

Product Characteristics

In a manufacturing environment, products often come with various configurable characteristics that demand for flexibility in production. These characteristics define specific attributes of a product, such as material type, size, color, or additional features. These different configurations can play a key role in managing **BOM** Variants and process-related entities, including services, documents, checklists, and data collections, among others.

Overview

This tutorial will walk you through the setup and usage of the **Product Characteristics** functionality in Critical Manufacturing **MES**.

We will explore:

- **BOM** variants
- **Product** Characteristic and Rules, including context for **Data Collection**, **Checklists**, and **Documents**
- Single Alternate **Flows** with condition expressions
- **Checklist** Items with condition expressions

Scenario

For this scenario, consider a Louvers **Product**, an air conditioning device. The product structure can vary based on two key characteristics:

- Number of blades - either 3 or 4
- Finishing type - Paint, Polish, or Varnish

As a result, a single product (Louvers) can have six different configurations based on these characteristics.

This tutorial will follow the production **Flow** outlined below:

```
flowchart LR
  A[Assembly Step] --> B{Metal Finish}
  B --> |Varnish| C[Varnish Finish Step]
  B --> |Paint| D[Paint Finish Step]
  B --> |Polished| E[Polished Finish Step]

  classDef mermaid_title fill:#fafafa, stroke:#fafafa, stroke-width:0x, font-size:100%, font-weight:200;
  classDef mermaid_start fill:#fafafa, stroke:#fafafa, color:#fafafa, stroke-width:0x, font-size:100%, visibility: hidden;
  classDef mermaid_initial_state fill:#274b76, stroke-width:0px, color:#fafafa, font-size:100%;

  class Title mermaid_title
  class Start mermaid_start
  class A,B,C,D,E mermaid_initial_state
```

Assembly Step

In the Assembly **Step**, two major consumptions must be considered:

- Blades - The quantity varies depending on the number of blades.
- Primary Coat - The type of coating depends on the metal finishing type.

```
graph TD
    A[Louvers] --> B{Number Of Blades}
    B -->|3| D[Blade <br>BOM Item Consumption <br> 3 Units]
    B -->|4| E[Blade <br>BOM Item Consumption <br> 4 Units]
    A --> C{Metal Finish}
    C -->|Paint| G[Paint Primary Coat <br> BOM Item Consumption <br> 1 L]
    C -->|Polished| H[Polished Primary Coat <br> BOM Item Consumption <br> 2 L]
    C -->|Varnish| F[Varnish Primary Coat <br>BOM Item Consumption <br> 3 L]

    classDef mermaid_title fill:#fafafa, stroke:#fafafa, stroke-width:0x, font-size:100%, font-weight:200;
    classDef mermaid_start fill:#fafafa, stroke:#fafafa, color:#fafafa, stroke-width:0x, font-size:100%, visibility: hidden;
    classDef mermaid_initial_state fill:#274b76, stroke-width:0px, color:#fafafa, font-size:100%;

    class Title mermaid_title
    class Start mermaid_start
    class A,B,C,D,E,F,G,H mermaid_initial_state
```

Additionally, for each combination of Number of Blades and Metal Finishing, specific **Checklist**, **Data Collection**, and **Document** need to be triggered.

Finishing Step

In the Finishing **Step**, there will be a single **Checklist**, but the items displayed will vary based on the **Product** Characteristics. The **Checklist** will have six different items, each corresponding to a unique Number of Blades and Metal Finishing combination.

Modeling

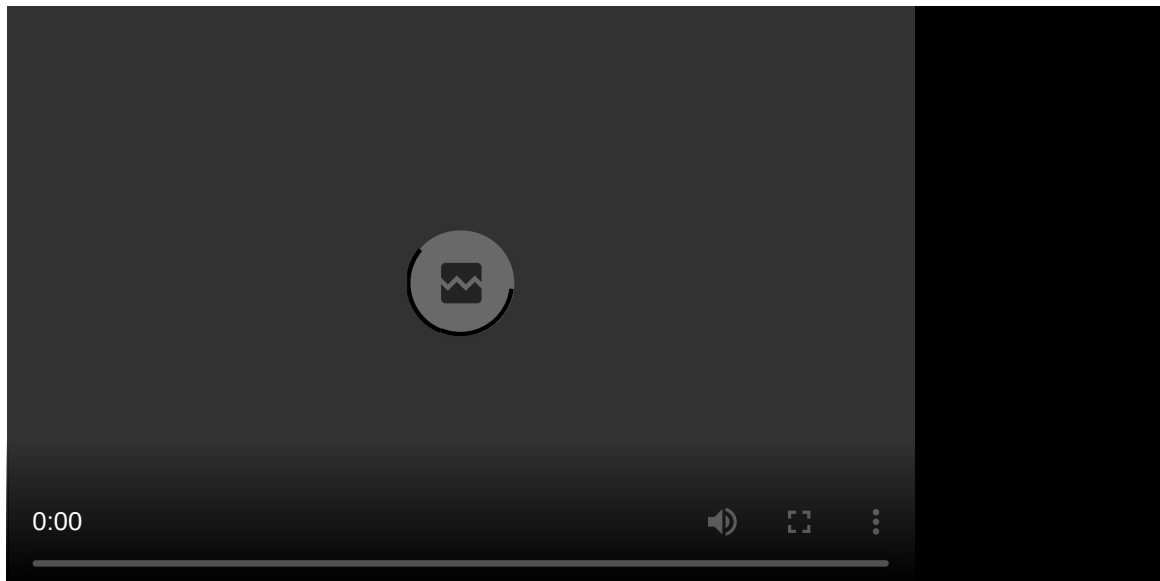
In this section, we will build the model to accommodate **Product Characteristics** and their impact on context variations.

In the following video, we cover:

- **Product Characteristics** Management - Defining and handling **Product** attributes.
- **Product Rule** Configuration - Defining context rules for **Data Collections**, **Checklists**, and **Documents**.
- **BOM** Configuration - Setting up the Bill of Materials and its variants.
- Single Alternate **Flow** Configuration - Configuring condition expressions for process variations.
- **Checklist** Item Configuration - Setting up conditional **Checklist** items.

Warning

Basic model configurations will not be covered in this video.



Note

You may have noticed that for the Assembly **Step**, where **Product** Characteristic Rules were set, there was no **Smart Table** context configuration for **Data Collection**, **Checklists**, or **Documents**. This is because when a **Production Order** is created a new entry is automatically generated based on its **Product Characteristics**.

Product Characteristics

The first crucial configuration is to [Manage Characteristics](#) of the **Product** , where specific characteristics are added along with the Lookup Tables that store their values.

Louvers [B.1] B (Default) 1 (Effective)

CHARACTERISTICS AND RULES

Refresh Manage Characteristics

CHARACTERISTICS (2) RULES (18) Search

ITEM	CHARACTERISTIC	DESCRIPTION	VALUE TABLE	DEFAULT VALUE	OPTIONAL
1	NumberOfBlades	Number of Blades	NumberOfBlades		X
2	MetalFinish	Metal Finish	MetalFinish		X

Useful documentation

- [How to: Create a Lookup Table](#)
- [How to: Edit a Lookup Table](#)

BOM

When performing [Manage BOM Items](#) of the Material **BOM**, the quantities and Bom Items vary according to the characteristics of the product.

Louvers BOM [A.1] A (Default) 1 (Effective)

DETAILS

BOM

Name: Louvers BOM

Description:

Type: Standard

Universal State: Effective

Information

Scope: Materials

Product:

Base Quantity: 1

Units: Units

Drawing:

BOM ITEMS

Refresh

More

Search

BOM Items (5)

ITEM	PRODUCT	QUANTITY	UNITS	SOURCE STEP	REFERENCE	ASSEMBLY STEP	CONDITION
1	Blades [A]	3	Units	Assembly	X	Assembly	NumberOfBlades = 3
2	Blades [A]	4	Units	Assembly	X	Assembly	NumberOfBlades = 4
3	Varnish Primary Coat [A]	3	L	Assembly	X	Assembly	MetalFinish = Varnish
4	Polished Primary Coat [A]	2	L	Assembly	X	Assembly	MetalFinish = Polished
5	Paint Primary Coat [A]	1	L	Assembly	X	Assembly	MetalFinish = Paint

Useful documentation

- How to: Create a BOM
- How to: Manage BOM Items

BOM Context

Since the **BOM** remains the same across all **Product** variations, and the **BOM** Items account for those variants, it can be configured in the **BOMContext** Smart Table.

BOM Context (1)

STEP

LOGICAL FLOW PA

PRODUCT

PRODUCT GROUP

FLOW

MATERIAL

PRODUCTION

RESOURCE

RESOURCE TYPE

MODEL

RECIPE

BOM

ASSEMBLY TYPE

TRACK-IN CHECK

TRACK-OUT LOSS

WE

Assembly

Louvers BOM Explicit Long Running

Useful documentation

- How to: Add Value to Smart Table

Data Collection Example

There is a **Data Collection** and a **Data Collection Limit Set** to be triggered for each combination of characteristics.

Page 4 of 12

DC3Blades.Paint [A.2] A (Default) 2 (Effective)

DETAILS

Data Collection

Name: DC3Blades.Paint

Description:

Type: Standard

Universal State: Effective

Details

Scope: General

SPC Post Mode: On Close Per Parameter

User Interface: Modern

PARAMETERS

Refresh More

Ventilation 3 Blades
FreeText

Dry Film Thickness Paint
FreeText

LIMIT SETS

Refresh Add Copy

Limit Sets (1)

LIMIT SET	DESCRIPTION
DCLS 3Blades.Paint [A]	

Useful documentation

- [How to: Create a Parameter](#)
- [How to: Create a Data Collection](#)
- [How to: Create a Data Collection Limit Set](#)

Document Example

There is a **Document** to be triggered for each combination of characteristics.

Doc 3Paint [A.1] A (Default) 1 (Effective)

DETAILS

Document

Name: Doc 3Paint

Description:

Type: Standard

Universal State: Effective

Content

Source: Internal

File: 3Paint.pdf

Change Description:

Information

Folder: Documents

Owner Role:

Group:

Author: MES Pessoa

Creation Date: 12/27/2023 04:35 PM

Link: [http://172.24.48.37/Entity/Document/Doc%203Paint|\[A\]|v.0/Open](http://172.24.48.37/Entity/Document/Doc%203Paint|[A]|v.0/Open)

Version Link: [http://172.24.48.37/Entity/Document/Doc%203Paint|\[A\]|v.1/Open](http://172.24.48.37/Entity/Document/Doc%203Paint|[A]|v.1/Open)

Keywords:

Distribution Lists

For New Version:

For New Effective Version:

Read and Understand

Require Signature for Read and Understand: No

Read and Understand

Expiration (Days):

Useful documentation

- [How to: Create a Document](#)

Checklist Example: Assembly step

For the Assembly Step, a **Checklist** needs to be triggered for each combination of characteristics. This **Checklist** consists of tree items: a generic manual task, a **BOM** assembly manual task, and a **Data Collection** manual task.

CL 3Blades:Paint [A.4] A (Default) 4 (Effective)

DETAILS

Checklist

CL 3Blades:Paint

Name: CL 3Blades:Paint

Description:

Type: Standard

Universal State: Effective

Information

Scope: MaterialTracking

Execution Mode: Long Running

BOM: Louvers BOM [A]

Product:

Data Collection: DC 3Blades:Paint [A]

Data Collection Limit Set:

Material Deviation Protocol:

Documentation Url:

Define Standard Times: No

Track Execution Times: No

Checklist Items (3)

Check for 3Blades:Paint

Confirm Structure and Finishing

Assemble

No Instructions

Collect Values

No Instructions

GENERAL DATA

INSTRUCTIONS

CONDITION

Name: Check for 3Blades:Paint

Type:

Documentation URL:

Activity Type: Manual Task

Tracking Type: End

Floating: No

Optional: No

Execute Out of Order: No

CL 3Blades:Paint [A.4] A (Default) 4 (Effective)

Checklist Items (3)

Check for 3Blades:Paint

Confirm Structure and Finishing

Assemble

No Instructions

Collect Values

No Instructions

GENERAL DATA

BOM

CONDITION

BOM Items (2)

PRODUCT	PRODUCT DESCRIPTION	BOM ITEM NUMBER	QUANTITY	COLOR
Blades [A]		1	3 Units	
Paint Primary Coat [A]			1 L	

CL 3Blades:Paint [A.4] A (Default) 4 (Effective)

Checklist Items (3)

Check for 3Blades:Paint

Confirm Structure and Finishing

Assemble

No Instructions

Collect Values

No Instructions

GENERAL DATA

DATA COLLECTION

CONDITION

Data Collection Parameters (2)

PARAMETERS	FROM SAMPLE	TO SAMPLE
Ventilation 3 Blades	1	1
Dry Film Thickness Paint	1	1

Useful documentation

- How to Create a Material Tracking Checklist

Product Rules

Considering all the necessary variations, the **BOM** configuration already accounts for the product configuration variants. The setup for **Data Collection**, **Documents**, and **Checklists** is managed by performing [Manage Rules](#) on the page of the main **Product**.

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Louvers [B.1] B (Default) 1 (Effective)

CHARACTERISTICS AND RULES

Refresh Preview Rules More

CHARACTERISTICS (2) RULES (18) CONTEXT: ALL STEP: Step Search

Assembly Checklist [Data Collection] Document

Checklist (6)

SEQUENCE	CONDITION	OPERATION	CHECKLIST
1	NumberOfBlades = '3' and MetalFinish = 'Paint'	TrackIn	CL 3Blades:Paint
2	NumberOfBlades = '3' and MetalFinish = 'Polished'	TrackIn	CL 3Blades:Polished
3	NumberOfBlades = '3' and MetalFinish = 'Varnish'	TrackIn	CL 3Blades:Varnish
4	NumberOfBlades = '4' and MetalFinish = 'Paint'	TrackIn	CL 4Blades:Paint
5	NumberOfBlades = '4' and MetalFinish = 'Polished'	TrackIn	CL 4Blades:Polished
6	NumberOfBlades = '4' and MetalFinish = 'Varnish'	TrackIn	CL 4Blades:Varnish

Rows per Page: 25 Page 1 of 1 (6 Records)

Data Collection (6)

SEQUENCE	CONDITION	OPERATION	DATA COLLECTION	DATA COLLECTION LIMIT SET	DATA COLLECTION TYPE
1	NumberOfBlades = '3' and MetalFinish ...	TrackIn	DC 3Blades:Paint	DCLS 3Blades:Paint	LongRunningAfterTrackIn
2	NumberOfBlades = '3' and MetalFinish ...	TrackIn	DC 3Blades:Polished	DCLS 3Blades:Polished	LongRunningAfterTrackIn
3	NumberOfBlades = '3' and MetalFinish ...	TrackIn	DC 3Blades:Varnish	DCLS 3Blades:Varnish	LongRunningAfterTrackIn
4	NumberOfBlades = '4' and MetalFinish ...	TrackIn	DC 4Blades:Paint	DCLS 4Blades:Paint	LongRunningAfterTrackIn
5	NumberOfBlades = '4' and MetalFinish ...	TrackIn	DC 4Blades:Polished	DCLS 4Blades:Polished	LongRunningAfterTrackIn
6	NumberOfBlades = '4' and MetalFinish ...	TrackIn	DC 4Blades:Varnish	DCLS 4Blades:Varnish	LongRunningAfterTrackIn

Document (6)

SEQUENCE	CONDITION	OPERATION	DOCUMENT
1	NumberOfBlades = '3' and MetalFinish = 'Paint'	TrackIn	Doc 3Paint
2	NumberOfBlades = '3' and MetalFinish = 'Polished'	TrackIn	Doc 3Polished
3	NumberOfBlades = '3' and MetalFinish = 'Varnish'	TrackIn	Doc 3Varnish
4	NumberOfBlades = '4' and MetalFinish = 'Paint'	TrackIn	Doc 4Paint
5	NumberOfBlades = '4' and MetalFinish = 'Polished'	TrackIn	Doc 4Polished
6	NumberOfBlades = '4' and MetalFinish = 'Varnish'	TrackIn	Doc 4Varnish

Checklist Example: Finishing Step

For all Finishing Steps, the same **Checklist** is triggered, but the displayed items vary based on the **Product Characteristics** combination. Each of the six items has a condition expression that defines its specific combination.

CL Louvers Finish [B.3] B (Default) 3 (Effective)

DETAILS

Checklist

Information

Name: CL Louvers Finish

Description:

Type: Standard

Universal State: Effective

Scope: MaterialTracking

Execution Mode: Immediate

Product:

Data Collection:

Data Collection Limit Set:

Documentation Url:

Define Standard Times: No

Track Execution Times: No

CL Louvers Finish [B.3] B (Default) 3 (Effective)

Checklist Items (6)

GENERAL DATA	INSTRUCTIONS	CONDITION
Check for 3Blades:Paint	Confirm Structure and Finishing	Condition Type: Expression
Check for 3Blades:Polished	Confirm Structure and Finishing	Condition Expression: MetalFinish= 'Paint' and NumberOfBlades= '3'
Check for 3Blades:Varnish	Confirm Structure and Finishing	
Check for 4Blades:Paint	Confirm Structure and Finishing	
Check for 4Blades:Polished	Confirm Structure and Finishing	
Check for 4Blades:Varnish	Confirm Structure and Finishing	

Useful documentation

- [How to Create a Material Tracking Checklist](#)

Material Checklist Context

The Finishing **Checklist** must be included in the [MaterialChecklistContext](#) Smart Table, as its configuration already determines which items will be displayed.

Material Checklist Context (3)

STEP	LOGICAL FLOW PATH	OPERATION	PRODUCT	PRODUCT GROUP	FLOW	MATERIAL	MATERIAL TYPE	PRODUCTION OF	RESOURCE	RESOURCE TYPE	MODEL	CHECKLIST
☐	Varnish Finish	TrackIn										CL Louvers Finish
☐	Paint Finish	TrackIn										CL Louvers Finish
☐	Polished Finish	TrackIn										CL Louvers Finish

Useful documentation

- [How to: Add Value to Smart Table](#)

Flow

The **Flow** begins with an Assembly **Step**, after which the **Material** enters a Single Alternate Flow. Based on its characteristics, it is directed to one of three available steps.

Louvers Production [A.1] A (Default) 1 (Effective)

Search

- Louvers Production [A]
 - 1. Assembly
 - 2. Finishing [A]
 - 1. Varnish Finish {}
 - 2. Paint Finish {}
 - 3. Polished Finish {}

DETAILS

FLOW

General Data

Flow: Finishing [A]

Description:

Optional: X No

Flow Type: Alternate Flow

Alternate Flow Selection Type: Single

STEP

General Data

Step: Polished Finish

Description:

Optional: X No

Line Step: X No

Skippable: X No

Rework: X No

Condition

Type: Expression

Expression:

View Expression

1 MaterialCharacteristics.MetalFinish = 'Polished'

Useful documentation

- [How to: Create a Flow](#)

Modeling Notes

Managing Rules

When managing product rules, multiple entities can be selected to define a context rule, including:

- [BOM Page](#) for Material or Durable scope
- [Checklist Page](#)
- [Data Collection Page](#)
- [Document Page](#)
- [Inspection Plan Page](#)
- [Recipe Page](#) and Recipe Parameter
- [Service Page](#)

Expressions for Rules

Here are some more examples of Product Characteristic Rules:

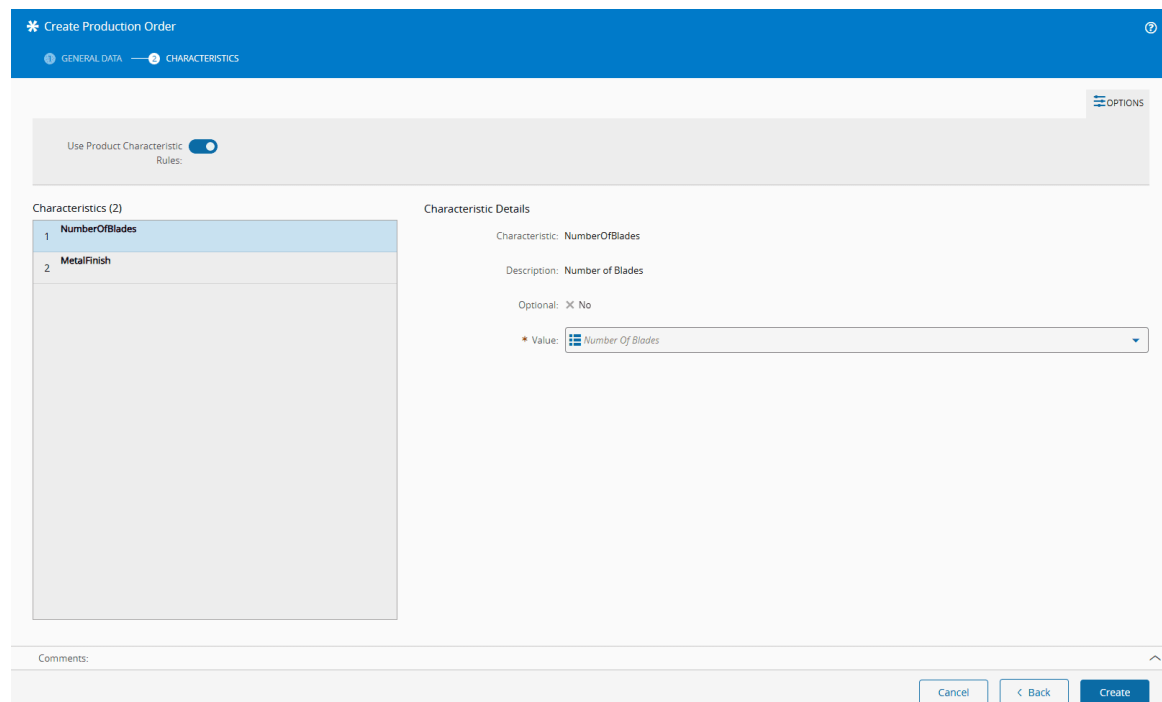
- `NumberOfBlades>='4'` and `MetalFinish!='Varnish'` : Applies when the product has 4 or more blades, but the metal finish is not varnish
- `NumberOfBlades>'3'` and `(MetalFinish ='Polished' or MetalFinish ='Paint')` : Applies when the product has more than 3 blades and the metal finish is either polished or painted
- `(NumberOfBlades='4' or NumberOfBlades ='3')` and `MetalFinish!='Paint'` : Applies when the product has 4 or 3 blades, as long as the metal finish is not painted.

For more details on JSONata query syntax for Product Characteristic Rule Conditions, see [Manage Rules](#) or [JSONata Homepage](#).

GUI Element Default Value

When a **Production Order** is created and the **Product** has characteristics, there is an option to "Use Product Characteristic Rules". If this setting is enabled, the system automatically generates a new entry in the Smart Tables involved in the Product Rule Context, based on the **Product Characteristics** assigned to the **Production Order**.

This option can have a default value (true or false), which can be set in the [GUIElementDefaultValue](#) Table under: `ProductionOrder.Create` context, `UseProductCharacteristicRules` element.



Create Production Order

GENERAL DATA — CHARACTERISTICS

Use Product Characteristic Rules: ☒

Options

Characteristics (2)	
1	NumberOfBlades
2	MetalFinish

Characteristic Details

Characteristic: NumberOfBlades

Description: Number of Blades

Optional: ☒ No

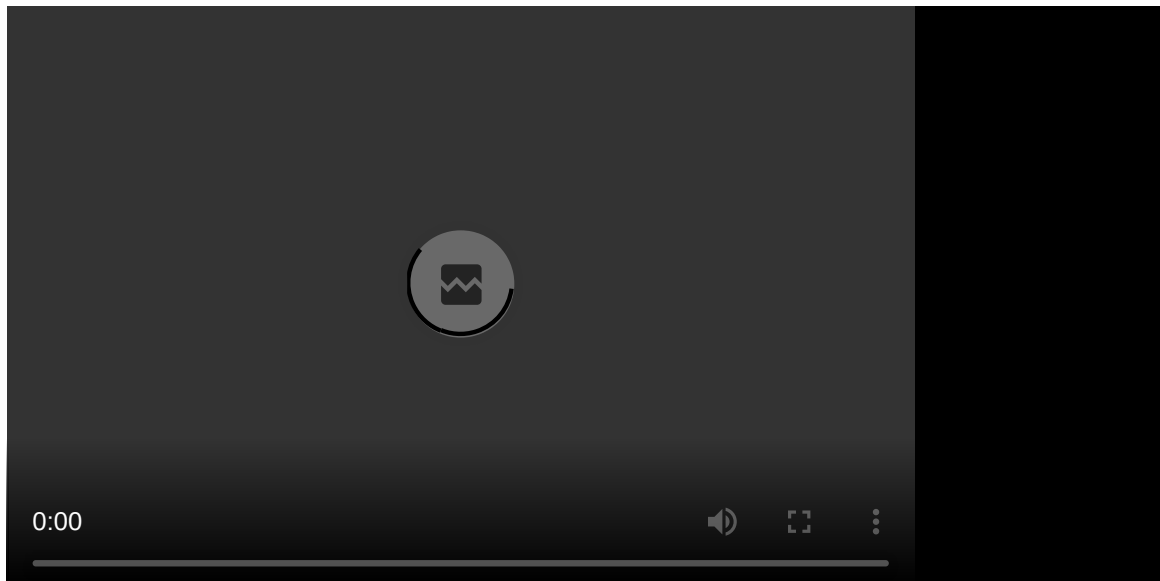
* Value:

Comments:

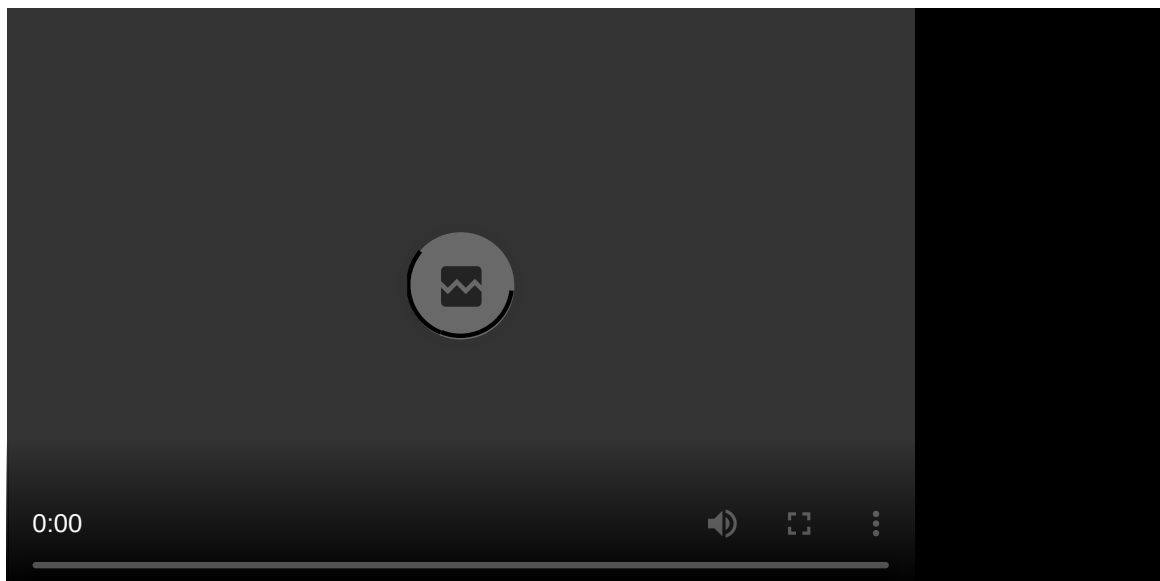
Cancel Back Create

Execution

In this section, we will follow the configured model in action, from **Production Order** creation to **Flow** completion.



If the configuration is complete and you need a summary of the existing rules for a specific **Product Characteristic** combination, the Preview option provides that overview.



Execution Notes

Inheritance and Characteristics Change

- When a **Product** of a **Production Order** has characteristics and rules, an entry is automatically created in the Smart Tables upon its creation (example of the Material Checklist, Document and Data Collection Context of the scenario of this tutorial)
- If the **Product Characteristic** values are modified, the system updates the corresponding Smart Tables entry to reflect the new contexts. These high-precedence key rows are resolved when processing **Materials** associated with that **Production Order**

- When a **Material** is created through the **Production Order**, it inherits the **Product Characteristic** values.

Warning

If the **Product Characteristic** values in the **Material** are changed and no longer match the **Production Order**, the required entities associated with Smart Tables may not be triggered correctly.

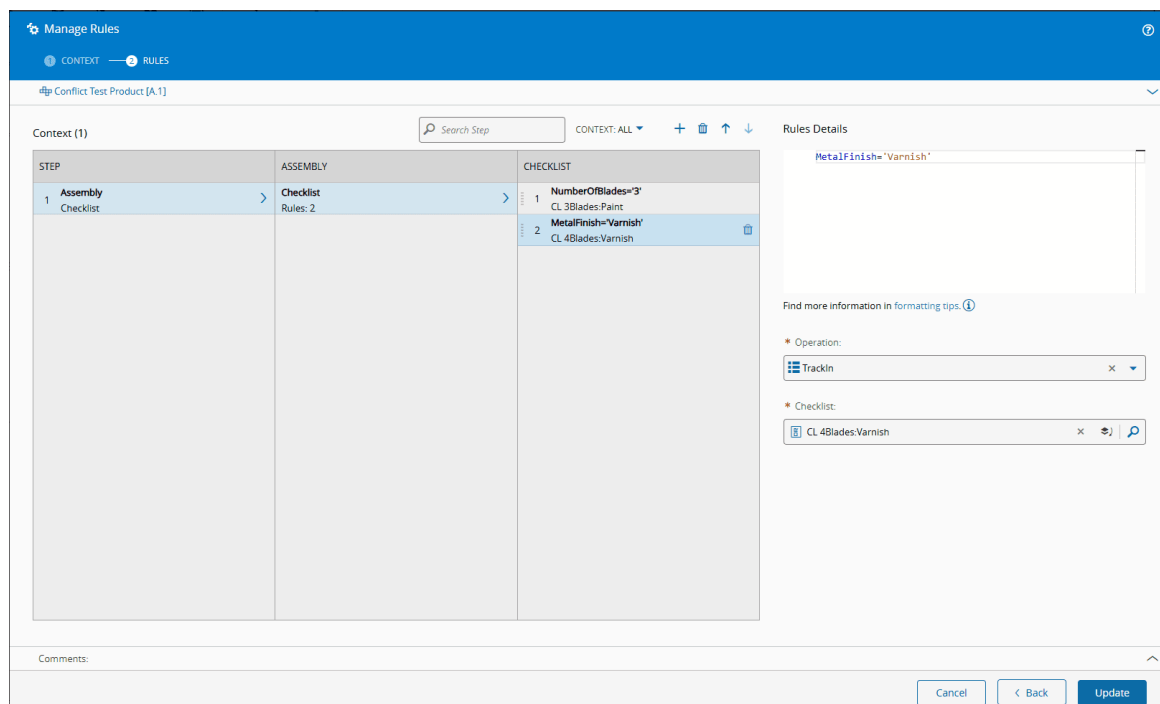
Context Conflicts

To prevent conflicts when multiple rules apply to the same **Step** and context, the system uses the rule sequence to determine the evaluation order.

To illustrate this, consider a **Production Order** where the **Product Configuration** has 3 blades and a varnish metal finish. The following rules are defined:

- Rule 1: If the number of blades is 3, the system needs to display the checklist "CL 3Blades:Paint".
- Rule 2: If the metal finish is varnish, the system needs to display the checklist "CL 4Blades:Varnish".

Since both rules apply, this would create a conflict. To resolve this, the system evaluates rules in sequence and applies the first one that evaluates to true. In this case, the system will add the CL "3Blades:Paint" checklist to the **MaterialChecklistContext**, and the second rule is ignored.



The screenshot shows the 'Manage Rules' interface with a table of rules and a 'Rules Details' panel. The table has columns for STEP, ASSEMBLY, and CHECKLIST. The first rule is '1 Assembly Checklist' and the second is '2 Checklist Rules: 2'. The 'Rules Details' panel shows the conditions for the second rule: 'MetalFinish="Varnish"'. The 'Operation' is 'TrackIn' and the 'Checklist' is 'CL 4Blades:Varnish'.

STEP	ASSEMBLY	CHECKLIST
1	Assembly Checklist	1 NumberOfBlades=3 CL 3Blades:Paint
2	Checklist Rules: 2	2 MetalFinish="Varnish" CL 4Blades:Varnish

Rules Details:

MetalFinish="Varnish"

Find more information in formatting tips.

* Operation: TrackIn

* Checklist: CL 4Blades:Varnish

Master Data

This is the [Master Data file](#) used to create this model.

Please Note:

- This feature is available in version 11.0.
- The model was created in version 11.1.
- At the time this tutorial was written, the Master Data file should be uploaded in two phases:
 - Phase I: Load the entire file excluding `<DM>ProductCharacteristicRule`.

- Phase II: Load the entire file or only `<DM>Product` and `<DM>ProductCharacteristicRule`.