Critical manufacturing
an ASM PT company

Recipe Management

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Recipe Management

Estimated time to read: 14 minutes

As manufacturing relies on increasingly more complex equipment, the management of the recipes that the equipment will use for a certain process becomes increasingly important. This type of management is a basic requirement to ensure that the right recipe, with the right parameters, is used for the right process.

The **Recipe Management** module provides capabilities to manage, download, upload, resolve and instantiate recipes.

> **Info**
>
> **Recipe Management** is a separately licensed module.

This document will guide you through the setup and usage of the **Recipe Management** module functionalities.

Overview

A **Recipe** defines the equipment information required for processing a given **Material** in a **Step**. **Recipe Management** is a critical functionality for complex industries, and it ensures that a **Material** is correctly processed at an equipment.

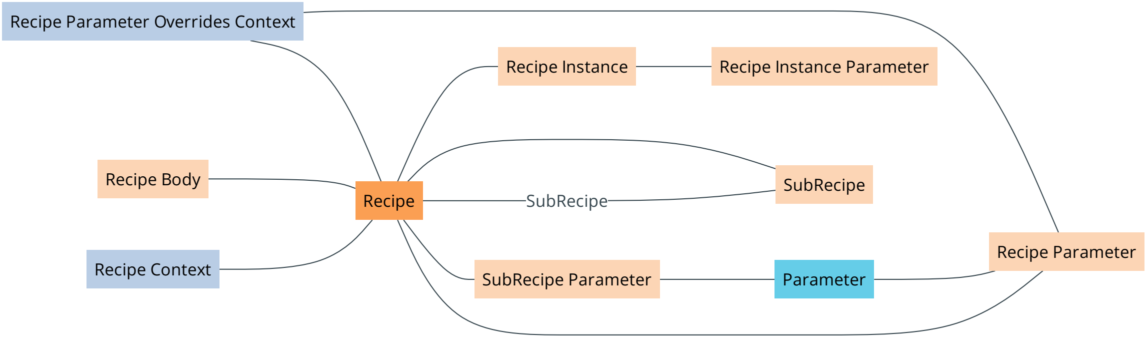
Concepts

The table below describes the main concepts related to **Recipe Management**.

Concept	Description
Parameter	An equipment variable to be controlled.
Recipe Parameter	A Recipe Parameter qualifies the value of the parameter in the Recipe.
Sub-Recipe	A Sub-Recipe provides a hierarchical structure to assemble recipes to any depth in order to promote re-usability of Recipes.
Recipe Body	A Recipe Body can be human readable or not. It is often in a binary form, only understandable by the equipment.

Table: Recipe Management main concepts

The Recipe Management object model is shown in the figure below.



The MES Recipe object model is based on SEMI E139, as shown in the table below. The SEMI E139 Recipe and Parameter Management is a standard developed to specify the cooperative interaction between the factory information and control system (*FICS*) and the equipment in order to manage the specifications of equipment processing (for instance, equipment recipes).

The PDE – Process Definition Element translates from the SEMI E139 into a **Recipe** in Critical Manufacturing, with the following element matching:

SEMI E139	Critical Manufacturing	Description
uid – universally unique identifier	`Id`	Recipe Id
Name	`Name`	Recipe Name
Description	`Description`	Recipe Description
type	`Type`	Recipe Type
executable	`IsExecutable`	Defines if a Recipe is executable or not.
userInfo	`UserInfo`	Recipe User Information
supplierInfo	`SupplierInfo`	Recipe Supplier Information
author	`CreatedBy`	The User who created the Recipe.
Specification (PDEBody or PDEBodyReference)	`Body`	Recipe Body
specificationChecksum	`Checksum`	Recipe Body Checksum
{PDEHeader/PDEParameter}	{ `RecipeParameter` }	Recipe Parameters
{PDEHeader/PDEParameter/ relatedParameters}	{ `SubRecipeParameter` }	Recipe Sub-Recipe Parameters

Table: SEMI E139 and Critical Manufacturing MES concepts

Setting Up a Recipe

The necessary steps to set up a Recipe shall be explained over the next sections.

Create a Parameter

A Parameter provides an abstraction to Resource specific variable names which have the same meaning at the MES/human level. A Recipe can contain static or dynamic Parameters.

To create a Parameter to be used in a Recipe, the properties listed in the table below need to be defined.

Property	Description
Scope	It needs to be defined as Recipe or EDC_SPC_Recipe.
Data Type	The Parameter Data Type.
Format	The defined Format will influence the value input and display. For more information about the Parameter Formats, please refer to the Create Parameter section.
Units	The Units of the Parameter to be displayed.
Minimum Value	A minimum value for the Parameter, only for numeric Parameters.
Maximum Value	A maximum value for the Parameter, only for numeric Parameters.
Lookup Table	A Lookup Table to be used as a source of values for the Parameter. The Lookup Table values must match the Data Type of the Parameter.

Table: Parameter creation wizard properties

Create a Recipe

To create a Recipe there are configurations regarding its Parameters, Sub-Recipes and Body that need to be defined.

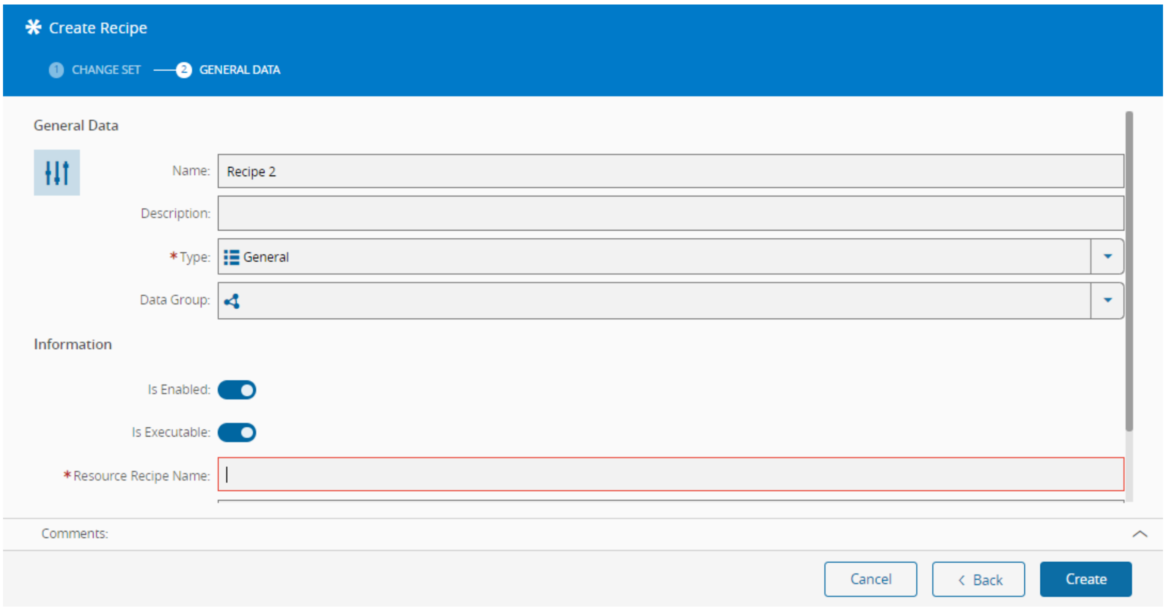
The next table describes the properties that need to be taken into consideration when creating a Recipe, the first step of the Recipe creation.

> **Info**
>
> The *IsEnabled* and *IsExecutable* properties are contained in the global data components of the Recipe, i.e. without Change Control required.

Property	Description
IsEnabled	Defines if a Recipe is enabled or not. A disabled Recipe cannot be used to create a Recipe instance.
IsExecutable	Defines if a Recipe is executable or not. An Executable Recipe can be used as the Recipe for a Material, whereas a non-Executable Recipe can only be used as a Sub-Recipe.

Property	Description
Resource Recipe Name	The Resource Recipe Name should match the local Recipe Name in the equipment.

Table: Recipe creation wizard properties



Name: Recipe 2

Description:

*Type: General

Data Group:

Is Enabled: ●

Is Executable: ●

*Resource Recipe Name:

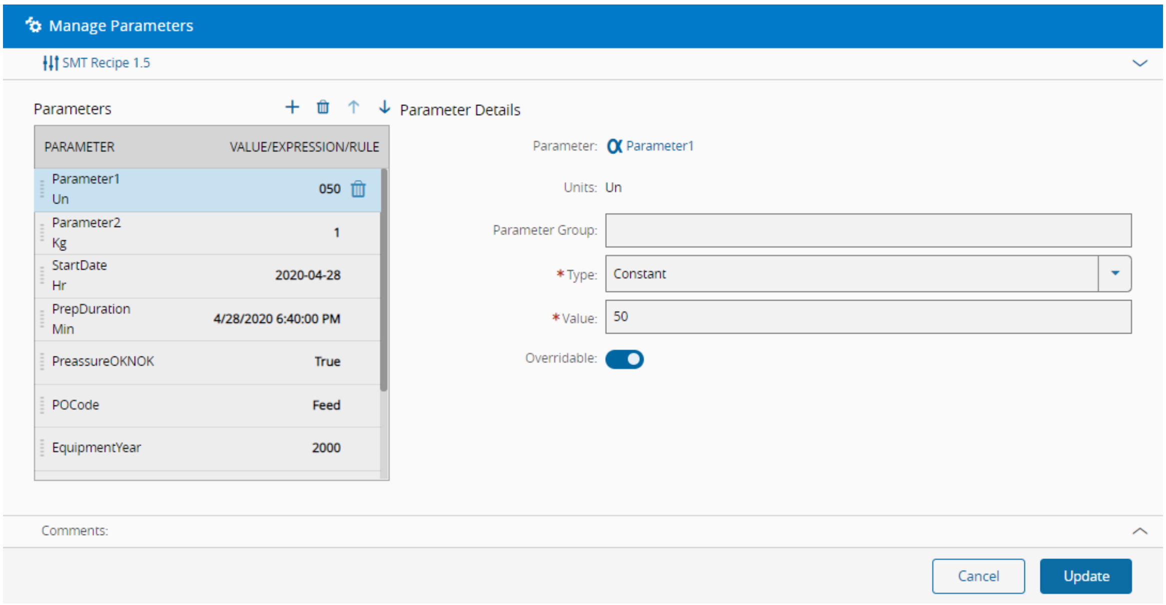
To manage the Recipe Parameters, the User must access the *Manage Parameters* wizard in the Recipe page, as shown in the table and figure below.

Property	Description
Parameter Group	Defines the Parameter Group name for display purposes.
Type	The following options are available: - **Constant**: a constant value - **Expression**: an Expression that calculates the Parameter value based on other Parameters. Parameters referred by the Expression must be defined before adding the Expression Parameter - **Input**: a value provided by the User or supplied by the parent Recipe - **Rule**: a Rule to be used to evaluate the Parameter value
Value	The value of the Parameter if the Type is **Constant** or **Input**.
Expression	The Expression to be used to calculate the Parameter if the type is Expression. For more information about the Expression syntax, please refer to the Expression Evaluator section.
Rule	The Rule to be used to evaluate the Parameter value. The Rule must have the scope defined as *Recipe Management*.
Overridable	Defines if a Parameter is Overridable. An Overridable Parameter may have its value changed depending on the Recipe Parameter Override Context Smart Table configuration.

Table: Parameter management wizard properties

Info

If a Parameter has Minimum or Maximum values defined, values outside this interval cannot be defined on the Value property.



Manage Parameters

SMT Recipe 1.5

Parameters

PARAMETER	VALUE/EXPRESSION/RULE
Parameter1 Un	050
Parameter2 Kg	1
StartDate Hr	2020-04-28
PrepDuration Min	4/28/2020 6:40:00 PM
PreassureOKNOK	True
POCode	Feed
EquipmentYear	2000

Parameter Details

Parameter: Parameter1

Units: Un

Parameter Group:

*Type: Constant

*Value: 50

Overridable: ●

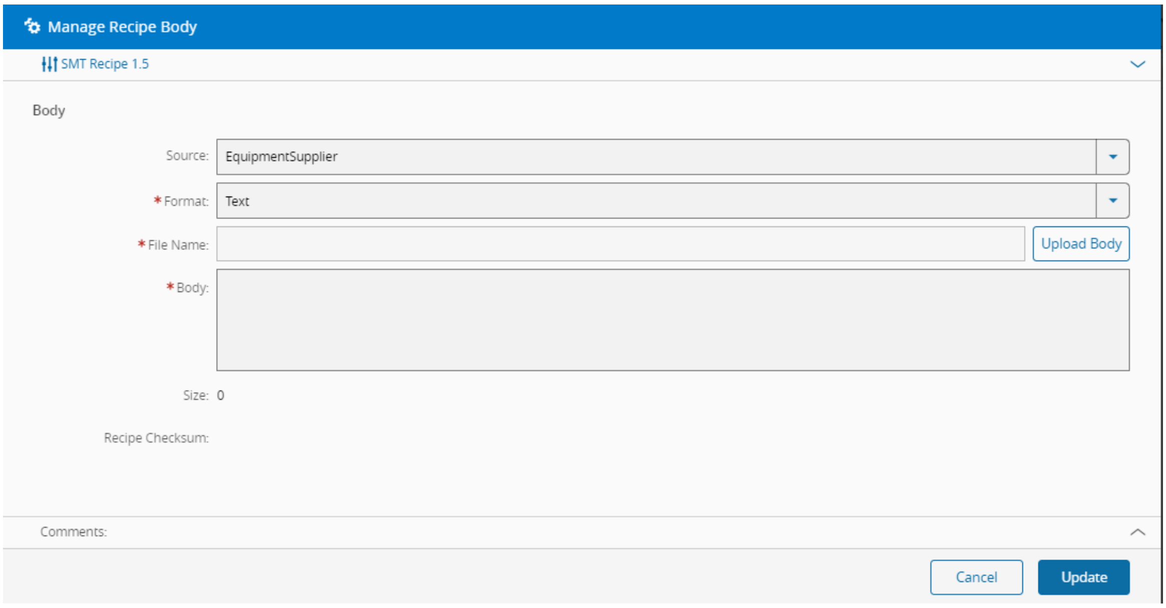
Comments:

To manage the Recipe Body, the User must access the *Manage Recipe Body* wizard in the Recipe page, as shown in the table and figure below.

Property	Description
Source	The Source of the Recipe. The following options are available: - **DownloadedFromEquipment**: MES will retrieve the Recipes from a Resource whose *RecipeManagement* property is enabled and whose automation mode is online and that supports Recipe download - **EquipmentSupplier** - **HumanEdited** - **None**
Format	The Recipe Format. The following options are available: - **Binary**: always set when the Recipe is *DownloadedFromEquipment* and available for selection for the *EquipmentSupplier* and *HumanEdited* Sources - **Text**: available for selection for the *EquipmentSupplier* and *HumanEdited* Sources - **URL**: available for selection for the *EquipmentSupplier* and *HumanEdited* Sources
Download From:	Selection of a Resource, if the selected Source is *DownloadedFromEquipment*.
Resource Recipe:	Selection of a Resource Recipe, if the selected Source is *DownloadedFromEquipment*.
Recipe Checksum:	It is used to ensure Recipe integrity since Recipes are often locally modified at the equipment.

Property	Description
File Name:	If the selected Format was *URL*, then the User must provide a *URL*. If the selected Format was *Binary*, then the User must provide a file. If the selected Format was a *Text* then the User can choose to load a file and edit the contents manually.

Table: Manage Recipe Body wizard properties



Source: EquipmentSupplier

*Format: Text

*File Name:

*Body:

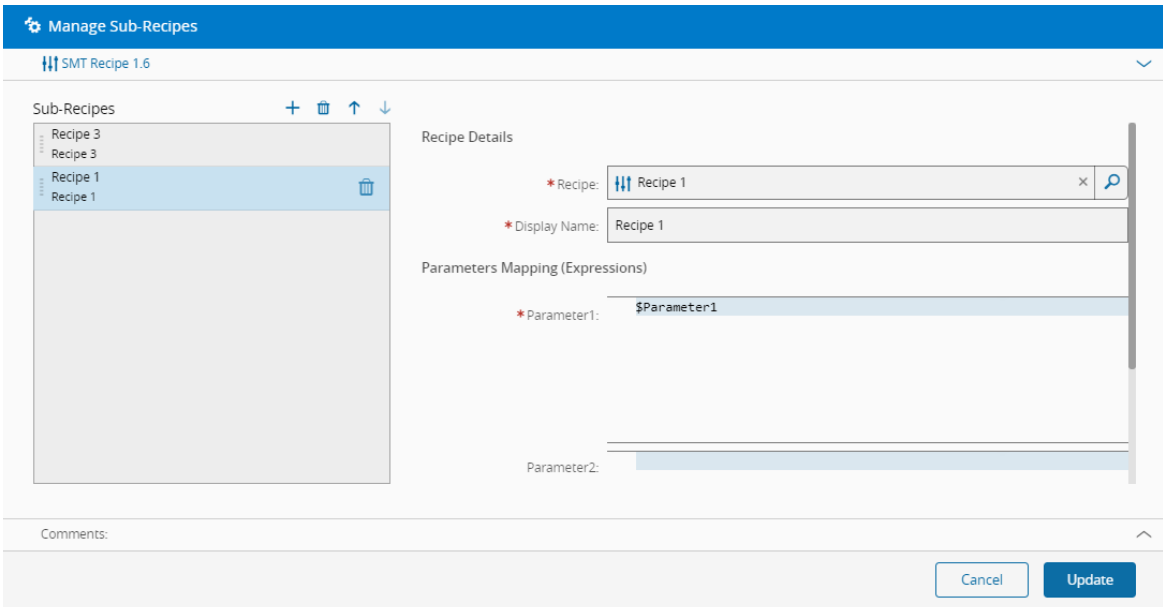
Size: 0

Recipe Checksum:

To manage the Recipe Sub-Recipes, the User must access the *Manage Sub-Recipes* wizard in the Recipe page, as shown in the table and figure below.

Property	Description
Recipe	The Recipe to be defined as a Sub-Recipe.
Display Name	The Recipe display Name.
Parameter Mapping	For each Sub-Recipe, it is mandatory to define the Parameter mapping for the Sub-Recipe Parameters which are of type Input and have no default value. For the Sub-Recipe Parameters which are Overridable, it is possible (but not mandatory) that the Sub-Recipe Parameters mappings are defined as well. A Parameter mapping is based on an expression that refers to the Parent Recipe Parameters.

Table: Manage Sub-Recipes wizard properties



Manage Sub-Recipes

SMT Recipe 1.6

Sub-Recipes

Recipe 3
Recipe 3

Recipe 1
Recipe 1

Recipe Details

*Recipe: Recipe 1

*Display Name: Recipe 1

Parameters Mapping (Expressions)

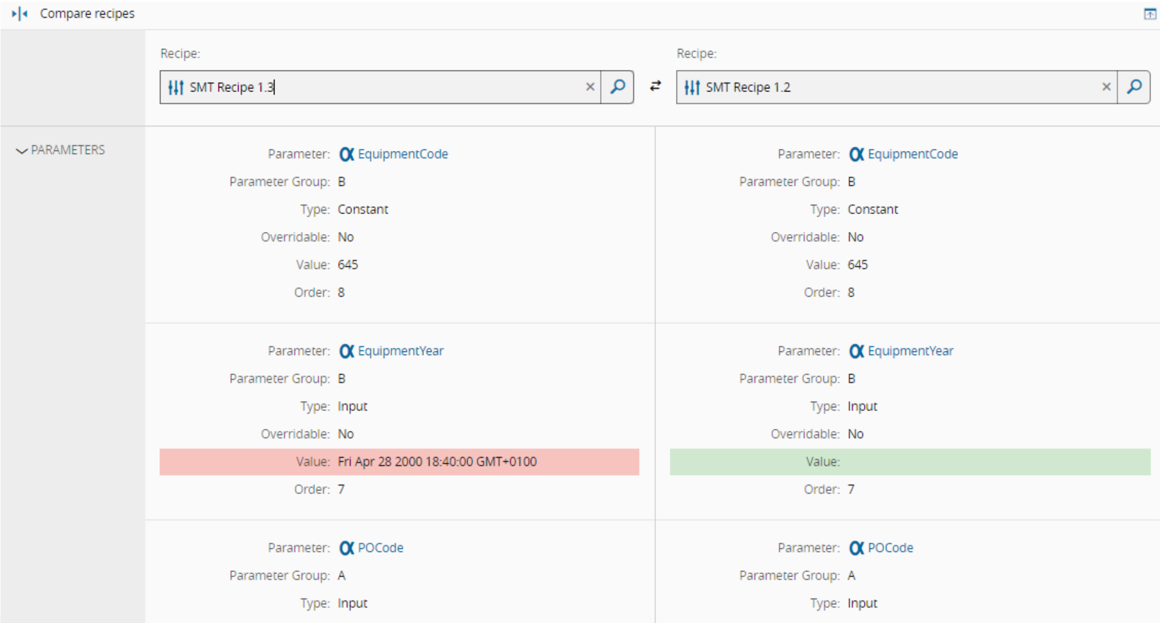
*Parameter1: `$Parameter1`

Parameter2:

Comments:

Compare Recipes

The *Compare Recipes* page provides the functionality to verify not only changes in Recipe Versions, but also to compare different Recipes, as shown on the figure below.



Compare recipes

Recipe: SMT Recipe 1.3 | Recipe: SMT Recipe 1.2

PARAMETERS

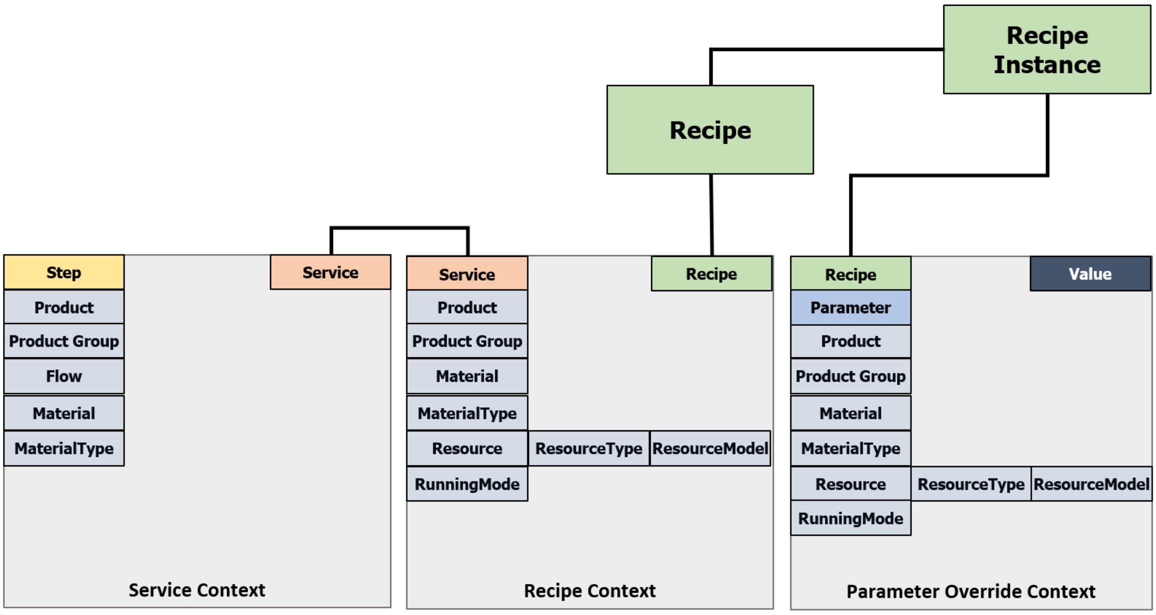
Parameter: EquipmentCode Parameter Group: B Type: Constant Overridable: No Value: 645 Order: 8	Parameter: EquipmentCode Parameter Group: B Type: Constant Overridable: No Value: 645 Order: 8
Parameter: EquipmentYear Parameter Group: B Type: Input Overridable: No Value: Fri Apr 28 2000 18:40:00 GMT+0100 Order: 7	Parameter: EquipmentYear Parameter Group: B Type: Input Overridable: No Value: Order: 7
Parameter: POCode Parameter Group: A Type: Input	Parameter: POCode Parameter Group: A Type: Input

Recipe Context Resolution and Recipe Instance Creation

A Material requires a Service at a Step, as defined in the *Service Context* Smart Table, and this Service is provided by a Resource. For this Service, in order to provide the necessary setup and configuration information to process a Material in a Resource, the *Recipe Context* is defined.

For a particular Material Context, the MES creates a Recipe Instance when performing a Material track-in. The Recipe Instance stores the used Recipe Version and Parameter information for traceability and analysis purposes.

The relationship between the above presented concepts can be found in the figure below.



Manage Recipe Context

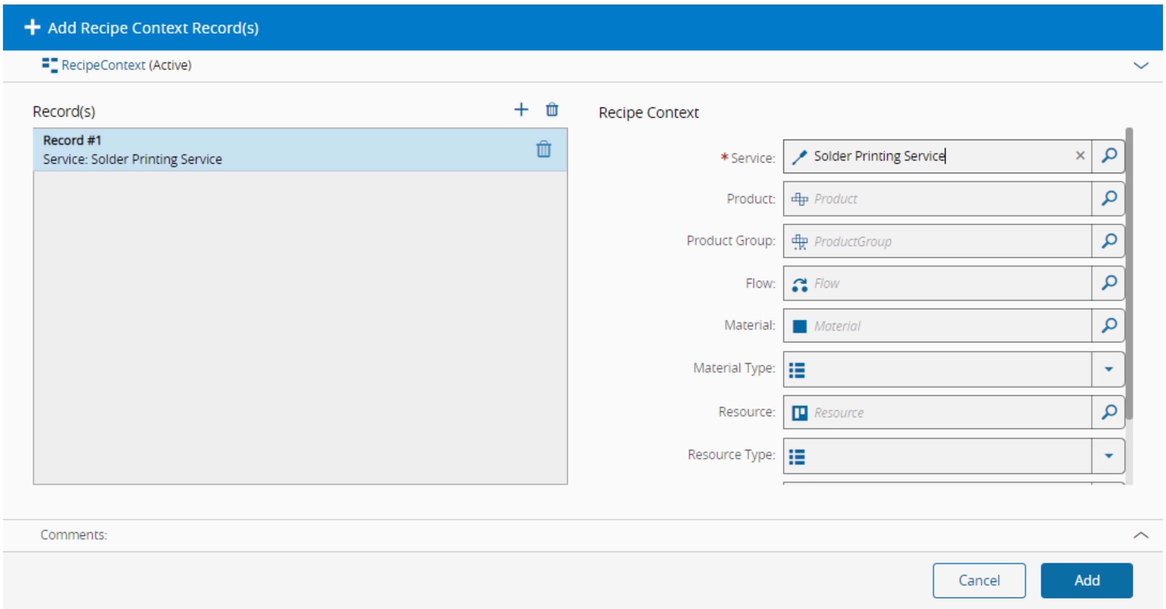
A Recipe is configured for processing a Material in a Step and Resource through the Service defined in the *Recipe Context* table, as detailed in the table and figure below.

Info

A Recipe needs to be marked as *Executable* to be referenced on the *Recipe Context* table.

Property	Description
Service	The Service which requires the Recipe.
Running Mode	The Running Mode provides an additional flexibility degree in maintaining and resolving Recipes in the case that the Recipe to be used depends on a particular Resource configuration. The Running Mode can be defined on the *Resource Running Mode* Smart Table.

Table: Add Recipe Context Record



Manage Parameter Overrides Context

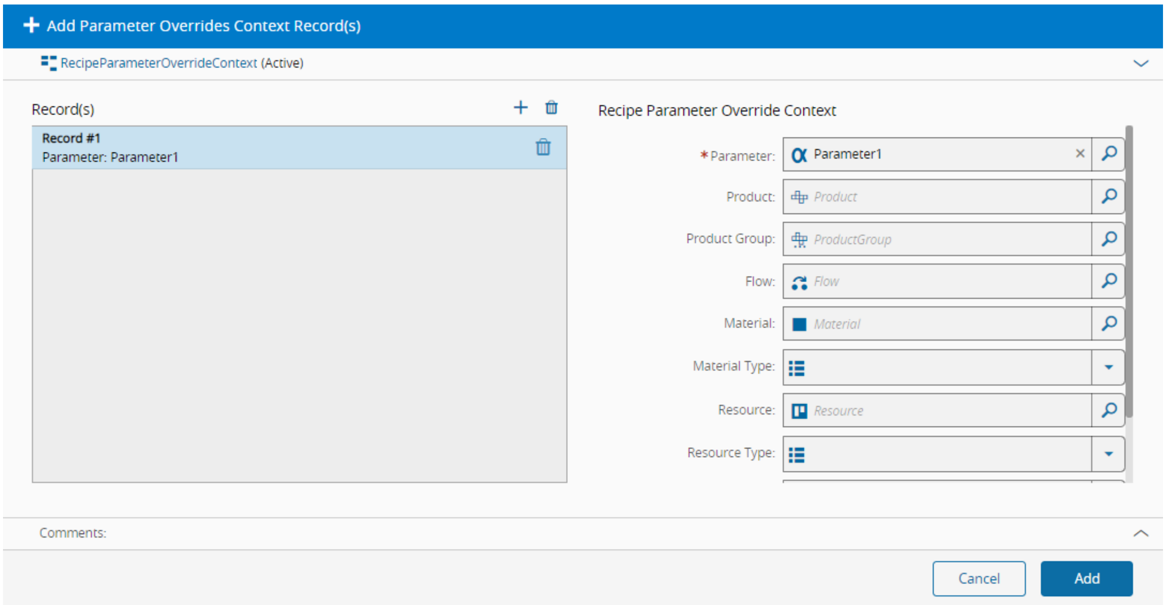
To promote Recipe reusability and to support a dynamic resolution of Parameters during runtime, a Parameter can be marked as Overridable.

Info

A Parameter needs to be marked as Overridable on the Recipe Parameters to be referenced on the *Recipe Parameter Override Context* table.

Property	Description
Parameter	The Parameter to be overridden.
Value	The Value to be considered for the Parameter on the defined context.

Table: Add Parameter Overrides Context Record



Add Parameter Overrides Context Record(s)

RecipeParameterOverrideContext (Active)

Record(s)

Record #1
Parameter: Parameter1

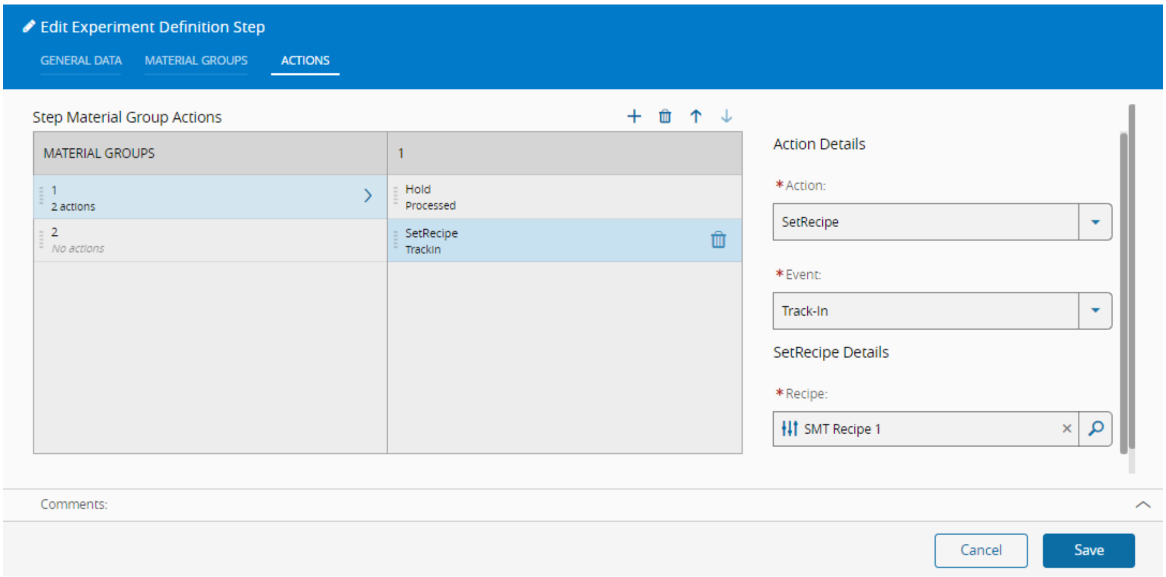
Recipe Parameter Override Context

- *Parameter: Parameter1
- Product: Product
- Product Group: ProductGroup
- Flow: Flow
- Material: Material
- Material Type:
- Resource: Resource
- Resource Type:

Comments:

Experiment Definition

An Experiment Definition allows the User to carry out controlled variations of the production process. A typical use case for this situation is the creation of an Experiment Definition in order to test a new Recipe. This can be configured by defining the Action *SetRecipe* at the Track-in Event for an Experiment Definition Material Group, as shown in the figure below.



Edit Experiment Definition Step

Step Material Group Actions

MATERIAL GROUPS	1
1 2 actions	Hold Processed
2 No actions	SetRecipe TrackIn

Action Details

- *Action: SetRecipe
- *Event: Track-In

SetRecipe Details

- *Recipe: SMT Recipe 1

Comments:

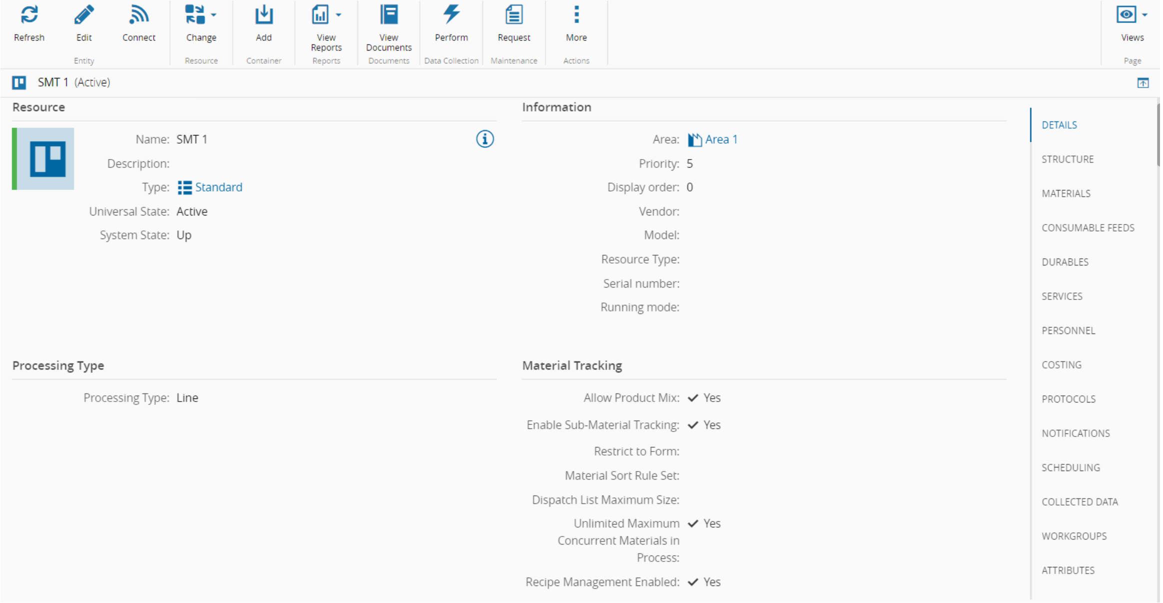
For more information about the Experiment Definition, please refer to the Create Experiment Definition section.

Using a Recipe

Over the next sections it is detailed how a Recipe can be used in MES.

Resource Configuration

In order to use Recipe Management for a particular Resource, it is necessary to set the property *Recipe Management Enabled* to true, as shown in the figure below.



SMT 1 (Active)

Resource

Name: SMT 1
Description:
Type: Standard
Universal State: Active
System State: Up

Information

Area: Area 1
Priority: 5
Display order: 0
Vendor:
Model:
Resource Type:
Serial number:
Running mode:

Processing Type

Processing Type: Line

Material Tracking

Allow Product Mix: ✓ Yes
Enable Sub-Material Tracking: ✓ Yes
Restrict to Form:
Material Sort Rule Set:
Dispatch List Maximum Size:
Unlimited Maximum Concurrent Materials in Process: ✓ Yes
Recipe Management Enabled: ✓ Yes

Set Resource Recipe

When the setup is performed manually, the User can access the *Set Recipe* wizard in order to select the Recipe to be set on the Resource, as shown in the figure below.

If the option *Validate Recipe Context* is set to True, then only Recipes that are defined on the Recipe Context are displayed.

After selecting the Recipe, it is set as the Current Recipe and the Current Recipe Source is set as User.

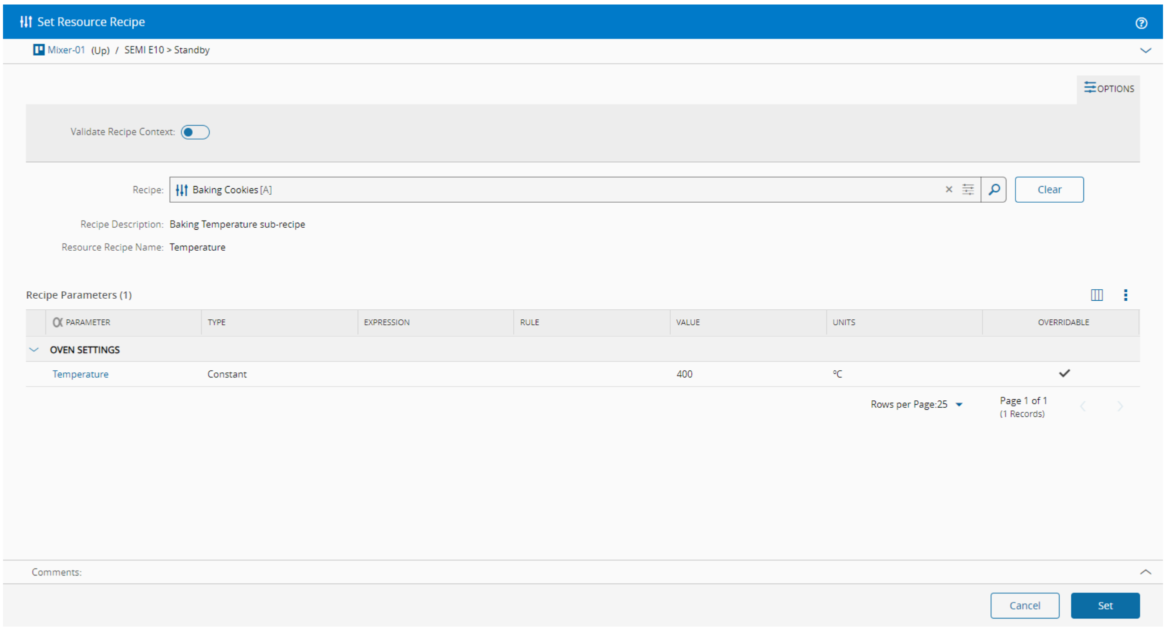
In this wizard it is also possible to clear the Resource Current Recipe, by selecting *Clear* and then *Set*.

Info

When a Recipe is set manually, it can only be reset manually as well.

Info

The Resource must have the property *Recipe Management Enabled* set to True.



Mixer-01 (Up) / SEMI E10 > Standby

Validate Recipe Context: ○

Recipe: Baking Cookies [A]

Recipe Description: Baking Temperature sub-recipe

Resource Recipe Name: Temperature

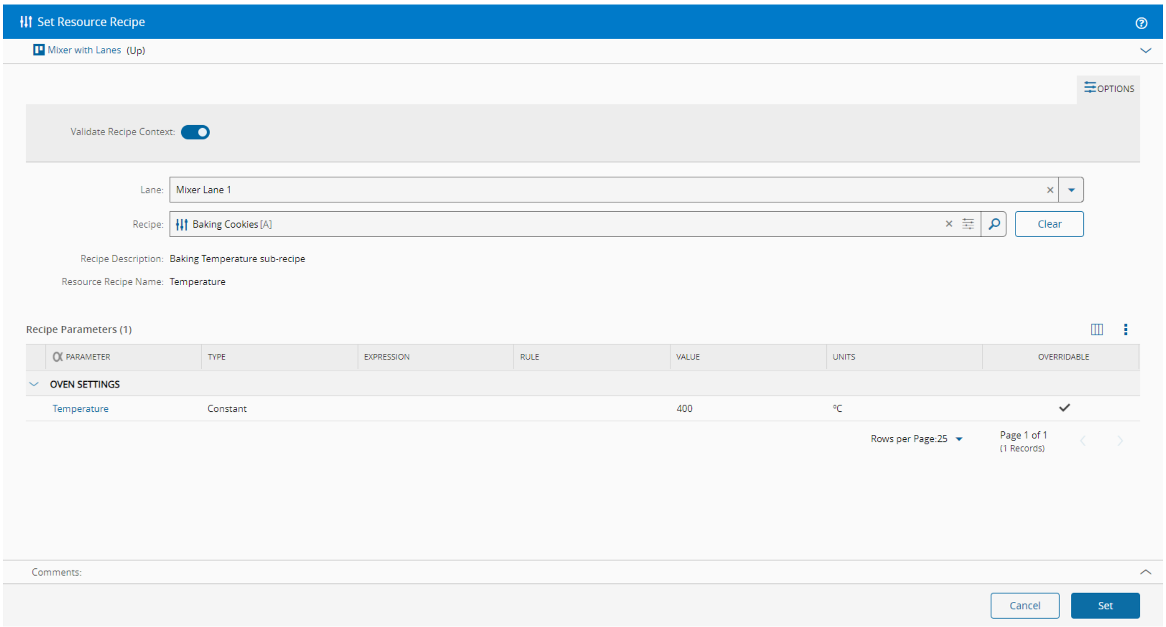
Recipe Parameters (1)

PARAMETER	TYPE	EXPRESSION	RULE	VALUE	UNITS	OVERRIDABLE
OVEN SETTINGS						
Temperature	Constant			400	ºC	✓

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

Comments:

If the **Resource** has lanes configured and Is Multilane Active enabled, you will have to select a valid Lane of the **Resource** for your recipe.



Mixer with Lanes (Up)

Validate Recipe Context: ●

Lane: Mixer Lane 1

Recipe: Baking Cookies [A]

Recipe Description: Baking Temperature sub-recipe

Resource Recipe Name: Temperature

Recipe Parameters (1)

PARAMETER	TYPE	EXPRESSION	RULE	VALUE	UNITS	OVERRIDABLE
OVEN SETTINGS						
Temperature	Constant			400	ºC	✓

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

Comments:

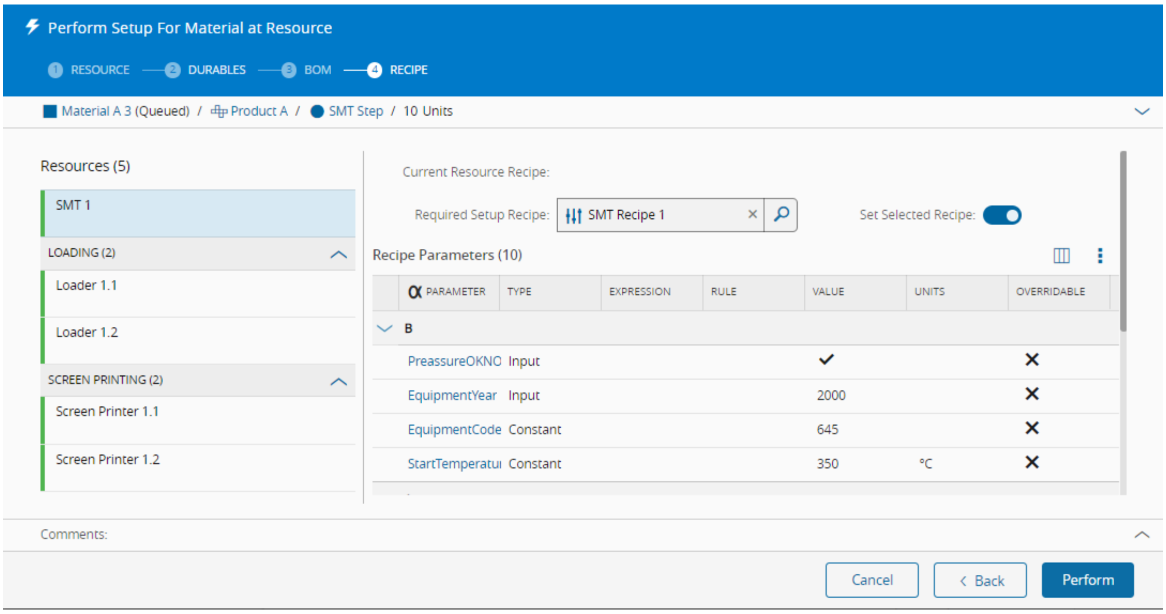
For more information, see Set Resource Recipe.

Perform Resource Setup

Before tracking-in a Material in a Resource it is possible to perform the Resource setup. The *Perform Setup For Material at Resource* wizard is available on the Resource view after selecting a Material, as shown in the figure below.

> **Info**
>
> Only Recipes that are defined on the Recipe Context are displayed.

If the option *Set Selected Recipe* is set to True, then the User has the option to set it manually at the Resource. The selected Recipe is set as the Resource Current Recipe and Current Recipe Source is set as User.



Perform Setup For Material at Resource

1 RESOURCE — 2 DURABLES — 3 BOM — 4 RECIPE

Material A 3 (Queued) / Product A / SMT Step / 10 Units

Resources (5)

- SMT 1
- LOADING (2)
  - Loader 1.1
  - Loader 1.2
- SCREEN PRINTING (2)
  - Screen Printer 1.1
  - Screen Printer 1.2

Current Resource Recipe:

Required Setup Recipe: SMT Recipe 1

Set Selected Recipe: ●

Recipe Parameters (10)

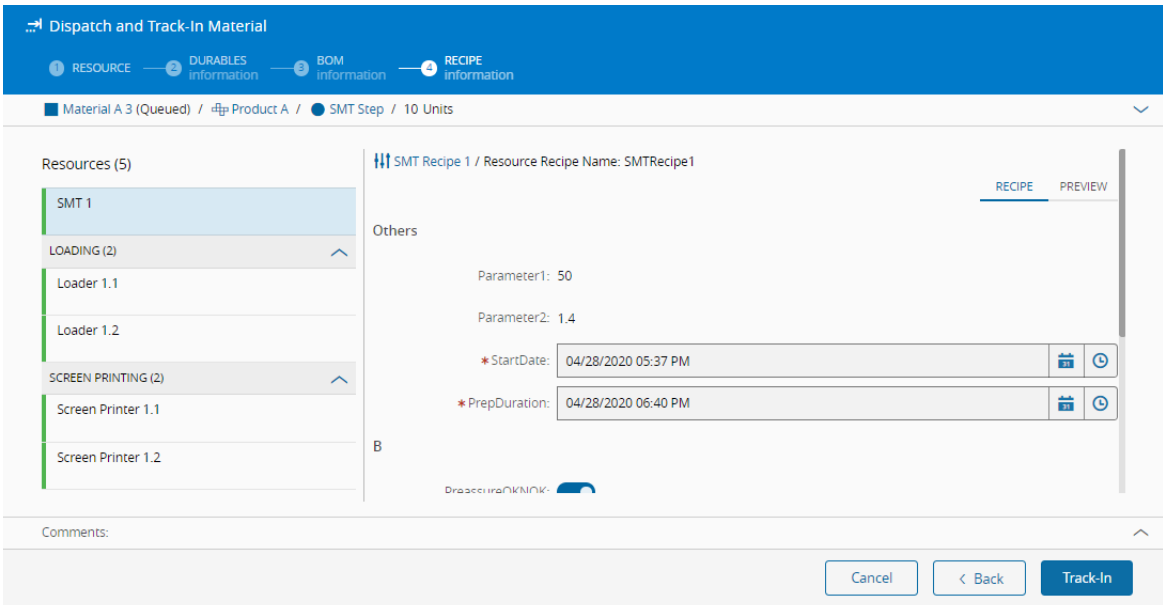
PARAMETER	TYPE	EXPRESSION	RULE	VALUE	UNITS	OVERRIDABLE
B						
PreassureOKNO	Input			✓		✕
EquipmentYear	Input			2000		✕
EquipmentCode	Constant			645		✕
StartTemperatu	Constant			350	°C	✕

Comments:

Material Track-in

When a Material is tracked-in, the Recipe defined in the *Recipe Context* is displayed, as shown in the figure below.

For the Recipe Input Parameters, it is possible to specify their values.



Dispatch and Track-In Material

1 RESOURCE — 2 DURABLES information — 3 BOM information — 4 RECIPE information

Material A 3 (Queued) / Product A / SMT Step / 10 Units

Resources (5)

- SMT 1
- LOADING (2)
  - Loader 1.1
  - Loader 1.2
- SCREEN PRINTING (2)
  - Screen Printer 1.1
  - Screen Printer 1.2

SMT Recipe 1 / Resource Recipe Name: SMTRecipe1

Others

Parameter1: 50

Parameter2: 1.4

*StartDate: 04/28/2020 05:37 PM

*PrepDuration: 04/28/2020 06:40 PM

B

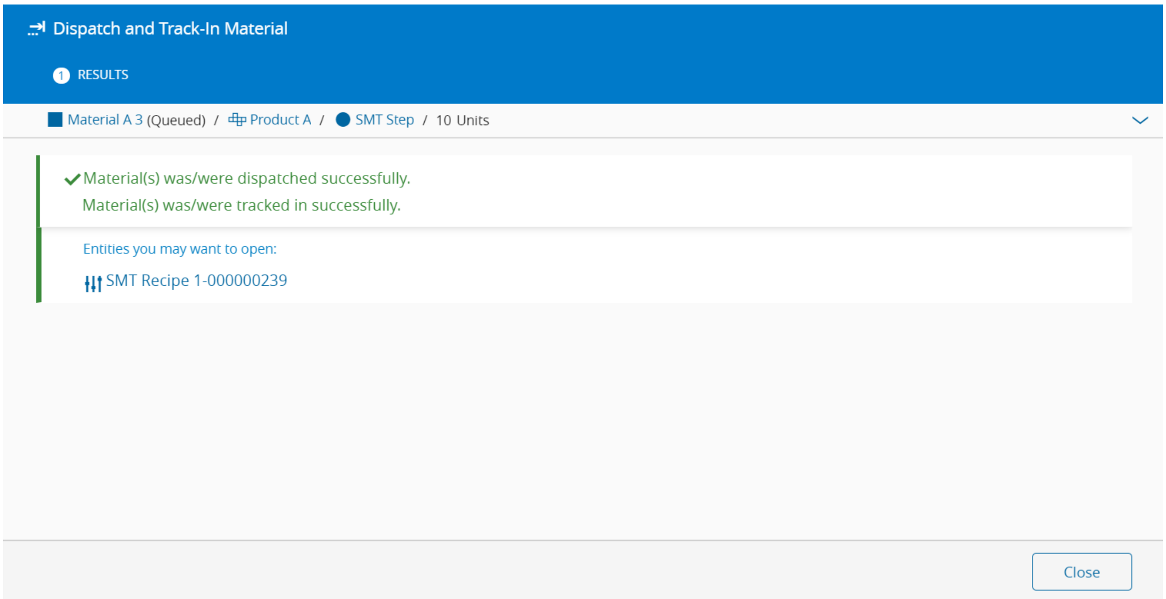
PreassureOKNOK: ●

Comments:

Info

The Resource property *Verify Material Recipe at Track-In* defines whether the System will validate if the Resource Current Recipe matches the defined Recipe Context when tracking-in material. If the *Verify Material Recipe at Track-In* is set to False and the Current Recipe Source is System, then it is possible to track-in the Material even if the Resource Current Recipe does not match the defined *Recipe Context*.

After performing the track-in, the resolved Recipe is set as the Resource Current Recipe, if not already, in which case the Current Recipe Source is set as System, and a Recipe Instance is created, as shown in the figure below.



Material A 3 (Queued) / Product A / SMT Step / 10 Units

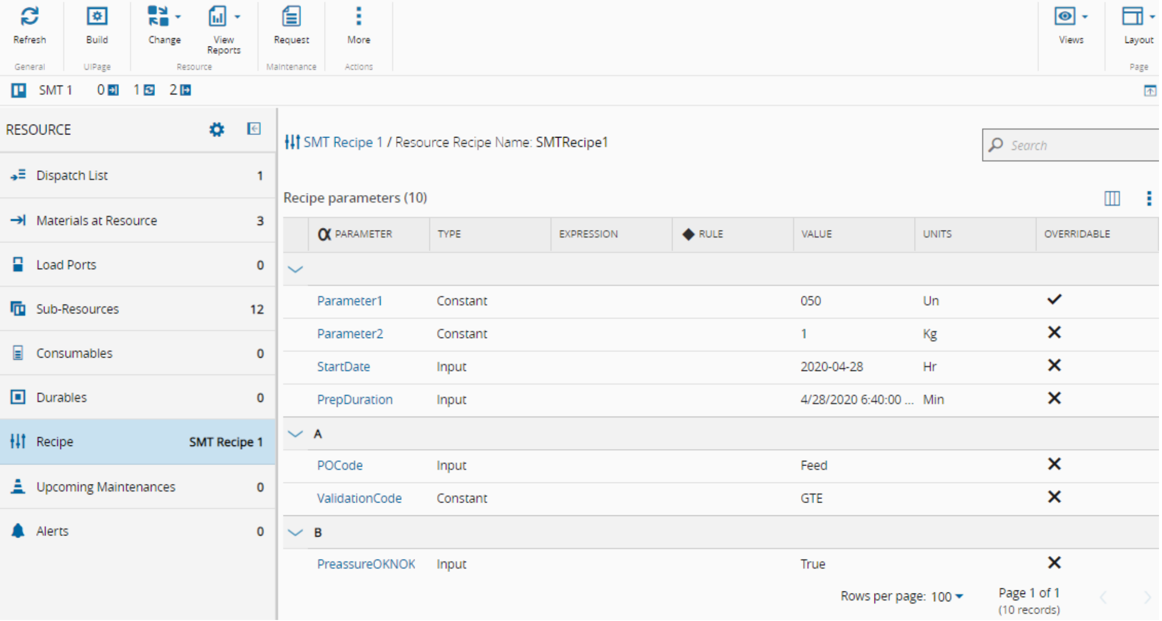
✓ Material(s) was/were dispatched successfully.
Material(s) was/were tracked in successfully.

Entities you may want to open:
SMT Recipe 1-000000239

Info

If the track-in is performed in a Line Resource, then the Recipe Instances are also created for the Resources of the Line Flow which provide the Services resolved, using the Service Context, and for which the Recipe Management is enabled.

The Recipe set for the Resource can be viewed on the Resource View Recipe tab, as shown in the figure below.



RESOURCE	
Dispatch List	1
Materials at Resource	3
Load Ports	0
Sub-Resources	12
Consumables	0
Durables	0
Recipe	SMT Recipe 1
Upcoming Maintenances	0
Alerts	0

SMT Recipe 1 / Resource Recipe Name: SMTRecipe1

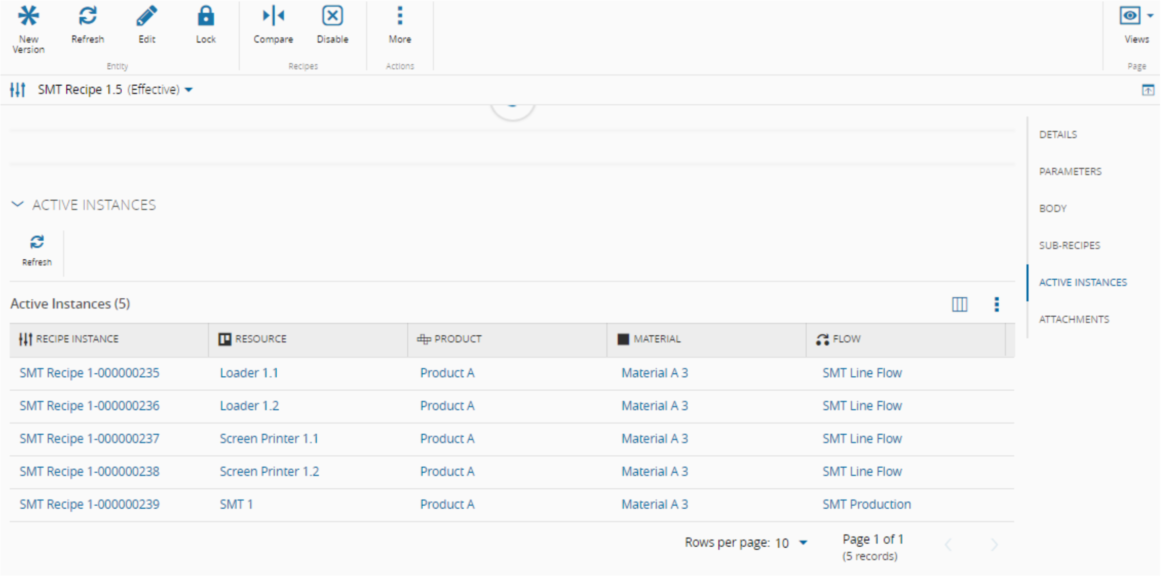
Recipe parameters (10)

PARAMETER	TYPE	EXPRESSION	RULE	VALUE	UNITS	OVERRIDABLE
Parameter1	Constant			050	Un	✓
Parameter2	Constant			1	Kg	✕
StartDate	Input			2020-04-28	Hr	✕
PrepDuration	Input			4/28/2020 6:40:00 ...	Min	✕
A						
POCode	Input			Feed		✕
ValidationCode	Constant			GTE		✕
B						
PreassureOKNOK	Input			True		✕

Rows per page: 100 Page 1 of 1 (10 records)

Recipe Active Instances

All active instances of the Recipe can be found on the *Active Instances* section of the Recipe page, as shown in the figure below.



Active Instances (5)

RECIPE INSTANCE	RESOURCE	PRODUCT	MATERIAL	FLOW
SMT Recipe 1-000000235	Loader 1.1	Product A	Material A 3	SMT Line Flow
SMT Recipe 1-000000236	Loader 1.2	Product A	Material A 3	SMT Line Flow
SMT Recipe 1-000000237	Screen Printer 1.1	Product A	Material A 3	SMT Line Flow
SMT Recipe 1-000000238	Screen Printer 1.2	Product A	Material A 3	SMT Line Flow
SMT Recipe 1-000000239	SMT 1	Product A	Material A 3	SMT Production

Rows per page: 10

Page 1 of 1
(5 records)

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