



SAP® Digital Supply Chain

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

PUBLIC

By SAP partner 
EXPERTS

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THE BEST RUN 

Agenda

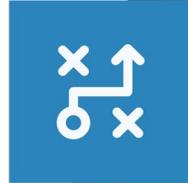
- SAP Partner BDF Experts
- SAP Product and Process Governance (PPG)
- SAP PPG @ Bosch Rexroth



About us

Founded in 2001

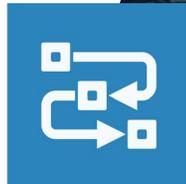
We help our customer digitalize and optimize their engineering-driven business processes in SAP.



SAP Product and Process Governance
is on the SAP pricelist since 2020.



More than 200 SAP projects
delivered successfully.



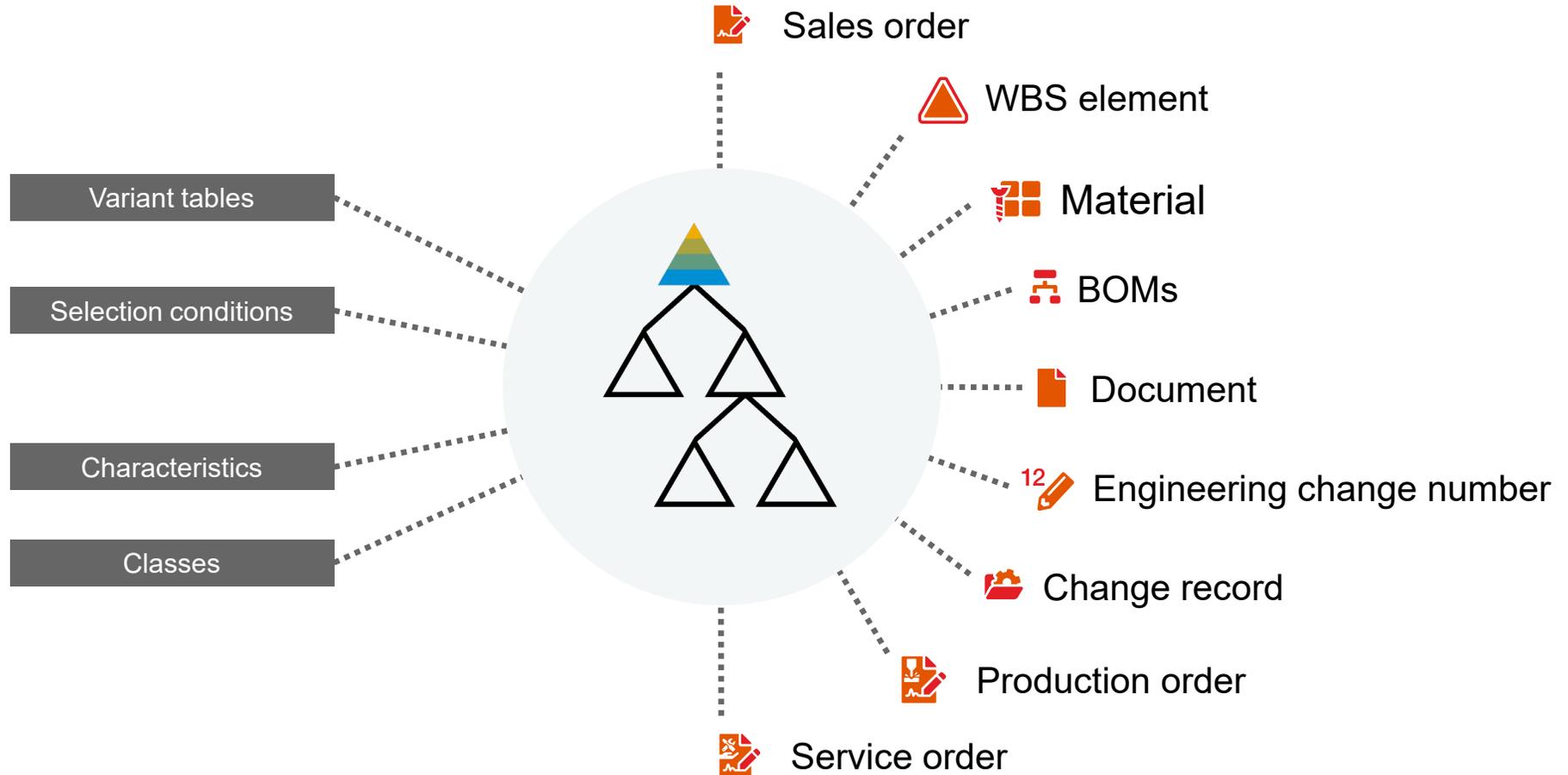
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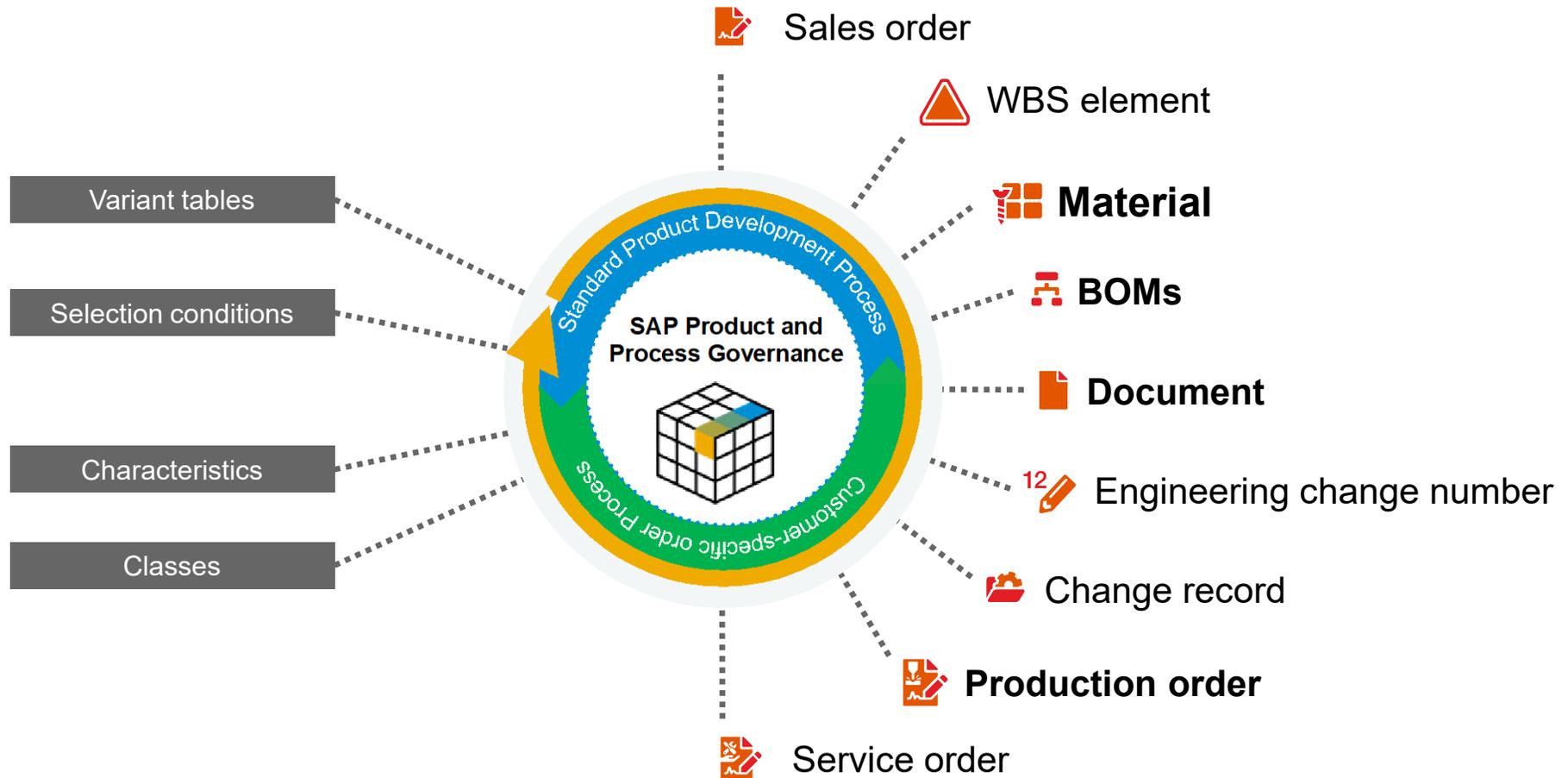
SAP Product and Process Governance

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



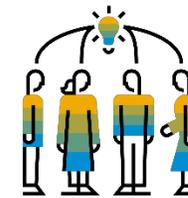
Engineering ...

... 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 ...

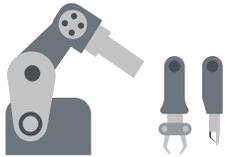
... execute integrated processes automatically via the enterprise data model.

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

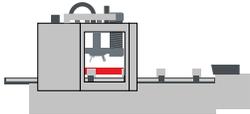
SAP Product and Process Governance

The Enterprise Product Structure supports all business models

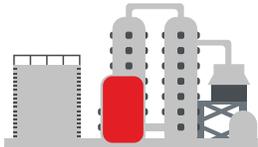
MTS
MTO
CTO



CTO
CTO+
ETO



ETO
PTO



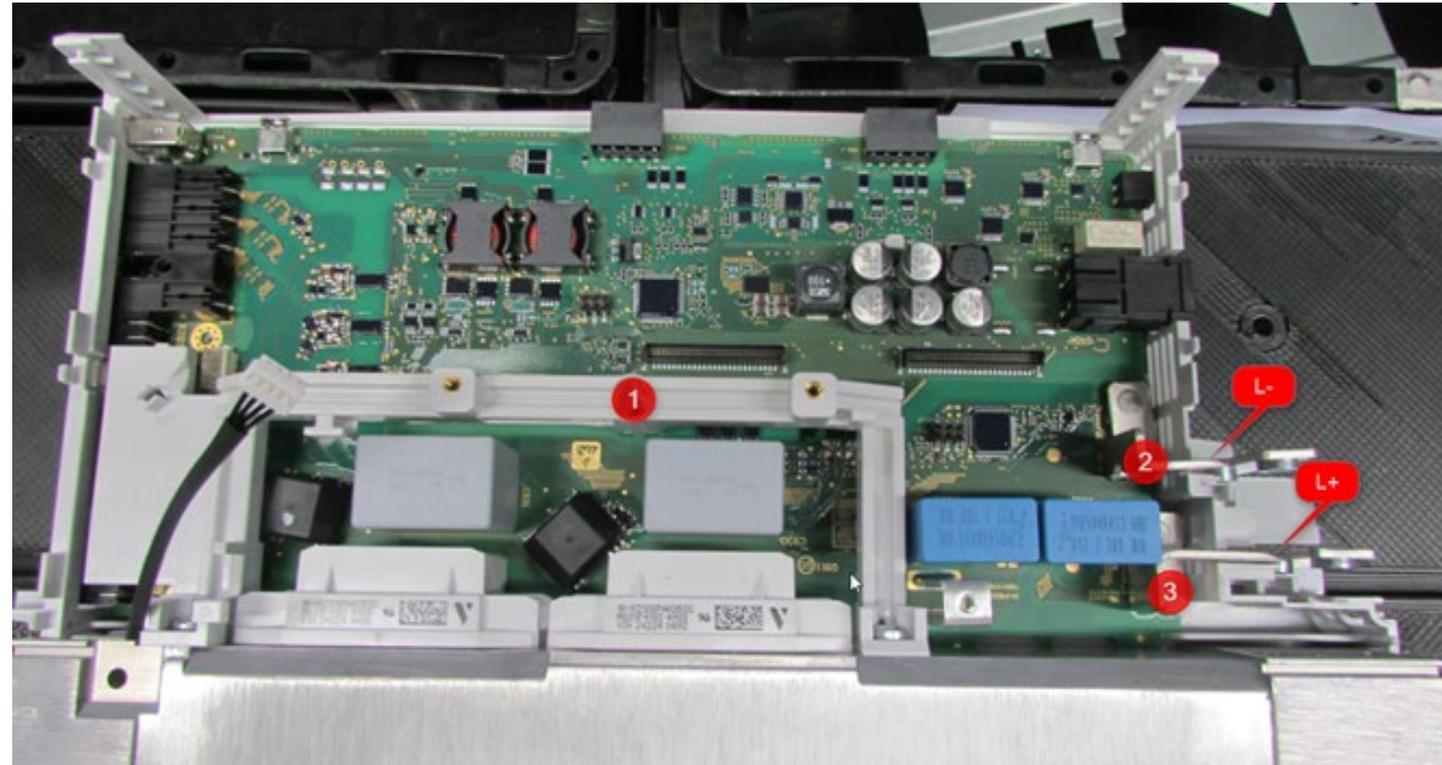
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What was the initial challenge?

AUTOMATION OF SCREWDRIVER FOR A CONFIGURABLE PRODUCT

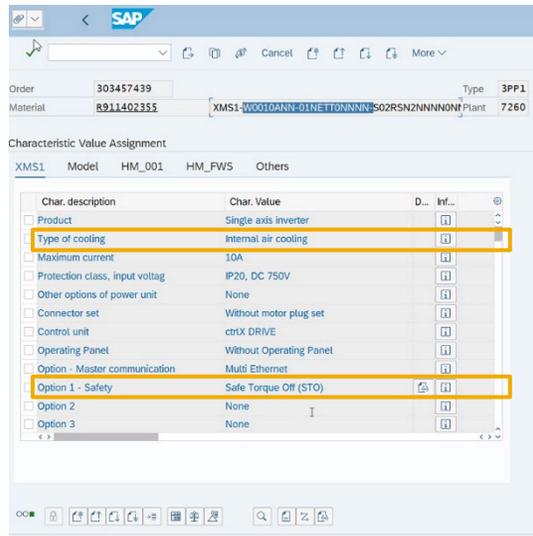


**How to
automate the configuration of a screwdriver?**

Automation of a Screwdriver with SAP PPG and SAP DMC

SAP ERP Input Data

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

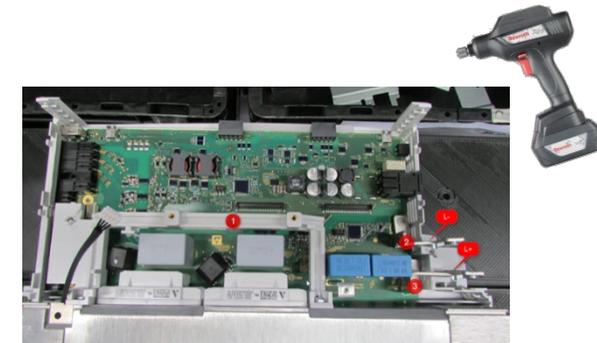


SAP PPG Logic

- ▶ 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

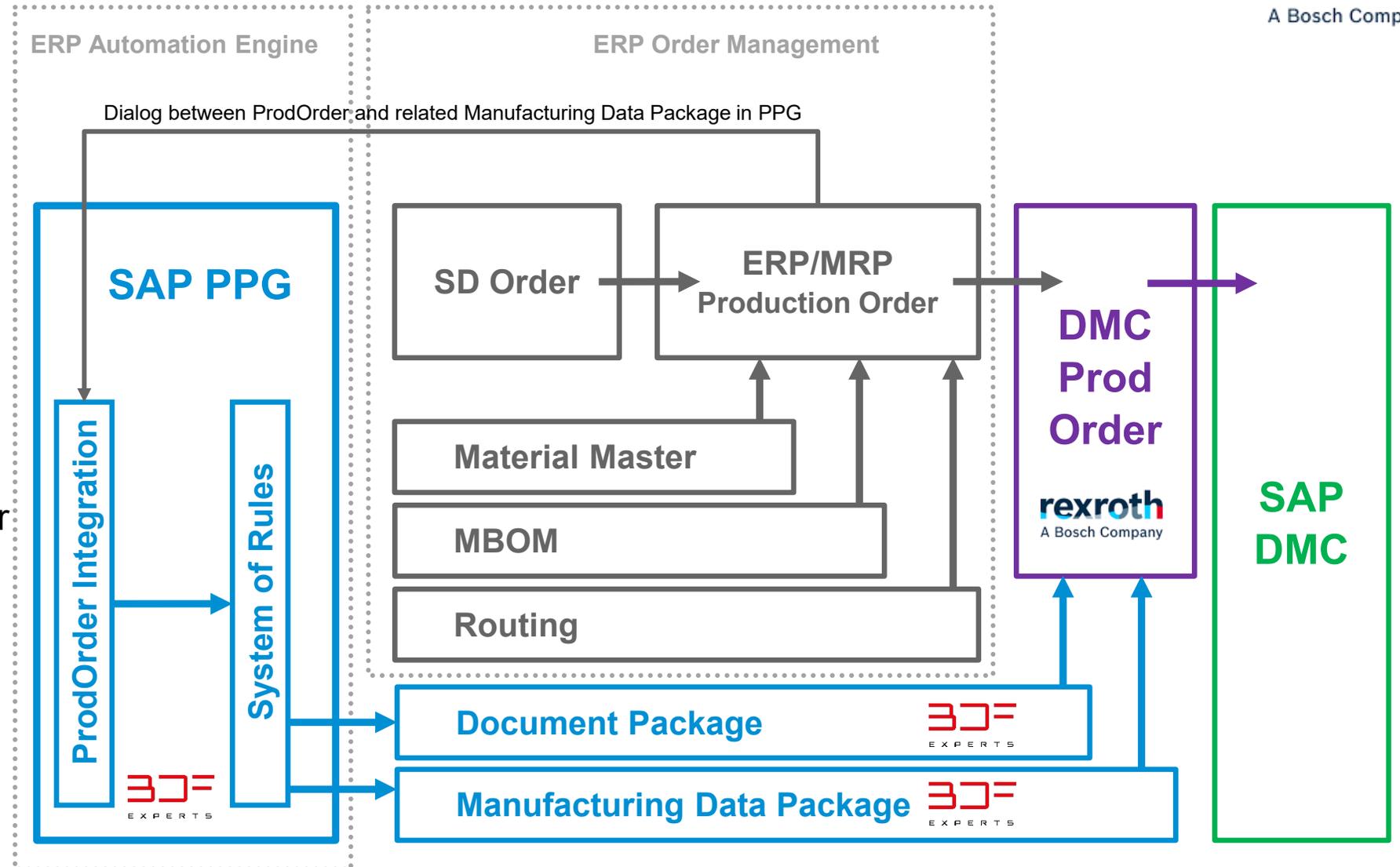


**How to integrate the screwdriver
configuration with SAP DMC?**

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)

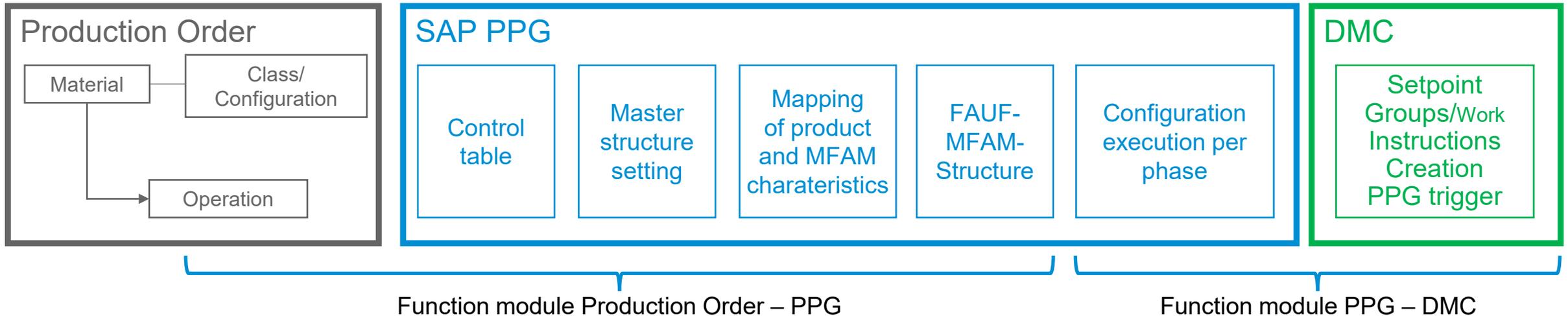


- A new production order or an order update triggers the generation of a **manufacturing data package** by PPG for a material and its operations.
- A PPG object refers to a particular routing operation which is subdivided into ‚process‘ and ‚phase‘. The **sub-structure of the production order operations 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 characteristics 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
Manfacturing
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

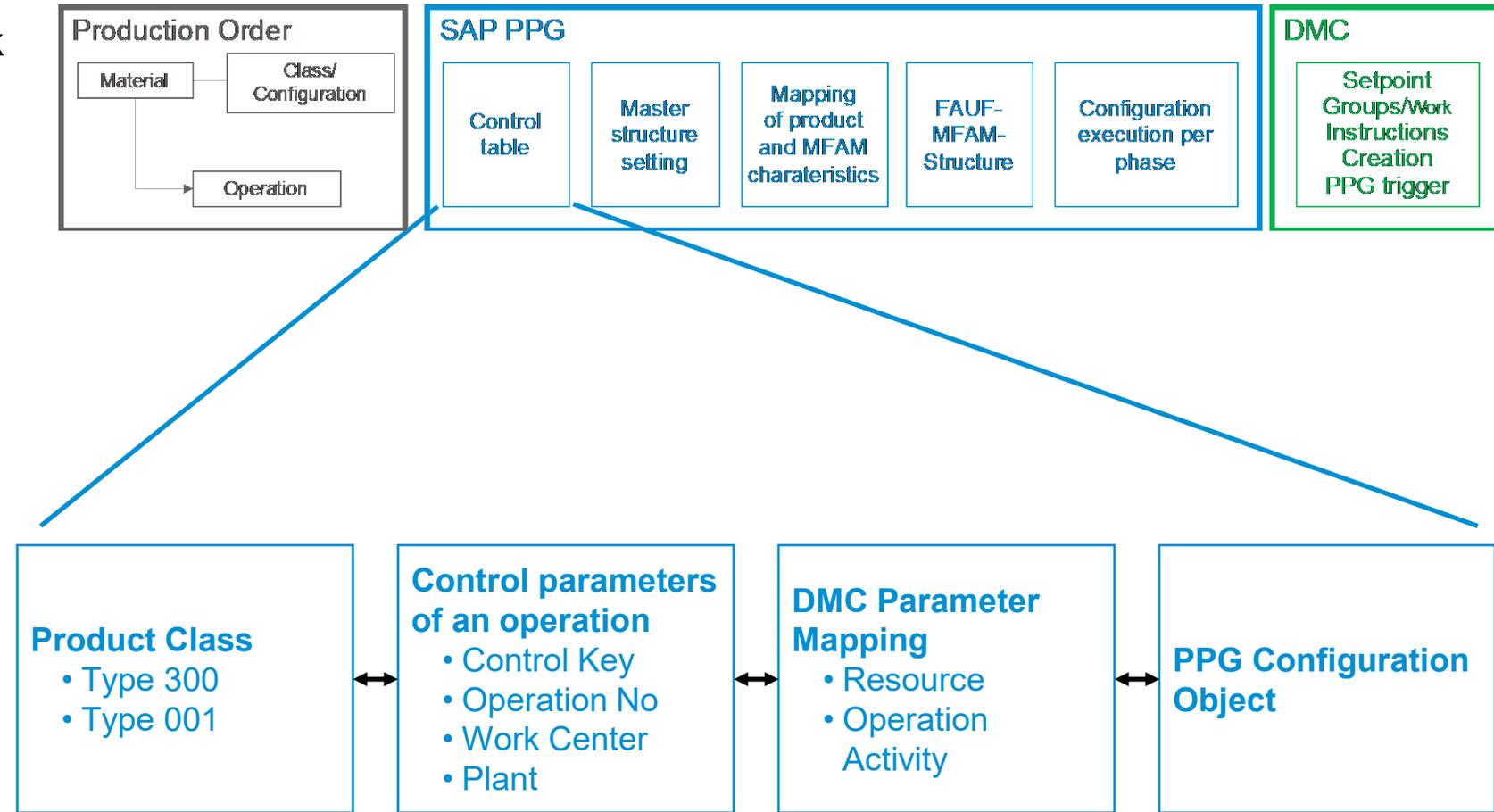


The PPG MFAM – Control Table is the Key for logistical Interaction between Product Class and DMC Attributes

- 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

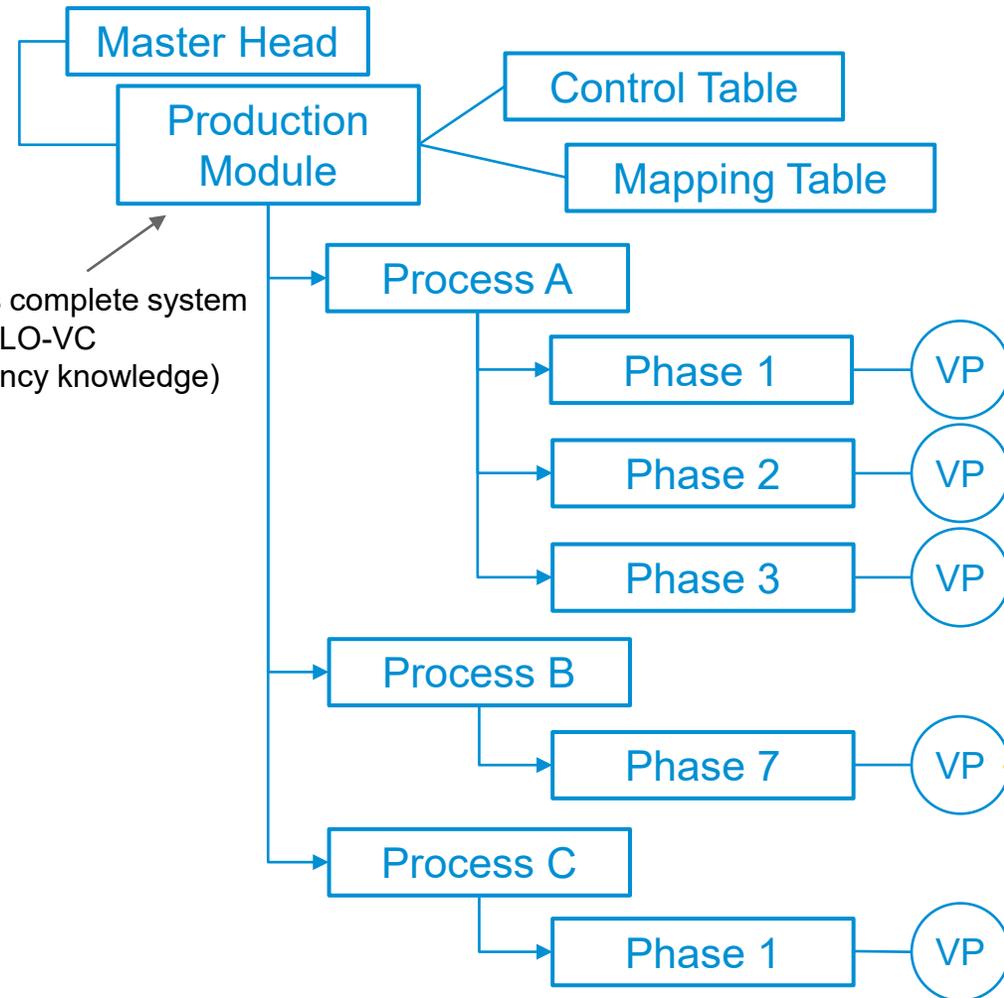
- This key is also used in DMC for the data objects
 - ‚SetPointGroup‘
 - ‚WorkInstruction‘



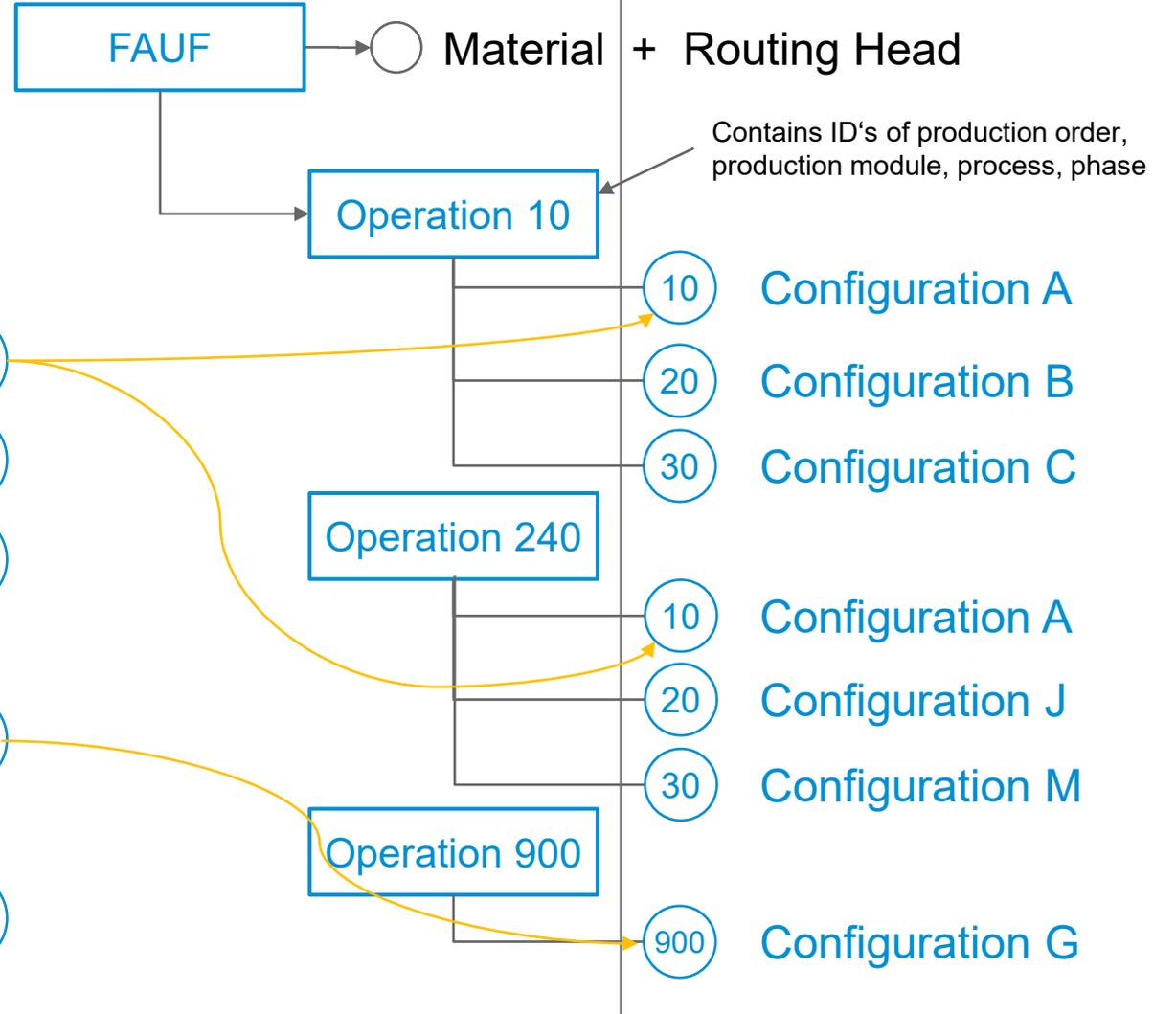
Relation 1:1 ..n

PPG MFAM – Production Module and Production Order Structure

PPG Master Structure Setting



ERP/FAUF View in PPG



How does the system look like?

SAP PPG – Live Demo

Manufacturing Data Package – Master Structure

The screenshot displays the SAP PPG interface for a Manufacturing Data Package (MFP) Master Structure. The left pane shows a tree view with the following structure:

- MFM_002 Production Module 'LoP2'
 - MFM_002_01 'LoP2' Screw Control
 - MFM_00002 Screw Job Determination
 - 10 Screw job attributes

Automatically generated Manufacturing Data Package for every relevant production order

Control Table

Exc...	Ty.	Class	Activity	Ctrl key	Work Ctr	Resource	Process I...	Phase ID	Material
<input type="checkbox"/>	300	R3G_EP_CP_CUD1	0380	3009	360006	360006	002_01	00002	R900ZG0002
<input type="checkbox"/>	300	R3G_EP_CP_CUD1	0390	3003	360006	360006	002_01	00002	R900ZG0002
<input type="checkbox"/>	300	R3G_EP_CP_CUD1	0400	3003	360006	360006	002_01	00002	R900ZG0002
<input type="checkbox"/>	300	R3G_EP_CP_CUD1	0610	3001	360200	360200	002_01	00002	R900ZG0002
<input type="checkbox"/>	300	R3G_EP_CP_CUD1	0630	3003	360205	360205	002_01	00002	R900ZG0002
<input type="checkbox"/>	300	R3G_EP_CP_CUD1	0640	3003	360206	360206	002_01	00002	R900ZG0002

Configuration

Char. description	Value
Cooling type (F03)	02
Control unit (F07)	ET
Property F09	M5
Property F10	EC
Property F11	NN
Screw control name	CTRLX-XMS-XMD3-AP5
Screw program number	005

Procedure: ROL_MFA_002_SYS_SCREW Sys. Screw Job Determination

```

000300 table ROL_MFA_XMS_XMD (
000310 ROL_MFA_PRODUCT_F01 = ROL_MFA_PRODUCT_F01,
000320 ROL_MFA_SYS_F02 = ROL_MFA_SYS_F02,
000330 ROL_MFA_SYS_F03 = ROL_MFA_SYS_F03,
000340 ROL_MFA_SCREW_CTRL_NAME = ROL_MFA_SCREW_CTRL_NAME,
000350 ROL_MFA_SCREW_JOB_NO ?= $SELF.ROL_MFA_SCREW_JOB_NO )
000360 IF $SELF.ROL_MFA_SCREW_CTRL_NAME <> 'CTRLX-STE1'.
    
```

Live Demo

MfAM Master Structure in PPG – Control Table

✓ Filter Tabular Display Cancel

Profile: iPPE Overview

Profile: iPPE Overview	Description
<input type="checkbox"/> MFM	MfAM Master Structure Head
<input type="checkbox"/> MFM_001	Production Module 'HorP'
<input type="checkbox"/> MFM_002	Production Module 'LoP2'
<input type="checkbox"/> MFM_002_01	'LoP2' Screw Control
<input type="checkbox"/> MFM_00002	Screw Job Determination
<input type="checkbox"/> 10	Screw job attributes

Header Data

Structure node: MFM_002_01

Description: 'LoP2' Screw Control

Control Table Char. Mapping Text Basic Data Status Documents Relati

Exc...	Ty.	Class	Act	Ctrl key	Work Ctr	Resource	Process I...	Phase ID	Material
<input type="checkbox"/>	300	R3G_EP_CP_CUD1	0380	3009	360006	360006	002_01	00002	R900ZG0002
<input type="checkbox"/>	300	R3G_EP_CP_CUD1	0390	3003	360006	360006	002_01	00002	R900ZG0002
<input type="checkbox"/>	300	R3G_EP_CP_CUD1	0400	3003	360006	360006	002_01	00002	R900ZG0002
<input type="checkbox"/>	300	R3G_EP_CP_CUD1	0610	3001	360200	360200	002_01	00002	R900ZG0002
<input type="checkbox"/>	300	R3G_EP_CP_CUD1	0630	3003	360205	360205	002_01	00002	R900ZG0002
<input type="checkbox"/>	300	R3G_EP_CP_CUD1	0640	3003	360206	360206	002_01	00002	R900ZG0002
<input type="checkbox"/>	300	R3G_EP_CP_CUD1	0650	3003	360207	360207	002_01	00002	R900ZG0002
<input type="checkbox"/>	300	R3G_FP_CP_CUD1	0660	3003	360210	360210	002_01	00002	R900ZG0002

Live Demo

MfAM Master Structure in PPG – Characteristic Mapping Table

Header Data

Structure node: MFM_002_01

Description: 'LoP2' Screw Control

Control Table | **Char. Mapping** | Text | Basic Data | Status | Documents | Relations

Exc...	Ty.	Class	Source Char. Name	Target Char. Name	Convert function
<input type="checkbox"/>	<input checked="" type="checkbox"/>	300	R3G_EP_CP_CUD1	R0L_MFA_CONTROL_KEY	/RBR1/D_BDF_PO_CONV_
<input type="checkbox"/>	<input checked="" type="checkbox"/>	300	R3G_EP_CP_CUD1	R0L_MFA_OPERATION_NO	/RBR1/D_BDF_PO_CONV_
<input type="checkbox"/>	<input checked="" type="checkbox"/>	300	R3G_EP_CP_CUD1	R0L_MFA_PLANT	/RBR1/D_BDF_PO_CONV_
<input type="checkbox"/>	<input checked="" type="checkbox"/>	300	R3G_EP_CP_CUD1	R0L_MFA_RESOURCE	/RBR1/D_BDF_PO_CONV_
<input type="checkbox"/>	<input checked="" type="checkbox"/>	300	R3G_EP_CP_CUD1	R0L_MFA_WORK_CENTER	/RBR1/D_BDF_PO_CONV_
<input type="checkbox"/>	<input checked="" type="checkbox"/>	300	R3G_EP_CP_CUD1	R3G_EP_CP_CUD1_F01	R0L_MFA_PRODUCT_F01
<input type="checkbox"/>	<input checked="" type="checkbox"/>	300	R3G_EP_CP_CUD1	R3G_EP_CP_CUD1_F02	R0L_MFA_EP_CP_F02
<input type="checkbox"/>	<input checked="" type="checkbox"/>	300	R3G_EP_CP_CUD1	R3G_EP_CP_CUD1_F03	R0L_MFA_EP_CP_F03
<input type="checkbox"/>	<input checked="" type="checkbox"/>	300	R3G_EP_CP_CUD1	R3G_EP_CP_CUD1_F04	R0L_MFA_EP_CP_F04
<input type="checkbox"/>	<input checked="" type="checkbox"/>	300	R3G_EP_CP_CUD1	R3G_EP_CP_CUD1_F05	R0L_MFA_EP_CP_F05
<input type="checkbox"/>	<input checked="" type="checkbox"/>	300	R3G_EP_CP_CUD1	R3G_EP_CP_CUD1_F06	R0L_MFA_EP_CP_F06
<input type="checkbox"/>	<input checked="" type="checkbox"/>	300	R3G_EP_CP_CUD2	R0L_MFA_CONTROL_KEY	/RBR1/D_BDF_PO_CONV_
<input type="checkbox"/>	<input checked="" type="checkbox"/>	300	R3G_EP_CP_CUD2	R0L_MFA_OPERATION_NO	/RBR1/D_BDF_PO_CONV_

Live Demo

MfAM Production Order Structure in PPG

Profile: iPPE Overview	Description
<ul style="list-style-type: none"> ▼ <input checked="" type="radio"/> MFA_000303842340 <ul style="list-style-type: none"> ▼ 10 <ul style="list-style-type: none"> R911410836 ▼ MFA_000303842340_0560 <ul style="list-style-type: none"> 20 ▼ MFA_000303842340_0570 <ul style="list-style-type: none"> 20 ▼ MFA_000303842340_0580 <ul style="list-style-type: none"> 20 	<ul style="list-style-type: none"> XMD2-W0606ANN-02AETM5EC XMD2-W0606ANN-02AETM5EC XMD2-W0606ANN-02AETM5EC screw job parameters screw job parameters screw job parameters

Structure node	MFA_000303842340_0580	
Description		
Component Variants	20	screw job parameters
Change State		
Material		

[Configuration](#) [Text](#) [Documents](#)

Reference Material: PARAMETER KIT MFA-LOP2-01_KONFIG

Characteristic Value Assignment

Char. description	Char. Value	In...
<input type="checkbox"/> Operation text, part 2	EW_4	
<input type="checkbox"/> Product (F01)	XMD2	
<input type="checkbox"/> Peak current (F02)	W	
<input type="checkbox"/> Cooling type (F03)	0606	
<input type="checkbox"/> Control unit (F07)	02	
<input type="checkbox"/> Property F09	ET	

Live Demo

MfAM Production Order Structure in PPG – Phase Configuration Detail

Configuration Text Documents

Reference Material  PARAMETER KIT MFA-LOP2-01_KONFIG. 

Characteristic Value Assignment

Char. description	Char. Value	In...
<input type="checkbox"/> Operation text, part 2	EW_4	
<input type="checkbox"/> Product (F01)	XMD2	
<input type="checkbox"/> Peak current (F02)	W	
<input type="checkbox"/> Cooling type (F03)	0606	
<input type="checkbox"/> Control unit (F07)	02	
<input type="checkbox"/> Property F09	ET	
<input type="checkbox"/> Property F10	M5	
<input type="checkbox"/> Property F11	EC	
<input type="checkbox"/> Property F12	NN	
<input type="checkbox"/> Screw control name	CTRLX-XMS-XMD3-AP5	
<input type="checkbox"/> Screw program number	005	

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	ROL_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
XMS2	W	0016	CTRLX-XMS-XMD3-AP5	006

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.....+

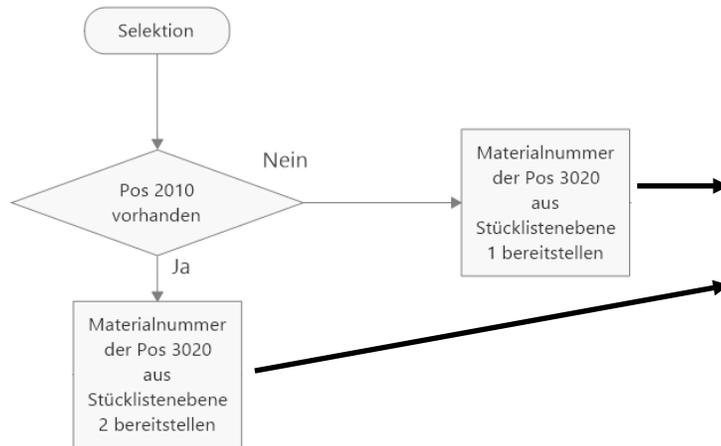
Source Code

```
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

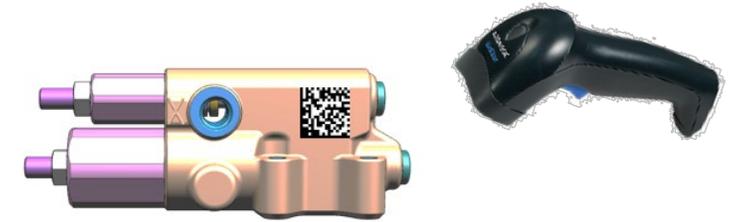
PPG MFAM



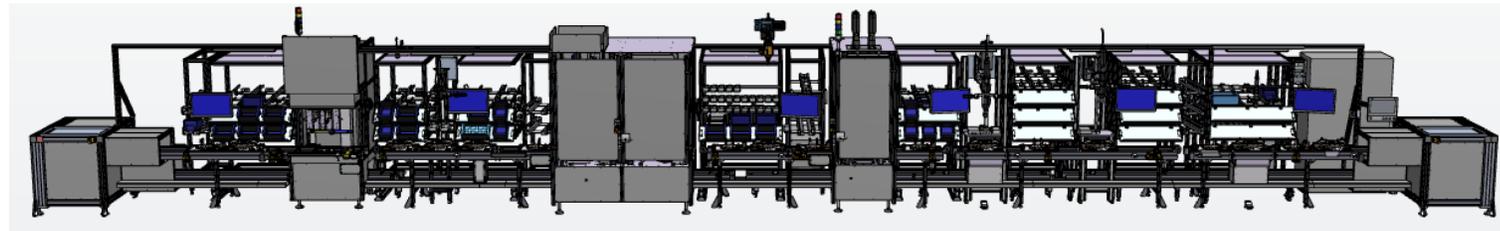
PLC Assembly Line

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

