Visualizing PI System Data

Version 2024

March 2025

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1. PI SYSTEM BASICS

1.1 What is a PI System?

Learning Outcomes

After completing this topic, you should be able to:

- Define the components of a PI System.
- Draw a diagram of the architecture of a PI System.

The PI System

The PI System was originally developed by OSIsoft to collect **P**lant **I**nformation from PLC, DCS and SCADA systems. The PI System collects, stores, and manages **time stamped** data. This data may have timestamps in the past, current or future.

Components of a PI System are:

Computers with a **PI Interface** collect data (known as points or tags) from a data source. These interface nodes get data from your data sources and send it to the Data Archive. This data may be collected from a variety of places, such as:

- The plant, weather stations,
- IT networks,
- Location data for trucks,
- Telemetry from monitoring systems.

Data is stored in the **Data Archive** in such a way as to make user retrieval as efficient as possible. The data is accessible to users in different ways: directly or via tools providing context.

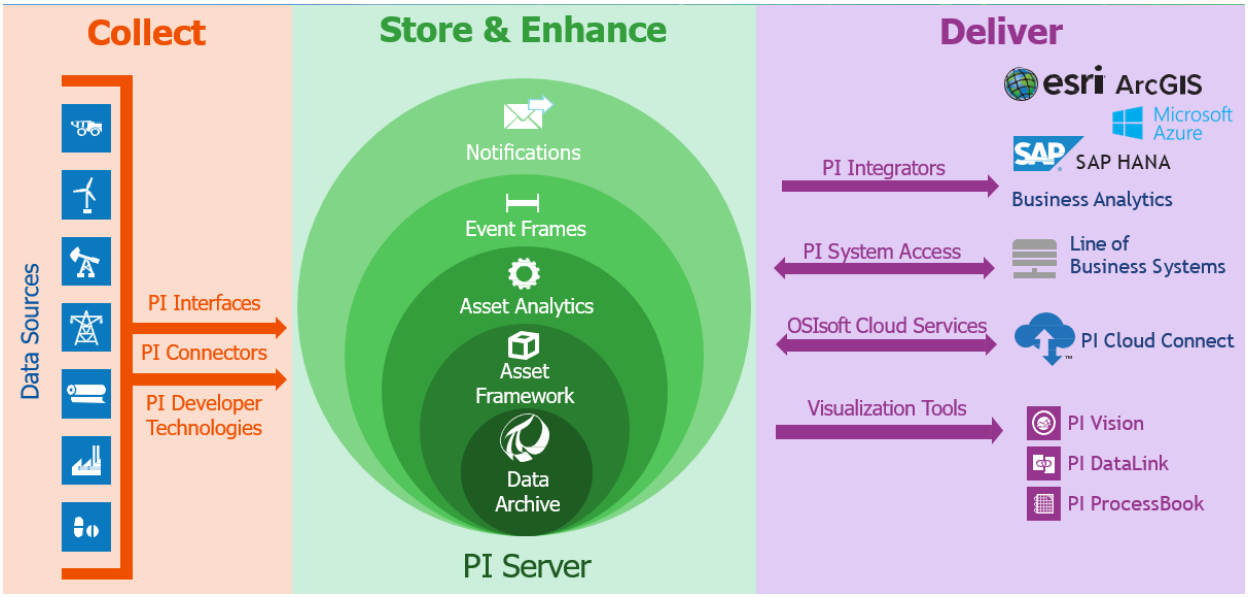
Accessing the data in context is provided by linking the data points to assets defined in an **Asset Framework** (AF) system.

To visualize the data collected and stored, users use tools in the Visualization Suite:

PI Vision (browser-based graphs and symbols),

PI Datalink (a Windows based Excel add in),

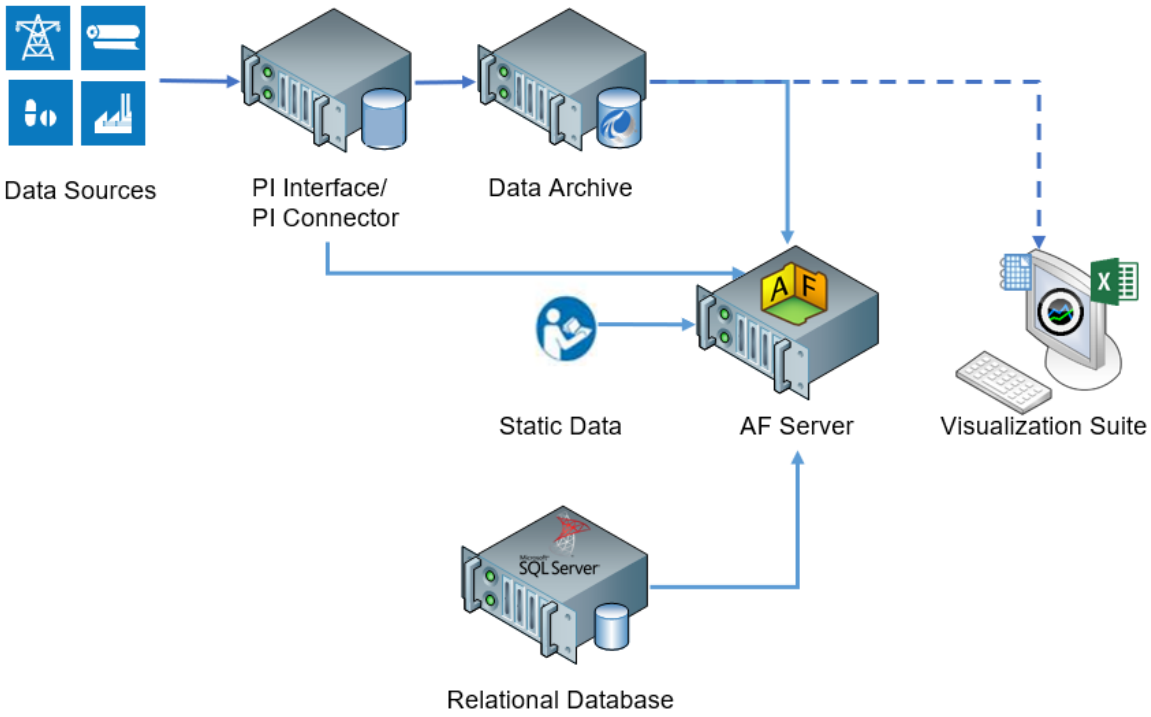
This diagram shows the 3 main categories and components of a typical PI System:



Architecture of a PI System

The architecture varies from simple to complex; some customers may have only a single interface sending data to a single Data Archive. There are many more combinations and configurations of the PI software components, so make sure to ask your PI System administrator about how your infrastructure is laid out.

Here is a conceptual diagram as an example:



✔ Quick Check

Having completed this topic, are you able to:

- Define the components of a PI System?
- Draw a diagram of the architecture of a PI System?

If you answered NO to any of these questions, ask your instructor for assistance.

1.2 Building Blocks of the PI System

LEARNING OUTCOMES

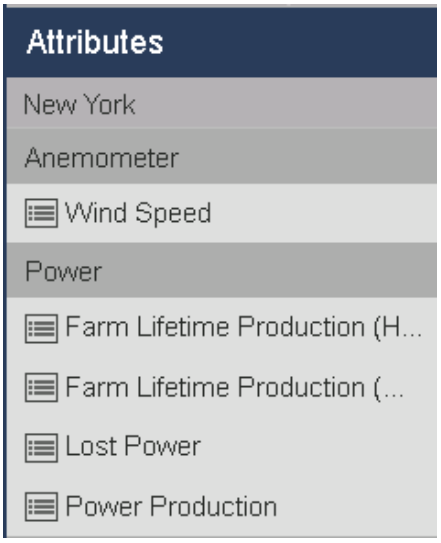
- Define the terms of Asset Framework (AF) and its components: elements and attributes.
- Define AF attribute types: static (none), PI Point, point array, formula, string builder, table lookup and Analysis.

What is an AF Element/Asset?

In Asset Framework, company locations, sites, processes and each piece of equipment is represented by an **Element**. Company **Assets** may be defined with an AF Element. The AF encourages organization of assets into a structure that makes it easier to find information.

A self-explanatory element structure for assets goes a long way to help users find the data they are seeking. With well-defined elements showing context for the assets, data can be located without the user needing to understand the technical details of each piece of equipment. The AF element structure assists in promoting a hierarchical and logical organization of assets.

What is an AF Attribute?



Attributes represent a single property associated with an asset element. Attributes hold values that can represent: static information, such as the diameter of a tank, a PI point stored in the Data Archive, such as the current temperature of the tank contents, formulas values linked to tables in relational databases, values held in internal AF tables and values derived from AF analytics.

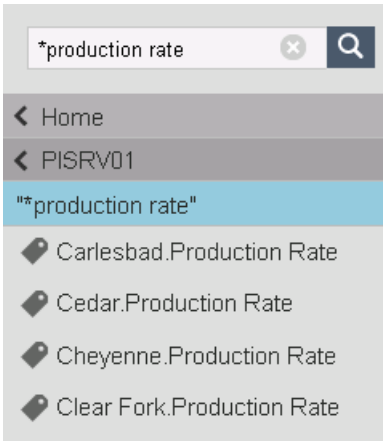
Note: All relevant data about an asset is grouped together with AF Attributes on AF Elements. This allows users to build displays and reports that maintain a complete view of the company's assets.

What is a PI Point?

A PI Point (sometimes referred to as a tag) is a unique storage point for data in the Data Archive. It is a single point of measurement and **has a value with a timestamp**, such as a temperature of 31.2 ºC on 2019-Dec-24 23:59.

Point name

Points stored in the Data Archive each have a unique name. It is a common practice to name the PI Points based on Control Systems point names. Since the point is the name that identifies the point to users, a consistent point-naming convention should be used that is meaningful to people in your organization. Knowing the naming convention can be helpful in searching for points.



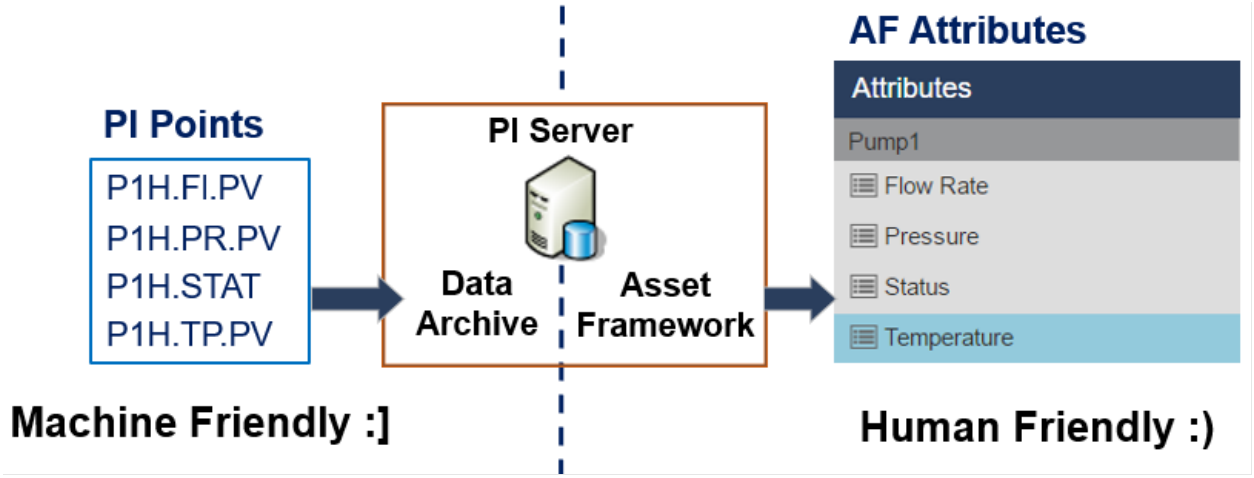
Try to determine what the following point may refer to:

M03_E1P1_MOTDRV1202_RUNSTAT

It refers to - Machine3 Enclosure 1 Panel 1 Motor Drive 1202 Run Status.

Is this intuitive? Probably not, unless you have spent time memorizing the equipment's naming conventions.

Most of the time, the PI Points themselves are not going to be easy enough for users to work with; therefore, AVEVA recommends developing your Asset Framework hierarchy to leverage the very "human friendly" nature of AF Attributes on AF Assets. Building an intuitive AF structure will make end users' work much easier to accomplish.



Note: The **PI Points** are also known as PI Tag.

2. PI TIME

LEARNING OUTCOMES

- Understand PI time expressions
- Explain the differences between fixed and referenced times
- Use time offsets
- Understand the effect of DST on the retrieval of PI point data.

When searching for data in PI you will use a timestamp since most PI data is time series data and this data has a timestamp associated with it. We can use a special syntax, called PI time, to specify inputs for timestamps and time intervals in the PI client applications, for example PI Vision. PI time uses specific abbreviations and rules in building valid time expressions.

2.1 PI Time Expressions

In PI there are two ways to specify time:

Fixed Time: An expression that signifies a specific date and time. Used when you want to save a view of your PI System data for a specific time in history.

Example**:** A user is creating a report that investigates an equipment failure event which occurred on the 15th of April 2020 at 11 am, so the date expression may be written as15-Apr-2020 11:00:00 AM

Reference Time: An expression that signifies a date and time relative to the current date and time. This may be used when you want to create a dynamic view of your data, which can be used to view data in real-time, or re-used on a periodic basis to create periodic reports.

Example**:** A user creates a report that summarizes weekly production totals. By using relative time expressions, the user will be able to re-use this report every week, so define a start date of “Monday”, meaning start the report from last Monday.

Both Fixed Time and Reference Time can be used with Time Offsets. Time Offsets may be used alone.

Fixed Time Syntax

A fixed time expression is an expression which includes a date, and optionally a time.

When the time component is omitted, **Midnight** is assumed and it occurs at the beginning of the day, not the end.

Expression	Meaning
26-jan-88 12:34	12:34 p.m. on January 26, 1988
25-sep-19	00:00:00 (midnight) on September 25, 2019

The PI System interprets many different formats for fixed time. In the event of an ambiguous input, the Windows Region and Language settings of the computer where the PI client tool is installed take precedence.

Note the following:

Expression	Region and Language Format	Meaning
1/5/2020	English (United States)	00:00:00 (midnight) on January 5th 2020
1/5/2020	Rest of the world	00:00:00 (midnight) on May 1st 2020

Reference Time Syntax

A reference-time abbreviation represents a time relative to the current time.

Abbreviation	Meaning	Reference time
*	Now	Current time
t or (T)	today	00:00:00 (midnight) of the current day
y or (Y)	yesterday	00:00:00 (midnight) of the previous day
fri *(mon,tue…)*	Friday *(Monday, Tuesday…)*	00:00:00 (midnight) on the most recent Friday *(00:00:00 (midnight) on the most recent Monday/Tuesday…)*
may *(jan,feb, …)*	May *(January, February…)*	00:00:00 (midnight) on the current day in May of the current year *(00:00:00 (midnight) on the current day in January/February… of the current year)*
apr-15	april-15	00:00:00 (midnight) on the *15*th day of April in the current year
YYYY	Year	00:00:00 (midnight) on the current day and month in year *YYYY*
M-D or *M/D*	In USA	00:00:00 (midnight) on the *D*th day of month *M* in the current year
D-M, D/M	In the Rest of the world	
15		00:00:00 (midnight) on the *15*th day of the **current** month

Time Offset Syntax

Time Offset

When specifying PI time use specific abbreviations that represent time units. These are used in constructing *Time Offsets* as in the table.

Abbreviation	Time Unit
s	second
m	minute
h	hour
d	day
mo	month
y	year
w	week

Specify the abbreviation, the full-time unit or the plural version of the time unit, such as *s*, *second*, or *seconds*. Time offset is any of the time units with a valid value and a + or – sign included, e.g., +8h.

Time offsets can be used alone in a time field or come with a fixed time or reference-time abbreviation.

Reference Time or Fixed Time and Offset Expression

When included with a reference-time abbreviation or with a fixed time, a time offset adds or subtracts from the specified time (indicated by either + or -) and a time unit with a value

Expression	Meaning
*-1h	One hour ago
t+8h	08:00:00 (8:00 a.m.) today
y-8h	16:00:00 (4:00 p.m.) the day before yesterday
mon+14.5h	14:30:00 (2:30 p.m.) last Monday
sat-1m	23:59:00 (11:59 p.m.) last Friday
1-jan-20 – 1d	Midnight 31 December 2019

Time Offsets Used Alone

Entered alone in a time field, time offsets specify a time relative to an *implied* reference time. The implied reference time depends on the field where you enter the expression:

For a start time, the reference time is the current clock time.
For an end time, the reference time is the start time.
For a single time stamp, the reference time is the current clock time.

Time field	Expression	Meaning
Start time	-1d	One day (24 hours) before the current clock time
End time	+6h	Six hours after the start time
End time	-30m	30 minutes before the start time
Time stamp	-15s	15 seconds before the current clock time

2.2 Rules to Remember

Rule 1: You can only include a single time offset in an expression. Including multiple offsets can lead to unpredictable results. For example, the following time expressions are not valid:

*+1d+4h

t-1d+12h

Rule 2: To define a time offset you must include a valid value with any time unit. Only for *seconds*, *minutes*, or *hours*, you can specify a fractional value. You cannot specify fractional values for other time units.

Rule 3: A fixed timestamp consists of the fields of Year, Month, Day and Time (hours, minutes and seconds). If any of these fields are not specified in the PI time expression, the following values will be assumed by default:

If Time is not specified, then the default value would be Midnight.
If Day is not specified, then the default value would be Current Day.
If Month is not specified, then the default value would be Current Month.
If Year is not specified, then the default value would be Current Year.

2.2.1 Exercise – PI Time

This solo or group exercise is designed to maximize learning in a specific topic area. Your instructor will have instructions and will coach you if you need assistance during the activity.

Activity Description

Part 1 – Determine the "real" dates and times indicated by the PI Times in the table below:

Timestamp Input	Meaning
* - 30m	
y + 8h	
T	
Thu	
Tuesday – 2d	
18	
y-2y	

Part 2 – Express the following times in valid PI time expression:

Timestamp Input	Meaning
	Today at 6:00 AM
	Monday at 6:30 am
	12 hours ago
	The first day this month
	The end of the week (Friday morning)
	7:00 am yesterday
	15 minutes ago
	First of March
	25th of September 2021

Part 3 – List at least 4 ways you can "PI Abbreviate" 8 am today.

✔ Quick Check

Having completed this topic, are you able to:

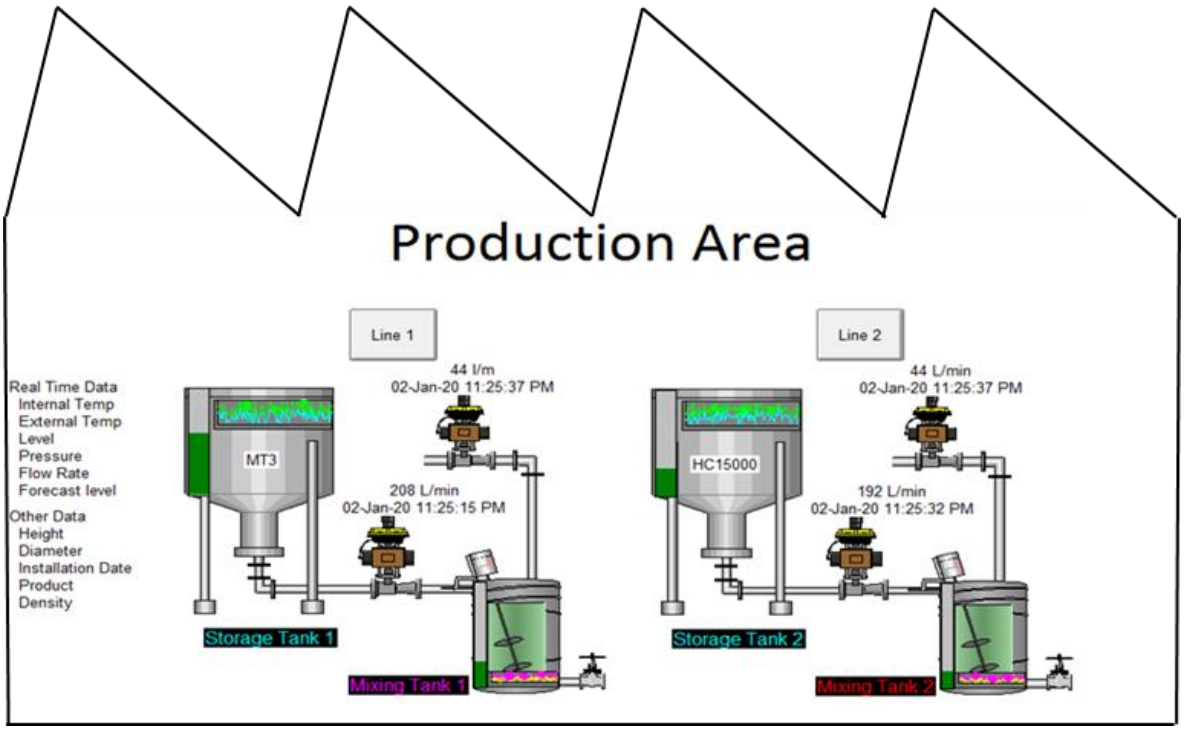
- Understand PI time expressions?
- Explain the differences between fixed and reference times?
- Use time offsets?

If you answered NO to any of these questions, ask your instructor for assistance.

3. COURSE SIMULATOR

Ideally this course uses data from your own site for the exercises. As this is not always possible this manual uses a fictitious manufacturing plant, OSIsoft Plant, for its exercise data. Initially this simple plant has two production lines; each line has one mixing tank and one storage tank.

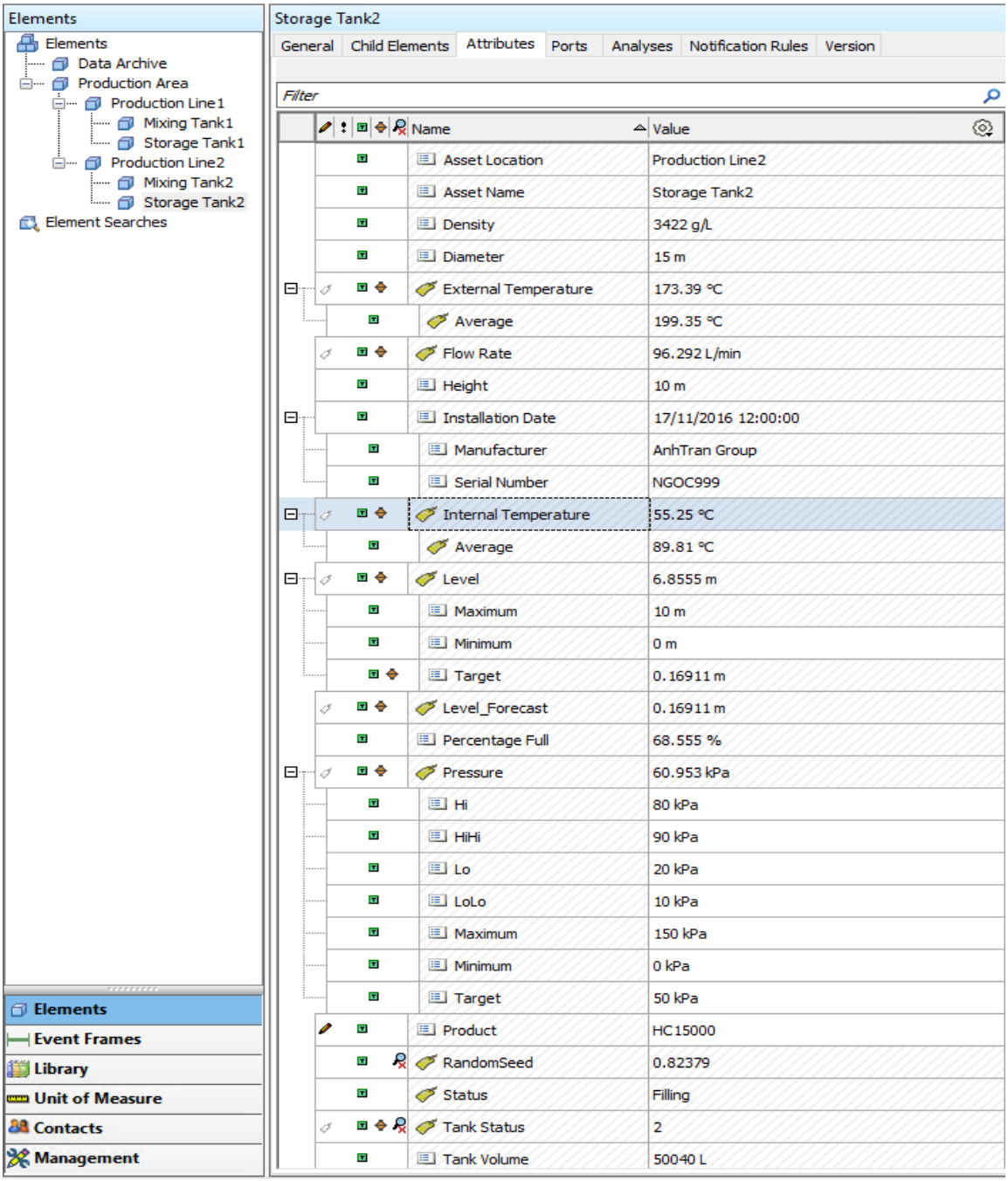
The 'It's Not Real' OSIsoft Plant



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. Even though 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 utilized, 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.



Note: All tank points that have colon ":" belong to the "OSIsoft Plant" AF database; for example - "...MXTK2:Flow Rate".. All tank points that use dot "." belong to the "OSI Production Facility" AF database - which is only used for the Final Project; for example "...MXTK2.Flow Rate".

4. PI VISION

LEARNING OUTCOMES

- Operational overview of PI Vision
- Look at live data using PI Vision
- Build a basic and complex displays in PI Vision with static and dynamic symbols.
- How to search data
- Work with time ranges
- How to reuse displays and escalate displays
- Configure visual alarms, comparison tables.
- Correlational analyzes

Now that you understand the terminology and concepts associated with the PI System, it's time to start driving value from our client tools. Let's demonstrate some of the concepts we discussed and create a display of live data in PI Vision.

4.1 What is PI Vision

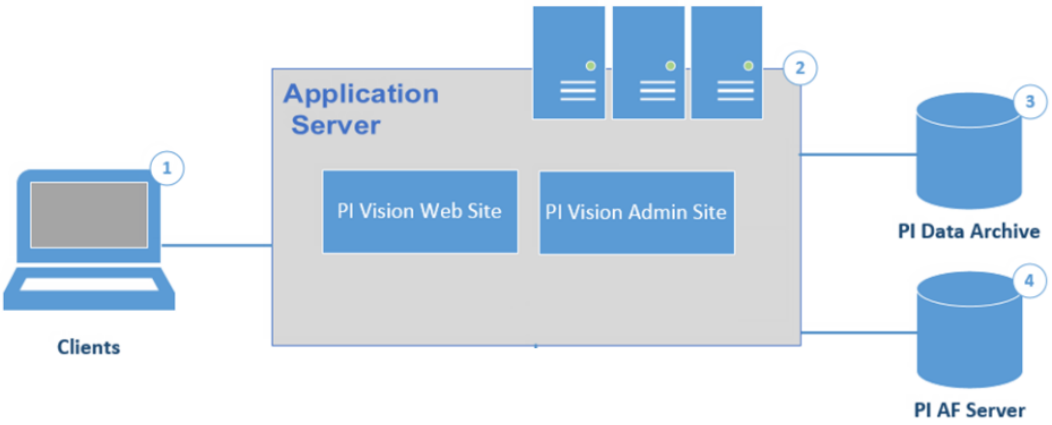
PI Vision is a web browser-based application that lets you retrieve, monitor, and analyze process information.

PI Vision allows users to:

- Search for and visualize time-series and other PI System data.
- Save displays for later use and further analysis.
- Reuse displays for multiple assets.
- Share displays with other members of a group or anyone with access to PI Vision.

PI Vision is supported by most modern browsers on a wide variety of computers, including tablets and phones running iOS or Android operating systems.

The main components of a PI Vision installation are:



Clients
Clients are individual PI Vision users accessing PI data. PI Vision is supported by most modern browsers on a wide variety of devices, including tablets and phones running iOS or Android operating systems.

PI Vision application server
The application server provides the execution environment for PI Vision. The application server handles all application operations between users (clients) and PI Data Archive servers, PI AF servers, and Microsoft SQL Server.

PI Data Archive server
The PI Data Archive is the heart of the PI System. It provides efficient storage and archiving of time series data, enabling high performance data retrieval by client software. PI retrieves PI System data from either PI Data Archive server or the PI AF server.

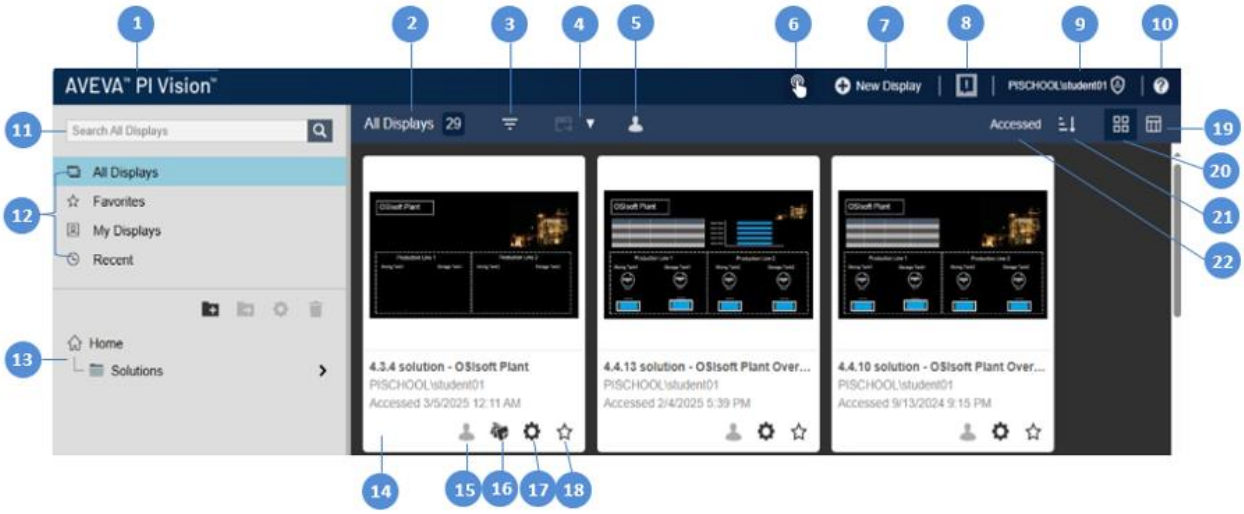
PI AF server
PI Asset Framework (PI AF) is a single repository for asset-centric models, hierarchies, objects, and equipment. It integrates, contextualizes, refines, references, and further analyzes data from multiple sources, including one or more PI Data Archive servers. Together, these metadata and time series data provide a detailed description of equipment or assets.

4.2 PI Vision Home Page

To start using PI Vision, navigate to the PI Vision application server set up by your administrator. In a default installation, the address is: https://*webServer*/PIVision where *webServer* is the name of the PI Vision web server, for example https://pisrv01/pivision.

The first page displayed on the web server is the PI Vision homepage. Here you are able to view the thumbnails of ‘All Displays’ that you can access; displays that you create as well as those displays your colleagues create and share with others.

Below is a typical home page for PI Vision.



Number	Name
1	Home
2	Group filter applied
3	Filter by keywords
4	Select displays to move
5	Show private displays
6	Toggle touch-friendly experience
7	Create New Display
8	PI Vision Messages
9	Identity connected
10	Help
11	Search display box

Number	Name
12	Predefined groups
13	Folders
14	Display thumbnail
15	Shared/public Display
16	Related displays
17	Display settings
18	Favorite
19	Table view
20	Thumbnail view
21	Sort displays in ascending/descending order
22	Sort displays (accessed, modified, name, owner)

Note: Since this course was not designed for a laptop-tablet hybrid device, we are not going deeper in the Toggle touch-friendly experience, but if you are interested, you can consult the section "Touch-sensitive device gestures" in the *PI Vision Installation and Administration Guide*.

4.2.1 Exercise – Exploring the Home page

You are invited to watch what the instructor is doing or perform the same steps at the same time.

Objectives

- Get familiar with the different buttons and functionalities of the Home page.

Activity Description

Pair each number of the buttons of the PI Vision home page with its functionality.

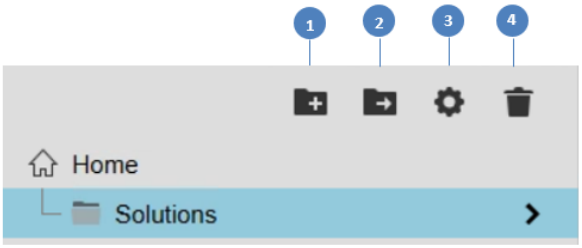
Functionality	Button
Folders let users more easily find displays and provide a place to store officially published displays. Administrators can create other folders to organize displays. You can select a specific group of displays to view.	
Mark any display as a favorite. Displays marked as a favorite appear in the predefined favorites group.	
Allows you to view the list of available displays as a table.	
Will display the selected group and the number of displays matching the search criteria.	
Open an empty display in the display creator.	
Control various facets of a display's visibility, ownership, and interactions. Create multiple labels for the same display and label as many displays as you wish.	
Allows you to filter the displays that appear based on keyword tags that are assigned to displays. If you select multiple keywords, you will only see displays that have all the selected keywords.	
Identifies the identity that is connected to PI Vision.	
If you are working on a laptop-tablet hybrid device such as a touch-sensitive laptop, you will see this button on the top right corner of the application to enable the Touch mode. Touch mode is designed to optimize touch experience when using a 2-in-1 hybrid device.	
Make the thumbnails of private displays to be showed if we have the needed permissions.	
It helps you select if the displays are sorted in ascending or descending order.	
Takes you to the home page and it is always visible.	
Takes you to the help guide and you can use it to access videos and give feedback.	
Shows any error or warning messages in PI Vision.	
Allows you to view the list of available displays as thumbnail images.	
Shows if the display has been shared.	
Select a specific group of displays to view. You can select: All Displays: All public and private displays to which you have access. Favorites: Displays that you have marked as favorites (starred displays) My Displays: Displays that you have created Recent: Displays that you used within the last seven days When you select one of these groups, PI Vision shows the thumbnails from only that group and filters the search box to search within only that group of displays.	
This will help you change how the displays are sorted. You can sort by: • *Accessed* (when the display was last viewed or modified. • *Modified:* when the display was last modified. • *Name:* the name of the display. • *Owner:* the owner of the display.	
Appears if the display has been tagged or has been assigned a keyword.	
Click to open an existing display.	
Search for displays with names, tags or owners.	
Allows administrators to select displays then move them to a different folder.	

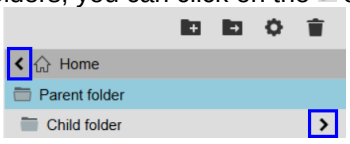
4.2.2 Working with folders

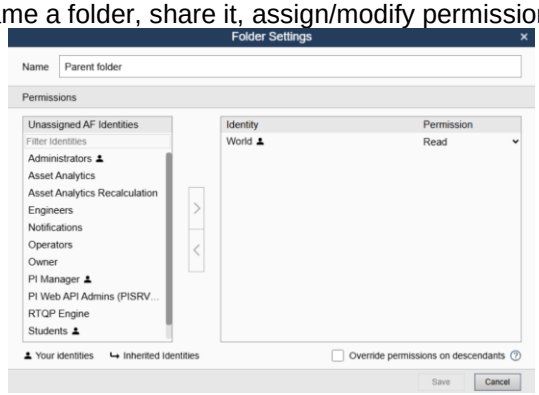
AVEVA PI Vision stores each display in a folder. By default, all displays are stored in the **Home folder**. However, administrators can create a customized folder structure so that your displays are organized in a manner that makes sense for your business, and displays are easy to find.

When an administrator creates a folder, they set permissions to indicate which users can view and modify the folder. Administrators can set up permissions so that when a user has access to view a folder, it means that the user also has access to view all the displays that are contained in that folder. So, in addition to simply organizing your displays in a logical manner, the folder structure can provide a framework for restricting access to displays among the users in your organization.

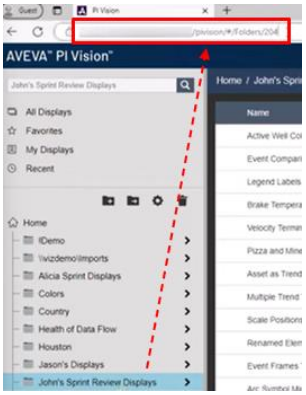
If you are not an administrator, your ability to view a folder and modify a folder such as to add displays, change the folder's name, or add subfolders depends on the permissions that you are granted.



Number	Name	Description
1	Create new folder	To **create a new folder at the same hierarchy level as the Home folder** you can simply click on the *Create new folder* button, then you must assign a folder name. If you want to **create a new folder hierarchy**, you much click on the folder that will act as the parent folder and then click on the *Create new folder* button so you can assign a folder name. You will notice the new hierarchy is created:  To navigate among folders, you can click on the or buttons:  By default, the folder inherits permissions from its parent folder. If desired, change access to the folder. See Set folder permissions.

2	Move folder	If you have full control permission to a folder, you can move it to another folder to which you have write permission
3	Edit folder settings	You can rename a folder, share it, assign/modify permissions: 
4	Delete folder	You can delete a folder if you have write-access to the folder and its parent folder. When you delete a folder, AVEVA PI Vision deletes any subfolders and moves any displays in the deleted folder or subfolders to the Home folder.

As of PI Vision 2024, folders can be shared using/referencing its URL.



Also as of PI Vision 2024, if working with a subfolder (it has a parent folder) the folder and display permissions can be inherited from the parent folder if the *inherit from [parent folder]* checkbox is selected.

For more information, see "Learn about folders" and its related links in *PI Vision Installation and Administration Guide*.

4.2.3 Directed activity – Create a Display Folder

You are invited to watch what the instructor is doing or perform the same steps at the same time.

Objectives

- Create folders to organize better the displays

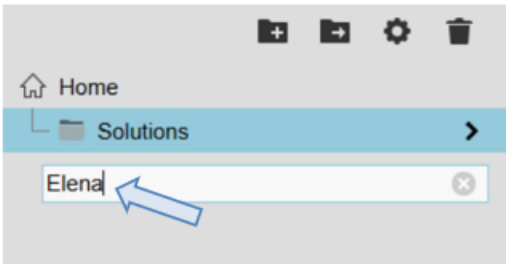
Activity Description

Imagine you have been hired by the Company “Industrial Plants of The World” to create all the Displays and reporting for the company. The first thing they recommended you is to be very organized, so you decided to create a new folder to order all the displays you will be creating.

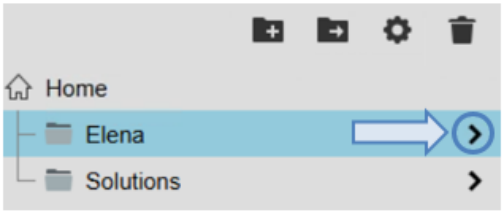
Approach

Step 1: On the Home page, click on the create new folder icon (you need Admin privileges to have this option available).

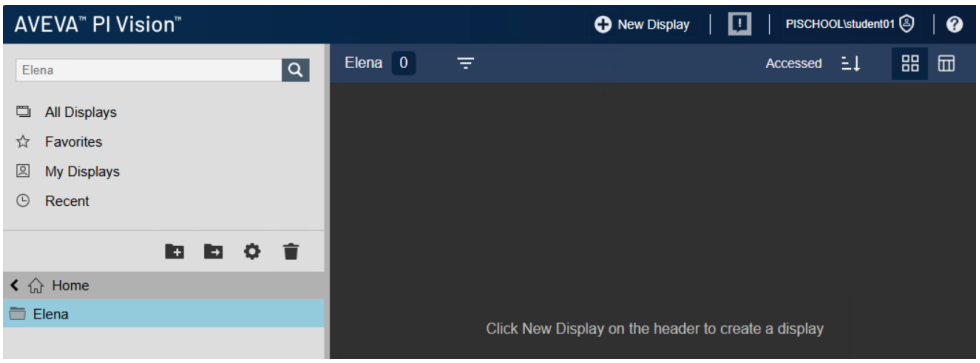
Step 2: Create a new folder with your name.



Step 3: Click on the › button right next to the just created folder.



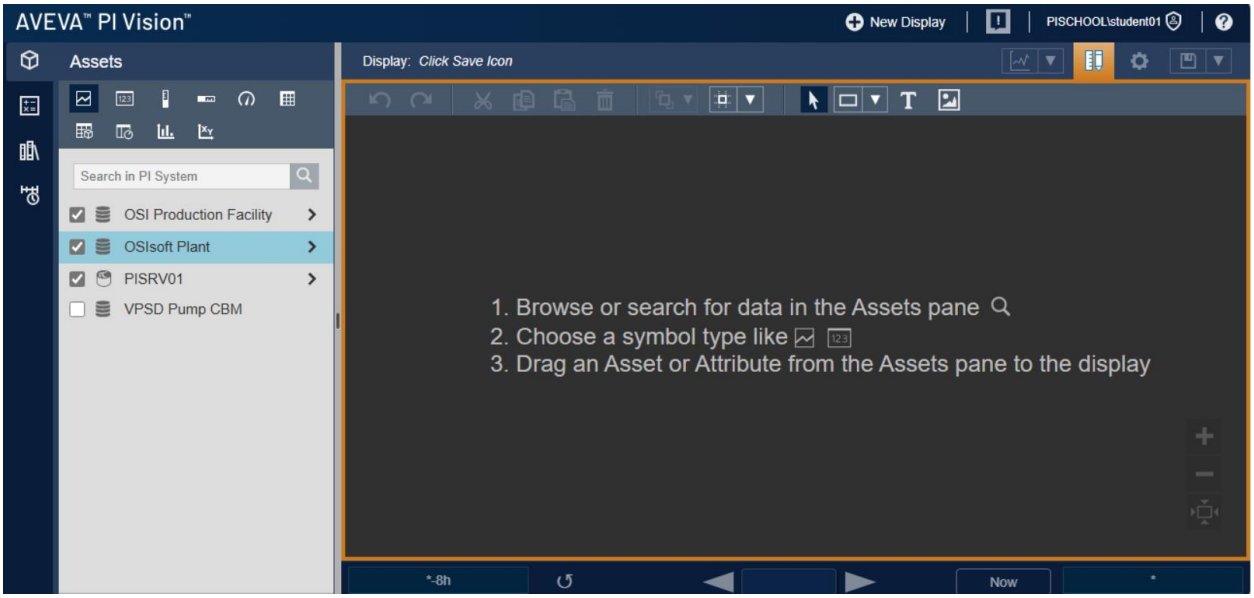
Since you have not created any display yet, the folder will be empty.


AVEVA™ PI Vision™
New Display
PISCHOOL\student01
Elena
All Displays
Favorites
My Displays
Recent
Home
Elena
Elena 0
Accessed
Click New Display on the header to create a display

4.3 Creating a new display

To create a new PI Vision display, click on 

in the Home page. A whole new display will appear.



LEARNING OUTCOMES

- Look at live data using PI Vision
- Build a basic display in PI Vision
- Use of PI Vision symbols
- Explain PI Vision components
- Explain the search mechanism
- List the dynamic and static symbols available
- Configure symbols
- Use the UOM feature
- Explain how to change the time range of a display
- Explain the options in the Design Mode toolbar

4.3.1 Searching for Data

PI Vision's Assets pane shows a navigation tree to help you visualize your data hierarchy. You can use the navigation tree to find assets and their attributes by drilling down through the data hierarchy.

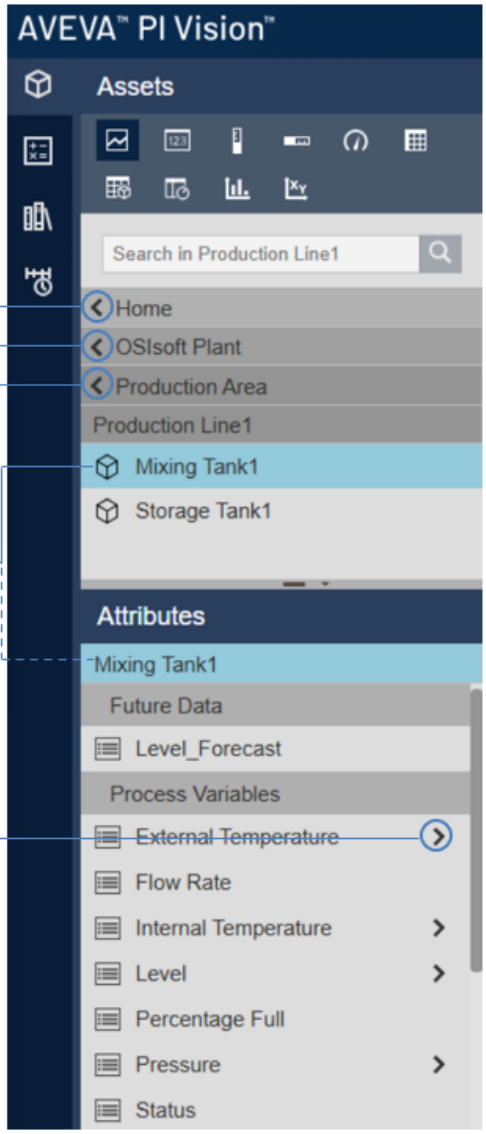
Let start exploring the hierarchy of the OSIsoft Plant, which is already set up as an AF database for you. The exploration of the contents of different AF Data Bases can be done using the grey right pane.

Click on the chevron (arrow) to the right of 'OSIsoft Plant' marked with a circle in the next picture to start inspecting.

Drill through your AF hierarchy by clicking on the black arrows to find assets in the plant. Notice the hierarchy of assets is displayed on the left.

Once you click on an asset, say Mixing Tank1, the Attributes list populates below the Assets' list

If any of the attributes has sub-attributes, it can also be accessed using the black arrow



In PI Vision you can also use the Search pane to locate data items in the PI System, such as PI Points and AF elements and attributes. You can also search for previously saved PI Vision displays. Ensure the search is being performed at the PI System level. The filter search query will attempt to find:

- PI points - Example: VPSD*Flow
- AF elements - Example: Mixing
- AF attributes - Example: temp
- Description of a PI Point - Example: *Tank1 in Production*
- Description of an AF Attribute - Example: *Net Flow*

The PI Vision search engine returns items that start with the search phrase by default and includes the use of any spaces in the string.

The scope of your search can be limited by drilling down to a specific Data Archive or into a specific AF Database and its subsequent element tree structure.

PI Vision searches the following fields:

- PI Point/Asset/Attribute Name
- PI Point/Asset/Attribute Description

You can use wildcards such as asterisks (*) when you do not know all the letters in the search phrase. An asterisk is always assumed at the end of each entered search query. A question mark (?) can be used when one character is unknown or when only a single character is different inside the field being searched. A question mark (?) and asterisk (*) can be used in conjunction based on the contents of the field.

4.3.2 Directed Activity – Search data in PI Vision

You are invited to watch what the instructor is doing or perform the same steps at the same time.

Objectives

- Search for PI Points and AF Attributes in PI Vision

Activity Description

Building a display in PI Vision starts with finding the data items in PI System. As a new employee you want to get familiar with the hierarchy, the assets and the attributes you will need to work with.

Approach

Step 1: Click on 

.

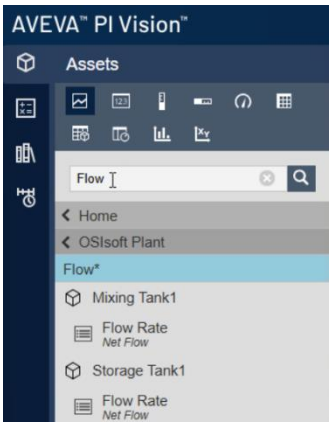
Step 2: Select the AF database named OSIsoft Plant.

Step 3: Try the following combinations of search queries (for Flow Rate) and see how it changes the search results. Explain why c. returns nothing.

a. Flow

b. *Rate

c. F?Rate



Step 4: Try the following combinations of search queries (for Mixing Tank) and see the differences in the results.

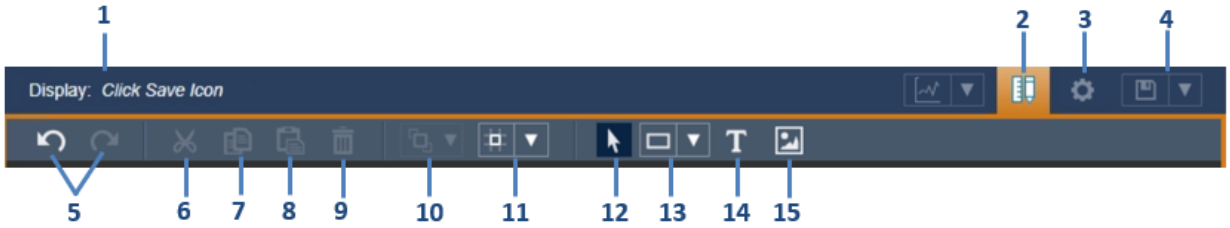
a. Mixing Tank

b. Tank

c. *tank

4.3.3 Display Design

The Display Design bar is in the top of the display creator window and helps with the creation/modification of the static symbols. It also permits arranging, copying, pasting, etc. all the symbols in the display (static or dynamics). All the symbols are described below:



Number	Functionality
1	Display name. If the display has not been assigned a name yet it will show "*Click Save Icon*". If recent changes have not been saved, a * symbol will appear right next to the display name, once the changes have been saved the * will automatically disappear.
2	Design mode button
3	Display settings. These can be changed from here or directly in the display thumbnail in the Home page.
4	Save Icon
5	Undo-Redo
6,7,8,9	Cut, Copy, Paste and delete
10	Arrange (Align, bring forward, send back, distribute…)
11	Turn the grid on/off
12	Select
13	Insert a predefined shape (lines, squares, polygons…)
14	Insert Text
15	Insert images or Gifs

4.3.4 Directed Activity – The first display

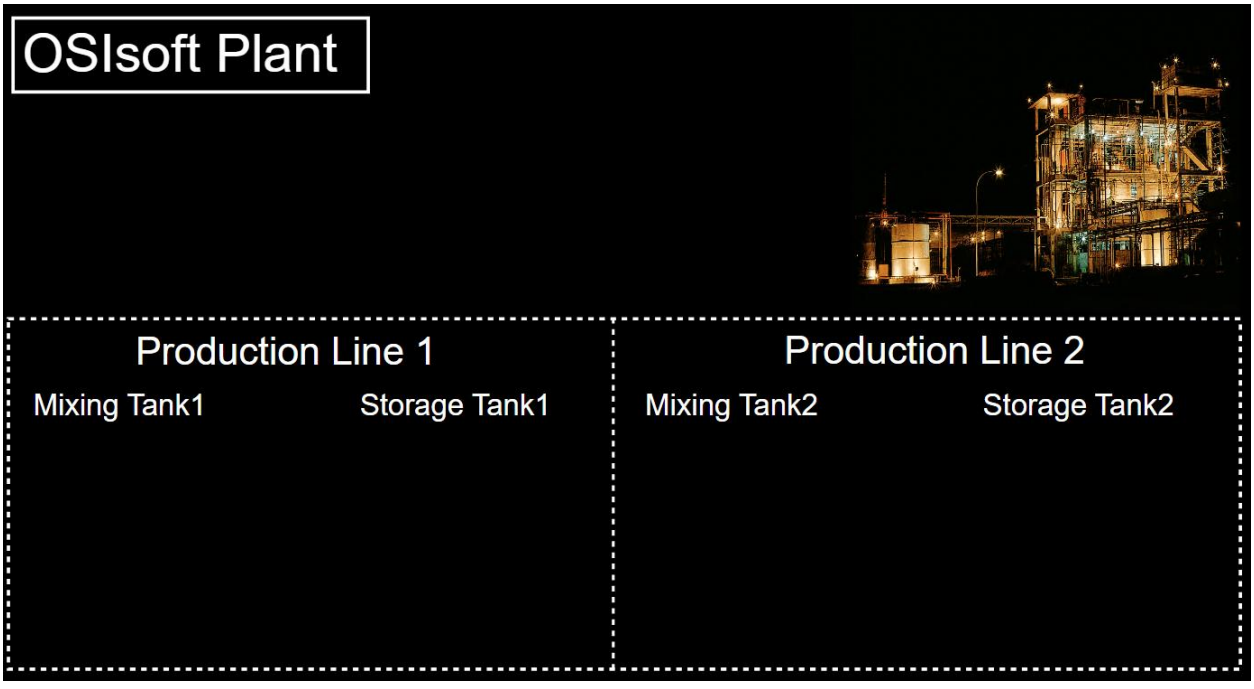
You are invited to watch what the instructor is doing or perform the same steps at the same time.

Objectives

- Create your first PI Vision Display
- Use the Display Design bar

Activity Description

In your new company “Industrial Plants of The World” no one has used PI Vision before and they want to start by creating all the needed displays for one of the plants, the OSIsoft Plant. Your fictitious manager wants you to create a welcome display to the OSIsoft Plant, not containing any data yet. The managers want something like the display shown in the next figure:



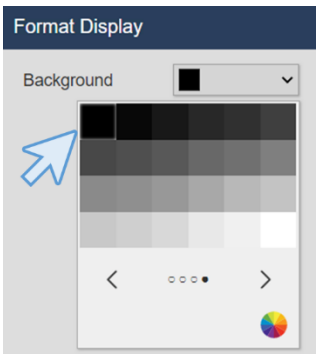
Approach

Step 1: If you are not in the display creation window, Click on 

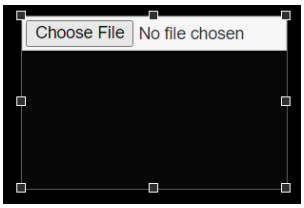
.

Step 2: Right click on any part of the display and select Format Display. A new menu will open on the right side.

Step 3: Change the background color to be black.

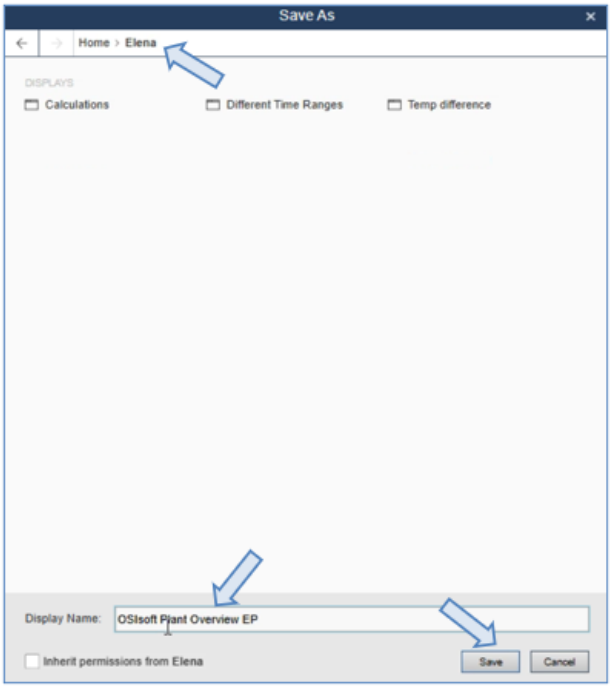


Step 4: Click on the Image icon in the Display Design Bar and draw a square in the top right corner of the display.



Step 5: Click on “Choose file” and navigate to "C:\Class\Images\” and select the file “industrial-factory.jpg".

Step 6: Save your display by clicking on the Save button , select the folder you created on Activity *4.2.3 – Create a display folder*. In the example image Elena’s folder was selected, please make sure you select your own folder.

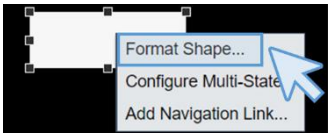


Name your display “*OSIsoft Plant Overview <your initials>*” and finally click on Save.

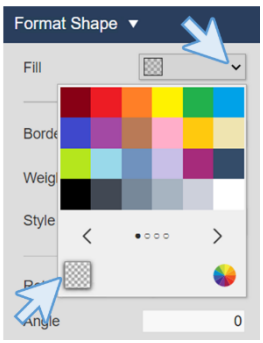
Step 7: The first time you save the display, the orange border around the display will disappear. That means that you are no longer in Design mode. To continue editing the display, click on the Design mode icon  (you will notice how it will turn orange and the orange border around the display will appear again).

Step 8: Click on the shape button  and select the rectangle.

Step 9: Draw a rectangle in the top left corner. Right click on the rectangle and select Format shape.

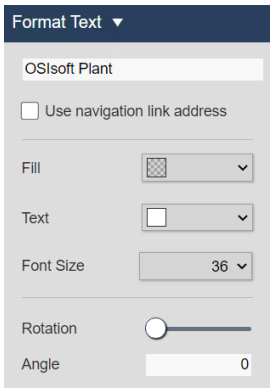


Step 10: In the menu that has appeared on the right modify the fill to be transparent and keep the other vales as default.

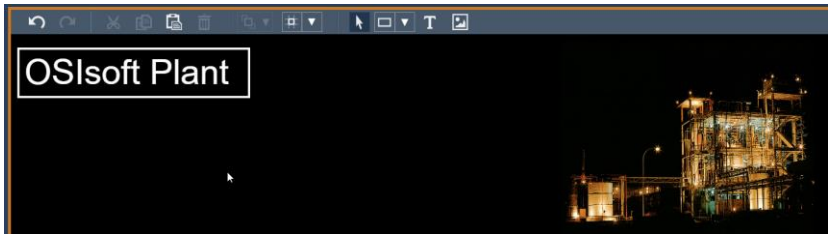


Step 11: Click on the text icon  and click inside the rectangle you have just drawn. A new menu will appear in the right.

Step 12: Enter the text OSIsoft Plant and change the Font Size to be 36. In this menu you can edit font size, color, fill, rotation, etc.

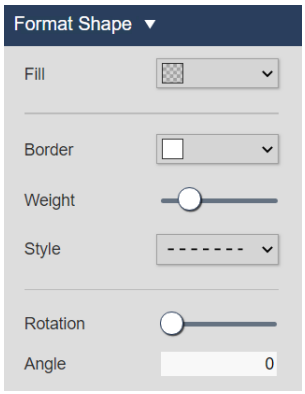


Step 13: Change the size of the square to the text fit inside. At this point the display should be like this:

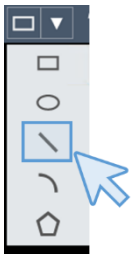


Step 14: Click on the shape button  and select the rectangle. Draw a rectangle. Right click over the rectangle and select “Format shape…”.

Step 15: On the right menu, select the Fill to be transparent and the style to be dashed.

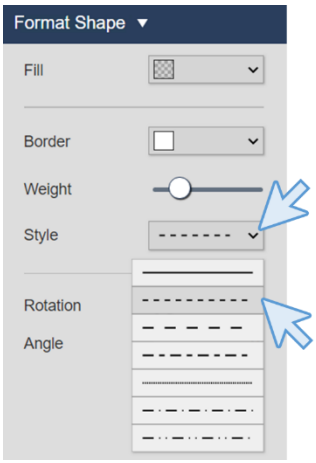


Step 16: Click again on the shape button and select a line.

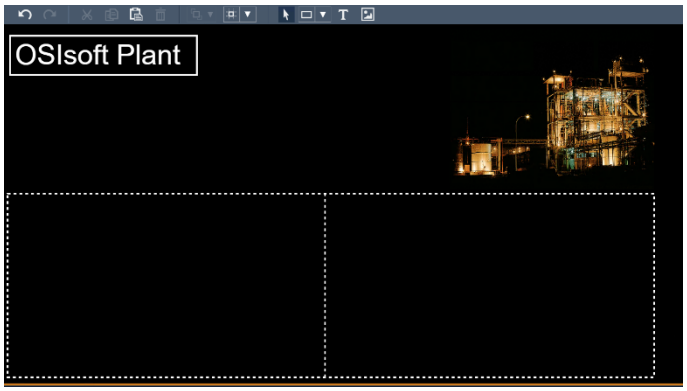


Step 17: Draw a vertical line in the middle of the big square in the bottom of the display. Holding down *Shift* while drawing will cause the Line shape to “snap” to the closest 45° angle and will help you with the drawing.

Step 18: Right click over the vertical line and select “Format line…” Select the style to be dashed.



Step 19: The result of the steps taken up to here is a display like the one below.



Step 20: It is time to save the progress. Click in the save icon  .

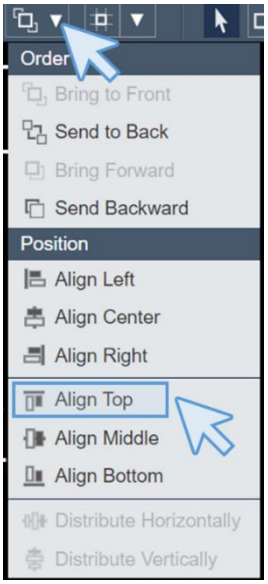
Step 21: Click on the text icon  and click inside the rectangle on the bottom of the display. In the right contextual menu enter the text “Production Line 1” and change the font size to be 24. *Tip: You can also change the font size by stretching the bottom of the text down.*

Step 22: With the text “Production Line 1” selected, click on the copy  button and then in the paste one  . You can also use “ctrl+c” and “ctrl+v”. Edit the text to be “Production Line 2”.

Step 23: Move the text “Production Line 2” to the other square. You can enable the grid icon  on the editing toolbar to help you with the placement of the text.

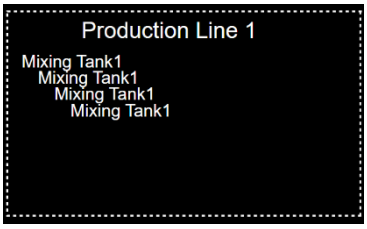
Step 24: Select both text “Production Line 1” and “Production Line 2”. To select two different elements in the display you can: 1) click on the pointer icon  then you can either draw a selection area containing all the elements you want to include or 2) clicking on the elements while holding the Ctrl key pressed.

Step 25: Click on the down arrow next to the arrange icon  and select “Align Top”.

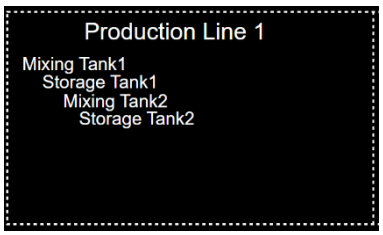


Step 26: Click on the text icon  and click somewhere under the “Production Line 1” text. In the right contextual menu enter the text “Mixing Tank1” and change the font size to be 20.

Step 27: Copy and paste the text “Mixing Tank1” four times using the Copy and paste icons or the shortcut keys “ctrl+c” and “ctrl+v”.



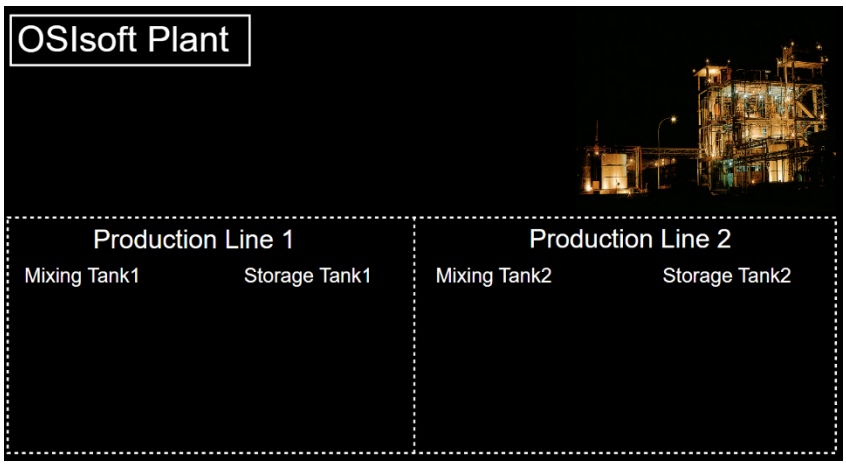
Step 28: Modify the texts to be: Mixing Tank1, Storage Tank1, Mixing Tank2, Storage Tank2. You can do those modifications on the menu on the right for each piece of text.



Step 29: Move the texts “Mixing Tank1” and “Storage Tank1” under “Production Line 1”, then move the texts “Mixing Tank2” and “Storage Tank2” under “Production Line 2” as in the image below.

Step 30: Select the texts “Mixing Tank1”, “Storage Tank1”, “Mixing Tank2”, “Storage Tank2” and align them to the top using the arrange icon  and selecting the Align top option (Tip: Press and hold Ctrl key to do a multi select).

Step 31: Click on Save  . The result should be the one requested by our fictitious manager.



4.3.5 The ten core dynamic symbols

PI Vision includes ten core symbols to be used with dynamic data, but other custom symbols can be programmed as needed. Creating custom symbols is out of the scope of this training, but if you are interested, you can sign for the training PI Vision Extensibility: Creating Custom Symbols.

The table below explains PI Vision symbols.

Symbol	Name	Functionality	Data Items allowed
	Trend	Trends show the value of one or more data items over a time period. Trends are typically used to display time series data, though they may also include non-time series data. When exiting Design mode, you can view trend cursors, pan across the time range, zoom in and out and hide traces. Right click to configure the value scale or remove traces.	Multiple
	Value	Used to show a data item value, at the end time of the display. It is shown as a number, time stamp, string, or digital state. Right click to format how the value is displayed or to add Multi-State.	Single
	Vertical Gauge	These three symbols are identical in every way, except their orientation. The zero and span of the symbol are from the PI point attributes. If the data item is an AF attribute of formula type, the minimum and maximum traits on the attribute are used. Right click to format the gauge or to add Multi-state.	Single
	Horizontal Gauge		
	Radial Gauge		
	Table	The table symbol contains columns that include the name, value, description, and other summary data about a data item. These summary data values take their intervals from the display's time range as defined in the time bar. Right click to configure table columns.	Multiple
	Asset Comp. Table	The asset comparison table symbol allows you to compare measurements from similar types of equipment by organizing your data by assets. Each asset is assigned its own row while columns contain the asset's selected attributes.	Multiple
	Time series table	Use a time series table symbol to show the values of a data item arranged sequentially along with their timestamps. The value that appears in this symbol is	Single

Symbol	Name	Functionality	Data Items allowed
		the reading that is obtained for a data item, shown as a number, time stamp, string, or digital state.	
	Bar chart	Bar chart symbol compares multiple values through graphical representation. Bar charts are often used to compare multiple data sources, where one bar represents one data source. Right click to format the bar chart or edit the search criteria.	Multiple
	XY Plot	An XY Plot shows a correlation between one or more paired sets of data. On an XY Plot (also called a scatter plot), the X scale shows possible values for one of the items in the pair and the Y scale shows the value of the other item in the pair.	Multiple

Dynamic symbols support future data and do not require any special configuration. When a display range is set into the future, a trace for future data continues to show new values in a staircase pattern.

For more information, see "Symbol types" and its related links in *PI Vision Installation and Administration Guide*.

4.3.6 Directed Activity – Display to monitor a tank

You are invited to watch what the instructor is doing or perform the same steps at the same time to explore the different concepts presented in this chapter or section. *Use your own data if you have access to such data.*

Objectives

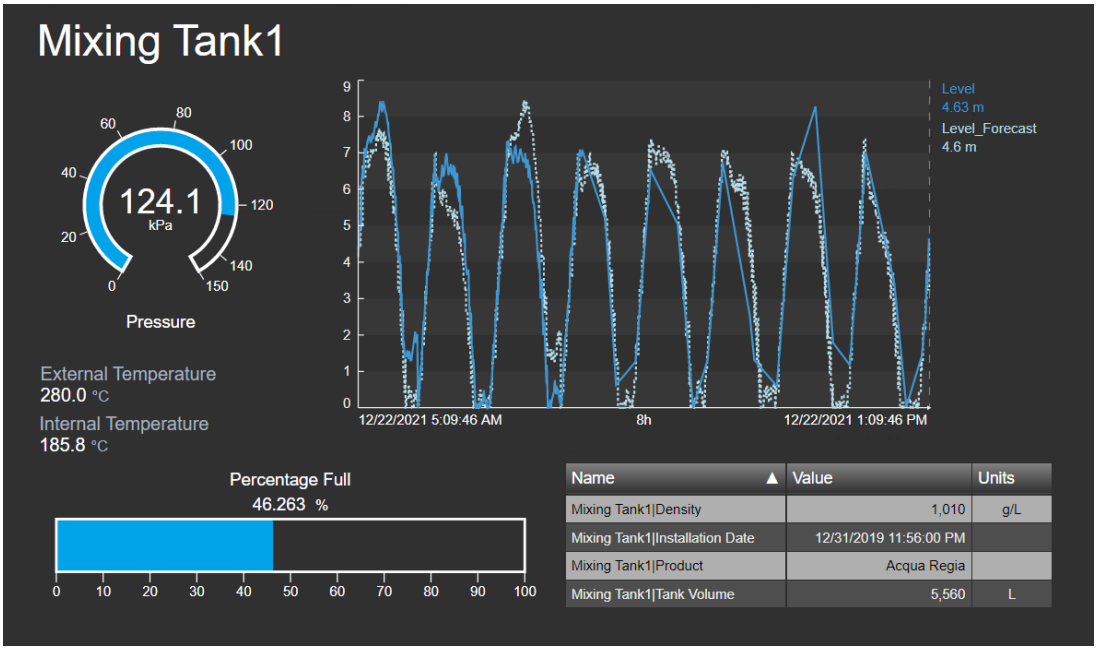
- Familiarize yourself with the nine core dynamic symbols.
- Represent dynamic data in a Display.

Activity Description

Your manager in "Industrial Plants of The World" is delighted by the job you did with the "*OSIsoft Plant Overview <your_initials>*" display. Now they want to check if the dynamic symbols can be useful for them. They want you to create a display called "*Tank General Overview <your initials>*" containing the following items.

	Measurement	Display Symbol	
Mixing Tank1	Pressure	Radial Gauge	
	Level	Trend	
	Level_Forecast		
	External Temperature	Value	
	Internal Temperature		
	Tank name		
	Product	Table	
	Density		
	Installation date		
	Tank Volume		
	Percentage full	Horizontal Gauge	

Your fictitious manager created a diagram for you to know what he/she is expecting.



Approach

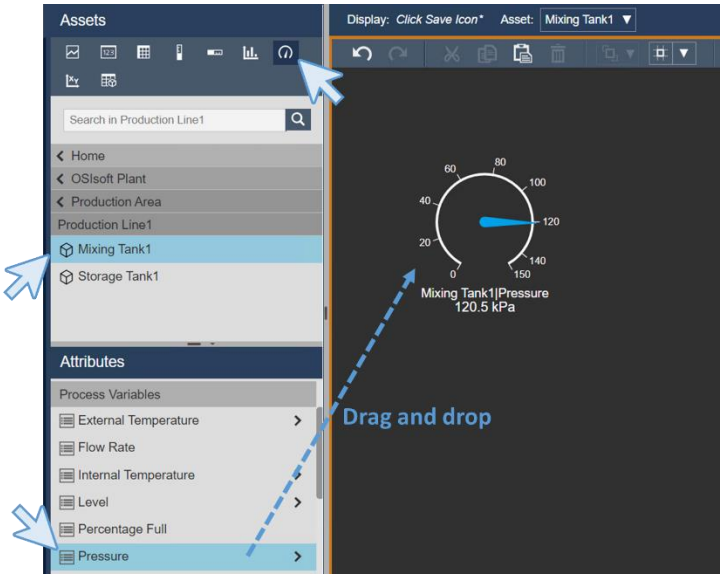
Step 1: Open your web browser to the PI Vision homepage if it is not already open.

Step 2: Create a new display with 

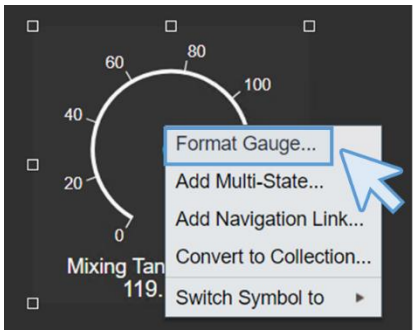
Step 3: Drill down through the hierarchy in AF Server PISRV1 and database OSIsoft Plant to determine the assets and their attributes.

Step 4: Drill down to Production Area > Production Line 1 > Mixing Tank1.

Select the Radial Gauge icon  and drag the Pressure attribute to the display area to create the radial gauge.



Step 5: Right click over the Gauge and select “Format Gauge …”. A contextual menu will appear on the right.

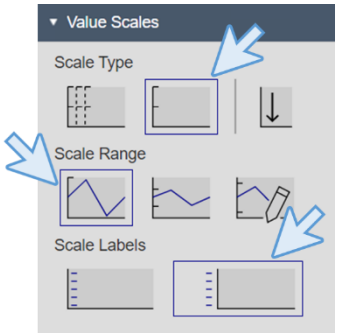


Step 6: Go to the Visibility section. In the Style section, Change the type to Arc. In the visibility section Change the label to show only Pressure.

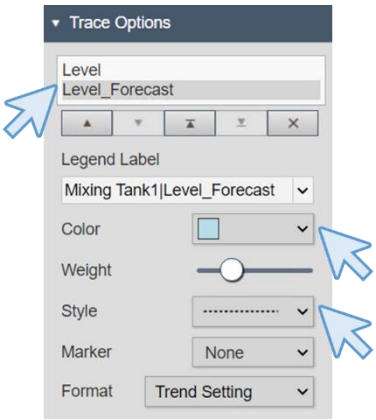
Step 7: Select the Trend icon  and drag the Level and Level_Forecast to create a trend. To select both you can hit the ctrl key while clicking over them.

Step 8: Right click and choose *Configure Trend*.

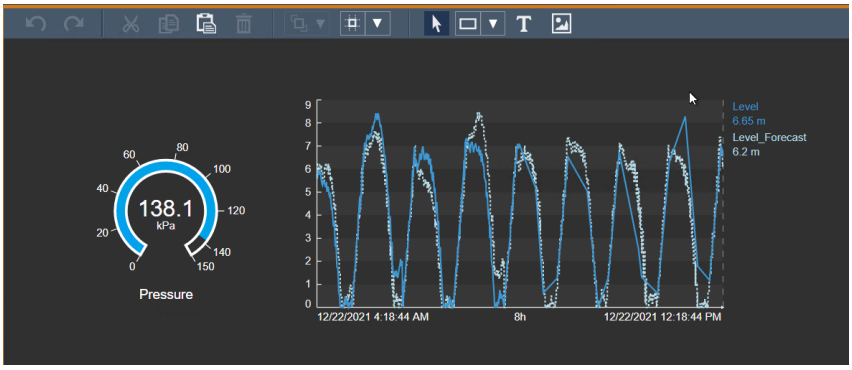
Step 9: In the Value Scales section, select single scale as scale type, Autorange of dynamic values as Scale Range and Outside the plot Area as Scale Labels.



Step 10: In the Trace Option, select Level_Forecast and change the color to be clear blue and the style to be dashed.



Step 11: The result up to this point should be similar to this image:



Step 12: It is time to save your display, click on the Save button  make sure to save it under the folder you created on Activity *4.2.3 – Create a display folder*. Name your display "*Tank General Overview <your initials>*". Then click on Save.

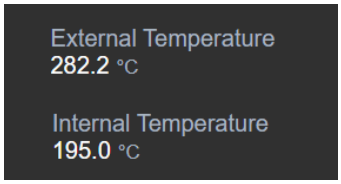
Step 13: Remember, since the first time you save the display, the orange border around the display will disappear. That means that you are no longer in the design mode. To continue editing the display click on the Design mode icon  .

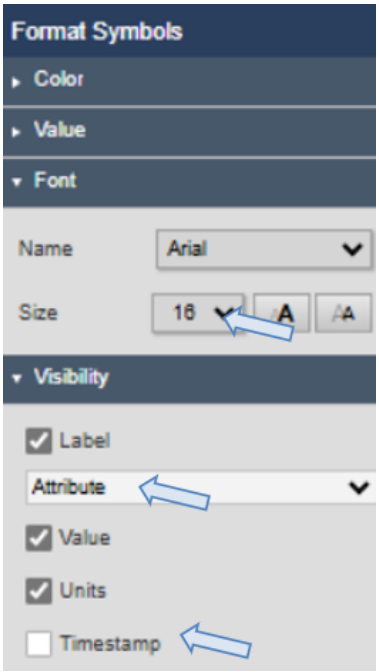
Step 14: Select the value icon  and drag the *External Temperature* to create the value.

Step 15: Drag the *Internal Temperature* to the display.

Step 16: Select both value symbols (tip: you can click and hold the Ctrl key while you select the values), then right click over any of them and click on "***Format Symbols…***", in the right menu, under the **Font** section increase the *font size* to 15 and in the **Visibility** section change the Label to be *Attribute* and uncheck the *Timestamp*.

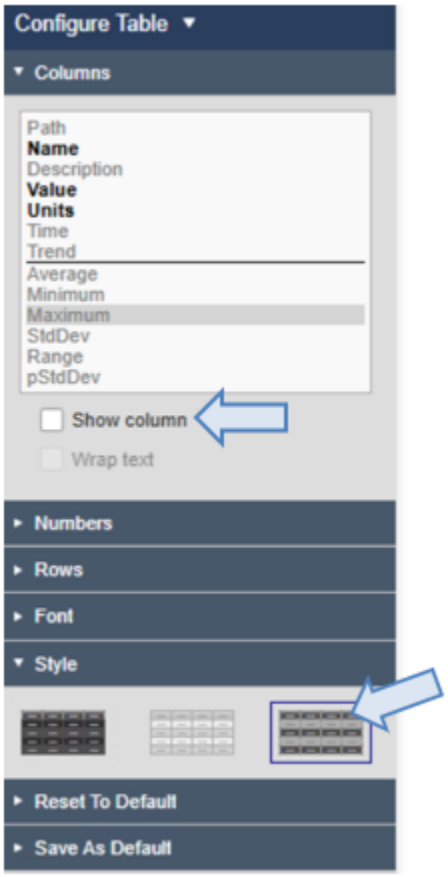
You will notice that the format change is applied to both value symbols:





Step 17: Select the table icon  and drag the Product and Density to the display area.

Step 18: Right click over the table an select “Configure Table…”. In the right menu, under the column section unselect the columns Description, Trend, Minimum and Maximum. To unselect them, just click over the column name and unmark the Show Column option. In the Style section select the black and grey.



Step 19: Drag and drop the Installation date over the table and check how the attribute is automatically added to the table. Do the same with the Tank Volume.

Step 20: Change the size of the columns and order the attributes by name by clicking in the header of the name column. The table will look like the image.

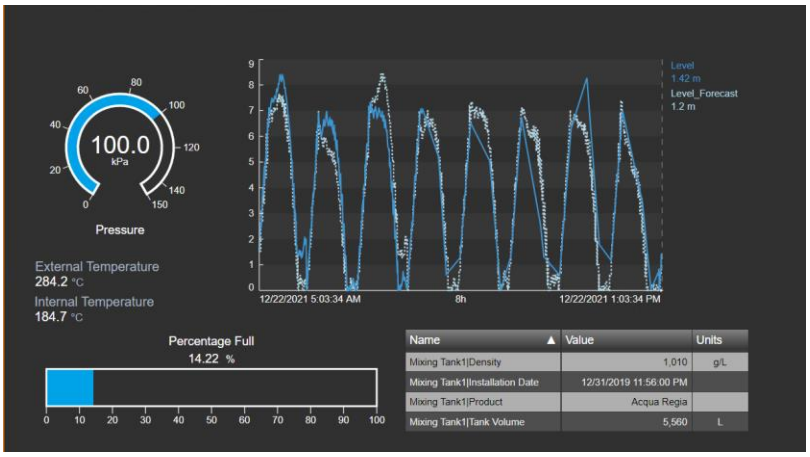
Name ▲	Value	Units
Mixing Tank1|Density	1,010	g/L
Mixing Tank1|Installation Date	12/31/2019 11:56:00 PM	
Mixing Tank1|Product	Acqua Regia	
Mixing Tank1|Tank Volume	5,560	L

Step 21: Click on save  to save your progress.

Step 22: Select the horizontal gauge symbol and drag and drop the Percentage Full.

Step 23: Right click over the Gauge. In the right pane, under the visibility section modify the Label to be Percentage Full.

Step 24: Change sizes and arrange the different symbols included in the display using what you have learned in directed activity 4.3.4. Remember to click on the pointer icon  and the arrange options  . At this point the display should looks like this:



Step 25: Click on the value icon  and drag and drop the Asset Name to the top of the display.

Step 26: Right click and select “Format Value …”. In the right menu under the style section change the Font size to be 28. Under the Visibility unmark Label, Units and Timestamp and keep marked Value. We are using this method to include the tank name, instead of using the text icon (this will help us to dynamically change the name in future exercises).

Step 27: Save your display. If it is not similar to the one above, do the needed modifications or ask your instructor.

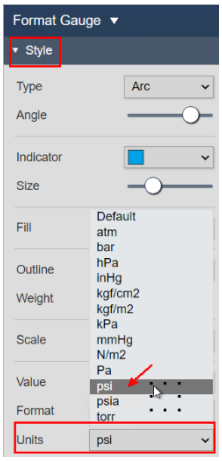
Unit of Measure (UOM)

Starting on PI Vision 2022, Unit of Measure (UOM) can be switched on a data item and symbol basis. A user can view AF attributes and asset-based AVEVA PI Vision calculations values in the UOM that is most applicable to their region and/or preferences.

To switch from one UOM to another simply access the symbol configuration panel, under Style section select the appropriate UOM at the Units option.

Step 28: Right click the radial gauge for Pressure and select "Format Gauge...". A contextual menu will appear in the right.

Step 29: In the Style section, select psi from the Units dropdown menu. See how UOM changes from the original kPa to psi (Pounds per square inch)



Step 30: Right click the External Temperature value and select "Format value...". A contextual menu will appear in the right.

Step 31: In the Style, section select **°F** at the Units dropdown menu. See how UOM changes from the original °C to °F.

Step 32: Similarly, change Internal Temperature's UOM from °C to °F.

Step 33: Save your display.

4.3.7 Directed Activity – Display to monitor a tank using PI Points

You are invited to watch what the instructor is doing or perform the same steps at the same time to explore the different concepts presented in this chapter or section. *Use your own data if you have access to such data.*

Objectives

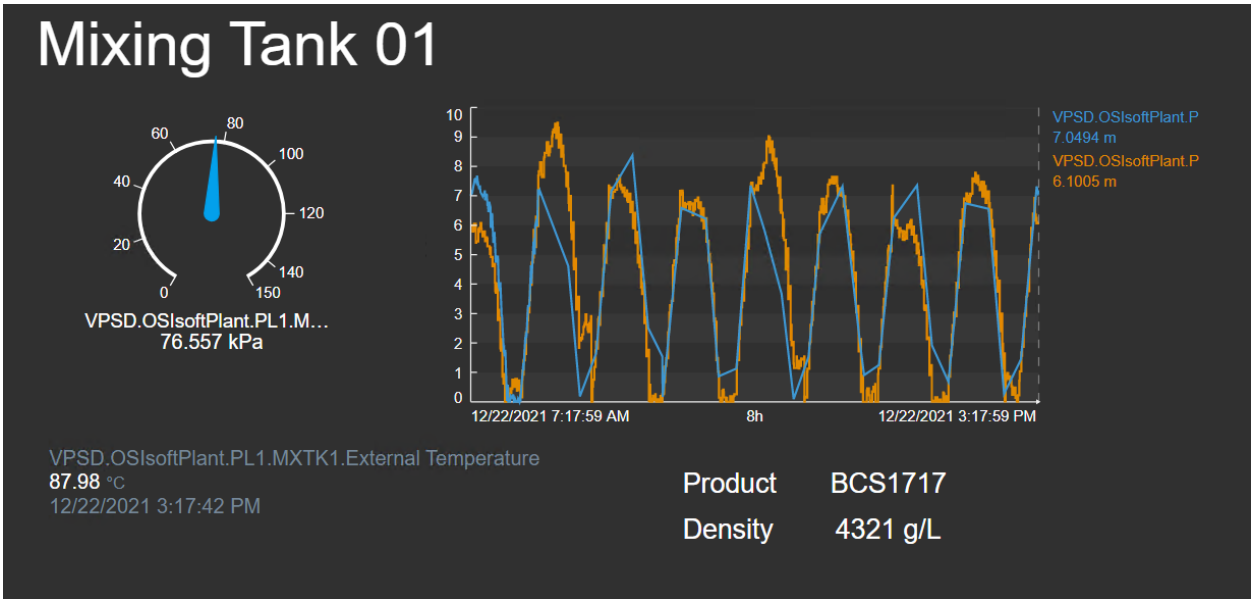
- Represent dynamic data in a Display using PI Points instead of AF attributes.
- Use the PI Points search
- Discover the advantages of using an AF Hierarchy

Activity Description

Your manager is really happy again with the job you did building the display "*Tank General Overview <your initials>*". Now they want to check if there is any difference between the displays created using the AF elements and attributes or PI Points, so they want you to create a display called "*Tank Overview PI Points <your initials>*" containing the following symbols.

	Measurement	PI Point	Display Symbol	
Mixing Tank1	Pressure	VPSD.OSIsoftPlant.PL1.MXTK1.Pressure	Radial Gauge	
	Level	VPSD.OSIsoftPlant.PL1.MXTK1.Level	Trend	
	Level_Forecast	VPSD.OSIsoftPlant.PL1.MXTK1.Level_Forecast		
	External Temperature	VPSD.OSIsoftPlant.PL1.MXTK1.External Temperature	Value	
	Tank name	Mixing Tank 1		
	Product	BCS1717	Table	
	Density	4321 g/L		

Your manager has created this picture for you to know what he/she is expecting to have.

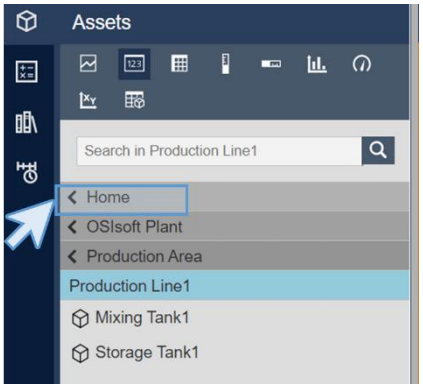


Approach

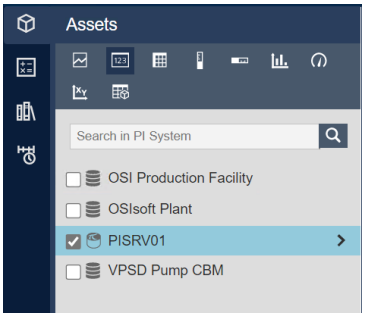
Step 1: Open your web browser to the PI Vision homepage if it is not already open.

Step 2: Create a new display with 

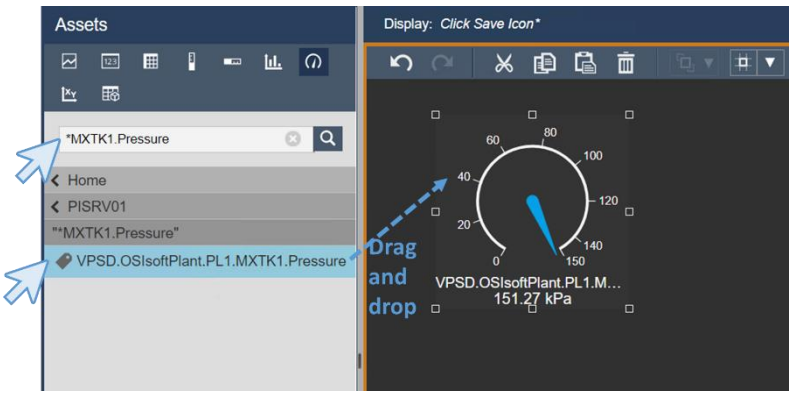
Step 3: Click on the black arrow next to the home word in the left pane. That will take you to the menu where all the AF Databases and PI Data Archives are. Remember section 1.2. where it is explained the differences between PI Data Archive and PI AF. The PI Data Archive stores the historical dynamic data in value-timestamp pairs and PI AF gives context, metadata and a hierarchy to those values.



Step 4: Unmark everything but the PI Data Archive called PISRV01. Click on the dark arrow next to PISRV01. You will notice that no attributes or hierarchies are shown, because we are working with the PI Data Archive.



Step 5: In the search box, type *MXTK1.Pressure. Select the Radial Gauge icon and drag and drop the result to the display area.

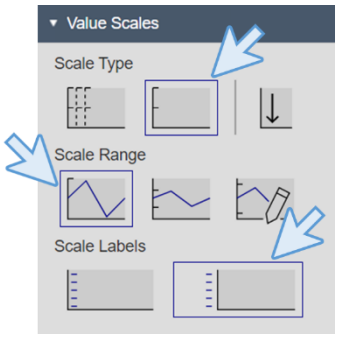


Step 6: Right click over the Gauge and select "Format Gauge …". Note that on Label, under the visibility section there are not as many options as before and they are not as descriptive.

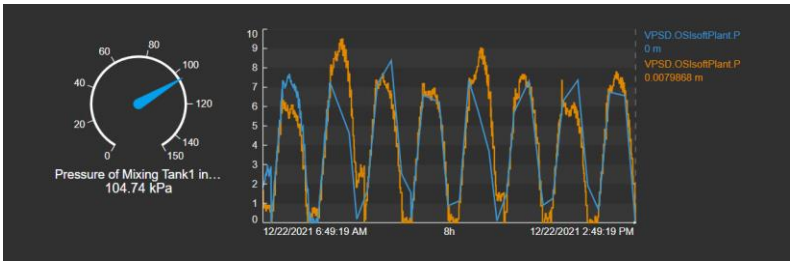
Step 7: In the search box, type *MXTK1.Level. There will appear two results. Select the Trend icon and drag the both results to the display area. Remember you can select multiple things by hitting the ctrl key while clicking.

Step 8: As in the previous activity, right click and choose *Configure Trend*.

Step 9: In the Value Scales section, select single scale as scale type, Autorange of dynamic values as Scale Range and Outside the plot Area as Scale Labels.



Step 10: The result up to this point should be something like what is shown in the picture.



Step 11: It is time to save your display, click on the Save button make sure to save it under the folder you created on Activity *4.2.3 – Create a display folder*. Name your display "*Tank Overview PI Points <your initials>*". Then click on Save.

Step 12: Remember to go back to Design mode .

Step 13: In the search box, type *MXTK1.External*. Select the value icon and drag the External Temperature to create the value.

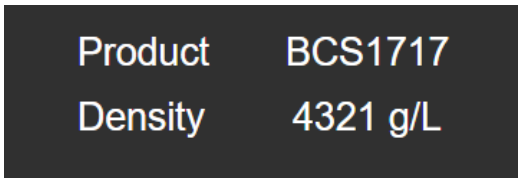
Step 14: Right click over the value and click on “Format Value…”. Under the visibility section, notice that again the Label options are not as useful as before.

Step 15: Since the Product and the density of the product that the tank contains are static attributes, there is no PI Point for them in the Data Archive, so you will need to use the Text Icon  to include them in the Display. So click on the Text Icon  , click in the display area and enter the text: Product. Reduce the size to be 16.

Step 16: Copy and paste the text Product 3 times using the copy paste icons or ctrl+c and ctrl+v.

Step 17: Edit the texts to have “Product”, “BCS1717”, “Density” and “4321 g/L”. Remember that you can edit the text by right clicking. Place them in a table shape.

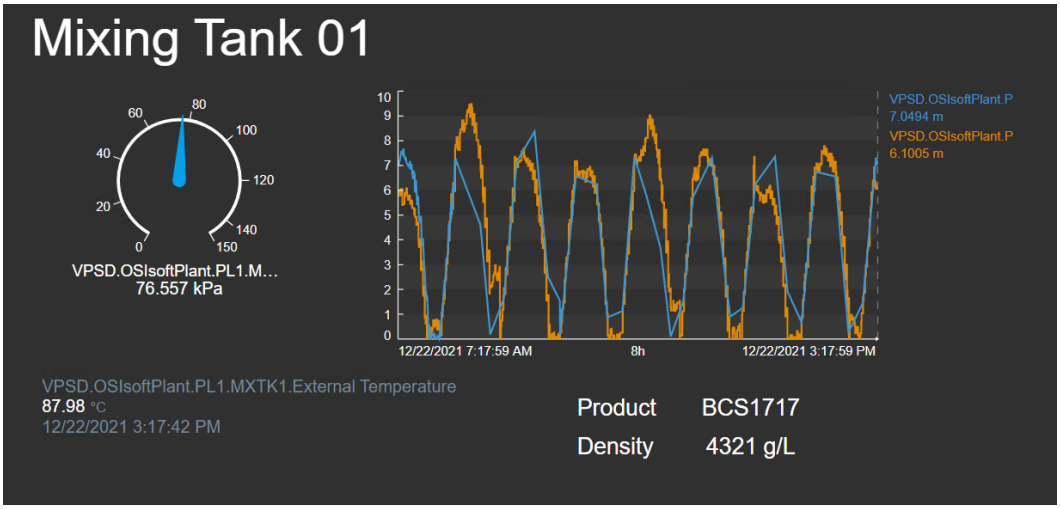
Step 18: Use the arrange options  to place them correctly. Select “Product” and “BCS1717” and use the option Align Top. Then Select “Product” and “Density” and Align Left. Select “Density” and “4321 g/L” and Align Top and finally, “BCS1717” and “4321 g/L” and Align Left.



Step 19: Click Text Icon  to include the tank name “Mixing Tank 01” in the Display. Change the font size to be 36.

Step 20: Save your Display.

Step 21: At this point the display should looks like this:



Discussion

- What differences did you notice when creating the display using PI Points instead of the AF hierarchy?

4.3.8 Exercise – Improve the display "OSIsoft Plant Overview"

This solo or group activity is designed to maximize learning in a specific topic area. Your instructor will coach you if you need assistance during the activity. *Use your own data if you have access to such data*.

Objectives

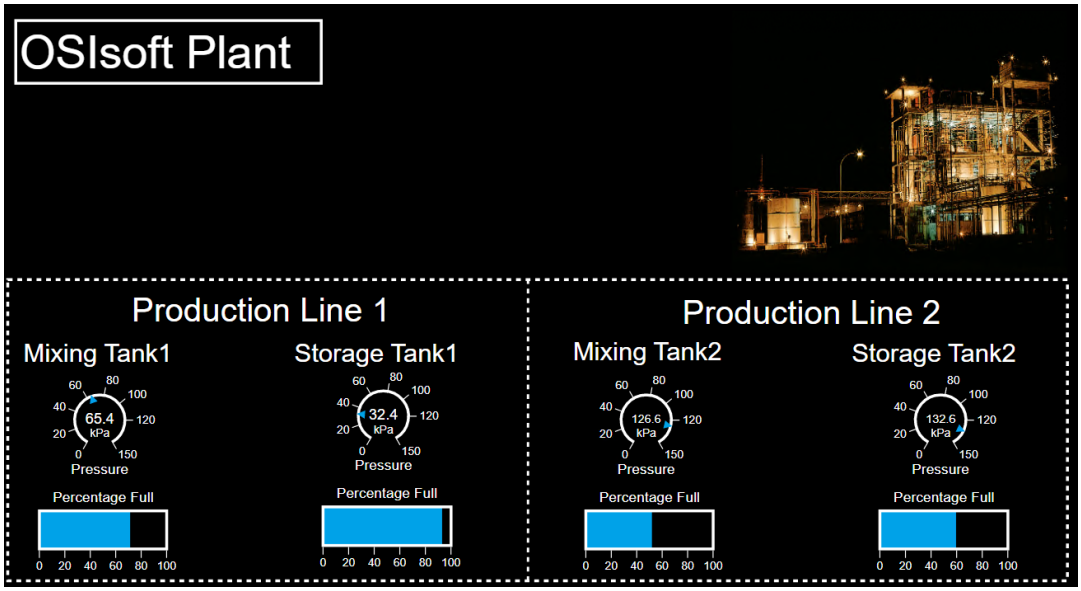
- Use of gauges in different displays.
- Copy and pasting symbols

Activity Description

Your manager in "Industrial Plants of The World" wants to include some measurements in the "*OSIsoft Plant Overview <your initials>*". Specifically, he/she wants you to include under every tank name:

	Measurement	Display Symbol
For all the tanks	Pressure	Radial Gauge
	Percentage full	Horizontal gauge

The result they want is like:



Approach

Step 1: Open the display called "*OSIsoft Plant Overview <your initials>*". Click on the Design mode icon  .

Step 2: Insert radial gauges for the Pressure for each tank and horizontal gauges for the Percentage full for each tank.

Step 3: Align them and save the display.

4.3.9 Graphics Library

PI Vision includes a complete graphics library containing most of the symbols you would need when building a display. You can open Graphics Library pane by clicking the Graphics Library icon in the left  .

The graphics belong to a wide range of categories, industries, and themes. You can customize their color, fill type, and orientation. You can also configure a graphic's multi-state behavior and allow it to automatically change color depending on the state of the associated asset. We will see this in section 4.4.

The graphics are divided by categories to make them easy to find and they can be added on any display by dragging and dropping them.

4.3.10 Directed activity – Add Graphics to your displays

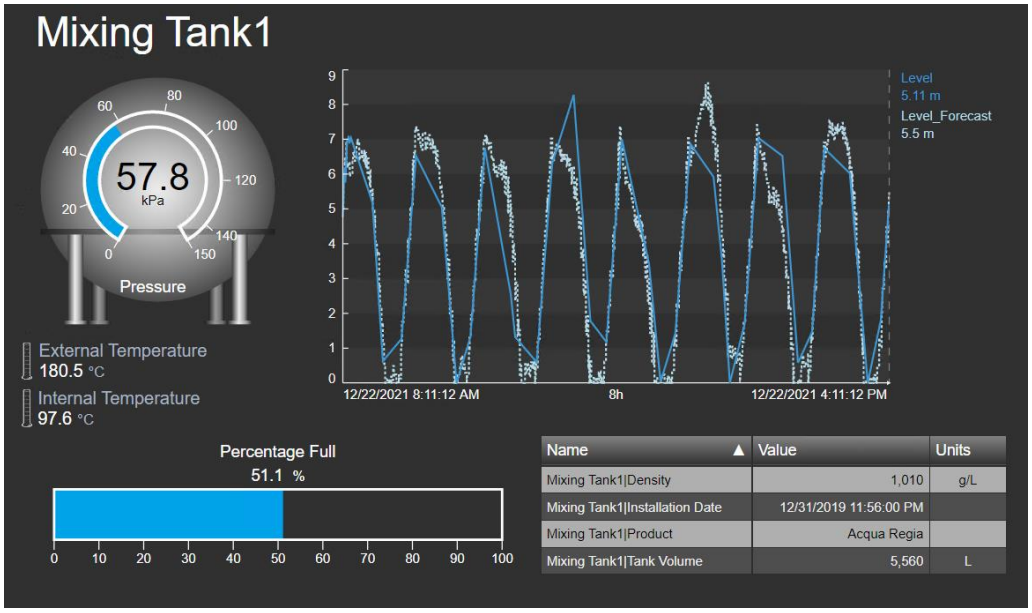
You are invited to watch what the instructor is doing or perform the same steps at the same time to explore the different concepts presented in this chapter or section.

Objectives

- Use the graphics library.

Activity Description

You showed your manager the graphics library and now they want you to include a tank symbol in the "*Tank General Overview <your initials>*" display for clarity. He/she also would like you to include small thermometers next to the temperature as shown in the image.



Approach

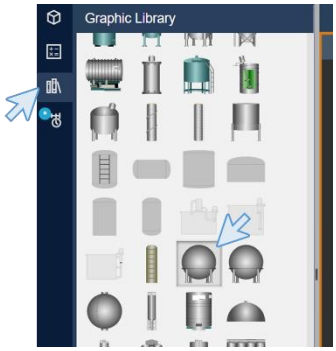
Step 1: Go to the Home page by clicking AVEVA™ PI Vision™ button on the top left corner.

Step 2: Find the display called "*Tank General Overview <your initials>*" and click on the Thumbnail.

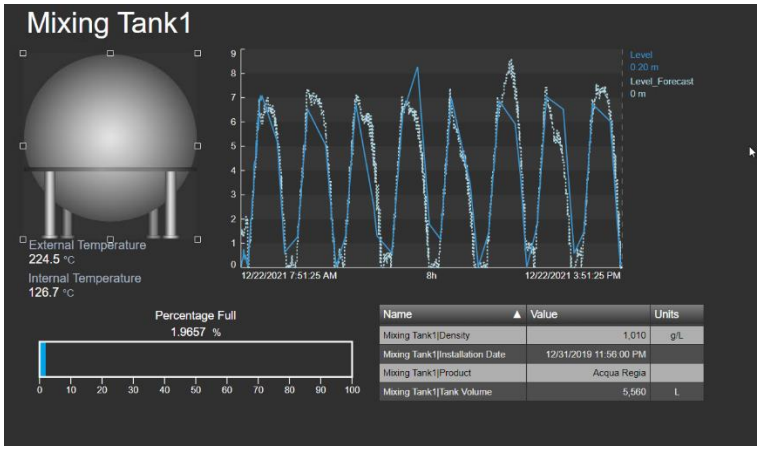
Step 3: Click on the Design mode icon .

Step 4: Click on the library icon and go the *Tanks* Category. They are in alphabetical order, so Tanks is one of last.

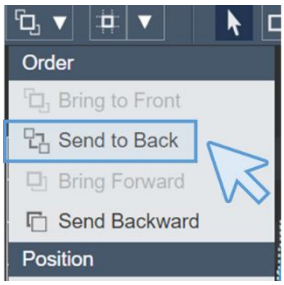
Step 5: Select one of the tanks images.



Step 6: Put the tank symbol over the radial gauge.



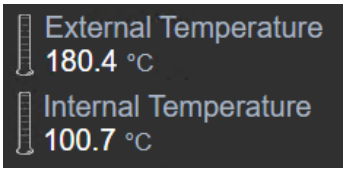
Step 7: Select the Tank symbol, send that to the back using the arrange button.



Step 8: Since the value is barely visible, right click over the gauge and change the color of the Value under the Style section.

Step 9: Go to the Graphics library and look for the *Thermometer* under the *Laboratory* category. Drag and drop it in the display.

Step 10: Make the thermometer smaller and put it next to the external temperature. Copy and paste the symbol and put it next to the Internal Temperature.



Step 11: Click on save.

4.3.11 Time bar

The time bar control at the bottom of the display workspace shows the start and end time for all symbols on your display. The duration of the display time range appears in the space between the start and end times and is initially set to 8 hours. If the end time for the display time range is set to Now (*), symbols on the display will dynamically update as information from their data items changes.

1. Start time
2. Revert display (and any trends) to original time configuration
3. Arrows shift the time range backwards or forwards
4. Duration button
5. Now button to return to current time
6. End time

The time bar control accepts valid PI System and Windows times and launches an error message in the event you enter an unsupported time format.

4.3.12 Directed activity – Modify the time bar duration

You are invited to watch what the instructor is doing or perform the same steps at the same time to explore the different concepts presented in this chapter or section.

Objectives

- Use the timebar and the PI Time.

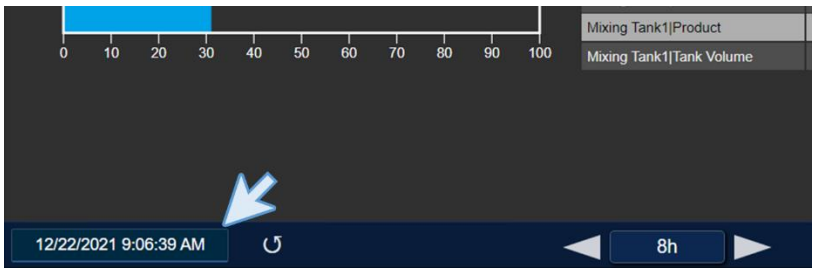
Activity Description

Someone in the Company “Industrial Plants of The World” told your manager about the PI Vision Timebar. He/she wants you to get familiar with that timebar in case they need to explore the data of a particular time.

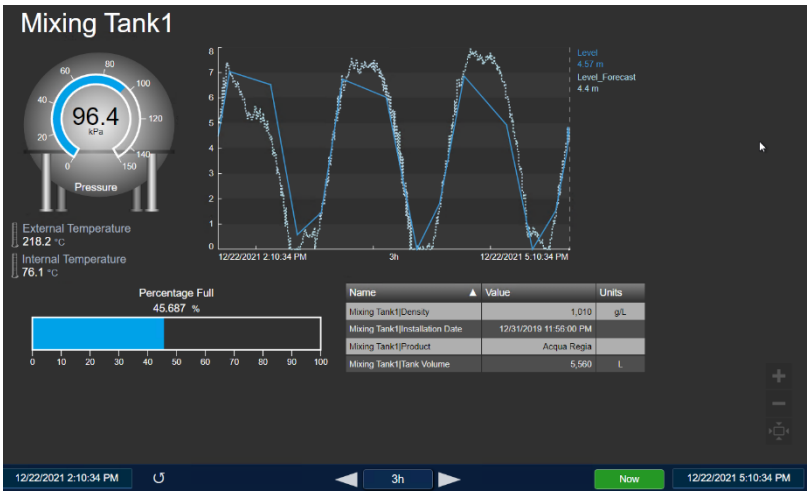
Approach

Step 1: Open the “*Tank General Overview <your initials>*” display if it is not already open. To open that display, go to the Home page by clicking AVEVA™ PI Vision™ on the top left corner and find the display called “*Tank General Overview <your initials>*”.

Step 2: Click on the start time. As soon as you click on it, the timestamp will change to "*-8h". This means is a relative time.



Step 3: Modify the Start Time to be "*-3h". You will notice that the data contained in the trend and the duration has changed.

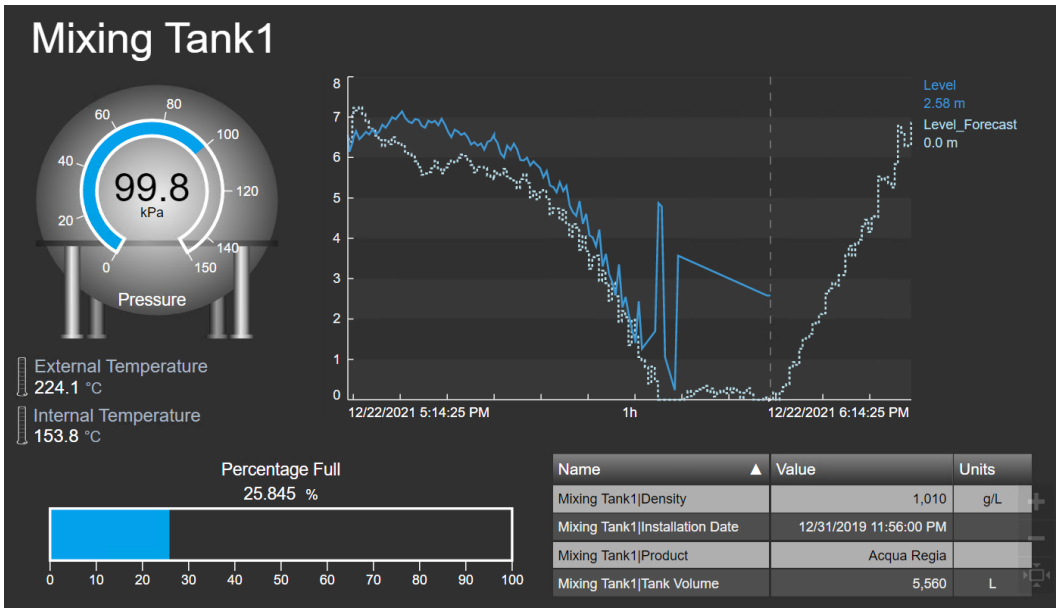


Step 4: Click on the duration button and select 1h (meaning 1 hour) and observe how the trend containing the level changes.

Step 5: Click on the arrow next to the duration button and observe how the start time, the end time and the trend change. These buttons shift the data forward or backward in time intervals to find the data of interest, in this case the interval is 1hr as configured in Step 4.

Step 6: Click on the now button and the check the end time and the start time updates every 5 seconds to show the current data, for all the values, because the end time has changed automatically to "*", which means "now".

Step 7: Change the End Time to be "*+15m". You will see that the Level Forecast in the trend is showing some data in the future. Notice that PI Vision is showing future data as it is doing with the historical data.



Step 8: Finally, click on the Revert display button to return to the original status.

4.3.13 Exercise – Monitoring all vital measurement

This solo or group activity is designed to maximize learning in a specific topic area. Your instructor will coach you if you need assistance during the activity. *Use your own data if you have access to such data.*

Objectives

- Search for data in PI Vision.
- Add symbols to a display in bulk.

Activity Description

Your manager in "Industrial Plants of The World" is interested in building a PI Vision display that shows all the vital measurements of the four tanks of OSIsoft plant in one place, for the past 4 hours until now.

Approach

Step 1: Build a PI Vision display including the following symbols for the key measurements of each of the four tanks:

	Measurement	Display Symbol
For both Mixing Tank1 and Storage Tank1	Internal and external temperatures	A single Trend
	Products	Table
	Asset Names	Values
Production Area	Asset Name	Values
Production Lines	Asset Names	Values

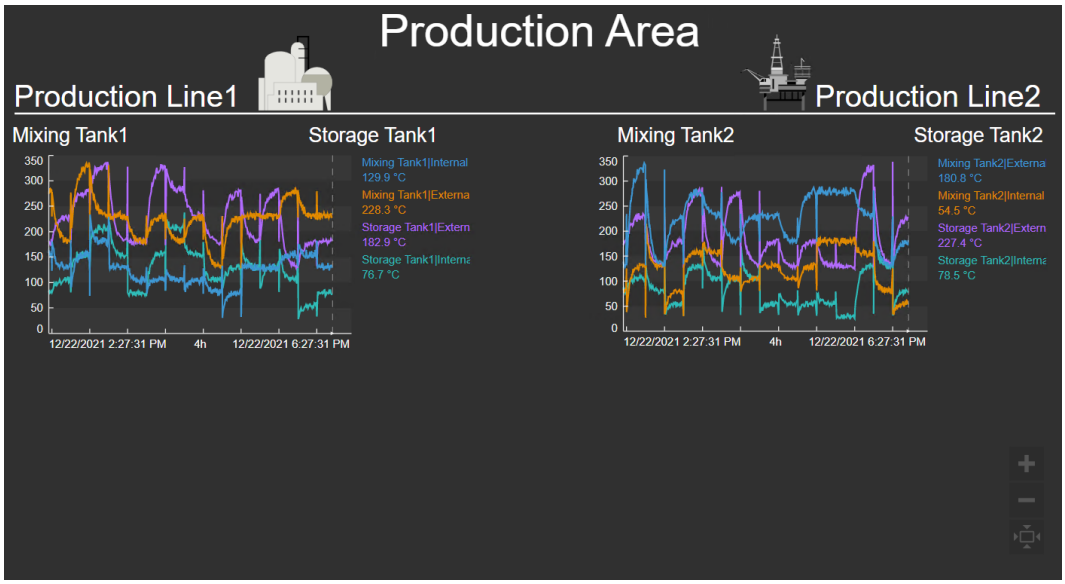
Step 2: Repeat the procedure for Production Line2

Step 3: Add shapes and images to complete the display (perform a quick Google search to find some images if needed)

Step 4: Change the start and end time of the display to the desired values mentioned above.

Step 5: Save your display as "*Production Area Dashboard <your initials>*".

An example of what the display might look like is shown below. There are many possible solutions – yours does not have to mirror it!



4.3.14 Keyboard shortcuts

PI Vision lets you use several keyboard shortcuts to accomplish your tasks faster.

Some useful shortcuts:

Press	Action
CTRL + C	Copy an object
CTRL + V	Paste an object
CTRL + X	Cut an object
DELETE or BACKSPACE	Delete an object
Arrow keys	Move an object
CTRL + Click	Select multiple objects
CTRL + A	Select all objects
SHIFT + Drag	Resize an object while maintaining its proportions
CTRL + Z	Undo an action
CTRL + Y	Redo an action
CTRL + S	Save a display

✔ Quick Check

Having completed this topic, are you able to:

- Search for data in PI Vision?
- Add symbols to a display?

If you answered NO to any of these questions, ask your instructor for assistance.

4.4 Features of PI Vision Displays

Now that the basic functionalities are clear, and you were able to create some displays it is time to get advantage of some of the useful features in PI Vision.

LEARNING OUTCOMES

- How to reuse displays using asset switching
- Configure visual alarms using Multi-states
- Displays scalability and collection
- Compare important assets using assets comparison tables and bar charts
- Manage time contexts in trends
- Correlational analyzes using XY plots

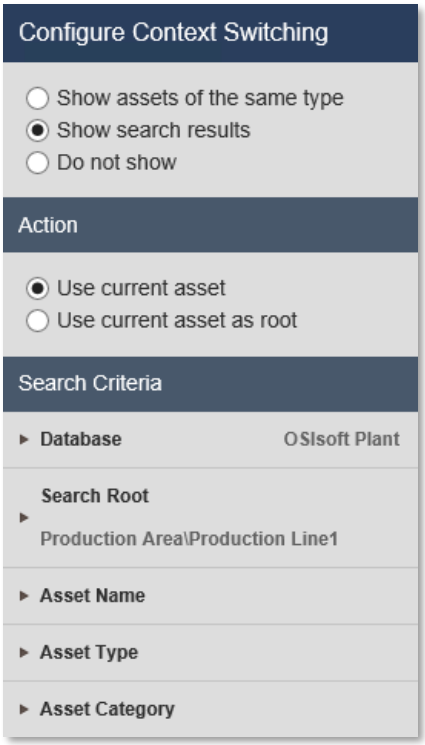
4.4.1 Reusing Displays for Multiple Assets

PI Vision automatically finds and shows all the assets that are related to the existing assets in a display. You can switch to these related assets to reuse displays. These related assets are assets that are built upon a **common** template.

Swapping the related assets is achieved by choosing the **Switch Asset** drop-down list 

and choosing a related asset from the list.

To configure which assets, appear in the asset list and other context settings, click **Configure asset context switching**. This will be examined in a later exercise.



4.4.2 Directed Activity – Reusing displays

You are invited to watch what the instructor is doing or perform the same steps at the same time.

Objectives

- Learn to reuse displays.

Activity Description

Your manager is totally pleased by the "*Tank General Overview <your initials>*" display. All the data is clear for the Mixing Tank 01, and the tank operators find it useful. Now your fictitious manager wants you to replicate the display for the rest of the tanks, but you tell him/her that there is no need thanks to the asset switching, but you need to get familiar with that.

Approach

Step 1: Go to the Home page by clicking AVEVA™ PI Vision™ on the top left corner.

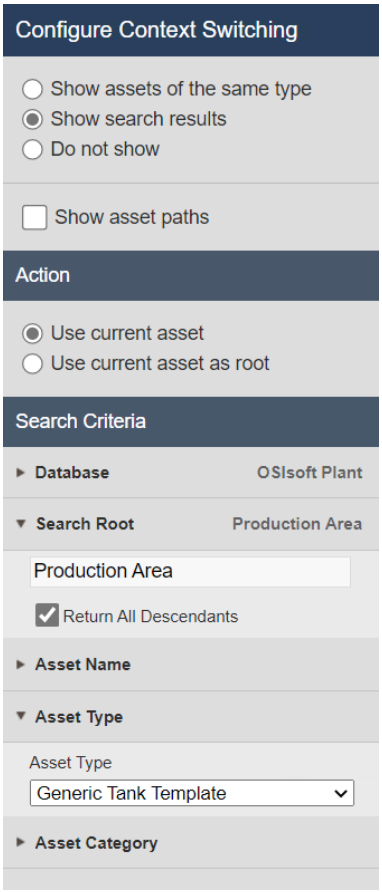
Step 2: Find the display called "*Tank General Overview <your initials>*" and double click on the Thumbnail.

Step 3: Have a look into the asset switching menu and check that shows Mixing Tank1.

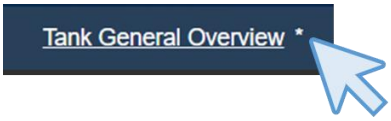
Step 4: Click on the arrow and switch between the tanks. Check that the values displayed of temperature, pressure, level… change when changing the Tank. Notice that, since we added the name of the tank as an AF attribute, it will change too.

Step 5: Click on the gear next to switch asset. A menu will appear on the right side.

Step 6: On the right menu, under the “Configure Context Switching” section select “Show search results” and uncheck “Show Assets paths”. Under the “Search Criteria section”, modify the Search Root to be “Production Area” and mark “Return All Descendants” (otherwise PI Vision will only browse the direct child of Production Area, which is Production Line 1 and 2, and it will not find the tanks). Modify also the “Asset Type” by selecting “Generic Tank Template” in the drop-down menu.



Step 7: After doing the changes in the “Configure Context Switching” menu, click anywhere outside the menu for it to close. If you look at the name of the display, there should be an asterisk next to the display name, indicating that some changes need to be saved. Click on the save icon (the asterisk next to the display name will disappear).



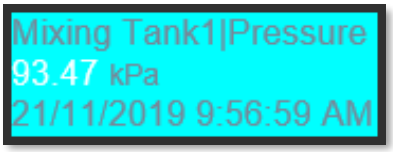
Step 8: Take a look at the asset switching menu, the four tanks should be listed (no path included).

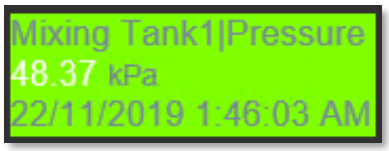
Discussion

- Why is the Context switching useful?
- What is needed to use this asset switching feature?
- Can we use this asset switching feature if the data displayed is coming from PI Points?

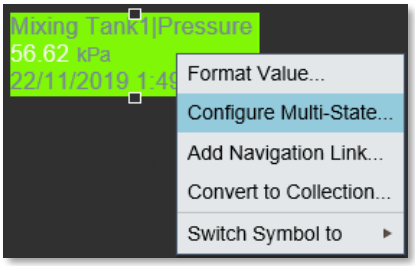
4.4.3 Multi-states

Multi-states behavior allows objects on the display to alter their color based on dynamic data values. Specific colors are assigned to ranges of values, corresponding to process states. When the value of a multi-state object enters the assigned range, its color will alter to indicate a change of state. Many display objects can be configured as multi-state symbols - text, graphics, values, gauges.

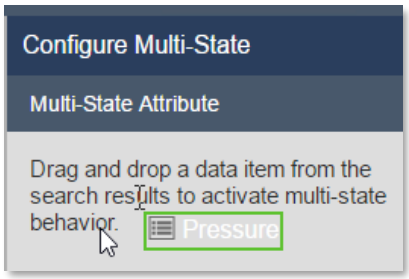




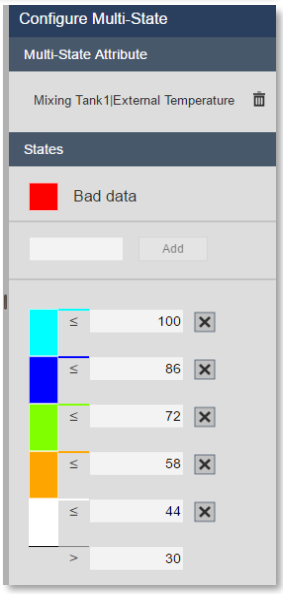
To add Multi-state behavior to a Value or Gauge symbol, right-click the symbol and select **Add Multi-State**. The attribute inside your symbol will now act as a trigger that will be associated with the multi-state behavior. If desired, the active attribute can be removed and replaced with a different attribute (example, your level gauge can have a multi-state based on whether a valve is open or closed).

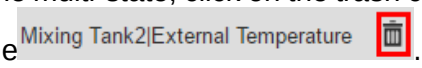


To configure multi-state behavior, right-click on the object and select **Configure Multi-State**. To trigger the multi-state with an alternate data item, find the item in the search results and drag it inside the top area of the Multi-State pane.



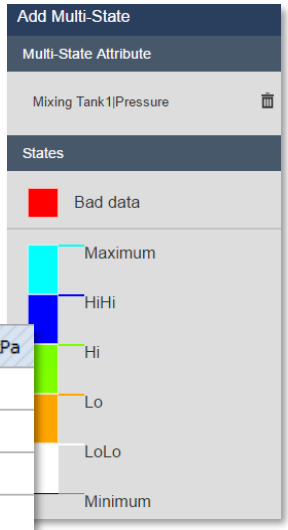
By default, the **Multi-State** pane contains five regular states, each assigned a different color. The **Bad data** state indicates when your value is either out of range or contains no data. The Bad data state can only be configured by a PI administrator, but any user can change its color. To modify the color of any state, click on it to open the color palette. In the color palette, you can also select **Blink** to call attention to the symbol. You can change the maximum value for any state in the value field. To add a new state, enter a maximum value in the empty top field and click **Add**. To remove a state, click **X** next to it.



To uncouple the attribute from the multi-state, click on the trash can icon at the top of the Multi-State pane 

.

Notice that you cannot change the Multi-State limits for Mixing Tank 1|Pressure



If the AF attribute has assigned Limits, then multi-state will use the limits defined in AF and the user will not be able to change them. The user will only be able to change the colors associated with each state. Pressure has been configured with AF Limits which are child attributes with the corresponding limits property:

Pressure		36.39988 kPa
	Hi	80 kPa
	HiHi	90 kPa
	Lo	20 kPa
	LoLo	10 kPa
	Maximum	100 kPa
	Minimum	0 kPa
	Target	50 kPa

For more information, see "Multi-state behaviors" and its related links in *PI Vision Installation and Administration Guide*.

4.4.4 Directed Activity – Add Multi-States to a gauge

You are invited to watch what the instructor is doing or perform the same steps at the same time.

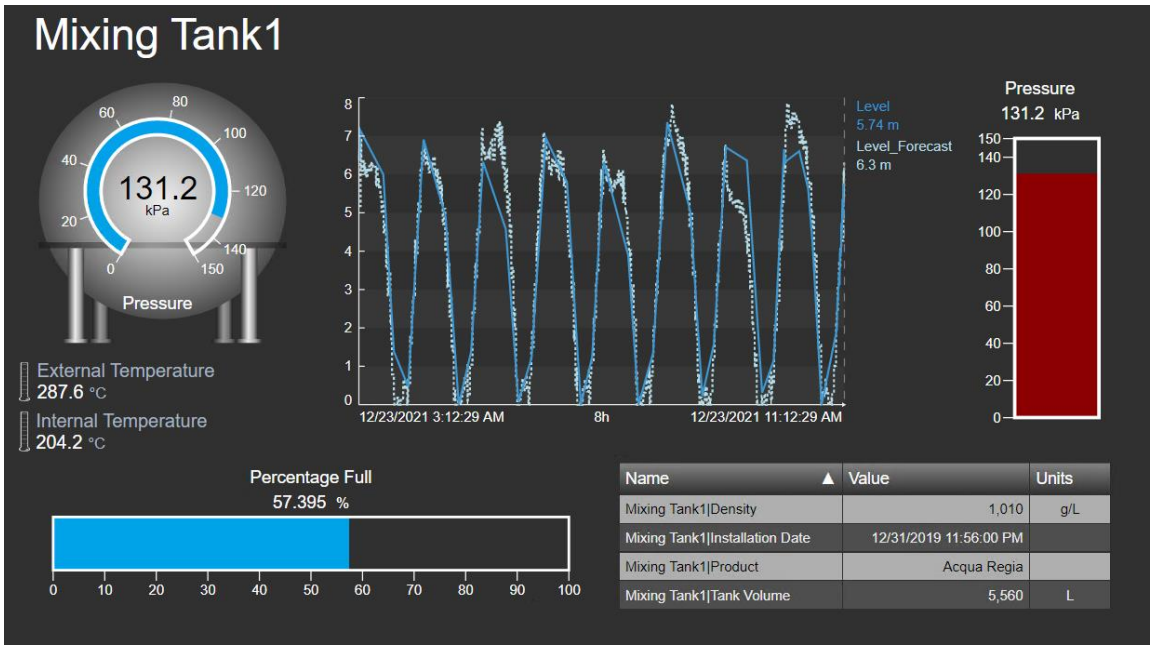
Objectives

- Add Multi-States to the display
- Multi-State Behavior

Activity Description

Your manager loved the dashboard you did that shows the temperature and the information about a tank, and she/he wants you to add a Vertical Gauge with the Pressure that changes its

color when reaching the different levels of pressure like Hi or Low. They are expecting something like this:



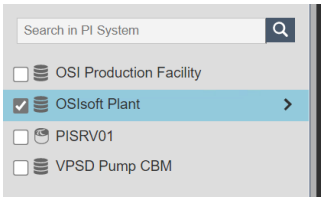
Approach

Step 1: If the display "*Tank General Overview <your initials>*" is not open please open it by going to the Home page and searching it. Once open click on the Design mode icon .

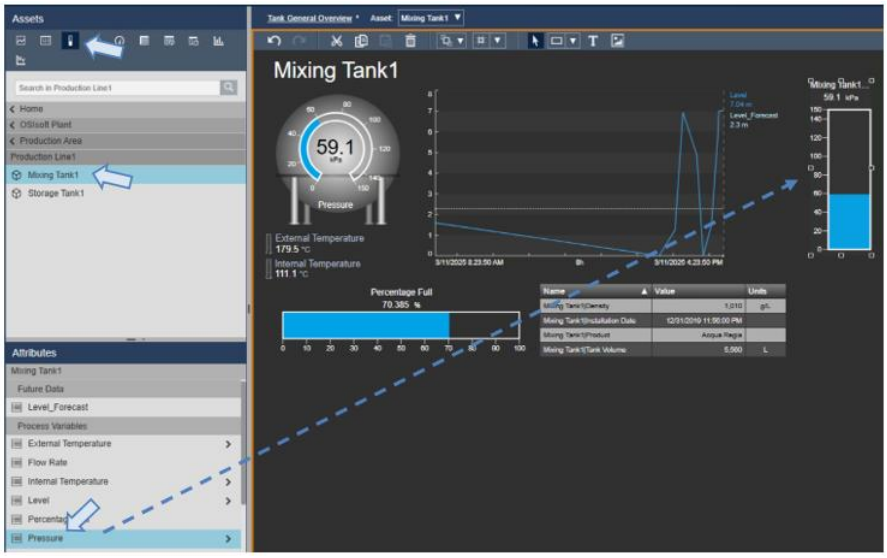
Step 2: Switch the asset to be Mixing Tank1.

Step 3: If the search and asset navigation pane is not open on the left side, click on the cube under the Home Page icon.

Step 3: Select the AF database named OSIsoft Plant if it is not already selected.

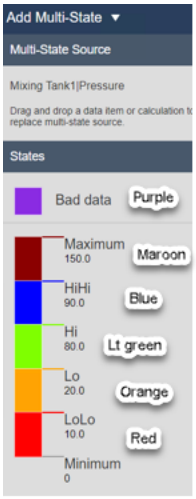


Step 4: Drill down to Mixing Tank1. Select the Vertical Gauge icon and drag the Pressure to the display area.



Step 5: Right click over the Vertical Gauge and select *Format Gauge*. Under *Visibility* change the label to show only *Pressure*.

Step 6: Right click again over the Vertical Gauge and select Add Multi-State. On the right pane click on the colorful squares next to levels to modify them as in the picture.



Step 7: Save the display and check that the vertical gauge changes its color if you switch the assets.

4.4.5 Directed Activity – Graphics and Multi-State Behavior in PI Vision

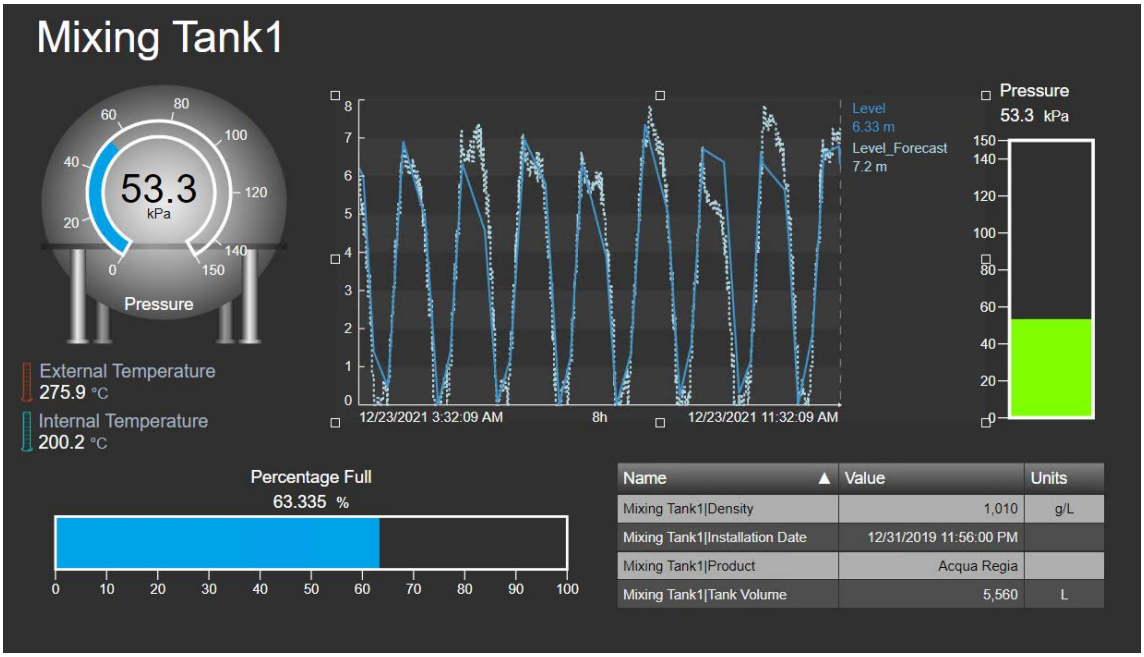
You are invited to watch what the instructor is doing or perform the same steps at the same time.

Objectives

- Add Graphics to the PI Vision display
- Add Multi-State behavior

Activity Description

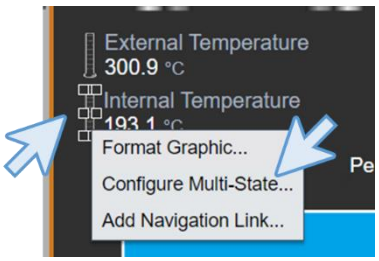
Since adding visual alarms with multi states, you ask your managers if they would like to have the thermometers next to the temperature changing the color depending on the temperature. They think it is a great idea and ask you to do it. The result should look like:



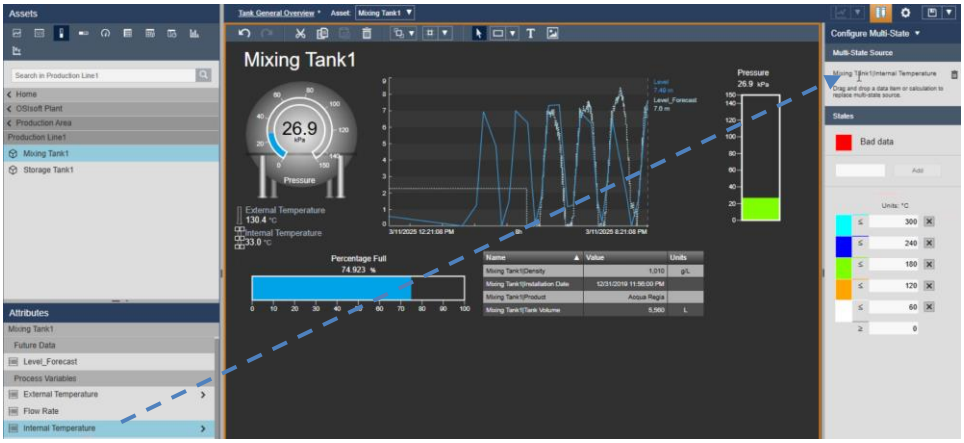
Approach

Step 1: If the display "*Tank General Overview <your initials>*" is not open in the design mode, please open it by going to the Home page and find the display called "*Tank General Overview <your initials>*". Click on the Design mode icon  .

Step 2: Right click over the thermometer icon text to the Internal temperature. Select “Configure Multi-State…”. A new pane will show up on the right side.



Step 3: Navigate back to the Asset pane  . If you are not seeing the Mixing Tank 1 attributes, drill down to it and find the internal temperature. Drag and drop the internal temperature to the right menu.



Step 4: Click on the colors to modify them as in the picture

Step 5: Do the same for the thermometer next to external temperature, but this time drag and drop the external temperature.

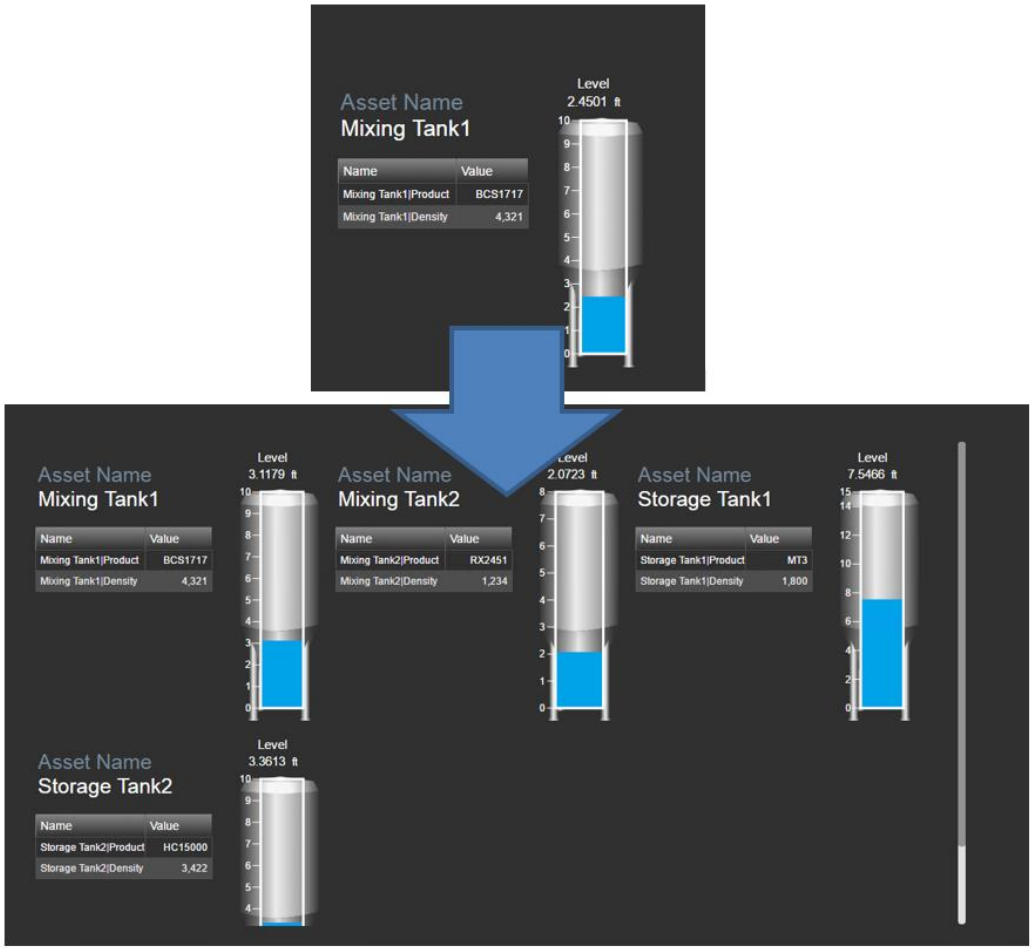
Step 6: Click on save.

4.4.6 Collections

Collections allow you to find and see all assets of the same type on the current display. With collections, you can choose one or more data symbols and automatically find and view their related assets and attributes on the same display, without having to search for each asset separately.

If, for example, there are ten tanks in one plant based on the same PI AF template, you can view the attributes of tank 1 and then convert them into a collection that shows those attributes for all ten tanks at the same time.

By changing the *collection search criteria*, you can then customize your collection to see only those assets whose parameters fall within a desired range, or which are in a specific state. The collection will update automatically as the parameters or state of the asset changes.



For more information, see "Understand symbol collections" and its related links in *PI Vision Installation and Administration Guide*.

4.4.7 Directed Activity – PI Vision Collections

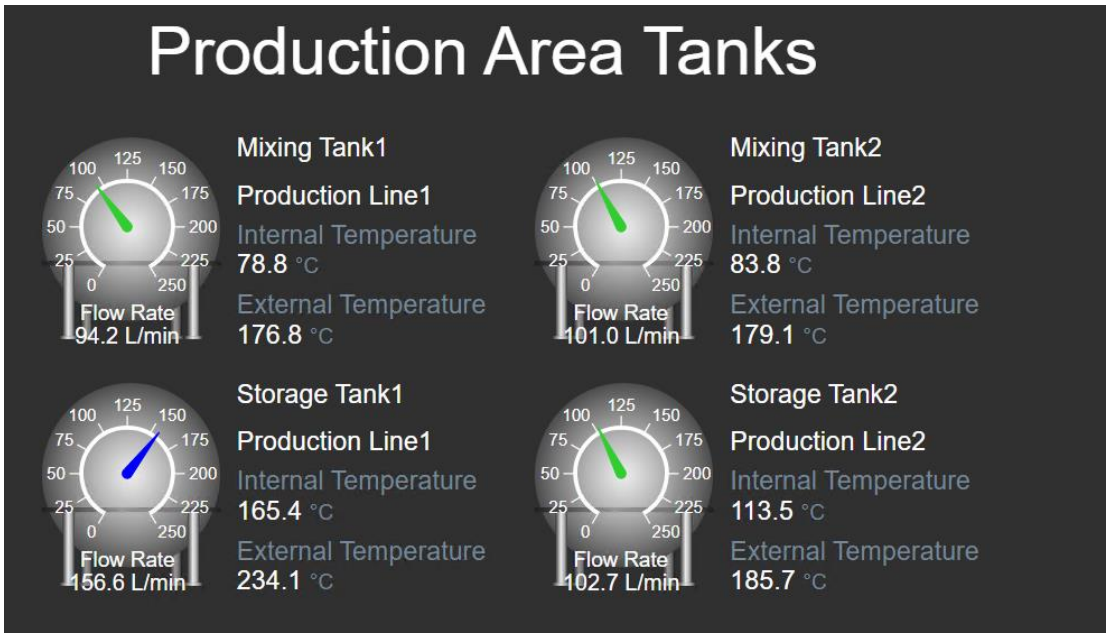
You are invited to watch what the instructor is doing or perform the same steps at the same time.

Objectives

- Create a Collection

Activity Description

The Production Area operators would love to see some important tank information in the same display, so they can have a general idea about how things are going. They know that so many attributes are going to be involved for so many tanks, so they think is going to be a difficult task. You have recently learnt about collection, so you let them know that they no need to worry and you will handle it. They are expecting something like:



Approach

Step 1: Create a new display with 

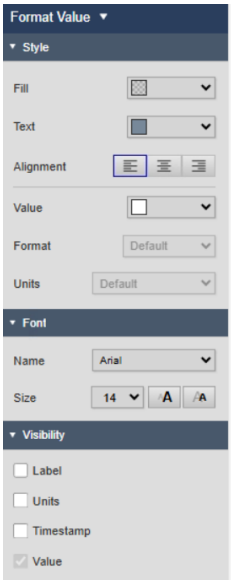
.

Step 2: Drill down through the hierarchy in the OSIsoft Plant AF database to find the Mixing Tank 1.

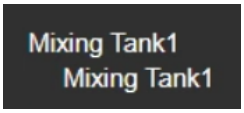
Step 3: Select the Value symbol 

, drag and drop the Asset name to the display.

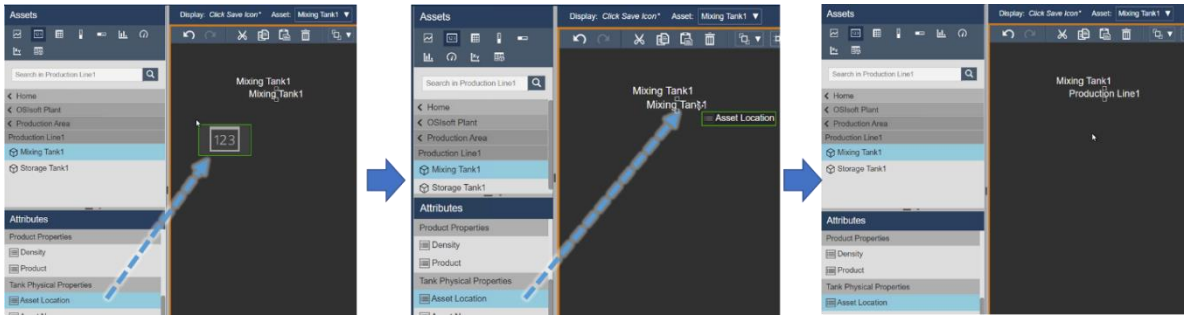
Step 4: Right click over the asset name and select Format Value. Change the font size to be 14 and remove everything from the visibility section but the Value.



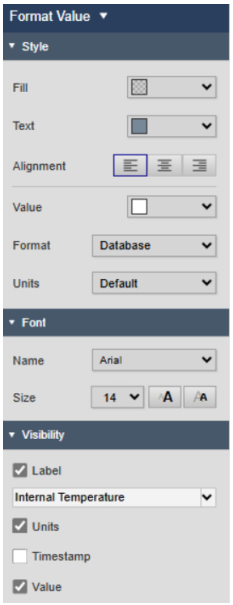
Step 5: Copy and paste the value “Mixing Tank1”.



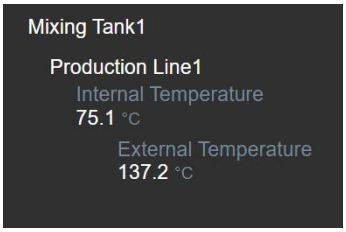
Step 6: Drag and drop over the copied text the asset location. If you do it correctly, when you put the mouse over Mixing Tank1, a green square with the name of the attribute will appear. Before appearing the name of the attribute, you will see the value symbol.



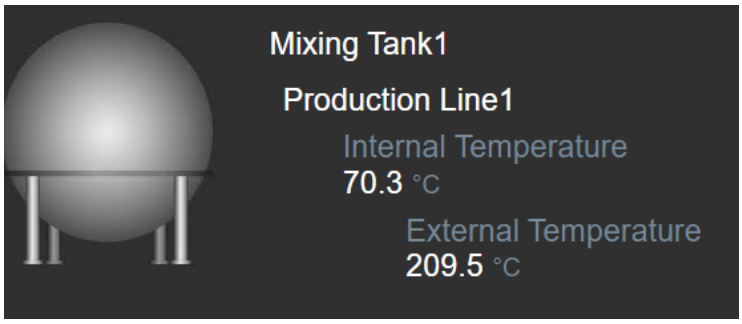
Step 7: With the Value symbol  still selected, drag and drop the internal temperature. Right click over the value and select Format Value. Increase the Font Size to be 14. In the Visibility section unmark the timestamp and change the label to be Internal Temperature.



Step 8: Do the same with the external temperature.



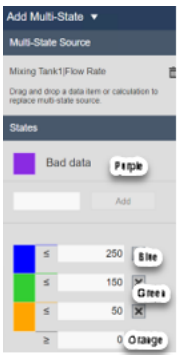
Step 9: Go to the graphic library  and select one of the tank symbols and drag and drop it into the display.



Step 10: Go back to the asset browsing pane by clicking the Asset pane  . Click on the radial gauge Symbol  and drag and drop the Flow Rate over the tank symbol.

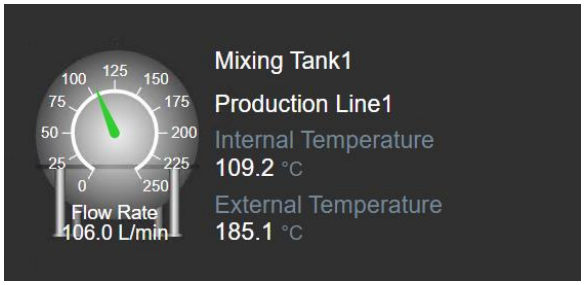
Step 11: Right click over the radial gauge and select Format Gauge. Under the visibility section select the label to be Flow Rate.

Step 12: Right click again over the gauge symbol and select “Add Multistate”. Remove the values 200 and 100 by clicking on the  next to them and change the colors to be like in the image.

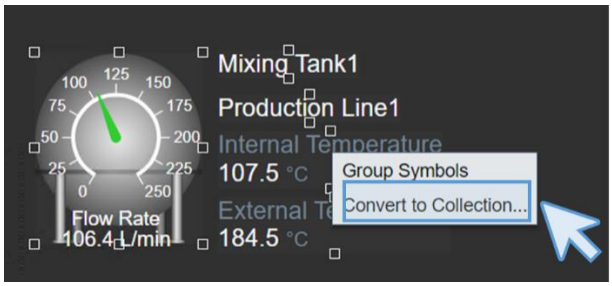


Step 13: It is time to save your display, click on the Save button  make sure to save it under the folder you created on Activity *4.2.3 – Create a display folder*. Name your display “*All Tanks <your initials>*”. Then click on Save. Remember to click in the Design mode icon to continue editing.

Step 14: Arrange all the symbols. Select the text and values and align them to the left. You should have at this point something like this.

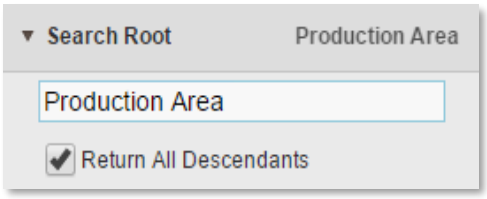


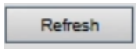
Step 15: Select all the symbols, do right click and "Convert to Collection..."



Step 16: Resize the collection canvas so the collection covers as much area as possible.

Step 17: Right click on the new collection and choose *Edit Collection Criteria*… Expand *Search Root* and enter **Production Area**; select the *Return All Descendants* checkbox.

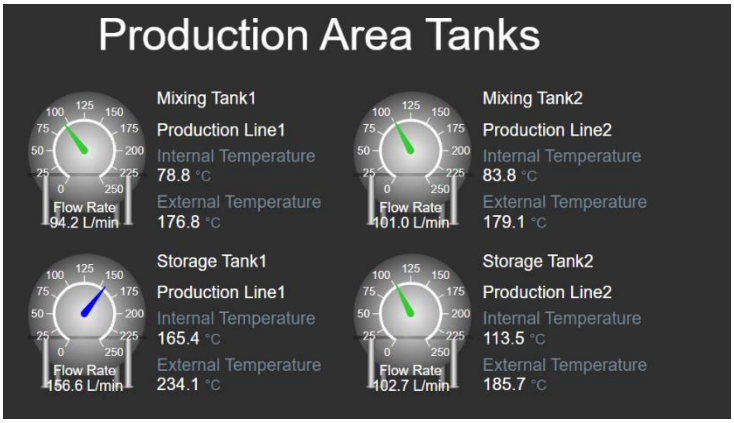


Step 18: Click on 

. You should be seeing all the tanks each one with its values as requested.

Step 19: Add the title **Production Area Tanks** using the Text Icon. Increase the size to 36.

Step 20: At this point you should have something like this:



Step 21: Click on save.

Discussion

- Can we create a collection using PI Point instead of AF attributes?
  - How do you create a collection?

4.4.8 Directed Activity – Modify and filter a Collection

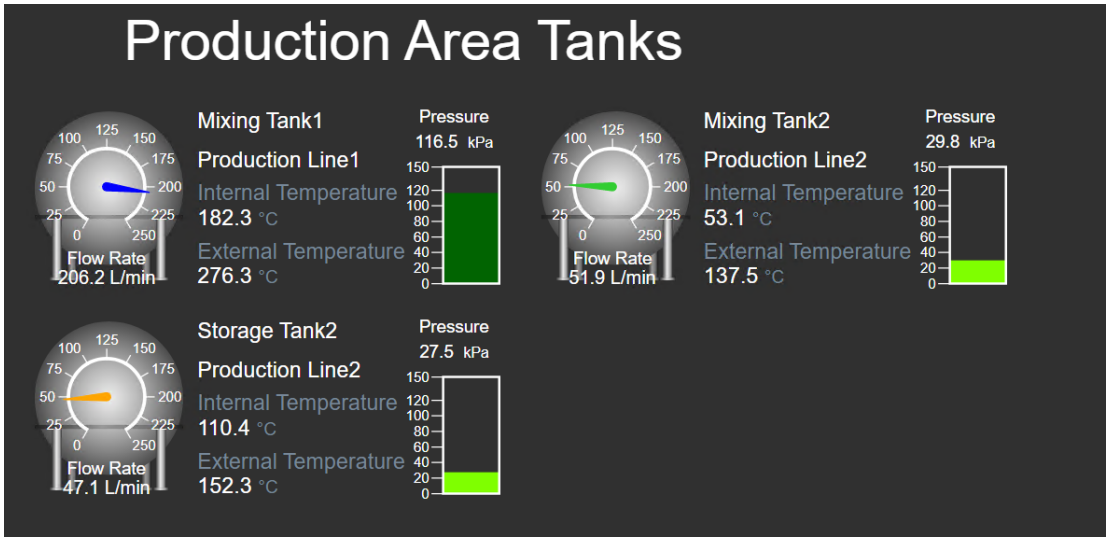
You are invited to watch what the instructor is doing or perform the same steps at the same time.

Objectives

- Modify collections
- Filter the showed values

Activity Description

The Production Area operators are so thankful for the display "*All Tanks <your initials>*". The have been using it for a while and they feel the display can be improved by including a vertical gauge to show the pressure and change the color depending on it. They are also interested in seeing only tanks with a flow rate over 50 L/min, because smaller flows means that the tank is not active. They are expecting something like:



Approach

Step 1: If it is not already open, open *All Tanks <your initials>*.

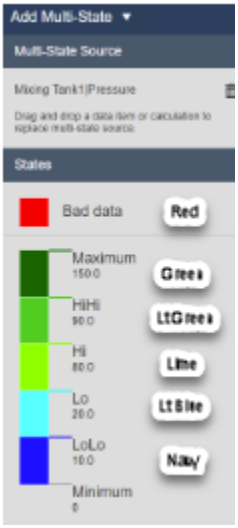
Step 2: If you are not in the design mode, click on the Design mode icon.

Step 3: Right click over the collection area and select *Modify collection*. You will see only the values for one of the tanks.

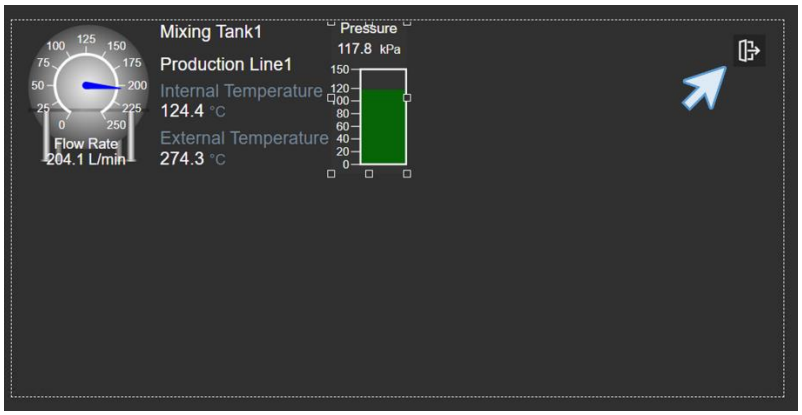
Step 4: Select the vertical gauge symbol  and drill down into the hierarchy to the Mixing Tank1. Then drag and drop the *Pressure*.

Step 5: If needed resize the vertical gauge and then right click over it. Select *Format gauge* and change the label to be *Pressure*.

Step 6: Right click again over the vertical gauge and select *"Add Multistate…"*. Modify the colors to fit the image.



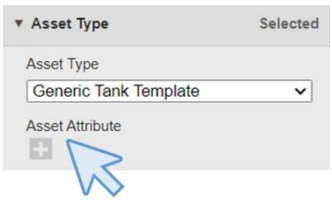
Step 7: Click in the small door on the top right corner of the collection area.



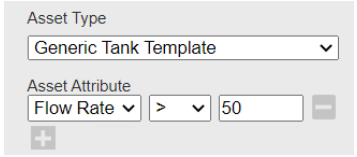
Step 8: Resize the collection canvas to see all the tanks and click on *Save*.

Step 9: Right click on the collection area and select *"Edit Collection Criteria…"*

Step 10: In the right pane, expand the asset type and click on the symbol.



Step 11: Under Asset Attribute select *Flow rate*, then select *">"* and write *"50"*.



Step 12: Click on 

. Now you should be seeing only the tanks with a flow rate over 50 L/min.

Step 13: Click on Save.

4.4.9 Asset comparison tables

Use an asset comparison table to compare measurements and other process information by organizing data by assets. Each asset has its own row. To include them in a display, use  .

Each column contains the asset's selected attributes or asset-based calculations. If an attribute stores a URL, then the cell becomes an active hyperlink, indicated by  .

A dynamic search criteria can be added to an asset comparison table to automatically find and show data from similar assets or asset-based calculations inside one table.

For more information, see "Asset comparison table" and its related links in *PI Vision Installation and Administration Guide*.

4.4.10 Directed activity – Create an asset comparison table

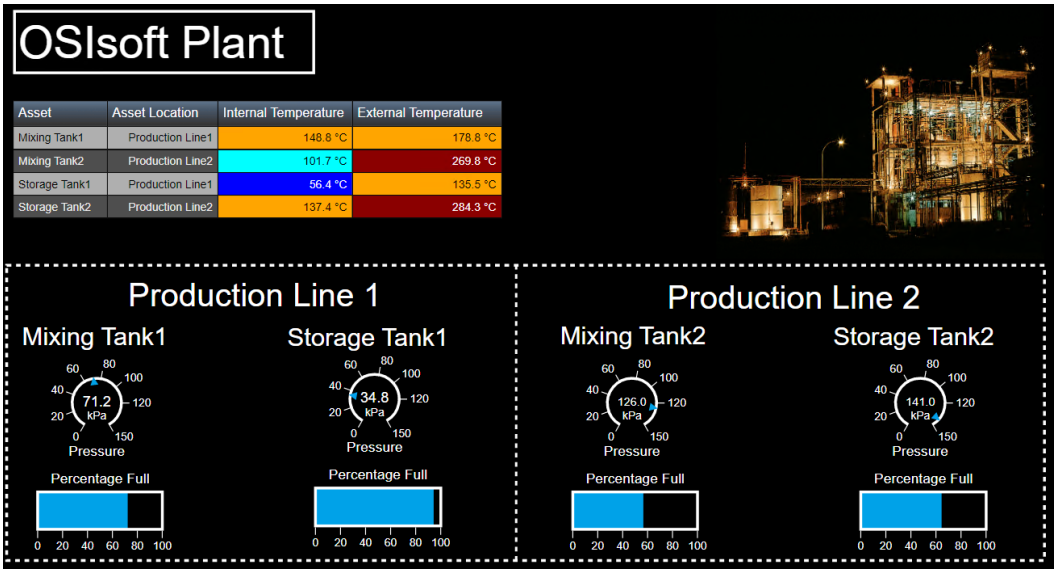
You are invited to watch what the instructor is doing or perform the same steps at the same time.

Objectives

- Create an asset comparison table
- Use the search criteria in the table
- Add multi-state in an asset comparison table

Activity Description

Your manager in "Industrial Plants of The World" is glad about your progress using PI Vision. He/she was expecting you to need weeks to prepare all the displays you have already created in some hours. Your manager now remembers that welcome display to the OSIsoft Plant, you created called "*OSIsoft Plant Overview <your_initials>*" that did not contain data. He/she wants you to add a table to that display with the following information for all the tanks: Name of the tank (asset name), asset location, External Temperature, and Internal Temperature. He/she also wonders if any visual alarm could be included for the temperatures. They are expecting something like:

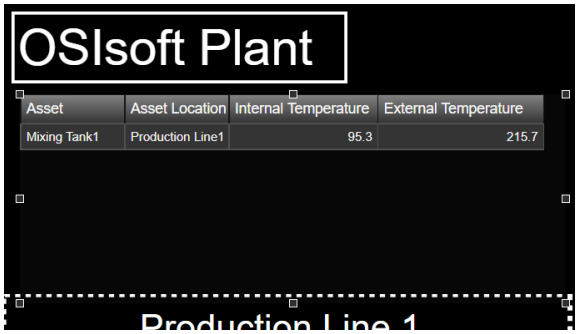


Approach

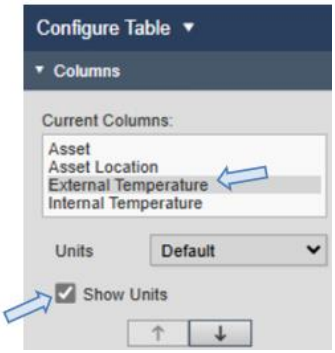
Step 1: If the display "*OSIsoft Plant Overview <your initials>*" is not open please open it by going to the Home page and searching it. Once open click on the Design mode icon  .

Step 2: Select the *asset comparison table* symbol  . Drill down in the Production area hierarchy to the Mixing Tank1. Select *Asset Location* and drag and drop it in the display area.

Step 3: Drag and drop over the table the *External Temperature* and the *Internal Temperature*. See how each attribute is added as a new column in the table. Increase the size of the table area to see the whole table. Increase the width of the columns to see the whole header.

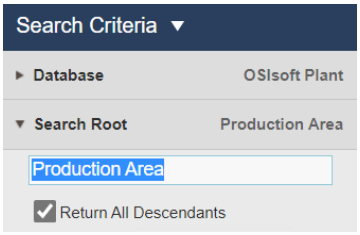


Step 4: Right click on the table and select *Configure Table…* A menu will appear in the right. In the *Columns* section you can add as many attributes as you want, but you have already in the table what you were requested. Click on the *External temperature* and click in *show units*. Do the same for the Internal Temperature.

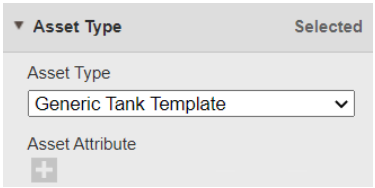


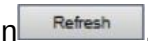
Step 5: In the style section select the grey and black table.

Step 6: Right click on the table area again and select *Add Dynamic Search Criteria*. In the menu expand the *Search root* section and modify it to be “Production Area”. Check the “Return All Descendants” box.

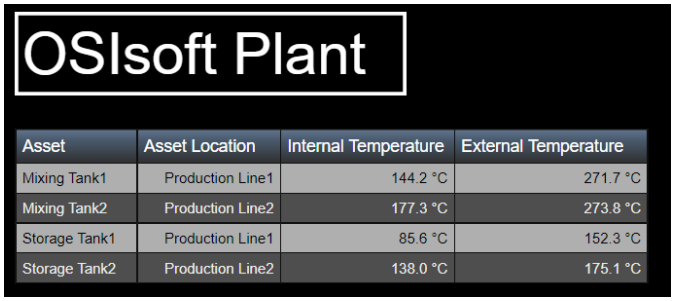


Step 7: Confirm under *Asset Type* that the “Generic Tank Template” is selected.



Step 8: Click on 

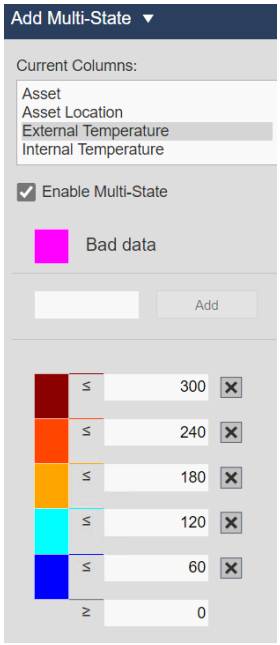
. Now you should be able to see the information for all the tanks. If not, increase the area of the table.



OSIsoft Plant

Asset	Asset Location	Internal Temperature	External Temperature
Mixing Tank1	Production Line1	144.2 °C	271.7 °C
Mixing Tank2	Production Line2	177.3 °C	273.8 °C
Storage Tank1	Production Line1	85.6 °C	152.3 °C
Storage Tank2	Production Line2	138.0 °C	175.1 °C

Step 9: Right click again on the table area and select *Add Multistate…* In the right pane, select the *External Temperature* and check the box "*Enable Multistate*" and modify the multistate colors as you wish.



Step 10: Do the same for the *Internal Temperature* (check the box "Enable Multistate" and modify the multistate colors as you wish).

Step 11: If you did this correctly, the table should look like this but with different colors.

Asset	Asset Location	Internal Temperature	External Temperature
Mixing Tank1	Production Line1	152.2 °C	282.4 °C
Mixing Tank2	Production Line2	180.7 °C	276.7 °C
Storage Tank1	Production Line1	81.5 °C	138.5 °C
Storage Tank2	Production Line2	130.0 °C	140.3 °C

Step 12: Click on save.

4.4.11 Exercise – Create a dynamic dashboard to Monitor the Tank temperature

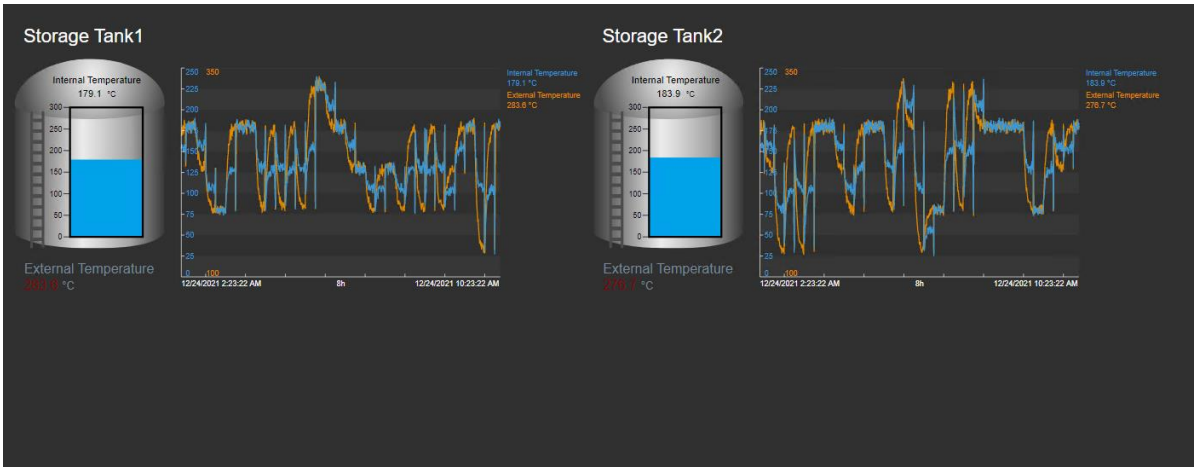
This solo or group activity is designed to maximize learning in a specific topic area. Your instructor will have instructions and will coach you if you need assistance during the activity.

Objectives

- Create a PI Vision dashboard using dynamic symbols.
- Use the collection feature

Activity Description

The Production Area operators love the finished display "*All Tanks <your initials>*" but now they have a new request for you. The operators would like to see only tanks that are overheated at any given time (Internal Temperature > 150°C). They are expecting something like:



Approach

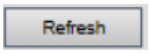
Step 1: Build a PI Vision display including the following symbols From Production Line2, Mixing Tank2, utilizing the Collection symbol:

	Measurement	Display Symbol
Collection	Asset Name	Value
	Tank	Graphic
	External Temperature	Value (Multi-State Use default values but change colors)
	Internal Temperature	Gauge
	Internal Temperature	Trend
	External Temperature	

Step 2: Select all components and Convert them to Collection.

Step 3: At the *Edit collection criteria* configuration panel go to the *Search Root* section, make sure the Search Root is Production Area and select *Return All Descendants.* Make sure the *Asset Type* is *Generic Tank Template*.

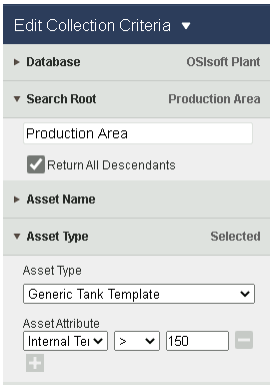
Step 4: In the *Asset type* section add an *Asset attribute* to show overheated tanks (Internal Temperature > 150°C).

Step 5: Click on 

.TIP: If no data is displayed, change the greater than symbol (>) to the not equal to (≠) symbol and click on Refresh one more time.

a. How many tanks were overheated at 8am today? _____

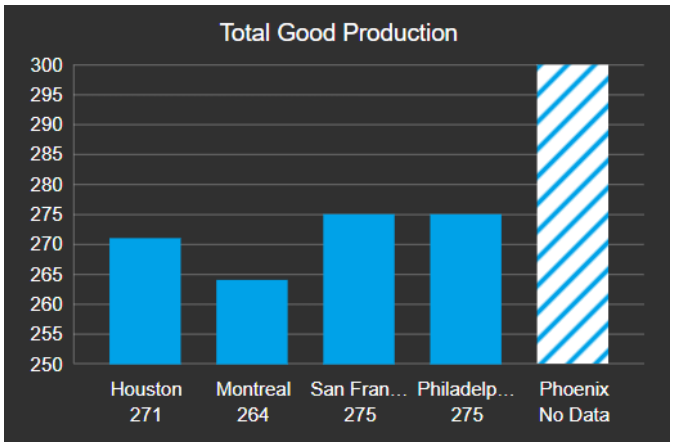
b. How many tanks were overheated at noon yesterday? _____



Step 5: Save your display as *Tank Temperature Dashboard <your initials>*

4.4.12 Bar Charts

The bar charts are meant to compare multiple values through graphical representation. Bar charts are often used to compare multiple data sources, where one bar represents one data asset.



To add a bar chart to a display, select the bar chart symbol from the Symbol Gallery and then drag a data item from the search results onto the display. The image shows a sample bar chart.

Hover your mouse over each bar to see the label, value, units, and time for the data source associated with that bar. When you resize the chart, the bars and the spaces between them adjust automatically.

The bar chart does not require configuration, but you can use the options available in the *Configuration pane* to customize the chart:

- **Orientation**: The default orientation is vertical, but you can change it to be horizontal.
- **Scale:** Data values on a bar chart appear within a range of values that is referred to as the scale. The scale indicates the highest high and lowest low values of the data items. The scale defaults to the maximum and minimum values of the combined database settings. At each scale value, a vertical grid line extends across the plot area.
- **Multi-state:** When you enable multi-state, there are five (5) equally spaced ranges for numeric values. The range of numeric values for a multi-state chart defaults to the same numeric range as the value scale. You can use the options available in the Multi-state Configuration pane to customize the chart. The display author can select whether to apply the multi-state definition to the bars or to define colored bands on the background of the bar chart.
- You can also adjust: **Style, Font** and **Visibility.**

For more information, see "Bar chart" and its related links in *PI Vision Installation and Administration Guide*.

4.4.13 Directed activity – Add a bar chart to a display

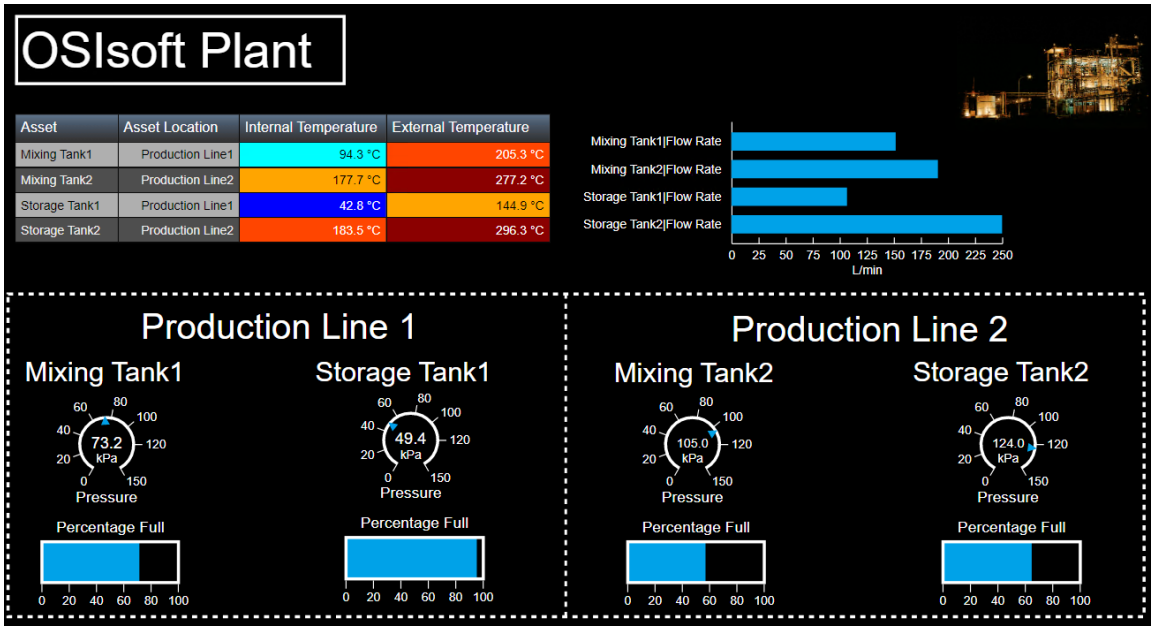
You are invited to watch what the instructor is doing or perform the same steps at the same time.

Objectives

- Create a bar chart
- Use the search criteria in the bar chart

Activity Description

Your manager in “Industrial Plants of The World” is glad about your progress using PI Vision. The look of the display “*OSIsoft Plant Overview <your_initials>*” after adding the table was impressive to your manager and he/she wants you to add a bar chart containing the flow rate of the different tanks next to the table. They are expecting something like:



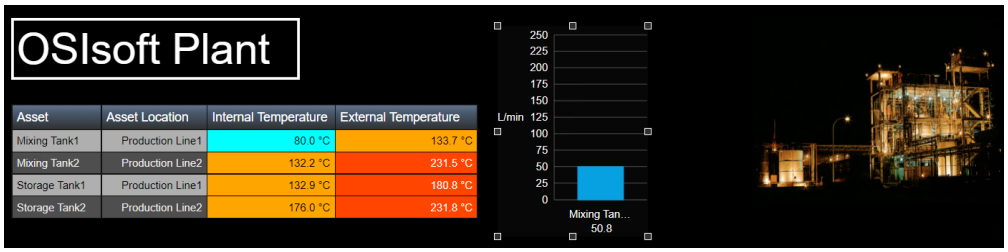
Approach

Step 1: Go to the PI Vision Home page and open the “*OSIsoft Plant Overview <your initials>*”.

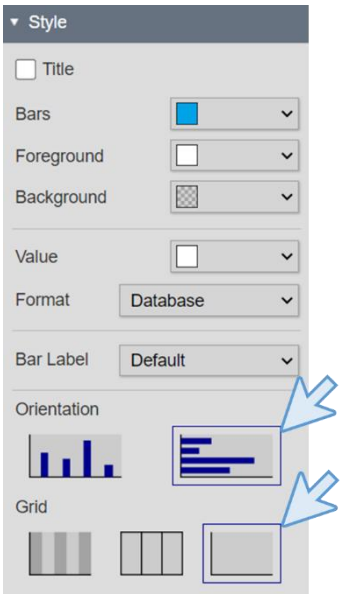
Click on the Design mode icon  .

Step 2: If the asset browsing pane is not open, click on the Asset pane  .

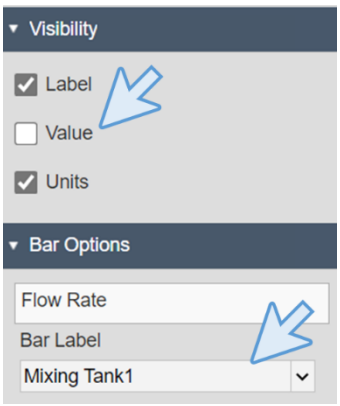
Step 3: Select the bar chart symbol  . Drill down in the Production area hierarchy to the Mixing Tank1. Select *Flow rate* and drag and drop it in the display area. Resize the bar chart to fit in the empty space, you may want to resize the plant picture as well.



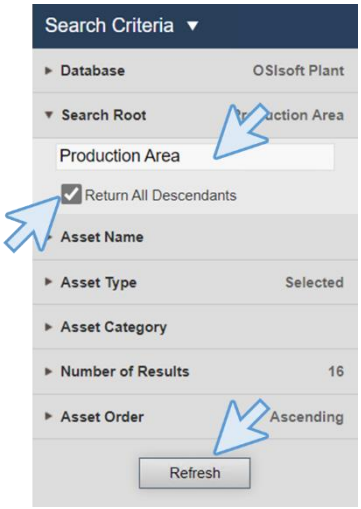
Step 4: Right click on the bar chart. Select *Format Bar chart...* Select the horizontal orientation and the plain grid under the Style section.



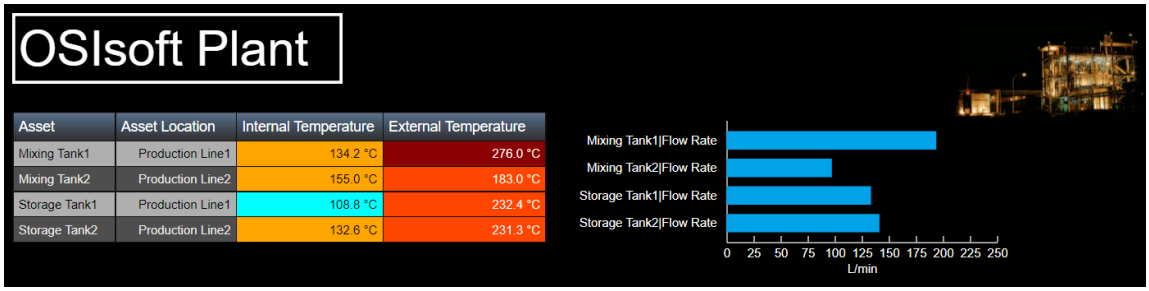
Step 5: Under the *Visibility* section uncheck *Value* and under the *Bar Options* section Select the *Bar label* to be Mixing Tank1.



Step 6: Right click on the bar chart and select *Add Dynamic Search Criteria*… On the right menu, modify the *Search root* to be *Production Area* and check the Return All Descendants checkbox. Click on Refresh.



Step 7: Resize the bar chart and click on save.



4.4.14 Multiple Time Context Trends

The Start and End Time of a trend can be configured for all the trends individually. For each trend there are three options:

Display time range

Set the trend time range to what is configured for the overall display. Trends configured with the Display time range option update when you change the display time. Conversely, changing the trend's time range by panning or zooming the trend will also update the display time.

Duration and Offset

Set the time range for the data displayed in the trend and the offset from the overall display's end time. Trends configured with the Duration and Offset option update when you change the display time. Updating the time range for a trend configured with the Duration and Offset option by panning or zooming the trend detaches it from the display's time.

Use custom time range

Set a custom start time and end time for the trend. Relative PI Time is also acceptable. Trends configured with the Use custom time range option do not update when you change the display time.

For more information, see "Trend" and its related links in *PI Vision Installation and Administration Guide*.

4.4.15 Directed activity - Monitoring assets in different Time with Trends

You are invited to watch what the instructor is doing or perform the same steps at the same time.

Objectives

- Learn how to use multiple time context trends.

Activity Description

The Production Area workers like to compare the temperature of the tanks in the same period of time from yesterday and today. They know they can use the time bar to see the data from different periods, but it would be useful if they could see the data for the same period of

yesterday and today at first sight. Having a trend with all the data of the last 48 hours would be helpful too. They are expecting something like:

Approach

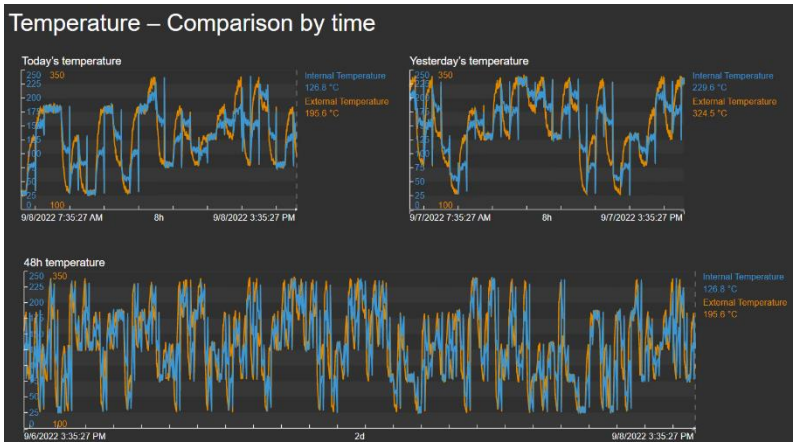
Step 1: Go to the PI Vision homepage and create a new display with 

.

Step 2: Click on the Text Icon  and enter the text "*Temperature – Comparison by time*". Increase the font size to 24.

Step 3: Select the Trend symbol  . Drill down through the hierarchy in the OSIsoft Plant database to find the Mixing Tank 1. Drag and drop the *Internal Temperature* and *External Temperature* to the display.

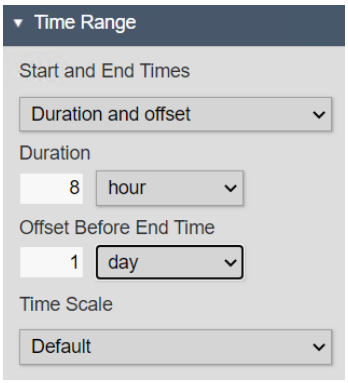
Step 4: Copy and paste the trend symbol twice. Resize and arrange the tree trends until you have something as in the image. Remember you can arrange them using the arrange icon  All of them are showing the same time context yet.



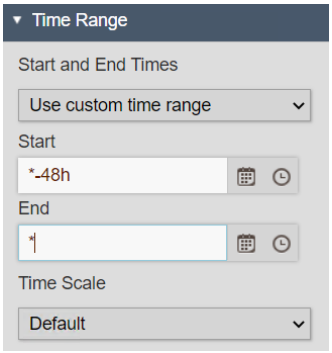
Step 5: Save the display as "*Tank Temperature – Comparison by time <your_initials>*", make sure to save it under the folder you created on Activity *4.2.3 – Create a display folder*. Click on the design mode icon  to continue editing.

Step 6: Right click on the **top left trend** and select *Configure trend.* Under the *Trend options* section check the *Title* box and write "**Today's temperature**".

Step 7: Right click the **top right trend** and select *Configure trend*. Under the *Trend options* section check the *Title* box and write "**Yesterday's temperature**". Under the *Time Range* section for *Start and End Times* select "Duration and offset" fill the d*uration* box to be 8 hours and the *Offset before end time* to be 1 day.



Step 8: Right click in the **bottom trend** and select *Configure trend*. Under the *Trend options* section check the *Title* box and write "**48h temperature**". Under the *Time Range* section for *Start and End Times* select "Use custom time range". Fill the *Start* box to be "*-48h" and the *End* box to be "*".



Step 9: Click on save.

Step 10: Turn off the display edition by clicking on the design mode icon  .

Step 11: Click on the trends to create trend cursors and check specific values in specific times.

4.4.16 Exercise – Displaying trends with different times

This solo or group activity is designed to maximize learning in a specific topic area. Your instructor will have instructions and will coach you if you need assistance during the activity.

Objectives

- Create trends with different time ranges

Activity Description

Your manager loved the display you built with multiple times for the temperature, and he/she thinks it is a good idea to do something similar with the flow rate. He/she ask you to display an 8-hour trend, a 24-hour trend and a 7-day trend on the same display, to have something like this:

Approach

Step 1: Go to the PI Vision homepage and create a new display with 

.

Step 2: Click on the Text Icon  and enter the text "*Flow Rate – Comparison by time*". Increase the font size to 24.

Step 3: Save the display as "*Tank Flow Rate – Comparison by time <your_initials>*", make sure to save it under the folder you created on Activity *4.2.3 – Create a display folder*. Click on the design mode icon  to continue editing.

Step 4: Select the Trend symbol  . Drill down through the hierarchy in the OSIsoft Plant database to find the Mixing Tank 1. Drag and drop the *Flow Rate* to the display.

Step 5: Copy and paste the trend two times.

Step 6: Right click on the **first trend** and select *Configure trend.*

a. Under the *Trend options* section check the *Title* box and write "**8 hours Flow Rate**", select *Lines* in the *Grid* option.

b. Under the *Value scale*s section, select the scale label to be outside the plot area.

Step 7: Right click the **second trend** and select *Configure trend*.

a. Under the *Trend options* section check the *Title* box and write "**24 hours Flow Rate**", select *Lines* in the *Grid* option.

b. Under the *Value scale*s section, select the scale label to be outside the plot area.

c. Under the *Time Range* section for *Start and End Times* select "Use custom time range". Fill the *Start* box to be "*-24h" and the *End* box to be "*".

Step 8: Right click the **third trend** and select *Configure trend*.

d. Under the *Trend options* section check the *Title* box and write "**7 days Flow Rate**", select *Plain* in the *Grid* option.

e. Under the *Value scale*s section, select the scale label to be outside the plot area.

f. Under the *Time Range* section for *Start and End Times* select "Use custom time range". Fill the *Start* box to be "*-7d" and the *End* box to be "*".

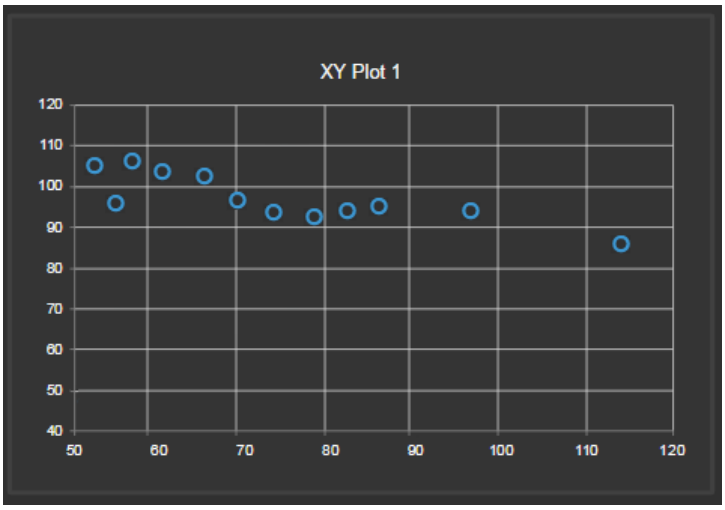
Step 9: Click on Save.

Symbol Enhancements

- Outside Scales on Trend: Display the Y-axis value scale outside of the trend plot area to improve data visibility.
- Configurable Grid Style on Trend: Use two additional grid styles for blank grid and horizontal/vertical gridlines.
- Data Markers on Trend: Use newly added trace styles to see data markers for recorded values on your trend and configure the marker visibility and shape for each trace.

4.4.17 XY Plots

The XY plot correlates one or more X-axis data sources with one or more Y-axis data sources. On an XY plot, each axis shows possible values from their respective data sources. The plot matches recorded values from the X-axis data source with recorded values from the Y-axis data source and marks each matched pair with a data point. For example, the following image shows a basic XY plot.



The example shows 10-minute intervals of two data items, A and B, for the last hour. Item A had 12 recorded values; item B had 16 recorded values. The number of plotted data points equals the number of pairs. Since A had fewer recorded values, the plot shows only 12 data points. PI Vision ignores the extra recorded values from point B. You can configure the method to pair values.

Correlation measures the strength of the relationship between two variables. The plot indicates correlation by the spread of the data points around a fitted straight line (for example, a straight line that indicates the trend of the data). In general, the closer the points are to the fitted line, the stronger the correlation. The following plot shows perfectly correlated data.

For more information, see "XY plot" and its related links in *PI Vision Installation and Administration Guide*.

4.4.18 Directed activity – Analyzing correlation between assets

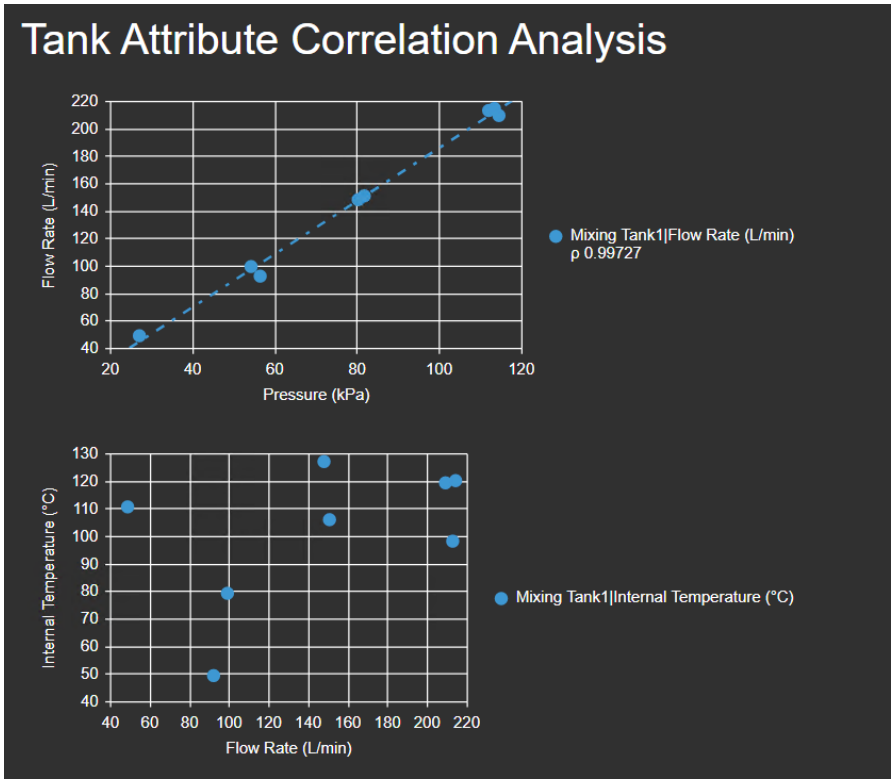
You are invited to watch what the instructor is doing or have a go yourself.

Objectives

- Create a PI Vision XY Plot.

Activity Description

You listen the analysis team in “Industrial Plants of The World” talking about a possible correlation between Flow and Pressure in the tanks and between Pressure and Internal temperature. You anticipate your manager will request a display to analyze that for the tanks, so you decided to start working on that and you think the display should be like this:



Approach

Step 1: Create a new display with 

.

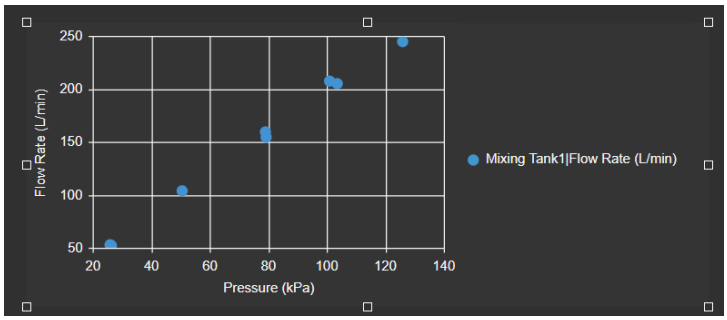
Step 2: Click on the Text Icon  and enter the text “Tank Attribute Correlation Analysis”. Increase the font size to 24.

Step 3: Select the XY plot symbol  .

Step 4: Drill down through the hierarchy in the OSIsoft Plant database to find the Mixing Tank 1.

Step 5: Select the *Flow rate* and the *Pressure* while pressing CTRL (remember that to select two attributes at the same time you only need to press CTRL while clicking over them).

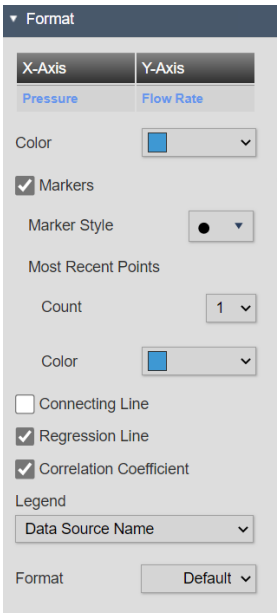
Step 6: Drag and drop the *Flow rate* and the *Pressure* to the display. The XY Plot may look like the picture.



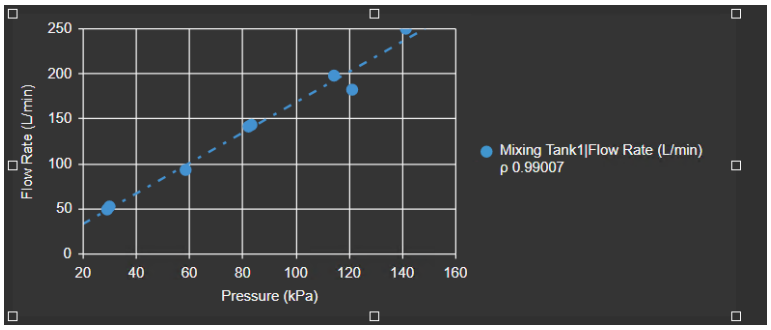
Step 7: Let's add a **Regression Line** and **Correlation Coefficient** by right clicking on the XY and selecting *Configure XY Plot*. This is because based on your observations, you see a relationship between *Flow Rate* and *Pressure* of the mixing tank.

Step 8: On the right menu expand the *Format* section.

Step 9: Select Regression Line and Correlation Coefficient.



Step 10: Your plot may look something like the picture. You are pleased with your initial plot and the correlation between the attributes. For the Correlation coefficient, the closer to 1 the better the correlation.



Step 11: Save the display as "*Tank Attribute Correlation Analysis <your initials>*", make sure to save it under the folder you created on Activity *4.2.3 – Create a display folder*. Click on the design mode icon  to continue editing.

Step 12: Check if the the XY plot symbol is selected, if not, select it  .

Step 13: Select the *Flow rate* and the *Internal Temperature* while pressing CTRL.

Step 14: Drag and drop the *Flow rate* and the *Internal Temperature* to the display. This time you do not see any correlation so there is no need add a regression line.

Step 15: Save the display.

4.4.19 Time series table

This dynamic symbol is available starting from PI Vision 2024. The time series table symbol will show the values of a data item arranged sequentially along with their timestamps.

The value that appears in this symbol is the reading that is obtained for a data item, shown as a number, timestamp, string, or digital state. If the data item stores a URL, then the symbol shows an active hyperlink in the display. When the underlying data updates, this symbol updates at the next update interval (default 5 seconds).

Can be configured to show fixed number of values, supports multi-state configuration.

Administrators can set the default configuration for time series table symbols across all displays.

For more information, see "Time series table" and its related links in *PI Vision Installation and Administration Guide*.

4.4.20 Directed Activity – Creating a Time Series table

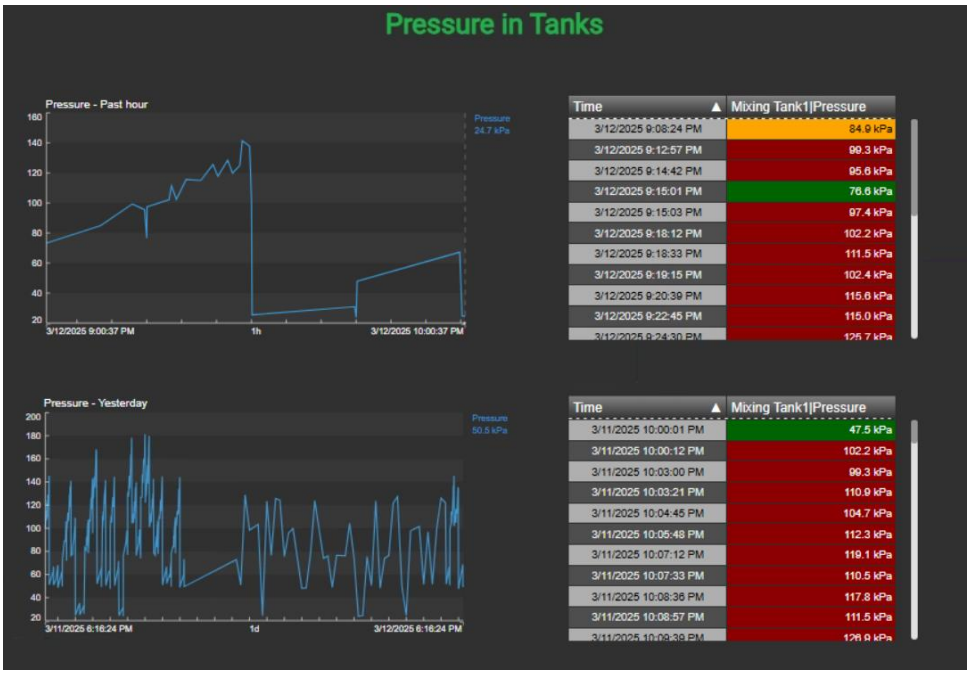
You are invited to watch what the instructor is doing or perform the same steps at the same time.

Objectives

- Create a time series table
- Use the Multi-state feature in the Time series table

Activity Description

Your manager in "Industrial Plants of The World" is glad about your progress using PI Vision, he has now asked you to create a display to monitor how the *Pressure* in the tanks behave yesterday and over the past hour. He needs something like the following image:



Approach

Step 1: Create a new display with 

.

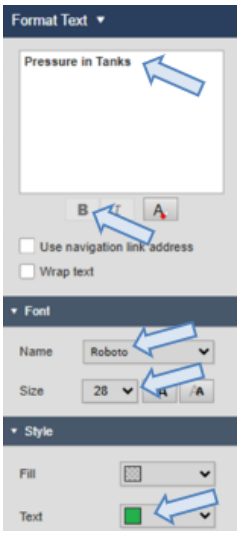
Step 2: Click on the Text Icon  and enter the text “Pressure in Tanks”.

a. Select the *Bold* option.

b. Change the font to be *Roboto.*

c. Increase the font size to *28*.

d. Change the text color from white to green.



Step 3: Save your display by clicking on the Save button  , select the folder you created on Activity *4.2.3 – Create a display folder*. Name your display “*Pressure monitoring <your initials>*” and finally click on *Save*. To continue editing the display click on the *Design mode* icon  .

Step 4: In the assets list, drill down through the hierarchy in the OSIsoft Plant database to find the Mixing Tank 1.

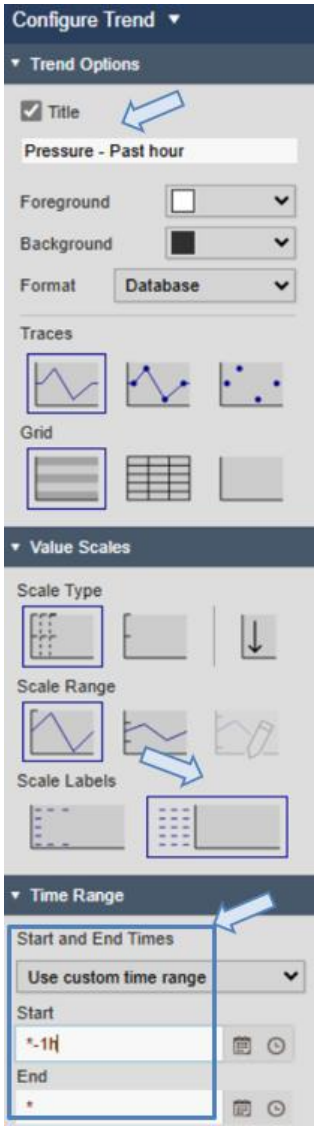
Step 5: Select the *Trend* symbol and then drag and drop the *Pressure* in the display.

Step 6: Right click the Trend and select *Configure Trend:*

a. Select the *Title* checkbox and enter *Pressure – Past hour*

b. In the *Value scales* section, select the *Scale labels* to be *Outside plot area.*

c. In the *Time Range* section, select *Use custom time range.* Fill the *Start* box to be "*-1h" and the *End* box to be "*".



Step 7: Copy the Trend created in **Step 6**, then right click the copied trend and select *Configure table*:

a. Change the *Title* to be *Pressure – Yesterday*

b. In the *Time Range* section, change the value in the *Start* box to be "y" and the *End* box to be "t".

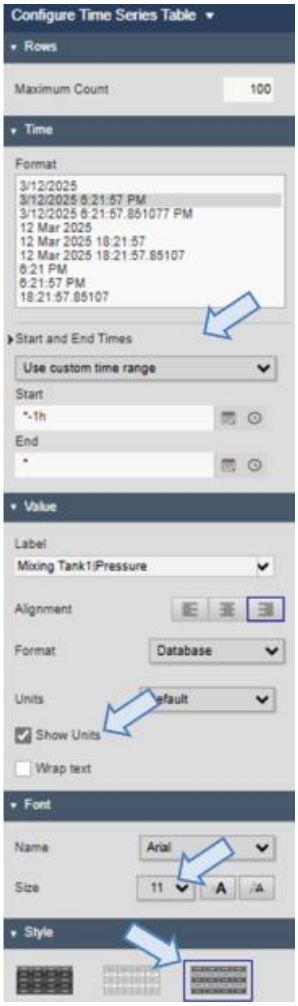
Step 8: Select the Time series table symbol  , then drag and drop the *Pressure* in the display. Adjust the Time series table size if needed. Right click the time series table and select *Configure Time Series Table*:

a. In the *Time* section, for the *Start and End Times* select *Use custom time range.* Fill the *Start* box to be "*-1h" and the *End* box to be "*".

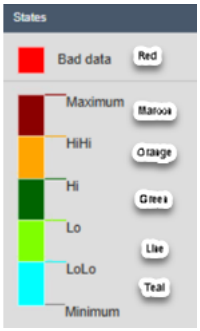
b. In the *Value* section, select the *Show Units* checkbox.

c. In the Font section, set the size to 11.

d. In the *Style* section, select the *striped* option.



Step 9: Right click the time series table and select *Add Multi-State*, adjust the State's colors to be similar as the ones in the image.

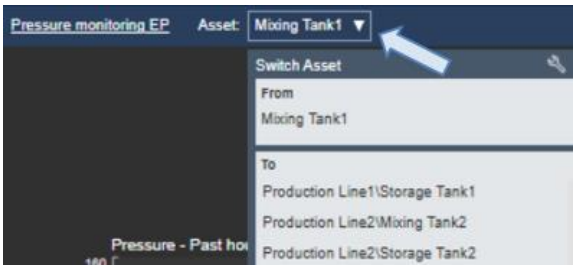


Step 10: Copy the time series table created in **step 8**. Right click the copied time series table and select *Configure Time Series Table*:

a. In the *Time* section, change the value in the *Start* box to be “y” and the *End* box to be “t”.

Step 11: Click on the Save button  .

Step 12: Change the referenced asset in the asset switching menu and notice how the information in the trends and time series tables adjust automatically.



4.4.21 Exercise - Monitoring the Mixing Tanks' Key Performance Indicators

This activity is designed to maximize learning in a specific topic area. Your instructor will help you if you need assistance during the activity. *Use your own data if you have access to such data.*

Objectives

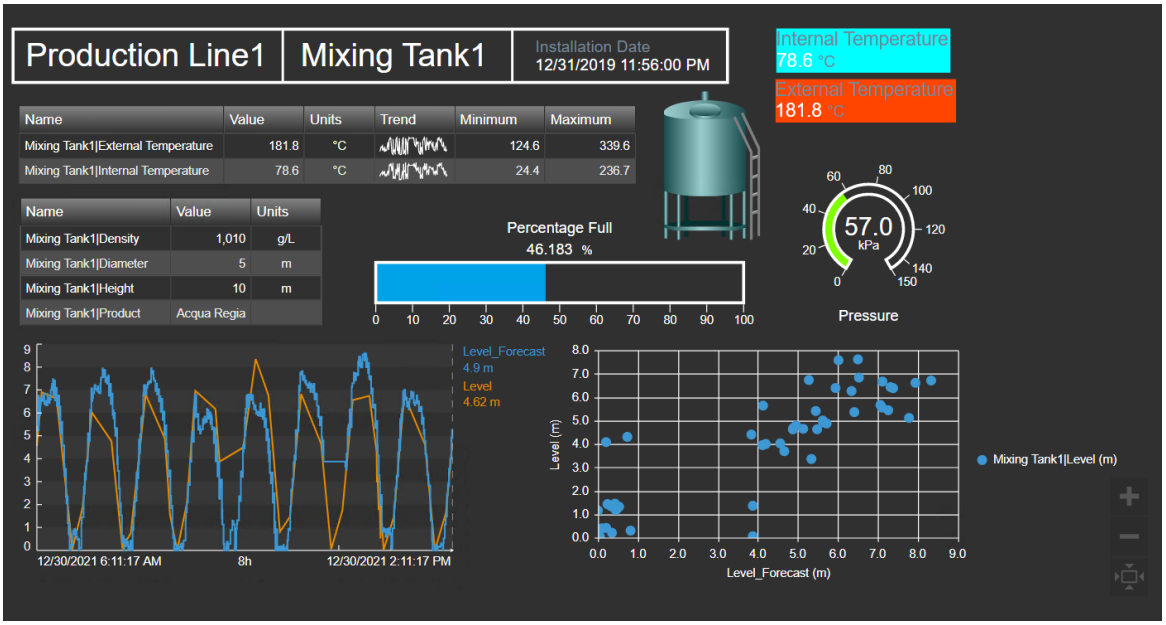
- Create a PI Vision dashboard using dynamic symbols.
- Add Multi-State behavior to symbols
- Reuse the PI Vision dashboard for multiple Assets

Activity Description

Your manager would like you to create another display to view details of each tank in your Production Area. With your large knowledge in PI Vision, you know that we don't need to create a new display for each Tank. We can easily use the Asset Swap functionality so that we only need to build one display and then re-use it for each tank. The information included in the display should be the following.

	Measurement	Display Symbol
Mixing Tank1	Asset Name	Value
	Asset Location	Value
	Internal Temperature	Value (Multi-State)
	External Temperature	Value (Multi-State)
	Installation Date	Value
	Internal Temperature	Table
	External Temperature	
	Level	• Trend • XY Plot (10-minute interval)
	Level_Forecast	
	Percentage Full	Horizontal Gauge (Multi-State)
	Pressure	Radial Gauge (Multi-State)
	Product	Table
	Diameter	
	Height	
	Density	

Here is a picture of what is your manager thinking about:



Approach

Step 1: Create a new display called *Tank Details <your initials>*. Including all the symbols in the description.

Step 2: Answer the questions:

a. What is the Maximum **External Temperature** for **Mixing Tank1** over the last 12 hours?

_____

b. What is the Minimum **Internal Temperature** for **Mixing Tank1** over the last 12 hours?

_____

(Hint: Tables in PI Vision have columns for the maximum and minimum values).

Step 3: Add shapes and images to the display

Step 4: Go to  *Configure asset context switching* in the asset drop-down list and select *Show search results*. Set the Search Root to **Production Area\Production Line2**.

Step 5: Reuse the same display to monitor the other mixing tank

a. What is the Maximum **External Temperature** for **Mixing Tank2** over the last 12 hours?

_____

b. What is the Minimum **Internal Temperature** for **Storage Tank2** over the last 12 hours?

_____

Step 6: Update the asset context switching to **Show assets of the same type**.

Discussion

- Answer the following questions using your display
    a. What is the Maximum **External Temperature** for **Mixing Tank1** over the last 12 hours? _____
    b. What is the Minimum **Internal Temperature** for **Mixing Tank1** over the last 12 hours? _____

        (Hint: Tables in PI Vision have columns for the maximum and minimum values).
    c. What is the Maximum **External Temperature** for **Mixing Tank2** over the last 12 hours? _____
    d. What is the Minimum **Internal Temperature** for **Storage Tank2** over the last 12 hours? _____

✔ **Quick Check**

Having completed this topic, are you able to:

- Use visual alarms with Multi-states?
- Make reusable displays using collections, asset comparison tables and taking advantage of assets switching?
- Adding Bar charts and XY plots to the display?
- Using Time Series Tables?

If you answered NO to any of these questions, ask your instructor for assistance.

5. ADVANCED FEATURES IN PI VISION

5.1 Recap of PI Vision

PI Vision is a web browser-based application that lets you retrieve, monitor, and analyze process information.

PI Vision allows:

- Searching for, and visualizing time-series data and other PI System data.
- Saving displays for later use and further analysis.
- Reusing displays across multiple assets.
- Sharing displays with other members of a group, or anyone with access to PI Vision.

PI Vision is supported by most modern browsers on a wide variety of computers, including tablets and phones running iOS or Android operating systems.

Learning Outcomes:

- Understanding PI Vision Calculations and use the Calculation Editor
- Create and use navigation links
- Organize and share displays
- Consume Event frames in Pi Vision

5.2 PI Vision Calculations

Displays in PI Vision can utilize simple calculations on the fly and use the results to analyze data in real time. This includes the use of summary calculations like Min, Max, and Avg and simple calculations that use basic mathematical operators such as +, -, *, and / on data within the display.

PI Vision calculations enable values to be calculated immediately, without an AF Analytics that may not be used again in other displays. Depending on the element used, we can divide the calculations in:

- **Tag-based (PI Vision) calculations**

  Are requested and executed at PI Data Archive server side. **If PI Data Archive is heavily requested, it might have performance issues for PI Vision and other applications requesting to PI Data Archive**. It is important to observe the amount of data requested.

- **Asset-based (PI Vision) calculations**

  Are **executed at PI Vision server and it can impact the performance if heavily used**. The PI AF attributes configuration, and nesting level can affect the input attributes evaluation time. So before creating an asset-based (PI Vision) calculation, it is recommended to verify if the input attributes are following the PI Analysis Service Best Practices.

  Additionally, as data is interpolated in trends, asset-based (PI Vision) calculations may not present all the outliers for high density data, so it may not be applied for this use case.

IMPORTANT NOTE: As a general recommendation, complex expressions or calculations that will be reused should be created leveraging PI AF Analysis, whenever possible. PI Vision calculations might be used for Ad Hoc calculations use cases.

Learning Outcomes:

- Understanding PI Vision Calculations
- Using the Calculation Editor

5.2.1 Equation syntax

To help in the development of calculations in PI Vision, there are three (3) rules to remember:

Rule 1: Numbers and operators require no special syntax

Rule 2: Tag names and timestamps are contained in apostrophes: 'CDT158'

Rule 3: Strings are contained in quotation marks: "This is a string"

Example:

If ('CDT158'+2*'Sinusoid')>100 Then "Good" Else "Bad"

More complex expressions for tag-based calculations are also possible.

For more information, see "Performance equations (PE) syntax and functions reference" in PI Server User Guide.

5.2.2 Directed Activity – Create a Tag-based calculation.

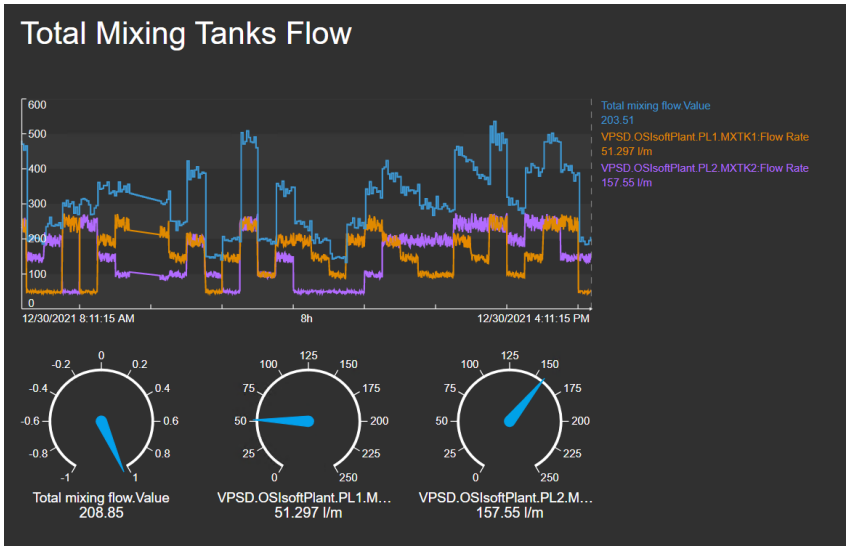
You are invited to watch what the instructor is doing or perform the same steps at the same time to explore the different concepts presented in this chapter or section.

Objectives

- Create and use a tag-based calculation

Activity Description

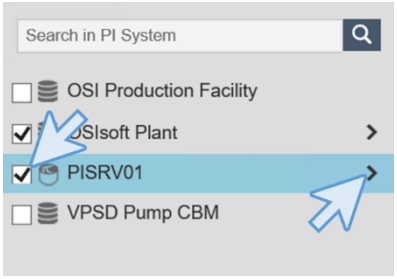
Your manager has just heard about the calculations in PI Vision. He/she is aware of OSIsoft recommendations of keeping the calculations in the PI Server instead of doing them in PI Vision but for testing purposes, he/she wants you to create a calculation to add the mixing tank flows to get a resultant flow. Once you have the calculation, he/she wants you to represent it on a display like this:



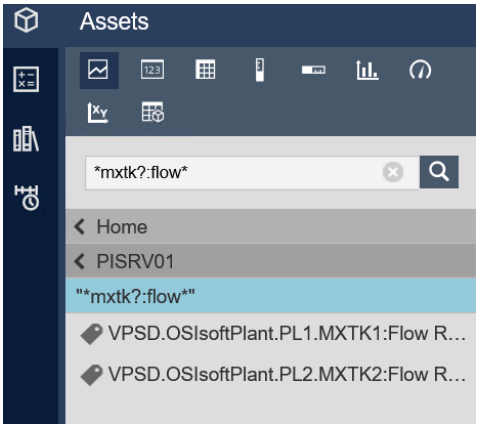
Approach

Step 1: Go to the PI Vision homepage if it is not already open and create a new display.

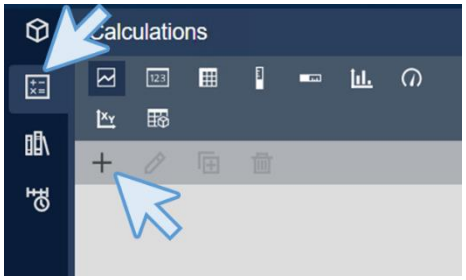
Step 2: Select the Assets pane and mark PISRV01 from the list of available assets and drill down using the arrow.



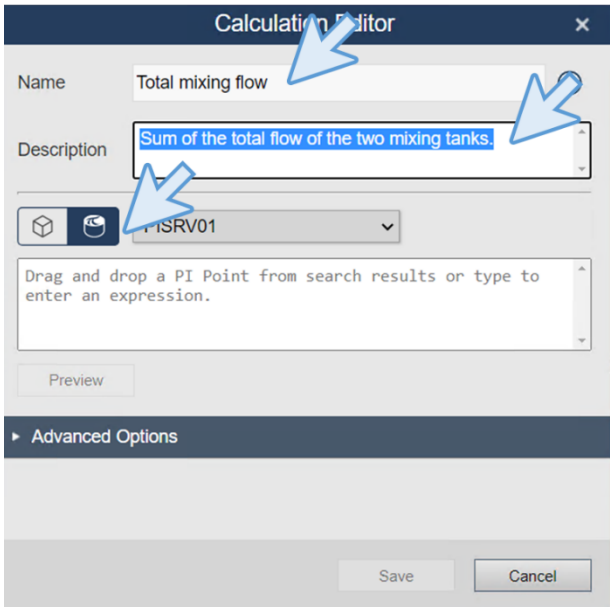
Step 3: In the search pane enter "*mxtk?:flow*"



Step 4: To open the calculation editor, on the left side of the screen, click Calculations and then click Add Calculation .



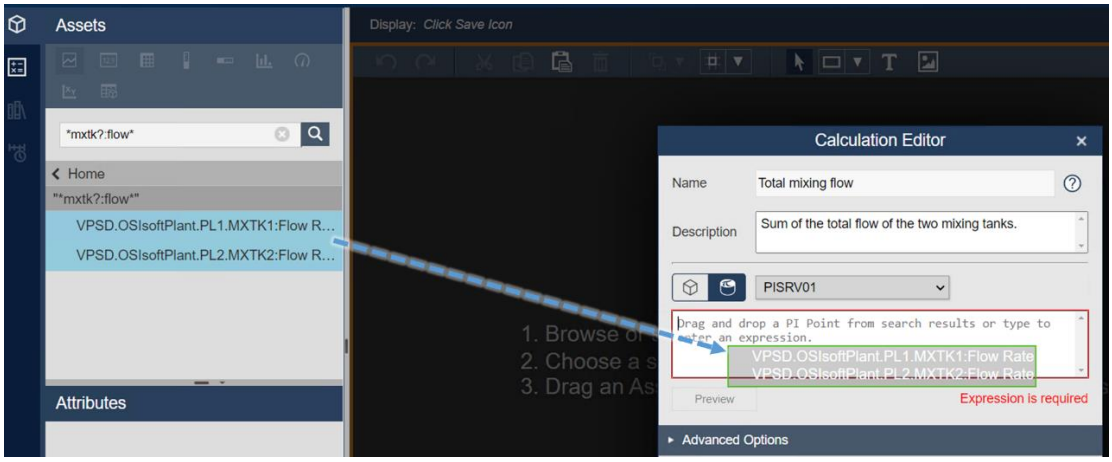
Step 5: Give the new calculation a Name "*Total mixing flow*" and a Description "*Sum of the total flow of the two mixing tanks*" to the calculation. Select the symbol of the PI Data Archive.



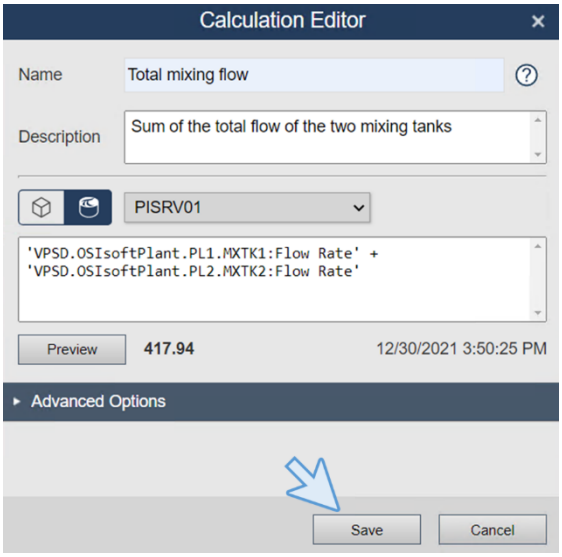
Note: Your calculation Name needs to be unique for the current display. You may reuse a Calculation Name on different displays.

Step 6: Without closing the Calculation editor, click on the Assets pane (cube in the top left corner) to see again the PI Points you have just found.

Step 7: Drag and drop the PI Points into the expression area at the Calculation editor.



Step 8: The calculation editor will add the two PI Points automatically creating a sum calculation. Which is exactly what you are looking for. Click on *Preview* to check how the calculation looks like.

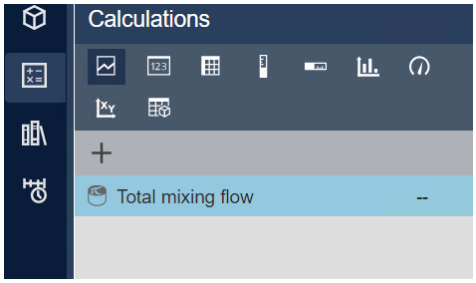


Note: You can only use PI Points from one Data Archive in a single Calculation

Step 9: Expand "*Advance Options*". Check the *Stepped Plot* box to display the calculation with stepped data. By default, the *Time Interval* parameter is set to Auto, but you can choose a *Custom* time interval if needed, for this example let's keep the interval as *Auto*. The Total Conversion Factor for the calculation only applies to the Total summary Column.

Step 10: Click on Save.

Step 11: Your calculation will appear in the left pane. To open and edit a calculation, double click on it.



Step 12: Select the trend icon, then drag the "Total mixing flow" calculation on the new display.

Step 13: Click on the Assets pane (cube in the top left corner) to see the PI Points you searched and drag and drop them both to the trend.

Step 14: Right click on the trend, select *Configure Trend*. In the Value scales section select *Single scale*.

Step 15: Save the display as "*Total Mixing Tanks Flow <your initials>*", make sure to save it under the folder you created on Activity *4.2.3 – Create a display folder*. Name your display "*All Tanks <your initials>*". Then click on Save. Remember to click in the Design mode icon to continue editing.

Step 16: Add a text on the top of the display and write "Total Mixing Tanks Flow", increase the font size to be 26.

Step 17: Represent the calculation result, and the two PI Points in radial gauges by selecting the radial gauge icon and dragging and dropping it into the display.

Step 18: Save the display.

5.2.3 Directed Activity – Create an Asset-based calculation

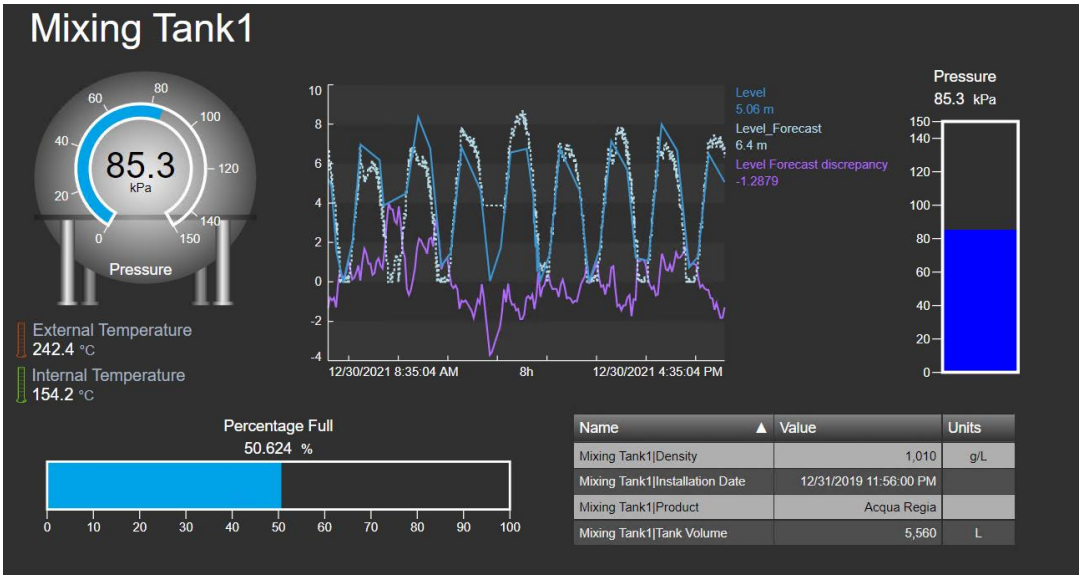
You are invited to watch what the instructor is doing or perform the same steps at the same time to explore the different concepts presented in this chapter or section.

Objectives

- Create and use an asset-based calculation

Activity Description

Your manager has just remembered the display tank general overview and he/she thinks that doing a calculation to know the differences between the level and the level forecast and represent it on the same trend would be nice, so he/she asks you to create it. The result should be like this:



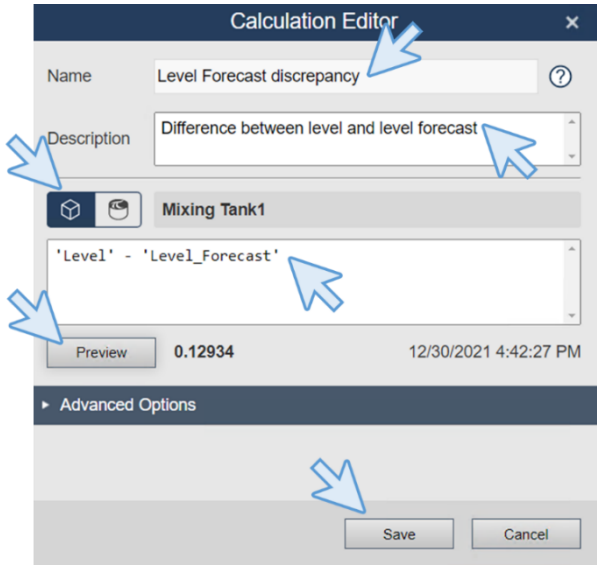
Approach

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

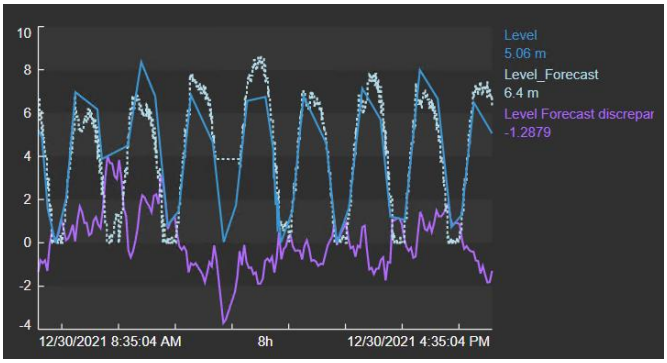
Step 2: Select the trend and click on the calculation icon  . In the calculation menu you will see a number 2, next to the "+" symbol. The number above the icon indicates how many PI tags or AF attributes will be included in the calculation. The number only appears when all

symbols on the display (not only the selected symbols) are the same type: either PI tags or AF attributes.

Step 3: Click on the  . Name the calculation "*Level Forecast discrepancy*" and fill the description. Check that the cube is selected because we are using an asset instead of a PI Point. Change the expression to be 'Level' - 'Level_Forecast'. Click on *Preview* and save the calculation.



Step 4: Your calculation will appear in the left pane. Drag and drop the calculation to the trend.



Step 5: Save the display.

Discussion

- What is the difference between using PI Points and AF attributes in the calculations?
- Where is the calculation done in each case?
- Change the asset, does the calculation change?

✔ **Quick Check**

- Do you understand PI Vision Calculations?
- Can you use the Calculation Editor?

If you answered NO to any of these questions, ask your instructor for assistance

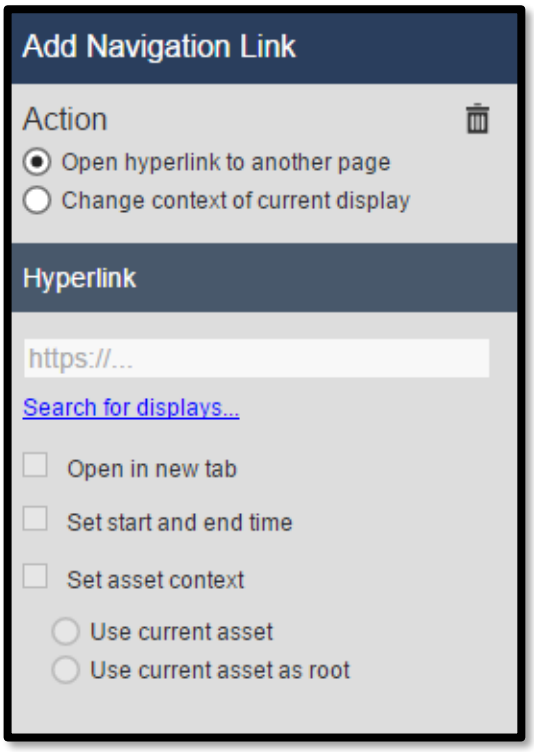
5.3 Additional features in PI Vision

Learning Outcomes:

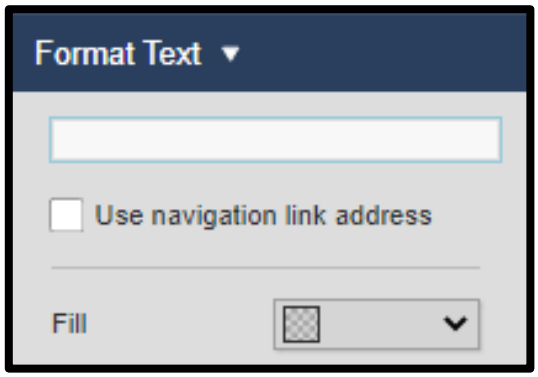
- Adding Navigation links
- Display URL parameters
- Ad hoc displays

5.3.1 Add Navigation Links to PI Vision Symbols

You can assign a hyperlink to any symbol, shape, or image on your display by right clicking on it and selecting "*Add Navigatio Link…*". The hyperlink can point to another PI Vision display or to an external website. Once you add a hyperlink, you can navigate from that hyperlink to your linked display or website. There is the option to have the linked display automatically match the asset and time context of the original display containing the hyperlink.



You may also add a hyperlink directly to the display by choosing the Text icon  and then clicking anywhere in the display. The text menu opens. Select 'Use navigation link address' link to enter a URL.



5.3.2 PI Vision URL Parameters

You can use a URL to open PI Vision displays programmatically from other applications.

You can use the URL to:

- Create a temporary display that shows a single trend populated with specified data items; the URL can also specify a time range for the display. This is called an Ad Hoc display.
- Specify a display time range.
- Specify kiosk mode to open a display with limited interactivity.
- Configure an existing display to use other assets that share the same AF template.
- Set the time zone for a display so that users see data in the time zone you specify, rather than in the time zone of their client machine.
- Hide the toolbar or time bar, or both, in a display.
- Prevent automatic redirection for users of PI Vision on mobile devices

Rules for adding a URL Parameter:

Rule 1: Separate query string parameters from the preceding base URL with a question mark (?).

Rule 2: Separate each query string parameter with an ampersand (&).

Below are some commonly used URL parameters:

StartTime=<PI Time> and EndTime=<PI Time>

Specify the start and end time of the display. Any valid PI Time format is acceptable.

Example:

http://PISRV01/PIVision/#/Displays/339/MyDisplay?StartTime=-1h&EndTime=**

Mode=Kiosk

Specify kiosk mode to open a display with limited interactivity.

Example:

http://PISRV01PIVision/#/Displays/339/MyDisplay?mode=kiosk

HideToolbar and HideTimebar

Hide the toolbar or timebar from the display

Example:

http://PISRV01/PIVision/#/Displays/339/MyDisplay?HideToolbar

http://PISRV01/PIVision/#/Displays/339/MyDisplay?HideTimebar

You can combine these parameters with other URL parameters. Example:

http://PISRV01/PIVision/#/Displays/339/MyDisplay?mode=kiosk&HideToolbar&HideTimebar

For more information, see "URL parameters reference" in PI Vision Installation and Administration Guide.

5.3.3 Directed Activity – Adding Hyperlinks

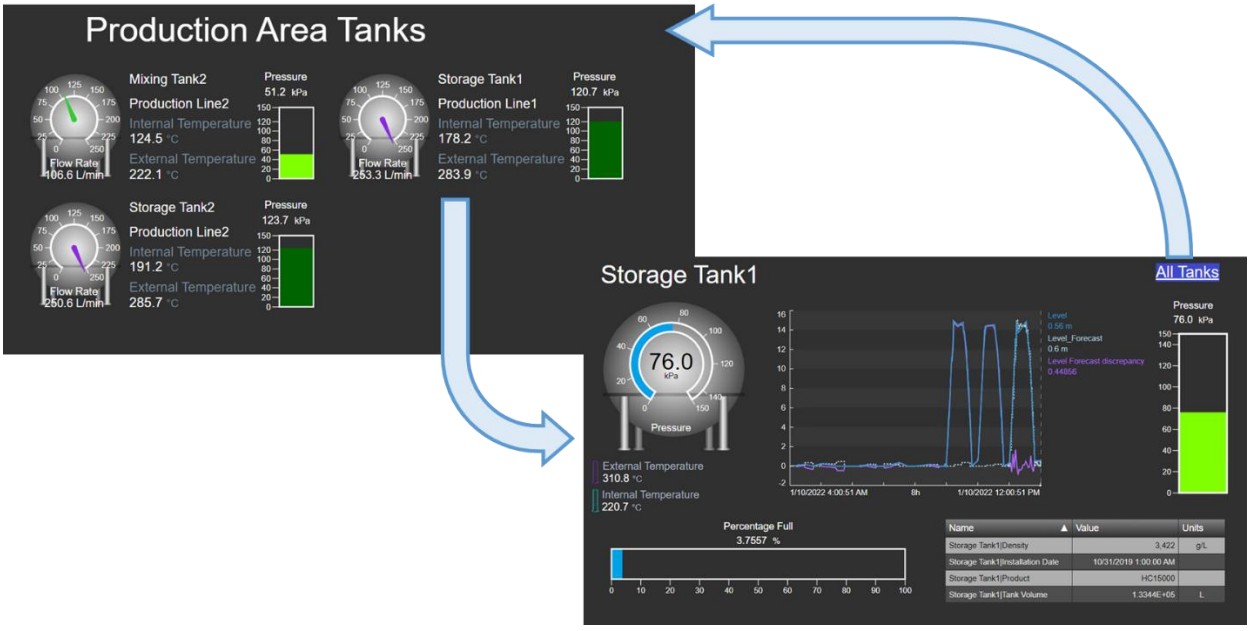
You are invited to watch what the instructor is doing or perform the same steps at the same time to explore the different concepts presented in this chapter or section.

Objectives

- Create links to PI Vision displays

Activity Description

Navigating between displays using the home button is a little bit annoying for operators,
Your manager asked you to add a navigation link in the ***All tanks*** display to the **Tank general overview** display, and a link to go back.

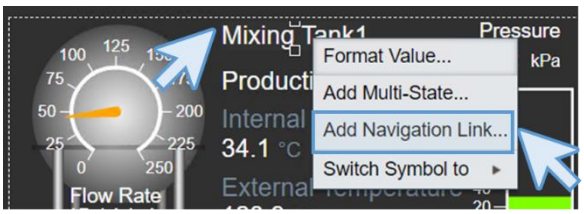


Approach

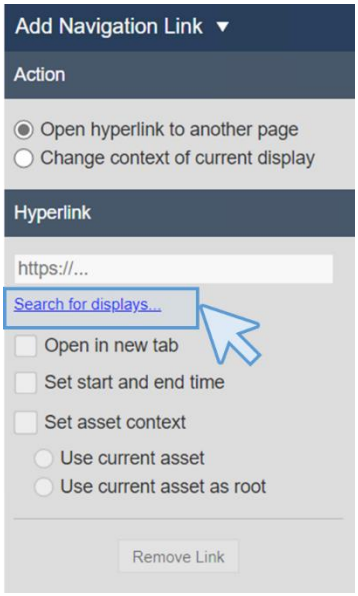
Step 1: Go to the PI Vision homepage if it is not already open and open the display "*All Tanks <your initials>*". Click on the Design mode icon.

Step 2: Right click and select *Modify collection*.

Step 3: Right click on the name “Mixing Tank1” and select *Add navigation link*.

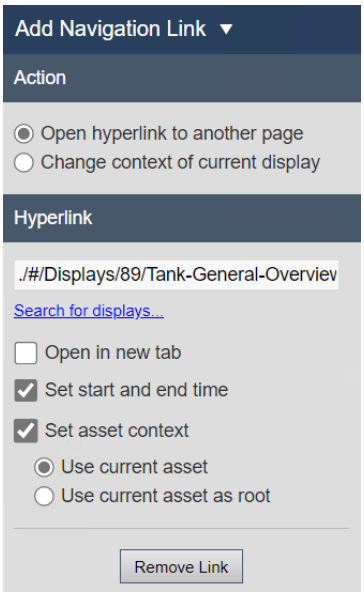


Step 4: In the menu that has appeared in the right, click on *Search for displays.*



Step 5: In the search box write “*Tank general*“ to find the “*Tank general overview* <your initials>” display and select it.

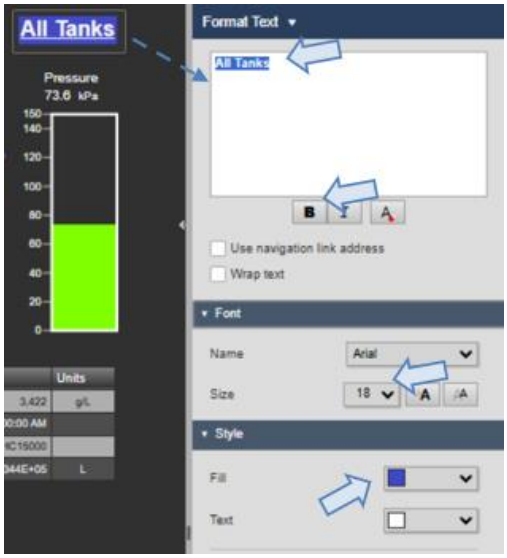
Step 6: Mark the boxes “*Set start and end time*”, “*Set asset context*” and “*Use current asset*”



Step 7: Click on the door icon to exit the edit collection mode  . Click on the *save* icon. Click on any of the names to check the links are working.

Step 8: Go PI Vision home page and open the display "*Tank General Overview <your initials>*". When open, click on the Design mode icon.

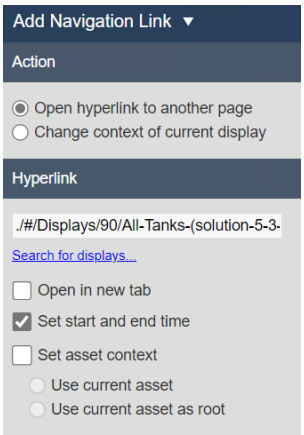
Step 9: Select the Text icon  and add the text "All Tanks". In the right pane, select the text and click in the *Bold* button, change the font size to be *18* and the *fill color* to be blue. Put the text in the top right corner of the display.



Step 10: Right click on the "*All Tanks*" text you just added and select "*Add navigation Link…"*

Step 11: Click on search for displays and write "all tanks" in the search box. Select the display "*All Tanks <your initials>*".

Step 12: Mark **ONLY** the "*Set start and end time*" box.



Step 13: Click on *Save*.

Step 14: Click on the "All Tanks" link to check the link is working.

5.3.4 Exercise – Using URL Parameters and Hyperlinks

This solo or group activity is designed to maximize learning in a specific topic area. Your instructor will have instructions and will coach you if you need assistance during the activity.

Objectives

- Use URL Parameters to create links to PI Vision displays

Activity Description

Early today the operations team reported that there was an issue from noon yesterday until midnight today with Mixing Tank1. They need to look at the data for this time period.

Approach

Step 1: Open your *Tank Temperature Dashboard display <your initials>*

Step 2: Enter Design mode, right-click and choose *Modify Collection*.

Step 3: Right click on the Tank Graphic and choose *Add a Navigation Link…*

Step 4: Leave the Action as *Open hyperlink to another page* and click the *Search for displays…* link. Search for your *Tank Details <your initials>* display and select it.

Step 5: Save your display and exit Design mode.

Step 6: Test the link.

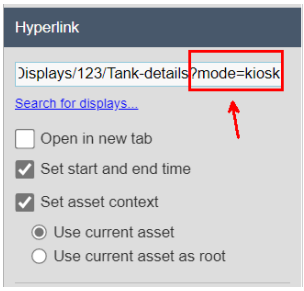
Step 7: Go back to *Tank Temperature Dashboard display <your initials>*

Step 8: Make the display read only by placing it in Kiosk mode

a. Repeat Step 2 through 4

b. In the Hyperlink section, append **?mode=Kiosk** to the end of the URL

c. Save the changes and exit Design mode.



Step 9: Retest the link. Are you able to make changes in the *Tank Details <your initials>* display?

5.3.5 Directed Activity – Add Hyperlinks in a table

You are invited to watch what the instructor is doing or perform the same steps at the same time to explore the different concepts presented in this chapter or section.

Objectives

- Create links to PI Vision displays

Activity Description

After seeing how useful links are, your manager wants you to add a navigation link in the table of the *OSIsoft Plant Overview* display to the *Tank Temperature comparison by time* display, and a link to go back.

Approach

Step 1: Go to the PI Vision homepage if it is not already open and open the display "*OSIsoft Plant Overview <your initials>*". Click on the design mode icon.

Step 2: Right click in the asset comparison table and select "Add Navigation Link..."

Step 3: On the right Pane click on "Search for display" and search Tank Temperature. Select the "*Tank Temperature – Comparison by time <your initials>*" display. Mark "Set start and end time", "Set Asset context" and "Use Current Asset".

Step 4: Click on save and check if the link works.

Step 5: Go to the PI Vision homepage if it is not already open and open the display "*Tank Temperature – Comparison by time <your initials>*". Click on the design mode icon.

Step 6: Click on the add text icon. Enter the text "OSIsoft Plant Overview". Reduce the font size to be 16. Change the fill color and place the text in the top right corner of the display.

Step 7: Right click on the text "OSIsoft Plant Overview" and select Add Navigation link. Click on Search for displays on the right pane and look for the display called "*OSIsoft Plant Overview <your initials>*".

Step 8: Mark ONLY the "Set start and end time" box.

Step 9: Click on save and check if the link works.

5.3.6 Ad hoc Displays

The Ad Hoc Workspace is the area where you can view and explore the trends of the data you select for analysis. You can interact with the trend by setting up the trend scales to see the right view of data, using cursors to view values at specific times, and changing the time range of the trend.

You have created your dashboard, but your team would like to select a few different items from the displays and do some additional analysis when they investigate specific issues. If they identity something of interest, they would like to be able to share their findings by saving the display. Let's use the ad hoc display functionality!

5.3.7 Directed Activity – Demonstrating Ad Hoc Analysis

You are invited to watch what the instructor is doing or perform the same steps at the same time to explore the different concepts presented in this chapter or section.

Objectives

- Create an ad hoc display

Activity Description

You have recently heard an increasing interest in comparing the external temperatures for all the tanks in trends, but you feel that creating a display only for that is not needed so you decide to check if it is possible to compare the external temperatures of all the tanks in the plant with an ad-hoc trend.

Approach:

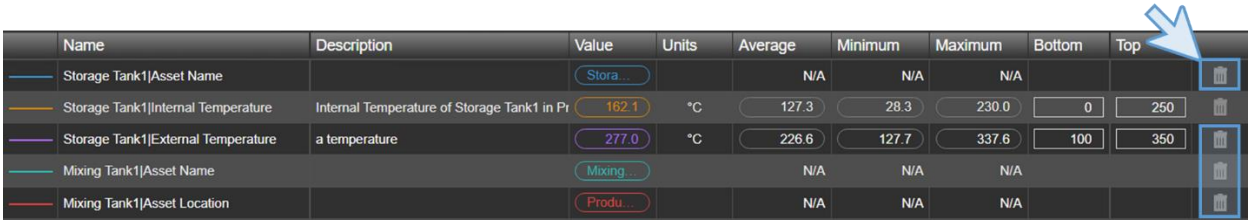
Step 1: Go to the PI Vision homepage and open the "*OSIsoft Plant Overview <your initials>*" display. Make sure you're **NOT** in design mode (if so, click in the design mode button to disable it).

Step 2: Select multiple symbols inside the display (Tip: you can select multiple symbols if you hold *Ctrl* in your keyboard while you select the symbols).

Step 3: Click *New Ad Hoc* (at the upper right corner). This will start a new ad Hoc display.

Step 4: Toggle off the Summary Table. See how the table disappears at the bottom of the display. The display will only show the trends from all the attributes now.

Step 5: Click on the *summary table* icon again and click on the *trash bin* icon to remove the undesired trends. The goal is to keep only two or three attributes.



	Name	Description	Value	Units	Average	Minimum	Maximum	Bottom	Top	
	Storage Tank1|Asset Name		Stora...		N/A	N/A	N/A			
	Storage Tank1|Internal Temperature	Internal Temperature of Storage Tank1 in Pr	162.1	°C	127.3	28.3	230.0	0	250	
	Storage Tank1|External Temperature	a temperature	277.0	°C	226.6	127.7	337.6	100	350	
	Mixing Tank1|Asset Name		Mixing...		N/A	N/A	N/A			
	Mixing Tank1|Asset Location		Produ...		N/A	N/A	N/A			

Step 6: Click anywhere in the trend, see how a trend cursor appears. Click again somewhere else to add another cursor (you can repeat this process to add multiple cursors in the trend).

Step 7: Select any of the recently added trend cursors, drag it to the right or the left and see how the trend cursor values update as you drag it across the trend area.

Step 8: Play around with the icons on the top of the display.

Step 9: Click on the *Convert to Display* button to place the Ad Hoc Workspace contents into an Editor Display that can be permanently saved and shared.

Step 10: Save your display, name it "*Ad hoc <your initials>*".

✔ Quick Check

Having completed this topic, are you able to:

- Add a Navigation links?
- Use display URL parameters?
- Create ad hoc displays?

If you answered NO to any of these questions, ask your instructor for assistance.

5.4 Managing PI Vision Displays

Learning Outcomes:

- Organize displays
- Change who can see a display

5.4.1 Manage PI Vision access

In PI Vision you can manage user access level either by using local Windows groups or through PI AF Identities.

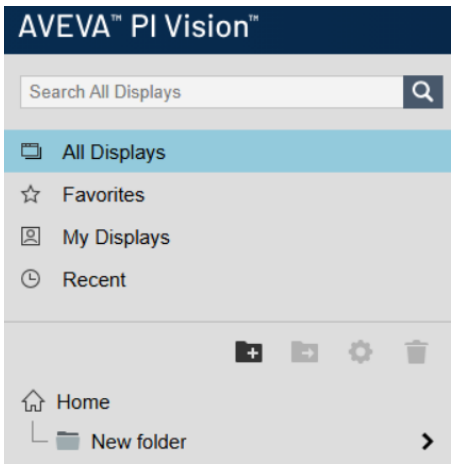
- **Local Windows Groups:** The AVEVA PI Vision setup program creates the following local user groups on the AVEVA PI Vision application server.
    - *PI Vision Admins:* Administer AVEVA PI Vision via the AVEVA PI Vision Administration website. Have access to restricted functions in the AVEVA PI Vision application such as reassigning displays to another user. View and edit all displays.
    - *PI Vision Users:* This group has full user access to the AVEVA PI Vision application and can view, save, and share displays.
    - *PI Vision Utility Users:* This group has permission to connect to the AVEVA PI Vision server for the purpose of using the PI Vision Display Utility, PI ProcessBook to PI Vision Migration Utility, or the public REST API.
- **PI AF identities:** Except for the Administrators role, if you manage a role through PI AF identities, its corresponding Windows group will be ignored. If you manage the Administrators role through PI AF identities, users in the PI Vision Admins Windows group still have access to the AVEVA PI Vision Administration website. The roles have the following access:
    - *Administrators:* Administer AVEVA PI Vision via the AVEVA PI Vision Administration website. Have access to restricted functions in the AVEVA PI Vision application such as reassigning displays to another user. View and edit all displays.
    - *Publishers:* Have full user access to the application and can view, save, and share displays.
    - *Explorers:* Have access to the application but cannot save or share displays. An Explorer can still export data from a display.
    - *Utility Users:* Have permission to connect to the AVEVA PI Vision server for the purpose of using the PI Vision Display Utility, PI ProcessBook to PI Vision Migration Utility, or the public REST API

For more information and procedure on how to configure access level, see "Configure security" and its subsections in PI Vision Installation and Administration Guide.

5.4.2 PI Vision Homepage

The home page shows groups of displays. In the left pane, you can select a specific group of displays to view. When you select a group, only the displays from that group are shown and any searches find matching displays only within the selected group. These groups are listed below:

- **ALL DISPLAYS:** Lists all public and private displays to which you have access
- **FAVORITES:** Displays that you have marked as favorites (starred displays)
- **MY DISPLAYS:** Displays that you have created.
- **RECENT:** Displays that you used within the last seven days.



Alternatively, if you don't want to use a group, you can select a folder in order to view the displays that are stored in that folder. The list of folders you will see will depend on the folders that your organization created as well as which of those folders you have permission to view. The **HOME FOLDER** stores displays that are not stored in another folder.

You can navigate to the PI Vision Homepage from any display by clicking AVEVA™ PI Vision™ button on the upper left corner.

5.4.3 Change display view and sort displays

As of PI Vision 2024 there are two useful enhancements, these new functionalities will allow you to organize your displays depending on your requirements.

- **Change display view:** Use the buttons in the upper right corner of the home page to change how the displays appear. You can select between thumbnail view and table view.

Thumbnail view

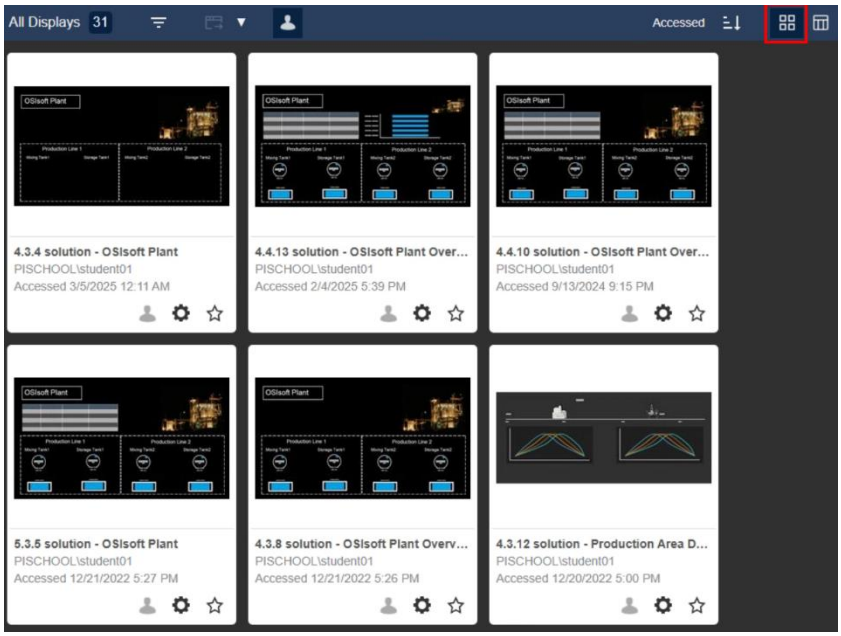
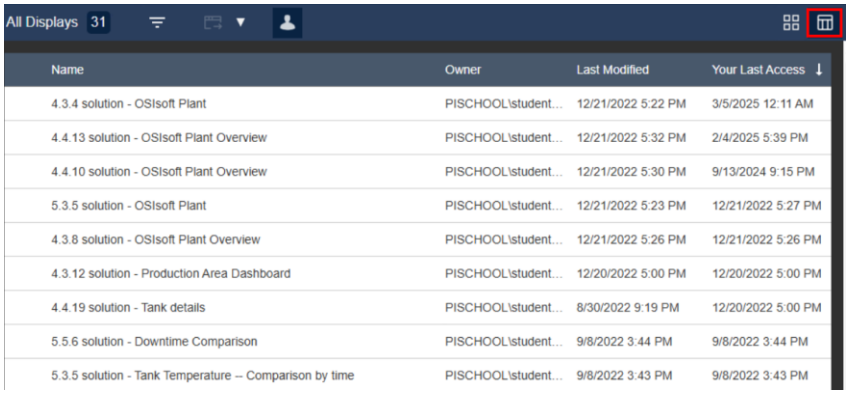
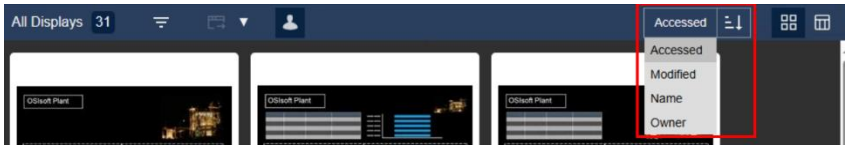


Table view



- **Sort displays:** Use the controls in the upper right corner of the home page to change how the displays are sorted.



  Select the sort direction button ( or ) to change whether the displays are sorted in ascending or descending order.

  You can sort by the following:

  - *Accessed*: When the display was last viewed or modified.
  - *Modified*: When the display was last modified.

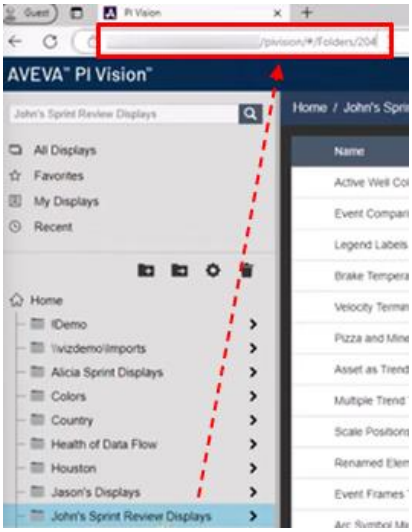
- *Name*: The name of the display.
- *Owner*: The owner of the display.

For more information, see "Change the display view" and "Sort displays" in PI Vision Installation and Administration Guide.

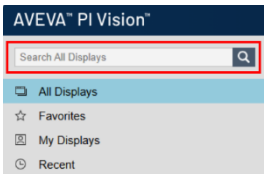
5.4.4 Organizing PI Vision Displays

PI Vision offers different options to organize displays, this provides the user a quicker way of finding displays of interest.

- ***By Folder:*** As learned before within the PI Vision home page, users can create folders to group alike displays. As of PI Vision 2024, folders can be shared using/referencing its URL.

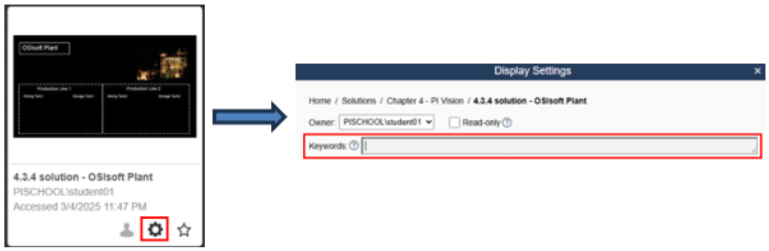


- ***By group:*** Displays are searchable by name or owner. You can use the search tab in the left pane.
  More details: Search for a display.



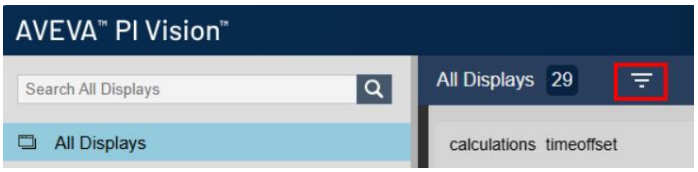
- ***Favorites***: You can mark displays as "favorites" by clicking the star icon ☆ in the Display thumbnail. Favorites are a user-specific property.
  More details: Mark a display as a favorite.

- ***Keywords*:** You can apply keywords to displays to categorize them. You can add a keyword by clicking the *Display Settings* icon  and typing in the keyword in the *Keywords box*, each keyword must be separated by a semicolon.



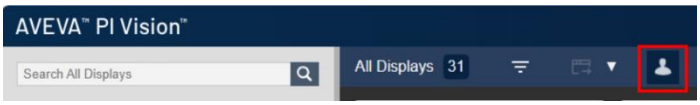
Once you start typing the keyword, the matching available keywords become available in a list.

The keywords can be viewed in a keyword cloud by selecting "*Filter by Keywords*" icon along the top of the home page. Within the keyword cloud, the keywords are sorted alphabetically, and their size is determined by their relative frequency. Keywords applied by one user are visible to the rest of the users.



More details: Filter displays by keywords.

- ***Show private displays:*** A private display is a display where no permissions were granted to any PI AF identities, so that it is generally intended to be used only by the user who created it. To show private displays, select the private displays icon  along the top of the home page. To hide private displays, select the icon again.



More details: Show private displays.

5.4.5 Editing PI Vision Displays

Some of the editing options are available from the PI Vision display itself (accessing the display and clicking in the *Design mode* button will allow you to edit any existing display) and the PI Vision homepage.

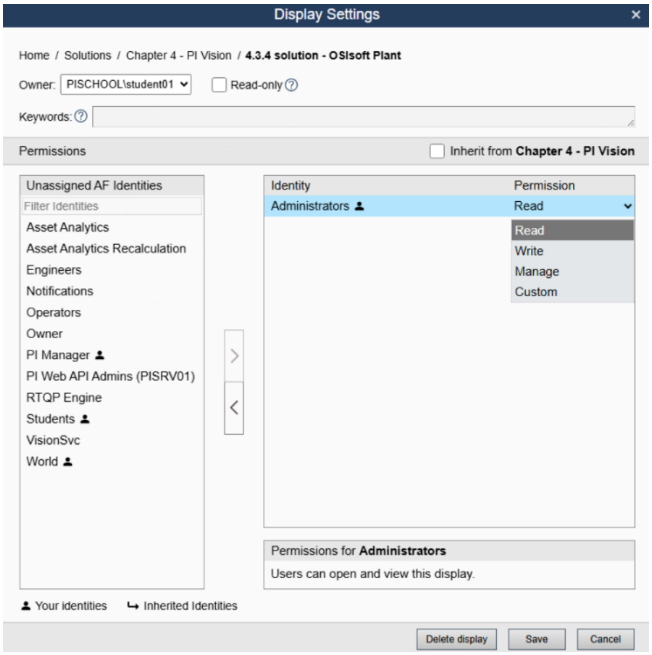
From the homepage, clicking on the *Display Settings* icon  in the display thumbnail will display the following options:

- **Keyword**: You can enter text in the Keywords field and use a semicolon (;) to separate multiple keywords.
- **Display Owner**: You can make anyone else in your organization the owner of any display. (Only visible to the Administrators).
- **Read-only:** This is used to not allow any users to save any changes to the display, including the display's owner and administrators. If you apply this option then later find that you want to make changes to the display, a user with the necessary permissions needs to first unselect Read-only.

- **Permissions**: As the creator of a display, you can keep these displays private, or to share them with other users in your organization.
- **Delete Display**: Currently, you can only delete displays that you created in PI Vision. You cannot undo this action.

The groups displayed in the Permissions/Unassigned AF identities are AF Identities, only the AF Identities that a user is a part of will display except for Administrators which is a share option for any user.

As a user you can create a display that you use to home in on a set of data and then quickly and easily share that display with others across your organization. You can also send the URL for a shared display in an email or instant message to someone else in your organization for them to see as a public display. You can also give team members *Read*, *Write*, *Manage* or *Custom* permissions for a display, allowing collaboration on the creation and maintenance of displays with your team, in case you want the day off.



For more information, see "Display settings and permissions" in PI Vision Installation and Administration Guide.

5.4.6 Exercise – Manage and share your PI Vision Displays

This solo or group activity is designed to maximize learning in a specific topic area. Your instructor will have instructions and will coach you if you need assistance during the activity.

Objectives

- Work with different options available in managing PI Vision displays

Activity Description

Your corporate PI Vision homepage has a long list of displays shared by others. You also have a lot of wonderful displays that you would like to share with your team members. You want to make the management of your displays and displays of your interest easy and label your displays in a way that your team members can find them easily.

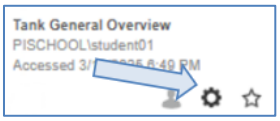
Approach

Step 1: From the Windows start menu right click the Microsoft Edge shortcut and select *More* > *Run as different user* > in the prompt enter *student02* as the user and *RecoverMealSpecialist* as the password. This will open a new Microsoft Edge session (window) than the one you have been working on.

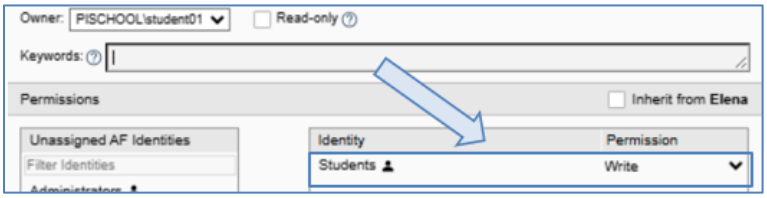
Step 2: In the Microsoft Edge session you just open, please access PI Vision home page (https://pisrv01.pischool.int/PIVision/#/). This is **student02's PI Vision session** (if you take a look at the upper right corner, you will notice that you accessed PI Vision as if you were the student02 (instead of student01 as you did for previous exercises).

Step 3: In the folders section, identify the folder you created in activity *4.2.3 – Create a display folder*, if you click on it and you will notice that there are no displays listed.

Step 4: Please go back to **student01's PI Vision session** and identify your *Tank General Overview <your initials>* display and click on the display settings button.



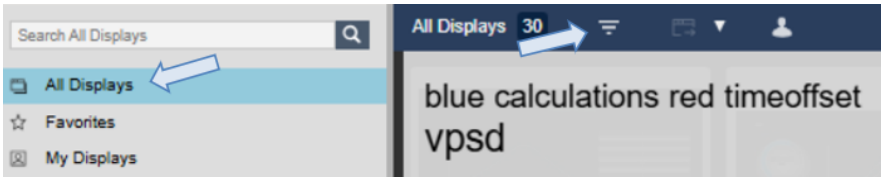
Step 5: Share your display with the *Students* identity and assign *Write* permissions, then click on Save. You will notice that it is now displayed as a public display.



Step 6: Go back to **student02's PI Vision session**. You will notice that the *Tank General Overview <your initials>* display is now listed (if it is not displayed automatically, you can reload the page). This is normal because the display is now shared with all the users who are part of the Students identity.

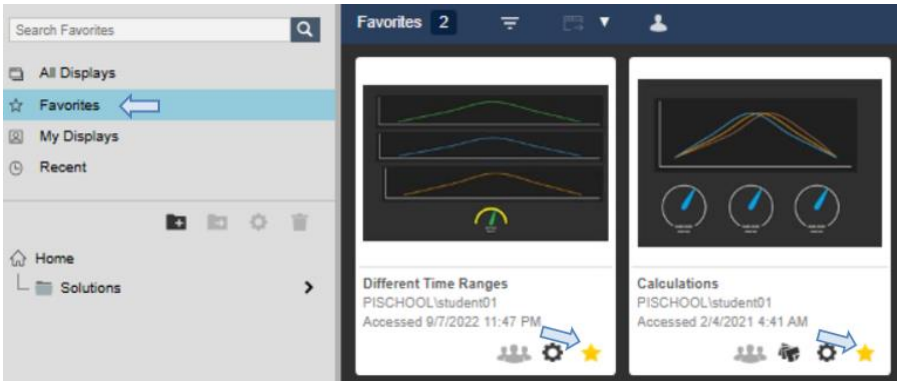
Step 7: From **student02's PI Vision session**, please click on the *Tank General Overview <your initials>* display settings button, this time please add the keyword of **VPSD** (stands for *Visualizing PI System Data*) and **one or more colors**, please be sure to separate them with a semicolon (**;**). Then click on *Save*.

Step 8: You can now select the *All displays* option and use the *Filter by keywords* button to find all the displays that have the label of VPSD or that match one of the colors you chose. You can do this either from **student01's or student02's PI Vision session**.



Step 9: From your displays folder pick your favorites and add them to your favorites list by clicking the favorites button ☆ (the button will automatically turn yellow ★) in the display thumbnail.

Step 10: You can now select the *Favorites* option from left menu to visualize only those marked as favorites.



✔ Quick Check

Can you:

- Organize displays?
- Share displays?

If you answered NO to either of these questions, ask your instructor for assistance.

5.5 Analyzing and Comparing Related Events

Events are important processes or business time periods that affect your operations. For example, an event can capture asset downtime, process excursions, operator shifts, or batches. You can analyze your data in the context of these events rather than by continuous time periods. Each event has a name, start time, end time, and associated data items (event attributes).

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	Suggested colors:	red
Level 4:	Major		peach
Level 3:	Minor		yellow
Level 2:	Warning		blue
Level 1:	Information		green
Level 0:	None		(no color)

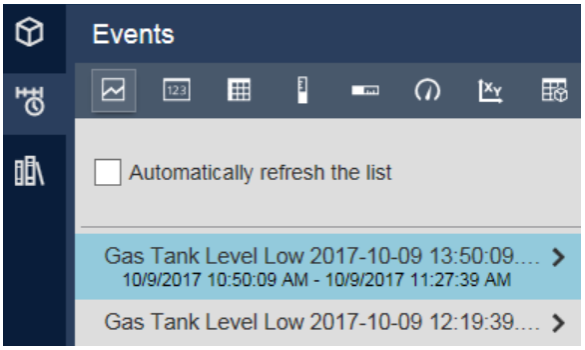
Learning Outcomes

- Retrieving Events
- Finding Related Events
- Comparing Events
- ‘Pinning’ Events
- Event frame table

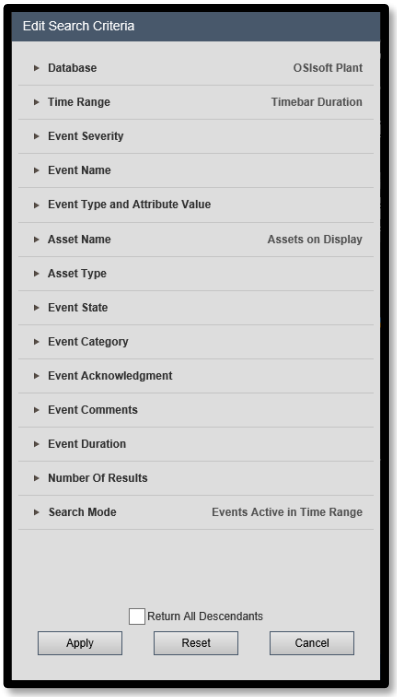
For more information about Events, see “Analyze and compare events” and its related links in *PI Vision Installation and Administration Guide.*

5.5.1 Find Related Events

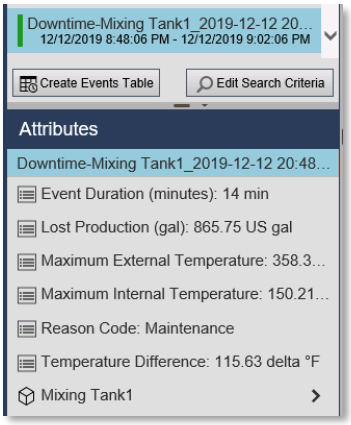
PI Vision enables you to view and analyze PI data during the time range of an event. For example, you may want to examine the performance of an asset during an operator shift or compare the data for several assets during a downtime period.



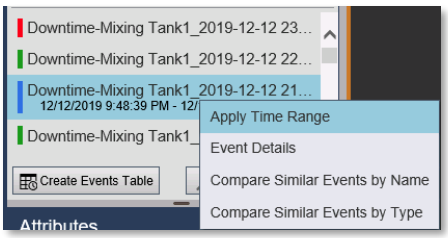
To view events, open the Events tab on the left side. Here you will find events related to your process, the color to the left of each event indicates its severity. By default, the *time range* of the display and the *context* of the symbols in the display determine which events are shown in the Events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



5.5.2 Directed Activity – Find Events

You are invited to watch what the instructor is doing or perform the same steps at the same time to explore the different concepts presented in this chapter or section.

Objectives

- Display Events based on Search criteria.

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:

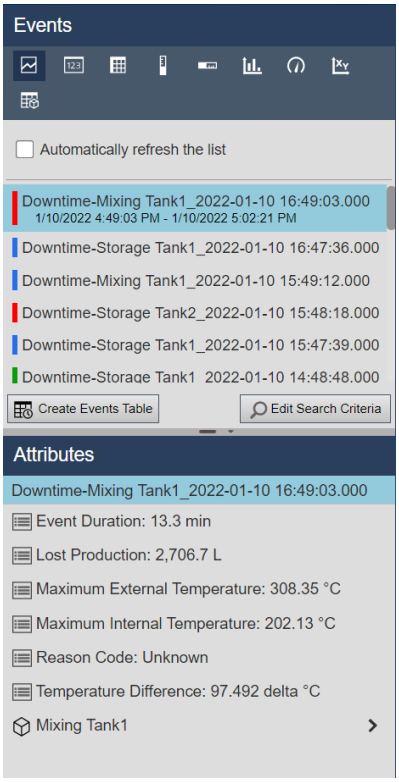
Step 1: Create a New Display

Step 2: Select *Events* 

Step 3: Select *Edit search Criteria*

Step 4: Set Database dropdown to OSIsoft Plant

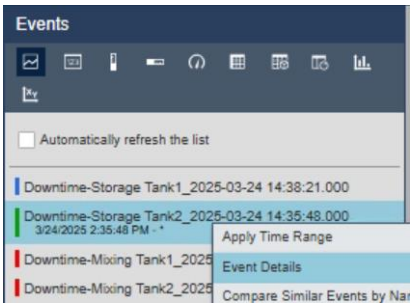
Step 5: Under Asset Name select *Any*, then click Apply.



- 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?_____

5.5.3 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.



5.5.4 Exercise – Event Details

This solo or group activity is designed to maximize learning in a specific topic area. Your instructor will have instructions and will coach you if you need assistance during the activity.

Objectives

- Display the Event details

Task 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.

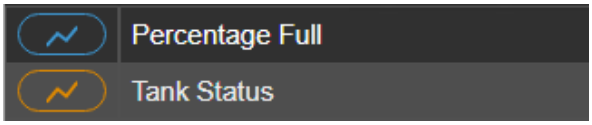
Approach:

Step 1: Follow steps in Directed Activity *5.5.2 Find Events* 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 11: 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.		

5.5.5 Compare Similar Events by Name or Type

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.

5.5.6 Directed Activity – Compare Events

You are invited to watch what the instructor is doing or perform the same steps at the same time to explore the different concepts presented in this chapter or section.

Objectives

- Comparing 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

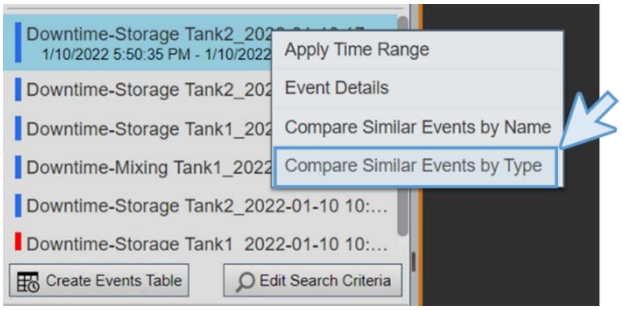
Step 2: Select *Events* 

Step 3: Select *Edit search Criteria*

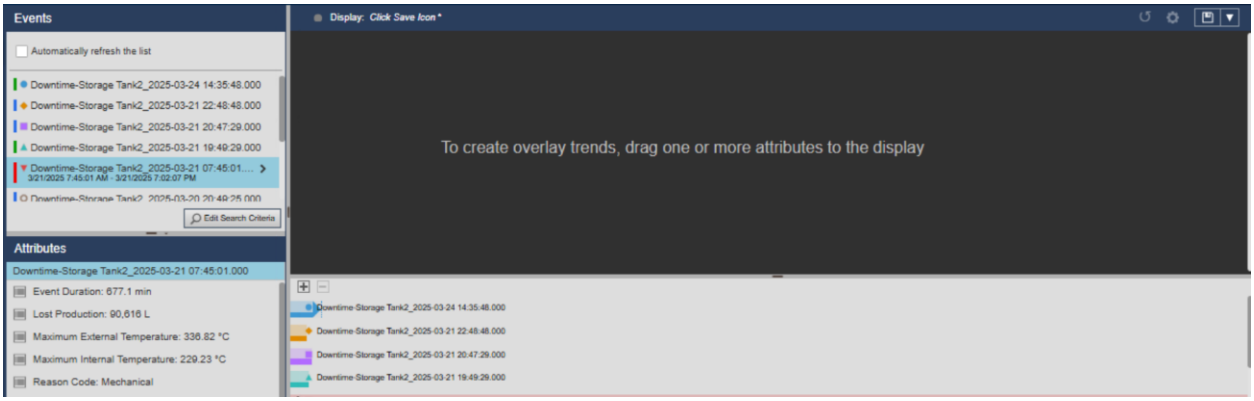
Step 4: Set Database dropdown to OSIsoft Plant

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”.

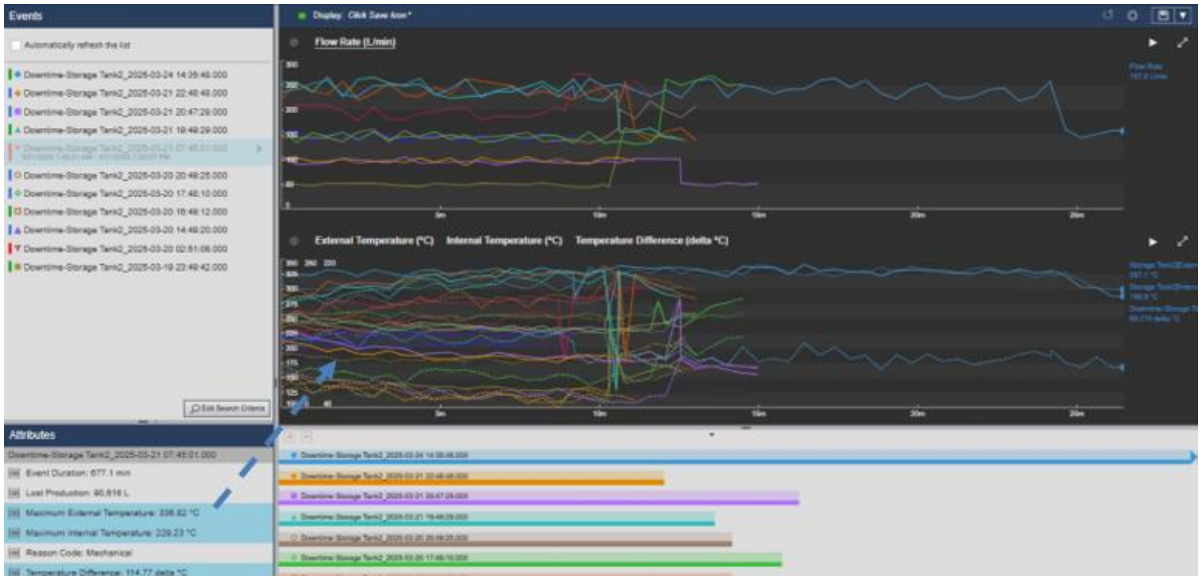


Step 7: A Gantt diagram will appear in the lowest part of the display.



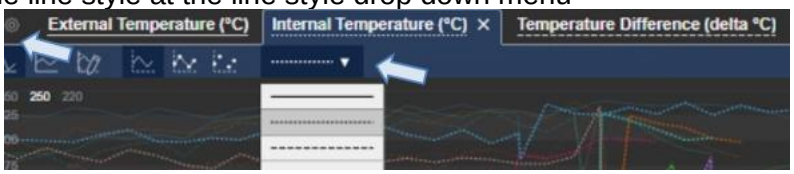
Step 8: Drag and drop the lost production into the display

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

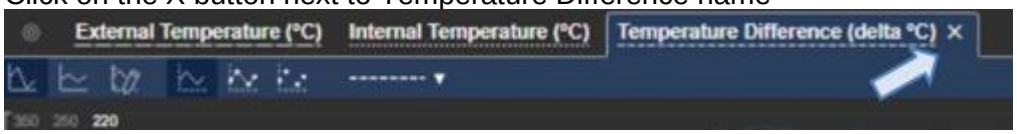


- Do the same for the *External Temperature* attribute.
- Once the changes have been made, click on the gear icon again to exit Trend configuration settings

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

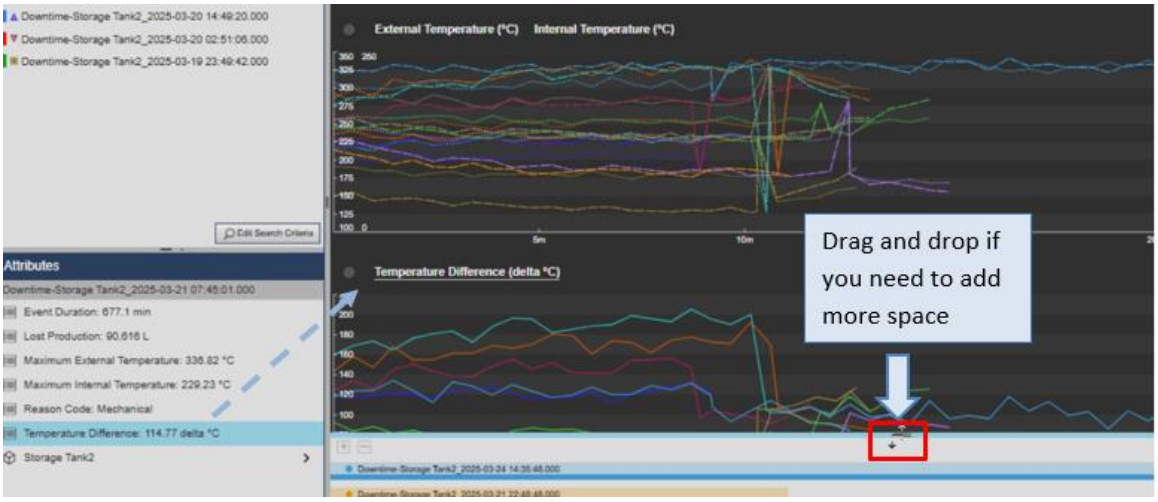
Step 11: Create a trend for *Maximum Internal* and *External temperatures* and another for *Temperature difference*:

- 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 Temperature Difference 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 by clicking on the Save button  , select the folder you created on Activity *4.2.3 – Create a display folder*. Name your display "*Downtime Comparison*

<your initials>" and finally click on *Save*. To continue editing the display click on the *Design mode* icon  .

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.

5.5.7 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.

5.5.8 Exercise – Pinning an Event

This solo or group activity is designed to maximize learning in a specific topic area. Your instructor will have instructions and will coach you if you need assistance during the activity.

Objectives

- Pin an Event

Task Description

While investigating these tank events you want to highlight some of the most interesting ones so you can easily compare them against others.

Approach:

Step 1: In your display from the previous exercise ("*Downtime Comparison <your initials>*") right-click the event in the Events pane 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 unpin your pinned event, right-click it and click **Unpin Event**.

Step 6: To hide an event, right-click the event and select **Hide event** (tip: to unhide it right-click the event and select *Show event*).

Step 7: To save your changes click the Save button.

Step 8: Here you have an example:

5.5.9 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.

5.5.10 Directed Activity – Add an event table

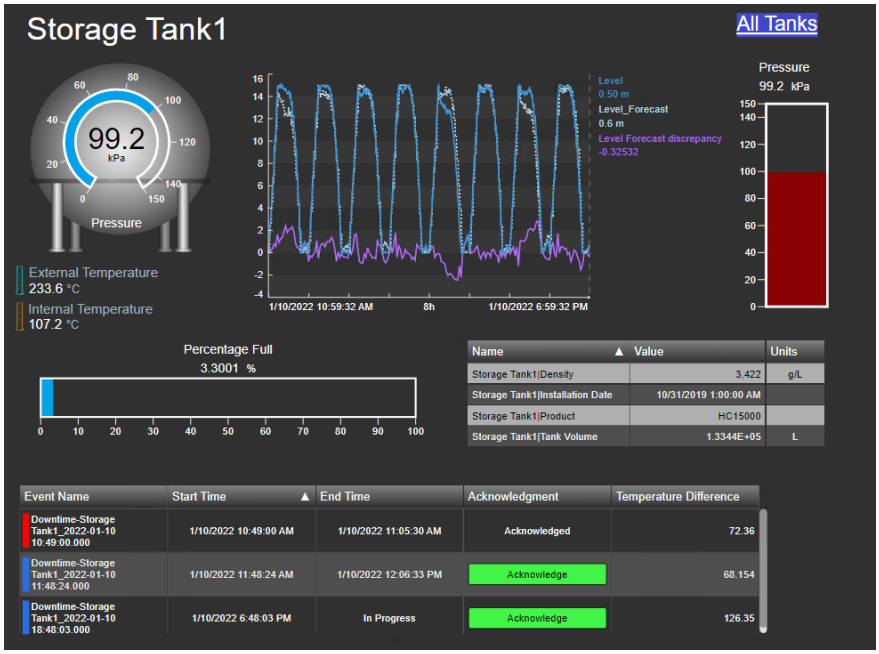
You are invited to watch what the instructor is doing or perform the same steps at the same time to explore the different concepts presented in this chapter or section.

Objectives

- Use an event table

Activity Description

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

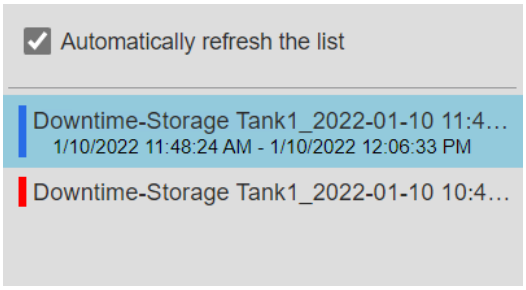


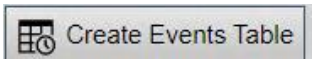
Approach:

Step 1: Go to the PI Vision homepage and open the display *Tank General Overview <your initials>*. 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. 

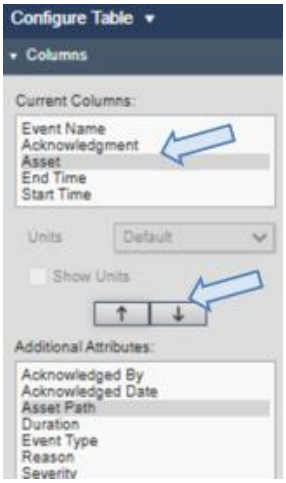
Step 3: Mark the box next to “Automatically refresh the list”.



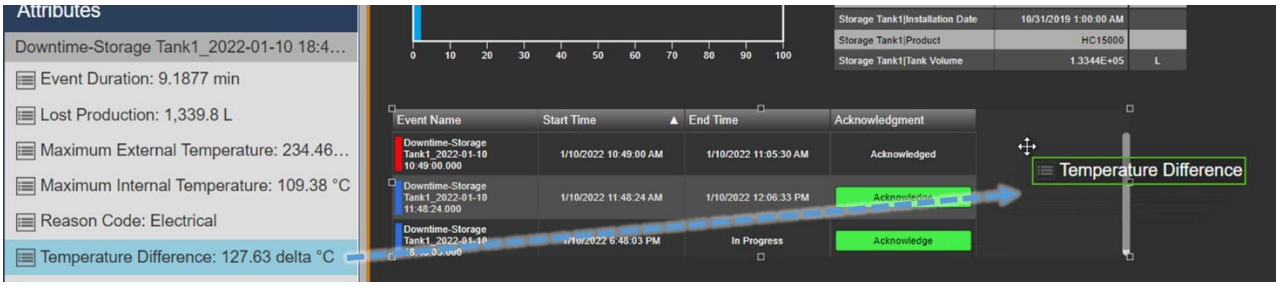
Step 4: Click on “Create Event Table” 

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 A*cknowledge* 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 menu* to see the different events for the other tanks.

✔ Quick Check

Having completed this topic, are you able to:

- Retrieve Events?
- Finding Related Events?
- Compare Events?
- ‘Pin’ Events?

If you answered NO to either of these questions, ask your instructor for assistance.

5.6 Some PI Vision Administration tasks

Learning Outcomes:

- PI Vision reports
- Default display and symbol configuration
- Patch to PI Vision

5.6.1 PI Vision Website

The AVEVA PI Vision Administration website provides an interface for AVEVA PI Vision administration tasks. The **Overview** page shows you a snapshot of your current AVEVA PI Vision installation. To access the site, browse to **https://webServer/PIVision/Admin**, where *webServer* is the name of your AVEVA PI Vision web server.

Users must be administrators to access to the AVEVA PI Vision Administration website.

For more information, see "PI Vision Administration tasks" in *PI Vision Installation and Administration Guide.*

5.6.2 Report types

When performing updates to displays or deleting 'unused' displays, their current usage could be reviewed by PI Vision administrators.

PI Vision administrators can view or export different reports about the usage of PI Vision. The reports are available under the **Reports** tab on the **PI Vision Administration site**. Information about each of the report types is defined as follows:

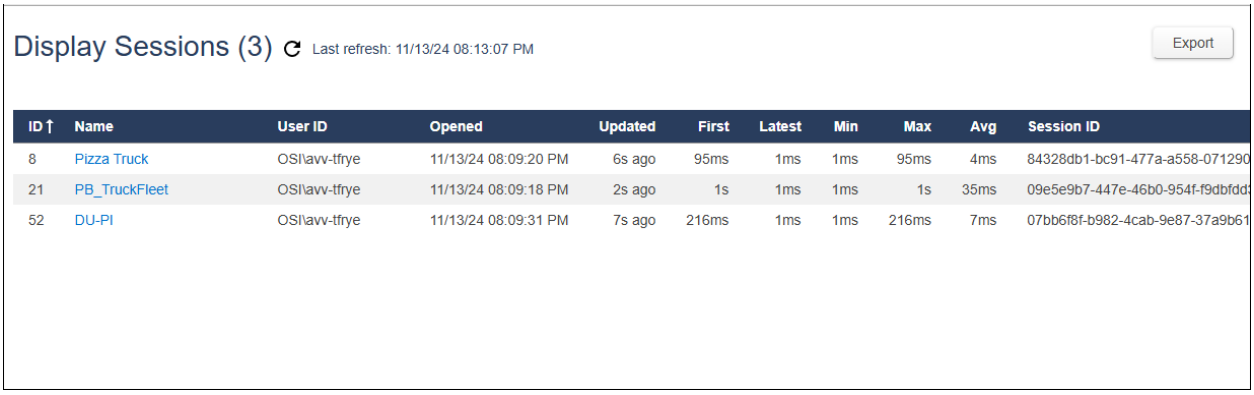
- **Detailed display content information**
  Provides a summary of the contents of displays created during a specified time range. This can include information about data items, symbols, display visibility, and display ownership.
- **Display usage information**
  Provides a count of total views and unique users that have accessed a display in the specified time range.
- **Calculation usage information**
  Provides detailed information about all PI and AF calculations used in AVEVA PI Vision displays.
- **Users who have accessed PI Vision within a specific time range**
  Provides a count of users who have opened AVEVA PI Vision displays each month during the specified time range.
- **List of all PI Vision users**
  Provides a count of displays owned by each AVEVA PI Vision user.
- **Get the count of Publishers and Explorers**

Provides a count Publisher and Explorer licensed users that have accessed AVEVA PI Vision in the specified time range.

For more information, see "Report types" in *PI Vision Installation and Administration Guide.*

5.6.3 See connected users

The **Display sessions** page available in the PI Vision Administration Website (*https://webServer/PIVision/Admin*) allows administrators to see which users are actively connected to PI Vision, which displays those users are connected to, as well as information about how long it took displays to load new data when updating. updating.



To refresh the Display Sessions page with the latest information, select the Refresh icon .

If you want to export the Display Sessions information into a .csv file, select **Export**.

Each row on the Display Sessions page represents a session, which is a connection to a single display. For example, if a user has multiple displays open, each of those sessions appears on a separate row. For each session, several pieces of information are provided such as Display name, ID, User ID, etc.

For more information and full details, see "Display sessions" in *PI Vision Installation and Administration Guide.*

5.6.4 Default display and symbol configuration

An AVEVA PI Vision administrator can set default display and symbol configurations to match a standard corporate style. Administrator can set the following types of defaults:

Symbol default

Are assigned for each symbol type from the configuration pane for an instance of a symbol on a display. The display defaults are assigned from the configuration pane for a display. Defaults are applied when a symbol or display is created. The defaults are not applied to existing symbols or displays and cannot be assigned in custom symbols.

System defaults

Are assigned from the AVEVA PI Vision Administration website. You can set default colors for the multi-state palette and colors for event severity and the event Acknowledge button. You can set the labels and durations that are shown on the time bar popup, used to quickly change the display duration to common intervals.

If needed, system and symbol defaults can be reset to the original settings.

For more information, see "Default display and symbol configuration" in *PI Vision Installation and Administration Guide.*

5.6.5 Essential patch to PI Vision

If your site is running PI Vision and having issues with elements and attributes being renamed and not appearing in your displays, running a patch by an administrator could correct the issue.

PIVisionPatchDisplayAFinds patches existing PI Vision displays so that elements and attributes renamed or moved on a PI AF Server automatically update if the display is newly opened or actively running. The utility requires one parameter to specify the PI Vision server. An optional second parameter specifies the path to a CSV file. If you don't specify one, output is logged to PIVisionPatchDisplayAFidsOutput.csv in the current directory.

For more information, see "Patch displays with PIVisionPatchDisplayAFinds" in *PI Vision Installation and Administration Guide*.

6. PI DATALINK: BUILDING REPORTS

6.1 PI DataLink Introduction

Learning Outcomes:

- Why use PI DataLink?
- Common terms.

PI DataLink is an OSIsoft add-in for Microsoft Excel. It lets you retrieve information from your PI System directly onto a worksheet. Combined with the computational, graphic, and formatting capabilities of Microsoft Excel, PI DataLink is a powerful tool for gathering, monitoring, analysing, and reporting PI System data.

For more information see "Introduction" in PI DataLink User Guide

PI DataLink has different functions for extracting PI System data into Excel. It is important to understand the following nomenclature when working with PI DataLink and its data retrieval functions.

Term	Meaning
Data item	A PI Point name or AF attribute name, for which the PI DataLink function returns property values.
Root path	The common path to specified data items within PI System. It is optional for PI DataLink functions. Valid entries include: Data Archive name if the data item is a PI Point. AF server and database if the data item is an AF attribute. For a data item of AF Attribute, root path can also include the name of parent elements. Blank if the data item is on the default Data Archive or the default AF Server and default database.
Output cell	The worksheet cell where the function writes the result. If you select a cell before you open the function task pane, PI DataLink inserts the selected cell into the output cell field.

✔ Quick Check

- Why would you want to use DataLink?
- What is a Root path?

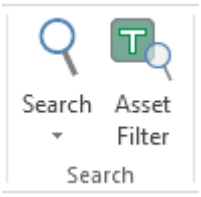
If you are unsure of the answer to these questions, ask your instructor for assistance.

6.2 Finding Data

Learning Outcomes

- Demonstrate searching for PI Points
- Demonstrate the different ways of finding element and element attributes within the PI Asset Framework (AF) hierarchy.

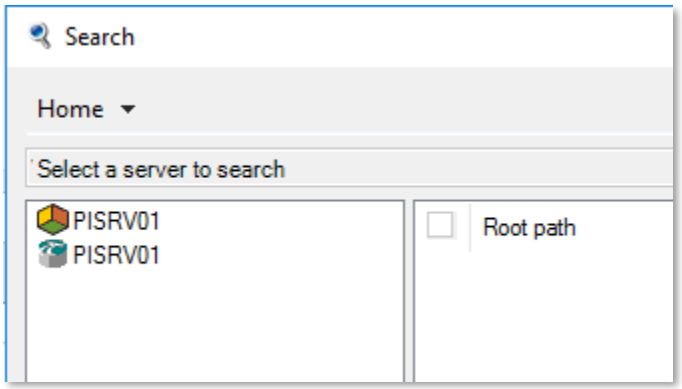
PI DataLink offers two ways to search for data items:



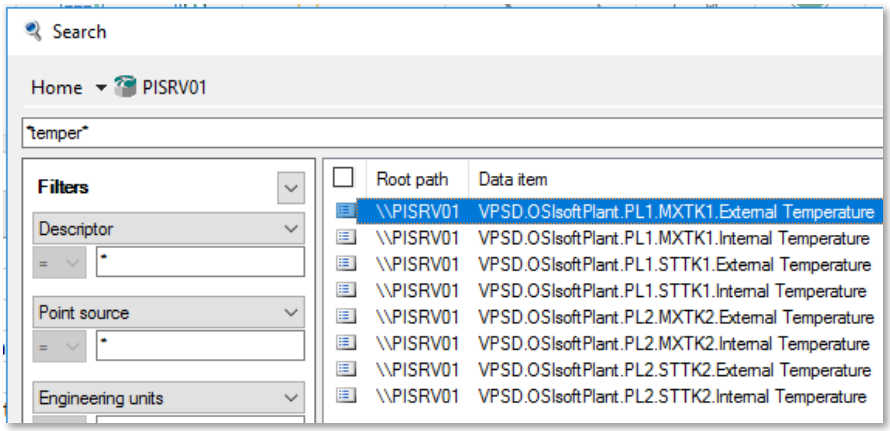
1. Search tool
2. Asset Filter Search function (this will be covered in a later section)

Search for Data Items

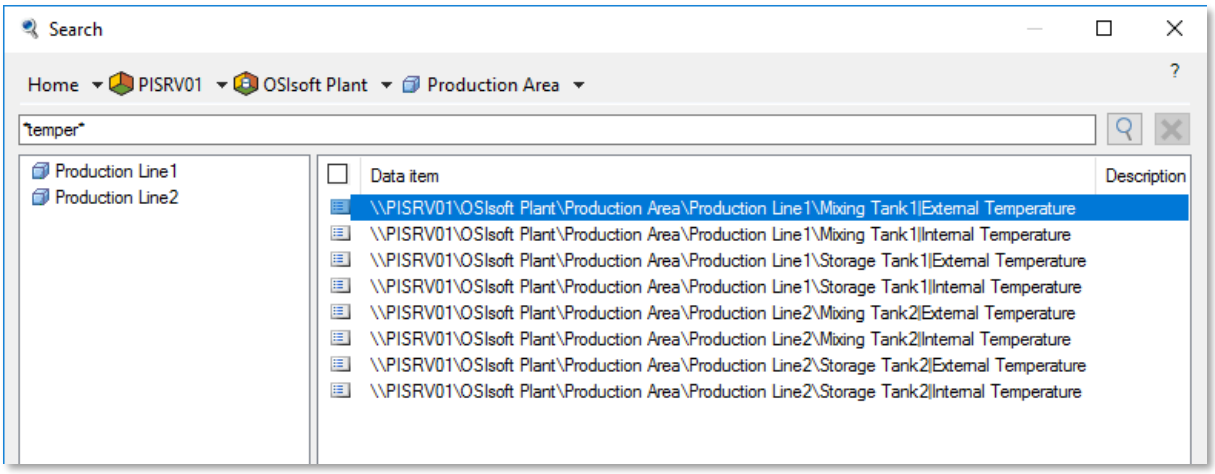
On first use, the tool starts at the Home node, which shows all the Data Archives and AF servers listed in Connection Manager. You must limit the search to a single Data Archive or single AF server, and can limit the search further to a single database on an AF server, and then to specific elements and parent attributes.



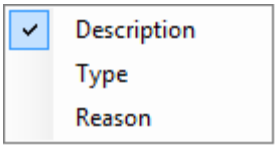
When your search scope is a Data Archive, the top search field is applied to the PI Point Name, only. Set the fields under Filters to specify any additional criteria the retrieved PI Points must match. You can use wildcard characters to augment your search.



When your scope is an AF Server or Database, the top search field is applied to AF Attribute name as well as the name, description and categories of the *parent element*.



You can change columns displayed in the results pane by right clicking a column name in the results pane and selecting which column you would like to be displayed.



6.2.1 Directed Activity – Searching in PI DataLink

You are invited to watch what the instructor is doing or perform the same steps at the same time to explore the different concepts presented in this chapter or section. *Use your own data if you have access to such data.*

Objectives

- Perform a search for PI Points and AF Attributes in PI DataLink

Activity Description

We will need to demonstrate how to use the search functionalities.

Approach

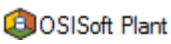
Step 1: Open Microsoft Excel.

Step 2: On the **PI DataLink** ribbon, select *Search***.**

Step 3: Select a Data Archive 

a. Search for ***temper***

b. Select an item and then **OK.**

Step 4: Select the AF Server  > 

a. Search for **flow*.**

b. Choose all items in the list.

Step 5: Select OK

✔ **Quick Check**

- Can you demonstrate searching for PI Points?
- Can you demonstrate the different ways of finding element and element attributes within the PI Asset Framework (AF) hierarchy?

If you answered NO to either of these questions, ask your instructor for assistance.

6.3 Functions Returning Data

With PI DataLink functions, you can query any Data Archive or AF server, apply calculations to retrieved results and return values to worksheet cells. These functions return results in function arrays, which you can recalculate to update values as needed.

Query Category	Function Name	What It Returns
Single value	Current Value	The current or most recent value of a Data Item
	Archive Value	Value of a Data Item at a specified time stamp
		Computed value of a performance equation at a specified time stamp
Multiple value	Compressed Data	All the values of a Data Item for a specified time period
		A specific number of Data Item values beginning at a certain time
	Sampled Data	Evenly spaced, interpolated values for a Data Item over a regular interval
		Evenly spaced, interpolated values of a performance equation over a regular interval.
	Timed Data	Actual or interpolated sample values for a Data Item at specified time stamps
		Values of a performance equation computed at specified time stamps
Calculation	Calculated Data	One or more evenly spaced, calculated values based on a Data Item's values and specified calculation preferences
		One or more evenly spaced, calculated values based on an evaluated performance equation and specified calculation preferences
	Time Filtered	The amount of time that a performance equation evaluates to true during a specified time period

For more information see "PI DataLink Functions" in PI DataLink User Guide

6.4 Single Value Queries

Learning Outcomes

- Retrieve a current value for a data item
- Retrieve an archived value for a data item
- Describe the different retrieval modes
- Retrieve data item attributes

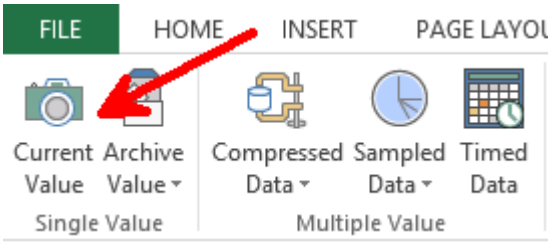
Quick Steps to Get Started

Most of the functions in PI DataLink can be done using these simple steps

> ***Step 1:*** *Select the Target cell*
> *Data/Information will be inserted below and to the right of the target cell*
>
> ***Step 2:*** *Choose the Function*
> *Search/Snapshot Value or any other function*
>
> ***Step 3:*** *Fill out the required parameters, or use cell references to make later editing easier*

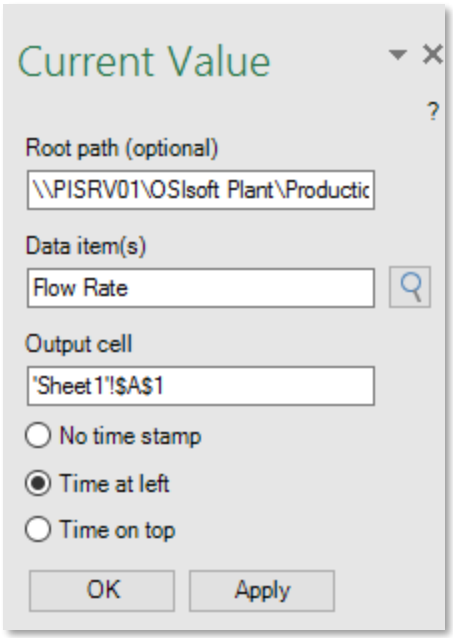
Obtain a Current Value

For the Current Value function no timestamp is required, as it is always assumed to be NOW (* in PI time or =NOW() in Excel time).

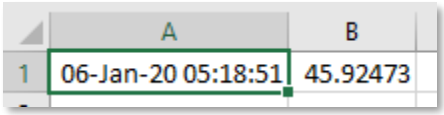


You can retrieve PI data from any PI System currently connected to your client machine. You must specify:

- **Data item(s)**
  - Can specify 1 or more, explicitly or via a cell reference
- **Output cell**
  - Any data currently in this cell will be replaced.



The result of this query will be the most current value and timestamp of the data item specified.



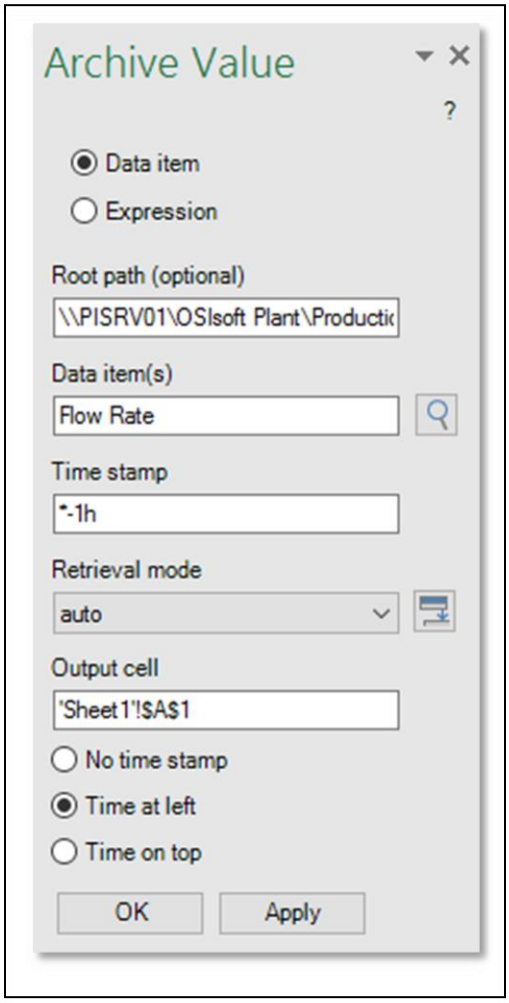
Note: Current Value is a volatile function: the function *recalculates and updates values* whenever Excel calculates or recalculates any cell in the worksheet. To force an immediate recalculation, press F9. More details in PI Current Value function video.

Obtain an Archive Value

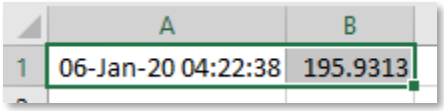
The other PI DataLink function that returns a single value is the Archive Value. This function retrieves an archived value at a specific timestamp.

You specify:

- Data item(s): 1 or more
- Time stamp: Excel Time Format or PI Time Format



The result being:



6.4.1 Directed Activity – Single Value Query

You are invited to watch what the instructor is doing or perform the same steps at the same time to explore the different concepts presented in this chapter or section. *Use your own data if you have access to such data*.

Objectives

- Perform Single Value Queries in PI DataLink

Activity Description

We would like to prepare a report that shows the current value of External Temperature, Pressure and Flow Rate of Mixing Tank2. You are also interested in knowing the value of these measurements at 7 am yesterday.

If you have access to your own data

Approach

Part 1 – Get Current Values

Step 1: Open Excel and in cell A1 type Current Values as a heading.

Step 2: Click on cell A2. Select **Current Value** function.

Step 3: Click on the magnifying glass next to **Data Item(s)** box.

Step 4: Select the AF Database of OSIsoft Plant. Type **Ext*Temp*** in the search box and click 'Enter'. The External Temperature of all four tanks should show up on the search results list. Select the External Temperature of Mixing Tank2.

Step 5: Select ***Time at Left*** and click ***OK***.

Step 6: Repeat these steps for Pressure and Flow Rate in cells A3 and A4, respectively (Tip: You can use the **Pressure** and **Flow*** filters in the search box when searching for attributes).

Part 2 – Add Archive Values

Step 1: In cell C1 type Archive Values as a heading.

Step 2: Click on cell C2. Select ***Archive Value*** function.

Step 3: Click on the magnifying glass next to **Data Item(s)** box.

Step 4: Select the AF Database of OSIsoft Plant. Type **Ext*Temp*** in the search box and click 'Enter'. The External Temperature of all four tanks should show up on the search results list. Select the External Temperature of Mixing Tank2.

Step 5: In the *Archive Value* function's configuration pane, type Y+7h in the **Time stamp** box. What time stamp will be retrieved? _____

Step 6: Select ***Time at Left*** and click ***OK***.

Step 7: Repeat these steps for Pressure and Flow Rate in cells C3 and C4, respectively (Tip: You can use the **Pressure** and **Flow*** filters in the search box when searching for attributes).

Example:

	A	B	C	D
1	Current values		Archive values	
2	20-Dec-22 19:25:38	281.1724	19-Dec-22 07:00:00	327.6573
3	20-Dec-22 19:25:38	116.3895	19-Dec-22 07:00:00	25.95572
4	20-Dec-22 19:25:38	191.2209	19-Dec-22 07:00:00	50.48545

Part 3 – Do you think this is an efficient way to search for the data item every time a value is retrieved?

6.4.2 Directed Activity – Single Value Query Using Cell Reference

You are invited to watch what the instructor is doing or perform the same steps at the same time to explore the different concepts presented in this chapter or section. *Use your own data if you have access to such data*.

Objectives

- Perform Single Value Queries in PI DataLink

Activity Description

You would like to include the current value of External Temperature of Mixing Tank1 in your daily report. You are also interested in the value of this tank's External Temperature at 7 am today.

Approach

Part 1 – Build a Template

Step 1: Open Excel and click on cell A2. Click on ***Search***.

Step 2: Select the AF Database of OSIsoft Plant. Type **Ext*Temp*** in the search box and click 'Enter'. The External Temperature of all four tanks should show up on the search results list.

Step 3: Select the external temperature of Mixing Tank1 and click ***OK***.

Step 4: In cell B1 type Current Value. In cell D1 type Archive Value as headings.

Step 5: In cell A4 type Timestamp, in B4 type t+7h. What time do you expect to see?

_____

Step 6: Your report template will look similar to this:

	A	B	C	D	E
1		Current Value		Archive Value	
2	\\PISRV1\OSISoft Plant\Production Area\Production Line1\Mixing Tank1|External Temperature				
3					
4	Timestamp	t+7h			

Part 2 – Query PI Data

Step 1: Select cell B2 (this will be your Output cell). Click on **Current Value** function.

Step 2: Refer to cell A2 in the **Data Item** field and select **Time at left**. Click **OK**.

Step 3: Select cell D2 (this will be your Output cell). Click on **Archive Value** function.

Step 4: Refer to cell A2 in the **Data Item** field. In the **Time stamp** field refer to cell B4. Do not change any of the other options. Select ***Time at left*** and click ***OK***.

6.4.3 Exercise –Temperature at a Glance

This solo or group activity is designed to maximize learning in a specific topic area. Your instructor will have instructions and will coach you if you need assistance during the activity. *Use your own data if you have access to suitable data*.

Objectives

- Extract values and attributes from the PI System using the following functions:
  - Current value.
  - Archive value.

Activity Description

You would like to include the current value of the External Temperature of all Tanks in your daily report. You are also interested in knowing the value of the tanks' External Temperature at midnight.

Approach

Step 1: Open the file *PI_DataLink-Exercises.xlsx*.

Step 2: Save it as*<your initials>_ PI_DataLink-Exercises.xlsx* then work on sheet *Temperature at a Glance* and fill in data into all of the fields.

Step 3: Use the **Current Value** and **Archive Value** queries to fill in the template. We should base our PI DataLink queries on cell references whenever possible.

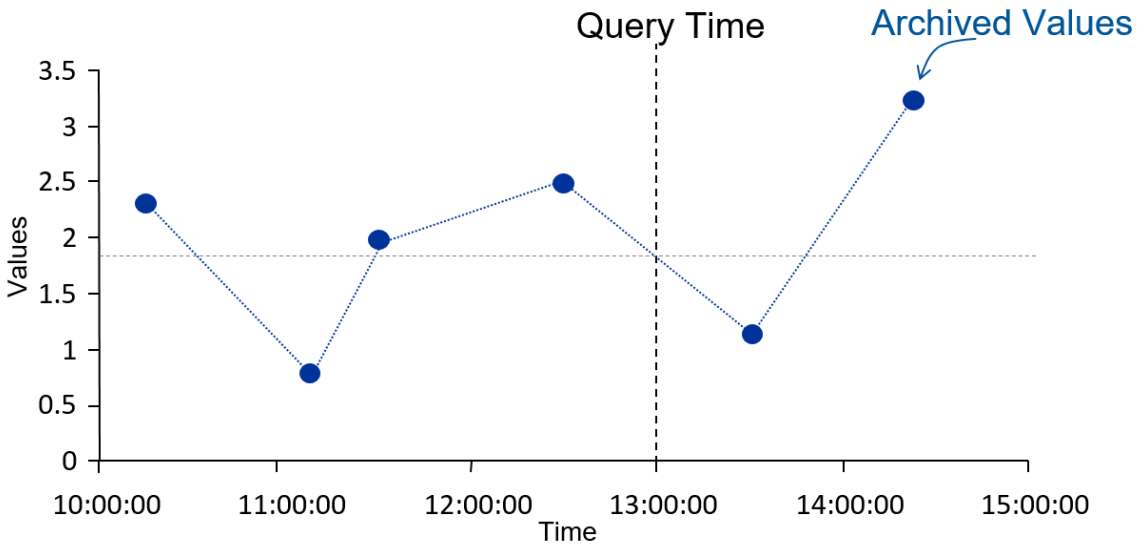
Retrieval Mode

When bringing the archive value to our report, we saw that a timestamp needs to be specified and the archived value will be retrieved for that timestamp. There may or may not be a value archived at the specified timestamp; how does PI DataLink decide just what data is retrieved?

You can decide the data retrieval behavior by selecting different options from the **Retrieval Mode** drop down list. The default option is **Auto**. Different modes will retrieve the value differently, as listed in the following table:

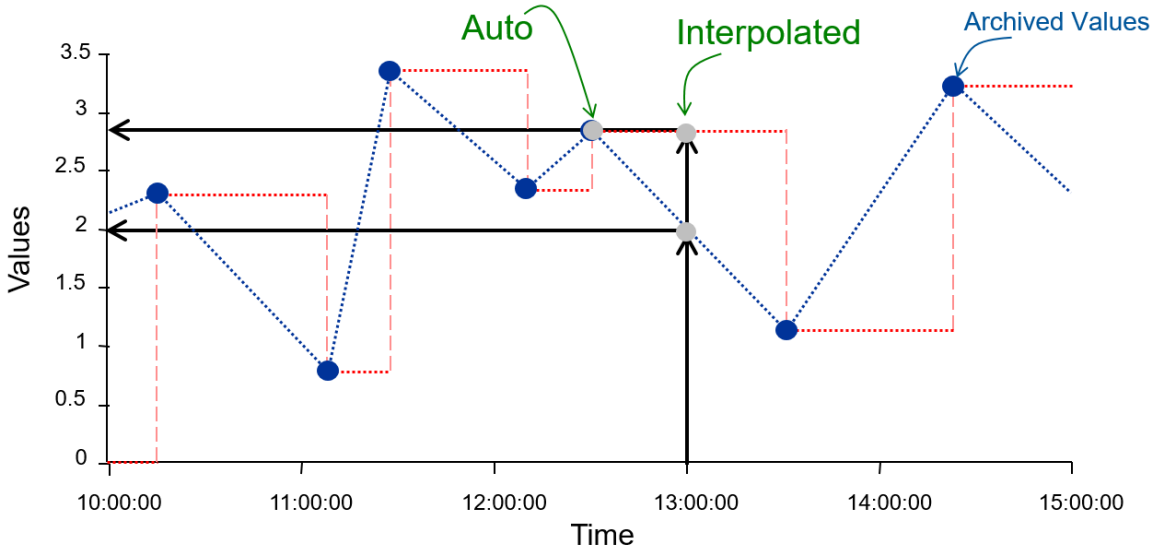
Retrieval Mode	Data retrieval behavior
Auto	(**Default**) Interpolates at the exact timestamp provided, unless the data item is a step point, which would retrieve the previous value.
Interpolated	Always interpolates at the exact timestamp provided.
Previous, Next	Retrieves the previous or next compressed event from the timestamp specified. If a compressed event does exist at the exact timestamp, it is retrieved.
Previous Only, Next Only	Same as Previous, Next, except it will ignore any event at the exact timestamp specified.
Exact Time	Retrieves the value if and only if an archived value exists at that exact timestamp (down to the second).

The graph and table below exemplify the different retrieval modes.



Retrieval Mode	Timestamp	Value
Interpolated	13:00:00	1.8
Previous	12:30:00	2.5
Next	13:30:00	1
Exact	No events found.	No events found.

The next graph shows the difference between Auto and Interpolated for a step point and an analogue point. The table shows the timestamps and values corresponding to this particular example:



	Auto	Interpolated
Step OFF (Rate point)	13:00:00 - 2	13:00:00 - 2
Step ON	**12:30:00 – 2.8**	13:00:00 – 2.8

6.4.4 Exercise – Activity Report

This solo or group activity is designed to maximize learning in a specific topic area. Your instructor will have instructions and will coach you if you need assistance during the activity. *Use your own data if you have access to such data*.

Objective

- Extract values and attributes from the PI System using the following functions:
  - Current value.
  - Archive value.

Activity Description

Your manager needs a report they can open each afternoon to see the current values of KPI's for Mixing Tank2, which are:

- External Temperature
- Internal Temperature
- Level
- Flow Rate

Your manager needs to see the KPIs values at midnight today. Not trusting this new "PI Thing" your manager wants to see archive values around midnight as well as be able to type in a timestamp and see if there is an archive value at an exact time.

Approach

Step 1: Open *<your initials>_PI_DataLink-Exercises.xlsx* then work on sheet *Activity Report* and fill in the data in all fields.

Step 2: Use the **Current Value** and **Archive Value** queries to fill in a template.

✔ **Quick Check**

Can you:

- Retrieve a current value?
- Retrieve an archived value?
- Describe the different retrieval modes?

If you answered NO to any of these questions, ask your instructor for assistance.

6.5 Multiple Value Queries

Learning Outcomes

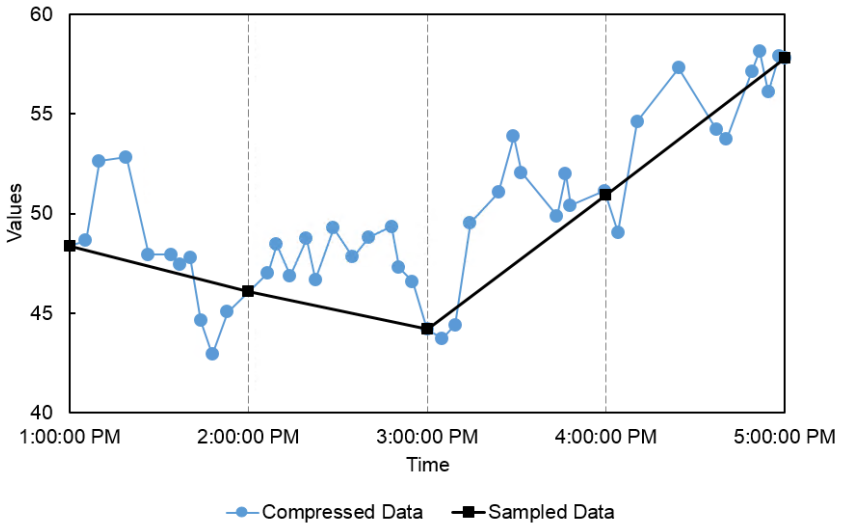
- Retrieve compressed data for a point.
- Retrieve sampled data for a point.
- Retrieve timed data for a point.

There are three types of queries that return multiple values.

Compressed Data	Actual archived data and is more properly termed Archived data, as not all data may be compressed.
Sampled Data	Evenly spaced interpolated data
Timed Data	Interpolates events to match existing timestamps

Below is a graph of Compressed Data compared to Sampled Data. The Compressed Data function returns all the data that had been archived for the data item of interest. Time intervals between the compressed data values are uneven and depends on when the data was received and archived by the PI System.

You may need to know the value of a data item at specific timestamps, for example at the beginning of every shift. Or you may need to compare the values of two different data items and having unevenly spaced time intervals would not be that helpful. In these cases, using the Sampled Data function is helpful in creating a PI DataLink report.



Retrieving Compressed Data

The **Compressed Data** function retrieves the actual archived data from the Data Archive.

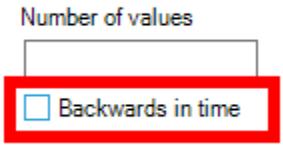
You must specify:

- **Data item(s):** Can specify 1 or more
- **Output cell:** Any data currently in this cell will be replaced
- **Start Time** and **End Time**.

Note: If you switch the timestamps for **Start** and **End Times**, the data will be returned in reverse order.

There are several optional checkboxes that will affect what is displayed, none of which are selected by default:

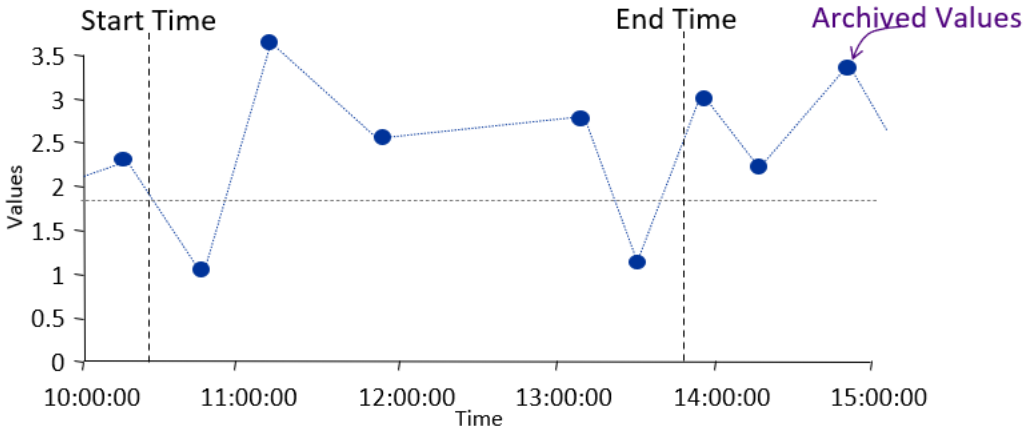
- **Hide count**: When this box is unchecked, the top line of your results will return the number of events found within that time range. When this box is checked, this count is not displayed and only the results are shown.
- **Show time stamps**: This checkbox determines if only the point values are returned, or if the corresponding timestamp is also retrieved.
- **Show Value Attributes** and **Show Annotations**: will return additional fields if there are any annotations or quality bits associated with the compressed events within the time range specified.
- **Column** and **Row**: This pair of radio buttons determine if the results are returned in columns or rows.
- The **Number of Values** option for this query behaves similarly, but rather than a specific time range, you will specify a **Start Time** and the **Number of Values** that you would like to retrieve. You can also check the box to have this go backwards, rather than forwards in time.



Boundary Types

Boundary type is the method that the function uses to determine which values to return near the start time or end time:

- **Inside**(default): Returns values at start and end times, if they exist, or the nearest values that occur within the range.
- **Outside**: Returns the nearest values that occur immediately outside the range.
- **Interpolated**: Returns interpolated values at the start and end times.
- **Auto**: Returns interpolated values but uses the inside method for data items with step attributes.



Boundary Type	Number of Values Retrieved
Inside	5
Outside	7
Interpolated	7

Obtaining Sampled Data

Sampled Data retrieves evenly spaced interpolated values from the archive. You specify:

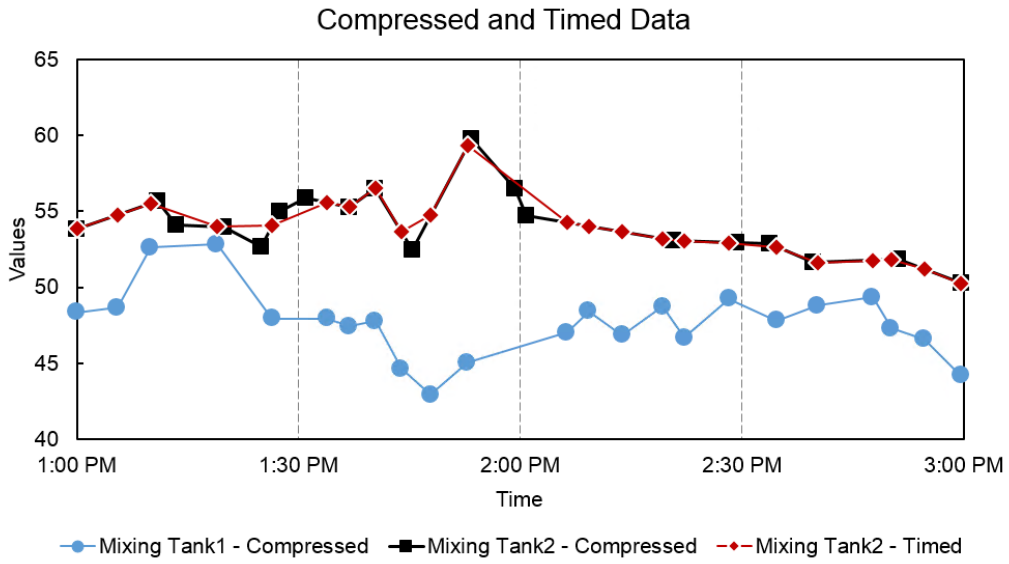
- **Data item(s):** Can specify 1 or more
- **Output cell:** Any data currently in this cell will be replaced
- **Start Time** and **End Time**.
- **Time Interval:** Used to divide the time range into discreet intervals.

Timed Data

The Timed Data function retrieves interpolated events to match existing timestamps. These time stamps are already in your spreadsheet and may be as a result of a related data item query.

The **Data item**, **Retrieval mode**, and **Output cell** need to be specified. In this case, the times used to retrieve events will be a range of cells containing timestamps. This is typically done by querying one point for events, and then using those timestamps to find the values for other, related points. The graph below shows an example of the External Temperature for Mixing

Tank1 queried for Compressed data, then going to Mixing Tank2 and getting the Compressed Data then the Timed Data matched to Mixing Tank1 External temperature timestamps.



6.5.1 Directed Activity – Archived, Sampled and Timed Data Functions

You are invited to watch what the instructor is doing or perform the same steps at the same time to explore the different concepts presented in this chapter or section.

Objectives

- Retrieve archive data with the different multiple value functions

Activity Description

You would like to analyze the archived values of the External Temperature of Mixing Tank1 in your daily report for the first two hours of every day. You would also like to see this temperature value every 10 minutes during these two hours.

You are also interested in doing a comparison between Mixing Tank1 and Mixing Tank2 at the timestamps where there is a value archived for external temperature of Mixing Tank1.

Approach

Part 1 – Build a Template

Step 1: In Excel, create a Template for your report by typing Data Item, Start Time, End Time and Time Interval in cells A1, A3, A4 and A5, respectively.

Step 2: Using Search, find the attribute External Temperature for Mixing Tank1 and Mixing Tank2 and place them in cells B1 and B2, respectively.

Step 3: Type the Start Time of **T** (in cell B3), End Time of **T+2h** (in cell B4) and time interval of **10m** (in cell B5).

Step 4: Type *Mixing Tank1* in cell C1 then merge cells C1 through F1.

Step 5: Type *Compressed* in cell C2 then merge cell C2 and D2.

Step 6: Type *Sampled* in cell E2 then merge cell E2 and F2.

Step 7: Type *Mixing Tank2* in cell G1 then merge cells G1 through J1.

Step 8: Type *Compressed* in cell G2 then merge cell G2 and H2.

Step 9: Type *Sampled* in cell I2 then merge cell I2 and J2.

Your format will look like:

	A	B	C	D	E	F	G	H	I	J
1	Data item	\\PISRV01\OSIsoft Plant\Production Area\Production Line1\Mixing Tank1|External Temperature	Mixing Tank1				Mixing Tank2			
2		\\PISRV01\OSIsoft Plant\Production Area\Production Line2\Mixing Tank2|External Temperature	Compressed		Sampled		Compressed		Sampled	
3	Start time	T								
4	End time	T+2								
5	Time Interval	10m								

Part 2 – Query PI Data

Step 1: Obtain the compressed data for Mixing Tank1 External Temperature and list it in cell C3.

Step 2: Do the same for Mixing Tank2 in cell G3.

Step 3: Obtain the Sampled data for Mixing Tank1 External Temperature in cell E3.

Step 4: Do the same for Mixing Tank2 External Temperature in cell I3.

Step 5: Comparing the timestamps of the *Compressed* data for the two mixing tanks you notice they are not the same so the comparison can't be accurately done. To have a better comparison, use **Timed Data** function and get the External Temperature of Mixing Tank2 at the timestamps in Column C.

6.5.2 Exercise – Tank Analysis Report

This solo or group activity is designed to maximize learning in a specific topic area. Your instructor will have instructions and will coach you if you need assistance during the activity. *Use your own data if you have access to suitable data*.

Objective

- Extract values and attributes from the PI System using the following functions:
  - Compressed Data.
  - Sampled Data.

Activity Description

Show the archived values of the **Pressure** of the two **Mixing Tanks** listed in your daily report for the **past 24 hours**. When retrieving the raw archived data for this process variable, you prefer to see **one value each hour for the past 24 hrs**.

You will use this report to do some analysis on this critical process variable of the mixing tanks.

Approach

Step 1: Spend a few minutes and fill out the following table:

Data Item	
Start Time	
End Time	
Time Interval	

Step 2: Open *<your initials>_PI_DataLink-Exercises.xlsx* then work on sheet *Tank Analysis Report* and fill in data for all of the fields.

Step 3: We will use the **Compressed Data** and **Sampled Data** queries to fill in a template.

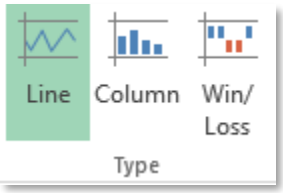
Bonus 1

Using Excel functions, modify your report such that you get one value at the top of each hour for the past 24 hours.

Bonus 2

The Excel Insert tab in the **Sparklines** section has several options to show lines and columns as well as additional options to format the axes and colors.

To use this functionality, first select the cell where you want to place the Sparkline. Then choose the Sparkline type. For Data Range, select the cells with the data (just select the values, not the timestamps). Verify your output cell and choose OK. The result is a small trend of your data, with an assumption of evenly spaced values over time.



6.5.3 Directed Activity – Multiple Value Queries

Instructor led class discussion.

Objectives

- Determine the best multiple value query for the job

Activity Description

You have just built a report to analyze the values for the pressures of all mixing tanks in your plant for the past 24 hours.

Approach

Part 1

Do you think the report you built is efficient? Since the same analysis would be done on the values retrieved for the internal and external temperatures of each of the mixing tanks, do you think your report can be built in a better way?

Part 2

What would you do if there were 50 mixing tanks in your plant and you needed to repeat the same process for each of them?

✔ **Quick Check**

Can you:

- Retrieve compressed data for a point?
- Retrieve sampled data for a point?
- Retrieve timed data for a point?

If you answer no to any question, ask your instructor for assistance.

6.6 Element Relative PI DataLink Reports

Learning Outcomes

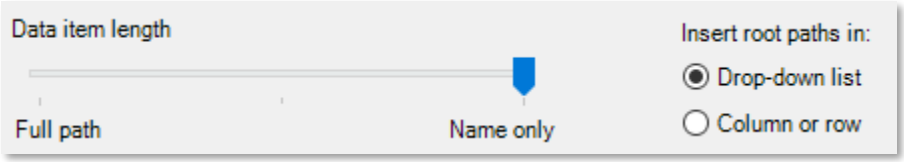
- Create Asset reports based on AF element templates
- Use Filters to search for Assets.

PI DataLink promotes the reusability of PI DataLink reports and the creation of Element Relative PI DataLink Reports.

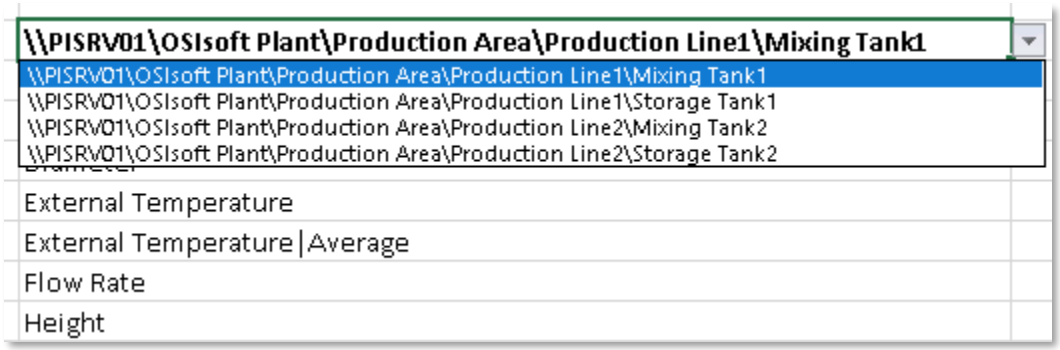
This functionality is provided via Search.

You will need to:

- Set the Root path length to the mark *before* **Name Only**
- Insert root paths in: **Drop-down list**



resulting in:



Search for Assets by Filtering

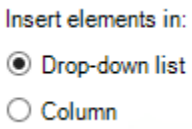
The Element Relative search functionality is provided in PI DataLink through the Asset Filter search option. The Asset Filter is helpful for searching the AF database for elements and filtering the returned elements by the attribute values. Note that you must select an element template to filter elements if using attribute values.

The Asset Filter Search function returns assets that meet specified filter criteria. The returned assets can be used in the worksheet as a function array which can update automatically, or as static values.

The filter criteria include:

- Element name
- Element template
- Element category
- Element description
- Value of attributes

Using the Asset Filter, you will have the option of returning the search results in a Drop-down list which would be used in building reusable reports.



Note: The Asset Filter option provides more options in filtering different assets and attributes when creating an Element Relative Report. However, it requires a template for filtering the related assets. More details in Element relative PI DataLink reports video.

6.6.1 Directed Activity – Element Relative PI DataLink Reports

You are invited to watch what the instructor is doing or perform the same steps at the same time to explore the different concepts presented in this chapter or section. *Use your own data if you have access to suitable data*.

Objectives

- Create an element relative PI DataLink report

Activity Description

You want to create a report to review the internal and external temperatures for all of the tanks.

Approach

We will follow two approaches in creating this report. The first approach is to use the Search functionality while the second approach is to use the Asset Filter functionality.

Method 1: Using Search

Step 1: Choose cell A1 in Excel

Step 2: Select the AF Server > OSIsoft Plant > Production Area in Search.

Step 3: Search for *TEMP*
You will notice that the results include all the attributes because their parent elements are based on the template named “Generic Tank Template”.

Step 4: Repeat the search for *TEMPER*

Step 5: Select all eight (8) results using the <Shift> Click (or individually with Ctrl Click).

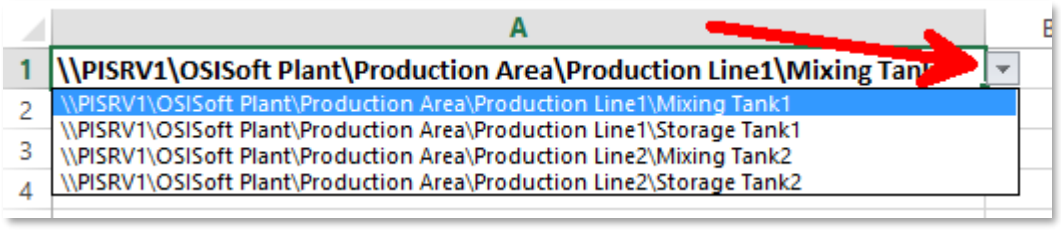
Step 6: Use the **Root path length** slider set to the mark before **Name Only.**

Step 7: Set ‘Insert root paths in:’ to Drop**-down list**.

Step 8: Choose cell B2 and select the **Current Value** function.

Step 9: Select the cells for **Data item(s)** and **Root Path**.

Step 10: Now the Tank path can be modified with the drop-down list.



Method 2: Using Asset Filter

Step 1: Add a new sheet.

Step 2: Choose cell A2.

Important

When working with Asset Filter and selecting the Drop-down list, the drop-down list will appear in the cell **above** your Output cell. The selected Output cell is where the selected attributes will start being listed.

Step 3: Click on **Asset Filter** from the Search section.

Step 4: Under the **Root path** specify the path to the Production Area Element in the form of \\PISRV01\OSIsoft Plant.

Step 5: Under the **Element template,** select “Generic Tank Template”.

Step 6: Under the **Attributes to display,** select External Temperature and Internal Temperature.

Step 7: Select **Drop-down list.**

Step 8: Click **Apply.**

6.6.2 Exercise – Operational Start Up

This solo or group activity is designed to maximize learning in a specific topic area. Your instructor will have instructions and will coach you if you need assistance during the activity. *Use your own data if you have access to suitable data*.

Objective

- Retrieve data using the **Compressed Data** and **Sampled Data** functions.

Activity Description

You want to determine if there is any deviation between start-up of operations for today compared to yesterday, during the same period of time. Four tanks exist on your plant and you want to be able to build and reuse a single report for all tanks.

- Your daily shift starts at 6:30 am and the critical start up time is the first 2 hours after the start up.
- Gather the values for the external temperature for this period of time for today and yesterday
- Compare the two by calculating the ratio of the two days' values (ideally, the ratio should stay as close as possible to 1).

Approach

Step 1: Spend a few minutes to fill out the following table:

Root Path	**Note**: This must be displayed as a drop-down menu.		
Data Item			
Yesterday's Start Time		**Yesterday's End Time**	
Today's Start Time		**Today's End Time**	
Time Interval	4 Minutes		
Function for Comparison (ratio)	=ValueA / ValueB		

Step 2: You will use the template provided in sheet *Operational Start Up* in the *PI_DataLink-Exercises.xlsx* file.

Step 3: Use both PI DataLink functions of Compressed and Sampled data in retrieving the values and doing the comparison.

✔ **Quick Check**

- Can you create Asset based reports?

- Can you use Filters to search for Assets?

If you answered NO to either of these questions, ask your instructor for assistance.

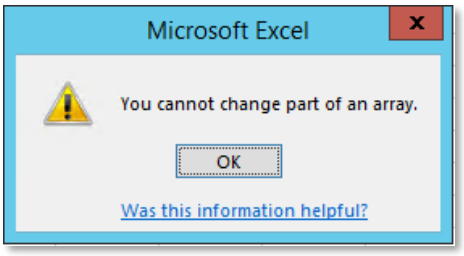
6.7 Excel Arrays in PI DataLink

Learning outcomes

- Identify when it is necessary to resize an array.
- List the ways to resize and edit an array.

Resizing an Excel Array

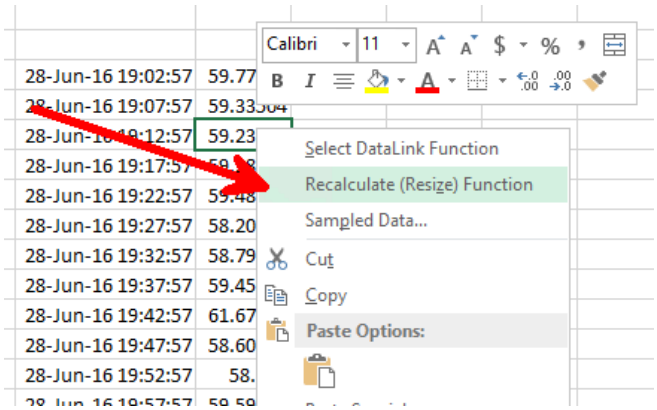
When using the PI DataLink product, end users may see this message below:



The **Multiple Value** functions just discussed return an array of values and timestamps. This array cannot be modified cell by cell, but the entire array can be modified. These values can change in size based on the point used, the time range specified, and exception and compression settings. Therefore, it can be necessary to resize the array.

If too many values are returned, you will receive the message "**Resize to show all values**" at the bottom of the array.

The easiest way to resize an array is to right click anywhere in the array, and choose **Recalculate (Resize) Function**



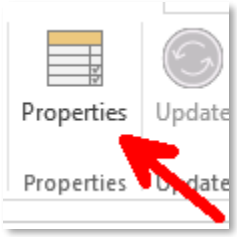
For more information see "Function arrays" in PI DataLink User Guide

✔ Quick Check

- Is the above concept clear? If not consult your friendly instructor.

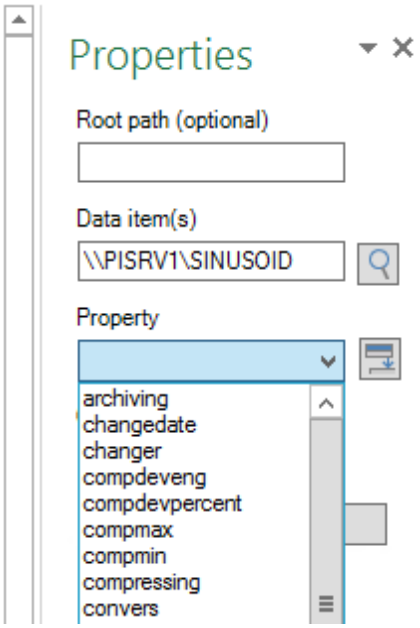
6.8 Units of Measure and Descriptions as Context in Reports

It is possible to add Units of Measure (UOM) and Descriptions to reports. Doing so will add more context to consumers. It is possible to retrieve these attributes, and any other attributes, for a data item using the **Properties** function.

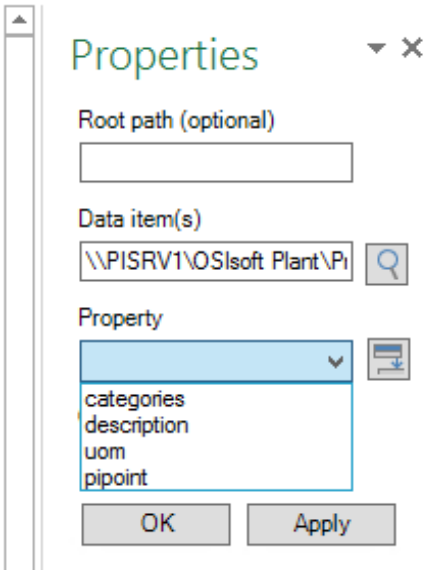


Different Properties will be shown depending on the Data Item listed. For both PI Points and AF Attributes, the Units of Measure are shown as UOM in PI DataLink Properties list.

Data Archive



AF Server



6.9 More PI DataLink Functions

Learning Outcomes

- Obtain calculated values.
- Obtain filtered values.
- Understand Conversion factors.

In the previous chapters, we used different PI DataLink functions to access the raw data stored in PI Server. However, you may not be interested in bringing all the raw data but instead apply calculations on these raw values as they are retrieved from PI Server.

PI DataLink offers two ways to bring in calculated values:

1. Use different predefined calculation modes in PI DataLink as part of the Calculated Data function.
2. Use custom expressions in defining your desired calculation. The syntax used in these calculations is the same as Performance Equations syntax which is explained later.

Calculated Data

The Calculated Data function returns a single calculated value or evenly spaced calculated values for a PI Point or an AF Attribute. Calculation modes are:

- Total
- Minimum
- Maximum
- Standard deviation
- Range
- Average
- Count
- Mean

These **summary** calculations provide statistical information for data over a specified time period.

Selecting the Data Item radio button of the Calculated Data Function, you will see most of the fields are similar to the other PI DataLink functions you have already worked with.

Some of the fields specific to this function are:

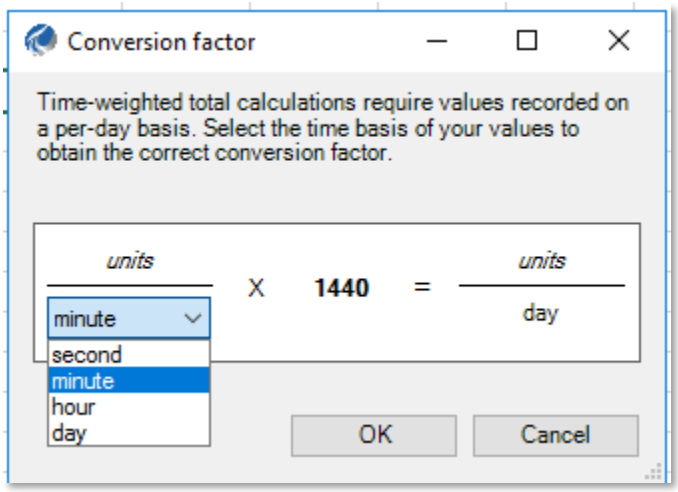
- **Time interval**: An optional field. If used, it allows the behavior to be similar to the Sampled Data function and the calculations will be done for the evenly spaced time intervals.
- **Calculation mode**: The available modes are the ones listed above.
- **Show percent good**: Checking this option displays the percentage of good data for the calculation time range. You can use this to determine if you want use data that may not be 100% ‘good’.

Note: A Bad value for PI System is defined as any of the digital states from the System Digital State Set in the Data Archive. Examples are I/O Timeout, No Data, Shutdown, No Sample, Intf Shut and Arc Off-line. It makes no inferences about the Quality of the data in the plant.

- **Conversion Factor**: If the calculation mode is set to **Total,** the conversion factor may need to be changed to a number other than 1.

For time-weighted total calculations, use the Conversion Factor calculator. From the dropdown select based on the units of measure of the process variable. The required conversion factor number will then be calculated and placed in the Conversion factor field.

When you click on the calculator icon next to the Conversion factor entry field you will get a popup that lets you select the appropriate conversion factor:



6.9.1 Directed Activity – Calculated Data

You are invited to watch what the instructor is doing or perform the same steps at the same time to explore the different concepts presented in this chapter or section.

Objectives

- Use the calculated data function in PI DataLink

Activity Description

We want to practice how to use Calculated Data and obtain the Average, Maximum and Minimum of Flow Rate for Mixing Tank1 for the period of past two hours and for the past one day.

Approach

Step 1: In Excel create a template with

a. **Root Path**: \\PISRV01\OSIsoft Plant\Production Area\Production Line1\Mixing Tank1

b. **Data Item**: Flow Rate

c. **Start Time**: *

d. **End Time**: *-2h

Step 2: Obtain the Average, Maximum and Minimum Flow Rate for this tank and for the past one day.

Step 3: Change the End Time to *-1d to see the PI Server recalculate these values.

	A	B	C	D	E
1			Average	Maximum	Minimum
2	Root Path	**\\PISRV1\OSISoft Plant\Production Area\Production Line1\Mixing Tank1**			
3	Data Item	Flow Rate			
4	Start Time	*			
5	End Time	*-2h			

Calculating Total and the Conversion Factor

The conversion factor is a multiplier used to change a number from one unit of measure to another.

Ex: 1000 g per kg, 2.54 cm per inch, 24 hours per day, 1440 minutes per day

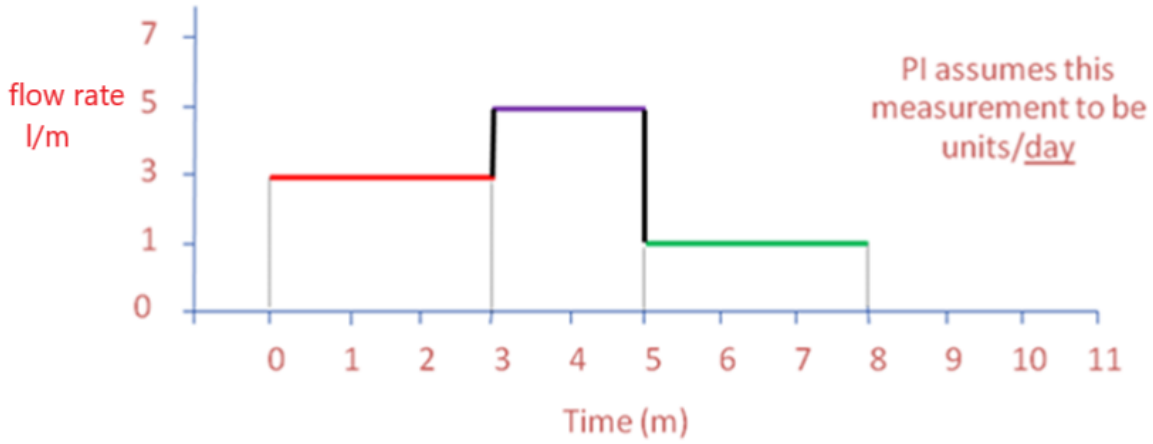
Since the Data Archive is not aware of engineering units, it assumes that rate points are in terms of units per day. Typically, this assumption is inaccurate as many points are measured in terms of units per second, units per minute, or units per hour. When using the **Total** function in **Calculated Data**, a conversion factor must be used to correct PI's assumption that the data is in units per day. The conversion factor is equal to 1.0 when the source data are in units per day.

Actual Engineering Unit of the Rate Point	Engineering Unit Assumed by Data Archive	Conversion Factor
units / day	units / day	1
units / hour	units / day	24
units / minute	units / day	1440
units / second	units / day	86400

Example: Flow rate is measure in liters per minute (l/m) and stored in the Data Archive. We are interested in calculating **total** liters for an 8-hour period. Shown in the following illustration, flow rate is:

- 3 l/m for 3 minutes
- 5 l/m for 2 minutes
- 1 l/m for 3 minutes

Total flow, is the area below the flow rate line (the area of the three rectangles added up).



The expected total flow would, therefore, be:

(3 l/m x 3 min) + (5 l/m x 2 min) + (1 l/m x 3 min) = 22 liters

Data Archive, however, assumes the unit of measure of the flow rate is gallons per day. Without applying the conversion factor, the total flow calculated by Data Archive is returned as:

(3 liters per **day** x 3 min x 1 day/1440 min) + (5 liters per **day** x 2 min x 1 day/1440 min) + (1 litre per **day** x 3 min x 1 day/1440 min) = 0.01528 liters

The total computed by the Data Archive must be multiplied by the conversion factor of 1440 to get 22 liters:

0.01528 liters x 1440 = 22 liters

When the calculation mode is **Total** and part of the archived data within the range is bad, the reported value is equal to the calculated total value divided by the fraction of the time period with good, archived data. This data normalization is equivalent to the assumption that for the bad data time range, the point value takes on the average value of the entire range. However, this assumption may not be valid when a large fraction of the time range contains bad data. Therefore, we recommend that you always look at the **percent good** value before using the calculation result.

For more information see "Calculated Data function" in PI DataLink User Guide

6.9.2 Directed Activity – Calculating the Total

You are invited to watch what the instructor is doing or perform the same steps at the same time to explore the different concepts presented in this chapter or section.

Objectives

- Calculate the Total value using the Calculated Data function

Activity Description

We want to calculate the total Flow and the Average Flow Rate of Mixing Tank1 for yesterday. To know what conversion factor to use, we need to bring the UOM of Flow Rate for Mixing Tank1.

Approach

Step 1: In Excel create a template with

a. **Root Path**: \\PISRV01\OSIsoft Plant\Production Area\Production Line1\Mixing Tank1

b. **Data Item**: Flow Rate

c. **Start Time**: Y

d. **End Time**: T

Step 2: Add a cell to your report template titled UOM and get this value for Flow Rate using **Properties**.

Step 3: Add a cell to your report template titled Conversion Factor and write the appropriate value there.

Step 4: Calculate the Average

Step 5: Calculate the Total of Flow for the time range (don't forget the Conversion Factor!)

Step 6: Add the percent good.

Root path	\\PISRV01\OSIsoft Plant\Production Area\Production Line1\Mixing Tank1	**average**	**total**	**% good**
Data item	Flow Rate			
Start time	Y			
End time	T			
UOM				
TOTAL conversion factor				

6.9.3 Exercise – Production Summaries

This solo or group activity is designed to maximize learning in a specific topic area. Your instructor will have instructions and will coach you if you need assistance during the activity.

Objective

- Extract calculated values using the **Calculated Data** function.

Activity Description

As the production manager, you want to create a report showing last week's production statistics. You want to display the following for the production from each day of the past 7 days:

- Total
- Average
- Maximum

You also want to do the same calculations for the entire week.

Approach

Step 1: On the PI Server, the production is the sum of the productions from the two production lines and is stored as an attribute named **Production** under the element of **Production Area**. It is defined as the sum of the flows of the two Mixing Tanks in liters per minute.

Step 2: Spend a few minutes and fill out the following table:

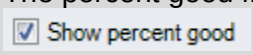
Root Path	
Data item	
Start time:	
End time:	
Time interval:	
UOM	

Step 3: You will use the template provided in sheet *Production Summaries* of the file *<your initials>_PI_DataLink-Exercises.xlsx*. Use the values of your table in the provided template.

Note:

When working with the weekly total, do not use the time interval. Only use it for the daily total (hint).

Be sure to show the Start Time for the daily Calculations.

The percent good field is located to the right of an aggregate calculation, so use 

with the **Maximum**.

✔ **Quick Check**

Can you:

- Obtain calculated values?
- Understand Conversion factors?

If you answered NO to any of these questions, ask your instructor for assistance.

6.10 Using Time Filtered Data in a Preventative Maintenance Example

Learning Outcomes

- Using the Time Filtered Function

Time Filtered Data

You have a Pump and would like to implement a Preventative Maintenance program. Firstly, you need to determine the period that the pump was running. These total hours can then be checked against the replacement period as indicated in the pump manufacturer's datasheet; every 10,000 hours, for example.

If you have a PI Point recording the status of the pump (when it is ON or OFF) you can report your Preventative Maintenance program by using the **Time Filtered** function. This function returns the amount of time that a performance equation evaluates to true during a specified time period.

You need to specify the following fields for this function:

- **Expression(s):** Can specify 1 or more and it would follow the Performance Equation format. Data items permitted in expressions are:
    - PI points
    - AF attributes that store data references to PI points
    - AF attributes that store constant values
- **Start Time** and **End Time**.
- **Time Unit:** i.e., The pump was running for 5 seconds/minutes/hours/days

6.10.1 Directed Activity – Controller State

You are invited to watch what the instructor is doing or perform the same steps at the same time to explore the different concepts presented in this chapter or section.

Objectives

- Extract Time Filtered data in PI DataLink

Activity Description

We want to determine the amount of time a controller has been in the **CASCADE** state. The controller is a digital point, named **CDM158**, and has five (5) discrete states. We are only concerned with the CASCADE state at this time.

Approach

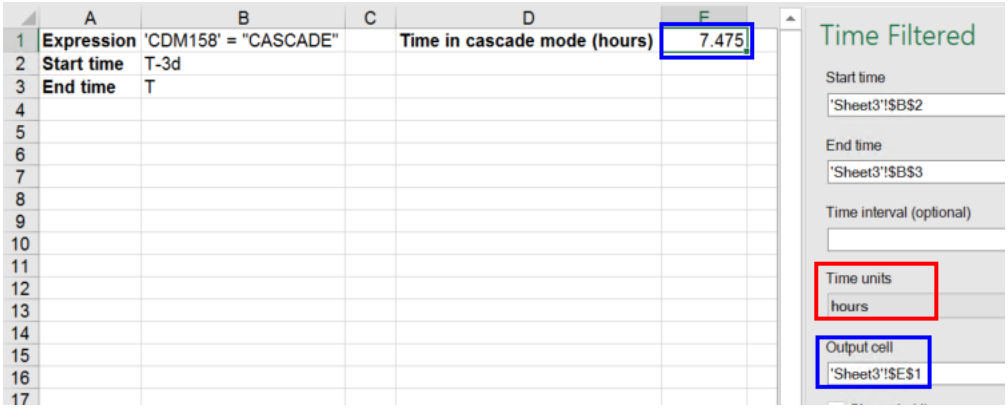
Step 1: In Excel create a sheet with

a. **Expression:** ‘‘CDM158’ = “Cascade”
b. **Start Time:** T-3d
c. **End Time**: T

Step 2: Click on an empty cell and create a label for the result named **Time in Cascade mode (hours)**, then click in an empty cell next to it (this will be our output cell).

Step 3: Select the Time Filtered function.

Step 4: Use cell references to fill out the required parameters and select hours for the *Time units* field. Example:



6.10.2 Directed Activity – Mixing Tank Level Control

You are invited to watch what the instructor is doing or perform the same steps at the same time to explore the different concepts presented in this chapter or section.

Objectives

- Use an expression in the **Time Filtered** function

Activity Description

Mixing tank1 level going above 7 is an indication of malfunctioning of the pump. In our analysis report, we want to find out for how many hours the pump was malfunctioning yesterday.

Approach

Step 1: In Excel create a report template like the screenshot at the end of the activity.

Step 2: Select cell B1 and search for the Mixing Tank1 Level attribute.

Step 3: Modify the expression and apply the PE syntax rules to ‘level’>7

Important Note: The first ‘ in an Excel cell is used to signify that the cell content is text and that no Excel formulas should be interpreted. To include an expression in a cell, you need to put a ‘ at the beginning of the expression.

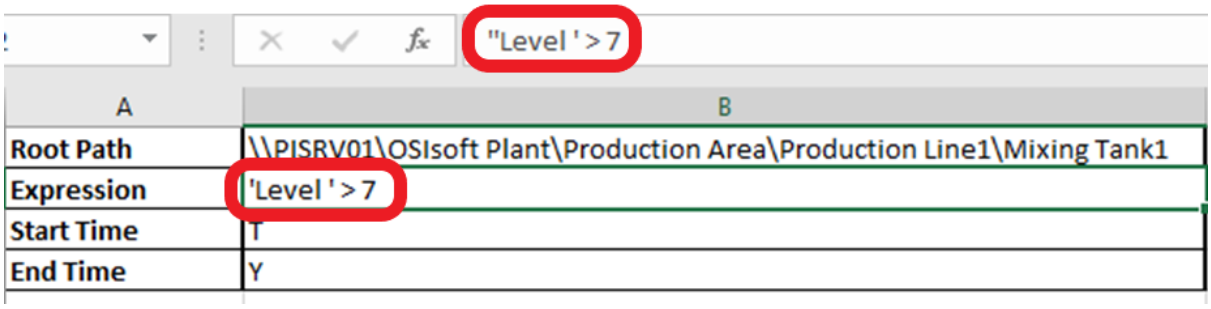
Step 4: Complete the report template with these values:

a. Start Time: T

b. End Time: Y

c. Time Units: Hours

Step 5: Select the Time Filtered function and use the output cell as B6.



6.10.3 Exercise – Condition Based Inspection

This solo or group activity is designed to maximize learning in a specific topic area. Your instructor will have instructions and will coach you if you need assistance during the activity.

Objective

- Calculate the operating time with the Time Filtered function.

Activity Description

The pumps on our mixing and storage tanks need to be visually inspected every 4 months only if they have been running for over 2,000 hours. As the person in charge of the Preventative Maintenance program, you want to know the operating time for the pumps on the tanks.

A PI Point does not exist to determine if the pump is ON or OFF, but the pump only runs when the tank **Level** is greater than **1.2**. Find the amount of time the pumps on each of the tanks have been running for the past 4 months and find out if any of the pumps need to be inspected.

Approach

You will use the template provided in sheet *Condition Based Inspection* of the file *<your initials>_PI_DataLink-Exercises.xlsx*. Get the total Operating Time of the pumps associated with tanks.

Step 1: Use **Asset Filter Search** to bring the list of Assets without any attribute.

a. Specify the appropriate Root Path and Element Template in the search dialogue box and without selecting any attributes, click Ok.

Step 2: Use **Time Filtered** function to calculate the number of hours each pump was running.

	A	B	C
1	Condition Based Inspection		
2			
3	Start time		
4	End time		
5	Expression	'Level'>1.2	
6			
7			
8	Asset (Root Path)	Operating Time (hours)	
9			
10			
11			
12			

✔ **Quick Check**

- Can you use the Time Filtered function?
- Obtain filtered values?

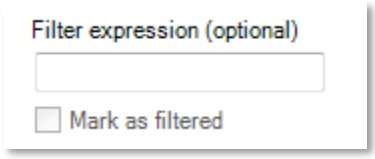
If you answered NO, ask your instructor for assistance.

6.11 Filtered Data Using Custom Expressions

Learning Outcomes

- Using Filtered expressions

When using different PI DataLink functions, we noticed an optional field of **Filter Expression**.



This option is available for the functions of:

- Compressed Data
- Sampled Data
- Calculated data

PI DataLink applies the filter expression to the raw data retrieved and only the values that make the specified expression **True**, would be included. Therefore, for the two functions of Compressed Data and Sampled Data, only the values that make the specified filter expression True would be listed in the output cell. For the Calculated Data function, only the raw values that make the filter expression True, would be considered in the calculations. With the use of Filter Expression, an option of **Mark as filtered** becomes available for the Compressed and Sampled Data functions; if the Mark as filtered option is selected, a **Filtered** status is returned for each group of values that does not satisfy the filter expression.

The Filter Expression is a performance equation and follows the formatting rules discussed in the previous section.

Note: When using a cell reference for your Filter Expression, be sure that if the Filter Expression begins with a timestamp or point name that you use two single quotes. The first single quote is used in Excel to identify a text string, rather than a value, and will not be seen by the filter expression. Another option is to enclose the entire filter expression in parenthesis, in which case the extra single quote is not needed.

For more information see the “Expressions” section in the PI DataLink User Guide.

Excel Conditional Formatting

This topic is not specific to PI DataLink, but the **Conditional Formatting** found in Microsoft Excel can give your PI DataLink reports a great perspective. It is useful for visually comparing values extracted from PI. **Conditional Formatting** is found in the **Home Ribbon** in the **Styles** section. You can use this functionality to provide highlighted maxima or minima, bar graph backgrounds, and many other visual cues about the data being displayed.

To use this functionality, first highlight the group of cells you wish to format. Then click on the **Conditional Formatting** button and choose a group and rule. For the **Highlight Cells Rules** and **Top/Bottom Rules**, you will see a preview of the formatting once you configure the appropriate limits. For **Data Bars**, **Color Scales** and **Icon Sets**, simply hover the mouse over each preconfigured option to preview its effect on the cells you selected. Click the desired rule to select it.

If none of the preconfigured rules suit your needs, you can configure additional rules using **Conditional Formatting > New Rule**. Multiple rules can be applied in configurable order using **Conditional Formatting > Manage Rules.**

Note: The MS Excel `TODAY()` function returns the serial number of the current date. The serial number is the date-time code used by Microsoft Excel for date and time calculations. Microsoft Excel stores dates as whole number of days starting at 1900. Dates and times are values and therefore can be added, subtracted, and included in other calculations.

Syntax: `=TODAY()`

Example: `=(TODAY() - 10 + 16/24)` is today minus 10 days at 4 PM

6.11.1 Directed Activity – Filtered Data Value Queries

You are invited to watch what the instructor is doing or perform the same steps at the same time to explore the different concepts presented in this chapter or section.

Objectives

- Apply a filter expression to the values retrieved using **Compressed Data** function

Activity Description

Retrieve data using the Compressed Data function and filter out all values below 100 because they are irrelevant to our report.

Approach

Part 1

Step 1: In Excel create a sheet with

d. **Data Item:** CDT158
e. **Start Time:** T
f. **End Time**: T-1d
g. **Filter Expression**: ‘‘CDT158’ > 100

	A	B
1	**Data Item**	CDT158
2	**Start Time**	T
3	**End Time**	T-1d
4	**Filter expression**	'CDT158' > 100

Step 2: Select cell D1, click on the Compressed Data function and fill out the required parameters (you can use cell references), verify there are no values less than 100.

Part 2

Step 1: On a new sheet, create a sheet with

a. **Tank**: \\PISRV01\OSIsoft Plant\Production Area\Production Line1\Mixing Tank1
b. **Process Variable**: External Temperature
c. **Start Time**: T
d. **End Time**: T-1d
e. **Filter Expression**: ‘‘External Temperature’ > 200

	A	B
1	**Tank**	\\PISRV01\OSIsoft Plant\Production Area\Production Line1\Mixing Tank1
2	**Process Variable**	External Temperature
3	**Start Time**	T
4	**End Time**	T-1d
5	**Filter Expression**	'External Temperature' > 200

Step 2: Retrieve the Compressed Data and verify there are no values less than 200; the filter expression removed them.

6.11.2 Exercise – Production Level Report

This solo or group activity is designed to maximize learning in a specific topic area. Your instructor will have instructions and will coach you if you need assistance during the activity.

Objectives

- Use the **Filter Expression** option of the **Sampled Data** function to constrain the values that are extracted.

Activity Description

As a quality control manager, you want to examine the level of product in Mixing Tank1. Since this is an analogue point, it is better to perform a Sampled Data query rather than a Compressed Data query.

You want to build a report for the level **yesterday** over **10-minute intervals**. The report filters out mean tank levels, which is defined as a level **between 4 and 6**.

Approach

Step 1: Spend a few minutes and fill out the following table:

Root Path	
Data Item	
Start Time	
End Time	
Interval	
Upper Limit	
Lower Limit	
Filter Expression	

Step 2: You will use the template provided in sheet *Production Level Report* of the file *<your initials>_PI_DataLink-Exercises.xlsx*.

Note: Are you familiar with the Excel function of `CONCATENATE`?

✔ Quick Check

Having completed this topic:

- Do you understand the use of Filtered Expressions?

If you answered NO, ask your instructor for assistance.

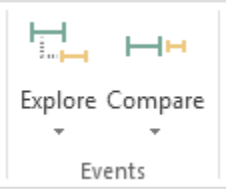
6.12 Event-related Features of PI DataLink

Learning Outcomes

- Understanding the Event Explore and Compare

Explore and Compare PI Events

PI DataLink allows browsing and comparing PI Events within Microsoft Excel.



These two Events functions return events that meet specified criteria in an AF database.

- **Explore Events:** this function returns one event per row and nests child events under parent events. This function is useful to show child events under a parent event while preserving the hierarchy structure.

- **Compare Events**: this function returns one event per row but can return attributes from related events in that same row. Specifically, to facilitate event comparison, the function can return attributes from child events or parent events in the same row as the returned event. This function is useful to flatten the hierarchy to show a particular child event that is common for each parent event.

6.12.1 Directed Activity – Monitoring downtime events

You are invited to watch what the instructor is doing or perform the same steps at the same time to explore the different concepts presented in this chapter or section.

Objectives

- Retrieve Event Frames in PI DataLink

Activity Description

Operations manager needs a report that lists the amount of time that the tanks at your site had been down due to mechanical issues (and not due to scheduled maintenance). Learn how to use event frames data in excel reports.

Approach

Step 1: In Excel select an Output cell

Step 2: Select Explore from the Events tab

Step 3: Make the following selections:

a. **Database**: \\PISRV01\OSIsoft Plant

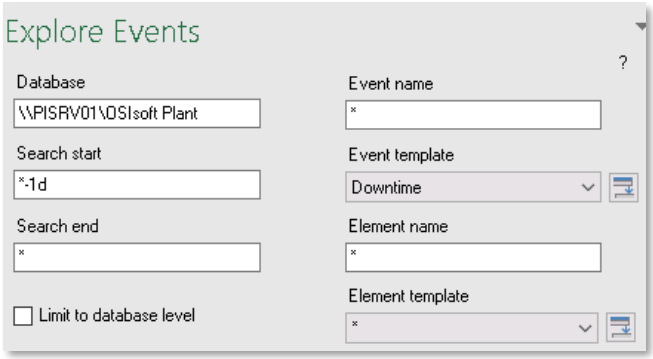
b. **Event name**: *

c. **Search start**: *-1d

d. **Search end**: *

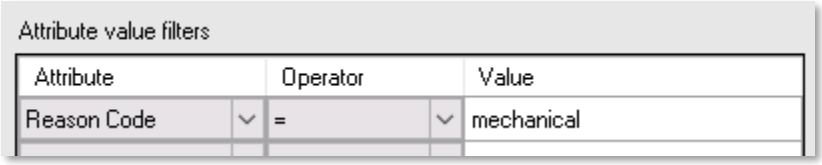
e. **Event template**: Downtime

f. **Element name**: *

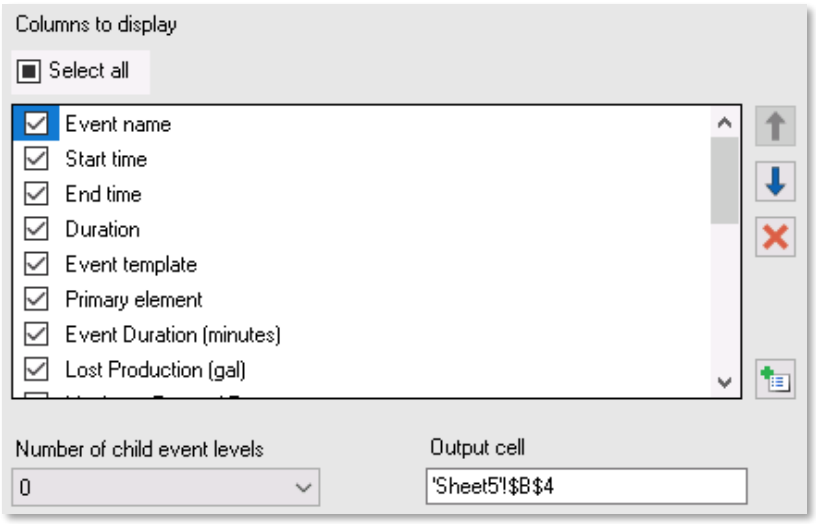


Step 4: Expand the More search options section. On the Attribute value filters select the “Reason Code” for the Attribute:

a. **Reason Code** = mechanical



Step 5: From Columns to display select Event name, Start time, End time, Duration, Primary element, Maximum External Temperature, Maximum Internal Temperature, Reason Code and Temperature Difference.



Step 6: Click Ok.

6.12.2 Directed Exercise – Analyzing downtime events

You are invited to watch what the instructor is doing. If you know Pivot Charts, have a go yourself.

Objectives

- Analyze Event Frames retrieved from PI DataLink using PivotChart and PivotTable

Activity Description

The operations manager now needs a report that shows which downtime reason is most prevalent and a comparison showing which tanks are the most problematic. He also would like to see information about the total production loss from the tanks.

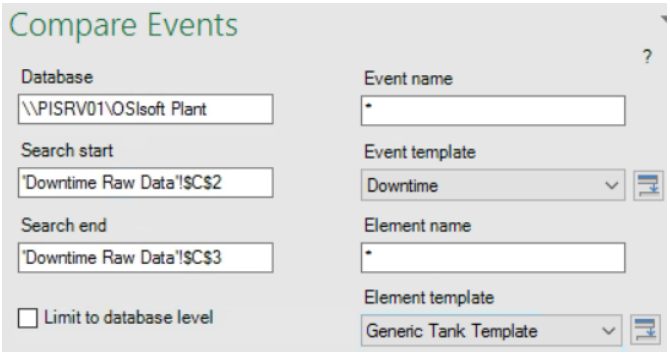
Approach

Step 1: Open the file *PI_DataLink-Exercises.xlsx* (C:\Class\PI DataLink) then work on sheet *Downtime Raw Data*.

Step 2: Enter *t-7d* and * in cells C2 and C3 respectively.

Step 3: Select cell A7 (this is the output cell.

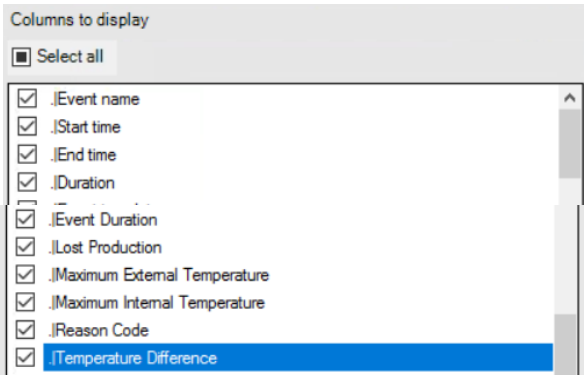
Step 4: On the Ribbon, Click **PI DataLink** > **Compare**



Step 5: In the task pane, select:

- **Root path:** \\PISRV01\OSIsoft Plant
- In the task pane click on the **Search start** field and then select cell C2.
- In the task pane click on the **Search end** field and then select cell C3.
- **Event template:** Downtime
- **Element template:** Generic Tank Template
- **Columns to display** section, choose only the following columns, note you may see the syntax as ".|AttributeName":

a. Event name
b. Start time
c. End time
d. Duration
e. Event Template
f. Primary element
g. Event duration
h. Lost Production
i. Maximum External Temperature
j. Maximum Internal Temperature
k. Reason Code
l. Temperature Difference

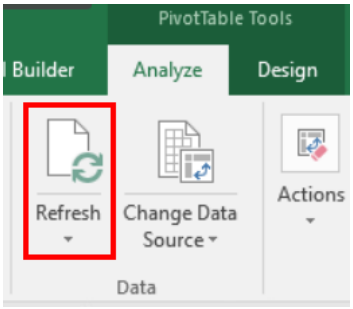


Step 6: Choose **OK** to return the events.

Step 7: Move to the *Evaluating Tank Downtime* sheet.

Step 8: Select the PivotChart on the left (blue chart) and select **PivotTable Tools** > **Analyze** > **Refresh** to update the data.

Step 9: Select the PivotChart on the right (red chart) and select **PivotTable Tools** > **Analyze** > **Refresh** to update the data.



Step 10: Which was the most common Reason Code for Events?

_____

Step 11: What was the production loss of Mixing Tank1 caused by the Electrical Reason Code?

_____

✔ **Quick Check**

- Do you now understand the Event Explore & Compare functions?

If you answered NO ask your instructor for assistance.

6.13 Functions using an Expression

Learning Outcomes

- Use an **Expression** instead of a **Data Item**
- Understand why Expressions are provided.

As we saw earlier, some PI DataLink functions accept either a data item or an expression as input. These functions have **Data item** and **Expression** options at the top of the task pane. So far, we only worked with the Data Item option. In PI DataLink, expressions are performance equations that you can use to incorporate mathematical operations and calculations based on PI System data items.

PI DataLink functions that can use Expressions (as well as Data Item) include:

- **Archive Value** function
- **Sampled Data** function
- **Timed Data** function

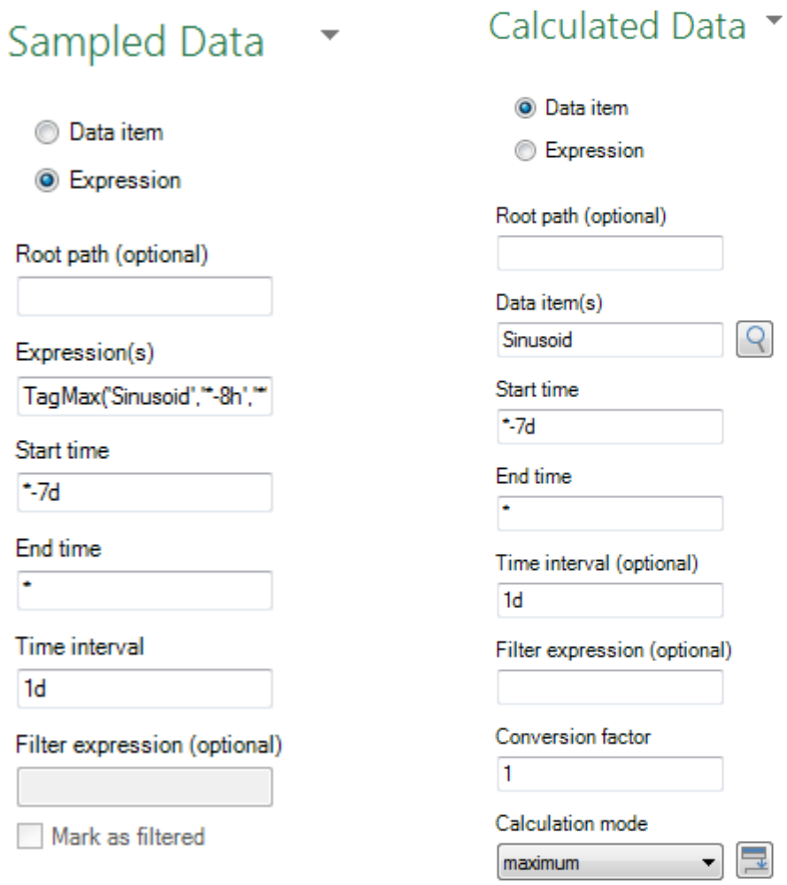
PI Expressions behave much the same way that PI PE do. They follow the same expression syntax and can use one or many of the following Data items:

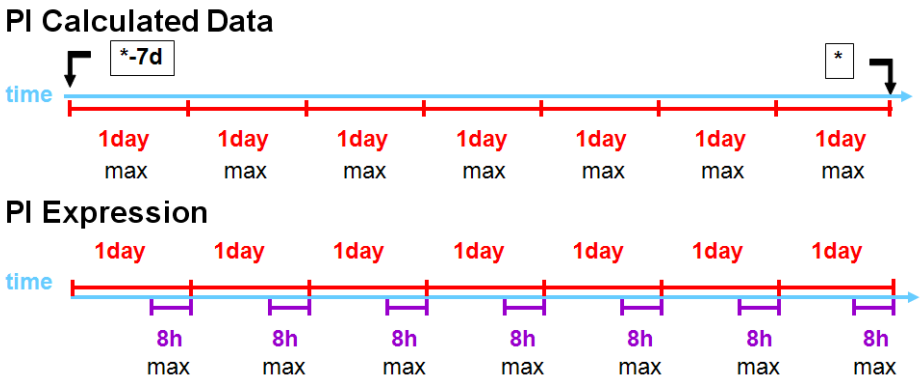
- PI points
- AF attributes that store data references to PI points
- AF attributes that store constant values

The benefit to PI Expressions is that they only calculate on demand. However, the downside is that, unlike PI PE, there is no history of these calculations stored on the PI Server, so it is more difficult to see historical trends.

How is Calculated Data Function Different from PI Expressions?

One difference between PI Calculated Data and PI Expressions is shown in an example below. The PI Calculated Data computes the maximum of the point over each 1-day period for the last 7 days. The PI Expression shown computes the maximum of the Sampled Data of point for the most recent 8 hours of every 1-day period, for the last 7 days.





The format for the PI Expression is: `TagMax('TagName','*-8h','*')`

Just like the PI Calculated Data, it would be configured with a start time of ***-7d**, an end time of *, and an interval of **1 day** (1d). Keep in mind that the '*' in the expression does not always go to the current time of the machine, the '*' in this case is represented by the right side of the 8-hour bar below. If the PI expression was changed to `TagMax('tag','*-1d','*')`, the results of the PI Calculated Data and the PI Expression would be identical. However, the PI Expression will contain an extra interval at the start time of the expression when compared directly with PI Calculated Data.

6.13.1 Directed Activity – Expression Queries

You are invited to watch what the instructor is doing or perform the same steps at the same time to explore the different concepts presented in this chapter or section.

Objectives

- Use Performance Equations in PI DataLink

Activity Description

We showed how we would be able to see the values of the Flow Rate of Mixing Tank2 for the past one day at the top of each hour, using Sampled Data function.

Here, instead of bringing the raw values of the flow rate, we are interested in getting the difference between the flow rate value and its average for the past day, and have it included in our Excel report.

Note: For simplicity, we will use PI Points in this example. You would be able to do this exercise using the AF Attribute and the Concatenate function in Excel for building the expression.

Approach

Step 1: Open Microsoft Excel.

Step 2: Create a Template with:

a. **Start Time**: y

b. **End Time**: t

c. **Time Interval**: 1h

d. **Expression**: TagVal('VPSD.OSIsoftPlant.PL2.MXTK2:Flow Rate')-TagAvg('VPSD.OSIsoftPlant.PL2.MXTK2:Flow Rate', '*-24h','*')

Step 3: Use *Sampled Data* function and use *Expression* in retrieving the data

	A	B	C	D	E
1	**Start Time**	y			
2	**End Time**	t			
3	**Time Interval**	1h			
4	**Expression**	TagVal('VPSD.OSIsoftPlant.PL2.MXTK2:Flow Rate')-TagAvg('VPSD.OSIsoftPlant.PL2.MXTK2:Flow Rate', '*-24h','*')		**Flow Rate of Mixing Tank2 Compared with the Daily**	
5				30-Jun-16 00:00:00	1487.533
6				30-Jun-16 01:00:00	-863.096
7				30-Jun-16 02:00:00	1185.073

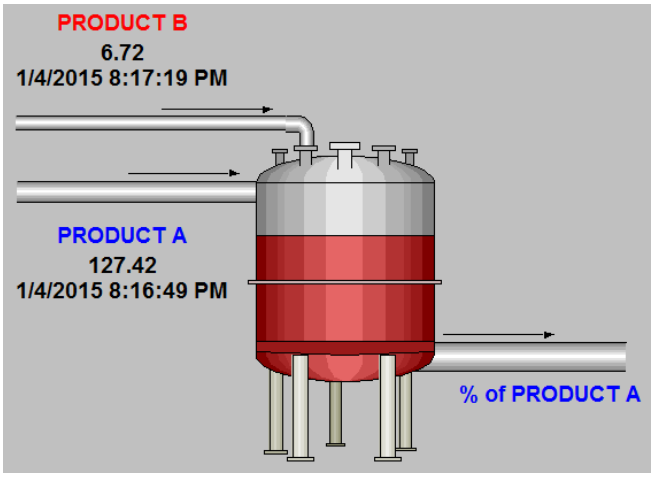
6.13.2 Exercise – Material Balance Report

This solo or group activity is designed to maximize learning in a specific topic area. Your instructor will have instructions and will coach you if you need assistance during the activity.

Objectives

- Use Performance Equations in PI DataLink

Activity Description



Two products, named Product A and Product B are being mixed in a tank, as shown in the following schematic.

The flow of Product A is stored in a PI Point named **VPSD.OSIsoftPlant.PL1.MXTK1:Flow Rate** and the flow of Product B is stored in a PI Point named **VPSD.OSIsoftPlant.PL2.MXTK2:Flow Rate**

You are interested in including the Percentage of Product A in the mix, as it is a critical indicator. There is no PI Point storing this value and you need to calculate it.

You are building this report for the **past 7 days** and would like to list this percentage for the **period of every 2 hours**.

Approach

Step 1: Develop the expression for calculating the Percentage of Product A in the resulting mix.

Step 2: Spend a few minutes and fill out the following table:

Expression	
Start Time	
End Time	
Time Interval	

Step 3: You will use the template provided in sheet *Material Balance Report* of the file *<your initials>_PI_DataLink-Exercises.xlsx*.

Step 4: How would you change the expression if one of the two Products was not flowing, and the associated point was showing a bad value of “Shutdown”? (Hint: If Then Else)

✔ **Quick Check**

- Can you use an Expression?
- Do you understand why Expressions are provided?

If you answered NO to either of these questions, ask your instructor for assistance.

7. FINAL EXERCISE

Now that you have the Visualization tools in your toolkit, it is time to put them to work. Your plant is so successful it has expanded and has a new database. It is now called the **OSI Production Facility***, or you may be using your own company assets if you have access to them*. Your task is to create new displays and reports for the production engineers.

Learning Outcomes

- Demonstrate Familiarity of the OSIsoft Visualization tools

Global Recap Exercise

This solo activity is designed to maximize learning in a specific topic area. Your instructor is available to assist if you need assistance during the activity.

Objectives

- Demonstrate understanding of the fundamentals of the PI System technology
- Access data in the PI System
- Demonstrate the use of PI Vision and PI DataLink client applications

Activity Description

The production facility has grown beyond company's wildest expectations resulting in an upgrade to a bigger plant. The old displays and reports are no longer acceptable. You have been asked to completely redesign the displays and reports from the previous environment.

Design a set of dashboards, displays and reports using the skills learned in this class. Creativity is highly encouraged. This is intended as a fun, open-ended exercise, and a friendly competition to wrap up the class. Feel free to work in small teams or alone. At the end of the session, all groups will give a brief presentation of their displays.

Work will be graded on:

1. Conveying your understanding of as many skills/concepts as possible.
2. Use of all the products, including PI DataLink and PI Vision.
3. Creativity in your design.
4. Your presentation to the class.

You may use any aspects of PI DataLink, and PI Vision discussed in class. This is open book, so feel free to consult the workbook as well as relevant documentation (all the relevant user guides are available in your learning environment).

Approach

Step 1: In the PI client tools - PI Vision and PI Datalink - set the database to OSI Production Facility.

Step 2: Explore the AF Structure to see the data available. *If you are using your own PI System, take note of the data surrounding your job role or your ideal business use case.*

Step 3: Build displays and reports using the tools studied in this course to show potential solutions for the business case you chose. Below are some of the things you need to implement.

PI Vision

a. Build a display with Tables, Trends, Values and Gauges

b. The **use of collections is a must**, incorporating **all** production lines.

c. Re-use displays for similar assets and add text, images, links, and multi-state behavior to enrich your PI Vision Display.

d. Create a **pinned** Event Frame representing an ideal run. Remember - pinned events are benchmark events that remain at the top of the Events panel.

e. Share the display, add keywords to sort displays and find your favorite displays.

f. Display your knowledge of multiple time contexts within a display.

g. Demonstrate the use of PI Vision calculations.

PI DataLink

a. Display Current Values and archived data for PI Points and AF Attributes

b. Calculate totals, averages, and other statistical values for your data

c. Report on Event Frames, particularly regarding Downtime & Lost Production

d. Re-use reports for multiple assets using drop-down lists

Share your displays and reports with the class, explaining how each fulfils the business case (or your own use case).

Additionally, showing what you have learned will help you when you return to your normal role.

If you don't know where to start here is what we are expecting:

PI Vision (3 displays)

- ***Display 1***: General display containing information about all the tanks inside a production line (collections will make this easy).
    - Include an asset comparison table.
    - Don't forget about multi-states.
    - Include symbols form the graphic library.
    - Include a bar chart.
    - Link this display to the detail display.

    - Share the display, add keywords to sort displays and find your favorite displays.
- ***Display 2***: Specific display to monitor tanks details (remember to use data from a single tank so it will be reusable with asset switching).
    - Include Tables, Trends, Values, XY plots and Gauges
        - Add a calculation like the difference between the level and level forecast.
        - Include multi-states and graphics
        - Include an event table.
        - Link this display to the generic one.
        - Share the display, add keywords to sort displays and find your favorite displays.
- ***Display 3 (bonus)***: Event frames comparison display.
        - Include some event attributes.
        - Pin an event.

PI DataLink (3 reports)

- ***Report 1:*** Tank data
    - Use drop-down lists o be reusable
    - Sigle value: Display Current Value and archived data for AF Attributes
    - Multiple values: Display sampled data for the last 2 hours data sampled every 10 minutes and display the archived data for the same period.
    - Create an excel graphic for the multiple values columns.
- ***Report 2***: Calculations
        - Use drop-down lists to be reusable
        - Calculate totals, averages, and other statistical values for your data
        - Be careful with the formats and take advantages of MS Excel features.
- ***Report 3 (bonus):*** Event frames
    - Report on Event Frames, particularly regarding Downtime & Lost Production

8. AVEVA SUPPORTING YOU

Learning Outcomes

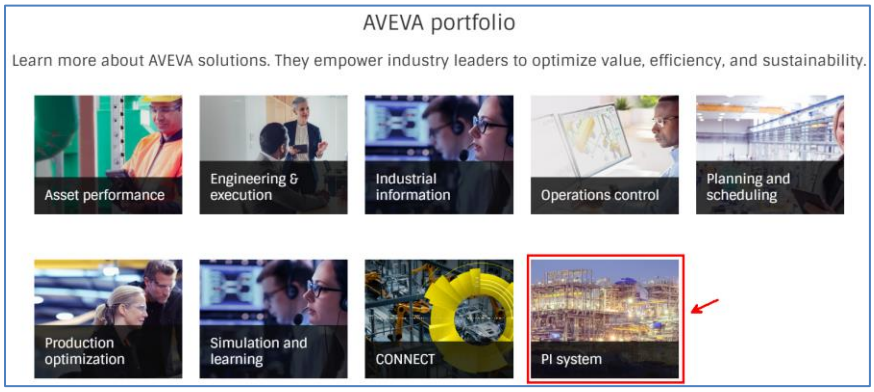
- Show the AVEVA Learning Academy Platform
- Explore the AVEVA PI System Learning YouTube Channel
- Introduce PI Square and the Customer Portal

8.1 Learning Platform

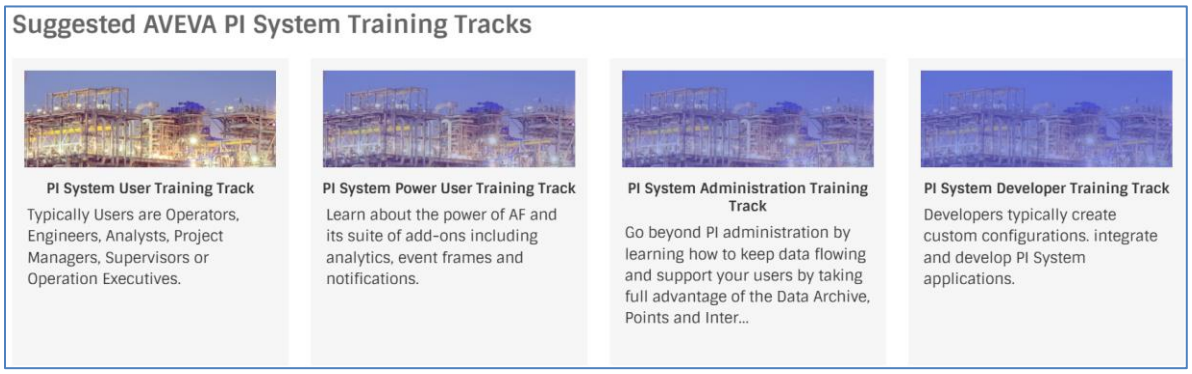
The best place to learn more about the PI System is through the AVEVA Learning Academy platform at https://learningacademy.aveva.com/. We have condensed our online courses, instructor-led training, and hands-on labs in an easy to browse website, so you can keep learning about the PI System long after PI World concludes.

Online Courses

Take a few minutes to navigate to the AVEVA portfolio and select PI System:



This will take you to a Web page where you can look at the different training paths, click on some of them to see their differences:



- **User** – who need to see the data in real time or build reports with PI System data.
- **Power User**– who are adept with the basics of the PI System and can boost their organization's efforts through building an enhanced Asset Framework structure.
- **Administrator** – who keep the data flowing and support end users. These courses dive into the backend components of the PI System.
- **Developer** – who write code to interact with the PI System programmatically.

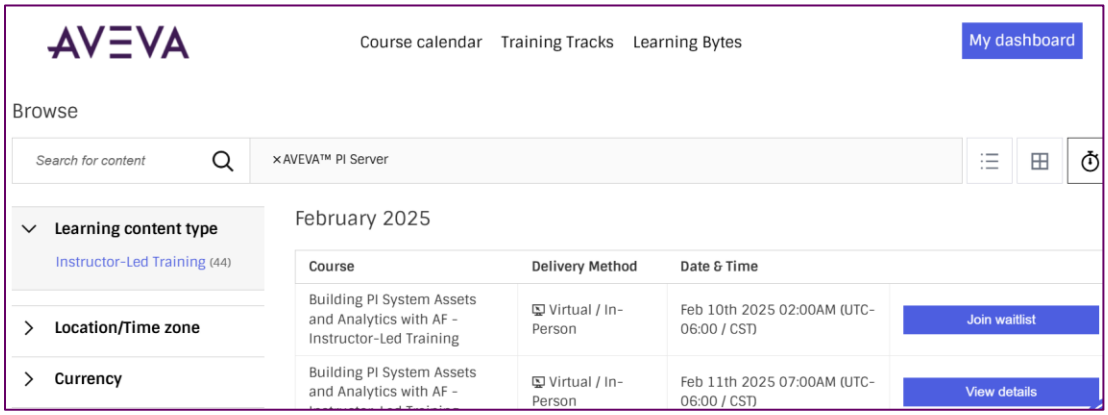
Our online courses cover a wide range of topics and are on-demand. When you sign up for an online course, you will immediately gain access to the course material for 30 days along with a Training Cloud Environment for you to practice the concepts discussed in the course.

Instructor Led Courses

If you prefer having an instructor, please navigate to [AVEVA Learning Academy home page] and select Instructor-led training. Then in the right menu you can filter by location, language or select Industrial Information where you will find all PI System training offers, we have available.

Another option to find instructor-led offerings is by selecting the *Course calendar* option in the [AVEVA Learning Academy home page]

By using the filters in the right menu you can find the available PI related trainings, for example:



8.2 AVEVA PI System Learning YouTube Channel

Visit our AVEVA PI System Learning YouTube channel to learn about the PI System by watching any of our 1000+ free videos on YouTube!

Playlists for various topics are available to help guide you through your training topic of choice from start to finish.

8.2.1 Exercise – Search the AVEVA PI System Learning Channel

This solo or group activity is designed to maximize learning in a specific topic area. Your instructor will have instructions and will coach you if you need assistance during the activity.

Objectives

- Find a video on the AVEVA PI System Learning Channel to learn about a topic not covered in the Visualizing PI System Data Course
- Demo accessibility features and playback settings in YouTube

Activity Description

You want to learn how to migrate a PI ProcessBook display to a native PI Vision display.

Approach

Step 1: Use a web browser to navigate to YouTube.com

Step 2: Search for the AVEVA PI System Learning Channel

Step 3: Click the search pane and run a search to find a video about migrating PI ProcessBook displays to PI Vision, sample search: "*PI ProcessBook to PI Vision*" or "Migration Utility".

Step 4: A video that will show you how to migrate displays is "PI ProcessBook to PI Vision Migration Utility" you can click on the snippet and take a look at the video.

Step 5: Turn on the Subtitles by clicking on the CC button.

Step 6: Change the quality of the video by clicking on the Settings icon, then select Quality and change it.

Step 7: While in Settings, choose Subtitles and notice that you can have Google auto-translate to the language of your choice.

Step 8: To get notified when AVEVA releases new videos, make sure to Subscribe and click on the bell icon to receive updates.

8.2.2 Directed Exercise – Find a playlist on AVEVA PI System Learning channel

You are invited to watch what the instructor is doing or perform the same steps at the same time to explore the different concepts presented in this chapter or section.

Objectives

- Search the AVEVA PI System Learning Channel for a playlist that interests you
- Use the playlist links to share structured content with your colleagues

Activity Description

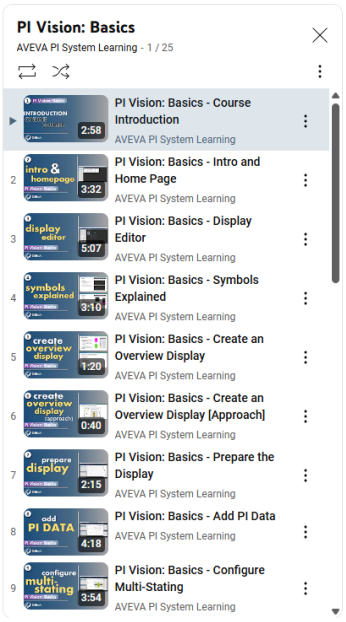
You want to learn as much about a product as possible, or you want to audit an online course for free.

Approach

Step 1: Use a web browser to navigate to YouTube.com

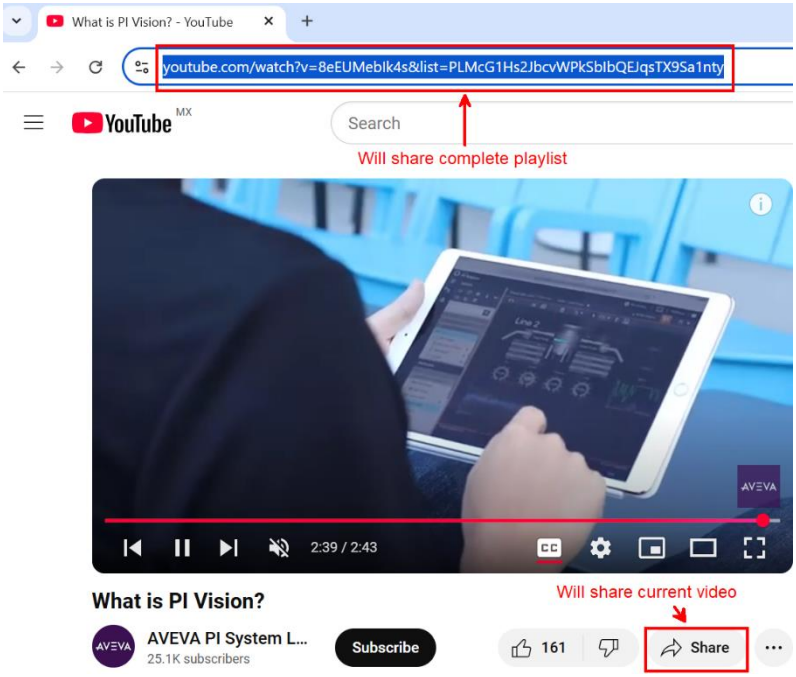
Step 2: Search for the AVEVA PI System Learning Channel.

Step 3: In the Home page click on the “Playlists” tab. You will notice several playlists on the channel.



Step 4: In the Search pane type “PI Vision”, please click on the PI Vision playlist. Note the playlist sidebar on the right side of the page. Now you can click into several related videos.

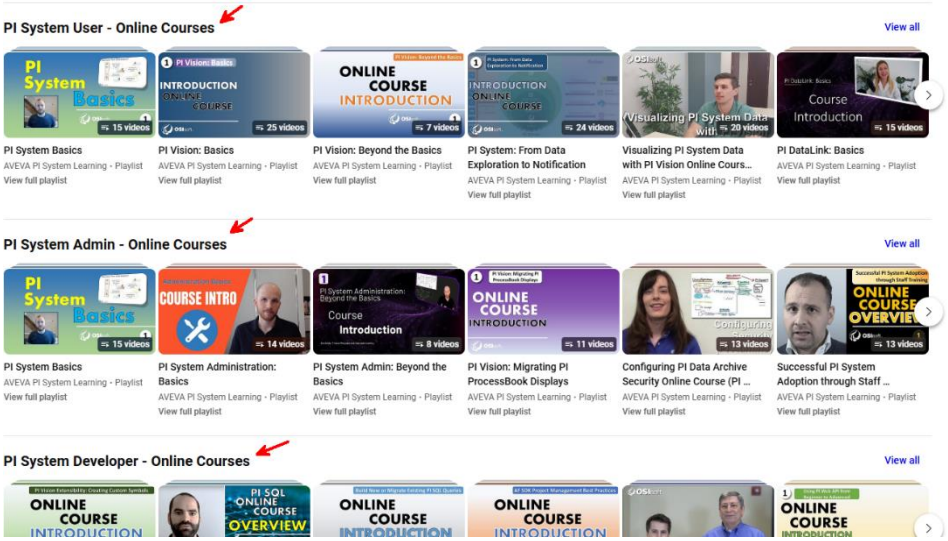
Step 5: Share the URL for the video with a colleague by selecting the entire URL on your page. If you use the share button on the video, it does **not** share the entire playlist, you will only share the video you are currently watching.



Step 6: Go back to the AVEVA PI System Learning channel homepage by clicking on the channel icon below the video player.

Step 7: Navigate in the homepage, you will notice there are several sections that group different playlist depending on the learning scope.

Step 8: You can also audit our online courses by selecting any of the “Online courses” identified sections and clicking on the title. Take note of all the **free** online course videos that you can view and share with your team!



8.3 Customer Portal

The my.osisoft.com website has many tutorials on how to support related activities as well as quick links to take you to commonly used support pages:

OSIsoft Customer Portal Hints

- How to Get an OSIsoft Customer Portal Login
- How to Create a New Case
- How to Download Products and Generate Licenses
- How to Search for Articles
- How to Manage Users

As seen in the above articles, from the Customer Portal you can:

- Download any PI product your company is licensed for using.
- View the PI System Roadmap to get information about the most current releases and what new features and products are on the horizon.
- Login and view your open and previously closed **Support Cases** or **create a new one.**
- Search through our **Knowledge Base** to try and troubleshoot any issues you may be having by referring to the rich collection of available KB Articles.

If you prefer not to open a technical support case yourself you can call us directly, here is the global phone number to contact AVEVA PI System Technical Support:

Phone: +1 510 297-5828  24 Hour Telephone Support

Support may be provided in languages other than English in certain centers based on availability of attendants. If you select a local language option, we will make best efforts to connect you with an available Technical Support Engineer with that language skill. If no local language tech support engineer is available to assist you, you will be routed to the first available attendant.

Before you contact Technical Support, it is helpful to have certain information readily available. AVEVA PI System technical support engineers will ask:

- Name of the product
- Version number
- The time that the difficulty started
- The computer platform (CPU type, operating system, and version number)

8.4 PI Square

PI Square is AVEVA PI System's community where you can get Technical Support for your questions, access the PI Developers Club (PI DevClub) for your coding projects, and connect to PI System users worldwide to get more value out of your PI System.

The PI Square community has places you go to collaborate, called Topics. These sections are generally named for a specific topic or purpose. Each topic can contain multiple types of content, including discussions, documents, blog posts, polls, and more. Currently, PI Square has the following four topics:

- **All Things PI -** OSIsoft Technical Support will keep watch to help answer questions and contribute to discussions related to topics such as Security, Buffering, System management, etc.
- **Products** - Here we have information related to specific PI Products such as PI Server, Interfaces and connectors, Visualization, Integrators, etc.
- **PI for Developers -** Here we have tools and support for developers to create applications for the PI System.
- **Learning forums -** Our hub for students to interact and learn from each other while they pursue certificates in our on-demand online courses.

In PI Square there is also a section called **Groups**, you can join a group or set of groups that relates to your specific industry's needs and learn from others in your field of their recommended best practices for projects on your horizon.

8.4.1 Exercise – Navigating PI Square

This solo or group activity is designed to maximize learning in a specific topic area. Your instructor will have instructions and will coach you if you need assistance during the activity.

Objectives

- Create a PI Square SSO Account and find answers about Visualization topics
- Discover the online course forums

Approach – Part 1

Step 1: Using a web browser, navigate to the PI Square website: https://pisquare.osisoft.com

Step 2: Log in to the PI Square community

a. If you don't have an OSIsoft SSO account, create one now. You'll use the same account for PI Square, the AVEVA Learning Academy platform, and the Customer Portal.

Step 3: Search for a post for each of the topics:

a. Future Data in PI DataLink

b. URL Parameters in PI Vision

Step 4: Read through past posts, comment, or ask your own question.

Approach – Part 2

Step 1: Navigate to the “Learning forums” topic:

a. Click “Topics” in the upper menu

b. Scroll down to the Learning Forums section

Step 2: Click on “Online Course: Visualizing PI System Data with PI Vision” under the “User Courses” learning path, and explore the questions posed and the answers given by the community for our on-demand Online Courses.

8.5 Further Questions?

For further questions you can contact us at aveva.com > Contact Us.

For questions about existing Support Issues, contact technical support or visit **my.osisoft.com**

For questions about unresolved training issues, contact your instructor or email learning@osisoft.com.

For all other questions, please contact our Customer Service group via email at customerservice@osisoft.com.

APPENDIX I: SOLUTIONS

Here are the step-by-step solutions to the proposed exercises. Please try to do the exercises by yourself before consulting this section.

2. PI Time

2.2.1 Exercise – PI Time

Part 1

Timestamp Input	Meaning
* - 30m	30 minutes ago
y + 8h	8 am yesterday
T	Today at midnight (start of today)
Thu	Midnight of the most recent Thursday
Tuesday – 2d	Sunday at midnight
18	18th day of the current month at midnight
y-2y	2 years before yesterday at midnight

Part 2

Timestamp Input	Meaning
T+6h	Today at 6:00 AM
Mon+6.5h	Monday at 6:30 am
*-12h	12 hours ago
1	The first day this month
Mon+5d	The end of the week (Friday morning)
Y+7h	7:00 am yesterday
*-15m	15 minutes ago
3/1 or 3-1 or mar-1	First of March
25-sep-2021	25th of September 2021

Part 3

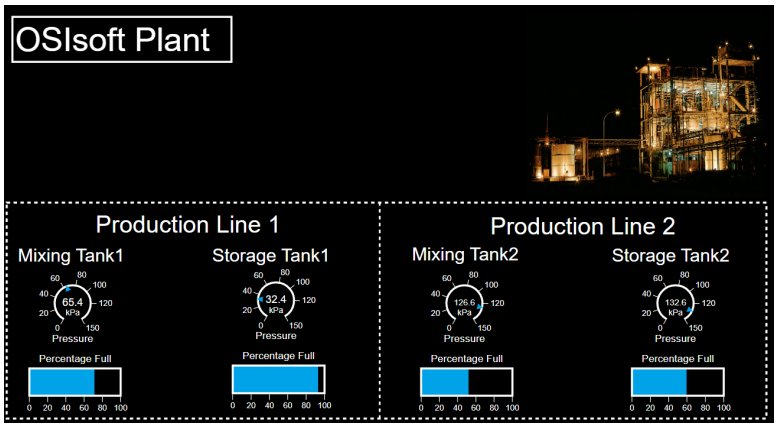
8: t+8h 8:00:00 8 am

4. PI Vision

4.2.1 Exercise – Exploring the Home page

Functionality	Button	Description
Folders let users more easily find displays and provide a place to store officially published displays. Administrators can create other folders to organize displays. You can select a specific group of displays to view.	13	Folders
Mark any display as a favorite. Displays marked as a favorite appear in the predefined favorites group.	18	Favorite
Allows you to view the list of available displays as a table.	19	Table view
Will display the selected group and the number of displays matching the search criteria.	2	Group filter applied
Open an empty display in the display creator.	7	Create New Display
Control various facets of a display's visibility, ownership, and interactions. Create multiple labels for the same display and label as many displays as you wish.	17	Display settings
Allows you to filter the displays that appear based on keyword tags that are assigned to displays. If you select multiple keywords, you will only see displays that have all the selected keywords.	3	Filter by keywords
Identifies the identity that is connected to PI Vision.	9	Identity connected
If you are working on a laptop-tablet hybrid device such as a touch-sensitive laptop, you will see this button on the top right corner of the application to enable the Touch mode. Touch mode is designed to optimize touch experience when using a 2-in-1 hybrid device.	6	Toggle touch-friendly experience
Make the thumbnails of private displays to be showed if we have the needed permissions.	5	Show private displays
It helps you select if the displays are sorted in ascending or descending order.	21	Sort displays in ascending/descending order
Takes you to the home page and it is always visible.	1	Home
Takes you to the help guide and you can use it to access videos and give feedback.	10	Help
Shows any error or warning messages in PI Vision.	8	PI Vision Messages
Allows you to view the list of available displays as thumbnail images.	20	Thumbnail view
Shows if the display has been shared.	15	Shared/public Display
Select a specific group of displays to view. You can select: All Displays: All public and private displays to which you have access. Favorites: Displays that you have marked as favorites (starred displays) My Displays: Displays that you have created Recent: Displays that you used within the last seven days When you select one of these groups, PI Vision shows the thumbnails from only that group and filters the search box to search within only that group of displays.	12	Predefined groups
This will help you change how the displays are sorted. You can sort by: • *Accessed* (when the display was last viewed or modified. • *Modified:* when the display was last modified. • *Name:* the name of the display. • *Owner:* the owner of the display.	22	Sort displays (accessed, modified, name, owner)
Appears if the display has been tagged or has been assigned a keyword.	16	Related displays
Click to open an existing display.	14	Display thumbnail
Search for displays with names, tags or owners.	11	Search display box
Allows administrators to select displays then move them to a different folder.	4	Select displays to move

4.3.8 Exercise – Improve the display "OSIsoft Plant Overview"

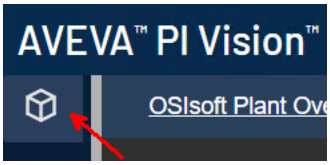


Step 1: Go to the Home page by clicking AVEVA™ PI Vision™ on the top left corner.

Step 2: Find the display called "*OSIsoft Plant Overview <your initials>*" and double click on the Thumbnail.

Step 3: Click on the Design mode icon .

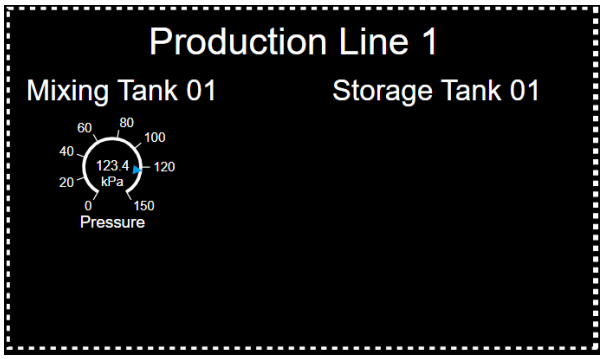
Step 4: If the asset browsing pane is not open, click on the cube in the left.



Step 5: Select the radial gauge icon . Drill down in the AF hierarchy and select The Mixing Tank1. Drag and drop the *Pressure* in the display area under text "Mixing Tank 01".

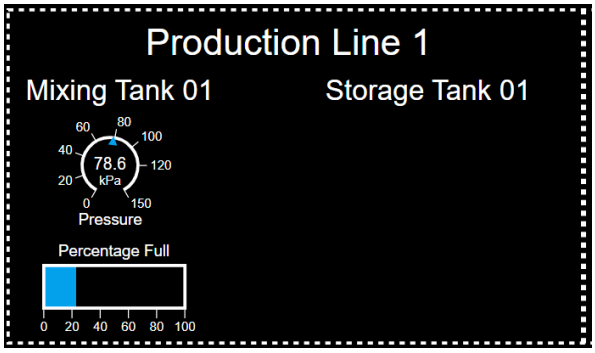
Step 6: Right click over the gauge and click on "Format Gauge". Under the Style section, select Pointer as Type and under the visibility section modify the label to be "Pressure".

Step 7: Resize the radial gauge to fit in the place assigned for it



Step 8: Select the horizontal Gauge Symbol and drag and drop the "*Percentage full*" under the radial gauge. Resize it to fit in the in the place assigned for it.

Step 9: Right click the horizontal gauge and select “Format Gauge..”. Go to the visibility section and uncheck value. Modify the label to be *Percentage full*.

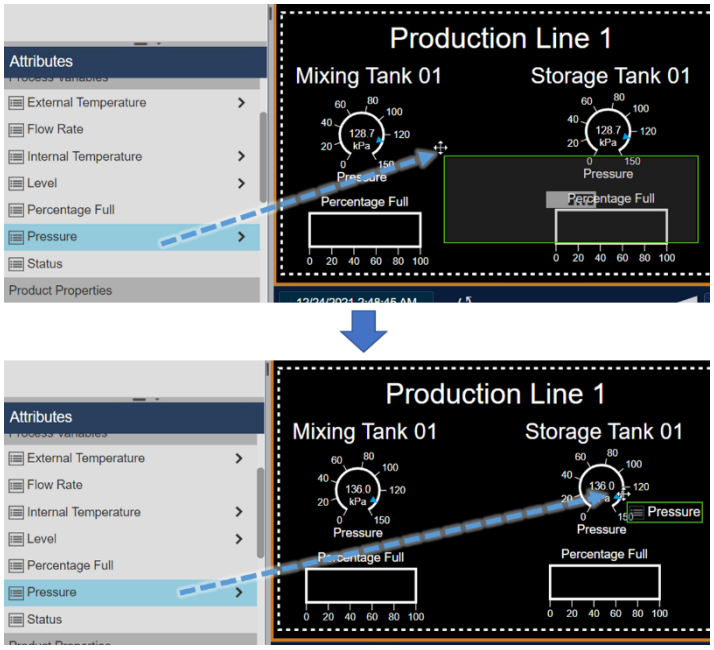


Step 10: Select both gauges, you can either click on both while hitting the control key or select the pointer  in the display design bar and draw a square that contains both gauges.

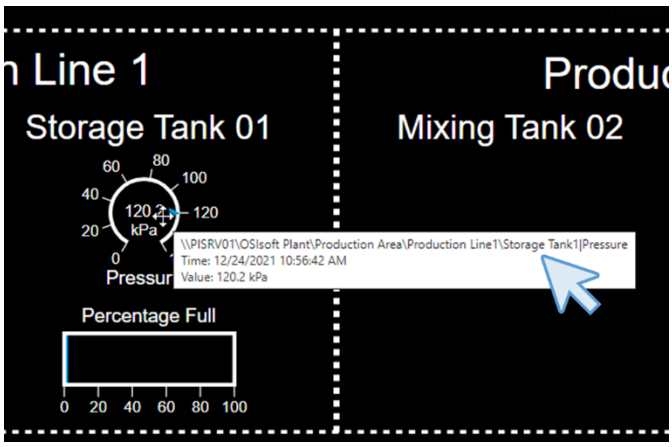
Step 11: Copy and paste the symbols. You can either use the icons in the display design bar or use ctrl+c and ctrl+v. Move the symbols under the text Storage Tank 01.

Step 12: In the asset browsing pane select the Storage tank 01.

Step 13: Drag and drop over the copied radial gauge the Storage Tank01’s *Pressure*. If you do it correctly, when you put the mouse over the radial gauge, a green square with the name of the attribute will appear. Before appearing the name of the attribute, you will see the horizontal gauge symbol.



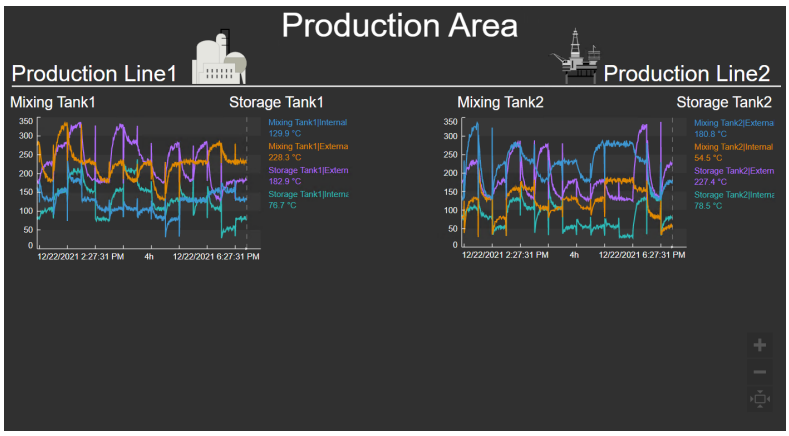
Step 14: Do the same for the horizontal gauge, this time please drag and drop Storage tank01's Percentage Full. If you did it correctly, when you hover the mouse over the radial or horizontal gauge you will see that in the path of the showed attribute includes the name Storage Tank01.



Step 15: Perform steps 12, 13 and 14 for the thanks in the "Production line2", the Mixing Tank2 and the Storage Tank2.

Step 16: Save the display.

4.3.13 Exercise – Monitoring all vital measurement



Step 1: Create a new display 

.

Step 2: Make sure the **Value** symbol is selected at the top of the Search Pane 

Step 3: Click the arrow next to the **OSIsoft Plant** database. Then click on the **Production Area** element. Drag the **Asset Name** attribute onto the display.

Step 4: Right-click on the value and click **Format Value**. Under the Visibility section, unselect the options for Label, Units, and Timestamp:

Step 5: Enlarge this value and move it to the top middle of the display near the Editor Toolbar.

Step 6: It's a good habit to save the display early on. **Save** the display a *Production Area Dashboard <your initials>*. (After saving, you may need to go back into Design mode.)

Step 7: Click the **Image** icon in the Display Editor Toolbar. Click anywhere in the display and create a square the size that you want your image to be.

Step 8: Perform a Google image search for a "Mixing Tank", choose one you like, and save it to your desktop.

Step 9: Back to your display, in the image box, click **Choose File** and navigate to the image saved above. **Open** this image.

Step 10: Resize the image to your liking and move it to the top left corner of the display.

Step 11: Use the Editor Toolbar buttons (or Ctrl+C, Ctrl+V) to Copy and Paste the image. Move the copied symbol to the right-hand side of the display.

Step 12: Perform a Google image search for a "Factory", choose one you like, and save it to your desktop.

Step 13: Double click on the copied Mixing Tank image. This should open up the Windows File Explorer. Navigate to the image saved above. **Open** this image.

Step 14: Change the size of the Factory image to roughly approximately the same proportions as the Mixing Tank image. Move the Factory image to the top right corner of the display.

Step 15: Click on the Mixing Tank image. Hold down Ctrl and then select the Production Area Value and the Factory image. Click on the **Alignment** Button

Step 16: Click **Align to Top**. This will re-align all symbols with the top edge of the highest placed symbol. Next, click the **Alignment** Button again and click **Distribute Horizontally**.

Step 17: In the Assets menu find the element named **Production Line1**. Drag the **Asset Name** attribute onto the Display and create a value symbol. Once again, format the symbol so that the Label, Units, and Timestamp do not appear.

Step 18: Resize the Production Line1 Value symbol to be slightly smaller than the Production Area Value symbol.

Step 19: Copy the Production Line1 Value symbol and paste it on the right-hand side of the display

Step 20: Select the **Production Line2** element in the Search Pane. Drag the **Asset Name** attribute over to the copied value symbol. This will overwrite the current value and replace it with Production Line2.

Step 21: Using the **Shapes** button, add a line underneath Production Line1 and Production Line2. After the line has been drawn, click the little square at the end of the line and hold the Shift key to easily snap the line horizontally.

Step 22: Focusing on Production Line1, we need to create detailed information about the Internal and External Temperature and the Products. Create a **Value** symbol for the **Asset Name** attribute for each tank in Production Line1 utilizing the copy/paste buttons as well as the Format Value Configuration Pane.

Step 23: Select the **Trend** symbol at the top of the Search Pane 

Step 24: Drag the **Internal Temperature** attribute for Mixing Tank1 onto the Display

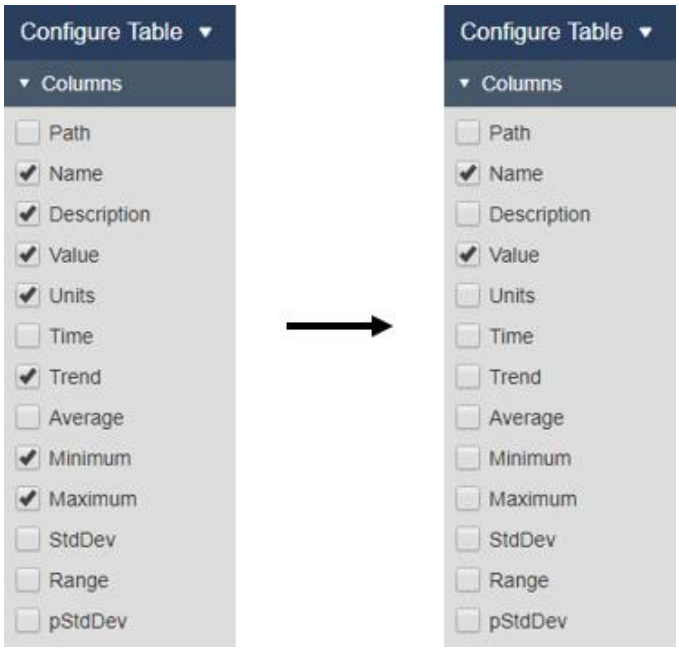
Step 25: Add the other **Temperature** attributes for the Production Line1 tanks onto the same trend

Step 26: Click the **Table** symbol at the top of the Search Pane 

Step 27: Drag the **Product** attribute for Mixing Tank1 onto the Display

Step 28: Right-click on the table and select **Configure Table**

Step 29: In the Configuration Pane, make sure only **Name** and **Value** are checked in Columns:



Step 30: Drag the **Product** attribute for the other tank on Production Line1 onto the table

Step 31: All pertinent data is now displayed for each tank on Production Line1!

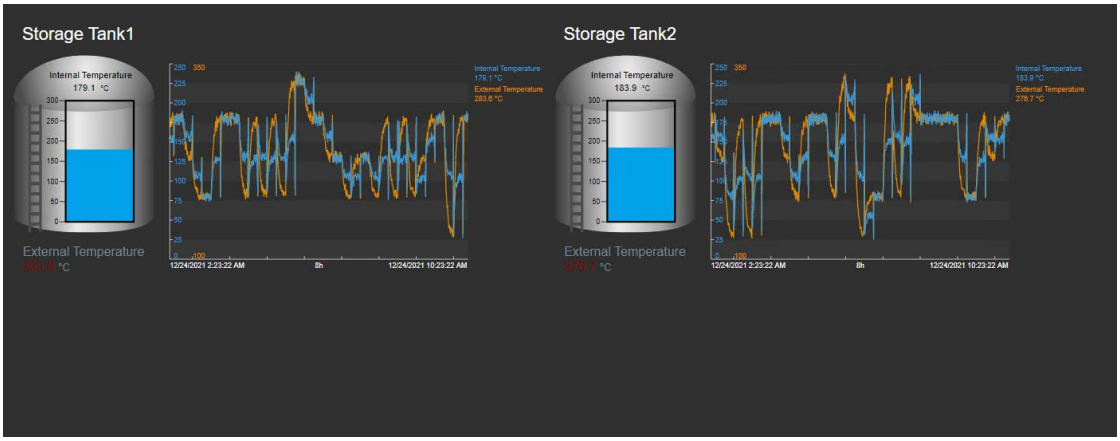
Step 32: Don't forget to **Save**!

Step 33: Repeat Steps 22 through 31 for the tanks on Production Line2.

Step 34: Challenge! (Optional): Use the **Alignment** Button (from Steps 15 and 16) in order to align all data items! Can you mimic the display above?

Step 35: Change the start time and end time of display to ***-4h** and ***+15m**, respectively.

4.4.11 Exercise – Create a dynamic dashboard to Monitor the Tank temperature



Step 1: Create a new display 

.

Step 2: Make sure the **Value** symbol is selected at the top of the Assets Pane

Step 3: Select the **OSIsoft Plant** database. Then click on the **Mixing Tank1** element. Drag the **Asset Name** attribute onto the display.

Step 4: Right-click on the value and click **Format Value**. Under the Visibility section, unselect the options for Label, Units, and Timestamp. Resize the value as appropriate

Step 5: Open the **Graphics Library** Pane and navigate to the **Tanks** category. Choose a tank graphic and drag it onto the display.

Step 6: Return to the **Assets** Pane and drag the **External Temperature** to the display as a value. Format the value to remove the timestamp and set the label to say only the attribute name.

Step 7: Right click on the **External Temperature** value and select **Add Multi-State**. Modify the colors.

Step 8: Select the **Vertical Gauge** symbol and drag **Internal Temperature** to the display. Position the gauge on top of the Tank Graphic. Right click and choose **Format Gauge**, in the visibility section, change the label to include only the attribute name. Modify the colors to ensure the gauge is visible.

Step 9: Select the **Trend** symbol and drag both **Internal Temperature** and **External Temperature** onto the display. Resize the trend as needed. Right click the trend and choose **Format Trend** and change the Multiple Scales option to **Show Single Scale**.

Step 10: Resize and position the symbols to fit in the top left corner of the display. Use the rubber band selection to select all items on the display, right click and choose **Convert to Collection**. Resize the collection to fill most of the display space.

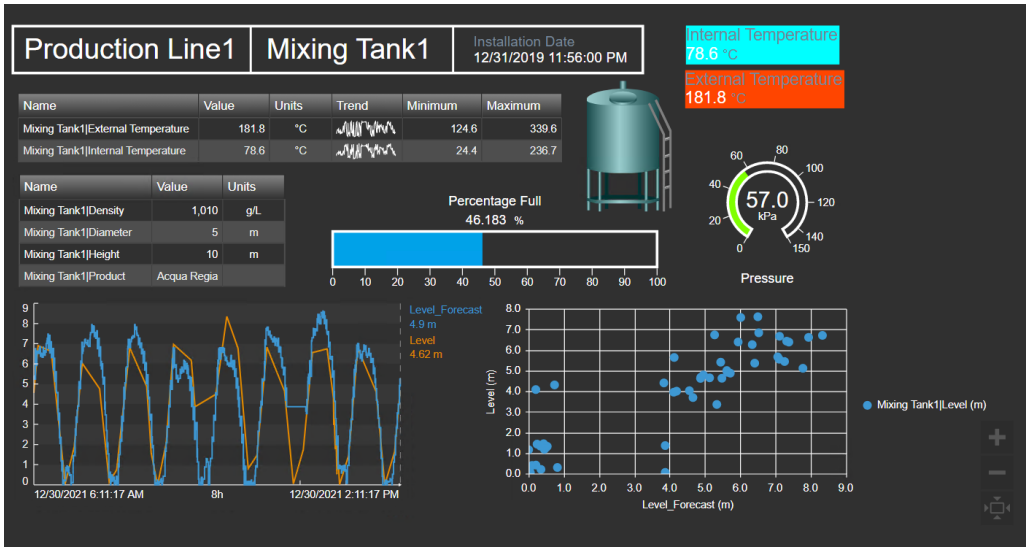
Step 11: Right click the Collection and choose **Edit Collection Criteria**. Change the search root to **Production Area** and select **Return All Descendants**. In the Asset Type section, ensure the Asset Type is set to **Generic Tank Template** then click the **+** symbol to add an Attribute. Choose **Internal Temperature** and set to **> 150**. Click **Refresh** to update the collection.

Step 12: Save your display as *Tank Temperature Dashboard <your initials>*

Step 13: Change the end time of your display to **t+8h** to see how many tanks were overheated at 8am today.

Step 14: Change the end time of your display to **y+12h** to see how many tanks were overheated at noon yesterday.

4.4.21 Exercise - Monitoring the Mixing Tanks' Key Performance Indicators



Step 1: Create a new display 

.

Step 2: Drill down the AF Hierarchy by clicking the arrow next to **OSIsoft Plant** > **Production Area** > **Production Line1** and select **Mixing Tank1**

Step 3: Click the **Value** symbol. Select the **Asset Name** and select **Asset Location** from the attributes pane and drag them onto the display

Step 4: The value symbols will be placed on the PI Vision display side by side and will both contain the Asset Name, Asset Value, and the Timestamp. Right click on the first value, and select **Format Value**. A new pane will pop up on the right-hand side. Under the Visibility section of the Format Value pane, we can uncheck the boxes for Label, Units, and Timestamp.

Step 5: Click on the next value symbol. The Format Value pane should stay open. Uncheck the same boxes.

Step 6: Add the **Installation Date** to the display as a **Value** symbol. Remove the timestamp and edit the label so that only Installation Date is displayed.

Step 7: Use a Square shape and a Line shape to create a table around your values. Leave some extra space between the values so that when you perform an asset swap elements with longer names don't run into each other! (Hint: You'll need to use **Format Shape** in order to remove the fill color in the square)

Step 8: Add the **External Temperature** and **Internal Temperature** to the display as **Value** symbols. Remove the timestamp, change the font size to be 14 and edit the labels so that only the attribute name is displayed with the value and units.

Step 9: Right click on the internal temperature and select Configure multistate and change the colors as you wish. Do the same with the external temperature. At this point you should have something like this.

Step 10: Save the display as *Tank Details <your initials>*.

Step 11: Click the **Table** button in the Search Pane.

Step 12: Drag **Internal Temperature** and **External Temperature** onto the display. They both should now be populated in one table. Right-click the table and choose **Configure Table**. Under Columns, select only Name, Value, Units, Trend, Minimum, and Maximum.

Step 13: In the assets pane select the Density, Diameter, Height and Product, these attributes should now populate in a separate table. Right-click the table and choose **Configure Table**. Select only Name, Value, and Units.

Step 14: Click the **Trend** button in the Search Pane. Then drag and drop the Level and Level _forecast attributes.

Step 15: Right-click the trend and select **Format Trend**. Select **Show Single Scale** under Single or Multiple Scales.

Step 16: Click the **XY Plot** button in the Search Pane. Then drag and drop the Level and Level_forecast attributes.

Step 17: They both should now be populated in one plot, with Level_Forecast on the X-Axis. Right-click the plot and choose **Configure XY Plot**. Under X Data Options, change the interval to **10 minutes**.

Step 18: Click on the **Horizontal Gauge** button. Drag **Percentage Full** onto the display to create a horizontal gauge. Right-click and choose **Format Gauge**. Under Visibility, modify the label so that it only contains the attribute name (and not Mixing Tank1). Resize the gauge so the label fits.

Step 19: Click on the **Radial Gauge** button. Drag **Pressure** onto the display. Right-click and choose **Format Gauge**, change the Style Type to **Arc**. Change the label to show only Pressure.

Step 20: Right click the radial gauge and select Add multi-state. Notice the limits for this multi-state behavior are already set. Change the colors as desired.

Step 21: Add shapes and images to the display

Step 22: Save your display

Step 23: Select the **Asset Dropdown** List to change the context of your display and answer the discussion questions referring to the Mixing Tank1

Step 24: Select the **Asset Dropdown** List to change the context of your display and answer the discussion questions referring to the Mixing Tank2

5. Advanced features in PI Vision

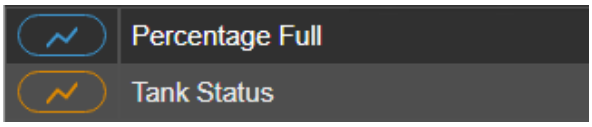
5.5.4 Exercise – Event Details

Step 1: Follow steps in Directed Activity 5.9.1 to obtain a list of Events

Step 2: Right click an Event and select *Event Details.* You might have a display like this:

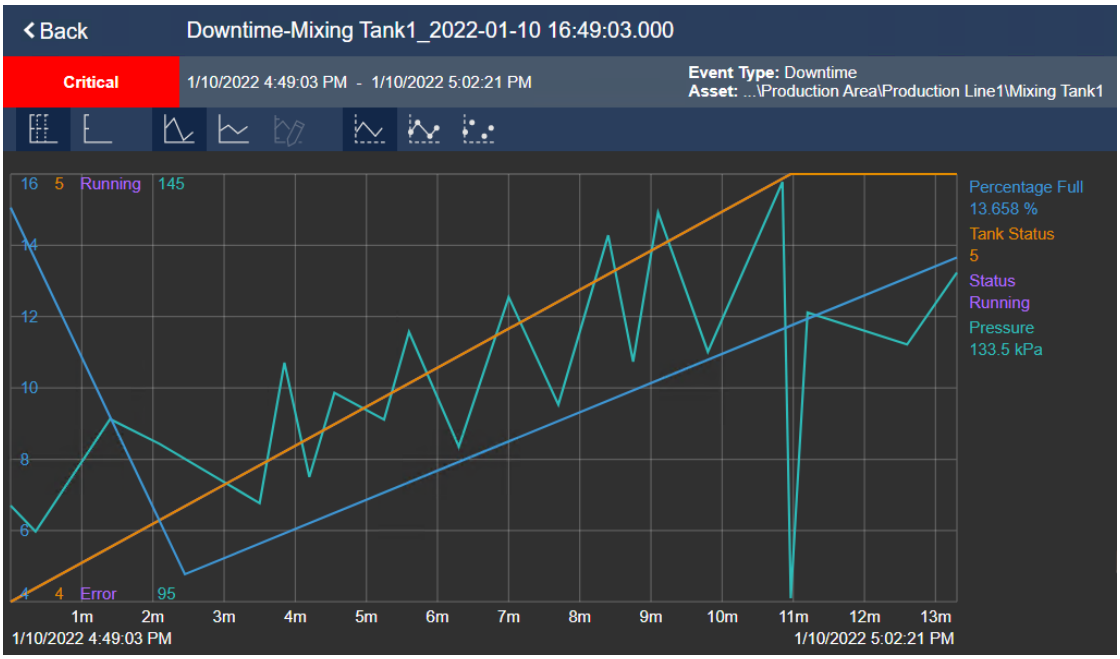
Step 3: Acknowledge the event with the Green Acknowledge button in the top right-hand corner. Why might you do this?

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



Step 5: Slide down to the bottom of the details and click the graph icon next to Pressure.

Step 6: Add back the Percentage Full and Tank Status.



Step 7: 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.		

6. PI DataLink

6.4.3 Exercise - Temperature at a Glance

Step 1: Open the file *PI_DataLink-Exercises.xlsx* file (*C:\Class\PI DataLink*) then work on sheet *Temperature at a Glance*.

Step 2: Select Cell B3.

Step 3: On the Ribbon, click on **PI DataLink** > **Search**.

Step 4: Select the AF Server > *OSIsoft Plant*.

Step 5: In the search box type *Ext*temp**

Step 6: Select all four data items (you can either click on the checkbox in the search results list or keep the Ctrl key pressed while you select all four results). Make sure the *Data item* length option is pointing to *Full path*. Click OK.

Step 7: Select Cell BC3 and click on **Current Value** function.

Step 8: Refer to cell B3-B6 in the **Data Item** field.

Step 9: Select **Time at left**. Click OK.

Step 10: Select Cell B10.

Step 11: From PI DataLink tab, select *Search*.

Step 12: Make sure you have selected AF Database *OSIsoft Plant*.

Step 13: Note the last search you made is maintained (the one for the *Ext*temp**)

Step 14: Select all four data items (you can either click on the checkbox in the search results list or keep the Ctrl key pressed while you select all four results). Make sure the *Data item* length option is pointing to *Full path*. Click OK.

Step 15: In Cell B9 type t.

Step 16: Select Cell C10 and click on **Archive Value** function.

Step 17: Refer to cell B10-B13 in the **Data Item** field.

Step 18: Refer to cell B9 in the **Time stamp** field.

Step 19: Select **Time at left**. Click OK.

6.4.4 Exercise - Activity Report

Step 1: Open the file *PI_DataLink-Exercises.xlsx* (C:\Class\PI DataLink) then work on sheet *Activity Report*.

Step 2: Select cell A8.

Step 3: On the Ribbon, click on **PI DataLink** > **Search**

Step 4: Select the AF Server > OSIsoft Plant > Production Area > Production Line2 > Mixing Tank2

Step 5: Select the following Attributes (you can keep the *Ctrl* key pressed while you select the attributes):

a. External Temperature
b. Internal Temperature

c. Level

d. Flow Rate

Make sure the *Data item* length option is pointing to *Full path*. Click OK.

Step 6: Select cell B8.

Step 7: On the Ribbon, click on **PI DataLink** > **Current Value.**

Step 8: In the task pane click on the **Data item(s)** field.

Step 9: Click and drag through cells A8 through A11 to select the cell range.

Step 10: Select the **time at left** radio button. Click **OK**.

To get the values at midnight:

Step 11: Copy cells A8 through A11 then paste them in cell A19.

Step 12: Select cell B19.

Step 13: On the Ribbon, click on **PI DataLink** > **Archive Value** (not on the drop-down menu).

Step 14: In the task pane click on the **Data item(s)** field.

Step 15: Click and drag through cells A19 through A22 to select the cell range.

Step 16: In the task pane select the **Timestamp** field and select cell D14.

Step 17: In the **Retrieval Mode** drop down list select *interpolated.*

Step 18: Select the **time at left**. Click **Apply** (notice how the task pane remains open).

Step 19: In the task pane, change the **Retrieval Mode** to *Previous*.

Step 20: In the task pane click on the **Output cell** field then select cell D19 (in the task pane notice how automatically the cell reference updates from B19 to D19). Click **Apply** (notice how the task pane remains open).

Step 21: In the task pane change the **Retrieval Mode** to Next.

Step 22: In the task pane click on the **Output cell** field then select cell F19 (in the task pane notice how automatically the cell reference updates from D19 to F19). Click **Apply** (notice how the task pane remains open).

For the last part of the exercise (getting the value at an exact time):

Step 23: In the task pane, click on the **Time stamp** field then select cell H14 (in the task pane notice how automatically the cell reference updates from D14 to H14).

Step 24: In the task pane, change the **Retrieval Mode** to Exact time.

Step 25: In the task pane, click on the **Output cell** field then select cell H19 (in the task pane notice how automatically the cell reference updates from F19 to H19).

Step 26: In the task pane select **No time stamp**. Click **OK** (notice how the task pane closes).

6.5.2 Exercise - Tank Analysis Report

Step 1: Open the file *PI_DataLink-Exercises.xlsx* (C:\Class\PI DataLink)

Step 2: The table could be filled out as:

Data Item	\\PISRV01\OSIsoft Plant\Production Area\Production Line1\Mixing Tank1|Pressure
	\\PISRV01\OSIsoft Plant\Production Area\Production Line2\Mixing Tank2|Pressure
Start Time	*-24h
End Time	*
Time Interval	1h

Step 3: Select Cell B3.

Step 4: On the Ribbon, click on **PI DataLink** > **Search**

Step 5: Select the AF Server  > *OSIsoft Plant*.

Step 6: In the search box type *Pressure*

Step 7: Select the pressure of the two mixing tanks from the Data Item list (you can keep the *Ctrl* key pressed while you select the attributes). Make sure the *Data item* length option is pointing to *Full path*. Click OK.

Step 8: Type **-24*, * and *1h* in cells B5, B6 and B7, respectively.

To get Compressed data:

Step 9: Select cell C5.

Step 10: On the Ribbon, click on **PI DataLink** > **Compressed Data**.

Step 11: In the task pane click on the **Data item(s)** field and then select cell B3.

Step 12: In the task pane click on the **Start Time** field and then select cell B5.

Step 13: In the task pane click on the **End Time** field and then select cell B6.

Step 14: Keep *Inside* as the **Boundary Type.**

Step 15: Select the **Hide count** and **Show time stamps** checkboxes. Click **Apply** (notice how the task pane remains open).

Step 16: In the task pane, click on the **Data Item(s)** then select cell B4 (in the task pane notice how automatically the cell reference updates from B3 to B4).

Step 17: In the task pane, click on the **Output cell** field then select cell E5 (in the task pane notice how automatically the cell reference updates from C5 to E5). Click **OK** (notice how the task pane closes).

To get Sampled data

Step 18: Select cell G5.

Step 19: On the Ribbon, click on **PI DataLink** > **Sampled Data**.

Step 20: In the task pane click on the **Data item(s)** field and then select cell B3.

Step 21: In the task pane click on the **Start Time** field and then select cell B5.

Step 22: In the task pane click on the **End Time** field and then select cell B6.

Step 23: In the task pane click on the **Time Interval** field and then select cell B7.

Step 25: Select the **Show time stamps** checkbox. Click **Apply** (notice how the task pane remains open).

Step 26: In the task pane, click on the **Data Item(s)** then select cell B4 (in the task pane notice how automatically the cell reference updates from B3 to B4).

Step 27: In the task pane, click on the **Output cell** field then select cell I5 (in the task pane notice how the cell reference updates from G5 to I5 automatically). Click **OK** (notice how the task pane closes).

***NOTE*:** The sparklines that are automatically added in cells C3, E3, G3 and I3 are NOT automatically generated by the Compressed Data or Sampled Data functions, these were created by using Excel's *Line* function (*Insert* tab > *Line* function).

6.6.2 Exercise - Operational Start Up

Step 1: Open the file *PI_DataLink-Exercises.xlsx* (C:\Class\PI DataLink) then work on sheet *Operational Start Up*.

Step 2: Select cell B2.

Step 3: On the Ribbon, click on **PI DataLink** > **Search**

Step 4: Select the AF Server  > OSIsoft Plant > Production Area

Step 5: Type Ext*temp* in the search bar.

Step 6: Select all four (4) data items (you can either click on the checkbox in the search results list or keep the Ctrl key pressed while you select all four results).

Step 7: Make sure the **Data item length** slider is pointing to **Name Only.**

Step 8: Set **Insert root paths in**: to Drop-down list. Click **OK** (Root paths will be displayed in cell B2 as a drop-down list and Data item will be displayed in cell B3).

Step 9: Please fill out the remaining data as on the table below:

Yesterday's Start Time	Y+6.5h	**Yesterday's End Time**	Y+8.5h
Today's Start Time	T+6.5h	**Today's End Time**	T+8.5h
Time Interval	4m		
Function for Comparison (ratio)	=G/I		

To get Compressed data:

Step 10: Select cell A11.

Step 11: On the Ribbon, Click **PI DataLink** > **Compressed Data**.

Step 12: In the task pane click on the **Root path** field and then select cell B2.

Step 13: In the task pane click on the **Data item(s)** field and then select cell B3.

Step 14: In the task pane click on the **Start time** field and then select cell B4.

Step 15: In the task pane click on the **End time** field and then select cell D4.

Step 16: Keep *Inside* as the **Boundary type**.

Step 17: Select the **Hide count** and **Show time stamps** checkboxes. Click **Apply** (notice how the task pane remains open).

Step 18: In the task pane click on the **Start time** field and then select cell B5 (in the task pane notice how automatically the cell reference updates from B4 to B5).

Step 19: In the task pane click on the **End time** field and then select cell D5 (in the task pane notice how automatically the cell reference updates from B4 to D5).

Step 20: In the task pane click on the **Output cell** field and then select cell C11 (in the task pane notice how automatically the cell reference updates from A11 to C11). Click **OK** (notice how the task pane closes).

To get Sampled data:

Step 21: Select cell F11

Step 22: On the Ribbon, click **PI DataLink** > **Sampled Data**.

Step 23: In the task pane click on the **Root path** field and then select cell B2.

Step 24: In the task pane click on the **Data item(s)** field and then select cell B3.

Step 25: In the task pane click on the **Start time** field and then select cell B4.

Step 26: In the task pane click on the **End time** field and then select cell D4.

Step 27: In the task pane click on the **Time interval** field and then select cell B6.

Step 28: Select the **Show time stamps** checkbox. Click **Apply** (notice how the task pane remains open).

Step 29: In the task pane click on the **Start time** field and then select cell B5 (in the task pane notice how automatically the cell reference updates from B4 to B5).

Step 30: In the task pane click on the **End time** field and then select cell D5 (in the task pane notice how automatically the cell reference updates from D4 to D5).

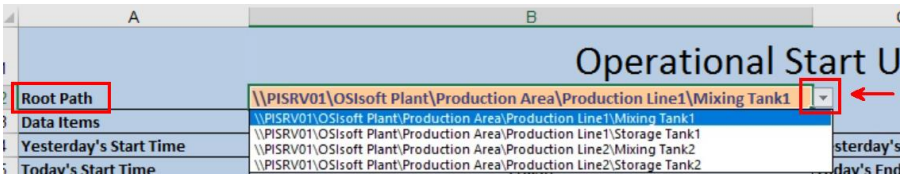
Step 31: In the task pane click on the **Output cell** field and then select cell H11 (in the task pane notice how automatically the cell reference updates from F11 to H11). Click **OK** (notice how the task pane closes).

To get the ratio

Step 32: Select cell K11 and then type **=G11/I11**.

Step 33: Propagate the result down dragging the cell by the lower-right corner (cursor will change to a black cross).

Step 34: Change the tank context by using the drop-down menu next to B2. As soon as you change the root path, the report's content will be automatically updated.

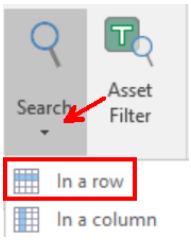


6.9.3 Exercise - Production Summaries

Step 1: Open the file *PI_DataLink-Exercises.xlsx* (C:\Class\PI DataLink) then work on sheet *Production Summaries*.

Step 2: Select cell B5.

Step 3: On the Ribbon, click on **PI DataLink** > **Search menu > In a row**



Step 4: Select the AF Server > OSIsoft Plant > Production Area

Step 5: Type *Production* in the search bar.

Step 6: Make sure the **Data item length** slider is pointing to **Name Only** and select **Column or row** in the **Insert root paths in** option. Click **OK**.

Step 7: Insert *y-7d*, *y* and *1d* in cells B7, B8 and B10 respectively.

Step 8: Select cell B11.

Step 9: In the PI DataLink tab select **Properties** function.

Step 10: In the task pane click on the **Root path** field and then select cell B5.

Step 11: In the task pane click on the **Data item(s)** field and then select cell B6.

Step 12: In the task pane set **Property** field as **UOM**. Click **OK** (the UOM is L/min).

Step 13: Select cell A21.

Step 14: In the PI DataLink tab select **Calculated Data** function.

Step 15: In the task pane click on the **Root path** field and then select cell B5.

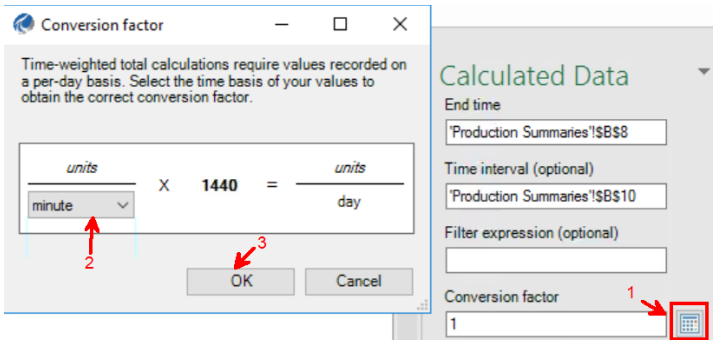
Step 16: In the task pane click on the **Data item(s)** field and then select cell B6.

Step 17: In the task pane click on the **Start time** field and then select cell B7.

Step 18: In the task pane click on the **End time** field and then select cell B8.

Step 19: In the task pane click on the **Time interval** field and then select cell B10.

Step 20: The first thing we will calculate is a Total, since the UOM for the *Production* data item is *L/min* the Conversion factor must me adjusted. In the task pane click on the *calculator button* next to the **Conversion factor** field, adjust the UOM to *minute* and then click *OK*. The Conversion factor field must be automatically populated with a value of **1440**.



Step 21: In the task pane click on the **Calculation Mode** drop-down field and select **total**.

Step 22: In the task pane select **c**heck the **Show start time** check box, this will fill the Start time column in the report. Click **Apply** (notice how the task pane remains open).

Step 23: For the other calculations, the Conversion factor should be adjusted back to 1. In the task pane select the **Conversion factor** field and change its value to **1**.

Step 24: In the task pane click on the **Calculation Mode** drop-down field and select **Average**.

Step 25: In the task pane click on the **Output cell** field and then select cell C21 (in the task pane notice how automatically the cell reference updates from A21 to C21).

Step 26: Uncheck the **Show start time** check box. Click **Apply** (notice how the task pane remains open).

Step 27: In the task pane click on the **Calculation Mode** drop-down field and select **Maximum**.

Step 28: In the task pane click on the **Output cell** field and then select cell D21 (in the task pane notice how automatically the cell reference updates from C21 to D21).

Step 29: Check the **Show percent good** check box. Click **Apply** (notice how the task pane remains open).

Step 30: We will now calculate the Total Average and Maximum values for the entire week, so the Time interval parameter is not needed anymore. In the task pane remove the cell reference inserted in the **Time interval** field.

Step 31: The first thing we will calculate is a Total, since the UOM for the *Production* data item is *L/min* the Conversion factor must me adjusted. In the task pane type **1440** in the **Conversion factor field** (you can also get this value by following instructions in Step 20 above).

Step 32: In the task pane click on the **Calculation Mode** drop-down field and select **total**.

Step 33: In the task pane click on the **Output cell** field and then select cell B32 (in the task pane notice how automatically the cell reference updates from D21 to B32).

Step 34: Uncheck the **Show percent good** check box. Click **Apply** (notice how the task pane remains open).

Step 35: For the other calculations, the Conversion factor should be adjusted back to 1. In the task pane select the **Conversion factor** field and change its value to **1**.

Step 36: In the task pane click on the **Calculation Mode** drop-down field and select **Average**.

Step 37: In the task pane click on the **Output cell** field and then select cell C32 (in the task pane notice how automatically the cell reference updates from B32 to C32). Click **Apply** (notice how the task pane remains open).

Step 38: In the task pane click on the **Calculation Mode** drop-down field and select **Maximum**.

Step 39: In the task pane click on the **Output cell** field and then select cell D32 (in the task pane notice how automatically the cell reference updates from C32 to D32).

Step 40: Check the **Show percent good** check box. Click **OK** (the task pane will automatically close).

***NOTE*:** The chart included in the report is NOT automatically generated by the *Calculated data* function, if you want to insert charts in your reports you can find the available options in Excel's Insert tab at the Charts menu.

6.10.3 Exercise - Condition Based Inspection

Step 1: Open the file *PI_DataLink-Exercises.xlsx* (C:\Class\PI DataLink) then work on sheet *Condition Based Inspection*.

Step 2: Enter **-4mo*, * and *''level'>1.2* in cells B3, B4 and B5 respectively (notice how at the beginning of the expression there are two single quotes (')).

Step 3: Select cell A9.

Step 4: On the Ribbon, Click **PI DataLink** > **Asset Filter**

Step 5: In the task pane, select:

- **Root path:** \\PISRV01\OSIsoft Plant

- **Element template:** Generic Tank Template
- Do not select any attributes
- Select **Column** in the *Insert elements in* option and **Values** in the *Output as* option. Click **OK**.

Step 6: Select Cell B9.

Step 7: On the Ribbon, Click **PI DataLink > Time Filtered**.

Step 15: In the task pane click on the **Root path** field and then select cell A9.

Step 16: In the task pane click on the **Expression** field and then select cell B5.

Step 17: In the task pane click on the **Start time** field and then select cell B4.

Step 18: In the task pane click on the **End time** field and then select cell B4

Step 19: In the task pane set the **Time units** field as hours. Click **Apply** (notice how the task pane remains open).

Step 37: In the task pane click on the **Root path** field and then select cell A10 (in the task pane notice how automatically the cell reference updates from A9 to A10).

Step 37: In the task pane click on the **Output cell** field and then select cell B10 (in the task pane notice how automatically the cell reference updates from B9 to B10). Click **Apply** (notice how the task pane remains open).

Step 37: In the task pane click on the **Root path** field and then select cell A11 (in the task pane notice how automatically the cell reference updates from A10 to A11).

Step 37: In the task pane click on the **Output cell** field and then select cell B11 (in the task pane notice how automatically the cell reference updates from B10 to B11). Click **Apply** (notice how the task pane remains open).

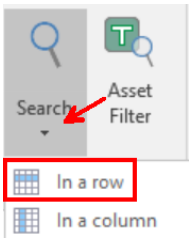
Step 37: In the task pane click on the **Root path** field and then select cell A12 (in the task pane notice how automatically the cell reference updates from A11 to A12).

Step 37: In the task pane click on the **Output cell** field and then select cell B12 (in the task pane notice how automatically the cell reference updates from B11 to B12). Click **OK** (the task pane will automatically close).

6.11.2 Exercise - Production Level Report

Step 1: Open the file *PI_DataLink-Exercises.xlsx* (C:\Class\PI DataLink) then work on sheet *Production Level Report*.

Step 2: Select cell B3.



Step 3: On the Ribbon, click on **PI DataLink** > **Search menu > In a row**

Step 4: Select the AF Server > OSIsoft Plant > Production Area > Production Line1 > Mixing Tank1.

Step 5: Type *Level* in the search bar and click on Enter or click in the Search button.

Step 6: Make sure the **Data item length** slider is pointing to **Name Only** and select **Column or row** in the **Insert root paths in** option. Click **OK**. (Root path is inserted in cell B3 and data item in cell B4).

Step 7: Enter *y*, *t* and *10m* in cells B5, B6 and B7 respectively (notice how the expression in cell is automatically generated by using the CONCATENATE() excel function).

Step 8: Select cell A13.

Step 9: On the Ribbon, Click **PI** > **Sampled Data**.

Step 10: In the task pane click on the **Root path** field and then select cell B3.

Step 11: In the task pane click on the **Data item** field and then select cell B4.

Step 12: In the task pane click on the **Start time** field and then select cell B5.

Step 13: In the task pane click on the **End time** field and then select cell B6.

Step 14: In the task pane click on the **Time interval** field and then select cell B7.

Step 15: In the task pane select the **Show time stamps** checkbox. Click **Apply** (notice how the task pane remains open).

NOTE: You will notice that the values to be filtered are highlighted in red, this is NOT automatically done by the *Sample data* function this is done by Excel's *Conditional formatting* function.

Step 16: In the task pane click on the **Filter expression** field and then select cell B10.

Step 17: In the task pane click on the **Output cell** field and then select cell C13 (in the task pane notice how automatically the cell reference updates from A13 to C13). Click **OK** (the task pane will automatically close).

6.12.2 Exercise - Analyzing Downtime Events

Step 1: Open the file *PI_DataLink-Exercises.xlsx* (C:\Class\PI DataLink) then work on sheet *Downtime Raw Data*.

Step 2: Enter *t-7d* and * in cells C2 and C3 respectively.

Step 3: Select cell A7.

Step 4: On the Ribbon, click **PI DataLink** > **Compare**

Step 5: In the task pane, select:

- **Root path:** \\PISRV01\OSIsoft Plant
- In the task pane click on the **Search start** field and then select cell C2.
- In the task pane click on the **Search end** field and then select cell C3.
- **Event template:** Downtime
- **Element template:** Generic Tank Template
- **Columns to display** section, choose only the following columns, note you may see the syntax as ".|AttributeName":
    a. Event name
    b. Start time
    c. End time
    d. Duration
    e. Event Template
    f. Primary element
    g. Event duration
    h. Lost Production
    i. Maximum External Temperature
    j. Maximum Internal Temperature
    k. Reason Code
    l. Temperature Difference

Step 6: Choose **OK** to return the events.

Step 7: Move to the *Evaluating Tank Downtime* sheet.

Step 8: Select the PivotChart on the left (blue chart) and select **PivotTable Tools** > **Analyze** > **Refresh** to update the data.

Step 9: Select the PivotChart on the right (red chart) and select **PivotTable Tools** > **Analyze** > **Refresh** to update the data.

6.13.2 Exercise - Material Balance Report

Step 1: Open the file *PI_DataLink-Exercises.xlsx* (C:\Class\PI DataLink) then work on sheet *Material Balance Report*.

Step 2: Fill out the table:

Expression	('VPSD.OSIsoftPlant.PL1.MXTK1:Flow Rate' / ('VPSD.OSIsoftPlant.PL1.MXTK1:Flow Rate' + 'VPSD.OSIsoftPlant.PL2.MXTK2:Flow Rate')) * 100
Start Time	T-7d
End Time	T
Time Interval	2h

Step 3: Select cell A12.

Step 4: On the Ribbon, select **PI DataLink** > **Sampled Data**.

Step 5: In the task pane select the **Expression** radio button.

Step 6: In the task pane click on the **Expression** field and then select cell B4.

Step 7: In the task pane click on the **Start time** field and then select cell B5.

Step 8: In the task pane click on the **End time** field and then select cell B6.

Step 9: In the task pane click on the **Time interval** field and then select cell B7.

Step 10: In the task pane select the **Show time stamps** checkbox. Click **OK** (the task pane will automatically close).

NOTE: In the exercise description, step 4 asks to change the used expression, you can change the expression in cell B4 to:

IF 'VPSD.OSIsoftPlant.PL1.MXTK1:Flow Rate' = "Shutdown" OR 'VPSD.OSIsoftPlant.PL2.MXTK2:Flow Rate' = "Shutdown" THEN "Shutdown" ELSE ('VPSD.OSIsoftPlant.PL1.MXTK1:Flow Rate' / ('VPSD.OSIsoftPlant.PL1.MXTK1:Flow Rate' + 'VPSD.OSIsoftPlant.PL2.MXTK2:Flow Rate')) * 100