SAP® Digital Supply Chain

Deep Dive: Production Engineering for “configurable production” at Bosch Rexroth

PUBLIC

By SAP partner 3DE EXPERTS

Dr.-Ing. Helmuth Oehler
Dr.-Ing. Ulrich Schmidt

THE BEST RUN SAP

Agenda

- SAP Partner BDF Experts
- SAP Product and Process Governance (PPG)
- SAP PPG @ Bosch Rexroth

About us

Founded in 2001

We help our customer digitalize and optimize their engineering-driven business processes in SAP.

SAP Product and Process Governance

is on the SAP pricelist since 2020.

More than 200 SAP projects

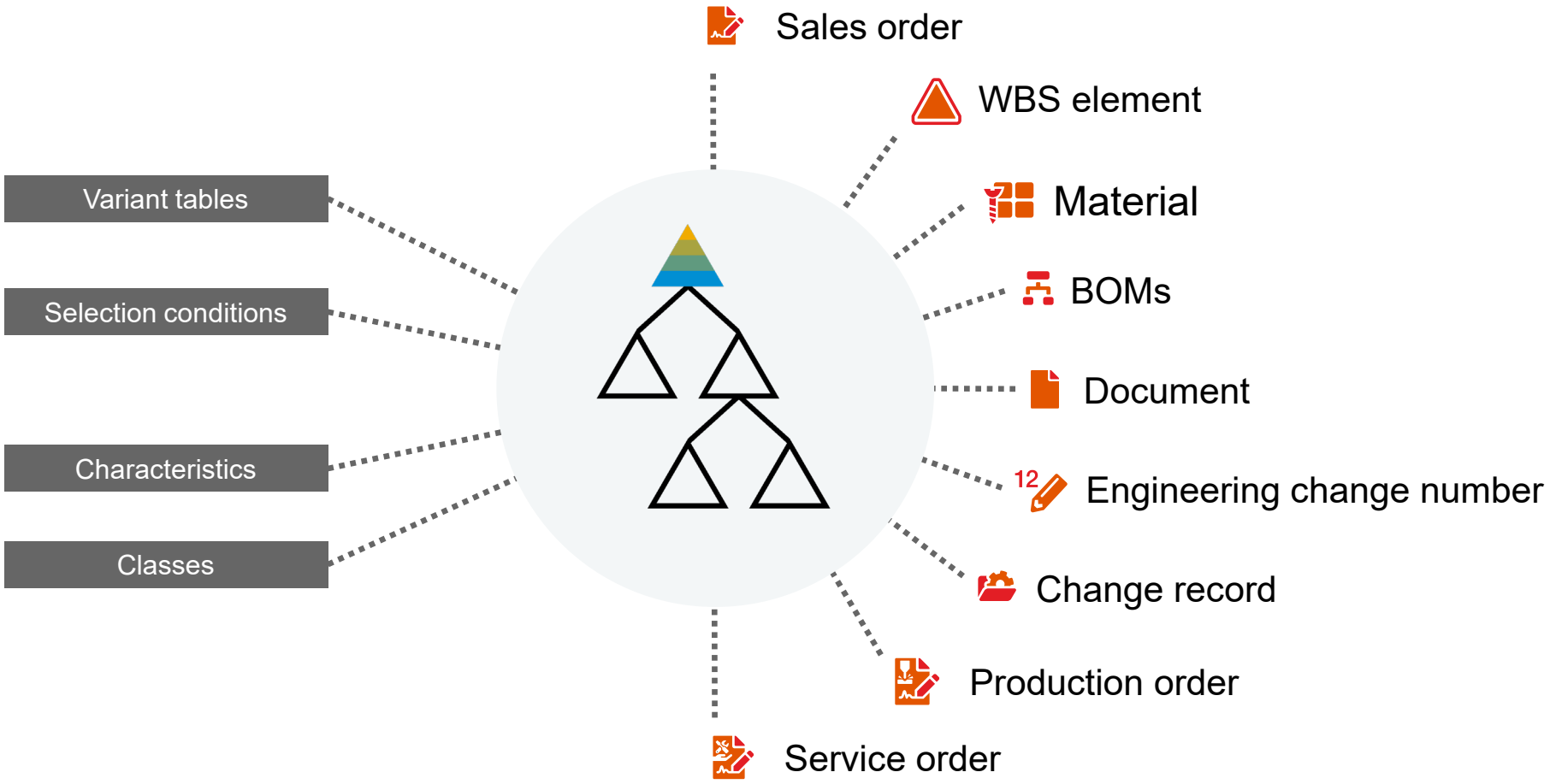
delivered successfully.

Agenda

- SAP Partner BDF Experts
- SAP Product and Process Governance (PPG)
- SAP PPG @ Bosch Rexroth

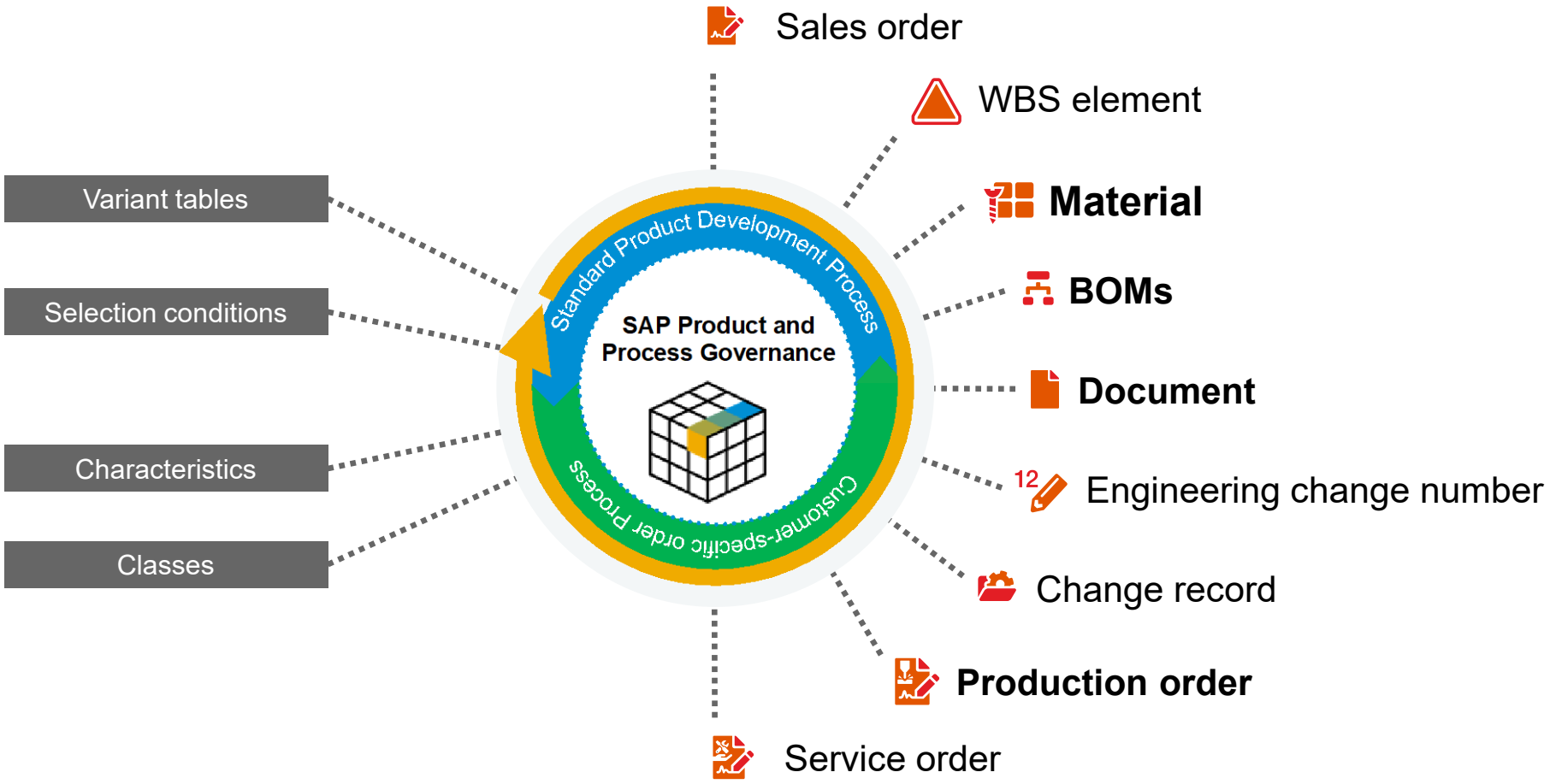
SAP Product and Process Governance

The Enterprise Product Structure



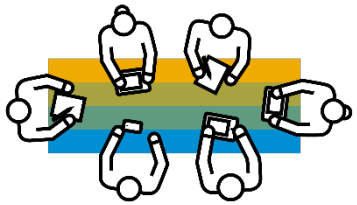
SAP Product and Process Governance

The Enterprise Product Structure



SAP Product and Process Governance

The Enterprise Product Structure generates, connects and distributes Data and Processes

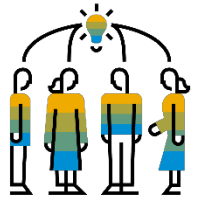


Engineering ...

… models new products and product changes with the enterprise data model

… utilizes the enterprise data model to design more efficiently

The Enterprise Product Structure



The Business units ...

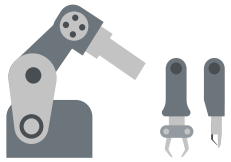
… execute integrated processes automatically via the enterprise data model.

… product changes are executed consistently in end to end processes through the enterprise data model .

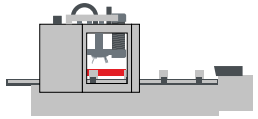
SAP Product and Process Governance

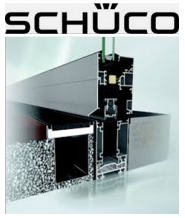
The Enterprise Product Structure supports all business models

MTS
MTO
CTO

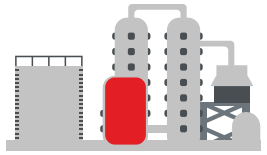


CTO
CTO+
ETO





ETO
PTO

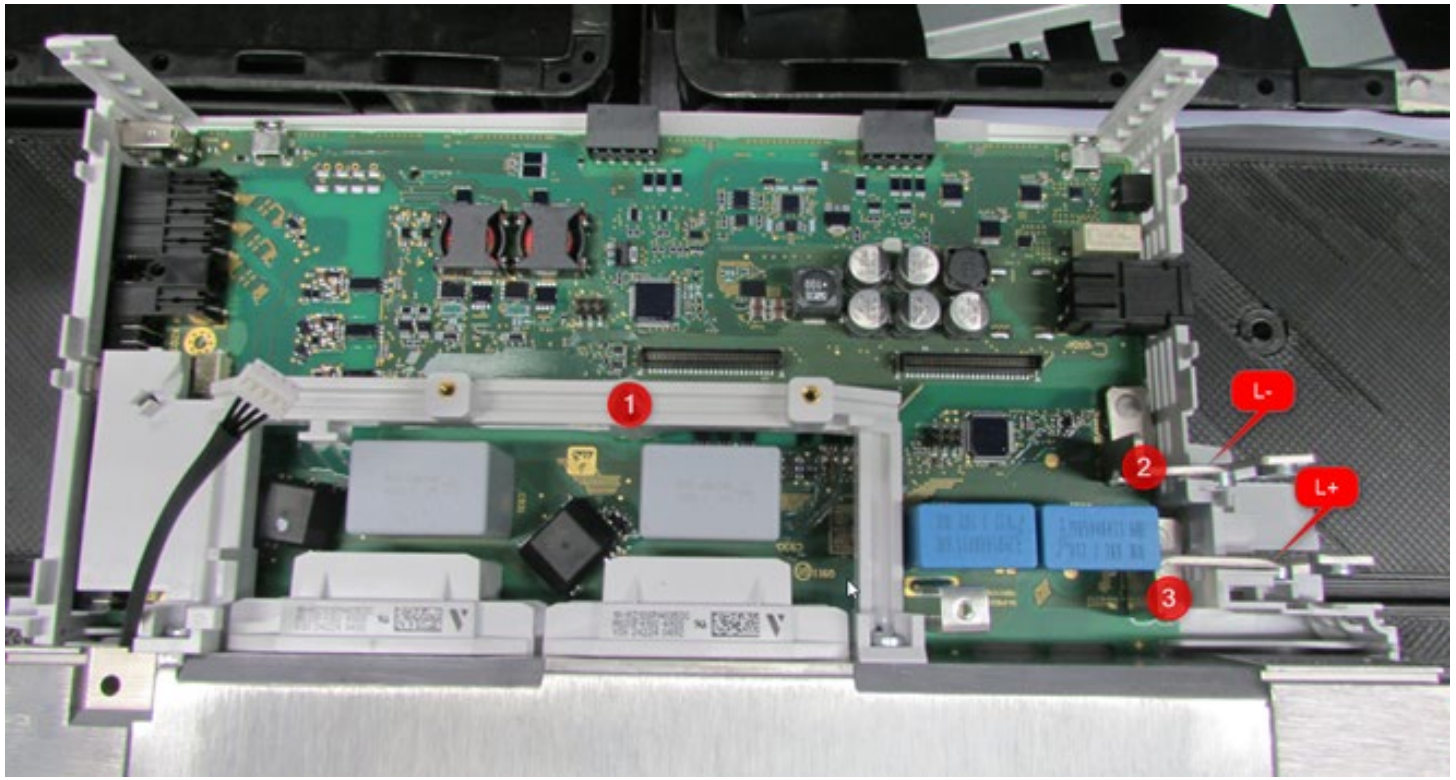


Agenda

- SAP partner BDF Experts
- SAP Product and Process Governance (PPG)
- SAP PPG @ Bosch Rexroth

What was the initial challenge?

AUTOMATION OF SCREWDRIVER FOR A CONFIGURABLE PRODUCT

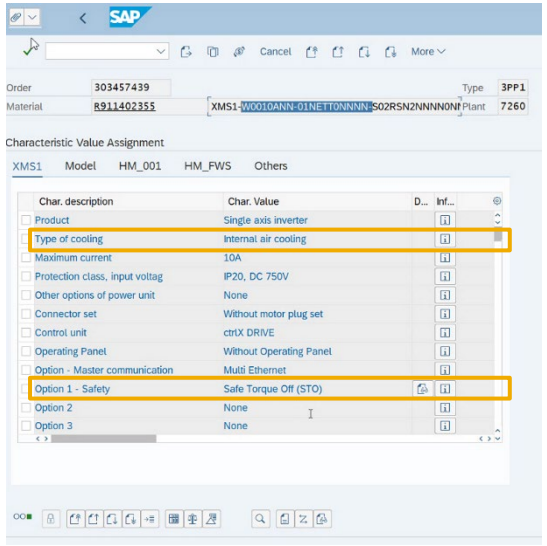


How to
automate the configuration of a screwdriver?

Automation of a Screwdriver with SAP PPG and SAP DMC

SAP ERP Input Data

- BOM/Routing from production order
- Product classification/configuration

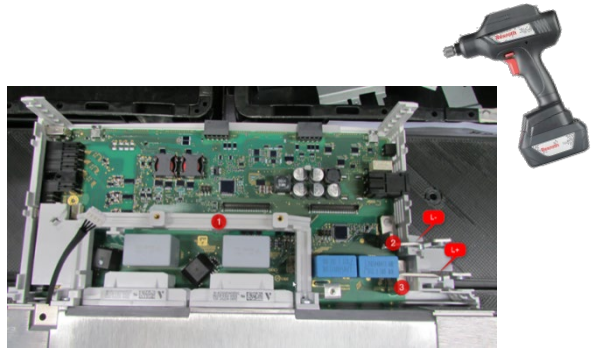


SAP PPG Logic

- Model all possible screwdriver jobs (program name, job no.)
- Select the right jobs for a mounting stage based on
  - a master structure which is related to all possible operations that can occur in production order
  - a configuration logic which is easy to be maintained by user
- Assign the jobs to the right process step
- Supply the mounting instructions

Output Information

- DMC connector transmits the screw jobs from SAP PPG to DMC
- DMC activates the screwdriver and loads the proper program
- DMC captures and tests the actual values of the screwdriver

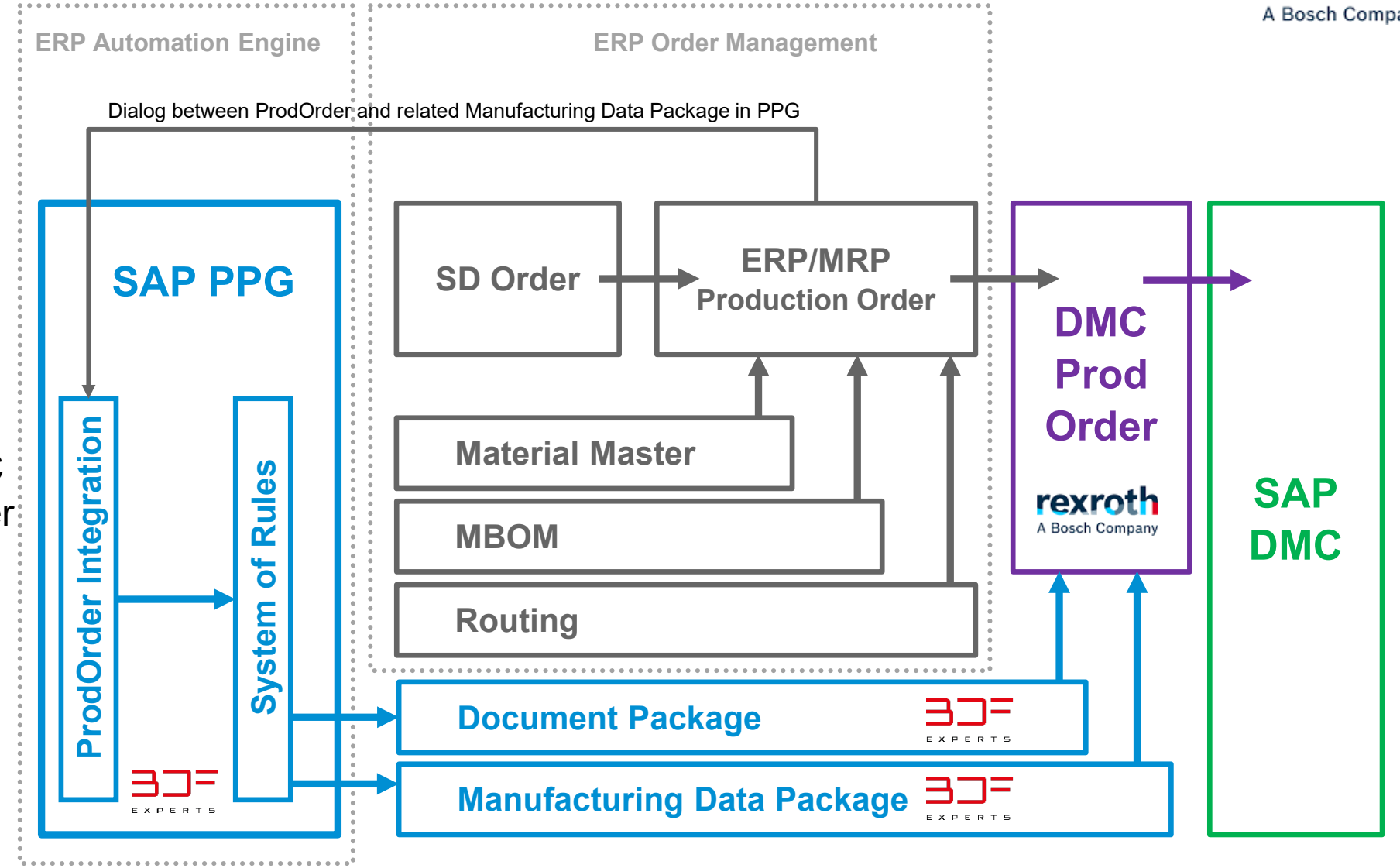


How to integrate the screwdriver configuration with SAP DMC?

SAP PPG Integration Approach for SAP Digital Manufacturing Cloud

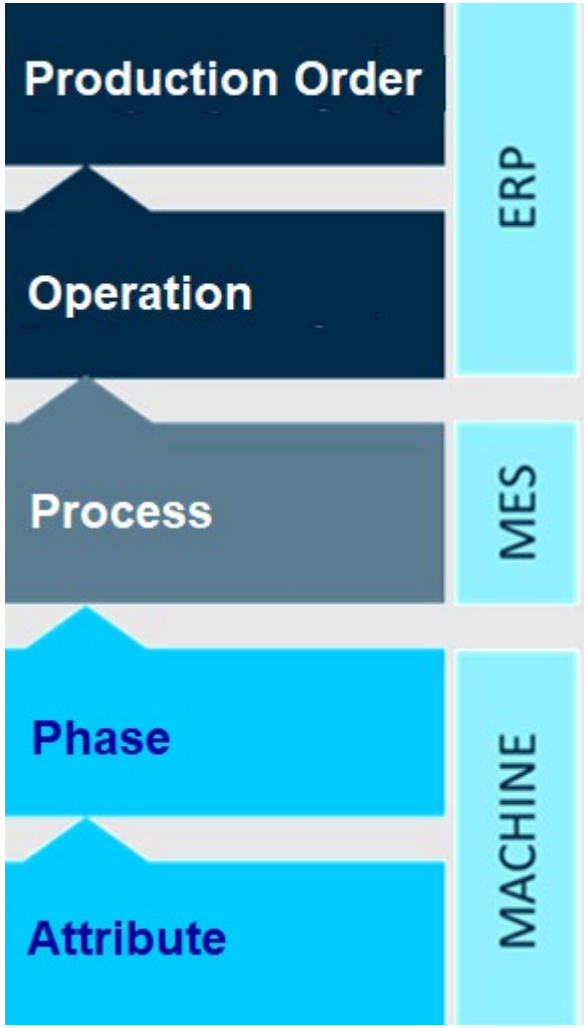
Use Case

- CMAT Operation
- Material with 001 Type Classification
- The individual integration scenarios are implemented differently
- Integration between DMC and PPG production order is project based



BOSCH Rexroth MFAM – How to create a universal approach to automating production configuration?

BOSCH REXROTH UNIVERSAL APPROACH (MFAM)

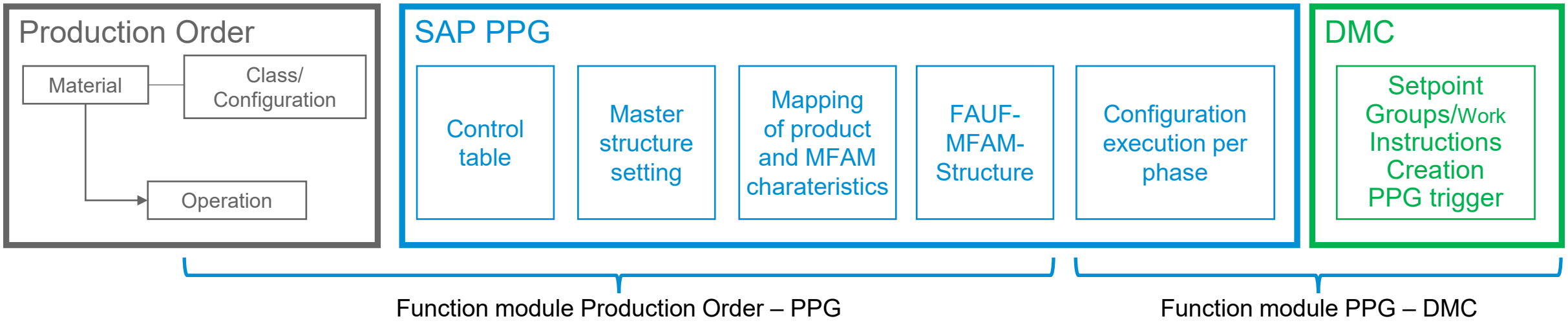


- A new production order or an order update triggers the generation of a **manufacturing data package** by PPG for a material and its operations.
- A PPG object refers to a particular routing operation which is subdivided into ‚process' and ‚phase'. The **sub-structure of the production order operations allows to configure each work step** and the creation of attributes for each work step.
- The **work step configuration** is derived from a combination of characterics and characteristic values related to the PPG object.
- **To transmit the work step configuration to DMC** in a manufacturing data package a unique key is necessary. The key contains the production order no., optionally the material no., the operation no., process no., phase no. and the resource.

How to implement the universal Manufacturing Attributes Management?

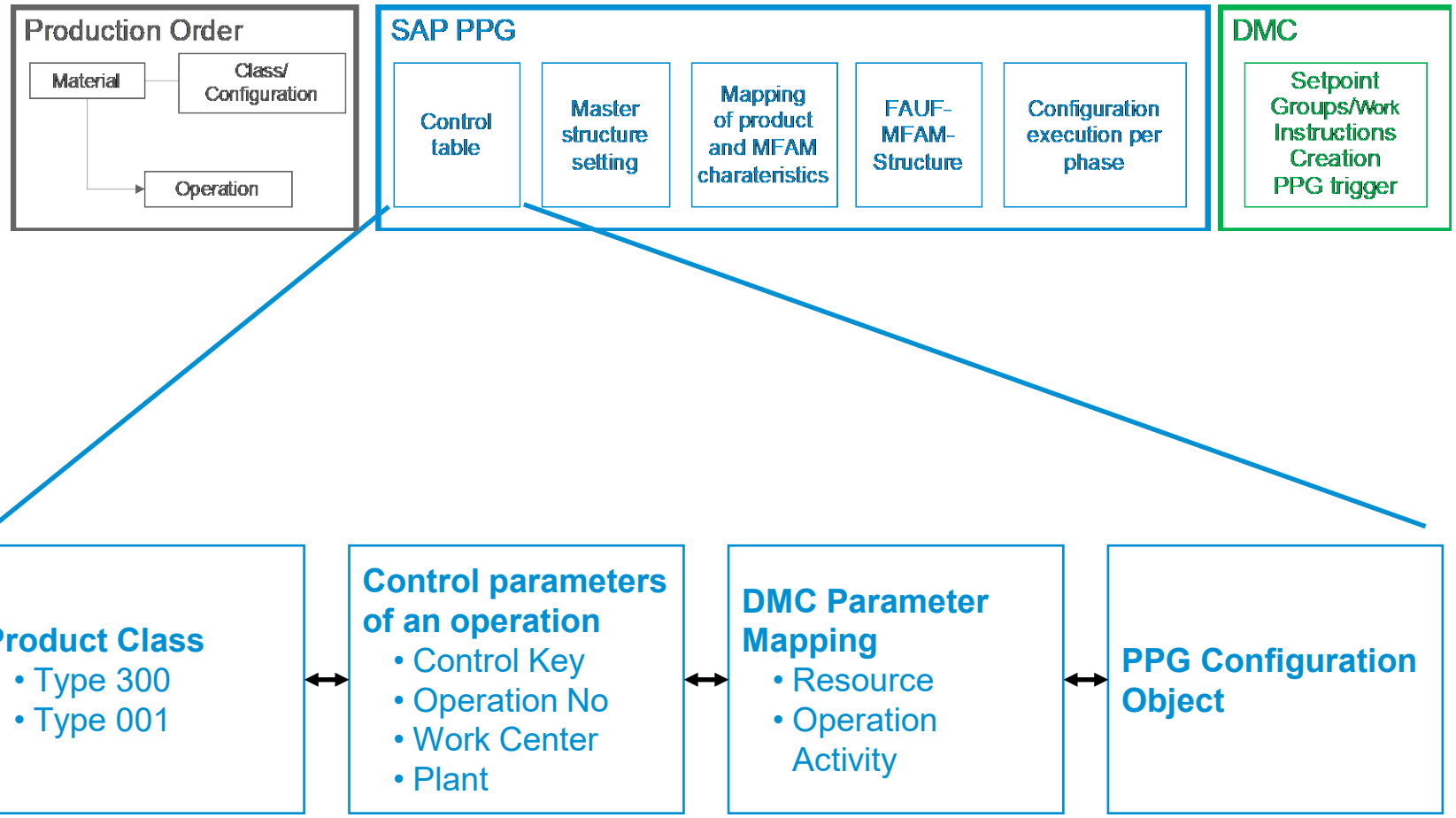
MFAM Data Model and Integration Approach

- MFAM is a universal approach which supports any shopfloor configuration with full automation
- Business logic in PPG enables the universal approach for the modelling of the configuration
- The ability of DMC to process the configuration enables the execution of the configuration



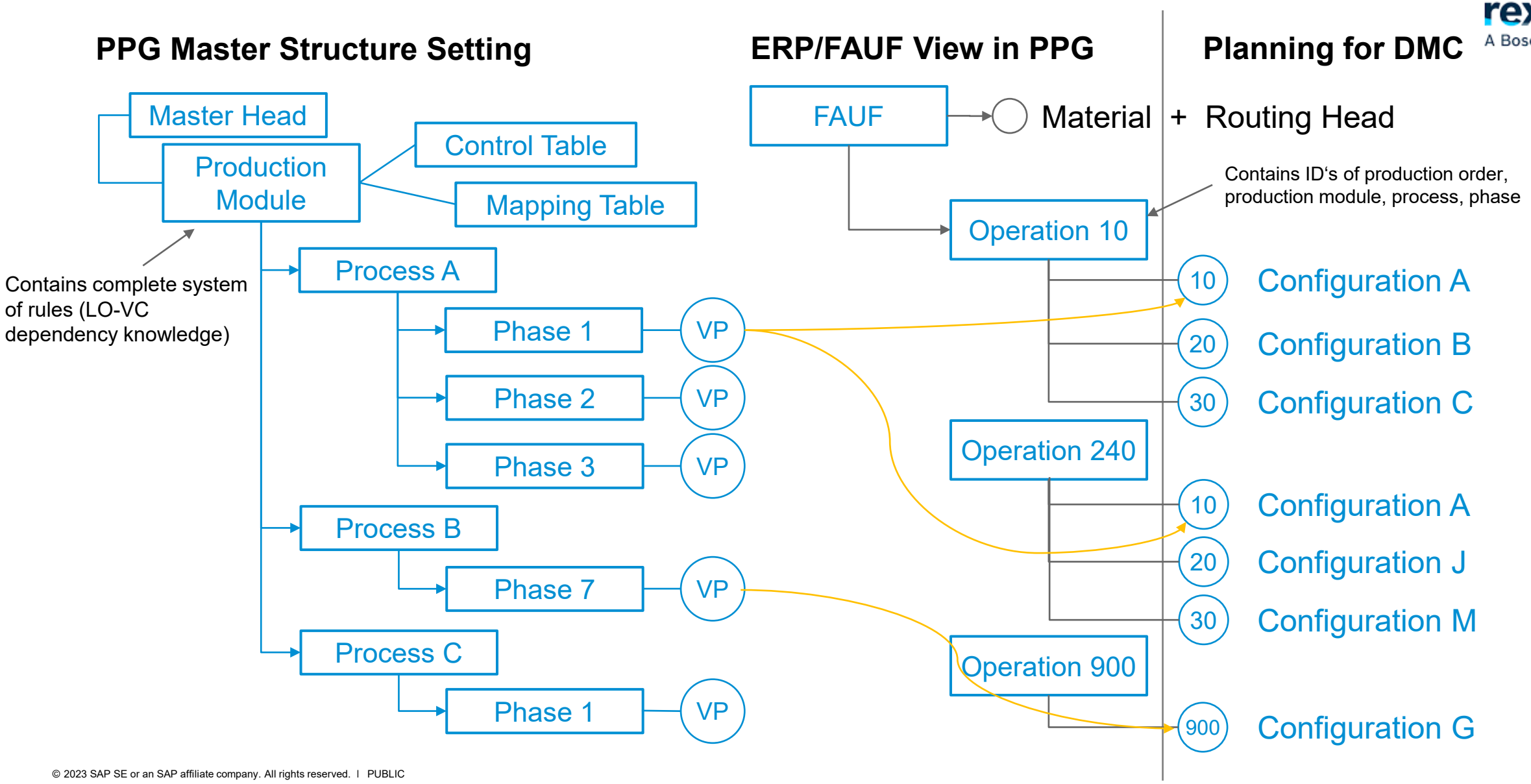
The PPG MFAM – Control Table is the Key for logistical Interaction between Product Class and DMC Attributes

- Determination of a ‚Resource‘
  - a possible Subdivision of a Work Center in DMC
  - 1:n related to a production order operation
- For every resource and phase ID (= key for ‚Operation Activity‘ in DMC) a configuration base (CMAT) is located in PPG control table and is executed within PPG
- This key is also used in DMC for the data objects
  - ‚SetPointGroup‘
  - ‚WorkInstruction‘



Relation 1:1 ..n

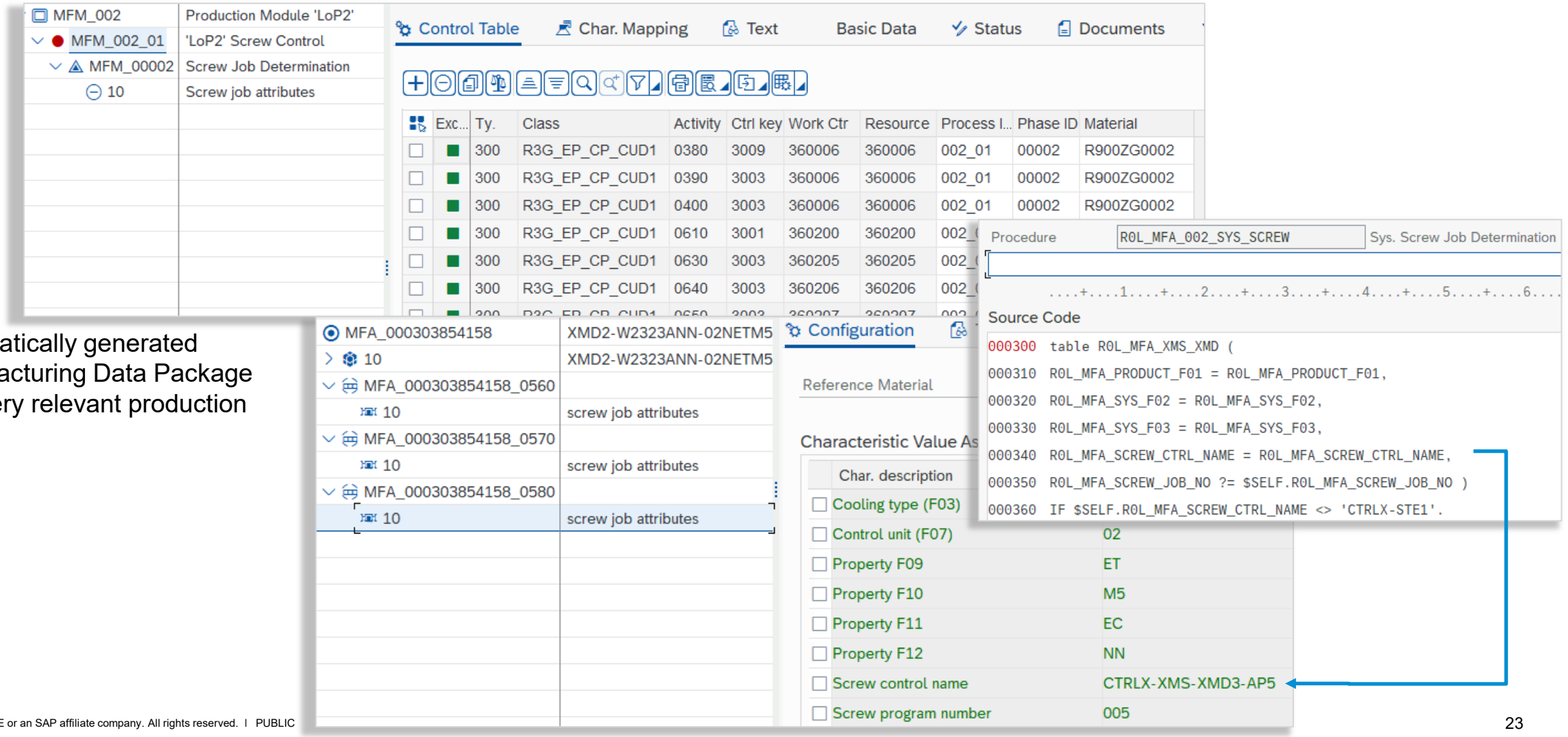
PPG MFAM – Production Module and Production Order Structure



How does the system look like?

SAP PPG – Live Demo

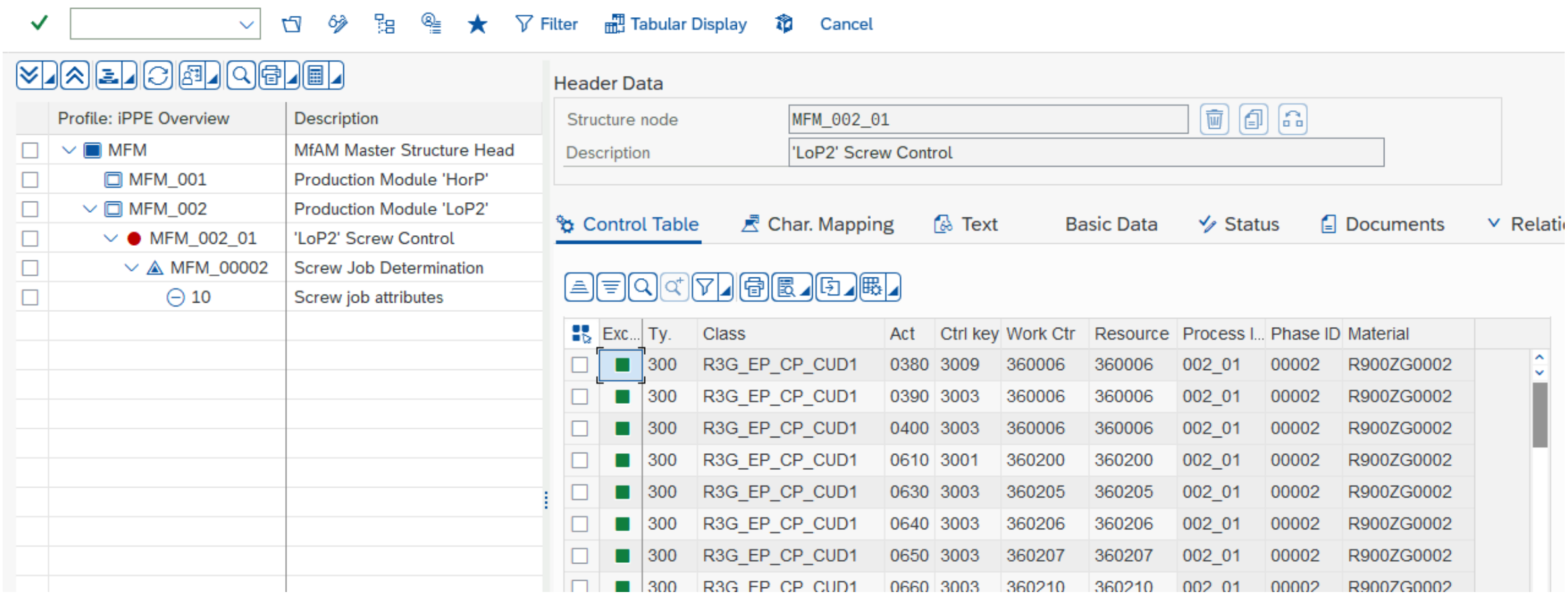
Manufacturing Data Package – Master Structure



Automatically generated Manufacturing Data Package for every relevant production order

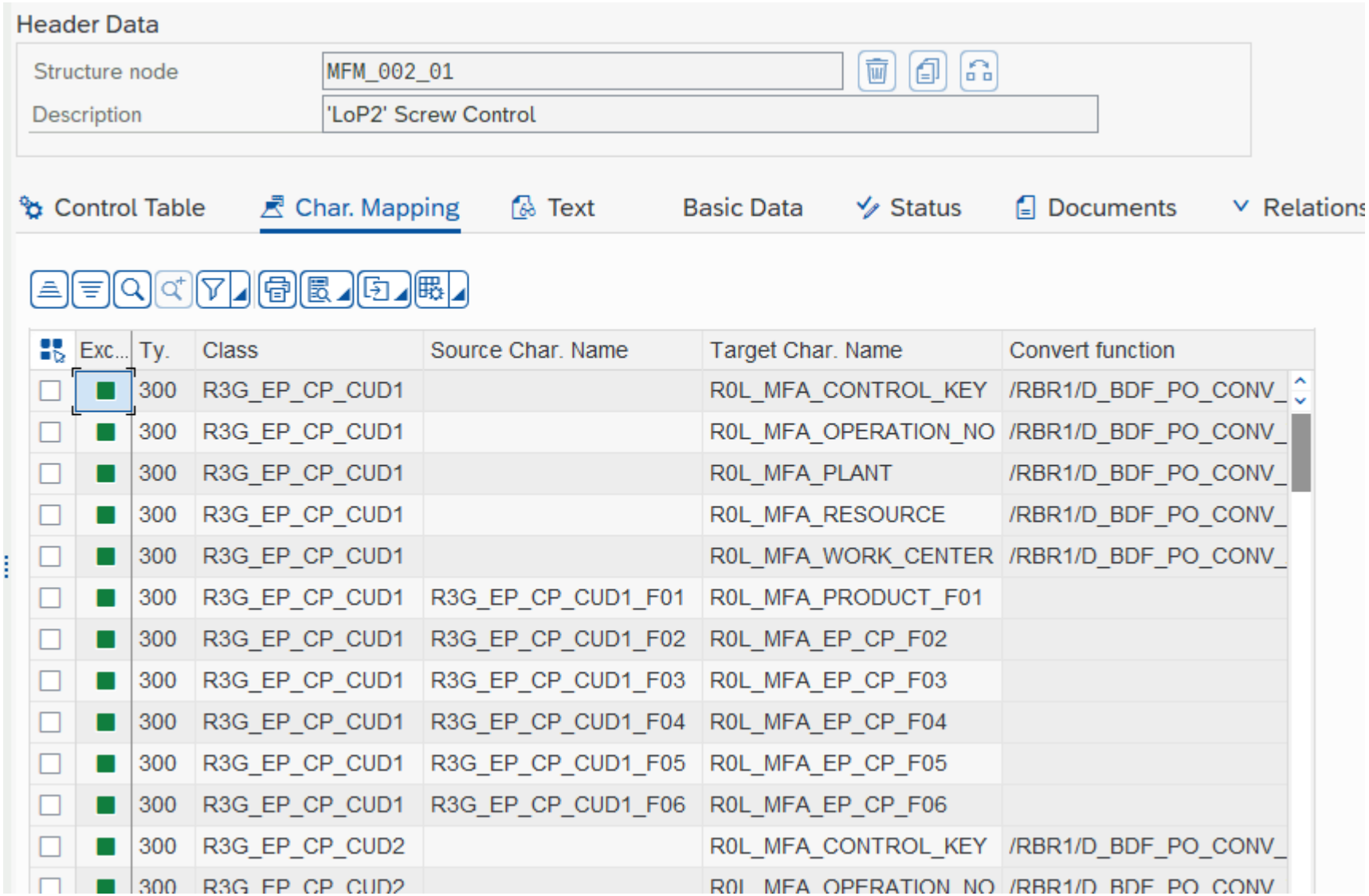
Live Demo

MfAM Master Structure in PPG – Control Table



Live Demo

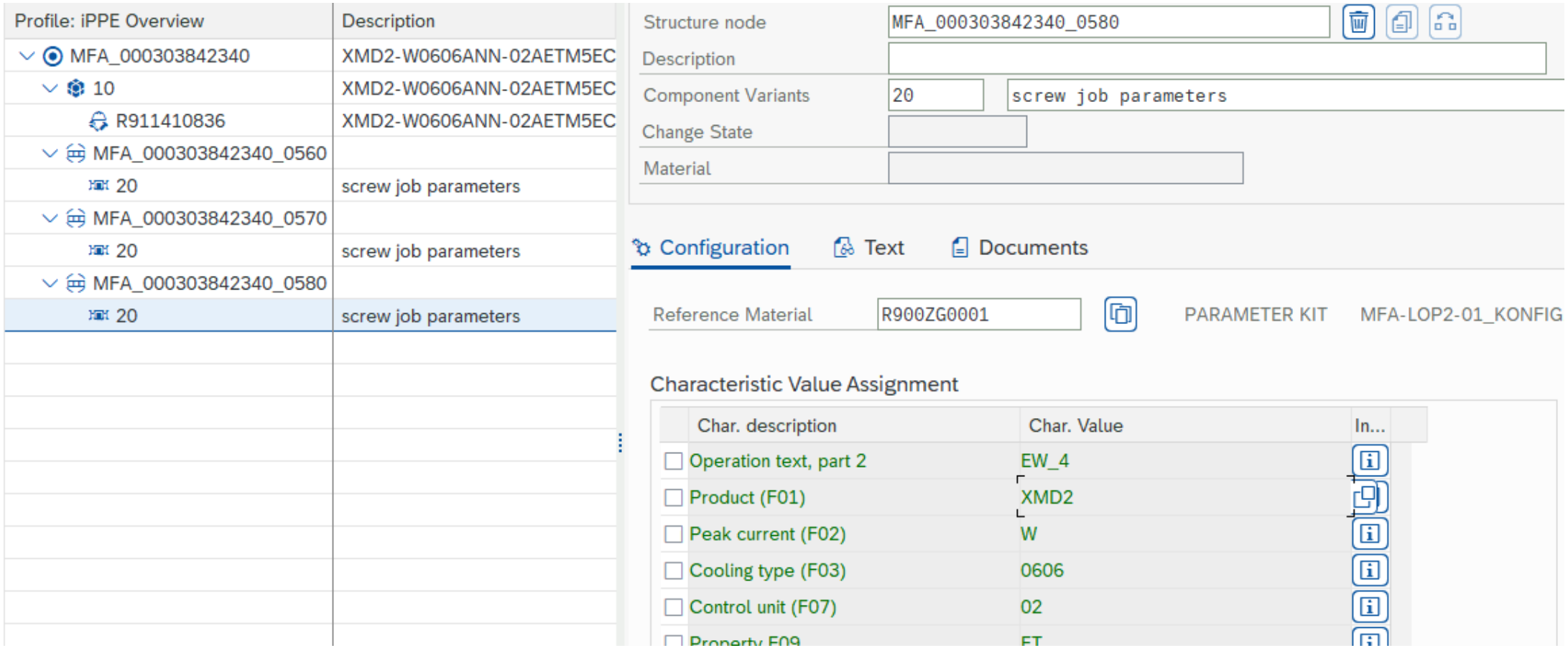
MfAM
Master Structure in PPG
– Characteristic Mapping Table



Exc...	Ty.	Class	Source Char. Name	Target Char. Name	Convert function
	300	R3G_EP_CP_CUD1		R0L_MFA_CONTROL_KEY	/RBR1/D_BDF_PO_CONV_
	300	R3G_EP_CP_CUD1		R0L_MFA_OPERATION_NO	/RBR1/D_BDF_PO_CONV_
	300	R3G_EP_CP_CUD1		R0L_MFA_PLANT	/RBR1/D_BDF_PO_CONV_
	300	R3G_EP_CP_CUD1		R0L_MFA_RESOURCE	/RBR1/D_BDF_PO_CONV_
	300	R3G_EP_CP_CUD1		R0L_MFA_WORK_CENTER	/RBR1/D_BDF_PO_CONV_
	300	R3G_EP_CP_CUD1	R3G_EP_CP_CUD1_F01	R0L_MFA_PRODUCT_F01	
	300	R3G_EP_CP_CUD1	R3G_EP_CP_CUD1_F02	R0L_MFA_EP_CP_F02	
	300	R3G_EP_CP_CUD1	R3G_EP_CP_CUD1_F03	R0L_MFA_EP_CP_F03	
	300	R3G_EP_CP_CUD1	R3G_EP_CP_CUD1_F04	R0L_MFA_EP_CP_F04	
	300	R3G_EP_CP_CUD1	R3G_EP_CP_CUD1_F05	R0L_MFA_EP_CP_F05	
	300	R3G_EP_CP_CUD1	R3G_EP_CP_CUD1_F06	R0L_MFA_EP_CP_F06	
	300	R3G_EP_CP_CUD2		R0L_MFA_CONTROL_KEY	/RBR1/D_BDF_PO_CONV_
	300	R3G_EP_CP_CUD2		R0L_MFA_OPERATION_NO	/RBR1/D_BDF_PO_CONV

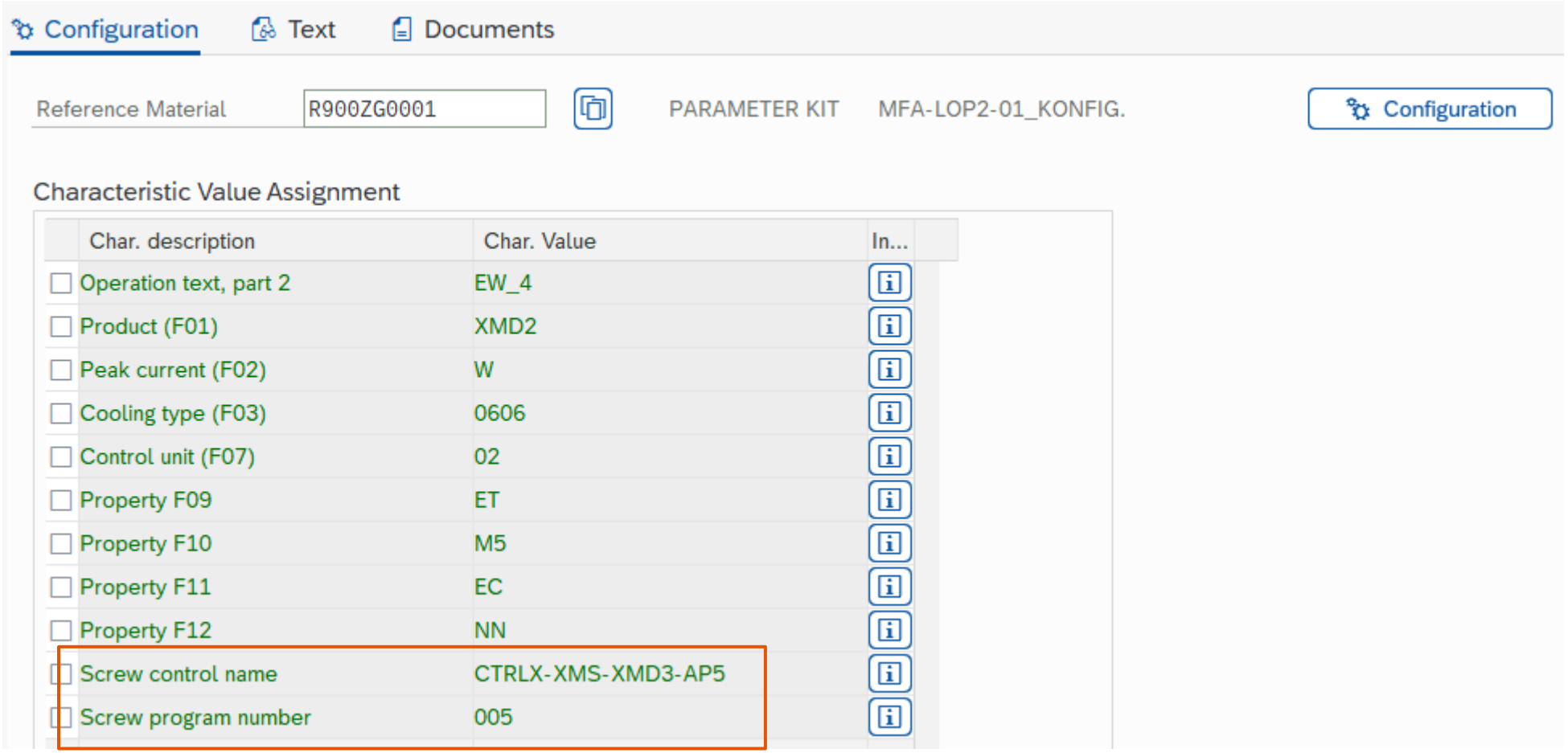
Live Demo

MfAM Production Order Structure in PPG



Live Demo

MfAM Production Order Structure in PPG – Phase Configuration Detail



Live Demo

MfAM Production Order Structure in PPG – Phase Configuration Detail

Extract of a variant table (one of three), that is used to determine the ‚Screw Program Number‘

Table R0L_MFA_XMS_XMD XMS XMD Screw Program Parameters

Product (F01)	Peak current (F02)	Cooling type (F03)	Screw control name	Screw program number
XMS2	W	0006	CTRLX-XMS-XMD1	003
XMS2	W	0006	CTRLX-XMS-XMD2	003
XMS2	W	0006	CTRLX-XMS-XMD3-AP4	003
XMS2	W	0006	CTRLX-XMS-XMD3-AP5	006
XMS2	W	0010	CTRLX-XMS-XMD1	003
XMS2	W	0010	CTRLX-XMS-XMD2	003
XMS2	W	0010	CTRLX-XMS-XMD3-AP4	003
XMS2	W	0010	CTRLX-XMS-XMD3-AP5	006
XMS2	W	0016	CTRLX-XMS-XMD1	003
XMS2	W	0016	CTRLX-XMS-XMD2	003
XMS2	W	0016	CTRLX-XMS-XMD3-AP4	003

Live Demo

MfAM Production Order Structure in PPG – Phase Configuration Detail

Procedure to read a Variant Table

Procedure R0L_MFA_002_EPCP_SCREW EP/CP Screw Job Determination

....+....1....+....2....+....3....+....4....+....5....+....6....+.

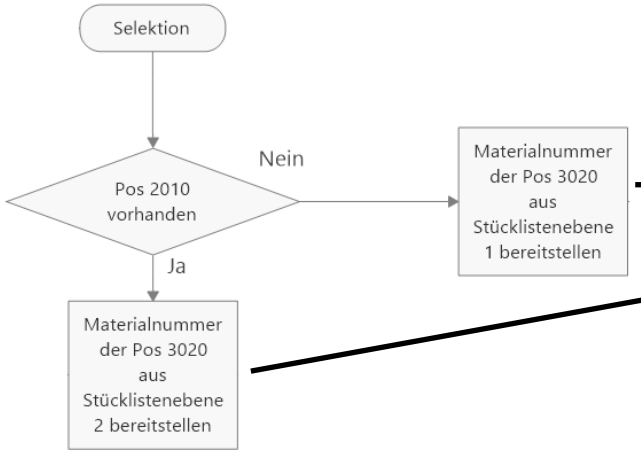
Source Code

```
000010  table R0L_MFA_EPCP_SCREW (
000020  R0L_MFA_PRODUCT_F01 = R0L_MFA_PRODUCT_F01,
000030  R0L_MFA_EP_CP_F02 = R0L_MFA_EP_CP_F02,
000040  R0L_MFA_EP_CP_F03 = R0L_MFA_EP_CP_F03,
000050  R0L_MFA_EP_CP_F04 = R0L_MFA_EP_CP_F04,
000060  R0L_MFA_EP_CP_F05 = R0L_MFA_EP_CP_F05,
000070  R0L_MFA_EP_CP_F06 = R0L_MFA_EP_CP_F06,
000080  R0L_MFA_SCREW_CTRL_NAME = R0L_MFA_SCREW_CTRL_NAME,
000090  R0L_MFA_SCREW_JOB_NO ?= $SELF.R0L_MFA_SCREW_JOB_NO ).
```

What is our next challenge?

Outlook – PPG MFAM 2.0

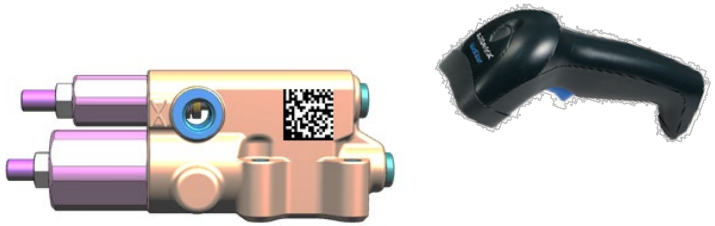
PPG MFAM



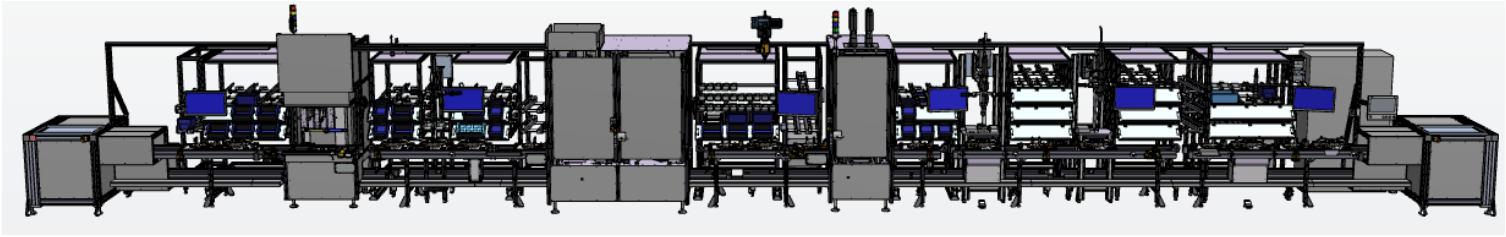
PLC Assembly Line

Matching the material number from the production order BOM with the material number read from the component

Operator



Scans Data Matrix Code
Reads out the material no.



Outlook – PPG MFAM 2.0

- Configuration of all production data for a complete production line
  - 11 stations
  - 1-3 phases
  - 17 „MfAM“ configurations
- The SAP production order contains only one operation for the production line
- All production details will be planned and controlled within DMC