



Event Frames and Notifications

Table of contents

1	INTRODUCTION.....	4
2	PI SYSTEM SOFTWARE USED IN THIS CLASS.....	5
3	EVENT FRAMES IN PI AF.....	6
3.1.	WHAT ARE PI EVENT FRAMES?.....	6
3.2.	BACKGROUND: COURSE SCENARIO	7
3.3.	BACKGROUND: WHAT ARE EVENT FRAME TEMPLATES?	9
3.3.1	Hands-On: Create an Event Frame template.....	10
3.3.2	Hands-On: Add attributes to your event frame template	11
3.4.	CREATING AN EF GENERATION ANALYSIS	15
3.5.	BACKFILLING EVENT FRAME ANALYSIS	19
3.6.	DEFINING AN OUTPUT EXPRESSION FOR AN EVENT FRAME ANALYSIS	22
4	CONSUMING EVENT FRAMES	24
4.1.	EVENT FRAMES IN PSE	24
4.1.1	Knowledge check: Event Frame Searches, Acknowledgement and Annotation	27
4.1.2	Knowledge check: Advanced Event Frame Searches.....	28
4.2.	EVENT FRAME REPORTS IN EXCEL WITH PI DATALINK	29
4.3.1	Knowledge check: Creating Event Frame reports with PI DataLink	30
4.5.1	Knowledge check: Using Pivot Charts to summarize Event Frames	32
4.3.	EVENT FRAMES IN PI VISION	36
4.5.2	Find Related Events	37
4.5.3	Background: New course scenario for PI Vision	39
4.5.4	Knowledge check: Find Events.....	41
4.5.5	Background: Get Event Details	43
4.5.6	Knowledge check: Event Details	44
4.5.7	Background: Compare Similar Events by Name or Type	45
4.5.8	Knowledge check : Compare Events	45
4.5.9	Background: Pinning Events	50
4.5.10	Knowledge check: Pinning an Event	50
4.5.11	Background : Event tables	52
4.5.12	Knowledge check: Add an event table.....	52

5	COMMUNICATING IMPORTANT EVENTS.....	54
5.1.	INTRODUCING NOTIFICATIONS	55
5.1.1	Background: Notification components.....	55
5.2.	DELIVERING NOTIFICATIONS.....	58
5.3.1	Background: Email Delivery Channel	58
5.3.2	Knowledge check: Email delivery configuration and checkout	59
5.3.3	Background: Web service delivery channel.....	61
5.3.	CONFIGURING NOTIFICATIONS	62
5.3.4	Background: Trigger conditions.....	62
5.3.5	Hands-on: Configuring a notification rule	64
5.3.6	Background: Trigger criteria options	65
5.4.	FORMATTING THE INFORMATION TO DELIVER	67
5.3.7	Hands-on: Customize Notifications message content & format	68
5.5.	ACKNOWLEDGING NOTIFICATIONS	70
5.3.8	Knowledge check: Commenting and acknowledging events.....	71
5.3.9	Knowledge check: Validating the acknowledgment process.....	72
5.6.	ADDING CONTACTS	74
5.6.1	Background: Active Directory (AD) access for contacts.....	74
5.6.2	Background: Searching for contacts	75
5.6.3	Background: Adding contact information.....	75
5.6.4	Background: Notifications groups	76
5.6.5	Background: Notifications escalation teams	76
5.6.6	Background: Subscribing contacts to Notifications	77
5.6.7	Background: Dynamic email delivery endpoints (since AF 2017 R2).....	77
5.6.8	Background: Sending Notification alerts in escalation sequence.....	77
6	(OPTIONAL) ADMINISTRATOR TASKS.....	80
6.1.	INSTALLING THE PI NOTIFICATIONS SERVICES.....	80
6.2.	ACCOUNT PERMISSIONS FOR THE PI NOTIFICATION SERVICE	84
6.2.1	Configure Data Archive access for PI Notifications Service	84
6.2.2	PI AF object and local machine permissions for PI Notifications Service	85
6.3.	TROUBLESHOOTING THE PI NOTIFICATIONS SERVICE.....	86
6.3.1	Configure logging for the PI Notifications Service	86
6.3.2	Access Performance Counters	86
7	FINAL EXAM.....	87

1 Introduction



Before reading this section, please refer to the following course YouTube video:
[Course Introduction](#)

In this course you will learn about *Event Frames* and *Notifications* that are a powerful combination of features in *Asset Framework* that help you *capture, store, find, compare* and *analyze* important system events and their related data. With notifications, you can send alerts to users in real time about conditions in the system that need specific attention. Corresponding actions can then be taken to be pro-active or to resolve the problem of the current situation.

By the end of this Course you'll be able to:

- Describe the uses and functions of Event Frames and the PI Notifications service.
- Understand the features and advantages of using Event Frame templates.
- Create Event Frames via asset analytics.
- Interact with different AVEVA PI System products that utilize Event Frames.
- Install and troubleshoot the PI Notifications service, and create a notification based on an Event Frame.

Throughout this class we will assume you have a basic knowledge of the PI System. If you are new to the PI System, we encourage you to complete the *PI System Basics* class that is available for free on our Learning Page.

The course consists of text-based lessons, and video lectures. You are encouraged to follow along with all video lectures using your Training Cloud Environment. Text-based lessons contain background theory, exercises, documentation, and other useful information.

Lessons are categorized using the following key words:

1. **Hands-On:** These lessons contain hands-on exercises with video step-by-step walkthroughs. While we are demonstrating how to use different functions of Event Frames and Notifications, you are encouraged to do the same on your virtual environment.
2. **Knowledge check:** Exercises with step-by-step solutions to complete on your own using your virtual environment, or quizzes to keep your skills sharp.
3. **Background:** Readings or videos containing useful background information to assist your understanding. These lessons are optional but encouraged as they will give you a more well-rounded understanding of the features of Event Frames and Notifications. Throughout these sections we will link out to reference documentation. You may be examined on the content inside these references, but as the exam is open book, you're welcome to visit these references during the exam.

In the next lesson we'll cover the Learning Cloud Environment used in this class.

2 PI System software used in this class

SOFTWARE	VERSION
PI Data Archive 2018 SP3	3.4.445.688
PI AF Server 2018 SP3	2.10.9.593
PI Analysis Service 2018 SP3	2.10.6.195
AVEVA PI Vision 2022	3.7.1.0
PI DataLink 2022	5.6.0.0

3 Event Frames in PI AF

3.1. What are PI Event Frames?



Before reading this section, please refer to the following course YouTube video:
[What are PI Event Frames?](#)

Events are important process or business time periods that represent something happening that affects your operations. In the AVEVA PI System, events are known as event frames. Thanks to Event Frames, you can analyze your PI data in the context of these events rather than by continuous time periods. Instead of searching by time, Event Frames enables users to easily search the AVEVA PI System for the events they are trying to analyze or report on.

With Event Frames, the AVEVA PI System helps you capture, store, find, compare and analyze the important events and their related data.

Event Frames represent occurrences in your process that you want to know about, for example:

- Downtime tracking
- Environmental monitoring excursions
- Process excursions
- Product tracking batches
- Equipment startups and shut downs
- Operator shifts

The following table presents some of the features and advantages of Event Frames:

Flexibility	<ol style="list-style-type: none">1. Reference multiple elements within the same event.2. Support multiple overlapping events on a AF element.3. Capture any event; a “batch” is just one type of capturable event.
Powerful search	<ol style="list-style-type: none">4. Search by time range, type of event or event frame attribute.

	5. Most common search attributes can be configured as indexed attributes to speed up end-user searches
Scalability	6. Event Frames are extremely scalable.

An Event Frame is defined by three characteristics:

- Name.
- Start time and end time: defines the event's time range.
- Context: event attributes and related assets.

References:

- For more information see "Event frames in PI AF" in [Asset Framework and PI System Explorer User Guide](#)

3.2. Background: Course scenario

PI Big Tires Co. has been falling behind their production schedule because, for various reasons, the tires presses are frequently down. To improve the situation they want to use Event Frames in AF to track the downtime periods for all their presses in Houston, Montreal and Philadelphia.

The Maintenance engineer has asked you to trace the root cause for every downtime. The curing press can be in one of five states, which have different criticality.



Press Status:

Running ✓

Press set-up !

Planned Maintenance !

Maintenance !!

No Operator !!!

They want to have a record of the investigations performed by the maintenance team. Therefore, it should be possible to acknowledge and save individual comments for each Downtime Event Frame.

To approach this problem in this course you will complete the following tasks:

1. Create an event frame template for the press downtime events. Set up a *Naming pattern* and enable the *Can be acknowledge* option.
2. Add attributes to the previously created event frame template. Your goal is to capture the value of the press status attribute at the start of the problem, the length of the downtime duration and production loss (knowing that producing 1 tire takes approximately 5 minutes).
3. Create an EF generation analysis to track the downtime events in your curing presses. Distinguish the different Press Status values and associate them with corresponding severities:
 - a. *Planned Maintenance* and *Press set-up* - assign an *Information* severity level.
 - b. *Maintenance* – assign a *Minor* severity level.
 - c. *No Operator* – assign a *Major* severity level.
4. Schedule it as Event-Triggered.
5. Backfill the analyses for all presses for the time since midnight today.
6. Set up a downtime log entry, which provides the information, whether it was a minor issue (when duration was less than 10 minutes) or whether it had a critical production impact.

3.3. Background: What are event frame templates?

Using event frame templates, you can define and standardize the related data (event frame attributes) associated with different types of events. For consistency, it is recommended to create event frame objects from templates. To learn more, see *Base and derived templates*. You can use event frame attributes to provide additional context around the event that are useful for searches and reports. For example, downtime events often have a reason code that users want to search for or filter on during analysis of their downtime events.

You can also configure event frame attributes to reference process data in the context of the event. For example, a temperature excursion event is likely to have an attribute for the maximum temperature. You can configure event frames to record those values for you. Additionally, for each event type, you can configure an index for the most frequently searched attributes. This approach enables faster and easier searches on the PI AF server when you track several event types or millions of events.

Data references in event frame templates

When you create event frames dynamically with event frame templates, you typically need to reference elements, attributes, templates or other related objects based on those event frame templates. Because each individual event frame occurs in a slightly different context, you can use substitution parameters to reference other PI AF objects dynamically, rather than static, absolute references. For example, you can use a downtime event frame template for any number of assets, such as a pump, motor, boiler, compressor, and so on.

In PI point data references, substitution parameters are useful for:

- Building tag name references based on hierarchy or other attribute values.
- Referencing other PI point attributes, such as from an event frame to the primary referenced element.

The main limitation of PI point data references is that the element attribute must also be a PI point data reference.

In String Builder data references, substitution parameters are useful for:

- Obtaining numeric values or string values when referenced element attributes do not have a PI point data reference.
- Creating a string by concatenating multiple values from referenced element attributes and other text.
- Passing a time context, including the end time of the event frame.
- Obtaining the name of referenced elements or their parents.

The limitation of String Builder data references is that they do not perform unit of measure conversions or perform aggregations or calculations.

A specific syntax is required to reference attributes from event frame templates, as described in *Data references to attributes in the primary referenced element* and *Data references to attributes in other elements*.

3.3.1 Hands-On: Create an Event Frame template




During this section, please refer to the following course YouTube video:
[Create an Event Frame Template](#)

Activity description

In this activity, you will learn how to create an event frame template.

Approach

1. Connect to **PISRV01** machine and from the Start menu open **PI System Explorer (PSE)**.
2. Click on **Database** and connect to the **PI Big Tires Co. AF** database and click OK.
3. Select **Library** from the navigator panel and select the *Event Frame Templates* tab and click on the blue [New template](#) link.
4. Name it *Press Downtime* and give it a description - *Press Downtime event*.
5. The *Naming Pattern* field enables you to dynamically build the name of the event frames produced from the template so that each event frame will have a unique, identifiable name. Use the arrow on the right () for a list of available substitution parameters. The most common ones are presented in the following table:

%ELEMENT%	Referenced element. Asset where the event happened.
..\ELEMENT%	Name of the parent element of the referenced element. To retrieve further ancestors, use the ..\ notation, such as %..\..\Element%.
%TEMPLATE%	Name of the event frame template.
%STARTTIME:yyyy-MM-dd HH:mm:ss.fff%	Event start time and format.

6. What naming pattern should we set so the downtime events are called something like the following?

DownTime HOU.Press.01 (Houston) 2023-05-24 23:22:21

Note: In case the **Naming Pattern** field is not set, event frames created with asset analytics will be named NameOfTheAnalysis – Starttime (i.e. Press Downtime – 2023-07-25 11:20:00).

Answer: Set the *Naming Pattern* as *Downtime %ELEMENT% (%.\ELEMENT%) %STARTTIME:yyyy-MM-dd HH:mm:ss%* where HH is 24-hour format.

7. To track, whether the event frames was read by an operator, enable the *Can be Acknowledged* option (Can Be Acknowledged).
8. *Check-in* you changes.

3.3.2 Hands-On: Add attributes to your event frame template



During this section, please refer to the following course YouTube video:
[Add attributes to the event frame template](#)

Activity description

In this activity, you will learn how to add attributes to your event frame template.

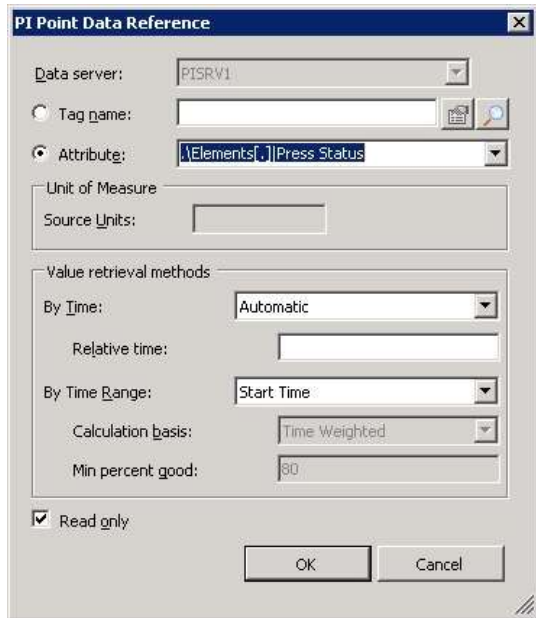
Approach

1. Double click on your event frame template to open it up.
2. The attributes you want captured in an event frame will need to be defined under the attribute templates. Click new attribute template.
3. The first thing that you want to track is the reason, why the press had a downtime. It is the value of the **Press Status** attribute at the start of the problem.

On the Attributes tab, click on the blue [New Attribute](#) link. For the attribute name, enter **Reason Code**. For the description enter **Reason code for the press downtime event**. For value type, select **Press Status** from enumeration sets. For *Data Reference* select *PI Point*. Click on *Settings*.

For the PI point data select attribute and type in the following syntax:
`.\Elements[.]|Press Status.`

For *By Time Range* select *Start Time*. Click on OK.



You will get the Press Status value for the beginning of the event frame period as it has been recorded before.

Note: If the value type was reset, switch it back to Press Status.

Event Frame Attributes

The generic format for attributes of event frames is `.\Elements[.]|Attribute.`

The attribute reference starts with `.\Elements[.]|` to indicate the primary element of the event frame's Elements collection. `.\` is the current reference, `[.]` is the default object of the collection. The pipe character (`|`) is used to separate the element from the attribute name.

4. Add an event duration attribute. For the attribute name, enter **Duration**. For the description enter **The length of the downtime duration**.

For value type, select **Double**. For *Data Reference* select *PI Point*. Click on *Settings*.

For the PI point data select attribute and type in the following syntax:
`.\Elements[.]|Press Status.`

Note: Even though there is not a specific attribute describing the duration, you still need to pick an attribute. You can choose any attribute from the referenced element.

For *By Time* select *Not Supported*. For *By Time Range* select *Count*. Click on OK.

PI Point Data Reference

Data server: %Server%

Tag name: []

Tag Creation: []

Attribute: \\Elements[...]|Press Status

Unit of Measure

Source Units: s

Value retrieval methods

By Time: Not Supported

Relative time: []

By Time Range: Count

Calculation basis: Time Weighted

Min percent good: 80

Preview

Example instance: [Select example instance](#)

Configuration: []

Value: []

Read only

OK Cancel

5. Producing one tire takes approximately 5 minutes. Based on the duration of the press downtime the number of tires can be calculated that could have been produced in case the press would have been running.

Add a **Production Loss** attribute (default UOM: tires, value type: Double, data reference: Formula) and enter a calculation to get the number of tires with a division by 5:

Formula Configuration

Parameters

D=Duration;UOM=min

Default Values Allowed

Equations

D/5

Result

UOM: Tires Minimum: Maximum: Stepped

Evaluate

OK Cancel

Press downtime

General Attribute Templates

Filter

Name	Value Type	Unit Of Measure	Data Reference	Settings...
Category: <None>				
Duration	Double	minute	PI Point	.\Elements[.]\Press Status;TimeMethod=NotSupported;TimeRangeMethod=Count
Production Loss	Double	Tires	Formula	D=Duration;UOM=min;[D/5];UOM=Tires
Reason code	Press Status	<None>	PI Point	.\Elements[.]\Press Status;TimeRangeMethod=StartTime

6. Check in the changes.

3.4. Creating an EF generation analysis



During this section, please refer to the following course YouTube video:
[Create an Event Frame Generation analysis](#)

Activity description

In this activity you will learn how to create an EF generation analysis to track the downtime events in your curing presses.

Approach

Tip: Before you create an EF generation analysis, be sure an event frame template is available for it.

1. Select **Library** from the navigator panel and select the *Templates > Element Templates* tab and click on the *Press* template.
2. Under the *Analysis Templates* tab click on the blue [Create a new analysis template](#) link. Choose *Event Frame Generation* for the Analysis Type. Give a meaningful name and description to your analysis.

An event frame analysis is based on an event frame template, go ahead and select the *Press Downtime* template from the dropdown list.

The screenshot displays the configuration window for an Event Frame Generation analysis. The interface includes a top navigation bar with tabs for General, Child Elements, Attributes, Ports, Analyses, Notification Rules, and Version. The main area is divided into several sections:

- General Information:** Name: Downtime, Description: Generation of downtime event frames, Categories: (empty), Analysis Type: Event Frame Generation, Expression, Rollup, SQC.
- Generation Mode:** Explicit Trigger
- Event Frame Template:** Press Downtime
- Table of Triggers and Expressions:**

Variable	Expression	True for	Severity	Value at Evaluation	Value at Last Trigger
Start Trigger	ss Status="Planned Maintenance"				
End Trigger	'Press Status'="Press set-up"	Set (optional)	Information		
Output Expression	ss Status="Maintenance"	Set (optional)	Minor		
StartTrigger3	Press Status="No Operator"	Set (optional)	Major		
End trigger					
EndTrigger	Press Status="Running"				

Annotations on the screenshot:

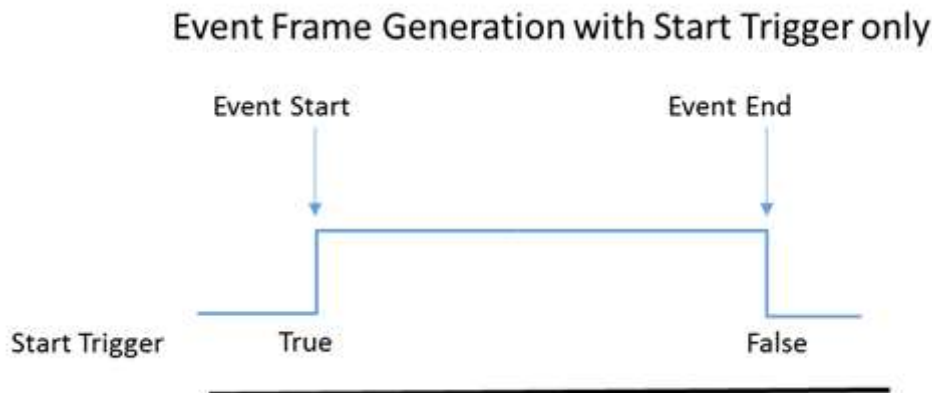
- An arrow points to the 'Add...' button with the text: "Add Variables, Start or End Trigger, or Output Expression".
- An arrow points to the 'True for' column with the text: "Time True Option".
- An arrow points to the 'Severity' column with the text: "Advanced Options such as option to create a root cause child event frame".
- An arrow points to the 'Advanced Event Frame Settings...' button.

At the bottom, there is a note: "Multiple start triggers are configured. Child event frames will be generated when the trigger changes. See documentation for more details." and a status bar showing "Scheduling: Event-Triggered Periodic" and "Trigger on: Any Input".

Triggering Conditions (Start Trigger Only)

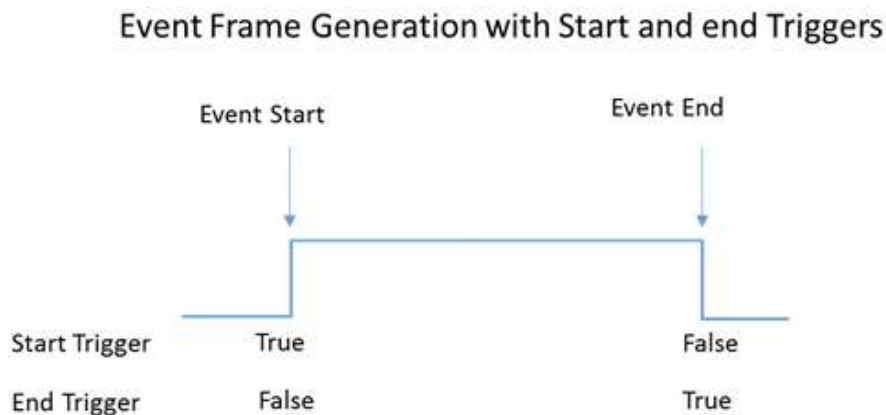
It is time to enter the conditions that will trigger the start and end event: *StartTrigger* and *EndTrigger*. These conditions are entered as expressions using the **Performance Equations (PE) syntax**.

When a single condition triggers both the start and the end of an event frame, only the *StartTrigger* expression is needed. When the expression evaluates to *TRUE* the event frame is started, and when it evaluates to *FALSE* the event frame is closed. For example a tank's level rising above a threshold might start an overflow event, the event would end when level is below the threshold.



Triggering Conditions (Start and End Trigger)

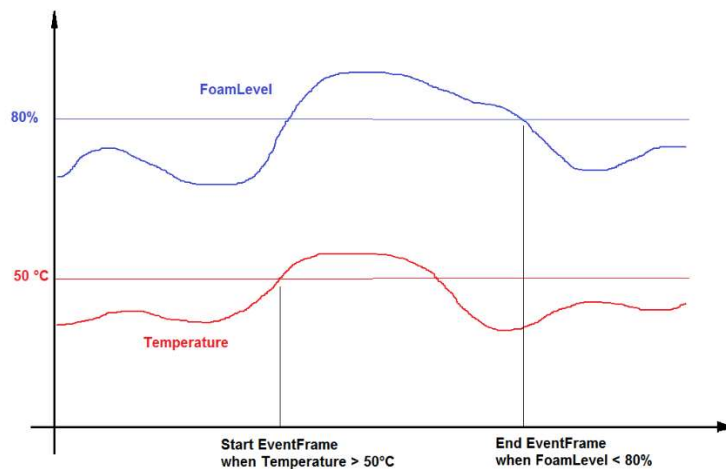
You can specify an *EndTrigger* expression when the start and end conditions are different:



In the case with Start and End Triggers, the end of the event is dependent on the *End Trigger* condition only. So after the event has started, the event ends when the *End Trigger* becomes true, independent from whether the *Start Trigger* is True or False.

Tip: If using start and end triggers, make sure the expressions never evaluate to TRUE at the same time since this may lead to event frames with zero second durations. Try to configure your event frames to use only a StartTrigger expression.

For example, if the temperature rises in your reactor the foam level rises accordingly. When the temperature drops again, the foam level drops as well, but with some delay in time. You would like to capture the time, when temperature is too high until foam level is back to normal:



Name	Expression
StartTrigger	'Temperature'>50
EndTrigger	'FoamLevel1'<80

Defining Triggering Condition for the Press Downtime

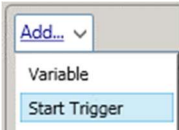
Since AF 2016 it is possible to define several start trigger conditions and associate them with different event frame severities. This meets our requirement to have event frames with different severity based on the reason why the press was down. Let us look at the first situation, when the press stopped running because of a *Planned maintenance* or a *Press set-up*.

The expression to start the event in that case is:

```
'Press Status'="Planned Maintenance" or 'Press Status'="Press set-up"
```

Assign an *Information* severity level.

To enter start and end triggers, click on blue [Add...](#) link and select corresponding option from the dropdown.



Enter the start and end trigger expressions and assign the severity levels as follows:

Event Frame Template: Press Downtime			
Add...			
Name	Expression	True for	Severity
Start triggers			
StartTrigger1	'Press Status'="Planned Maintenance" or 'Press Status'="Press set-up"	Set (optional)	Information
StartTrigger2	'Press Status'="Maintenance"	Set (optional)	Minor
StartTrigger3	'Press Status'="No Operator"	Set (optional)	Major
End trigger			
EndTrigger	'Press Status'="Running"		

Tip: Use the StartTrigger *True for* option to require the start trigger remain true for a set time interval before creating the event frame. This is useful for attributes with continuous, non-stepped data to prevent spikes in the input data from generating unwanted event frames.

Scheduling an Event Frame Analysis

The last thing to do is to schedule the event frame analysis. As with expressions and rollups, two scheduling options are available: Event-Trigger and Periodic. For this exercise, schedule it as Event-Triggered.

Since you set up the analysis at a template level the analyses should be started automatically. Confirm that this analysis was applied to all of the equipment pieces by navigating back under elements.

If you want to see if event frames are being generated, navigate to the event frames tab. Right click and do a new search, and this brings up the event frame search menu.

I know that downtime was in the name of my event frame so I'm going to do the wild card asterisk, downtime, asterisk, and do a search.

3.5. Backfilling Event Frame analysis



During this section, please refer to the following course YouTube video:
[Backfilling Event Frame analysis](#)

Activity description

The analysis we have created will monitor the Press Status from now on. However, with the Backfill function of analysis, it is possible to also backfill past periods in time! This means that the archived values for Press Status will be examined and event frames with dates in the past will be created accordingly.

In this activity your goal is to backfill the event frames since today at midnight.

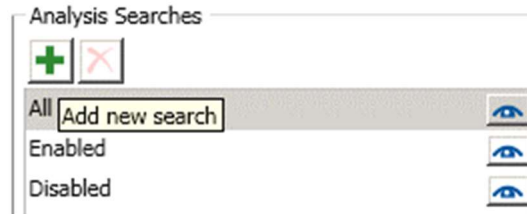
Approach

1. Use the *Management* plugin in the *Navigator Panel* to backfill multiple event frames. Initially, all analyses in that AF database will be listed.

To work with a specific set of analyses (all the downtime analyses for all presses), you can define and save a search that will filter just those analyses:

2. Click on the green  sign to add a new search:





3. For the search name, enter *Press Downtime Analyses* and select **Template** under the Add Criteria dropdown.
4. From the Template dropdown, select *Press Template\Downtime* and click on OK. Result: the list of analyses on the right hand side lists twelve analyses (four from each location).
5. To perform a backfill for all Presses click on the checkbox on top of the list to select all presses.

Analyses							
12 total analyses selected (12 on this page)							
<input checked="" type="checkbox"/>	Status			Element	Name	Template	Backfilling
<input checked="" type="checkbox"/>				Philly\PHI.Press.04	Downtime	Downtime	
<input checked="" type="checkbox"/>				Philly\PHI.Press.03	Downtime	Downtime	
<input checked="" type="checkbox"/>				Philly\PHI.Press.02	Downtime	Downtime	
<input checked="" type="checkbox"/>				Philly\PHI.Press.01	Downtime	Downtime	
<input checked="" type="checkbox"/>				Montreal\MTL.Press.04	Downtime	Downtime	
<input checked="" type="checkbox"/>				Montreal\MTL.Press.03	Downtime	Downtime	
<input checked="" type="checkbox"/>				Montreal\MTL.Press.02	Downtime	Downtime	
<input checked="" type="checkbox"/>				Montreal\MTL.Press.01	Downtime	Downtime	
<input checked="" type="checkbox"/>				Houston\HOU.Press.04	Downtime	Downtime	
<input checked="" type="checkbox"/>				Houston\HOU.Press.03	Downtime	Downtime	
<input checked="" type="checkbox"/>				Houston\HOU.Press.02	Downtime	Downtime	
<input checked="" type="checkbox"/>				Houston\HOU.Press.01	Downtime	Downtime	

6. Click on blue [Queue backfilling or recalculation for 12 selected analyses](#) link.
For Start Time, enter a *t* (=today midnight), for End Time enter a *** (=now).
Acknowledge that existing event frames in the time range will be deleted, then click on *Queue* button.

Management

Analyses Performance Service Summary Service Details

Filter

12 total analyses selected (12 on this page) 1 - 12 of 12

✓	Status	Element	Name	Template	Backfilling
✓	✓	Houston\HOU.Press.02	Downtime	Downtime	✓
✓	✓	Houston\HOU.Press.01	Downtime	Downtime	✓
✓	✓	Philly\PHI.Press.04	Downtime	Downtime	✓
✓	✓	Philly\PHI.Press.03	Downtime	Downtime	✓
✓	✓	Philly\PHI.Press.02	Downtime	Downtime	✓
✓	✓	Philly\PHI.Press.01	Downtime	Downtime	✓
✓	✓	Montreal\MTL.Press.04	Downtime	Downtime	✓
✓	✓	Montreal\MTL.Press.03	Downtime	Downtime	✓
✓	✓	Montreal\MTL.Press.02	Downtime	Downtime	✓
✓	✓	Montreal\MTL.Press.01	Downtime	Downtime	✓
✓	✓	Houston\HOU.Press.04	Downtime	Downtime	✓
✓	✓	Houston\HOU.Press.03	Downtime	Downtime	✓

Operations

Enable | Disable selected analyses

Enable | Disable automatic recalculation for selected analyses

Queue | Cancel backfilling or recalculation for selected analyses

Start t

End *

What should we do with existing data?

Leave existing data and fill in gaps

Permanently delete existing data and recalculate

I acknowledge that my selection contains event frame analyses. Event frames in the time range will be permanently deleted. This will result in loss of annotations and acknowledgements associated with the event frames.

Queue

Pending Operations

Backfilling 12 analyses

Time Submitted: 5/30/2023 12:00:08 PM

Queued by: PISCHOOL\student01

Complete

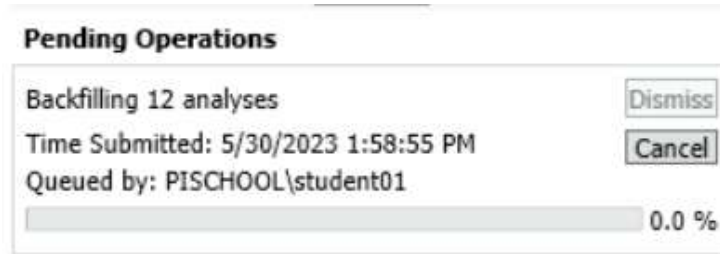
Note with regard to the required acknowledgement: For an event-frame-generation analysis (different to the backfill case in context with non event-frame-generation analyses), data is automatically deleted and recalculated. This is the only mode allowed. Be aware that annotations on those event frames will be lost.

Automatic Recalculation: (AF 2017 R2 and later)



In case you expect that data from your inputs will be late-arriving or be out-of-order, you can request automatic recalculation for an analysis. The Management list allows to set this option for multiple analyses within one command. To set the option on an individual analysis base, use Advanced Options on the Analyses tab of an element or an element template.

The *Backfilling* column will show the progress of the backfill activity.



After backfilling is completed, switch to the Elements tab and select one of the presses. On the General tab and click on the blue [Event Frames](#) link. You will get a list with all event frames linked with that element.

(optional) Verification: what is the start time of the first event frame?

(The first event will be from some time past today midnight, because we backfilled from today midnight onwards.)

3.6. Defining an output expression for an event frame analysis

Activity description

When the downtime event is closed, we want to set a downtime log entry, which provides the information, whether it was a minor issue (when duration was less than 10 minutes) or whether it had a critical production impact.

Explore the option to output the result of an expression in an event frame attribute at the time when an event frame is closed.

Approach

1. Add a string attribute to the event frame template for press downtimes.
2. Define an expression with a string result depending on the event duration.
3. Store the expression output in an event frame attribute.

Step-by-Step Instructions

1. Add a string attribute **Downtime Log Entry** into the **Press Downtime** event frame template:

Press downtime					
General Attribute Templates					
Filter					
Name	Default Value	Value Type	Data Reference	Settings...	
Category: <None>					
Downtime Log Entry	0	String	<None>		
Duration	0 min	Double	PI Point	.\Elements[.]Press Status;TimeMethod=NotSupported;Time...	
Reason code		Press Status	PI Point	.\Elements[.]Press Status;TimeRangeMethod=StartTime	
Production loss	0 Tires	Double	Formula	D=Duration;UOM=min;[D/5];UOM=Tires	

- Open the Downtime analysis in the Press element template.
- Click on blue [Add...](#) link on top of the triggers section and select *Output Expression* option from the dropdown.

For the expression, enter

```
IF EventFrame("Duration") > 10
  then "** critical production impact *"
  else "minor issue"
```

Note: To start a new line, insert Shift-Enter.

- Click on the blue [Map](#) link at the right hand side, and select the **Downtime Log Entry** attribute.

Outputs at close				
Output1	IF EventFrame("Duration") > 10 then "** critical production impact *" else "minor issue"			Downtime Log Entry

- Check-in your changes.
- Search for event frames and confirm that you are getting expected values:

Downtime HOU.Press.02 (Houston) 2023-05-30 14:24:00.000						
General Child Event Frames Referenced Elements Attributes						
Filter						
Name	Value	Display Digits	Value Type	Unit Of Measure	Data Reference	
Category: <None>						
Downtime Log Entry	** critical production impact *	-5	String	<None>	<None>	
Duration	6 min	-5	Double	minute	PI Point	
Production loss	1.2 Tires	-5	Double	Tires	Formula	
Reason code	No Operator	-5	Press Status	<None>	PI Point	

4 Consuming Event Frames

Event Frames are stored in the AF Server. Visualization clients, such as PI Vision and PI Datalink access the AF Server to retrieve the events and their related data providing you with powerful tools to analyze important events.

Note: PI ProcessBook, PI BatchView, and PI Manual Logger do not support event frame visualization.

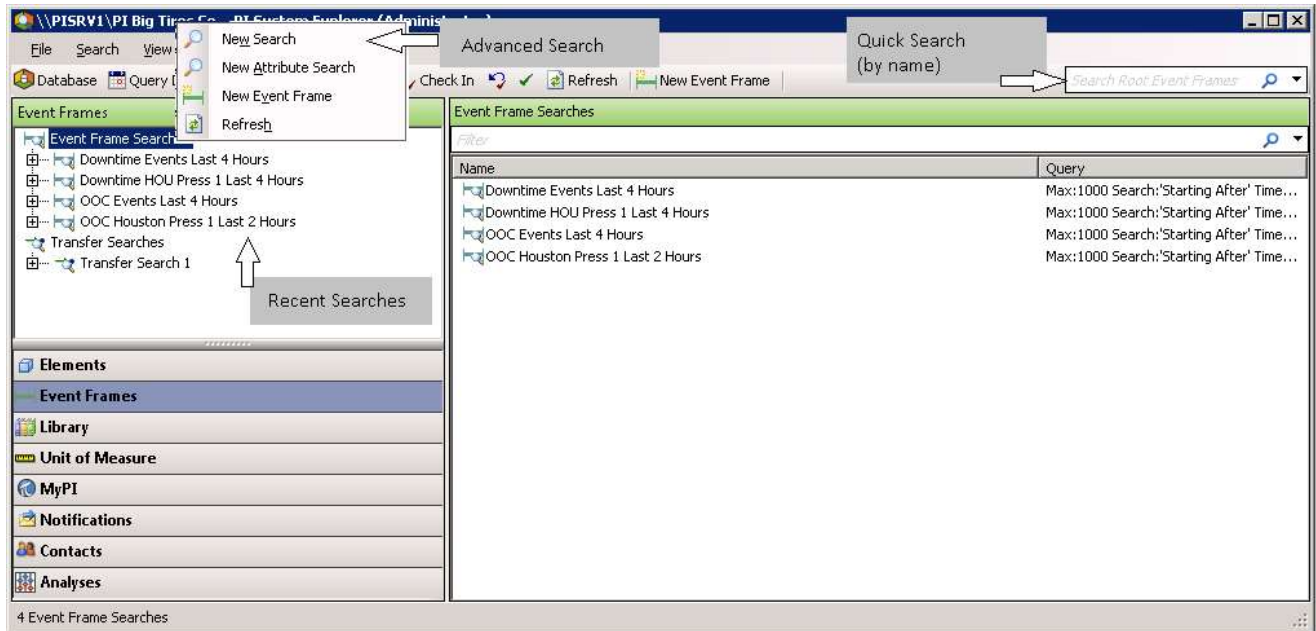
4.1. Event Frames in PSE

In this section, we will be exploring how to consume event frames in PI System Explorer (PSE). As an administrator, you can use PSE to search for events and analyze them. The results are presented in a practical table format that features a Gantt chart and columns for the attributes. Moreover, this is a quick way of verifying the creation of event frames.

In order to access event frames in PSE, click on the *Event Frames* plugin under the navigator panel.

Note: Unlike elements, it is not possible to browse events. You actually have to search for them.

The following screenshot presents the main features of the *Event Frames* plugin:



Event Frame Search Results

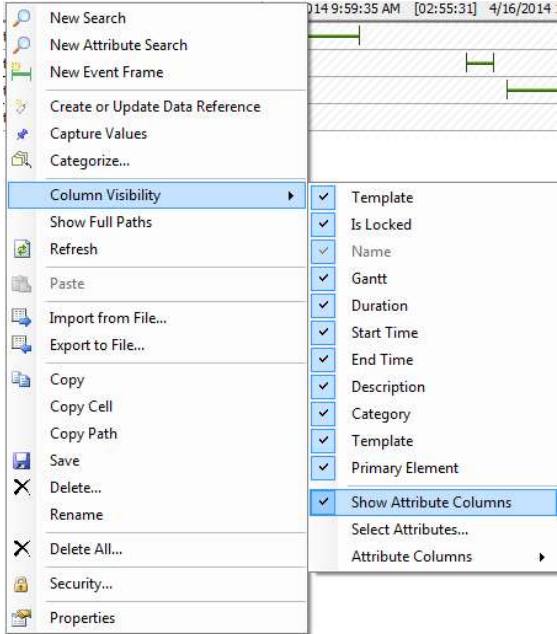
Event frames are listed with their information such as the event frame name, a Gantt diagram, the event duration, the severity, and the start and end time:


Name	Duration	Start Time	End Time	Severity	Primary Element	Event Duration	Production L...	Reason Code
Downtime MTL.Press.02 (Montreal) 2016-06-23 05:07	0:06:30	6/23/2016 5:07:23 AM	6/23/2016 5:13:53 AM	Major	MTL.Press.02	390 s	1.3 Tires	No Operator
Downtime PHL.Press.03 (Philly) 2016-06-23 05:14	0:26:00	6/23/2016 5:14:23 AM	6/23/2016 5:40:23 AM	Information	PHL.Press.03	1560 s	5.2 Tires	Planned Maintenance
Downtime MTL.Press.02 (Montreal) 2016-06-23 05:20	0:06:30	6/23/2016 5:20:23 AM	6/23/2016 5:26:53 AM	Minor	MTL.Press.02	390 s	1.3 Tires	Maintenance
Downtime HOU.Press.01 (Houston) 2016-06-23 05:25	0:13:00	6/23/2016 5:25:23 AM	6/23/2016 5:38:23 AM	Information	HOU.Press.01	780 s	2.6 Tires	Press set-up
Downtime MTL.Press.01 (Montreal) 2016-06-23 05:26	0:06:30	6/23/2016 5:26:53 AM	6/23/2016 5:33:23 AM	Minor	MTL.Press.01	390 s	1.3 Tires	Maintenance
Downtime MTL.Press.03 (Montreal) 2016-06-23 05:26	0:13:00	6/23/2016 5:26:53 AM	6/23/2016 5:39:53 AM	Major	MTL.Press.03	780 s	2.6 Tires	No Operator
Downtime MTL.Press.04 (Montreal) 2016-06-23 05:26	0:06:30	6/23/2016 5:26:53 AM	6/23/2016 5:33:23 AM	Minor	MTL.Press.04	390 s	1.3 Tires	Maintenance
Downtime PHL.Press.01 (Philly) 2016-06-23 05:26	0:06:30	6/23/2016 5:26:53 AM	6/23/2016 5:33:23 AM	Information	PHL.Press.01	390 s	1.3 Tires	Planned Maintenance
Downtime PHL.Press.02 (Philly) 2016-06-23 05:27	0:06:30	6/23/2016 5:27:23 AM	6/23/2016 5:33:53 AM	Information	PHL.Press.02	390 s	1.3 Tires	Press set-up
Downtime PHL.Press.04 (Philly) 2016-06-23 05:27	0:13:00	6/23/2016 5:27:53 AM	6/23/2016 5:40:53 AM	Information	PHL.Press.04	780 s	2.6 Tires	Planned Maintenance
Downtime HOU.Press.02 (Houston) 2016-06-23 05:31	0:13:00	6/23/2016 5:31:53 AM	6/23/2016 5:44:53 AM	Minor	HOU.Press.02	780 s	2.6 Tires	Maintenance
Downtime HOU.Press.04 (Houston) 2016-06-23 05:32	0:06:30	6/23/2016 5:32:23 AM	6/23/2016 5:38:53 AM	Information	HOU.Press.04	390 s	1.3 Tires	Press set-up









Displaying the Event Frame attributes

By default, the event attributes are not displayed in the result window.

By right-clicking and selecting *Column Visibility*, you will be able to choose the attributes you want to display.



Tip: To change the column visibility you can also click on the Settings icon  in the header row of the search results.

Column (Meaning)	Column (Header Icon)	EF Row Information	Meaning
Is Template			Hover with the mouse over this column to get the event frame template.
		<empty>	Event frame is not based on an event frame template.
Is Locked			Captured Values: values for the event frame attributes are saved in AF (see note below).
		<empty>	Values for the event frame attributes are not saved in AF (see note below).
Is Annotated			Event Frame is annotated. Hover with the mouse over the icon to get the annotation(s). Use EF right mouse button menu option <i>Annotate...</i> to enter new annotations.
		<empty>	Event Frame is not annotated. Use EF right mouse button menu option <i>Annotate...</i> to enter new annotations.
Is Not Acknowledged			Event Frame can be acknowledged. Use EF right mouse button menu option <i>Acknowledge...</i> to acknowledge the EF.
		OK	Event Frame is acknowledged. Hover with the mouse over the icon to get acknowledgement info (by whom?, when?).
		<empty>	Event Frame cannot be acknowledged. Whether an event frame can be acknowledged is defined in the corresponding event frame template (General tab)

Note: You capture values to save the values for event frame attributes in a table in the PI AF database. This can improve performance since PI AF does not execute any data references. If you add new attributes to event frames with captured values, you should recapture those values to ensure that values are also captured for the new attributes.

4.1.1 Knowledge check: Event Frame Searches, Acknowledgement and Annotation

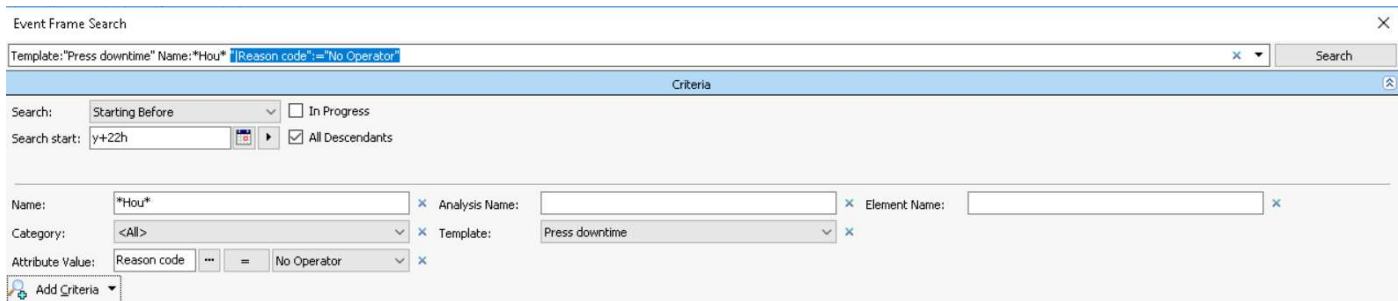
Activity description

You want to get the details for any downtimes after 10PM yesterday triggered by a “No Operator” root cause so you can annotate the events, and acknowledge them.

Approach

Use the *Event Frame Search* window to perform the following:

1. Select *New Search* from the right mouse button menu of the Event Frame search root.
2. Enter following criteria: start time: *y+22h*, event frame template: *Press Downtime*, element name: **Hou**, Reason Code= *No Operator* (you have to use *Add Criteria* to enter that)



The screenshot shows the 'Event Frame Search' window. At the top, there is a search bar containing the criteria: 'Template: "Press downtime" Name: "*Hou*" Reason code: "= No Operator"'. Below this is a 'Criteria' section with a 'Search:' dropdown set to 'Starting Before', an 'In Progress' checkbox, and a 'Search start:' field with 'y+22h'. There is also an 'All Descendants' checkbox. Below the search section, there are several criteria fields: 'Name: "*Hou*"', 'Analysis Name:', 'Element Name:', 'Category: "<All>"', 'Template: "Press downtime"', and 'Attribute Value: "Reason code" = "No Operator"'. At the bottom left, there is an 'Add Criteria' button.

Hint: you can enter the criteria one by one and click on Search every time. If you enter more criteria, then you get less event frames that match your criteria. Click on OK when the returned event frames meet the desired scope.

3. Rename your narrowed down search: *Downtime Events No Operator after 10PM yesterday*

Background: Once performed, your searches and their criteria are saved. Use *Rename* from the context menu of a search to assign a descriptive name for the search. To further refine an existing search, while keeping the existing search saved, select *New Search* from the context menu of the search and then modify the new one.

4. Add columns for the *Reason Code* and the *Event Duration* attributes. Verify the *Reason Code* is *No Operator* in every case.
5. Select the first event frame and add annotation: “Bob was busy with representative from press manufacturer.” (Hint: Right-click on an event frame and select *Annotate...*)

6. Select all event frames that started before midnight and acknowledge them in one action. (Hint: Select event frames, right click on your selection and select *Acknowledge...*)

4.1.2 Knowledge check: Advanced Event Frame Searches

Activity description

Perform the following event frame searches in PSE:

- Find all downtime events for Montreal's press2 for the last 12 hours.
- Add columns to show the *Production Lost* and *Reason code*.
- Narrow down your search to find events that lasted more than 10 minutes.
- Narrow down your search to find downtime events caused by Press set-up.

Approach

Use the *Event Frame Search* window to perform your searches. Make sure to add the necessary search criteria.

4.2. Event Frame Reports in Excel with PI Datalink



During this section, please refer to the following course YouTube videos:

- [Use the Explore Events Function in PI DataLink to Build Event Reports](#)
- [When and How to Use the Compare Events Function in PI DataLink](#)

Explore versus Compare Events functions

You can use PI Datalink (2014 or later) to import event frames from AF into Excel and then create reports for viewing and analyzing those events. Pivot tables and pivot charts are great Excel features for summarizing the data and getting better insight into event frames

Under the PI Datalink ribbon in Excel you will find two functions (buttons) to import event frame data into Excel: The **Explore Events** function and the **Compare Events** function.

The **Explore Events** function returns one event per row, which is useful to analyze events sharing the same EF template.

	A	B	C	D	E
1	Event name	Start time	End time	Primary element	Temp.Max
2	Batch 1222	30/01/2015 12:23:07	30/01/2015 14:05:07	RE100	89.56497955
3	Batch 1317	30/01/2015 13:18:37	30/01/2015 14:19:37	RE200	73.08377075
4	Batch 1327	30/01/2015 13:28:07	30/01/2015 14:04:07	RE300	92.61405945
5	Batch 1410	30/01/2015 14:11:07	30/01/2015 14:47:07	RE300	101.1487427

Here: maximum temperature of event frame named *Batch 1222* has been highlighted above in yellow (89.56).

In case an event frame has child events, it is possible to also list child elements in further lines below the parent event. In the example below, there are nine child event frames (Material Add 1, Agitate, ...):

	A	B	C	D	E	F
1	Event name	Child 1	Start time	End time	Primary element	Temp.Max
2	Batch 1222		30/01/2015 12:23:07	30/01/2015 14:05:07	RE100	89.56497955
3	Batch 1222	Material Add 1	30/01/2015 12:24:37	30/01/2015 12:35:07		12.45047569
4	Batch 1222	Agitate	30/01/2015 12:35:07	30/01/2015 12:41:37		13.08228683
5	Batch 1222	Material Add 2	30/01/2015 12:41:37	30/01/2015 12:56:37		14.34287834
6	Batch 1222	Agitate	30/01/2015 12:56:37	30/01/2015 13:07:37		16.33535957
7	Batch 1222	Heat	30/01/2015 13:07:37	30/01/2015 13:14:07		41.38076401
8	Batch 1222	Dwell	30/01/2015 13:14:07	30/01/2015 13:34:37		89.26969147
9	Batch 1222	Agitate	30/01/2015 13:34:37	30/01/2015 13:39:37		89.56497955
10	Batch 1222	Cool	30/01/2015 13:39:37	30/01/2015 13:53:37		89.56497955
11	Batch 1222	XFER_OUT	30/01/2015 13:53:37	30/01/2015 14:05:07		47.95473671
12	Batch 1317		30/01/2015 13:18:37	30/01/2015 14:19:37	RE200	73.08377075
13	Batch 1317	Material Add 1	30/01/2015 13:20:07	30/01/2015 13:25:07		19.77932739
14	Batch 1317	Agitate	30/01/2015 13:25:07	30/01/2015 13:32:37		19.77932739
15	Batch 1317	Material Add 2	30/01/2015 13:32:37	30/01/2015 13:42:07		19.32192421
16	Batch 1317	Agitate	30/01/2015 13:42:07	30/01/2015 13:46:07		18.90079117
17	Batch 1317	Heat	30/01/2015 13:46:07	30/01/2015 13:55:37		72.09648132
18	Batch 1317	Dwell	30/01/2015 13:55:37	30/01/2015 14:06:37		73.08377075
19	Batch 1317	Agitate	30/01/2015 14:06:37	30/01/2015 14:08:37		71.17395782
20	Batch 1317	Cool	30/01/2015 14:08:37	30/01/2015 14:13:37		60.78569031
21	Batch 1317	XFER_OUT	30/01/2015 14:13:37	30/01/2015 14:19:37		3.42448926
22	Batch 1327		30/01/2015 13:28:07	30/01/2015 14:04:07	RE300	92.61405945
23	Batch 1327	Material Add 1	30/01/2015 13:29:27	30/01/2015 13:31:07		21.78729439

Here: the maximum temperature of child event frames *Material Add 1* and *Agitate* have been highlighted in green (12.45 and 13.08).

The second function, **Compare Events**, allows you to compare hierarchical events, in other words, events with child events. The compare events function shows attributes from both the parent event and the child event(s). In the following example maximum temperature for the complete production batch as well as for the first child event frames *Material Add 1* and *Agitate* is returned:

	A	B	C	D	E	F	G
1	. Event name	. Start time	. End time	. Primary element	. Temp.Max	. Material Add 1 Temp.Max	. Agitate[1] Temp.Max
2	Batch 1222	30/01/2015 12:23:07	30/01/2015 14:05:07	RE100	89.56497955	12.45047569	13.08228683
3	Batch 1247	30/01/2015 12:48:07	30/01/2015 13:49:07	RE400	113.7231445	35.76528931	43.35900879
4	Batch 1317	30/01/2015 13:18:37	30/01/2015 14:19:37	RE200	73.08377075	19.77932739	19.77932739
5	Batch 1327	30/01/2015 13:28:07	30/01/2015 14:04:07	RE300	92.61405945	21.78729439	23.9196682
6	Batch 1410	30/01/2015 14:11:07	30/01/2015 14:47:07	RE300	101.1487427	21.77057076	22.690979

4.3.1 Knowledge check: Creating Event Frame reports with PI DataLink

Activity description

Management wants to answer the following questions about the downtime events:

1. What is the most offending cause of downtimes?
2. How much production are we losing because of downtime events?

The best way to find an answer to these questions is by creating an Excel report which imports the event frames into an Excel spreadsheet. Excel offers some useful business intelligence tools that will help us aggregate the data so management can make decisions.

Approach

We will be using PI Datalink to import the event frame information and then use Excel PowerPivot and PowerChart to analyze the downtime events.

Building the DownTime Analysis Report

For this exercise, you will be using a template: *Press DownTime Analysis.xlsx*, located in the class\exercises folder. The template contains two sheets; we will be importing the event frames data into the *Raw Data* sheet, which will be read from the *Report* sheet via a pivot table and a pivot chart.

Since we want to analyze the downtime events which are all based on the same EF template, we will be taking advantage of the *Explore function* in PI Datalink. Go to the *Raw Data* sheet, set the cursor into cell A2 and click on the *Explore function* in the PI Datalink ribbon



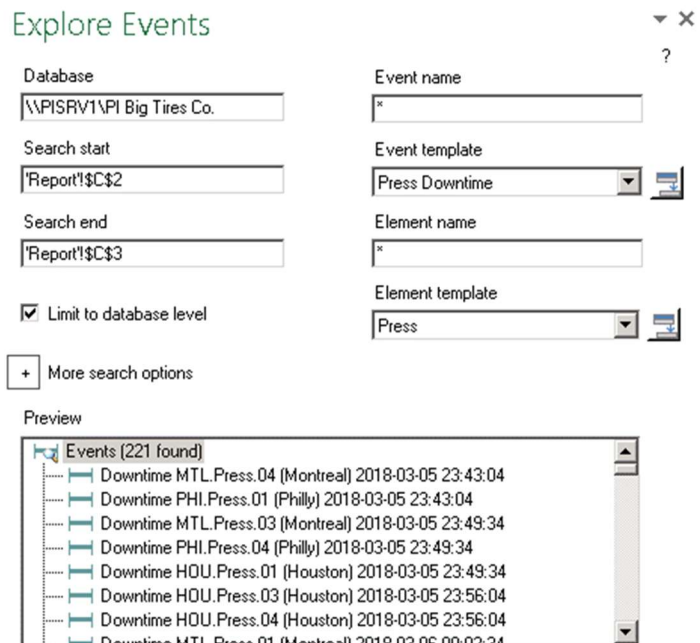
Configuring the Explore Events Function

The *Explore Events* pane will show up. This pane offers several fields for you to refine your event frames search. Moreover, it features a results preview section.

For the *Search start* and *Search end* fields point to the corresponding cells on the *Report sheet* (see figure).

Keep * for event name and element name.

Note: It is expected you will not get Event Frames that are not yet finished. To exclude Event Frames that are not finished, click on *More Search Options* and select *entirely in range* under the search mode.

A screenshot of the 'Explore Events' configuration pane. The pane has a title bar 'Explore Events' with a close button. It contains several input fields: 'Database' (\\PISRV1\PI Big Tires Co.), 'Event name' (*), 'Search start' ('Report!\$C\$2'), 'Event template' (Press Downtime), 'Search end' ('Report!\$C\$3'), 'Element name' (*), and 'Element template' (Press). There is a checkbox for 'Limit to database level' which is checked. Below these fields is a '+ More search options' button. At the bottom is a 'Preview' section showing a list of event frames with their names and timestamps. The list is titled 'Events (221 found)' and includes entries like 'Downtime MTL.Press.04 (Montreal) 2018-03-05 23:43:04'.

Select the seven columns to display; you can as well set the column order. The columns are actually the event frame attributes. The following columns are needed for the analysis:

Columns to display

Select all

- Event name
- Start time
- End time
- Primary element
- Event Duration
- Production Loss
- Reason Code
- Duration

Hit OK to display all event frame information in the *Raw Data* sheet.

	A	B	C	D	E	F	G	H
1	This sheet retrieves the event frames raw data. The "Report" sheet queries the data from this spreadsheet							
2	Event name	Start time	End time	Primary element	Event Duration	Production Loss	Reason Code	
3	Downtime PHI.Press.03 (Philly) 2017-01-08 23:37:53	08-Jan-17 23:37:53	09-Jan-17 00:23:23	PHI.Press.03	2730	9.1	Press set-up	
4	Downtime MTL.Press.03 (Montreal) 2017-01-08 23:50:53	08-Jan-17 23:50:53	09-Jan-17 00:03:53	MTL.Press.03	780	2.6	No Operator	
5	Downtime MTL.Press.01 (Montreal) 2017-01-08 23:50:53	08-Jan-17 23:50:53	09-Jan-17 00:03:53	MTL.Press.01	780	2.6	Maintenance	
6	Downtime MTL.Press.01 (Montreal) 2017-01-08 23:50:53	08-Jan-17 23:50:53	09-Jan-17 00:10:23	MTL.Press.01	1170	3.9	Maintenance	
7	Downtime PHI.Press.03 (Philly) 2017-01-08 23:57:23	08-Jan-17 23:57:23	09-Jan-17 00:03:53	PHI.Press.03	390	1.3	Maintenance	
8	Downtime MTL.Press.03 (Montreal) 2017-01-08 23:57:23	08-Jan-17 23:57:23	09-Jan-17 00:03:53	MTL.Press.03	390	1.3	Planned Maintenance	
9	Downtime HOU.Press.03 (Houston) 2017-01-08 23:57:23	08-Jan-17 23:57:23	09-Jan-17 00:03:53	HOU.Press.03	390	1.3	Planned Maintenance	
10	Downtime HOU.Press.01 (Houston) 2017-01-08 23:57:23	08-Jan-17 23:57:23	09-Jan-17 00:03:53	HOU.Press.01	390	1.3	No Operator	
11	Downtime PHI.Press.04 (Philly) 2017-01-09 00:03:53	09-Jan-17 00:03:53	09-Jan-17 00:10:23	PHI.Press.04	390	1.3	Planned Maintenance	
12	Downtime PHI.Press.03 (Philly) 2017-01-09 00:03:53	09-Jan-17 00:03:53	09-Jan-17 00:10:23	PHI.Press.03	390	1.3	Planned Maintenance	
13	Downtime MTL.Press.01 (Montreal) 2017-01-09 00:03:53	09-Jan-17 00:03:53	09-Jan-17 00:10:23	MTL.Press.01	390	1.3	Press set-up	
14	Downtime HOU.Press.04 (Houston) 2017-01-09 00:03:53	09-Jan-17 00:03:53	09-Jan-17 00:10:23	HOU.Press.04	390	1.3	No Operator	
15	Downtime PHI.Press.03 (Philly) 2017-01-09 00:10:23	09-Jan-17 00:10:23	09-Jan-17 00:23:23	PHI.Press.03	780	2.6	No Operator	
16	Downtime PHI.Press.01 (Philly) 2017-01-09 00:10:23	09-Jan-17 00:10:23	09-Jan-17 00:16:53	PHI.Press.01	390	1.3	Planned Maintenance	
17	Downtime MTL.Press.03 (Montreal) 2017-01-09 00:10:23	09-Jan-17 00:10:23	09-Jan-17 00:23:23	MTL.Press.03	780	2.6	No Operator	
18	Downtime HOU.Press.01 (Houston) 2017-01-09 00:10:23	09-Jan-17 00:10:23	09-Jan-17 00:16:53	HOU.Press.01	390	1.3	Press set-up	
19	Downtime HOU.Press.01 (Houston) 2017-01-09 00:10:23	09-Jan-17 00:10:23	09-Jan-17 00:23:23	HOU.Press.01	780	2.6	Press set-up	
20	Downtime MTL.Press.04 (Montreal) 2017-01-09 00:16:53	09-Jan-17 00:16:53	09-Jan-17 00:29:53	MTL.Press.04	780	2.6	No Operator	
21	Downtime MTL.Press.04 (Montreal) 2017-01-09 00:16:53	09-Jan-17 00:16:53	09-Jan-17 00:49:23	MTL.Press.04	1950	6.5	No Operator	
22	Downtime MTL.Press.01 (Montreal) 2017-01-09 00:16:53	09-Jan-17 00:16:53	09-Jan-17 00:29:53	MTL.Press.01	780	2.6	Planned Maintenance	
23	Downtime MTL.Press.01 (Montreal) 2017-01-09 00:16:53	09-Jan-17 00:16:53	09-Jan-17 00:36:23	MTL.Press.01	1170	3.9	Planned Maintenance	
24	Downtime HOU.Press.03 (Houston) 2017-01-09 00:16:53	09-Jan-17 00:16:53	09-Jan-17 00:23:23	HOU.Press.03	390	1.3	Press set-up	
25	Downtime HOU.Press.02 (Houston) 2017-01-09 00:16:53	09-Jan-17 00:16:53	09-Jan-17 00:23:23	HOU.Press.02	390	1.3	No Operator	
26	Downtime HOU.Press.01 (Houston) 2017-01-09 00:16:53	09-Jan-17 00:16:53	09-Jan-17 00:23:23	HOU.Press.01	390	1.3	Maintenance	

Just by looking at this spreadsheet, it is very difficult to identify the most offending downtime cause or the production lost. By using an Excel tool, *Pivot tables*, we will be able to automatically extract, organize, and summarize the event frame data. PivotTables, and their graphical companions, Pivot Charts, are very versatile and easy to create. No formulas needed!

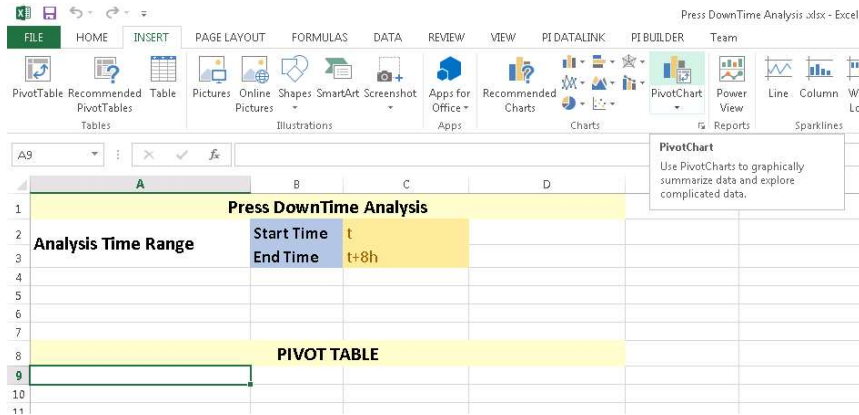
4.5.1 Knowledge check: Using Pivot Charts to summarize Event Frames

Activity description

Use Excel Pivot Chart functionalities to summarize event frame information.

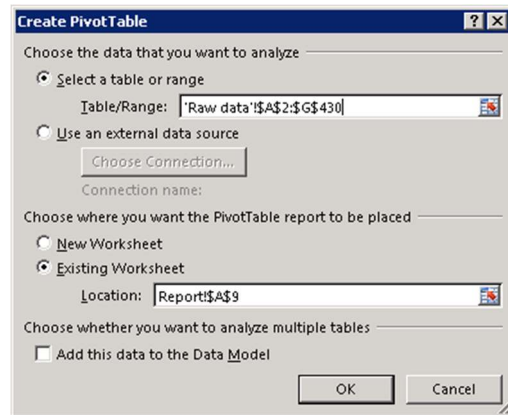
Approach

1. Go to the *Report* sheet, select the *Insert* ribbon and select the *PivotCharts* option to create a PivotTable and a PivotChart.

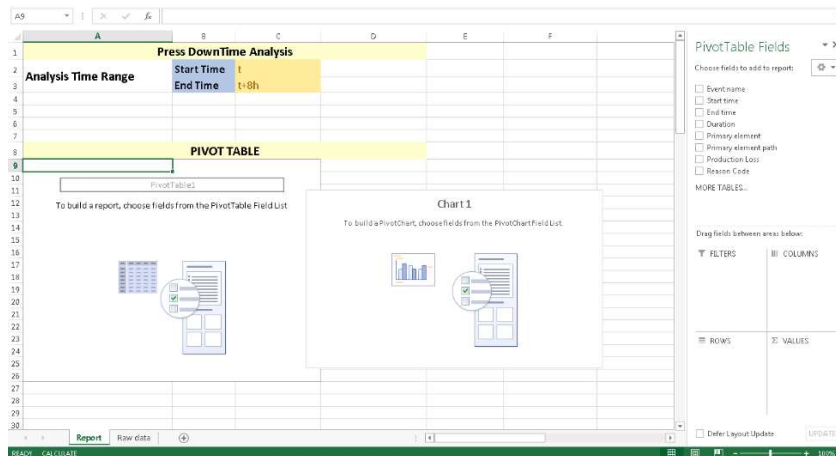


- As input for the PivotTable select the cell range in the *Raw Data* sheet where the ExploreEvents function has returned the data (including the header line). Then choose to place the PivotTable and PivotChart in the *Report* sheet.

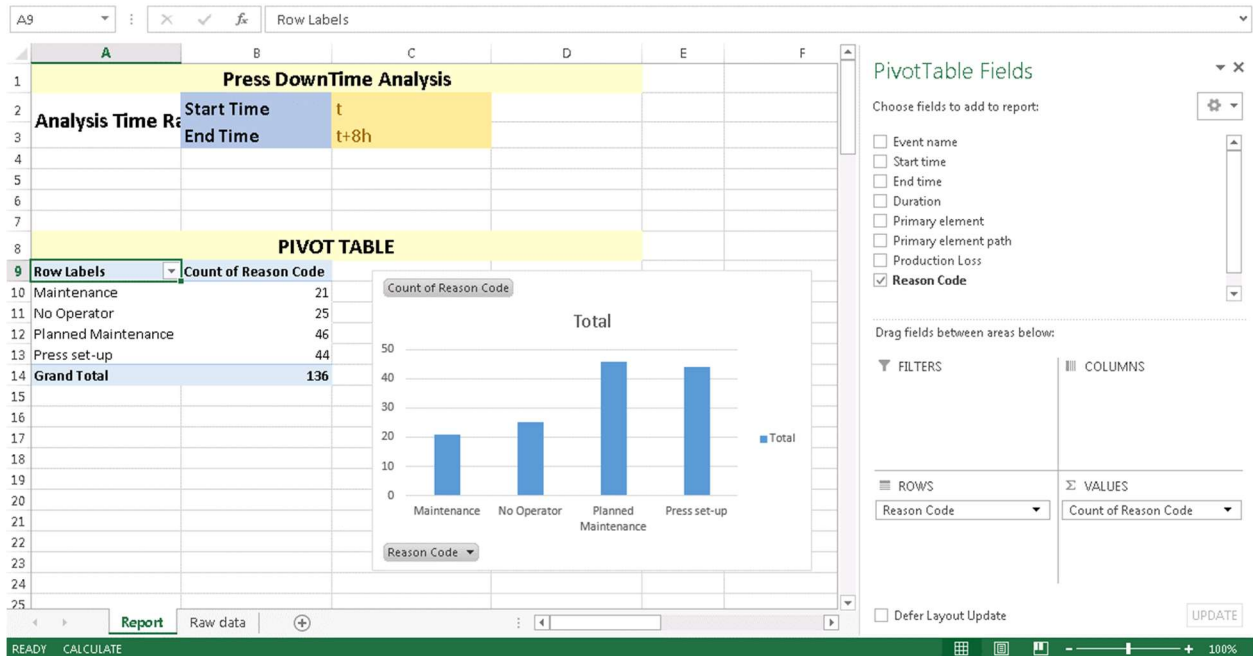
Tip: if you want to correct the source area later in time, select all cells of your PivotTable (or choose the Analyse ribbon), then from the Analyse Ribbon, select **Change Data Source**.



The PivotChart field list should now be shown in your Excel worksheet and a range of the worksheet should be designated where the pivot table will be located, as shown below.



3. Select the PivotTable, and review the PivotTable Field list. These fields come from the column names of the *Raw Data* sheet.
4. To perform a downtime analysis for our Event Frames based on the corresponding reason code, select the **Reason Code** line and drag into the *Values* area. The applied Aggregation for the reason codes is COUNT, because these are non-numeric values. Select the **Reason Code** line again and drag into the *Axis (Categories)* area:



5. Select the **Production Loss** line and drag into the *Values* area. The aggregation applied for these numeric values is SUM. Your PIVOT table is extended by another row, which summarizes corresponding production losses, based on the reason codes:

The screenshot shows an Excel spreadsheet with a PivotTable and a PivotTable Fields task pane. The PivotTable is located in cells A9:C12 and has the following data:

Row Labels	Count of Reason code	Sum of Production loss
No Operator	4	13.2
Press set-up	10	21.6
Grand Total	14	34.8

The PivotTable Fields task pane on the right shows the following configuration:

- Choose fields to add to report:**
 - Event name
 - Start time
 - End time
 - Primary element
 - Production loss
 - Reason code
 - Duration
- Drag fields between areas below:**
 - FILTERS:** (Empty)
 - COLUMNS:** Σ Values
 - ROWS:** Reason code
 - VALUES:** Count of Reason code, Sum of Production loss

A bar chart is displayed next to the PivotTable, comparing the 'Count of Reason code' (blue bars) and 'Sum of Production loss' (orange bars) for 'No Operator' and 'Press set-up'.

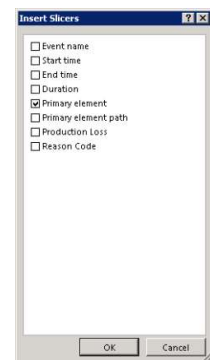
Tip1: if the PivotTable Fields pane was closed and you want to have it available again, select a cell of your PivotTable. From the right-mouse button menu, select **Show Field List**.

Tip2: to change the aggregation that is applied to your data, select the dropdown icon on the field, and choose Value Field Settings... to select another aggregation type.

- Let us enhance our Pivot table for analysis depending on individual press selections.

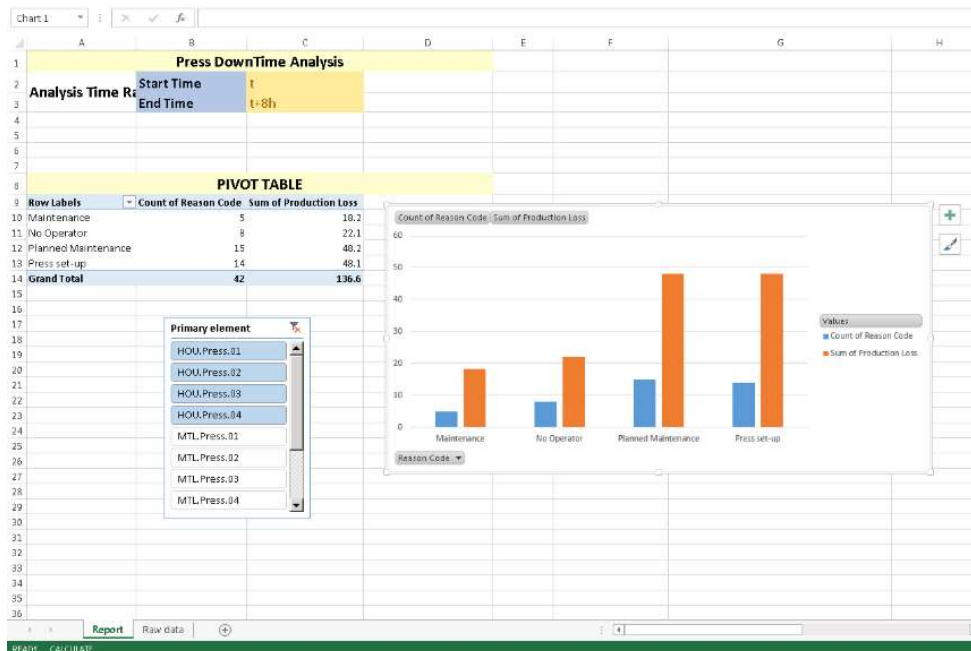
Which column of our data represents a press ?

- Select a cell in the Pivot table, and select the Analyze ribbon from the Pivot Table tools. Click on insert slicer, select primary element and click on OK.



- The slicer for the primary element is added. It allows selecting any combination of one or more presses for our analysis. Check various combinations (use Shift- and Ctrl-key for selections in the slicer):

- all presses
- PHI. Press01 only
- all "Number 01"- presses (i.e. HOU.Press.01, MTL.Press.01 and PHI. Press01)
- all presses in Houston



The PivotTable and the PivotChart will update to show you what reason code is causing most of the downtime events. In the screenshot above, it is clear that during the observed period of time, planned maintenance has caused most of the production losses for the Houston Presses.

4.3. Event Frames in PI Vision

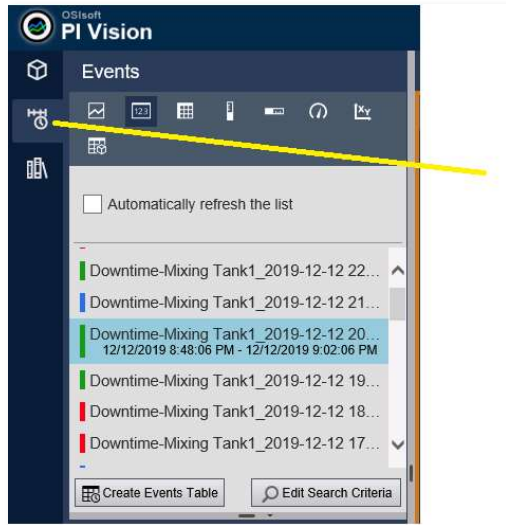
PI Vision enables you to view and analyze your data during the time range of a particular event. For example, you may want to examine the performance of an asset during an operator shift or compare the data for several assets during a downtime period. You can compare multiple events on a single trend, analyze root causes, investigate an event by examining it in detail, and annotate it with notes that you can share with colleagues.

Each event has a severity level associated with it. The severity level is marked in the Events pane with a color-coded bar in front of each event. Severity levels have the following default levels, names and color codes:

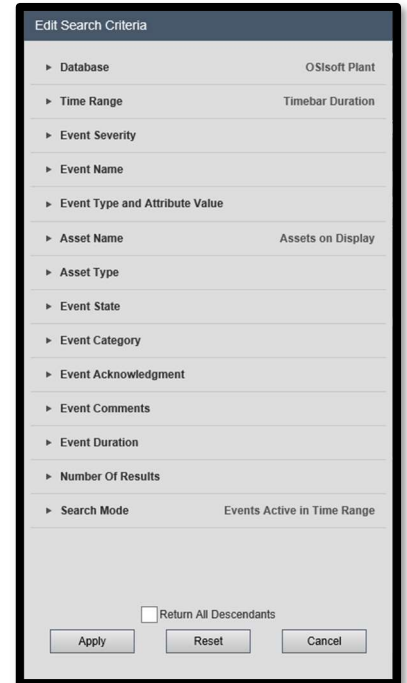
- Level 5: █ Critical
- Level 4: █ Major
- Level 3: █ Minor
- Level 2: █ Warning
- Level 1: █ Information
- Level 0: None (no color)

4.5.2 Find Related Events

PI Vision enables you to view and analyze PI data during the time range of an event. For example, you may want to examine the performance of an asset during an operator shift or compare the data for several assets during a downtime period.

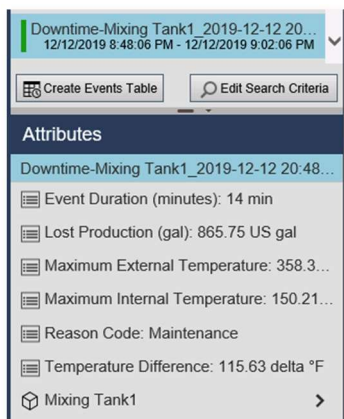


To view events, open the Events tab on the left side. Here you will find events related to your process, the color to the left of each event indicates its severity. By default, the *time range* of the display and the *context* of the symbols in the display determine which events are shown in the Events list. To discover additional events, modify the time range or choose *Edit Search Criteria*.



When editing the search criteria, there are a number of filtering options to find the *Event Frames* you are looking for, as shown at left.

Select an event to find its Data Items (event attributes) and its start and end time.



By right clicking on an event, you can choose *Apply Time Range* apply the event's time range to the display.

The screenshot shows a software interface with a list of events on the left and a context menu on the right. The list contains three entries, each with a colored bar on the left: a red bar for the first, a green bar for the second, and a blue bar for the third. The third entry is selected and has a context menu open over it. The context menu has a light blue background and contains four items: 'Apply Time Range', 'Event Details', 'Compare Similar Events by Name', and 'Compare Similar Events by Type'. Below the list, there is a button labeled 'Create Events Table' with a grid icon. At the bottom of the interface, the word 'Attributes' is visible.

Downtime-Mixing Tank1_2019-12-12 23...

Downtime-Mixing Tank1_2019-12-12 22...

Downtime-Mixing Tank1_2019-12-12 21...
12/12/2019 9:48:39 PM - 12/12/2019 9:48:39 PM

Apply Time Range

Event Details

Compare Similar Events by Name

Compare Similar Events by Type

Create Events Table

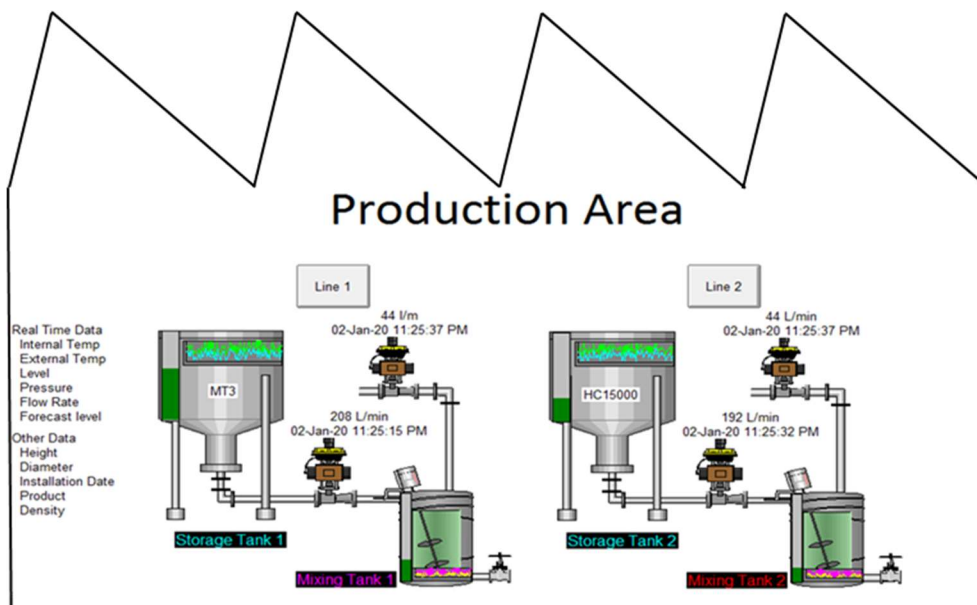
Attributes

4.5.3 Background: New course scenario for PI Vision

Note: In this segment of the course, you will be introduced to a new database called "OSIsoft Plant" that will be used for training purposes. Prior to commencing the PI Vision exercises, we encourage you to carefully review the details provided below in order to become familiar with the database.

The next practical exercises dedicated to PI Vision will use a fictitious manufacturing plant, OSIsoft Plant. Initially this simple plant has two production lines; each line has one mixing tank and one storage tank.

The 'It's Not Real' OSIsoft Plant



Each tank has different analogue process variables such as Internal and External Temperatures, Flow Rate, Pressure and Level; values continuously collected from devices in the Plant.

Other data associated with these tanks such as the manufacturer, model and installation date are stored in the maintenance sheets available on tables in an SQL Server. The information related to the material flowing in these tanks is also kept in tables on the plant's SQL Servers. Despite the fact that these tables may be available in a relation database, this information cannot be easily integrated with the historical data stored in the **Data Archive**. To integrate the time series data with SQL based data, the **Asset Framework** with an asset hierarchy is utilised, bringing all the data and information into one place - the **PI System**.

A collection of PI Points has been built in the PI Data Archive for storing the process variable values along with their timestamps. The plant hierarchy in the PI Asset Framework brings all the important information and data into one place, as shown below.

Elements

- Elements
 - Data Archive
 - Production Area
 - Production Line 1
 - Mixing Tank1
 - Storage Tank1
 - Production Line 2
 - Mixing Tank2
 - Storage Tank2
 - Element Searches

Elements

Event Frames

Library

Unit of Measure

Contacts

Management

Storage Tank2

General Child Elements Attributes Ports Analyses Notification Rules Version

Filter

	Name	Value
	Asset Location	Production Line2
	Asset Name	Storage Tank2
	Density	3422 g/L
	Diameter	15 m
[-]	External Temperature	173.39 °C
	Average	199.35 °C
	Flow Rate	96.292 L/min
	Height	10 m
[-]	Installation Date	17/11/2016 12:00:00
	Manufacturer	AnhTran Group
	Serial Number	NGOC999
[-]	Internal Temperature	55.25 °C
	Average	89.81 °C
[-]	Level	6.8555 m
	Maximum	10 m
	Minimum	0 m
	Target	0.16911 m
	Level_Forecast	0.16911 m
	Percentage Full	68.555 %
[-]	Pressure	60.953 kPa
	Hi	80 kPa
	HiHi	90 kPa
	Lo	20 kPa
	LoLo	10 kPa
	Maximum	150 kPa
	Minimum	0 kPa
	Target	50 kPa
	Product	HC15000
	RandomSeed	0.82379
	Status	Filling
	Tank Status	2
	Tank Volume	50040 L

4.5.4 Knowledge check: Find Events

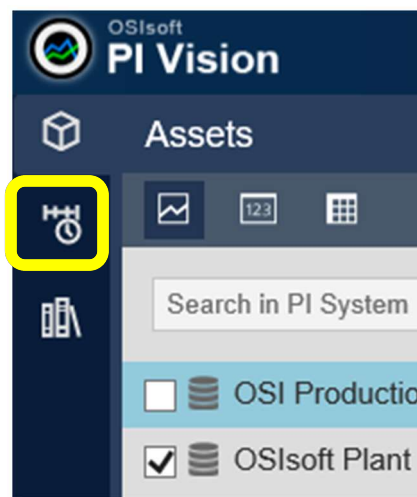
Activity Description

In “Industrial Plants of The World”, the process engineer has set up Downtime tracking using AF Event Frames. An Event is created when the tank level drops below 10% full. You have been asked to provide details on how much production was lost in the last event.

Approach:

Step 1: Create a New Display

Step 2: Select *Events*



Step 3: Select *Edit search Criteria*

Step 4: Set Database dropdown to OSIsoft Plant

Step 5: Under Asset Name select ANY, then click APPLY.

Events

Automatically refresh the list

- Downtime-Mixing Tank1_2022-01-10 16:49:03.000
1/10/2022 4:49:03 PM - 1/10/2022 5:02:21 PM
- Downtime-Storage Tank1_2022-01-10 16:47:36.000
- Downtime-Mixing Tank1_2022-01-10 15:49:12.000
- Downtime-Storage Tank2_2022-01-10 15:48:18.000
- Downtime-Storage Tank1_2022-01-10 15:47:39.000
- Downtime-Storage Tank1 2022-01-10 14:48:48.000

Attributes

Downtime-Mixing Tank1_2022-01-10 16:49:03.000

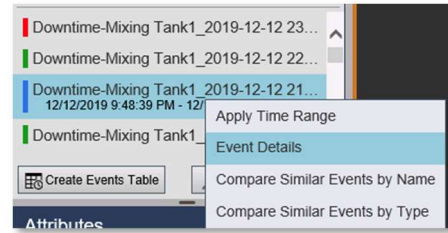
- Event Duration: 13.3 min
- Lost Production: 2,706.7 L
- Maximum External Temperature: 308.35 °C
- Maximum Internal Temperature: 202.13 °C
- Reason Code: Unknown
- Temperature Difference: 97.492 delta °C
- Mixing Tank1 >

- What is the last value for Lost Production? (Hint: the event highest in the list is the last one)

- When did it occur? _____
- What was the Reason Code? _____
- How many minutes did the Event last for? _____

4.5.5 Background: Get Event Details

Choosing *Event Details* will create a trend and table with information about the event, click an item to add it to the trend. On the right, will also see the Actions and Comments associated with an event. If you have access to do so, you can add a new comment to the Event Frame and 'Acknowledge' it. The access is controlled in PI System Explorer with the Annotate permission.



Downtime-Mixing Tank2_2019-12-12 20:53:11.000

Acknowledge Events
Acknowledge

Critical 12/12/2019 8:53:11 PM - 12/12/2019 9:02:15 PM
 Event Type: Downtime
Asset: ...Production Area\Production Line2\Mixing Tank2

Selected Attribute Trends

External Temperature
277.07 °C

Percentage Full
10.161 %

Pressure
100.88 kPa

Tank Status
4

	Start Value	End Value	Units
Attribute details			
Mixing Tank2 Percentage Full	8.8267	10.161	%
Mixing Tank2 Tank Status	4	4	

Event Attributes (6) Downtime-Mixing Tank2_2019-12-12 20:53:11.000	Value	Units

Comments

Add Comment

Add

Actions and Comments (0)

4.5.6 Knowledge check: Event Details

Activity Description

You have been asked to provide more details about the event you have analyzed in the last directed activity including:

- % Full for the beginning and end of the event
- Event duration
- Reason Code at the start of the event
- Tank status at the beginning and end of the Event.

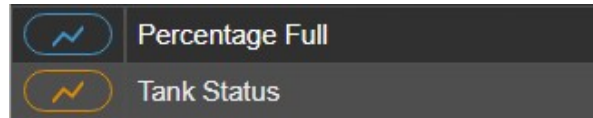
Approach:

Step 1: Follow steps in the previous activity to obtain a list of Events.

Step 2: Right click an Event and select *Event Details*.

Step 3: Acknowledge the event with the Green Acknowledge button in the top right-hand corner. Why might you do this?

Step 4: Click the top two graph symbols. What happened?



Step 5: Fill in the table:

% Full for the beginning and end of the event		
Event duration		
Reason Code at the start of the event		
Tank status at the beginning and end of the event.		

4.5.7 Background: Compare Similar Events by Name or Type



During this section, please refer to the following course YouTube videos:

[View & Compare related Event Frames](#)

PI Vision lets you compare events such as process downtime, process excursions, operator shifts, or batches. With the event comparison feature, you can analyze process data across multiple events on a single overlay trend. The feature is designed to help you identify similarities and differences between events, assess sub-events, and determine root causes.

Choosing *Compare Similar Events* will open a list of similar events with overlaid trends and a Gantt chart. You can hide events or highlight an event in the overlay trends. Additionally, you can drag more attributes to the display area to create more overlay trends.

4.5.8 Knowledge check : Compare Events

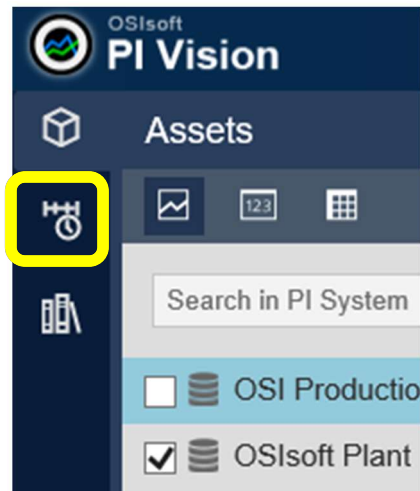
Activity Description

The visualization and acknowledge of the events have been found really useful by managers and operators but they have asked you to show them how to compare the most recent event with similar events in the past for the same asset.

Approach:

Step 1: Create a New Display

Step 2: Select *Events*

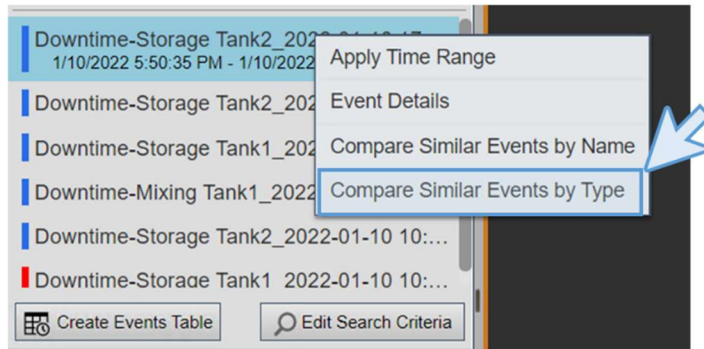


Step 3: Select *Edit search Criteria*

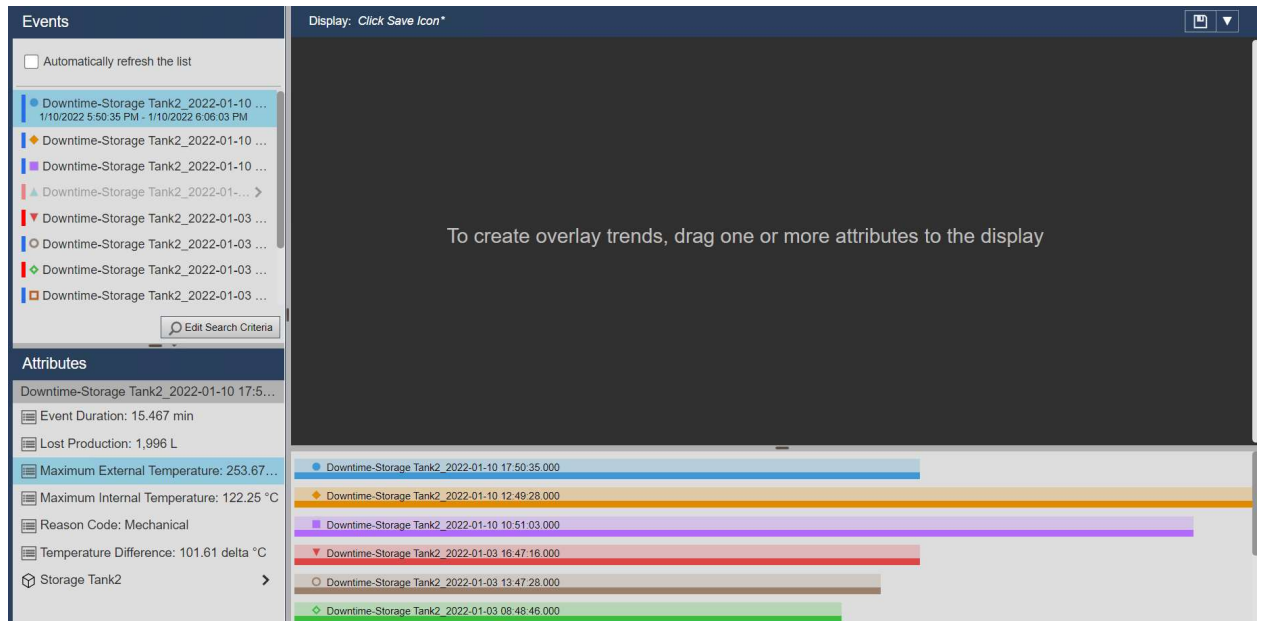
Step 4: Set Database dropdown to OSIsoft Plant

Step 5: Under Asset Name select ANY, then click APPLY.

Step 6: Right click on the first event and select “Compare Similar Events by Type”.



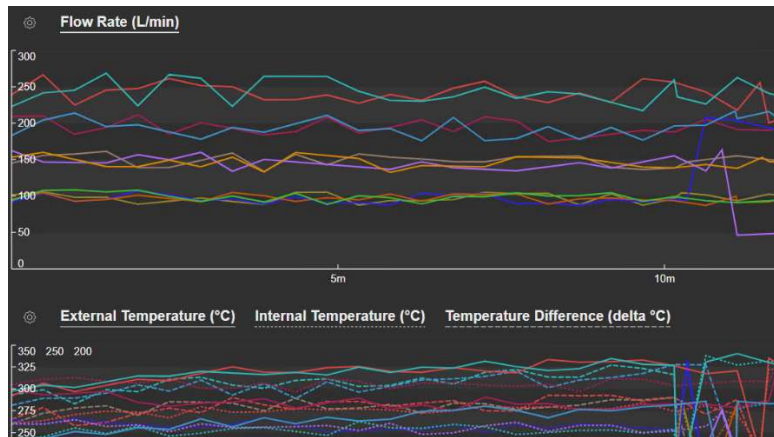
Step 7: A Gantt diagram will appear in the lowest part of the display.



Step 8: Drag and drop the lost production into the display

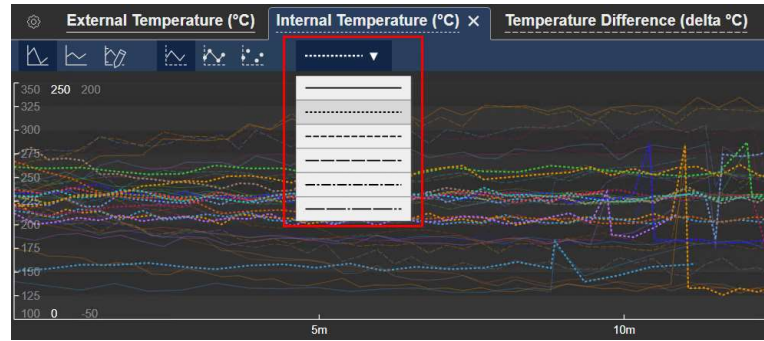


Step 9: Drag and drop *Maximum Internal Temperature*, *Maximum External Temperature* and *Temperature Difference* (Hint: you can drag and drop them individually into the same trend or if you click and hold Ctrl in your keyboard you can make multiple attribute selection).



Step 10: Change line style for Temperatures' attributes:

- In the trend that created in Step 9 click on the gear icon
- Click on the *Internal Temperature* attribute
- Change the line style at the line style drop down menu

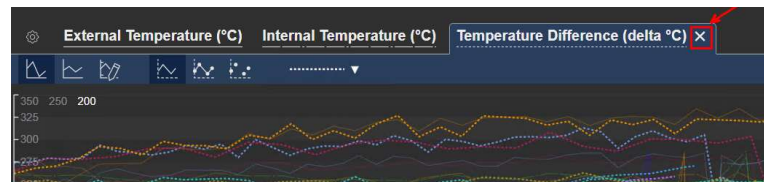


- Do the same for the *External Temperature* attribute.
- Once the changes have been made, click on the gear icon again to exit Trend configuration settings

After an initial review, operators requested us to separate Maximum temperatures and Temperature Difference into different trends so they can easily analyze the information:

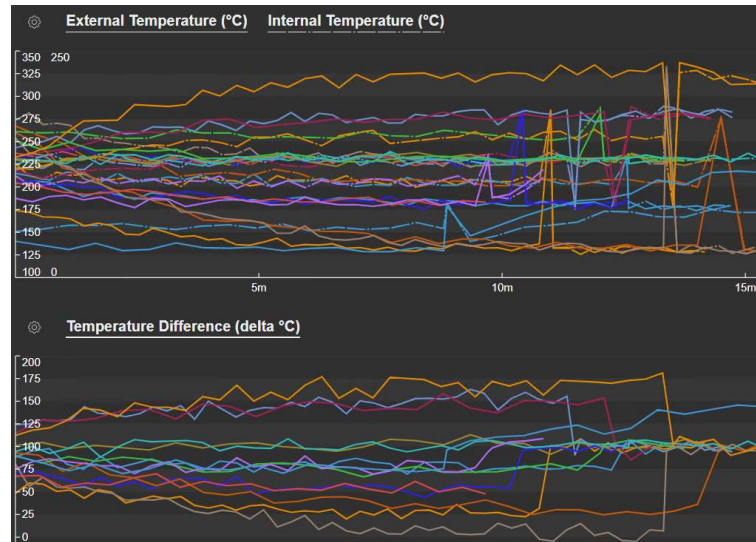
Step 11: Create a trend for *Maximum Internal and External temperatures* and another for *Temperature difference*:

- In the trend that created in Step 9 click on the gear icon
- Click on the *Temperature Difference* attribute
- Click on the X button next to attribute's name



- Click on the gear icon again to exit Trend configuration settings.

Step 12: Drag and drop *Temperature Difference* into the display, now we have two different trends:



Step 13: Save your display, name it “*Downtime Comparison <your initials>*”.


Operators will use this display to further analyze what is happening when there are Downtimes, help them analyze the information by using different functionalities:

Step 14: If you click different events at the Events pane or at the Gantt chart the trends related to that event will be highlighted allowing you to identify specific details for that particular event.



Step 15: *Pan* an event comparison:

- At the *Temperature Difference* trend move the cursor to the bottom of the trend until the cursor changes to a drag cursor
- Click the highlighted lower section of the trend and drag the trend left or right to pan across the time range backwards or forwards
- See how panning across an individual trend will change the time range of all displayed event comparisons. The duration of the time range will not be affected.

Step 16: *Zoom in* on an event comparison:

- At the *Temperature Difference* trend drag your pointer over an area of your interest.
- Release the pointer. You will see how the trend redraws, zooming in on the area you selected (The start time and end time of all trend traces are adjusted accordingly, also the corresponding area of the Gantt chart is highlighted)
- To remove the Zoom, click the Revert button  at the top right corner on your screen.

Step 17: *Maximize* an event comparison:

- At the *Temperature Difference* trend click on the Maximize Trend button  in the upper right corner of the trend.
- Click on the Collapse Trend button  to restore the trend to its original size.

4.5.9 Background: Pinning Events

Once you created an event comparison screen, you can pin events from the search results as your *reference event*. Pinned events are your benchmark events that remain at the top of the Events pane even after you perform new event searches. Once you no longer want an event to be pinned at the top of the pane, you can remove it from the Pinned events list.

4.5.10 Knowledge check: Pinning an Event

Activity Description

While investigating these tank events you noticed that the shortest event is the event against which you can compare all other events. You want to highlight so you can easily compare this event against others.

Approach:

Step 1: In your display from the previous exercise right-click the event in the Events pane corresponding to the shortest event on the Gantt chart and click Pin Event. The pinned event appears at the top of the pane in the Pinned section and have yellow legend marker next to them.

Step 2: After you pin an event, you can perform the following operations:

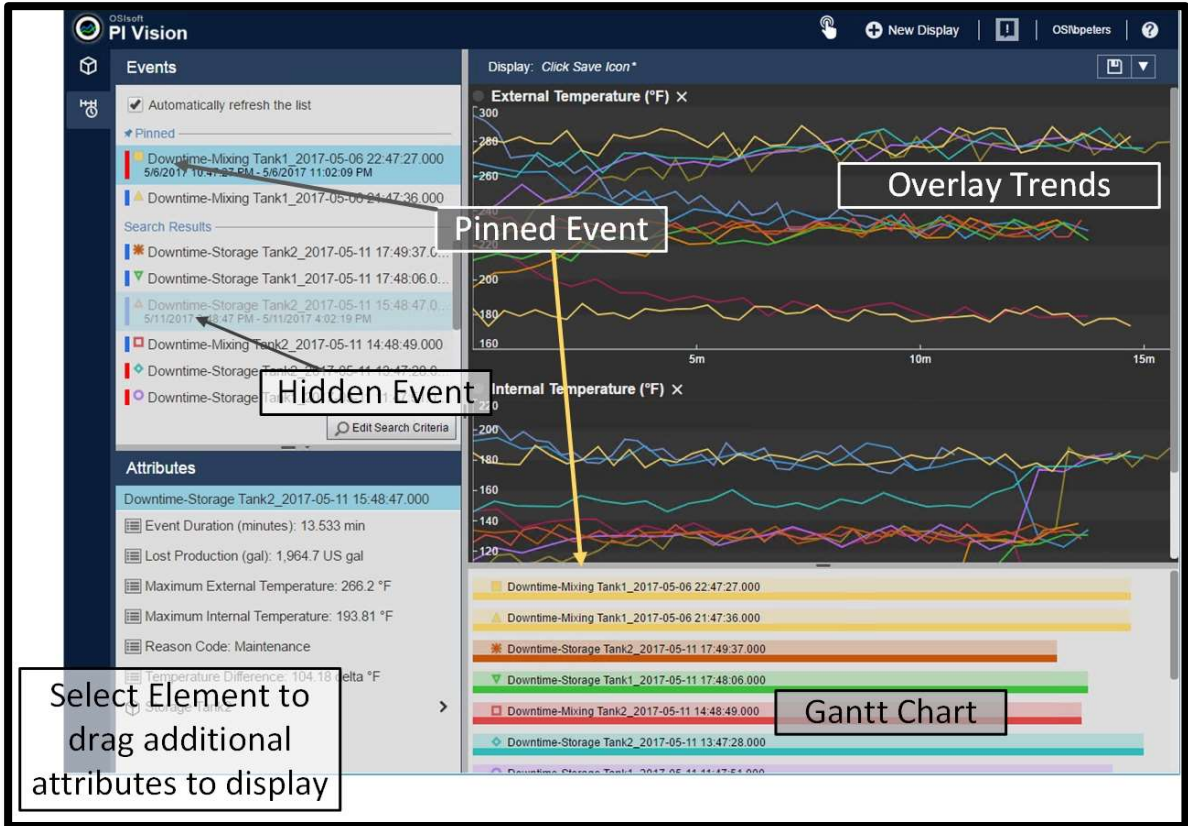
Step 3: To highlight the pinned event on the Overlay Trend, select the event in the Events pane.

Step 4: To add another pinned event, right-click that event and click **Pin Event**.

Step 5: To save the pinned event, save the event comparison display by clicking the Save button.

Step 6: To unpin your pinned event, right-click it and click Unpin Event.

Step 7: Here you have an example.



4.5.11 Background : Event tables

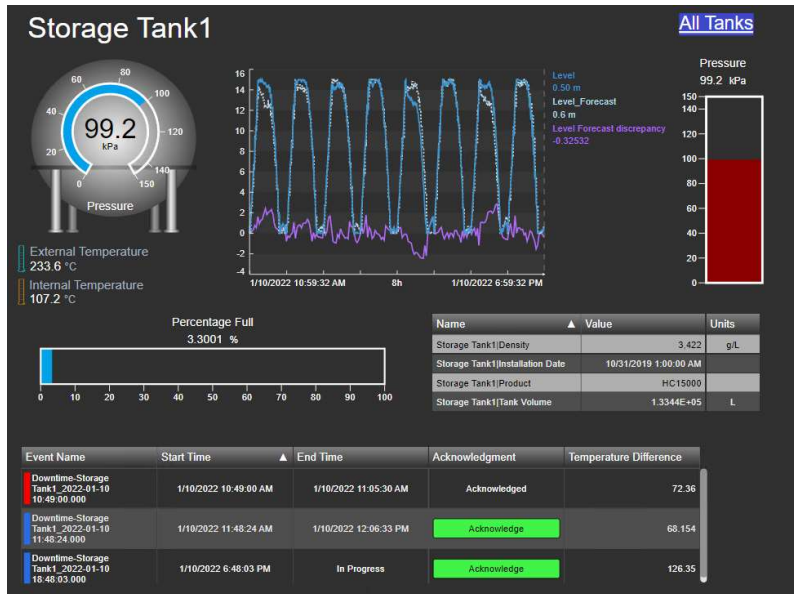
The events table provides a dynamically updating, tabular view of events that meet specified criteria. Upon creation, the table shows the events from the Events pane, based on the criteria in the Edit Search Criteria menu. After you create an events table, you can change the events inside the table by changing the criteria in the Search Criteria pane. You can sort events in the table, and the sorting options on the events table are saved with the display.

Use the Configure Table pane to configure the columns, style, and criteria for events of an events table. Upon creation, the table shows the events from the Events pane, and those search settings are copied to the Configure Table pane. After you create the table, use the Search Criteria menu to change the search criteria that sets the events that appear in the table. The Configure Table pane opens automatically when you create an events table.

4.5.12 Knowledge check: Add an event table

Activity Description

Your manager found very interesting all the event configuration, but he/she would love to see those events related to one tank in the tank display together with the rest of attributes. You talk them about the event frame tables and they ask you to add one into the Tank General overview display. They want something like:



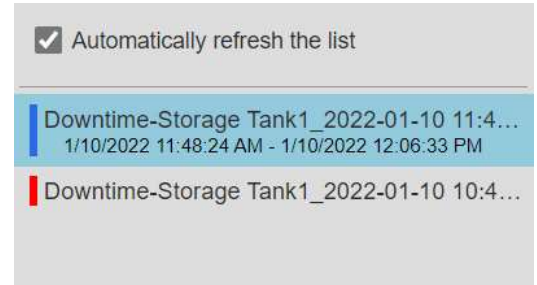
Approach:


Step 1: Go to the PI Vision homepage if it is not already open and open the display *Tank General Overview*. Click on the design mode icon.

Step 2: Open the event frame icon. It should have a blue star indicating that there are some events related to the asset on the display.

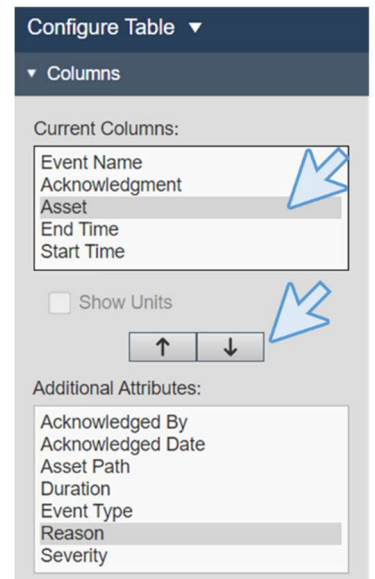


Step 3: Mark the box next to “Automatically refresh the list”.

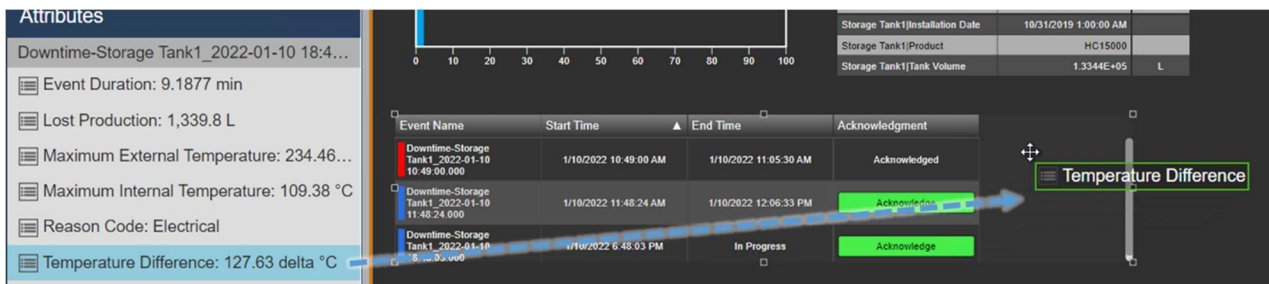


Step 4: Click on “Create Event Table”  Create Events Table and move the table to the lower part of the display.

Step 5: A menu is opened on the right, on the Columns section, remove the asset by selecting it and clicking on the down arrow.



Step 6: Attributes can also be added directly by dragging and dropping from the event details. Add the Temperature Difference to the table.



Step 7: Click on save.

Step 8: Now the events can be acknowledged using the display. Click on the green acknowledge button in the table (you should be out of the design mode). Every time you acknowledge an event you need to click on save.

Step 9: Use the asset switching to see the different events for the other tanks.

5 Communicating Important Events



During this section, please refer to the following course YouTube video:
What are Notifications?

Notifications, which is a feature in Asset Framework, allows alerts to users in real time about conditions in their system that need specific attention. Corresponding actions can be taken to be pro-active or to resolve the problem of the current situation. The information is either sent via email or is passed onto a Web Service.

The recipients for the notifications (“subscribers”) have the option to acknowledge notifications. In case a situation, that requires action, is not acknowledged in time, notifications can be sent out again.

Examples for the use of notifications are:

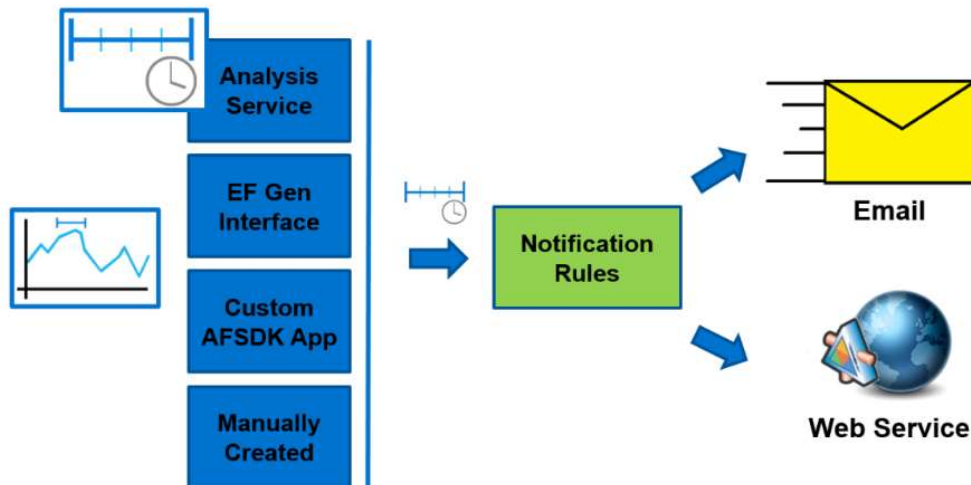
- Temperature is outside the normal range
- Equipment is shutdown
- Runtime counters have elapsed indicating a maintenance is required
- Amount of supply material is below a critical minimum level

Note: Notifications have been revised in the AF 2016 R2 version. In previous versions, there was a different concept for the Notifications, which is now referred to as “Legacy Notifications”. When upgrading the PI System to 2016 R2, existing legacy notifications can be migrated to the new concept using a dedicated migration tool.

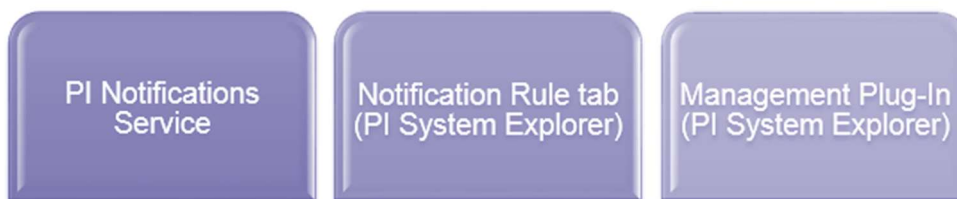
5.1. Introducing Notifications

With AF 2016 R2, notifications are triggered when new Event Frames are generated in AF. Conditions for the trigger are defined in notification rules.

The event frames generation may be related to different sources. It can be performed by asset analytics, by an Event Frame Generator (EFGen) interface, by a custom AF SDK application or a manual creation.



5.1.1 Background: Notification components

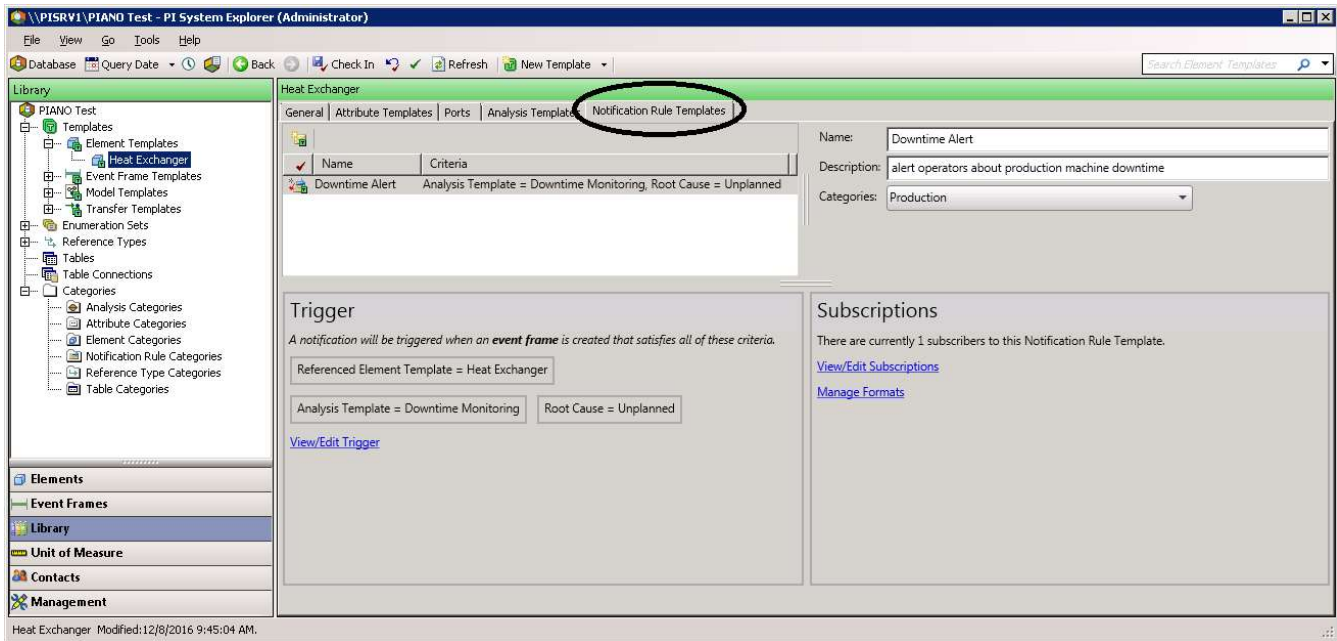


PI Notifications Service

The PI Notifications Service processes event frames defined in the Asset Framework (AF) in real-time and sends out email and web service notifications. The service is installed from the AF Server 2016 R2 Install Kit.

Notification Rule tab (PI System Explorer)

Notification Rules can be defined for individual elements or be created as a template. The User Interface for configuring notification rules in PI System Explorer is in a dedicated tab on elements and element templates:



The definition includes the trigger criteria, adding subscribers to the notification rule, and formatting the message to suit the needs of your organization.

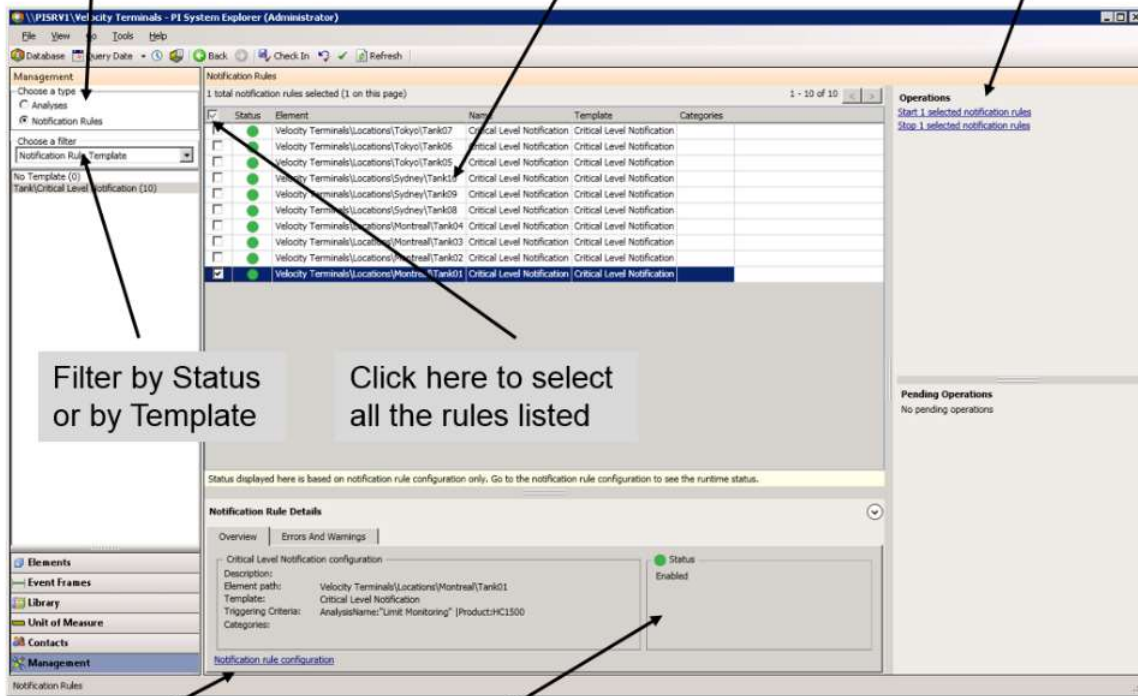
Management Plug-In (PI System Explorer)

Allows management of analyses and notification rules on the AF Server.

Management of your Analyses or your Notification Rules

List of the Rules along with status (enabled, disabled)

Start, Stop, one or multiple rules



Filter by Status or by Template

Click here to select all the rules listed

Shortcut to Element

Status in AF (Enabled, Disabled)

5.2. Delivering Notifications



During this section, please refer to the following course YouTube video:
[Delivering Notifications](#)

Notifications **Delivery Channels** provide for the mechanism by which alerts are delivered to subscribers. With the standard installation of Notifications, the following delivery channels are available:

Email

Email delivery channel supports sending emails with notification alerts via an SMTP Mail Server.

Web Service

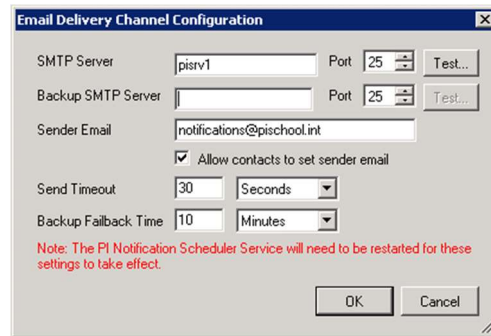
Web service channel supports providing information to a web service by calling one of its methods.

Note: Legacy Notifications in earlier AF versions also supported OCS and Custom delivery channels. These are not supported with the new Notifications in AF 2016 R2

5.3.1 Background: Email Delivery Channel

The settings for the Email delivery channel allow you to configure the primary and backup SMTP server to relay the emails as well as the “From” email address for the alerts. The IT department should indicate which servers and ports to use for the primary and backup **SMTP servers**. As for the “**Sender Email**”, this address is not validated and can thus be set to any address desired (i.e.: [PINotifications@domain.com](#)). In most cases, the **Allow contacts to set sender email** should not be enabled.

Note: In the Training Cloud Environment (TCE) use [notifications@pischool.int](#).



Once the email delivery channel is setup, most email addresses should be provided by **Active Directory (AD)**. If the AD does not include all email addresses needed, it will be possible to create additional emails within the *Contacts* section of PSE.

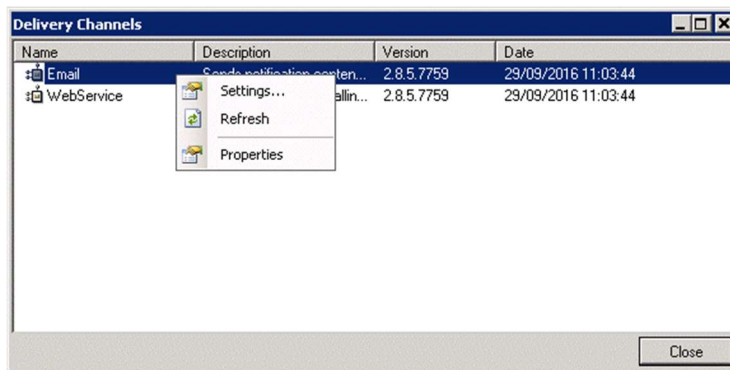
5.3.2 Knowledge check: Email delivery configuration and checkout

Activity description

The goal of this exercise is to understand the required settings for the email delivery.

Approach

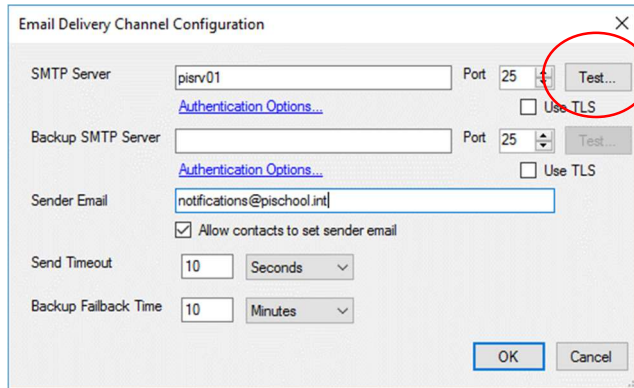
1. From PSE, select Contacts in the Navigator and navigate to **Tools > Delivery Channel Plugins**, then from the **Email Delivery Channel Plug-In context menu** select the **Settings**.



2. In case of the Training Cloud Environment (TCE), the mail server is installed on *PISRV01*.

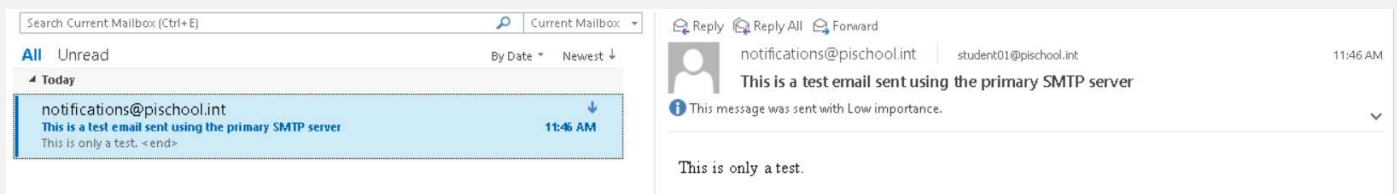
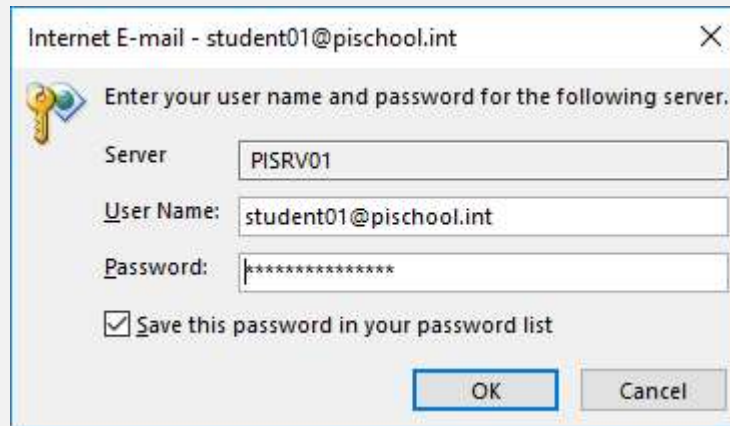
Note: The mail server on PISRV01 is configured just for some user accounts in the pischool.int domain.

3. Click on the *Test...* button to send a test email to **student01@pischool.int**.



4. Start Microsoft Office Outlook and verify reception of the test email.

Note: If you start Outlook the first time, you will be prompted to enter the password for student01, student02 and student03. Enter the password (enter same password for all the three accounts), select the option to save the password and click on OK.



5.3.3 Background: Web service delivery channel

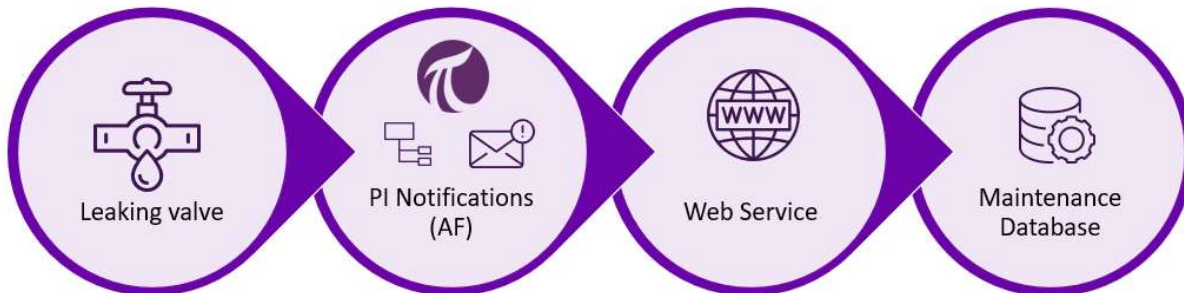
The web service delivery channel allows Notifications to contact and provide information to a web service by calling one of its methods. To use this delivery channel, a web service must thus be available on a web server.

About Web Services

A web service is a method of communication between two electronic devices over the web. In most cases, it is a service hosted on a web server that provides methods to its clients. Those methods will usually wait for incoming information from one end, then crunch the data, to finally return the data to the same client or pass that information to another one.

There are many web services commercially available, and many development environments offer templates and other tools to develop custom Web services.

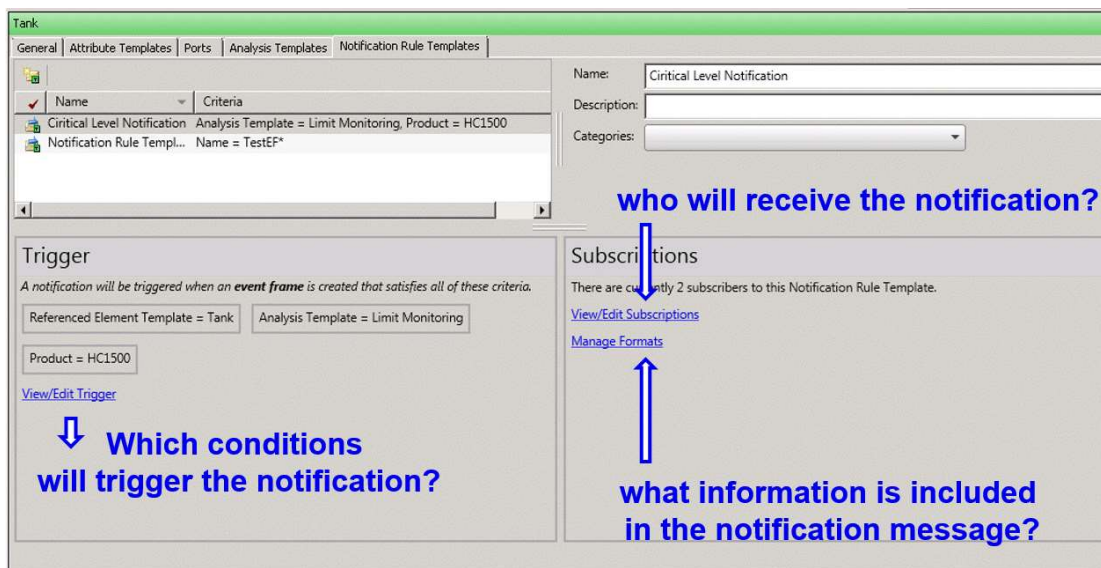
Example: A custom Web Service could process the received information and generate corresponding work orders in a customer Maintenance System:



5.3. Configuring Notifications

Configuring a notification rule includes specifying the trigger criteria, adding subscribers to the notification rule, and formatting the message to suit the needs of your organization.

1. Select element or element template on which Notification Rule will be created
2. Create a new Notification Rule:
 - a. Define the notification trigger conditions
 - b. Add the subscribers
 - c. Format the Notification message
3. Test the Notification



Note: If you have created a notification rule for an individual element, you can extend the scope to the corresponding element template by using the *Convert to Template* function.



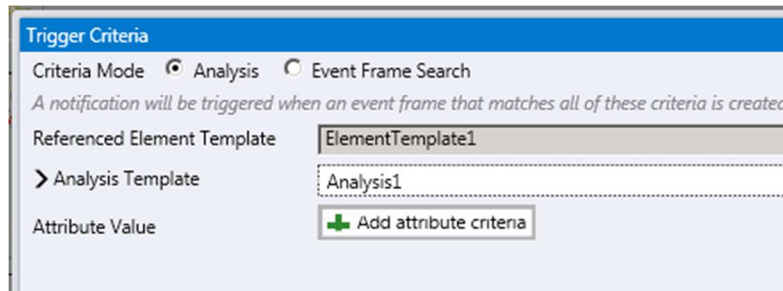
5.3.4 Background: Trigger conditions

The Notification Rules define the criteria that identify, which event frame generation will initiate a new notification.

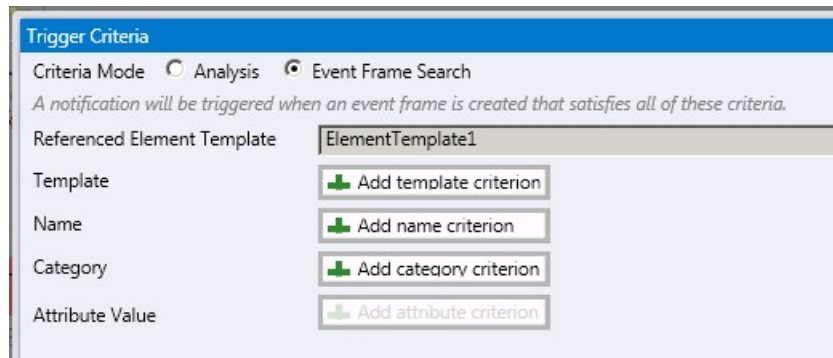
There are two possible trigger criteria modes for the Notification Rules:

- Analysis
- Event Frame Search

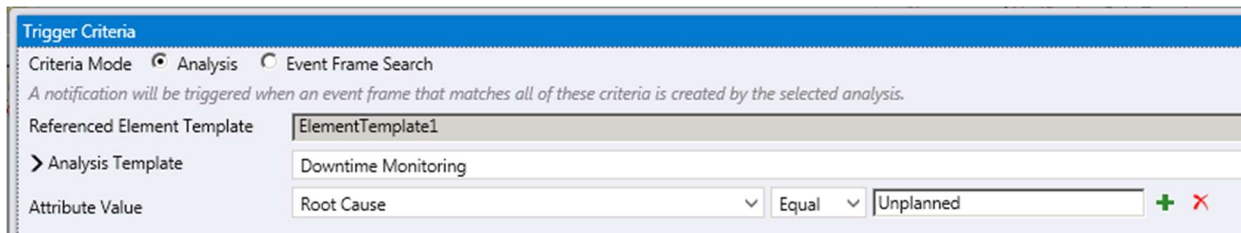
Use the *Analysis* mode to trigger a notification rule on event frames generated by a particular analysis.



Use *Event Frame Search* mode to trigger a notification rule based on event frame name, template and category. In the *Event Frame Search* mode, you can select a configured event frame template, from the drop-down list, and then configure the name and category for the event frames that will trigger your notifications. The name may contain wildcard characters that are supported by event frame search.



For both the modes, you can add additional trigger criteria using event frame attribute values. Criteria can be any specified for any attribute in the event frame template that is specified in the notification rule trigger criteria. For example, if your event frame template defines an event like "downtime" but you only want an email about "unplanned" downtime, you can configure an attribute value condition where a "reason code" attribute on the "downtime" event frame template has a value indicating "unplanned" downtime.



Note: Very often at work, the measure of success is made on how many things are produced. For Notifications, the more alerts that are produced, very often the less successful the use of Notifications becomes. If **too many alerts** are provided to a recipient, she/he probably won't be able to give each one of them the appropriate attention or response. This will make the implementation useless, as all of the alerts will become **noise to the recipients**.

5.3.5 Hands-on: Configuring a notification rule



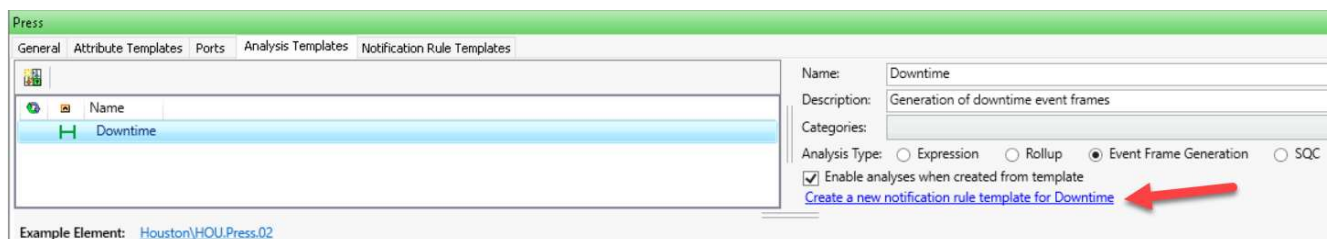
During this section, please refer to the following course YouTube video:
[Configuring a notification rule](#)


Activity description

PI Big Tires Co. is monitoring the downtime periods for all their presses in Houston, Montreal and Philadelphia. The operational personnel has asked to receive notification emails whenever a press is down due to *No Operator* press status.

Approach

1. Select Press from Element Templates. Select *Analysis Templates* tab, select the **Downtime** Analysis.
2. Click on the blue link to create a new notification rule template:



3. On Notification Rule Templates tab change the name to **Press Downtime Notification** and give it a description - **Press Downtime due to No Operator**.
4. In the *Trigger* section, select the blue [View/Edit Trigger](#) link.
5. Select the link to add attribute criteria 
6. Add *Reason code* Equal **No Operator**. Click on OK.

Press Downtime Notification - Trigger Criteria

Criteria Mode Analysis Event Frame Search
A notification will be triggered when an event frame that matches all of these criteria is created by the selected analysis.

Referenced Element Template: Press

> Analysis Template: Downtime

Attribute Value: Reason code Equal No Operator + X

- In the *Subscriptions* section, select the blue [View/Edit Subscriptions](#) link.
- Expand student01 so that the email occurs and drag it into the Subscriptions section. Click OK. Check In.

Name	Configuration	Notify Option
student01 - Email	Inherited (Global Default Email)	Event start

- Start Outlook for student01 and monitor if you are receiving any emails.

5.3.6 Background: Trigger criteria options

When the Trigger Criteria are defined, following options can be set:

Options

Resend Interval: 0 Seconds

Non-repetition Interval: 0 Seconds

Event Frame can be acknowledged

Choose when to be notified if child event frames are created for multiple trigger conditions

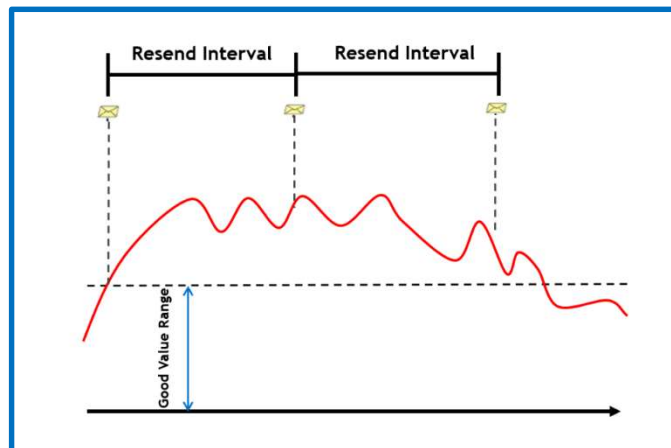
When the severity is higher than any previously true trigger condition

When the severity is higher than the previous true trigger condition

When any trigger condition is true

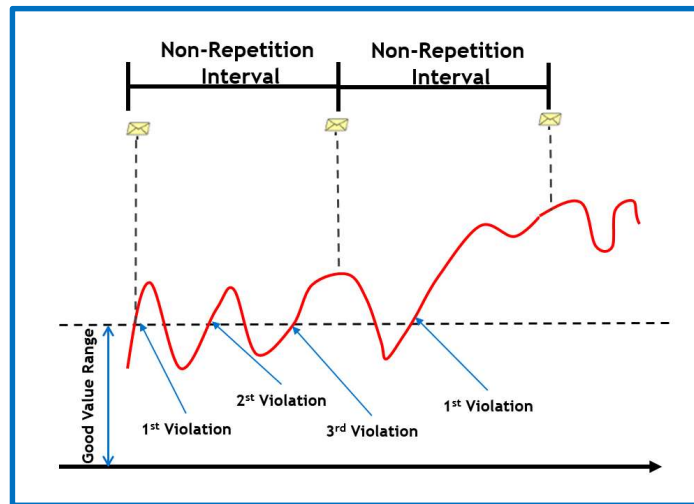
Resend Interval

The time interval after which PI Notifications Service will send additional alerts until the event frame matching the notification rule is acknowledged or closed.



Non-Repetition Interval

The time interval during which PI Notifications Service will not send similar alerts associated with the same notification rule.



Event Frame Can be acknowledged

Option to enable event frame to be acknowledged; the event frame template is also modified accordingly. This option is automatically selected if the event frame template has been configured for acknowledgement

Severity Option

This option applies only to event frame generation analyses. If you have configured multiple start triggers for your analysis, you may choose to be notified in these ways:

- When the current trigger severity is higher than any trigger severity encountered so far.
- When the current trigger severity is higher than the previous trigger severity.
- Every time a trigger condition is true, regardless of its relative severity to other previous triggers.

Choose when to be notified if child event frames are created for multiple trigger conditions

When the severity is higher than any previously true trigger condition

When the severity is higher than the previous true trigger condition

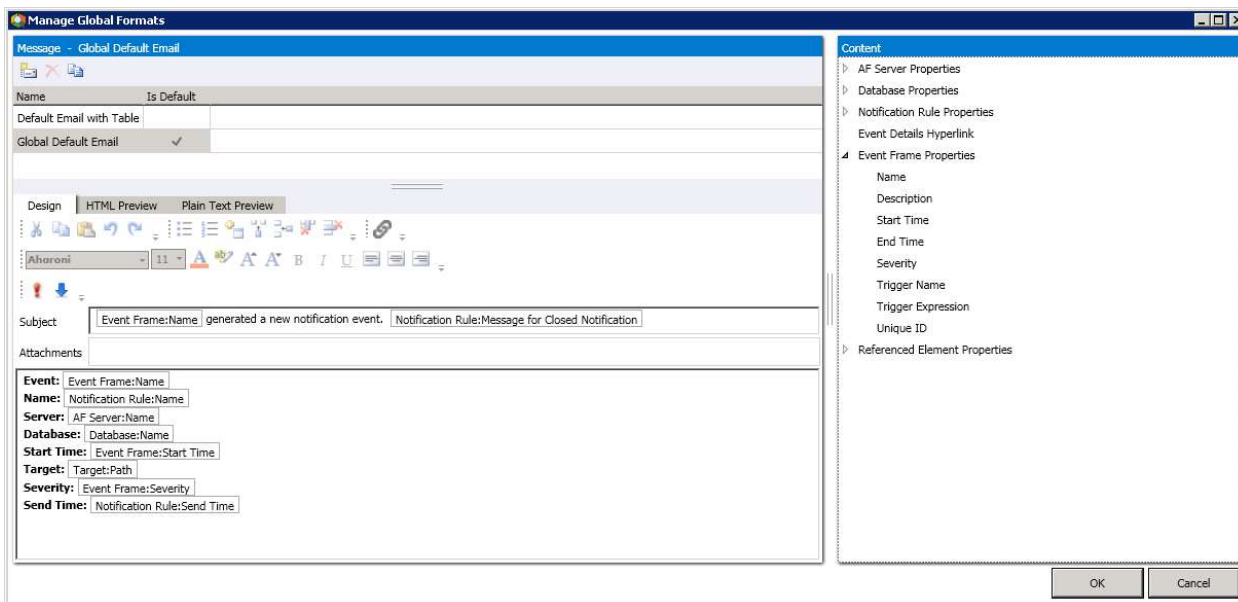
When any trigger condition is true

5.4. Formatting the information to deliver

The Notifications software includes a complete formatting tool, which enables you to define the formatting, and information that is included in email alerts.

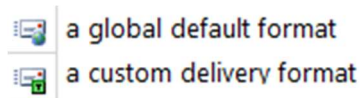
Global default formats

The system provides one global format that is used as the default format. You can edit or rename the global format, but cannot delete it. Additional formats can be added. To access global default formats, navigate to *Tools -> Global Formats* .



Custom delivery formats

To edit or add specific Custom delivery formats for a particular Notification Rule, select the blue [Message Formats](#) link. The formats can be distinguished by their corresponding icons:



5.3.7 Hands-on: Customize Notifications message content & format




During this section, please refer to the following course YouTube video:
[Formatting the information to deliver](#)

Activity description

The goal of this exercise is to customize Notifications message content and format for the Equipment downtime email.

Approach

1. From PSE, navigate to **Library > Element Templates** and select the “*Press*” template.
2. Select the “*Press downtime notification*” template and then click on the blue [Manage Formats](#) link under the **Subscriptions** tab.
3. Select the line with *Global Default Email* (color changes to light blue), and click on the Duplicate  icon above. Rename the new format as “**Equipment downtime email**”.

About Formatting Messages

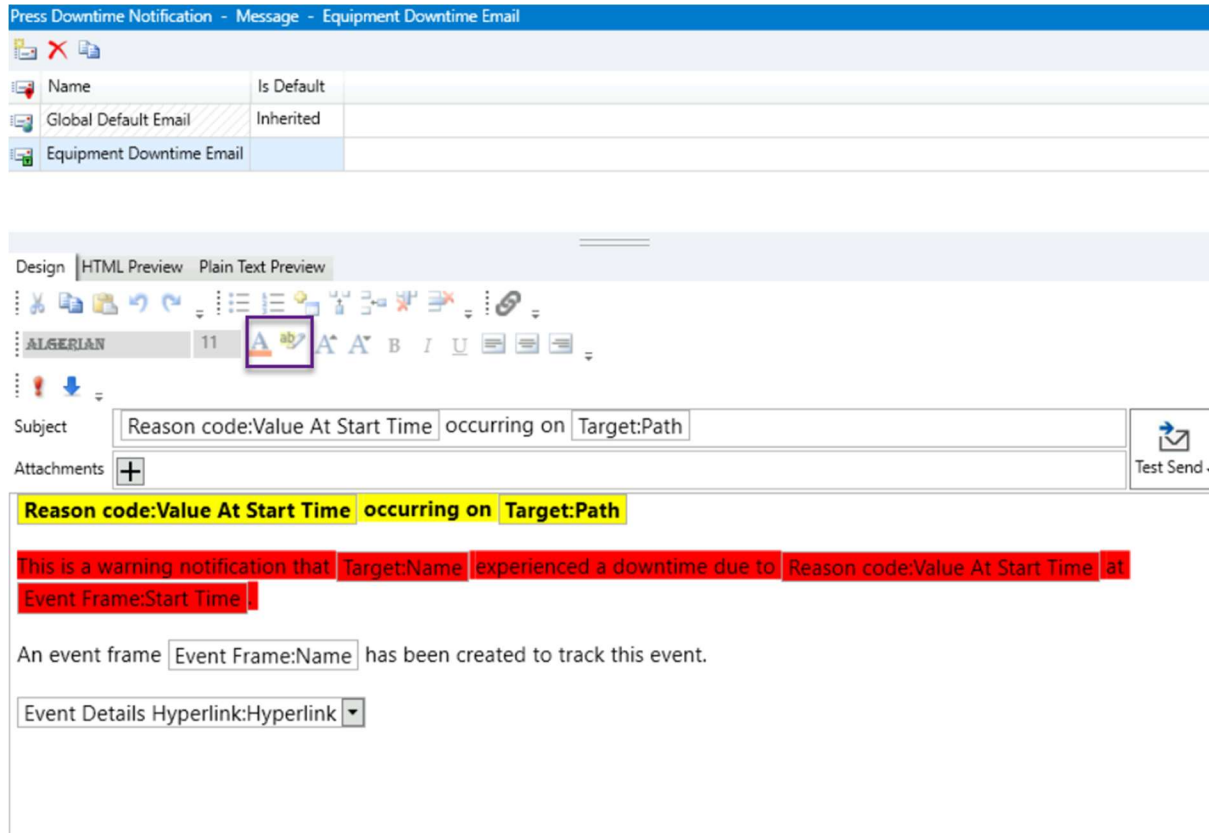
The **Formats** window has a **Content** section on the right side to add extra content to the message. From that Content pane, simply **drag and drop**, or **double-click** on the desired content to add it to the message. Only generic content can be added within the Global Formats section. Specific content can be added when configuring the Message tab for a specific notification rule or a notification rule template.


4. Select the Equipment downtime email format and modify the formatting to match the figure below.
5. To highlight some parts of the text, use the controls highlighted in the screenshot above. When you add the Hyperlink, select the option to *send the link as text*:

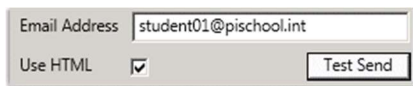


We will be able to use the link and open a related display in PI Vision. When sending an email to someone outside the organization with no access to PI Vision use the option to *send a screenshot*.

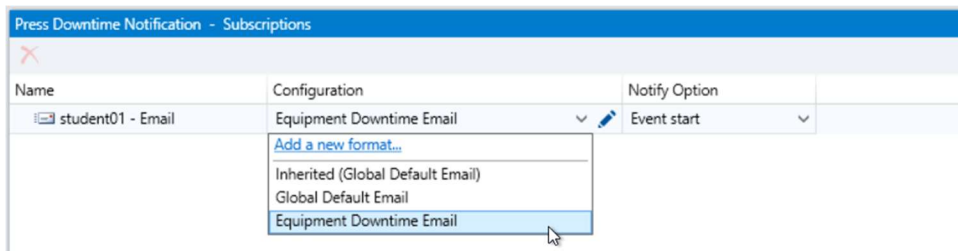
Note: the mail server used in the Training Cloud Environment (TCE) for this class does not support to include screenshots in the email!



- To perform a test send click on the  button.
For the Email address, enter student01@pischool.int:



- Click OK.
- Make sure the “*Press downtime notification*” template is still selected and then click on the blue [View/Edit Subscriptions](#) link under the **Subscriptions** tab.
- Click on the drop down menu and select the Equipment Downtime Email format under Configuration:



- Check-in your changes.

5.5. Acknowledging Notifications

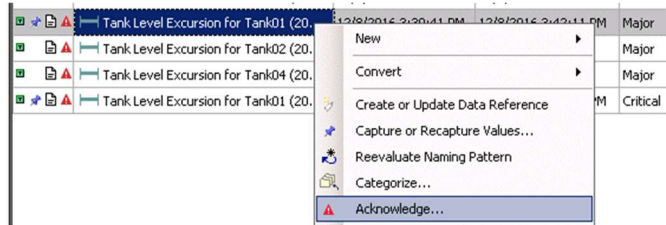
Acknowledgements of Notifications can be used to confirm that important notifications are read and acted on.



Note: A pre-requisite for the Acknowledgement feature is that the *Can be Acknowledged* setting in the event frame template has been checked.

Ways of acknowledging

Acknowledgment can be performed in two ways:

- Display the event in PI System Explorer (Event Frame Search Result). Select the context menu function *Acknowledge...*



When acknowledged, the red exclamation mark  changes into an . When you hover with the mouse over the OK you get information about who and when the acknowledgement was made.



- Open the corresponding Event details display in PI Vision. Click on the Acknowledgement link for the event frame.
To display the corresponding event details, either follow the Event Details link in the notification email or use the event search options in PI Vision.



5.3.8 Knowledge check: Commenting and acknowledging events

Activity description

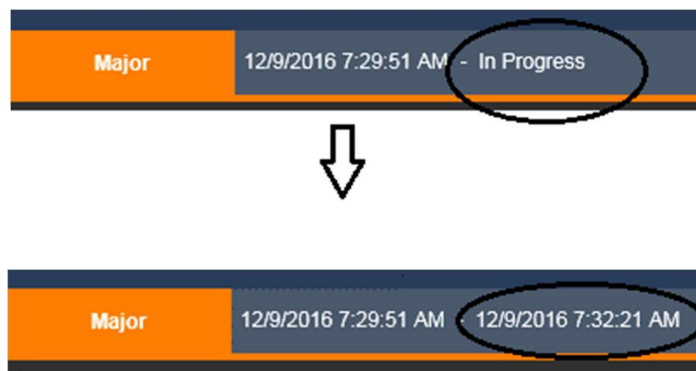
Press02 in Houston is critical for the whole operation at that site. If the press is not running, it is the duty of student01 to add a comment on the problem and to acknowledge the notification to document that action has been taken.

Approach

1. In Outlook, open the latest notification email for Press02.
(If the email is quite new there is a high chance that the status has not yet returned to Running)
2. Click on the blue [Events Details Hyperlink](#) link. Details page for the event will be displayed in PI Vision.



3. If the press is still not running, the event is still ongoing. In that case, the end time is displayed as *In Progress*. In case you continue to observe the display for some time, the time span covered in the trend will increase until the press is running again (PI Vision update rate is 15 seconds).



4. Add and remove trend lines by selecting and unselecting them in the list below the trend.

5. Add a text into the comment field and click on the *Add* button to enter.
6. Click on the *Acknowledge* button to acknowledge the event. Information about the notifications being sent, the comment and the acknowledgement are shown in PI Vision.

5.3.9 Knowledge check: Validating the acknowledgment process



Activity description

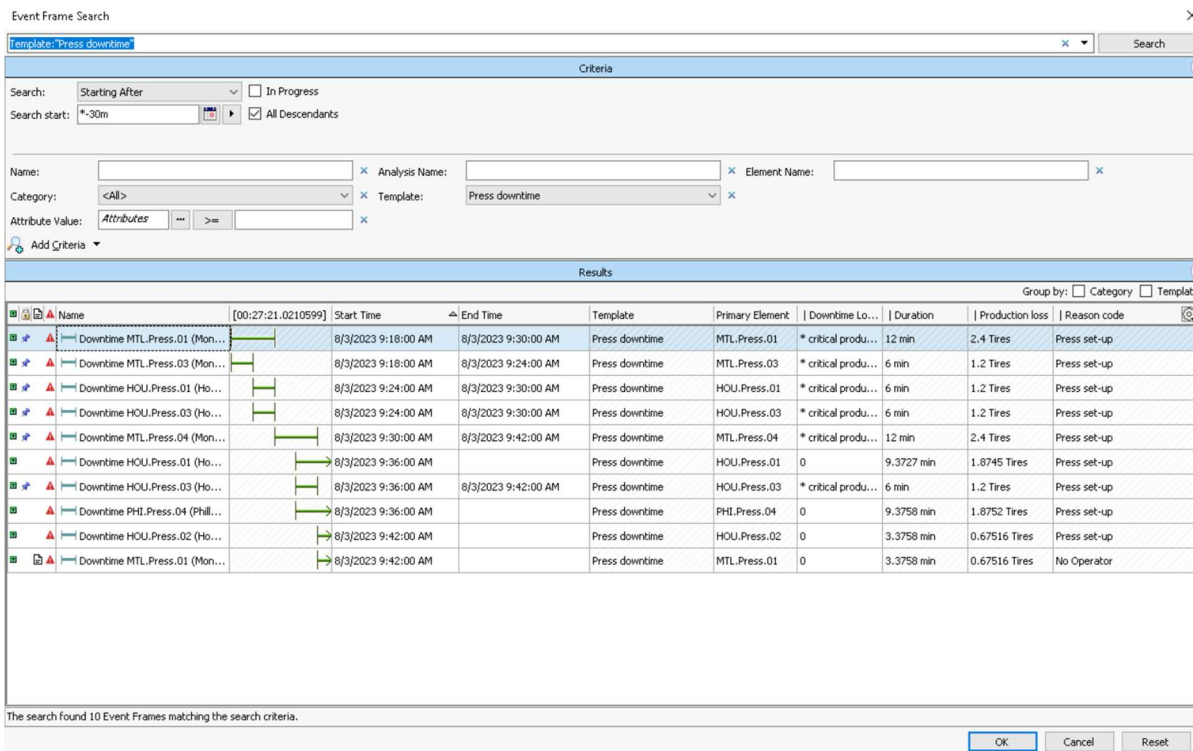
The goal of this exercise is to compare the commenting and acknowledgment of notification alerts in PI Vision and PI System Explorer.

Approach

1. Open the PI System Explorer and select Event Frames in the Navigator.
2. Select *New Search...* from Event Frame Searches context menu
3. Set Search to: *Starting After*
4. Set Search Start to: ***-30m**
5. Set Template to: **Press downtime**. Click on *Search*.

The screenshot shows the 'Event Frame Search' dialog box. At the top, there is a search bar containing 'Template: Press downtime' and a 'Search' button. Below this is a 'Criteria' section with a blue header. The 'Search' dropdown is set to 'Starting After'. There are checkboxes for 'In Progress' (unchecked) and 'All Descendants' (checked). The 'Search start' field contains '*-30m'. Below the criteria section, there are several input fields: 'Name', 'Analysis Name', and 'Element Name' (all empty); 'Category' set to '<All>'; 'Template' set to 'Press downtime'; and 'Attribute Value' set to 'Attributes' with a '>=' operator. An 'Add Criteria' button is at the bottom left.

- Click on the Wheel icon  in the header line of the results.
- Click on Select Attributes. Click on  icon to add all four (4) attributes. Click on OK. The list will be extended by the four selected attributes. Click on OK.



Event Frame Search

Criteria

Search: Starting After In Progress
 Search start: *-30m All Descendants

Name: Analysis Name: Element Name:
 Category: <All> Template: Press downtime
 Attribute Value: Attributes >=

Add Criteria

Results

Name	[00:27:21.0210599]	Start Time	End Time	Template	Primary Element	Downtime Lo...	Duration	Production loss	Reason code
Downtime MTL.Press.01 (Mon...		8/3/2023 9:18:00 AM	8/3/2023 9:30:00 AM	Press downtime	MTL.Press.01	* critical produ...	12 min	2.4 Tires	Press set-up
Downtime MTL.Press.03 (Mon...		8/3/2023 9:18:00 AM	8/3/2023 9:24:00 AM	Press downtime	MTL.Press.03	* critical produ...	6 min	1.2 Tires	Press set-up
Downtime HOU.Press.01 (Ho...		8/3/2023 9:24:00 AM	8/3/2023 9:30:00 AM	Press downtime	HOU.Press.01	* critical produ...	6 min	1.2 Tires	Press set-up
Downtime HOU.Press.03 (Ho...		8/3/2023 9:24:00 AM	8/3/2023 9:30:00 AM	Press downtime	HOU.Press.03	* critical produ...	6 min	1.2 Tires	Press set-up
Downtime MTL.Press.04 (Mon...		8/3/2023 9:30:00 AM	8/3/2023 9:42:00 AM	Press downtime	MTL.Press.04	* critical produ...	12 min	2.4 Tires	Press set-up
Downtime HOU.Press.01 (Ho...		8/3/2023 9:36:00 AM		Press downtime	HOU.Press.01	0	9.3727 min	1.8745 Tires	Press set-up
Downtime HOU.Press.03 (Ho...		8/3/2023 9:36:00 AM	8/3/2023 9:42:00 AM	Press downtime	HOU.Press.03	* critical produ...	6 min	1.2 Tires	Press set-up
Downtime PHI.Press.04 (Phill...		8/3/2023 9:36:00 AM		Press downtime	PHI.Press.04	0	9.3758 min	1.8752 Tires	Press set-up
Downtime HOU.Press.02 (Ho...		8/3/2023 9:42:00 AM		Press downtime	HOU.Press.02	0	3.3758 min	0.67516 Tires	Press set-up
Downtime MTL.Press.01 (Mon...		8/3/2023 9:42:00 AM		Press downtime	MTL.Press.01	0	3.3758 min	0.67516 Tires	No Operator

The search found 10 Event Frames matching the search criteria.



OK Cancel Reset

- Rename default Search name to **Press Downtime Last 30 Minutes**
- Verify whether the event frames have an annotation icon. If you hover over the Annotation icon it displays *Notification sent to 1 subscriber(s)*.



Downtime HOU.Press.02 (Ho...		8/3/2023 9:42:00 AM		Press downtime	HOU.Press.02	0	4.8932 min	0.97864 Tires	Press set-up
Downtime MTL.Press.01 (Mon...		8/3/2023 9:42:00 AM		Press downtime	MTL.Press.01	0	4.8932 min	0.97864 Tires	No Operator

Notification sent to 1 subscriber(s).

- Verify that comment and acknowledgement information from the previous exercise is displayed in PI System Explorer.
- To acknowledge alerts in PI System Explorer, select one or several lines of the event frame list. From the context menu, select *Acknowledge...* The icon in the acknowledgement column changes from Unacknowledged  to Acknowledged .

5.6. Adding contacts



During this section, please refer to the following course YouTube video:
[Setup Contacts, Delivery Endpoints, Groups, & Escalation Teams for Notifications](#)

The Contacts section of the navigator panel of PSE allows for the definition of contacts. The contacts will be receiving the notification messages once they are triggered. This section defines the various types of contact objects that can be created and used by Notifications.

5.6.1 Background: Active Directory (AD) access for contacts

Notifications normally gets the contacts and their addresses from the configured domain AD database. This prevents the administrator from having to do the tedious task of entering all of the potential subscribers and their contact information in order to start using Notifications.


Each AF server provides the option to specify the domain and contact sub-folder, as well as the account needed to access Active Directory and retrieve contact names. By default, the account under which the AF server application service is running is used for Active Directory access. The AD access is configurable in the AF Server Properties dialog box (with Contacts being selected in the Navigator, go to *Tools > Active Directory Properties*).

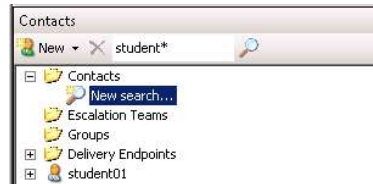
By default, the AF server is installed using a virtual account, *NT SERVICE\AFService*. However, the AF server service account can be changed. If the AF server service account does not have the necessary permission to read the Active Directory, no contact names will be retrieved in the Contacts list. If your Active Directory security is configured to allow the AF server service account to read the Active Directory, this is the simplest option.

In the *Active Directory Domain Name* text box, enter the full DNS name of the Active Directory domain from which the contact names will be retrieved for the PI Notifications Service Contacts.

In the *Active Directory Contact Sub-Folder* text box, enter the path to the folder containing the list of contacts for this domain. In larger Active Directory domains, contacts may be organized within sub-folders. The use of sub-folders can allow for faster retrieval of a list of Active Directory contacts.

5.6.2 Background: Searching for contacts

Because the AD database are often very large, contacts information is only available from search results. To search for contacts, click the  **New search** button under the Contacts section or use the search field. The star (*) can be used as a wildcard for that search. In case of the Training Cloud Environment (TCE) a search for student* will return all the student AD users (student01, student02, student03, student04).



5.6.3 Background: Adding contact information

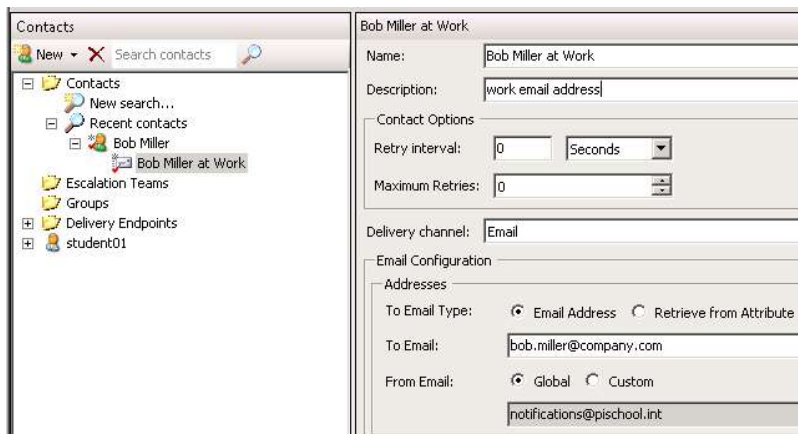
Activity description

For those who do not have entries in AD you can enter custom contacts one at a time. This may be appropriate for vendors or other contacts not in your company who you may want to receive notifications. Custom contacts are available to all AF databases.

Approach

Adding a custom contact in PSE:

1. To create a custom contact, select **Contacts** from the navigator panel.
2. Select **New > New Contact** from the toolbar and enter your name for the contact **Name**.
3. Right click the contact for you and select **New Delivery Endpoint**
4. Enter a delivery endpoint name (e.g. <your name> at Work). From the Delivery Channel dropdown, select Email.
Fill in your work email address and check in your changes.



5. (optional) Enter a second delivery endpoint for the home email address.

Note: in the Training Cloud Environment (TCE) there are only some email addresses in the pischool.int AD you can actually use for sending emails to.

5.6.4 Background: Notifications groups

A Notifications Group is an unordered collection of delivery endpoints, which includes Active Directory recipients. If a notification is configured to send a message to a Notifications Group, the message is sent to all members of the group simultaneously.

5.6.5 Background: Notifications escalation teams

An escalation team is a delayed delivery group, which receives alerts on a notification only if a specified time period called the *Escalation Period* has elapsed, and the acknowledgement requirement is not satisfied.

Acknowledgments will be discussed in a later section, but it is the ability to inform the Notifications server that the alert was acknowledged by a contact.

A notification alert is sent to the first contact on the list. If the notification is not acknowledged within a specified time, then notification messages are sent sequentially to the remaining members of the escalation team until the notification instance is acknowledged.

Building escalation teams is very similar to building groups and so they can be included in the subscribers' area of a notification. Keep in mind that if an escalation team is added to a notification, that does not require acknowledgements, they will never receive alerts.

5.6.6 Background: Subscribing contacts to Notifications

To maintain subscribers of a notification, navigate to the Notification Rules tab for a selected element or a selected element template, and then click *View/Edit Subscriptions* in the Subscriptions pane.

To add contacts, endpoints or groups to existing notifications, drag and drop them into the Subscriptions list. To remove, select a line with a subscription and click on the *Unsubscribe* icon on the top.

5.6.7 Background: Dynamic email delivery endpoints (since AF 2017 R2)

You can configure an email delivery endpoint as a value of an attribute. This provides an additional flexibility in situations where notification emails can be sent to different recipients without making changes to the notification rule template.

5.6.8 Background: Sending Notification alerts in escalation sequence

Activity description

The goal of this exercise is to:

- Assign several contacts to an escalation team
- Understand and apply options for an escalation team.
- Explore the sequence of notifications for an escalation team.

You want to change the strategy, which people in the organization are informed in case of a Press downtime due to No Operator. In order to avoid a confusion during the period when you change the strategy, you want to suspend the notification emails during the time, when you reconfigure the system.

Two people from the operational personnel, the tank operator and the safety engineer can handle the situation when the press is down. The tank operator should be informed first. In case he does not take action within 5 minutes, the safety engineer should be informed as well. Do not send email to student01 anymore.

Use the following email addresses:

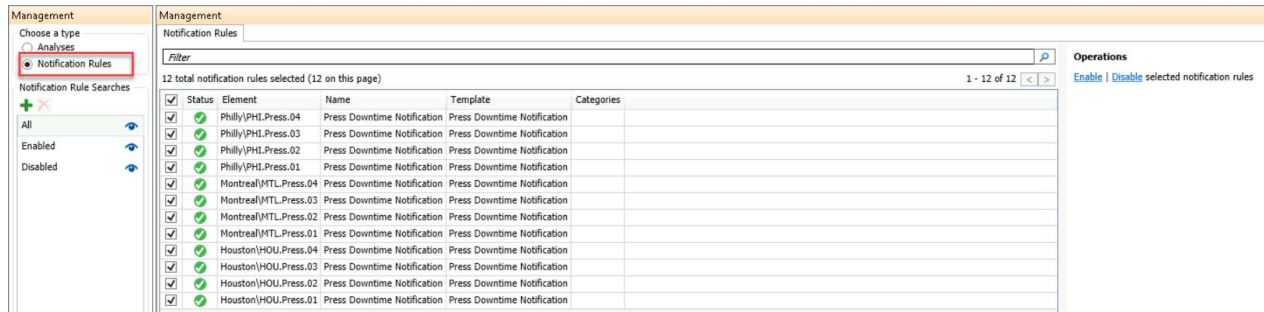
Tank Operator: student02@pischool.int

Safety Engineer: student03@pischool.int

Note, that if you are executing this exercise in a local language environment, email addresses for local language accounts corresponding to student02 and student03 are not supported.

Approach

1. Open the PI System Explorer and select *Management* in the Navigator. Choose *Notification Rules* type.



Note: The status displayed here is based on the notification rule configuration only. The status does not give information on whether the notification is running or in error.

2. Enable the check box in the header line to select all notifications for the twelve (12) presses, then click *Disable selected notification rules*.

Tip: By selecting any combination of lines with rules, you can start or stop the selected rules.

3. Select *Contacts* in the Navigator.
4. Create a new escalation team called **Press Personnel Escalation Team** by right clicking the Escalation Teams folder and selecting *New Escalation Team*.
5. In the right-hand side Contacts window, select *Contacts > New Search...* Search for the contacts with *Name= student**
6. Expand student02 and drag the email address (student02 - Email) into the escalation list area (is empty in the beginning). Repeat the same for student03. Select a **5 minutes** Escalation period. Do not repeat the escalation sequence, if the alert was not acknowledged.

Press: Personnel Escalation Team

Name: Press Personnel Escalation Team


Description:

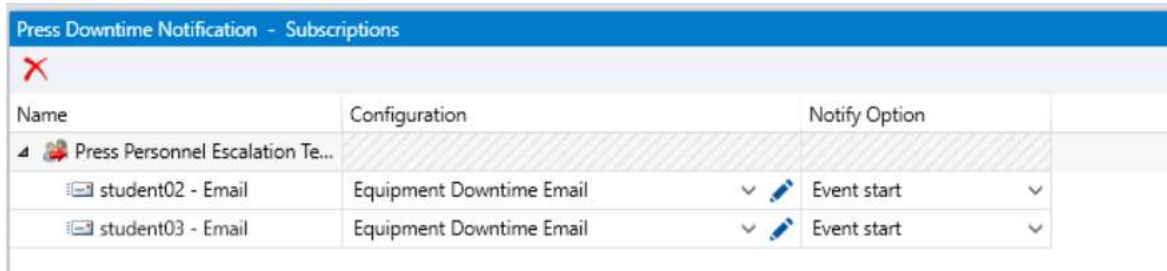
Escalation period: 5 Minutes


If not acknowledged: End escalation
 Repeat 1 times
 Repeat while active

student02 - Email
student03 - Email

7. Select *Library* in the Navigator and open the *Notification Rule Templates* for the **Press** element template.
8. Click on the blue *View/Edit Subscriptions* link

9. Expand *Escalation Teams* in the *Contacts* section and drag **Press Personnel Escalation Team** to the Subscriptions list. Click on the dropdown icon of the team name to expand the team members. Select **Equipment Downtime Email** for both.
10. Select the line(s) with the other subscriptions and click on the Unsubscribe  icon on the top.



Name	Configuration	Notify Option
▲  Press Personnel Escalation Te...		
student02 - Email	Equipment Downtime Email	Event start
student03 - Email	Equipment Downtime Email	Event start

11. Click on OK to exit the *View/Edit Subscriptions* dialog box.
12. Check in the changes.
13. Select *Management* in the Navigator. Start the notifications in the same way as they were stopped before.

6 (Optional) Administrator tasks

6.1. Installing the PI Notifications services

Use the PI Server install kit to install PI Notifications Service. This section provides details specifically on installing the PI Notifications Service through the install kit.

Before you start:

- Ensure that the computer on which you are installing PI Notifications Service meets all the system requirements. See [System requirements for PI Notifications Service](#).
- Install the PI AF server. A connection is required to PI AF Server to complete the installation.

Process:

1. Go to the directory where you downloaded the PI Server install kit, and double-click the setup file to launch the installation.

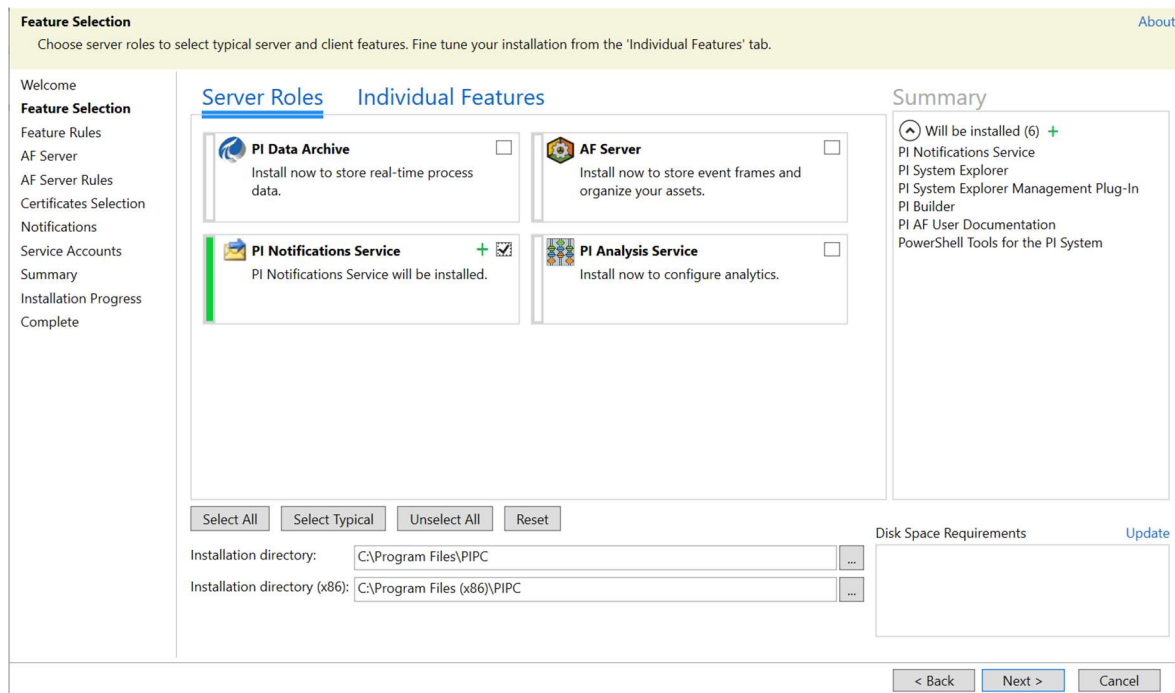
The **Welcome** page opens.

2. Click **Next**.

The **Feature Selection** page opens.

3. In the **Server Roles** tab, select **PI Notifications Service**.

A list of components to be installed is displayed in the **Summary** panel.



4. Click **Next**.

The **AF Server** page opens.

5. Enter the PI AF server name to associate with PI Notifications Service.
6. Click **Next** to proceed with the setup.

The **Certificates Selection** page opens.

7. Take one of the following actions:
 - To enable TLS certificates encryption for OpenID Connect (OIDC), ensure that the **Configure certificate for TLS Encryption** option is selected.

If you do not provide a certificate, a certificate will be automatically generated for you when this option is selected.
 - If you do not plan to use TLS, deselect the **Configure certificate for TLS Encryption** option and proceed to step 10.

Certificates Selection About

Select certificates for server communication.

TLS Certificate ?

Configure certificate for TLS Encryption.

SSL Certificate thumbprint:

Click Select to choose a new certificate.

8. Click **Select** to choose a new certificate.

The **Select Certificate** dialog opens. Any certificate that is already installed and meets certificate requirements will be detected and displayed in this dialog.

9. Select **OK**.

The **SSL Certificate** thumbprint is displayed in the **TLS Certificate** section. The TLS certificate thumbprint is required for encryption.

10. Select **Next** to advance to the **Notifications** page.
11. On the **Notifications** page, enter the following information:
 - **SMTP Server:** Port number (The default port number for the SMTP server is 25.)
 - Optional. **Backup SMTP Server:** Port number

From Email Address: The email address (name@domain.com) to be used with PI Notifications Service.

12. Select the **Use TLS** checkboxes to enable TLS encryption for the SMTP server or backup SMTP server connection. Specify the **PI Vision Server** URL address to integrate PI Notifications Service with AVEVA PI Vision.
13. Select **Next**.

The **Service Accounts** window appears.

14. Specify the service account for **PI Notifications Service**.

Select the default account NT SERVICE\PINotificationsService or specify a different service account. If the AF Server is remote to PI Notifications Service, then you must use a domain account or a Managed Service Account because the service account credentials will be mapped to the Notifications identity on the AF Server. If your computer is in a Workgroup, the installation must be run silently and additional steps might be necessary to guarantee that PI Notifications Service has access to AF Server. Since PI Notifications Service also needs read access to PI Points, a domain account or Managed Service Account may also be desired for configuring Windows integrated security in PI Data Archive.

15. Click **Next** to proceed with the setup.

The **Summary** window appears, listing the selected features and version numbers scheduled for the installation.

16. Click **Install**.

The **Installation Progress** page opens, then the **Complete** page opens when the installation is complete.

Note: If you cancel the installation before it is complete, the PI AF SQL database might have already been created and you will need to remove the database manually.

17. Take one of the following actions:
 - If you did not select to enable TLS certificates, click **Close** to exit the setup.
 - If you enabled TLS certificates encryption, ensure the **OpenID Connect Authentication requires configuration** option is selected and then select **Yes** to restart now or **No** to restart later.
 - To bypass running the OpenID Connect Configurator utility, deselect the **OpenID Connect Authentication requires configuration** option, then select **Yes** or **No**.

See [Register PI Server components with the AVEVA Identity Manager](#) if you selected the "Configure certificate for TLS Encryption" option and want to use OIDC for claims-based authentication.

18. Optional. Run the migration tool.

Run the PI Notification Migration tool if you have existing legacy notifications that you want to migrate to notification rules. The migration tool can be launched from PI System Explorer only if PI Notifications Service is installed on the machine; the **PINotificationsMigrationTool.exe** command is located in the **%PIHOME64%\Notifications** directory.

6.2. Account permissions for the PI Notification service

The account that PI Notifications Service uses requires read access to the PI point database (PIPOINT) on each **Data Archive** server that the service accesses. The PI Notifications Service account also requires specific permissions to **PI AF objects and local directories**.

6.2.1 Configure Data Archive access for PI Notifications Service

The account that PI Notifications Service uses must have read access to the necessary PI points on any Data Archive that the service accesses.

1. Use PI SMT to grant the PI Notifications Service account read access to the PIPOINT database on any Data Archive to which PI Notifications Service requires access:

- a. Create a new PI identity (**Security > Identities, Users, & Groups**).

We recommend that an account being used for a service should only have the minimum required privilege, that is, the least required privilege. Therefore, administrative accounts or groups such as 'piadmin' or 'piadmins' should not be used as a service account.

- b. Give the identity read and write access to the PIPOINT database (**Security > Database Security**).

For more information on access permissions for PI points, see the PI SMT topic [PI point access permissions](#).

- c. Create a mapping between the PI identity and the account that runs the service (**Security > Mappings and Trusts**).

If you are using the virtual account, you will need to use the PI AF server machine's computer account to create the mapping. See also the Microsoft article [Understanding Computer Accounts](#).

After you grant the PI Notifications Service account access to the PIPOINT database, the service will, by default, have the necessary access to all points subsequently created on that Data Archive server.

2. For any pre-existing points that you will use for notifications, make sure that the PI Notifications Service account has the following access permissions:

PtSecurity	(r)
DataSecurity	(r)

3. You can use PI SMT or PI Builder to configure the point access for PI Notifications Service.

6.2.2 PI AF object and local machine permissions for PI Notifications Service

The PI Notifications Service setup process using the PI Server install kit creates the PI AF identity Notifications, maps the PI Notifications Service account to that identity, and grants that identity the PI AF object permissions shown in the following tables. The setup process also grants the PI Notifications Service account permission to access the local machine directory.

- If an account has administration privileges on the PI AF server, then the account has all security rights to all objects within the PI AF server, including all databases. This is true whether the account is granted or denied specific rights on individual objects.
- If you change the PI Notifications Service log on account after installation, you must make sure the new user has permissions to access necessary AF objects. The easiest way to do this is to add a mapping for the user to the Notifications identity in the PI AF Server. The sections below describe the necessary permissions in detail.

PI AF Object	Permissions
PI AF server and children ¹	Read/Write, Read/Write Data
Event Frames	Read/Write, Read/Write Data, Annotate

¹ Children of PI AF server include but are not limited to database, elements, element templates, notification rules, enumeration sets, contacts, and categories.

Local Machine Directory	Permissions
%ProgramData%\OSIsoft\PINotifications	Read, Write, Modify

6.3. Troubleshooting the PI Notifications Service

6.3.1 Configure logging for the PI Notifications Service

Notifications message logs contain useful information to troubleshoot issues with PI Notifications Service. Adjusting the severity level and verbosity of message logs can assist with identifying issues more easily and better troubleshooting.

At the end of installation, the notifications folder (*%PIHOME64%\Notifications* or *<Drive name>:\Program Files\PIPC\Notifications*) contains the:

- PINotifications.exe.config file for each process and
- the Notifications.UserNLog.config file for NLog configuration, a popular logging tool for troubleshooting.


Caution: Increasing the debug level from the default can flood the logs and decrease performance. Do not leave the debug level higher than the default for longer than necessary.

%programdata%\OS\soft\PINotifications\Logs is the default directory that the logs are written to. More information on configuring logging can be found [here](#).

6.3.2 Access Performance Counters

The PI Notifications Service has performance counters for monitoring the status of notification rules.

To gather statistics around PI Notifications service, use Windows performance counters. You can view and access available performance counters with the Windows Performance Monitor.

1. On the Windows system hosting the service, click **Control Panel > System and Security > Administrative Tools**. A list of administrative tools are listed.
2. Double-click **Performance Monitor** to open Windows Performance Monitor.
3. Expand **Monitoring Tools** and click on **Performance Monitor** in the navigation panel on the left.
4. Click the  button. The **Add Counters** window appears.
5. In the **Available counters** panel, expand **PI Notifications Service**. The list of PI Notifications Service performance counters is here.

For a full list of the available counters explained, have a look at [this article](#).

7 Final Exam

The final exam in this course is taken online. Please check the course listing online for more details.