

Production Management for Batteries Engineering Guideline

Production Management for Batteries V 1.1

Siemens Industry Online Support

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1 Preface

Purpose of the guideline

This guideline contains all information for the installation of the Production Management for Batteries and the configuration of WinCC OA battery projects using the library.

This manual is intended for qualified personnel from the following target groups:

- Engineers
- Architects
- Commissioning engineers
- Maintenance and service personnel
- Operators

Required basic knowledge

General knowledge in the area of SCADA engineering is required to understand this documentation. In particular the following software versions and documents should be learned and well understood:

- WinCC OA V3.19:
  Link to documentation
- SiOME V2.5:
  Link to documentation and SW download
- Information Model KIT V2:
  Information Model Kit v2.0
- OPCENTER REST API:
  Execution Core Technical Reference: REST API Release 8G.1

To execute the described examples the following SW examples should be used:

- Production Management for Batteries delivery:
  ProductionManagementForBatteriesV1_1.zip
- Machine Interface Definition:
  Taglist Example PM4B v2_0.xml
  Taglist Template PM4B v2_0.xlsx

Security Guideline

Please respect the WinCC OA security guideline (WinCC OA Security Guideline) for all work done using the Production Management for Batteries and WinCC OA.

Security Recommendation

It is assumed that the engineering teams will forward the library and the generated software in a secure way to the end customer. See description in this engineering guideline (6.7 Deployment).

Validity

This document is valid for the Production Management for Batteries V1.1.

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2 Introduction

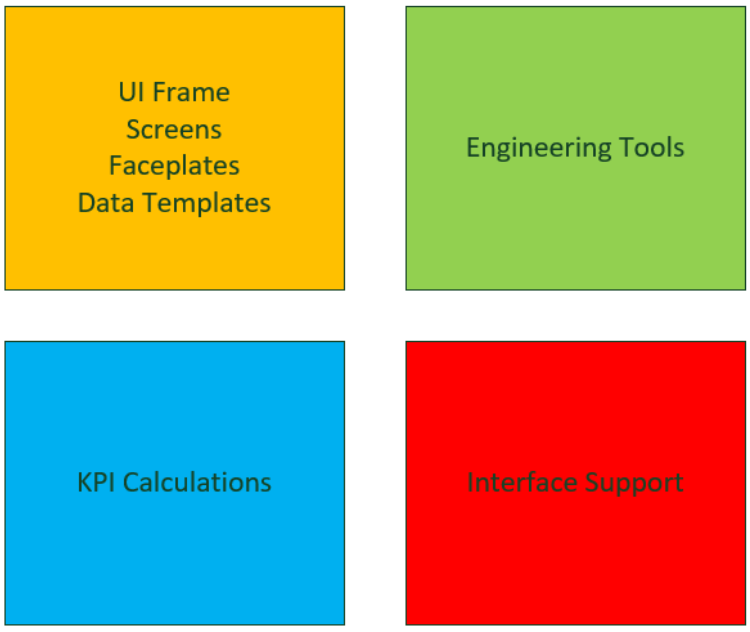
2.1 Description

Production Management for Batteries is a set of engineering components and tools, that helps to create and operate a specific supervision, control, and data acquisition system based on WinCC OA. With its usage you can operate and monitor your battery production efficiently, with a comprehensive visualization of all your technical processes. Production Management for Batteries is sometimes referred to as “library”.

2.2 Content of Production Management for Batteries

Production Management for Batteries (PM4B) can be used as a subproject in an engineering WinCC OA project for battery production. It contains preconfigured and predefined components and functions. The following figure shows the main components of the Production Management for Batteries.

Figure 2-1 Production Management for Batteries Main Components



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UI Frame and Data Templates (see chapter 3)

- Datapoint Types (DPT) representing the information model (see Information Model KIT V2)
- Datapoint Lists (DPL) with internal configurations (alarm classes, alarm windows, trend windows, etc.)
- Color definitions and color schemes
- Pictures and symbols for machines, areas, and lines
- Text libraries
- Basic UI panels (e.g., header, navigation)
- Ready to use process panels (alarms, trends etc.)

- Object references (object templates with connection to DPs)
- Script libraries for common functions (e.g., print trends)

Engineering Tools (see chapter 6)

- Administrative Tools
- Project Settings
- DP Settings
- User Interface Settings
- Testing Tools
- Deployment Tools

KPI Calculations (see chapter 5)

- Script libraries for OEE calculations
- Script libraries for statistical calculations

Interfaces (see chapter 7)

- RESTful Opcenter Interface
- OPC UA Interface

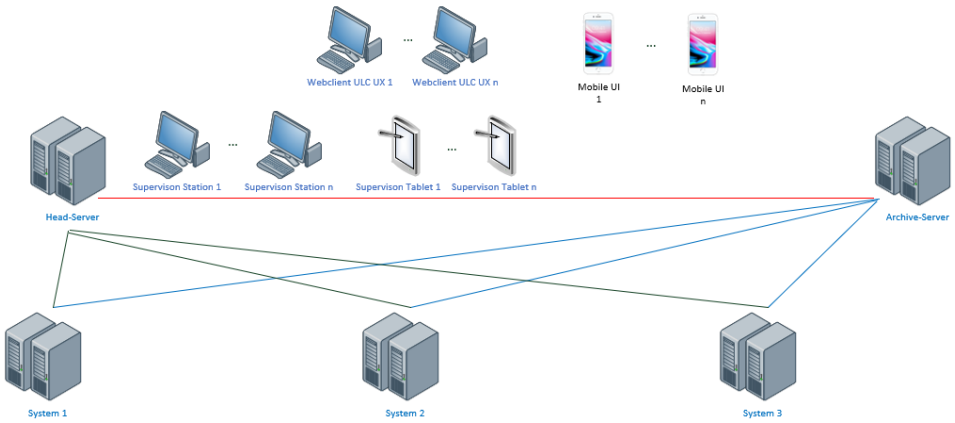
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2.3 Simatic WinCC OA System

SCADA or Integration Layer systems based on WinCC OA could consist of a single server or could be distributed to several redundant server pairs.

The whole system for the plant shall be built in one engineering project in WinCC OA. Depending on the size of the project and its requirements a system can be distributed among several systems in a deployment procedure.

Figure 2-2 WinCC OA Systems



For every WinCC OA server or server pair a system name must be specified to be able to address all data on all servers. In distributed systems one Head-System must exist, which is connected to all sub-systems.

3 UI Framework

Following chapters describe Production Management for Batteries user interface elements, templates, tools, as well as data templates.

NOTE In case of a distributed system, the user interface can only be used for the head system.

It is important to set up plant UI correctly using PM4B tools. In case of incorrect configurations of the plant in the Plant Settings tool, the User Interface will show an error message and not be opened properly.

For details about the possible errors and their fixes see section 6.3.2 Plant Settings.

3.1 UI Frame

The UI frame delivered with the Production Management for Batteries consists of:

- **Header**
  Date and time, customer logo, Siemens logo and "*Quit*" button
- **Icon Bar**
  "*Plant*" button, "*Navigation*" button, "*Summarized Alarms*" icon and "*Scheme*" button
- **Navigation Bar**
  Plant structure
- **Tabulator Bar**
  Screen selection for navigation object
- **Process Screen**
  Process data

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3.1.1 Icon Bar

The icons in the icon bar have the following functionality:


Open plant screens


Open navigation tree

NOTE The icon for opening the navigation tree is only visible, if the user has the visualization permission set for at least one line.



Open plant screen for alarms. Also shows number of active alarms.


Toggle the scheme between dark and light

3.1.2 Tabulator Bar

Each level in the navigation tree has its own tabulator bar. Content of a tabulator bar depends on the availability of process screens for objects of this level. The sequence and number of tabulators for each level can be modified with the tool Navigation Settings.

Figure 3-1 Tabulator Bar Example for Area



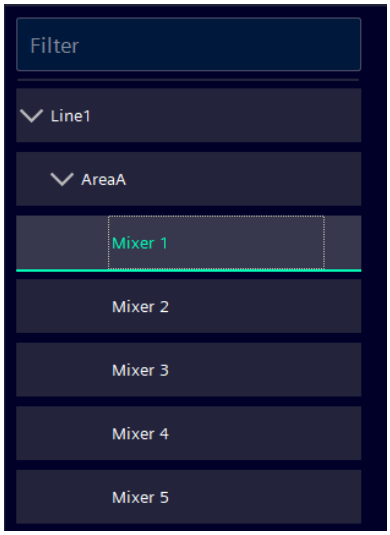
3.1.3 Navigation Bar

Plant Structure

The navigation tree shows the structure of the whole plant. All production lines, all areas of the production lines and all machines of the production areas are shown in the tree.

The plant structure can be configured with the tool Plant Settings.

Figure 3-2 Part of Navigation Tree



The filter option on top of the navigation tree can be used for filtering the tree by a given name.

Navigation through the plant screens is possible both by the navigation bar and also through objects on the process screens.

When switching between levels or objects in the navigation bar, the tabulator stays at the last tab selected.

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Alarms

Alarms button in the Icon Bar on the left has a badge showing number of all equipment related alarms on the plant. Clicking on it navigates to an Alarms screen with all plant alarms.

Figure 3-3 Alarms button in Icon Bar



The color of the badge is defined by the highest alert class of active alerts.

Clicking on the alert badge opens the Alarms screen filtered to the corresponding area.

In the navigation tree an indicator on every level shows the number of alarms in lines, areas, and machines. This indicator is hidden when there are no alarms.

Figure 3-4 Alarms in Navigation



The number of alarms is fetched using Sum Alarms as described in 9.3 Sum Alarms.

3.2 Screens

3.2.1 Generic Screens

Alarms

Alarms screen can be opened for:

- Plant
- Line
- Area
- Machine

Displayed alarms in the alarm list are filtered, so that only alarms of the selected object and its children are shown. For example, alarms screen of the *Area* will

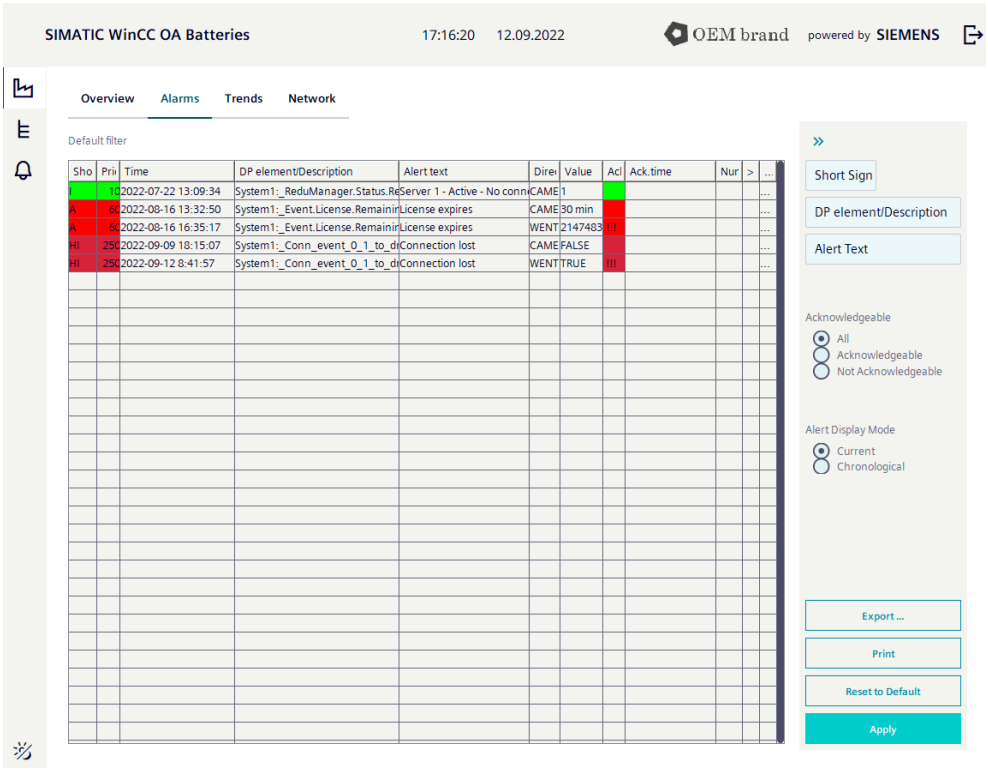
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show alarms of the area itself as well as alarms for all machines in that area. It will not show alarms of the Line or Plant or other Areas.

Alarms screen supports the following display modes:

- **Current**
  Shows current alarms
- **Chronological**
  Shows historical alarms in defined time range

Figure 3-5 Alarms screen



NOTE Alarms screen on a *Plant* level always shows all alarms (unfiltered).

It is possible to set custom filters by expanding the toolbar on the right as shown on the picture above.

Alarm list can be filtered by:

- Short sign of alarm class
- DP element/ description
- Alert text
- Acknowledgeable (filtered by alarm priority)
  - Acknowledgeable: priority >= 50
  - Not Acknowledgeable: priority < 50

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NOTE Alarms can only be acknowledged, if the user has permission bit 5 set in the associated access field. See Permissions.

It is also possible to filter alarms by their direction (CAME, WENT) in the chronological display mode.

For quick filtering filters can be set using drag and drop from the table content into a corresponding filter field.

Filters are applied by clicking the "*Apply*" button at the bottom of the toolbar section. Filters can also be reset to default by clicking "*Reset to Default*" button.

It is possible to export alarm table into a file by clicking "*Export*" button. It is also possible to print the table by clicking "*Print*" button.

For more information on how alarms are filtered for each hierarchical level see chapter 9.3 Sum Alarms.

Trends

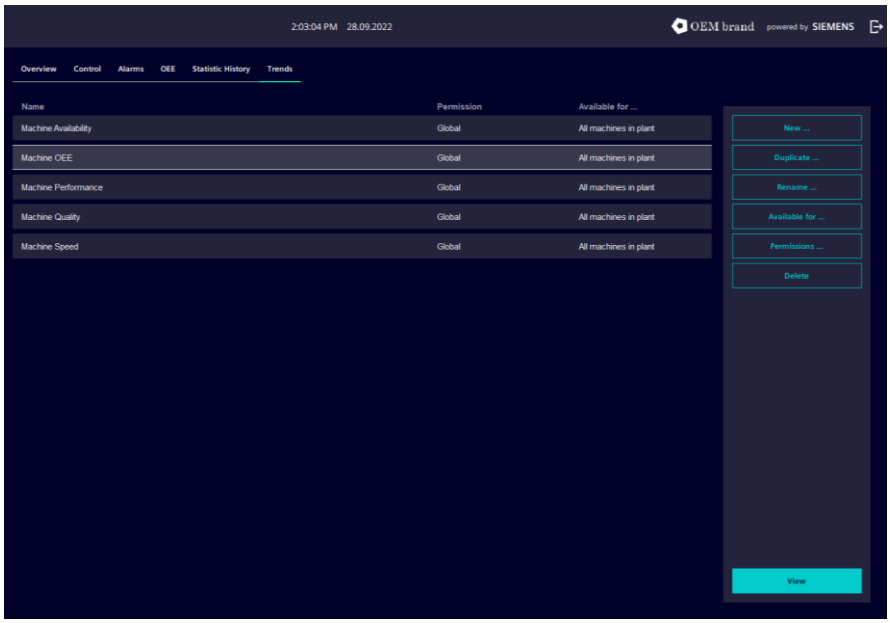
Production Management for Batteries supports trends for:

- Plant
- Line
- Area
- Machine Type
- Machine

A list of available trend configurations is shown in the *Trends* tab.

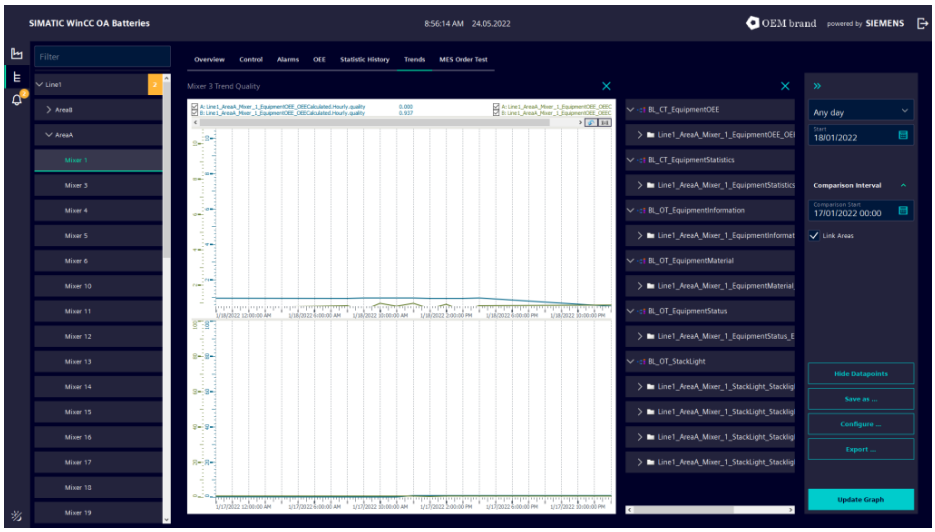
To open a trend, double-click on a trend name, or select a trend and click *"View"* button at bottom right corner of the UI.

Figure 3-6 List of available trend configurations



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Figure 3-7 Trend View



The following trends are shipped with the library and are used on the *Overview* screens and therefore are mandatory to be configured in the project:

- Plant Availability
- Plant OEE
- Plant Performance
- Plant Quality
- Line Availability
- Line OEE
- Line Performance
- Line Quality
- Area Availability
- Area OEE
- Area Performance
- Area Quality
- Machine Availability
- Machine OEE
- Machine Performance
- Machine Quality
- Machine Speed

More information about Trends can be found in chapter 11.3 Adapting Trend Configurations.

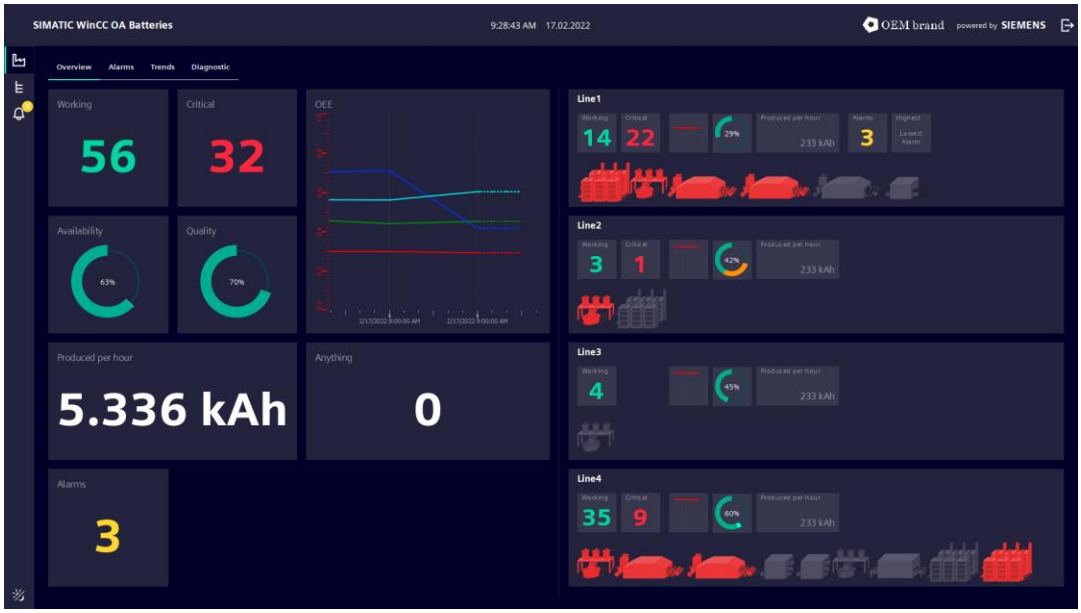
3.2.2 Plant Level Screens

Overview

Plant Overview screen shows most important information about the plant and its lines and is divided into two parts.

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Figure 3-8 Plant Overview



Left side of *Plant Overview* screen shows following dashboard information of the whole plant:

- Number of critical/working machines
- KPI values
- OEE trend
  Uses Trend configuration named “Plant OEE”. Can also be opened from trend screen.
- Number of alarms

NOTE By default, example data is displayed which can be changed by editing the panel *panels/objects/plant/PlantDashboardInfo.xml*.

- Right side of Plant Overview screen shows important information about the lines. Line symbols show:
- General info of the line
  - Number of critical/working machines
  - KPI values
  - Availability trend
    Uses Trend configuration named “Line Availability”. Can also be opened from trend screen.
  - Number of alarms and highest alarm class
- Area symbols (one symbol for each parallel group)
  - Colored red when number of critical machines > 0

NOTE By default, example data is displayed which can be changed by editing the panel file *panels/objects/plant/PlantLineOverview.xml*.

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Machine images are defined by machine type and can be modified by editing the files in the following folders:

- pictures/themes/BL_dark/PlantAreaIcons (images for dark theme)
- pictures/themes/BL_light/PlantAreaIcons (images for light theme)

For every machine type the following image files must exist:

- pictures/themes/BL_dark/PlantAreaIcons/<machineType>.png
- pictures/themes/BL_dark/PlantAreaIcons /<machineType>_critical.png
- pictures/themes/BL_light/PlantAreaIcons /<machineType>.png
- pictures/themes/BL_light/PlantAreaIcons/<machineType>_critical.png

NOTE Displayed trends can be changed by adapting the associated trend configurations in the *Trends* screen.

Network

Network screen gives information about system components and connections between them.

It always shows the 3 columns:

- **User Interfaces**
  Shows the connected User Interfaces. The column shows summarized information by default. It can be expanded to show the connection state for each individual UI by clicking the “+” button.
- **Head Server**
  Shows the head system and redundancy state (if configured).
- **PLCs**
  Shows the configured OPC UA connections. The column shows summarized information by default. It can be expanded to show information for each individual PLC connection by clicking the “+” button.

For distributed systems another column displaying the connection states of the distributed systems is shown between the Head Server and PLC columns.

Green lines between symbols mean that connection is established, red lines indicate a broken connection.

Each column has a header which summarizes the states for all connections in the column (e.g., the header for *User Interfaces* column shows how many UIs are connected).

The following information is shown about the system components:

- User Interface details
  - User Interface number
  - Connection Status
- Head Server details
  - System Name, System Number
  - IP address, host name of server
  - IP address, host name of redundant server (if redundant server is configured)

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  - Active Server (left or right) if redundant server is configured.
  - Redundancy state, shown by icon, see table below for details.
- Distributed Server details
  - System Name, System Number
  - IP address, host name of server
  - IP address, host name of redundant server (if redundant server is configured)
  - Active Server (left or right) if redundant server is configured.
  - Redundancy state, shown by icon, see table below for details.
  - Information about connection to the head server.
- PLC details
  - Connection name
  - PLC IP address or host name
  - Port
  - Connection state to the left server
  - Connection state to the right server (if redundant server is configured)

Table 3-1 Possible server icons

Icon	Description
	Single Server, no redundancy
	Redundant Server without errors
	Redundant Server with errors, e.g. no connection to redundant server

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Figure 3-9 Head server with UI summary and PLC summary

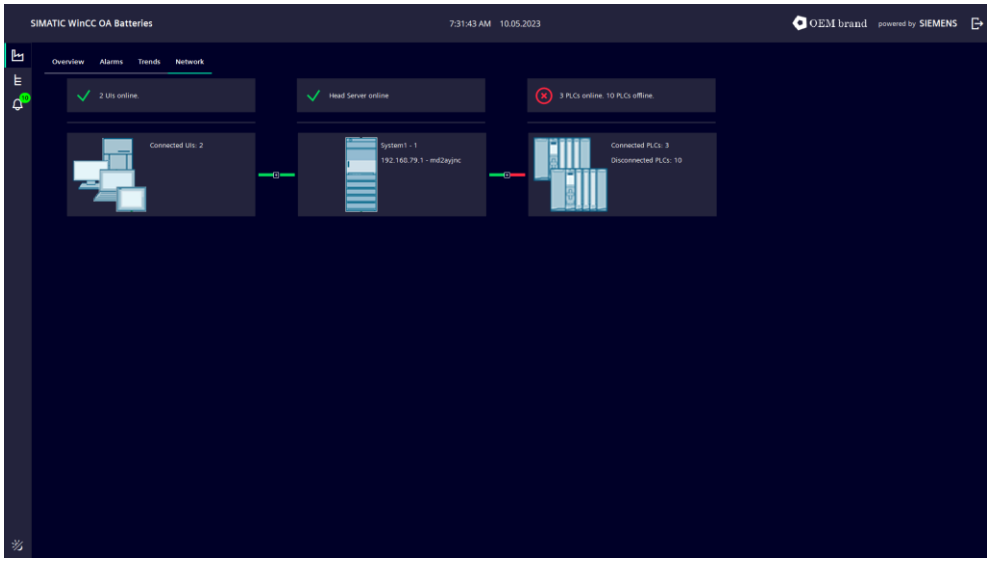
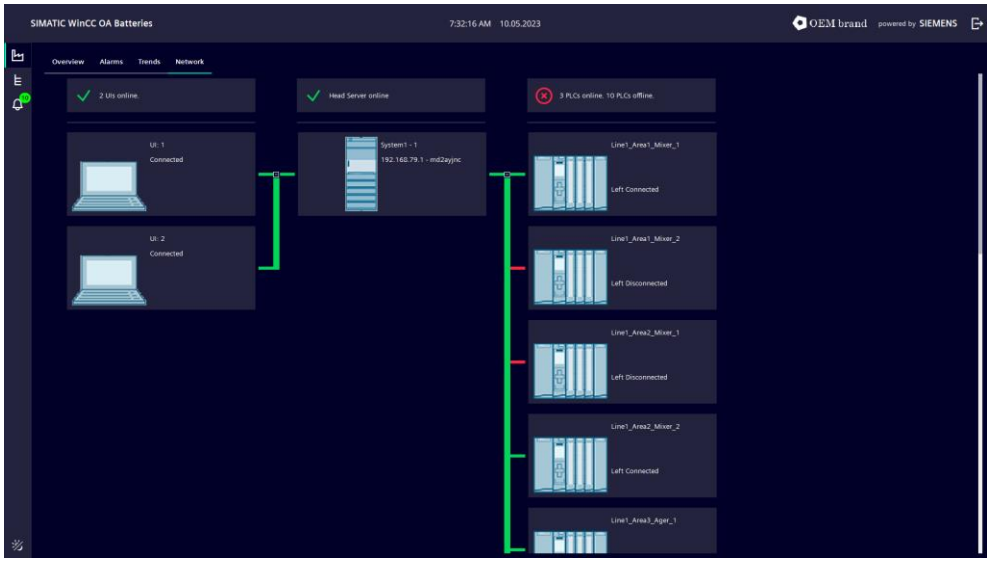
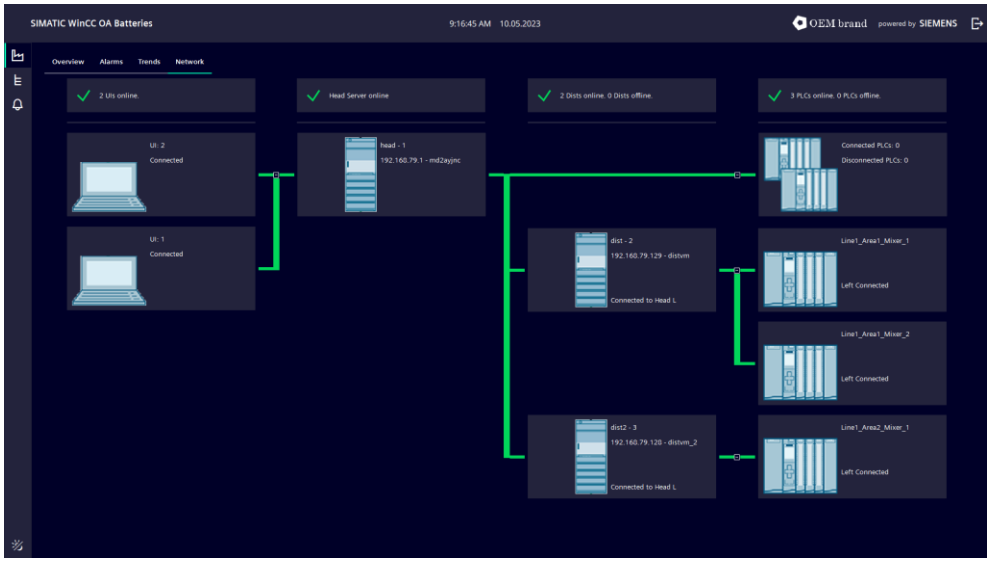


Figure 3-10 Head server with UIs details and PLCs details



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Figure 3-11 Head server with multiple DIST servers with UIs details and PLCs details



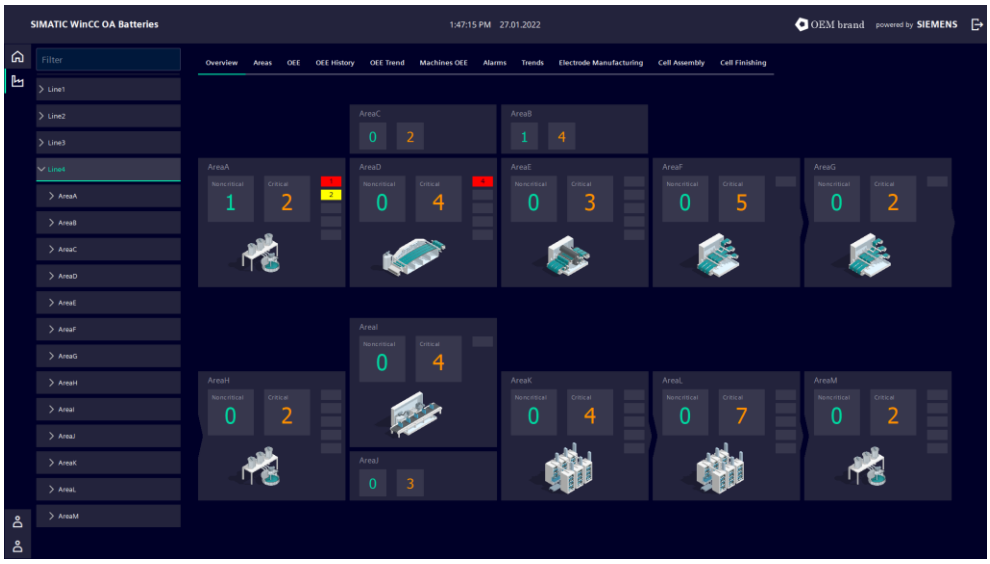
3.2.3 Line Screens

Overview

Line Overview screen shows important information for each area of the line. Areas are displayed in the order configured in Plant Settings tool.

In case of parallel areas only the first one is expanded the others are collapsed. A collapsed area can be expanded by clicking on it.

Figure 3-12 Line Overview



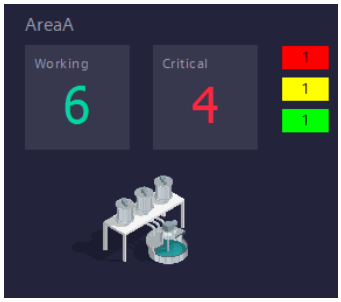
An area panel reference contains:

- Summary of active stacklights
- Number of machines in a non-critical state
- Number of machines in a critical state

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- Machine Type image of the area (defined in Symbol Settings)

Figure 3-13 Area panel reference in line overview

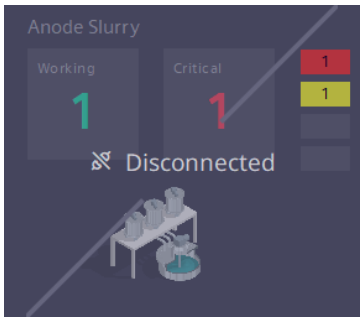


Collapsed area panel reference only show:

- Number of machines in non-critical state
- Number of machines in critical state

If a distributed system of a corresponding area is disconnected, an overlay is shown on the panel reference, and user interactions are blocked, see Figure 3-14.

Figure 3-14 Area panel reference in line overview for disconnected system



OEE

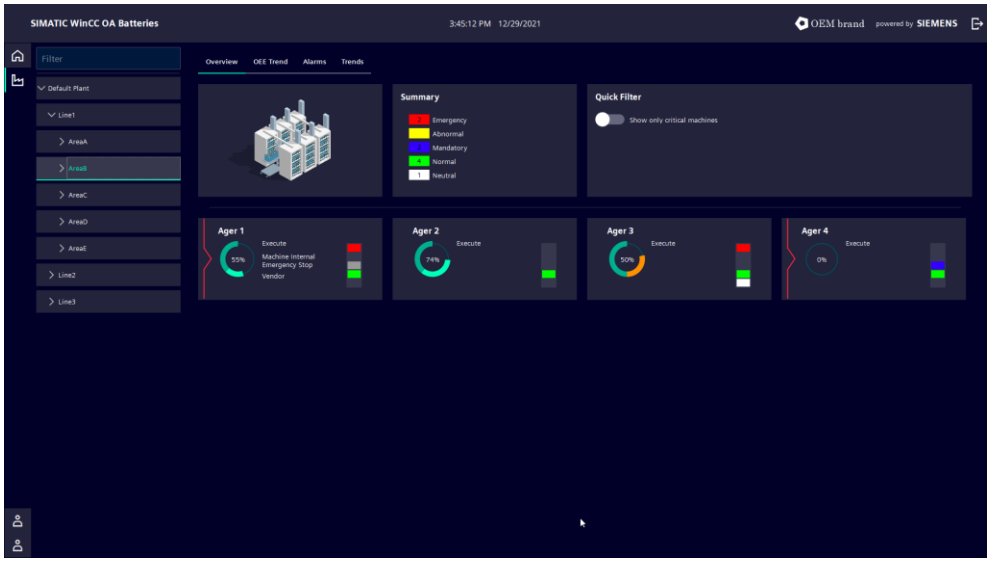
For the functionality of the OEE screen please see 3.2.5 Machine Screens.

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3.2.4 Area Screens

Overview

Figure 3-15 Area *Overview* screen



Area *Overview* screens show:

- Area image (defined in Symbol Settings)
- Important information for each machine
- Summary of active stacklights

It is possible to only show machines with critical states (see Critical Machine Parameter).

Area *Overview* also shows panel references for each machine with the following information:

- OEE value of the last hour
- machine state
- standstill reason
- call mode
- starved and blocked flags
- stacklight

Figure 3-16 Machine panel reference in Area *Overview*



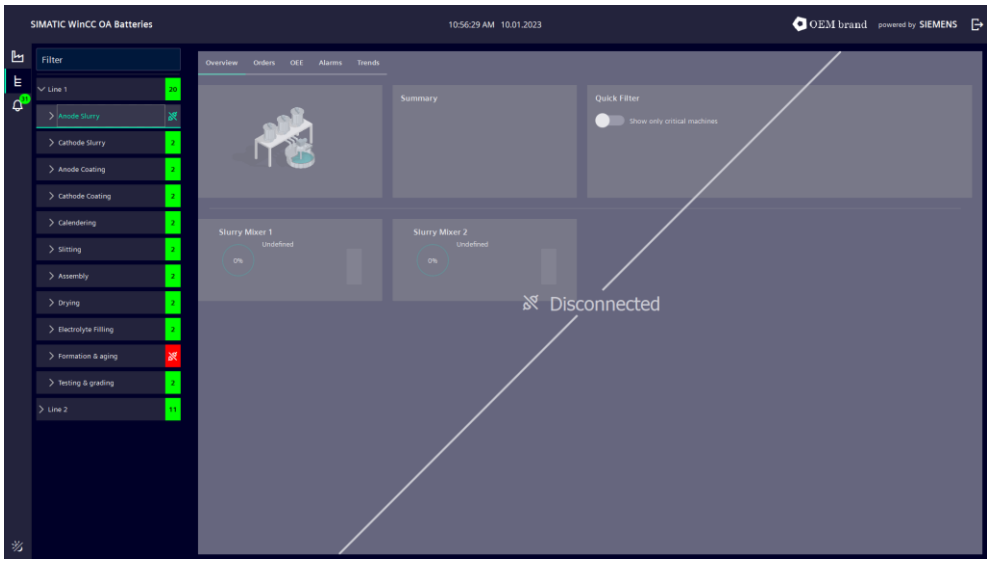
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If the starved flag is set a red line on the left edge of the machine visualization is shown, for the blocked flag a red line on the right edge appears.

The OEE gauge also shows OEE difference for the last hour. If the previous OEE value was higher, the difference is shows in orange color on the gauge (see Ager 3 Figure 3-15 Area Overview), if the new OEE value has increased, the difference is shown in green on the gauge. Text in the middle of the gauge shows the most recent OEE value.

If a distributed system containing an area is disconnected, an overlay is shown over all tabs, see Figure 3-17.

Figure 3-17 *Area* screen for disconnected systems



OEE

For the functionality of the OEE screen please see 3.2.5 Machine Screens OEE.

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3.2.5 Machine Screens

Overview

Figure 3-18 Machine *Overview* screen



Machine *Overview* screens show:

- Inbound and outbound information for the machine
- State of machine stacklights
- Important environment and machine parameters (like last standstill reason)
- Trend for current speed in comparison to the designed speed
  Uses trend configuration named "*Machine Speed*". Can also be displayed in *Trends* screen.
- Gantt chart for machine state and machine mode
- Alert window for machine alerts

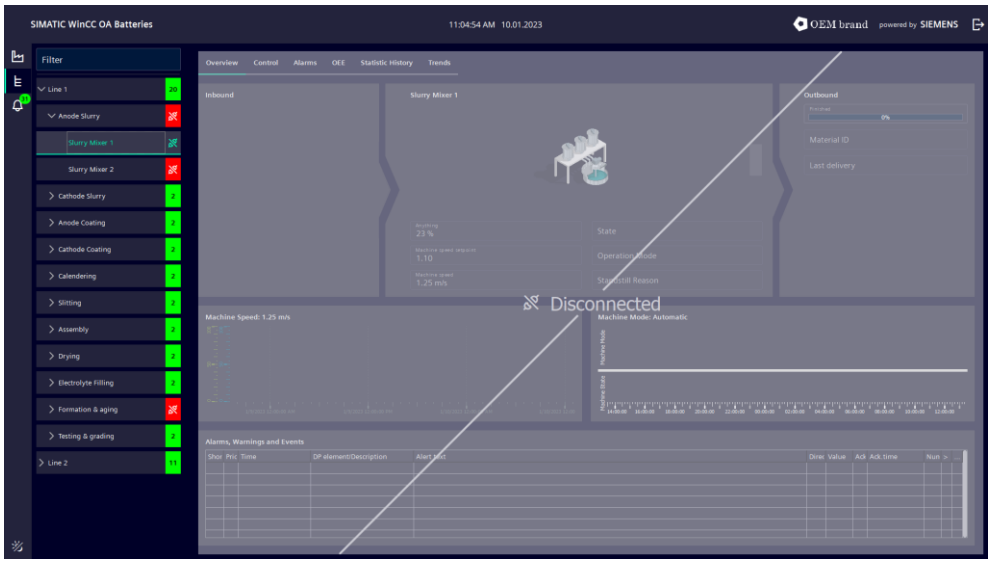
NOTE The displayed trend can be changed by adapting the associated trend configuration in the *Trends* screen.

NOTE The header text for the speed trend uses the specified unit for the *"CurrentSpeed"* DPE of the Equipment Status DPT, or if not configured the speed unit defined for the machine type.

If a distributed system containing an area is disconnected an overlay is shown over all tabs, see Figure 3-19.

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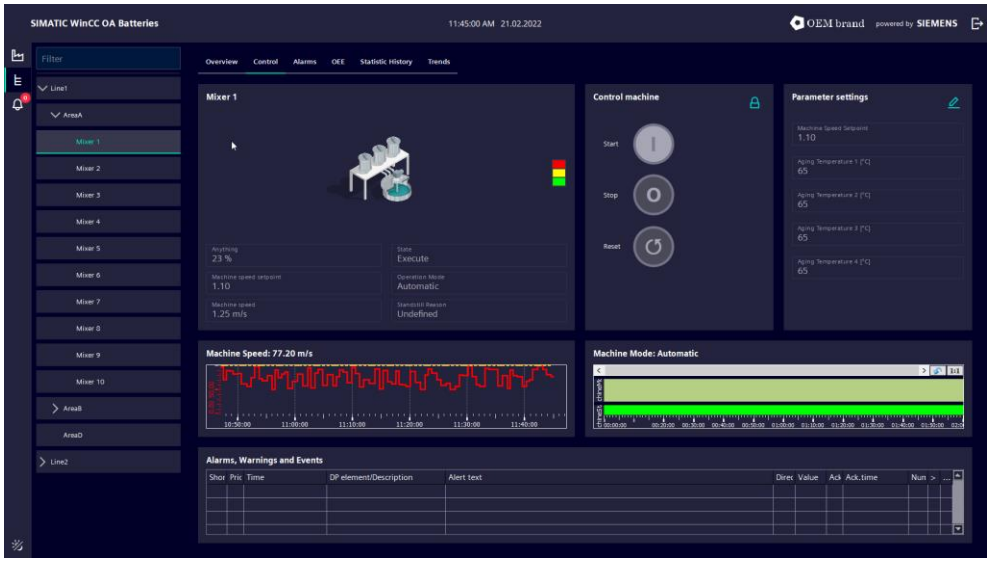
Figure 3-19 *Machine* screen for disconnected systems



Control

Machine *Control* screen is described in Application Examples. It contains examples of control buttons for operating a machine via OPC UA method calls and it should be further developed for the use in projects.

Figure 3-20 Machine *Control* screen



OEE

OEE screen shows OEEs for a machine which is calculated automatically in the background. The screen allows to switch between current and historical OEE values.

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Figure 3-21 Shown Period for OEE



The Machine *OEE* screen shows the following information concerning the calculated OEE of a machine when the period “Current” is selected:

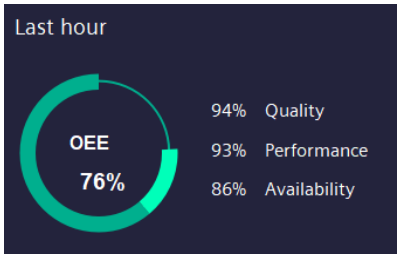
- Last hour OEE in comparison to all hours of the current day
- Yesterday OEE in comparison to all days of the current month
- Last week OEE in comparison to the last 10 weeks
- Last month OEE in comparison to all month of the current year

Figure 3-22 Machine OEE for Period “*Current*”



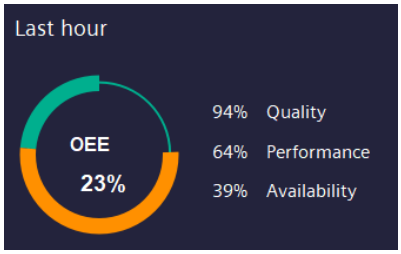
The current OEE value of each period is shown in a gauge and the difference to the last value is indicated with a light green color (improved) or an orange color (degraded). Also shown are the three parameters for the calculation of the OEE: “Quality”, “Performance” and “Availability”.

Figure 3-23 Example for improved OEE



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Figure 3-24 Example for degraded OEE



When switching from current to historical data, a date time selector is shown which can be used for selecting a day and an hour in the day.

Figure 3-25 Calendar selector for Historical OEE



The machine OEE screen shows the following information regarding calculated OEE of a machine when the period “Historical Data” is selected:

- Selected hour OEE in comparison to all hours of the selected day
- Selected day OEE in comparison to all days of the selected month
- Selected week OEE in comparison to last 10 weeks
- Selected month OEE in comparison to all months of the selected year

Figure 3-26 Machine OEE for a period “*Historical Data*”



In the comparison information the bars which belong to the selected date and time are “highlighted”.

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Statistics History

Machine *Statistics* screen shows statistics for state and mode of a machine and allows to switch between daily, monthly, and yearly data for the statistical values. A date and time selector is shown which can be used for selecting a year, a month, and a day.

Figure 3-27 Select a Period and a date for historical *Statistics*



NOTE The calendar selector always needs to have a date at least one day from now or earlier, even if the selected period is month or year.

The following information concerning the calculated statistics of a machine is shown:

- Day Selection:
  - A Gantt chart for the machine state and mode of the current day.
  - Hourly statistic values of the selected day for the machine state in a stacked bar chart.
  - Hourly statistic values of the selected day for the machine mode in a stacked bar chart.
- Month Selection:
  - A Gantt chart for the machine state and mode of the current day.
  - Daily statistic values of the selected month for the machine state in a stacked bar chart.
  - Daily statistic values of the selected month for the machine mode in a stacked bar chart.
- Year Selection:
  - A Gantt chart for the machine state and mode of the current day.
  - Monthly statistic values of the selected year for the machine state in a stacked bar chart.
  - Monthly statistic values of the selected year for the machine mode in a stacked bar chart.

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Figure 3-28 Example for hourly statistics for a day



The following details are shown in the statistics visualization:

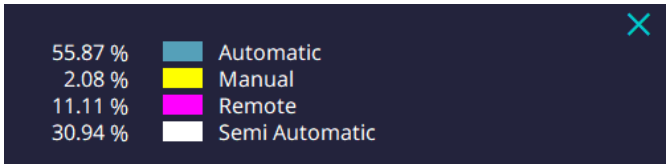
- In the Gantt diagram the axes can be scrolled and a ruler can be shown.
- For the shown statistics of state and mode a legend can be opened (“attachment” symbol).

Figure 3-29 Legend for statistical values (machine state)



For a single stacked bar, the values can be shown in a table (popup when selecting the bar).

Figure 3-30 Statistics table for a selected period (machine mode)



The colors for the different states and modes of a machine can be defined with the “*Color Setting*” tool.

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NOTE The popup legend window and percentage table can be closed using the ESC key or the “X” button in the window.

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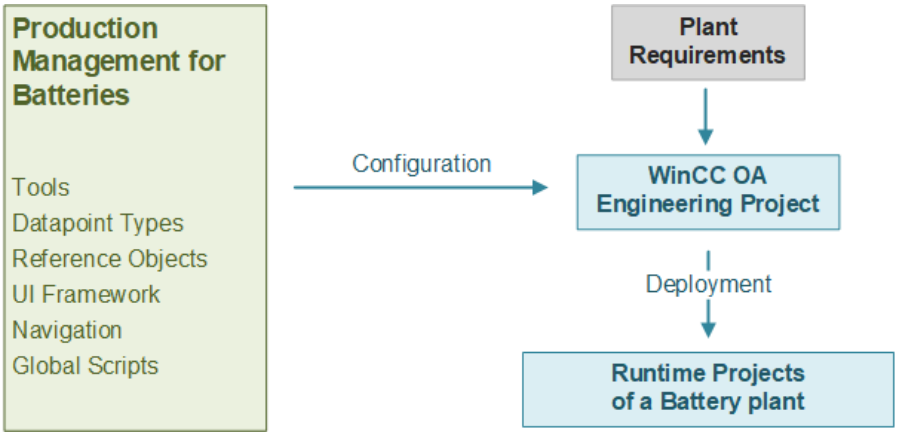
4 General Engineering

This chapter describes basic WinCC OA project setup and engineering workflows to enable the use of Production Management for Batteries.

4.1 Engineering and Deployment Workflow

The idea behind Production Management for Batteries is to use predefined components and engineering tools for creating a battery plant SCADA or Integration Layer system instead of manually creating panels and implementing code for the needed functionality.

Figure 4-1 Deployment Workflow



The engineering workflow using the Production Management for Batteries starts with the creation of the Datapoints (DPs), which are the containers for the process data. DPs are used for visualization, alarming, and archiving.

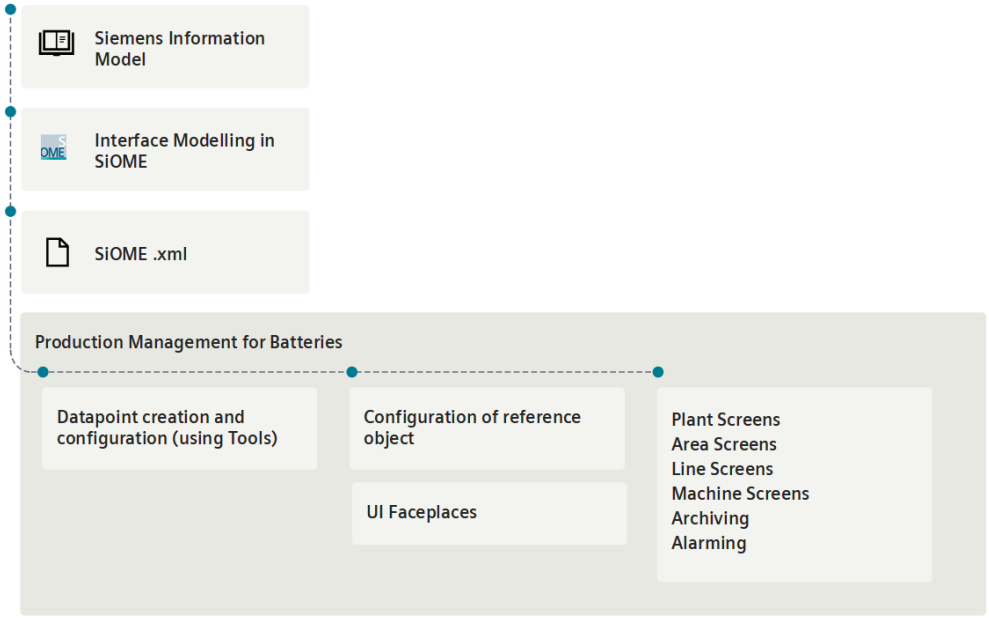
DPs can be automatically created by importing configuration file from the SiOME (Siemens OPC Modeling Editor) using the DP Objects tool. In SiOME data structure of the production machines can be modeled using an OPC UA node-set which represents the Siemens Information Model.

NOTE OPC UA Interface file structure should be based on Machine Interface Definition (*Taglist Example PM4B v2_0.xml*).

A unique naming concept for the DPs is necessary. Each DP should have a unique name to dynamically connect DPs to delivered library objects for visualization. In Production Management for Batteries the concept of $-parameters is used which allows the reusability of the graphical objects.

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Figure 4-2 Engineering Workflow



4.2 Permissions

The plant can be split into different access fields, in which the permissions of every user can be limited accordingly.

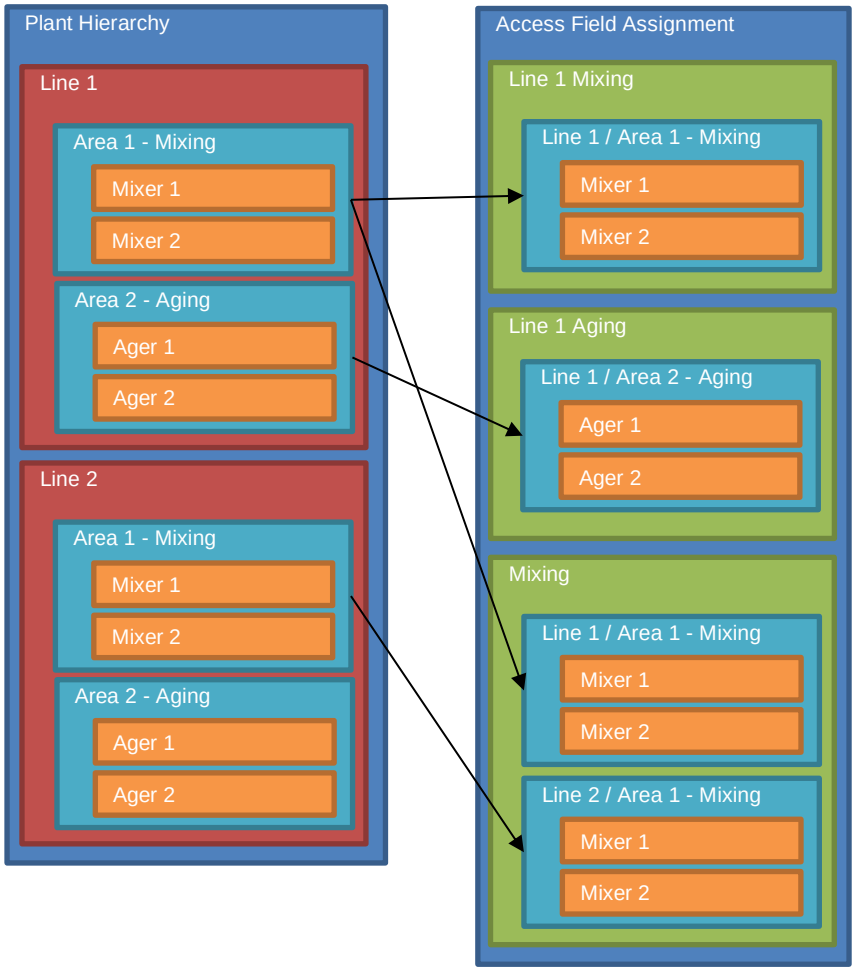
The access field can be defined using the tool Access Field Assets Settings. It can be used to assign multiple lines, areas, or individual machines to an access field. Internally the access areas are default WinCC OA areas, see WinCC OA documentation for more information.

The access fields can be assigned to user groups and the permission bits can be defined within each field. When a line or area is assigned to an access field, it means that all its areas and machines are also associated with the field.

In case a Line, Area, or Machine is associated to multiple access fields and a user has different permission bits defined for the fields, the least of them is considered (if one of them does not have a certain permission bit set, it is seen as if the bit would not be set).

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Example



A user group for *Line 2 – Aging* should therefore contain all access fields, where the users do not have permission.

The user group must contain the access fields *Mixing* and *Line 1 – Aging*, the permissions in these access fields can then be limited accordingly. It is also possible to add the access field for *Line 2 – Aging* in case the permissions should be adaptable within the *Line 2 / Area 2 – Aging* area.

The following configuration would **not** work:

User Group for *Line 1 – Mixing* (with permissions only for *Line 1 / Area 1 – Mixing*) with the access fields *Aging* and *Mixing* with limited permissions, and *Line 1 – Mixing* with full permissions. With this configuration the overlapping access field assignments will contain the least of all defined permissions, therefore *Line 1 / Area 1 – Mixing* would also have limited permissions.

The same scenario also applies for higher permissions on machine level inside areas with limited permissions. The machines inside the area will also always have the least of all defined permissions.

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Table 4-1 Considered permission bits in the Production Management for Batteries Screens

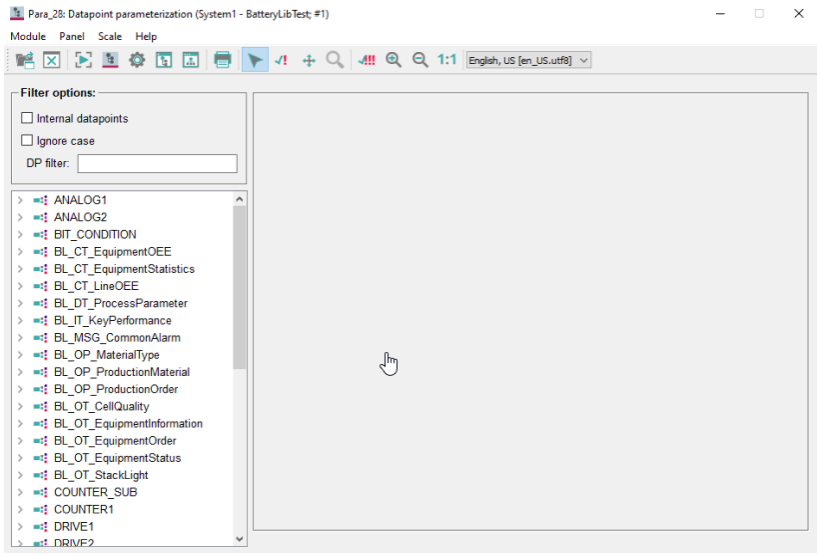
Bit	Name	Description
1	Visualization	Show screens and faceplates Used for opening the screens of lines, areas, and machines. If the global visualization bit is not set, the User Interface will not start, if the bit is not set for one of the access fields, the assigned lines, areas, and machines will not be shown in the navigation tree.
2	Normal Operation	Machine control like start, stop, reset The tab for controlling machines will not be visible in case the bit is not set.
3	Extended Operation	Modify control parameters The control parameters in the machine control screen will not be changeable in case the bit is not set.
4	Administration	Create users and user groups Assign user groups to access areas Change user group rights Only used in standard WinCC OA panels.
5	Acknowledge	Acknowledge alarms
6	Service	Service Commands Only used in standard WinCC OA panels.

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4.3 Data Points and Data Point Types

Following chapters describe configurations in WinCC OA Para tool – a tool for editing data point types and data points.

Figure 4-3 WinCC OA Para



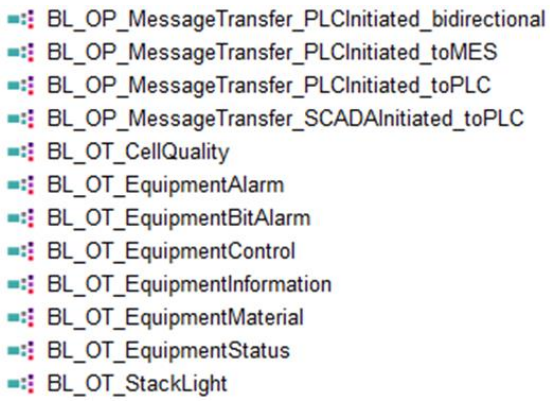
4.3.1 Datapoint Types

In WinCC OA datapoint types (DPTs) can be defined as object structures. The datapoint types are used for creating datapoints. The datapoints represent the objects in the plant process and leaves of the datapoints (datapoint elements) hold the information about peripheral addresses, archiving and alarming (configs).

Here is a short overview of available data templates in Production Management for Batteries.

More details concerning the data templates can be found in Data Model.

Figure 4-4 Complex Datapoint Types for Process Data



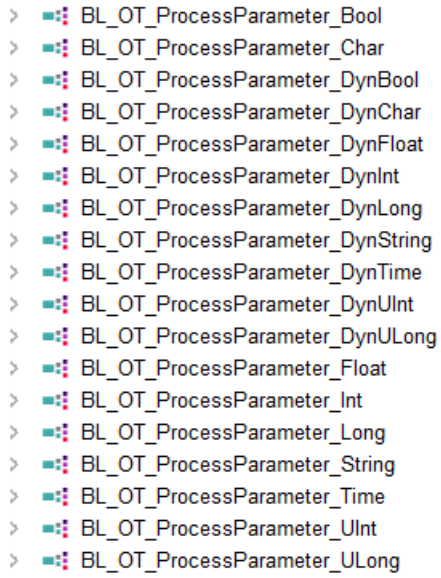
The following table shows the purpose for the use of the datapoint types of the Production Management for Batteries.

Table 4-2 Purpose of Datapoint Types

Datapoint Type	Purpose
BL_OP_MessageTransfer_ PLCInitiated_bidirectional	Type for sequential message transfer with handshake (e.g., material consumption)
BL_OP_MessageTransfer_ PLCInitiated_toMES	Type for message transfer from PLC to MES (e.g., batch record)
BL_OP_MessageTransfer_ PLCInitiated_toPLC	Type for message transfer from MES to PLC (e.g., request all barcodes)
BL_OP_MessageTransfer_ SCADAInitiated_toPLC	Type for one time message transfer from SCADA to PLC (e.g., workorder download)
BL_OT_CellQuality	Type representing the quality of single battery cells
BL_OT_EquipmentAlarm	Type for handling alerts with OPC Alarms&Conditions
BL_OT_EquipmentBitAlarm	Type for handling of bit-triggered alarms
BL_OT_EquipmentControl	Type for sending operations to the machine with OPC method
BL_OT_EquipmentInformation	Type for common information of the machine
BL_OT_EquipmentMaterial	Type for inbound and outbound material description of a machine
BL_OT_EquipmentStatus	Type for the state properties of a machine (state, mode, counter, …)
BL_OT_StackLight	Type for representing a stacklight of the machine

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Figure 4-5 Simple Datapoint Types for Process Data



The creation and configuration of datapoints on the basis of described datapoint types is handled with the tools of the category “Datapoint Settings”, see Datapoint Settings.

For explanation on how to use DPTs in user interface see 11.4.3 Using Dollar-Parameters.

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4.3.2 Naming Conventions

The DP names at least consist of the following components:

- <Line Name>
- <Area Name>
- <Machine Type>
- <Machine Instance>
- <Object Type>
- <Object Instance / Object Name>

Examples:

Line1_AreaA_Mixer_1_EquipmentStatus_EquipmentStatus

Line1_AreaA_Mixer_1_StackLight_Stacklight1

The following $-parameters are used for the identification of the parts of DP names:

- $system
- $line
- $area
- $mType
- $mInstance

- $oType
- $oName

$-parameters provide flexibility in referencing panels or other parameters. For more information see chapter 11.4.3 Using Dollar-Parameters and WinCC OA Documentation: Parameters and Dollar-parameter.

4.3.3 Check Address Configs for Datapoint Elements (DPE)

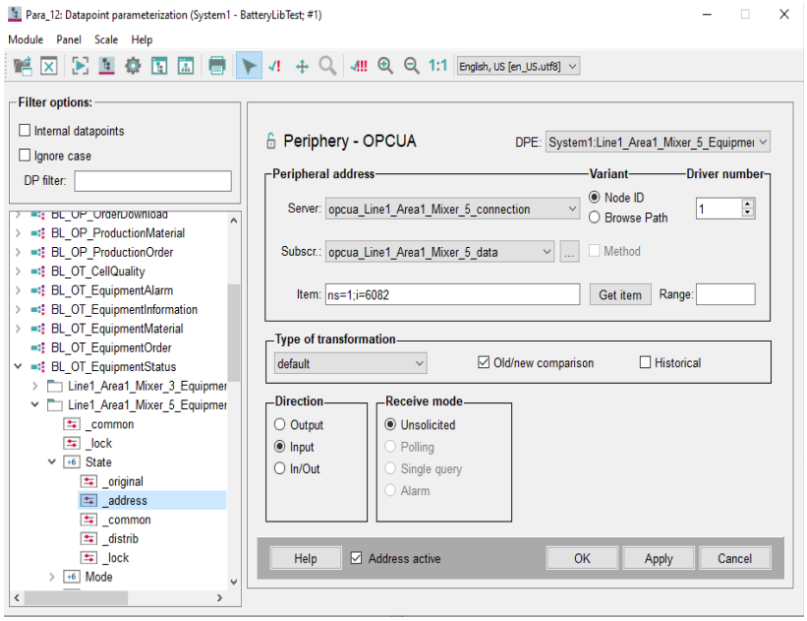
Configuring OPC UA addresses for datapoint elements include specifying OPC UA connection and subscription. See also chapter 4.3.

Configure OPC UA address:

1. Open the DPE you generate with Tool DP Objects
   e.g., *Line1_Area1_Mixer_5_EquipmentStatus*
2. Select *"_address*" of a DPE
3. Check or specify OPC UA connection "*Server*" and subscription "*Subscr*."

NOTE Address configuration data in *"_address*" config can be generated from OPC UA interface using "DP Objects Tool".

Figure 4-6 OPC Address Example in Para



For more information on how to use DPs in UI panels and on $-parameters see chapter 11.4.3 Using Dollar-Parameters.

4.4 OPC UA connections and subscriptions

Production Management for Batteries uses OPC UA as a main protocol for shopfloor-connectivity. Production Management for Batteries has built-in tools and

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templates for quick integration of shopfloor machines into the Project. In order to leverage Production Management for Batteries data- and UI-templates OPC UA interface shall be based on Siemens Information Model (see "*Taglist Template PM4B v2_0.xlsx*" and Information Model Kit V2.0).

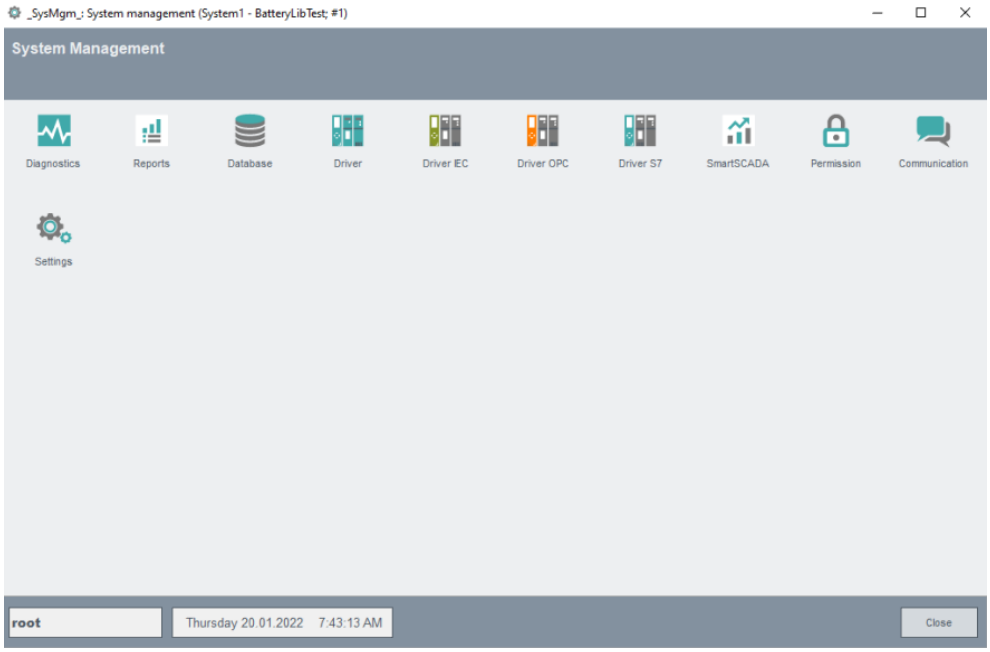
For information on connectivity concept see chapter 7 Interface Support and Data Model.

Connections

Production Management for Batteries comes with a default OPC UA connection named `BL_default_opcua_connection` for OPC UA client 1. This connection is cloned for each machine if addresses are created for the corresponding imported OPC UA interface (see chapter DP Objects).

Settings of the default configuration can be changed with the default WinCC OA OPC UA client configuration panel from the System Management.

Figure 4-7 WinCC OA System Management



How to modify OPC UA driver parameters:

1. Click the Driver OPC button in the System Management
2. Click the OPC UA Client button
3. Select the connection to be modified in the Combo Box (e.g. `BL_default_opcua_connection`)
4. Modify the parameters as required

NOTE It is strongly recommended to use authentications (certificates) and security settings when creating an OPC UA connection.

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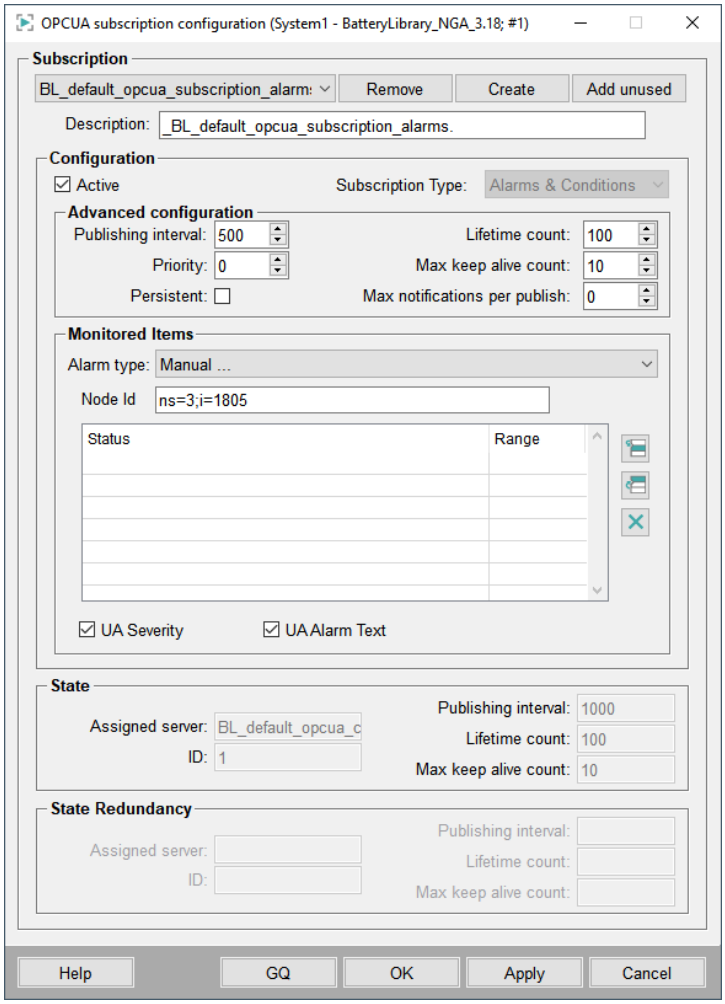
Subscription

Subscriptions must be defined for each OPC UA connection.
The subscriptions `BL_default_opcua_subscription_alarms` (for OPC UA Alarms & Conditions) and `BL_default_opcua_subscription_data` (for data) exist for the default OPC UA connection and are cloned for each machine (if OPC UA addresses are created).

To change the parameters of the subscription the following steps can be performed:

1. Click Button "Manage" in Subscriptions section
2. Select the subscription to be modified (e.g. "BL_default_opcua_subscription_alarms" or "BL_default_opcua_subscription_data")
3. Modify the parameters as required
4. Click "Apply"

Figure 4-8 Example for default Alarm Subscription



5. Click "OK"

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5 KPI Calculations

KPI calculations are based on archived process data. The calculations can only be done when the corresponding basic data are stored in archives. The configuration of the archiving of process data can be done with tool “DP Archives” within the category “DP Settings”.

Calculation is done by two control scripts:

oeeCalculation_Lines_and_Plant_Handler.ctl

oeeCalculation_Machines_and_Areas_Handler.ctl

These scripts must always be running. At startup time and once every hour, the calculation is executed. The calculation searches the last calculated value in the past for maximum 24 hours back and recalculates the missing values.

In distributed systems the Head system must run a Ctrl Manager with the script *oeeCalculation_Lines_and_Plant_Handler.ctl*. Each of the distributed systems with assigned areas must run a Ctrl Manager with the script *oeeCalculation_Machines_and_Areas_Handler.ctl* .

If area OEEs are missing no line and plant OEEs are calculated. They will be calculated in the next hour, if available.

NOTE The OEE calculation scripts of the library are delivered unencrypted, so that they can be adapted, in case changes are necessary.

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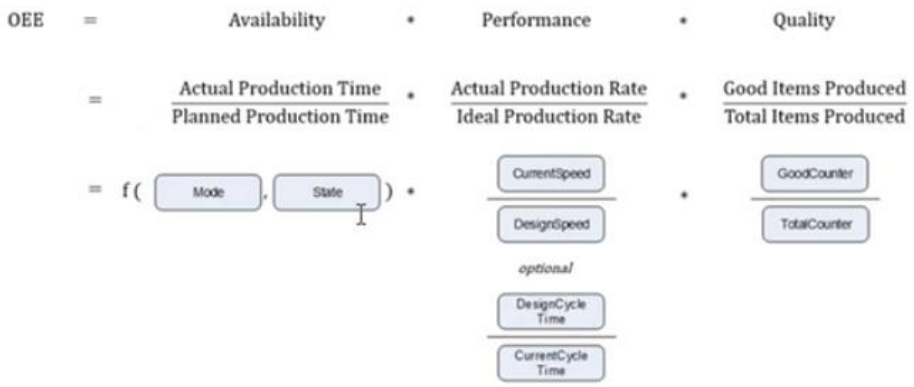
5.1 OEE

The Overall Equipment Efficiency (OEE) is calculated for machine, area, line, and plant.

The OEE is calculated based on the product of the availability, the performance, and the quality.

Complex KPI “Overall Equipment Effectiveness” (OEE)

The OEE calculation is shown in the following formula.

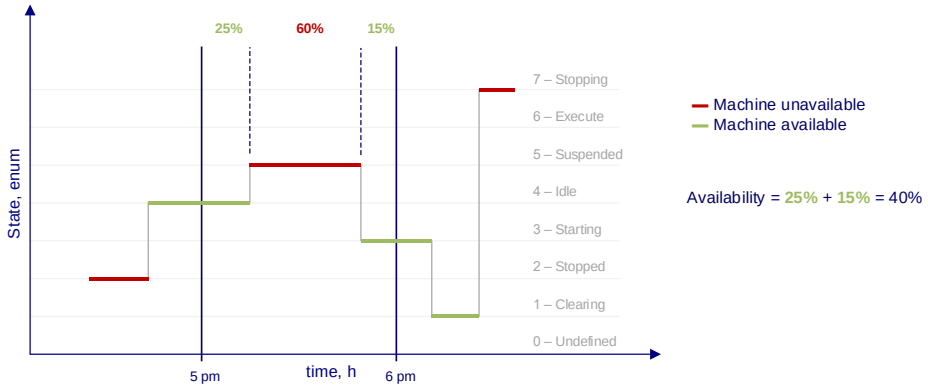


Availability

For the calculation of the availability the *EquipmentStatus.State* is used. The equipment states that are considered as available can be defined with the OE*E Settings* tool. Recommended default values are the following:

- Clearing = 1
- Starting = 3
- Idle = 4
- Execute = 6
- Completing = 16
- Complete = 17
- Setup = 18

Figure 5-1 Example of hourly “Availability” KPI calculation



NOTE Invalid machine states (not defined in *machineState* enumeration), are considered as “*Undefined*” in the calculation.

Performance

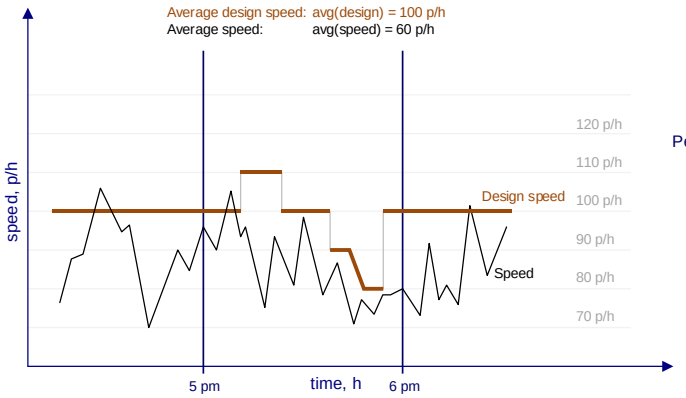
The performance can be calculated in different ways. The *OEE Settings* tool can be used to select the source and operation that is needed. Options are:

- The ratio of actual machine speed and design machine speed (actual/design).
- The ratio of design machine cycle time and actual machine cycle time (design/actual).
- The ratio of actual value of dedicated process parameter and design machine speed (actual/design).

It is supposed that the machine updates the current values. It is also supposed that the design value can be changed any time. Hence, the average values are used of the whole hour.

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Figure 5-2 Example of hourly “Performance” KPI calculation

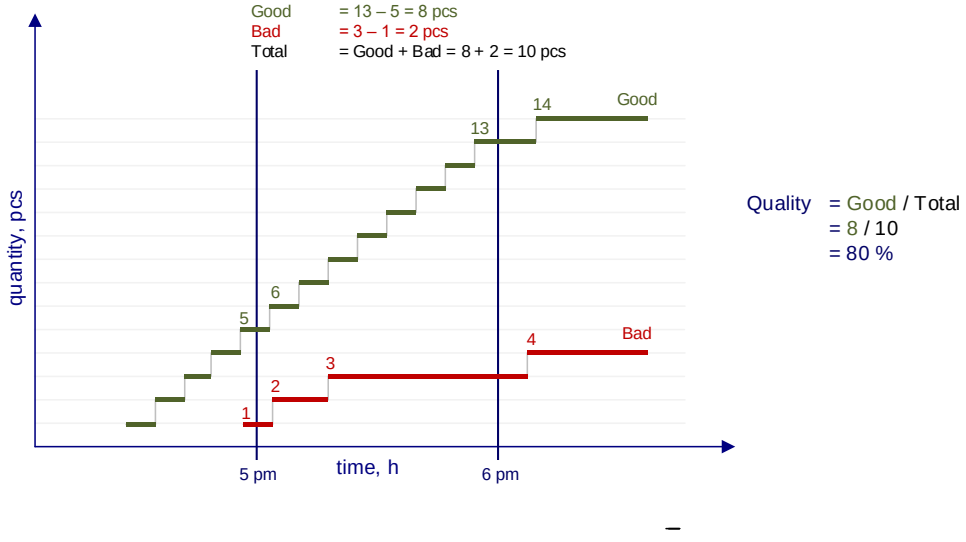


Quality

The quality is calculated as the ratio of the number of good products and the number of totally made products. It is assumed that the counters are updated continuously during all operation time. The counters may also be reset, e.g., when the machine is restarted.

On the OEE Settings tool, it can be configured that a specified default Quality must be used. In this case no calculation will be made, but the specified value is used as Quality. It makes sense if the equipment does not produce quality information.

Figure 5-3 Example of hourly “Quality” KPI calculation



General

The OEE values are calculated for each machine and for each of the following time periods:

- Hour
- Day
- Week
- Month

The OEE values are also calculated for each area and production line in the plant. The basis for the calculation of these values are the archived Machine OEEs.

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The downtime can be specified for days on the OEE Setting panel. If the machine is in downtime, then the values during this time frame are excluded from calculations.

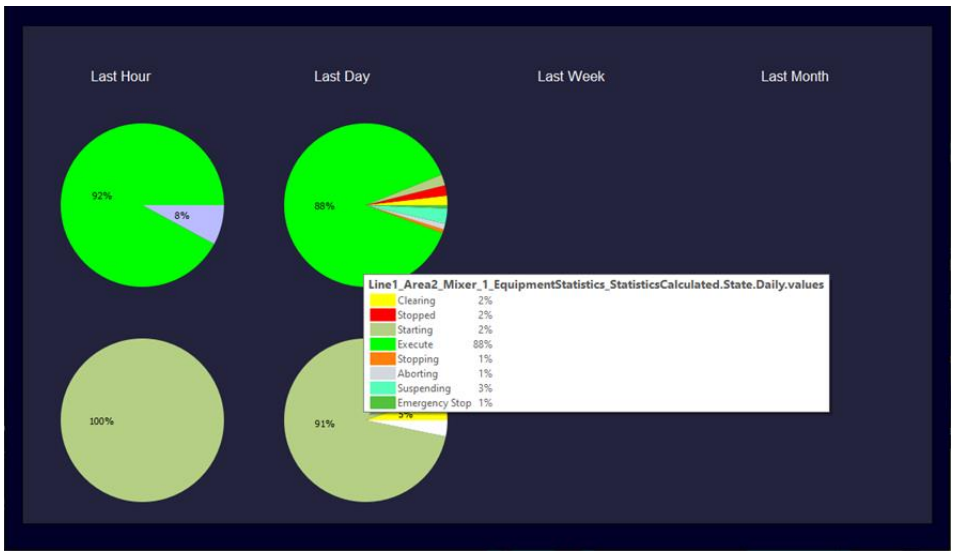
For example: Availability 100% Monday to Friday. Availability 0% on Saturday and Sunday. If downtime is specified for Saturday and Sunday, then the calculated Availability for the week will be 100% ((100+100+100+100+100+0+0) / 5) instead of 71% ((100+100+100+100+100+0+0) / 7).

5.2 Statistics

Hourly, daily, weekly, and monthly statistics are calculated for each machine for the machine state and the machine mode. The statistics need to be archived to calculate the longer period values from the shorter period values and in order to display the historical values.

The legend and a list of all displayed values are shown in the tooltips of the pie charts.

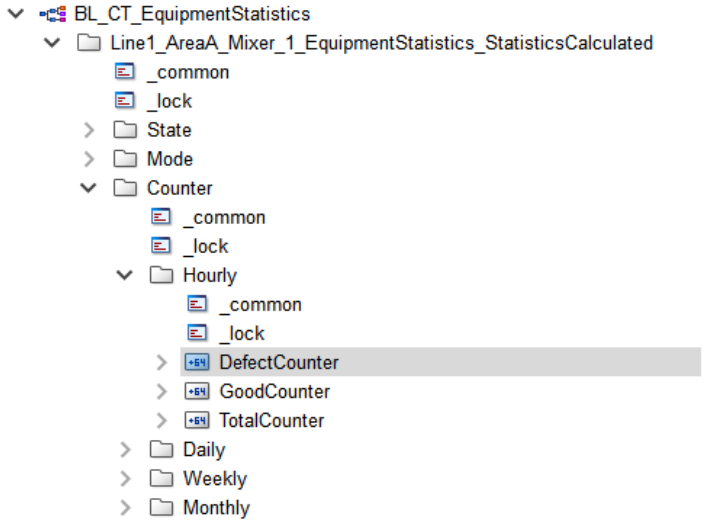
Figure 5-4 Statistics for Machine State and Mode



Statistics are also calculated for the counters of each machine:

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Figure 5-5 Statistics for Machine Counters



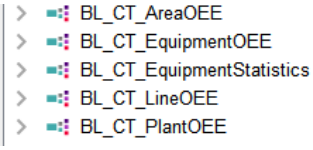
The downtime can be specified for days on the *OEE Setting* panel. If the machine is in downtime, then zero (0) is used instead of the counters during this time frame.

5.3 Calculated Data

For the calculation and archiving of KPIs special datapoint types are defined. The DPEs of this DPs do not have peripheral addresses but they should have configured archive handles (see DP Archives) for having historical data when showing the KPIs.

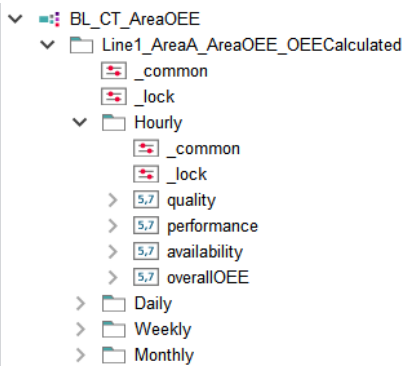
The following DPTs are available for calculated data.

Figure 5-6 DPTs for KPIs



Instances of this DPTs are created automatically when the calculation of the KPIs is started. A DP is created for each machine (*EquipmentStatistics*, *EquipmentOEE*), each area (*AreaOEE*), each line (*LineOEE*) and for the plant (*PlantOEE*).

Figure 5-7 Example DP for OEE

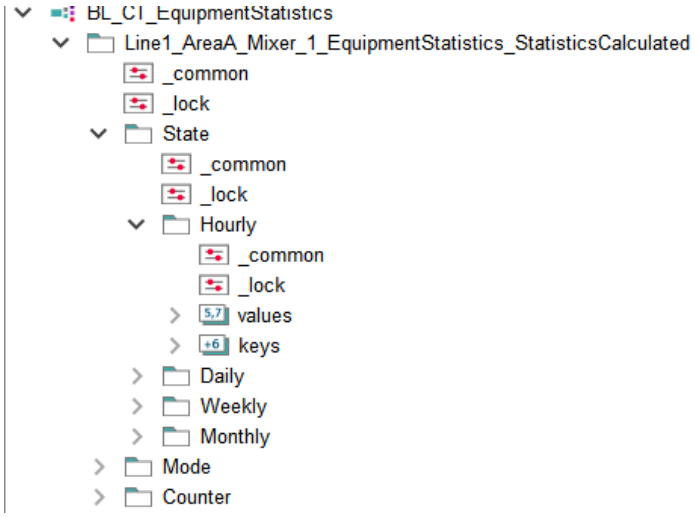


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The parts “*Daily*”, “*Weekly*” and “*Monthly*” of the DP have the same structure than “*Hourly*”.

Statistics are calculated for the “*state*”, “*mode*” and “*counters*” of each machine.

Figure 5-8 Example DP for Statistics



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6 Engineering Tools

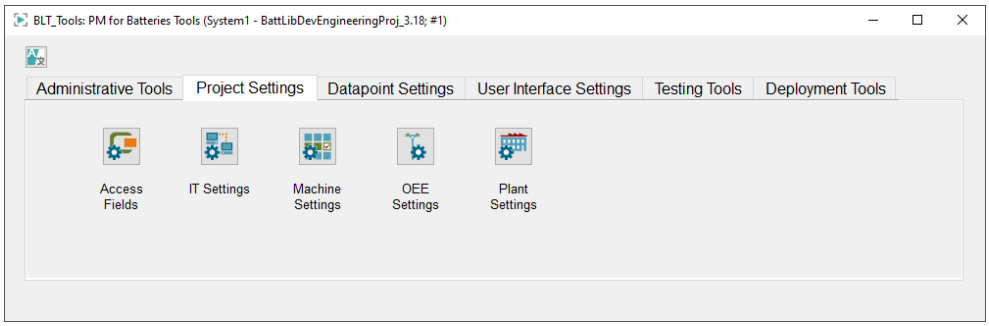
Engineering tools can be opened from the WinCC OA graphical editor (Gedi).

Figure 6-1 “Engineering tools” button



The icon represents Production Management for Batteries tools and can be used for opening the tool panel.

Figure 6-2 Tools in category "Project Settings"

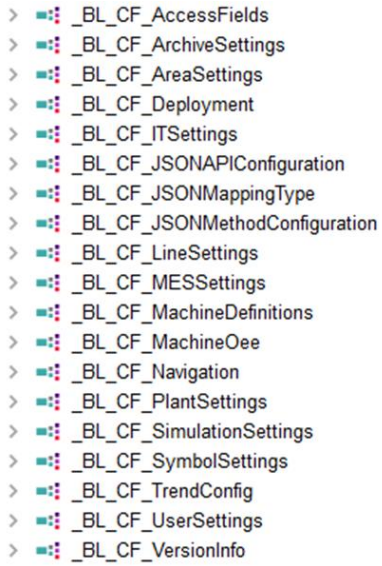


6.1 Tool related Data

6.1.1 DPTs for Tool Results

When using the library tools for configurating things in the engineering projects, the results must be stored in the database of the project. This is done using “internal” datapoint types. In the deployment process the created datapoints of this DPTs are also supplied for being imported into the runnable WinCC OA projects.

Figure 6-3 DPTs for Configurations with Tools



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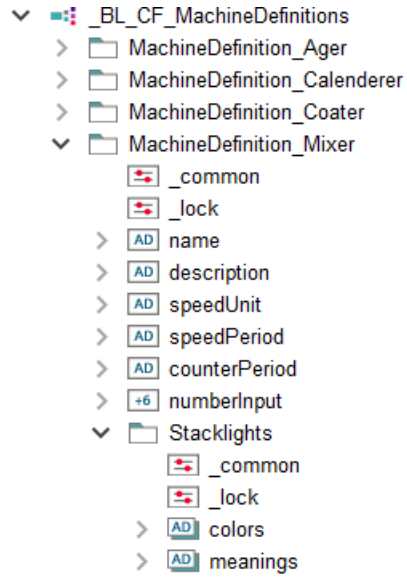
Below are examples of DPTs for “Machine Definitions”, “Area Definitions”, “Symbol Settings” tools.

NOTE It is not recommended to change internal tool’s DPs through Para directly. The following description is for informational purposes only.

Machine Definitions

The results for the machine type settings can be found in DPs of DPT “_BL_CF_MachineDefinitions”. For each machine type there exists one DP for the configuration data.

Figure 6-4 Storage for Machine Definitions

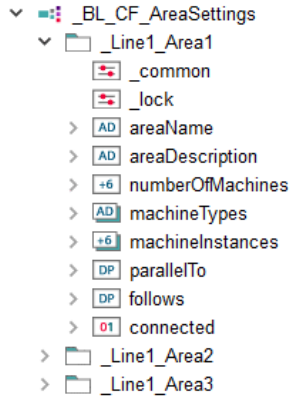


Area Definitions

The results for the area settings can be found in DPs of DPT “_BL_CF_AreaSettings”. For each defined area there exists one DP for the configuration data.

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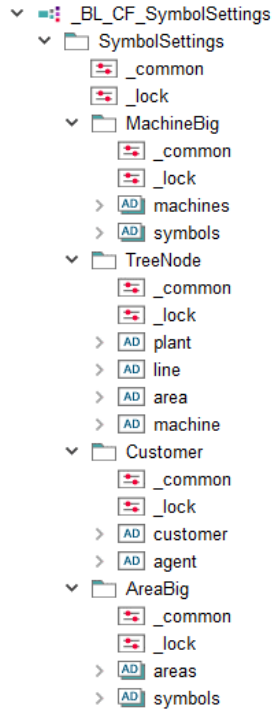
Figure 6-5 Storage for Area Definitions



Symbol Settings

The results for the symbol settings can be found in one DP of DPT "_BL_CF_SymbolSettings" named "SymbolSettings".

Figure 6-6 Storage for Symbol Settings



6.1.2 DP Lists

When using the Export/Import of data from the database there are three different types of datapoint lists due to technical reasons:

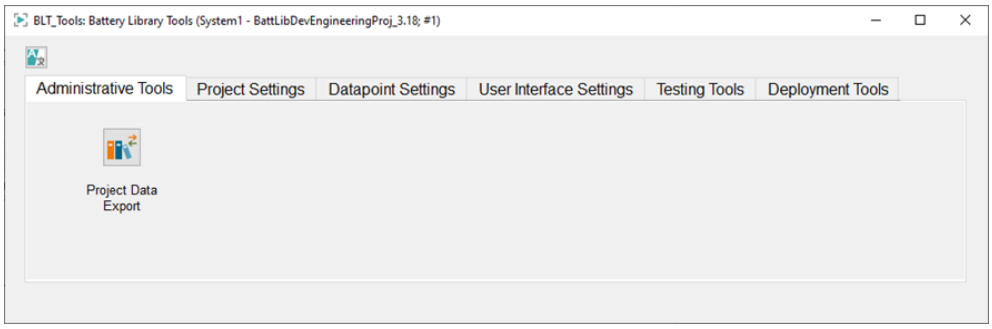
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Table 6-1 Types of DP Lists

Name of .dpl-File	Description
01_DPT_<Name>.dpl	These files contain the datapoint types.
02_DPE_<Name>.dpl	These files contain the datapoints and their configuration (Configs).
03_DPE_<Name>.dpl	These files contain the datapoints and their online values.

6.2 Administrative Tools

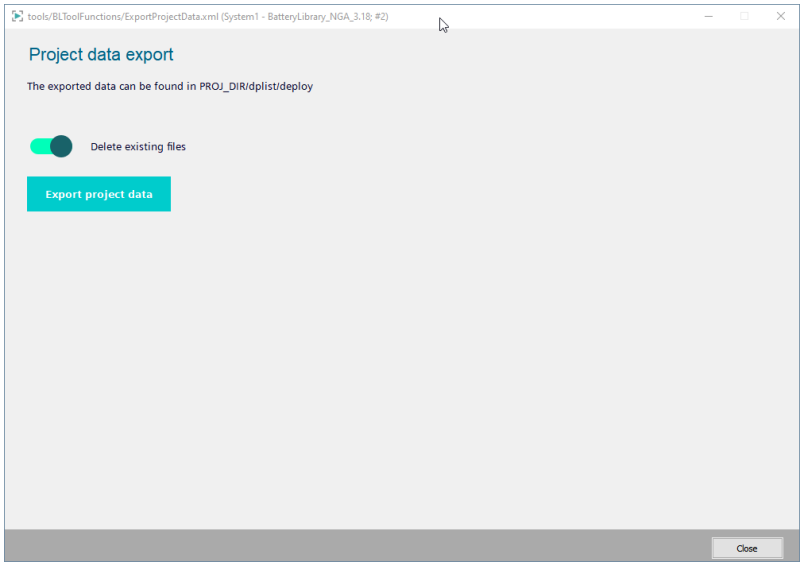
Figure 6-7 Administrative Tools



6.2.1 Export of Project Data

Export the whole project and configuration data to data point lists. Those are used by the deployment tool afterwards (Deployment).

The exported data includes everything the Production Management for Batteries needs to operate. If the engineer needs additional data to be included in the export, the function „initializeProjectDataExportFilter“ in the file scripts/libs/tools/exportsImports.ctl must be adapted.



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Export

1. Click Button "Export project data"

NOTE When changing *exportsImports.ctl* one must not remove the predefined filters, otherwise the runtime project may not work.

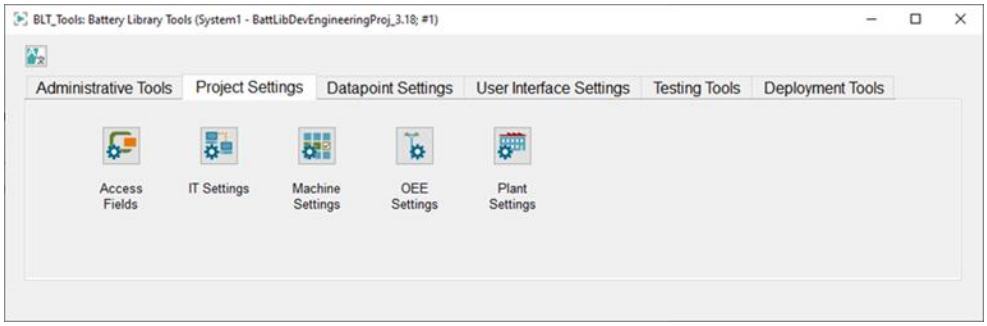
The panel exports Data Point Types, Data Points and Data Point Element values and configurations from the engineering project.
The data is stored in dplist files in <*PROJ_DIR*>*/dplist/deploy*.

The DPTs are stored in files named in pattern "*01_DPT_*.dpl*", Data Points and DPE configs are stored in "*02_DPE_*.dpl*", and original values for DPEs are stored in "*03_DPE_*.dpl*".

The DPs for a specific line, area, machine are stored in files that contain the line, area, machine type and machine instance in the file name. This is used for filtering the files according to the area assignments in IT Settings.

6.3 Project Settings

Figure 6-8 Project Settings



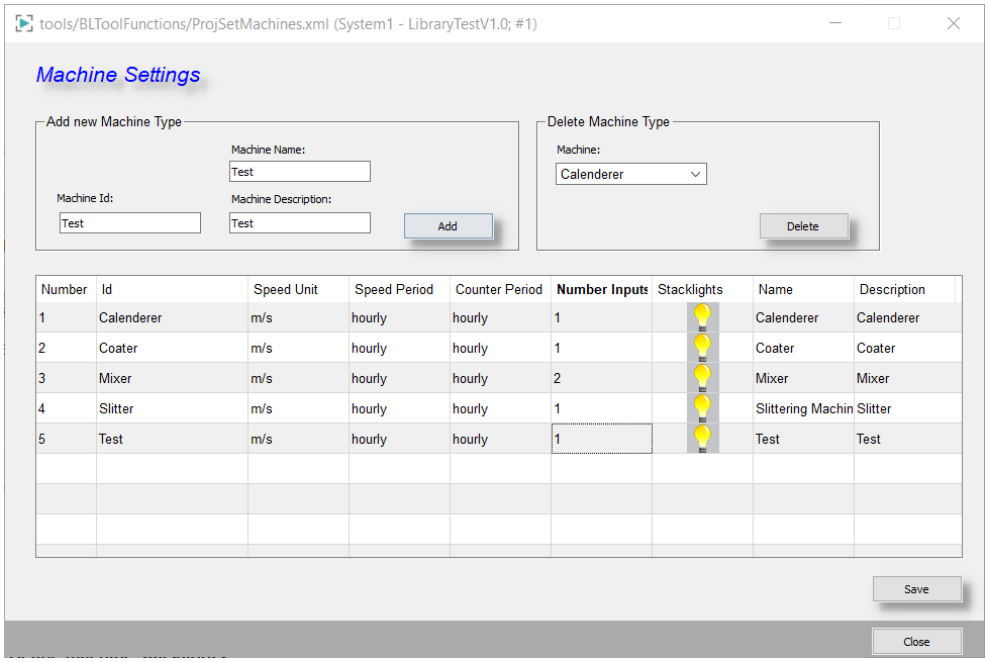
6.3.1 Machine Settings

With the tool "*Machine Settings*" the different machine types in the plant can be defined. The machine types must be defined before the process tags for all the machine instances can be created.

NOTE The ids of the machine types are part of the DP names for the machine instances. The same naming rules as for DP names count for the machine type ids. Additionally underline ("_") is not allowed.

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Figure 6-9 Machine Settings



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Add new machine type

1. Enter the machine type id in field "*Machine Id*"
2. Enter the machine type name in field "*Machine Name*"
3. Enter the machine type description in field "*Machine Description*"
4. Click button "*Add*"
5. Click button "*Save*"

NOTE The following default OEE Availability States are also automatically configured when a new machine type is created.

- Clearing
- Starting
- Idle
- Execute
- Completing
- Complete
- Setup

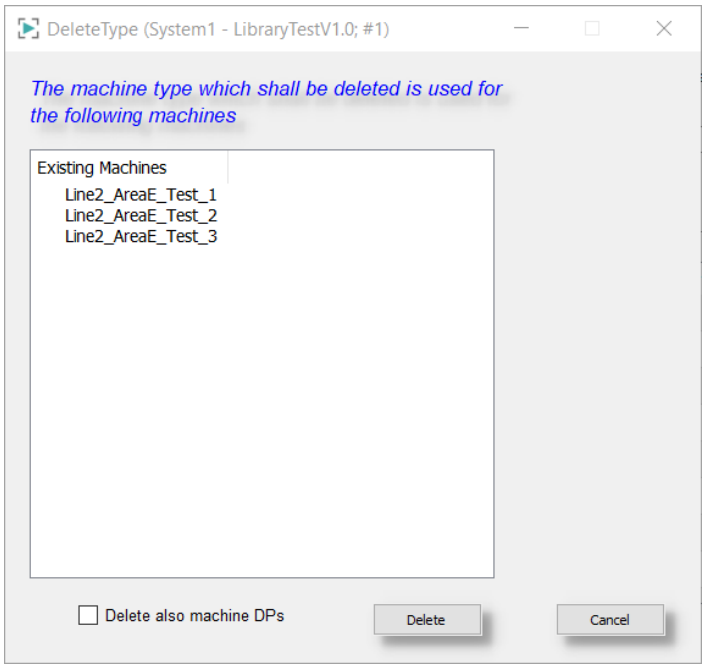
Delete machine type

1. Select machine type in the drop-down list "*Machine*"
2. Click button "*Delete*"
3. If the machine type is currently not used:
   a. The machine type is deleted from the table

b. Click button "*Save*"

4. If the machine type is used for machines:
   a. A popup window shows the existing machines

Figure 6-10 Delete machine type - existing machines



5.
   a. Click button “*Cancel*” if you do not want to delete the machine type
   b. Check “*Delete also machine DPs*” if you want to delete the machine datapoints with the machine type
   c. Click button “*Delete*” in the popup window
   d. Close the popup window
   e. Click button "*Save*"

Modify properties of a machine type

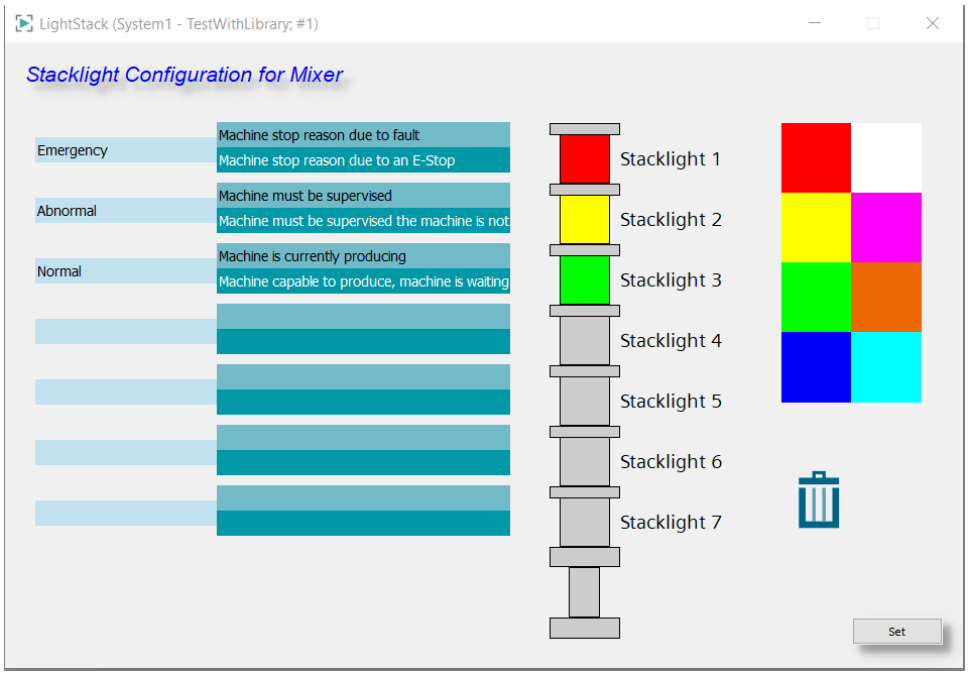
1. Select a field in the table
2. Choose a value
   from a list or enter a new value
3. Click button "*Save*"

Define machine stacklights

1. Click a symbol in the column “*Stacklights*”

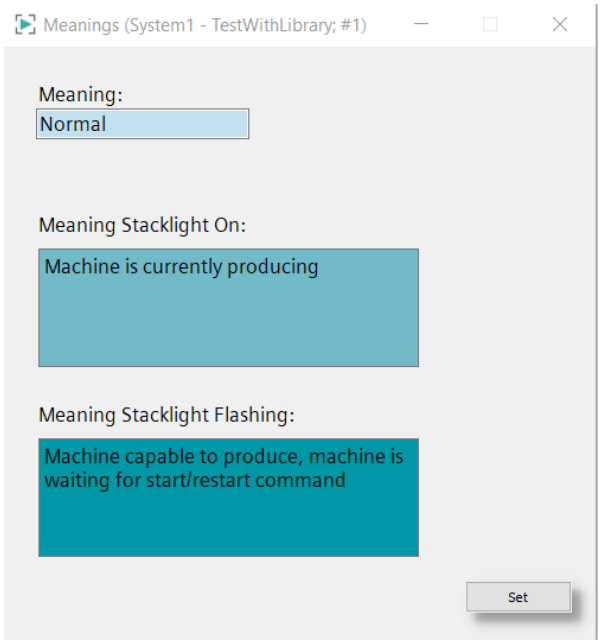
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Figure 6-11 Stacklight configuration for machine type



2. Drag and drop a color on a stacklight to configure or change the color of the stacklight
3. Drag and Drop a stacklight to “trash bin” to reset the stacklight configuration
4. Click on a text field for the stacklight meaning on the left side and open the editor for the stacklight meanings

Figure 6-12 Edit stacklight meanings



5. Click button "*Set*" in meaning editor
6. Click button “*Set*“ in stacklight dialog

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7. Click button “*Save*“ in tool overview

NOTE The stacklights must be configured starting from “*Stacklight1*” without gaps (unused stacklights in-between).

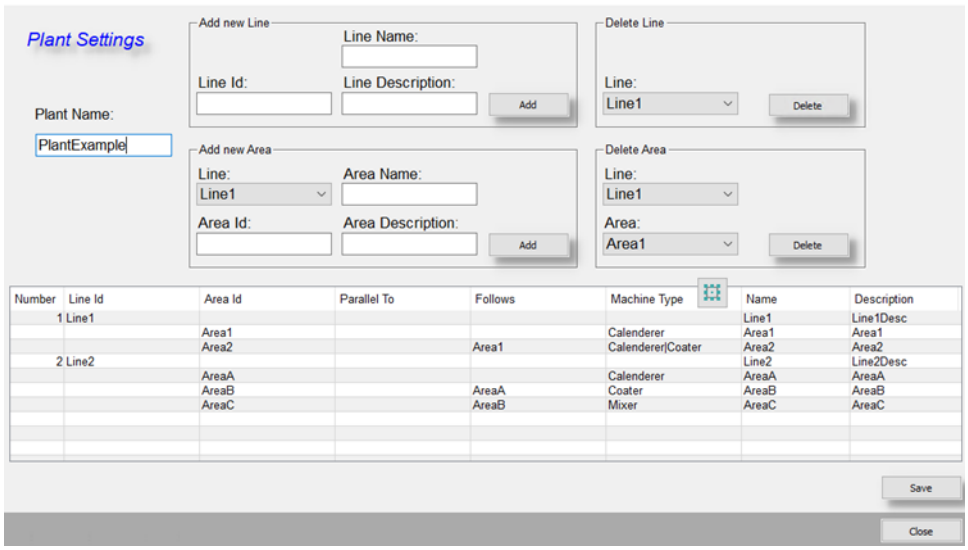
The stacklight configurations are only saved permanently when the “*Save*” button in the tool is clicked.

6.3.2 Plant Settings

With the tool “*Plant Settings*” the structure of the plant is configured. A plant consists of one or more production lines, and a line consists of one or more production areas.

The position of the areas to each other also can be defined. This plant configuration is used for building the navigation tree, the lines in the tree are sorted alphabetically.

Figure 6-13 Plant configuration



NOTE There must be configured at least one machine type for each area in the list.

When defining which areas are in parallel and which area follows another area it must be considered that there must not be a cycle in the configuration.

NOTE The ids for lines and areas are part of the DP names for the machine instances. The same naming rules as for DP names apply here. Additionally underline (“_”) is not allowed.

Plant name

1. Enter the plant name in field "*Plant Name*"

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Add new Line

1. Enter the line id in field "*Line Id*" in frame "*Add new Line*"
2. Enter the line name in field "*Line Name*" in frame "*Add new Line*"
3. Enter the line description in field "*Line Description*" in frame "*Add new Line*"
4. Click button "*Add*" in frame "*Add new Line*"

NOTE The given Line Id must always start with "*Line<number>*" (e.g. "*Line1*", "*Line2*"), otherwise the DP pattern in the default plant sum alarm must be adapted.

Add new Area

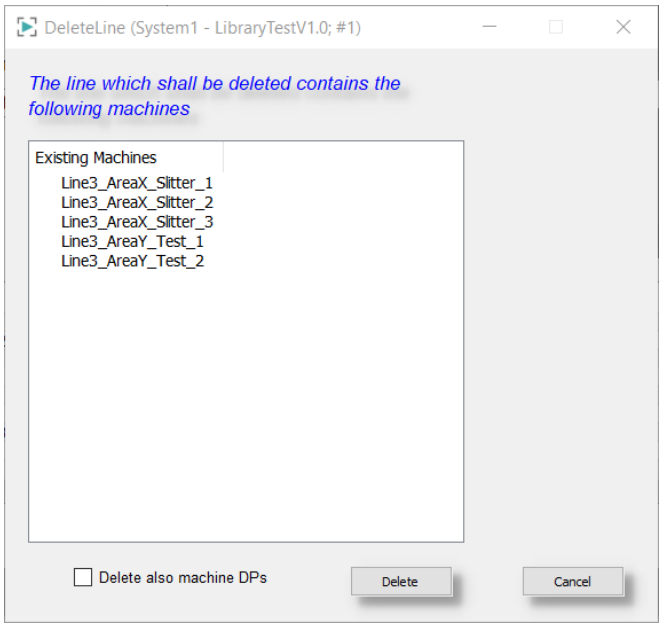
1. Select an existing line in frame "*Add new Area*"
2. Enter the area id in field "*Area Id*" in frame "*Add new Area*"
3. Enter the area name in field "*Area Name*" in frame "*Add new Area*"
4. Enter the area description in field "*Area Description*" in frame "*Add new Area*"
5. Click button "*Add*" in frame "*Add new Area*"

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Delete Line

1. Select a production line in the drop-down list "*Line*" in frame "*Delete Line*"
2. Click button "*Delete*" in frame "*Delete Line*"
3. If the line currently has no machines:
    a. The line and it's areas are deleted from the table
    b. Click button "*Save*"
4. If the line contains machines:
    a. A popup window shows the existing machines

Figure 6-14 Delete line – existing machines



b. Click button “*Cancel*” if you do not want to delete the line
c. Check “*Delete also machine DPs*” if you want to delete the machine datapoints with the line
d. Click button “*Delete*” in the popup window
e. Close the popup window
f. Click button "*Save*"

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Delete Area

1. Select a production line in the drop-down list "*Line*" in frame “*Delete Area*”
2. Select a production area in the drop-down list "*Area*" in frame “*Delete Area*”
3. Click button "*Delete*" in frame “*Delete Area*”
4. If the area currently has no machines:
   a. The area is deleted from the table
   b. Click button "*Save*"
5. If the area contains machines:
   a. A popup window shows the existing machines
   b. Click button “*Cancel*” if you do not want to delete the area
   c. Check “*Delete also machine DPs*” if you want to delete the machine datapoints with the area
   d. Click button “*Delete*” in the popup window
   e. Close the popup window
   f. Click button "*Save*"

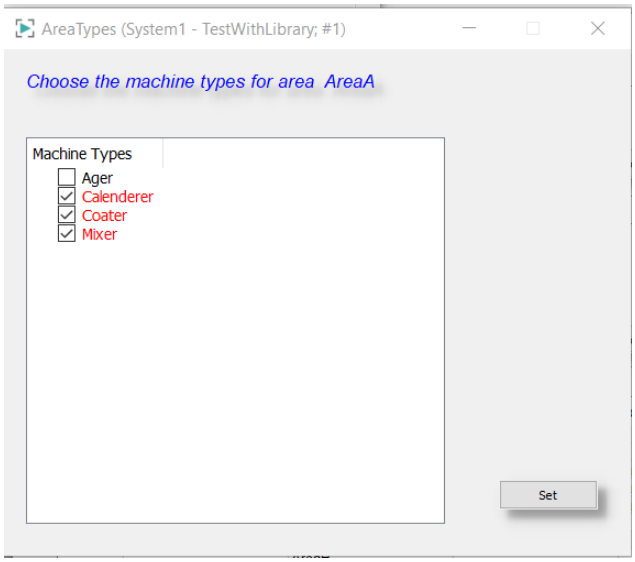
Position of an area

1. Select in the drop-down list in column “*Parallel To*” the area to which the area lies in parallel
2. Select in the drop-down list in column “*Follows*” the area on which the area follows in the production line

Machine type in an Area

1. Select a row in the table which belongs to an area
2. Click the button in the headline of column “*Machine Type*”

Figure 6-15 Machine Type for Area



3. Select the machine types of the area in the shown machine types tree
4. Click button “Set”

Save configuration

1. Click button "Save"

NOTE It is possible to configure different machine types in one area. But it is not advised to do that, especially when the machine types have different stacklight definitions. In this case the shown summary of the stacklights in the area overview is not unique. Everywhere where a summary information of the machines of an area is shown, the first defined machine type is used (e.g., for the symbol file in plant overview).

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NOTE Clicking the "*Save*" button updates all already existing configurations, such as:

- line and area name and description
- plant name
- plant, line, and area Sum Alarms
- area connected alarm configuration (shows connection state of distributed systems)
  - alert text is defined in WinCC OA message catalog *BL_basic.cat* with the key "*DistConnectionLost*"
  - updated every time "Save" button is clicked
- follows, parallel to, and machine types for area

In case of inconsistent configurations an error message is shown after clicking the "*Save*" button. The errors must be fixed, otherwise the User Interface will not open.

The following errors are possible:

- **"PlantSettings DP is missing"**
  Proposed fix: Create a DP named `_PlantSettings` of DPT `_BL_CF_PlantSettings`
- **"Plant OEE DP "Plant_PlantOEE_OEECalculated" is missing"**
  Proposed fix: Create a DP named `Plant_PlantOEE_OEECalculated` of DPT `BL_CT_PlantOEE`. Make sure to set the archive configurations again and restart the OEE calculation scripts afterwards.
- **"Plant Sum Alarm DP "SumAlarm_Plant" is missing"**
  Proposed fix: Create a DP named `SumAlarm_Plant` of DPT `BL_CT_SumAlarm` and click "Save" in the Plant Settings tool again (for updating the alert configuration).
- **"Line OEE DP for line "<line>" is missing"**
  Proposed fix: Create a DP named `<line>_LineOEE_OEECalculated` of DPT `BL_CT_LineOEE`. Make sure to set the archive configurations again and restart the OEE calculation scripts afterwards.
- **"Line Sum Alarm DP for line "<line>" is missing"**
  Proposed fix: Create a DP named `SumAlarm_<line>` of DPT `BL_CT_SumAlarm` and click "Save" in the Plant Settings tool again (for updating the alert configuration).
- **"No line name found for line <line>"**
  Proposed fix: Set a unique line name in the column "Name" for the row defining the specified line in the Plant Settings tool. Click the "Save" button again.
- **"Line name found for line "<line>" is not unique"**
  Proposed fix: Update the line name for the specified line to be unique in the Plant Settings tool. Click the "Save" button again.
- **"Line found without any areas"**
  Proposed fix: Use the Plant Settings tool to add at least one area to the specified line. Click "Save" afterwards.
- **"Invalid area order configuration for line <line>"**
  Proposed fix: Check/update the values of the Follows and Parallel To columns for areas of the specified line in the Plant Configuration tool.
- **"Line for area "<line>_<area>" does not exist"**
  Proposed fix: Add a line with Line ID = <line> using the Plant Settings tool.
- **"No area name found for area <line>_<area>"**
  Proposed fix: Set a unique area name (within the line) in the column "Name" for

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the row defining the specified area in the Plant Settings tool. Click the “Save” button again.

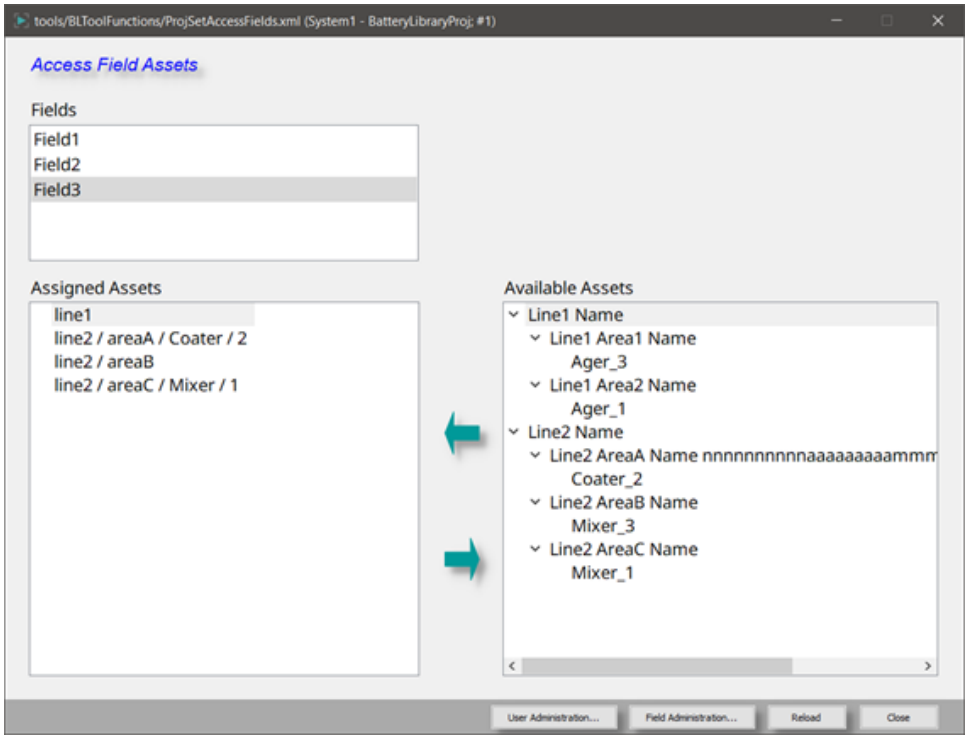
- **“Area name found for area “<line>_<area>” is not unique”**
  Proposed fix: Set a unique area name (within the line) in the column “Name” for the row defining the specified area in the Plant Settings tool. Click the “Save” button again.
- **“Area does not have assigned machine types”**
  Proposed fix: Define at least one valid machine type for the specified area using the Plant Settings tool. Click the “Save” button again afterwards.
- **“Area contains invalid assigned machine type”**
  Proposed fix: Check the configured machine type(s) for the specified area. The assigned machine types for the area must be configured in the tool Machine Settings first.
- **“Area Sum Alarm DP for area “<line>_<area>” is missing”**
  Proposed fix: Create a DP named `SumAlarm_<line>_<area>` of DPT `BL_CT_SumAlarm` and click “Save” in the Plant Settings tool again (for updating the alert configuration).
- **“Area OEE DP for area “<line>_<area>” is missing”**
  Proposed fix: Create a DP named `<line>_<area>_AreaOEE_OEECalculated` of DPT `BL_CT_AreaOEE`. Make sure to set the archive configurations again and restart the OEE calculation scripts afterwards.

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6.3.3 Access Field Assets Settings

With this tool the Access Field Assets can be configured. An Access Field in Production Management for Batteries is a User Area in WinCC OA. An Asset in Production Management for Batteries is a Line, an Area, or a Machine.

Figure 6-16 Access Field Assets



Manage WinCC OA Users

1. Push the *User Administration* button to open the WinCC OA User Administration panel
2. Do the configuration on WinCC OA User Administration panel
3. Close the WinCC OA User Administration panel
4. Push the *Reload* button to refresh and overtake changes

Manage Fields

1. Push the *Field Administration* button to open the WinCC OA User Area Administration panel
2. Do the configuration on WinCC OA User Area Administration panel
3. Close the WinCC OA User Area Administration panel
4. Push the *Reload* button to refresh and overtake changes

Add Assets to Field

1. Select the *Field* under Fields
2. Drag an Asset from *Available Assets* and drop it to *Assigned Assets*, or select an Asset under *Available Assets* and push the Left Arrow Symbol or use Ctrl + Left Arrow shortcut key

Remove Assets from Field

1. Select the *Field* under Fields
2. Drag an Asset from *Assigned Assets* and drop it to *Available Assets*, or select an Asset under *Assigned Assets* and push the Right Arrow Symbol or use Ctrl + Right Arrow shortcut key

Delete Field Configuration

1. Select *Field*
2. Remove all *Assignment Assets* from the *Field*
3. Push the *Reload* button

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6.3.4 IT Settings

This tool enables the configuration of the servers running the deployed projects.

It contains the following tabs for defining the servers and assigning responsibilities for each server.

Servers

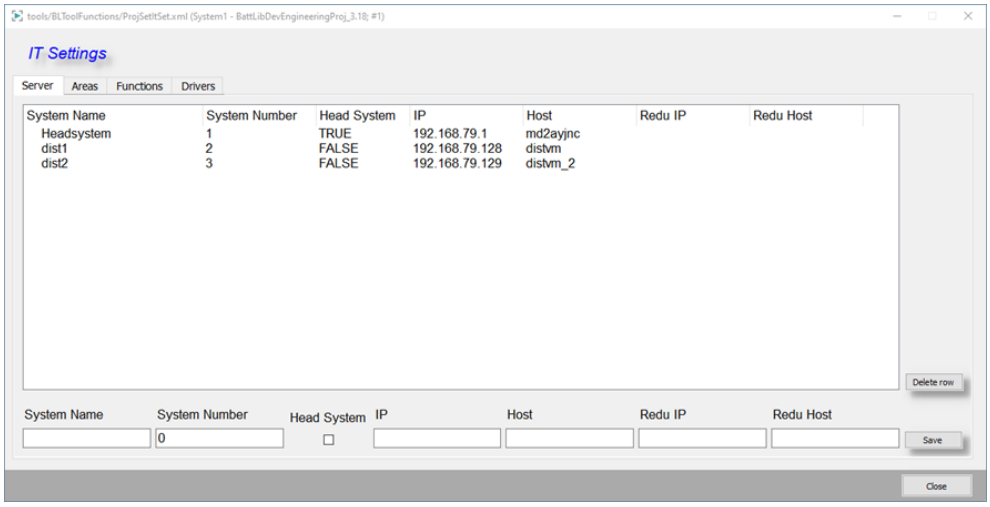
With this tab the servers can be configured. You can add the unique System Name with a unique System Number.

Exactly one system should be marked as Head System, which means that it will have connections to all other systems.

For each server, the IP address and Hostname must be supplied, in case of redundant servers the fields for Redu IP and Redu Host should be filled.

The table lists already added Systems data. The input fields under the table enable adding new or updating existing server details.

Figure 6-17 IT Settings – Servers



Add System

1. Fill the input fields at the bottom of the screen
2. Use new unique *System Name*
3. Use unique *System Number*
4. Push the *Save* button or use the shortcut key Ctrl + S

Modify System

1. Select an existing *System* from the list, data will be shown in the input fields
2. Do not modify the *System Name*
3. Do not modify the *System Number* or use new unique *System Number*
4. Edit further data at the bottom of the screen
5. Push the *Save* button or use the shortcut key Ctrl + S

Copy System

1. Select an existing *System* from the list, data will be shown in the input fields.
2. Use new unique *System Name*
3. Use unique *System Number*
4. Edit further data at the bottom of the screen
5. Push the *Save* button or use the shortcut key Ctrl + S

Delete existing System

1. Select an existing *System* from the list
2. Push the *Delete row* button

Reload List

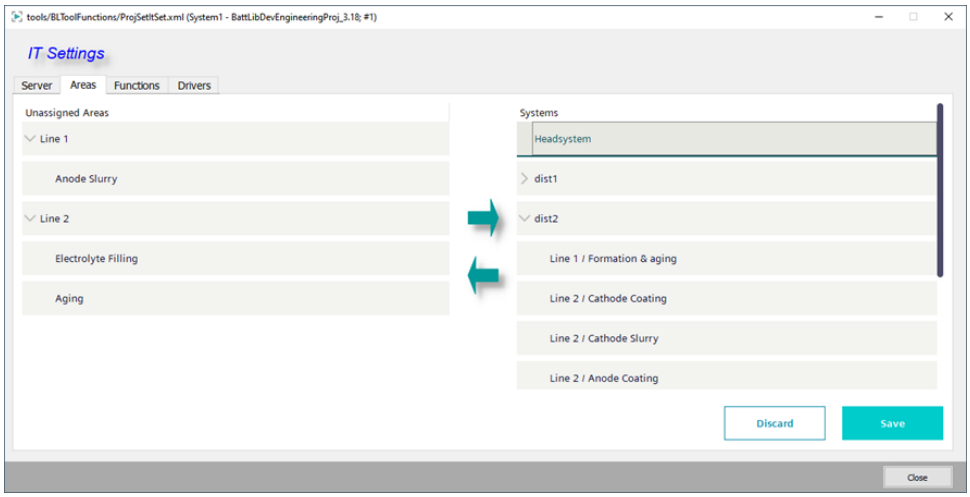
1. Double click on an element in the list

Areas

This tab allows the assignment of areas (configured in Plant Settings) to systems defined in the "*Server*" tab above. It also allows to assign Areas to distributed systems.

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Figure 6-18 IT Settings – Areas



The assignment can be done by selecting an area or line in the left tree and a server in the right tree. Afterwards the right arrow button can be pressed to assign the selected area / line to the server.

To remove an assignment the area can be selected in the right tree and the left arrow button pressed.

Alternatively, drag and drop can be used to assign/unassign areas or lines.

The assignments can be saved by pressing the "*Save*" button. In case of unwanted changes, the "*Revert*" button can be used to reset the shopfloor assignments to the last saved ones.

NOTE

If an area is not assigned to any of the servers, it will not be deployed in any of the server projects.

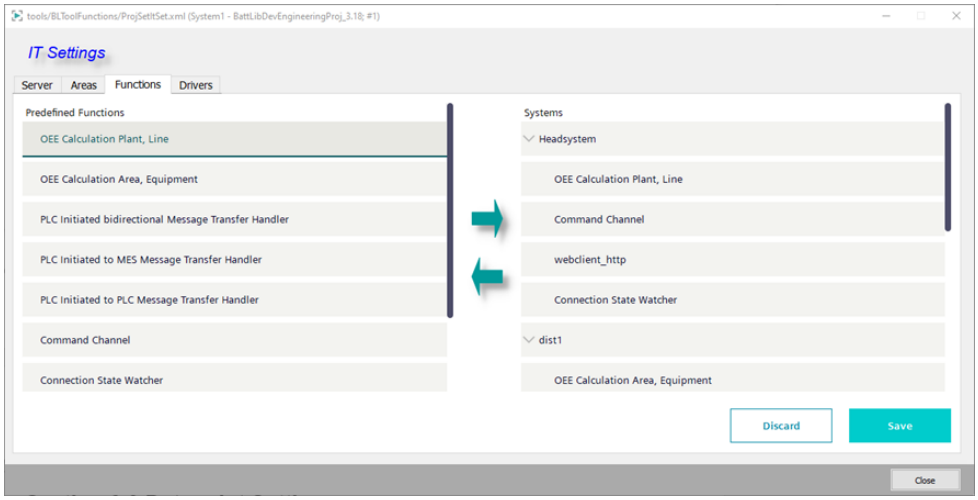
The configuration is not done automatically, areas always must be assigned to the servers manually using the tool described above (even if only one server exists).

Functions

The tab allows the assignment of predefined functions and custom functions to configured servers. The functions are CTRL managers with defined parameters, which are predefined for the predefined functions. For custom functions they can be defined as needed.

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Figure 6-19 IT Settings – Functions



The assignment can be done by selecting a predefined function or the entry "*Custom Function*" in the left tree and a server in the right tree.

When "*Custom Function*" is selected a field for defining the parameters for the CTRL manager appears.

Afterwards the right arrow button can be pressed to assign the selected function to the server.

To remove an assignment the function can be selected in the right tree and the left arrow button pressed.

Alternatively, drag and drop can be used to assign/unassign functions.

The assignments can be saved by pressing the *Save* button. In case of unwanted changes, the *Revert* button can be used to reset the function assignments to the last saved ones.

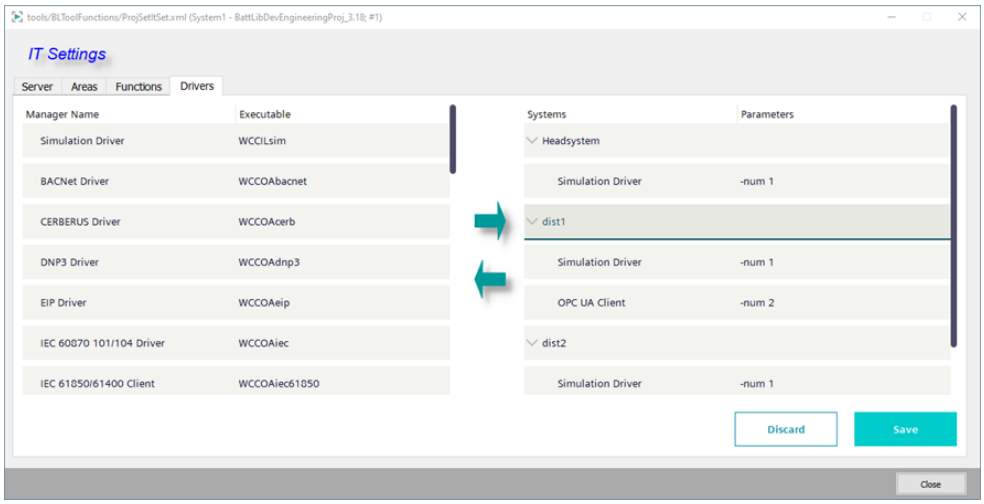
By default, the functions are assigned as suggested by the server configuration.

Drivers

Drivers tab can be used to define, which drivers should be running on each of the configured servers.

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Figure 6-20 IT Settings – Drivers



The left tree shows a list of available drivers, the configured servers are displayed in the tree on the right.

A driver can be assigned to a server by selecting the driver in the left tree, selecting the server in the right tree, and pressing the right arrow button.

A dialogue panel is opened asking for the parameters of the driver.

To remove an assignment the driver can be selected in the right tree and the left arrow button pressed.

Alternatively, drag and drop can be used to assign/unassign drivers.

The assignments can be saved by pressing the *Save* button. In case of unwanted changes, the *Revert* button can be used to reset the driver assignments to the last saved ones.

By default, all servers with attached machines have an assigned OPC UA Client with parameter *"-num 1"*. If there are no machines connected to a server and it is a head server, then it will have assigned a simulation driver by default (*"-num 1"*).

The default driver assignments can be changed before saving the configuration.

NOTE The driver numbers must be unique within each server, starting at 1.

6.3.5 OEE Settings

This tool allows some first simple settings for controlling the calculation of the OEE values. It contains the following tabs for defining common settings and settings for the calculation of availability, quality, and performance of equipment (machines).

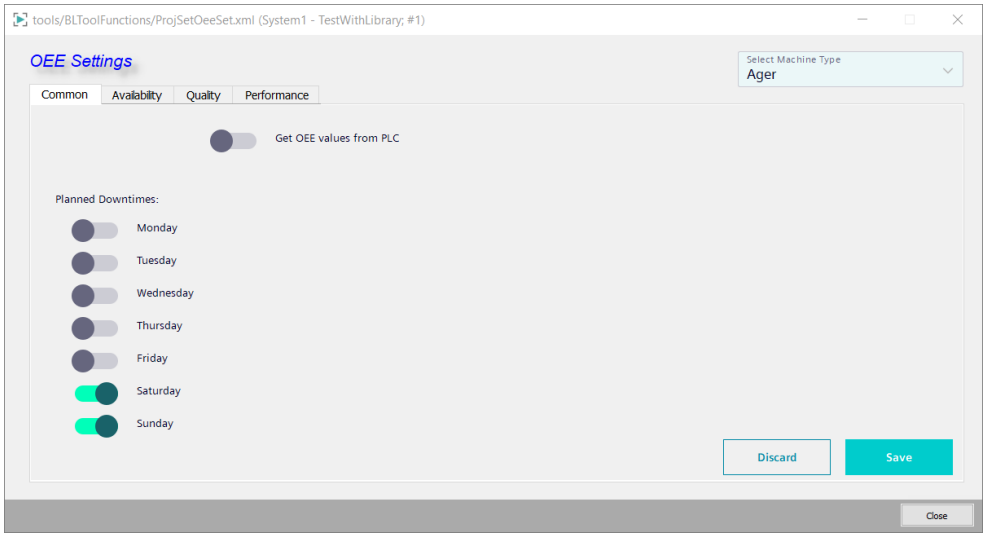
The OEE settings can be configured for each machine type. The machine type can be selected outside of the specific tabs.

Common

With this tab the planned downtimes for machine types can be configured. In the current version this is done by selecting weekdays.

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Figure 6-21 OEE Settings – Common

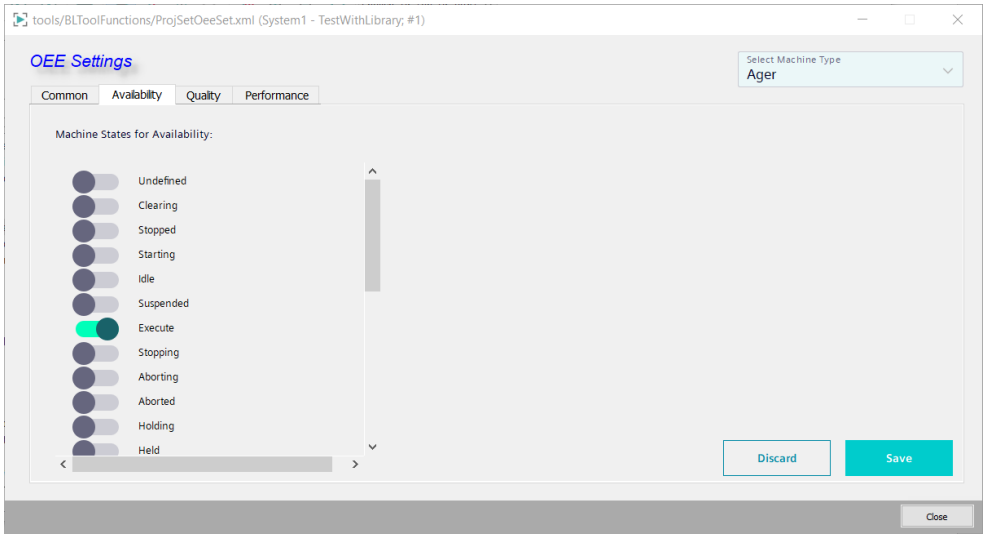


1. Select an existing machine type.
2. Select the weekdays which should be considered as planned downtimes.
3. Click button “*Save*” to store the settings.
4. Click button “*Discard*” to discard the last changes. The already stored settings are shown.

Availability

With this tab the availability states for machine types can be configured. The shown states are based on the common definition of machine states.

Figure 6-22 OEE Settings – Availability



1. Select an existing machine type.
2. Select the states which should be considered as states where the machines are seen as available.

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3. Click button “*Save*” to store the settings.
4. Click button “*Discard*” to discard the last changes. The already stored settings are shown.

NOTE

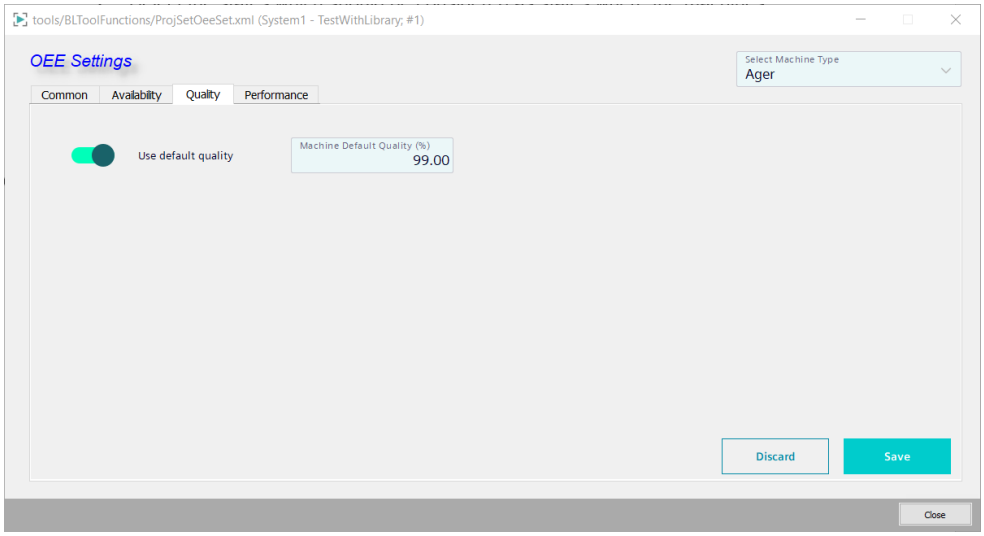
If the selected machine type is newly created, the following availability states are automatically selected by default.

- Clearing
- Starting
- Idle
- Execute
- Completing
- Complete
- Setup

Quality

With this tab a default quality can be configured. This is useful when machine types do not supply data which can be used for calculating the quality.

Figure 6-23 OEE Settings – Quality



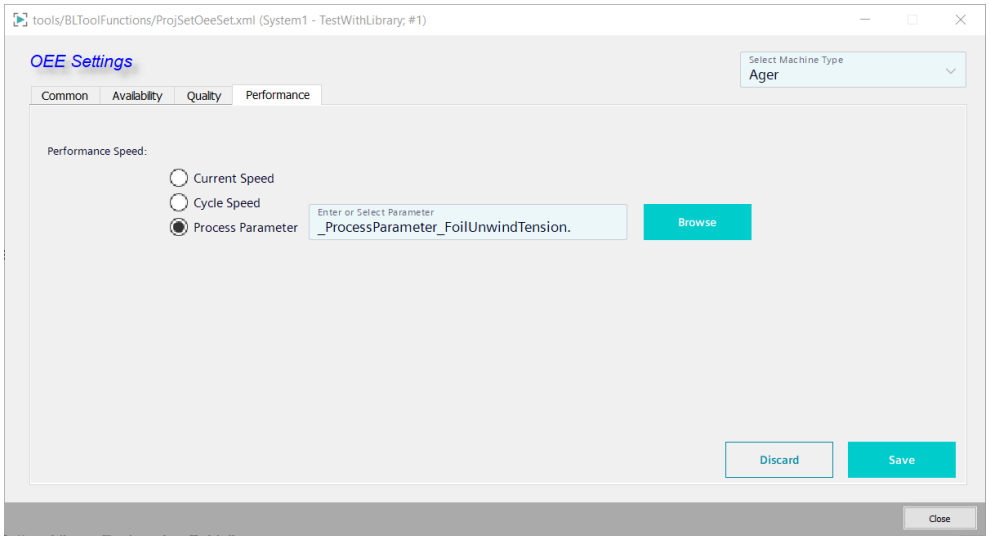
1. Select an existing machine type.
2. Set the “*Use default quality*” option if a default value for quality should be used for OEE calculation.
3. Enter a value between 0 and 100 which is used as percentage value for the quality.
4. Click button “*Save*” to store the settings.
5. Click button “*Discard*” to discard the last changes. The already stored settings are shown.

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Performance

With this tab the source for the speed can be chosen, which should be used for the performance calculation.

Figure 6-24 OEE Settings – Performance



1. Select an existing machine type.
2. Check the source for the speed value.
3. If the cycle speed is used the calculation of the performance is done different from using the current speed. For the speed setpoint the designed cycle time is used instead of the designed current speed.
4. If an existing process parameter is used for the speed source, the calculation is handled like with the current speed, only the source of the current speed is different.
5. Click button “*Save*” to store the settings.
6. Click button “*Discard*” to discard the last changes. The already stored settings are shown.

NOTE If Cycle Speed is selected, then the Archive Configuration must be added to *DesignCycleTime* and *CurrentCycleTime* DPEs.

If *Process Parameter* is selected, then the respective DPE must be available for all machine types and the *Archive Configuration* must be added to the *Process Parameter* and *DesignSpeed* DPEs.

NOTE The *Archive Configuration* must be added to respective parameters to ensure correct calculation of OEE values. E.g.:

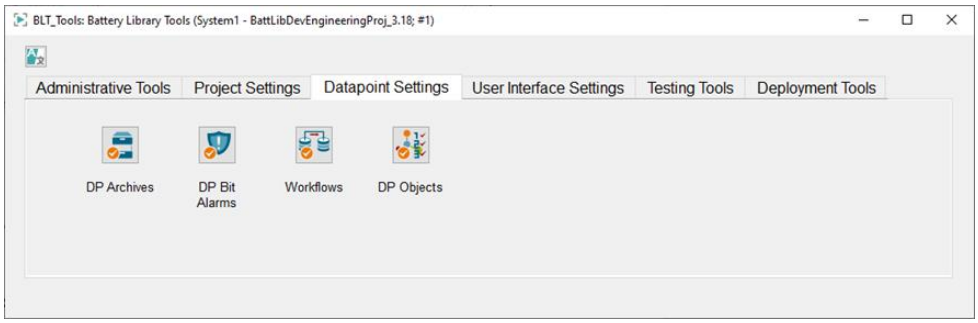
EquipmentStatus: State, Mode, DesignSpeed, CurrentSpeed, DesignCycleTime, CurrentCycleTime, GoodCounter, BadCounter, TotalCounter.

EquipmentOEE.*, AreOEE.*, LineOEE.*, PlantOEE.*, ProcessParameter.*

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6.4 Datapoint Settings

Figure 6-25 Tools for Datapoint Settings



It is assumed that for each real OPC UA server there is existing one SiOME file, which contains all instances of object types which are needed for one machine or several machines.

Creation and configuration of DPs. Basically, the generation of the following DP Element configs is possible:

- External address (_address, _distrib)
- Alarm handling (_alert_hdl)
- Archive handling (_archive)

The WinCC OA Datapoints (DPs) contain the values of the process data.

For each process value which should be monitored and/ or operated a corresponding (Datapoint Element) DPE is necessary. The DPs should be automatically created from some engineering output when implementing the PLC software.

When the engineering for the OPC UA data model is done with the SiOME tool, an xml-File can be exported which contains the types and instances.

The SiOME file can be used for creating the corresponding DPs in WinCC OA. Therefore, the types which are used in OPC UA data model engineering need to be also available in WinCC OA as DPTs.

The basic mechanism with the SiOME file is having definitions for object types and creating instances of the object types. The object types normally contain variables with basic types (Float, String, …) or enumeration types.

But there are exceptions in the current version of the SiOME file which must be considered. There can be instances of data types (e.g., processParameterDataType) which are summarized to an object which has no object type definition. And there are special definitions for messages.

6.4.1 DP Objects

The Tool “DP Objects” has the following tasks:

- Reads the SiOME files and structures the content
- Creates/updates the object DPs for machines from the SiOME file content
- Create/update the OPC UA addresses from the SiOME file content

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- Clones a default OPC UA connection, since every machine needs to have its own dedicated OPC UA connection
- Maps the namespaces found in the SiOME file to different namespace IDs used in the PLC.

OPC UA connections and subscriptions

For each machine the default OPC UA connection

- BL_default_opcua_connection

and the default data and alarm subscriptions

- BL_default_opcua_subscription_data
- BL_default_opcua_subscription_alarms

are copied and saved as DPs named by the following schemes:

- opcua<Line>_<Area>_<MachineType>_<MachineInstance>_connection
- opcua<Line>_<Area>_<MachineType>_<MachineInstance>_data
- opcua<Line>_<Area>_<MachineType>_<MachineInstance>_alarms

Generation of object DPs from predefined DPTs

DPs are created using the following DPTs for OPC UA objects:

Table 6-2 Used object DPTs

OPC UA Data Type	WinCC OA DPT
EquipmentStatusObjectType	BL_OT_EquipmentStatus
EquipmentInformationObjectType	BL_OT_EquipmentInformation
StacklightObjectType	BL_OT_StackLight
BatteryMessageTransferObjectType	BL_OP_MessageTransfer_PLCInitiated_bidirectional / BL_OP_MessageTransfer_PLCInitiated_toMES / BL_OP_MessageTransfer_PLCInitiated_toPLC / BL_OP_MessageTransfer_SCADAInitiated_toPLC
---	BL_OT_EquipmentAlarm
	BL_OT_EquipmentBitAlarm

The tool automatically creates DPs for *Message Transfer* types for OPC UA Objects with data type *BatteryMessageTransferObjectType*.

In case the object contains a Node named *Handshake* and Methods for *SetEnvelope* and *GetEnvelope* it is assumed to be a bidirectional (PLC initiated) message transfer and a DP of DPT *BL_OP_MessageTransfer_PLCInitiated_bidirectional* is created. See 7.2.6 “PULL-PUSH REQUES” Message – PLC Initiated bidirectional

If only *Handshake* and *GetEnvelope* exist it is handled as PLC initiated message transfer and a DP of DPT *BL_OP_MessageTransfer_PLCInitiated_toMES* is created. See 7.2.5 “PULL REQUEST” Message – PLC Initiated to MES.

If only *Handshake* and *SetEnvelope* exist it is handled as PLC initiated message transfer and a DP of DPT *BL_OP_MessageTransfer_PLCInitiated_toPLC* is created. See 7.2.4 “PUSH REQUEST” Message – PLC Initiated to PLC.

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OPC UA Objects for Message Transfers without a *Handshake* Node are handled as SCADA initiated message transfers and a DP of DPT *BL_OP_MessageTransfer_SCADAInitiated_toPLC* is created. See 7.2.3 "PUSH" Message – SCADA Initiated to PLC.

For each machine one DP of DPT "*BL_OT_EquipmentAlarm*" is created if "Create Equipment Alarm" option is selected. This DP is used for handling the alarms of the PLC by OPC UA Alarms&Conditions.

Whenever an OPC UA object with data type "*EquipmentStatusObjectType*" is found, the DP Objects tool creates additional DPs using the following DPTs:

Table 6-3 Additional DPs for KPIs

OPC UA Data Type	WinCC OA DPT
---	BL_CT_EquipmentOEE
---	BL_CT_EquipmentStatistics
---	BL_CT_PlantOEE
---	BL_CT_LineOEE
---	BL_CT_AreaOEE

These DPs are used for handling the KPI calculations.

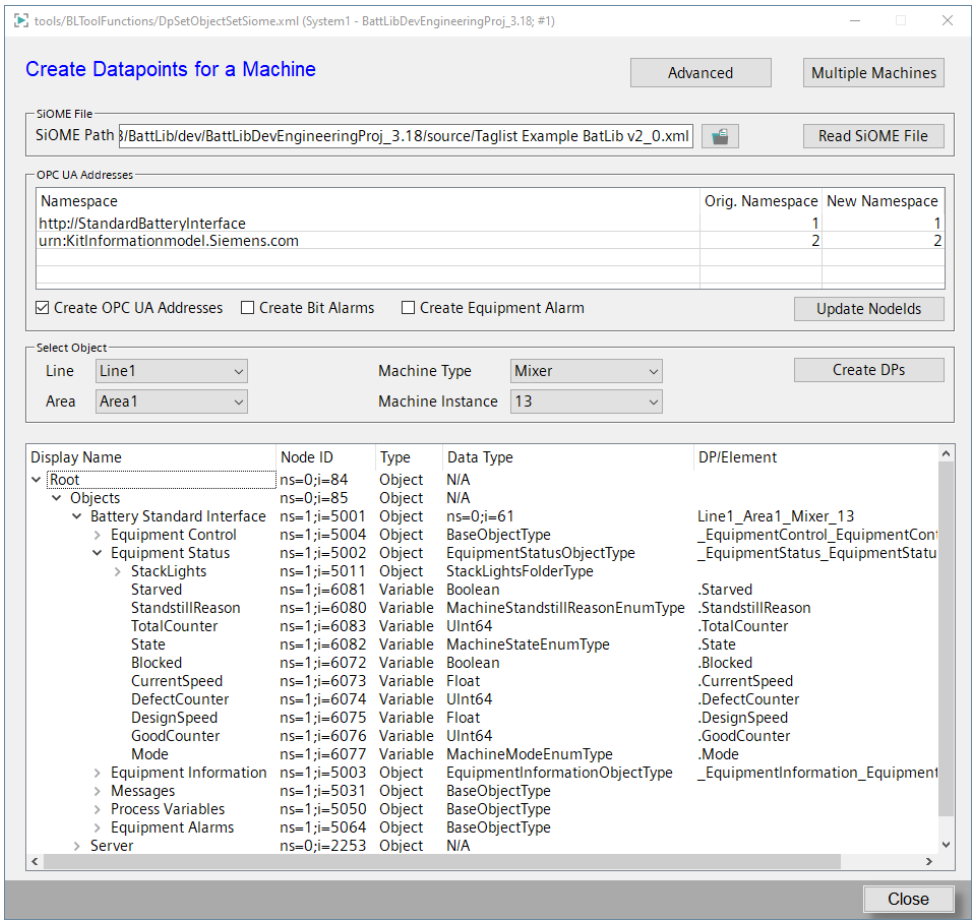
Process Parameters are represented by base variable types (such as Int32, Float, String, …). They must be placed under a OPC UA Object named "Process Variables" in the SiOME file. There is one DP created for every Process Variable with one of the following types (depending on the OPC UA datatype):

- BL_OT_ProcessParameter_Bool
- BL_OT_ProcessParameter_DynBool
- BL_OT_ProcessParameter_Char
- BL_OT_ProcessParameter_DynChar
- BL_OT_ProcessParameter_Float
- BL_OT_ProcessParameter_DynFloat
- BL_OT_ProcessParameter_Int
- BL_OT_ProcessParameter_DynInt
- BL_OT_ProcessParameter_Long
- BL_OT_ProcessParameter_DynLong
- BL_OT_ProcessParameter_String
- BL_OT_ProcessParameter_DynString
- BL_OT_ProcessParameter_Time
- BL_OT_ProcessParameter_DynTime
- BL_OT_ProcessParameter_UInt
- BL_OT_ProcessParameter_DynUInt
- BL_OT_ProcessParameter_ULong
- BL_OT_ProcessParameter_DynULong

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All “*AlarmBitXXX(Boolean)*” variables under “*Equipment Alarms*” object type are created as an DPE of “*BL_OT_EquipmentBitAlarm*” DPT. These variables are used when OPC UA Alarms&Conditions mechanism is not used for alarms, but bit alarms are used instead.

Figure 6-26 DP Objects Generation Panel



Create single machine from SiOME file

1. Click the button with “file open” symbol and choose a SiOME file
2. Click button "*Read SiOME File*"
3. Select a new machine for which the data objects shall be created by selecting *Line*, *Area*, *Machine Type* and *Machine Instance*
4. Select the checkbox “*Create OPC UA Addresses*”
5. Select the checkbox “*Create Bit Alarms*” if needed for a particular machine
6. Select the checkbox “*Create Equipment Alarm*” if OPC UA Alarms&Conditions are needed for a particular machine
7. Enter the namespaces in the table in “*OPC UA Addresses*” which should be used instead of the namespaces found in the file
8. Click button “*Update NodeIds*”
9. Check the tree column “*DP/Element*” to determine which DP or element configuration will be created.

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10. Click button "*Create DPs*"
11. Verify the DPs (and element configs if "*Created OPC UA Addresses*" was selected) to be created in the popup message. Unnecessary DPs can be de-selected and will therefore not be created.
12. Click button "*Create/Update selected DPs*"
13. You can check created DPs in Para, see 4.3.3 Check Address Configs for Datapoint Elements (DPE)

Update single machine from SiOME file

The following steps show, how DPs for an already created machine can be updated.

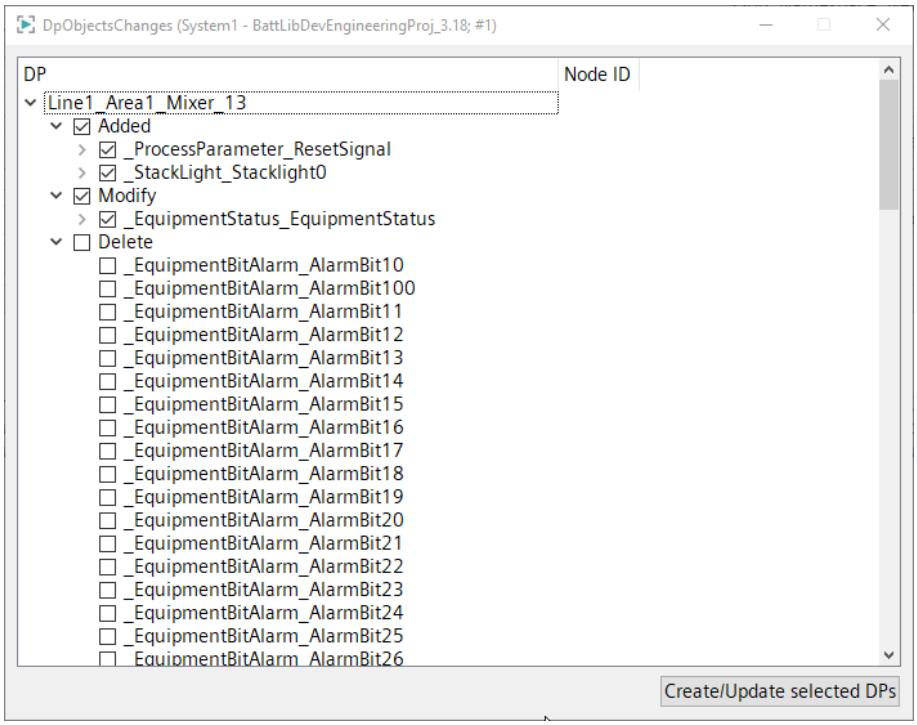
The tool reads the existing configuration from the DPs and compares the DPs and configurations, what would be created for the machine based on the new SiOME file to the already existing DPs and their configurations.

NOTE The update-mechanism only works for machines, which were previously created using the DP Objects tool.

1. Click the button with "file open" symbol and choose a SiOME file
2. Click button "*Read SiOME File*"
3. Select the machine for which the data objects shall be updated by selecting *Line*, *Area*, *Machine Type* and *Machine Instance*
4. Select the checkbox "*Create OPC UA Addresses*"
5. Select the checkbox "*Create Bit Alarms*" if it is needed for a particular machine
6. Select the checkbox "*Create Equipment Alarm*" if OPC UA Alarms&Conditions are needed for a particular machine
7. Enter the namespaces in the table in "*OPC UA Addresses*" which should be used instead of the namespaces found in the file
8. Click button "*Update NodeIds*"
9. Check the tree column "*DP/Element*" to determine which DP or element configuration will be created.
10. Click button "*Update DPs*"
11. Verify the DPs (and element configs if "*Created OPC UA Addresses*" was selected) to be updated in the popup message. Unnecessary DPs can be de-selected and will therefore remain unchanged.

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Figure 6-27 DP Objects – Changes of single machine



NOTE

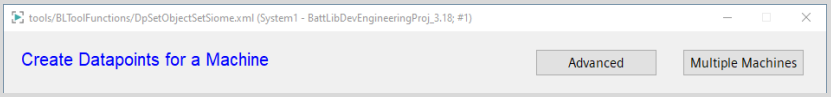
DPs to be removed must be reviewed and manually selected in the popup by the engineer.

In case of an updated DPT (e.g. if the data type of a process parameter changes) the DP will be shown as added and as deleted. In this case the original DP would be removed and created again. It must be ensured that the delete-entry has to be selected, if the DP should be added, otherwise the update will fail.

12. Click button "*Create/Update selected DPs*"
13. You can check created DPs in Para, see 4.3.3 Check Address Configs for Datapoint Elements (DPE)

NOTE

If a machine was created as part of multiple machines from one SiOME file, it must always be updated using the "*Multiple Machines*" dialog.



Create multiple machines from SiOME file

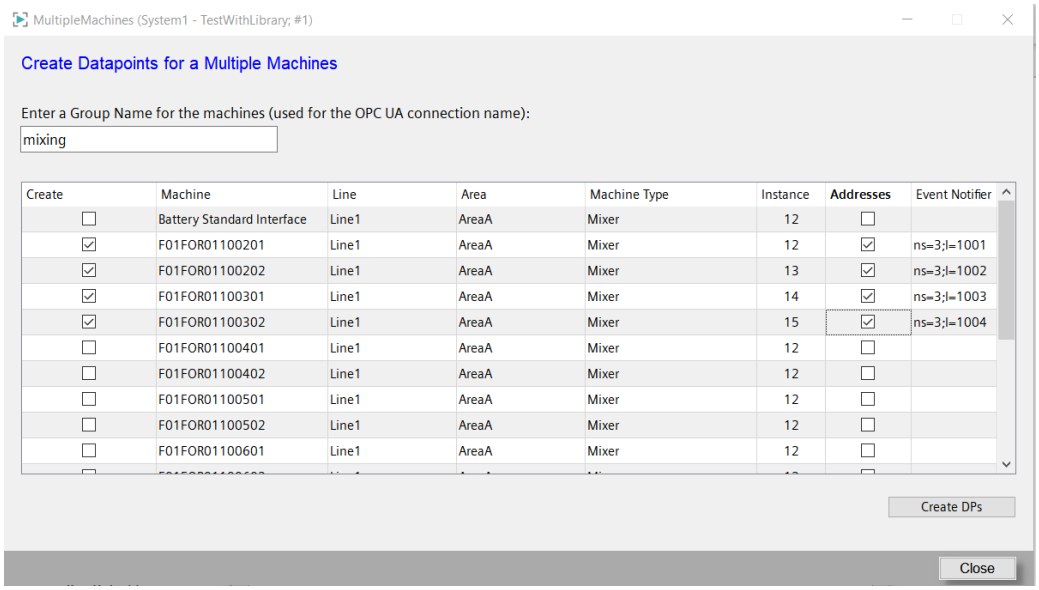
If the SiOME file contains multiple equipment, then several machines are connected to one OPC UA server.

1. Click the button with "file open" symbol and choose a SiOME file
2. Click button "*Read SiOME File*"

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3. Select the checkbox “*Create OPC UA Addresses*”
4. Select the checkbox “*Create Bit Alarms*” if it is needed for the machines.
5. Select the checkbox “*Create Equipment Alarm*” if OPC UA Alarms&Conditions are needed for the machines.
6. Enter the namespaces in the table in “*OPC UA Addresses*” which should be used instead of the namespaces found in the file
7. Click button “*Update NodeIds*”
8. Click button “*Multiple Machines*”

Figure 6-28 DP Objects Generation for Multiple Machines



9. Select all machines for which the data objects shall be created with the checkboxes in column “*Create*”
10. Select *Line*, *Area*, *Machine Type* and *Machine Instance* for each machine
11. Select the checkboxes in column “*Addresses*” for creating the address for the datapoint elements
12. Enter in the column “*Event Notifier*” the node address for the corresponding Alarms&Conditions node
13. Click button "*Create/Update DPs*"
14. Verify the DPs (and element configs if “*Created OPC UA Addresses*” was selected) to be created in the popup message. Unnecessary DPs can be de-selected and will therefore not be created.
15. Click button “*Create/Update selected DPs*”

Update multiple machines from SiOME file

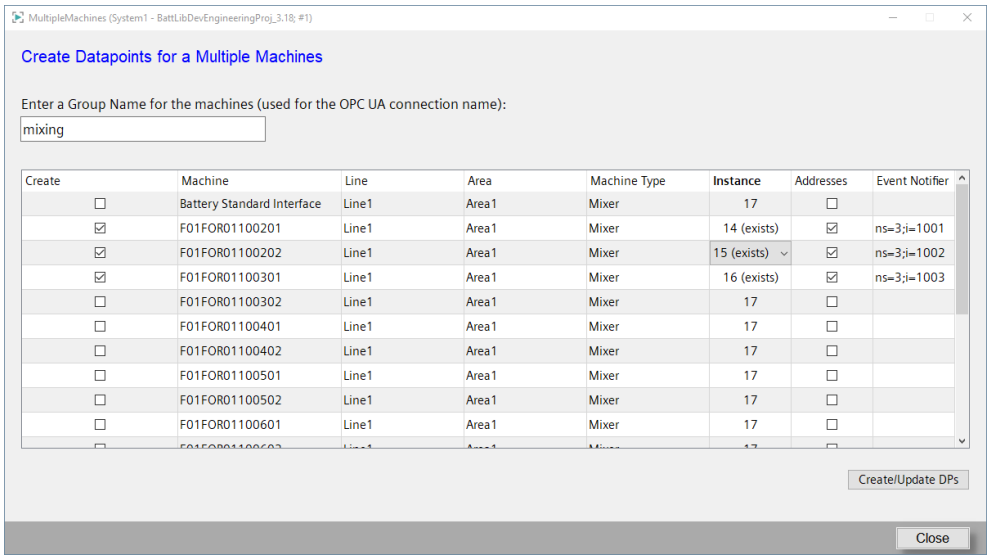
If the SiOME file contains multiple equipment, then several machines are connected to one OPC UA server. In this case the following steps should be used to update one (or more) machines created for a previous version of the SiOME file.

1. Click the button with “*file open*” symbol and choose a SiOME file
2. Click button "*Read SiOME File*"

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3. Select the checkbox “*Create OPC UA Addresses*”
4. Select the checkbox “*Create Bit Alarms*” if it is needed for the machines.
5. Select the checkbox “*Create Equipment Alarm*” if OPC UA Alarms&Conditions are needed for the machines.
6. Enter the namespaces in the table in “*OPC UA Addresses*” which should be used instead of the namespaces found in the file
7. Click button “*Update NodeIds*”
8. Click button “*Multiple Machines*”

Figure 6-29 DP Objects update for Multiple Machines



9. Select all machines for which the data objects shall be updated with the checkboxes in column “*Create*”
10. Select *Line*, *Area*, *Machine Type* and *Machine Instance* for each machine

NOTE It must be ensured that only machines, which were created using the “*Multiple Machines*” dialog are updated this way.

The same machine instance must be created for the same OPC UA Object (e.g. *Line1_Area1_Mixer_14* must always be updated for OPC UA “Machine” “F01FOR01100201” in the screenshot above). If this should change, the machines must be removed manually.

11. Select the checkboxes in column “*Addresses*” for creating the address for the datapoint elements The group name field and the event notifier will be filled with the currently configured values.

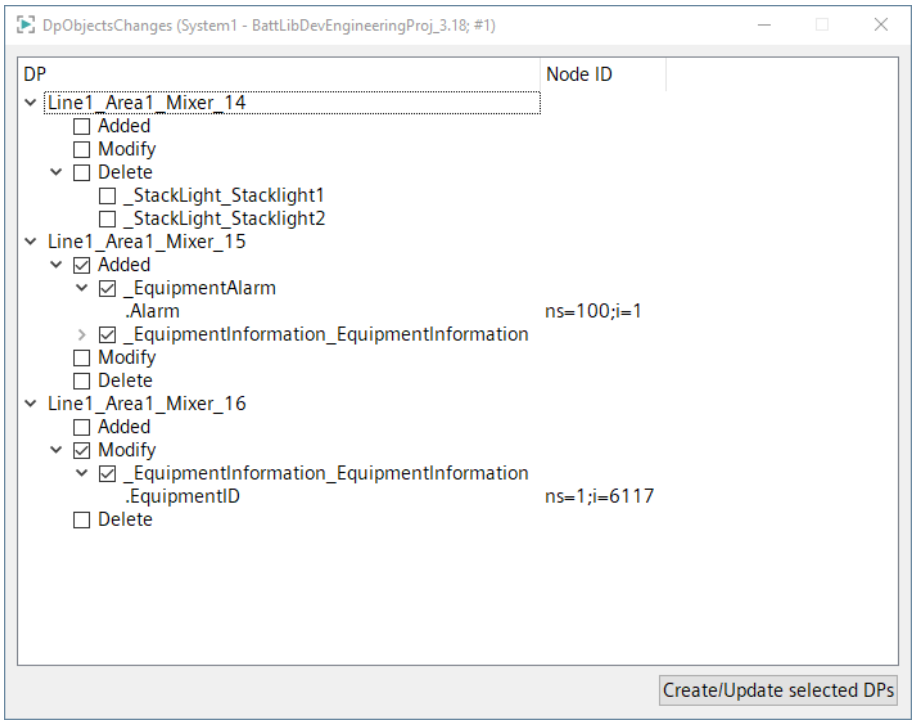
NOTE The “*Group Name*” cannot be updated using the tool.

12. If required the “*Event Notifier”* can be updated
13. Click button "*Create/Update DPs*"

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14. Verify the DPs (and element configs if "*Created OPC UA Addresses*" was selected) to be updated in the popup message. Unnecessary DP updates can be de-selected and will therefore remain unchanged.

Figure 6-30 DP Objects – Changes of multiple machines



NOTE

DPs to be removed must be reviewed and manually selected in the popup by the engineer.

In case of an updated DPT (e.g. if the data type of a process parameter changes) the DP will be shown as added and as deleted. In this case the original DP would be removed and created again. It must be ensured that the delete-entry has to be selected, if the DP should be added, otherwise the update will fail.

15. Click button "*Create/Update selected DPs*"

Connection Loss Alert

To implement OPC UA Connection Loss System Messages the Discrete Alert Handler needs to be used and configured for *".State.ConnState"* connection DPEs under "*_OPCUAServer*" DPT. The Discrete Alert Handler type ensures that the alert can be activated and deactivated by WinCC OA based on the current original value. No specific script is needed which must always run during runtime to supervise the connection changes. We need only one script which does the configuration in engineering time.

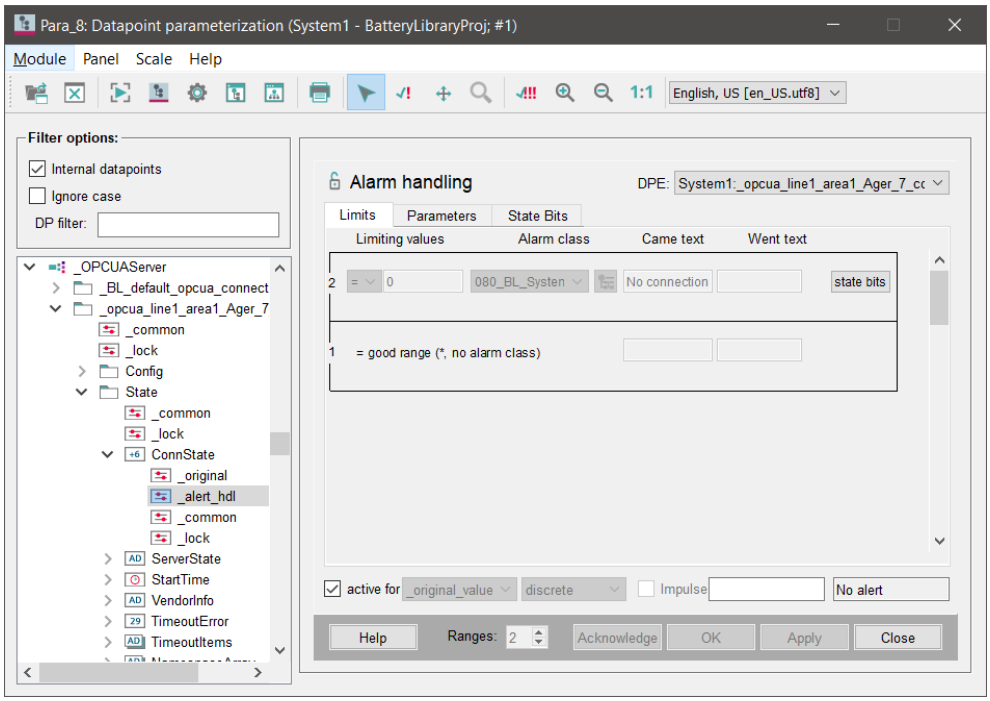
Alert Texts should be defined in WinCC OA message catalog (*BL_basic.cat*) file. This file holds key and value pairs. We will use the key "*OPCUAConnectionLost*" for our entry. This is identical for all connections. Dedicated file is available for each language. Scripts should take the texts from cat file and put them to alert configurations.

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The connection name can be set as Device Description on OPCUA client configuration panel.

When the "*Create DPs*" button is pressed this configuration is automatically created.

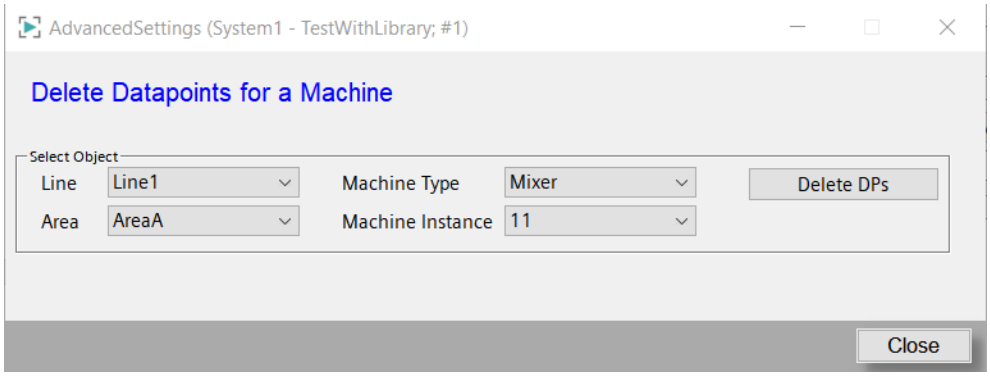
Figure 6-31 System message - OPC UA connection loss



Delete Datapoints for Machine

1. Click button "*Advanced*"

Figure 6-32 DP Objects Deletion for Machine



2. Select the machine for which the data objects shall be deleted by selecting line, area, machine type and machine instance
3. Click button "*Delete DPs*"

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NOTE The archive configurations for the datapoint elements must be added afterwards by using the archive configuration tool, see 6.4.2 DP Archives for further information.

NOTE The OPC UA driver must be restarted to reload the subscriptions before a removed machine can be created again.

6.4.2 DP Archives

Depending on if the engineering project is using the Next Generation Archiver (NGA) or not, the archive tool will also configure the archive configs for the used archiving solution.

NOTE Depending on the archiving solution the engineer has to make sure to configure the archive groups/ NGA groups. The configuration provided by the Production Management for Batteries is only an example configuration, the engineer is responsible for configuring the whole archive and backup parameters – otherwise data can be lost! When using Historical Database (HDB) make sure that the changed configuration is applied. Also, the archive tool does not configure an archive smoothing, this must be configured additionally by the engineer.

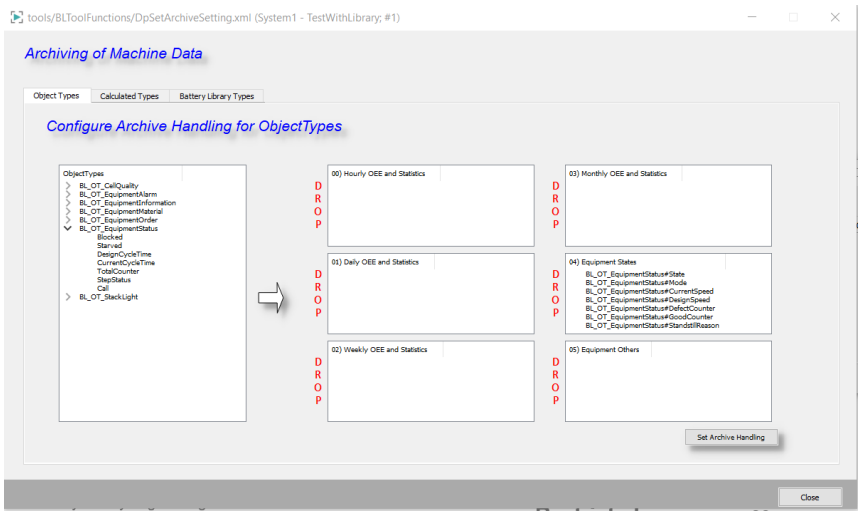
NOTE If any data points are created after the archive configs were created, those data points will not have any archive configs. The tool must be run once more.

Archive Configs with HDB

After opening the archive tool, the user can configure the archives for each DPE per drag and drop. Depending on the active register all “*Object Type*” or “*Calculated Type*” DPT are shown. The user must press the “*Set Archive Handling*” button on each register to create the archive configs on all DPEs.

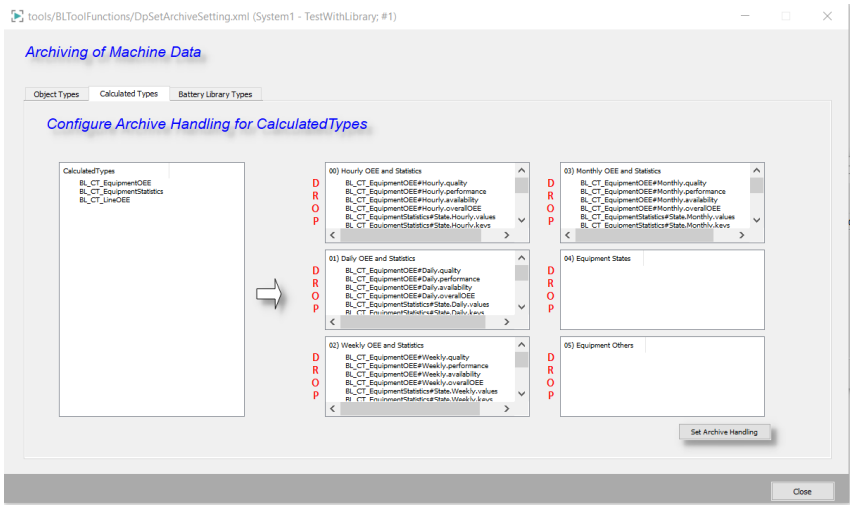
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Figure 6-33 HDB Archive Configuration for Object Types



1. Open an object type in the "*Object Types*" tree
2. Drag a leaf element of the tree to the archive it shall be stored
3. Drop the element (DPE) on the tree (if possible, because of a free space) or on the "D R O P" zone
4. Repeat drag and drop for all data object elements which should be archived
5. Drag and drop an element from an archive tree back to the "*Object Types*" tree if you want to undo the assignment
6. Click button "*Set Archive Handling*" for creating the archive configs for all DPs of the configured object types

Figure 6-34 HDB Archive Configuration for Calculated Types



7. Open a calculated type in the "*Calculated Types*" tree
8. Drag a leaf element of the tree to the archive it shall be stored
9. Drop the element (DPE) on the tree (if possible, because of a free space) or on the "D R O P" zone
10. Repeat drag and drop for all data object elements which should be archived

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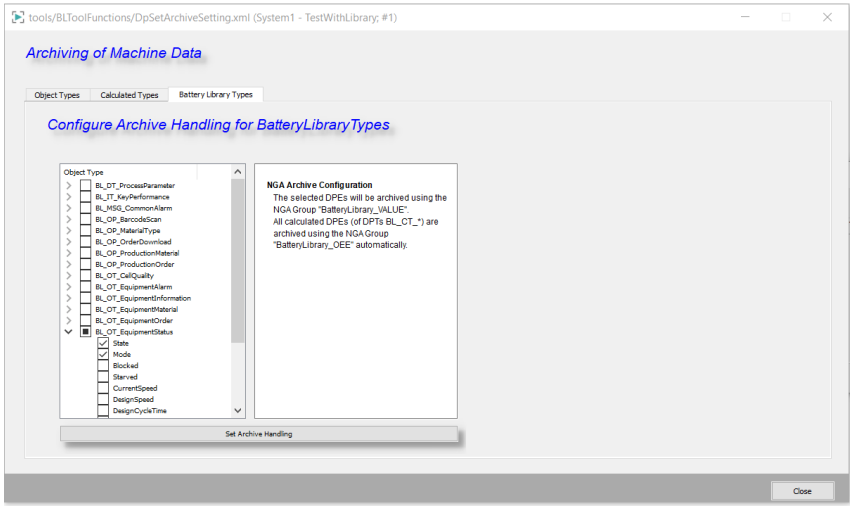
11. Drag and drop an element from an archive tree back to the “*Calculated Types*” tree if you want to undo the assignment
12. Click button “*Set Archive Handling*” for creating the archive configs for all DPs of the configured calculated types

Archive Configs with NGA

After opening the archive tool tab “Battery Library Types”, the user can select all DPEs of all Production Management for Batteries DPT. For all selected DPEs an archive config will be created.

NOTE All DPE of the DPT "BL_CT_*" (all statistics and OEE data) will get an archive config automatically on setting the archive configs.

Figure 6-35 NGA Archive Configuration



1. Open an object type in the “*Object Types*” tree
2. Check the leaf elements of the tree which shall be archived
3. Repeat checking elements for all data types
4. Click button “*Set Archive Handling*” for creating the archive configs for all DPs of the configured object types

NOTE When opening the “DP Archives” tool there will be shown the currently used configuration. This configuration is remembered from the tool from the last usage. The real configuration in the DPs is not checked currently. This means, if there have been made manual changes in the archive configs, this is not reflected in the configuration shown.

6.4.3 Workflows

The communication between the PLC and the MES system is intended to be managed by SCADA. For example, available workorders can be requested from

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MES and then sent to PLCs by SCADA. Another example – “Batch record” can be fetched from the PLC and forwarded to the MES. See 7.1 Communication Concept.

Communication logic between PLCs and MES (workflows) shall be configured within CTRL scripts in a WinCC OA project.

NOTE “Workflow” tool for tool-based communication configuration (instead of scripts) is not yet available in Production Management for Batteries V1.1.

There are 4 script templates that allow fast and easy configuration of data exchange via OPC UA messages mechanism.

See 7.5 Method-based Workflows for more information on message-based data exchange.

See additional document “PM4B Workflow Scripts How-to.docx” for detailed description of script templates.

These scripts can be also used to create communication with MES (Opcenter) via REST API. There are standard transactions available in Production Management for Batteries for that.

See 7.6 Opcenter Execution Core Communication for REST API transactions examples.

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6.4.4 DP Bit Alarms

DP Bit Alarms Tool allows to configure “bit-triggered” alarms within the project.

In order to use this tool Bit Alarms shall be part of imported machine interface. Bit Alarms are the alternative to OPC UA Alarms&Conditions, when it is not possible to use OPC UA A&C.

“DP Bit Alarms” Tool allows to:

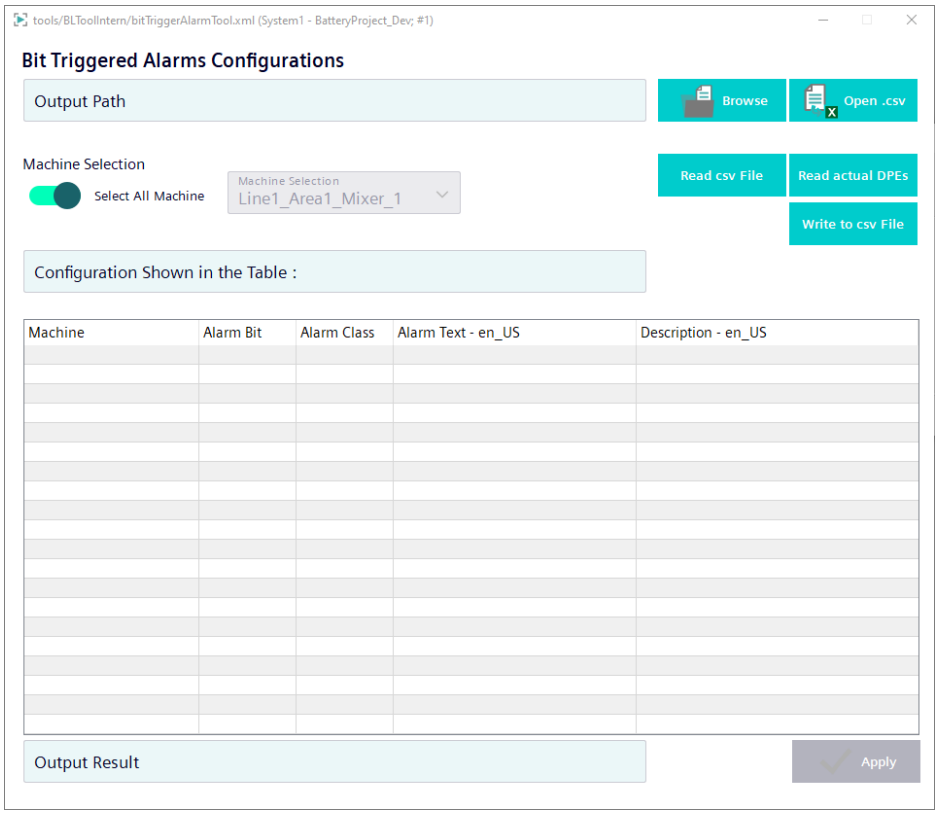
- Read all or selected DPEs of the “BL_OT_EquipmentBitAlarm” DPT.
- Save, update, and read alarm configurations with .csv file.
- Create or update “_alert_hdl” config parameters of the related DPEs.

NOTE Bit alarms DPEs must be created using “DP Object” tool before using “DP Bit Alarms” tool. See Chapter 6.3.1 DP Objects.

“DP Object” tool does not configure/create “_alert_hdl” config for the bit alarm DPEs.

Using the tool “DP Bit Alarms”

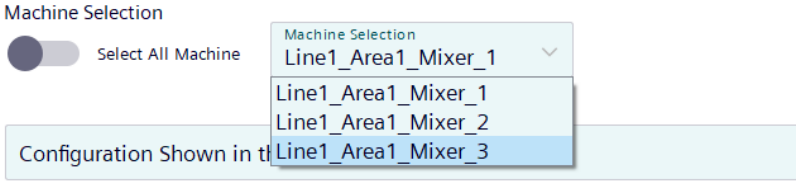
Figure 6-36 DP Settings – Bit Triggered Alarms Configurations



Here are steps for configuring Bit Alarms:

1. Machine Selection.
   There are 2 different options for the machine selection:
   a. Activate "*Select All Machine*" option to select all DPEs of bit triggered alarm DPT.
   b. Disable "*Select All Machine*" option to choose a Machine manually using drop-down list to the right.

Figure 6-37 DP Settings – Machine Selection Options



NOTE The drop-down list is filled automatically with all machines defined in PARA using DP Object tool.

2. Reading data points.
   Click the "*Read Actual DPEs*" button to display all available DPEs in the table below.

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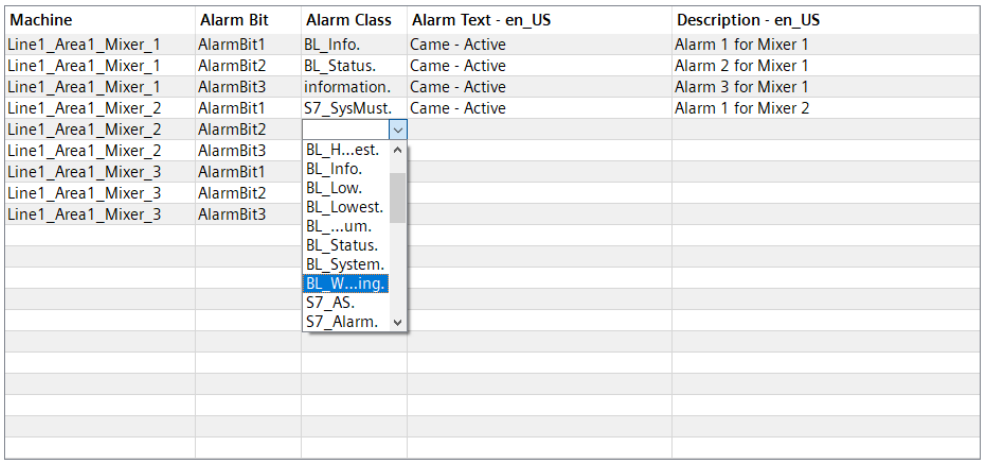
Figure 6-38 DP Settings – Configuration Table1

Machine	Alarm Bit	Alarm Class	Alarm Text - en_US	Description - en_US
Line1_Area1_Mixer_1	AlarmBit1	BL_Info.	Came - Active	Alarm 1 for Mixer 1
Line1_Area1_Mixer_1	AlarmBit2	BL_Status.	Came - Active	Alarm 2 for Mixer 1
Line1_Area1_Mixer_1	AlarmBit3	information.	Came - Active	Alarm 3 for Mixer 1
Line1_Area1_Mixer_2	AlarmBit1	S7_SysMust.	Came - Active	Alarm 1 for Mixer 2
Line1_Area1_Mixer_2	AlarmBit2			
Line1_Area1_Mixer_2	AlarmBit3			
Line1_Area1_Mixer_3	AlarmBit1			
Line1_Area1_Mixer_3	AlarmBit2			
Line1_Area1_Mixer_3	AlarmBit3			

NOTE "*Machine*" and "*Alarm Bit*" columns will be filled automatically. Other columns might be empty.

3. Specify Alarm Class for each Alarm Bit.
   There are 2 options for filling alarm class data:
   a. Select alarm class using drop-down list in "*Alarm Class*" column which includes all alarm classes in the project.
   b. Read configuration from .csv file (see step 4).

Figure 6-39 DP Settings – Selection of alarm class



4. Specify Alarm Text and Description for each Alarm Bit.

NOTE "*Alarm Text*" and "*Description*" columns can be edited in .csv file only.

   a. Click "*Write to .csv File*" button to save all configurations from the tool to .csv file. If you do not have a .csv file, it will be created now.
   b. Click "*Browse*" button to specify location of a .csv file you want to use.
   c. Click "*Open .csv File*" to open this .csv file in Excel.

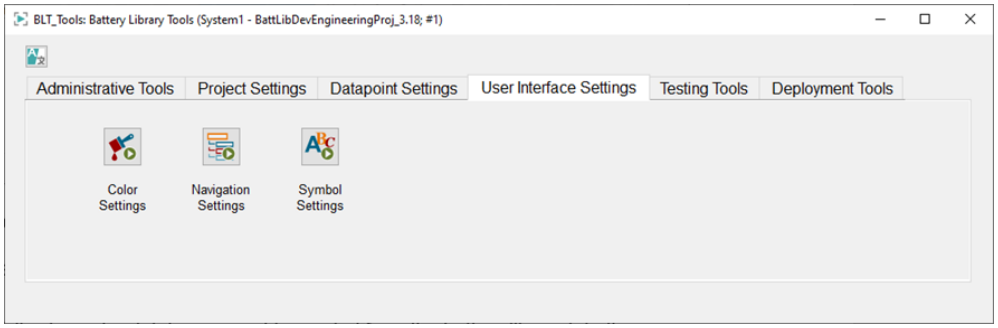
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d. Edit the configuration in the .csv file and save the file:
    i. specify *Alarm Text*
    ii. specify *Description*
    iii. optionally: specify *Alarm Class*
e. Read data from .csv file by clicking "*Read csv File*" button. Tool will be filled with all configurations from the .csv file.
f. Update actual DPE configs by clicking "*Apply*" button. All alarm configurations will be written to DPs.
g. Check "*Output Result*" field for any errors.

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6.5 User Interface Settings

Figure 6-40 User Interface Settings

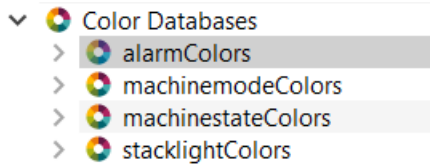


6.5.1 Color Settings

Values of predefined colors which are not part of a scheme can be changed.

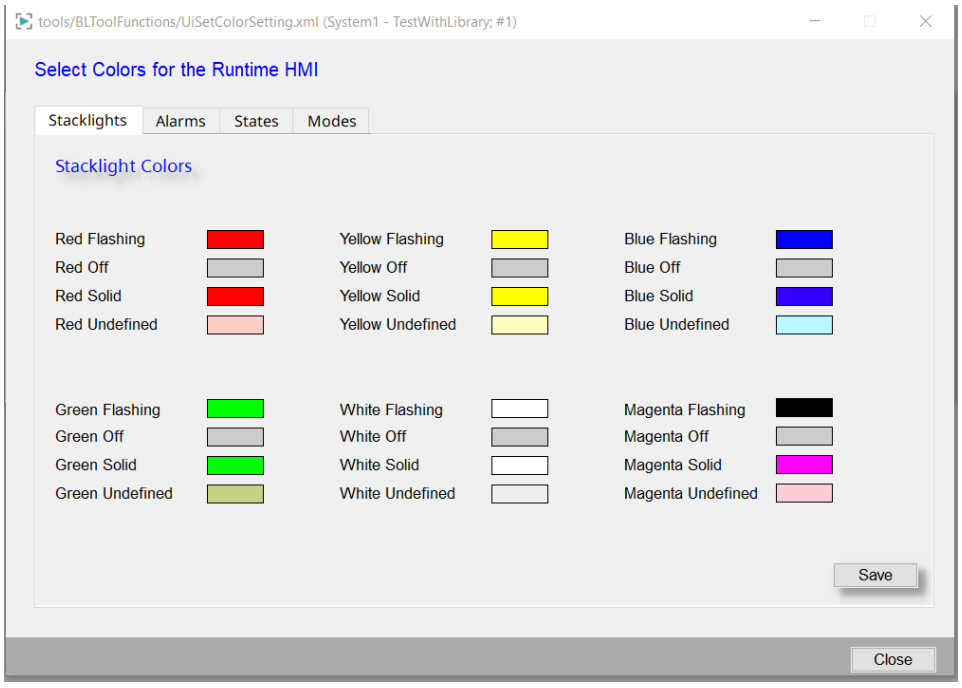
The following color databases must be copied from the Production Management for Batteries into the engineering project if their colors should be modified with the tool:

Figure 6-41 Color Databases



Stacklights

Figure 6-42 Color Setting Tool, Stacklights



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Assign colors to the stacklights:

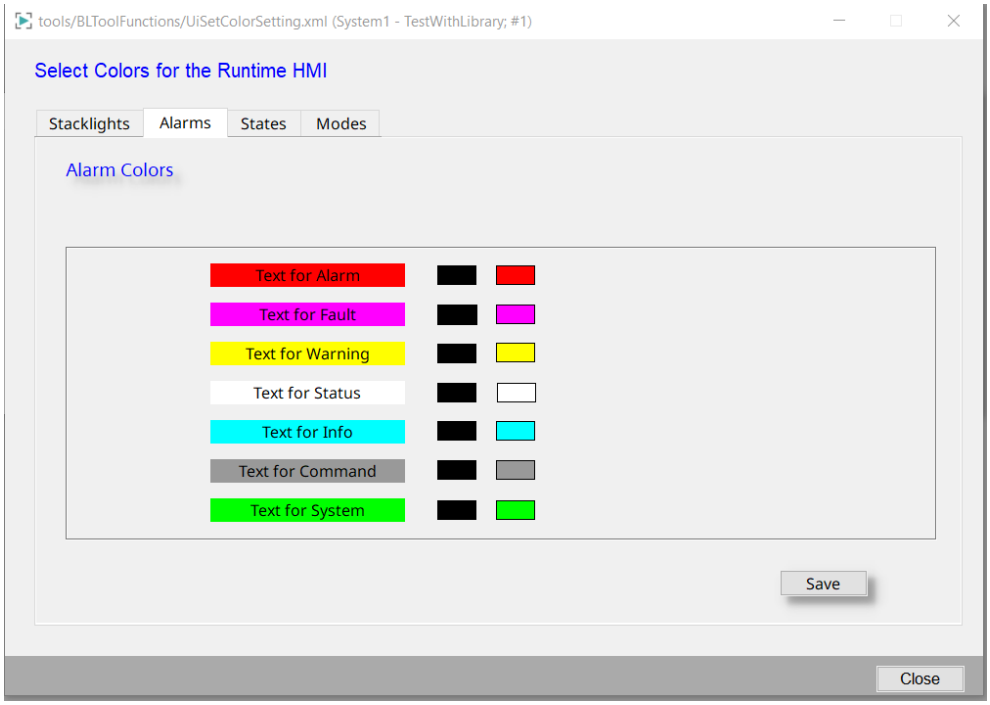
1. Select rectangle for a stacklight color
2. choose a color in the color selector
3. Repeat for all colors to change
4. Click Button "*Save*"

NOTE It is possible to define colors for the stacklight behaviour “undefined” and the stacklight behaviour “off”, but in the current version these colors are not used when showing the stacklights in runtime. In runtime no colors are shown for these behaviours.

Alarms

The tool for the definition of the alarm colors allows to select a text color and a background color for each alarm class. The colors are used in the alarm screens.

Figure 6-43 Colors for Alarm Classes



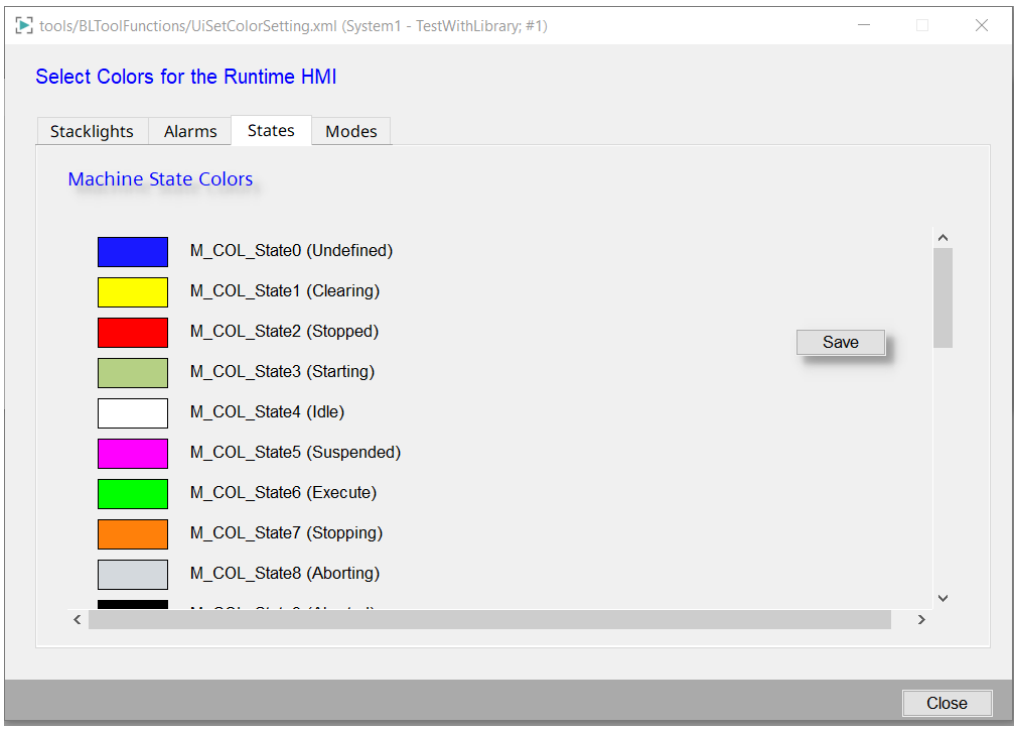
Assign colors to the alarm classes:

1. Select the left rectangle for an alarm class
2. choose a color for the text in the color selector
3. Select the right rectangle for an alarm class
4. choose a color for the background in the color selector
5. Click Button "*Save*"

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States

Figure 6-44 Colors for Machine States



Assign colors to machine states:

1. Select rectangle for a state color
2. choose a color in the color selector
3. Repeat for all colors to change
4. Click Button "*Save*"

Modes

The behavior of the tool for the machine mode colors is analogous to the states.

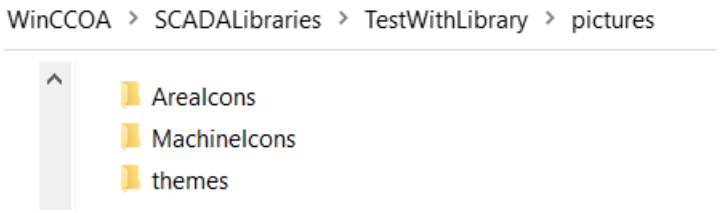
6.5.2 Symbol Settings

New symbols for machines, areas and customer can be supplied in the engineering project and be assigned in the tool “*Symbol Settings*”. This way project specific symbols can be used in the UIs.

The symbol files must be copied to the corresponding folders in the engineering project. Pictures for areas and machines are independent from schemes and located directly in the folders “*AreaIcons*” and “*MachineIcons*”.

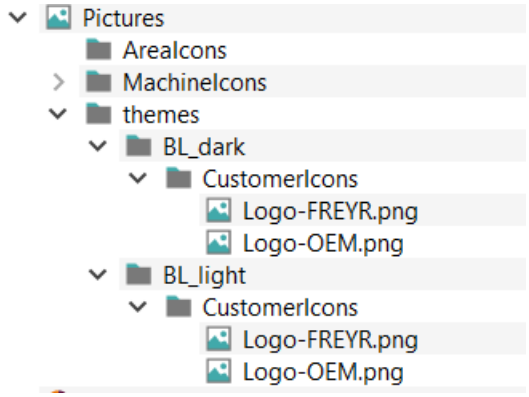
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Figure 6-45 New project specific symbols



As the customer symbols are not independent from the used schemes, they must be put into the scheme specific folders within the “themes” folder.

Figure 6-46 New project specific customer symbols



The pictures for the “dark” scheme must be placed in the folder “BL_dark” and the pictures for the “light” scheme must be placed in the folder “BL_light”. The files for the two corresponding pictures for both schemes need to have the identical name.

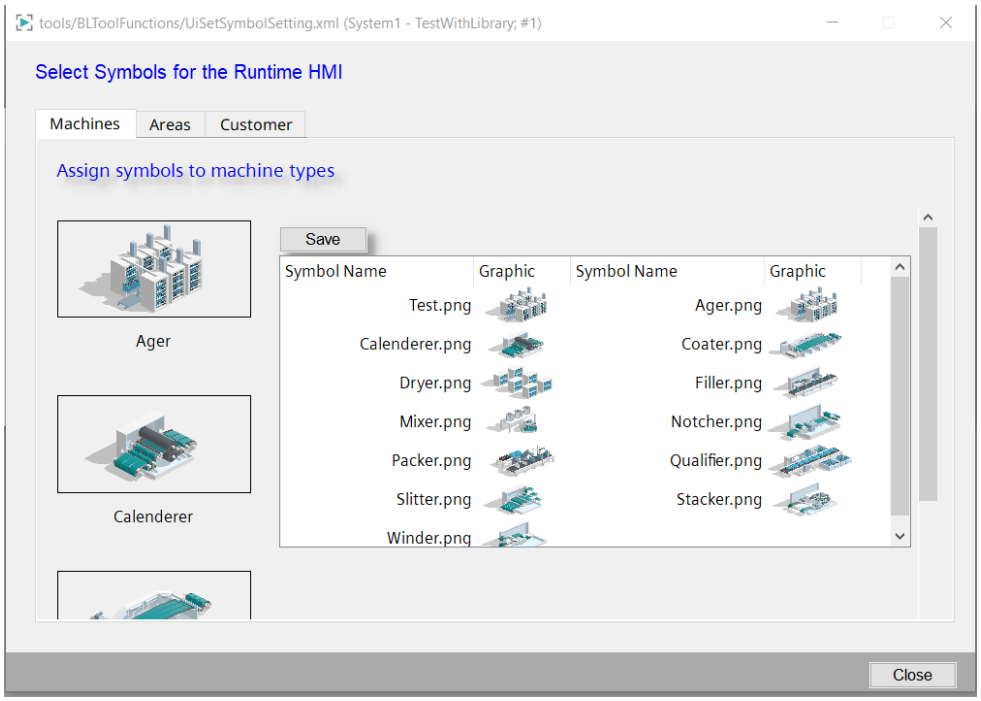
NOTE If in the “*CustomerIcons*” folders there is existing a picture file named “*Customer.png*” this picture is used as default picture. There is no need to configure this symbol as customer symbol in the symbol setting tool.

Machine Symbols

The tool for the assignment of machine symbols shows all defined machine types listed on the left side.

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Figure 6-47 Assign Machine Symbols



Assign symbols to the machine types:

1. Select a symbol from the table and put it on a machine type with drag and drop
2. Click Button "*Save*"

Provide new symbols for machine types:

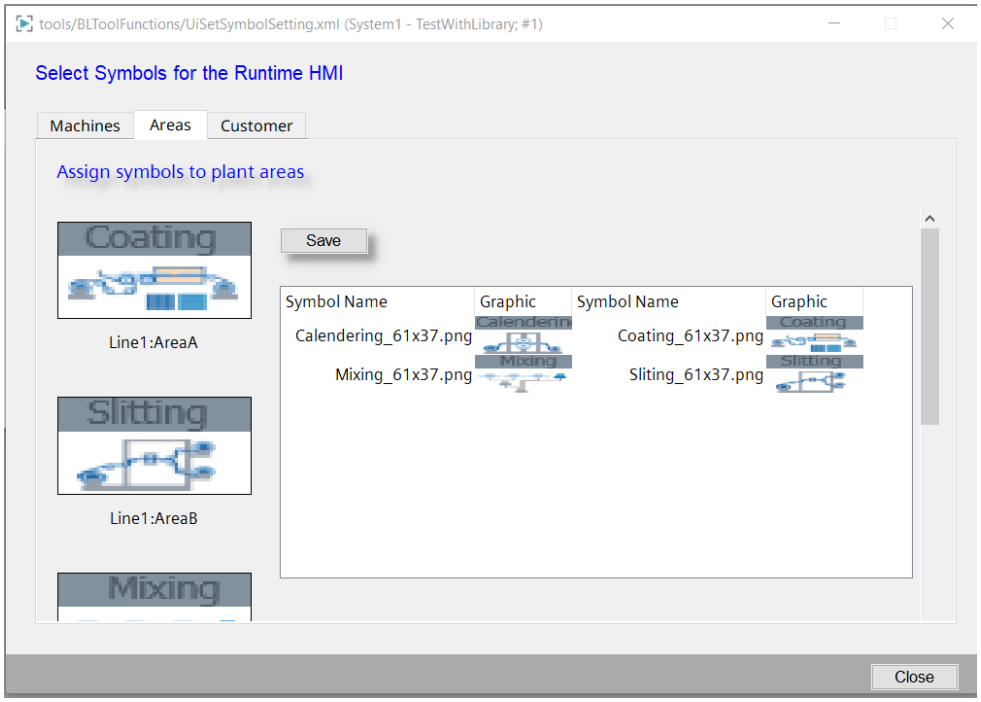
1. Copy a new symbol file to path *"…\pictures\MachineIcons\"* in your engineering project
2. Restart the tool for "*Symbol Settings*"
3. The new symbol is now available for drag and drop

Area Symbols

The tool for the assignment of area symbols shows all configured plant areas listed on the left side.

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Figure 6-48 Assign Area Symbols



Assign symbols to plant areas:

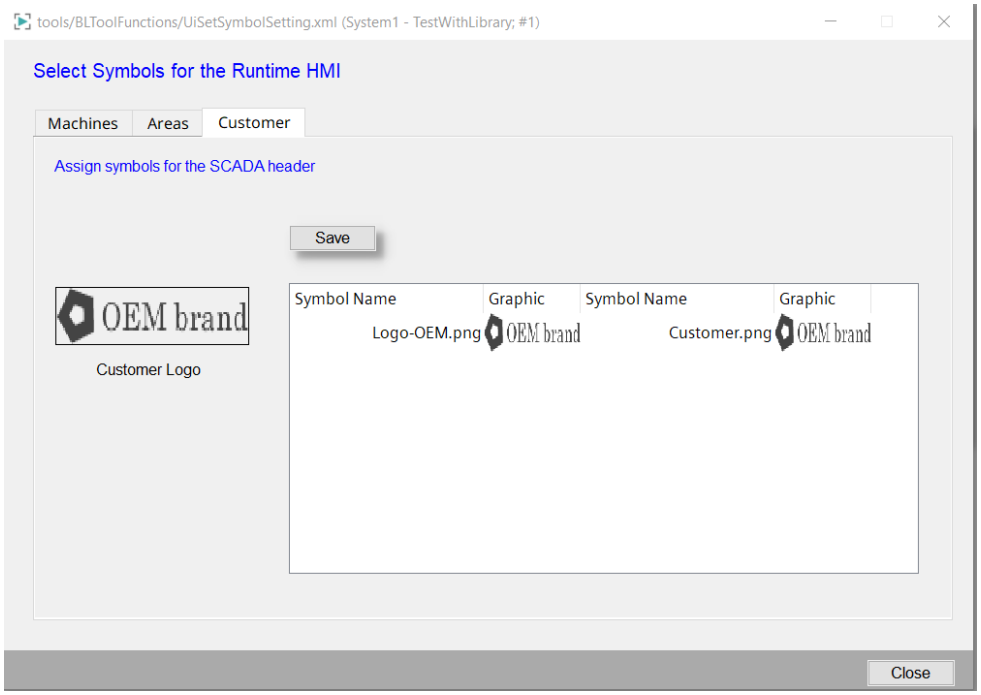
4. Select a symbol from the table and put it on a plant area with drag and drop
5. Scroll down to find all areas
6. Click button "*Save*"

Customer Symbol

The tool for the assignment of a customer symbol only shows the currently configured symbol on the left side. The customer symbol is used in the header of the UI screens.

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Figure 6-49 Assign a Customer Symbol



Assign a symbol for the customer logo:

1. Select a symbol from the table and drag and drop it to the area for the customer logo
2. Click button "*Save*"

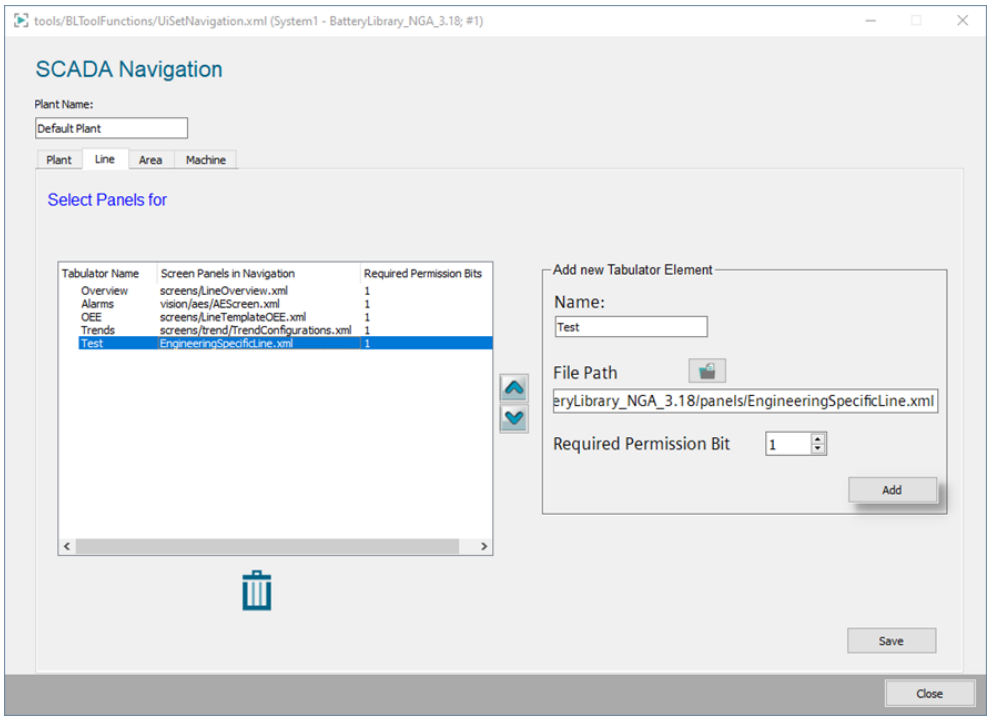
6.5.3 Navigation Settings

When opening this tool for the first time the default navigation settings for the levels plant, line, area and machine are shown. For each level the names of the available tabulators and the corresponding screen panels are shown in a tree.

In this tool the sequence of the tabulators on a level can be modified, tabulators can be deleted, and new tabulators can be added. The adding of tabulators allows the integration of new screens, which are developed by the engineering team, into the standard navigation.

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Figure 6-50 Insert a new screen into the standard navigation



Insert a new screen panel for navigation:

1. Enter a name for the navigation tab in the field “*Name*”
2. Select a screen panel from the engineering project using the file selector button
3. Select the permission bit, which is required for showing the navigation tab
4. Click button “*Add*”
5. Click button “*Save*”

Delete a navigation tab:

1. Select a navigation tab in the tree
2. Drag and drop the selected tabulator to the trash can symbol or just click on the trash can symbol
3. Click button “*Save*”

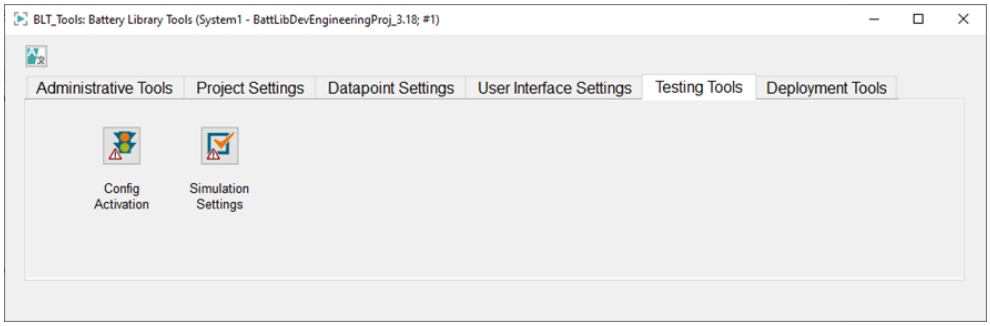
Change the tab sequence:

1. Select a navigation tab in the tree
2. Click on the arrow up symbol or on the arrow down symbol to move the tab
3. Repeat this until the tab is on the right place
4. Click button “*Save*”

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6.6 Testing Tools

Figure 6-51 Testing Tools



6.6.1 Activation/Deactivation

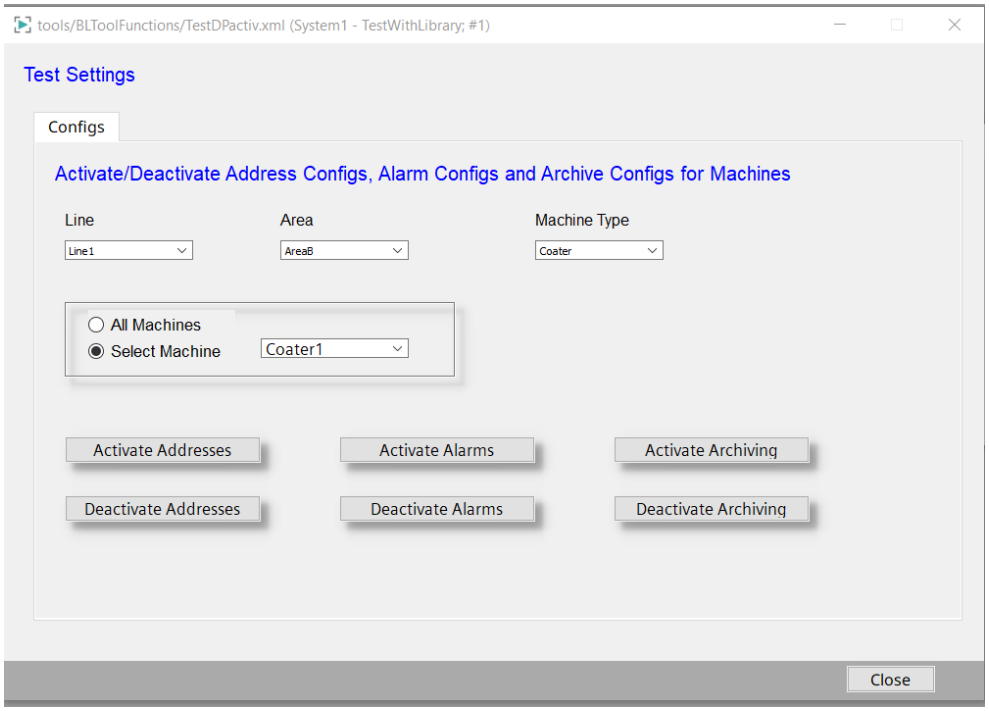
This tool is intended to support testing of the SCADA system by giving the possibility to activate and deactivate functions.

Configs

The configs of DPEs which are used for external addresses, alarming or archiving can be activated or deactivated. This can be done for all machines of a machine type in an area, or for just one machine in an area.

All datapoints which are related to the machine are identified and all DPEs are searched for the specific config.

Figure 6-52 Activation/Deactivation of Configs



Activate/Deactivate external addresses:

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1. Select line, area and machine type
2. Select “*All Machines*” or “*Select Machine*” in the combobox
3. Select a special machine in the dropdown list
4. Click button “*Activate Addresses*” or button “*Deactivate Addresses*”

Activate/Deactivate alarming:

1. Select line, area and machine type
2. Select “*All Machines*” or “*Select Machine*” in the combobox
3. Select a special machine in the dropdown list
4. Click button “*Activate Alarms*” or button “*Deactivate Alarms*”

Activate/Deactivate archiving:

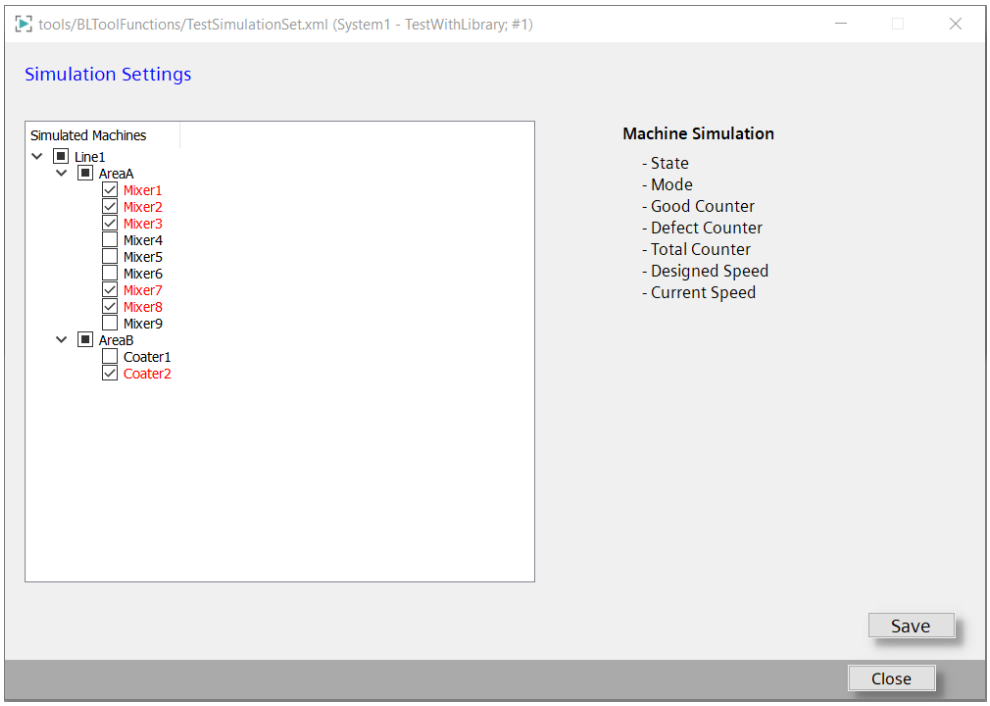
5. Select line, area and machine type
6. Select “*All Machines*” or “*Select Machine*” in the combobox
7. Select a special machine in the dropdown list
8. Click button “*Activate Archiving*” or button “*Deactivate Archiving*”

6.6.2 Simulation Settings

This tool is intended to support testing of the SCADA system by giving the possibility to configure which parts of the whole plant should be simulated. This way a mixture of already “living” machines and of just simulated machines is possible for test purposes.

After starting the tool, the current configuration is shown.

Figure 6-53 Simulated Machines



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Configure the machines which should be simulated:

1. Check the machines which should be simulated
2. Uncheck the machines which should not be simulated
3. Click button “*Save*”

NOTE After the modification of the simulation settings the control manager which is working the simulation needs to be restarted.



6.7 Deployment

NOTE During the deployment process new WinCC OA projects are created while the engineering project is running. This is the reason for the following preconditions in the engineering project:

1. The manager “Multiplexing Proxy” needs to have start mode “manual” and must be stopped.
2. In the config file in section [general] the following entry has to be included: **mxProxy = "none"**
3. In the config file in section [general] some standard ports must be set to different values than the default values, e.g.,
4. pmonPort = 14999 (default 4999)
5. data = "localhost:14897" (default 4897)
6. event = "localhost:14997" (default 4997)

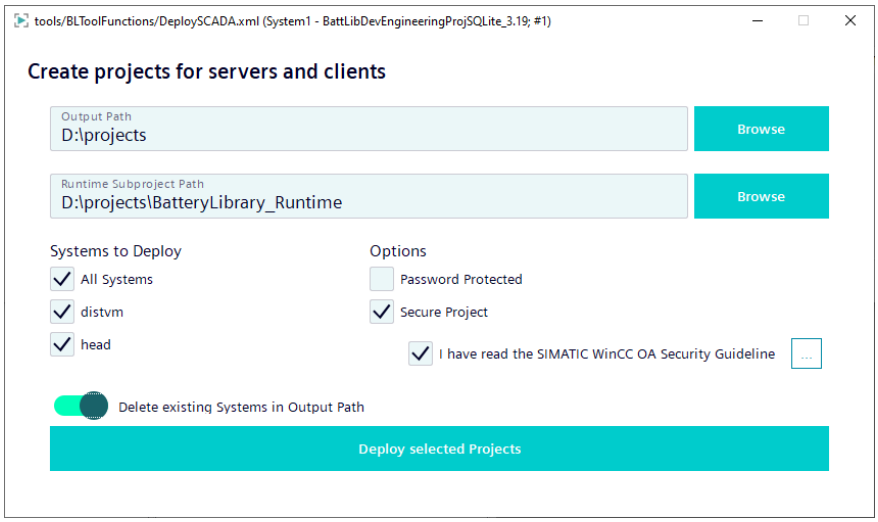
Deployment tool provides the ability to create fresh runtime projects with the needed Production Management for Batteries data points. One project for each configured server is created (see IT Settings).

This tool uses the data point lists generated by Export of Project Data and the assignments performed in the *IT Settings* tool.

The deployed projects will be created with the same options as the engineering project.
For engineering projects using NextGen Archiver, the deployed projects will also use NextGen Archiver.
Engineering projects using SQLite will result in deployed projects using SQLite as well.

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Figure 6-54 Deployment tool



Project Deployment

Deploy the data from the engineering project using the deployment tool:

1. Enter the output directory for the generated projects in the field „*Output Path*“
2. Enter the library directory of the runtime for usage in the generated projects in the field “*Battery Library Runtime Path*”
3. Select the projects to be deployed
4. Enter *username* and *password* in case *Password Protection* is selected
5. Select Secure Project for enabling Server-side Authentication (see WinCC OA Security Guideline for details)
6. Click button „*Deploy selected Projects*“
7. Enter details for Server-side Authentication in case *Secure Project* was selected

The project deployment creates one folder for each server (named by hostname) containing a folder for the project (named by system name).

NOTE The deployment tool automatically adds the config entry “*useNGADirectRead = 1*” to optimize performance if NextGen-Archiver is used.

NOTE The deployment tool automatically adds the config entry “*useLocalIdentification = 1*” for the Head System in case of a distributed system, to save the DP identification of all systems after first connection.

NOTE The project deployment always creates new projects when deploying.

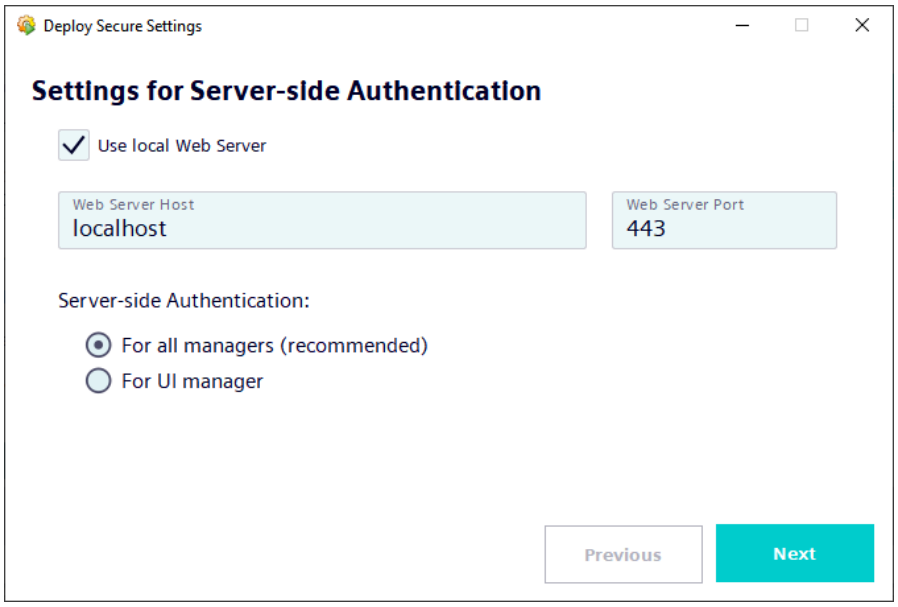
If incremental changes (such as adding a machine in an already deployed project) should be made in the engineering project, a new project will be generated when deploying again and all archived data will be lost!

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Secure Project Options

The following options for secure projects must be given, afterwards the project generation starts.

Figure 6-55 Deployment tool – Secure Project – Settings for Server-side Authentication



NOTE Before creating secure projects, the WinCC OA Security Guideline must be read!

NOTE It is strongly recommended to create and to deliver only secure projects!

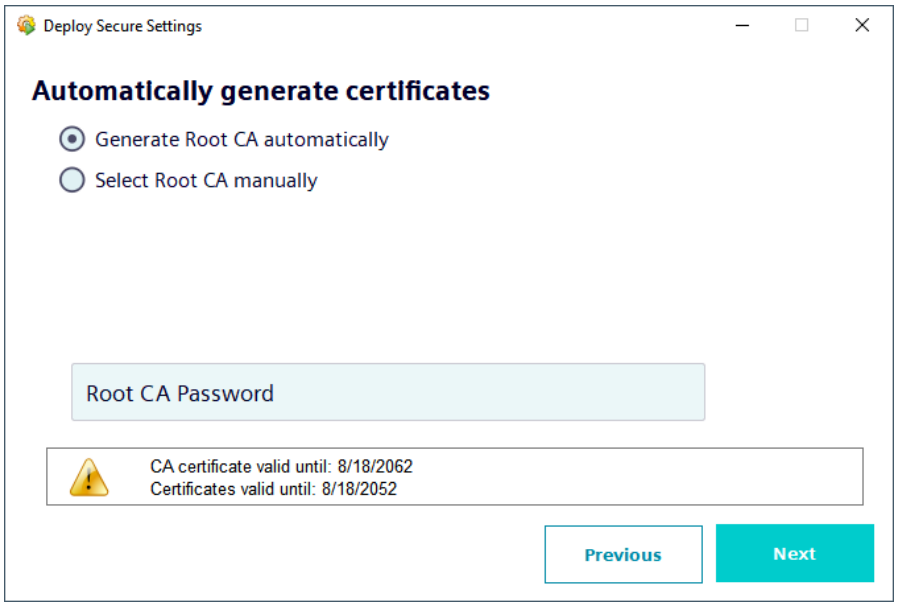
"Use local Web Server" determines if the default WinCC OA *webclient_http.ctl* manager should be used for authentication.

The given "*Web Server Host"* and "*Web Server Port"* are used by the Managers for authentication.

It can be chosen, if all managers should use Server-side Authentication or it should only be used for User Interfaces.

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Figure 6-56 Deployment tool – Secure Project – Certificate settings



Afterwards the settings for the certificates must be entered.

The deployment tool always automatically creates the certificates for each server.

For this generation, a *Root Certificate Authority* (Root CA) is required, which is password protected.

The *Root CA* can either be generated automatically as well (new password required), or an existing one can be used (private key, public key and password for the existing Root CA required).

The certificates are created first in a “certificates” directory in the *Output Path*. In case the Root CA is created automatically, it is stored directly inside this directory (public key and private key).

A separate directory for each server contains its certificates.

The certificates are automatically copied to the correct project directory in the last phase of the deployment process.

NOTE The Root CA private key remains in the certificates directory only and should be kept safe!

NOTE The generated server certificates are valid for 30 years, afterwards the certificates need to be updated.

The generated Root CA certificate is valid for 40 years.

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NOTE

The user “root” does not work for Secure Projects, use “para” instead.

User Interfaces must add the argument “-ssa” in Secure Projects (with Server-side Authentication). It is added automatically for the User Interfaces existing per default.

Secure Project deployment only supports automatically generating file-based certificates based on a Root Certificate Authority.

All systems must use the same Root Certificate Authority for their certificates, the certificates for the systems must contain the full qualified domain names of the server, where the project is running. Per default the names configured in the IT Settings tool are used (see IT Settings).

In case other certificates should be used, the certificates in the deployed projects can be changed and the config file can be adapted as needed.

Deploying on physical servers

Now the projects can be deployed to the production machines:

1. Copy the projects to the servers
2. Register the project in the WinCC OA project administration
3. Open the WinCC OA console for the newly registered project
4. Start the project

NOTE

The BatteryLibrary_Runtime subproject should be located at the path specified in the deployment tool and be registered in the WinCC OA project administration.

On first startup the deployed data is imported into the database of the runtime project and afterwards the project is restarted.

NOTE

In case a Password Protected project was created, the project must be restarted manually.

NOTE

When deploying redundant projects, only one of the projects should be started at first.

The second server can be started after the first one finished initializing the database, indicated by a project restart.

The initial data on the second server is then recovered from the other redundant partner. After the data recovery is finished the project should be restarted on the second server.

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NOTE In case of distributed systems, the User Interface must only be started from the Head System.

The User Interface must only be started after all systems have been connected once, otherwise machines assigned to unknown areas will be missing.

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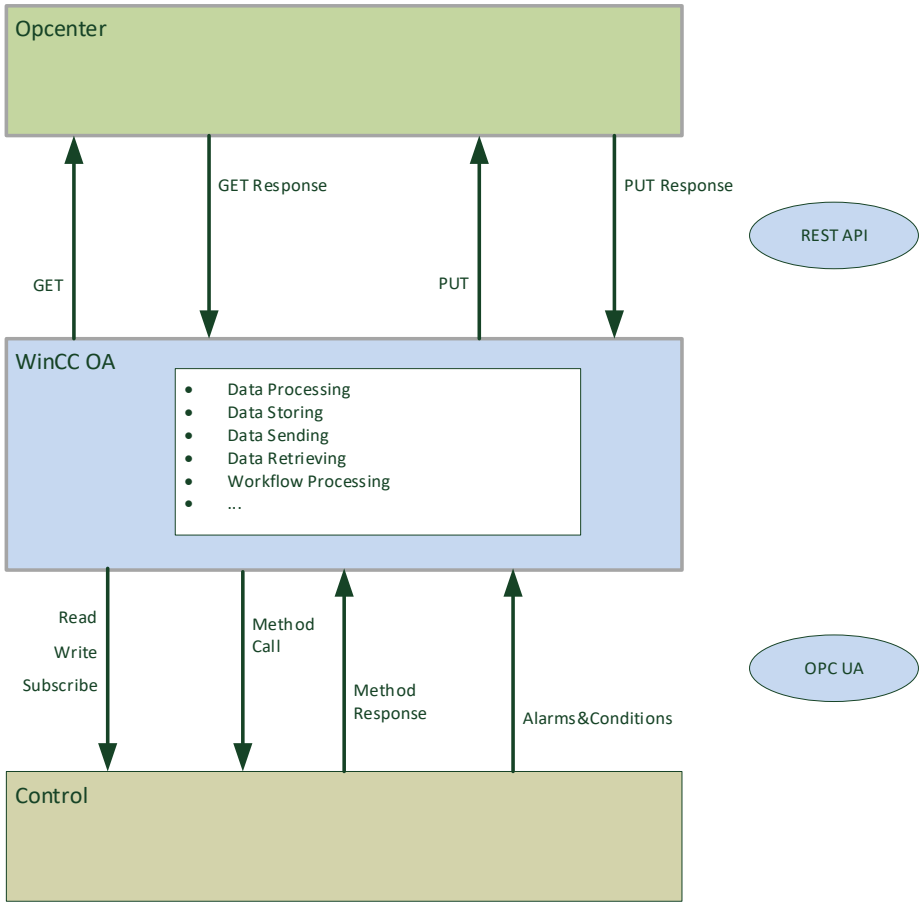
7 Interface Support and Data Model

7.1 Communication Concept

Production Management for Batteries for the SCADA system supports the communication to the higher-level MES system and the communication to the field level. The communication to the MES is based on a REST API, the communication to the PLCs is based on OPC UA.

Production Management for Batteries contains functionality for handling specific workflows for the data flow between MES and PLCs.

Figure 7-1 Communication Interfaces

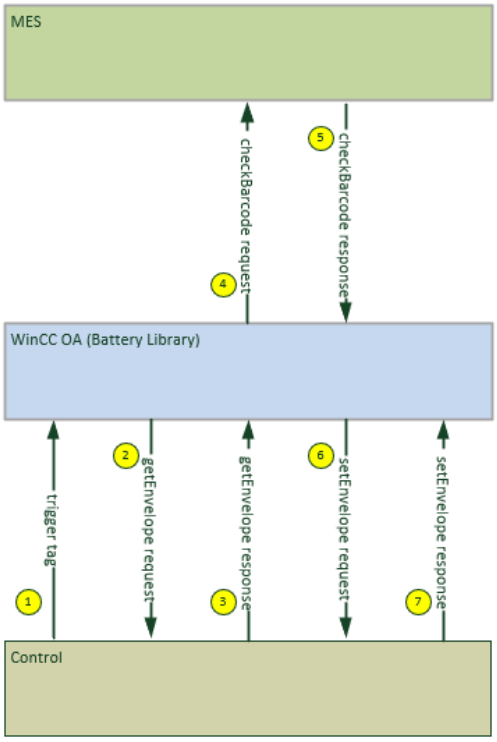


For the OPC UA communication to the PLCs the library also supports OPC UA method calls and alarming with OPC UA Alarms&Conditions.

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Example: Barcode Scan

Figure 7-2 Workflow for Barcode Scan



Execution of the workflow sequence:

1. PLC triggers the SCADA after a barcode scan	Handshake
2. SCADA calls a method to get the scan result 3. The response of the method call contains the scan result	OPC UA Method
4. SCADA calls an API function to check the scan result in the MES system 5. The API call response contains the check result	REST API call
6. SCADA calls a method to send the check result to control 7. The response of the method call contains the control confirmation	OPC UA Method

This cycle is repeated for each material scan which e.g., is needed for starting a workorder in the control. That is an example of “PULL-PUSH REQUES” Message – PLC Initiated bidirectional.

7.2 OPC UA Communication

Production Management for Batteries uses OPC UA as main protocol for shopfloor-connectivity. Shopfloor machines are OPC UA Servers and WinCC OA is an OPC UA Client.

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OPC UA data exchange in Production Management for Batteries leverages two mechanisms:

1. Tag-based data exchange
2. Message-based data exchange

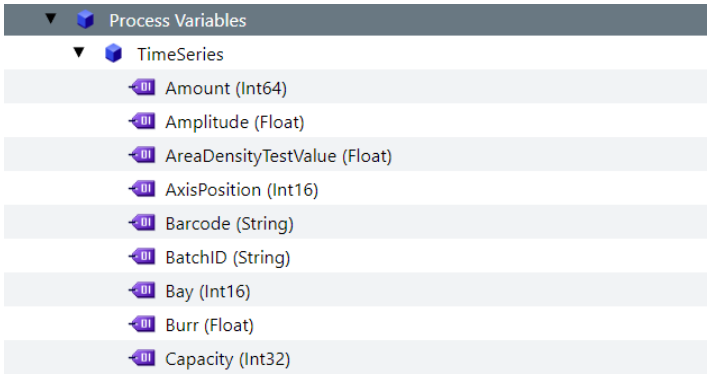
For alarms from shopfloor machines:

3. OPC UA Alarms&Conditions is used.

7.2.1 OPC UA Tag-based data exchange

OPC UA Data Access subscription-based exchange is used for shopfloor-related process data. Process data shall be sent to WinCC OA on value change.

Figure 7-3 Example of Process Variable (screenshot from SiOME)

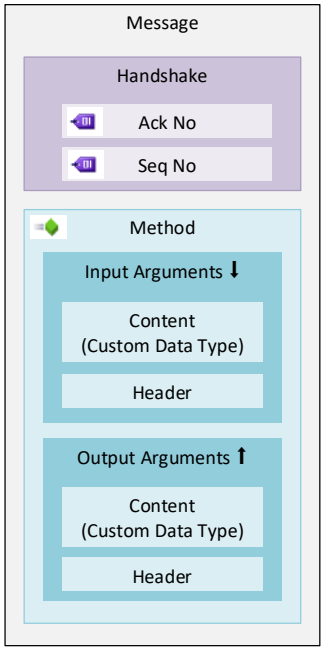


7.2.2 OPC UA Message-based data exchange

OPC UA Message-based data exchange is a type of event-driven communication and is based on OPC UA Methods. It combines tag-based data exchange (Handshake for trigger mechanism) and methods.

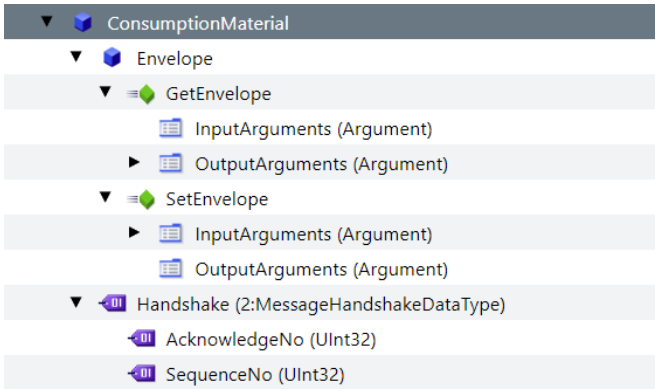
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Figure 7-4 Message Structure

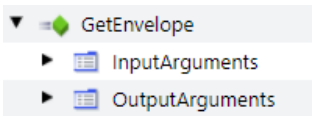


OPC UA messages that are built according to Information Model Kit have the following structure:

Figure 7-5 Example of OPC UA Message (screenshot from SIOME)



Content of a message:

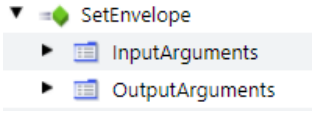


GetEnvelope – method for transferring data from PLC to SCADA

InputArguments – data provided to PLC along with Method call (typically has no payload)

OutputArguments – data from PLC, actual payload consisting of several values

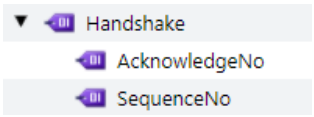
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SetEnvelope – method for transferring data from SCADA to PLC

InputArguments – data sent to PLC, actual payload consisting of several values

OutputArguments – data from PLC (typically has no payload, used for status check of the transfer)



Handshake tags – for triggering exchange by PLC

SequenceNo – used to initialize data exchange by PLC, increase of this tag by +1 indicates that PLC "wants" to transfer data

AcknowledgeNo – used to indicate end of data transfer, increase of this tag by +1 indicates that data transfer is complete (at the end data transfer it should *SequenceNo=AcknowledgeNo*)

Message transfer from PLC is started when *SequenceNo* is different from the *AcknowledgeNo* (incremented or reset by PLC).

NOTE Only one data exchange can be triggered at a time for a specific message transfer. For example, only one Consumption Material message can be executed at a time, the next consumption material message must not be triggered by PLC before the current one was acknowledged, otherwise the new one will be ignored.

Messages can have different combination of included content based on the purpose of the message.

Below are examples of the message types in Production Management for Batteries:

1. "PUSH" Message – SCADA Initiated to PLC
2. "PUSH REQUEST" Message – PLC Initiated to PLC
3. "PULL REQUEST" Message – PLC Initiated to MES
4. "PULL-PUSH REQUEST" Message – PLC Initiated bidirectional

For each of these 4 message type there is a script template in Production Management for Batteries.

See additional document "PM4B Workflow Scripts How-to.docx" for detailed description of script templates.

7.2.3 "PUSH" Message – SCADA Initiated to PLC

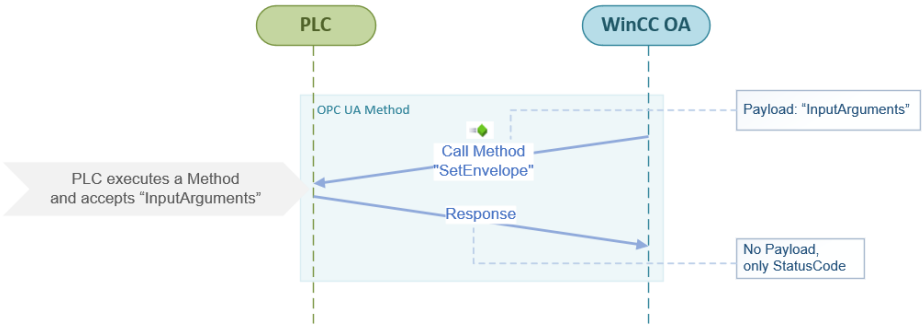
Use case: download Work Order information to PLC.

Messages of this type in the template: WorkOrderDownload.

Script name in the project: "*messageTransfer_SCADAInitiated.ctl*"

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This type of message is used to download information to PLC (e.g. Manufacturing order details). It is one-directional message – payload is sent to PLC, data transfer initiated by WinCC OA.



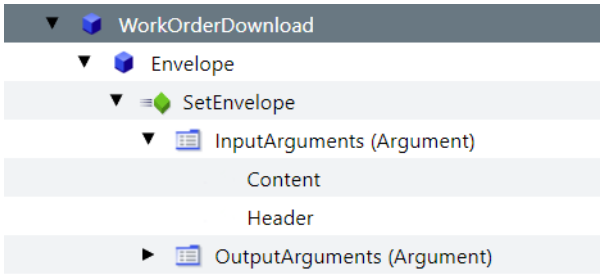
This type of messages include:

SetEnvelope – method for transferring data from WinCC OA to PLC.

InputAgruments – data sent to PLC, actual payload: WorkOrderID, ProductID, Quantity etc.

OutputAgruments – typically has no payload, used for status check of the transfer.

Figure 7-6 Example of WorkOrderDownload message (screenshot from SIOME)



Content attribute includes actual values; *Header* includes service data of the method.

Implementation

SCADA Initiated Message *Transfers* are modeled as OPC UA Methods.

For every Method, a separate DP of type *BL_OP_MessageTransfer_SCADAInitiated_toPLC* should be created.

Necessary DPs are automatically created in the DP Objects tool.

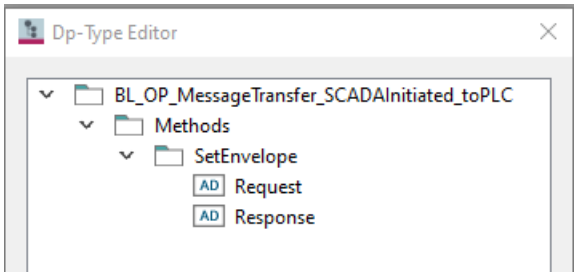
The following change must be made within the project:

- *messageTransfer_SCADAInitiated.ctl* must be adapted to process the messages

To support custom message transfers functions for interpreting Method request and response JSON strings must be implemented.

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Figure 7-7 Structure of Message Transfer SCADA Initiated to PLC DPs

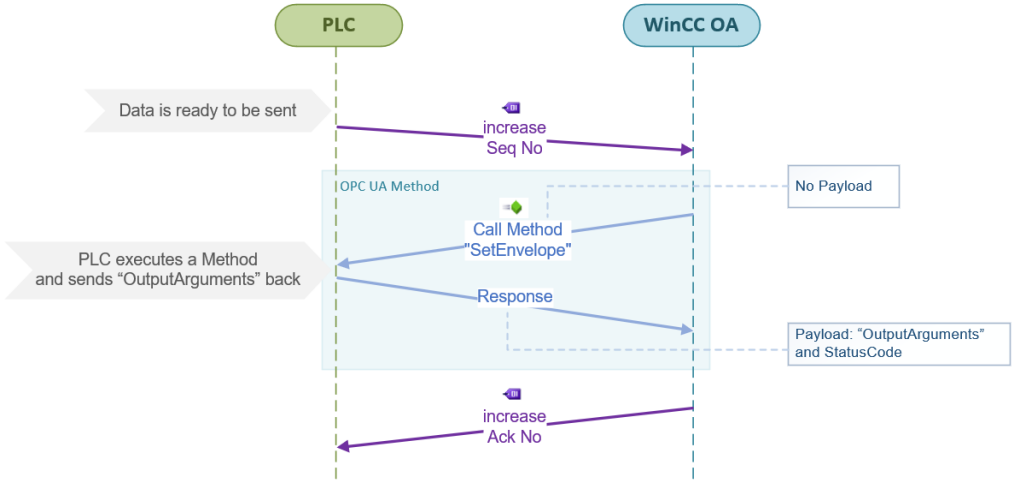


7.2.4 "PUSH REQUEST" Message – PLC Initiated to PLC

Use case: download information to PLC on request.

Script name in the project: "*messageTransfer_PLCInitiated_toMES_customized.ctl*"

This type of message is used to download information to PLC (e.g. setpoints). It is one-directional message – payload is sent to PLC, data transfer initiated by PLC. PLC initiates data exchange by increasing SequenceNo by +1.



This type of messages include:

SetEnvelope – method for transferring data from WinCC OA to PLC.

- *InputAgruments* – data sent to PLC, actual payload: tag values etc.
- *OutputAgruments* – typically has no payload, used for status check of the transfer.

Handshake tags – for initializing exchange by PLC:

- *SequenceNo* – PLC increases of this tag by +1 to start data exchange.
- *AcknowledgeNo* – WinCC OA increases of this tag by +1 to indicate that data transfer is complete.

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NOTE It is necessary that SequenceNo is not incremented by PLC again until the current message transfer is complete. PLC should wait for the AcknowledgeNo to be incremented, and only then to request another message transfer by incrementing SequenceNo by +1.

For more information on consistent data exchange with PLC see Support Page.

For PLC initiated message transfers to MES the library includes an example for batch record processing.

Implementation

For every message transfer PLC initiated to MES a DP of type *BL_OP_MessageTransfer_PLCInitiated_toMES* must exist.

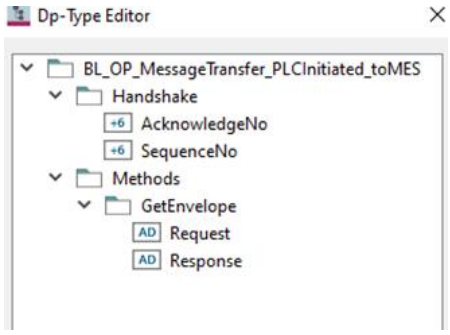
By default, the library creates those DPs in the DP Objects tool.

The following change must be made within the project:

- *messageTransfer_PLCInitiated_toMES_customized.*ctl must be adapted to process the messages

NOTE A Ctrl-Manager with the included script *messageTransfer_PLCInitiated_toMES_Handler* must be added to handle PLC initiated message transfers.

Figure 7-8 Structure of Message Transfer PLC Initiated to MES DPs



7.2.5 “PULL REQUEST” Message – PLC Initiated to MES

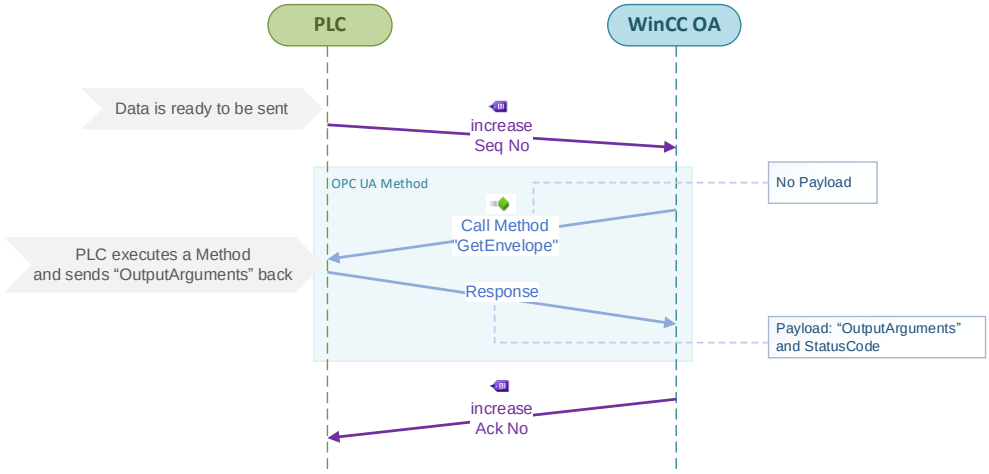
Use case: record information at the end of production order or step (Batch data, Quality data etc.).

Messages of this type in the template: BatchRecord.

Script name in the project:
“*messageTransfer_PLCInitiated_bidirectional_customized.ctl*”

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This type of message is used to transfer data to WinCC OA from PLC. It is one-directional message – payload is sent to WinCC OA. PLC initiates data exchange by increasing SequenceNo by +1.



This type of messages include:

GetEnvelope – method for transferring data from PLC to WinCC OA.

- *InputAgruments* – data provided to PLC along with Method call (typically has no payload).
- *OutputAgruments* – data from PLC, actual payload: BatchID, Quantity, QualityData etc.

Handshake tags – for initializing exchange by PLC:

- *SequenceNo* – PLC increases of this tag by +1 to start data exchange.
- *AcknowledgeNo* – WinCC OA increases of this tag by +1 to indicate that data transfer is complete.

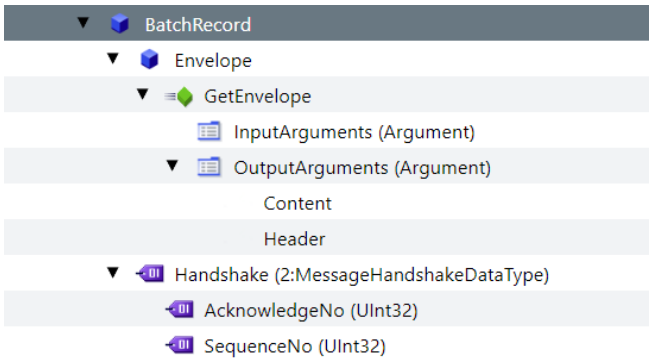
NOTE

It is necessary that *SequenceNo* is not incremented by PLC again until the current message transfer is completed successfully. PLC should wait for the *AcknowledgeNo* to be incremented, and only then to request another message transfer by incrementing *SequenceNo* by +1.

For more information on consistent data exchange with PLC see Support Page.

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Figure 7-9 Example of a BatchRecord message (screenshot from SiOME)



Content attribute includes actual values; *Header* includes service data of the method.

Implementation

For every PLC initiated message transfer to PLC a DP of type *BL_OP_MessageTransfer_PLCInitiated_toPLC* must exist.

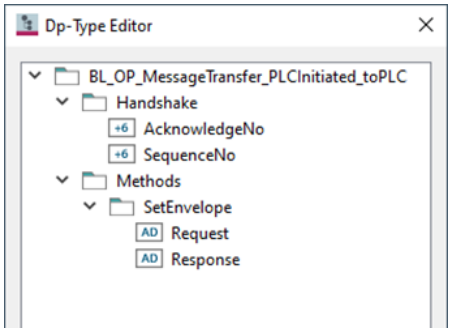
By default, the library creates those DPs in the DP Objects tool.

The following change must be made within the project:

- *messageTransfer_PLCInitiated_toPLC_customized.ctl* must be adapted to process the messages

NOTE A Ctrl-Manager with the included script *messageTransfer_PLCInitiated_toPLC_Handler* must be added to handle PLC initiated message transfers to PLC.

Figure 7-10 Structure of Message Transfer PLC Initiated to PLC DPs



7.2.6 "PULL-PUSH REQUES" Message – PLC Initiated bidirectional

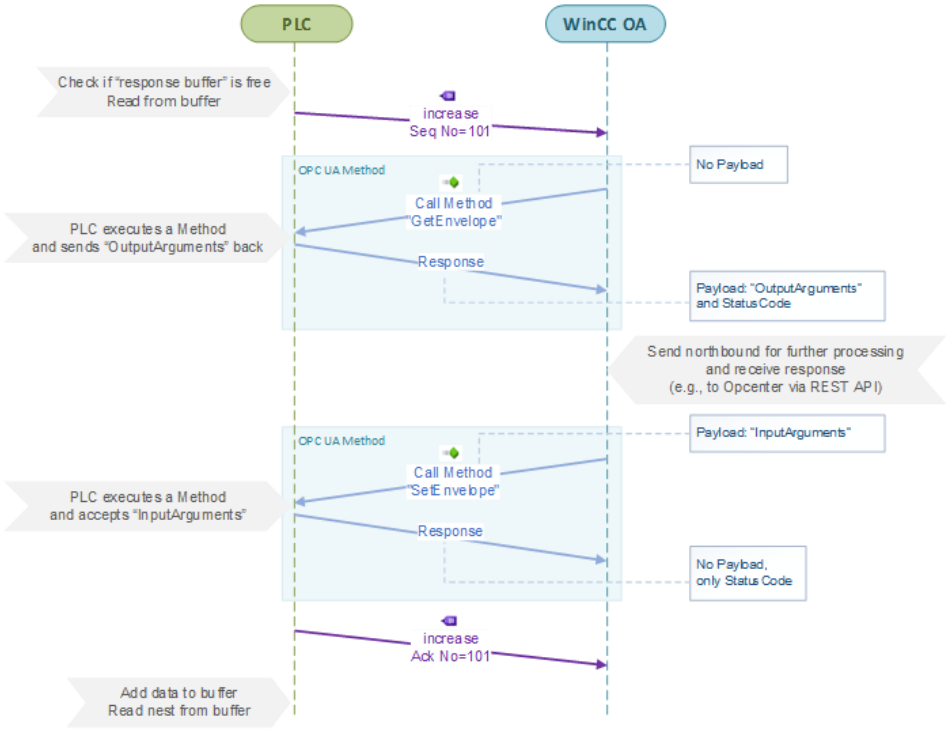
Use case: material verification/check.

Messages of this type in the template: ConsumptionMaterial.

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Script name in the project: "*messageTransfer_PLCInitiated_toPLC_customized.ctl*"

This message is used for bidirectional transfer of data from PLC to WinCC OA and then back from WinCC OA to PLC with OPC UA messages. For example, it is used for material verification workflow.



Process

1. PLC increases the Sequence number *SequenceNo*
2. WinCC OA calls "*GetEnvelope*" OPC UA Method
3. WinCC OA processes the received Method response (optionally forwards to MES)
4. WinCC OA calls "*SetEnvelope*" OPC UA Method
5. WinCC OA processes the received Method response
6. WinCC OA increases Acknowledge number *AcknowledgeNo*

NOTE After receiving response from "*GetEnvelope*" method data might be sent further to other system (e.g., to Opcenter) for additional processing.

This type of messages include:

GetEnvelope – method for transferring data from PLC to WinCC OA.

- *InputArguments* – data provided to PLC along with Method call (typically has no payload).
- *OutputArguments* – data from PLC, actual payload: BarcodeID, ProductionOrderID, EquipmentID etc.

SetEnvelope – method for transferring data from WinCC OA to PLC.

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- *InputArguments* – data sent to PLC, actual payload: RejectFlag, Material Name etc.
- *OutputArguments* – typically has no payload, used for status check of the transfer.

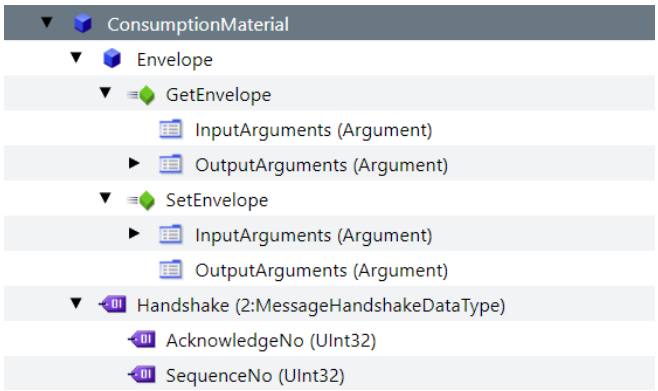
Handshake tags – for initializing exchange by PLC:

- *SequenceNo* – PLC increases of this tag by +1 to start data exchange.
- *AcknowledgeNo* – PLC increases of this tag by +1 to indicate that data transfer is complete, after SetEnvelope is executed.

NOTE It is necessary that *SequenceNo* is not incremented by PLC again until the current message transfer is complete. PLC should wait for the *AcknowledgeNo* to be incremented, and only then to request another message transfer by incrementing *SequenceNo* by +1.

For more information on consistent data exchange with PLC see Support Page.

Figure 7-11 Example of a *ConsumptionMaterial* message (screenshot from SIOME)



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Implementation

For every bidirectional message transfer a DP of type *BL_OP_MessageTransfer_PLCInitiated_bidirectional* must exist.

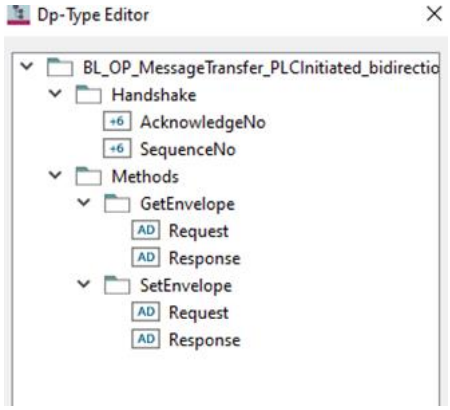
By default, the library creates those DPs in the DP Objects tool.

The following change must be made within the project:

- *messageTransfer_PLCInitiated_bidirectional_customized.ctl* must be adapted to process the messages

NOTE A Ctrl-Manager with the included script *messageTransfer_PLCInitiated_bidirectional_Handler* must be added to handle PLC initiated bidirectional message transfers.

Figure 7-12 Structure of PLC initiated Message Transfer bidirectional DPs



7.2.7 OPC UA Method Configuration in WinCC OA Para

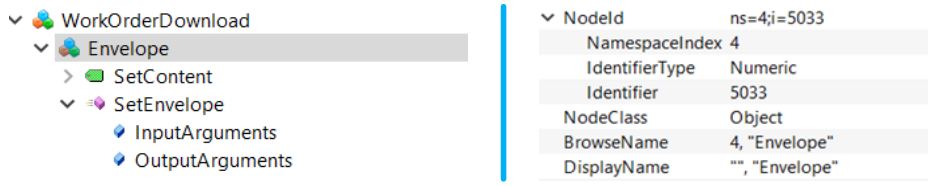
In the following figures address configuration for the datapoints representing OPC UA methods is shown.

Methods DPs are created by importing machine interface XML file (from SiOME) with DP Objects tool. Methods DPs are created according to configured messages (methods) in imported XML file.

Each OPC UA Method is represented as two Data Point Elements in a WinCC OA Project, one for the method request, one for the response.
Each Method has "*Server*" and "*Item*" specified in the address configuration (can be shown using the Para). "Item" represents OPC UA node address. On the screenshots below an example for the "*WorkOrderDownload*" method is shown. "*Server*" and "*Item*" is filled automatically when importing the OPC UA interface definition using DP Objects Tool (see chapter 6.4.1).

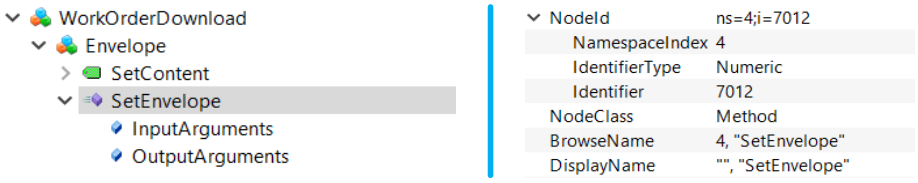
This is an example for an envelope NodeId in the PLC

Figure 7-13 Envelope Address in PLC (using UaExpert)



This is the corresponding NodeId for the *SetEnvelope* method:

Figure 7-14 SetEnvelope Address in PLC (using UaExpert)



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This results in the shown address configurations for the *Request* object and the *Response* object of the method:

Figure 7-15 Peripheral Address for the *SetEnvelope* Request Object

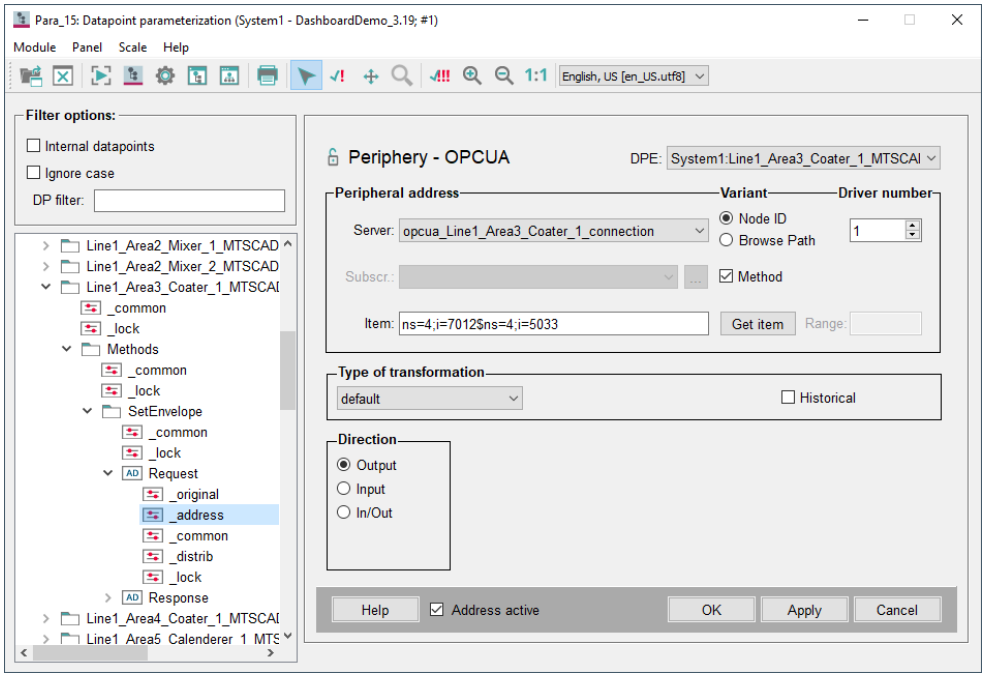
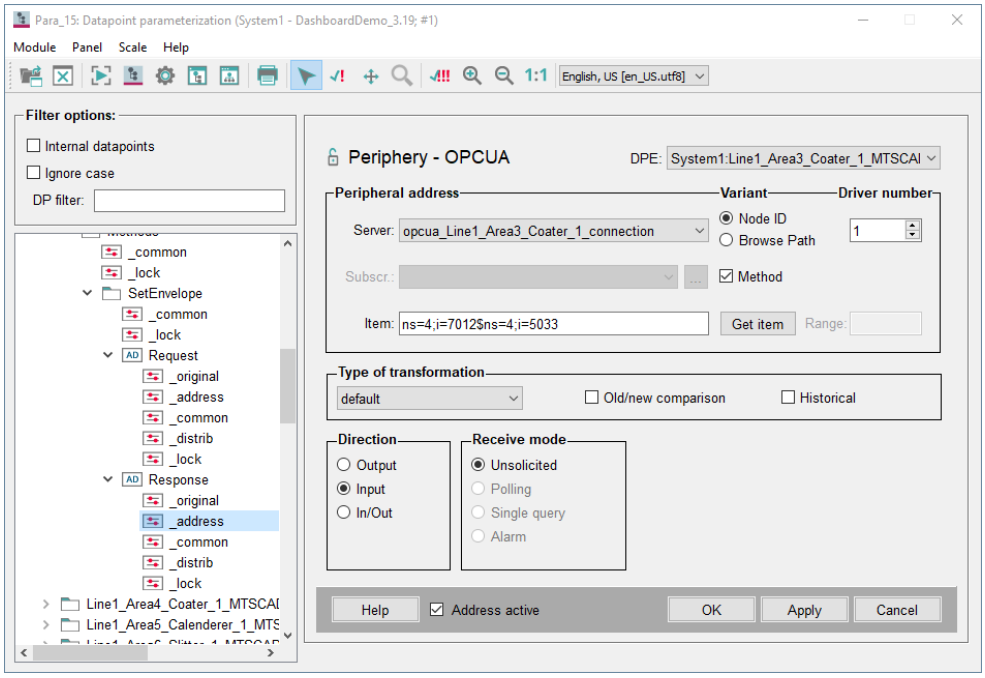


Figure 7-16 Peripheral Address for the *SetEnvelope* Response Object



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7.2.8 OPC UA Messages Error Handling

There is a function in PM4B that builds up method call: prepares parameters for a Method, prepares a JSON string for a method call with all parameters. This JSON string is set to a Method Request DPE, and it also contains a timeout for the Response (10 sec by default). Method is then requested/called by OPC UA Driver.

If Response is not received from a PLC, OPC UA Driver of WinCC OA will generate its own response with Status code “timeout error”. So, the PM4B script always has a response that it evaluates – either from a PLC or internally (from a Driver).

The Ctrl-Manager acknowledges the message by updating the *AcknowledgeNo* after the message was processed successfully. Increase of *AcknowledgeNo* marks a successful message transfer (*AcknowledgeNo* becomes equal to *SequenceNo*).

If a message transfer fails because of no *Response* within a timeout (neither from a PLC or internally), message transfer is retried 5 times total. Message is acknowledged only after receiving *Response*. After 5 retries the message will not be acknowledged – *AcknowledgeNo* will remain unchanged. In this case the message transfer can be triggered again by the PLC by increasing the *SequenceNo* once more.

NOTE There is no *Response* only in the case of OPC UA Driver is not running. If OPC UA Driver is running, there is always a *Response*.

A script handling message retries can be edited according to project requirements. Copy file from Runtime subproject to the Project, edit if necessary: *…/scripts/libs/workflows/messageTransferHandlerHelpers.ctl*.

In this script an engineer can change: number of retries, number of seconds between retries, timeout for receiving response for the OPC UA Method call.

NOTE Logic above is true for “PUSH Request” Message and “PULL Request” Message.

7.3 OPC UA Alarms and Conditions

For sending alarms from a PLC to the SCADA system the OPC UA mechanism Alarms & Conditions is supported. WinCC OA (SCADA) acts as OPC UA client and allows receiving and acknowledging alarms from an OPC UA alarm server (PLCs). The alarm is mapped to a data point element in the WinCC OA OPC UA client project via a corresponding peripheral address.

Alarms coming from PLCs via OPC UA Alarms and Conditions must have at least these properties:

Acknowledgement – the user has seen the alarm condition

Severity – the severity of the alarm (from 1 to 1000)

Message – the message to be shown to the user

AlarmId – the unique name of the alarm on the device

Active – the alarm condition is active

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In the following table there is an example of how Severity correlates with Alarms classes in MES/SCADA:

Alarm class (SCADA)	**Severity** (OPC UA A&C)		**Description**
	w/o ack.	with ack.	
Info	150	225	Diagnostic messages, help messages to operator, i.e., “system is ready”
Warning	400	450	A deviation of system parameters by a certain level
Alarm	600	650	Persistent indication of a fault, a deviation from normal operation condition, i.e., abnormal operating situations
Critical Error	860	930	A critical deviation of a system parameters from normal operation, where further operation is effected or not possible.

Alarms are not part of OPC UA interface template and are specified separately. Machine vendor/supplier is expected to specify valid alarms for each machine and make them available via OPC UA A&C.

See also OPC UA Alarms and Conditions Configuration.

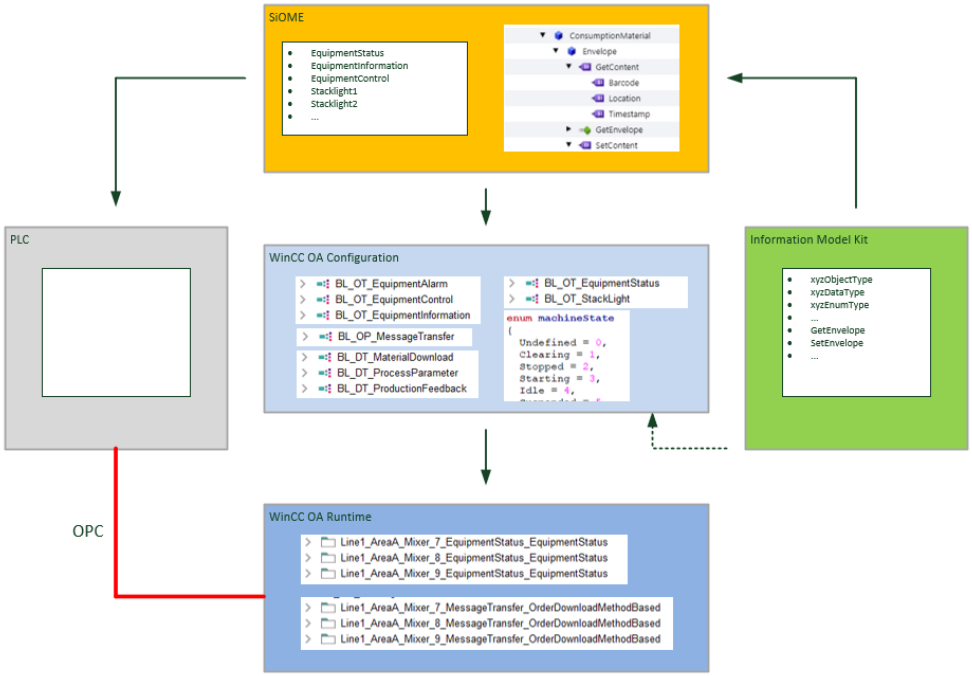
7.4 Data Model

7.4.1 OPC UA Based Model

The data model for process data in the Production Management for Batteries is based on the Siemens “Information Model Kit”. The information model kit is provided as node set and can be used within the SiOME tool to configure the OPC UA interface for the PLC.

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Figure 7-17 Using the Information Model Kit



Information Model Kit provides enumerated types, object types and data types based on the OPC UA definitions. In Production Management for Batteries the enumeration types are implemented as “enum” definitions, the object types and data types are implemented as DPTs.

NOTE It is very important to stick to the datatypes and data structure of Information Model Kit when modelling the machine data. Only in this case it is possible to create process data easily with the tool “DP Objects”. If the machine interface is designed differently and does not comply with Information Model Kit, then manual work will be necessary for creating and configuring Data Points in WinCC OA project.

Figure 7-18 Example Enumerated Type

```
enum machineMode
{
  Undefined = 0,
  Manual = 1,
  Maintenance = 2,
  Automatic = 3,
  SemiAutomatic = 4,
  Remote = 5,
  StepMode = 6
};
```

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Figure 7-19 Example Object Type

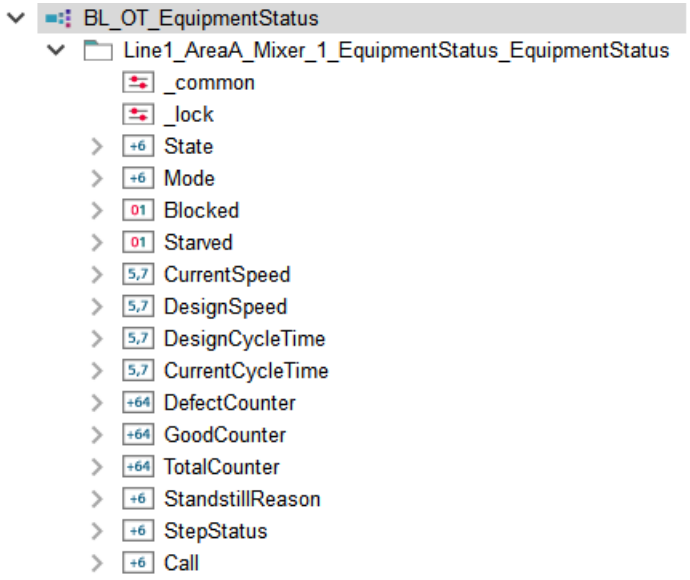
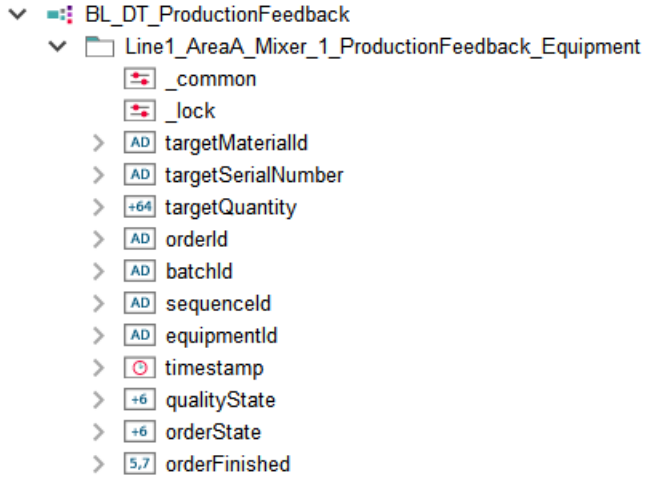


Figure 7-20 Example Data Type



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7.4.2 Overview of OPC UA Data

	Data	Mechanism	Machine Supplier Input
Time Series Data Collection (e.g. Process Variables)	Equipment Status Equipment Information Process Data	OPC UA Data Access (subscription based)	Make data available on OPC UA Server (PLC)
Event Driven Data (e.g. Material Movements & Verifications)	Workorder data Quality data Traceability data Equipment control	OPC UA Methods + OPC UA Data Access	Implement message-based exchange. Align PLC logic with production scenarios.

	Data	Mechanism	Machine Supplier Input
Alarms and Events (e.g. Exceeded Thresholds etc.)	Alarms	OPC UA Alarms & Conditions	Setup alarms via OPC UA Alarms & Conditions

7.4.3 Template Example

For more detailed templated see Excel file “Taglist Template PM4B v42_0.xlsx” or SiOME file “Taglist Example PM4B v2_0.xml”.

Equipment Information	InterfaceVersionProject	String
	EquipmentName	String
	EquipmentTypeID	Int32
	LineID	Int32
	VendorID	Int32
	EquipmentID	Int32
Equipment Status	State	MachineStateEnumType
	Mode	MachineModeEnumType
	Blocked	Boolean
	Starved	Boolean
	CurrentSpeed	Float
	DesignSpeed	Float
	DefectCounter	UInt64
	GoodCounter	UInt64
	TotalCounter	UInt64
	StandstillReason	MachineStandstillReason EnumType
	Stacklight1 Stacklight Behavior Stacklight Color	 StackLightColorEnumType StackLightColorBehaviorType
Equipment Control	Abort	Method
	Clear	Method
	Hold	Method
	Reset	Method
	Start	Method
	Stop	Method
	Suspend	Method
Equipment Alarms (not recommended, use OPC UA A&C instead)	AlarmBit1	Boolean
	AlarmBit2	Boolean
	AlarmBit3	Boolean
ProcessVariables	ExampleTemperature1	Float
	ExampleTemperature2	Float
	ExamplePressure1	Float

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	ExamplePressure2	Float
Messages (example, amount and content shall be designed)	WorkOrderDownload	Method
	ConsumptionMaterial	Handshake + Method
	BatchRecord	Handshake + Method

7.4.4 MachineStateEnumType

The MachineStateEnumType describes predefined states for a machine. This is a default state enumeration. It is possible to extend it for your project specific use-cases.

Table 1: MachineStateEnumType values

Name	Value	Description
Undefined	0	Undefined
Clearing	1	The machine is in the time period between the release after an Emergency Stop by the operator and the resulting end state
Stopped	2	The machine has electrical power but is in a stationary state.
Starting	3	The machine is in production start. This is not to be confused with program Start up. An example might be the self-test of a packing robot, which tests the functionality of the individual servo motors through a movement test.
Idle	4	The machine is ready to carry out its intended function. It is however in a waiting state and must first be brought into operation by the operators or by external automatic release.
Suspended	5	Will be used in case of no detail status of suspended is needed
Execute	6	The machine is carrying out its intended function
Stopping	7	The machine is being transferred to the stopped state (Stopped) by a controlled stop routine.
Aborting	8	The machine is in the time period between the occurrence of the failure and the resulting end state (Emergency Stop).
Aborted	9	Machine is aborted and is not operating any more.
Holding	10	The machine is in the time period between the holding and the resulting end state (Held, Equipment Failure, External Failure).
Held	11	The machine is not carrying out its intended function due to an unpermitted deviation from the SET-state detected by a control system sensor.

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Name	Value	Description
Unholding	12	The machine is in the time period between the release of held (Held, Equipment Failure, External Failure) by the operator and the resulting end state (Operating).
Suspending	13	The machine is in the time period between the initiation of Suspending and the resulting end state (Prepared, Lack, Tailback, Lack Branch Line or Tailback Branch Line).
Unsuspending	14	The machine is in the time period between the release of being suspended (Prepared, Lack, Tailback, Lack Branch Line or Tailback Branch Line) and the resulting end state (Operating).
Resetting	15	The machine is in the time period between the release after a stop (Stopped) and the resulting end state (Idle).
Completing	16	Order quantity is going to reached.
Complete	17	Order quantity is reached.
Setup	18	Setup activities are performed on the machine.
EmergencyStop	19	The machine is in EmergencyStop state after operator hat pushed the emergency stop
HeldEquipmentFailure	20	Failure, which occurs in the machine itself and leads to a machine stop (in accordance with DIN 8782).
HeldExternalFailure	21	A failure which is not attributable to the machine, but which nonetheless leads to a machine stop (in accordance with DIN 8782).
SuspendedPrepared	22	The machine is ready to carry out its intended function. However, it is in a waiting state which was not recognized as a lack or tailback state and can automatically start again.
SuspendedLack	23	The machine is not carrying out its intended function due to a lack detected by the sensor system in the inlet of the machine (Machine Stop).
SuspendedTailback	24	The machine is not carrying out its intended function due to a tailback detected by the sensor system in the outlet of the machine (Machine Stop).
SuspendedLackBranchLine	25	The machine is not carrying out its intended function due to a lack in the secondary inlet or a tailback in the secondary outlet of the machine (Machine Stop).
SuspendedTailbackBranchLine	26	The machine is not carrying out its intended function due to a lack in the secondary inlet or a tailback in the secondary outlet of the machine (Machine Stop).

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7.4.5 MachineModeEnumType

The MachineModeEnumType describes predefined modes for a machine. This is a default mode enumeration. It is possible to extend it for your project specific use-cases.

Table 2: MachineModeEnumType values

Name	Value	Description
Undefined	0	Undefined
Manual	1	This mode indicates that the machine is in manual mode. This feature may be used for the commissioning of the individual drives, verifying the operation of synchronized drives, testing the drive as result of modifying parameters, etc
Maintenance	2	This mode indicates that the machine is in maintenance mode. This mode would typically be used for faultfinding, machine trials or testing operational improvements.
Automatic	3	The machine executes relevant logic in production mode. The machine is producing product or able to produce product.
SemiAutomatic	4	The machine executes relevant logic in semi-automatic mode. The machine is producing product or able to produce product where some operations are executed manually, while other operations are executed automatic.
Remote	5	The machine executes relevant logic in remote mode, e.g. it is controlled from a supervision control system.
StepMode	6	The machine executes relevant logic in step mode. This mode is typically used during commissioning where the machine processes a product step by step and the operator must start the next step manually.

Note:

7.4.6 MachineStandstillReasonEnumType

The MachineStandstillReasonEnum should contain all the machine specific standstill reasons. It is necessary to add all machine specific standstill reasons. The following table is just a suggestion how to cluster different category. Detailed values and descriptions must be defined at project level for each machine type. The number of the value is the start value of the range. Each range ends with the start number of the next range, e.g.
MachineInternalSafeties_2-23
MachineInternalOperatorAction_33-64
…..

Table 3: MachineStandstillReasonEnumType values

Name	Value	Description
Undefined	0	Undefined

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Name	Value	Description
MachineInternalEStop	1	Machine Internal EStop
MachineInternalSafeties	2..32	Safety relevant standstill reason
MachineInternalOperatorAction_	33..64	Standstill due to operator action
MachineInternalProductAndMaterialRelated	65..256	Standstill due to product or material reasons
MachineInternalEquipmentFault	257..512	Machine internal equipment fault
MachineInternalAllOtherFaults	513..1999	Machine internal all other faults
MachineExtUpstreamProcessReason	2000...2999	Machine ext. upstream process reason main product flow
MachineExtDownstreamProcessReason	3000...3999	Machine ext. downstream process reason main product flow
OutOfService	4000…4499	Out of service (planned and unplanned)
OtherExternalReasons	4500	Other external reasons branch- or sub-utility equipment

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7.4.7 StackLightColorEnumType

The StackLightColorEnumType describes predefined colors of a stack light. If a color is missing it is possible to extend the enumeration for the project

Table 4: StackLightColorEnumType values

Name	Value	Description
Undefined	0	Undefined
Red	1	Red
Yellow	2	Yellow
Green	3	Green
Blue	4	Blue
White	5	White

7.4.8 StackLightBehaviorEnumType

The StackLightBehaviourEnumType describes predefined modes of a light. If any behaviour, e.g. fast/ slow flashing is missing it is possible to extend the enumeration.

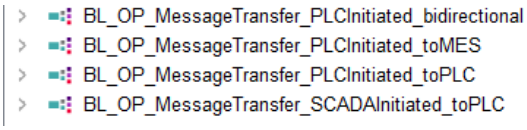
Table 5: StackLightBehaviorEnumType values

Name	Value	Description
Undefined	0	Undefined
OFF	1	OFF
Solid	2	Solid
Flashing	3	Flashing

7.5 Method-based Workflows

In the current version of Production Management for Batteries there are four DPTs for method based standard workflows:

Figure 7-21 Standard Workflows



7.6 Opcenter Execution Core Communication

REST API communication in PM4B is based on WinCC OA “Opcenter Execution Core V8.9 REST interface” wrapper. See WinCC OA local documentation for more info.

Production Management for Batteries provides the following CTRL-functions to execute standard Opcenter transactions. These functions must be used in custom scripts or panels by the engineer.

7.6.1 Standard Transactions

The following standard transactions are included:

Table 7-1 Delivered Opcenter standard transactions

Transaction	Endpoint	Description
MoveIn	POST https://<server>/Shopfloor/api/MoveIn	Used to start a given queued container in the current workflow step.
Move	POST https://<server>/Shopfloor/api/MoveStd	Used to move a given container to the next step in the workflow.
MoveNonStd	POST https://<server>/Shopfloor/api/MoveNonStd	Moves a given container to the any step in the workflow.
Combine	POST https://<server>/Shopfloor/api/Combine	Combines multiple containers into one.
Start	POST https://<server>/Shopfloor/api/Start	Creates a new container.

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Transaction	Endpoint	Description
ComponentIssue	POST https://<server>/Shopfloor/api/ComponentIssue	Used to supply material/containers to another container.
AdhocQuery	POST https://<server>/query/api/Adhoc	Executes a custom SQL query on the Opcenter Database.
UserDataCollectionDefs	POST https://<server>/modeling/api/UserDataCollectionDefs	Creates a new definition for data collections (UserDataCollectionDef).
CollectResourceData	POST https://<server>/Shopfloor/api/CollectResourceData	Used to collect data for a specified resource according to a DataCollectionDef.
CollectData	POST https://<server>/Shopfloor/api/CollectData	Used to collect data for a specified container according to a DataCollectionDef.

Functions return “true” if successful and “false” if transaction failed.

To use the provided Opcenter Execution Core standard transactions the Opcenter Server URL and Bearer Token must be specified in the library script *scripts/libs/classes/mes/BLOpcenterTransactionsCustomized.ctl*.

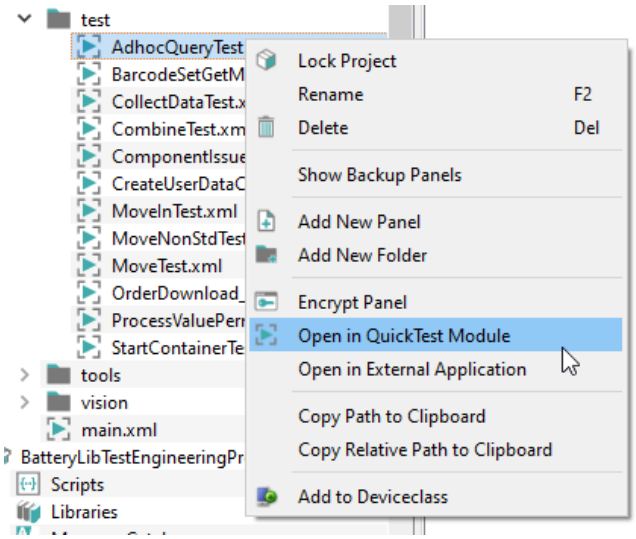
For more information about the given endpoints please take a look at the Opcenter documentation.

7.6.2 Example Panels

The Production Management for Batteries delivers example panels, which show how the Opcenter transactions can be executed.

The panels can be started directly from the Gedi, by right-clicking and selecting “*Open in QuickTest Module*”.

Figure 7-22 Starting Opcenter transaction example panels



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Start

The panel *test/StartContainerTest.xml* shows the example usage of the *Start* transaction.

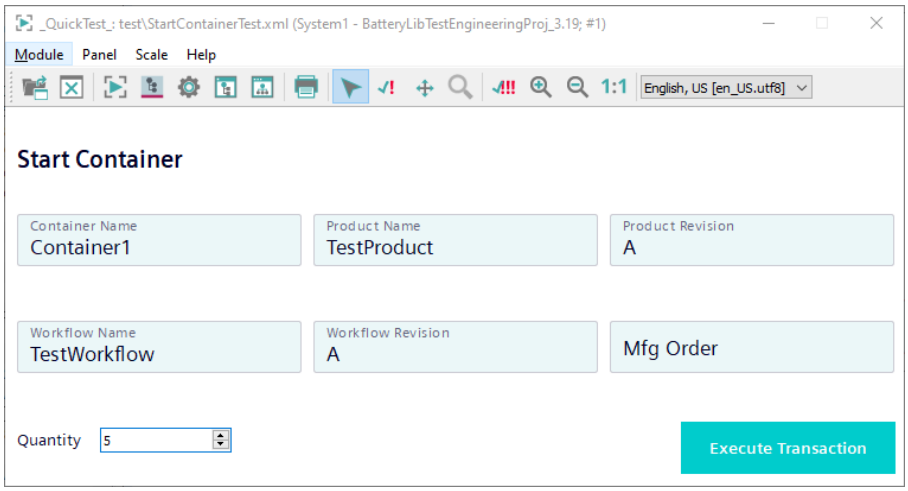
The following fields must be filled:

- Container Name: name of the container to be created
- Product Name: name of the product in the container
- Workflow Name: name of the workflow to be used for the container
- Quantity: quantity to be produced for the container

The fields *Product Revision* and *Workflow Revision* must be filled with the correct revision in case the Product/Workflow uses revision of record.

If necessary, the *Mfg Order* can be filled with a valid order name, for which the container should be created.

Figure 7-23 Example panel for Start transaction



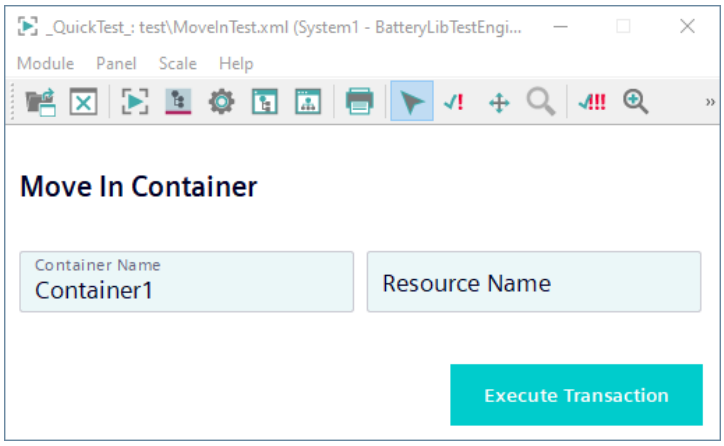
MoveIn

The panel *test/MoveInTest.xml* shows the example usage of the *MoveIn* transaction.

The *Container Name* for the container to be started must be specified, the *Resource Name* used for starting is optional.

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Figure 7-24 Example panel for MoveIn transaction

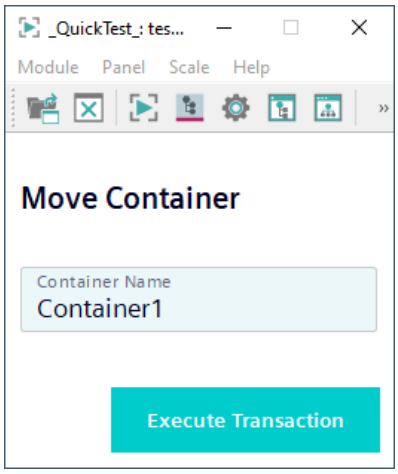


Move

The panel *test/MoveTest.xml* shows the example usage of the *Move* transaction.

The *Container Name* for the container to be moved to the next step is required.

Figure 7-25 Example panel for Move transaction



MoveNonStd

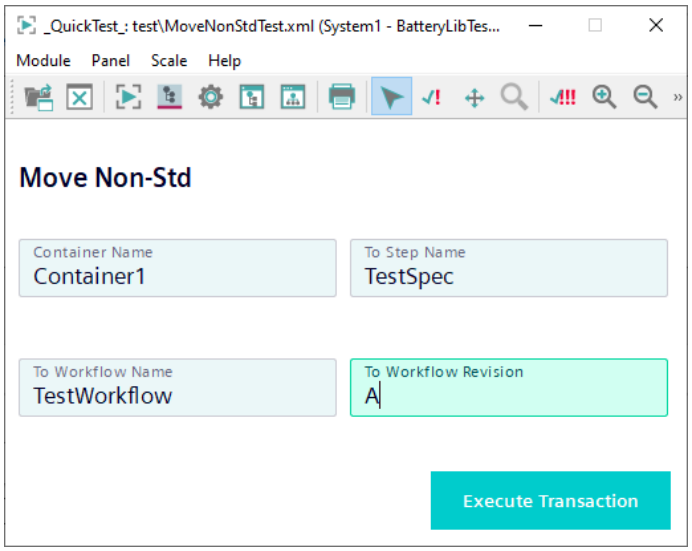
The panel *test/MoveNonStd.xml* shows the example usage for the MoveNonStd transaction.

The following fields must be filled:

- Container Name: name of container to be moved
- To Step Name: name of the step to move to
- To Workflow Name: name of the workflow, in which the container should be moved
- To Workflow Revision: revision of the workflow

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Figure 7-26 Example panel for MoveNonStd



ComponentIssue

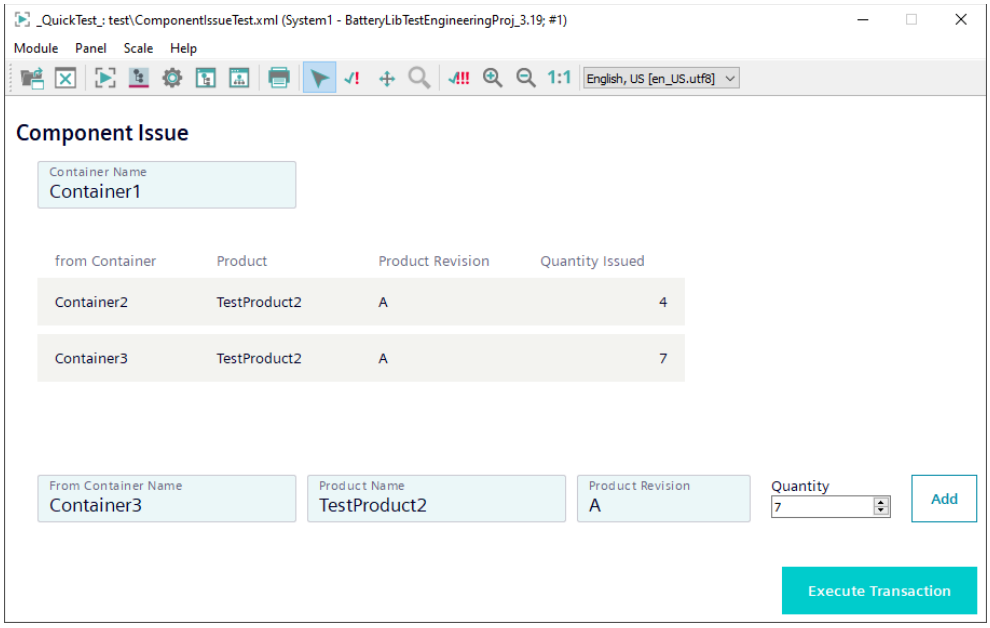
The panel *test/ComponentIssueTest.xml* shows the example usage for the *ComponentIssue* transaction.

The following fields must be filled:

- *Container Name*: name of container, where components should be supplied to
- List of Containers and Products to issue
  - *From Container Name*: name of container to be issued
  - *Product Name*: name of the product to be issued
  - *Product* **Revision**: revision of the product to be issued
  - *Quantity*: quantity of material to be issued

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Figure 7-27 Example panel for ComponentIssue



Combine

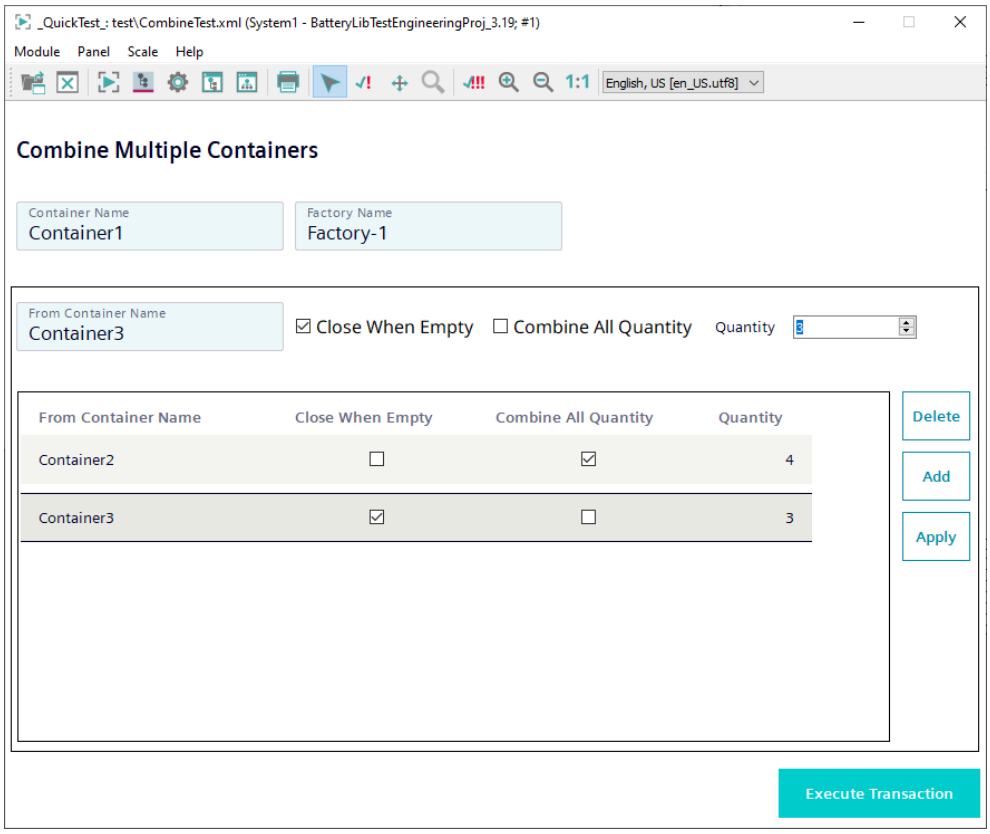
The panel *test/CombineTest.xml* shows the example usage for the *Combine* transaction.

The following fields must be filled:

- *Container Name*: name of the container, where the other containers should be combined into
- *Factory Name*: name of factory in Opcenter
- List of Containers to combine
  - *From Container Name*: name of container to be combined
  - *Close when empty*: determines if the container should be closed if it is empty after combine.
  - *Combine all quantity*: determines if all quantity of the container should be combined or not.
  - *Quantity*: quantity to be combined

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Figure 7-28 Example panel for Combine



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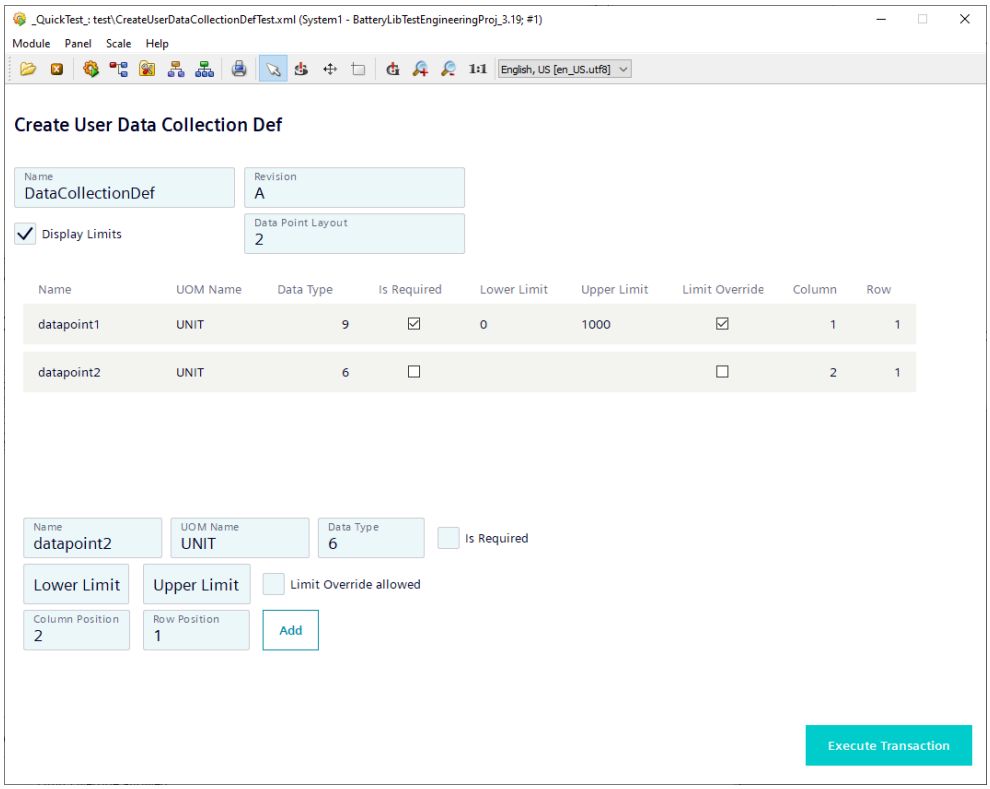
UserDataCollectionDefs

The panel *test/CreateUserDataCollectionDefTest.xml* shows the example usage for the *UserDataCollectionDefs* transaction.

The following fields must be filled:

- *Name*: name of the user data collection definition to be created
- *Revision*: revision to be created
- *Data Point Layout* (value 2 = Iteration Grid)
- Display Limits:
- List of Data Points in the data collection
  - *Name*: data point name
  - *UOM Name*: unit name, optional
  - *Data Type*: (value 9 = Decimal, 6 = Timestamp)
  - *Is Required*: specifies if the datapoint must be provided when collecting data
  - Lower Limit: optional
  - Upper Limit: optional
  - Limit Override allowed
  - Column Position
  - Row Position

Figure 7-29 Example panel for creating UserDataCollectionDefs



CollectResourceData

The panel *test/CollectDataTest.xml* shows the example usage for the *CollectData* and *CollectResourceData* transaction.

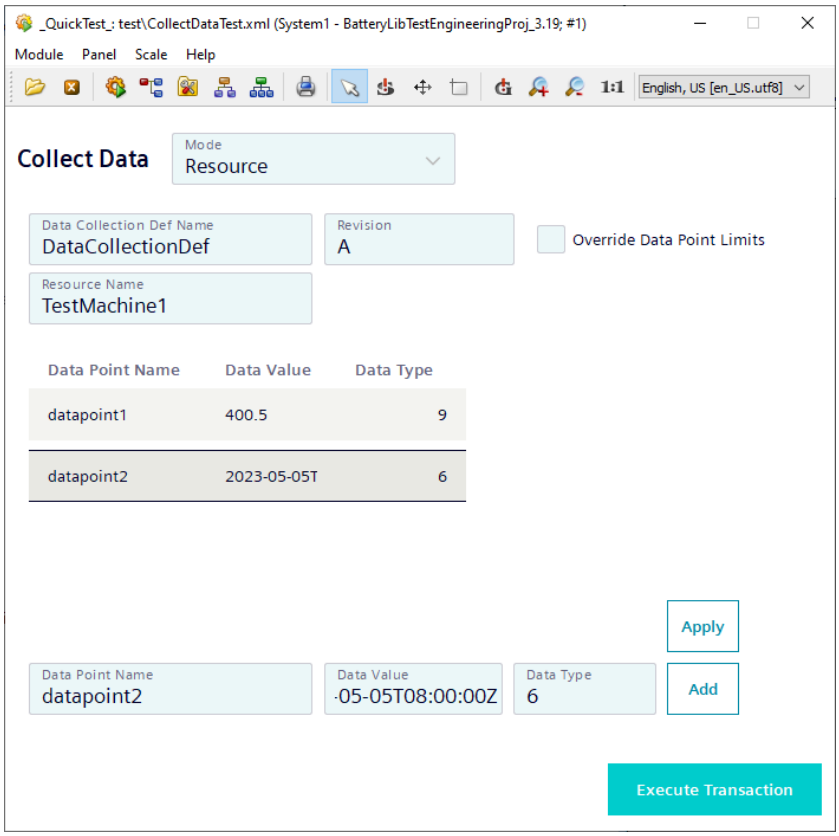
Selecting "*Resource*" as *Mode* in the panel executes the *CollectResourceData* transaction.

The following fields must be filled:

- *Data Collection Def Name*: name of the data collection definition
- *Revision*: revision of the data collection definition
- Override Data Point Limits
- *Resource Name*: name of the resource
- List of Data Points to collect
  - *Data Point Name*: name of the data point
  - Data Value: value
  - *Data Type*: (value 9 = Decimal, 6 = Timestamp)

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Figure 7-30 Example panel for CollectResourceData



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CollectData

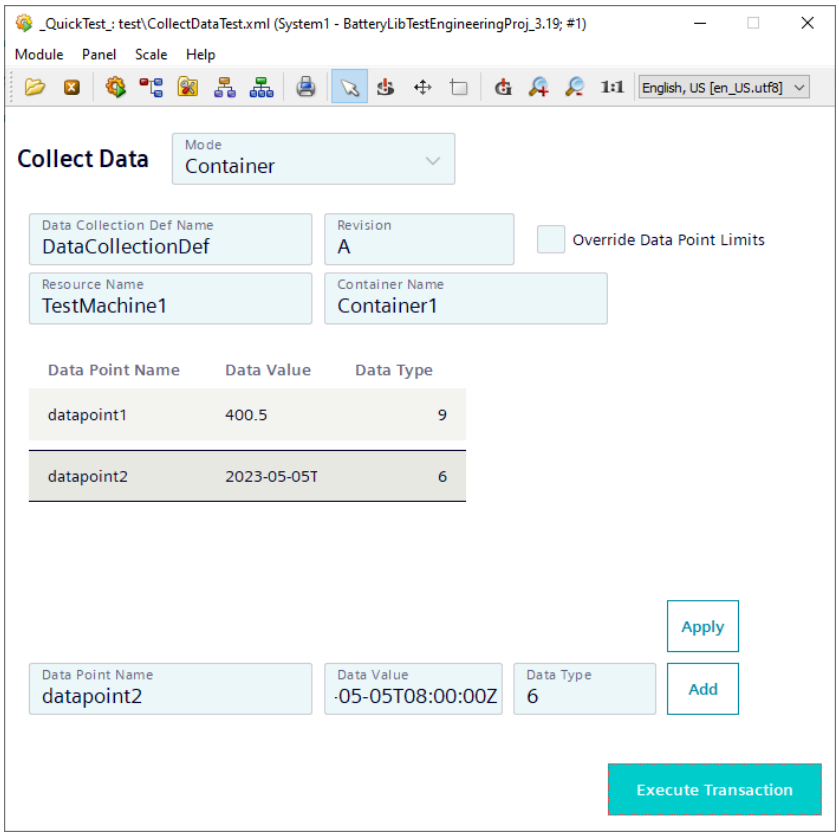
The panel *test/CollectDataTest.xml* shows the example usage for the *CollectData* and *CollectResourceData* transaction.

Selecting “Container” as *Mode* in the panel executes the *CollectData* transaction.

The following fields must be filled:

- *Data Collection Def Name*: name of the data collection definition
- *Revision*: revision of the data collection definition, only required if ROR is enabled for the data collection definition
- *Container Name*: name of the container, for which the data should be collected
- Override Data Point Limits
- *Resource Name*: name of the resource, optional
- List of Data Points to collect
  - *Data Point Name*: name of the data point
  - Data Value: value
  - *Data Type*: (value 9 = Decimal, 6 = Timestamp)

Figure 7-31 Example panel for CollectData



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AdhocQuery

The panel *test/AdhocQueryTest.xml* shows the example usage of the transaction. The transaction allows the execution of custom SQL queries on the Opcenter database.

The panel shows how custom queries can be executed, and how stored queries (in WinCC OA) can be shown, read, and executed.

For custom queries the following fields must be filled:

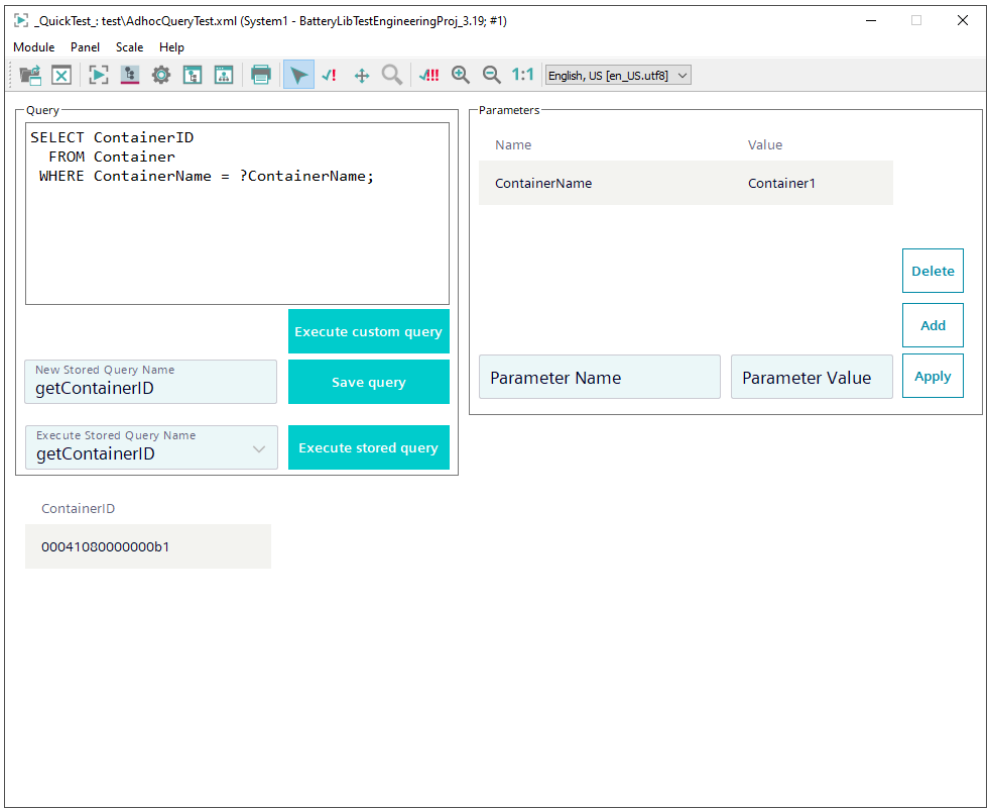
- *Query*: SQL query string (can contain parameters, such as *?ContainerName* in the example below)
- *List of Parameters* used in the query
  - *Name*: Parameter Name
  - *Value*: Parameter Value

The button *Save query* stores a query with the name given in the field *New Stored Query Name*, it is then stored in the file *data/mes/queries/<queryName>.sql*.

The combo box *Execute Stored Query Name* allows executing one of the stored queries. It shows elements for each .sql files in *data/mes/queries*.

The lower section of the panel shows the query result in a table.

Figure 7-32 Example panel for AdhocQuery



7.6.3 Custom Transactions

An example transaction file BatteryLibrary_Engineering/scripts/examples/libs/classes/mes/BLOpcenterTransactionsCustomized.ctl shows how custom Opcenter transactions can be implemented.

It must be moved into the projects *scripts/libs/classes/mes* directory to be usable.

The panels panels/examples/mes/ContainerTransactionsTest.xml and panels/examples/mes/MfgOrderTransactionsTest.xml show the usage of the example transactions.

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Figure 7-33 Example panel for custom container transactions

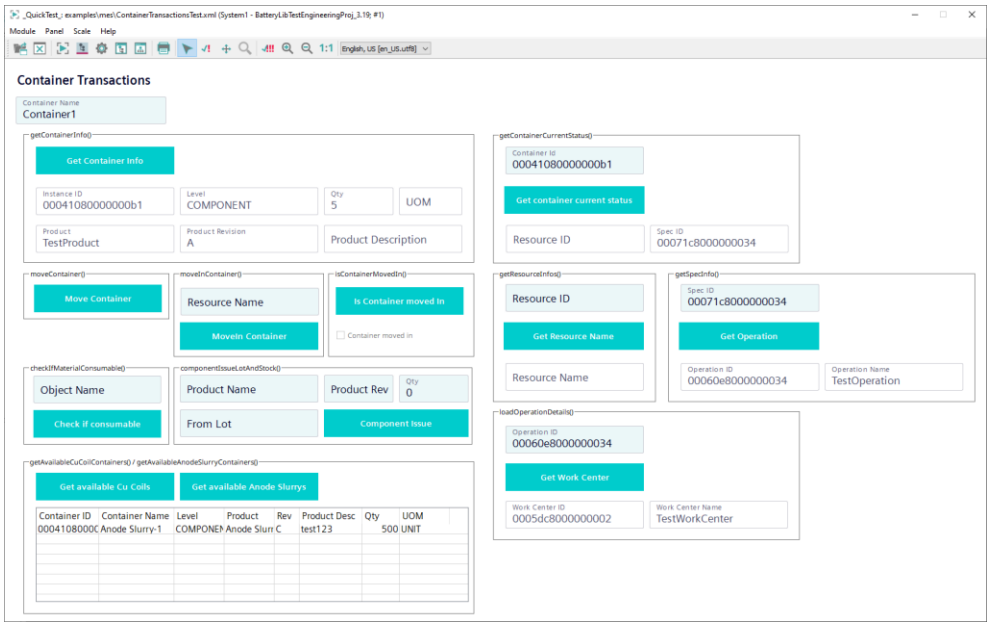
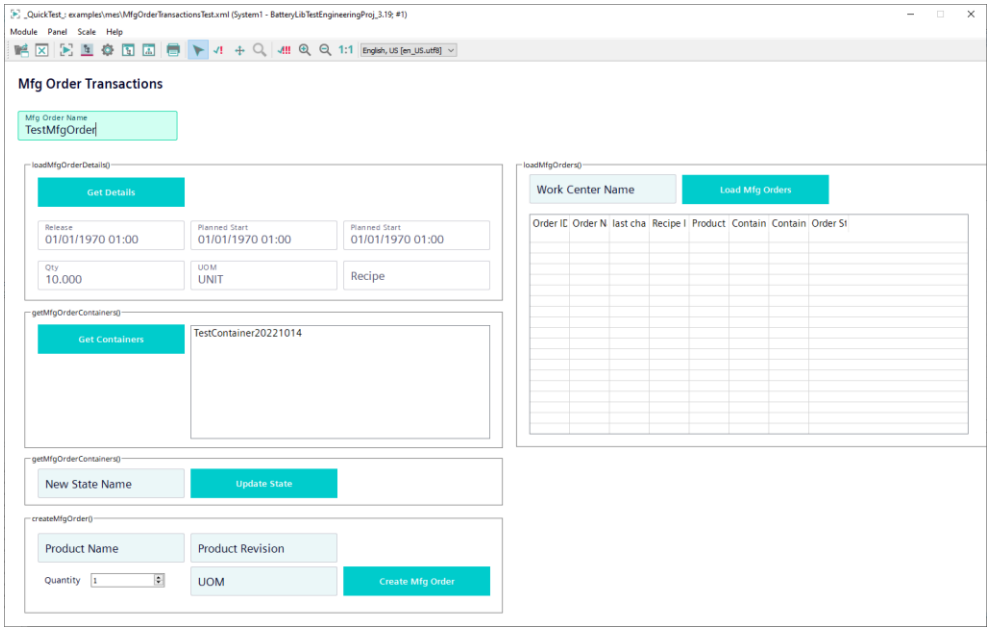


Figure 7-34 Example panel for custom MfgOrder transactions



7.6.4 REST API Messages Error Handling

REST API communication in PM4B is based on WinCC OA “Opcenter Execution Core V8.9 REST interface” wrapper. See WinCC OA local documentation for more info.

There are functions in PM4B to handle HTTPS communication with Opcenter via REST API. PM4B evaluation responses from Opcenter for errors, timeouts etc.

Functions return “true” if successful and “false” if transactions fail. Transaction is considered „failed“ if it is timed out (Opcenter is not reachable) or Opcenter returns a response with an error code.

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There is a possibility to change the way transactions are handled by editing WinCC OA wrapper configuration.

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8 Getting Started

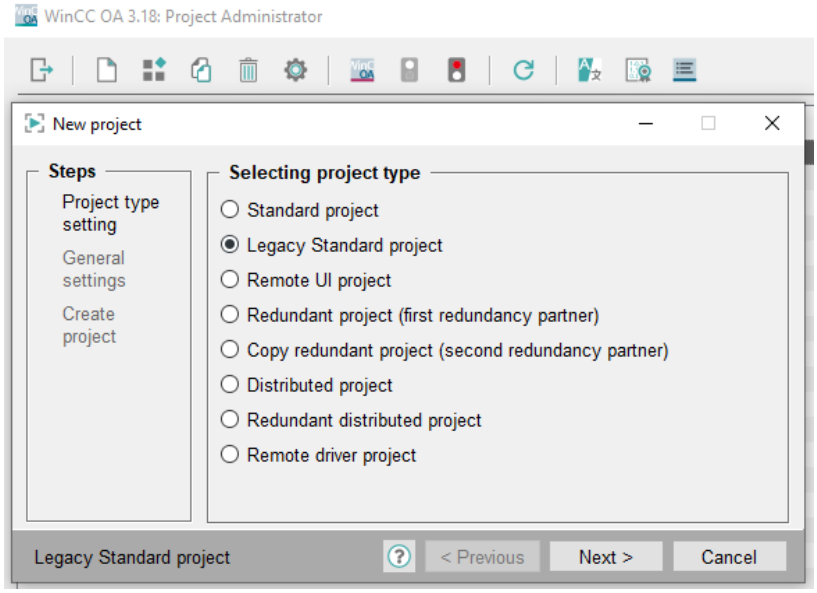
8.1 Setting up an Engineering Project

8.1.1 Create new WinCC OA Project

For creating a new WinCC OA project do the following steps:

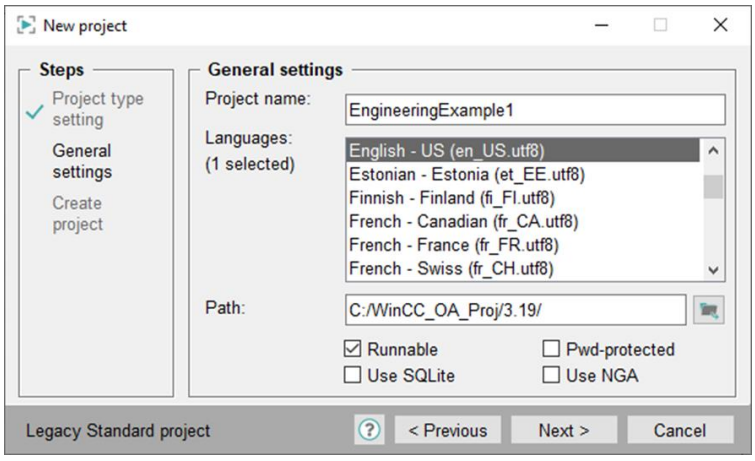
1. Start the WinCC OA Project Administrator
2. Click the symbol "*New Project*"
3. Select the project type "*Legacy Standard project*"

Figure 8-1 New Legacy Standard WinCC OA Project



4. Click Button "*Next*"

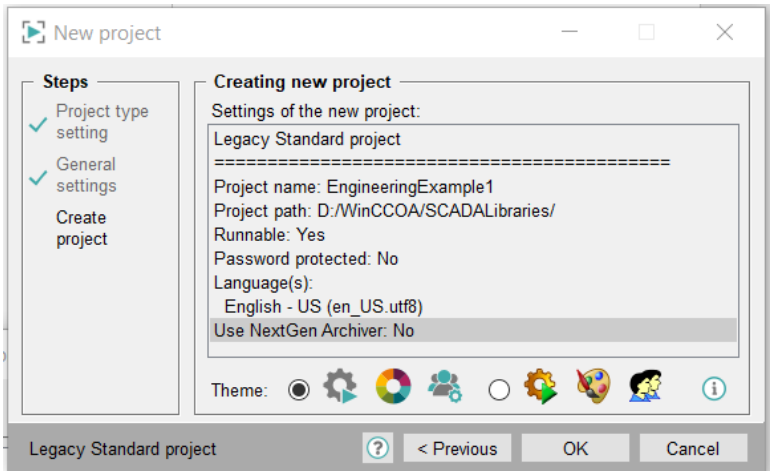
Figure 8-2 Project Parameters



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5. Enter a project name
6. Select the project language English - US
7. Enter path for new project on your PC
8. If the end projects should use the NextGenArchvier, select "*Use NextGenArchiver*"
9. Click button "*Next*"

Figure 8-3 Create Engineering Project



10. Click button "*OK*" for creating the project

NOTE The WinCC OA Multiplexing Proxy must be disabled (by setting *mxProxy = "none"* in *general* section project config) or changing the ports for data and event managers, otherwise project deployment will not work.

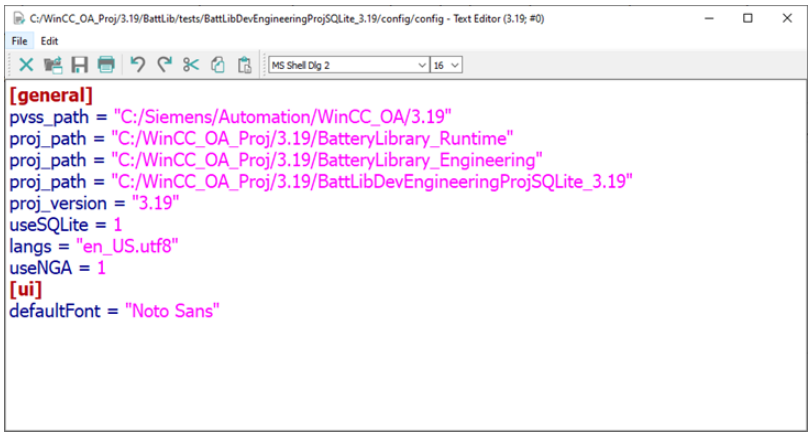
8.1.2 Use Production Management for Batteries as Subproject

1. Open the config file of the new engineering project with the Project Edit button  or with the Windows explorer
2. Add the two paths for the Production Management for Batteries subprojects

- BatteryLibrary_Runtime
- BatteryLibrary_Engineering

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Figure 8-4 Project config, integrate necessary subprojects



NOTE The shown sequence for the project paths needs to be applied.

NOTE The default font in the engineering project and in the deployed projects running in a plant must be set to "*Noto Sans*". Otherwise, the stylesheet will not work correctly.

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8.1.3 Initialization of Engineering Project

The following steps must be performed to initialize the project database and tools to be used as Production Management for Batteries engineering project:

1. Ensure the newly created project is not running, close open WinCC OA console and Project Administration.
2. Copy the template progs file from the engineering subproject's config folder to the newly created projects config folder.
   Use the correct template progs-file according to the type of engineering project.
   a. for SQLite projects use the file `progs_nga_sqlite.template`
   b. for RAIMA projects with NextGenArchiver use the file `progs_nga.template`
   c. otherwise use the file `progs_valarch.template`
3. Rename the original `progs` file (as backup) in the project's config directory
4. Rename the progs template file to `progs` in the project's config directory
5. Start the new project using the WinCC OA Project Administration or Console
6. Wait for the project to be restarted (will happen automatically after initialization is finished)

When starting the project for the first time the necessary DPTs and DPs are automatically imported from the delivered DP lists.

8.2 First Engineering Steps

This chapter describes the first engineering steps which should be done. After following these steps, the runtime can be started and there will already be appropriate contents for navigation and screens.

8.2.1 OPC UA Connection in System Management

The address configurations for the process tags can be created from the OPC UA item information in the SiOME files. At least one OPC UA connection for an OPC UA client in WinCC OA with two subscriptions, one data subscription and one for alarms and conditions, are necessary for creating the address configs.

The connection and the subscriptions must have the following names:

- BL_default_opcua_connection
- BL_default_opcua_subscription_data
- BL_default_opcua_subscription_alarms

See chapter 4.4 OPC UA connections and subscriptions for more information.

NOTE The default connection and the default subscriptions are used to make copies for each created machine. The copies for connections and subscriptions can be adopted in the WinCC OA System Management.

NOTE It is strongly recommended to use authentications (certificates) and security settings when creating an OPC UA connection!

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8.2.2 Basic Configurations in Engineering Tools

For showing information in the standard screens of the Production Management for Batteries some basic configuration is needed. The most important objects in the SCADA system are the process tags for the machines. To be able to create structured data objects for the process (and the calculated values) a definition of machine types and a plant configuration are needed.

1. Define needed machine types in tool “Machine Settings”
2. Define the plant structure in tool “Plant Settings”
3. Configure Process Tags in tool “DP Objects”
4. Configure the archiving of process tags and calculated tags in tool “DP Archives”

NOTE The WinCC OPC UA connection with data and alarm subscription must be created manually before using the “DP Objects” tool with the automatic address creation option.

KPI calculations are only possible if the basic data for the calculations are archived.

8.2.3 Basic UI Settings in Engineering Tools

NOTE The tool Navigation Settings must be started once to create or adopt the navigation structures.

The Production Management for Batteries contains a couple of predefined color databases and color schemes. They can be used as they are and there is no need to change the colors in the color databases to get the system running. But there is the possibility to change colors using the "Color Settings" tool (e.g., for alarms or stacklights).

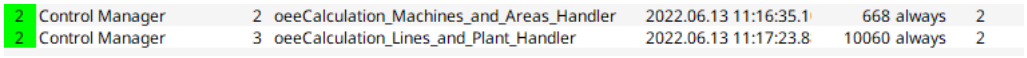
Nice pictures can be shown for the different machine types in the screens and for the customer logo in the header if the pictures are copied into the pictures folder of the engineering project and are assigned with the "Symbol Settings" tool.

8.2.4 Create and Start required Managers

The calculation of machine OEEs, area OEEs and machine statistics is done by one control manager. The calculation of the line OEEs and the plant OEEs is done by a second control manager. This separation was introduced to a support distributed systems with lines split between systems. The calculation for the line and plant is done on the head system.

Following control managers and a driver are necessary for sending/receiving data via OPC UA and having the KPI calculations running. For any additional functionality other managers shall be started, e.g., for handling the communication to the MES.

Figure 8-5 Control Manager for OEE and Statistic Calculation



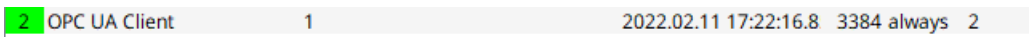
Since not all users must have permissions to create DPs themselves, the following control manager must be started, that creates the necessary DPs for creating trend configurations and saving User Interface settings.

Figure 8-6 Control Manager for User Interface Setting and Trend DP Creation



At least one OPC UA client is necessary for connecting the PLCs via OPC. For information about additional engineering steps for using the driver please refer to chapter 4.4.

Figure 8-7 OPC UA Client



8.2.5 Start the Process Tag Simulator

If there are no real or simulated PLCs for the process values of the machines, the most important machine values can be simulated with functions of the Production

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Management for Batteries. Therefore, a control manager must be created which is running the simulation script.

Figure 8-8 Control Manager for Simulation in WinCC OA Console



If not all machines should be simulated this can be configured with the tool Simulation Settings.

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9 Alerts

The following predefined alert classes are delivered with the Production Management for Batteries.

Table 9-1 Alert Classes

Name	Priority	Short Name	Acknowledgement
BL_Alarm	80	ALM	CAME or WENT
BL_Fault	70	FLT	CAME or WENT
BL_Warning	60	WRN	CAME or WENT
BL_Status	40	STT	---
BL_Command	30	CMD	---
BL_Info	20	INF	---
BL_System	10	SYS	---

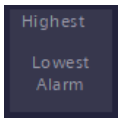
See OPC UA Alarm Severity for configuring Alert Classes for OPC UA Alarms.

All alert classes used within the Production Management for Batteries must use permission bit 5 as acknowledgement authorization bit.

NOTE In Production Management for Batteries only authorization bit 5 can as acknowledgment bit (allows users to acknowledge alarms).

To show a custom text in UI instead of the alert class DP as “highest alert class”, a description for the alert class DPE must be defined. “Highest alert class” is displayed on Plant Overview screen – see 3.2.2.

Figure 9-1 Highest alert class indication of a line on a “Plant Overview” screen



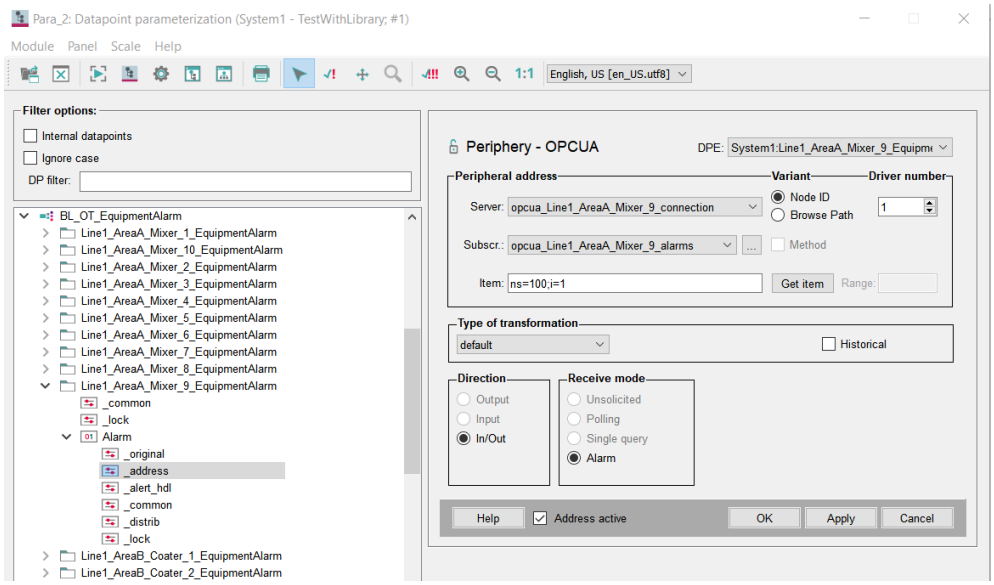
9.1 OPC UA Alarms and Conditions Configuration

For sending alarms from a PLC to the SCADA system the OPC UA mechanism Alarms & Conditions is supported. The WinCC OA OPC UA client allows receiving and acknowledging alarms from an OPC UA alarm server. The alarm is mapped to a data point element in the WinCC OA OPC UA client project via a corresponding peripheral address.

For each machine, a special datapoint for this purpose is created using the tool DP Objects.

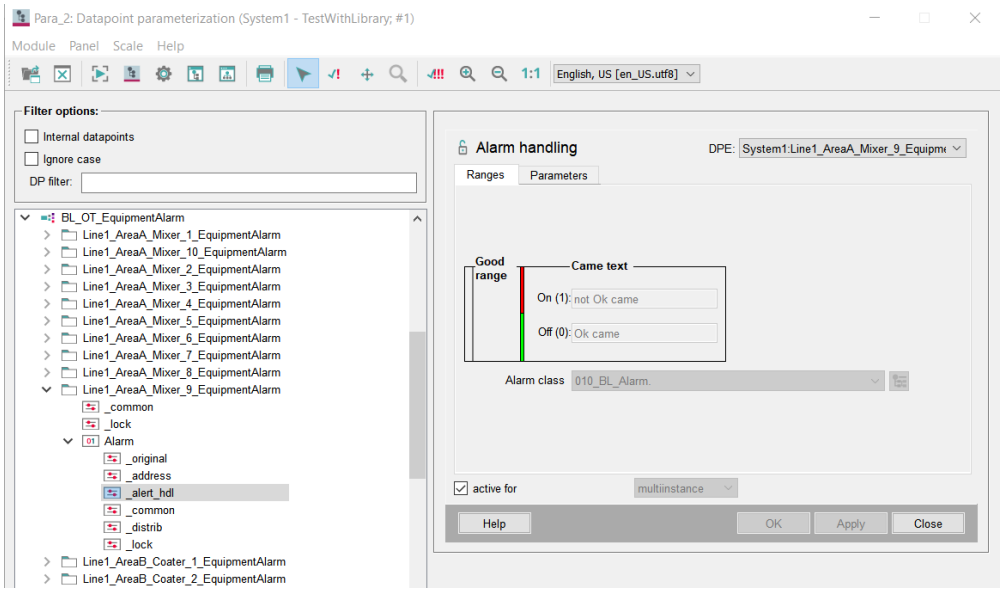
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Figure 9-2 Alarm Datapoint with Peripheral Address



NOTE In the peripheral address the special subscription for the alarms is used. The subscription has been created automatically in the tool which creates the datapoints.

Figure 9-3 Alert Handling for Alarm Datapoint



The alert handling automatically is configured for a multiinstance alarm.

NOTE The OPC UA severities must be mapped to WinCC OA alarm classes, see OPC UA Alarm Severity. More information can be found in the WinCC OA online help.

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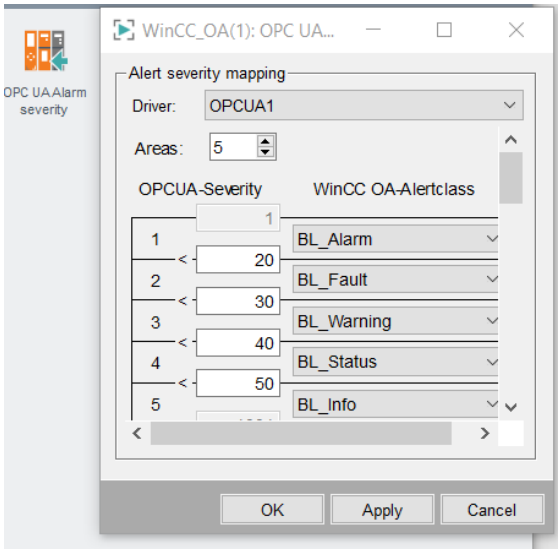
9.2 OPC UA Alarm Severity

Mapping between the OPC UA severity and the alert classes in WinCC OA must be configured in case OPC UA Alarms & Conditions mechanism is used for the transmission of alarms from the PLCs to the SCADA system.

The following steps show how to configure the mapping.

1. Open Driver OPC -> OPC UA Alarm Severity
2. Select the OPC UA Client from the drop-down list "*Driver*"
3. Enter the number of mapping "*Areas*"
   Areas represent number of Severity ranges
4. Enter the area limits
5. Enter the alert class which should be used for each area
6. Click button "*Apply*"

Figure 9-4 Alert Severity Mapping



NOTE The shown configuration is automatically configured for OPC UA Client 1, after setting up the library.

9.3 Sum Alarms

Alarms screens show alarms according to a DP Patterns of a current level – machine, area, line. DP Patterns are defined in "Sum Alarms".

NOTE Alarm screen on a "Plant" level always shows all alarms (unfiltered).

Sum alarms are automatically created for

- The plant

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- Lines
- Areas
- Machines

It uses a filter to summarize all alarms of the according object. It always includes alarms of all underlaying objects on any element by default.

The filters are defined as follows:

- Plant:
  - Line*.**
  - _Line*.connected
  - _opcua_Line*.**
- Lines:
  - <line>_*.**
  - _<line>_*.connected
  - _opcua_<line>_*.**
- Areas:
  - <line>_<area>_*.**
  - _opcua_<line>_<area>_*.**
- Machines:
  - <line>_<area>_<mType>_<mInstance>_*.**
  - _opcua_<line>_<area>_<mType>_<mInstance>_*.**

They can be adapted by the engineer if needed. The DPs can be found in DPT *BL_CT_SumAlarm* and have *SumAlarm_* as prefix in their name.

Example DP Names are:

- SumAlarm_Plant for the plant
- SumAlarm_Line1 for a line
- SumAlarm_Line1_Area1 for an area
- SumAlarm_Line1_Area1_Mixer_1 for a machine

NOTE The alarm screen shows all alarms for a specific object. Filters can be defined by changing the DP Pattern of the associated SumAlarm DP (e.g., the filter for Line1/Area1 can be changed by adapting the DP Pattern of SumAlarm_Line1_Area1).

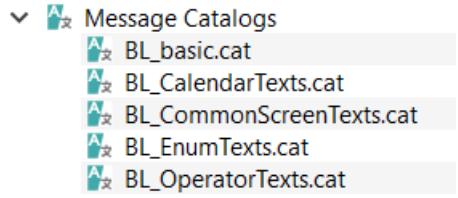
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10 Definitions and Agreements

10.1 Message Catalogs

The Production Management for Batteries contains several message catalogs for different purposes:

Figure 10-1 Message Catalogs



The catalog “BL_EnumTexts.cat” e.g., contains the texts for the ENUM definitions which are shown in the UI.

Figure 10-2 Texts for Enumerations (extract)

D:\WinCCOA\SCADALibraries\BatteryLibrary\msg\BL_EnumTexts.cat - Message Catalog Editor (System1 - TestWithLibrary; #1)

	Keyword	English, US [en_US]
1	machineMode_Undefined	Undefined
2	machineMode_Manual	Manual
3	machineMode_Maintenance	Maintenance
4	machineMode_Automatic	Automatic
5	machineMode_SemiAutomatic	Semi Automatic
6	machineMode_Remote	Remote
7	machineMode_StepMode	Step Mode
8	machineState_Undefined	Undefined
9	machineState_Clearing	Clearing
10	machineState_Stopped	Stopped

NOTE Production Management for Batteries is designed only for one language which is the English language. This means all screens are only available in English language in the current version and this also applies to the engineering tools.

NOTE In a coming version there will be even more catalogs for texts which can be used for translating the runtime user interface to different languages. The user interface of the engineering tools will not be translatable.

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10.2 Color Schemes, Stylesheets, and Icon Themes

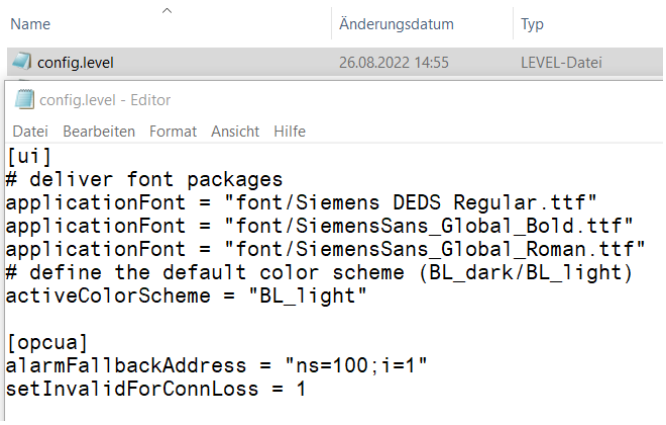
10.2.1 Color Schemes

Production Management for Batteries contains two predefined color schemes, which are based on the Siemens Brandville definitions:

- BL_dark
- BL_light

The active color scheme when starting runtime is defined in the “config.level” file of Production Management for Batteries:

Figure 10-3 Default Color Scheme in config.level



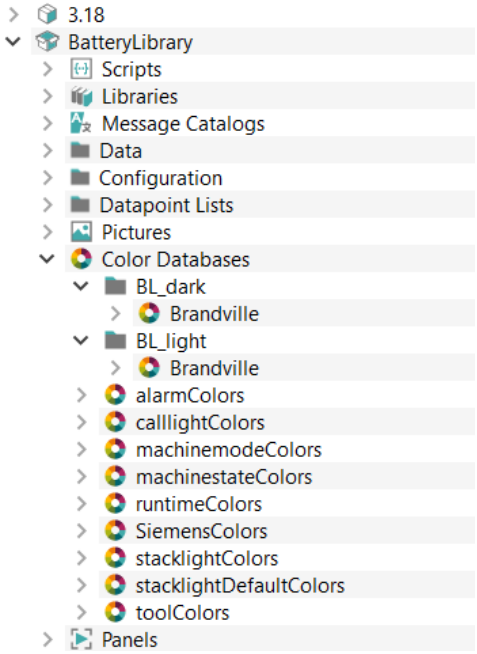
The used color scheme can be dynamically changed at runtime.

NOTE The “config.level” file also contains the path for the application font which contains symbols which are used in the HMI and the paths for the “SiemensSans Global” fonts which allow non-European languages

Besides the color schemes Production Management for Batteries contains a couple of color databases which are independent from a scheme. The colors of some color databases can be changed with the “Color Setting” tool (e.g., alarm colors or machine state colors), see Color Settings.

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Figure 10-4 Color Scemes and Color Databases



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10.2.2 Stylesheets

The file

…/config/stylesheet.css

in contains the Brandville styles for the Qt classes.

Figure 10-5 Brandville Styles for Qt Classes

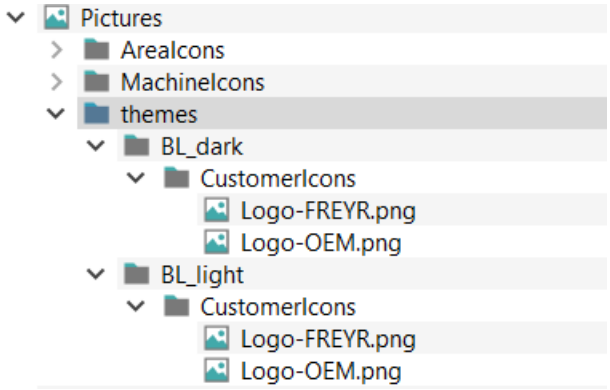
```
/*#############################################################################
# Tree
#############################################################################*/

/* global tree properties */
QTreeView[type ^= "Brandville_Tree"]
{
  border: none;
  show-decoration-selected: 1;
  selection-background-color: transparent;
  background: oa-color(Brandville_Tree_Background);
}
/* default tree item */
QTreeView[type ^= "Brandville_Tree"]::item,
QTreeView[type ^= "Brandville_Tree"]::branch
{
  min-height: 44px;
  margin-bottom: 6px;
  border-bottom: 2px solid oa-color(Brandville_Tree_Background);
}
QTreeView[type = "Brandville_Tree"]::item,
QTreeView[type = "Brandville_Tree"]::branch
{
  color: oa-color(Brandville_Tree_Item_Color);
  background: oa-color(Brandville_Tree_Item_Background);
}
/* hovered tree item */
```

10.2.3 Icon Themes

Symbols can be supplied and shown depending on the color scheme. This is done by creating a subfolder “themes” in the folder “pictures” and creating a subfolder for each scheme in “themes”. This has to be done in the engineering project. The following example shows the structure for scheme dependent customer icons.

Figure 10-6 Themes in Engineering Project



NOTE These customer icons are subject of the symbol setting tool, see Symbol Settings.

Production Management for Batteries itself contains scheme dependent icons, e.g., icons for the areas in the plant dashboard.

Figure 10-7 Area Icons for “dark” Scheme

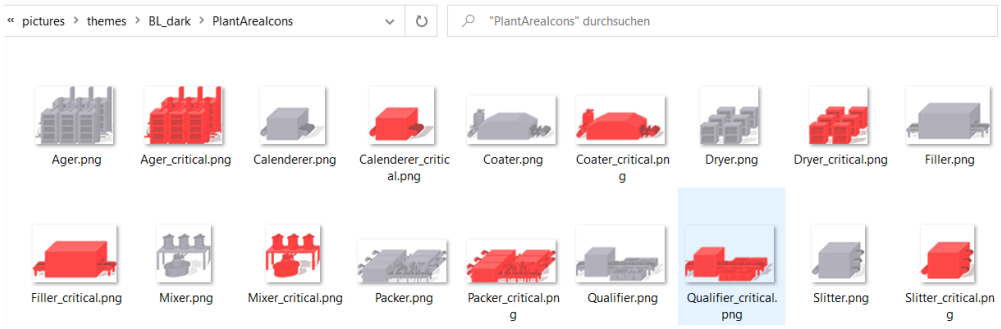
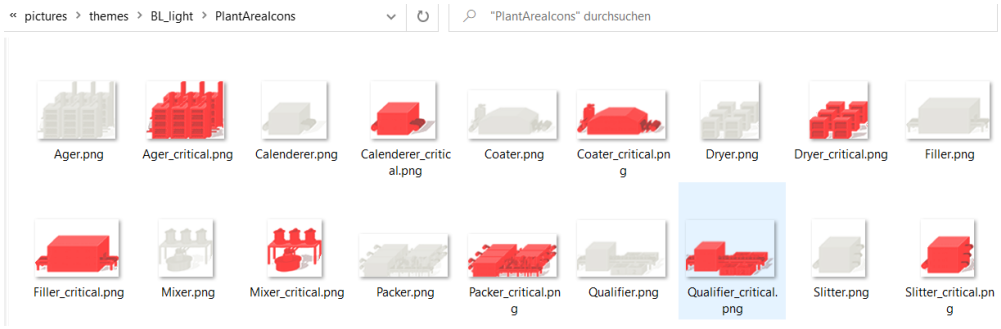


Figure 10-8 Area Icons for “light” Scheme



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NOTE These icons are not subject of the symbol setting tool up to now. But they can be substituted by supplying symbols with the same name in the same folder structure in the engineering project.

10.3 Critical Machine Parameter

The criteria for a critical machine are defined by adapting the script

`scripts/libs/machines/machineCriticalCustomzied.ctl`

Figure 10-9 scripts/libs/machines/machineCriticalCustomzied.ctl

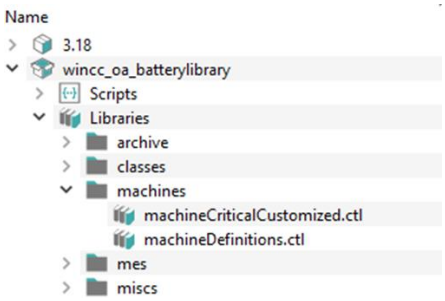


Figure 10-10 machineCriticalCustomized.ctl

```
/**
  The method is used to define which value for a given DPE specifies as critical.
  It is executed whenever a DPE value of a DP contained in the DPGroup BL_CriticalParameters is changed.
  @param dp string: DP part of the DPE
  @param element string: element part of the DPE. dp + "." + element = DPE
  @param value anytype: current value of the DPE
  @return TRUE when state is critical because of the given parameters, otherwise FALSE.
 */
public bool isCritical(const string &dp, const string &element, const anytype &value)
{
  string dpt = dpTypeName(dp);

  if (dpt == BL_DPT_EQUIPMENT_STATUS)
  {
    if (element == "Starved" || element == "Blocked")
    {
      return (bool)value;
    }
    else if (element == "State")
    {
      machineState state = (machineState)((int)value);
      return !machineStatesMachineAvailable.contains(state);
    }
  }
  else if (dpt == BL_DPT_STACKLIGHT)
  {
    if (dp.endsWith("_Stacklight1") && element == "Behavior")
    {
      stacklightBehaviour behavior = (stacklightBehaviour)((int)value);
      return (behavior == stacklightBehaviour::Flashing || behavior == stacklightBehaviour::Solid);
    }
  }

  return true;
}

```

The library contains a function

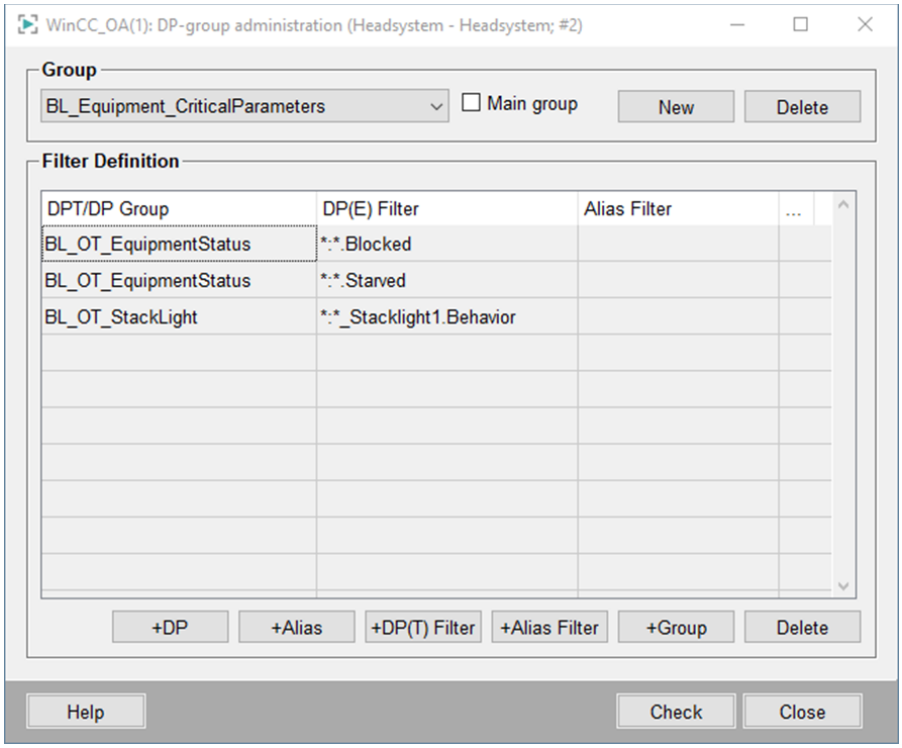
`isCritical()`

that defines the critical value ranges for the parameters.

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The critical parameters are defined by a DP Group named *BL_Equipment_CriticalParameters*.

Figure 10-11 DP Group for critical parameters



NOTE The DP Group must include DPEs of all systems, by adding "*:" to the start of the DP(E) filter, as a value change is only interpreted as critical parameter change if the DPE is included in this (local) DP group.

More details and examples can be found in the file or in Figure 10-10 and Figure 10-11.

10.4 Library Version Updates

Updating the library version in an existing engineering project is partially automated, but also requires some manual work.

The following changes were made within this version (V1.1):

- New colors have been added
  - in Brandville colorDB
- Stylesheet has been changed
- Icon font has been updated
- dplist files were updated and moved to *dplist/base* and *dplist/update*
- New template progs files for easier engineering project setup were added

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- New unencrypted panels/scripts have been added:
  - panels/examples/mes/MfgOrderTransactionsTest.xml (engineering subproject)
  - panels/examples/mes/ContainerTransactionsTest.xml (engineering subproject)
  - panels/testAdhocQueryTest.xml (engineering subproject)
  - panels/test/CollectDataTest.xml (engineering subproject)
  - panels/test/CombineTest.xml (engineering subproject)
  - panels/test/CreateUserDataCollectionDefTest.xml (engineering subproject)
  - panels/test/MoveInTest.xml (engineering subproject)
  - panels/test/MoveNonStdTest.xml (engineering subproject)
  - panels/test/MoveTest.xml (engineering subproject)
  - scripts/examples/libs/classes/mes/BLOpcenterTransactionsCustomized.ctl (engineering subproject)
  - panels/objects/mes/MfgOrderDetails.xml (runtime subproject)
  - panels/objects/mes/MfgOrderList.xml (runtime subproject)
  - panels/objects/process/Examples.xml (runtime subproject)
- Updated unencrypted panels/scripts:
  - panels/test/StartContainerTest.xml
  - panels/screens/AreaTemplateMESData.xml: New workorder screen using the example transactions was added.
  - panels/screens/MachineTemplateControl.xml: Updated to show the configured speed unit for the machine type.
  - panels/objects/machines/MachineInfo.xml: Added support for distributed systems.
  - panels/objects/plant/PlantLineOverview.xml: Added support for lines with more areas than fit in a row
  - scripts/libs/messageTransfer_PLCInitiated_bidirectional_customized.ctl: Updated example
  - scripts/libs/messageTransfer_PLCInitiated_toMES_customized.ctl: Updated example
  - scripts/libs/messageTransfer_PLCInitiated_toPLC_customized.ctl: Updated example
  - scripts/libs/miscs/calculateKPI.ctl: Updated to use configured OEE Settings in calculation.
  - scripts/oeeCalculation_Lines_and_Plant_Handler.ctl: Updated to use configured OEE Settings in calculation and support distributed systems.
  - scripts/oeeCalculation_Machines_and_Areas_Handler.ctl: Updated to use configured OEE Settings in calculation and support distributed systems.
  - scripts/libs/machines/machineCriticalCustomized.ctl: Updated to handle invalid machine states and stacklight behaviors as Undefined.
  - scripts/libs/classes/objectImport/BLUaDPCreatorCustomized.ctl: Updated to handle machine interface updates.
  - scripts/libs/tools/exportsImports.ctl: Updated to include new DPs.
- Updated message catalogues:
  - BL_basics.cat

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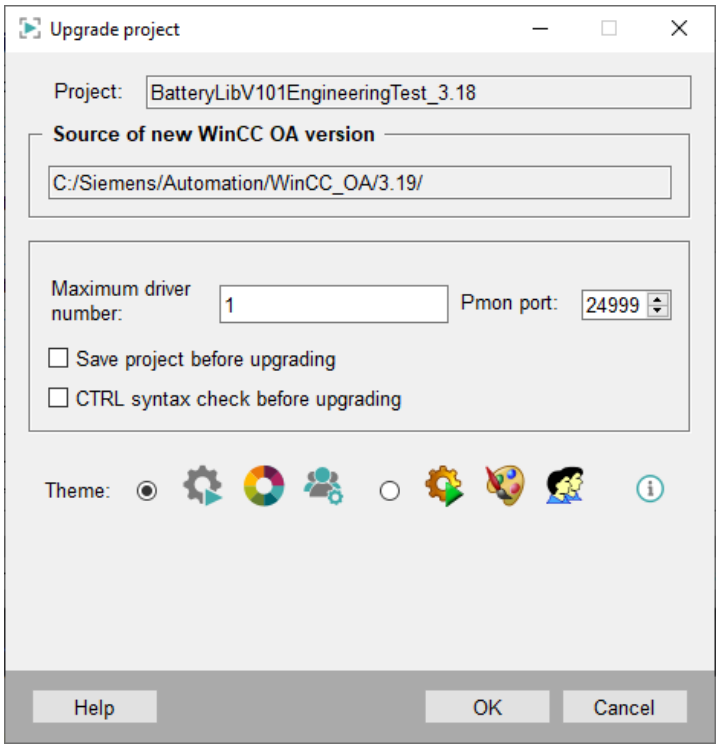
  - BL_OperatorTexts.cat
- New DPTs:
  - DPT *BL_OT_EquipmentBitAlarm* for bit triggered alarms was added.
  - New internal tool DPT *_BL_CF_MachineOee* was added.
- Modified DPTs:
  - BL_OP_MessageTransfer_PLCInitiated_toPLC DPE .Progress.state was added.
  - BL_OP_MessageTransfer_PLCInitiated_toMES DPE .Progress.state was added.
  - BL_OP_MessageTransfer_PLCInitiated_bidirectional DPE .Progress.state was added.
  - Internal DPT *_BL_CF_AreaSettings* DPE *.connected* was added.
  - Internal DPT _BL_CT_EquipmentOEE DPE .Hourly.downtime was added.
  - Internal tools DPT: *_BL_CF_Navigation*, new element for storing permission bit added.
  - Internal tools DPT: *_BL_CF_ITSettings*, assignments of areas, Ctrl-managers and drivers to each system added.
- New DPs:
  - Master DP for DPT *BL_OT_EquipmentAlarm* was added, which contains the _alert_hdl configuration.
- Updated encrypted panels.
- Updated encrypted scripts.
- New filters for plant, line, and area sum alarms to also include new area connection state DPEs.

Steps to upgrade Engineering project to WinCC OA 3.19

1. Install WinCC OA 3.19 with Old Version Support
2. Ensure the engineering project is registered (WinCC OA 3.18) and stopped.
3. Create a backup of the stopped engineering project.
4. Start WinCC OA 3.19 Project Administration
5. Double click the list entry “Doubleclick for list of older projects”
6. Select the WinCC OA 3.18 engineering project in the popup.
7. Click the  button to upgrade the selected project to WinCC OA 3.19
8. Enter the maximum driver number, validate the pre-filled Pmon port.

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Figure 10-12 Upgrade WinCC OA 3.18 project to 3.19



9. Click “OK” Button to start the upgrade.

Details about this procedure can be found in the WinCC OA documentation.

NOTE Before upgrade please note if there are any Project-specific over-parameterized WinCC OA panels or scripts. If they exist in the Project, they must be merged manually by the engineer.

NOTE WinCC OA 3.19 is only supported by Production Management for Batteries V1.1 and later, therefore the existing engineering project must be updated to the latest Production Management for Batteries version using the steps described below.

Steps to upgrade Production Management for Batteries (Battery Library) version in existing engineering Project

1. Create a backup of the stopped engineering project and deployed projects
2. Change the subprojects of the engineering Project to the new Production Management for Batteries subprojects.
3. Check changes that could affect custom added components
4. Add new CTRL Manager with script `batteryEngineeringProjectInitialization` and start mode “Once” as last manager (if not already existing).
   The script automatically updates the project database to the newest library version.

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NOTE If the update procedure fails (indicated by an error message), the backup can be restored.

5. Start the Project
6. Check for overparameterized scripts and panels (printed in the logs of the CTRL Manager `batteryEngineeringProjectInitialization`)
   Check if they have been changed from V1.0.1 to V1.1.0
   a. If yes: check if overparameterization is still necessary, otherwise remove script/panel from the Project

NOTE It must be ensured, that none of the modified/updated library scripts are over-parameterized in the Project.

Notes when updating from V1.0.1 to V1.1.0

The following configurations will be changed when updating to V1.1.0:

- Existing AESRow configuration will be overwritten
- Existing sum alarm DP patterns will be overwritten
- DP list files in PROJ_PATH/dplist should be removed before updating
- A new function “Connection State Watcher” should be assigned to the Head System in the IT Settings tab for Functions (see chapter 6.3.4).
- Project deployment does no longer automatically add a Simulation driver with number 1, it must be added in the IT Settings tab for Drivers (see chapter 6.3.4).

NOTE The project must be thoroughly tested after upgrading before use in a production environment.

10.5 Debug Flags

Debug flags can be used for additional log entries of Production Management for Batteries components, see table below.

Table 10-1 Production Management for Batteries – Debug flags

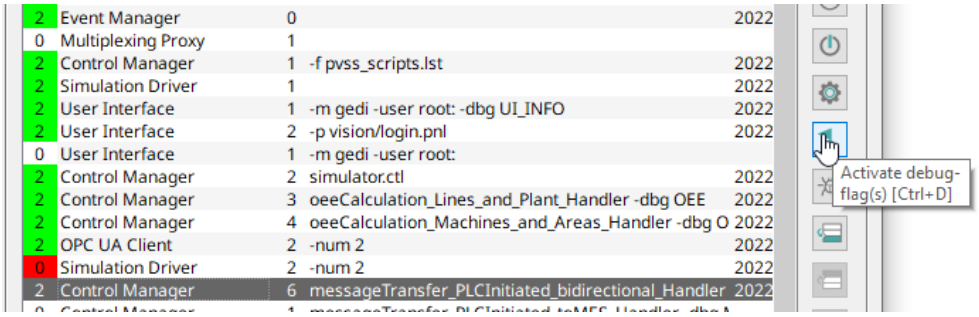
Debug Flag	Used In
MessageTransfer	CTRL Managers with: • messageTransfer_PLCInitiated_bidirectional_Handler • messageTransfer_PLCInitiated_toMES_Handler • messageTransfer_PLCInitiated_toPLC_Handler

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Debug Flag	Used In
OEE	CTRL Managers with: • oeeCalculation_Lines_and_Plant_Handler • oeeCalculation_Machines_and_Areas_Handler
BL_Trend	User Interface Additional log entries for trends.
VarTrend	User Interface Additional log entries for trends.
SiOME	DP Objects tool Must be activated for Gedi. Additional log entries for parsing SiOME files and creating necessary DPs.
Archive	DP Archives tool Must be activated for Gedi.
ExportImport	Project data export tool Must be activated for Gedi.

The debug flags can be activated using the Activate debug-flag button in the console (see Figure 10-13).

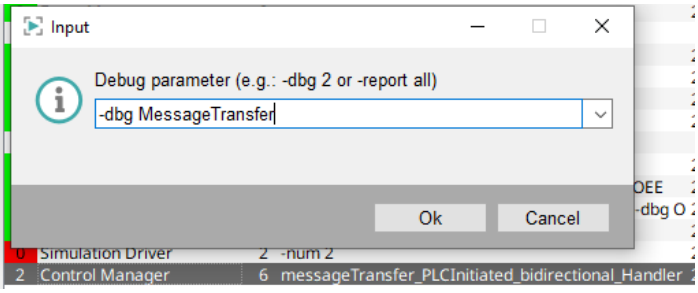
Figure 10-13 Activate Debug Flag



Afterwards, the debug flags to be activated can be specified with *"-dbg <debug flag 1>[,<debug flag n>]"*, see Figure 10-14.

To deactivate the debug flags *"-dbg NONE"* must be set.

Figure 10-14 Activate debug flags – Debug parameter input



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11 Adapting the Battery SCADA

11.1 Adding new Language

Adding of new languages to an engineering project will be subject of a future version. In the current version English is supported.

11.2 Creating Color Schemes

Creating of new color schemes to an engineering project will be subject of a future version.

11.3 Adapting Trend Configurations

11.3.1 Trend Functionality

Production Management for Batteries contains trend configurations, which can be configured to show all archived process data.

General Functionality

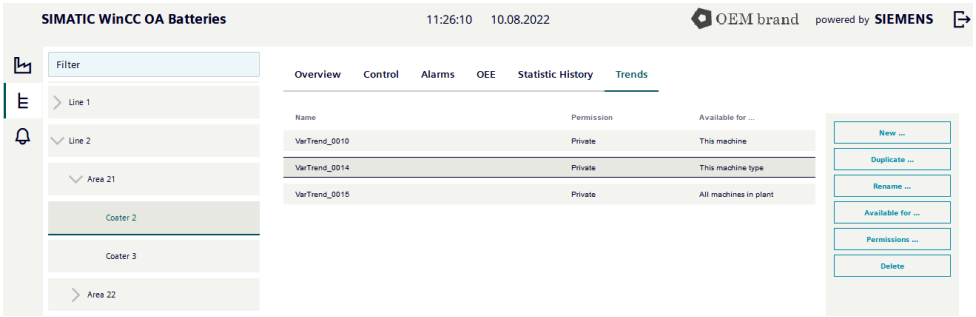
Trend configurations can be defined to be available

- global for all users
- for members of specified user groups (multiple)
- for a specific user (creator).

The last two options can also be combined.

Additionally, trend configurations can be assigned to a specific machine, line, area, machine type, or all machines, lines, or areas.

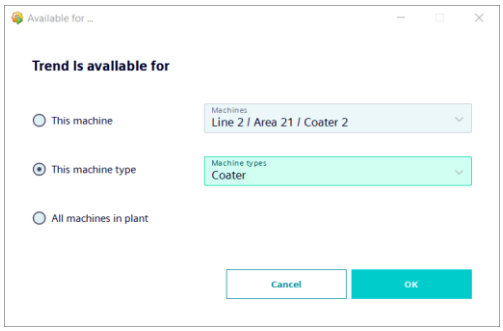
Here is an example how to assign trends to machines:



Trend assignments can be changed by the "*Available for …*" button:

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Figure 11-1 Trend assignment "*Available for …*"



Assigning trends to Lines or Areas can be done similarly.

Available trends are shown in a list in the trend configurations panel. They can be opened from the trend configurations panel per double click or clicking the *"View"* button on the bottom right after selecting the trend configuration. Trends are opened with a time range of the current week. Displayed time range can be changed afterwards in the trend view panel.

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Figure 11-2 Trend Configurations Panel

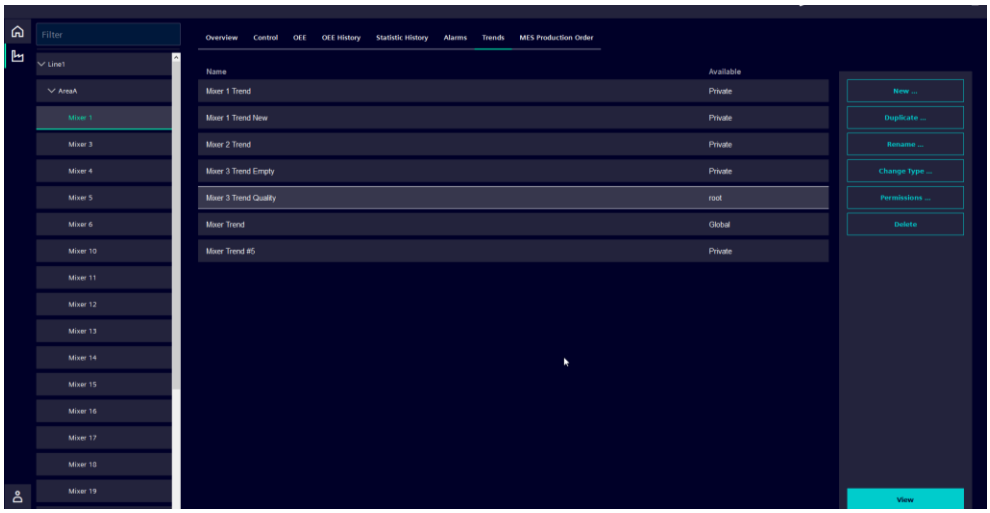
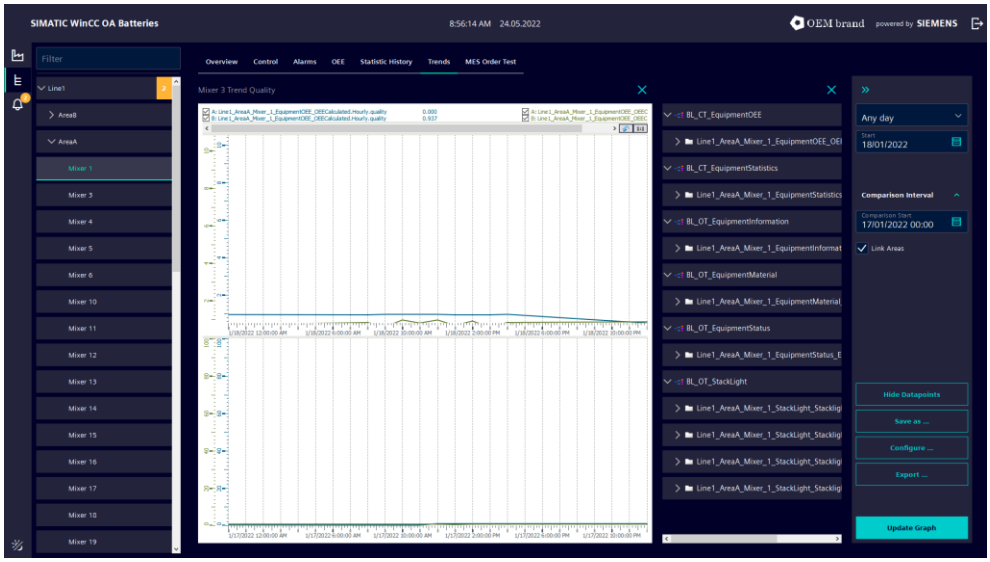


Figure 11-3 Trend View Panel



Trend Permissions

A user can have the following permissions for a specific trend configuration:

- Every User can
  - Display and open global trend configurations
  - Display trends with at least one specified user group that the user is a member of
  - Change trend configuration of global trends at runtime (saving is not possible)
  - Change trend configuration of trends with at least one specified user group that the user is a member of
- User with Permission to create DPs additionally can
  - Duplicate global trends
  - Duplicate trends with at least one specified user group that the user is a member of
  - Create new trends

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- The trend owner additionally can
  - Display and open trend configuration
  - Change the trend configuration at runtime and save the changes (overwrite)
  - Rename trend configuration
  - Change the assigned machine, line, area, or machine type
  - Delete the trend configuration
- User with user bit 10 (VarTrend Permission for global enable) additionally can
  - Display and open all trend configurations
  - Change the trend configuration at runtime and save the changes (overwrite)
  - Rename all trend configurations
  - Change permissions for all trend configurations (make trend global available, change owner, change allowed user groups)
  - Change the assigned machine, line, area, or machine type of all trend configurations
  - Delete all trend configurations

11.3.2 Creating new Trend Configurations

A new trend configuration can be created by clicking the *"New"* button in the trend configurations panel. Afterwards a unique trend name needs to be defined and the associated machine type, machine, line, or area must be selected.

Trend can then be configured at runtime in the trend view panel and saved as described in chapter Modify existing Trend Configurations.

11.3.3 Modify existing Trend Configurations

Change Type

A trend type defines the associated machine type, machine, area, or line. To change the type of a trend either right click it in the list of trend configurations and select *"Edit Type"* or select the configuration in the list and click the *"Change Type"* button in the right section. Afterwards a panel with all possible options is opened, where the new type can be selected.

When changing the trend type make sure to only set a trend type that contains all elements used in the trend configuration.

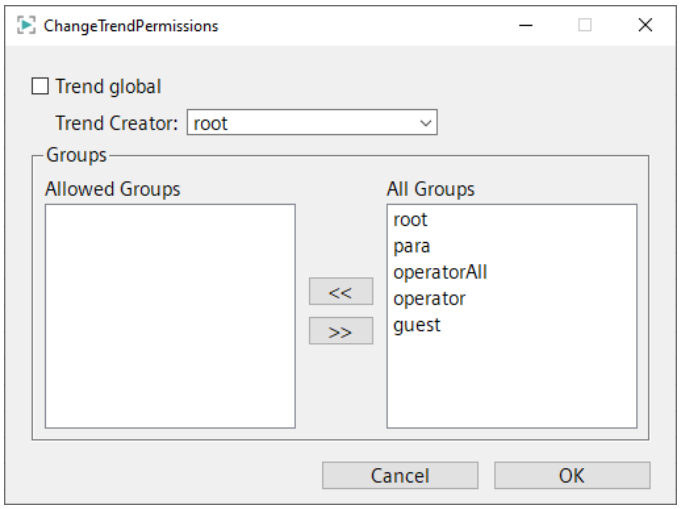
Change Permissions

The trend permissions define which users can modify and/or display a given trend configuration.

To change the permissions of a trend either right click it in the list of trend configurations and select *"Change Permissions"* or select the configuration in the list and click the *"Permissions"* button in the right section. Afterwards a panel is opened, which allows to change the permissions.

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Figure 11-4 Change Trend Permissions Panel



Rename Trend

Renaming a trend configuration can be done in the trend configurations panel by either right clicking the configuration in the list and selecting *"Rename Trend"* or selecting the configuration in the list and clicking the *"Rename"* button in the right section. Afterwards a panel is opened, where a unique trend name (not used by any other trend) can be given.

Change Trend Configurations

Changing the trend configuration can be done in the trend view panel by clicking the *"Configure"* button on the right section of the trend view panel. The actual settings are the same as for a standard WinCC OA Variable Trend, for more information please refer to WinCC OA documentation - VarTrend.

NOTE It must be ensured to only use non-internal DPEs that exist for the configured trend type.

NOTE The configuration must afterwards be saved, otherwise the stored trend config will remain unchanged.

11.3.4 Duplicate existing Trend Configurations

Trend Configurations can be duplicated in the trend view panel by right clicking the trend configuration that should be copied and selecting *"Duplicate Trend"* or by selecting the trend configuration in the table and clicking the *"Duplicate"* button in the right section of the panel.

It is also possible to duplicate a trend configuration by opening it in the trend view panel, clicking the *"Save"* button and selecting "*Save As*".

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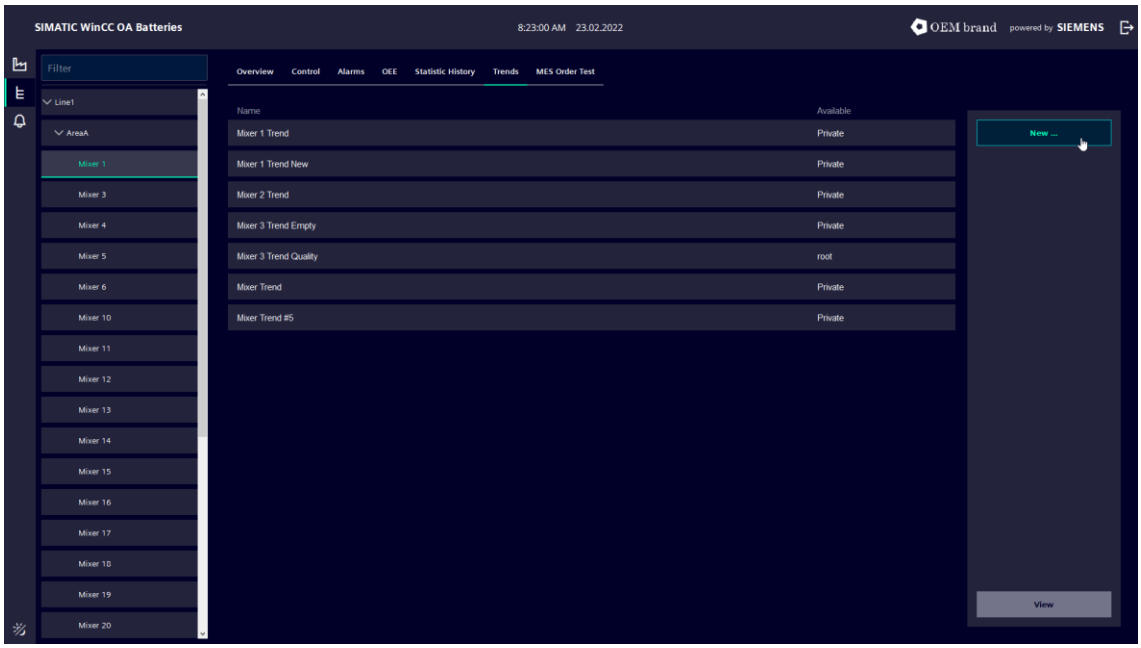
11.3.5 Remove Trend Configurations

Trend Configurations can be removed in the trend view panel. Therefore, the configuration must be selected and removed by either right clicking the trend configuration in the table and selecting "*Delete Trend"* or by clicking the "*Delete"* button in the right section of the panel.

11.3.6 Example – Creating Trend for Equipment OEE

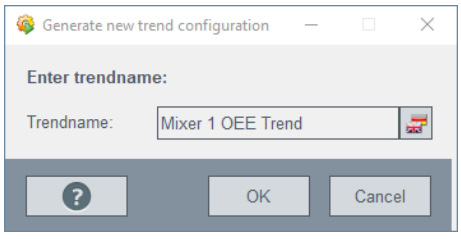
1. Navigate to the Trends tab for the desired equipment
2. Click *"New"* button

Figure 11-5 Create new trend config



3. Enter a new unique trend name and click *"OK"*

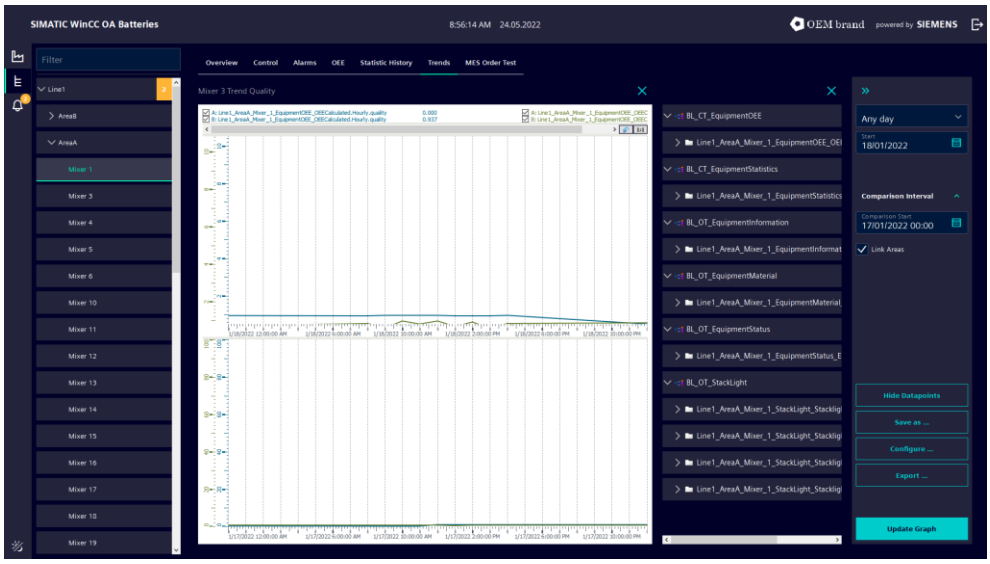
Figure 11-6 New trend name



4. Select the equipment for which the trend should be defined
5. Select the new trend configuration in the list and press "*View"*
6. Click *"Add Datapoints"*
7. Drag the desired DP into the trend view

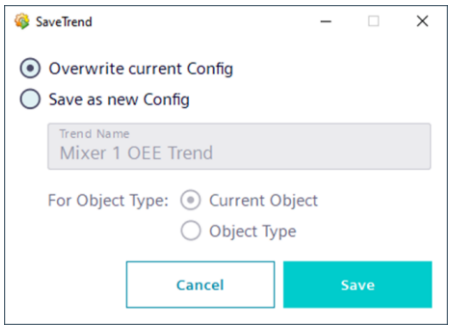
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Figure 11-7 Add DPEs to trend



8. Click *"Configure"* to change the curve settings if required
9. Click *"Save as"* and select *"Overwrite"* to save the changes to the trend configuration

Figure 11-8 Save trend config



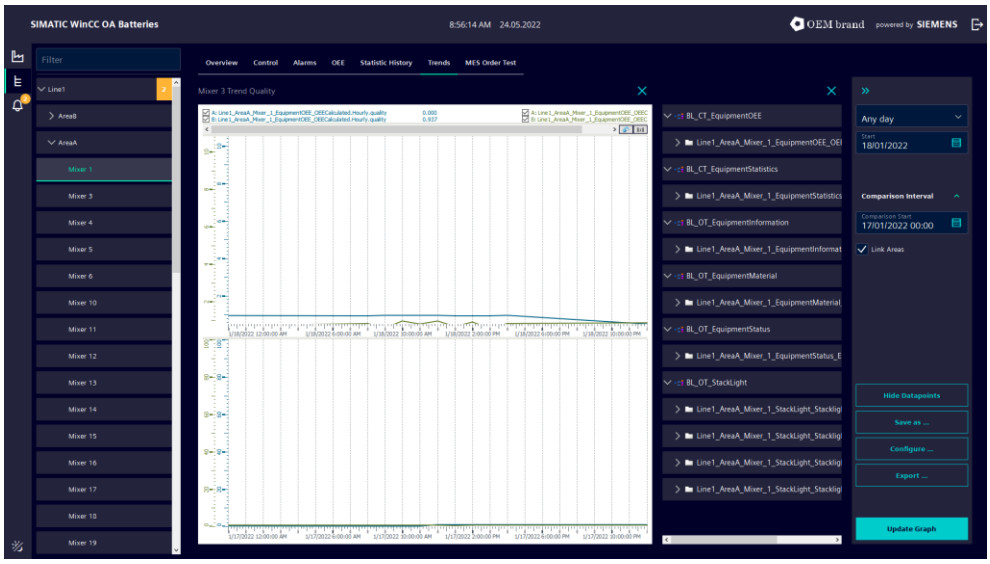
The trend configuration for an equipment is saved as a local trend for the current user. The trend can be made available for everyone or for defined groups by selecting the configuration in the trend config list and clicking *"Permissions".*

11.3.7 Export of Trend

It is possible to export data from the display of the curve to a CSV file. There is an *"Export"* button on the bottom right corner, which can be used to start the exporting process. A file selector windows will pop up, where you can specify the name of the file. The file is saved in *<project path>/data* by default. This functionality uses the build export mechanism in WinCC OA, so the format of the CVS file is the same that WinCC OA produces. You can import and edit or further process these CSV files in Excel. Select some Trends and specify the time interval and export it. Maximum 16 Trends can be exported into one file.

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Figure 11-9 Save trend config



Example file data.csv:

DPE;System1:line1_LineOEE_OEECalculated.Hourly.quality;System1:line1_LineOEE_OEECalculated.Hourly.performance;System1:line1_LineOEE_OEECalculated.Hourly.availability;System1:line1_LineOEE_OEECalculated.Hourly.overallOEE

Comment;System1:line1_LineOEE_OEECalculated.Hourly.quality;System1:line1_LineOEE_OEECalculated.Hourly.performance;System1:line1_LineOEE_OEECalculated.Hourly.availability;System1:line1_LineOEE_OEECalculated.Hourly.overallOEE

Unit;;;;

2022.03.11 10:00:00.000 ; 0.000000 ; 0.848464 ; 0.750000 ; 0.000000
2022.04.13 12:00:00.000 ; 0.000000 ; 0.424232 ; 0.375000 ; 0.000000
2022.04.13 13:00:00.000 ; 0.000000 ; 0.424232 ; 0.375000 ; 0.000000
2022.04.13 14:00:00.000 ; 0.000000 ; 0.424232 ; 0.375000 ; 0.000000
2022.04.14 10:00:00.000 ; 0.000000 ; 0.424232 ; 0.375000 ; 0.000000
2022.04.14 11:00:00.000 ; 0.000000 ; 0.424232 ; 0.375000 ; 0.000000
2022.04.14 12:00:00.000 ; 0.000000 ; 0.424232 ; 0.375000 ; 0.000000
2022.04.14 13:00:00.000 ; 0.000000 ; 0.424232 ; 0.375000 ; 0.000000
2022.04.14 14:00:00.000 ; 0.000000 ; 0.424232 ; 0.375000 ; 0.000000
2022.04.25 10:00:00.000 ; 0.000000 ; 0.565643 ; 0.500000 ; 0.000000
2022.04.25 11:00:00.000 ; 0.000000 ; 0.565643 ; 0.500000 ; 0.000000
2022.04.25 12:00:00.000 ; 0.000000 ; 0.565643 ; 0.500000 ; 0.000000
2022.04.25 13:00:00.000 ; 0.000000 ; 0.424232 ; 0.375000 ; 0.000000
2022.04.25 14:00:00.000 ; 0.000000 ; 0.424232 ; 0.375000 ; 0.000000
2022.04.25 15:00:00.000 ; 0.000000 ; 0.424232 ; 0.375000 ; 0.000000

11.4 Creating new Panels

When creating new panels which shall be integrated into the runtime HMI there specific dollar parameters should be supplied depending on the level where the new panel (screen) shall be used.

- Plant level: $system
- Line level: $system, $line

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- Area level: $system, $line, $area
- Machine level: $system, $line, $area, $mType, $mInstance

NOTE New panels can be integrated into the navigation of the UI framework of Production Management for Batteries using the tool Navigation Settings.

NOTE The dollar parameter $system contains:

- the assigned system (in IT Settings) in deployed projects for areas and machines
- the head system name in deployed projects for lines and plant
- the current system name in engineering projects

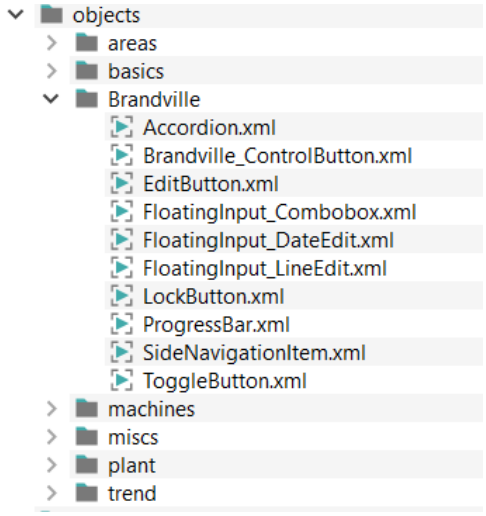
11.4.1 Existing UI objects

The folder

…/panels/objects/…

of panel references which can be used when creating new panels.

Figure 11-10 Reusable Objects in Production Management for Batteries



11.4.2 Value UI Objects

The following UI objects are delivered with Production Management for Batteries and can be used to display data point values in custom screens.

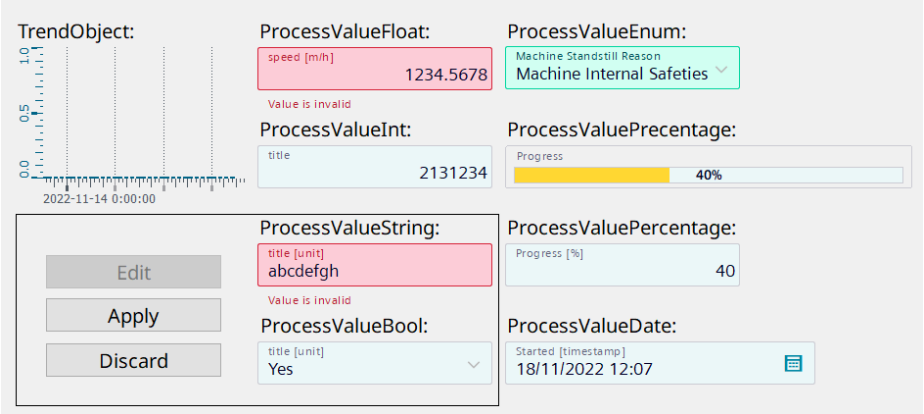
- FLOAT – objects/process/ProcessValueFloat.xml
- INTEGER – objects/process/ProcessValueInteger.xml
- STRING – objects/process/ProcessValueString.xml
- BOOL – objects/process/ProcessValueBool.xml

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- ENUM – objects/process/ProcessValueEnum.xml
- PERCENTAGE – objects/process/ProcessValuePercentage.xml
- DATETIME – objects/process/ProcessValueDate.xml

There is an example panel "*objects/process/Examples.xml*" that shows the usage of existing process value objects ("object references").

Figure 11-11 Example panel for "Object references"



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Common Features (extended properties / dollar parameter / methods / behavior)

- *$DPE* dollar parameter - Specifies the DPE which is assigned to the object. The online value is always displayed on the object.
- To use dynamic DPEs depending on the selected *line/area/machine*, the provided $-Parameters
- If the value is invalid, then an error message with red text *"Value is invalid"* is shown under the object.
- Size and positions are controlled by layout management, so that layouts can be used on the panel which holds the object.
- *title* property - If the property is empty, then the DPE common config description is used.
- *unit* property - If the property is empty, then the DPE common config unit is used.
- *toolTip* property - If the property is empty, then the DPE name is used.
- *readOnly* property - If the property is true, then the component is grayed out, otherwise the DPE value can be modified by the user via the user interface.
- *autoApply* property - Specifies if the value should automatically be saved on DPE, when it has been changed.
- The star (*) character in the title of the object indicates that the value is changed but not applied.
- *apply public method* - It can be called by the engineer to save value on DPE, if the *readOnly* property is false.
- *discard public method* - It can be called by the engineer to refresh value from DPE.
- *readPerm* - Specifies the Permission Bit (1-32) needed to make the object visible. Zero (0) means no check is performed.

- *wirtePerm* - Specifies the Permission Bit (1-32) needed to make the value changeable. Zero (0) means no check is performed.

FLOAT

- *valueFormat* property - If the property is empty, then DPE common format is used. If the DPE common format is not specified, then the default 0.3f is used.
- *align* property - Specifies the align of the value. The default value is AlignRight. Possible values are AlignLeft, AlignCenter or AlignRight.
- If the value is changed by the user via the user interface and the *autoApply* property is true, then the value is applied when pressing the *Enter* key.
- *factor* property – Specifies a factor how to display the value. The DPE value is multiplied with this factor and that value is shown. If the value is applied, then the displayed value is divided with this factor and saved as DPE value.

INTEGER

- *valueFormat* property - If the property is empty, then DPE common format is used. If the DPE common format is not specified, then the default *0d* is used.
- *align* property - Specifies the align of the value. The default value is *AlignRight*. Possible values are *AlignLeft*, *AlignCenter* or *AlignRight*.
- If the value is changed by the user via the user interface and the *autoApply* property is true, then the value is applied when pressing the *Enter* key.

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STRING

- *valueFormat* property - If the property is empty, then DPE common format is used. If the DPE common format is not specified, then the default *0s* is used.
- *align* property - Specifies the align of the value. The default value is *AlignRight*. Possible values are *AlignLeft*, *AlignCenter* or *AlignRight*.
- If the value is changed by the user via the user interface and the *autoApply* property is true, then the value is applied when pressing the *Enter* key.

BOOL

- *valueFormat* property - Specifies how the values are represented int the combo box. Accepted values are "*TRUE/FALSE*", "*Yes/No*", "*OK/NOK*" or "*1/0*".
- If the value is changed by the user via the user interface and the *autoApply* property is true, then the value is applied immediately.

ENUM

- *valueFormat* property - Specifies the name of the Enum where the constants for values are defined. Texts are displayed from the text catalog "*BL_EnumTexts.cat*". The control script (.ctl file) which defines the Enum must be included with the *#uses* keyword on the panel (in the scope lib) where the object is placed. For "*enum machineState*", the "*machines/machineDefinitions.ctl*" must be included. For value "*Stopped = 2*", the text "*machineState_Stopped,Stopped*" from .cat file is used.

- If the value is changed by the user via the user interface and the *autoApply* property is true, then the value is applied immediately.

PERCENTAGE output

- The percentage value is displayed with horizontal progress bar.
- The DPE value should be between 0 and 1.

PERCENTAGE input/output

- For this the *ProcessValueFloat* with factor configuration can be used.
- *valueFormat* property should be set to *0d* to show the percentage as a decimal number.
- *factor* property should be set to 100 to show the percentage correctly.
- *unit* property should be set to “%”.
- The DPE value should be between 0 and 1.

DATETIME

- *showTime* property – Specifies if the time is shown after the date.
- *dateFormat* property - Specifies how the date is represented on the user interface. This format is used if the *showTime* property is false.
- *dateTimeFormat* property - Specifies how the date and time are represented on the user interface. This format is used if the *showTime* property is true.
- If the value is changed by the user via the user interface and the *autoApply* property is true, then the value is applied immediately.
- A calendar can also be opened by clicking on the *calendar icon* on the right side of the component.

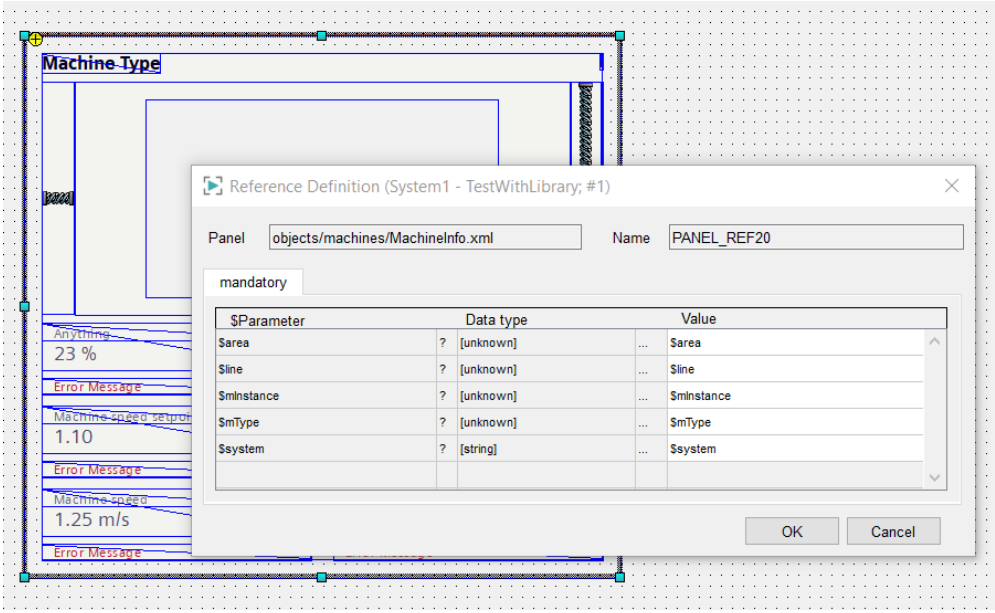
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11.4.3 Using Dollar-Parameters

When using a machine faceplate (e.g. in a line visualization) the $-parameters *$area*, *$mType* and *$mInstance* have to be set for each machine reference panel placed in the line panel. The $-parameter *$line* has to be set when using the line panel itself.

NOTE The dollar parameter *$system* also must be set for each *machine/area* accordingly if the panel should work in distributed systems.
This is because *$system* for lines and plant always contains the head system name (in deployed projects), but the areas and machines can be located on other systems (as defined in IT Settings).

Figure 11-12 Using $-parameters



There are “object references” available in PM4B that can be used to build UI panel within the projects. See chapter 11.4.2 Value UI Objects.

11.4.4 Using Data Watcher and Events

Production Management for Batteries contains a data watcher which can be used to get data changes into the own faceplates. The data watcher knows the following events:

- EVENT_STACKLIGHT_CHANGED
- EVENT_MACHINE_CHANGED
- EVENT_AREA_CHANGED
- EVENT_LINE_CHANGED
- EVENT_PLANT_CHANGED
- EVENT_ALARMS_CHANGED

For including the data watcher, please use the following procedure:

Figure 11-13 Including the Data Watcher

```
#uses "classes/dataWatcher/BLEquipmentDataWatcher"
```

For the use of the data watcher, please use the following procedure:

Figure 11-14 Using the Data Watcher

```
uiConnect("machineUpdatedCB", BLEquipmentDataWatcher::EVENT_MACHINE_CHANGED);
```

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When using the data watcher, the event name defines the data the watcher is listening to. The callback function then is working on the changed data and updating the HMI.

Figure 11-15 Data Watcher Callback Example

```
void machineUpdatedCB(int changeMask, shared_ptr<BLMachine> machinePtr)
{
  if (equalPtr(machinePtr, m_machinePtr))
  {
    if ((changeMask & (int)BLMachineChangedType::call) > 0)
    {
      updateCallModeLabel();
    }

    if ((changeMask & (int)BLMachineChangedType::standstillReason) > 0)
    {
      updateStandstillReasonLabel();
    }

    if ((changeMask & (int)BLMachineChangedType::state) > 0)
    {
      updateStateLabel();
    }

    if ((changeMask & (int)BLMachineChangedType::blocked) > 0)
    {
      updateBlocked();
    }

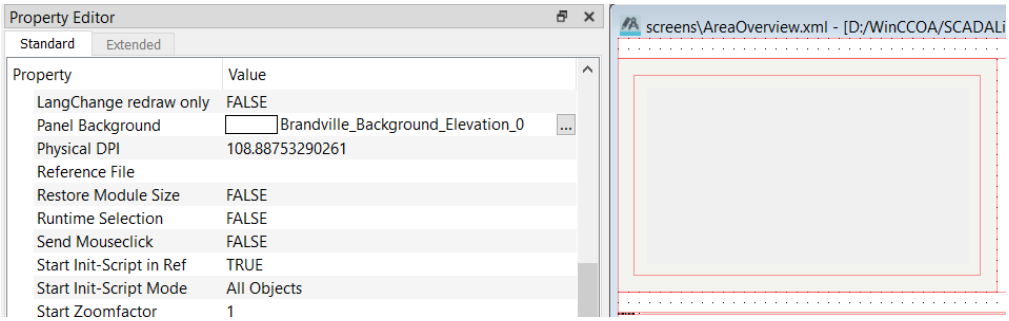
    if ((changeMask & (int)BLMachineChangedType::starved) > 0)
    {
      updateStarved();
    }
  }
}
```

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11.4.5 Using the Brandville Colors

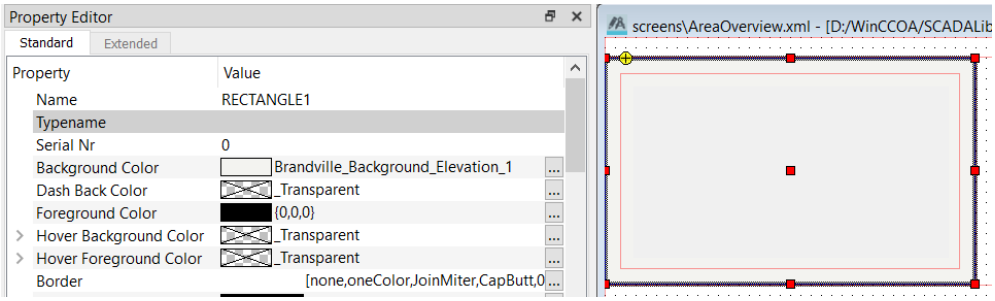
The following figure shows an example for using a scheme dependent Brandville color for a panel background. Brandville is a collection of official Siemens branding guidelines and templates.

Figure 11-16 Brandville Color for Panel Background



The following figure shows an example for using a scheme dependent Brandville color for a rectangle background.

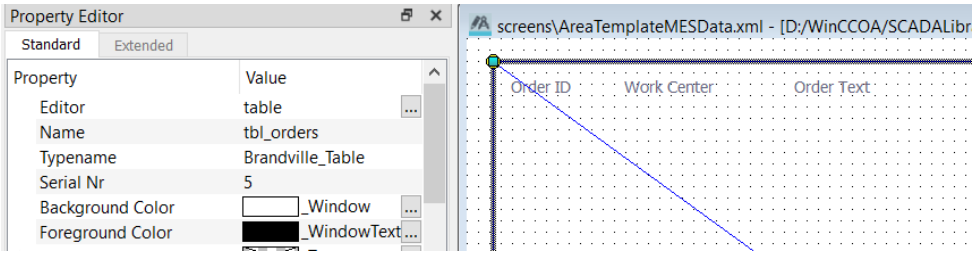
Figure 11-17 Brandville Color for Rectangle



11.4.6 Using the Stylesheet

A stylesheet definition for a Qt class can be used in a panel by setting the property "*Typename*" of a shape to the name of the type in the stylesheet, e.g., "*Brandville_Table*" to a table.

Figure 11-18 Using the Stylesheet Types



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12 Application Examples

12.1 OPC UA Structure Mapping

In OPC UA a variable can be of type structure. This means that the variable contains several other variables.

There are two options for using structures in combination with WinCC OA:

12.1.1 One address for every leaf element of the structure variable

12.1.2 One address referencing the root structure variable with transformation “structure”

The latter option reads/writes the structure as a JSON string, which can then be decoded and mapped to the other DPEs.

To simplify this procedure the library comes with an example for a Ctrl-Manager (*scripts/structureHandler.ctl*), that automatically decodes the JSON string and writes the values on the equally named elements of the DP. It also updates the JSON string whenever a DPE value is changed.

NOTE The structure of the DPT must match the one of the OPC UA structure and additionally must contain an element for the JSON string with the address configured.

To use the functionality, the script must be adapted to include the DPT and the name of the element containing the JSON string in *STRUCTURE_TYPES* and in *STRUCTURE_ELEMENTS*.

Then a Ctrl-Manager with the script must be started.

12.2 Workorder Download Screen

A very important scenario is the download of workorders into the machines of a work center. The workorders are defined in the ERP and MES systems and requested by the SCADA system from the MES system.

In this example the work centers are area based. In other examples one work center also could contain several plant areas. This depends on the modelling of the work centers in the ERP and MES systems.

The basic workflow used in the download scenario is described in 7.2.3 “PUSH” Message – SCADA Initiated to PLC.

The screen for the workorder download is located on the area level in the tabulator called *“Orders”*. When the screen is opened it automatically loads the scheduled (not yet downloaded to PLCs) workorders and shows them in a table.

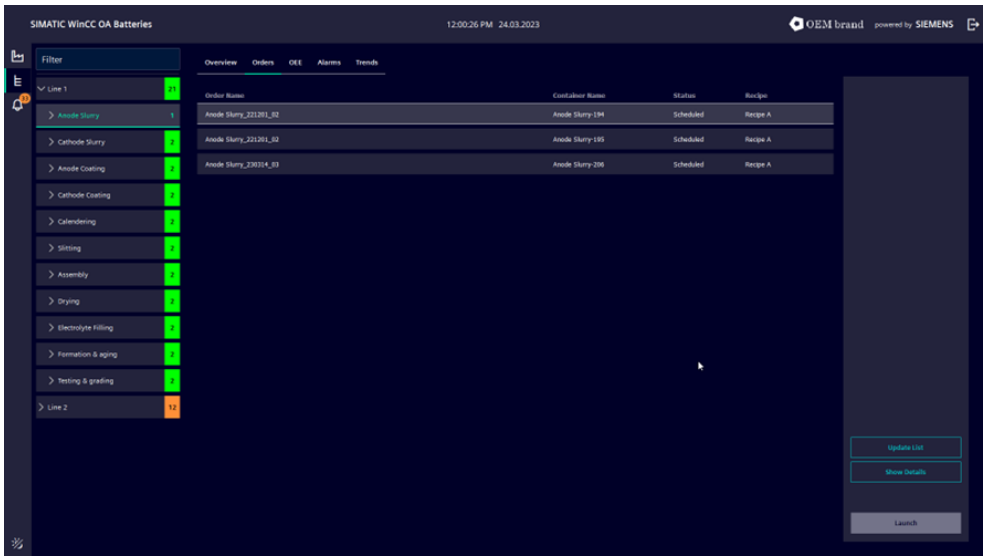
The scheduled workorders for the area are fetched from Opcenter using the stored Ad hoc query named `getScheduledOrdersForArea` with the area name as a parameter.

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NOTE Query example in PM4B only works, if each workorder always contains exactly one container.

NOTE The example only filters for the area name (not including line), therefore it only works in plants with one line. For the use in a plant with several line a script for fetching data from Opcenter shall be adapted.

Figure 12-1 Workorder Download Screen



Workflow for workorder download:

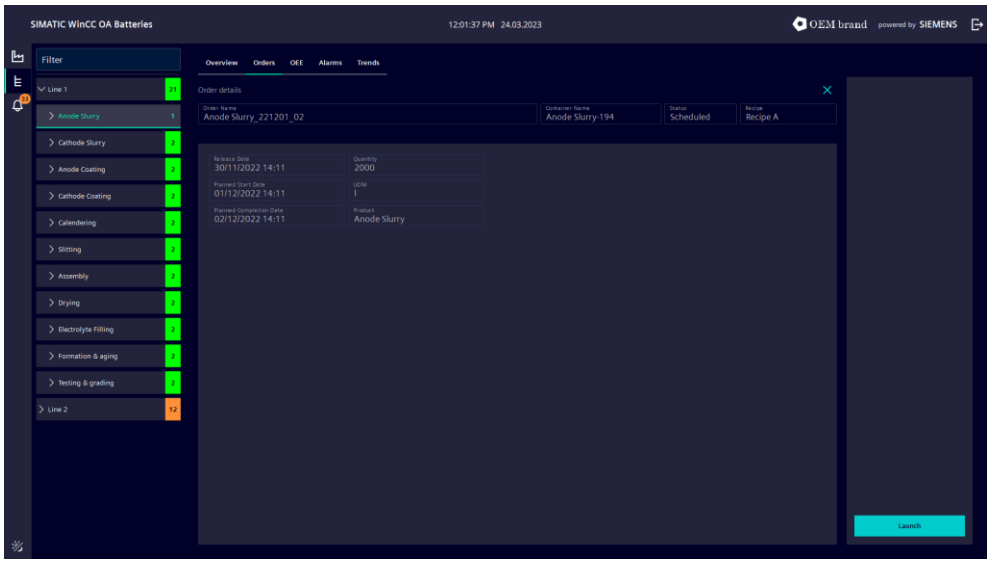
1. Open screen
2. Optionally click “*Update List*” button to update loaded contents
3. The orders are listed in the order table
4. Select an order in the table
5. Click button “*Show Details*”
6. Details are shown instead of the table

The details are loaded using the Opcenter transaction `modeling/api/MfgOrders/<orderName>$expand=attributes,uom`, which is defined in the Opcenter transaction examples.

NOTE Loading details only works, after copying the Opcenter transaction examples located in “BatteryLibrary_Engineering/scripts/examples/libs/classes/mes/BLOpcenterTransactionsCustomized.ctl” to the project into the folder “<PROJ_PATH>/scripts/libs/classes/mes”.

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Figure 12-2 Workorder Download Details Screen



7. Click button “*Launch*”
8. The workorder is downloaded to the first machine in the area (as example)

Launching the workorder executes the SCADA initiated message transfer “*OrderDownloadMethodBased”* for the first machine in the area.

NOTE

The machine must contain the SCADA initiated message transfer named *“OrderDownloadMethodBased*”.

The input and output argument are filled within the example panel. The panel should be adapted, to provide/read the necessary arguments according to the machine interface.

If the order download to the machine is successful, the *MoveIn* transaction is executed, and the order status is updated to “*Started*” in Opcenter.

These panels are delivered unencrypted and can be edited within the Project:

- panels/screens/AreaTemplateMESData.xml
- panels/objects/mes/MfgOrderDetails.xml
- panels/objects/mes/MfgOrderList.xml

Additional information can be found in the comments of the panels.

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12.3 Machine Control Screen

Figure 12-3 Machine control screen example



It shows basically the same information as the machine overview panel.

The machine control buttons can be unlocked by clicking the “Lock” button in the upper right corner. Control buttons will lock again after 10 seconds. The auto-lock-timer is reset every time a control button is clicked.

NOTE

The control buttons are only a sample implementation. They currently execute the OPC UA methods Start, Stop and Reset for a given machine.

This behavior can be changed by the engineer if needed.

The upper right section allows modifying machine parameters. To change the parameters the “*edit*” button (pencil icon) must be clicked. The parameters are applied by clicking the “*checkmark*” button.

NOTE

The section only shows sample parameters without actual underlaying DPs, therefore changing is not supported.

The engineer must fill this section with actual data and implement the actual saving and dismissing of changes.

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13 List of abbreviations/acronyms

Table 13-1

Abbreviation	
BL	Battery Library (former product name)
DP	Datapoint
DPs	Datapoints
DPE	Datapoint Element
DPL	Datapoint list
DPT	Datapoint Type
Gedi	Graphical Editor (WinCC OA)
HDB	Historical Database
HMI	Human Machine Interface
KPI	Key Performance Indicator
MES	Manufacturing Execution Systems
NGA	Next Generation Archive
OPC UA	Open Platform Communications Unified Architecture
Para	Tool for datapoints Parametrization (WinCC OA)
PLE	Process Line Equipment
PM for Batteries	Production Management for Batteries
PM4B	Production Management for Batteries
SCADA	Supervisory Control and Data Acquisition
SiOME	Siemens OPC UA Modeling Editor
UI	User Interface
WinCC OA	WinCC Open Architecture

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14 Appendix

14.1 Service and Support

Industry Online Support

Do you have any questions or need assistance?

Siemens Industry Online Support offers round the clock access to our entire service and support know-how and portfolio.

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pm.batteries.industry@siemens.com

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Industry Online Support app

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support.industry.siemens.com/cs/ww/en/sc/2067

14.2 Industry Mall



The Siemens Industry Mall is the platform on which the entire siemens Industry product portfolio is accessible. From the selection of products to the order and the delivery tracking, the Industry Mall enables the complete purchasing processing – directly and independently of time and location:
mall.industry.siemens.com

14.3 Change Documentation

Table 14-1

Version	Date	Modifications
V1.0	02/2022	First version
V1.5	06/2022	Updates for new version
V2.0	09/2022	Updates for new version
V2.1	05/2023	Updates for new version - PM for Batteries V1.1

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