PM-MAINT

The intelligent
maintenance management system

System description

PM-MAINT version 10

Release 2020/11/15

Contents

1 Overview

1.1 General

PM-MAINT is a **maintenance management system** which can be used for a wide range of applications **in any industrial sector or technology**. Some examples of its application range are: administration, production engineering, process engineering, power engineering and building systems.

According to German standard DIN 31051, maintenance of a technical system is based on the following activities:

- Inspection Determining the actual condition
- Maintenance Retaining the target condition
- Repair Restoring the target condition

PM-MAINT supports all these activities extensively. In terms of **„Total Productive Maintenance“,** retaining the target condition through **preventive and performance-dependent maintenance** is the main objective so that as few repairs as possible are required.

The performance-dependent maintenance is enabled by the **online connection with the process**. The values of existing operating hours and operating cycle counters can be taken cyclically from the automation systems or can be calculated in PM-MAINT from the on/off messages of the maintenance objects. In addition the maintenance can be activated by process events and calendar intervals (days, weeks, months, quarters and years).

"**Recommended maintenance dates**" are calculated cyclically from the actual operating hours, operating cycles and calendar data. These "Recommended maintenance dates" form the basis for an **efficient planning of maintenance and service work**.

Preventive and performance-dependent maintenance “just in time” leads to the reduction of the maintenance-cost because inspections and services are carried out not too early and not too late. The associated reduction of repairs leads to the **increase of the plant availability** and therefore to the reduction of the total cost of the plant.

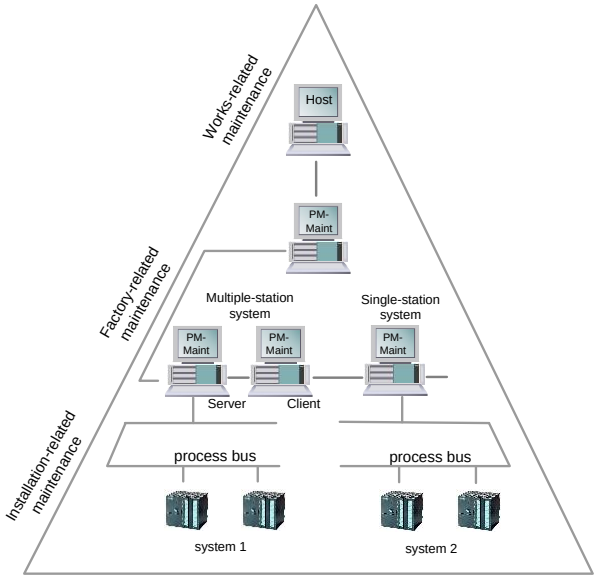
1.2 Universal application

PM-MAINT grows with your requirements from the local system to network systems, with distributed functions in client/server technology.

PM-MAINT is optimized for use in SIMATIC WinCC / PCS7 / WinCC RT Professional from V11 SP2. Data from other base systems (e.g. WinCC flexible, WinCC RT Advanced and systems from other manufacturers) can be read into PM-MAINT using the OPC DA interface.

Another variant for the transfer of process data is the import of text files in CSV format into process value archives.

Exclusively calendar-controlled maintenance do not require the process connection.



PM-MAINT: Client/Server-Technology with distributed functions for future proof investment

1 Overview

1.3 Functional scope

An excerpt from the extensive functionality of the PM-MAINT system software is shown in the following list:

- Plant wide performance, calendar and event based maintenance
- On-line process coupling to various base systems for PM-MAINT-integrated operating hours, switching cycle counter and process events
- Object-oriented graphical system structuring
- Assignment of priority and status for each object
- Definition of planned orders with maintenance intervals and activities to be performed. Additionally with adjustable personnel resources, material consumption, etc.
- Generation of maintenance jobs with optional job announcement prior to the expiry of the maintenance interval
- Configurable modes for starting the maintenance interval
- E-mail delivery for new maintenance orders and announcements and also for selected order state transitions
- Mutiple maintenance order feedbacks including object state, hours worked, material cost and additional text information
- Resumption of work on a finished but not yet completed maintenance order
- Final completion of the orders in a separate step
- Comprehensible editing of used materials and performed working hours from the order feedbacks by authorized personal
- Splitting of costs to multiple cost centers
- List of maintenance materials indicating the storage location
- Details of the manufacturers / suppliers with contact infomation
- Identification of the organizations and staff involved in the maintenance process
- Definition of qualifications and qualification types required to perform maintenance activities
- Attachment of documents to each object, planned order, maintenance order or announcement
- Reports for announcements, maintenance orders and maintenance feedbacks
- Configurable report layouts
- Display of current operating hours, operation cycles counters and further maintenance information with tags of the base HMI system
- Import / export function for material and text lists
- Multi-user system (server / client)
- Online language switching system for text:
  German / English, other languages are possible

The innovated user interface offers a variety of views for monitoring and controlling all maintenance activities. The display of most views can be customized in multiple configurations including custom column selection, coloring based on attribute values etc. Comfortable and sophisticated filtering capabilities allow the quick retrieval of required information.

PM-MAINT offers the following views for the control and monitoring of maintenance activities:

- Project hierarchy view: Graphical, hierarchical object structure
- Object view: Tabular overview of all created mainteanance objects
- Planned ordes view: List of planned orders created with graphical representation of the maintenance interval progress
- Orders view: List of maintenance orders that are to be processed
- Notifications view: Generated list of announcements for upcoming maintenance orders
- Requests view: List of maintenance request like e.g. damage reports
- Feedbacks view: List of all feedbacks that were submitted in PM-MAINT
- Activity log view: Listing of individual user actions that have been made within PM-MAINT
- Transactions view: Overview over all booking processes regarding personnel and material costs that have been specified in order or announcement feedbacks.

Significant functions can be configured with an access protection. Only users which are members in special, pre-defined user groups have access for operating. These operations are stored with date and name in the logbook.

User groups can be imported from WinCC and PCS7.

1 Overview

1.4 Easy connection to base systems

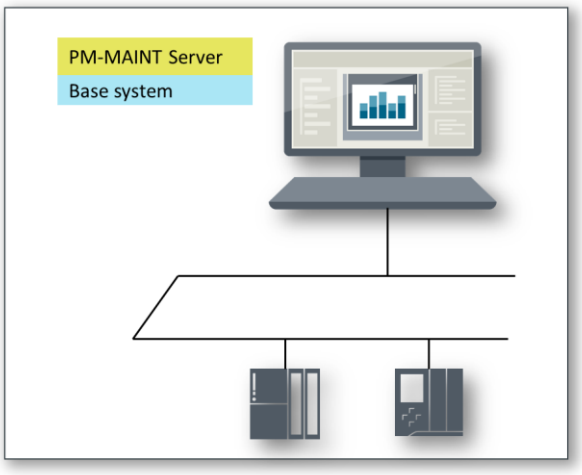
A performance / event-controlled PM-MAINT system requires a process connection for recording and processing the operating hours counters, the operating cycle counters and process events.

The values of existing operating hours counters and operating cycle counters can be read cyclic or can be calculated in the PM-MAINT system, through the on / off messages of the maintenance objects.

Because of the integration of the components PM-SERVER / PM-AGENT Unified, PM-MAINT is open for an easy connection to different HMI base systems. The connection is made either in a local system or via a LAN (TCP/IP). In base systems[1] like SIMATIC WinCC™, SIMATIC PCS7™, WinCC RT Professional from V13™ or SIMATIC WinCC Unified PC-Runtime V16 the PM-AGENT Unified together with the PM-SERVER manages transmission of process values, archive values, alarms and permissions to PM-MAINT.

Process values can be read by PM-MAINT from the base system WinCC flexible, WinCC RT Advanced or other base systems via the integrated OPC DA client interface in PM-SERVER.

Exclusively calendar controlled maintenance does not require a connection to the automation process.



PM-MAINT in a local system

The PM-MAINT system software offers optimum solutions through modular design and the use of client / server technology, also for special customer requirements.

[1] Current release information about tested HMI systems and their versions are in contained in the PM-MAINT product documentation.

2 System configuration

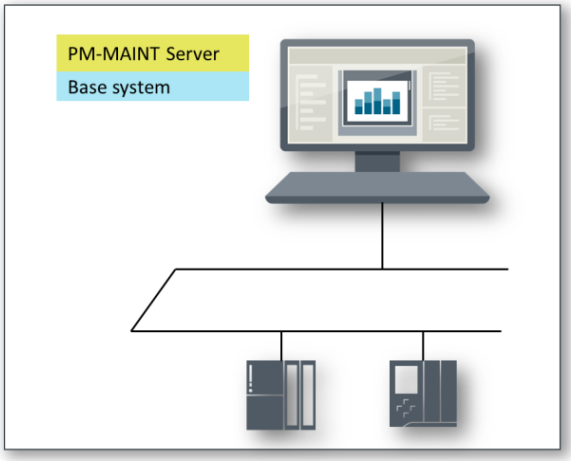
2.1 PM-MAINT single-user system

PM-MAINT system software can be installed on a base system single-user system and runs on the following operating systems[2]

- Windows 7 / 8.1 / 10 (32/64 Bit)
- Windows Server 2008 / 2012 / 2016 / 2019

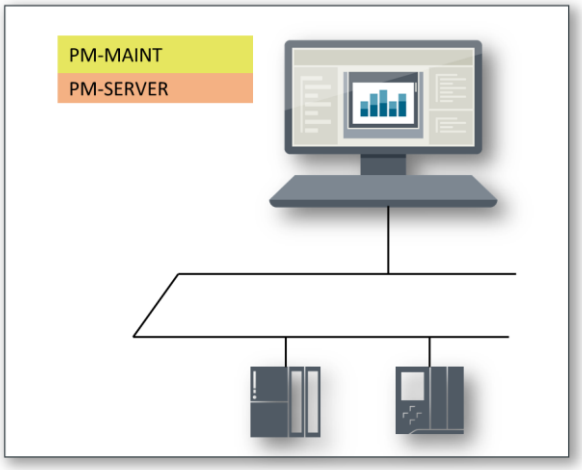
in accordance with the specifications of the base system.

A single-user system can grow into a multi-user system at any time by installing PM-MAINT clients on additional computers on the network. The single-user system is then replaced by the PM-MAINT server.



PM-MAINT single-user system

Exclusively calendar controlled maintenance does not require a connection to the automation process. In this case PM-MAINT can be installed on one computer in the network and runs on the mentioned operating systems.



PM-MAINT single-user system without process interface

[2] Current release information about tested HMI and operating systems and their versions are in contained in the PM-MAINT product documentation.

2 System configuration

2.2 PM-MAINT multi-user system (server/client)

A PM-MAINT multi-user configuration consists of:

- One PM-MAINT server
- One or more PM-MAINT client(s)

The individual computers (server/clients) are connected over a TCP/IP network.

Several PM-MAINT multi-user configurations can be set up within one network. That can be useful, if different company departments want to work with separate PM-MAINT projects including different maintenance strategies and master data.

The **PM-MAINT server** is the central coordinator within a PM-MAINT multi-user configuration.

A connection from one PM-MAINT server to anther PM-MAINT server is not supported.

The PM-MAINT system software consists of the following system packages:

- System package type S for the Server
- System package type C for the Client

The **PM-MAINT clients** can be connected to any PM-MAINT server within a network. Data access takes place by connecting to the selected PM-MAINT-server.

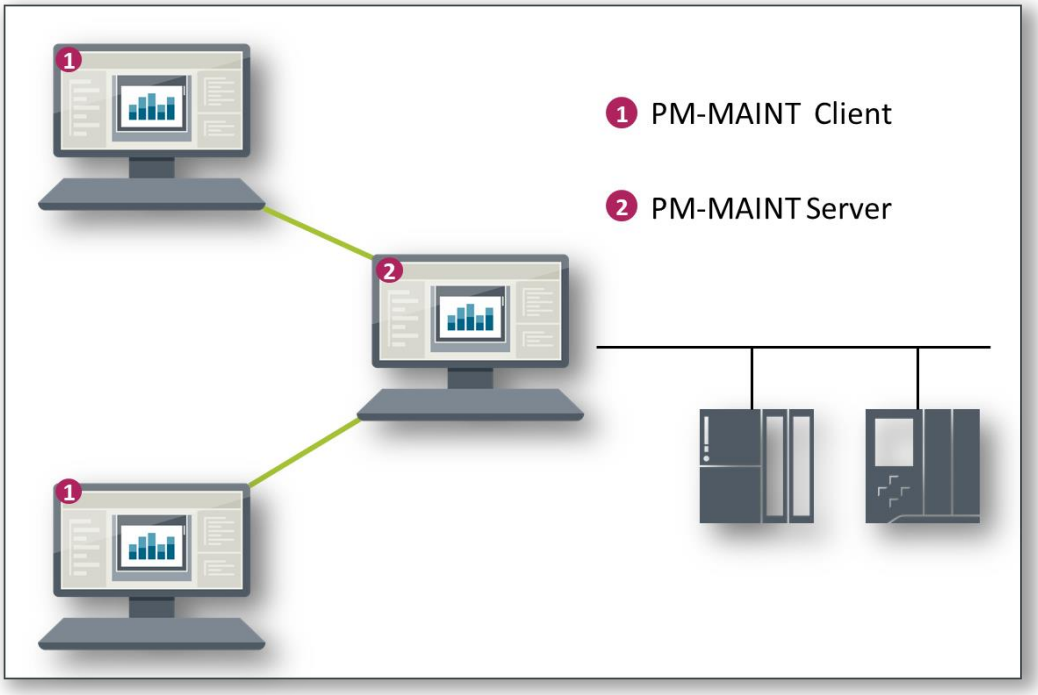
The configuration and operation of PM-MAINT can be accessed on the computer with the PM-MAINT server installation and also in the same way on the PM-MAINT client(s).

Depending on the requirements, a multi-user system can be a combination of various system packages.

Operating systems[3]:

Server: Windows 7 / 8.1 / 10 (32/64Bit);
Windows Server 2008 R2 / 2012 R2
Windows Server 2016 / 2019;.

Client: Windows 7 / 8.1 / 10 (32/64Bit);
Windows Server 2008 R2 / 2012 R2
Windows Server 2016 / 2019



PM-MAINT Multi-user system

[3] Current release information about tested operating systems and their versions are in contained in the PM-MAINT product documentation.

3 Mode of operation

3.1 Maintenance structure

In PM-MAINT all objects of a plant are defined in a project hierarchy. For those objects that should be monitored for maintenance, planned orders are created. A planned order contains all data that is related to maintenance activity and also the settings for the triggering of the maintenance interval.

3.2 Generating maintenance orders

When the configured maintenance interval has expired or the configured trigger event has occurred a copy of the planned order is made. This copy is entered as an order for processing into the "orders" view.

The creation of jobs can be configured differently:

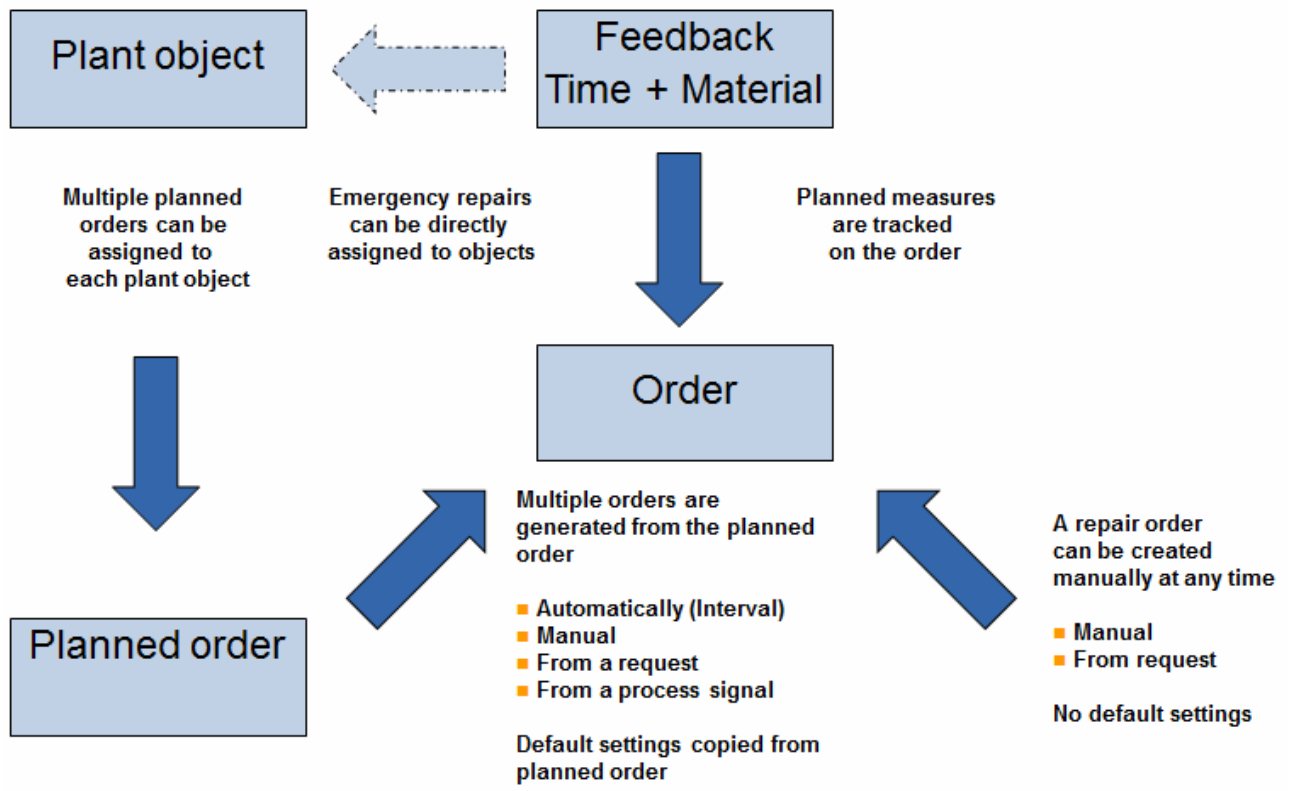
- automatically after expiry of the configured interval
  - cyclically
  - once (e.g. initial inspection)
- through a process signal
  (e.g. alams from the underlying process, limit violations of analog signals)
- manual by an operator
- based on a request

Maintenance requests originating from sightings of damage can be manually created in parallel to scheduled orders. These requests can be either turned into an order or discarded by authorized personnel.

For purchasing of required material and also for resource planning regarding personnel a notification can be created prior to the calculated activation date of an order. If required, the notification may be reactivated a second time.

The actual hours worked and materials used are entered in the maintenance order feedbacks. The working hours and used materials are converted into costs that are posted either on the maintenance order or on the object.

All operator activities are recorded in a logbook.



Schematic representation of an order life cycle

3 Mode of operation

3.3 Automatic planned order date calculation

The intervals for maintenance activities can be defined

- *performance based* calculated from
  - running time (i.e. operating hours) and / or
  - operation cycles and / or
- *calendar based* interval defined in days, weeks, months, quarters or years

For performance-based maintenance, the On/Off signals for the calculation of the operating hours and operation cycles are transferred into PM-MAINT from the plcs via the process communication bus. The operation hours and operation cycles counters can be either calculated within PM-MAINT or directly read from existing counters in the automaton systems.

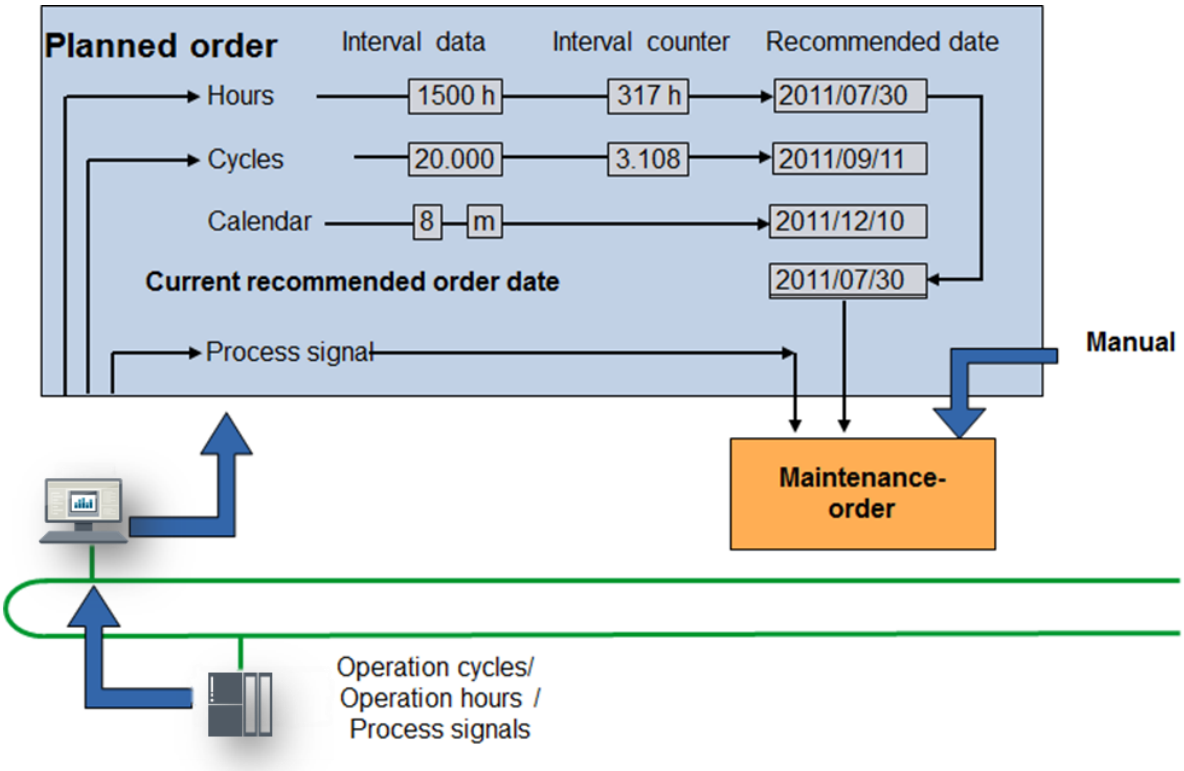
For each criterion (i.e. running time, operation cycles and calendar) a "recommended planned date" is cyclically calculated. The basis for the calculation of the performance-based planning is the object utilization. For each object, the daily utilization regarding operation cycles and/or operating hours is accumulated. The average of the daily values from the last 10 weeks is projected into the future to calculate the next recommended maintenance date.

PM-MAINT selects the date which is the closest one in the future from up to three recommended date candidates. If this date is reached and the maintenance order generation policy is set to "Auto", a copy of the planned order is made and inserted into the "orders" view.

Depending on the configuration of each interval counter (run time, cycles, calendar) the interval is reset either "when reaching the planned date", "after job completion" or "with the expiry of the operating cycles/counters or calendar interval". If the counters are exceeding the preset maintenance interval, they are counted as negative until the final completion of the maintenance order.

When the order generation is set to "Automatic (manual planning)" the calculated "next recommended date" provides an optimal orientation for manual scheduling.

In parallel the automatic generation controlled by the interval the order may also be generated directly by a process signal or by manual operation..



4 Operator control

4.1 General

To operate and monitor the maintenance a variety of views are available to the user.

- Planned orders
- Orders
- Notifications
- Feedbacks
- Requests
- Log book
- Project hierarchy
- Objects
- Documents

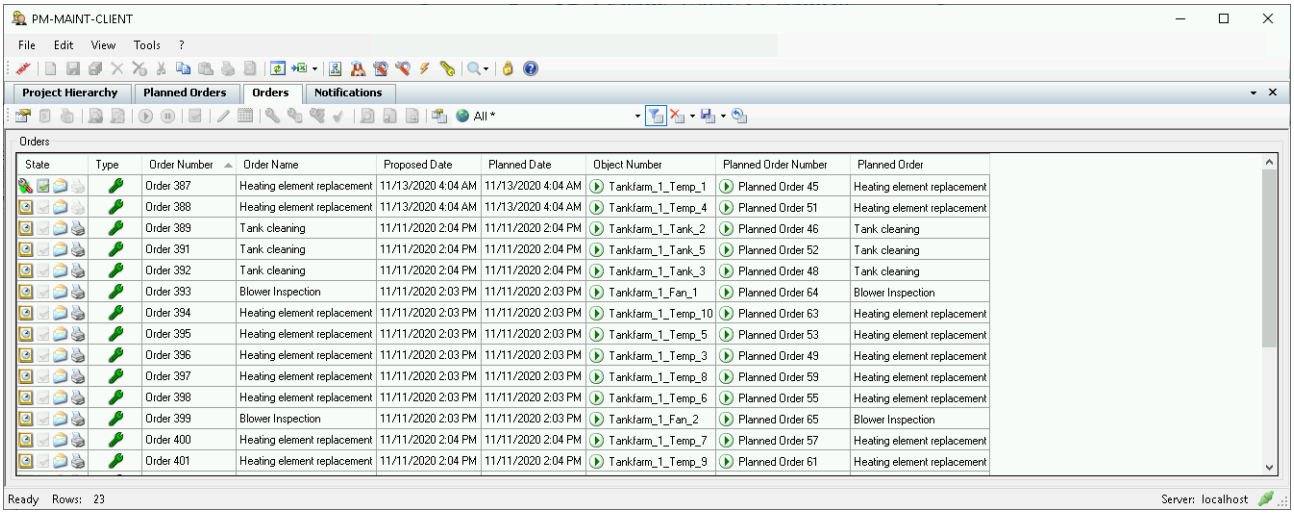
Display of the various views and the possible actions within the views can be protected against unauthorized access. Only members in user groups with the appropriate authorization are granted access. A prerequisite is that the user logs in into PM-MAINT with user name and password.

Opened views are organized in registers. This allows the user to quickly switch between different views.

The user interface has two toolbars. The toolbar at the top contains buttons for the most common operations like New, Save, Delete etc. and also the buttons for opening the major views. The second toolbar below contains the buttons that are specific for the operation of the view. This toolbar is dynamically adjusted according to the view that is currently displayed in the foreground.

In order to show individual prefered views at the startup of the user interface the view configuration can be saved into a default profile. If individual logins are used each users has its own configuration profile which is applied when the user logs on into PM-MAINT.

For views containing a table, multiple individual table view configurations may be defined. Such a configuration holds information about filtering, displayed columns, sort order and row coloring. Comfortable and extensive filtering options list only the necessary records. Each view configuration can be saved and retrieved under a comprehensive name. A view configuration may be saved as beeing accessible for all users, a group of users or exclusively for the creating user.



State	Type	Order Number	Order Name	Proposed Date	Planned Date	Object Number	Planned Order Number	Planned Order
		Order 387	Heating element replacement	11/13/2020 4:04 AM	11/13/2020 4:04 AM	Tankfarm_1_Temp_1	Planned Order 45	Heating element replacement
		Order 388	Heating element replacement	11/13/2020 4:04 AM	11/13/2020 4:04 AM	Tankfarm_1_Temp_4	Planned Order 51	Heating element replacement
		Order 389	Tank cleaning	11/11/2020 2:04 PM	11/11/2020 2:04 PM	Tankfarm_1_Tank_2	Planned Order 46	Tank cleaning
		Order 391	Tank cleaning	11/11/2020 2:04 PM	11/11/2020 2:04 PM	Tankfarm_1_Tank_5	Planned Order 52	Tank cleaning
		Order 392	Tank cleaning	11/11/2020 2:04 PM	11/11/2020 2:04 PM	Tankfarm_1_Tank_3	Planned Order 48	Tank cleaning
		Order 393	Blower Inspection	11/11/2020 2:03 PM	11/11/2020 2:03 PM	Tankfarm_1_Fan_1	Planned Order 64	Blower Inspection
		Order 394	Heating element replacement	11/11/2020 2:03 PM	11/11/2020 2:03 PM	Tankfarm_1_Temp_10	Planned Order 63	Heating element replacement
		Order 395	Heating element replacement	11/11/2020 2:03 PM	11/11/2020 2:03 PM	Tankfarm_1_Temp_5	Planned Order 53	Heating element replacement
		Order 396	Heating element replacement	11/11/2020 2:03 PM	11/11/2020 2:03 PM	Tankfarm_1_Temp_3	Planned Order 49	Heating element replacement
		Order 397	Heating element replacement	11/11/2020 2:03 PM	11/11/2020 2:03 PM	Tankfarm_1_Temp_8	Planned Order 59	Heating element replacement
		Order 398	Heating element replacement	11/11/2020 2:03 PM	11/11/2020 2:03 PM	Tankfarm_1_Temp_6	Planned Order 55	Heating element replacement
		Order 399	Blower Inspection	11/11/2020 2:03 PM	11/11/2020 2:03 PM	Tankfarm_1_Fan_2	Planned Order 65	Blower Inspection
		Order 400	Heating element replacement	11/11/2020 2:04 PM	11/11/2020 2:04 PM	Tankfarm_1_Temp_7	Planned Order 57	Heating element replacement
		Order 401	Heating element replacement	11/11/2020 2:04 PM	11/11/2020 2:04 PM	Tankfarm_1_Temp_9	Planned Order 61	Heating element replacement

PM-MAINT user interface displaying the “orders” view

4 Operator control

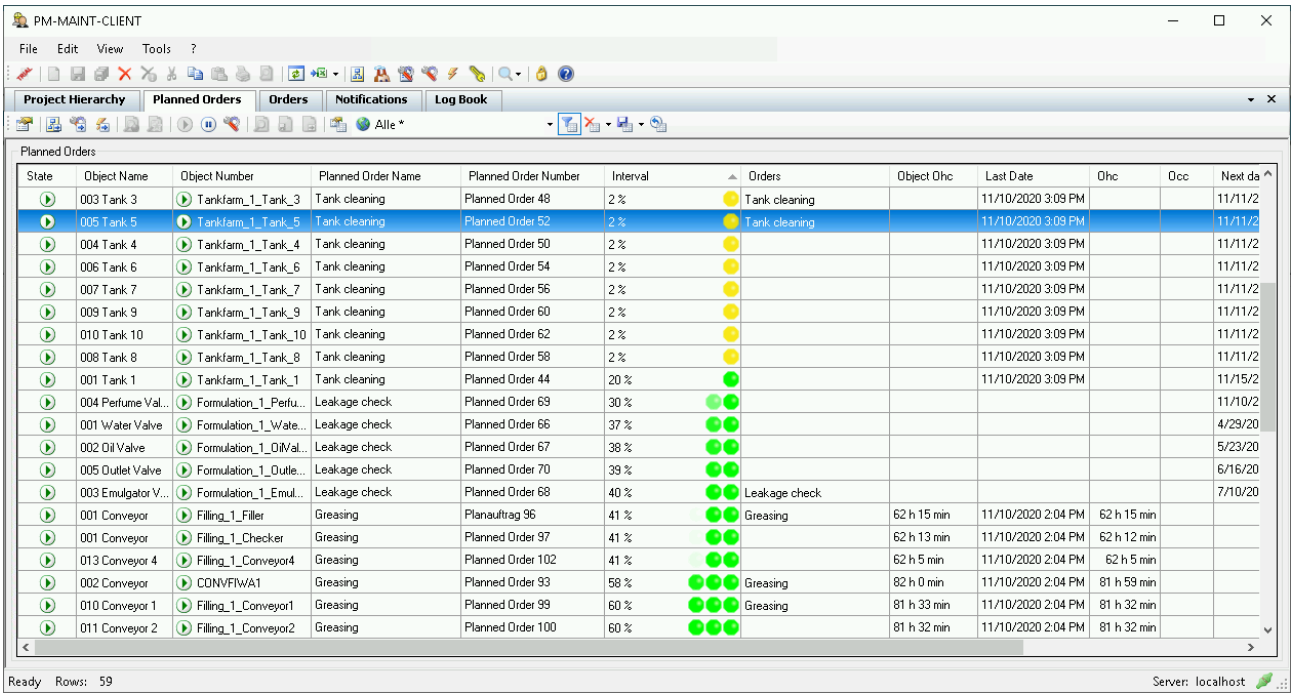
4.2 Planned orders overview

The "planned orders" view lists all created planned orders in a table. The current data for each planned order is displayed line by line. All properties of a planned order can be quickly made available by switching to the properties view by clicking a button on the toolbar.

The default view shows the following information:

- The "Status" column indicates whether the planned order is released or locked. Interval settings are processed only for released planned orders.
- Order number, order name and assigned object number
- The columns "Object Occ" and "Object Ohc" output the current performance information of the object as operating hours and/or operation cycles.
- The column "interval" provides a quick overview of the remaining period until the next maintenance is due. The interval is displayed in the form of a percentage value and also graphically.

  The maximum maintenance interval of 100% is indicated by 5 LED-like symbols. Each LED represents 20% of the interval. With the decrease of the remaining interval the LEDs fade and disappear one after the other. The last LED changes its color to yellow if less than 20% are available. If the interval changes into the negative range, the color fades from yellow towards red and stays red when the interval is overdue for more than -20%.
- In the column "orders" the name of eventually existing generated maintenance orders is displayed.
- The column "Last Date", "Ohc" and "Occ"show the date and the meter readings when the last maintenance measure was performed.
- "Next date" shows the calculated estimate for the next maintenance measure.
- The columns "remaining OC" and "remaining OH" display the remaining operation cycles and operating hours until the next scheduled maintenance.



State	Object Name	Object Number	Planned Order Name	Planned Order Number	Interval	Orders	Object Ohc	Last Date	Ohc	Occ	Next da
	003 Tank 3	Tankfarm_1_Tank_3	Tank cleaning	Planned Order 48	2 %	Tank cleaning		11/10/2020 3:09 PM			11/11/2
	005 Tank 5	Tankfarm_1_Tank_5	Tank cleaning	Planned Order 52	2 %	Tank cleaning		11/10/2020 3:09 PM			11/11/2
	004 Tank 4	Tankfarm_1_Tank_4	Tank cleaning	Planned Order 50	2 %			11/10/2020 3:09 PM			11/11/2
	006 Tank 6	Tankfarm_1_Tank_6	Tank cleaning	Planned Order 54	2 %			11/10/2020 3:09 PM			11/11/2
	007 Tank 7	Tankfarm_1_Tank_7	Tank cleaning	Planned Order 56	2 %			11/10/2020 3:09 PM			11/11/2
	009 Tank 9	Tankfarm_1_Tank_9	Tank cleaning	Planned Order 60	2 %			11/10/2020 3:09 PM			11/11/2
	010 Tank 10	Tankfarm_1_Tank_10	Tank cleaning	Planned Order 62	2 %			11/10/2020 3:09 PM			11/11/2
	008 Tank 8	Tankfarm_1_Tank_8	Tank cleaning	Planned Order 58	2 %			11/10/2020 3:09 PM			11/11/2
	001 Tank 1	Tankfarm_1_Tank_1	Tank cleaning	Planned Order 44	20 %			11/10/2020 3:09 PM			11/15/2
	004 Perfume Val...	Formulation_1_Perfu...	Leakage check	Planned Order 69	30 %						11/10/2
	001 Water Valve	Formulation_1_Wate...	Leakage check	Planned Order 66	37 %						4/29/20
	002 Oil Valve	Formulation_1_OilVal...	Leakage check	Planned Order 67	38 %						5/23/20
	005 Outlet Valve	Formulation_1_Outle...	Leakage check	Planned Order 70	39 %						6/16/20
	003 Emulgator V...	Formulation_1_Emul...	Leakage check	Planned Order 68	40 %	Leakage check					7/10/20
	001 Conveyor	Filling_1_Filler	Greasing	Planauftrag 96	41 %	Greasing	62 h 15 min	11/10/2020 2:04 PM	62 h 15 min		
	001 Conveyor	Filling_1_Checker	Greasing	Planned Order 97	41 %		62 h 13 min	11/10/2020 2:04 PM	62 h 12 min		
	013 Conveyor 4	Filling_1_Conveyor4	Greasing	Planned Order 102	41 %		62 h 5 min	11/10/2020 2:04 PM	62 h 5 min		
	002 Conveyor	CONVFIWA1	Greasing	Planned Order 93	58 %	Greasing	82 h 0 min	11/10/2020 2:04 PM	81 h 59 min		
	010 Conveyor 1	Filling_1_Conveyor1	Greasing	Planned Order 99	60 %	Greasing	81 h 33 min	11/10/2020 2:04 PM	81 h 32 min		
	011 Conveyor 2	Filling_1_Conveyor2	Greasing	Planned Order 100	60 %		81 h 32 min	11/10/2020 2:04 PM	81 h 32 min		

Planned orders view

4 Operator control

The following additional columns are available in the planned orders view:

- Notification options like notification type and notification priority
- User text
- Maintenance order generation mode
- Maintenance order options like order type, order priority, operating state, min. number of required employees and primary qualification
- Triggering mode (cyclically, one time, event based) and the corresponding operating hours, operation cycles or calendar intervals
- Resopnsible employee
- Planned total working time
- Planned total cost
- Cost center
- Object
- Object position
- Object type
- Responsible organisation

For some of the columns the output format can be set to display either only an icon, only text or an icon combined with text.

The presentation of the view can be customized by using different view configurations. E.g. by creating a view configuration that displays planned orders having a high priority in a different background color.

Displaying interval data on a HMI screen

Significant maintenance information, such as the current status of the interval, the next recommended maintenance date, the remaining time until the next due date, the remaining operations, the remaining calendar interval as well as the order status can be written into process tags of the connected HMI systems.

4.3 Overview of orders to be processed

The "orders" view lists all maintenance orders that are currently to be processed.

A maintenance order is generated from a planned order either

- Automatically after expiry of the planned maintenance interval
  or
- When a triggering event occurs
  or
- Manually by clicking a button in the UI

The maintenance order contains a copy of the configured properties of the undrelying planned order including all instructions and activities, the estimated working hours and material requirements, labor and safety information and optionally attached, explanatory documents. All properties of the order may be modified if required.

According to the working progress the individual maintenance orders are "processed" in this list. The current job status is displayed in the corresponding "Status" column.

An order can have the following states:

	**Acknowledged** the order has been recognized by personal
	**Released** the order has currently no planned date
	**Planned** the order has been planned with an explicit date for execution
	**Work started**
	**Work finished**
	**Work restarted**
	**Completed** the order has been fully completed
	**Deleted**
	**Locked**

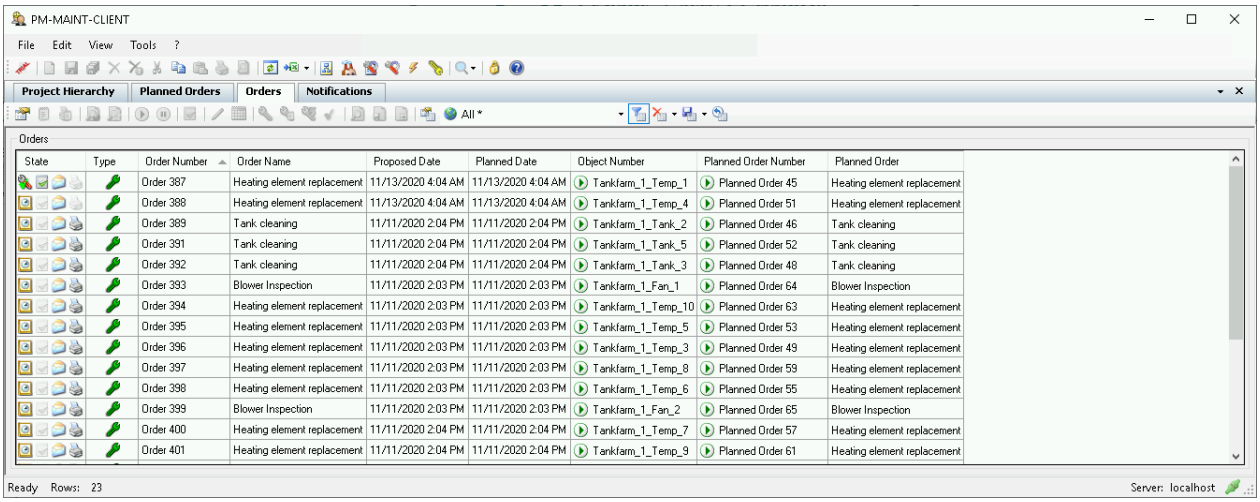
Other icons in the "Status" column indicate:

- A order report has been printed,
- An e-mail notification has been sent

4 Operator control

The column “Type” displays different icons to indicate the type of maintenance order:

	**Planned order**
	**Repair order**

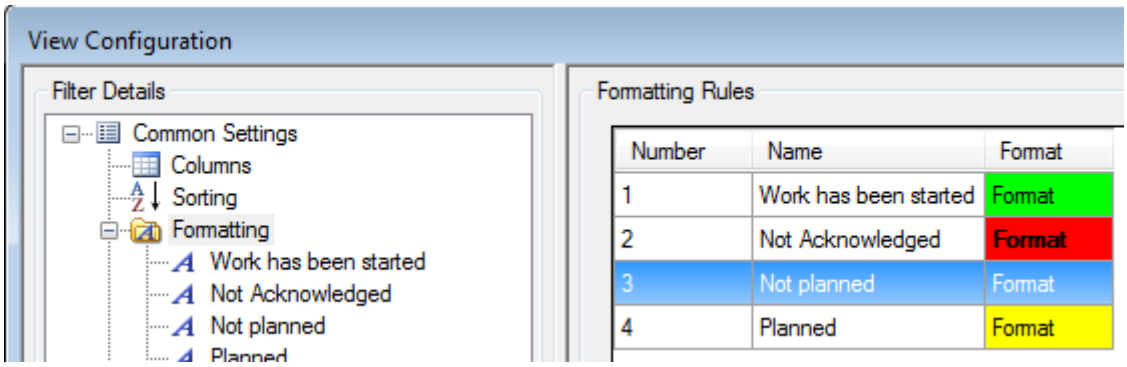


Orders view

In the representation of maintenance orders in the illustration above a view configuration has been used. The background color of the rows and also the typeface can be changed depending e.g. on the particular job status. This provides the operator with an excellent overview about the pending workload.

Maintenance orders that have reached the state "completed" or “deleted” are no longer displayed in the default view configuration for the table. This behavior can be easily changed to show historical orders in these states if necessary.

By reaching the state "Completed" the interval is reset and the calculations for the next maintenance interval are reset and restarted.



Sample view configuration

4 Operator control

4.3.1 Order feedback

Typically a feedback is reported for every order. This feedback includes the information related to the maintenance actions that have been carried out like hours worked and materials used. Additionally the status of the object can be documented with a feedback code, a weak point code and the assessment of the object condition.
Annotations may be added as required.

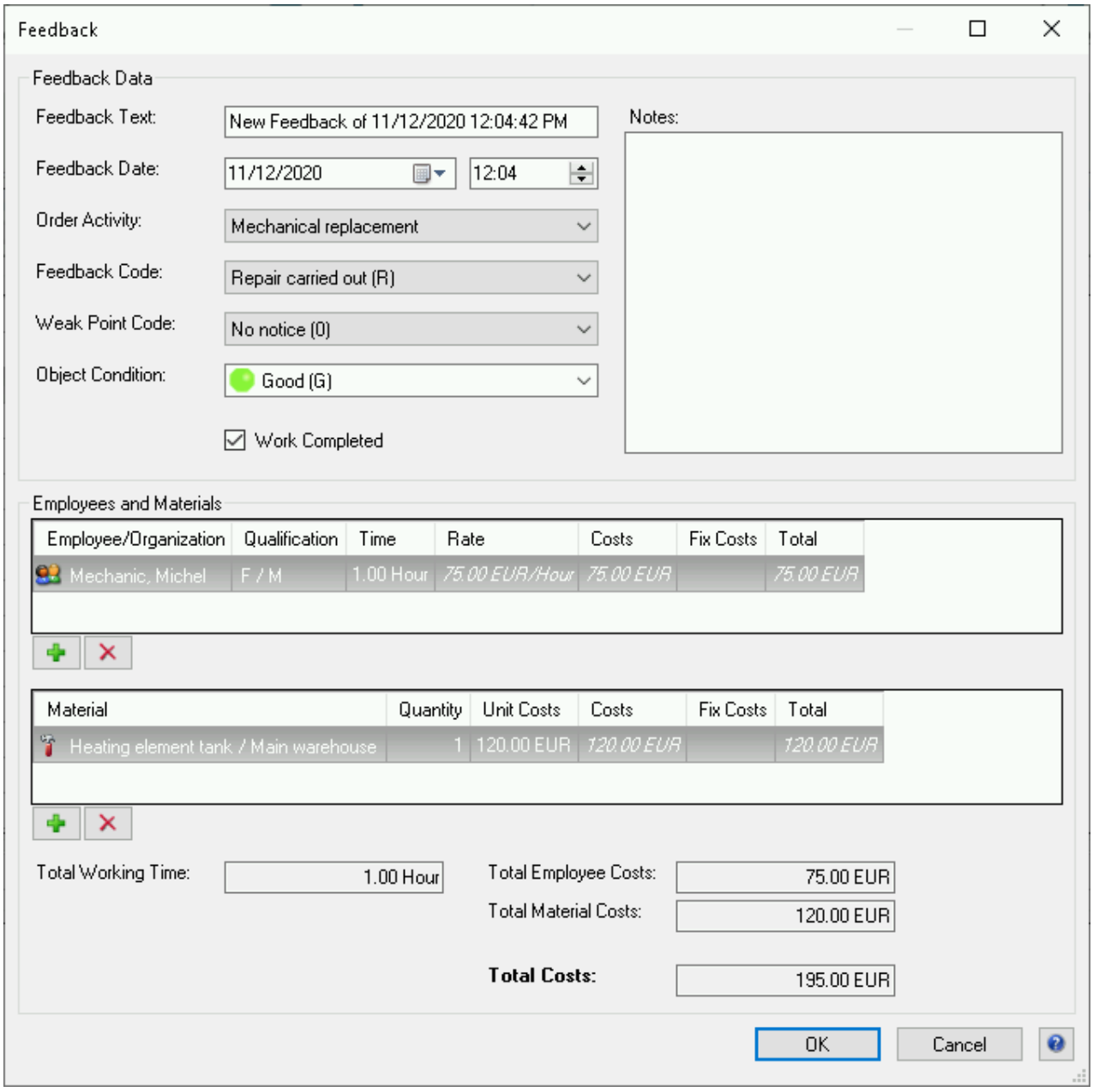
The plan versus actual cost comparison for each maintenance order is based on the information regarding the affected employees and their working hours and the cost of used material.

As long as the maintenance order has not been completed, the cost reported by order feedback can still be adjusted by authorized personal.

If a maintenance order has been planned with multiple activities e.g. for different employees, each activity may receive separate feedbacks.

If the option "Work finished" has been set in the order feedback, the order transitions into the status "work finished". This status is prerequisite to the final completion of the job.

If additional work needs to be done, further feedbacks towards the order can be permitted by performing the “restart work” action.



Feedback form for maintenance ordes

Subject to change without prior notice

4 Operator control

4.4 Notifications overview

The "Notifications" view lists all generated notifications for maintenance orders that are becoming due within a configurable time frame in the near future. Thus, individual maintenance measures can be prepared ahead of time if needed.

Notifications are configured in the properties of the planned order. According to the defined period of time the notification is generated before the next planned maintenance date is reached. Notifications may also include tasks that are to be carried out in preparation of the maintenance order.

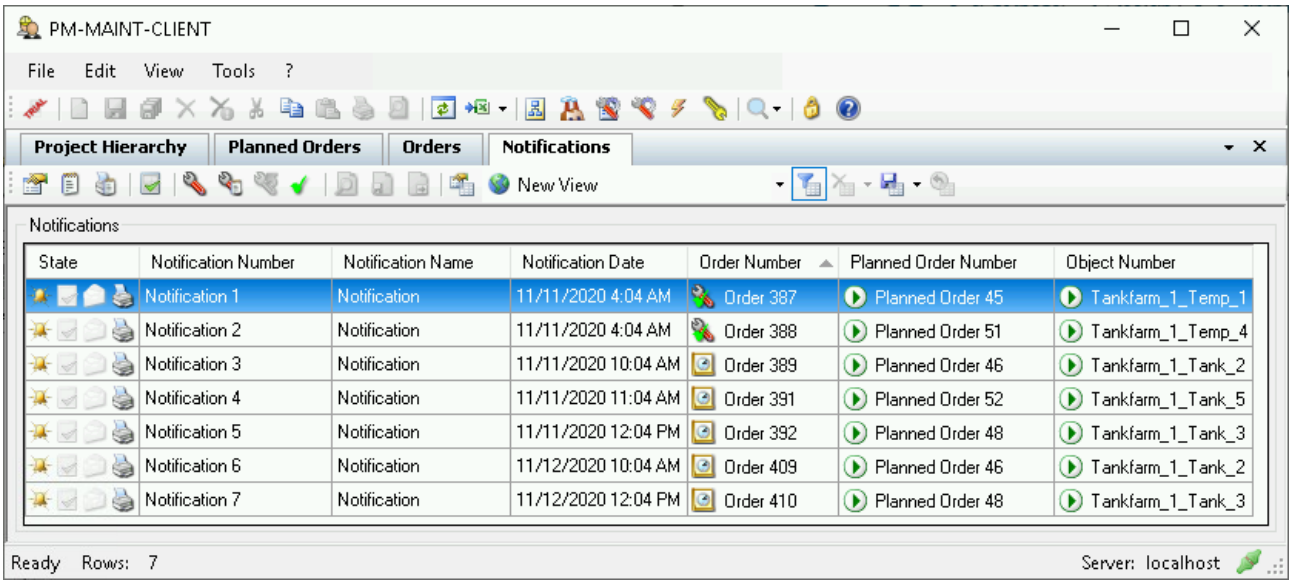
The notification is "processed" according to the progress of the preparations. Buttons in the toolbar allow changing the status of the notification.

The current status of the notification is shown in the "Status" column:

	Acknowledged the notification has been recognized
	Startet
	Work finished
	Work restarted
	Completed the notification has been fully processed

Other icons in the "Status" column indicate:

- A notification report has been printed,
- An e-mail message has been sent



Notification view

Notifications can also be used for reporting feedback about the progress of the preparation activities. If the includes working hours of employees, the resulting costs are added to the total cost for the maintenance order.

4 Operator control

4.5 Repair requests

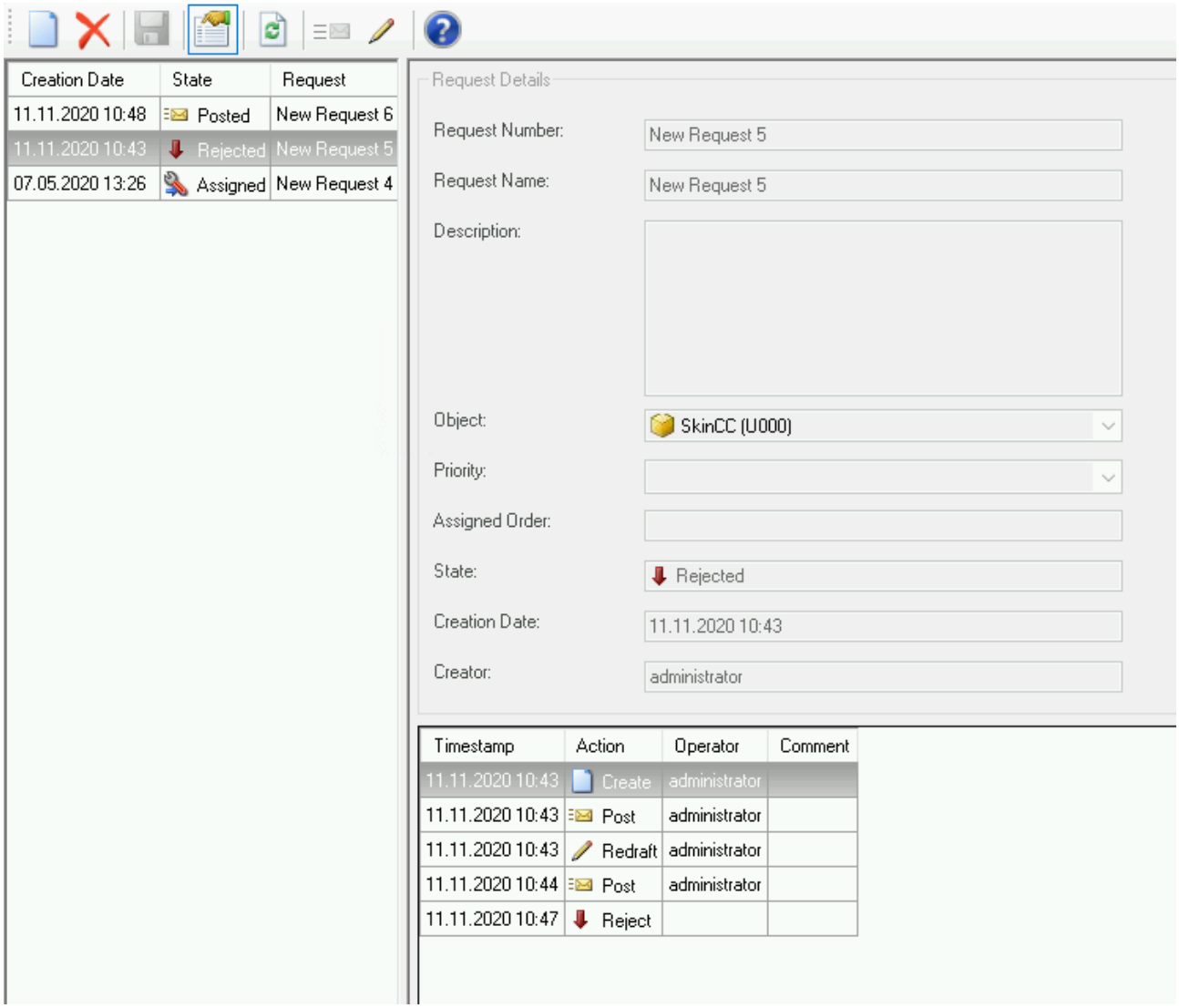
In order to report problems in the plant, e.g. leakage or unusual vibrations, manual repair requests can be created.
The ActiveX Control "PMMAINT.RequestControl" which available in PM-MAINT may be embedded into an operator screen for the HMI systems SIMATIC WinCC, PCS7, WinCC flexible (PC-based runtime) and WinCC V13 (PC-based Advanced and Professional RT). This allows the operational personal to participate in the maintenance process by allowing them to enter repair requests from within the HMI system.

If a repair request has been entered into the control, the requests can be “posted”. The request is then shown in the PM-MAINT client UI in the “requests” view. From here the request is reviewed by authorized personnel that decides about the further processing:

- The request is attached to an already existing maintenance order
- A new maintenance order is created and the requests is attached to it
- The request is rejected

A request that has been rejected may be redrafted in the ActiveX-Control and posted to maintenance staff again.

The current status of the request is displayed in the ActiveX control, as well as in the "requests" view of the PM-MAINT client.



PMMAINT.RequestControl

4 Operator control

4.6 Feedbacks view

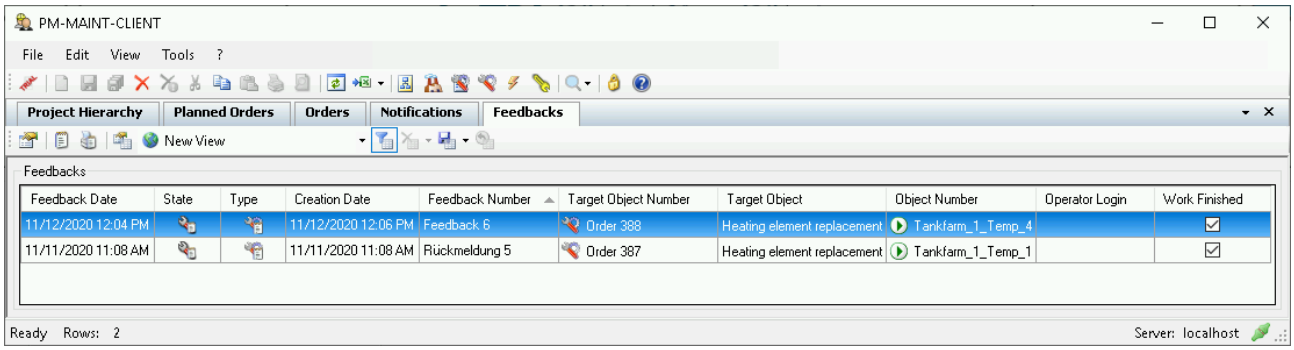
All feedbacks that have been reported for maintenance orders and notifications are listed in the “feedbacks” view.

In the properties for the feedback, the information about hours worked, cost rate and material used rate is available for editing. All changes that are applied to a feedback are recorded as transactions providing a change tracking mechanism.

When a maintenance order has reached the status “completed”, all linked notifications and feedbacks are also set to the state completed. By default those items are not shown any more in the corresponding views. Editing the information contained in the feedbacks is than not permitted anymore.

Beside the feedbacks applied to notifications and maintenance orders a feedback may also be entered directly on an object. In the case of a fault, no maintenance order needs to be created for emergency repairs. The activities related to the incident including the material consumption and working hours spent can be reported directly by creating an object feedback.

The type of feedback applied to either maintenance orders, notifications or emergency repairs is indicated by a separate icon in the feedbacks view.

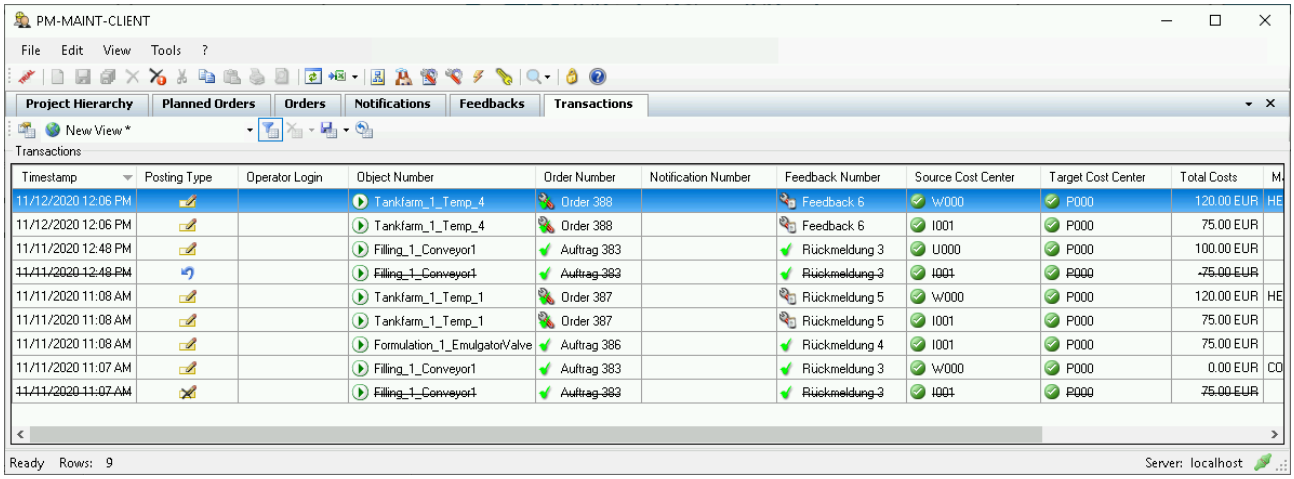


Feedbacks view

Transaction properties

All corrections regarding hours worked or materials used that are applied to feedbacks are recorded in detail as transactions.

All transactions are displayed including the original postings and all reversed and canceled postings created from feedback modifications.



4 Operator control

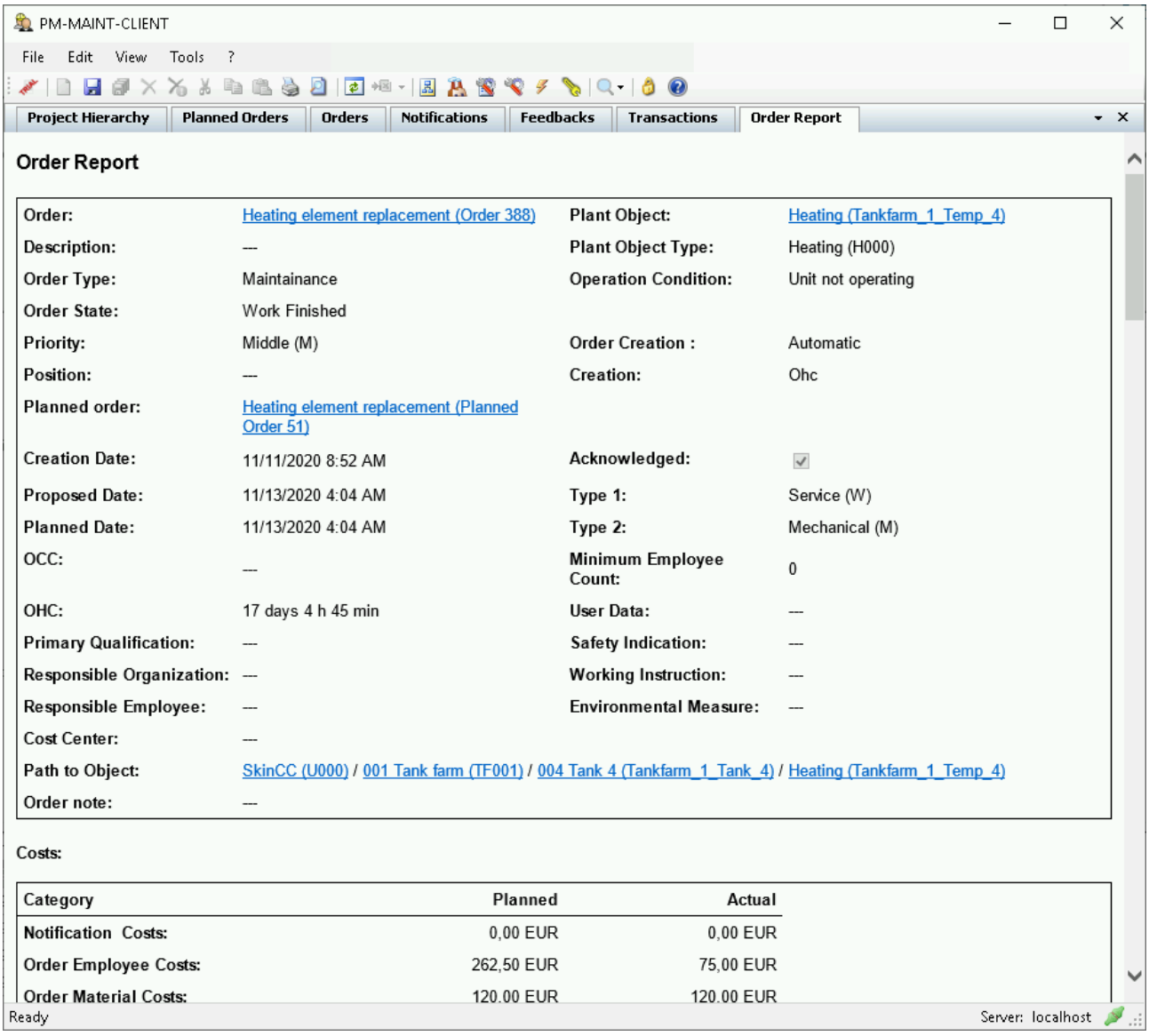
4.7 Reports

Notifications, maintenance orders and feedbacks can be displayed on a report and sent to a printer. The printout of the notification and the maintenance order report can be automatically triggered by PM-MAINT. The default printer configured on the PM-MAINT server computer will be used for automatic printouts.

An on screen report preview or a manual printout can be created for the selected object in the UI at any time.

PM-MAINT offers a fully customizable default report layout that is based on an xsl format for the following reports:

- Notification
- Maintenance order
- Feedback
  (Notification-, order-, emergency repair feedback)

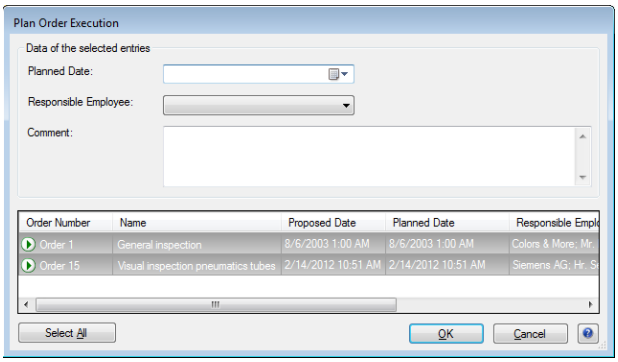


Maintenance order report preview

4 Operator control

4.8 Tracking of operator activity (logbook)

Most of the activities in the user interface open a confirmation dialog box. This two-step operation helps to prevent inadvertent changes and also acts as a confirmation step. It also allows entering a comment regarding the action performed.

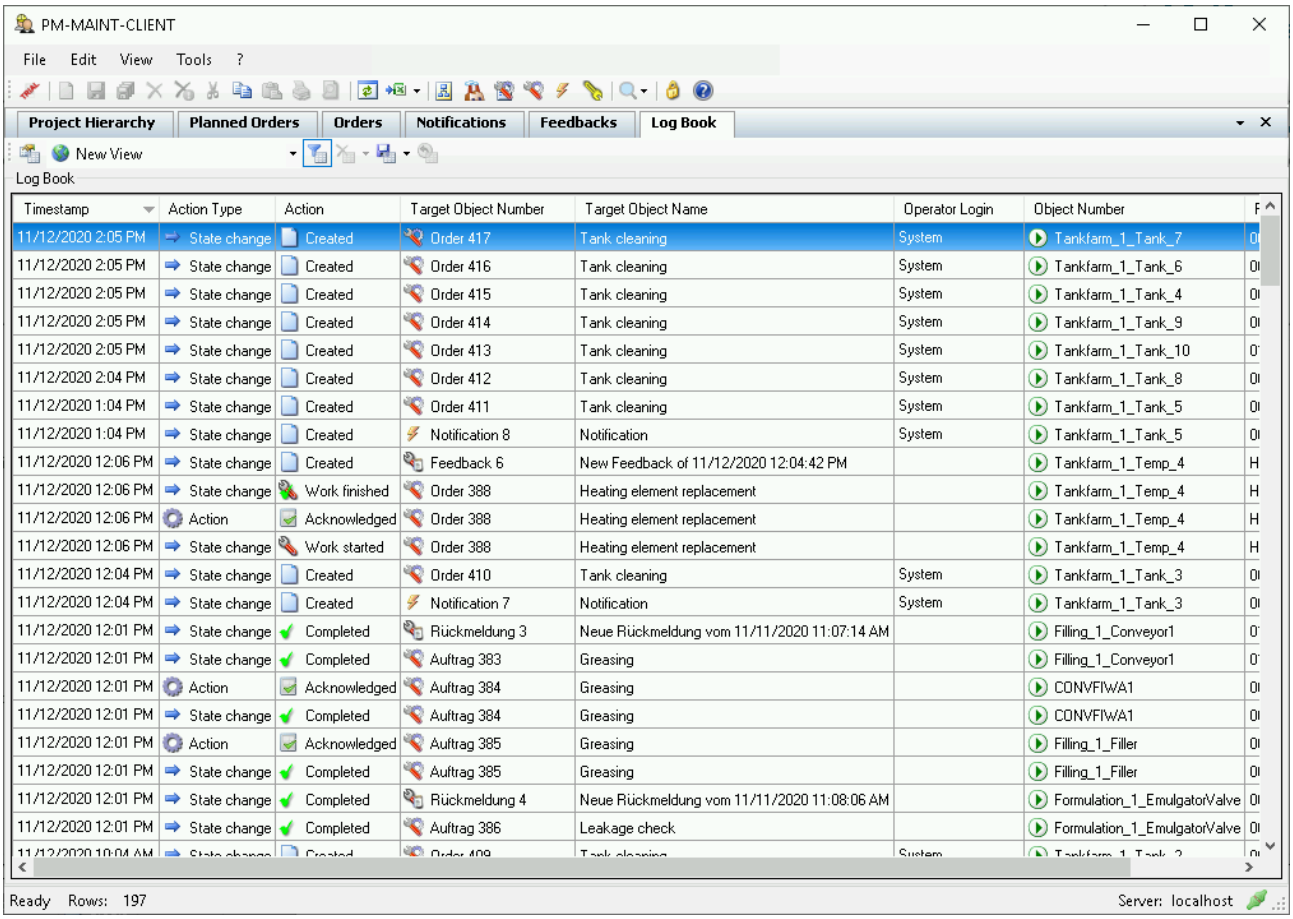


Confirmation dialog

All user activities are recorded with the current login and the current timestamp in a central logbook. The logbook additionally tracks the action type, action performed, object name and number of modified object (plant object, maintenance order, notification etc.)

The “logbook” view lists all operator activities in a chronological manner which allows tracking all activities in detail.

Comfortable sorting and filtering functions provide quick access to the relevant information.



Logbook view

4 Operator control

4.9 Maintenance order workflow

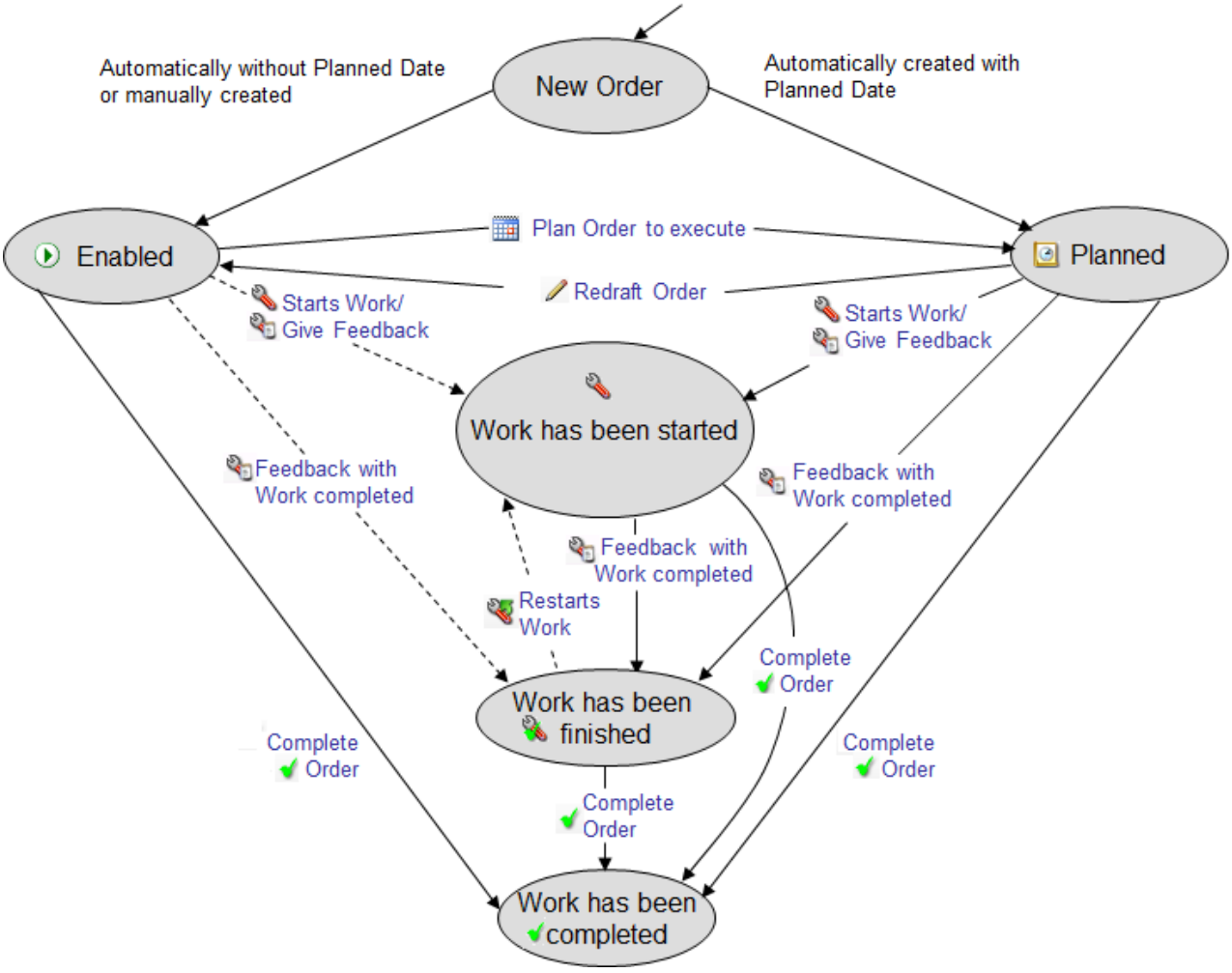
Maintenance orders are processed by applying specific actions in the maintenance order view corresponding to the state and progress of the maintenance activities. These actions change the state of the order according to the order state model.

The following list shows a typical sequence of steps applied to a maintenance order:

1. Acknowledge order (optional)
2. Set planned date
   (optional, based on planned order policy)
3. Start work
4. Give feedback
5. Complete order

A maintenance order has to be processed. In the default configuration the maintenance interval is reset when the “Complete order” action is performed.

Notifications also have an attached state model. If a notification is not explicitly set to “completed”, the notification is automatically completed when the corresponding maintenance order is completed.



Maintenance order worflow

4 Operator control

4.10 Request workflow

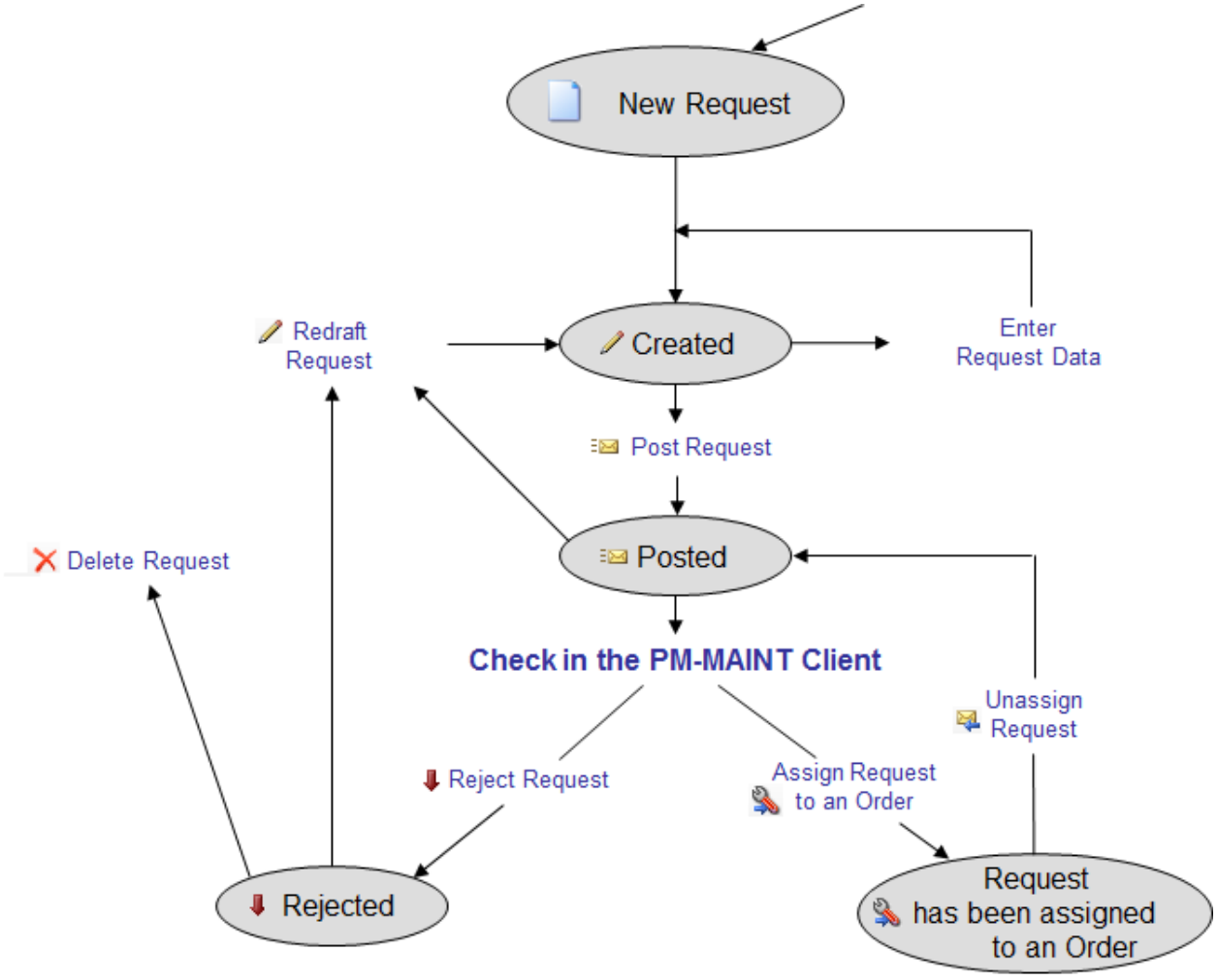
The workflow that applies to maintenance requests that have been created from within the PMMAINT.RequestControl is illustrated below.

The following acations can be performed:

- Create
- Post

Review and evaluation of the request in the PM-MAINT client UI and resulting in the actions:

- Assign request to order
- Reject request



Maintenance request workflow

5 Configuration

5.1 General information about configuration

Together with the installation of the PM-MAINT server the additional components PM-SERVER and PM-AGENT Unified are installed. The PM-SERVER manages all data connections to the various connected HMI systems. Each connected HMI system is set up as a station. By using an import function the tags and user groups are imported and are then available in the configuration of PM-MAINT. When using PM-MAINT for purely calendar based maintenance without any process communication the PM-SERVER manages only users and user groups.

5.2 Project hierarchy

In the first configuration step the maintenance objects of the plant are modeled in a user-defined hierarchical structure. The structure that is starting from the enterprise level down to the smallest serviceable unit is composed of a variety of object templates that are easily inserted by using drag and drop.

Existing standard object templates are:

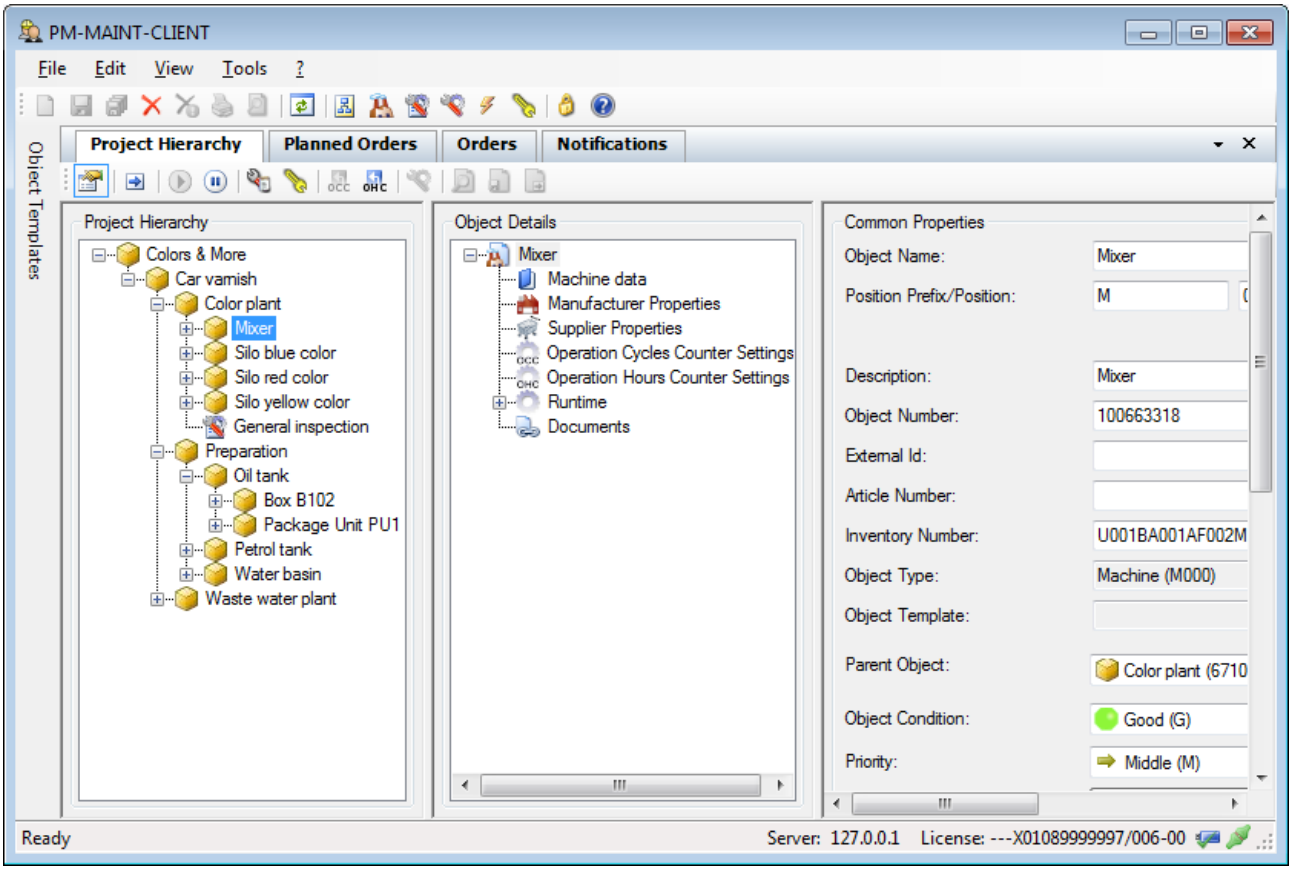
Company, plant, plant part, machine, component, part

Further custom object templates can be created as needed by the user.

Each object specifies its own individual properties. Common settings can be preconfigured in the object template and therefore have a default value as soon as they are inserted into the project hierarchy.

The various properties of each object are organized in property groups. All available properties of each object group are listed under the object details. When a property group is selected the contained properties are displayed in a property panel on the right.

The property groups that are mandatory for an object can be configured in the object template.



Project hierarchy view

5 Configuration

5.2.1 Available object properties

General properties

Basic properties like object name and number have to be defined to uniquely identify each object. The specification of other object properties such as priority within the structure, object state, assignment of a responsible employee etc. are optional.

Object data

Additional data object can be configured as needed. This group is optional.

Manufacturer data / supplier data

These properties offer the possibility to specify information about manufacturers and suppliers of an object. Specifically required properties can be configured as needed. These groups are optional.

Settings for operation cycles and operating hours

These property groups are mandatory if performance data is to be collected for the object. The method of data collection and the connection to the HMI system is defined in the respective group. Both groups are optional.

Documents

Documents of different kinds such as circuit diagrams, curves, drawings etc. can be added to further detail the description of the object.

Runtime

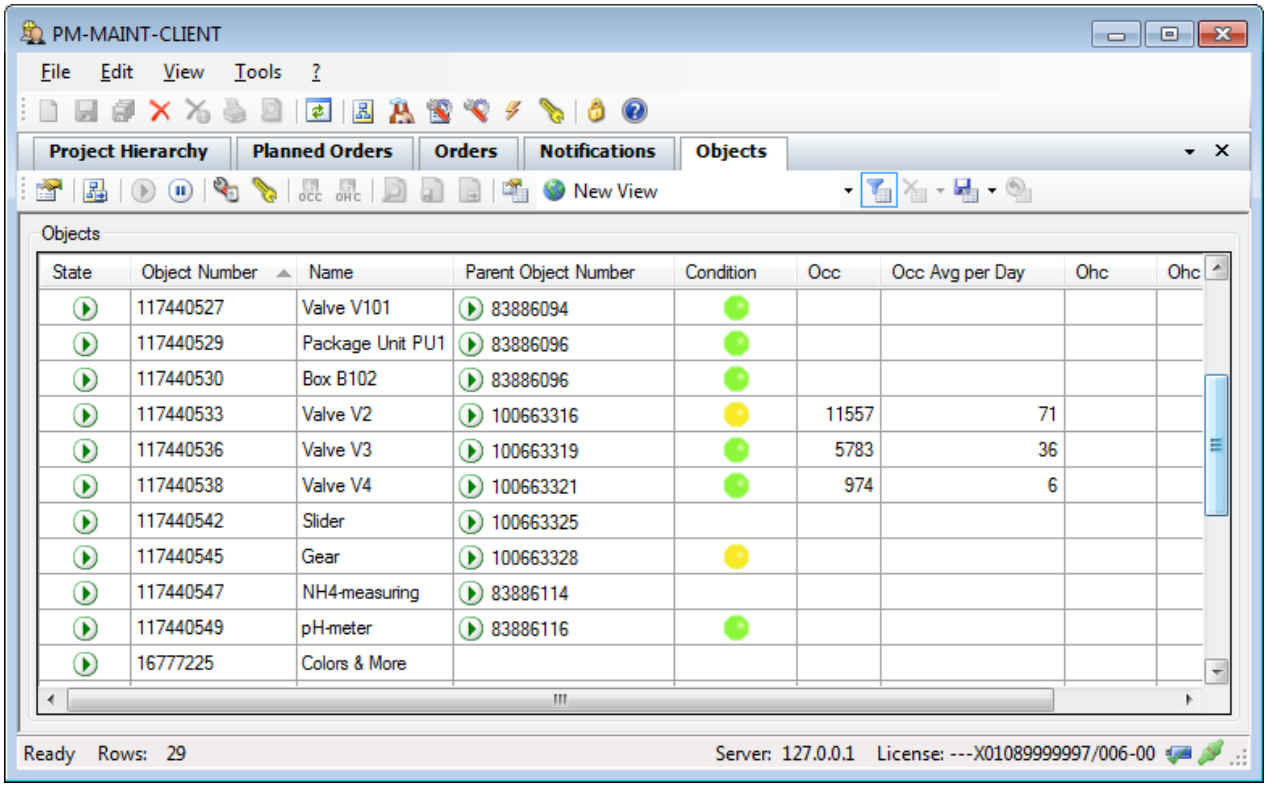
This property group is only available if performance data is collected for the object. The daily values for operation cycles and/or operating hours are recorded. Manual modifications to the daily values are tracked in a log.

5.3 Object overview

All objects that have been inserted into the "project hierarchy" tree are listed in the "objects" view as a table. The default sort order is based on the item number and can be changed as needed in the view configuration.

The object properties can be viewed and configured in this view in the same way like in the "project hierarchy" view.

A navigation link allows to directly “jump” from the selected object to the representation in the project hierarchy.



Objects view

5 Configuration

5.4 Creating planned orders

Each object in the system that is to be monitored for maintenance has at least one planned order attached to it. If several maintenance activities are to be planned with different schedules and/or activities, multiple “planned orders” can also be assigned.

All relevant data about the maintenance activities are specified in the planned order. The properties are arranged in groups for optimum overview.

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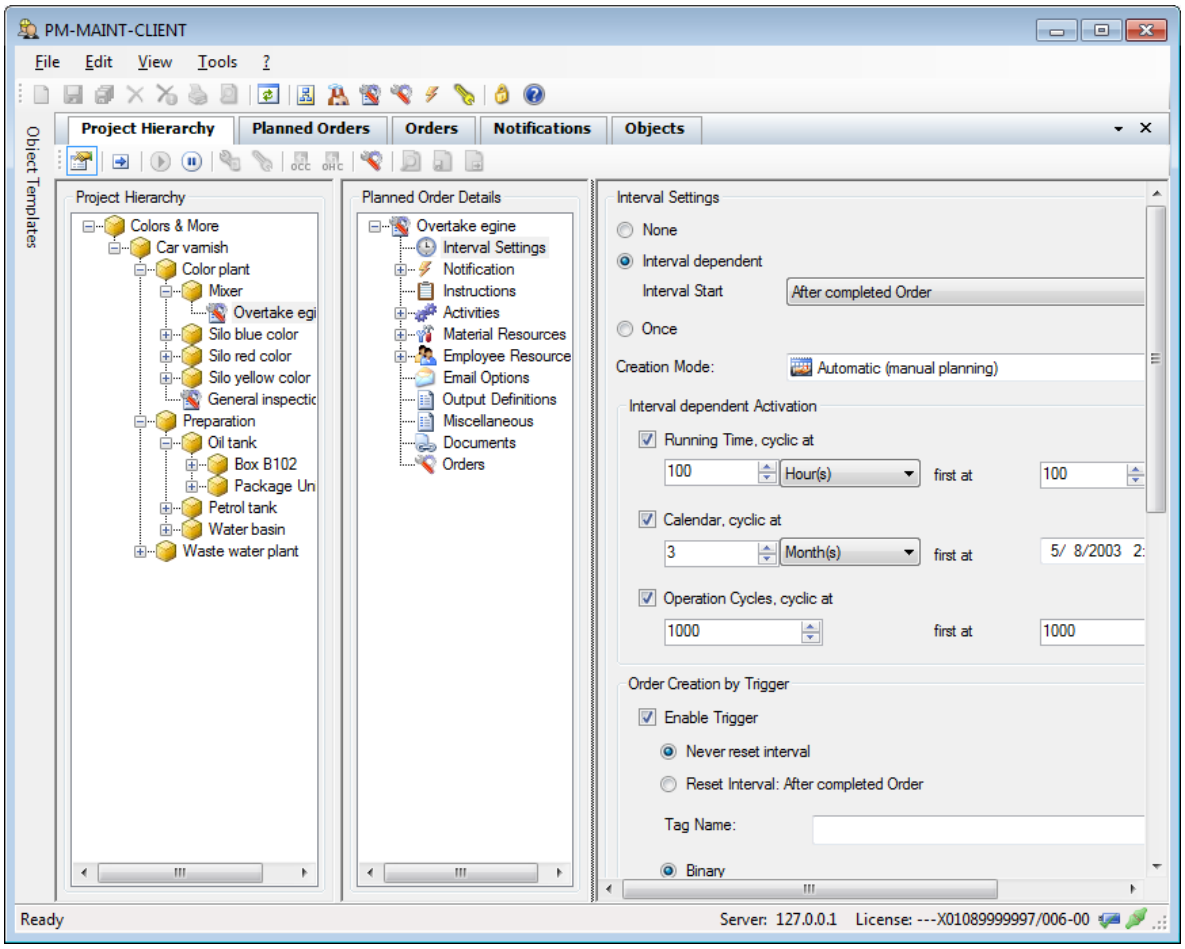


Project hierarchy view with selected planned order

5.4.1 Object properties for planned orders

The details area for the planned orders shows all available properties.

General properties

Planned orders are identified by a name. The specification of other properties like e.g. priority, responsible employee and qualification, cost center, automatic report printout etc. is optional.

Interval settings

The maintenance interval is specified in the interval settings. The creation of a maintenance order can be initiated either interval dependent, one time, based on a triggering event from the process or manually.

The interval-based generation of maintenance orders requires the definition of the corresponding interval. The settings for operating hours and operation cycles will only be available if the associated object has the corresponding connection to counters from the HMI system. The evaluation of the maintenance interval can be based on accumulated operating hours, operation cycles and a calendar based time span in parallel. The interval that expires first determines the next planned date when a maintenance order is created. For the initial setup an initial counter value or an initial date can be specified. Following the initial generation, the interval settings of the planned order are processed to trigger the subsequent generation of maintenance orders.

5 Configuration

Notification

To ensure that all maintenance activities are scheduled on time a notification can be set up. According to the configured time span the notification is created before the planned date of the maintenance order. The notification can include activities with corresponding planned working hours.

Instructions

The activities that necessary for the maintenance of the object are stored in the form of text instructions.

Activities

For more complex maintenance plans, PM-MAINT has the ability to configure multiple activities. An activity describes the work to be performed, the necessary employee resources including qualification needed and the quantity of required material. The planned cost for material and labor is calculated based on the planned number of working hours and the planned material consumption. These planning figures can be compared for each generated maintenance order with the expenses actually incurred from recorded feedbacks.

Each activity of a maintenance order may receive its own feedbacks. This allows e.g. splitting mechanical and electrical activities.

Material requirements

Material requirements can be specified for each individual activity and also for the planned order itself. The material requirements overview shows the total requirements including all activities.

Employee requirements

Employee requirement can be specified for each individual activity and also for the planned order itself. The employee requirements overview shows the total requirements including all activities.

E-mail settings

The responsible employee, the responsible organization and additional persons can be notified by e-mail when a notification or a maintenance order becomes active. Furthermore an e-mail message can be sent on each status transition of a maintenance order.

Output definitions

The relevant current data, like interval state, recommended maintenance date, remaining operating hours, remaining operating cycles, remaining calendar interval and order status can be attached to process tags in order to be displayed on a HMI screen.

Miscellaneous

Further information like safety and environmental protection measures, work instructions and the like can be defined.

Documents

Documents of any kind e.g. technical descriptions, photographs, drawings, which assist in the maintenance process, may be added to planned orders.

Maintenance orders

All maintenance orders that have been generated from the planned order are listed including processing timestamps and planned cost vs. actual cost comparison.

5 Configuration

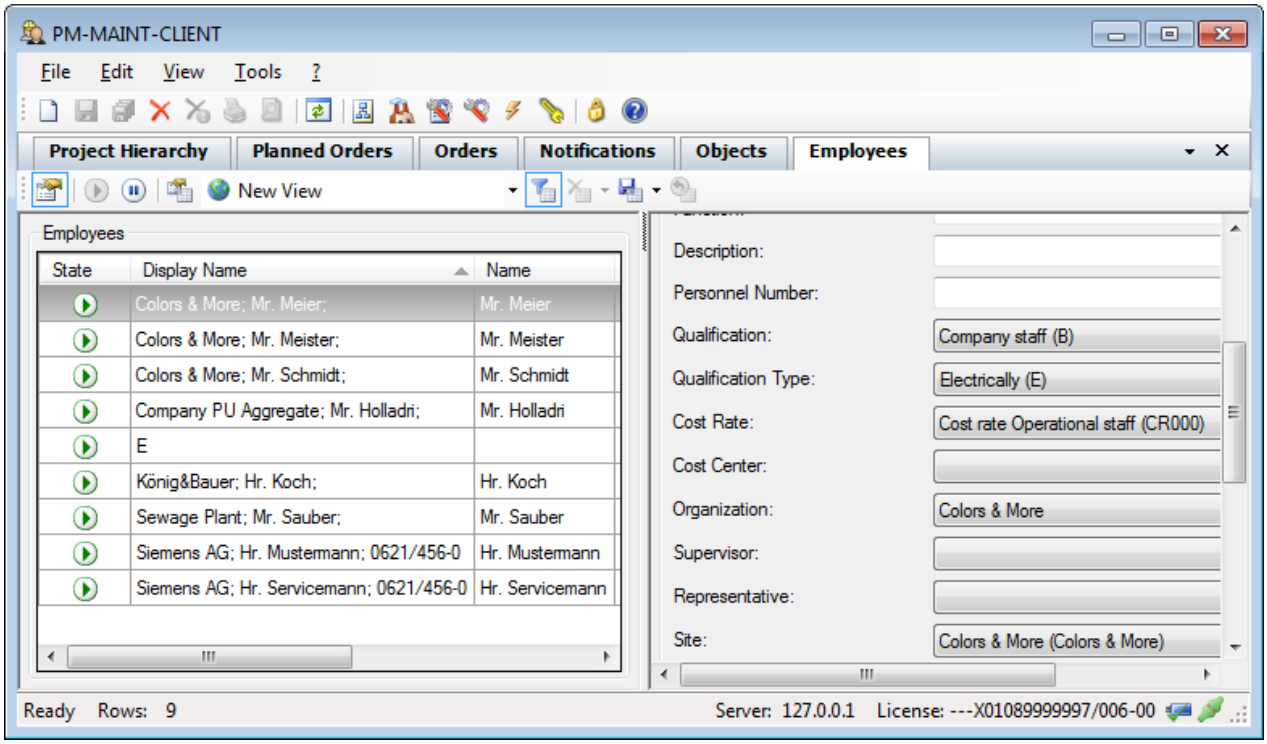
5.5 Employees

All employees involved in the maintenance process are managed in the "Employees" view. The properties available include contact information, organization, representative, cost center and many more. The cost rate is calculated based on the settings made for qualification and qualification type. All available qualifications, qualification types and cost rates are configurable within the general PM-MAINT settings.

An employee may be assigned as a responsible person in planned orders.

If an e-mail address has been entered for an employee, a message can be sent by PM-MAINT upon the generation of the notification or the maintenance order. The e-mail message contains the corresponding report for the notification or maintenance order either directly in HTML-format or alternatively as an attachment.

Similar to employees the organizations are maintained in the "Organizations" view. In parallel to an employee an organization may be assigned as a responsible organization for the maintenance order. In this case e-mail messages will be sent to the e-mail address of the employee responsible for the organization.

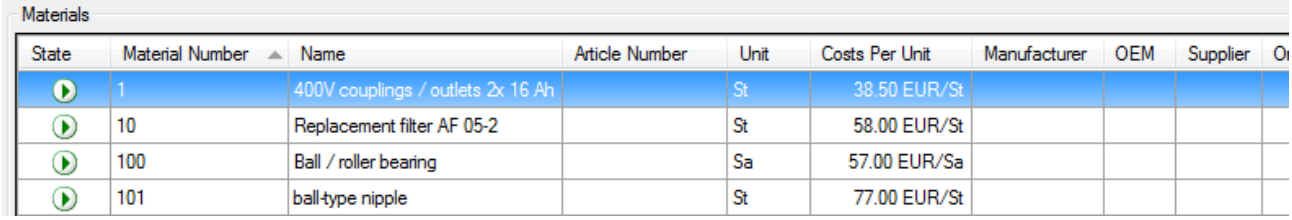


Employees view

5.6 Material data

Material required for maintenance activities is stored in a material table. All relevant material information like material number, part number, manufacturer information, supplier information for re-ordering, cost per unit, storage location etc. can be entered.

Material that has been used in maintenance activities e.g. grease, seals, bearings or other spare parts can be added in feedbacks entered for maintenance orders. Based on the material consumption the maintenance order is charged with the corresponding material cost.



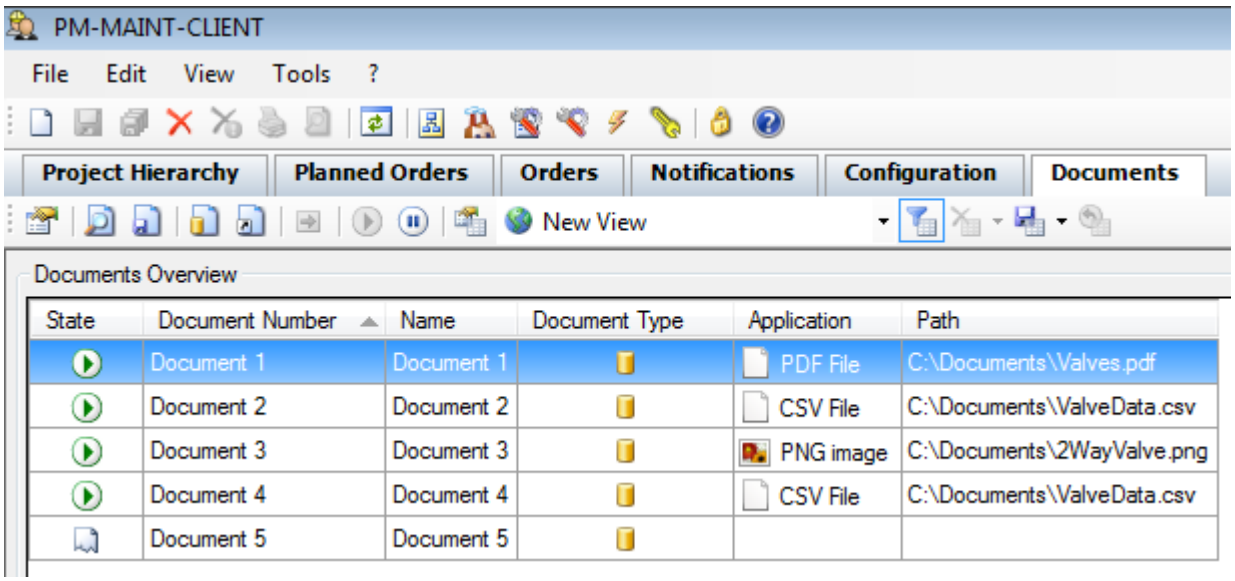
Material view

5 Configuration

5.7 Documents

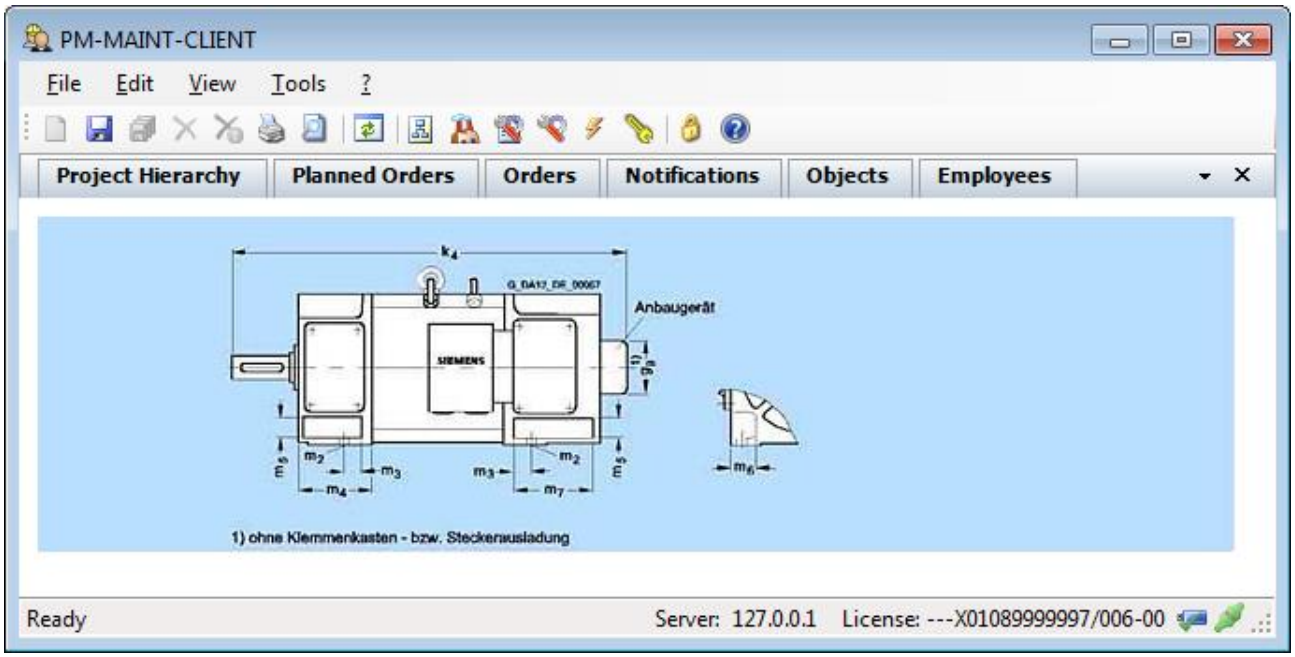
All documents that are used for a more detailed description of the maintenance objects such as data sheets, curves, photographs, descriptions, etc., are maintained in the "Documents" view. Individual documents are either stored directly in the PM-MAINT database or as a link to the original location of the document on a file share.

From this central document library an arbitrary number of documents may be linked to each object, each planned order, each order and each notification.



Documents view

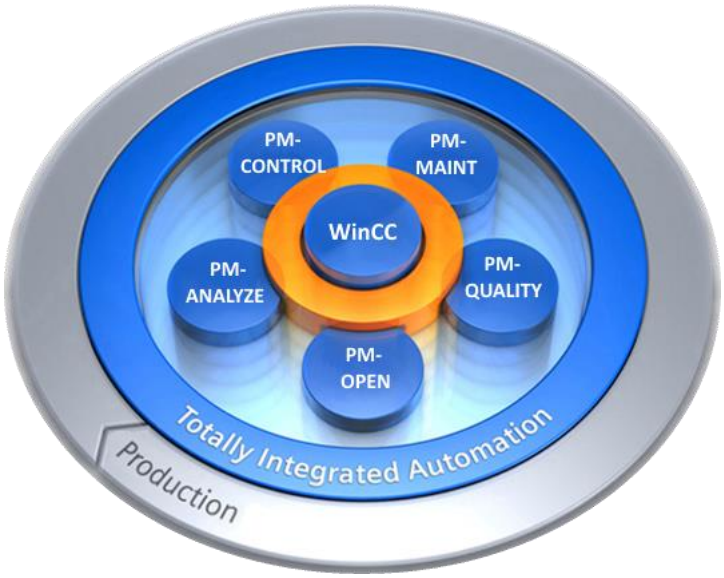
The documents can directly be opened and viewed within PM-MAINT. For this functionality the software required for viewing the corresponding document type must be installed on the local computer.



Documents view

Process Management System

Economical Automation with Standard Software



PM-CONTROL
Recipe/Product Data Management, Job Control

PM-QUALITY
Job/Batch-oriented Archiving and Recording

PM-MAINT
Intelligent Maintenance Management System

PM-ANALYZE
Analysis of Alarms and Process Data

PM-OPEN
Solutions for Communication and Integration

Further technical information?

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