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1 Introduction

Unscrambler® X Process Pulse II is an intuitive real-time process monitoring tool that reads data from various Data Sources, executes the full range of Models available in The Unscrambler® X and other third-party software, and presents data and results as they are gathered. The software offers early event detection and immediate identification of out-of-limit variables for real-time process control, giving the possibility to remedy potential failures before they occur.

Unscrambler® X Process Pulse II can further be connected to existing control systems to enable control actions based on Models, i.e. Model Predictive Control.

In this manual, Unscrambler® X Process Pulse II is referred to as Process Pulse.

1.1 Installation

The Installation Manual covers installation and activation of Process Pulse. Contact your local IT department for installation support.

1.2 Opening the Application

1.2.1 Application Icon

Process Pulse appears on the user’s computer when installed with the application icon shown in Figure 1-1.

![Figure 1-1: Process Pulse Application Icon](image)

Double-click the icon to start Process Pulse’s Dashboard application.

1.2.2 Login

Language preference is prompted at each login in case multiple users with different language preferences are using the software. The languages available are English and German.

Username and password information is private. Please contact your local IT for support relating forgotten login information.

The login screen is shown in Figure 1-2.
In the login screen, information about the current product version installed is displayed.

1.3 Prerequisites

This manual assumes that the user:

- has already installed and set up the software (ref. Installation Manual)
- has data to analyse in one of the compatible formats
2 Getting Started

2.1 Main Concepts

Process Pulse is designed to help the user monitor a process. This is achieved by reading data, performing calculations, presenting data and results to the end user, and storing the same data and results for future use and review. The source for the data is labelled ‘Data Source’ and the predefined calculations are labelled ‘Models’. The data sources and models can be combined in ‘Configurations’. A configuration contains information about the data source, the model and how the data should be presented to the end user or shared with other systems during processing. An overview of a configuration setup is shown in Figure 2-1.

![Figure 2-1: Configuration Setup](image)

The definition of a configuration is as follows: “A configuration is the operational combination of the data source(s), a single model, the visualization of the model outputs, and the storage of the resultant data in the data historian. In some instances where simple visualisation of the raw data is preferred, a model is not required to set up a configuration.”

Data is gathered through a watch folder, database, or directly from a probe. The Model then performs predefined statistical analysis on the data. The model is optional, as it is possible to monitor a Data Source, visualize measurements and store them without performing any analysis. The Configuration combines all the elements: what data to use, what to do with it and how to present it.

The use of Process Pulse is Configuration centric. Configurations always have a defined data source and defined output. Configurations can be “run”, like experiments, with different variables in each trial. In a running configuration, Process Pulse is reading new data from the Data Source, running it with the model, and presenting data and results in appropriate plots.

2.2 Dashboard

After open and log in to Process Pulse, the Dashboard appears (Figure 2-2). This is the user interface for Process Pulse and all functionalities available in Process Pulse can be managed from there.

The Dashboard is split into three sections: The Main Menu Toolbar, the Main View, and the Bottom Tiles.
2.2.1 Main Menu Toolbar

The Main Menu Toolbar is located at the top of the Dashboard, as shown highlighted in Figure 2-3. The Main Menu Toolbar has three main parts: Operation, Review and Settings. In Operation, it is possible to set up and manage Data Sources, Models and Configurations. In Review, the user can review the audit trail, recorded data and results, and set up and create reports for the data. In Settings, the users can be added and managed, and preferences or settings of Process Pulse can be modified.

Besides those main parts you can also find the buttons for the Help section and for log out from the application.
2.2.1.1 Minimizing the Main Menu Toolbar

![Figure 2-4: Main Menu Toolbar Shown](image1.png)

Clicking Hide Menu will hide the Main Menu Toolbar, as seen in Figure 2-5.

![Figure 2-5: Main Menu Toolbar Hidden](image2.png)

Clicking Show Menu will open the Main Menu Toolbar again.

2.2.2 Main View

![Figure 2-6: Dashboard (Main View Highlighted)](image3.png)

The Main View is the working area in Process Pulse. It shows data and results plots of running configurations, and also the setup and listing of data sources, models and configurations when required. When the user first opens Process Pulse, there will not be any configurations created, so the main view will be empty. The user must set up a data source, a model (optional), and a configuration to see the configuration plots in the main screen. Once a configuration is set up, it will appear on the Main View when it is running if the logged on user created it or has been granted with permissions. Set up of configurations is described in section 5.2, but for the purposes of this explanation, four configurations have already been set up and started as shown in Figure 2-7.
In Figure 2-7 there is no data being fed in to the configuration, so there are no plotted values, even though the Configurations are running. The four configurations appear side by side in this view. In the above example, Configurations “3D”, “Test”, and “22” all have two plots in each configuration: Spectral Raw Data, and Raw Data. Configuration “Config8” has only the Eigenvalues plot. The plot types that appear for each configuration can be customized. Go to Section 6.1 to learn more about Plot Types.

### 2.2.2.1 Configuration Cards

Each configuration has a Configuration Card. One of the configuration cards from Figure 2-7 is shown magnified in Figure 2-8.

![Figure 2-8: A Configuration Card](image)

Clicking a Configuration Card will minimize a running configuration. Clicking the Configuration Card of a minimized running configuration will open it again. The blue marker on top of the configuration card indicates that the configuration is in view.

### 2.2.2.2 The Main View Buttons

The buttons at the top of the Main View are shown below. The Notifications button lists all active notifications - notifications are covered in depth in Section 6.3. The other buttons (Main Screen, Change View, and Tile View/Single View toggle) allow the user to manipulate the view of the running configurations. At times there are many configurations running, and the user may want to organize them.
Main Screen is used when the user wants to return to the main screen from other screens, i.e. the main view displaying running configurations. This is useful if the user is working on a new data source say, and want to or need to, check the progress of running configurations.

Change view will change the position of the Configuration Cards. It is possible to show horizontally the Configuration Cards on top of the Running Configurations view which is the default view, or vertically on the left side of the Running Configurations. Clicking the Change View button toggles between the two different views, as shown in Figure 2-10 and Figure 2-11.

The Tile View/Single View button allows the user to toggle between seeing multiple running configurations side by side (up to 10), or seeing only one configuration at a time.
2.2.3  Bottom Tiles

The bottom tiles contain information relevant for process monitoring. Each tile is described in the sections below.

2.2.3.1  User

![User Tile](image)

**Figure 2-13: User Tile**

This tile displays the ID or username of the currently logged-in user.

2.2.3.2  Previous login

![Previous Login Tile](image)

**Figure 2-14: Previous Login Tile**

This tile indicates the last time the user logged in to the system.

2.2.3.3  Type

![Type Tile](image)

**Figure 2-15: Type Tile**

This tile indicates the last time the user logged in to the system.
This tile indicates the user type that is logged in. There are four user types: Operator, Developer, Supervisor, and Administrator. Each of these levels has different privileges. To view the full list of user rights, go to Section 8.1.

2.2.3.4 Flags

![Flags Tile](image)

Figure 2-16: Flags Tile

Flags are markers that can be inserted while a configuration is running, in other words, while a process is being monitored. Flags are a type of Annotation and can be used to keep track of events during the current configuration(s) run. Go to Section 6.2.1 to learn about Flags in depth. The Flag tile shows how many flags are currently active. If there are active flags, clicking the Flag tile will open a box which shows the Flags that are active.

2.2.3.5 Comments

![Comments Tile](image)

Figure 2-17: Comments Tile

This tile shows how many Comments have been added during the current configuration(s) run. Comments are also a type of Annotation. To learn about Comments in depth, go to Section 6.2.2. If there have been any comments added, clicking the Comments Tile will open a box which shows the Comments and allows the user to modify them as required.

2.2.3.6 Samples

![Samples Tile](image)

Figure 2-18: Samples Tile

Samples are a type of Annotation. The user can add Samples during process monitoring. To learn about Samples in depth, go to Section 6.2.3. If there are any Samples added to the current running configurations, they will appear in the Samples tile. The user can view these samples by clicking the Samples tile.

2.2.3.7 Warnings and Alarms

Warnings and Alarms are types of Notifications. Warnings are shown in amber, and indicate that a limit is being reached, typically a control limit. Alarms are shown in red, and indicate that the alarm limit is reached. Notifications appear in the Main View, and also in the Warnings and Alarms tile in the Bottom Tiles.
The Warnings and Alarms tile contain all notifications for currently running configurations (Figure 2-19). When a configuration is stopped, the corresponding notifications are removed from the Warnings and Alarms tile. The Notifications list contains all warnings and alarms until they are acknowledged. Stopping a configuration does not remove the corresponding warnings and alarms from the Notifications list but all notifications from the stopped configuration are combined into one entry in the list.

Notifications (which include Warnings and Alarms) are covered in detail in Section 6.3. Clicking the Warnings and Alarms tile opens a box which shows the Warnings and Alarms from the current running configurations.

2.2.3.8 Input Controls

Some data cannot be run in the Configuration because of incompatibility (for example a data file on different format than the one provided as example during the data source setup) or instrument problems. The Input Controls tile lists the samples which are excluded from the view.
3 Data Source

The Data Source is the source to which Process Pulse connects to retrieve data.

Data can be **Online** or **Offline**. Online Data is being uploaded and processed in the current experiment, while Offline Data is from a previous experiment. (Do not confuse the term “Online” with the Web Terminal, *Section 10.*

### 3.1 Data Source Management

![Figure 3-1: Data Source Management (Main Functions Circled in Red)](image)

Clicking **Data Source** in the Main Toolbar opens the Data Source Management page, shown in *Figure 3-1*. In this display, existing data sources are listed. To disable a Data Source, tick the checkbox corresponding to the Data Source and click **Disable**. It will then be stored under the Disabled tab, and it will not be possible to use it in any Configurations. By default, the Enabled tab opens automatically, but by clicking the **Disabled** tab, the user can see Data Sources that have been disabled. From the Disabled tab, data sources can be re-**Enabled**. Please note that the **Disabled** tab is not enabled for Operator-type users.

Information and settings for each Data Source can be accessed by clicking the buttons circled in red in *Figure 3-2*.

![Figure 3-2: Data Source Management (Action Buttons Circled in Red)](image)

Clicking the Config button ( ) allows the user to edit the data source through the same steps as in the data source setup, which is described in the next section.
Clicking the Info button ( ) opens the Data Source Details window as shown in Figure 3-3.

**Figure 3-3: Data Source Details**

All of the customizations made during Data Source Setup are listed in the Data Source Details (Figure 3-3). In the example, the details for a folder read-out data source are shown. The types of data sources and the accompanying settings are described in the following sections.

Clicking the info button ( ) allows the user to update Dark and Reference measurements for instrument data sources. This button is only available for instrument data sources. The interface for the Dark and Reference update is shown in Figure 3-4.

**Figure 3-4: Updating Dark and Reference Measurements**
In the Dark and Reference update window, *Figure 3-4*, the user can start Dark and Reference collection. When the spectra are collected the Status turns green and the text changes to Success, as shown in *Figure 3-4*.

### 3.2 Setting Up a Data Source

To create a new Data Source, click on **Add New Source** (circled in *Figure 3-1*). The screen shown in *Figure 3-5* appears.

![Figure 3-5: Data Source Type Setup](image)

Type in the name of the data source, choose the type and click **Next**. The different data types have different templates for data source setup, as described in the following sections. Here, the main steps in the data source setup are illustrated using the setup of a JCAMP data source.

In the next page, the setup of the data source is defined, *Figure 3-6*. The information in the form depends on the specific data type, but the purpose of this step in the data source template is to specify where Process Pulse can find the data. For the folder read-out data source, the watch folder and an example file are defined, *Figure 3-6*.

![Figure 3-6: Data Source Setup – Specify Location](image)

After specifying the location of the data, the user is given the opportunity to manage tag names (*Figure 3-7*). There are two main options here depending on whether the data type is
spectral or process type. For spectral data, the user can define a range and Process Pulse generates labels with equal distances. For process data, the user can modify the names for each of the parameters. This is also where the Aliases are applied. Aliases are described and explained in section 8.2.12.

Figure 3-7: Data Source Setup – Manage Tag Names

The next step in the data source template allows the user to set up conditions for data recording (Figure 3-8). The Trigger option allows to either using an external trigger, i.e. another data source, or self-triggering, i.e. based on conditions on the data source itself. In both cases either numeric or string tags can be used.

Figure 3-8: Data Source Setup – Triggering Settings

The last stage in the data source setup template is the preview page (Figure 3-9). In the Preview page, the data from the example file is displayed both in a table and in a plot allowing the user to assess whether the data source setup is working.
3.3 Data Source Types

The Data Sources available for use in Process Pulse are ever increasing. Most Data Sources belong in one of four categories: Folder Read-out (Section 3.3.1), Database (Section 3.3.2), Instrument (Section 3.3.3) and Other (Section 3.3.4).

**Folder Read-out**
- XML
- OMNIC
- OPUS
- VIAVI .SAM
- GRAMS
- Brimrose
- Empower
- JCAMP-DX
- Image
- Excel
- ASCII

**Database**
- LIMS
- ODBC

**Instrument**
- Bruker
- Kaiser
- Mettler Toledo
- Viavi MicroNIR
- Zeiss
- Ocean Optics
- tec5

**Other**
- Manual Sampling
- Pretreatment
- TCP/IP
- OPC DA
- OPC UA
- OPC DA Spectral
- PI

Setup for each data type is discussed in the next sections. Prerequisites for Data Source setup are that the user has a data source, that the user knows what data type it is, and that the source is one of the types listed in Figure 3-10. If all of these are true, the user is ready to begin the Data Source setup.

If you require a data source not listed in Figure 3-10, contact your CAMO representative to discuss the possibility of adding it.
3.3.1 Folder Read-out

In Folder Read-out, Process Pulse monitors a watch folder and reads files as they appear in it. The read operation is triggered by a change in the watch folder, either by a new file that is added or an existing file that is modified. The folder read-out can either read the new file or read the last sample added to an existing file.

The generic folder read-out setup page is shown in Figure 3-6. The watch folder is the location where the data source is reading new data from. Process Pulse monitors the file activity in the folder and detects when there has been a change, either by a new added file or by a change in an existing file. The example file is an existing file which indicates the format of the data for Process Pulse. If there are problems with the settings for the folder read-out formats which have more detailed settings, i.e. ASCII and Excel, Process Pulse uses the example file to detect this and provide a warning to the user. The example file is also used in the Preview step (Figure 3-9) where the user can assess whether the data are correctly read.

In the setup page for folder read-out, there is also an On Recovery option as shown in Figure 3-11.

![On Recovery Options for Folder Read-out](image)

**Figure 3-11: On Recovery Options for Folder Read-out**

The recovery options list the possible settings for data recovery if there is a disaster event disturbing the running of Process Pulse, e.g. if network connection between Process Pulse components is lost. If ‘No Action’ is chosen, there is no recovery action and any data written to the watch folder during the downtime is not read by Process Pulse when the situation is recovered. The other two options depend on whether the folder read-out is reading multi-sample files or single-sample files. The multi-sample files grow by adding new measurements to the end of the file and, if this is the recovery option, the whole multi sample file is read. Accordingly, any samples already in the file before the downtime are read a second time. The recover single-sample file option reads all files added to the watch folder during the downtime.

For the data formats where timestamps are available, there is an option to use the timestamp from within the file rather than the time the sample is read and saved in the Process Pulse database. This option is activated by ticking the checkbox in the Setup page (Figure 3-6).

3.3.1.1 ASCII

ASCII is a Folder Read-out type which requires additional input parameters to specify the layout of the file. The parameters required for ASCII are shown in Figure 3-12.
Watch folder, Example File and On Recovery settings are the same as for all the other folder read-out data sources. In the ASCII format, data is always separated by some sort of punctuation, commonly a comma, space, tab or semicolon. In the Separator Options, mark the punctuation used by your particular data files. Decimal Separator is usually a period (e.g. 3.14) but in some countries commas are used instead (e.g. 3,14). Process Double Quotes means that it will ignore double quotes in a string (e.g. 123 instead of “123”). Treat Consecutive Separators as One, means that Process Pulse will read two consecutive separators as one. Transpose data transposes columns to rows and vice versa. The Headers information allows the user to specify whether there is any header information in the files or only data. The appropriate settings can be worked out by reviewing an existing ASCII data file from the system which is to be monitored.

3.3.1.2 Empower

The Empower format allows user to read files from the Waters-Empower system. The file format is XML with certain settings. In the definition of the Empower data source in Process Pulse there is an extra step after the folder settings page, as shown in Figure 3-13.
The drop down list, Figure 3-13, displays the data types available in the Empower file. The user selects the required data type and the rest of the setup is analogous to the other folder read-out data sources.

### 3.3.1.3 Excel

Excel is a Folder Read-out data type which has additional input parameters to allow the user to define the structure of the data in the spreadsheet. The form for Excel data type is shown in Figure 3-14.

![Figure 3-14: Excel Type Form](image)

Watch folder, Example File and On Recovery settings are the same as for all the other folder read-out data sources.

Process Pulse needs to know where in the table the data starts. For example, if the data looks like this:

<table>
<thead>
<tr>
<th>Time</th>
<th>B</th>
<th>A</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 hr</td>
<td>4.3</td>
<td>1.5</td>
</tr>
<tr>
<td>2 hr</td>
<td>3.9</td>
<td>3.1</td>
</tr>
</tbody>
</table>

**Figure 3-15: Example Table**

Skip 1 column and check the **Use first row as header** box. In that way, Process Pulse will not attempt to work the time information or the header into the analysis.

If it looks like this:

<table>
<thead>
<tr>
<th>Time</th>
<th>B</th>
<th>A</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.2</td>
<td>5.1</td>
<td>0.4</td>
</tr>
<tr>
<td>6.8</td>
<td>4.3</td>
<td>1.5</td>
</tr>
<tr>
<td>9.2</td>
<td>3.9</td>
<td>3.1</td>
</tr>
</tbody>
</table>

**Figure 3-16: Example Table**

Make sure to **uncheck Use first row as header**, and **do not** skip any rows or columns, as the table contains only data.

Check one of the **File Read Option radio buttons** to tell Process Pulse to analyze only the last row of data, or the whole spreadsheet.
**File Read Option** allows the user to specify whether the Excel files contain multiple samples or not.

### 3.3.1.4 Image

For the Image data source, it is possible to read data using polling (Figure 3-17).

![Figure 3-17: Image Data Source Setup](image)

In polling mode, Process Pulse goes to the watch folder and reads the latest file available at the given frequency. This is useful if, for instance, the images are generated at a high frequency, while the user is interested in the images at a lower frequency. The event option is analogous to the standard folder read-out.

### 3.3.1.5 XML

The XML file type has an additional step where the user can specify which items in the XML file should be read by Process Pulse (Figure 3-18).

![Figure 3-18: XML Data Source - Selecting Items](image)

In the item selector, Figure 3-18, the user can navigate the tag hierarchy which is defined in the XML file. The user selects the required items in the upper half of the screen and the selected items are listed in the lower half. In the list the data type and the value for the item in the Example File is shown. User can modify the sequence of the items and remove them if required.
3.3.2 ODBC (Database)

Some of the Process Pulse data sources are databases. The reading of databases is executed by polling, which means that Process Pulse will send queries to the database at the given interval (Figure 3-19).

![Figure 3-19: ODBC Data Source Setup](image)

In addition to specifying the polling intervals for the data reading, the user must select the data source location analogously to folder read-out data sources. For the database connections Process Pulse uses Microsoft Data Link. The first step is to select the driver for the connection (Figure 3-20). For standard databases, the standard drivers can be used. Some providers deliver proprietary drivers which, if correctly installed, will also be listed as in Figure 3-20. Check with your IT responsible or CAMO if you need support for selecting the correct drivers. In the example shown, a SQL connection is selected.

![Figure 3-20: ODBC Data Source – Selecting Database Driver](image)

After selecting the driver or database type, the user must select the server and provide the connection details (Figure 3-21). When the details are provided, the connection can be tested using the Test Connection button.
With a successful connection, the next step in the data source setup is to select the values to be used, Figure 3-22.

In Figure 3-22, the user selects which table in the database contains the values of interest. The table is selected on the left side of the view and, when a table is selected, the available fields and their types are listed on the right side. The fields of interest are selected by ticking their corresponding checkbox next to each field. After making the selection and clicking on the Next button, the user is taken to the view where the values can be labelled, Figure 3-7.

3.3.2.1 LIMS

The SampleManager LIMS™ Software is a database for laboratory data. LIMS is typically used for storing of IPC (In Process Control) sample results. It can also be used to store raw material results. Setup of a LIMS data source is very similar to the setup of other database sources. There is one difference though, and that is that there is no polling settings for LIMS, but only the data source name in the data source setup page, Figure 3-23.
The reason for not including polling information is that the use of LIMS data source in Process Pulse is as IPC, analogous to Manual Sampling. The user inserts a LIMS sample where required, including the LIMS ID, and Process Pulse is subsequently retrieving the data for the sample from the LIMS database.

3.3.2.2 ODBC (MDB File)

The ODBC connection is very similar to the ODBC (database) data source and it only differs by the choice of the database driver. Selecting the ODBC driver shows the connection screen, as shown in Figure 3-24.

![Figure 3-24: ODBC Connection Details](image)

The user specifies the location and connection details to make the connection. Contact your local IT resource, or CAMO, if you need further details about the connection.

3.3.3 Instrument

Process Pulse supports direct connection to a number of instruments. Some of these connections use vendor’s SDKs, some use other vendor’s software and some are using OPC.

In general there are three new or modified steps in the instrument data sources setup. This includes the setup data source where the sensor location is defined, the parameter setting page where the instrument parameters can be modified and the reference step where reference measurements are taken and stored.

3.3.3.1 Bruker

The Bruker connection is based on OPC UA and has very much in common with the generic OPC UA connection. After selecting the Bruker type data source, the location of the
instrument must be specified (Figure 3-25). The Server field must point to the relevant OPC UA server and instrument. The user can write the location directly or use the Browse option.

![Figure 3-25: Bruker Data Source – Setting Up Connection to OPC Server](image)

After pointing to the instrument the user can specify whether new spectra should be acquired by Polling or Event. In Polling mode, Process Pulse will request a new spectra at the given interval and the Bruker instrument will return the available spectrum. For Event mode Process Pulse will wait for new spectra being broadcasted from the Bruker instrument.

![Figure 3-26: Bruker Data Source – Parameters Settings](image)

The available settings for the Bruker instrument are shown in Figure 3-26. The user must first select the instrument in case multiple instruments are available on the specified server. For multi-channel instruments, such as Matrix-F, the user must also select which channel the data source should monitor. When the instrument is chosen the user can specify Wavelength Range, Resolution and Oldest Allowed Reference Spectrum. For the individual measurements the user can set Integration Time and Scan Count.

### 3.3.3.2 Kaiser

The Kaiser data source in Process Pulse is based on an OPC connection and requires a Kaiser OPC server. In the setup of the data source the Kaiser OPC server is identified by typing the address or browsing for the server (Figure 3-27).

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The user also chooses the data update type and the frequency of the updates. In polling mode, Process Pulse requests data at a given frequency; they are read regardless of whether they have changed from the previous reading. In event mode, Process Pulse reads data and imports only if the values have changed.

Next, the user must select the channel of the instrument on the server:

![Selection of Instrument](image)

When the required channel is selected, the user can take the Reference spectrum, *Figure 3-29*, before verifying variable names and run mode.

![Reference Spectrum](image)

### 3.3.3.3 Mettler Toledo

The Mettler Toledo connection is done by connecting to the Mettler Toledo server (*Figure 3-30*). After specifying the server connection details, the user must choose between Polling and Event modes. In Polling mode Process Pulse will request data at a given frequency; they are read regardless of whether they have changed from the previous reading. In Event mode
Process Pulse reads data and this is imported *only* if the values have changed from the last reading.

![Server configuration](image1)

**Figure 3-30: Mettler Toledo Data Source Setup**

In the next step the user selects the instrument which should be used in the data source. In *Figure 3-31* an FBRM instrument is selected and the location is indicated. The screenshot is from a simulated environment and the instrument is also simulated. Depending on the instrument selection there are different settings required. For FBRM the user selects the Sampling Interval and a template file which contains the more detailed instrument settings. For instruments which support multiple probes it is also required to select which probe should be monitored by the data source.

![Instrument selection](image2)

**Figure 3-31: Mettler Toledo Data Source - Instrument Setup**

After verifying the variable names and determining the run mode the preview of the data source is shown. In *Figure 3-32* the preview of the simulated FBRM probe is shown.

![Data preview](image3)
3.3.3.1 Ocean Optics

Ocean Optics instruments are supported in Process Pulse. After selecting the Ocean Optics data source type the instrument setup page is shown, Figure 3-33.

In the instrument setup, Figure 3-33, the available Ocean Optics instruments are listed. The user must select the correct instrument and the polling frequency for acquiring new spectra. There are no further settings for the Ocean Optics instrument and the rest of the data source setup follows the standard steps.

3.3.3.2 Tec5

The tec5 data source requires a tec5 configuration file which must be prepared before setting up the data source in Process Pulse. The configuration file contains information which Process Pulse requires to connect to the tec5 instrument. After selecting the tec5 data source the tec5 configuration file must be provided, Figure 3-34. It is also required to specify the Polling Frequency for new spectra.

In the next step of the tec5 data source setup a selection of instrument settings can be set. Figure 3-35 shows the settings available for the tec5 NIR probe which includes Integration Time, Number of Averaged Spectra, Measurement mode and the expiration of the Metadata. Metadata refers to the Dark and Reference spectra.
After specifying the instrument settings the user must request Dark and Reference spectra before the same Manage Tag Names and Run Mode steps analogously for other data sources setup.

3.3.3.3 VIAVI MicroNIR

The VIAVI MicroNIR instruments can be connected to Process Pulse via USB or through the network. After selecting the VIAVI MicroNIR data source type the user must select the VIAVI data source unit (Figure 3-36). If the sensor is connected via USB use the Scan option to identify it. If multiple sensors are available select the one which is required. NB! Any Process Pulse data source can be created to one single sensor.

In the case a wireless VIAVI sensor is used the IP address is required to connect to the unit. Select the ‘I have PAT device IP’ option and fill in the IP address of the instrument.

After identifying the sensor the settings for the sensor can be modified (Figure 3-31). The sensor can be run in Diffuse Reflectance or Transmission modes.

Figure 3-35: Tec5 Data Source - Instrument Setup

Figure 3-36: VIAVI MicroNIR Data Source Setup

Figure 3-37: VIAVI MicroNIR Data Source - Instrument Setup
User can set Integration Time of probe or use the option to let Process Pulse determine a suitable integration time by clicking the Determine button. Scan count determines how many scans should be averaged for the signal. The Reference validity is an option for the user to define an expiry date of the reference measurements to ensure that the operator remembers to renew them if required. At the expiry date Process Pulse will inform that the reference is expired.

The Scan Mode options for the VIAVI MicroNIR are only **Continuous**. This means that after starting the probe (via a configuration) the probe will record spectra until it is stopped (via a configuration). User can determine the frequency of the data collection at a given interval.

### 3.3.3.4 **ZEISS**

The ZEISS data source requires an OSIS configuration file which must be prepared before setting up the data source in Process Pulse. The configuration file contains information which Process Pulse requires to connect to the ZEISS instrument. After selecting the ZEISS data source the OSIS configuration file must be provided (Figure 3-39). In addition to selecting the OSIS file the user must select the Spectrometer Process Pulse will connect to.

**Figure 3-38: ZEISS Data Source Setup – Selecting Configuration File**

In the next step the Instrument is set up. For the instrument settings the user must specify the integration time and the validity period for the reference measurements. The user also must specify some measurement settings including Scan count, Scan Interval and Scan Mode.

**Figure 3-39: ZEISS Data Source – Instrument Setup**

After specifying the measurement settings the user must record reference spectra (Figure 3-40).
In the following steps the variable names are verified, the run mode is decided and a preview is shown.

3.3.4 Other

3.3.4.1 Manual Sampling

The Manual Sampling data source is used to define a layout for external data. In Process Pulse external data corresponds to data inserted during Process Monitoring. Terminology varies among industries but the term **IPC (In Process Control) data** is often used for external data. The Manual Sampling data sources can be used to insert the data as described in section 6.2.3.

In order to set up a Manual Sampling data source this is chosen as the data source type:

![Figure 3-41: Selecting Manual Sampling Data Source Type](image)

After selecting the name of the Manual Sampling data source the user must define what variables should be included in the data source *(Figure 3-42).*
There is a drop down option in Figure 3-42 for the user to select the view type. The view type is referring to the layout of the variables during the input of the values. The options are ‘Table view’ where each sample is a row and the variables are the columns; and ‘List view’ where the sample ID and the variables are listed in separate rows. Both view types are shown in Figure 3-43.

For the sample layout, Figure 3-43, the Sample ID is compulsory although the user can select the format of the ID. Analogously to the measurement variables the sample ID can be:

i) Real

ii) Integer

iii) String

iv) DateTime

The user can add new variables to the data source by using the Add button at the bottom of the view, Figure 3-42. A variable will correspond to a measurement in the IPC samples, e.g. pH or weight. For all variables a name and data type must be provided. The user can decide whether a variable is required or not, except the Sample ID which is mandatory. All required
variables must be populated by the operator when a new sample is added; otherwise the operator is not allowed to save the sample.

3.3.4.2 Pretreatment Model

The Pretreatment Model data sources are used to prepare data for use in Process Pulse. They are model based and require a model from The Unscrambler® X as part of the setup. The model is prepared in The Unscrambler® X and uploaded to Process Pulse as any other models.

The two types of models currently supported are:

1) Sample Alignment models
2) Instrument Diagnostic models

3.3.4.2.1 Sample Alignment

Sample Alignment is used to combine data with different sampling frequency in a common data matrix. The user can subsequently use the combined data in a model or graphical representations where aligned data are required. An example is process data and spectral data where process data can be collected every two seconds and spectral data are recorded every ten seconds. Depending on the chosen alignment method the data can be combined in different ways but for all methods the result after alignment is a data set with equal number and time aligned recordings for both process and spectral data. Sample alignment is often applied to two data sources but it can also be used for more than two data sources.

The different types of sample alignment are discussed in more detail in The Unscrambler® X documentation.

Using Sample Alignment in Process Pulse requires that a model is created in The Unscrambler® X and uploaded into Process Pulse as any other model (section 4.2). Also, the individual data sources which should be combined to create the aligned data source must exist in Process Pulse. When both criteria are met the user can set up the Pretreatment data source.

To define a new Pretreatment data source the user must select a name and choose Pretreatment Model as data source type. In the next screen the user can choose the relevant pretreatment model (Figure 3-44).
In the Model selection view, Figure 3-44, the user can choose between any of the pretreatment models uploaded in Process Pulse. Analogously to other model selections, the user must select the model and version. The model information provided after selecting the model describes the type of model chosen and importantly, the number of data sources required for the pretreatment model. In Figure 3-44 this is highlighted by the red rectangle, and the number is two.

In the next step of the Pretreatment data source setup the data sources which should be used in the data alignment steps are specified (Figure 3-45). Following the selection of data sources the user can set up the data source to be triggered or run normally as for any of the data sources.
In the final screen of the Sample Alignment (Pretreatment Model) data source setup an overview of the chosen data sources and their dimension is shown. After completion the Sample Alignment (Pretreatment Model) data source can be used like any other data source in both No Model and model based configurations. The models must obviously be created based on the dimensions of the aligned data, and not the individual data sources.

3.3.4.2.2 Instrument Diagnostics

Instrument Diagnostics is a tool for filtering of data. Different filtering options can be set up in The Unscrambler® X, saved as a model and used later to filter data in real time in Process Pulse. Data which are not meeting the filtering criteria are registered and stored as not compatible data and not used in models or plots. During monitoring the incompatible data are listed in the Input Controls tile, Figure 3-47. The counter increases with every new sample filtered away on the currently running configurations. The data removed are available in the Data Historian on the Incompatible Data tab.

![Figure 3-47: Input Controls (Incompatible Data) Tile](image)

Details on the Instrument Diagnostics tools available can be found in The Unscrambler® X documentation.

Setting up the Instrument Diagnostics follows the same steps as Sample Alignment, see section 3.3.4.2.1. Before setting up the Instrument Diagnostics data source a relevant model must be uploaded to Process Pulse. The Pretreatment Model data source is chosen and the Instrument Diagnostics model is selected. Next, the data source which Instrument Diagnostics filtering is applied to is chosen. The user can choose triggering or normal operation mode for the data source and the completed data source is listed in the data source table. The Instrument Diagnostics data source can be applied in the same manner as any other data source.

3.3.4.3 TCP/IP

The TCP/IP data source is direct port communication. After selecting the TCP/IP data source the user must specify at which Port the data will become available (Figure 3-48).

![Figure 3-48: TCP/IP Data Source Setup - Port Selection](image)

When the port is specified Process Pulse immediately tests the communication (Figure 3-49). Accordingly, data generation must be active on the chosen port during the data source setup.
In the following steps the variable names are verified, run mode is decided and a preview is shown analogously to the other data sources.

### 3.3.4.4 OPC DA

After selecting the OPC DA data source the user must specify the server in the **Server** field (**Figure 3-50**). It is also possible to browse to the right OPC server. When the correct OPC server is chosen the user must choose between Polling and Event update of the data. In polling mode, Process Pulse II requests data at a given frequency; they are read regardless of whether they have changed from the previous reading. In event mode, Process Pulse reads the data and imports it only if the values have changed.

The next step in the OPC DA data source setup is the selection of the tags to include (**Figure 3-51**). The user can navigate the hierarchy in the chosen OPC DA server and select the desired tags. The hierarchy and selection of the available tags on the OPC DA server varies from vendor to vendor. Tags are selected by the mouse and added to the data source using the **Add** button.

After adding the tag, it is listed in the **Selected Items** list (**Figure 3-51**). The tags can be moved up and down, and removed if required, to ensure that the content of the data source
become exactly as wanted. The Clear button clears the Selected Items view. For each tag the Item ID is shown together with the data type, quality and timestamp of the last reading. Aggregate allows the user to choose between End and Average aggregation. End means that the last value available on the tag is used while Average means that the average of the values since the last reading is used for the new sample.

The subsequent steps for setting up an OPC DA data source are analogous to other data sources.

### 3.3.4.5 OPC DA Spectral

OPC DA Spectral is an OPC DA data source variant adapted to spectral data. The connection is analogous to the OPC DA data source, section 3.3.4.4, except some differences in the tags selection.

![Figure 3-52: OPC DA Spectral Data Source - Tags Selection](image)

After selecting the OPC DA server the tag selector shown in Figure 3-52 is displayed. As for standard OPC DA data sources, the user can navigate the hierarchy of the OPC DA server. The difference is that only two tags are selected: One tag with values, typically an array type, and one tag with variable name. The number of elements in the Name tag must correspond to the number of elements in the Value tag. If there is no suitable Name tag available the user can use the Custom option for the variable names. In this case the user is indicating a First X and Last X, both numerical values. Process Pulse then generates as many even spaced values within this range as there are numerical values.

The subsequent steps for setting up an OPC DA Spectral data source are analogous to other data sources.
3.3.4.6 OPC UA

OPC UA is a newer version of the OPC standard for data exchange and does have many similarities with the preceding OPC DA. The first step after selecting the OPC UA data source type is to define the location of the OPC UA server providing the data (Figure 3-53). If the user has the location it can be typed in, otherwise it is possible to browse for available OPC UA servers in the network.

![Figure 3-53: OPC UA Data Source Setup - Server Identification](image)

The user also must specify whether the data should be retrieved by Polling or Event (Figure 3-53). In polling mode, Process Pulse requests data at a given frequency; they are read regardless of whether they have changed from the previous reading. In event mode, Process Pulse reads the data and imports it only if the values have changed.

![Figure 3-54: OPC UA Data Source Setup - Tags Selection](image)

The next step is to select the tags which should be monitored in the data source, Figure 3-54. User selects the tags by browsing the hierarchy on the chosen OPC UA server. Tags are selected by the mouse and added to the data source using the Add button.

After adding the tag it is listed in the Selected Items list, Figure 3-54. Tags can be moved up and down, and removed if required, to ensure that the content of the data source become exactly as wanted. The Clear button clears the Selected Items view. For each tag the Item ID is shown together with the data type, quality and timestamp of the last reading.
In the step after the tags selection, an overview of the chosen tags is shown. The user can then review whether the selection is as required. Otherwise, click the Back button and modify accordingly.

The subsequent steps for setting up an OPC UA data source are analogous to other data sources.
4 Models

Models are external files which perform analysis on the data. They are typically generated on The Unscrambler® X.

Models can be uploaded to Process Pulse. They perform analysis on the data.

In Process Pulse, raw data can be monitored and stored. However, if models are available and used, more information is accessible during monitoring. The user can for instance compare the current run with earlier runs and statistically assess whether the process is running as expected or not. The models used in Process Pulse are mainly multivariate models although some other model types are supported as well. All models created in appropriate The Unscrambler® X versions (10.3 or later) and also Models developed in some third-party software including Eigenvector, PEAXACT and Opus (Bruker) are supported.

In order to use a model in Process Pulse the model file must be uploaded. Uploaded models can later be pushed back to The Unscrambler® X for modification and update.

4.1 Model Management

Access Models through Main Toolbar > Models. The Model Management view lists all models already uploaded and available in the system that the current user has access to. Model name and Revision number are listed in addition to the date of model uploading and the type of the model, i.e. which software the model is created in. The main functions are highlighted in red above (Figure 4-1).

In order to update a model, first it must be downloaded to The Unscrambler® X or other relevant model software, and the required modifications must be done. Subsequently, the user must upload the modified model with the same name as the original model. Process Pulse will ask whether an existing model name should be used and if confirmed the revision number for the uploaded model is incremented. Do note that there is no check by Process Pulse whether two successive models use the same type of data etc., so the user must control this to avoid problems when using the model.
4.1.1 Disable a Model

Disable a model by ticking the checkbox next to it and clicking the Disable button (\[x\] DISABLE) at the top of the page. Disabled models appear in the Disabled tab.

Disabling a model allows the user to remove expired models from the view. Disabled models can be re-enabled so the disabled state can also be used to remove from the general view the models not currently in use. Do note that if a model is disabled any configurations using that model cannot be run.

4.1.2 Download a Model

A model can be downloaded by pressing the Download button (\[\downarrow\]) next to the desired model in the Model Management screen. This allows the user to save the model and use it outside Process Pulse.

The user can, as seen in Figure 4-2, choose the location where to save the model.

![Figure 4-2: Save Model File Dialog](image)

4.1.3 Push to The Unscrambler® X

Models cannot be edited within Process Pulse but must be opened in The Unscrambler® X or other suitable modelling software. Models can be pushed to The Unscrambler® X by clicking the Unscrambler button (\[\] ) next to the desired model. This opens the dialog below.

![Figure 4-3: The Unscrambler® X Login Dialog](image)
After Login, the Model is opened automatically in The Unscrambler® X. The user can review and edit the model as required in The Unscrambler® X.

### 4.1.4 Search a Model

At times there may be too many models in the Models list to find them easily. The search bar allows the user to search models by the name of the model, the Model Identifier Tag, or by the user that uploaded the model. Enter the search term in the search bar (highlighted in red below) and press the Enter key on the keyboard. The user can also use the time range fields to restrict the search further or to search for any model created within a certain time range.

![Figure 4-4: Model Management (Search Bar Circled in Red)](image)

### 4.1.5 Sorting Models

It is easier to find and organize models with the sorting feature. Click on the arrows (↑) located at the column headers in the Model Management screen. As seen in Figure 4-4, the arrows are located next to the columns **Model Name** (sorts alphabetically by name), **Uploaded** (sorts chronologically by the time the model was uploaded), **Model Software** (sorts alphabetically by the software the model was created in), and **User** (sorts alphabetically by the user who uploaded the model).

### 4.1.6 View Model Information

Clicking the Info button (ℹ️) of a chosen model opens the Model Details window as shown below. This dialog shows all information about a particular model that was input during the model setup.
4.2 Uploading a Model

To upload a model, click the Upload button on the Model Management screen. The Upload button is circled in Figure 4-1.

The screen shown in Figure 4-6 appears. Browse to select the model file.

Unscrambler® X files can contain complete projects with multiple models. If this is the case all models will be listed as shown in Figure 4-7. The user must select the model to use and
name the chosen model. The user can also enter any desired comments which are shown as part of the model information. The number of components is the chosen number of components for the model in The Unscrambler® X, and this cannot be changed in Process Pulse. It is possible to simultaneously upload multiple models from a project by selecting more than one model.

![Figure 4-7: Model Upload - Select Models (2)](image)

The Figure 4-8 appears where the user can enter values for the Model Identifier Tags. The models are tracked using these tags. The tags and corresponding values can for example be used in the search for models in the Data Historian > Model Search. The users with the appropriate credentials can modify and add tags in Preferences > Model as described in section 8.2.2.

![Figure 4-8: Model Upload - Model Identifiers](image)
The user uploading the model can decide which other users should have permissions to use the Model, as shown in Figure 4-9. Permissions can be granted to an individual user or to a group. The user uploading the model always has permission to the model. A user without access to a certain model will not see this model in his model management list.

![Figure 4-9: Model Upload - Permissions](image)

The final page shown during model upload is the Summary page. Here, all of the information entered during model upload is presented for a last check, as shown in Figure 4-10.

![Figure 4-10: Model Upload - Summary](image)

Click **Finish** button to finalize uploading the model and return to the Model Management screen.
4.2.1 Version Control

Version Control is circled in red in Figure 4-10. In Process Pulse, Version Control is also referred to as Revision Number or Version Number. All Models have a revision number and it conveys how many times the model has been uploaded and saved as a new version with the same name. The revision number ensures that a model cannot be changed or replaced without this being tracked. If a model is updated, the configuration using the model must be updated to use the latest revision of the model. All versions of a model are available for review and download if required.

4.2.2 Approve Models

It is possible to set up Process Pulse to require approval for all new models. This allows peer review of models to be tracked in the system. The functionality is activated in Preferences > Model and it can be chosen which user level is required for the approval of the models. When activated, the following button is shown for all new models:

If a user with appropriate permissions clicks the button, the model is approved and can be used normally. Prior to approval, the model is not available for any configurations.

4.3 Model Types

In addition to The Unscrambler® X models, several third-party model types are supported:

1) Opus models (Bruker)
2) PLS Toolbox models (Eigenvector)
3) Peaxact models (S-Pact)

The third-party models can be used analogously to Unscrambler® X models. All the steps in the model upload process are the same and the third-party models can only be used in the specific configuration types (see section 5.2.2).
5 Configurations

Configurations are the combination of the Data Source, Models and output setup. Typically, a Configuration is set up by a developer and can later be used by operators to monitor a process or system.

There are a number of Configuration types in Process Pulse. Mostly, the Configuration type has the same name as the model (e.g. the Batch configuration is for Batch models).

In No-Model configurations, like No Model, Dynamic MCR and Dynamic PCA, data can be collected and stored without predefined models. In the case of No Model, there is no model executed. Dynamic MCR and Dynamic PCA perform a Moving Block calculation as new data are recorded. It is possible to define the number of samples within the moving windows and the number of expected components.

5.1 Configuration Management

The list of configurations, Figure 5-1, is accessed using the Configuration option in the main menu. This takes the user to the Configuration Management view where all available configurations are listed.

In addition to the names of the available configurations also the Method types are listed. This corresponds to the type of configuration. For each configuration there are also two dates given, Date Created which corresponds to when the configuration was made, and Date Started which corresponds to the start time for any running configurations. For configurations not running Date Started is NA. User ID is the username for the user who created the configuration. The final information column contains State information. The three different states for a configuration are Stopped, Pulsing and Running. The Stopped state indicates that the configuration is not running, Pulsing means that the configuration is in the startup stage, i.e. after starting the configuration but before recording any data. In the Running state data are collected and handled according to the setup of the configuration.
5.1.1 Disable a Configuration

Disable a configuration by ticking the checkbox next to it and clicking the Disable button (DISABLE) at the top of the page. Disabled configurations appear in the Disabled tab. Disabled configurations can be re-enabled in the Disabled tab by clicking the Enable button (ENABLE).

Disabling a configuration allows the user to remove expired configurations and also to hide configurations which are not in use. This is particularly useful in environments where there are many product changes.

5.1.2 Barcode for a Configuration

The user can generate barcodes and QR codes for the configurations. This is done by ticking the checkbox next to the configuration of interest and clicking the Barcode button. The interface shown in Figure 5-2 is then displayed.

![Figure 5-2: Configuration – Generate Barcode Screen](image)

In the barcode interface the user can choose between Barcode and QR code in addition to the action which should be assigned to the code. The options are Start or show, Start, and Show, and it is used to indicate the action which should be triggered when using the code. The code also contains configuration ID and revision of the configuration. The user can select which revision should be coded in the Revision drop down list.

Barcodes can be printed or saved by clicking the Print or Save buttons:
If barcodes are printed onto stickers these stickers can be included in process running instructions so that a user can later scan the code and start or show the correct configuration.

The barcodes can be used in the Web Terminal as described in section 9.3, while the QR codes can be used from any device with access to a web browser and the URL address encoded in the QR code.

5.1.3 Search for a Configuration

At times there may be too many configurations in the Configuration list to find them easily. The search bar allows the user to search configurations by the name of the configuration, the configuration metadata tags, or by the user that created the configuration. Enter the search term in the search bar highlighted in red below, and press the Enter key on the keyboard. The configurations on the list will be filtered by the search criteria entered.

5.1.4 Sort Configurations

Like in Models, it is easier to find and organize configurations with the sorting feature. Click the arrows button ( ) located by the column headers in Configuration Management to trigger the sorting. As seen in Figure 5-4, the arrows are located next to Configuration Name (sorts alphabetically by name), Date Created (sorts chronologically by the date the configuration was created), Date Started (sorts chronologically by the date the configuration was started), Method (sorts alphabetically by the model type the configuration was created with), and User ID (sorts alphabetically by the user who created the configuration).
5.1.5 Filter Configurations

The Configuration Management page has a function to filter the configurations. This is especially useful if there are many configurations in the list, as it helps the user to identify the configuration of interest in an efficient manner.

Clicking on the Filter button (circled in red above), will open a small box with the filter options, as shown in Figure 5-6. The user can use these options to limit the configurations shown in the view. Ticking the Groups only option will show only the existing configuration groups. Configuration groups are defined in section 5.3. The Running only option will show only configurations that are currently running.

5.1.6 Edit a Configuration

Clicking the Edit button ( ) of a chosen configuration will bring the user back to the same steps available during Configuration Setup, which is described in Section 5.2.
5.1.7 Edit Configuration Permissions

Clicking the Users button ( ) of a chosen configuration will open the Permissions page for changing the user permissions for the configuration. Permissions can be changed, added and/or removed, and the changes will be saved after clicking the Save button.

![Permissions - PLS 01](image)

Figure 5-7: Configuration Permissions

5.1.8 View Configuration Information

Clicking the Info button ( ) of a chosen configuration opens the Configuration Details window as shown below. Configuration Details includes a history of revision for the chosen configuration, as well as the model used.

![Configuration Information](image)

Figure 5-8: Configuration Information

Each of the revisions of the configuration is listed and has a separate Info button ( ). Clicking this button opens a new window with more detailed information about the specific revision. Multiple revisions can be selected and the accompanying windows can be compared to each other.
5.2 Configuration Setup

Create a configuration by clicking the New Configuration button ( ) in the Configuration Management page. This results in the following view:

![New Configuration Screen](image)

**Figure 5-9: New Configuration Screen**

5.2.1 Configuration Setup - Configuration Name

The configuration name input is shown in **Figure 5-10** and **Figure 5-11**.

![New Configuration Name Input](image)

**Figure 5-10: New Configuration Name Input**

The user must type the Configuration Name. If used an existing configuration name, when going to the next step the user will be warned about it is going to modify an existing configuration, i.e. create a new revision of it. If that is not the desired action, it can be cancelled and use a different configuration name.

5.2.2 Configuration Setup - Configuration Type

The user must also select the Configuration type on the Configuration Type setup page, **Figure 5-11**. The configuration types are in general relating to the model type the user wants to apply, as the different models have different outputs and plots. Overall, the configuration types are named according to the type of model which it applies for.

![Configuration Type](image)

**Figure 5-11: Configuration Setup - Selecting Method**

5.2.3 Configuration Setup - Choose Model

The next step is to choose a model. This does not apply if No Model was chosen as Method in the first setup page.
The drop down in Figure 5-12 contains all models uploaded and available in the system of the Model Type that correspond to the Configuration Type selected on the first setup page. For models with multiple revisions the Version Number must be selected after selecting the model.

Once a model is chosen, the information for that model is shown, as seen in Figure 5-13.

Tick the Allow to modify model parameters checkbox if it should be possible to update the mean centering during monitoring.

5.2.4 Configuration Setup - Choose Data Source

After selecting the model the next step is to choose the Data Source and accompanying Version Number. Some basic information about the data source selected is also presented, as shown in Figure 5-14.
5.2.5 Configuration Setup - Output

On the Output setup page, the user can decide which results and graphs should be available for plotting. The options depend on the type of model as different models have different outputs available.

**NB!** Plots which are not selected in this page are not available for plotting during process monitoring.

In **Figure 5-15** the options for a PCA configuration are shown.
Under **Scores** it is possible to choose between Line and Scatter plots.

Tick the **Raw Data** checkbox to make the configuration display the raw data alongside the model.

**Outlier Detection** options are: Q residuals, F residuals, Hotelling’s $T^2$ and Influence Plot.

### 5.2.6 Configuration Setup - Display Options

In the Display options page the user can customize how the data should be presented. The items on this page will vary depending on the selections made on the previous screen.

The checkbox circled in red below is the **Autoscaling** option. When it is ticked, the Minimum, Maximum and Increment text boxes cannot be changed, as shown in *Figure 5-16*. To customize these, untick the Autoscaling checkbox, as shown in *Figure 5-17*.

![Configuration Setup - Display Options (Autoscale Enabled)](image-url)
05. Display Options

Specify settings for each plot individually.

<table>
<thead>
<tr>
<th>Model</th>
<th>Variable</th>
<th>Components</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Increment</th>
<th>Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCA01</td>
<td>Scores</td>
<td>5</td>
<td>0</td>
<td>10</td>
<td>1</td>
<td>Linear</td>
</tr>
<tr>
<td>PCA01</td>
<td>Hotelling's T²</td>
<td>5</td>
<td>1</td>
<td>5</td>
<td>1</td>
<td>Linear</td>
</tr>
<tr>
<td>PCA01</td>
<td>Q Residuals</td>
<td>5</td>
<td>2</td>
<td>8</td>
<td>1</td>
<td>Linear</td>
</tr>
<tr>
<td>PCA01</td>
<td>Influence</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>1</td>
<td>Linear</td>
</tr>
</tbody>
</table>

**Figure 5-17: Configuration Setup – Display Options (Autoscale Disabled)**

The scale of the axes can be customized in the **Scale** drop down, as shown in **Figure 5-18**. The user can choose between Linear and Logarithmic.

**Figure 5-18: Configuration Setup – Display Options – Scale**

The display options can also be changed later during the configuration run and this is the recommended approach. To learn how to do this, go to **Section 6**.

5.2.7 Configuration Setup - Layout

On the Layout setup page, the layout of the configuration output can be modified (see **Figure 5-19**). The layout can be a matter of preference while it can also be defined by certain requirement for a project. In addition to define the layout, the user can also define what should go into each of the plots. What is displayed in a certain plot can be changed during monitoring as described in **Section 6**.
5.2.8 Configuration Setup - External Output

It is possible to set up Process Pulse to write data or results to third-party systems during monitoring. This can be used in Model Predictive Control (MPC) setups where e.g. predicted values are used as input to a control loop. It is also possible to make outputs available for use in other configurations in Process Pulse. Note that the output is exported in parallel to be saved in the Process Pulse database.

The dropdown shown in Figure 5-20 contains the supported formats for External Output.

Each output format has a form that must be filled in. Each type of form is discussed in the sections below.

For all of the External Output formats the user selects what should be written. The options include raw data and various model statistics. The available model statistics depend on the type of model. In the case of PCA for instance, Scores, Hotellings T2, Q and F residuals are available for output.
### 5.2.8.1 Configuration Setup - External Output - ASCII

ASCII output is a file output and requires a destination for the files and the specifications of the file layout as shown in *Figure 5-21*.

The options and meaning of the file specifications are as follows:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Destination Directory</strong></td>
<td>This is the location where the file(s) are written to during configuration runs. The location can be specified directly or found by using the Browse option.</td>
</tr>
<tr>
<td><strong>File Name Pattern</strong></td>
<td>This is the stem of the name used for the saved file(s). Process Pulse adds a suffix containing a timestamp-based unique ID to avoid overwriting files from multiple runs or multiple files from the same run. E.g. if output.csv is chosen as filename pattern the written files have filenames: output_suffix.csv.</td>
</tr>
<tr>
<td><strong>Time Zone</strong></td>
<td>This allows the user to choose what time zone should be used in the output. Options are UTC and local.</td>
</tr>
<tr>
<td><strong>Missing Value Symbol</strong></td>
<td>This defines how any missing data should be represented in the file.</td>
</tr>
<tr>
<td><strong>Enclose Text In</strong></td>
<td>This allows the user to define if the text should be enclosed by single quotes, double quotes, or not enclosed: None: <code>text</code>, <code>text</code></td>
</tr>
</tbody>
</table>
Max File Size: This defines the acceptable size in megabytes of the output files. If value is 0 then each file will contain one sample only.

Separator Options: This defines how data elements are separated in the file, e.g. for csv choose ',' and format is 1,2,3 etc.

Export Row Headers: When ticked, row headers are exported in every file.

Export Column Headers: When ticked, column headers are exported in every file.

### 5.2.8.2 Configuration Setup - External Output - GRAMS

GRAMS (aka SPC) output is a file output and requires a destination for the file and specification of the file layout as shown in Figure 5-23.

The options and meaning of the file specifications are as follows:

#### Figure 5-24: External Output - GRAMS Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Destination Directory</td>
<td>This is the location where the file(s) are written to during configuration runs. The location can be specified directly or found by using the Browse option.</td>
</tr>
<tr>
<td>File Name Pattern</td>
<td>This is the stem of the name used for the saved file(s). Process Pulse adds a suffix containing a timestamp based unique ID to avoid overwriting files from multiple runs or multiple files from the same run. E.g. if output.csv is chosen as filename pattern the written</td>
</tr>
</tbody>
</table>
files have filenames: output_suffix.csv.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Time Zone</strong></td>
<td>This allows user to choose what time zone should be used in the output. Options are UTC and local.</td>
</tr>
<tr>
<td><strong>Max Samples Count</strong></td>
<td>This defines the acceptable number of samples to include in the output files.</td>
</tr>
</tbody>
</table>

5.2.8.3 **Configuration Setup - External Output - Modbus**

Modbus output is based on the Modbus protocol and requires a destination for the data as shown in Figure 5-25.

**Figure 5-25: Modbus Output Form**

The options and meaning of the file specifications are as follows:

**Figure 5-26: External Output – Modbus Specifications**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Port</strong></td>
<td>This is the port number used for the Modbus communication.</td>
</tr>
<tr>
<td><strong>Slave Id</strong></td>
<td>This is the Slave ID within the Modbus protocol.</td>
</tr>
<tr>
<td><strong>UID Register Reference</strong></td>
<td>UID is the Unique Identifier for every result.</td>
</tr>
<tr>
<td><strong>Register reference</strong></td>
<td>This defines the register for the different results. Each result requires two consecutive registers by default. Result in this context corresponds to array so a three components model has three scores and requires 6 registers. The chosen register location cannot be overlapping.</td>
</tr>
</tbody>
</table>
5.2.8.4 *Configuration Setup - External Output - ODBC*

ODBC output is used for writing to databases and requires a database and a table as shown in *Figure 5-27*.

![Figure 5-27: Configuration Setup - External Output: ODBC](image)

The options and meaning of the file specifications are as follows:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Database</td>
<td>This is the database where data are written. Using the Browse button the user can link to the correct database.</td>
</tr>
<tr>
<td>Table name</td>
<td>When a database is selected, the available tables are listed in the Table name field. The user can select the required table.</td>
</tr>
</tbody>
</table>

5.2.8.5 *Configuration Setup - External Output - OPC DA*

OPC DA output is using the OPC DA protocol for external output as shown in *Figure 5-28*.

![Figure 5-28](image)
The options and meaning of the file specifications are as follows:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Server</td>
<td>This is the server where data are made available. Currently only CAMO OPC DA Server is supported and external systems must read values from there, i.e. data are retrieved by an OPC DA client. Use the Browse button to select the local CAMO.PP.DA server from the list.</td>
</tr>
</tbody>
</table>

Tag  
These are the tags which will be used for the corresponding output elements.

### 5.2.8.6 Configuration Setup - External Output - OPC UA

OPC UA output is using the OPC UA protocol for external output as shown in [Figure 5-29](#).

![Figure 5-29: Configuration Setup - External Output: OPC UA](image)

The options and meaning of the file specifications are as follows:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Server</td>
<td>This is the server where data are made available. Currently only CAMO OPC UA Server is supported and external systems must read values from there, i.e. data are retrieved by an OPC UA client. Example: net.tcp://PPMainServiceHost:8010</td>
</tr>
</tbody>
</table>

Tag  
These are the tags which will be used for the
5.2.8.7 Configuration Setup - External Output - PP

PP output is an external output which makes output from a configuration available as input for other Process Pulse configurations. The screen for setup of PP external output is shown in Figure 5-30.

![Figure 5-30: PP Output Form](image)

The options and meaning of the file specifications are as follows:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Source Name</td>
<td>This is the name the data source is given. The data source name for a PP external output is available for other configurations as any other data sources in Process Pulse. Obviously, the configuration where the PP External Output is defined must be running for any data to be available.</td>
</tr>
</tbody>
</table>

5.2.8.8 Configuration Setup - External Output - TCP-IP

TCP-IP output is based on the TCP/IP protocol and requires a destination for the data as shown in Figure 5-31.
The options and meaning of the file specifications are as follows:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Destination Host</td>
<td>This is the IP address of the listening host.</td>
</tr>
<tr>
<td>Destination Port</td>
<td>This is the TCP/IP port over which data are sent.</td>
</tr>
</tbody>
</table>

5.2.9 **Configuration Setup - Run Mode**

In the Run Mode setup page, the Run Mode can be selected:

**Normal** is the default run mode and this means that the operator starts and stops the configurations. Alternatively, the **External Trigger** option can be chosen, which means that the configuration is triggered by predefined requirements. The predefined requirements relate to any of the data sources defined for Process Pulse and can be chosen as shown in **Figure 5-33**.
Note that the appropriate revision number of the data source must be chosen as well. When the data source is chosen the criteria for triggering must be defined. The criteria can either be String or Numeric.

When setting up the Trigger criteria the user selects the variable which should be evaluated, the logical operator to be used and the value, as shown in Figure 5-34.

![Figure 5-34: Defining External Trigger Criteria](image)

Obviously, the value must correspond to the type of variable.

### 5.2.10 Configuration Setup - Notifications

In the Notifications setup page, the user can choose to set up Notifications for the configuration. Notification is a general label for warnings and alarms, and they can be based on model limits from the model development in The Unscrambler® X or user defined. The different types of notifications are described in the next sections.

#### 5.2.10.1 Configuration Setup – Notifications - Select Alarms

The first tab in the Notifications page is ‘Select Alarms’ (Figure 5-35). Here, the default alarms from The Unscrambler® X for the model type are listed. The list will also be updated with any new user defined alarms created in the other tabs.
For each alarm there are a number of radio buttons allowing the user to designate the notification as Alarm, Warning or None. The levels determine how the notification should be presented to the end user as shown in Figure 5-36, where Warning, Alarm and None are shown from left to right.

The E-mail checkbox allows the user to define e-mail recipients for the chosen notifications. The pre-requisite here is that e-mails have been set up in Preferences > Notifications as described in section 8.2.10.

For the default notifications there is a default message to accompany it. This message is used in Notifications list, Warning and Alarms tile, and stored in the database. The user can customize the message after unticking the Default Message checkbox.

In the user defined messages the user can use the system variables from the default messages:

- [configName]: Name of the running configuration where the notification is raised.
- [sample]: Sample label (if it exists) for the sample which caused the notification.
- [timestamp]: Timestamp for the sample which caused the notification.
5.2.10.2 Configuration Setup – Notifications - User Defined Alarms

In the User Defined Alarms tab the user can set up alarms based on the variables available in the data source used in the configuration (Figure 5-37). The user can also define alarms for the output variables from the configuration such as predicted values (Y). The output variables are found on the bottom of the Variables list.

![Figure 5-37: Configuration Setup – Notifications – User Defined Alarms](image)

The process of setting up a User Defined Alarm is as follows:

- Go to User Defined Alarms tab.
- Type the desired Alarm Name and click on the Add button.
- Select the alarm just added from the list.
- Select Variable, Operator and Value for the selected alarm.
- The alarm is automatically defined and added to the list in the Select Alarms tab.
- Go to Select Alarms tab.
- Type in the Custom Message for the new user defined alarm.

After setting up a User Defined Alarm it can be edited by selecting it in the list of User Defined Alarms.

**NB!** All notifications for a configuration must have unique names.

5.2.10.3 Configuration Setup - Notifications - Multiple Criteria Alarms

In the Multiple Criteria Alarms tab the user can set up combinations of existing notifications which should trigger a new notification (Figure 5-38). Any of the Notifications from the list in the Select Alarms tab can be included in a Multiple Criteria Alarm.
The process of setting up a Multiple Criteria Alarm is as follows:

- Go to Multiple Criteria Alarms tab.
- Write the desired Alarm Name and click on the Add button.
- Select the alarm just added from the list.
- Select the alarms (Notifications) to be included and click on the Add button.
- The selected Notifications are added to the list. The user can add as many notifications as required.
- Choose the operator for the Multiple Criteria Alarm. The options are ALL and ANY.

After setting up a Multiple Criteria Alarm it can be edited by selecting it from the list of Multiple Criteria Alarms.

**NB!** All notifications for a configuration must have unique names.

### 5.2.10.4 Configuration Setup - Notifications - Trend Alarms

In the Trend Alarms tab the user can define alarms based on a series of samples (Figure 5-39). The test is based on the number of samples meeting the test criteria within a defined number of successive samples, e.g. 3 out of 5. The test is always performed on the most recent samples for a configuration, e.g. the last 5 samples.
The process of setting up a Trend Alarm is as follows:

- Go to Trend Alarms tab.
- Type in the desired Alarm Name and click on the Add button.
- Select the alarm just added from the list.
- Select which Variable should be used and the relevant operator.
- Set Value for the alarm. Depending on the variable selected, there are two options here: System Limit and User Defined. System Limit applies to the default limits from The Unscrambler® X. For the system limit the user can choose a Multiplier to modify the limit, e.g. enter 2 for 2 * T2 limit. For the User Defined limit the user defines the value.
- Determine the window size, i.e. the number of successive samples the test should be performed on.
- Set the number of samples to meet criteria. This must be equal to or less than the window size.

After setting up a Trend Alarm it can be edited by selecting it from the list of Trend Alarms.

**NB!** All notifications for a configuration must have unique names.
5.2.11 Configuration Setup - Permissions

In the Permissions setup page, the permissions to view and use the configuration can be assigned to individual users or to groups, *Figure 5-40*. The user creating the configuration has always permission to her configurations by default.

![Figure 5-40: Configuration Setup - Permissions](image)

**Read** will grant the user permission to start a configuration and view its data, offline and online. **Edit** will grant the user permission to modify a configuration. **Disable** will grant the user permission to disable an existing configuration. Please note that users of type Operator can only have Read permissions. The definition of User Groups is described in section 8.1.

5.2.12 Configuration Setup - Summary

The Summary page displays a summary with all the settings defined during the Configuration setup, *Figure 5-41*. The summary page can be used to review settings and ensure that all required modifications are recorded. Clicking **Finish** completes the Configuration Setup, and takes the user back to the Configuration Management page.
5.3 Configuration Groups

A Configuration Group is a selection of configurations which the user for some reason chooses to group together. The configuration group is a logical entity which is shown in the configuration list with Method labelled with this icon:

Starting a Configuration Group starts all configurations within the group which are not running, and stopping a Configuration Group stops all running configurations within that group. Configurations can be started and stopped individually even if they belong to a Configuration Group.

Choosing the New Group option allows the user to set up Configuration Groups. The interface for the Configuration Group set up is shown in Figure 5-42.
The user can set the name of the group by clicking the Edit button ( ). While typing the group name the Check and Cancel buttons are available.

After confirming the group name, the user must select any number of configurations (at least one) to be included on the group. Then click the Finish button to save the changes.

## 5.4 Running a Configuration

From the Configuration Management page, a configuration can be run by clicking the Start button ( ).

The user is then automatically taken to the Start Configuration page (Figure 5-43).

![Figure 5-43: Starting a Configuration](image)

In the Start Configuration page (Figure 5-43) the user can select which revision of the configuration should run, where default is the latest revision. In the Tags drop down menu the user can select which Metadata Template should be used for the configuration run. The Metadata template determines which configuration tags are used for the experiment. Setup of the metadata templates is explained in section 8.2.14.

The metadata tags or experiment tags are fields the user can populate with context information for the configuration run. The tags are either text, numerical or drop down lists depending on the setup, see section 8.2.16. The mandatory tags are labelled by an asterisk [*] and all of these fields must be populated before the user is allowed to run the configuration. Process Pulse remembers the values from the previous run, so if no changes are made the metadata are the same as for the previous run. The metadata tags can be used to retrieve the data in Data Historian, see section 7.3.1.

After populating the metadata tags and clicking Next the user is taken to the Main View, where he will see the configuration running. The next section will discuss all of the actions that can be done during a configuration run.
6 Process Monitoring

The main purposes of Process Pulse are to monitor processes and predict results during the processing. A range of plots and tools are available to make the monitoring as efficient as possible. This includes annotation, labelling and interaction with the process data during monitoring.

Do right-click any of the plots to open the context menu seen below. Figure 6-1 shows each item on the menu with some references to the sections where the item is explained further.

![Figure 6-1: Plot Context Menu]

6.1 Plots

There is a range of plot types available in Process Pulse. Right-clicking the plot and choosing Plots will open a context menu with the available plot types (Figure 6-2). The number of plots available in the context menu changes according to the type of running configuration.

Together, Table 6-1, Table 6-2 and Table 6-3 show all available plots in Process Pulse.

![Figure 6-2: Plot Type Context Menu]
6.1.1 Raw Data Plots

There are numerous ways of representing data graphically. The plot types in Table 6-1 are the plots available for viewing raw data in Process Pulse.

<table>
<thead>
<tr>
<th>Plot Type</th>
<th>Description</th>
<th>New Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timeline</td>
<td>Variable vs. Time</td>
<td>Added to the end of the line.</td>
</tr>
<tr>
<td></td>
<td>Multiple y-axes are available.</td>
<td></td>
</tr>
<tr>
<td>Spectral</td>
<td>Spectral data (NIR, NMR). X axis is wavelengths, frequencies etc.</td>
<td>Plotted on top of old data. The 5 previous spectra are shown in grey.</td>
</tr>
<tr>
<td>Process</td>
<td>Plotting variable values as bars for a sample.</td>
<td>Plotted on top of old data, only last sample is visible.</td>
</tr>
<tr>
<td>Process variable</td>
<td>A box-plot variant. For each variable a box with whiskers is plotted. The median is shown as a horizontal line. The range is the quartiles of the sample selection, and the extent of the whiskers can be modified.</td>
<td>Plotted as a point on the box, red outside the whiskers, orange outside the box and green inside the box.</td>
</tr>
<tr>
<td>Scatter</td>
<td>Plots two or more variables against each other.</td>
<td>New point.</td>
</tr>
<tr>
<td></td>
<td>Multiple y-axes and point series are available.</td>
<td></td>
</tr>
</tbody>
</table>
6.1.2 Configuration-Specific Plot Types

There is a range of plots available to present specific model outputs. Table 6-2 contains the configuration-specific plots with information about compatible configurations. The plots available for SPC, Moving Block Modeling and Batch Modeling are shown in Table 6-3 as the plots for these configurations are more specialized.

In models where scores are available, scores can be viewed in either scatter or line plots. Scatter plots show score values for each sample in a plot where the axes correspond to different scores, typically PC2 vs. PC1. Line plots show one or more of the scores available in the model plotted along the time axis.

<table>
<thead>
<tr>
<th>Table 6-2: Configuration-Specific Plots</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plot</td>
</tr>
<tr>
<td>--------</td>
</tr>
<tr>
<td>Scores</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Hotelling's T2</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Q Residuals</td>
</tr>
<tr>
<td>Influence</td>
</tr>
<tr>
<td>Histogram</td>
</tr>
<tr>
<td>F Residuals</td>
</tr>
<tr>
<td>Y Predictions</td>
</tr>
<tr>
<td>Concentration Profiles</td>
</tr>
<tr>
<td>Eigenvalues</td>
</tr>
<tr>
<td>Plot Type</td>
</tr>
<tr>
<td>---------------------------------------</td>
</tr>
<tr>
<td><strong>SPC Configuration Only</strong></td>
</tr>
<tr>
<td>I Chart</td>
</tr>
<tr>
<td>Moving Range (MR) Chart</td>
</tr>
<tr>
<td>X bar Chart</td>
</tr>
<tr>
<td>S Chart</td>
</tr>
<tr>
<td>R Chart</td>
</tr>
<tr>
<td><strong>Moving Block Model Configuration Only</strong></td>
</tr>
<tr>
<td>Moving Block Mean</td>
</tr>
<tr>
<td>MB Standard Deviation</td>
</tr>
<tr>
<td>Moving Block % RSD</td>
</tr>
<tr>
<td>Moving Block F-test</td>
</tr>
<tr>
<td><strong>Batch Configuration Only</strong></td>
</tr>
<tr>
<td>Trajectory Scores</td>
</tr>
<tr>
<td>Trajectory Model Distances</td>
</tr>
<tr>
<td>Trajectory F residuals</td>
</tr>
<tr>
<td>Batch Contribution</td>
</tr>
</tbody>
</table>
6.2 Annotations

Annotations make it possible to add extra information to specific data points. The annotations are stored with the data and can thus be used in the analysis or review of the data as well as the real-time tracking of events. The available annotations are flags, comments and samples, and they are added manually during process monitoring. The Annotation Management window (Figure 6-3) is opened by right-clicking a data point on a Configuration plot and selecting Annotation Management (Figure 6-1).

NB! Click directly on the line or point; otherwise Annotation Management will not appear as an option on the context menu.

In all Annotations, the Sample Timestamp can be modified (indicated in Figure 6-3). The system automatically chooses the original timestamp of the data point. It can be changed by selecting the calendar icon ( ) at the right of the Sample Timestamp box.

6.2.1 Flags

Flags are markers used to highlight events that occur during process execution such as phase changes or process adjustments. Flags can be added to a running Configuration in real time in the Annotation Management window (Figure 6-3).

Open the Flag drop down menu, as shown in Figure 6-4. Here, the user can see all the available flags. Configuration started and Configuration stopped cannot be selected because these are default flags the system adds automatically at the start and stop of the configuration. Select the desired Flag and click Save. The Flag is now connected to the data point.
The flags can be used as reference points for comparison of previous runs with the current run. Accordingly, if a flag is marking a phase change for instance, using the offline data function the process evolution after the phase change can be compared with an earlier run. This is described in more detail in section 6.11.

### 6.2.1.1 Creating a Flag

There are two default flags, i.e. Configuration started and Configuration stopped. The user defined flags are created in Preferences > Comparison Flag, where the user can create, enable, disable and search flags with a chosen colour and event (Figure 6-5).

![Figure 6-5: Flag Management in Preferences](image)

### 6.2.1.2 Viewing Flags

After creating a flag, the flag counter in the Flag tile in the bottom tiles is incremented (Figure 6-6).
Opening the flag tile by clicking it shows the list of flags. The flags can be searched and viewed or removed.

6.2.2 Comments

The user can insert Comments to share observations or add context information. Comments are a free text addition, analogous to a remark in a laboratory journal. A comment can be added by right-click on a data point of a running configuration, and select Annotation Management (Figure 6-4). Enter text in the Comment box and click Save. The comment is now associated with that data point.

Comments are marked in the plots by the comment symbol, a black speech bubble icon next to its associated data point (Figure 6-7).

Mouse-over the comment symbol gives information about the sample corresponding to the point as well as the comment (Figure 6-8).

The list of all comments for the running configurations can also be reviewed by clicking Comment in the bottom tiles, shown in Figure 6-9.
In the list of comments it is possible to edit or delete any of them.

### 6.2.2.1 Comment - Attachments

The user can attach files at a data point using Attachments. This can be useful e.g. if operators have cameras and take pictures to document deviations or unclear observations. Attachments appear as Comments in both the bottom tiles (Figure 6-9) and on the plot (Figure 6-7). Analogously to text comments the user can add attachments in the Annotation Management window (Figure 6-3).

Clicking the open file button ( ) will allow the user to select the file to attach, as shown below in Figure 6-10. Choose a file and click Open.

By default all file types can be attached except: .exe, .com, .bat, .cmd, .vbs, .vbe, .js, .jse, .wsf, .ws, .msc, .ps1. The list of denied file types can be modified in Preferences > Configuration.

### 6.2.3 External Samples - IPC

During a process run it might be required to take samples and analyse them at-line or offline. In many industries this is called In Process Control (IPC) samples. Process Pulse allows the user to register samples and store measurement results with the online process data. A record of samples and results are thus stored and it is easy to use IPC results in the process monitoring or future reports and data reviews.

There are two main types of IPC sampling supported in Process Pulse: 1) Manual Sampling and 2) LIMS sampling. For the Manual Sampling the user must add the sample ID and the
values for the sample manually, while for the LIMS sampling the user adds the LIMS ID of the
sample and Process Pulse retrieves the corresponding values automatically. For both types
of sampling the IDs can be read from a barcode. Before using external samples they must be
set up as data sources, use the types “Manual Sampling” or “LIMS Sampling”. The External
Sample data sources are available across configurations and the user selects the appropriate
sample type before inserting IDs and results.

To insert an External Sample do right-click on a data point of a running configuration, and
select Annotation Management (Figure 6-3). Then select External Sample, which is
indicated in Figure 6-11. Select Sample Type and Sample Type Name, and click Save.

![Figure 6-11: Annotation Management - External Sample Input](image1)

To insert an External sample do right-click on a data point of a running configuration, and
select Annotation Management (Figure 6-3). Then select External Sample, which is
indicated in Figure 6-11. Select Sample Type and Sample Type Name which enables input of
the sample ID and values (Figure 6-12).

![Figure 6-12: Annotation Management - External Sample ID and Values Input.](image2)

When the required information is filled in, click Save. Do note that the samples can be
viewed, edited and removed from the Samples tile (Figure 6-13).
6.2.4 Multiple External Samples - IPC

The user can add Multiple External Samples (Figure 6-14). This can be useful if there is a series of samples which should be registered. One example is if samples have been taken, measured and recorded on paper during the processing then the operator might want to register all samples in one operation. Another example is if one operator is controlling multiple reactors monitored in multiple configurations and is required to sample across all of them at a given time point.

The Multiple External Samples interface, Figure 6-14, allows the user to select the type of external sample, configuration to add values into and subsequently add (Add button) any number of samples. Save button triggers the storing of the added samples.

6.3 Notifications

In Process Pulse, Notifications is the term used for Warnings and Alarms. These notify the user if one of the model or user defined Limits are exceeded.

In traditional statistical process control Warnings correspond to control limits, and Alarms correspond to critical or alarm limits in the operation.
Apart from Warnings and Alarms, there are also **System Alerts**, which tell the Process Pulse administrator about any system issues.

A **Limit** is passed when a variable is too high or low. Then a notification is provided to the operator, and appropriate action can be taken to avoid any further issues.

The specification of Warning and Alarm Limits are specified in the **Configuration** setup as described in section 5.2.10.

Any notifications are provided to the operator in four different ways:

1) **Colouring of the Configuration card**

   During process monitoring, the Configuration card turns amber for Warnings, and red for Alarms.

   ![](image)

   **Figure 6-15: Notification on Configuration Cards**

2) **Warnings and Alarms tile**

   The tile counts the number of notifications, and also displays the type of notification and accompanying message. The notifications bottom tile (Warnings and Alarms) is shown in **Figure 6-16**. Unlike the Notifications list, the bottom tile counter only contains notifications from running configurations. If the same notification is repeated for successive samples the notification type and text are shown once and the number of occurrences is displayed.

   ![](image)

   **Figure 6-16: Bottom Tiles (Warnings and Alarms Tile Circled)**

3) **Notifications list**

   The notification is also added to the Notifications List, whose location is circled in **Figure 6-17**. It contains all previous notifications until they are acknowledged, which removes them from the Notifications List.
For stopped configurations the list entry is modified to display the total number of warnings and alarms not acknowledged during a configuration run, i.e. it is sufficient to acknowledge the warnings and alarms once for stopped configurations. For running configurations the list contains the same information as the Warnings and Alarms tile except that it is possible to acknowledge the notifications.

The purpose of the acknowledge function is that the operators by acknowledging the notification confirm that it is received. The User ID and time for acknowledging the notifications are recorded in the Audit Trail to allow audits of interaction with running configurations.

Clicking the Acknowledge button shown in Figure 6-18 will Acknowledge a notification and remove it from this view.

It is possible to require signatures for acknowledging alarms. The setup of this is described in section 8.2.10.

4) E-mail (optional)
It is possible to set up Process Pulse to send notifications by e-mail. This allows the user to look after a process remotely. All processes are of course not suitable for remote monitoring only.

The requirement for using e-mail notifications is that an SMTP server is set up and available for connection for Process Pulse to send emails. The setup of this is described in section 8.2.10.

### 6.4 Offline Data

In Offline Data, it is possible to search for previous runs of a configuration and overlay these with the current run in a Combined Plot. The data are aligned either by Configuration Started flag or by user defined flags. Again, in Process Pulse “Offline Data” means that it is from a previous configuration run and that the data are collected from the Process Pulse database.

To access Offline Data, right-click on a running configuration plot, select **Offline Data** from the context menu, and then select **Search**. The option to Clear offline data, shown in the window on the right in *Figure 6-20* below, becomes available when there have been Offline Data added to the plot.

![Figure 6-19: Plot Context Menu - Offline Data Options](image)

If the user clicks **Offline Data > Search**, the window shown in *Figure 6-20* appears. There, the user can search by flags, configuration, and date range to find past data.

![Figure 6-20: Offline Data Search](image)
Ticking a checkbox next to an item and clicking **OK** will plot the chosen data in the plot for the current run. The offline data are marked using a dotted line as shown in *Figure 6-21*.

![Figure 6-21: Offline Data Search - Plot Showing Offline Data](image)

The overlay of the earlier run allows the user to visually assess whether the current run is similar or different to earlier runs. Note that no model is needed and this tool can be used with No Model configurations as well as any of the model configurations. The overlay is only available for time-based plots.

### 6.5 Trend Analysis

**Trend analysis** is an opportunity for the user to interactively review trends in running configurations. **Trend analysis** is added from the plot’s context menu (*Figure 6-23*) and is available for timeline and scatter plots.

![Figure 6-22: Plot’s Context Menu - Trend Analysis Option](image)
For the time plots, trends are calculated based on the samples in the time domain. This is done by looking at moving windows in the data, and any calculations are always done for the $n$ most recent samples. The trend analysis is split in two, where the first part contains Moving Average and Exponential Moving Average. For these two calculations the size of the moving window and the alpha level (EWMA) can be set. The result within each window is shown as a point in the plots providing a view of the change in the average.

The second part of calculations includes Mean, Standard Deviation and Min-Max. Again the calculations are performed on the $n$ last samples and the user can decide the size of the moving window. The difference compared to the Moving Averages is that the results for the second part are shown as dotted horizontal lines in the plot as shown in Figure 6-25.

![Trend Analysis Window](image)

**Figure 6-23: Trend Analysis Window**

By choosing a large window for the second part of the calculations, e.g. 200 or larger, the horizontal lines are providing an estimate for the mean or standard deviation for full run.
The trend analysis options for scatter plots are a bit different compared to time series trends, as shown in *Figure 6-26*. For scatter plots, the trends are numerical fitted trends, i.e. polynomial, linear, exponential or logarithmic.

![Figure 6-25: Types of Trend Analysis for Scatter Plots](image)

The fit equations are displayed in the legend as shown in *Figure 6-27*.

![Figure 6-26 Example of Trend Line for a Scatter Plot](image)

In the example, a 4th Order Polynomial is fitted as shown in the legend.

For all types of trend analysis the trend is added to specific plots. It is possible to add trend analysis for multiple plots of the same configuration.

### 6.6 Save plots

It is possible to save plots from running configurations. This is done by selecting **Save** from the plot’s context menu. Activating the option allows the user to save the selected plot anywhere on the disk in PNG format. The saved plot has the layout which was shown at the time of selecting **Save**, i.e. all trend lines zoomed areas are shown as they were.

### 6.7 Experiment Metadata

The **Experiment Metadata** option in the plot’s context menu provides a view of the metadata for the configuration as shown in *Figure 6-27*. The metadata is the same information provided during the configuration start. Each individual metadata element, e.g. Experiment ID, is labelled a ‘tag’. The exact layout of the metadata tags is determined in **Preferences > Metadata Template** and the use is explained in section 8.2.14.
Next to the tags in the Experiment Metadata view there is an Edit symbol ( ) allowing the user to modify the tag’s value. When changing the value the user also needs to provide a reason for the modification (Figure 6-28). Change is confirmed by choosing Save in Experiment Metadata view.

After modification of the value the tag field is highlighted and the previous value as well as the reason for the modification is available (Figure 6-29). The change and reason for change is also tracked in Audit Trail.

Using the metadata templates in Preferences > Metadata Template, section 8.2.14, quite complex metadata patterns can be designed. It is for instance possible to define phases (Figure 6-30), and the tag values can be changed for each of these
phases as they come about. A phase change can for example be due to feeding in bio-processes, addition in chemical processes, change of raw material batch, etc.

![Experiment Metadata View for a Metadata Template Including Phases](image)

**Figure 6-30** Experiment Metadata View for a Metadata Template Including Phases

As can be seen in **Figure 6-30**, the values are an input to a new phase and, if required, the user can go back and modify the values for earlier phases. Changes are then tracked as described above.

### 6.8 Visualization

The **Visualization** submenu contains different options to customize the presentation of the plots to fit the user needs. Hiding/showing annotations and legends are also available from this submenu. The following subsections describe each of the entries on this submenu.

#### 6.8.1 Show Legend

The **Show Legend** option from the Visualization submenu shows the legends for a plot. In general the legend is the name of the variable which is plotted, i.e. the y-label. One notable exception to this is that legend for scores, where trend analysis is used as the legend.

#### 6.8.2 Show Annotations

The **Show Annotations** option from the Visualization submenu shows/hides the different annotations that are available for plots, as Attachments and Flags.

#### 6.8.3 Chart Options

In **Right-click > Visualization > Chart Options**, **Figure 6-31**, plot colour and layout can be specified.
There are four tabs in the Chart Options window: Main Settings, Axis X, Axis Y, and Series.

6.8.3.1 Chart Options - Main Settings

In the Main Settings tab, the user can customize the background color of the Configuration plots (Figure 6-32).

Any colours and combinations are allowed although the user does need to consider contrast with colours chosen for points etc.

6.8.3.2 Chart Options - Axis Settings

Under both tabs, Axis X and Axis Y, the user can modify the appearance of the tick marks on each axis, as shown in Figure 6-33.
The user can also adjust the Height and Thickness of the tick marks on the axes.

### 6.8.3.3 Chart Options - Series

Under the Series tab, the user can customize how Process Pulse represents the data point series in the plot as shown in Figure 6-34.

![Chart Options - Series](image)

**Figure 6-34: Chart Options - Series**

The user can modify the colour of the points, style of the lines as well as symbol styles and sizes. If the plot to be modified has multiple series there is a drop down allowing the user to select the different series. After selecting a series the settings made apply to this series only.

### 6.9 Configuration Plot Formatting

During configuration setup it is possible to do some plot formatting (Section 5.2.6), but it is also possible to customize the plots in a configuration during a configuration run.

#### 6.9.1 Configuration View Menu

The configuration view options can be changed by clicking the menu button () in the top-right corner of the Main View, as shown below in Figure 6-35.
The options for the different plot types vary. Figure 6-36 shows the options for time series plots and Figure 6-37 shows the options for Scores scatter plots. Raw data scatter plot has similar options to Scores scatter plot but the Calibration Scores option is replaced by Y-Axis option.

The complete listing of options from the real-time configuration view menu is shown in Table 6-4.

<table>
<thead>
<tr>
<th>Menu Item</th>
<th>Options</th>
<th>Relevant plots</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>View</strong></td>
<td><strong>Plot</strong>: Shows the plot.</td>
<td>All</td>
</tr>
<tr>
<td></td>
<td><strong>Numeric Values</strong>: Shows numerical values.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>One value at a time, the value is replaced</td>
<td></td>
</tr>
<tr>
<td></td>
<td>when a new measurement is available.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>**Timestamp and variable name is shown as</td>
<td></td>
</tr>
<tr>
<td></td>
<td>well.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Table View</strong>: Shows a table with</td>
<td></td>
</tr>
<tr>
<td></td>
<td>timestamp and values. New values are added</td>
<td></td>
</tr>
<tr>
<td></td>
<td>to the top of the table.</td>
<td></td>
</tr>
<tr>
<td><strong>Y-axis</strong></td>
<td>Single: One y-axis.</td>
<td>Time series plots</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Multiple: Multiple y-axes, selection done in Select Series.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Select series</strong></th>
<th>Select variables or series to be shown in the plot. If Multiple Y-axes is selected then multiple selections can be done.</th>
<th>Time series plots</th>
</tr>
</thead>
</table>

| **Calibration Scores** | Hide: Shows scores values for new data only. | Scores plots |
| Show: Shows scores values for calibration set used in model building in addition to scores for new data. |

<table>
<thead>
<tr>
<th><strong>X Series</strong></th>
<th>Select the series/variables for the x-axis.</th>
<th>Scores scatter and raw data scatter</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th><strong>Y Series</strong></th>
<th>Select one or more series/variables for y-axes.</th>
<th>Scores scatter and raw data scatter</th>
</tr>
</thead>
</table>

| **View** | Overview: Shows box-cox type plot for one or more variables. The central horizontal marker shows Median, rectangle shows Quartiles, and whiskers shows the Defined range (see below). | Process Variables plot |
| Time Series: Shows time series plot for one or more variables. (This is done by switching to time series plot). |

| **Window size** | 10 Samples. | Process Variables plot, Histogram |
| 30 Samples. |
| 100 Samples. |
| 1000 Samples. |
| Defines the window size for the calculations in the Process Variables and Histogram Plot. |

<table>
<thead>
<tr>
<th><strong>Whisker Range</strong></th>
<th>Min-Max: Uses a whisker range of min and max value within the chosen</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Process Variables plot</td>
<td>Process Variables plot, Histogram</td>
</tr>
</tbody>
</table>
window (see above).

±1.5 IQR range: Uses a whisker range of ±1.5 the inter-quartile range (IQR) within the chosen window (see above). This corresponds to the standard Box-Cox plot.

Bin size Defines the number of bins to use in histogram plots.

6.9.2 Time Range

The time range of the plots is shown as a blue or green (depending on the time selection is static or dynamic) shaded area on the time bar on the dashboard (Figure 6-38). Click and drag or pull the edges of the shaded area to change the time range.

To modify the time range directly, right-click the time bar, and the context menu shown in Figure 6-39 will appear.

In addition to the predefined time ranges, there is a Custom time range option, which opens a dialog as shown in Figure 6-39. Here the user can enter the time range manually.
The Full Range option corresponds to the full time range of the running configuration.

### 6.9.3 Axis Scale and Range

The scale and range of the Y axis can be modified. Right-clicking on the vertical axis of a plot opens the context menu (Figure 6-40).

The axis scale can be changed to logarithmic or inverse in the context menu that appears. Inverse means that smallest values are on the top of the axis as opposed to the traditional view where the largest values are on the top of the axis.

The axis range can be modified in **Set Limits**. (If the **Auto** option is selected, the range will adapt during processing so that all samples are in the frame at all times.). Notice that the Lower Limit is on the top and Upper Limit is at the bottom.

### 6.10 Advanced Plot Use

The vision for Process Pulse is that in addition to view data and results in real time it should be possible to interact with the plots to explore and understand process behaviour interactively during processing.
6.10.1 Drill Down Plots

In some of the plots double-clicking on any chosen data point opens a second plot which provides more information about the point, such as contribution plots for scores points. This process of digging into points of interest is called Drill Down. In some plots, it is possible to Drill Down once (1st level), and then drill down again into the plot that appears (2nd level).

<table>
<thead>
<tr>
<th>Plots</th>
<th>1st Level</th>
<th>2nd level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scores plot</td>
<td>a. Transformed raw data with ranges from</td>
<td>Most recent values for selected variable.</td>
</tr>
<tr>
<td></td>
<td>reference set</td>
<td>None.</td>
</tr>
<tr>
<td></td>
<td>b. T2 contribution with ranges from reference</td>
<td></td>
</tr>
<tr>
<td></td>
<td>set.</td>
<td></td>
</tr>
<tr>
<td>Residuals plot</td>
<td>a. Residuals contribution with ranges from</td>
<td>None.</td>
</tr>
<tr>
<td></td>
<td>reference set</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b. T2 contribution with ranges from reference</td>
<td></td>
</tr>
<tr>
<td></td>
<td>set.</td>
<td></td>
</tr>
<tr>
<td>T2 plot</td>
<td>a. Residuals contribution with ranges from</td>
<td>None.</td>
</tr>
<tr>
<td></td>
<td>reference set</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b. T2 contribution with ranges from reference</td>
<td></td>
</tr>
<tr>
<td></td>
<td>set.</td>
<td></td>
</tr>
<tr>
<td>Influence plot</td>
<td>a. Residuals contribution with ranges from</td>
<td>None.</td>
</tr>
<tr>
<td></td>
<td>reference set</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b. T2 contribution with ranges from reference</td>
<td></td>
</tr>
<tr>
<td></td>
<td>set.</td>
<td></td>
</tr>
<tr>
<td>Y Predicted</td>
<td>Transformed raw data with ranges from</td>
<td>Most recent values for selected variable.</td>
</tr>
<tr>
<td></td>
<td>reference set</td>
<td></td>
</tr>
</tbody>
</table>

An example of a Scores plot is shown in Figure 6-42. As listed in Table 6-5, it is possible to drill down twice in Scores plots.

![Figure 6-42: Example of Drill Down Plot – Level 0 (Scores)](image)

After double-clicking on one of the data points, the raw data and the Hotellings T2 contribution plot is shown (Figure 6-43). The raw data in this model is NIR data and the transformed raw data are shown since it is the transformed data which are used in the model.
After double-clicking on e.g. wavelength 1352, the time series of the variable is shown (Figure 6-44).

6.10.2 Combined Plots

Time series from different time line plots can be overlaid to create Combined Plots. In Figure 6-45 a combined plot showing the predicted value, octane, is overlaid the first scores vector.
Combined Plot is created by dragging a time series to another timeline plot. To perform this function, hold down Ctrl-key, click on the selected time series and drag it to the plot where series should be combined. If there are multiple time series in the source plot, all of them will be shown in the combined destination plot.

Combined Plots supports overlay of plots from one or from multiple configurations.

6.10.3 Mouse and Keyboard Gestures for plots

There are a number of different mouse and keyboard gestures available. They are listed in Table 6-6.

<table>
<thead>
<tr>
<th>Shortcut</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Esc</td>
<td>Resets plot to default view.</td>
</tr>
<tr>
<td>Click + drag</td>
<td>Moves plot along timeline (time-plots only).</td>
</tr>
<tr>
<td>Mouse wheel</td>
<td>Zooms in and out.</td>
</tr>
<tr>
<td>Right-click</td>
<td>Opens the Drop-down Context Menu.</td>
</tr>
<tr>
<td>Shift + select</td>
<td>Marks a rectangular area and zooms in on it.</td>
</tr>
<tr>
<td>Mouse over</td>
<td>Shows values and timestamp for the selected point.</td>
</tr>
<tr>
<td>Ctrl + drag</td>
<td>Creates Combined Plots.</td>
</tr>
<tr>
<td>Double-click points</td>
<td>Drills Down on data.</td>
</tr>
</tbody>
</table>
7 Reviewing Data

The “Review” section on the main toolbar consists of Audit Trail, Report and Data Historian functionalities.

Common for Audit Trail, Report and Data Historian is that they are used after running configurations. They can be accessed while configurations are running but obviously any review of a running configuration is by nature incomplete.

7.1 Audit Trail

The Audit Trail provides a record of actions performed by different users in Process Pulse as shown in Figure 7-2. Each of the activities are recorded with a timestamp, User ID who took the action and corresponding user level, machine from which the action was taken and the description of the action itself.

It is possible to search for relevant items and generate audit trail reports in PDF format. The search can be narrowed down by entering From and To dates, and the results can be sorted by any column by clicking any arrows (üşay). If the action is a change in a data source, model or configuration, it is possible to use the Compare Now function to compare the settings before and after the change, as shown in Figure 7-3.
By comparing the settings, the differences between the two revisions are easily spotted. Note that Process Pulse increases the revision number for all configurations and data sources that the user edits, even if no changes are implemented.

### 7.2 Reports

Process Pulse can generate reports based on data from earlier configuration runs. The reports provide a summary of the configuration run and can be used to document a process run, in product releases, etc.

All Reports have the general format shown in Figure 7-4.

The Reports are based on templates which are created by the user, and later can be applied to new data sets. Reports are created by applying an existing template to a chosen data set. Reports cannot be generated without a suitable template.

Selecting Reports in the Review section of the main toolbar (Figure 2-3), the screen shown in Figure 7-5 appears. The screen lists the report templates currently available for the user. It is possible to Edit and Delete the created templates. Clicking the edit button takes the user.
through the same steps as the New Template setup. If there are many templates in the list it can be useful to use the search functionality to find the correct template.

Figure 7-5: Report - Templates List

To make a report, first **Create a Template** and then **Generate Report**. If the user wants to use a previously existing template, simply slick **Generate Report**.

### 7.2.1 Setting Up a Template

Reports are configuration type specific. Accordingly, the first step in the report template setup is to choose a configuration type in the **Method Filter** drop down. On the first page it is also required to choose a name for the template. The name must be unique, and Process Pulse gives a warning message if this is not the case. If a new report should replace an existing report with the same name, it is suggested to use the Edit option from **Figure 7-5**.

Figure 7-6: Report Template Setup - Main Information

In the next page, indicate whether a sensitivity label should be used. The sensitivity label is a stamp on the report and does not include access control to printed reports which must be handled separately external to Process Pulse. Sensitivity labels can be customized under Preferences > Report.
Decide whether to include an approval section. A sample Approval section is shown in Figure 7-8, and if included then the approval section takes up the first page of the report. The text for the approval section can be modified in Preferences > Report.

In the Header Definition setup page, shown in Figure 7-9, the user can modify the Header. In Figure 7-4, this is the [Info about Configuration] section. The list itself is not modifiable, but the user can choose which elements to include from the list. Do not confuse this header with the Section headers in Table 7-1.

NB! The list has some predefined items but it is extended with the configuration metadata. Accordingly, if the user wants to include some specific information in the header this can be achieved by adding a configuration metadata tag in Preferences > Experiment Tags.
The numeric format page in the template setup allows the user to specify the layout of the numbers in the report (Figure 7-10). The user can specify the number of decimal digits and select Exponential (Scientific) Notation or not.

Figure 7-10: Report Template Setup - Numeric Format

The layout of the report is specified in the content definition (Figure 7-11). Here, it is decided which elements should be included in the report and the specifications of each of these elements.

Figure 7-11: Report Template Setup - Content Definition

The available elements are listed in Table 7-1.

<table>
<thead>
<tr>
<th>Table 7-1: Report Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Element</strong></td>
</tr>
<tr>
<td>Section headers</td>
</tr>
<tr>
<td>Text fields</td>
</tr>
<tr>
<td>Input fields</td>
</tr>
<tr>
<td>Charts</td>
</tr>
</tbody>
</table>
Chart templates | Display any plots included in a chart template previously saved from the CDM. Only plots suitable for the selected data will be displayed.

Tables | Information from the configuration tables including flags, external samples, comments and notifications.

Results table | Summaries for variables such as sums or averages. The selection of the samples can be limited to those within the chosen time range that satisfies specific criteria, e.g. within alarm limits.

All the elements in the report are sequentially numbered (Figure 7-12). The user cannot modify this although the elements can be moved to ensure that the desired sequence is achieved. Elements can be moved by selecting them and using the up/down arrows as seen in Figure 7-11. The selected items can be edited using the edit button ( ↗).

Figure 7-12: Report Template – Example of Template Layout with Numbered Items

Defining a Section Header or Text Field element the input is simply header or text block. For the Input Field element the input is a static lead text and a help text which is available as mouse over information when the user is generating the report. The Chart element allows the user to choose from the plots which are available for the current type of configuration. The user can also insert a caption for the figure; no caption results in the label Figure x, where x is the sequence number for the chart element. The radio buttons for Folded and Unfolded apply if the report is generated using multiple process runs. In that case Folded view results in the runs being plotted on top of each other (Figure 7-13). The Unfolded view results in the runs being plotted side by side (Figure 7-14).

Figure 7-13: Folded View: Different Runs are Plotted on Top of Each Other
Figure 7-14: Unfolded View: Different Runs are Plotted Side by Side

The Chart template element works similarly to the Chart element just including the plots defined and configured in the template saved from CDM. Note that only plots suitable for the data/model will be displayed. The table element works analogously to the chart element allowing the user to include tables listing comments, external samples, flags or notifications. The Results Table element allows the user to include calculations and assessments in the report (Figure 7-15).

Figure 7-15: Report Template – Results Table Settings

The Calculations option to the right allows the user to calculate Sum, Average and Standard Deviation. It is also a Count function which counts the occurrences of the variable. The Min-Max boxes allow the user to define acceptable ranges for the calculated values. The presentation of the results is shown in Figure 7-16. The variable is indicated in the
parenthesis in the left column, the results are shown in the centre column and PASS/FAIL is shown in the right column. If no ranges are given the labels are set to PASS.

<table>
<thead>
<tr>
<th>Calculation</th>
<th>Value</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sum (octane)</td>
<td>8879</td>
<td>PASS</td>
</tr>
<tr>
<td>Average (octane)</td>
<td>89</td>
<td>PASS</td>
</tr>
<tr>
<td>Count (octane)</td>
<td>100</td>
<td>FAIL</td>
</tr>
<tr>
<td>Standard Deviation (octane)</td>
<td>2</td>
<td>PASS</td>
</tr>
</tbody>
</table>

4. Calculations

![Figure 7-16: Report Template – Example of Presentation of Calculations](image)

The sample filter (left side in Figure 7-15) allows the user to filter the results which are used in the calculations. Accordingly, calculations can be based on e.g. only passing samples. There are two types of Sample Filter (Figure 7-17): Variable Filter, where the user can select variables and define the criteria using a relational operator and a chosen value; and Notification Filter, where the user can choose among the Notifications which are available for the configuration. For Notification Filter no relational operators are available, as sample can only be either within or outside limits.

![Figure 7-17: Report Template – Combining Filter Options](image)

The user can combine filters as shown in Figure 7-17. A sample can either meet the requirement in a filter (PASS) or not (FAIL). PASS for a combination of filters requires that all filters are PASS.

![Figure 7-18: Report Template – Options Available for Output](image)

The view of filters and results in the report is defined using the Output checkboxes (Figure 7-18):


i) Include sample filter results: If ticked, the results for each sample are shown.

ii) Display individual values of variable: If ticked, this displays the values of the variables which are used in criteria.

iii) Display each condition result: If ticked, the results (PASS/FAIL) for each condition in the Sample Filter are displayed.

iv) Display all conditions result: If ticked, the results (PASS/FAIL) for the combined criteria are displayed.

The view of the report when all options are included is shown in *Figure 7-19*.

### 4. Calculations

<table>
<thead>
<tr>
<th>Sample Time</th>
<th>Sample name</th>
<th>Q Residues</th>
<th>Limit</th>
<th>octane</th>
<th>val&lt;90</th>
<th>Accept</th>
<th>octane</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017-07-05 09:04:54</td>
<td>S007</td>
<td>0</td>
<td>FAIL</td>
<td>88</td>
<td>FAIL</td>
<td>FAIL</td>
<td>88</td>
</tr>
<tr>
<td>2017-07-05 09:04:57</td>
<td>S008</td>
<td>0</td>
<td>FAIL</td>
<td>87</td>
<td>FAIL</td>
<td>FAIL</td>
<td>87</td>
</tr>
<tr>
<td>2017-07-05 09:05:00</td>
<td>M52</td>
<td>0</td>
<td>FAIL</td>
<td>86</td>
<td>FAIL</td>
<td>FAIL</td>
<td>86</td>
</tr>
<tr>
<td>2017-07-05 09:05:03</td>
<td>H52</td>
<td>0</td>
<td>FAIL</td>
<td>88</td>
<td>FAIL</td>
<td>FAIL</td>
<td>88</td>
</tr>
<tr>
<td>2017-07-05 09:05:06</td>
<td>S003</td>
<td>0</td>
<td>PASS</td>
<td>89</td>
<td>FAIL</td>
<td>FAIL</td>
<td>89</td>
</tr>
<tr>
<td>2017-07-05 09:05:09</td>
<td>S003</td>
<td>0</td>
<td>PASS</td>
<td>89</td>
<td>FAIL</td>
<td>FAIL</td>
<td>89</td>
</tr>
<tr>
<td>2017-07-05 09:05:12</td>
<td>S004</td>
<td>0</td>
<td>PASS</td>
<td>89</td>
<td>FAIL</td>
<td>FAIL</td>
<td>89</td>
</tr>
<tr>
<td>2017-07-05 09:05:13</td>
<td>S0010</td>
<td>0</td>
<td>PASS</td>
<td>91</td>
<td>PASS</td>
<td>PASS</td>
<td>91</td>
</tr>
</tbody>
</table>

*Figure 7-19: Example of Report Layout Where a Notification and Variable Filter are Applied and Shown*

The Caption area for Results Table element, *Figure 7-15*, is used to define the static caption for the element.

### 7.2.2 Generate a Report

If the desired template exists, select **Generate Report**. In the Report Input Parameters page, *Figure 7-20*, select a template, configuration, and revision number. The search can be further refined by providing a date-time range. The report generator supports reports including several runs. Note that the type of configuration is defined in the Report Template and only data from the same configuration type can be used in a template.

A data search returns a list of configuration runs. Tick the checkboxes next to the chosen configuration runs, and click **Next**.
In the Report Fields Definition page, Figure 7-21, the user can do some modifications to the plots. The options for modification vary from plot to plot. This is also the step where the user can add information in the input field elements.

The plots and elements which can be modified are labelled with the Edit icon (📝). Click the Edit button to access the modifications.

After all modifications are done, click Next to view the final report (Figure 7-22). In this page the user can Print or Save the report. The supported file formats are PDF and DOC.
It is possible to add a company logo like shown in Figure 7-22. This and other layout modifications for Reports are done in Preferences > Report.

### 7.3 Data Historian

Data Historian includes these data handling possibilities: Data Search, Model Search, Flag Search, Replay, CDM Search, and Data Import, as shown in Figure 7-23.
7.3.1 Data Search

Data Search allows the user to search and review data from previous configuration runs. All plots and interaction tools that were available for a configuration during the original run can be reviewed and used in retrospect. This includes all annotations, any axis customization and all notifications. The data will be presented in the plot types that were originally chosen during the configuration setup so the user can review the Configuration exactly as it was during a run. Also new Annotations can be inserted, viewed and edited as required.

![Data Search - Search Criteria](image1)

**Figure 7-24: Data Search - Search Criteria**

The search options are shown in *Figure 7-24*. The user fills in search criteria as required and uses the Search button (🔍) to perform the search. The user can fill in search criteria using free text. Alternatively, by double-clicking in the fields the list of available options can be selected from a drop down list. Note that if there are no logical options the list is empty, e.g. there is no drop down list for revision numbers until the configuration name is selected.

It is possible to search within a time range (*Figure 7-25*). For the time range search the user can select dates, but the range can be specified further by using times. The default time if no time is specified is 00:00:00 so it is recommended to double-check that the day you are interested in is included in the search period.

![Date Selection View](image2)

**Figure 7-25: Date Selection View**

For advanced searches, filters can be applied. The user gets access to filters via the filter button ( 🔍 ) which displays the filter options (*Figure 7-26*).
The fields shown in the filter option correspond to the metadata tags included for configurations as described in section 8.2.3. Analogously to the search fields in Figure 7-24, the fields can be populated by free text or relevant options can be chosen from drop down lists. For numerical tags, relational operators can be used in addition to the “equal to” premise.

On the top of the filter options there are two options relating to: i) Sample Alignment Data, and ii) Incompatible Data. Including sample alignment data means that also data used for sample alignment, i.e. data before the alignment operation, are included in the search. In the same manner Incompatible Data are included if this option is selected.

The Clear button clears all search fields and allows the user to restart the specification of search criteria.

If the search returns multiple configurations and revisions the Search Results window shown in Figure 7-27 is displayed. The figure shows a list of all configurations meeting the search criteria. The user selects then the configuration of interest from the list.

When the search is completed and, if required, the appropriate configuration is selected from the Search Results window, the results are shown (Figure 7-28).
The Selected Experiment drop down menu indicated by the arrow in Figure 7-28, can be used to select among different configuration runs. The search is configuration centric so a search with constraints will return a configuration with a certain revision number. The drop down menu contains all runs for the specific configuration satisfying the search criteria. The user selects the run to review.

The search results can be exported to an ASCII or Excel data file using the Download button. Data can also be pushed to The Unscrambler® X if it is installed in the system.

In the results view there are 5 tabs containing different types of information. If the corresponding type of information is not available for the chosen run the tab is greyed out.

7.3.1.1 Data Search: Results tab

The Results tab view is shown in Figure 7-29.

As seen in Figure 7-29 there are several views in the results tab. The active view in the figure is the Results Chart. This view is effectively what user saw when configuration was running. The layout and selection of plots are the same which were chosen during the configuration
setup, and the user can interact with the plots in the same manner as when the configuration was running, i.e. insert annotations, change plots, modify chart options, etc.

The **Data Table** view shows the data table for all samples. The samples are listed line by line with timestamp followed by the measured values. It is possible to change values in the **Data Table** by double-clicking the value. The value can only be changed if a reason for the change is given. After any value is changed the change is highlighted by colouring in red the **Results** tab, and also by colouring in red the borders of the cell for the changed value (*Figure 7-30*).

**NB!** Note that no results are updated when the raw data are changed.

*Figure 7-30: Modifying Raw Data from Data Search*

The **Data Chart** view shows two raw data plots by default, one spectral and one time series plot (*Figure 7-31*). The two raw data plots can be changed and modified although only to other raw data or transformed raw data plots. Nevertheless, it is possible to add annotations, review offline data, add trends, modify metadata and make chart modifications.

*Figure 7-31: Data Chart View from Results Tab*

The **Results Table** view shows a table with the results for all the samples found in the search. Each sample is identified by a timestamp. The exact content of the results table depends on
the type of configuration and correspond to the output settings during configuration setup, section 5.2.5.

The **Transformed Table** shows the transformed raw data and each sample is identified by timestamp. It is not possible to modify values in the **Transformed Table**.

### 7.3.1.2 Data Search: Annotations

In the **Annotations** tab, all the annotations added to the configuration run or during the review are listed. They are split into **Flag**, **Comments** and **Samples** views, *Figure 7-32*.

![Figure 7-32: Samples View in Annotations Tab](image)

The **Flags** view lists all flags added to the configuration run including the default Configuration Started and Configuration Stopped flags, while the **Comments** view lists all inserted comments. In *Figure 7-32* the **Samples** view is shown. It is possible to select samples type (Manual Sampling or LIMS, if available) as well as the Sample Type name and revision. The list displays all samples inserted during the configuration run for the corresponding sample type.

### 7.3.1.3 Data Search: Warnings/Alarms

The **Warnings/Alarms** tab lists all Notifications raised during the configuration run (*Figure 7-33*).

![Figure 7-33: Warnings/Alarms Tab with the List of Notifications](image)

### 7.3.1.4 Data Search: Incompatible data

The **Incompatible Data** tab lists all incompatible data identified during the configuration run.

### 7.3.1.5 Data Search: Metadata

The **Metadata** tab displays the metadata generated during the configuration run (*Figure 7-34*).
Figure 7-34: Experiment Metadata and Sample Metadata Views in Metadata Tab

There are two views in the Metadata tab: **Experiment Metadata** and **Sample Metadata**. The **Experiment Metadata** corresponds to the metadata tags for the configuration. The first line represents the values captured as part of a configuration start and if the values have changed during the configuration run, new lines are added with the updated values. The **Sample Metadata** will display information about the sample files processed for Folder read-out data sources.

### 7.3.2 Model Search

The **Model Search** allows the user to search for models installed in the system. The search view is shown in **Figure 7-35**. Analogously to **Data Search**, the fields can be populated by free text or by double-clicking and selecting from the drop down list of relevant alternatives.

![Figure 7-35: Model Search (Export Options Circled in Red)](image)

The available search criteria are: model names, time ranges, and the model tags. The model tags are the model identifiers populated during the model upload to Process Pulse. The model identifiers can be modified in **Preferences > Model** (see section 8.2.2).
In Figure 7-35, the results from a Model Search are shown. It is a list of the models meeting the search criteria, including the revision number and state. State can be Enabled or Disabled, depending on the model is available for use or not. The Model Software used for generating the model is also listed.

Any of the models in the list, Figure 7-35, can be selected and either opened in The Unscrambler® X (if installed on the system), or downloaded for use in third-party applications using the export buttons circled in red in the figure.

### 7.3.3 Flag Search

Flag Search searches configurations based on Flags. Then, if desired, it is possible to do a Flag Analysis. The view of the Flag Search is shown in Figure 7-36. As seen in the picture, the search is based on configuration name, flag type and date range. Using the Filter option ( ), the user can specify tag values as search criteria analogously to Data Search.

As described in Section 6.2.1, important events can be marked by Flags by a user during the Process Monitoring. Each type of event has a different coloured Flag designated. The user defines flags and corresponding colours in Preferences > Flags (see section 8.2.11).

To do a flag analysis, do a flag search selecting the flag of interest. Then, choose two configuration runs where the same flag has been used. Click Analyze to execute the flag analysis. In the flag search Process Pulse aligns the selected configurations with respect to the chosen flag. The result screen is shown in Figure 7-37. All data are aligned with relative times according to the time for the flag. In the Chart tab the user can step through the different variables and view how the different configuration runs with aligned data compares.
7.3.4 Replay

The purpose of the Replay option is to allow the user to compare the performance of different models for the same data. Figure 7-38 displays the view of the Replay page.

The first step in Replay is to search for the data which should be used in the comparison. This is done by using the search options analogously to Data Search. The search returns a list of experiments satisfying the criteria in the Experiment Selection box. When selecting one or more Experiments, a list of applicable models appears in the Model Selection box. Select two or more models by choosing them from the drop down menu and clicking Add. The models are then added to the Model Selection list (Figure 7-39). Note that only models of the same type are allowed.
Clicking **Analyze** displays the results from the comparison (*Figure 7-40*). The user can step through the different **Plot Types** using the upper left list selector. The selection of **Plot Types** depends on the type of models and are identical with the model output plots available during a configuration run. If data from multiple runs were selected the user can switch between these using the **Experiment ID** selector. The right-most list selector in *Figure 7-40* allows the user to change between different components if available. Different components in this context means different YPred arrays as well as different score components etc.

*Figure 7-40: Data Historian – Replay Results (Plot View)*

The results can also be viewed in Table format, *Figure 7-41*, by selecting Table View.
7.3.5 CDM Search

CDM is an abbreviation for Central Data Matrix. It is a tool for reviewing data, including varying options for adapted graphical representation and calculations. It is possible to save the adaptations in templates and later use these in reports. There are two types of templates:

i) **CDM template** – This is a template which contains the search options for the CDM and is specific for those data. This template can be used if the user is working with a data set and wants to revisit this in a later session. CDM templates are managed on the **Matrix** tab.

ii) **Graph template** – This is a template containing the user defined settings for a specific graph/plot in CDM. The template is not data specific and can be applied to other data than those used when creating the template. Graph templates are managed from the plot’s context menu on the **Chart** tab.

The start screen for CDM is shown in Figure 7-42. On the top there are search options analogously to the **Data Search** view. Note that while Data Search results are configuration-based, CDM Search results are experiment-based (configuration runs). In CDM, the term ‘experiment’ is widely used instead of ‘configuration run’.

A logical operator will appear next to any numerical fields. **Experiment ID** is numerical in the example setup used here.
The search can be further refined by using the tag selector button ( ), which gives access to all the metadata tags (Figure 7-43). In the Metadata view the user can select the relevant metadata templates which will show the tags included in the template. The Default Tags option shows all tags available.

The buttons in the bottom of the view allow the user to load a CDM template, save a CDM template, download data to file, and push data to The Unscrambler® X.

Entering the relevant configuration information and searching will return the dialog shown in Figure 7-44 where all experiments meeting the search criteria are listed, including start and stop time and metadata tags. The Hide Empty Columns toggle allows the user to hide columns without information. The user can select specific experiments by ticking the checkbox next to the experiment, or select all listed experiments by ticking the checkbox next to the headers in the header row.
After selecting the required experiments, clicking OK imports the data and displays the list of experiments in the CDM Matrix tab (Figure 7-45). All variables are listed in separate columns. If different configuration types are shown, all data types are shown for all experiments, and the variables with data available are indicated by ticks in the corresponding checkboxes.

Experiments (configuration runs) can be removed from the list by right-clicking in the margin next to the desired experiment and selecting the Remove option (Figure 7-46). Additional experiments can be added by doing a new search and selecting the required experiments as described above. An experiment can only be added once, and a warning is given if an experiment is selected a second time.

The user can plot data directly from the CDM matrix by selecting one or more cells with data from the CDM matrix tab. Cells can be selected analogously to cell selection in a spreadsheet: mouse click and Ctrl button for multiple selections. Right-clicking the selection offers the Plot menu with the plot layout currently chosen in the Chart tab (Figure 7-47). The user selects which section of the grid the data should be plotted in. The plot can be viewed in the Chart tab.
The user can perform calculations on the data available in the CDM matrix. The calculations are accessed through the Add button at the bottom left in the Matrix tab.

The Add Calculated Columns options are shown in Figure 7-49. Variable Name is the name chosen for the added column. For Expression Type there are three options:

- **Formula** – This is the standard calculations including standard operators (+, - , /, *) and basic functions (sum, stddev, etc.). It is analogous to Add Columns options in No Model configurations.
- **Fixed** – This is some defined calculations performed along the variables. Calculations include Derivative, Integration and Normalization in addition to the smooth operations Savitsky-Golay, Moving Average and Exponential Moving Average.
- **Trend** – This is fitting of different trend functions to the trend in the data. Trends available are Linear, Log Linear, Exponential and Polynomial.

In the three types of calculations there are additional settings depending on the type of calculation. The variables (columns) to include in the calculation are chosen in the Variables drop down list, and the desired functions are chosen in the Functions drop down list. The selections are shown in the Formula field where it also can be modified.
The Add Interpolated Column options are shown in Figure 7-50. This is for interpolation of external samples variables. If no external samples are available, interpolated columns cannot be added. After selecting the Sample Type, the specific Sample Type Name is selected and finally the variable within the sample type is selected.

The Add Calculated Row option is similar to the Add Calculated Column option as shown in Figure 7-51. For adding of rows the concept of Main Variable is introduced and this is the variable which is included in calculations if only one experiment is required in calculations. If the objective is to calculate e.g. sums across experiments then additional variables can be added. Add Calculated Row only supports the expression type Formula (Figure 7-49), i.e. Fixed and Trend are not supported.
The Add Transformed Row is analogous to Pretreatment option in No Model setup. In effect, the calculation is analogous to doing the pretreatment on the data in The Unscrambler® X. The available transformations are Baseline correction, Derivatives, Normalization, Smoothing and SNV (Figure 7-52).

All added calculations are shown in the CDM Matrix as new columns or rows using the chosen names. The calculated elements can be used as any other data element, including for plotting and other calculations.

7.3.5.1 CDM Charts

All the different tabs can be popped out by clicking the pop out symbol ( ). Normal view is resumed by closing the popped out window. The popped out chart tab is shown in Figure 7-53.
The Layout option allows the user to define the grid pattern of the Chart view. In Figure 7-53 a 2-by-2 grid is chosen. In the Experiments list the experiments listed in the CDM Matrix view are shown. The user can view the variables available for each experiment by selecting it, and the variables are then listed in the Variables view. The user can drag and drop from the Experiments and Variables lists and into the plot section of interest. Dragging an experiment displays all variables for the experiment in the plot, while dragging a variable plots this variable for the chosen experiment. The user can also drag lines between plots in the plot grid by using Ctrl and select analogously to real time monitoring.

In Figure 7-54 the CDM chart view is shown with data plotted. In the upper plot two variables from Experiment 4 are shown, and in the lower plot one variable from Experiment 2 is shown. Notice that the terminology in the legends is [Variable(Experiment)]. It is necessary to distinguish based on Variable and Experiment since plots can also consist of variable series from different experiments.
As mentioned, series can be added to the plots by selecting and dragging, but also by using the selector which can be reached from the top-right corner in the individual plots (*Figure 7-55*).

![Series Selector for Plots](image)

The series selector is highlighted by the red box in *Figure 7-55*. The user selects the experiment of interest in the left drop down, and the right drop down is then populated with the available variables. Clicking the + symbol confirms the selection and adds the series to the plot.

Series can be removed from the plot by clicking the Delete button ( ) for the series which should be removed.

Analogously to plots during monitoring and in Data Historian, in CDM graphs the user can choose to view the plot, numerical values or a table over values. The information is of course the same independent of chosen representation.

There are three plot types available in CDM graphs:

---

1. **Timeline**
   - Displays time series data over a time range.

2. **Table**
   - Provides a tabular view of the data points.

3. **Numerical Values**
   - Shows individual data points with numerical values and timestamps.
i) Timeline plots where variables are shown along time.

ii) Scatter plots where variables are plotted against each other.

iii) Bar plots where a variable values are plotted against experiments or vice versa, where an experiment is plotted against variables.

7.3.5.1.1 CDM Chart context menu

Right-clicking in the CDM graph plots gives access to the plot menu (Figure 7-56). The Trend Analysis is specific for Scatter plots, while the other menu items are common for all three plot types.

The Plots option allows the user to switch between Timeline, Scatter and Bar plots. Plot Template allows the user to save any setup of a plot into a chart template or alternatively, to load an existing chart template. The chart template only contains information about the plot setup and not the selection of data. If a user wants to save the CDM search information the CDM template should be saved instead, which is accessed from CDM Matrix tab.

The Trend Analysis option is only available for the scatter plot. It allows the user to fit Linear, Logarithmic Linear, Exponential and Polynomial trends to the scatter plots. One trend is added to each of the series in the scatter plot. The trend analysis in CDM graphs is analogous to Trend Analysis in scatter plots elsewhere in Process Pulse, including the display of trend equation in chart legend if displayed.

Figure 7-56: CDM graphs’ Context Menu
Align by allows the user to choose how data should be aligned. Here, only Configuration Started and Configuration Stopped flags are available. However, if the data belongs to an experiment with phases, the data could also be aligned by phases. Do notice that the x-axis in the time series plot are relative time, not absolute time. This is a requirement to allow display of time series across experiments.

The Visualization option allows the user to adapt the chart. It is possible to toggle between showing and hiding legends. If legend is shown the location of the legend can be changed by right-clicking the legend. The user can also toggle annotations, i.e. display flag locations, etc., or not. The Chart Options give access to the same chart options as during process monitoring, allowing the user to change the colors and layout of plot area and series. The Add Text Field option adds a text field at the location in the plot where the option was chosen. Multiple text fields can be added to a plot. If a text field needs modification it can be activated by moving the mouse pointer over the text field. The Phase Visualization option will be available for experiments with phases.

Save is an option for the user to save the plot to a .PNG image file.

### 7.3.5.1 CDM Metadata

The Metadata tab contains the metadata for all the experiments included in the CDM Search.

### 7.3.6 Data Import

The Data Import function allows the user to import historical data into the Process Pulse database. The supported data formats are ASCII, Excel and OSI PI. The prerequisite for using Data Import is that there is a data source fitting to the data format for the data to be imported. If no such data source exists then it must be created. Also, if the data source reads files (ASCII, Excel) a timestamp column is required in the file.

![Data Import Search Screen](image)

**Figure 7-57: Data Import Search Screen**

To create a Data Import template, select the Create new import template option, then provide a name for the template and select the correct Data Source Name and Revision number.
If an ASCII or Excel data source has been selected, the user will be presented with additional fields for modifying the path of the watched folder, and also to indicate if each file should be handled as a separate experiment or all the files should be part of the same experiment (Figure 7-58).

![Figure 7-58: Data Import Template - Additional Options for ASCII/Excel Data Sources](image)

If a PI data source has been selected, the user will be presented with additional fields for selecting the time range from which the samples must be read (Figure 7-59).

![Figure 7-59: Data Import Template - Additional Options for PI Data Sources](image)

When all the information provided is correct, click Next.

For ASCII and Excel data sources, if the warning in Figure 7-60 appears, it means that the data source lacks a timestamp column. The first column of the table in the ASCII or Excel file must have a date and time in it.
The upload screens shown in Figure 7-61 will appear during the loading of the data (for ASCII/Excel and PI data sources). Please note that the data has not been written into the database but only read.

Once the loading has completed, click Next.

Then a Preview page will appear, as shown in Figure 7-62. This allows the user to review data and ensure that the correct data has been selected and loaded. Then click Next.
The **Assign Tags** page (*Figure 7-63*) allows the user to select the metadata tags that will be assigned to the experiment being imported. Here also the user has the possibility to select from the existing metadata templates. These are the same tags which are shown during configuration start and they are used for future data searches.

The **Permissions** page allows the user to select which users and/or groups will have access to the imported data (*Figure 7-64*).
After clicking on **Next** the data will start being imported and the screen below will be presented after completing the importing. Click **Next** again to go back to the Data Import start page.
8 Settings

The two options in Settings are Preferences and Users. In Preferences the settings available for the user for the different functions in the application can be accessed. They are listed in separate sections below.

8.1 User Settings

There are two types of user access control available for Process Pulse:

i) Local User Access Control (Installation in Non-compliance Mode). The user access control is performed on and by the computer where the main service is installed. The users are managed in Process Pulse.

ii) Centralised User Access Control – LDAP (Installation in Compliance Mode). The user access control is performed by connection to an LDAP server. This is the typical user access control in regulated industries and enterprise installations. The users and access levels are managed in the company’s Active Directory specified during Process Pulse setup.

The end user cannot change the type of user access control as the settings are determined as part of the application installation. Please refer to your IT responsible or Installation Manual if you require further information relating to this.

8.1.1 Local User Access Control Settings

In the user management settings the user can modify:

1. Password strength requirements.
2. Which user levels are allowed to access the password recovery option.
3. Guest account settings (not recommended for regulated environments).

In Process Pulse there are four user levels: Administrator, Supervisor, Developer, and Operator. Table 8-1 shows which aspects of the application each user level has access to. The operator can only use existing configurations while users at the higher levels can also set up Data Sources, Models and Configurations. Accordingly, Process Pulse is suitable for use in laboratory, pilot and other development settings as well as in production on single or multiple sites.

8.1.2 User Management Rights

The different user rights for the four user levels in Process Pulse are listed in Table 8-1.
<table>
<thead>
<tr>
<th>Table 8-1: User Rights</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operator</strong></td>
</tr>
<tr>
<td>Data Source</td>
</tr>
<tr>
<td>Create Data Source</td>
</tr>
<tr>
<td>Edit Data Source</td>
</tr>
<tr>
<td>Disable Data Source</td>
</tr>
<tr>
<td>Enable Disabled Data Source</td>
</tr>
<tr>
<td>Search and view Data Sources</td>
</tr>
<tr>
<td>Model</td>
</tr>
<tr>
<td>Upload Model</td>
</tr>
<tr>
<td>Modify [up-version] Model</td>
</tr>
<tr>
<td>Disable Model</td>
</tr>
<tr>
<td>Enable Disabled Model</td>
</tr>
<tr>
<td>Assign Model</td>
</tr>
<tr>
<td>Search and View Model</td>
</tr>
<tr>
<td>Download Model</td>
</tr>
<tr>
<td>Push Models to The Unscrambler®</td>
</tr>
<tr>
<td>Re-assign Model</td>
</tr>
<tr>
<td>Configuration</td>
</tr>
<tr>
<td>Create Configuration</td>
</tr>
<tr>
<td>Assign Configuration</td>
</tr>
<tr>
<td>Edit Configuration</td>
</tr>
<tr>
<td>Disable Configuration</td>
</tr>
<tr>
<td>Enable Disabled Configuration</td>
</tr>
<tr>
<td>Search and View Configuration</td>
</tr>
<tr>
<td>Create Configuration Group</td>
</tr>
<tr>
<td>Monitor Process</td>
</tr>
<tr>
<td>Insert Comment</td>
</tr>
<tr>
<td>Insert Flag</td>
</tr>
<tr>
<td>Insert External Values</td>
</tr>
<tr>
<td>Change Plots</td>
</tr>
<tr>
<td>Overlay earlier runs</td>
</tr>
<tr>
<td>Trend Analysis</td>
</tr>
<tr>
<td>Root Cause Analysis (drill down)</td>
</tr>
<tr>
<td>Modify Metadata</td>
</tr>
<tr>
<td>Audit Trail</td>
</tr>
<tr>
<td>Search and view Audit Trail</td>
</tr>
<tr>
<td>Generate audit reports</td>
</tr>
<tr>
<td>(own activity)</td>
</tr>
<tr>
<td>(own activity)</td>
</tr>
<tr>
<td>(own activity)</td>
</tr>
<tr>
<td>Reports</td>
</tr>
<tr>
<td>Create Report Templates</td>
</tr>
<tr>
<td>Generate Reports</td>
</tr>
<tr>
<td>Data Historian</td>
</tr>
<tr>
<td>Search and review Data</td>
</tr>
<tr>
<td>Modify Data</td>
</tr>
<tr>
<td>Export Data</td>
</tr>
<tr>
<td>Model Search</td>
</tr>
<tr>
<td>Flag Search</td>
</tr>
<tr>
<td>Replay</td>
</tr>
<tr>
<td>Data Import</td>
</tr>
<tr>
<td>CDM</td>
</tr>
<tr>
<td>Chart Templates</td>
</tr>
</tbody>
</table>
8.1.3 Adding Users

For the local user access control, the users can be added by choosing the Add New User option (Figure 8-1).
In the Add New User dialogue the user provides details about the new user and required privileges (Figure 8-2). Privileges are given by including the user in an existing group. The compulsory fields are indicated by red asterisks.

For LDAP user access control new users cannot be added from within Process Pulse, they must be added in the relevant LDAP groups at the LDAP server. After that is done, the Sync option must be used in Process Pulse through Preferences > User Management.

8.1.4 Adding User Groups

New User Groups are added by choosing the Add New Group option in Figure 8-1. In the New Group dialogue the name of the new group is given as well as the privilege level (Figure 8-3). In Figure 8-3 existing users in the system are also listed and they can be added to the new group by ticking the checkbox next to the user. A user can be member of multiple groups and, if so, the user has the privileges of the most privileged group.
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**Figure 8-3: Adding User Groups**

**NB!** The user groups are used to manage access to configurations and models, and as such they are different from the *user levels* which control which user rights the user can access (*Table 8-1*).

### 8.2 Preferences

All preferences are shown in *Figure 8-1*. The Preferences items which are greyed out are not accessible to the user level granted to the current user. The items greyed out in *Figure 8-1* currently do not have any customisable settings.

![Figure 8-4: Preferences](image)

#### 8.2.1 Preferences: Data Source

In the Data Source Settings, *Figure 8-5*, it is possible to define the number of columns that are shown in the *Preview* step of Data Source setup. This can be useful if the data sources typically used contain many variable/columns. Nevertheless, it is also possible to show all columns by ticking the ALL checkbox.
It is also possible to specify where Data Source Files and Image Data Source Files should be stored. The Data Source Files are configuration files containing basic information about the data sources created in Process Pulse. No data is saved in this folder. The Image Data Source Files folder will contain all the data files processed by data sources of type Image, as these are not saved in the Process Pulse database.

**NB!** These locations should only be modified by the system administrator as incorrect settings will result in a non-working system.

### 8.2.2 Preferences: Model

In Model preferences, it is possible to specify whether models must be approved prior to use. This step can be used as a strategy to ensure and log peer-review of models which are used. The default setting is blank which means that models can be used without approval. The other options are Supervisor and Developer which reflect the user level required for a model approval. The user uploading the model cannot approve the same models.

It is also possible to change where Model files should be stored. This step is mandatory when installing Process Pulse and should only be modified by the system administrator, as incorrect settings will result in a non-working system.

In the Model Identifiers page the different tags for the models can be added, modified or disabled (*Figure 8-7*). The model identifiers are often referred to as ‘Model Tags’ and they are the fields which are shown when a model is uploaded. The Model Tags are stored with the models in the database and can be used in the Model Search as described in section 7.3.2.
A new tag can be added by clicking the New Tag button which opens the dialog shown in Figure 8-8. The user must enter all the information required as shown. The Tag ID is a default label which Process Pulse uses internally, while the Chosen Tag Name is the label used and visible for users.

Model identifiers can be a text field input, numeric, or a drop down list. Text field is a free text field where any information can be added, the Numeric requires numbers as input, and the drop down list shows options defined by the user which can be selected while uploading a model. The options for the drop down list are added using a comma separated list, i.e.: option1, option2, etc.

A model tag can be made mandatory, and if so the identifier must be populated when a Model is uploaded to Process Pulse. Model tags which are not mandatory can be left blank during a Model Upload.

If required, tags can be selected from the list shown in Figure 8-7 and be disabled. Disabled tags are indicated by Disabled in the State column. Disabled tags are of course not visible during Model Upload. Tags can be re-enabled if required.

8.2.3 Preferences: Configuration

The settings available for configurations are listed in Table 8-2.

Note that these settings apply to all configurations in the Process Pulse system.
Table 8-2: Configuration Settings

<table>
<thead>
<tr>
<th>Setting</th>
<th>Description</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approval of Configurations</td>
<td>Specify whether configurations need to be approved by a developer or supervisor prior to use.</td>
<td>Disabled</td>
</tr>
<tr>
<td>Electronic Signature for Stopping Configurations</td>
<td>Determine whether a password signature is required to stop a running configuration. Independent of this, the Audit Trail always logs which user stopped a configuration.</td>
<td>Disabled</td>
</tr>
<tr>
<td>Unique Experiment Value</td>
<td>Determine whether unique experiment identifiers are required for every configuration. This will not affect past experiments.</td>
<td>Disabled</td>
</tr>
<tr>
<td>Configuration Files Storage</td>
<td>Specify where the configuration files should be stored.</td>
<td>Blank</td>
</tr>
<tr>
<td>Block Annotation File Attachments</td>
<td>Determine which types of files should be banned from upload into online annotation. The All option prohibits all attachments.</td>
<td>.exe;.com;.bat;.cmd;.vbs;.vbe;.js;.jse;.wsf;.wsh;.msc;.ps1</td>
</tr>
</tbody>
</table>

8.2.4 Preferences: Audit Trail

There are currently no customisable settings available for Audit Trail.

8.2.5 Preferences: Report

The settings available for Report allow the user to customise the Report Layout.

In the Logo Image settings page (Figure 8-9) the user can add an optional logo which will be added to all reports generated. If no logo is added the logo area in the report is left blank. The location of the logo cannot be changed by user.

![Logo Image](image-url)

Figure 8-9: Report Preferences – Logo Image
In the Sensitivity Labels settings page, the user can replace or add custom sensitivity labels. The default labels are Public and Confidential but depending on industry other labels might be more appropriate. The number of labels is decided by the user. The default labels can be removed as well as any user defined labels.

![Figure 8-10: Report Preferences - Sensitivity Labels](image)

In the Approval Section settings page, the user can modify the text used in the Approval section of the generated reports. The option Include Title Column adds or removes a column where the job title/role can be captured.

![Figure 8-11: Report Preferences - Approval Section](image)

The other fields in the approval section (Figure 8-11) allow the user to modify the wording in the Approval section.

### 8.2.6 Preferences: Historian

The historian preferences are limited to selecting the number of rows to be shown in each page of the search results in the Data Historian.
8.2.7 Preferences: User Management

In the settings for User Management (Figure 8-10) it is possible to define Password Strength requirement with three options: None, Min. 8 characters, Min. 8 mixed characters. Default is the strongest requirement Min. 8 mixed characters, which requires passwords including lowercase and uppercase letters, and numbers.

It is also possible to specify which user level should be allowed to use password recovery if the password is lost.

Guest Privileges refers to a rarely used feature of guest accounts.

8.2.8 Preferences: Output

There are currently no customisable settings available for Output.

8.2.9 Preferences: System

System Settings contains the license information including Machine ID which CAMO uses when generating new licenses and the current activation key. There is also information about the number of simultaneously running configurations and simultaneous users the current license allows. Updating the activation key modifies the license. If you require an increase in your license rights contact CAMO to get a new license key.
The other currently valid options in System Settings are:

- **Web Terminal URL**: The user can specify the URL to the Web Terminal installation, e.g. http://company-web-server/processpulse. This URL can later be used for generating QR codes for starting and showing configurations from the Web Terminal.

- **Date Time Format**: The user can select among a range of pre-defined standard formats.

- **Number of Rows in Table View**: This is the setting for the various tables in the interface e.g. the configuration list. Changing the value has an impact on pagination of the tables. If the chosen number of rows is bigger than can be shown on the screen a scroll bar is made available in the right-hand part of the tables.

- **Log Out After**: This regulates how long the system can be inactive before the user is logged out from the Dashboard. Using 0 disables the auto-log off.

**NB!** When user is logged off all running configurations continue to run.

- **Port for metadata sharing**: If a port number is given, basic metadata information from any configurations could be retrieved from this port. Contact CAMO Support if you need more information.

### 8.2.10 Preferences: Notification

In the **Notifications Settings** the user can set up Notifications (**Figure 8-15**). The first options are checkbox for Use Alarms and Use Warnings. Default setting is ticked, otherwise Alarms and Warnings are not available during configuration setup. There is also a checkbox where the user can require electronic signature when acknowledging notifications.
The other settings relate to System Alerts. These can be set up to be sent by e-mail to nominated users. Tick the appropriate checkbox and add the required user(s) to the list.

**NB!** The SMTP settings in the Alarm E-mails Settings page must be correctly set up for e-mail notifications to work.

In addition to sending system notification e-mails to internal users, system alerts can also be sent directly to CAMO Support. Depending on your support agreement CAMO uses these messages for information and future improvements, or directly as a support tool.

The last checkbox option is to include System Warnings in the System Notification e-mails.

Clicking **Next** displays the Alarm E-mail Settings page (*Figure 8-16*).

*Figure 8-16: Notification Preferences – E-mail Settings*

The first part in *Figure 8-16* contains the SMTP settings of the system. This is the definition of how e-mails should be sent out of Process Pulse. This is dependent on the system setup in your environment. Contact your IT responsible to get the right settings.
The Sender E-mail address and Default Subject fields allow the user to define how the e-mail from Process Pulse should look. The setup for sending e-mails can be tested by the Send test e-mail button.

The last two fields in Figure 8-16 relate to the sending of the Support Package from Help > Support Package. The user can define recipients of the Support Package e-mail when this is sent, as well as the maximal size of the support package. If the size limit is exceeded the e-mail is not sent. The support package recipients can be internal or external (CAMO).

### 8.2.11 Preferences: Comparison Flag

In the Comparison Flag settings the user can Add, Edit and Disable flags. The view when opening Preferences > Comparison Flag is a list of all available flags (Figure 8-17). There are two default flags, Configuration Started and Configuration Stopped, which cannot be edited or removed by the user. The default flags are inserted for every configuration by the system at the start and end point. All other flags are user defined but they are not user-specific, i.e. if user A creates a flag user B can use and also modify this flag.

![Figure 8-17: Comparison Flag Preferences](image)

The user can add New Flags (Figure 8-18). When creating a New Flag the user chooses a Flag Name and also a Flag colour. Both the Flag Name and the Flag Colour must be unique. If either is not unique, Process Pulse returns a warning and does not allow the flag to be created.
Choosing Edit of an existing flag type shows the same interface as shown in Figure 8-18. The user can then modify Name or Colour. This is useful if the user wants to e.g. re-use a flag colour for a new event.

**NB!** Modifying a flag type does not change flags which are already used and stored in the database.

Flags can be disabled and re-enabled by selecting the flags in the flag table. The status for all the flags are shown as Disabled or Enabled in the state column. If the list of flags is long it can be useful to use the Search option. The Search option searches through the names of the flags. The search supports segment searches, i.e. parts of a flag name can be used as search parameter.

### 8.2.12 Preferences: Aliases

Aliases can be defined and used to replace variable names in the data sources. This is useful if, for instance, there are multiple vessels where the same measurement is made with derived variable names \([T_{\text{vessel1}}, T_{\text{vessel2}}, \text{etc}]\) and it is wanted to compare these variables directly. Aliases are also useful if a system is giving out a standard name and the user wants to give it a more meaningful name.

Aliases are defined in **Preferences > Aliases** (Figure 8-19), and can be used in all data sources. Analogously to flags, aliases are not user-specific and can be shared.
The steps for adding a new Alias are as follows:

1: Chose Add to create a new Alias. A separate window will pop up for adding the name of the alias and the variable names that would be replaced.

2: Write the name of the Alias, i.e. the variable name which is going to replace the variable names which should be changed.

3: Click Add Variable name to add entities which should be replaced.

4: Write in name of the Variables which should be renamed, e.g. T_vessel1. Multiple names can be added by jumping back to 3. One line is added for every variable.

5: Click on OK to save the new Alias.

The aliases are used automatically in the Data Source, Manage Tag Names step (Figure 8-20). If Approve All Aliases is clicked then the aliases are inserted into the New Name fields, and the names in these fields are used in plots and tables in Process Pulse.
8.2.13 Preferences: User Settings

In User Settings it is possible to customize the maximum number of points allowed on a plot in Process Pulse. The maximum value is 5000 and any values above this are automatically reset to 500.
The correct number of points in a plot depends on system performance and what is feasible to view in one plot. If the number is large it might have a performance impact, and also, depending on screen resolution, large numbers of points in a plot might make it impossible to distinguish between neighbouring points.

### 8.2.14 Preferences: Metadata Template

When a configuration is started in Process Pulse the first step in the starting procedure is to provide the metadata information. Addition and modification of the metadata tags is done as described in section 8.2.16. Specification of the layout and selection of experiment tags is done using Metadata Templates as described in this section.

![Metadata Template Preferences](image)
When accessing **Preferences > Metadata Template** the view shown in Figure 8-22 appears. It is a list of the available metadata templates. Templates can be viewed and modified by other users with the correct permissions.

Templates can be selected using the checkboxes and then be disabled or re-enabled. The status of the template is shown in the State column. Templates can be edited by using the Edit button ( ).

The other columns shown in Figure 8-22 contain the following information:

a) **Number of General Tags.**
   This is the number of experiment tags used in the template. It includes all types of tags.

b) **Number of Tags Groups.**
   This is the number of groups of tags. A group is a collection of tags within the tag template as described below.

c) **Number of Phase Tags.**
   This is the number of tags which are used in phases. Phases are steps in a process and for phase tags it is possible for the user to add phase relevant information in each of the phases.
   A phase tag is included in all of the phases.

d) **Number of Phases.**
   This is the number of phases defined in the template. Phases are steps in a process and for phase tags it is possible for the user to add phase relevant information in each of the phases.

![Create new metadata template](image)

*Figure 8-23: Phases Setup*
In Figure 8-24 a template in progress is shown. The template shown includes three tags, two groups, three phase tags (one unspecified) and three phases.

Figure 8-24: Setting Up Phases - Sequence of Operations
The red numbers in Figure 8-22 link to the group and phase actions available.

1: Adding Groups: The Add button allows the user to add groups. Added groups are appended as new columns. The user can name groups by modifying the New Group text field. + adds experiment tags to the group and X deletes the group.

2: Adding Tags to Groups: + adds experiment tags to the group and X deletes the group. Which tag to include is selected from a drop down list. Each tag can only be included once so when a tag is selected it is removed from the drop down list for other tags. The user can delete tags by using the X next to the tag.

3: Adding Phases: The Add button allows the user to add phases. Added phases are appended as new columns. The user can name phases by modifying the New Phase text field. Each phase has a colour analogously to flags, Section 8.2.11., and this can be changed by using the drop down option. + adds experiment tags to the phase and X deletes the phases.

4: Adding Tags to Phases: + adds experiment tags to the phases and X deletes the phase. Which tags to include is selected from a drop down list. Each tag can only be included once so when a tag is selected it is removed from the drop down list for other tag areas. The user can delete tags by using the X next to the tag. If a tag is chosen as phase tag it is included for all phases.

An example of a Metadata Template layout is shown in Figure 8-25. The template to use is chosen in the Tags drop down menu. If no template is chosen the default metadata layout is used. The ELN ID is available since ELN is set up, see section 8.2.15.

In Figure 8-25 there are six tags, two groups, two phase tags and two phases. Adding more tags will add rows to the layout while adding more groups will add columns to the layout. The number of tags in different groups can be different, while the number of tags in different phases must be the same.

8.2.15 Preferences: ELN Preferences

ELN is an abbreviation for Electronic Lab Notebook. It is a third-party database system where all measurements and results for an experiment or project are stored. Process Pulse can be set up to interface with this type of system. Typically, Process Pulse can get the ID or other metadata from the ELN. The ELN settings in Preferences > ELN Settings define the link to ELN.
for the reading of information and using this in combination with Experiment Tags (Figure 8-26).

Figure 8-26: ELN Preferences

Selecting the Browse option for ELN connection opens the Microsoft DataLink dialogue. The use of this is described in section 3.3.2. Selecting the appropriate ELN connection will create a connection string shown in the ELN connection field and the user can select the correct Table within the database using the drop down option. All available tables are listed. If the required table is not listed and does exist in the database, the connection itself should be revisited. After selecting the appropriate table Process Pulse displays all available fields, Figure 8-27.

Figure 8-27: ELN Settings

The link shown in Figure 8-27 is a demo connection to the Process Pulse database for a local PC installation. In the selected Table there are two fields, one numerical (Int32) and one text (String). The user can map the data to the existing Experiment Tags (see Section 8.2.16). The experiment tags listed in the drop down menus are those fitting the data type of the ELN database field. When setting up an ELN connection the Experiment ID tag must be mapped to an appropriate field. For the other tags mapping or not is a user decision.
Figure 8-28: Configuration Start Using ELN

In Figure 8-28 the view of a configuration start when ELN is setup is shown. The setup of the experiment tags is defined in a Metadata Template as described in Section 8.2.14. Note the new field ELN ID in the top right corner. This is a drop down field reading the available values for the field mapped to Experiment ID in the ELN Setup. The user can select any of the values and all the Experiment tags mapped to ELN fields are updated accordingly. If the user chooses the blank option at the top of the list, ELN mapped fields can be populated as any other Experiment Tag field. The Edit symbol (>Edit) allows the user to type in the ELN ID. Process Pulse then searches the ELN database and uses the value if it exists. If the value does not exist a warning is given and the user must correct the ELN ID value.

8.2.16 Preferences: Experiment Tags

When a configuration is started in Process Pulse the user is asked to provide the metadata information. The default metadata information requested is Experiment ID, Project Name and Product. The user can modify the names of the default tags and also add new tags as required. Tags, or experiment tags, are used as the labels for the metadata variables analogously to model tags for the model identifiers.

The metadata information can later be used to search and identify the data from the run, and the numerical tags can also be used in calculations.

The Experiment Tags view is accessed from Preferences > Experiment Tags (Figure 8-27). The available tags are listed and checkboxes indicate whether a tag is Mandatory and/or Default. Mandatory tags must be populated during configuration start before the configuration is allowed to start. Default tags are included in the default tag list during a configuration start. The default tag list can be overruled by using Metadata Templates as described in section 8.2.14.
All but the three first tags which are system defaults, can be selected and disabled by the checkbox to the left of the tag. The Disable button becomes active when a selection is done. Disabled tags are identified by ‘Disabled’ in the State column. Disabled tags can be re-enabled by selecting them and using the Enable option.

**NB!** Tags which are used in a Metadata Template are not possible to disable. In that case Process Pulse displays a warning and denies the operation.

A new tag can be added by clicking the New Tag button ( ) which opens the dialog shown in **Figure 8-30**. Note that this is identical to the Model Identifier tags (**Figure 8-8**). The user enters the information to create a new Experiment Tag. The **Tag ID** is a default label which Process Pulse uses internally while the **Chosen Tag Name** is the label used and visible for users.

![Create new tag dialog](image)

**Figure 8-30: Creating New Experiment Tag**

Experiment tags can be a text field input, numeric, or a drop down list. Text field is a free text field where any information can be added, the Numeric requires numbers as input, and the drop down list shows predefined options the user can select from when uploading a model. Options for the drop down list are added using a comma separated list, i.e.: option1, option2, etc.

The Edit option displays the same interface as for a New Tag, **Figure 8-30**, although the fields are populated, of course.
9 Web Terminal

Process Pulse has a Web Terminal available where users can monitor configuration runs using a web browser. Accordingly the web terminal can be used for PCs, tablets, phones and any other device. The web terminal is configured to work in any device running the latest version of the most popular internet browsers (Chrome, Firefox, Safari and Internet Explorer).

The address for the web terminal and the accessibility (internal or external) depend on the Process Pulse installation. Contact your local IT responsible for information on this.

9.1 Starting Web Terminal

The Process Pulse Web Terminal is accessed by filling in the appropriate web address in the web browser, i.e. http://<server-address>/processpulse. The correct address depends on the installation parameter used during the installation of the Web Terminal component and how the Web Server can be accessed from the specific device where you are using the web browser.

In the start screen Process Pulse requests the login credentials analogously to the desktop client (Dashboard) as shown in Figure 9-1. The username and password is the same as for the desktop client.

![Figure 9-1: Web Terminal - Login Page](image)

As in the desktop client the user can select the language of the interface and there is information about the installed version of Process Pulse.

9.2 User Interface

The web terminal interface looks different from the desktop client (Figure 9-2). The home page looks a little bit like the Configuration Management page in the Dashboard since the main objective for the Web Terminal is to start and view configurations. There is no support
for editing configurations, setting up data sources or uploading models, nor any historical
data review tools. The Web Terminal is very much a real-time monitoring tool.

Figure 9-2: Web Terminal – Home Page

The top bar contains the product name on the left, and some actions on the right. The
product name is an active link which takes the user back to the main page (Figure 9-2).

Figure 9-3: Web Terminal Top Bar

Clicking the barcode icon ( ) in the top bar opens the dialog shown in Figure 9-4. When
this view is activated a suitable barcode scanner can be used to read in configuration ID.
How to generate a Barcode for this use is described in section 5.1.2.

Figure 9-4: Barcode Processing Dialog

Clicking the Home icon ( ) in the top bar returns the user to the home page (Figure 9-2).

Clicking the Log Out icon ( ) in the top bar logs the user out, and the Web Terminal login
screen is shown.

The Search field, shown in Figure 9-5, allows the user to search through the configurations
listed in the home page.
The Search field, shown in Figure 9-5, allows the user to search through the Configurations listed in the home page.

Below the configuration list, it is possible to adjust the number of items per page in the drop down menu shown in Figure 9-6.

The bottom tiles in the web terminal are exactly the same as in the desktop client (Figure 9-7). The functionalities for the tiles are described in section 2.2.3. They apply only to the running Configurations.

9.3 Process Monitoring in Web Terminal

From the home page, Configurations can be started or viewed. It is not possible to stop Configurations or do any modifications in the Web Terminal.
Clicking **Start** in the Main Screen will open the dialog shown in *Figure 9-8*. This is the Experiment tags analogously to Configuration start in the desktop client. The user populates the fields as required and starts the configuration.

*Figure 9-8: Web Terminal – Starting Configuration*

After filling the metadata information and clicking **Start** the user is returned to the Main Screen (*Figure 9-2*). For running configurations the **Start** button is changed to **Show**. Clicking **Show** opens the monitoring view shown in *Figure 9-9*.

*Figure 9-9: Web Terminal – Show Configuration*

Instead of configuration cards, the web terminal has buttons in the Top Bar where the user can toggle between running Configurations (*Figure 9-10*).
The user can view one or multiple configurations at a time. The maximal number of simultaneous configurations to display in the Web Terminal is four. **NB!** Only four configurations can be viewed at the same time in the Web Terminal but there is no upper limit on the number of configurations which can be run simultaneously (excepting the license allowance).

One option available in Web Terminal is to change the window layout during the configuration run (**Figure 9-11**). The user can select to look at 1-4 plots, either for a single configuration or a combination of configurations. If less than four plots are chosen this will impact the number of how many configurations can be viewed simultaneously.

Clicking the plot options menu button in the top-right corner of any plot provides the same options which are available in the desktop client.

The user can switch view between Plot, Table and Numerical Value. It is also possible to select which series to include in the plot. The exact options for the plots depend on the type of plots as described in section 6.1.

### 9.3.1 Process Interaction

Right-clicking on the time bar opens the context menu shown in **Figure 9-13**. Note that this is the same interface as in the desktop client.
Right-clicking on a plot of a running Configuration opens the context menu shown in Figure 9-14. It contains the same content as the menu that appears when right-clicking on a plot in the program.

![Figure 9-14: Web Terminal - Plot Context Menu](image)

Under the Plots drop down, the same plots are available as in the desktop client. To read more about the plots, go to Section 6.1. Offline Data (Section 6.5.3), Trend Analysis (Section 6.4.2) and Save are also the same as in the desktop client.

The Limits drop down is unique to the web terminal. As shown in Figure 9-14, the limits are set between 0.1% and 25%.

![Figure 9-15: Web Terminal - Plot Context Menu - Limits](image)

The Add Comment, Add Flag and Add Sample options are basically the same as in the desktop client, although the layout is different (shown in Figure 9-15, Figure 9-16, and Figure 9-17).
9.3.2 Mouse Gestures

The mouse gestures for the Web Terminal are slightly different from the desktop client. The changes are highlighted in Table 9-1 below.

<table>
<thead>
<tr>
<th>Shortcut</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Click + drag</td>
<td>Creates a box to zoom</td>
</tr>
<tr>
<td>Mouse wheel</td>
<td>Zooms in and out</td>
</tr>
<tr>
<td>Right-click</td>
<td>Opens the Context Menu</td>
</tr>
<tr>
<td>Shift + select</td>
<td>Marks a rectangular area and zooms in on it</td>
</tr>
<tr>
<td>Mouse over</td>
<td>Shows values and timestamp for the selected point</td>
</tr>
<tr>
<td>Ctrl + drag</td>
<td>Creates Combined Plots (Section 6.5.2)</td>
</tr>
<tr>
<td>Double-click points</td>
<td>Drills Down on data (Section 6.5.1)</td>
</tr>
<tr>
<td>Two finger swipe left</td>
<td>Zooms in</td>
</tr>
<tr>
<td>Two finger swipe right</td>
<td>Zooms out</td>
</tr>
</tbody>
</table>