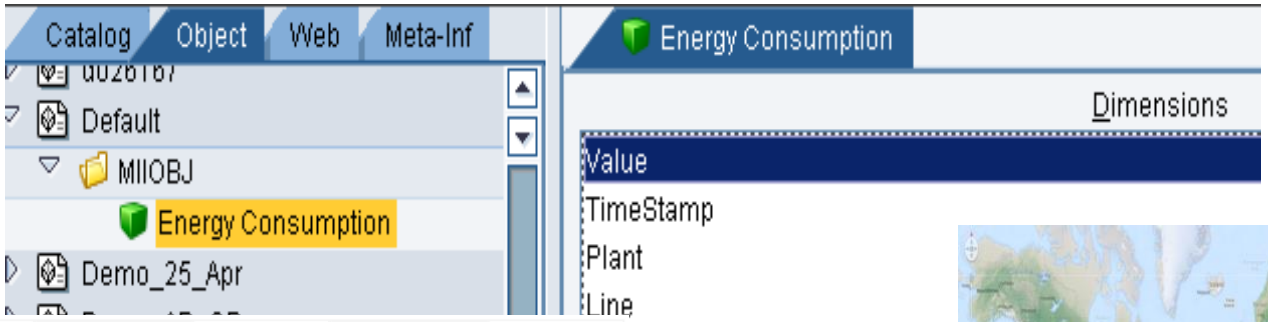
Energy monitoring & Analysis

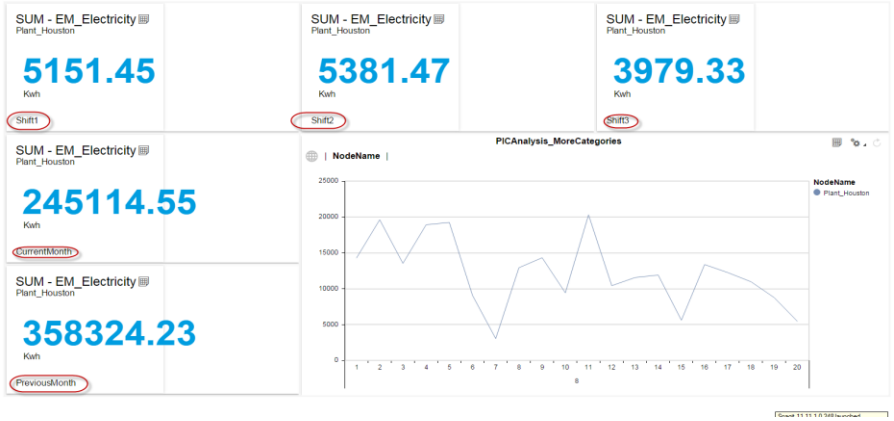
Description

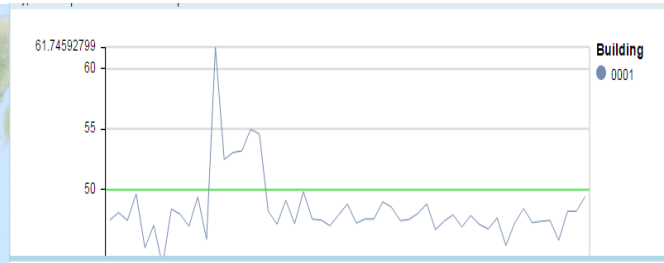
- Enhance the core MII product to meet Energy management requirements e.g. maintaining hierarchies, storing time series data, and reporting capabilities against those hierarchies, Order, shift and time series data

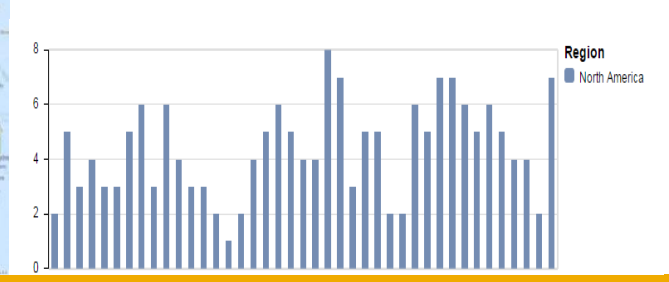
Key Benefits

- Out of box content with core MII to manage energy consumption
- Reduce TCO to monitor energy consumptions
- Simplified software stack to collect and analyze energy consumption







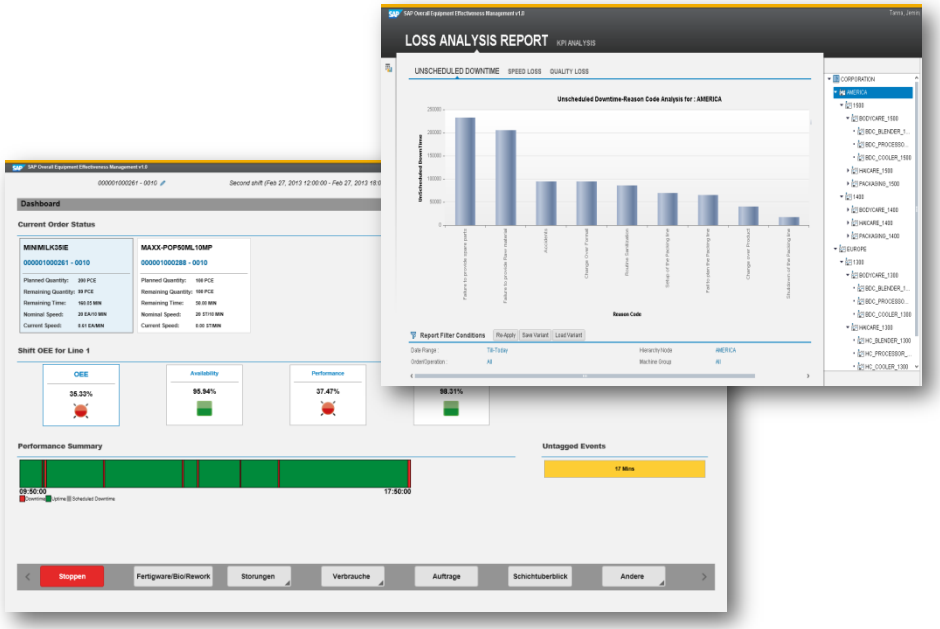


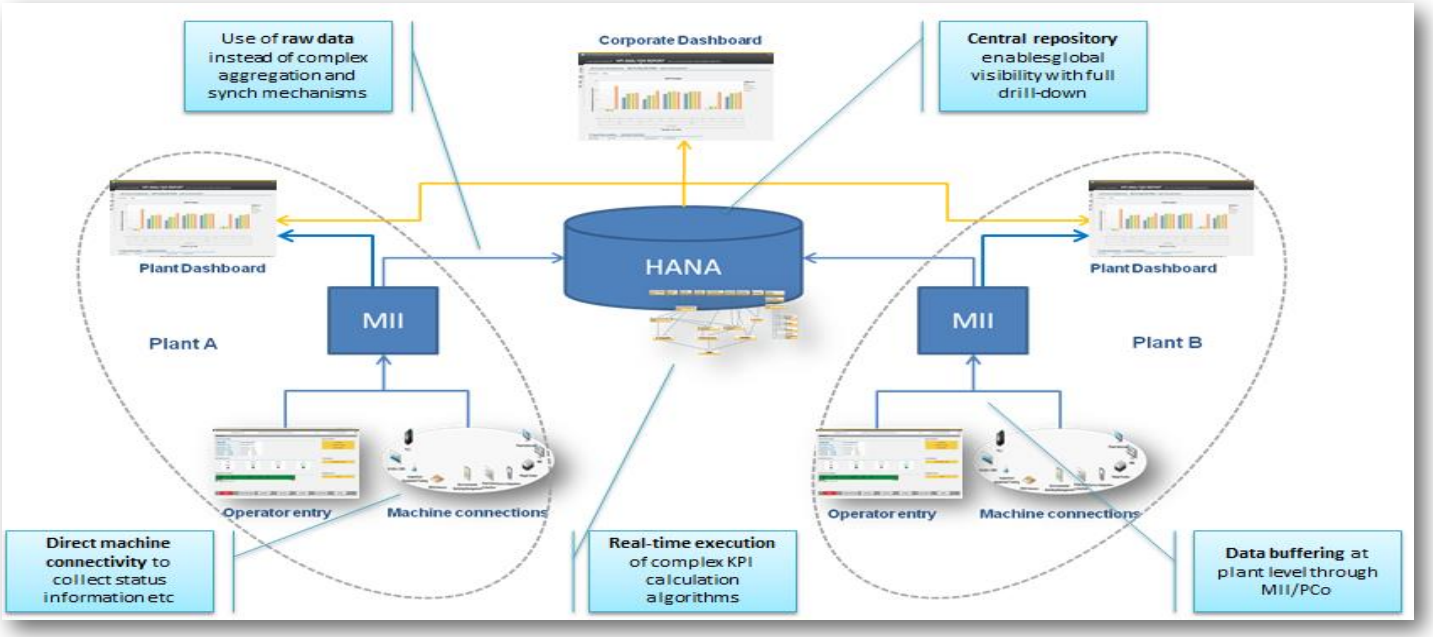
Overall Equipment Effectiveness

Global, Multi Site Analysis with SAP HANA and SAP MII

- Analysis and Real Time information on OEE, Availability, Performance and Quality on various hierarchy levels
- Local Data Collection and Analysis in MII
- Global, multi site Analysis **via SAP HANA**
- C**ombination of shop floor data with enterprise information**

- Real time monitoring
- Cross plant analysis / Best Practice
- Analysis of Shop Floor with Top Floor Context



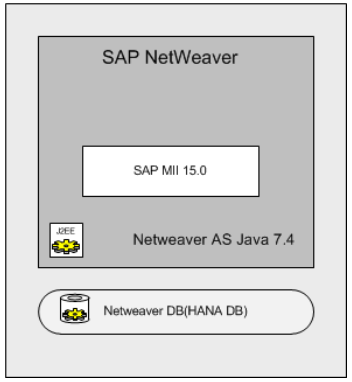


Solution Today – SAP MII

MII on HANA

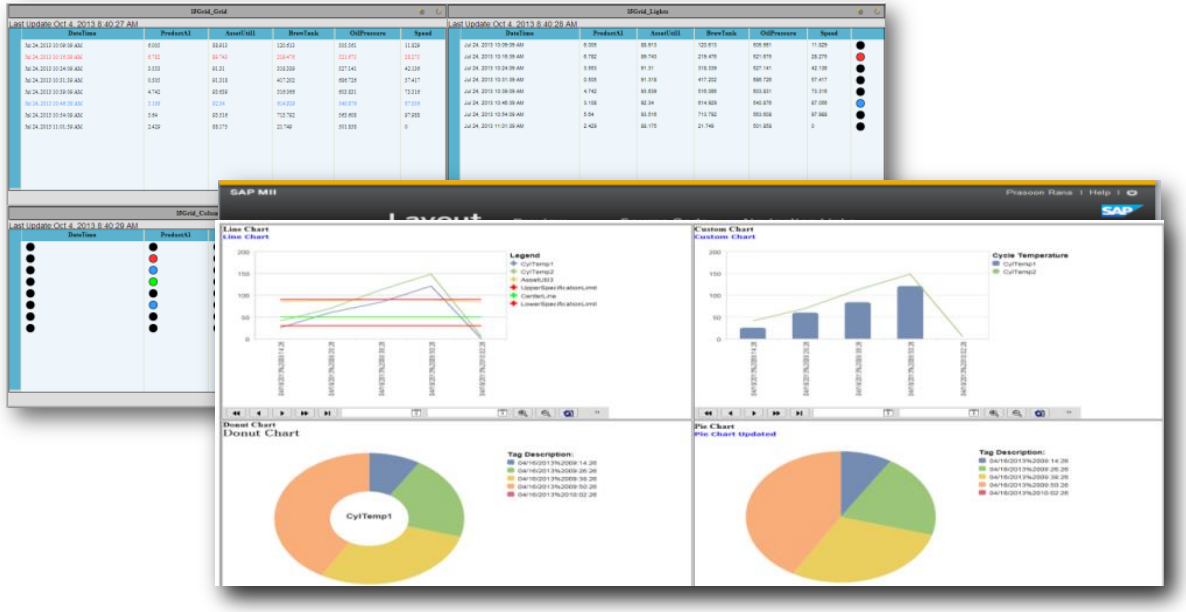
Description

- Run SAP MII on NW 7.40 stack with **HANA as underlying database**
- High performing In-Memory Analytics for large amount of Data (“Big Data”)
- HANA provides the ability to store a significant and broader selection of manufacturing data for more thorough analysis and more complex comparison of data.
- HANA provides various statistical algorithms for deep analysis, clustering and prediction
- The ability to manage large volumes and multiple types of data provides ability to develop, train and utilize predictive techniques (e.g., regression and heuristic) for forward looking analysis.



Key Benefits

- **Simplifies the overall stack** for customers by reducing the maintenance cost of non-HANA DB
- New insights into the shop floor based on trends / prediction with HANA capabilities
- Enables near real time analysis of shop floor data to identify preventive actions



Solution Today – SAP PCo

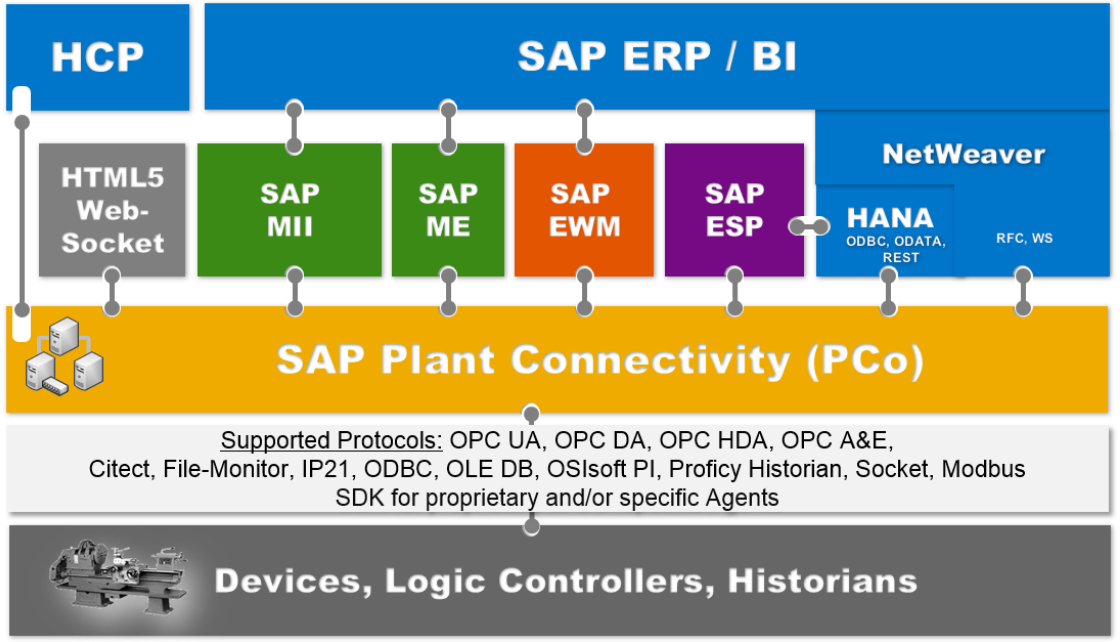
Enhanced Connectivity

Description

- Basis for the three core IoT/Industrie 4.0 communication patterns:
  - Notifications
  - Queries
  - Bidirectional machine communication
- Near Real Time UI Support with PCo as WebSocket-Server
- Mass Data supply into HANA
- Integration with SAP ESP / HANA Smart Data Streaming
- Flexible WebService Orchestration (RESTful, ODATA, SOAP)
- High throughput performance on .Net/C# architecture
- Bundling and buffering of data – notification delivery retry
- Remote Configuration of PCo from MII
- Enablement of machine automation scenarios

Key Benefits

- Support of Big Data Scenarios in the Shop Floor
- Foundation for interaction with automation layer and “Things”
- Support of the key machine protocol architecture: OPC UA



Solution Today – SAP MII

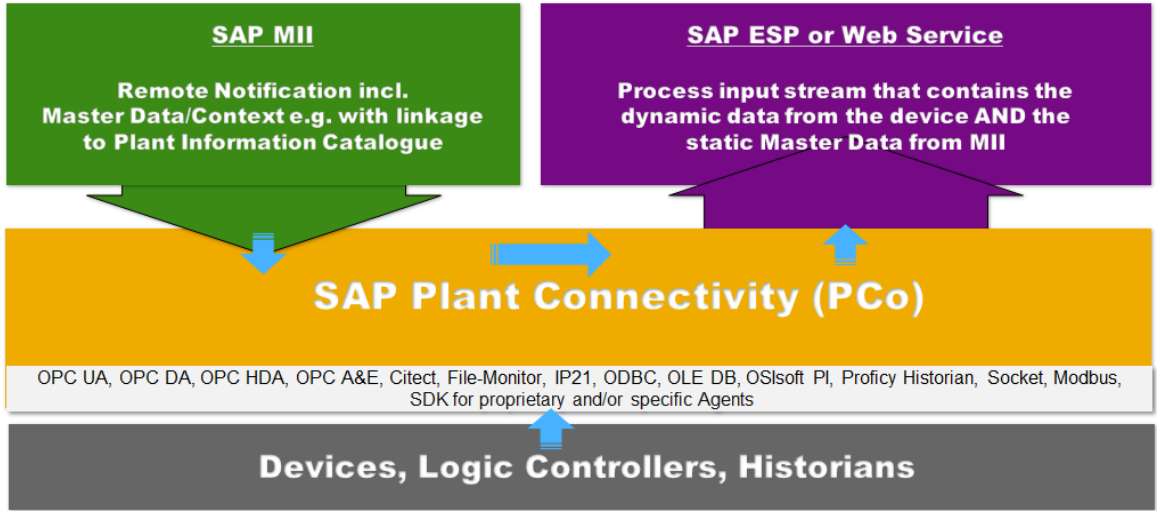
"Remote Configuration of PCo from MII" – enablement of SAP ESP and Web Service Destination

Description

- **Support for additional destination for remote configuration of PCO from MII. Key feature of remote PCO are highlighted below.**
- **Fiori based HTML5 client** for maintaining PCO Notification from MII
- Enhance the PCo notification payload with **business context** e.g. boiler pressure value coming along with functional location, equipment number or work center ID.
- Maintain notification even when Agent is running
- Ability to **pause a notification** for certain duration without having to stop the agent
- Ability to **export and import** the notification object
- Ability to **start and stop PCo agent** from SAP MII

Key Benefits

- MII can act as the single source of truth for Master Data and especially for static context
- the Destination System e.g. the SAP ESP can consider the context in rules and decisions avoiding time consuming data base access
- PCo provides Services for the Rem.Conf. from MII – these services can be used in later releases also for Rem. Conf. from Cloud Apps



Planned Innovation – SAP ME

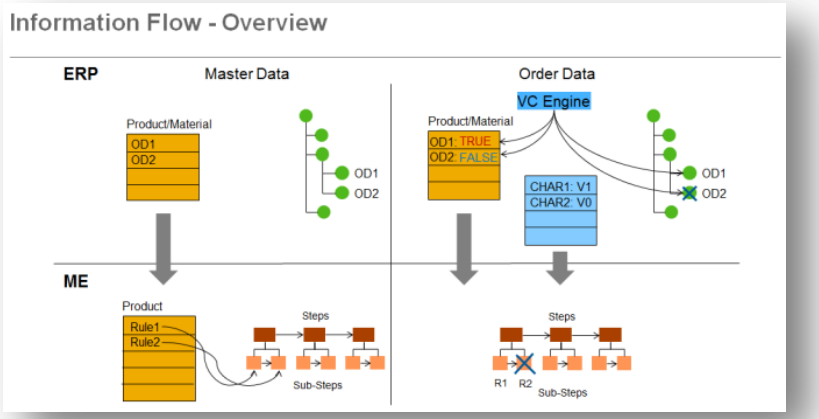
Industrie 4.0: Configurable Product

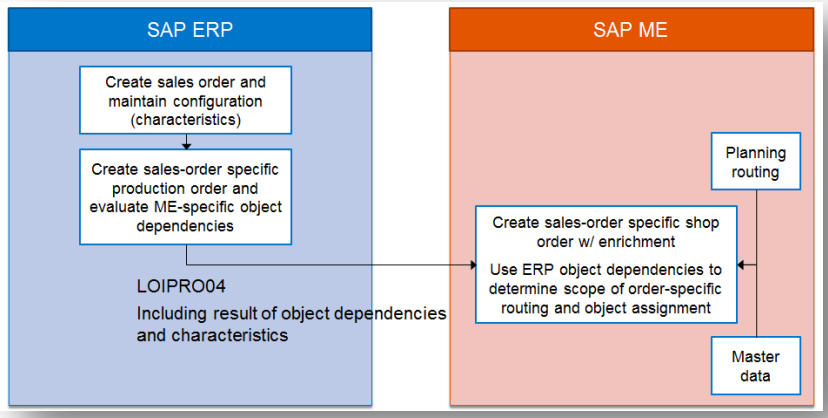
Description

- Up to real-time lot-size one production in high volume production scenarios for addressing individual customer requirements
- Configurable product via Variant Configuration is **supported today** within the complete E2E process where the primary manufacturing **planning is maintained w/in ERP**
- **New development** will focus on supporting the same E2E process **more seamlessly**
- Following objects in ME will depend upon the configuration:
  - BOM (from ERP)
  - Production Steps
  - Sub-steps
  - Automation Parameters (Set Points)
  - Data Collection
  - Work Instruction

Key Benefits

- Reduces costs associated to building customized products by enabling the manufacturing of product variations in any given order and quantity, all on the same production line
- Producing highly configurable product at costs comparable to those of mass production can provide a key competitive advantage





Manufacturing Innovation Roadmap

Manufacturing Execution Discrete Industries

Planned

- **Industrie 4.0**
- Configurable Product
- Sub Steps Integration

Continuous Improvements & Simplifications ; e.g.

- Integration Excellence
- Performance optimizations
- Monitoring & Safeguard

Manufacturing Analytics

- SAP ME Global HANA

Future

- **Complex Assembly Processes**
- **Cloud Based Manufacturing Services**

Manufacturing Innovation Roadmap

Manufacturing Integration and Intelligence

Planned

Enhanced Energy Monitoring & Analytics

UX & Self Service Composition Environment Enhancements

Fiori Launchpad like MII Entry Page

Predefined Analytics Content

Integration Scenarios with IoT / HCP; e.g. for PDMS

Worker UI / OEE Enhancements

Future

Predefined Analytics Content - extended

Integration Scenarios with IoT / HCP – extended

Manufacturing Innovation Roadmap

SAP Plant Connectivity

Planned

Orchestration of independent machine units by means of OPC UA capabilities

Local buffering of automation related master data for high- speed response times

Simplified footprint for embedded systems/microcontrollers

Future

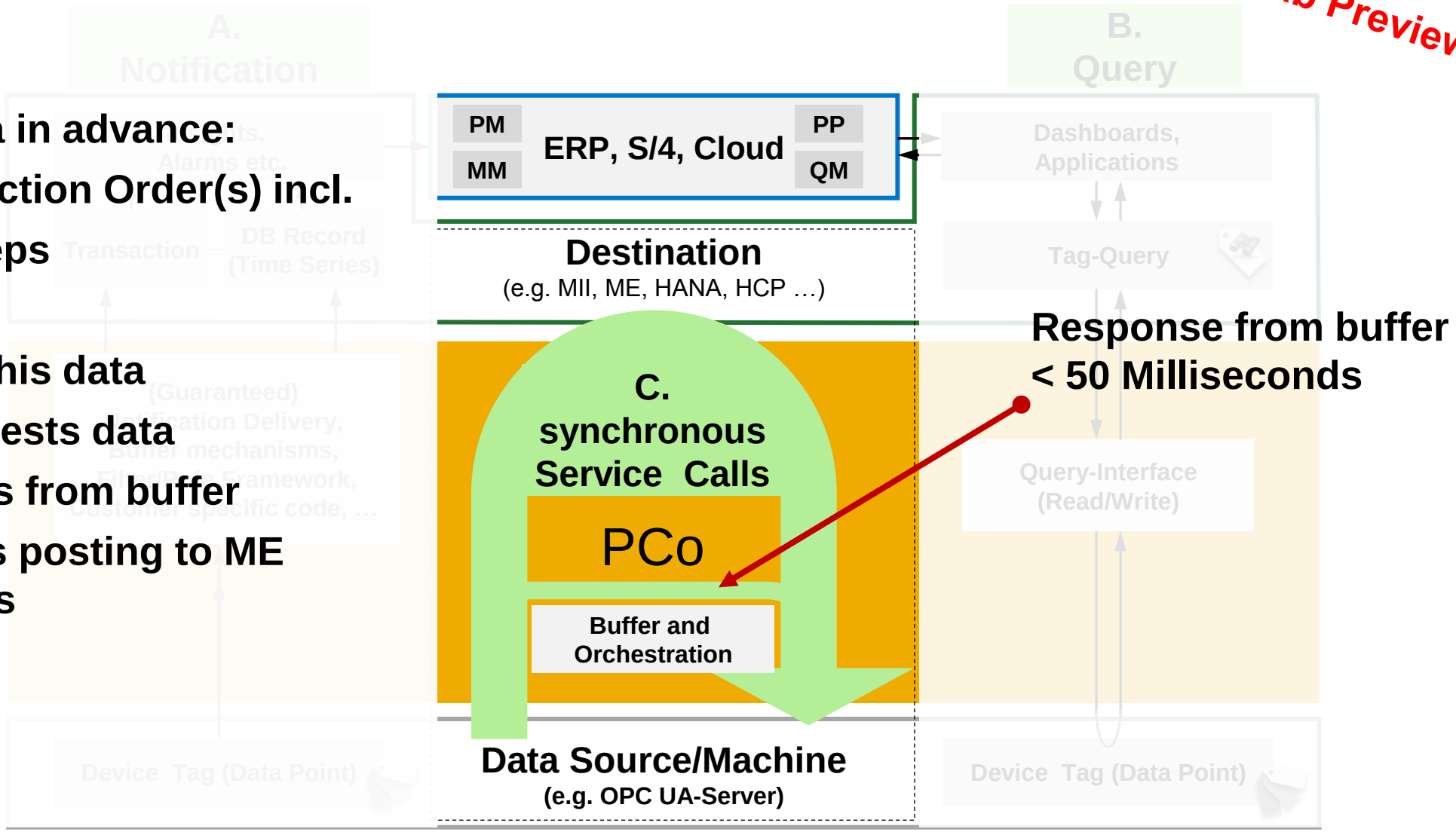
Decentralized autonomous agents

Edge processing enablement for all industries

“Edge Processing” – 1. buffer data, enable shortcuts

Lab Preview

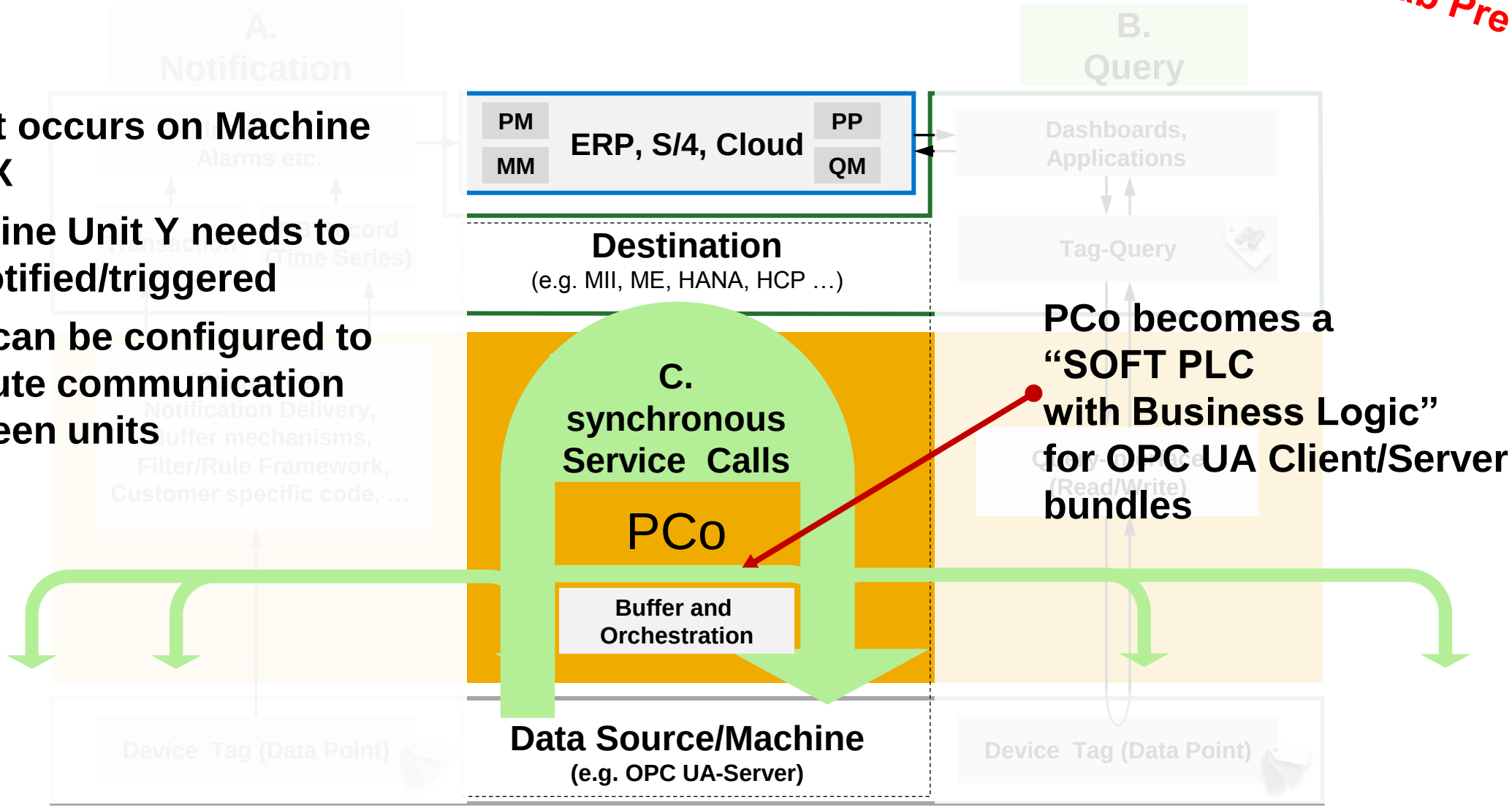
1. **Read ME data in advance:**
   - **Next Production Order(s) incl.**
   - **Routing steps**
   - **Set-Points**
2. **PCo buffers this data**
3. **Machine requests data**
4. **PCo responds from buffer**
5. **PCo manages posting to ME asynchronous**



“Edge Processing” – 2. orchestrate independent machine units

Lab Preview

1. Event occurs on Machine Unit X
2. Machine Unit Y needs to be notified/triggered
3. PCo can be configured to execute communication between units



Key Takeaways

- SAP Connected Manufacturing is a key enabler for Industry 4.0.
- SAP Connected Manufacturing is a key component of our IoT Strategy.
- SAP Manufacturing supports HANA today with SAP MII and SAP ME.
- SAP Manufacturing extends the investments our customers have made in ECC through MRP, Production Planning, Scheduling, Inventory Management, Quality Management and Maintenance down to the value on the shop floor.

"We are convinced that manufacturing in the digital world requires a completely new approach how to run the shop floor. Therefore our solution is much more connected and intelligent in order to empower production workers, re-invent flexibly manufacturing processes and to increase responsiveness. We build Industry 4.0."

Bernd Leukert
Member of the Executive Board SAP SE

Where to find more information

SAP CONNECTED MANUFACTURING Links

SAP Manufacturing	http://www54.sap.com/lob/manufacturing.html
SAP Manufacturing YouTube	http://www.youtube.com/sapvideomom
SAP Manufacturing Community	http://scn.sap.com/community/manufacturing
SAP ME WIKI	http://wiki.sdn.sap.com/wiki/display/ME/Home
SAP MII WIKI	http://wiki.scn.sap.com/wiki/display/xMII/Manufacturing+Integration+and+Intelligence
Sales Play	https://jam4.sapjam.com/groups/6Z7XS2hflTQOrb951FeC3x
Products Solution Hub	https://jam4.sapjam.com/groups/about_page/6p6pZ4XtQN7fJe5bxbwZAY

Thank You …

Jutta Wesemann-Ruzicka
SAP LoB Manufacturing

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