MindSphere

MindSphere application
SIMATIC Machine Monitor

Application manual
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.

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DANGER</strong></td>
<td>Indicates that death or severe personal injury will result if proper precautions are not taken.</td>
</tr>
<tr>
<td><strong>WARNING</strong></td>
<td>Indicates that death or severe personal injury may result if proper precautions are not taken.</td>
</tr>
<tr>
<td><strong>CAUTION</strong></td>
<td>Indicates that minor personal injury can result if proper precautions are not taken.</td>
</tr>
<tr>
<td><strong>NOTICE</strong></td>
<td>Indicates that property damage can result if proper precautions are not taken.</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WARNING</strong></td>
<td>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.</td>
</tr>
</tbody>
</table>

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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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1 Introduction

Data protection

Siemens adheres to the basic principles of data protection, in particular the principle of data minimization (privacy by design). For the SIMATIC Machine Monitor product, this means that the product processes/stores the following personal data: Username (first name and last name), email address, user role.

The above data is required for login and billing. The username is saved in the "Configuration" module when Machine Types and Machine Instances are created as well as in the "Maintenance" module when maintenance work is registered. The storage of data is reasonable and limited to what is necessary, since it is essential to identify the authorized operators. The above data will not be stored anonymously or pseudonymized, because the purpose (identification of the operating personnel) cannot be achieved otherwise. Our product does not offer automatic deletion of the data listed above. If necessary, the data can be deleted manually. Please contact customer support about this.

Introduction

SIMATIC Machine Monitor (SMM) is a MindSphere application. The SMM supports users in worldwide monitoring of the operating states and service requirements of their machines. The user can quickly obtain an overview of the relevant KPIs. With this information, the performance and availability of the machine can be improved and the total cost of operation (TCO) can be reduced. Furthermore, the application allows the user a better planning of services for the connected machines.

Modules

- "Productivity": Monitoring and trend analysis of the basic KPIs “Availability”, “Performance” and “Quality”. Display and analysis of machine states and operating modes
- "Maintenance": Monitoring and display of the current maintenance requirements of machine elements incl. relevant maintenance information and the maintenance history (service logbook function).
- "Configuration": Configuration of Machine Types. This function is only available for Tenant administrators.

Activating SMM for a user

To activate access to the SIMATIC Machine Monitor, roles must be assigned to the user. Open User Management in the “Settings” application of your MindSphere tenant and assign either role “machinemonitorsimapp (mdsp:simapps) user” or “machinemonitorsimapp (mdsp:simapps) admin”.

You can find more information on assigning roles in the documentation on the "Settings" application of your MindSphere account. (https://documentation.mindsphere.io/resources/html/settings/en-US/index.html)

Pricing model

For information on the pricing model of the SMM, refer to the following link in the MindSphere Store: https://siemens.mindsphere.io/en/store
2 Configuration

To be able to visualize and analyze the data of a machine with the SMM, various configurations need to be performed in the SMM. This is only possible in the role of a Tenant Administrator.

The configuration steps in the "Configuration" module are in the following order:

1. Configure status mapping
2. Create Machine Types
3. Create the Machine Instance

2.1 Status mapping

The creation of a "status mapping" is necessary to be able to calculate the KPI "Availability".

Availability is generally defined as the ratio between "actual productive time" and planned or "potential productive time"

\[
\text{Availability} = \frac{\text{Actual productive time}}{\text{Potential productive time}}
\]

In status mapping, an assignment is carried out that defines which machine states, alone or in combination with operating modes, should be evaluated as productive or potentially productive and therefore included in the calculation.

Machine states and operating modes must be made available to the app as integer values. In addition to this assignment of how the transmitted states and operating modes should be evaluated in terms of their productivity, a plain text designation is assigned to the states and/or operating modes during status mapping. The defined designation is used in the visualization and analysis in the Status tab of the Productivity module.
2.1.1 Status mapping management

List

The table shows all existing status mappings and how many times the respective status mappings were used in Machine Types.

From here, new mappings can be created, and existing mappings can be edited, duplicated or deleted. Deletion is only possible if the mapping is not being used.

The mapping for the "OMAC" standard is supplied by default and cannot be edited or deleted.

Filter

The entries in the list can be filtered by entering a term in the search field. The free text filter is applied to the following properties: “Name” and “Last edited by”.

Create new mapping

A new status mapping can be created by clicking on "Create new status mapping". Creation of a new mapping is broken down into two steps, see also sections 2.1.2 and 2.1.3.

Display mapping

The current mapping configuration can be displayed in a read-only mode by clicking on “View”.

Duplicate mapping

It is possible to use an existing mapping as a template for a new mapping. For this purpose, the existing mapping can be duplicated in the list by clicking on “Duplicate” in the dropdown list of the split button.

Delete mapping

Delete the mapping by clicking on “Delete” in the dropdown list of the split button. A mapping can only be deleted from the list if it is not being used.

Edit mapping

All properties of a mapping can be edited if the mapping is not already being used in a Machine Type. Otherwise, only the following properties can be edited:

- Name of the mapping
- Description
• Names of existing states/modes (not the values)
• Addition of new states/modes

The "OMAC" standard mapping cannot be edited.

2.1.2 States and Modes configuration

The following information is queried in the first step "States and Modes":
• Name of the mapping (mandatory field and unique)
• Description (optional)
• States (at least one mandatory) – Name and value. The value must be an integer that is unique within the states.
• Modes (optional) – Name and value. The value must be an integer that is unique within the modes. The mode list is only visible if the Modes checkbox is enabled.

2.1.3 Mapping configuration

In the second step "Mapping", combinations are configured for the state and mode defining how these times should be incorporated in the calculation of machine availability. The following options exist:
• productive
• nonproductive
• not applicable

By default, all combinations are first evaluated as non-productive time.

<table>
<thead>
<tr>
<th>States</th>
<th>1 - Productive</th>
<th>2 - Not productive</th>
<th>0 - Undefined</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - Automatic</td>
<td>productive</td>
<td>nonproductive</td>
<td>not applicable</td>
</tr>
<tr>
<td>2 - MDA</td>
<td>productive</td>
<td>nonproductive</td>
<td>not applicable</td>
</tr>
<tr>
<td>3 - Manual mode</td>
<td>productive</td>
<td>nonproductive</td>
<td>not applicable</td>
</tr>
<tr>
<td>0 - Undefined</td>
<td>productive</td>
<td>nonproductive</td>
<td>not applicable</td>
</tr>
</tbody>
</table>
2.2 Machine Type

The data generally valid for a type of machine, such as maintenance intervals, limits, status mapping etc., is defined in a Machine Type. It serves as a template to easily create Machine Instances. All configurations affect all instances of this type.

The Machine Type defines which application modules are supported for the machine. In addition, the Machine Type contains the connectivity configuration for the parameters to connect to the machine.

2.2.1 Machine Type management

List

The table shows all existing Machine Types. Furthermore, it shows who created the type and when, as well as the number of Machine Instances that have been created from the Machine Types.

New Machine Types can also be created in the list. Existing types can be viewed, edited or deleted. If there are Machine Instances of this type, a limited editing possibility is available. Deletion is only possible if no instance exists. A Machine Instance can also be created directly from the list.

Filter

The entries in the list can be filtered by entering a term in the search field. The free text filter is applied to the following properties: “Name”, “Description”, “Status” and “Last edited by”.

Create new type

A new Machine Type can be created by clicking on “Create new Machine Type”. The user is guided through a configuration wizard with multiple steps, see also sections 2.2.2 to 2.2.5.

Delete existing type

A Machine Type can only be deleted from the list if no Machine Instances exist. When the user clicks on “Delete”, a dialog is displayed to confirm the deletion.
Edit existing Machine Type

If there are no Machine Instances of this type, all properties of the Machine Type can be edited.

If there is at least 1 existing Machine Instances of this type, editing possibilities are limited. The following changes are not possible:

a. Enabling/Disabling of application modules (chapter 2.2.2)
b. Changing the setting “Generate PLC code” (chapter 2.2.2)
c. Enabling/Disabling of productivity KPIs (chapter 2.2.3)
d. Adding/Removing maintenance intervals (chapter 2.2.4)
e. Changing of any process value and connectivity configuration (connection, protocol, PLC variable path)
f. Changing the maintenance interval type (chapter 2.2.4)

2.2.2 General information

The following information is stored in the first step of the Machine Type configuration:

- Name of the Machine Type (mandatory, must be unique)
- Description (optional)
- Series ID (optional).
- Supported modules (at least 1):
  - "Productivity" – For monitoring and trend analysis of the basic KPIs “Availability”, “Performance” and "Quality". Display and analysis of machine states and operating modes.
  - "Maintenance" – For monitoring and display of the current maintenance requirements of machine elements incl. relevant maintenance information and the maintenance history (service logbook function).
- General documents (optional)
- "PLC code generation": If this checkbox is selected, all variable addresses are then automatically created and thus no longer need to be configured manually by the user. A file containing the PLC data block configuration for the import into SIMATIC/SIMOTION projects is available in the last step of the configuration wizard.
Attaching documents

The user can attach documents to the Machine Type configuration by clicking on “Choose Files” in the “General documents” section. The file upload dialogue allows to select multiple files with a maximum size of 5MB per file. The user can click on the “Save” button to start uploading the files.

Already attached documents can be removed by clicking on the “X”- button and saving the configuration.

2.2.3 Productivity configuration

The configuration for "Productivity" is available if the module was activated in the first step of the Machine Type configuration.

KPI "Availability" (mandatory)

The availability is the ratio of the value of the productive time of the machine to the aggregate of the values of the productive and unproductive time.

To configure this KPI for the Machine Type, the user must provide the following information:

- **Status mapping** (mandatory): Selection of status mapping for the evaluation of the machine availability.
- **Connection** (mandatory): Selection of the controller family from which the process values for the Machine Type are supplied. This property is only relevant, if the user has enabled the “PLC code generation” option in the first step of the wizard.
- **Protocol** (mandatory): Protocol to be used for reading data from the data source.
- **Input parameters**
  - **Machine state / Machine mode** (mandatory): Datapoint address to read the data from. If the "Generate PLC code" option is...
activated and the connection and protocol are selected, the PLC variable paths are filled automatically with a default setting, as soon as the user clicks on “Save”.

- **Limits**

  **Warning threshold / Error threshold** (mandatory):
  Configuration of the value limits from which a warning or error is displayed
  - The value in the "Warning Threshold" field specifies the percentage limit value at which the warning range begins. If the high or low warning threshold value is violated, a yellow warning symbol is assigned to the asset and the top of the KPI card is colored yellow.
  - The value in the "Error Threshold" field specifies the percentage limit value at which the alarm range begins. If the high or low error threshold value is violated, a red alarm symbol is assigned to the asset and the top of the KPI card is colored red.

The limit value for all KPI thresholds must be an integer value within the range of 1 to 100.
KPI "Performance" (optional)

Configuration of the performance KPI card is optional. If this KPI is not to be used, it can be disabled by deselecting with the slider in the "Performance parameters" configuration area.

To configure this KPI for the Machine Type, the user must fill in all the parameters in the mask. For instructions on how to configure the parameters, see the section KPI "Availability" (see above).

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KPI "Quality" (optional)

Configuration of the quality KPI card is optional. If this KPI is not to be used, it can be disabled by deselecting with the slider in the "Performance parameters" configuration area.

To configure this KPI for the Machine Type, the user must fill in all the parameters in the mask. For instructions on how to configure the parameters, see the section KPI "Availability" (see above).

If both the "Performance" KPI and the "Quality" KPI are activated, the "Total pieces" input field of the "Quality" KPI is also used for the "Total pieces" parameter of the "Performance" KPI.
2.2.4 Maintenance configuration

The configuration for "Maintenance" is available if the module was activated in the first step of the Machine Type configuration.

Machine elements can be created in this screen. Maintenance intervals can be configured for each machine element.

Add machine element

A new machine element is created by clicking on "Add new machine element".

Machine element name: Automatic culling machine
Element group (optional): 
Create new element group: 

Maintenance intervals

# 0
Internal name: Cull expression
Internal type: usage-based
• **Machine element name** (mandatory field): Name of the new machine element.  
  *Example*: "Drive chain", "Fan", "Ball screw".

• **Element group** (optional): Assignment of the current machine element to a machine element group.  
  This assignment to a group results in a grouped display of the maintenance intervals in the maintenance interval display.

• **Create new element group** (optional): The user can create a new element. The new group name is then available for selection in the "Element group" dropdown menu.  
  *Example*: "Conveyor belt A", "Drive group B"

**Create maintenance interval**

Clicking on "Add New" opens a dialog for creating a new maintenance interval for the current machine element.

• **Maintenance interval name** (mandatory): Name of the maintenance interval. Up to 40 characters.  
  *Example*: "Clean fan", "Oil ball screw", "General check"

• **Maintenance instructions** (optional): Up to 400 characters can be entered here, e.g. for instructions or references to detailed manuals.

• **Maintenance interval type** (mandatory): Choice between a "usage based" maintenance interval and a "calendar based" maintenance interval.
Usage based maintenance intervals

With a maintenance interval of the type "usage based", the due date for maintenance is linked directly to a process tag from the machine controller.

Examples:
- Maintenance of a ball screw after a distance of 5000 m is traveled.
- Maintenance of a fan after 1000 hours of operation.

A process value needs to be configured for this purpose. See the section "Process value" in the configuration dialog:

- **Connection** (mandatory): Selection of the controller family from which the process values for the Machine Type are supplied. This property is relevant, if the user has enabled the "PLC code generation" option in the first step of the wizard.

- **Protocol** (mandatory): Protocol to be used for reading data from the data source.

- **PLC variable path** (mandatory): Datapoint address to read the data from. If the "Generate PLC code" option is activated and the connection and protocol are selected, the PLC variable paths are filled automatically with a default setting, as soon as the user clicks on "Save".

- **Measured value** (mandatory): Name of the process value (maximum 30 characters).

- **Unit** (mandatory): Unit of the process value (maximum 10 characters).
Usage based maintenance intervals – Variants

Three variants are available for selection in the "Usage-based interval configuration":

• "Direct measurement"
  This variant always monitors and displays the actual process value. This is suitable for process values that return to a normal range after maintenance is performed.
  Examples:
    o Extension of a drive chain
    o Tank level
    o Trip meter which is reset in the machine controller after maintenance is performed

Limit configuration:
  o The user can specify the threshold values for monitoring (exceeding / falling below / deviation from value range).
  o All threshold values must be positive integer values.

If the user selects the option "Automatic entry to maintenance history", an automatic entry is made in the maintenance history as soon as the process value returns to the normal range. An additional reset threshold needs to be configured for this purpose (see figure above).

• "Continuous cycle"
  Suitable for cyclic maintenance operations that are dependent on a continuously increasing process value. This option creates an infinitely repeating maintenance interval.
  Examples:
    o Runtime meter-based maintenance, maintenance every 3000 hours
    o Traveled distance of a ball screw, maintenance every 5000 meters
Limit configuration:

- **Due value (cycle)** (mandatory):
  This threshold means, that maintenance is due.

- **Overdue cycle** (mandatory):
  This threshold means, that maintenance is overdue.
  Must be higher than the “Due value”.

- Both threshold values must be positive integer values.

- "Custom intervals"
  Suitable for a finite series of maintenance intervals. Also appropriate for once-off maintenance work.

  Example:
  - Recalibration of the machine after 500 operating hours.
  - Consecutive service intervals with different interval lengths.

The user can add consecutive intervals to the configuration by clicking on “Add entry to series”:

- **Due threshold** (mandatory):
  Must be higher than the “Overdue threshold” of the previous interval.

- **Overdue threshold** (mandatory):
  Must be higher than the “Due threshold” value.

- All threshold values must be positive integer values.
Calendar based maintenance intervals

With a maintenance interval of the type "Calendar based", the due date is calculated directly. The first due date is calculated based on the machine's commissioning date.

- **First due date** (mandatory):
  Configures the date of the first maintenance, calculated in days/weeks/months from the date of commissioning.
  The value must be an integer equal to or greater than zero.

- **Due date repeat pattern** (mandatory):
  Configures the repeat pattern of the maintenance dates.
  For a one-off maintenance date, "None" should be selected.
  For a recurring date, a cycle in days/weeks/months should be set, e.g. repeat every 2 weeks (see figure).
  The value must be an integer equal to or greater than 1.

- **Overdue date** (mandatory):
  Specifies the number in days after which the maintenance interval becomes overdue after reaching the due date.
  The value must be an integer equal to or greater than zero.

2.2.5 Summary

The last step provides a summary of the configuration. The PLC export files with the data block configuration for import into the SIMATIC/SIMOTION projects can also be downloaded on this page.
The Machine Type configuration must be set to "Ready to use" to use it as a template for creating Machine Instances. Click on "Next" to complete and save the configuration.

2.3 Machine Instance

2.3.1 Machine Instance management

List

The table shows all existing Machine Instances and some detailed information on each instance.

New Machine Instances can be created from here. Existing instance configurations can be viewed, edited, duplicated or deleted.

Filter

The entries in the list can be filtered by entering a term in the search field. The free text filter is applied to the following properties: "Name", "Machine Type", "Status", "Modules" and "Last edited by".
Usage information
The user can see the number of Machine Instances that are currently included in the monthly billing (Machine Instances with "In Use" status).

Create new instance
There are two ways to get to the configuration of a new Machine Instance:
- By clicking on "Create new Machine Instance" above the list of Machine Instances
- From the configuration page of Machine Types, by selecting “Create instance” directly from the Machine Type that the user wants to create a Machine Instance from (see chapter 2.2.1)

During instantiation, SMM creates an associated Asset in the MindSphere tenant with the Asset type "SIMATIC Machine Monitor". The generated Asset has the same name as the Machine Instance and can be accessed via the Asset Manager application of the MindSphere tenant.

Delete existing instance
A user with administrator rights can delete an existing Machine Instance at any time. When the user clicks on "Delete", a dialog is displayed to confirm the deletion.

When the Machine Instance is deleted, the associated Asset in the "Asset Manager" and the uploaded data in MindSphere are not deleted. If these should also be deleted, the Asset must be explicitly deleted via the Asset Manager.

Deleting a Machine Instance with "In Use" status will decrease the counter of Machine Instances for the monthly billing (see usage information).

Edit existing instance
A user with administrator rights can edit an existing Machine Instance at any time.
If the Machine Instance has the status “Draft”, the user can edit any parameter of the configuration (see following chapters).
If the Machine Instance has the status “In Use”, the user can edit any parameter of the configuration with the following exceptions:
- Associated Machine Type can no longer be changed.
- Status of the Machine Instance cannot be changed back to “Draft”

Duplicate existing instance
A Machine Instance can be duplicated to quickly create a second Machine Instance of the same type.

An appended "- copy" is added to the name of the duplicate Machine Instance. The duplicate Machine Instance has the status “Draft” and needs to be edited to set it to "In Use" status.
### 2.3.2 Basic configuration

The creation of a new instance in broken down into multiple steps. The following information is queried in the first step "Basic configuration":

- **Name (mandatory):** The name of the Machine Instance
- **Description (optional):** Additional descriptive text
- **Assign to subtenant (optional):** The user can select from the list of existing subtenants of the MindSphere tenant. The corresponding MindSphere Asset is created within the selected subtenant. If no subtenant is selected, the Asset is created directly at the top level in the MindSphere tenant.
- **Machine Type (mandatory)**
- **Commissioning date (mandatory):** Start date for all "calendar based" maintenance intervals from the Machine Type configuration
- **Location (optional):** Location of the Asset. **Attention:** The time zone cannot be changed after the first save.
- **Geolocation (optional)**

![Image of Basic configuration form]

Enter a unique name for your Machine Instance and provide the basic configuration. You can also save and exit the Machine Instance creation process at any time to continue later.
Visibility of modules

If the Machine Instance is assigned to a subtenant, the user can specify whether a subtenant user can see this Machine Instance in the app modules.

2.3.3 Connectivity configuration

In the second step “Connectivity”, the user can select the MindConnect Elements that provide the data for the Machine Instance.

MindConnect Nano and MindConnect IoT 2040

The user can select MindConnect Elements of the type MindConnect Nano or MindConnect IoT 2040. The MindConnect Elements must already be created in the Asset Manager. Multiple MindConnect elements can also be used for one Machine Instance.

Other connectivity options

The user can choose to use any other connectivity element as data source for the Machine Instance (e.g. MindConnect Lib). To do this the user has to manually link the data points of the connectivity element to the parameters of the Machine Instance in the Asset Manager application.
Click "Next" without selecting a connectivity element. If there is no connectivity element selected, then in the next step a help for a data mapping to other connectivity elements is displayed (see following image).

<table>
<thead>
<tr>
<th>Variables</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automatic setting machine</td>
<td>53 exploded view Maintenance Component_Doesn’t Work!</td>
</tr>
<tr>
<td>Line state and costs</td>
<td>Flexibility Machine state: Maintenance Component, Data: Left Monitor</td>
</tr>
<tr>
<td>Performance</td>
<td>Quality Machine speed: Production Status, Data: Target Throughput</td>
</tr>
</tbody>
</table>

MiniConnect It! instructions:
1. If you want to use MiniConnect It! as a connectivity element, please follow these steps:
   - Go to Asset Manager and search for your MiniConnect It! agent.
   - Enter the MiniConnect It! configuration and go to the "Data mapping" tab.
   - A new asset definition is created for your new Machine Instance.
   - Select the data points of your MiniConnect It! agent and link them to the variables (see left panel of the new Asset Definition).

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2.3.4 Mapping configuration

In the "Mapping" step, the variables of the selected MindConnect elements can be mapped to the variables. There are generally two different scenarios:

Scenario 1: The right data sources and/or datapoints have not yet been created for the MindConnect element:

a. Create new data source:
   By clicking on the plus symbol ("+") of the MindConnect Element on the right-hand, the user can create a new data source for this MindConnect Element. A dialog with the following input options is displayed:
   - Name (mandatory)
   - Description (optional)
   - Reading cycle (mandatory)
   - Protocol (mandatory)
   - OPCUA Server name (mandatory) – This option appears when the OPCUA protocol is selected
   - IP Address (mandatory)
b. Add new datapoint to data source:
If the user selects a variable in the left area, a matching data point can be added to a data source of the MindConnect Element. Adding new datapoints is only possible for compatible data sources with the same protocol as the variable of the Machine Instance.

A plus symbol (“+”) appears on the data source. Clicking on this plus symbol opens a dialog for data point configuration.

A dialog with the following input options is displayed:

- Name (mandatory)
- Description (optional)
- Unit (preset)
- PLC variable path (mandatory) – Input value is preset according to the Machine Type template but can be edited.
- Data Type (preset)

The newly created datapoint can now be mapped to the Machine Instance variable. This is described in scenario 2 (see below).
Scenario 2: Data sources and datapoints are configured for the MindConnect element (e.g. by scenario 1 or via the Asset Manager):

All variables of the Machine Instance must be mapped to data points of connectivity elements so that the Machine Instance can process the machine data correctly. It is only possible to map variables and datapoints of the same data type and unit.

To create a mapping, the variable must first be selected. Then a compatible data point can be selected.

Compatible data points are highlighted in blue. As soon as a data point is selected, the mapping can be created by clicking on "Connect".

Dissolve mappings
Existing links between variables and data points can be removed by clicking "X" on the respective mapping configuration.

Minimize/maximize MindConnect element
The data sources and datapoints can be hidden or shown by clicking on the name of the MindConnect element (right-hand column).
2.3.5 Summary

The "Summary" page is the last step of the configuration. The user can activate the Machine Instance for productive operation here.

Activating the Machine Instance

To complete the configuration of the Machine Instance, the status must be set to "In Use". The Machine Instance then appears in the application modules and can be used productively.

Activating the Machine Instance increases the counter of the connected Machine Instances that is relevant for the billing and additional costs are incurred at the end of the month.
3 Application modules

3.1 Machine list

The application modules “Maintenance” and “Productivity” each have their own machine list. Each list only contains those Machine Instances for which the corresponding module is activated.

Grouping, filtering and selection is only applied to the machine list of the selected application module. Both application modules store the state of grouping, filtering and selection separately for the duration of the current browser session.

Select machine

The machine list for the Maintenance module allows single selection only.

<table>
<thead>
<tr>
<th>Machines</th>
<th>Sort: A to Z ▼</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DemoMachine</td>
</tr>
<tr>
<td></td>
<td>DemoMachineType</td>
</tr>
<tr>
<td></td>
<td>Test_SIMM</td>
</tr>
<tr>
<td></td>
<td>Erlangen</td>
</tr>
<tr>
<td>Productivity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Marmo+Mac Fair</td>
</tr>
<tr>
<td></td>
<td>Machine State</td>
</tr>
<tr>
<td></td>
<td>Penzing()Machine</td>
</tr>
<tr>
<td></td>
<td>Lisa2019</td>
</tr>
<tr>
<td></td>
<td>Location unspecified</td>
</tr>
<tr>
<td>Configuration</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TestMachine</td>
</tr>
<tr>
<td></td>
<td>R202-Series</td>
</tr>
<tr>
<td></td>
<td>Test_SIMM</td>
</tr>
<tr>
<td></td>
<td>Location unspecified</td>
</tr>
</tbody>
</table>

The machine list for the Productivity module allows the selection of multiple machines.

<table>
<thead>
<tr>
<th>Machines</th>
<th>Sort: A to Z ▼</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DemoMachine</td>
</tr>
<tr>
<td></td>
<td>DemoMachineType</td>
</tr>
<tr>
<td></td>
<td>Test_SIMM</td>
</tr>
<tr>
<td></td>
<td>Erlangen</td>
</tr>
<tr>
<td>Productivity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Marmo+Mac Fair</td>
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<td>Lisa2019</td>
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<tr>
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<td>Location unspecified</td>
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<tr>
<td>Configuration</td>
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<tr>
<td></td>
<td>TestMachine</td>
</tr>
<tr>
<td></td>
<td>R202-Series</td>
</tr>
<tr>
<td></td>
<td>Test_SIMM</td>
</tr>
<tr>
<td></td>
<td>Location unspecified</td>
</tr>
</tbody>
</table>
Show/hide machine list

The machine list can be collapsed and expanded if required.

Filter machines

Using the search input, the list of machines can be filtered. The filter is applied to the following properties:

- Machine Instance name
- Location
- Machine Type
- Subtenant

Group machines

It is possible to group the machines in the list by the following properties:

- Location
- Machine Type
- Subtenant

Grouping according to multiple categories at the same time is possible. The grouping hierarchy is defined by the order of the selection.
The grouping is done in the order in which the grouping criteria are clicked. Clicking the grouping criterion in the selection list again will ungroup this grouping criterion again. Clicking on “Reset” will deselect all grouping criteria.

**Sort machines**

It is possible to sort the machine list in ascending or descending alphabetical order. If there is a grouping selected for the machine list, the sorting is applied for the groups and also for the Machine Instances within the groups.

**Severity indicators**

If a maintenance interval of a Machine Instance is due or even overdue, this is also indicated by corresponding severity indicator icon in the machine list. A yellow warning rectangle indicates a due maintenance interval, and a red alert triangle indicates an overdue maintenance interval.
3.2 Maintenance module

The maintenance state of a machine can be easily monitored using the "Maintenance" module. The display of the individual elements depends on the Machine Type configuration.

Show attached files

Additional documents (e.g. maintenance instructions) can be attached to a Machine Type configuration. These documents are accessible from each Machine Instance that is based on that Machine Type configuration.

3.2.1 Current maintenance status

The "Current" tab displays the current status of all maintenance intervals that have been configured for this Machine Instance.

The maintenance interval displays are sorted by machine component and, if applicable, additional grouping, according to the Machine Type configuration of this Machine Instance.
Visualization
The maintenance interval displays of the Machine Instance provide a quick overview of the progress and severity status for each interval.

The maintenance interval widget displays the progress, due date limits and the current process value.
A due interval is additionally highlighted with a yellow bar, an overdue interval with a red bar on the maintenance interval display.

Maintenance interval detail
By clicking on the maintenance interval display, the detailed information on this interval appears on the right side of the screen.

3.2.2 Registering a maintenance job
From the detailed information panel, a maintenance job can be registered as completed by clicking on the "Register maintenance job" button. This opens a dialog for registering the maintenance activity. The user can enter the date and time and add an optional comment.

Usage-based intervals,
In the case of a usage-based maintenance interval, the current process value at the time of maintenance is also recorded. This value from the time series data of the process value is automatically added to the input field but can be edited by the user. If no actual value is found up to 7 days retroactively from the time of maintenance, the user must enter the value manually.
By clicking on “Submit”, the entry is added to the maintenance history. Depending on the configuration, the maintenance interval display is reset and starts with the next interval or is marked as completed and hidden.

The visualization of usage-based intervals of the “Direct measurement” type is not affected by the registration of a maintenance job.

Calendar-based intervals,

In the case of a calendar-based maintenance interval, the user needs to provide only the date and time and an optional comment in the “Register new maintenance job” dialogue.
Automatic entry to maintenance history

If a usage-based maintenance interval of the type "Direct measurement" is configured for an automatic entry in the maintenance history (see chapter 2.2.4), then instead of the button "Register maintenance job" a note appears in the detail that entries are made automatically.

3.2.3 Maintenance history

This tab contains the list of all entries in the maintenance history, both manual and automatic. The user can filter the entries according to the machine element names.
Sorting

The list can be sorted by all columns.

Filtering

The user can filter the list by directly selecting the machine element to which the maintenance intervals are related.

Alternatively, the list can be filtered by a free search term - in this case the columns "Machine element", "Maintenance interval", "Interval type" and "Registered by" are searched.

The entries can be narrowed down by the date of maintenance. A click on "Conducted date filter" opens a date picker to select the date range:

Detail view

For each entry in the maintenance history, additional information can be viewed by clicking on "Details".

The details dialog box also shows the limit values of the interval and, in the case of usage-based maintenance intervals, the actual value at the time of maintenance.

In addition, the comment that was entered when registering the maintenance is also displayed here.
Undo maintenance entry

The user can undo and delete entries in the maintenance history if the entry was created no more than 7 days ago.

3.3 Productivity module

The "Productivity" module provides a simple overview of the standard KPIs for the productivity of the connected machines. The standard KPIs include "Availability", "Performance" and "Quality".

Which KPIs are available for display depends on the configuration in the Machine Type for the selected Machine Instances.

3.3.1 KPI visualization

In the line chart a line is drawn for each selected machine. This allows the direct comparison of one KPI across all selected machines. The user can select which KPI should be shown in the line chart with the dropdown selection menu above the diagram.

The density of datapoints can be selected (e.g. one datapoint per Hour/Day/Week/Month). The available selection depends on the chosen time frame in the date and time picker.

The gauge display elements show the average value over all selected machines over the selected time frame.

Date and time picker

The user can select the date and time range for the KPI display via the date and time picker in the upper right corner of the page.
Selection of a single Machine Instance

If only one machine is selected, the gauge display elements show the average value over this machine over the selected time frame. The configured limits are also highlighted (green, yellow, red).

Selection of a multiple Machine Instances

To allow easier comparability of machines, the user can select up to 20 Machine Instances from the list.

The main gauge display elements show the average value over all selected machines over the selected time frame.

Additionally, the KPI values for each selected machine are displayed in a table below. The table allows sorting in ascending and descending order.
3.3.2 Machine state visualization

The Gantt diagram shows the progression of the "States" for one Machine Instance. If multiple Machine Instances have been selected in the list, the user can switch between the machines via the dropdown selector directly above the Gantt diagram.

The bar diagram visualizes the proportional distribution of the "States" in percentages. One bar is displayed per selected machine.
## History

### Table 1 History

<table>
<thead>
<tr>
<th>Version</th>
<th>Date</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>V1.0</td>
<td>04/2019</td>
<td>First edition</td>
</tr>
<tr>
<td>V1.1</td>
<td>03/2020</td>
<td>Update with the changes for version V1.1</td>
</tr>
</tbody>
</table>