

## MindSphere

### MindSphere app SIMATIC Performance Insight MindSphere app

#### Application Manual

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## Legal information

### Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

 <b>DANGER</b>
indicates that death or severe personal injury <b>will</b> result if proper precautions are not taken.

 <b>WARNING</b>
indicates that death or severe personal injury <b>may</b> result if proper precautions are not taken.

 <b>CAUTION</b>
indicates that minor personal injury can result if proper precautions are not taken.

<b>NOTICE</b>
indicates that property damage can result if proper precautions are not taken.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

### Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

### Proper use of Siemens products

Note the following:

 <b>WARNING</b>
Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.

### Trademarks

All names identified by ® are registered trademarks of Siemens AG. The remaining trademarks in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owner.

### Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

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# Introduction

## 1.1 Security information

### Security information

Siemens provides products and solutions with industrial security functions that support the secure operation of plants, systems, machines and networks.

In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement - and continuously maintain - a holistic, state-of-the-art industrial security concept. Siemens' products and solutions constitute one element of such a concept.

Customers are responsible for preventing unauthorized access to their plants, systems, machines and networks. Such systems, machines and components should only be connected to an enterprise network or the internet if and to the extent such a connection is necessary and only when appropriate security measures (e.g. firewalls and/or network segmentation) are in place.

For additional information on industrial security measures that may be implemented, please visit:

<https://www.siemens.com/industrialsecurity> (<https://new.siemens.com/global/en/company/topic-areas/future-of-manufacturing/industrial-security.html>)

Siemens' products and solutions undergo continuous development to make them more secure. Siemens strongly recommends that product updates are applied as soon as they are available and that the latest product versions are used. Use of product versions that are no longer supported, and failure to apply latest updates may increase customer's exposure to cyber threats.

To stay informed about product updates, subscribe to the Siemens Industrial Security RSS Feed under:

<https://www.siemens.com/industrialsecurity> (<https://new.siemens.com/global/en/company/topic-areas/future-of-manufacturing/industrial-security.html>)

## 1.2 Note on EU General Data Protection Regulation

### Data protection

Siemens observes the principles of data protection, in particular the principle of data minimization (privacy by design). For the SIMATIC Performance Insight product, this means: the product processes/stores the following personal data: User name (first name and last name), email address, user role and app usage data (number of users, number of KPIs).

No private or intimate data is processed or stored.

The above data are required for the login, the billing function and for the internal user administration (administrator can see the role and the status of other users). The storage of data is appropriate and limited to what is necessary, as it is essential to identify the authorized

operators. The data needs to be maintained manually by you and if necessary, these can also be deleted. If you need support, please contact customer support.

The above data will not be stored anonymously or pseudonymized, because the purpose (identification of the operating personnel) cannot be achieved otherwise.

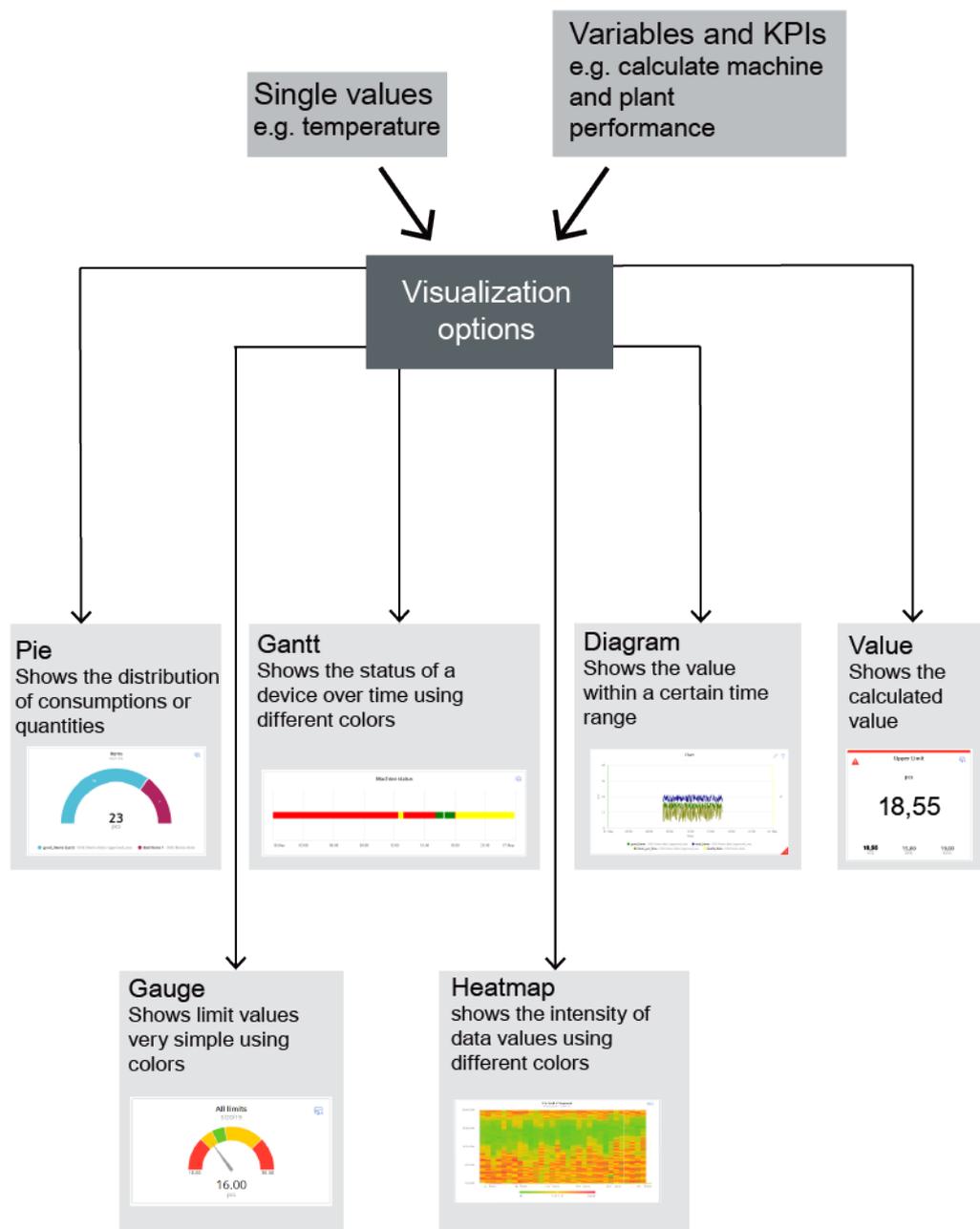
The above data is protected against loss of integrity and confidentiality by state-of-the-art security measures.

## 1.3 Function overview

### Introduction

The MindSphere app SIMATIC Performance Insight offers an online performance overview of machines, production lines or entire production sites.

- You have access to machine and plant performance data worldwide.
- You can use individual KPI types to calculate machine and plant performance, e.g. for overall plant efficiency or quality.
- In addition to the KPI type and KPI instance application in combination, you can also create a KPI instance directly at the asset without having defined a KPI type beforehand.
- Widgets allow you to visualize machine states and performance and configure flexible dashboards to monitor your plant.
- The detailed view of the widgets allows you to determine and compare production performance over different time periods. This will help you identify unused performance potential in retrospect.
- You obtain valuable information for accurate decision-making in order to optimize machine availability.



### Browser recommendation

You require an HTML5-capable Internet browser to run the app.

The Google Chrome and Microsoft Edge browsers are supported. Google Chrome is recommended. You should preferably use 1920x1080 resolution.

The app can run on any mobile device with an HTML5-enabled browser. Tablets are recommended.

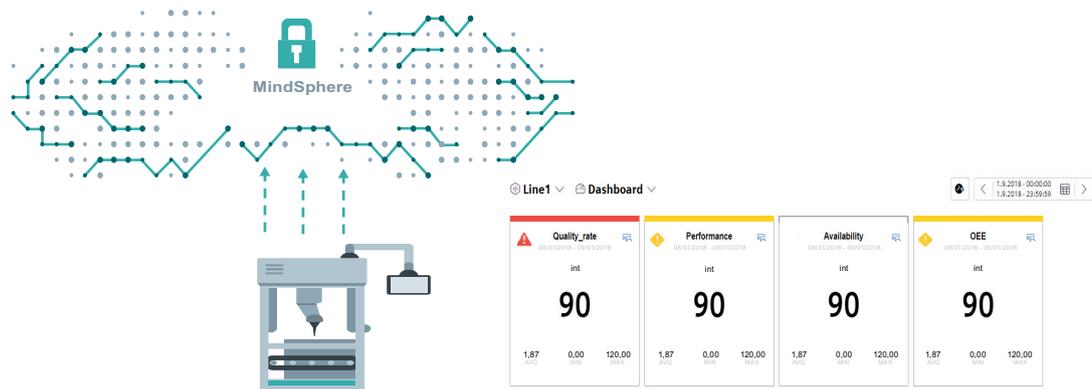
## 1.4 What's new in Performance Insight?

You can find all important new features in Performance Insight here: New features in Performance Insight ([https://sie.ag/whatsnew\\_performanceinsight](https://sie.ag/whatsnew_performanceinsight))

## 1.5 Application examples

### Application example visualization

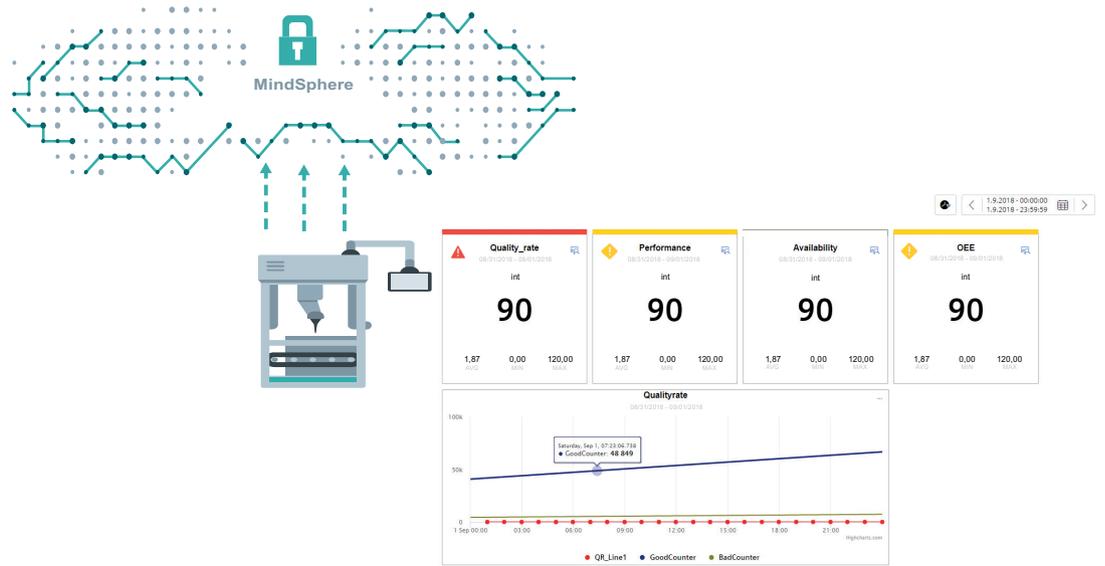
From the plant, you transfer data such as quality rate, power and availability to MindSphere. You visualize the data in Performance Insight with the help of widgets.



### Application example KPI calculation

Raw data, such as production numbers, machine runtimes and water consumption, are transferred from production to MindSphere.

You use the transferred raw data to calculate and visualize indicators for your plant performance with the app.

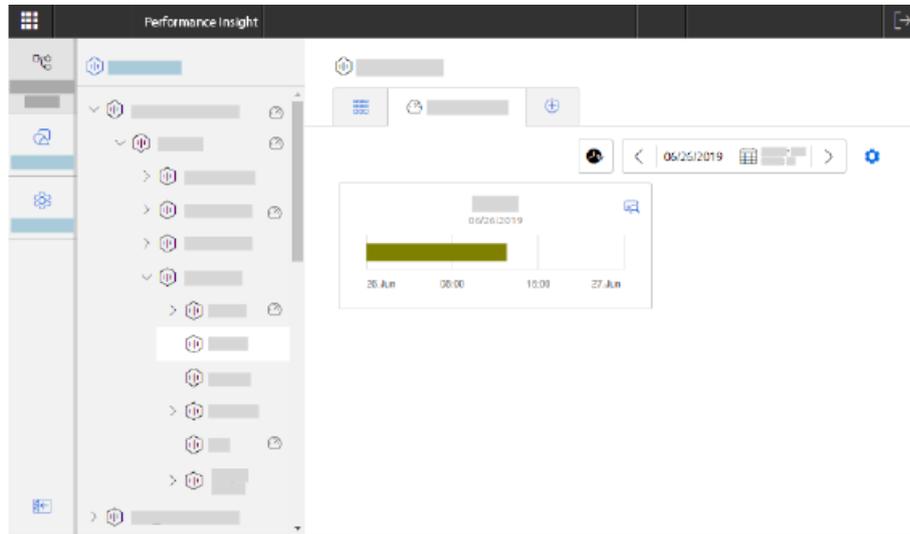




## Structure of the app

### Views in the app

The Performance Insight app has the following tabs:



	My Plant	<p>Allows you to manage the dashboard configuration of your plants and create KPI instances. My Plant is imported from the Asset Manager.</p> <p>You can find additional information on the Asset Manager here: Asset Manager system manual (<a href="https://documentation.mindsphere.io/resources/html/asset-manager/en-US/index.html">https://documentation.mindsphere.io/resources/html/asset-manager/en-US/index.html</a>)</p> <p>You can create dashboards and widgets for the individual elements of My Plant.</p>
	Configuration	In the configuration, you manage KPI types and view the table with the status mappings. The actual status mapping to a variable or a KPI type takes place during configuration of the Gantt widget.
	Settings	<p>In the settings, you manage the</p> <ul style="list-style-type: none"> <li>• User information (e.g. the language region and the user roles)</li> <li>• Usage information (e.g. the number of users and KPI instances)</li> <li>• User list</li> </ul>
	Symbol in My Plant	This symbol indicates that there is at least one dashboard within the asset.



## User profile

### User information

Here you can see your user information and set both the interface language and the language region of the app. The selection of the language region affects all numbers, such as decimal separators, and dates in dashboards and widgets within the app and can be selected regardless of the interface language.

### User roles

If you are logged on as a user or administrator in MindSphere, you have the following options:

Activities	Users	Administrator
Create and instantiate KPI types (typed)	-	x
Create KPI instances (typeless)	-	x
Create, edit and delete dashboards	-	x
Create, edit and delete widgets	-	x
Display dashboards	x	x
Display widgets	x	x
Create, edit and delete status mappings	-	x
Define limit values for tags and KPI instances and enable the "Activate notifications" function	-	x
Define a time model (time categories)	-	x

---

#### Note

##### For use in subtenants

Users of a subtenant can only see the dashboards and widgets that belong to an asset of their subtenant.

Administrators are currently not supported in the subtenant.

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## Note

### General information on tenants and subtenants

A tenant is the digital representation of a real company in MindSphere. A tenant includes users, data, assets, locations and other properties.

You can also create and manage subtenants in a tenant. The subtenants form a self-contained subarea so that users of this subtenant can only access the contents of this area.

Assets can also be shared by one tenant with another tenant. (Cross tenancy)

You can find more on this topic in the documentation for MindSphere Settings.

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## Usage information

In the Usage Information you can view the number of KPI instances and the number of users logged on to the Tenant with the "Performance Insight" role for specific months (mdsp:wccop:performanceinsight.admin).

If the maximum number of users is reached, purchase an additional user license or remove the role "Performance Insight" from another user.

## Adding/deleting users (as an administrator)

As administrator, you can manage the "Performance Insight" roles of administrator and user for a user in the MindSphere settings as follows:

1. Open the MindSphere settings in the overview page of the MindSphere applications.
2. Select the required user in the "Users" menu. The assigned roles are displayed.
3. Click "Edit direct assignment".
4. Add or remove the "mdsp:wccop:performanceinsight.admin" role and close the dialog.

## Deleting users

To free up a user license, you can deregister yourself as a user from the Performance Insight app:

1. Open the "Settings" menu.
2. You can deregister from the Performance Insight app under "User information > User account".

# Present the productivity of a plant transparently

## 4.1 Overview

### Description

With the key performance indicator of the overall equipment effectiveness (Overall Equipment Effectiveness OEE) you can display the productivity of a plant or its losses and display it transparently using the Gantt widget. The overall equipment effectiveness is a measure of the added value of a system.

The overall equipment effectiveness of a plant is defined as the product of the following three factors:

- Availability factor (e.g. whether there are fault times)
- Performance factor (e.g. whether the system is running at full load or reduced load)
- Quality factor (e.g. how much scrap is produced)

The range of value is between 0% and 100%.

### Time model as extension of a plant status model

The corresponding time category can be defined in the status mapping table. Thus, for each machine status, the time category to which the machine status belongs is defined.

In order to be able to calculate the key performance indicators for the overall equipment effectiveness, the following time categories are available:



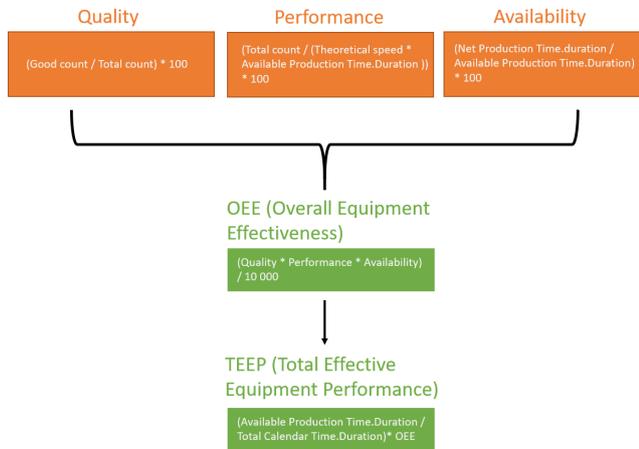
- **Total Scheduled Time**  
The total number of hours available, for example 1 week = 168 hours
- **Available Production Time**  
The total number of hours available minus the planned downtimes, such as breaks => 168 hours - 21 hours = 147 hours
- **Net Production Time**  
The number of hours available after subtracting the planned downtimes minus the unplanned downtimes, such as malfunctions => 147 - (1.5 \* 7) = 136.5 hours

4.1 Overview

- Unplanned Downtime
- Planned Downtime

OEE key performance indicators

In the figure below you can see the structure of the key performance indicators in order to ultimately get a meaningful figure for the productivity of your plant:



The following predefined key performance indicators (KPI types) are available in Performance Insight to determine the productivity of your plant. You can still edit the KPI types later:

- Quality  
The quality factor is a measure of the loss due to defective parts that need to be reworked. Formula for the key performance indicator:

$$\text{Quality [\%]} = \frac{\text{GoodCount}}{\text{TotalCount}} * 100$$

- Performance  
The performance factor is a measure of losses due to deviations from the planned machining time, minor failures (i.e. the downtimes that do not affect availability) and no-load operations. Formula for the key performance indicator:

$$\text{Performance [\%]} = \frac{\text{TotalCount [pcs]}}{\text{TheoreticalSpeed} \left[ \frac{\text{pcs}}{\text{s}} \right] * \text{Available Production Time.Duration[s]}} * 100$$

**Note**

**Unit for "Theoretical speed"**

The value for "Theoretical speed" must be defined in quantity/second, as the .Duration function also returns the value in seconds.

- **Availability**  
The availability factor is the ratio of the time until a fault occurs and the time that the function fails.

Formula for the key performance indicator:

$$\text{Availability [\%]} = \frac{\text{Net Production Time.Duration}}{\text{Available Production Time.Duration}} * 100$$

- **OEE (Overall Equipment Effectiveness)**  
OEE is a key performance indicator for unplanned downtimes or losses of a plant. Therefore, in the first step, the planned downtimes are deducted from the calendar time (24 hours, 7 days a week). Planned downtimes can be, for example:

- No occupancy/manning
- Planned maintenance
- Pause
- Strike
- No product manufacturing

The remaining operating time is the basis for the overall equipment effectiveness and is therefore defined as 100%. From this 100%, the losses in performance, availability and quality are now deducted, resulting in the overall equipment effectiveness of the plant.  
Formula for the key performance indicator:

$$\text{OEE [\%]} = \frac{\text{Availability} * \text{Performance} * \text{Quality}}{10\,000}$$

- **MTBF (Mean Time Between Failures)**  
Formula for the key performance indicator:

$$\text{MTBF [s]} = \frac{\text{Net Production Time.Duration}}{\text{Unplanned Downtime.Occurence}}$$

- **MTTR (Mean Time To Repair)**  
Formula for the key performance indicator:

$$\text{MTTR [s]} = \frac{\text{Unplanned Downtime.Duration}}{\text{Unplanned Downtime.Occurence}}$$

- **TEEP (Total Effective Equipment Performance)**  
In addition to the unplanned downtimes, TEEP also takes the planned downtimes into account.

Formula for the key performance indicator:

$$\text{TEEP [\%]} = \frac{\text{Available Production Time.Duration}}{\text{Total Calendar Time.Duration}} * \text{OEE}$$

## Procedure

To display the productivity of your plant, follow these steps:

1. Create a status mapping whose values are mapped to the time categories listed above.  
You can find additional information here: [Creating status mappings for the "Gantt" widget \(Page 43\)](#)
2. Create a KPI type with time categories or select one of the predefined KPI types, e.g. Availability, during the KPI instance creation.  
You can find additional information here: [Creating KPI types \(Page 54\)](#)
3. Create KPI instances that you link to the status mapping.  
You can find additional information here: [Creating and deleting KPI instances \(Page 55\)](#)
4. Create a Gantt widget in which you can view the machine status at a glance.

# Variable declarations

## 5.1 Introduction to variable declarations

### Description

The variables that are available on any asset were transferred from the plant to MindSphere using the Asset Manager. In SIMATIC Performance Insight, the plant structure with all existing variables is mapped on this basis.

The name, aspect name and the unit of each variable are transferred from MindSphere.

### See also

Variable declarations on the asset (Page 20)

Variable declaration in the widget (Page 24)

## 5.2 Variable declarations on the asset

### Description

You can extend the declaration of each variable directly on the asset in the "Parameter" area by the following properties:

- Unit: You can either apply the unit transferred from MindSphere or specify your own unit.
- Acquisition category:  
You use the acquisition category to determine how the value was acquired and stored in MindSphere. In addition, the acquisition category is linked directly to an aggregation function. As soon as you use the variable in a widget, the respective aggregation function is automatically selected:
  - ProcessValue => aggregation function: Average
  - Power => aggregation function: Average
  - Energy => aggregation function: Sum
  - Flow => aggregation function: Average
  - Amount => aggregation function: Sum
  - Counter => aggregation function: Counter  
When you select the acquisition category "Counter", you can define additional settings for each counter used.  
Additional information on the counting method of the individual counters can be found here: Introduction to the "Counter" acquisition category (Page 24)
  - Status value (State)
- Activate the "The value is aggregated" function:  
If the value is not aggregated, the values are continuously (actual values) transferred to MindSphere when the value changes. The currently transferred value is valid until the next value is transferred to MindSphere. When the value is aggregated, the value is always valid for the last cycle, e.g. 15 minutes.  
We recommend that you activate the function for the energy data management.  
You can find additional information on the aggregation functions here: Introduction to the aggregation functions (Page 26)

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### Note

#### Data gaps

Data gaps occur, for example, when the connection to the network is interrupted. No data from the plant is transferred to MindSphere during the interruption.

When you have activated the "The value is aggregated" function and are using an acquisition category with the "Sum" aggregation function, data gaps will distort the final result.

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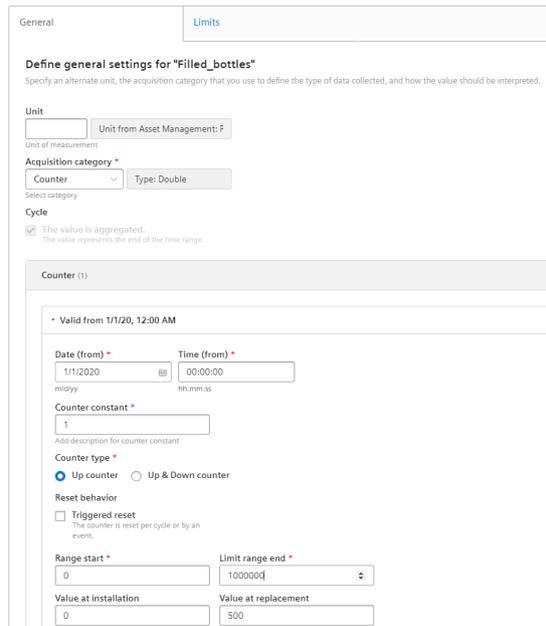
## 5.3 "Activate notifications" for variables of the data type "Integer" and KPI instances

## Procedure

To extend the declaration of a variable on the asset, follow these steps:

1. Click on the required asset and open the "Parameter" area.
2. Next to the variable, click on the "Edit" icon.
3. Select the desired properties.

In addition to the acquisition category, the data type of the variable is displayed.



General Limits

Define general settings for "Filled\_bottles"  
Specify an alternate unit, the acquisition category that you use to define the type of data collected, and how the value should be interpreted.

Unit  
Unit from Asset Management: F

Unit of measurement

Acquisition category \*  
Counter Type: Double

Select category

Cycle  
 The value is aggregated.  
The value represents the end of the time range.

Counter (1)

Valid from 1/1/20, 12:00 AM

Date (from) \* 1/1/2020 Time (from) \* 00:00:00  
yyyy hh:mm:ss

Counter constant \*  
1

Add description for counter constant

Counter type \*  
 Up counter  Up & Down counter

Reset behavior  
 Triggered reset  
The counter is reset per cycle or by an event.

Range start \* 0 Limit range end \* 1000000

Value at installation 0 Value at replacement 500

## 5.3 "Activate notifications" for variables of the data type "Integer" and KPI instances

## Description

For each tag of the "Integer" data type and for KPI instances, you can define high and low limits that trigger a notification when these limits are exceeded or not reached. This notification is displayed in the SIMATIC Notifier MindSphere app and sent directly to the desired mobile device.

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### Note

#### SIMATIC Notifier

The SIMATIC Notifier must also be installed and running so that you can enable the "Activate notifications" function.

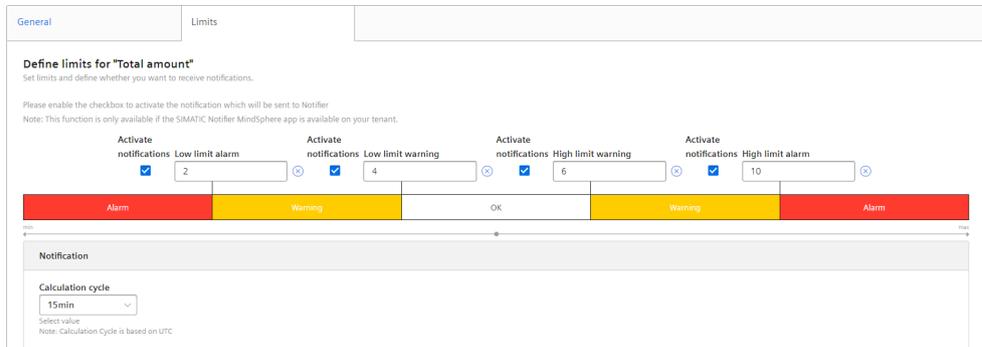
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The limits defined here for the tag or KPI instance are applied by default in the widget as soon as the tag or KPI instance is used. You can adapt the limits in the widget if necessary.

### Procedure

To enable the "Activate notifications" function, proceed as follows:

1. Click on the required asset and open the "Parameter" area.
2. Click the "Edit" icon next to the desired tag or KPI instance, or create a new KPI instance.
3. Click on the "Limits" tab.  
You can select the check box for the respective notification next to the fields "Low limit alarm/warning" and "High limit alarm/warning". As soon as the function is activated and the specified high or low limit has been violated, a notification is triggered and sent to the mobile device.
4. You can also select the following settings in the "Notification" section:
  - For tags:  
Select whether the raw data or the aggregated data should be validated.  
If you want to validate the raw data, a fixed calculation cycle of 10 seconds is used.  
If you want to validate the aggregated data, you need to select a calculation cycle and an aggregate function. The following calculation cycles are available:  
10 sec, 30 sec, 1 min, 10 min, 15 min, 30 min, 1 hour, 2 hour, 8 hour, 1 day  
The calculation cycle always starts at 00:00 UTC time (Universal Time Coordinated), e.g. 00:00:00; 00:15:00; ...  
For example, if you define a calculation cycle of 15 minutes, the system checks every 15 minutes whether or not a high or low limit has been violated and sends a notification if necessary.  
The following aggregation functions are available: Introduction to the aggregation functions (Page 26)
  - For KPI instances:  
Select a calculation cycle:  
10 sec, 30 sec, 1 min, 10 min, 15 min, 30 min, 1 hour, 2 hour, 8 hour, 1 day  
The calculation cycle always starts at 00:00 UTC time (Universal Time Coordinated), e.g. 00:00:00; 00:15:00; ...  
For example, if you define a calculation cycle of 15 minutes, the system checks every 15 minutes whether or not a high or low limit has been violated and sends a notification if necessary.



## 5.4 "Activate notifications" for variables of the data type "Bool" and "String"

### Description

For each variable of the "Bool" or "String" data type, you can define conditions that trigger a notification. This notification is displayed in the SIMATIC Notifier MindSphere app and sent directly to the desired mobile device.

#### Note

##### Variables of the data type "Bool" or "String"

You can activate notifications for these tags.

- You cannot use a tag of the data type "String" as a parameter in a widget or a KPI instance.
- You cannot use a tag of the data type "Bool" as a parameter in a widget or a KPI instance.

Limit values can also be defined, but these limit values are not transferred to the widget.

### Procedure

To enable the "Activate notifications" function, proceed as follows:

1. Click on the required asset and open the "Parameter" area.
2. Click the "Edit" icon next to the desired variable (Bool or String)
3. Click on the "Notification configuration" tab.

The screenshot shows the 'Notification configuration' interface. At the top, there are tabs for 'General' and 'Notification configuration'. Below the tabs, the title is 'Define notification configuration for "Name\_Boolean".' and the subtitle is 'Set notification configuration and define whether you want to receive notifications.' A note below states: 'Note: This function is only available if the SIMATIC Notifier MindSphere app is available on your tenant.' The main configuration area has three columns: 'Activate notifications', 'Type', and 'Value'. Under 'Activate notifications', there is a checked checkbox. Under 'Type', there is a dropdown menu with 'Alert' selected. Under 'Value', there is a dropdown menu with 'True' selected.

4. Select the check box under "Activate notifications".
5. Select a notification type:
  - Alert
  - Warning
6. Select "=" or "<>" as operator and enter a value:
  - For the data type "Bool": "True" or "False"
  - For the data type "String": Enter a value.
7. Click "Save".

### Result

A green check mark appears in the parameter list next to the desired variable in the "Notification activated" column.

## 5.5 Variable declaration in the widget

### Description

When you create a widget, you can select one of the following aggregation functions for a variable in step 3 "Parameter":

- None (Only with diagram)
- Average
- Min
- Max
- Sum
- Last
- Counter
- Timer
- EnergyToPower
- PowerToEnergy
- AmountToFlow
- FlowToAmount

You can find additional information on the individual aggregation functions here: [Introduction to the aggregation functions \(Page 26\)](#)

## 5.6 "Counter" acquisition category

### 5.6.1 Introduction to the "Counter" acquisition category

#### Description

You can define properties for each counter:

- Installation date
- Installation time
- Counter constant (value by which the counter is counted up or down, e.g. 1 kWh.)
- Counter types
  - Up counter = The counter can only count up. As soon as a subsequent counter value is less than the current one, it is treated as an overflow and the counter is restarted.
  - Up & Down counter = The counter can count up and down. You can not only calculate the energy consumption of an energy medium, for example, but you can also detect when energy is fed back.

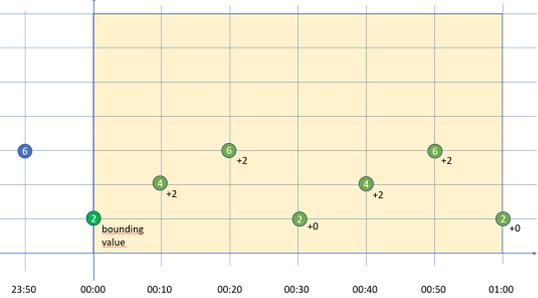
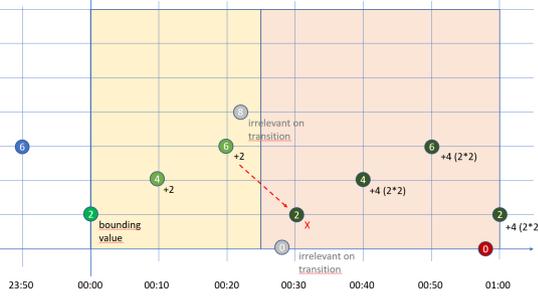
- Reset behavior (Only for an Up counter: You can specify whether the counter is reset daily or by an event, such as a defined overflow limit.)
- Overflow limit (If you have not activated the reset behavior, the counter is automatically reset when it reaches the specified count limit.)
- Value at installation (Here you can specify the actual value at which the counter is to start. If the counter is not to start with the start value of the limit range.)
- Value at replacement of the counter

## 5.6.2 Counting method of the "Up" counter

### Description

Only positive changes in value are recorded. The sum of the positive value changes between two points in time is output in each case. If the value remains the same between two points in time or is reduced, the value is not counted.

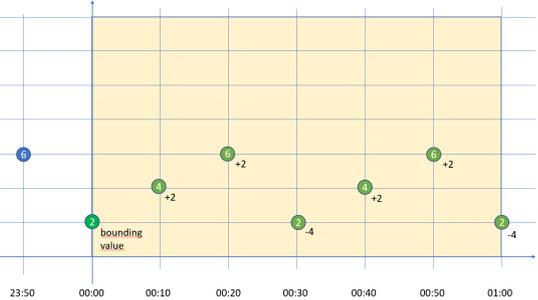
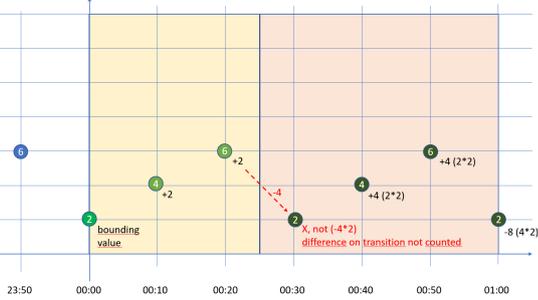
Depending on the settings you select for a counter, you will see different counter values as a result. By default, the "The value is aggregated" function is activated:

Settings	Explanation		
Start and end of the limit range is not defined. Result: $+ 2 + 2 + 0 + 2 + 2 + 0 = 8$			
When you change the counter, you can define different settings for each counter. This example shows the transition from one counter to the next:  <table border="1" data-bbox="387 1485 759 1789"> <tr> <td>Counter for the year 2018 00:00 - 00:25 Counter constant: 1 End of the limit range: 8 Result: <math>+ 2 + 2 = 4</math></td> <td>Counter for the year 2019 00:25 - 01:00 Counter constant: 2 Start of the limit range: 0 Result: <math>+ 4 + 4 + 0 + 4 = 12</math></td> </tr> </table> Final result: $4 + 12 = 16$	Counter for the year 2018 00:00 - 00:25 Counter constant: 1 End of the limit range: 8 Result: $+ 2 + 2 = 4$	Counter for the year 2019 00:25 - 01:00 Counter constant: 2 Start of the limit range: 0 Result: $+ 4 + 4 + 0 + 4 = 12$	
Counter for the year 2018 00:00 - 00:25 Counter constant: 1 End of the limit range: 8 Result: $+ 2 + 2 = 4$	Counter for the year 2019 00:25 - 01:00 Counter constant: 2 Start of the limit range: 0 Result: $+ 4 + 4 + 0 + 4 = 12$		

### 5.6.3 "Up & Down" counting method of the counter

#### Description

Depending on the settings you select for a counter, you will see different counter values as a result. By default, the "The value is aggregated" function is activated. You cannot define any limit ranges for the "Up & Down" counter.

Settings	Explanation				
Result: $+ 2 + 2 - 4 + 2 + 2 - 4 = 0$					
When you change the counter, you can define different settings for each counter. This example shows the transition from one counter to the next:					
<table border="1" style="width: 100%;"> <tr> <td style="width: 50%;">                             Counter for the year 2018                              00:00 - 00:25                              Counter constant: 1                              Result: <math>+ 2 + 2 = 4</math> </td> <td style="width: 50%;">                             Counter for the year 2019                              00:25 - 01:00                              Counter constant: 2                              Result: <math>+ 4 + 4 - 8 = 0</math> </td> </tr> <tr> <td colspan="2">                             Final result: <math>4 + 0 = 4</math> </td> </tr> </table>	Counter for the year 2018 00:00 - 00:25 Counter constant: 1 Result: $+ 2 + 2 = 4$	Counter for the year 2019 00:25 - 01:00 Counter constant: 2 Result: $+ 4 + 4 - 8 = 0$	Final result: $4 + 0 = 4$		
Counter for the year 2018 00:00 - 00:25 Counter constant: 1 Result: $+ 2 + 2 = 4$	Counter for the year 2019 00:25 - 01:00 Counter constant: 2 Result: $+ 4 + 4 - 8 = 0$				
Final result: $4 + 0 = 4$					

## 5.7 Aggregation functions

### 5.7.1 Introduction to the aggregation functions

#### Description

You use an aggregation function to select which value is to be output for a variable.

- Output the last read value with "Last".
- Use the other functions to gather summary information from the read values, for example, the sum of all read values.

The following aggregation functions are available:

Function	Meaning
Average	Calculates the time-weighted average value of the read values.
Min	Outputs the smallest read value.
Max	Outputs the largest read value.
Sum	Adds all read values.
Last	Outputs the last read value.
Counter	The sum of the positive value changes between two points in time is output in each case.
Timer	The Timer calculates the time interval in which the variable was not 0. Unit = milliseconds.
EnergyToPower	A consumption value can be converted into power. This aggregation function can only be selected in combination with the acquisition category consumption value (Energy) and Counter.
PowerToEnergy	Power can be converted into a consumption value. This aggregation function can only be selected in combination with the acquisition category power value (Power).
AmountToFlow	An amount (per hour) can be converted directly into a flow value. This aggregation function can only be selected in combination with the acquisition category amount value (Amount) and Counter.
FlowToAmount	A flow value (amount/h) can be converted directly into an amount value. This aggregation function can only be selected in combination with the acquisition category flow value (Flow).

### Note

#### Activating the interval in the first step of the Widget wizard

For this function to be executed, the aggregation function of the variable must not be set to "None" because the values are displayed directly in the widget without further processing in this case.

### 5.7.2 Aggregation functions in combination with the "The value is aggregated" function:

#### Description

For each variable and thus for each aggregation function, you can activate the "The value is aggregated" function:

"The value is aggregated" = not activated	"The value is aggregated" = activated
When the "The value is aggregated" function is not activated, actual values are transferred to MindSphere every 10 minutes, for example. The respective actual value is valid for 10 minutes until the next actual value is transferred to MindSphere. If the time of the last reading operation is identical to the end of the specified period, the last value is not read.	When the "The value is aggregated" function is activated, no actual values are transferred but the value that has already been calculated or processed in the last 10 minutes is transferred to MindSphere. Application example: A temperature measured value is recorded in the plant every minute, and an average value of the recorded values is then transferred to MindSphere every 10 minutes.
Result: Different results are calculated for the same time range, depending on the initial situation of how you want to collect data. Only the values marked in green are taken into account for the calculation of the result.	

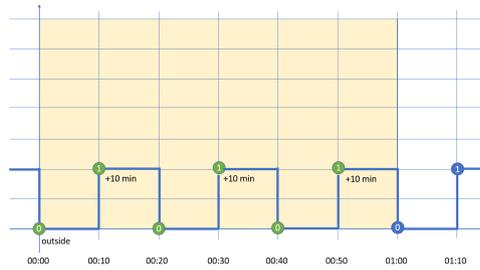
#### "Counter" aggregation function

"The value is aggregated" = not activated	"The value is aggregated" = activated
<p>Calculation example: The calculation period is from 00:10 to 00:50. Result: 1 + 1 + 1 + 1 = 4</p>	<p>Calculation example: The calculation period is from 00:10 to 00:50. Result: 1 + 1 + 1 + 1 = 4</p>

#### "Timer" aggregation function

The timer calculates the time interval in which the variable was not "0". Unit = milliseconds.

For the timer, the "The value is aggregated" function is always = False.



Calculation example:

The calculation period is from 00:00 to 01:00.

Result: 10 Min + 10 Min + 10 Min = 30 Min =>  $30 * 60 * 1000 \text{ ms} \Rightarrow 1,800,000 \text{ ms}$

### "Average" aggregation function

"The value is aggregated" = not activated	"The value is aggregated" = activated
<p>Calculation example: The calculation period is from 00:10 to 00:50. <math>(10 + 20 + 30 + 40) / 40 = 2.5</math> (average value across the calculation period)</p>	<p>Calculation example: The calculation period is from 00:10 to 00:50. <math>(20 + 30 + 40 + 50) / 40 = 3.5</math> (average value across the calculation period)</p>
<p>The aggregation function determines the weighted average depending on the time interval (every 10 minutes). If the time interval changes within a period, e.g. from 10 minutes to 12 minutes, then the values with the time interval 10 minutes are first added and divided by the number of read values. The values are then added together with the time interval 12 minutes and divided by the number of values read. The weighted average is formed from the two results of the two time intervals (result1 + result2) / 2=x.</p>	

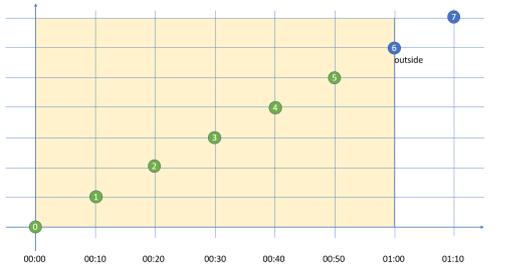
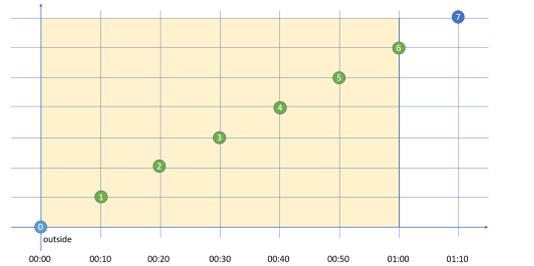
"Min", "Max" and "Last" aggregation functions

"The value is aggregated" = not activated	"The value is aggregated" = activated
<p>Calculation example:                      The calculation period is from 00:10 to 00:50.                      Min: 1                      Max: 4                      Load: 4</p>	<p>Calculation example:                      The calculation period is from 00:10 to 00:50.                      Min: 2                      Max: 5                      Load: 5</p>

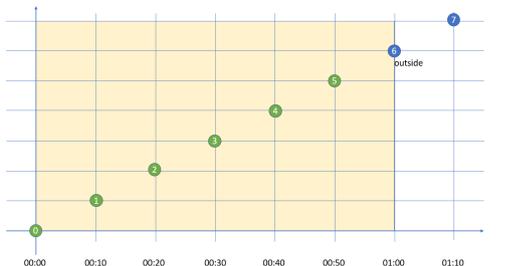
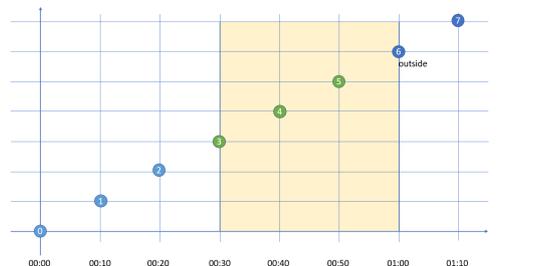
"Sum" aggregation function

"The value is aggregated" = not activated	"The value is aggregated" = activated
<p>Calculation example:                      The calculation period is from 00:10 to 00:50.  <math>1 + 2 + 3 + 4 = 10</math></p>	<p>Calculation example:                      The calculation period is from 00:10 to 00:50.  <math>2 + 3 + 4 + 5 = 14</math></p>

### "AmountToFlow" aggregation function

"The value is aggregated" = not activated	"The value is aggregated" = activated
	
<p>Calculation example: The calculation period is from 00:00 to 01:00. Sum: <math>0 + 1 + 2 + 3 + 4 + 5 = 15</math> AmountToFlow: <math>\text{Sum} / \text{time in hours} = 15 / 1 = 15</math></p>	<p>Calculation example: The calculation period is from 00:00 to 01:00. Sum: <math>1 + 2 + 3 + 4 + 5 + 6 = 21</math> AmountToFlow: <math>\text{Sum} / \text{time in hours} = 21 / 1 = 21</math></p>

### "EnergyToPower" aggregation function

"The value is aggregated" = not activated	"The value is aggregated" = activated
	
<p>Calculation example: The calculation period is from 00:00 to 01:00. Sum: <math>0 + 1 + 2 + 3 + 4 + 5 = 15</math> AmountToFlow: <math>\text{Sum} / \text{time in hours} = 15 / 1 = 15</math></p>	<p>Calculation example: The calculation period is from 00:30 to 01:00. Sum: <math>3 + 4 + 5 = 12</math> AmountToFlow: <math>\text{Sum} / \text{time in hours} = 12 / 0.5 = 24</math></p>

**Example of process tags of BOOL data type**

This example only applies when the "The value is aggregated" function is not activated:

- Only the values = "1" are added.
- Time intervals are only recorded when the new value = "1" (Timer).
- One value is read every 10 minutes between 10:00 a.m. and 11:00 a.m., i.e. six in total. One value is read every 12 minutes between 11:00 a.m. and 12:00 a.m., i.e. five in total. Because the last reading operation takes place at 12:00 a.m. and the evaluation period also ends at 12:00 a.m, the last value is not read. To evaluate the last value at 12:00 a.m., you must set the end of the evaluation period to at least 12:01 a.m.

Time	Sum (BOOL)	INT	Timer (BOOL)	In minutes
10:00	1	1	1	+ 10
10:10	1	2	1	+ 10
10:20	1	3	1	+ 10
10:30	1	4	1	+ 10
10:40	1	1	1	+ 10
10:50	1	2	1	+ 10
11:00	0	0	0	
11:12	1	3	1	+ 12
11:24	1	4	1	+ 12
11:36	1	5	1	+ 12
11:48	1	2	1	+ 12
12:00	1	0	1	+ 12
Result	10	27		108 (1 h 48 min)
Aggregation function	Sum	Sum	Timer	Timer

Evaluation:

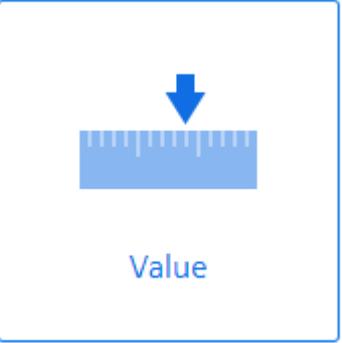
- The "Sum" aggregation function returns the result = 10  
All values = "1" between 10:00 a.m. and 11:48 a.m. are added.
- The "Timer" aggregation function returns the result = 108 minutes (1 hour 48 minutes)  
The sum of all time intervals with the state "1" is recorded. The value "1" is read six times between 10:00 and 10:50, with 10-minute intervals between each read. This results in a sum of 60 minutes. No value is read at 11:00. The value "1" is read four times between 11:12 and 12:00. The time interval is 12 minutes each. This results in a sum of 48 minutes. The total is a sum of 108 minutes or 1 hour 48 minutes or 6,480,000 milliseconds.

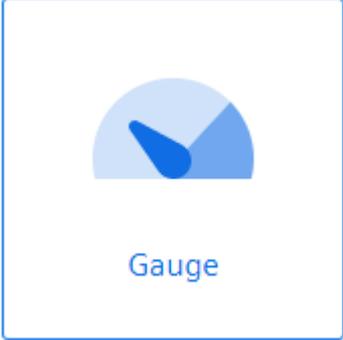
## Data analysis

### 6.1 Introduction to data analysis (widgets)

#### Description

The following widget are available for data analysis:

Widget type	Description
 <p style="text-align: center;">Diagram</p>	<p>Displays the value of variables or KPI calculations as a diagram over time.</p> <p>You can find additional information here: <a href="#">Visualizing correlations in the diagram (Diagram) (Page 38)</a></p>
 <p style="text-align: center;">Value</p>	<p>Displays the current value of a variable or a KPI.</p> <p>You can find additional information here: <a href="#">Visualizing individual values (Value) (Page 40)</a></p>
 <p style="text-align: center;">Gantt</p>	<p>The Gantt widget shows you the status of a device at a glance using different color codes. For example, the status can represent the current state or the state within a specific time range.</p> <p>This allows you to see at a glance, for example:</p> <ul style="list-style-type: none"> <li>• When the device started up and how long it was in the "RUN" operating state.</li> <li>• When it switched to the "STOP" operating state and how long it remained in this state.</li> </ul> <p>You can find additional information here: <a href="#">Visualizing machine statuses (Gantt) (Page 42)</a></p>

Widget type	Description
 <p data-bbox="485 538 579 570">Gauge</p>	<p data-bbox="791 280 1431 363">Using the gauge, you can display limit values very simply using colors and thus recognize at a glance whether limit values are exceeded.</p> <p data-bbox="791 374 1431 431">You can find additional information here: Visualizing the violation of limit values (gauge) (Page 44)</p>
 <p data-bbox="507 912 549 944">Pie</p>	<p data-bbox="791 655 1431 738">Using the pie chart, you can display the distribution of consumption or quantities very simply. Clicking on a segment highlights the segment and displays the corresponding value.</p> <p data-bbox="791 749 1431 806">You can find additional information here: Visualizing the distribution of consumptions or quantities (Pie chart) (Page 46)</p>
 <p data-bbox="464 1291 592 1323">Heatmap</p>	<p data-bbox="791 1029 1431 1112">Using the Heatmap, you can visualize the intensity of data values. You can, for example, display the energy consumption (green = low consumption; red = high consumption).</p> <p data-bbox="791 1123 1431 1181">You can find additional information here: Visualizing the intensity of data values (Heatmap) (Page 48)</p>

### Error display in the widget

If a network error occurs or an operand required to display the widget has been deleted, for example, the error symbol is shown in the bottom right corner of the widget.



## 6.2 Create a widget

### Requirement

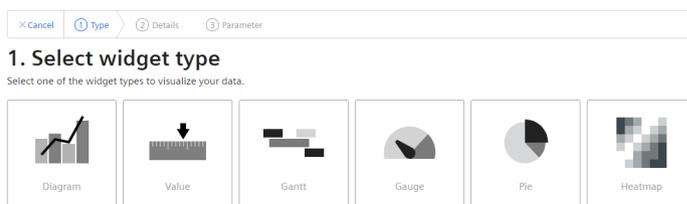
To visualize and calculate the data from the plant, such as production figures, machine operating times or water consumption, using KPIs, these figures must be transferred from the plant to MindSphere using the Asset Manager. The data structure of your plant is then automatically displayed in the app.

At least one dashboard is created on the desired asset.

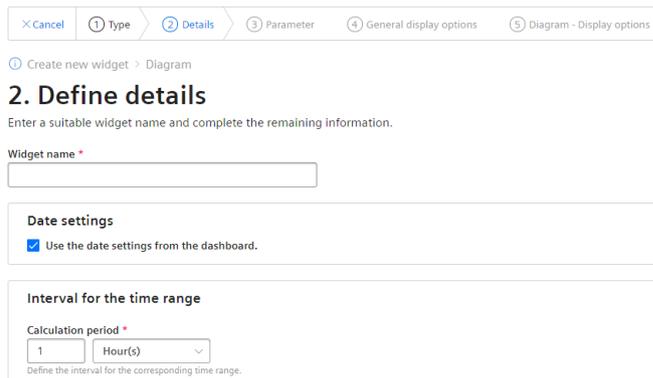
### Widget configuration

A wizard will guide you through the individual steps when creating a widget. However, the first four steps are identical for all widget types:

- Step 1: Select the widget type



- Step 2: Define details



## 6.2 Create a widget

- Step 3: Select parameters

Cancel 1 Type 2 Details 3 Parameter 4 General display options 5 Diagram - Display options

Create new widget > Diagram > Diagram

### 3. Select parameter

Select KPI instances or tags.

No parameter was selected.

Select parameter

**New KPI instance**

If no matching KPI instance exists, you can create a new KPI instance.

+ New KPI instance

- Step 4: Define general display options

Cancel 1 Type 2 Details 3 Parameter 4 General display options 5 Diagram - Display options Back Continue >

Create new widget > Diagram > Diagram

### 4. Define general display options

Define the general display options for the selected parameters.

01 Filled\_bottles (Sum) Path: ... / Production / Filling Type: VAR Aggregation: Sum

**Alternative label**  
Optionally, you can specify an alternative label for the display in the widget.

**Number of decimal places \***  
The values in the widget are displayed according to the specified number of decimal places.

**Color**  
Select the color which is to be used for displaying the parameter values.

**Limits**  
Optional. The limits are used to display general restrictions.

Low limit alert	Low limit warning	High limit warning	High limit alert	
			120	
Alert	Warning	OK	Warning	Alert

Note: The notifications have been activated for this tag.

- Step 5: Define widget-specific display options

Cancel 1 Type 2 Details 3 Parameter 4 General display options 5 Diagram - Display options

Create new widget > Diagram > Diagram

### 5. Diagram - Define display options

Define the widget specific display options.

01 Filled\_bottles (Sum) Path: ... / Production / Filling Type: VAR Aggregation: Sum

**Type**  
Shows how the parameter will be displayed.

**Further options**

Visible  Stacked  
Shows whether the parameter is displayed stacked with another one.

**Y-axis (1)**

## Procedure for creating the general steps of a widget

To create a widget, follow these steps:

1. Either click "Create first widget" or click  and "New widget" and select a widget type.

2. Assign a name and define the date settings:

### Define date settings:

With the date settings you define the time range from which the values are to be visualized. You can apply the dashboard date settings to a widget or define your own date settings for this widget.

The following variants are available for setting your own date:

- Default: "Use the date settings from the dashboard" to use the time range that is defined in the dashboard.
- You disable "Use the date settings from the dashboard" to define a specific time range. You have the following options to do this:
  - Default: "Use current date" and enter the duration (e.g. week) under "Time range". The start and end time are given by the predefined time ranges (day, week, month, year, etc.). If you prefer, you can also disable "Use current date" and enter the start date and start time manually. The end time is calculated based on the duration under "Time range". Under "Offset", you can enter the number of days, weeks, months or years by which the start time should be postponed. The start time can be either in the future or in the past.

If you use the dashboard date settings for the widget, all changes to the date settings are displayed directly in all widgets of the dashboard.

### Define interval:

You can also specify an interval at which the values are to be displayed, e.g., every 5 minutes, every 2 hours, etc..

3. You can select either a variable or a KPI type as parameter. Up to 10 parameters can be defined.

For each variable you can select one of the aggregation functions (Average, Min, Max, Sum, Last, Counter, Timer, EnergyToPower, PowerToEnergy, AmountToFlow, FlowToAmount).

You can find additional information on the aggregation functions here: [Introduction to the aggregation functions \(Page 26\)](#)

In this step, you can also directly create KPI instances and link the operands with the desired parameters.

You can find additional information on KPI instances here: [Introduction to KPI calculations \(Page 53\)](#)

### 6.3 Visualizing correlations in the diagram (Diagram)

4. In the general display options, you can assign an alternative label for the variable or KPI type. This label is then displayed in the legend in the detail view instead of the asset and the aspect name of a parameter.

In this step, you can also enter the limit values for warnings and alerts.

- Red = the alert limit was violated
- Yellow = the warning limit was violated

The limit values are also displayed in the detail view as dashed lines.

You can also specify the number of decimal places and a color for each parameter in which the graph is displayed in the detail view.

If you have already defined limits for the variable or KPI used, these are displayed in the widget as pre-setting. However, these limits can be overwritten at any time.

5. In this last tab you specify all widget-specific details. You can find additional information on the respective details of the widgets here:
  - Visualizing correlations in the diagram (Diagram) (Page 38)
  - Visualizing individual values (Value) (Page 40)
  - Visualizing machine statuses (Gantt) (Page 42)
  - Visualizing the violation of limit values (gauge) (Page 44)
  - Visualizing the distribution of consumptions or quantities (Pie chart) (Page 46)
  - Visualizing the intensity of data values (Heatmap) (Page 48)

## 6.3 Visualizing correlations in the diagram (Diagram)

### Description

Displays the value of variables or KPI calculations as a diagram over time. The following diagram types are available:

- Line graph (Line)
- Bar graph (Bar); the bars of multiple parameters can also be stacked
- Area graph (Area)
- Spline curve
- Scatter diagram (Scatter)

The following views are also available in the diagram:

- Detail view
- Histogram
- Regression

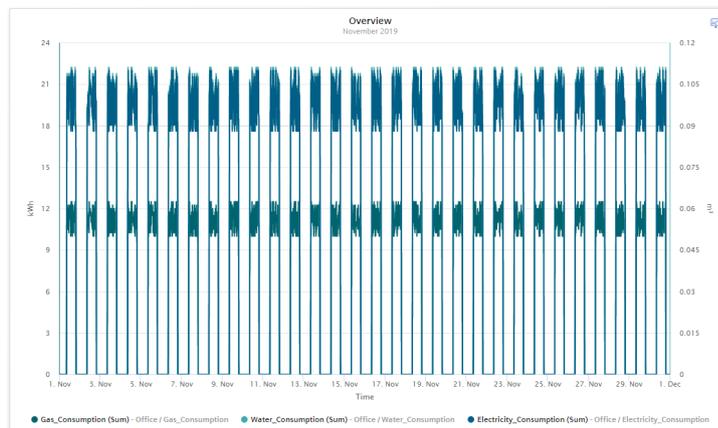
## Procedure

To define widget-specific display options for a bar graph, follow these steps:

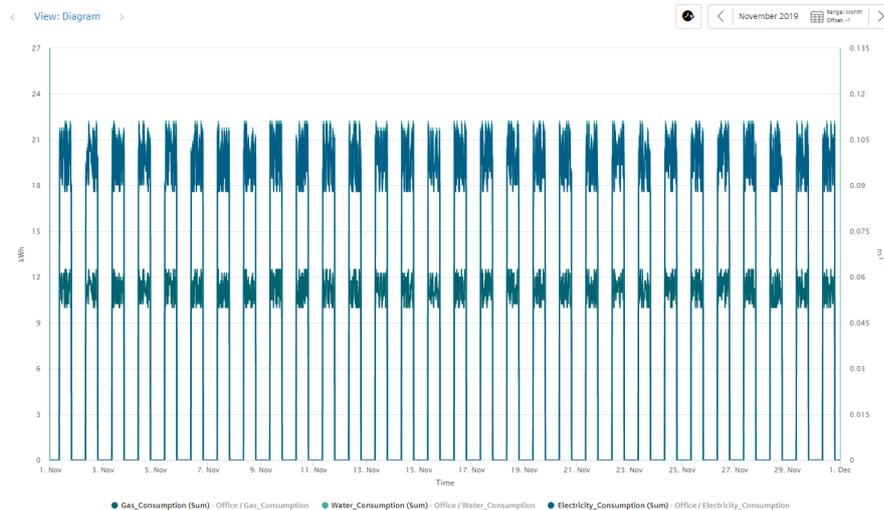
1. In the last step, select a diagram type. You can also specify whether the value should be visible and/or stacked (in the case of a bar graph).
2. A Y-axis is created for each unit that a parameter provides. A maximum of 5 Y-axes can be defined per widget.  
Each parameter is automatically assigned to a Y-axis. However, you can also manually assign the parameters to a different Y-axis.  
You can define a low and high limit for each Y-axis. This means that you can only display a section between specific values in the widget.

## Result

As a result, you see a line graph:



In the detail view, you can see the graphs of the parameters "Gas\_Consumption", "Water\_Consumption" and "Electricity\_Consumption" in the colors that you have defined in the display options:

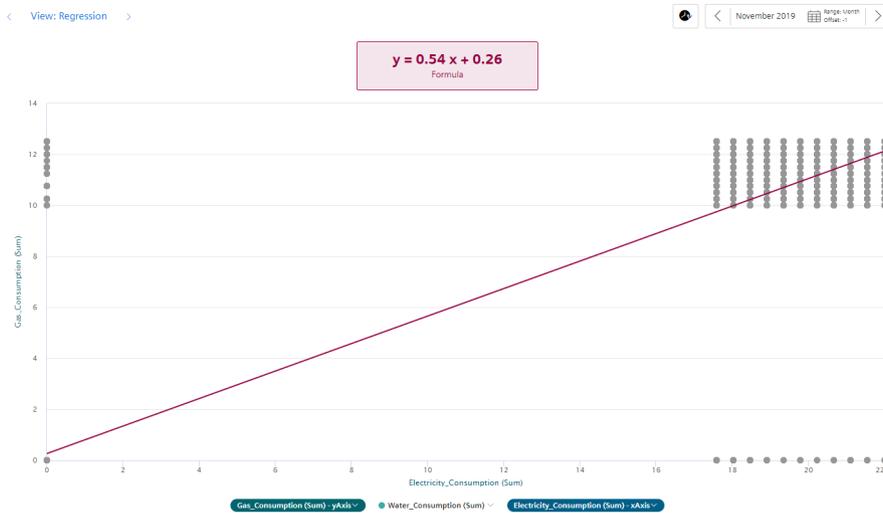


### 6.4 Visualizing individual values (Value)

In the histogram, you can see the frequency distribution of the parameter "Electricity\_Consumption":



In the regression analysis, you can see the correlation between the two parameters "Gas\_Consumption" and "Electricity\_Consumption":



## 6.4 Visualizing individual values (Value)

### Description

Displays the value of a specific time range. The value is derived either from a variable with a corresponding aggregation function or from a KPI result.

The following views are also available for Value:

- Detail view
- Histogram

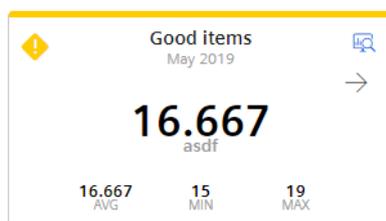
## Procedure

To define widget-specific display options, follow these steps:

1. In the last step, you select whether the statistics (average, minimum, maximum) should be displayed or not.

## Result

As a result, you see an individual value that violated the warning limit. A yellow bar and the warning symbol are therefore displayed.



The arrow shows you the tendency of the displayed value.

The statistical data of average, minimum and maximum are displayed in the bottom line if they were activated in the last step.

---

### Note

#### Values of the statistical data

The displayed statistics is calculated from the calculated values in the cycle that is specified in the widget configuration.

---

View of the detail view with activated limit values:

## 6.5 Visualizing machine statuses (Gantt)



## 6.5 Visualizing machine statuses (Gantt)

### Description

The Gantt widget shows you the status of a device at a glance using different color codes. For example, the status can represent the current state or the state within a specific time range.

This allows you to see at a glance, for example:

- When the device started up and how long it was in the "RUN" operating state.
- When it switched to the "STOP" operating state and how long it remained in this state.

In addition to the complete overview, you can also see all status displays broken down individually in the detail view.

### Procedure

To define widget-specific display options, follow these steps:

1. In the last step, select a status mapping from the drop-down list. If no status mapping exists yet, you can create one with "Create new status mapping".

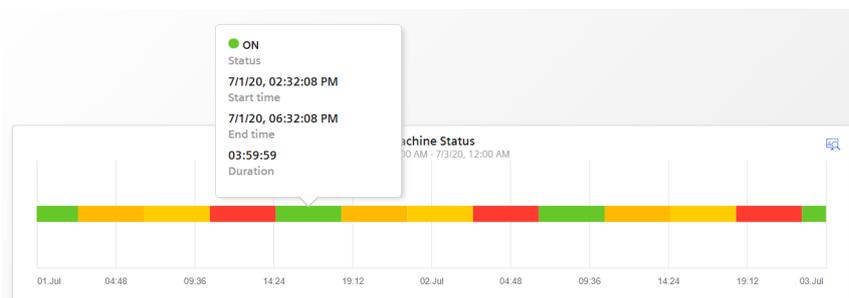
### Result

The result shows the machine status:

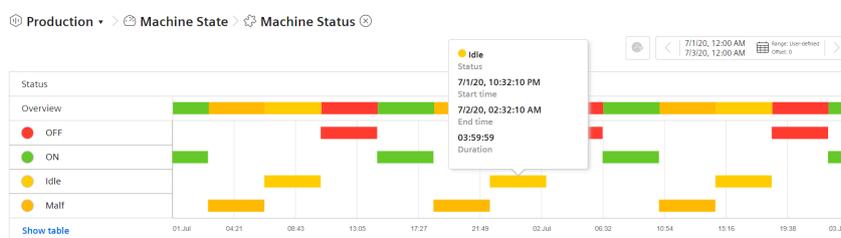
- Red: Machine in STOP state
- Green: Machine in RUN state
- Yellow: Idling
- Orange: An error has occurred

The tooltips offer more information extending beyond the selected time range of the widget. In the figure below you see, for example, that the machine state with the color "Green" was pending for 3 hours, 59 minutes and 59 seconds on 1 July 2020.

Using the tooltip for each machine state you can see exactly when this operating state occurred. In the case of the machine state "Red" this is of particular importance, for example, to determine immediately when the machine stopped.



The individual values are still displayed itemized in the detail view:



## 6.6 Creating status mappings for the "Gantt" widget

### Description

Using a status mapping, you can display changes in the value of a variable at a glance in the "Gantt" widget.

In addition to a color, a label and a description you can now also assign a time category to a value (machine status) and work with a time model.

Based on this time model, you can calculate how long the machine was in a specific time category or how often one of the assigned machine statuses was in a specific time category.

These calculations are used as the basis for determining the OEE KPI (Overall Equipment Effectiveness) and the TEEP KPI (Total Effective Equipment Performance).

You can find additional information about the productivity of a machine or plant here: [Overview](#) (Page 15)

### Status mappings

You can either create status mappings directly when creating a Gantt widget or you can create a new status mapping in the "Configuration" tab. This tab also shows you a list of the existing status mappings.

## 6.7 Visualizing the violation of limit values (gauge)

### Creating and editing a status mapping

To create a status mapping, follow these steps:

1. Open the "Configuration">"Status mappings".
2. Click on "New status mapping".
3. Assign a unique name and a description.
4. Select the "Use time categories" check box if you want to map the status mapping in connection with the calculation of the productivity of your plant (overall equipment effectiveness) to a KPI instance.
5. You can assign a color, a label and a description for each value that a tag can assume. If a value that is not defined in the status mapping table occurs in the variable, it is displayed with the status "not defined" and the color white in the Gantt widget.

Name \*

G\_NPU

The status mapping name must be unique.

Description

Description

Use time categories  
Time category is used for eg. OEE calculation

Color *	Value *	Label *	Time Category *	Description
●	1	NetProductionTime	Net Production Time	Description
●	0	PlannedDowntime	Planned Downtime	Description
●	2	UnplannedDowntime	Unplanned Downtime	Description

+ New row

\* These fields must be filled out.

Save Cancel Delete

You use the created status mapping in connection with the "Gantt" widget. The order of each state mapping is reflected in the Gantt widget in the same way as shown in the table. You can change the order using drag-and-drop.

## 6.7 Visualizing the violation of limit values (gauge)

### Description

Using the gauge, you can display limit values very simply using colors and thus recognize at a glance whether limit values are exceeded.

The following views are also available in the gauge:

- Detail view
- Histogram

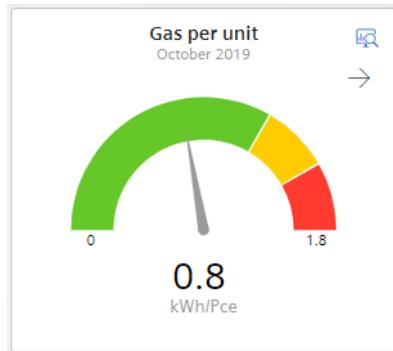
### Procedure

To define widget-specific display options, follow these steps:

1. The final step is to apply the limit values from the general display options if you have already defined them there. In addition, you specify the value with which the gauge scale starts and ends.

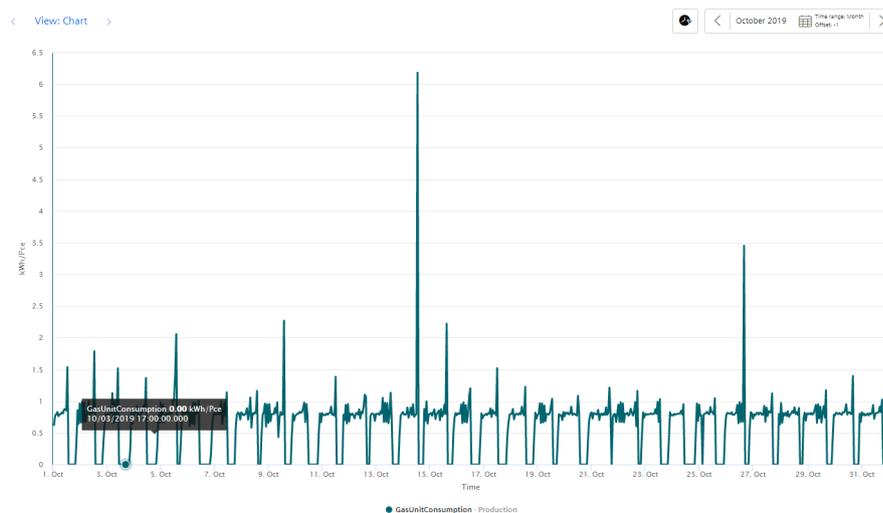
## Result

The gauge shows you that the gas consumption per unit is in the acceptable range (green):



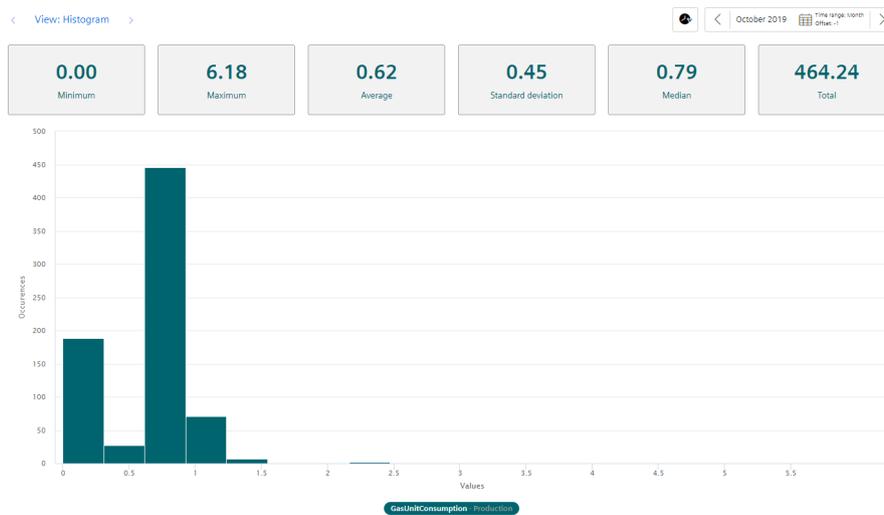
The arrow at the top right shows you the tendency of the displayed value.

In the detail view, you see the graph of the KPI instance "GasUnitConsumption" in the color that you have defined in the display options:



In the histogram, you can see the frequency distribution of the KPI instance "GasUnitConsumption":

## 6.8 Visualizing the distribution of consumptions or quantities (Pie chart)



## 6.8 Visualizing the distribution of consumptions or quantities (Pie chart)

### Description

Using the pie chart, you can display the distribution of consumption or quantities very simply. Clicking on a segment highlights the segment and displays the corresponding value.

The following views are also available in the pie chart:

- Detail view
- Histogram
- Regression

### Procedure

To define widget-specific display options, follow these steps:

1. In the last step, you specify whether the values are to be displayed as absolute or percentage values.

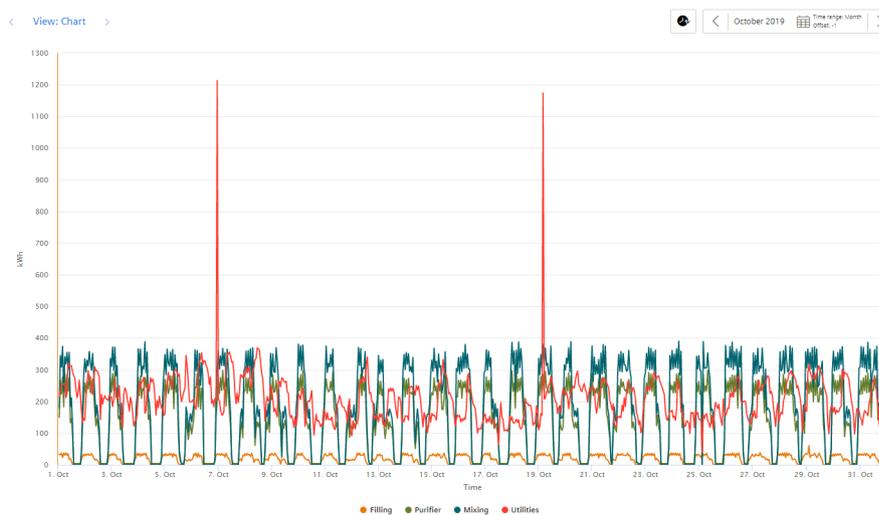
## 6.8 Visualizing the distribution of consumptions or quantities (Pie chart)

## Result

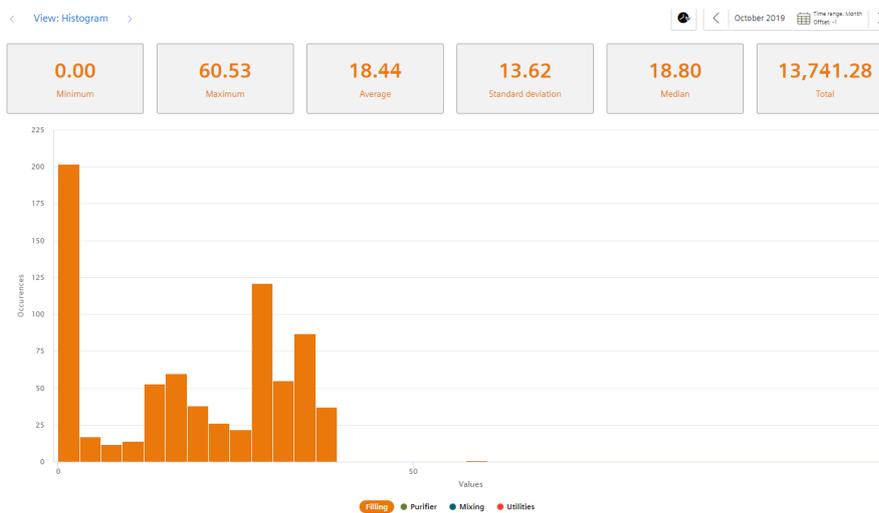
The pie chart shows you the percentage values of the parameters "Filling", "Purifier", "Mixing" and "Utilities":



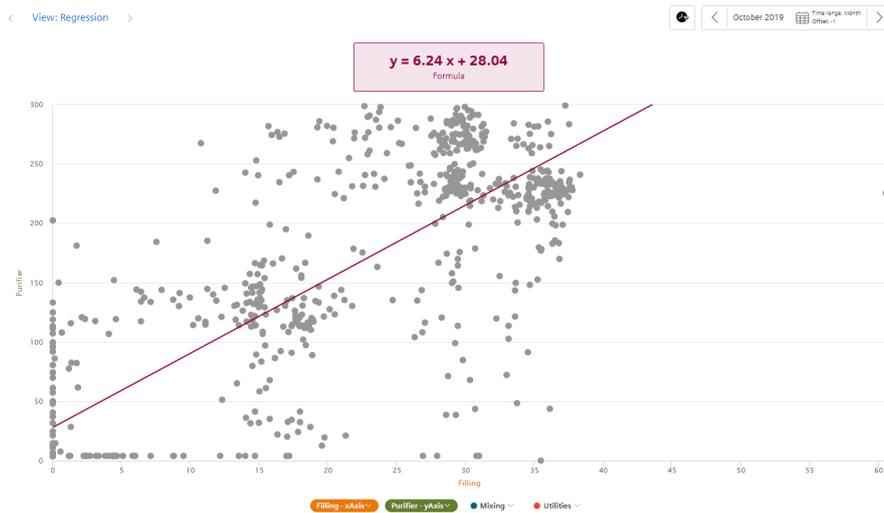
In the detail view, you can see the graphs of all four parameters in the colors that you have defined in the display options:



In the histogram, you can see the frequency distribution of the parameter "Filling":



In the regression analysis, you can see the correlation between the two parameters "Filling" and "Purifier":



## 6.9 Visualizing the intensity of data values (Heatmap)

### Description

Using the Heatmap, you can visualize the intensity of data values over time. You can, for example, display the energy consumption (red = high energy consumption; green = low energy consumption), temperatures or production quantities in a specific time range.

The following additional views are also available in the Heatmap:

- Detail view
- Histogram

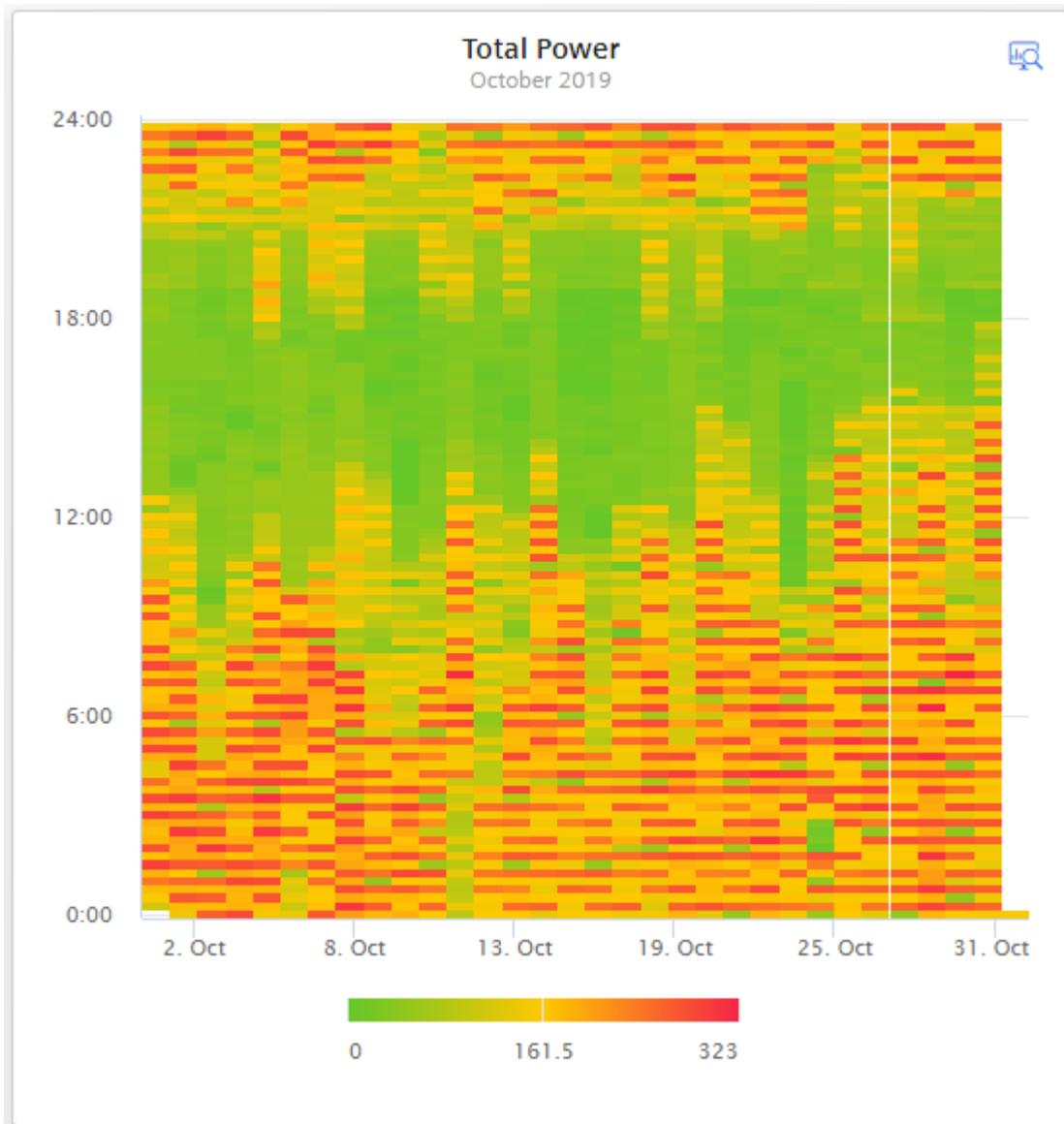
### Procedure

To define widget-specific display options, follow these steps:

1. In the last step, you define the following settings:
  - Whether the data is displayed in the day view or the week view.
  - The color in which the different intensities are going to be displayed.
  - You can enter a fixed range for the color scaling.  
If you do not define fixed values, the lowest and the highest measured value is used for the color scale. This may result in a distorted picture displayed by the heatmap in case of extreme peaks.

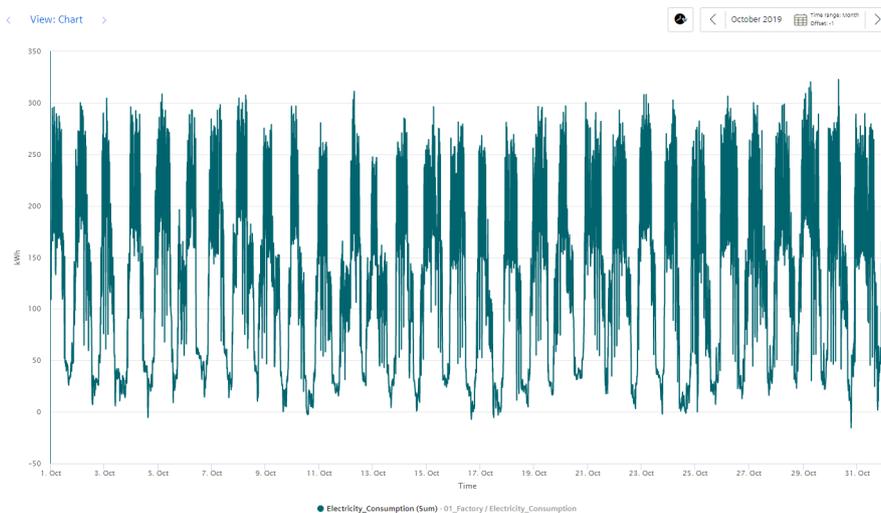
## Result

The Heatmap shows the energy consumptions for the entire month of October (y-axis), broken down by each day (x-axis). You can see at a glance that frequent energy peaks occurred between 0:00 and 12:00 o'clock and that energy consumption was lower in the afternoon and evening.

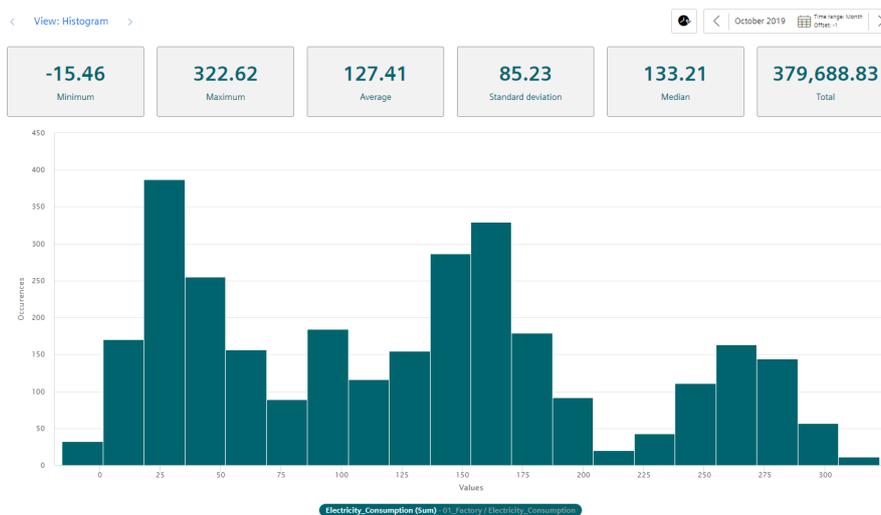


In the detail view, you can see the graph of the "Electricity\_Consumption" parameter in the color that you have defined in the display options:

## 6.10 Editing widgets



In the histogram, you can see the frequency distribution of the parameter "Electricity\_Consumption":



## 6.10 Editing widgets

### Description

If you have already created a widget, you can still change it afterwards.

## Procedure

To change an existing widget, do the following:

1. Click the  icon in the dashboard.  
The dashboard is now in edit mode.
2. Click the  icon in the desired widget.  
The widget wizard opens.
3. You can switch freely between steps 2 and 5 and change the details accordingly.
4. Then click on "Finish" in the wizard and on "Finish" in the dashboard.

## Result

All changes have been applied to the widget and are displayed directly.



# KPI calculations (KPIs)

## 7.1 Introduction to KPI calculations

### Description

The acronym KPI stands for Key Performance Indicator. KPI types are formulas made up of operands, constants, and operators. The definition and calculation of KPI types are plant-specific. An example of a KPI type could be:

- $\text{Quality rate} = \text{Good Items} / \text{Total Items} * 100$

The KPI instance can be created either during the widget configuration in the "Parameter" step or in the parameter list on the asset. The KPI instance can

- be derived from a KPI type (typed)
- or can be created typeless.

The KPI types can be instantiated multiple times. When you make changes to the KPI type, these changes are also implemented in all KPI instances.

---

#### Note

##### Data in the buffer

The KPIs are saved in a buffer (cache). If values were overwritten in MindSphere in the past (except for the current and last hour), it may take up to one hour before you will be able to see the data or KPIs and aggregations based on them.

---

### Operands

Operands serve as placeholders that are later filled with actual values from the variables. They are created directly when creating a KPI type and defined more precisely during the instantiation of the KPI type. Operands may contain no space, mathematical symbols or numbers at the beginning of the operand name. They can be moved and copied.

### Structure of a KPI instance

The KPI instance is created as follows:

- You either instantiate a KPI type including linked variables or KPI instances (typed; multiple use is possible) or
- You create a KPI instance directly and link it to variables or KPI instances (typeless).

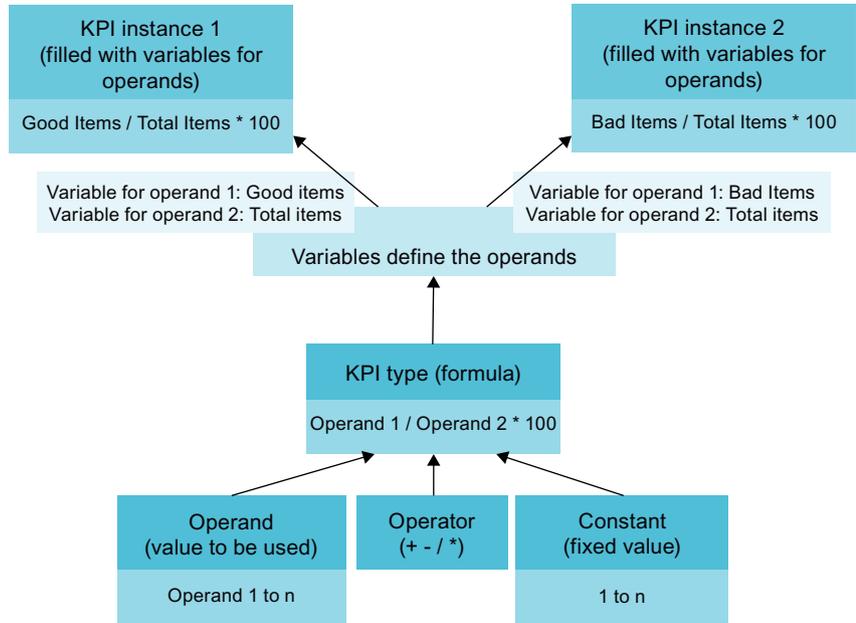
Each KPI instance must be assigned to an asset, but variables from other assets can also be linked to the KPI instance.

## 7.2 Creating KPI types

The following figure shows the individual components that make up a KPI instance.

- Operands serve as placeholders that are later filled with actual values from the variables or KPI instances.
- Constants can only contain numerical values
- Operators

The following diagram shows the structure of the KPI type/instance concept:



## 7.2 Creating KPI types

### Description

New KPI types can be created in the "Configuration" tab and a list of existing KPI types is displayed.

## Procedure

Follow these steps to create a KPI type:

1. Click on "New KPI type".
2. Assign a unique name and a unit.
3. In the formula editor, use operands, constants, time categories and operators to compose the formula that is used to calculate the KPI. You can create operands and constants directly for this purpose.

### Note

#### Time categories

The time category is used for the calculation of OEE key performance indicators. You can select the time category and, depending on the time category, define whether you are interested in the duration or the number of events.

An operand is a placeholder that is later filled with actual values from the variables or KPI instances.

**Name \***

**Unit \***

**Formula editor \***

TIME CATEGORY

( Net Production Time ▾ Duration /

TIME CATEGORY

Available Production Time ▾ Duration ) \* CONSTANT

100

\* These fields must be filled out.

Connect the operands with the variables or KPI instances transferred to the MindSphere.

## 7.3 Creating and deleting KPI instances

### KPI instances

KPI instances can be created either in the parameter list of the respective dashboard or in the 3rd step when a widget is created. You can create the KPI instance either directly when creating a widget or later by editing the widget again.

You have several options to create a KPI instance:

- You create a KPI type in the configuration and instantiate it either directly in the widget or in the parameter list. (typed)
- You create a new KPI instance directly in the widget or the parameter list. (typeless)

### 7.3 Creating and deleting KPI instances

In the preview, you can see the formula it contains and which operand is linked to which variable.

New KPI instances cause costs. The number of currently used KPI instances is displayed in the "Settings" menu under "Usage information".

If all KPI instances are occupied, order additional KPI instances or delete a KPI instance that is no longer needed.

#### Creating KPI instances based on a KPI type (typed)

Follow these steps to create a KPI instance:

1. Click "Create a new KPI instance".
2. Click the "General" tab.
3. Assign a unique KPI instance name per plant object.
4. Select "On basis of a KPI type (typed)".
5. Select the desired KPI type. The preview shows the formula it contains.  
If you select a KPI type with time categories, you also have the option of linking a status mapping and a parameter for the machine status.
6. Link all operands contained therein to a variable or a KPI type. If you assign a variable to the operand, you also need to select an aggregation function.

The screenshot shows the 'General' tab of a KPI instance configuration interface. At the top, there are two tabs: 'General' (selected) and 'Limits'. Below the tabs is a section titled 'Define general settings' with a sub-instruction: 'Define a name, the type of the KPI instance, the unit and the formula and link each operand with a parameter.' An information box states: 'Costs for one KPI: Creating a KPI instance incurs costs.' The 'KPI instance name' field is empty with a placeholder 'Enter a KPI instance name.'. Under 'Select a KPI basis', the 'On basis of a KPI type (typed)' radio button is selected. The 'KPI type' dropdown is set to 'Availability'. The '1. Formula preview' section shows a formula:  $( \text{Net Production Time} / \text{Duration} ) * 100$ . The '2. Choose parameter representing your machine status' section shows a dropdown with 'Working' selected. The '3. Choose a status mapping that represents your time model' section shows a dropdown with 'G\_NetProductionTime' selected.

## Creating KPI instances without KPI type (typeless)

Follow these steps to create a KPI instance:

1. Click "Create a new KPI instance".
2. Click the "General" tab.
3. Assign a unique KPI instance name per plant object.
4. Select "Without KPI type (typeless)".
5. Enter a unit.
6. Create the desired formula from constants, operands, time categories and operators.  
If you select a time category, you also have the option of linking a status mapping and a parameter for the machine status.
7. Link all operands contained therein to a variable or a KPI type. If you assign a variable to the operand, you also need to select an aggregation function.

### Define general settings for "Total amount"

Define a name, the type of the KPI instance, the unit and the formula and link each operand with a parameter.

**i** Costs for one KPI  
Creating a KPI instance incurs costs.

KPI instance name \*

Select a KPI basis

On basis of a KPI type (typed)  
Select this option if the KPI definition is inherited from a KPI type.

Without KPI type (type less)  
Select this option if the KPI definition is used only once.

---

Unit \*

**1. Formula editor**

?

OPERAND 
OPERAND 
OPERAND 
TIME CATEGORY

**2. Choose parameter representing your machine status** ?

**3. Choose a status mapping that represents your time model** ?

**4. Link each operand to a tag to continue.** ?

## Defining limits

You can define limits both for typed and for typeless KPI instances (user-based KPI instances).

To define the limits, follow these steps:

1. Click the "Limits" tab.
2. Enable the "Activate notifications" function for the desired limit area, e.g. low limit alarm.
3. Enter a limit.

The screenshot shows the 'Limits' configuration interface. At the top, there are tabs for 'General' and 'Limits'. The main heading is 'Define limits for "Total amount"'. Below this, there is a note: 'Please enable the checkbox to activate the notification which will be sent to Notifier. Note: This function is only available if the SIMATIC Notifier MindSphere app is available on your tenant.' The interface displays four notification settings in a row, each with an 'Activate notifications' checkbox checked and a numerical value in a text box. Below the values is a color-coded bar indicating the severity: 'Alarm' (red), 'Warning' (yellow), 'OK' (white), 'Warning' (yellow), and 'Alarm' (red). At the bottom, there is a 'Notification' section with a 'Calculation cycle' dropdown menu set to '15min' and a note: 'Note: Calculation Cycle is based on UTC'.

You can find additional information on the "Activate notifications" function here: [AUTOHOTSPOT](#)

## Deleting KPI instances

You have two options for deleting KPI instances: Either in the parameter list on the asset or in the configuration under "Delete unused KPI instances".

To delete a KPI instance in the parameter list, follow these steps:

1. Under "My Plant", open the dashboard in which the KPI instance is used.
2. Next to the plant object, click the downward arrow and select the "Parameter" view. A list with all variables and KPI instances used is displayed.
3. Click the Delete icon in the parameter list.

To delete KPI instances in the configuration, follow these steps:

1. Click "Configuration".
2. Click "Delete unused KPI instances".

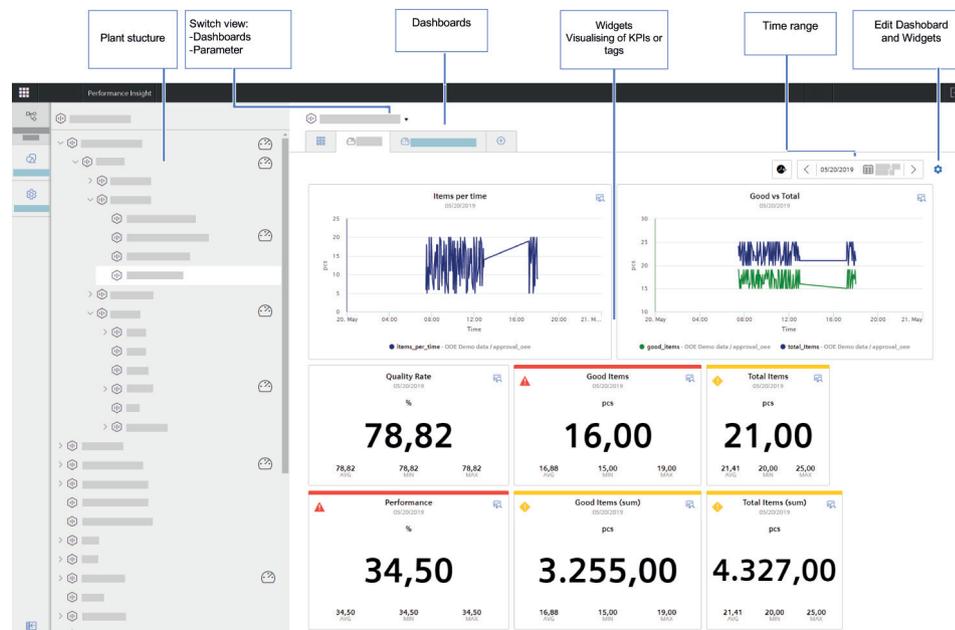
# Creating dashboards

## 8.1 Structure of the dashboards

### Overview

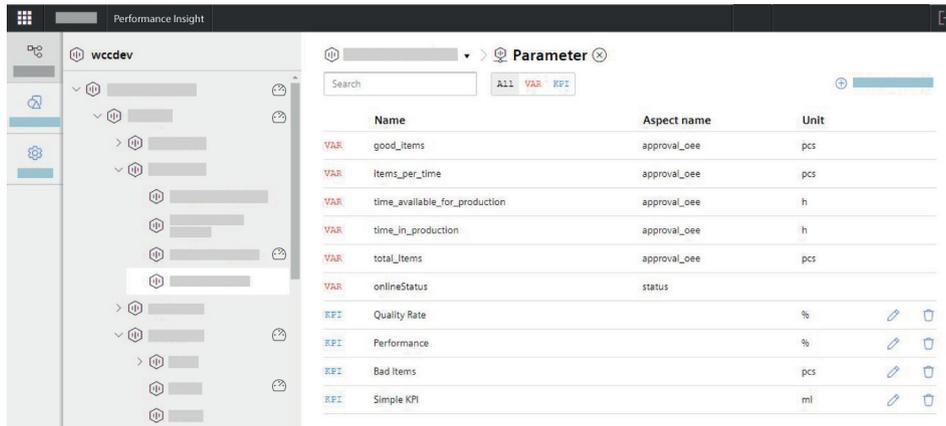
The dashboards contain a graphical representation of variables or KPI types. Widgets are used for the graphical representation. A maximum of 5 dashboards can be created per asset object within My Plant.

The figure below provides an overview of the structure of a dashboard:



### Parameter overview

You can switch the view of the parameters using the drop-down list of the plant object. Here you can create additional KPI instances. The list of existing KPI instances and variables that were created for the selected plant object or a lower-level plant object can be seen below.



### See also

Setting the time period in dashboards and widgets (Page 60)

## 8.2 Setting the time period in dashboards and widgets

### Description

For each dashboard, you can define a specific time period for which the values of all parameters are to be read and displayed in the widgets. In addition, you also have the option of specifying a separate time period for each individual widget.

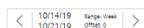
The values of the current date are always displayed by default. You can use the left < and right > arrows to jump forward or backward day by day. As soon as you deviate from the current day, -1 (one day back) or 1 (one day forward) is displayed accordingly as offset.

The current date is displayed again when you click on the symbol

However, instead of "Day", you can also, for example, select "Week", "The last 3 hours", "The last 7 days" etc. as time period. If you select "The last 3 hours" as the time period, then you can specify an exact time from which the last 3 hours are to be displayed.

### Result

The values of the parameters for the period from 14.10.2019 to 21.10.2019 are displayed in all widgets of the dashboard.



## Widget views

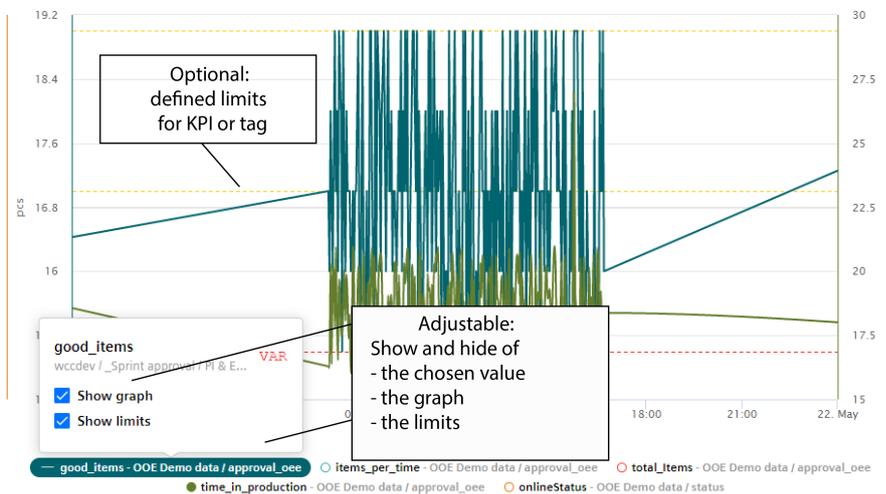
### 9.1 Detail view

#### Description

In the detail view, you can display the load profile of the parameters, for example, or an enlarged view of the widget. To open the detail view, click  in the widget. The functions of the detail view depend on the widget type.

For a widget of the "Diagram" type, the detail view contains the following functions, for example:

- Showing and hiding individual lines
- Showing and hiding limits
- Output of detailed values when you move over the line with the mouse
- Zooming in on the diagram



### 9.2 Histogram

#### Description

In addition to the detail view, you can also display the Histogram if you want to see the curve of the frequency distribution. A variety of statistic KPIs are available for this:

- Minimum
- Maximum
- Average

### 9.3 Regression analysis

- Standard deviation
- Median (central value)
- Total



## 9.3 Regression analysis

### Description

In the x-y display, the production amount is mapped on the x-axis and the energy consumption is mapped on the y-axis. By using the regression line, you can determine, for example, whether too much energy is being consumed for a specific production amount. This is the case when the dot is above the regression line.

The regression analysis is available for the widgets "Pie chart" and "Diagram":

