Getting more out of Asset Analytics

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Agenda

- Asset Analytics overview
- Best practices
  - Building expressions
  - Using Event Frames to capture critical events
  - Backfilling and recalculations
  - Management
- Summary

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Asset Analytics

- 150+ built in functions
- Streaming calculations triggered by events or clock
- Output to PI Points for reporting and trending
- Create event frames and rollups
- Trigger notifications
- Supports templates, fully integrated into PI AF
- Backfill and Manual recalculation
- Auto-recalculation for late or out-of-order data

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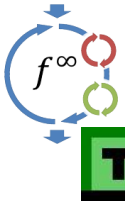
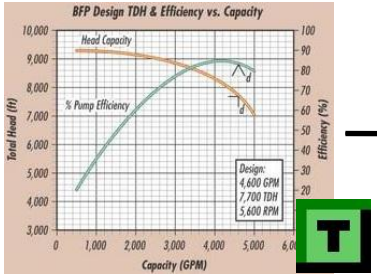
Workflow

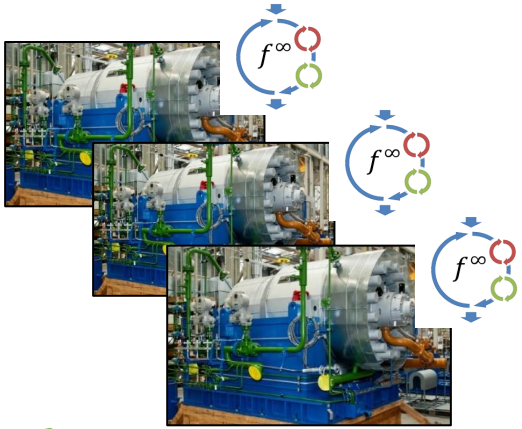
Configure



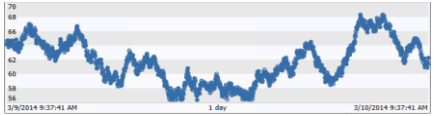
Test



Schedule



Backfill/Recalculate



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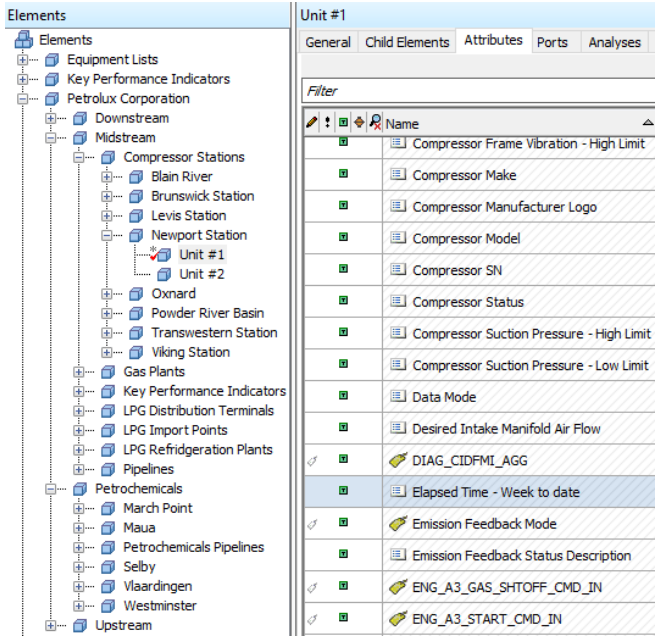
A bit about Context…



Typical use case:

I want to monitor and detect problems with my compressor, before they become catastrophic.

- AF models assets and processes
- Inputs (typically) come from the asset
- Analysis outputs are mapped on the asset

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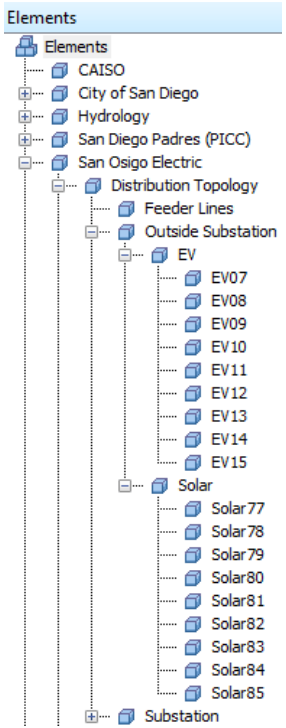
A bit about Context…



Typical use case:

I want to aggregate EV and Solar production for my substations.

- Inputs come from asset hierarchy
- Analysis outputs used in dashboards, CBM, KPIs & reports

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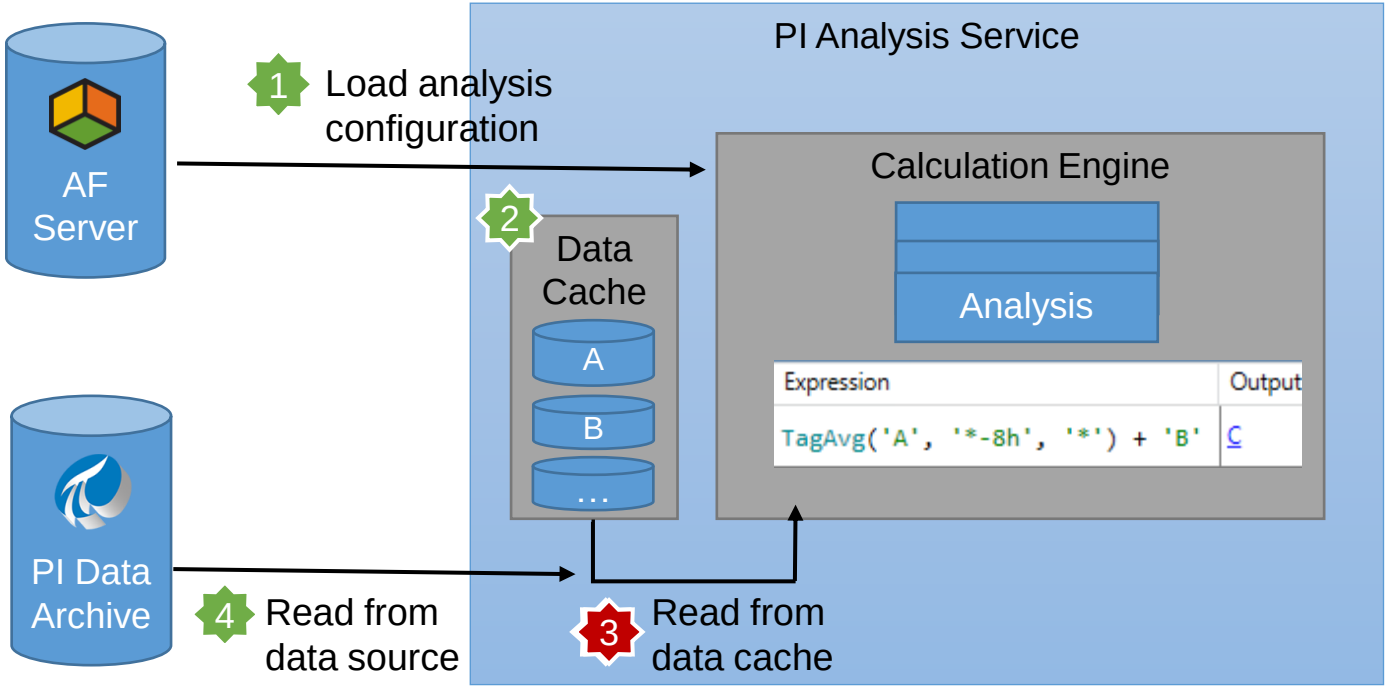
PI Analysis Service - Overview



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Design Tradeoffs

- Optimized for
  - Streaming analytics use case
  - Real-time calculations take priority over recalculations
  - Easy configuration - no programming experience required

- Not suitable for
  - Executing queries across really large number of attributes
  - Extracting large amounts of time series data
  - Ad-hoc calculations

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Building Expressions

Use of variables

Add a new variable | Evaluate

Name	Expression	Output Attribute	
RatedFlowRate	// Typical Flow Rate of the Pump 450	Map	⊗
RatedPressure	// Typical Pressure of the Pump 150	Map	⊗
RatedTemperature	// Typical Temperature of the Pump 170	Map	⊗
FlowRate	IF 'Pump Status' = "ON" THEN Rand(RatedFlowRate,35) ELSE 0	Discharge Flow Rate	⊗
Pressure	IF 'Pump Status' = "ON" THEN Rand(RatedPressure,10) ELSE Rand(.1,.2)	Suction Pressure	⊗
PumpStatusSeconds	SecSinceChange('Pump Status')	Map	⊗
Temperature	IF 'Pump Status' = "ON" and 'Bearing Temperature' < RatedTemperature THEN 'Bearing Temperature'+Rand(5,2) ELSE IF 'Pump Status' = "ON" and 'Bearing Temperature' > RatedTemperature THEN Rand(RatedTemperature,6) ELSE If 'Pump Status' = "OFF" THEN ((Rand(1,.1)*RatedTemperature - 90) * Exp(-.001*PumpStatusSeconds)) + 90 ELSE NoOutput()	Bearing Temperature	⊗

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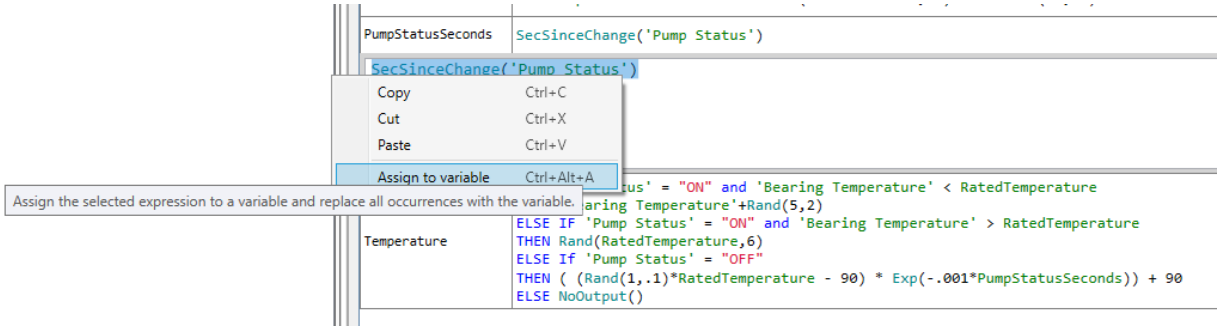
Building Expressions

Use of variables

Easily assign variables to expressions, by highlighting and right-clicking on the highlighted text:



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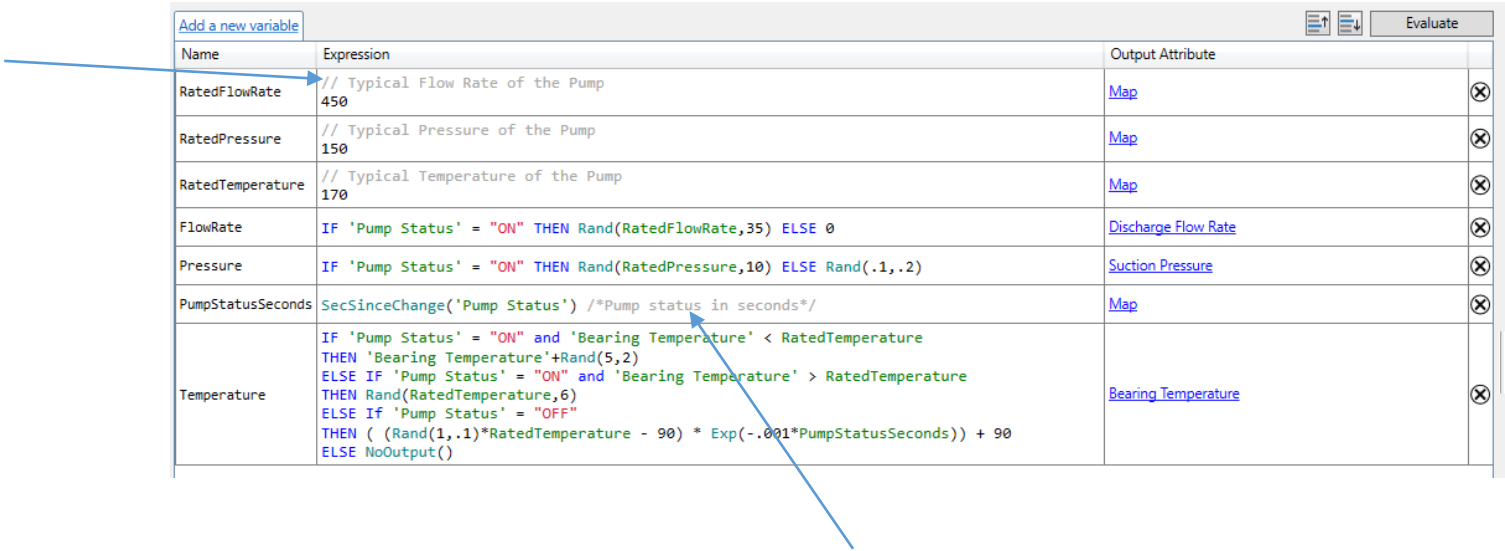
Building Expressions

Comments

Use of comments in expressions helps with readability:



Add a new variable | Evaluate

Name	Expression	Output Attribute
RatedFlowRate	// Typical Flow Rate of the Pump 450	Map
RatedPressure	// Typical Pressure of the Pump 150	Map
RatedTemperature	// Typical Temperature of the Pump 170	Map
FlowRate	IF 'Pump Status' = "ON" THEN Rand(RatedFlowRate,35) ELSE 0	Discharge Flow Rate
Pressure	IF 'Pump Status' = "ON" THEN Rand(RatedPressure,10) ELSE Rand(.1,.2)	Suction Pressure
PumpStatusSeconds	SecSinceChange('Pump Status') /*Pump status in seconds*/	Map
Temperature	IF 'Pump Status' = "ON" and 'Bearing Temperature' < RatedTemperature THEN 'Bearing Temperature'+Rand(5,2) ELSE IF 'Pump Status' = "ON" and 'Bearing Temperature' > RatedTemperature THEN Rand(RatedTemperature,6) ELSE If 'Pump Status' = "OFF" THEN ((Rand(1,.1)*RatedTemperature - 90) * Exp(-.001*PumpStatusSeconds)) + 90 ELSE NoOutput()	Bearing Temperature

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Building Expressions

Exit early

If some expressions are not needed to be evaluated based on same conditions, the Exit() function can be used:

Add a new variable | Evaluate

Name	Expression	Output Attribute
RatedFlowRate	// Typical Flow Rate of the Pump 450	Map
RatedPressure	// Typical Pressure of the Pump 150	Map
RatedTemperature	// Typical Temperature of the Pump 170	Map
Validation	if (BadVal('Pump Status')) then Exit() else NoOutput()	Map
FlowRate	IF 'Pump Status' = "ON" THEN Rand(RatedFlowRate,35) ELSE 0	Discharge Flow Rate
Pressure	IF 'Pump Status' = "ON" THEN Rand(RatedPressure,10) ELSE Rand(.1,.2)	Suction Pressure
PumpStatusSeconds	SecSinceChange('Pump Status')	Map
Temperature	IF 'Pump Status' = "ON" and 'Bearing Temperature' < RatedTemperature THEN 'Bearing Temperature'+Rand(5,2) ELSE IF 'Pump Status' = "ON" and 'Bearing Temperature' > RatedTemperature THEN Rand(RatedTemperature,6) ELSE If 'Pump Status' = "OFF" THEN ((Rand(1,.1)*RatedTemperature - 90) * Exp(-.001*PumpStatusSeconds)) + 90 ELSE NoOutput()	Bearing Temperature

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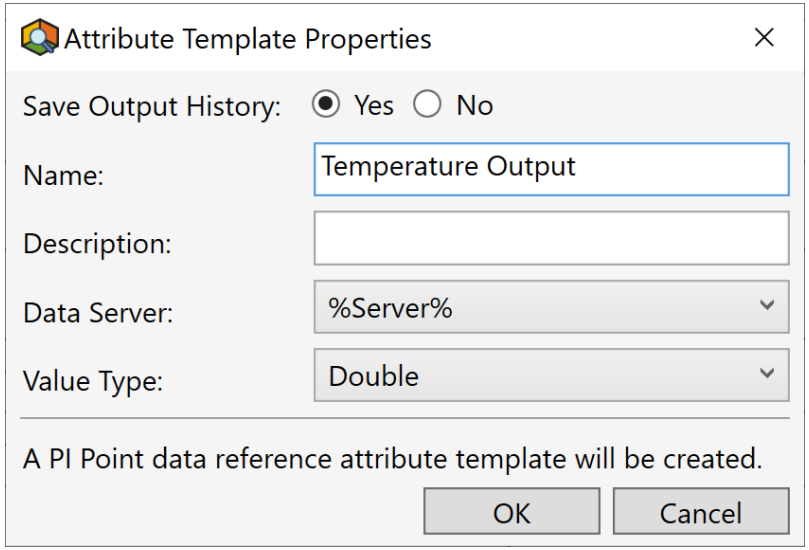
Historizing Data

Store data history into PI Points:



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Working with Multiple Values

Retrieve and filter data in your calculations:

Add a new variable | Evaluate

Name	Expression	Value at Evaluatio	Value at Last Trigc	Output At	
BearingTemperature20	RecordedValuesByCount('Bearing Temperature', '*', 20)	[93.889 °F, ..., 1	[93.889 °F, ..., 1	Map	⊗
BearingTemperatureDay	RecordedValues('Bearing Temperature', 't', '*')	[109.93 °F, ..., 9	[109.93 °F, ..., 9	Map	⊗
BearingTemperatureFiltered	FilterData(BearingTemperature_20, $val > 110)	[114.48 °F, ..., 1	[114.48 °F, ..., 1	Map	⊗
BearingTemperatureDayNew	MapData(BearingTemperatureDay, if $val < 100 then 100 else $val)	[109.93 °F, ..., 1	[109.93 °F, ..., 1	Map	⊗
BearingTemperatureDayNewMin	Min(BearingTemperatureDayNew)	100 °F	100 °F	Map	⊗
BearingTemperatureDayNewMax	Max(BearingTemperatureDayNew)	175.52 °F	175.52 °F	Map	⊗

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Templates

- Provide manageability, consistency and governance
- Use templates for any repetitive work or for future extensions.
- A modification to the template is applied to all analyses from that template.
- Searching and filtering in UI is also easier with templates.
- More performant.

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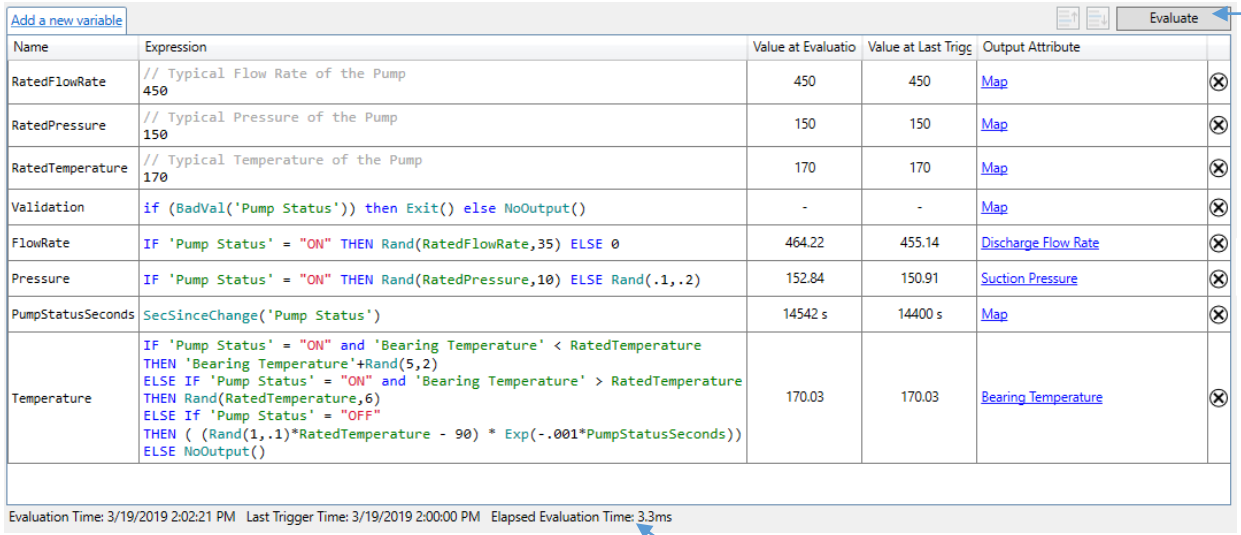
Evaluate

Perform an Evaluate to identify possible issues during configuration:



Add a new variable

Evaluate

Name	Expression	Value at Evaluatio	Value at Last Trigg	Output Attribute
RatedFlowRate	// Typical Flow Rate of the Pump 450	450	450	Map
RatedPressure	// Typical Pressure of the Pump 150	150	150	Map
RatedTemperature	// Typical Temperature of the Pump 170	170	170	Map
Validation	if (BadVal('Pump Status')) then Exit() else NoOutput()	-	-	Map
FlowRate	IF 'Pump Status' = "ON" THEN Rand(RatedFlowRate,35) ELSE 0	464.22	455.14	Discharge Flow Rate
Pressure	IF 'Pump Status' = "ON" THEN Rand(RatedPressure,10) ELSE Rand(.1,.2)	152.84	150.91	Suction Pressure
PumpStatusSeconds	SecSinceChange('Pump Status')	14542 s	14400 s	Map
Temperature	IF 'Pump Status' = "ON" and 'Bearing Temperature' < RatedTemperature THEN 'Bearing Temperature'+Rand(5,2) ELSE IF 'Pump Status' = "ON" and 'Bearing Temperature' > RatedTemperature THEN Rand(RatedTemperature,6) ELSE If 'Pump Status' = "OFF" THEN ((Rand(1,.1)*RatedTemperature - 90) * Exp(-.001*PumpStatusSeconds)) ELSE NoOutput()	170.03	170.03	Bearing Temperature

Evaluation Time: 3/19/2019 2:02:21 PM Last Trigger Time: 3/19/2019 2:00:00 PM Elapsed Evaluation Time: 3.3ms

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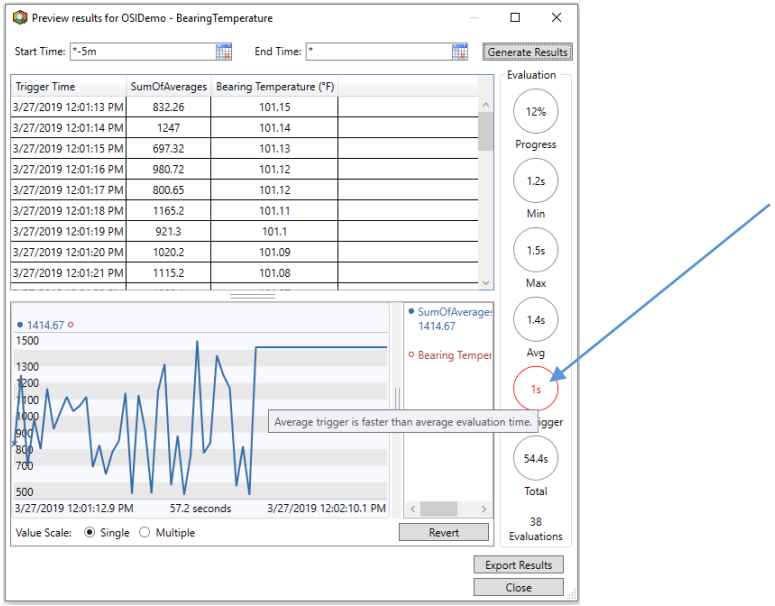
Preview

Preview calculation before checking in:



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Expensive Functions

- Some functions such as summary functions (TagAvg etc.) might require a lot of data in the past to perform a calculation.
- Optimizations can be made by using a smaller range or evaluating less often if the range is larger.
- Compression on PI points can also help with density of data.

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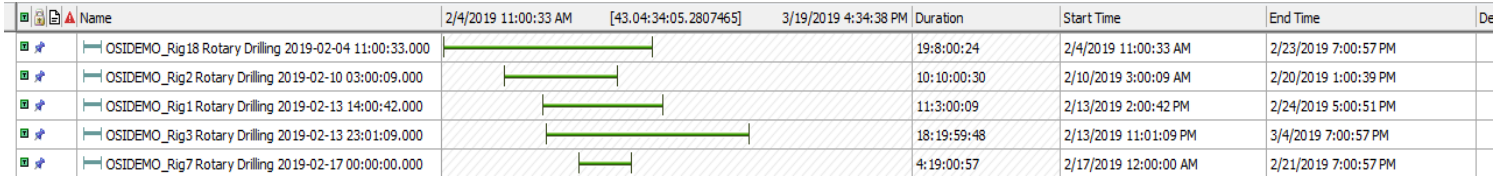
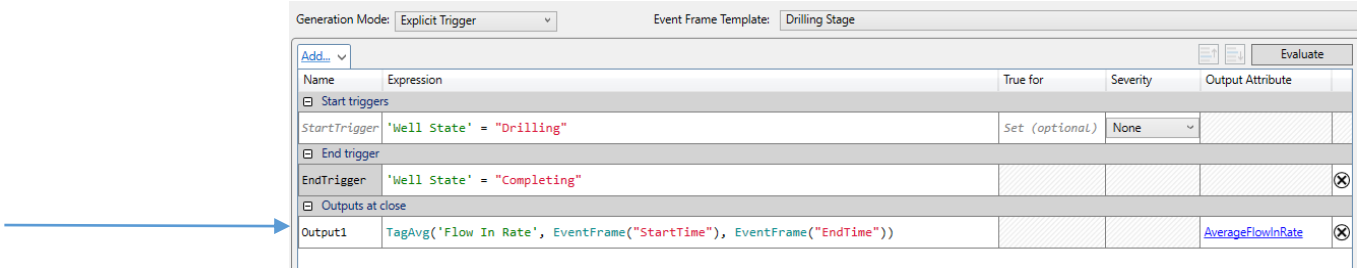
Event Frames and Notifications

- Utilize Event Frames to capture events.
- Good for reports, comparisons and tracking.



Name	2/4/2019 11:00:33 AM [43.04:34:05.2807465] 3/19/2019 4:34:38 PM	Duration	Start Time	End Time
OSIDEMO_Rig18 Rotary Drilling 2019-02-04 11:00:33.000		19:8:00:24	2/4/2019 11:00:33 AM	2/23/2019 7:00:57 PM
OSIDEMO_Rig2 Rotary Drilling 2019-02-10 03:00:09.000		10:10:00:30	2/10/2019 3:00:09 AM	2/20/2019 1:00:39 PM
OSIDEMO_Rig1 Rotary Drilling 2019-02-13 14:00:42.000		11:3:00:09	2/13/2019 2:00:42 PM	2/24/2019 5:00:51 PM
OSIDEMO_Rig3 Rotary Drilling 2019-02-13 23:01:09.000		18:19:59:48	2/13/2019 11:01:09 PM	3/4/2019 7:00:57 PM
OSIDEMO_Rig7 Rotary Drilling 2019-02-17 00:00:00.000		4:19:00:57	2/17/2019 12:00:00 AM	2/21/2019 7:00:57 PM

- Capture data points at the close of event frame.



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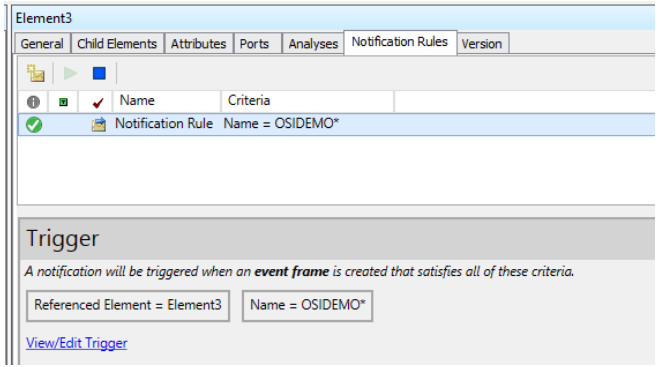
Event Frames and Notifications

- Get notified when an event starts and/or ends.



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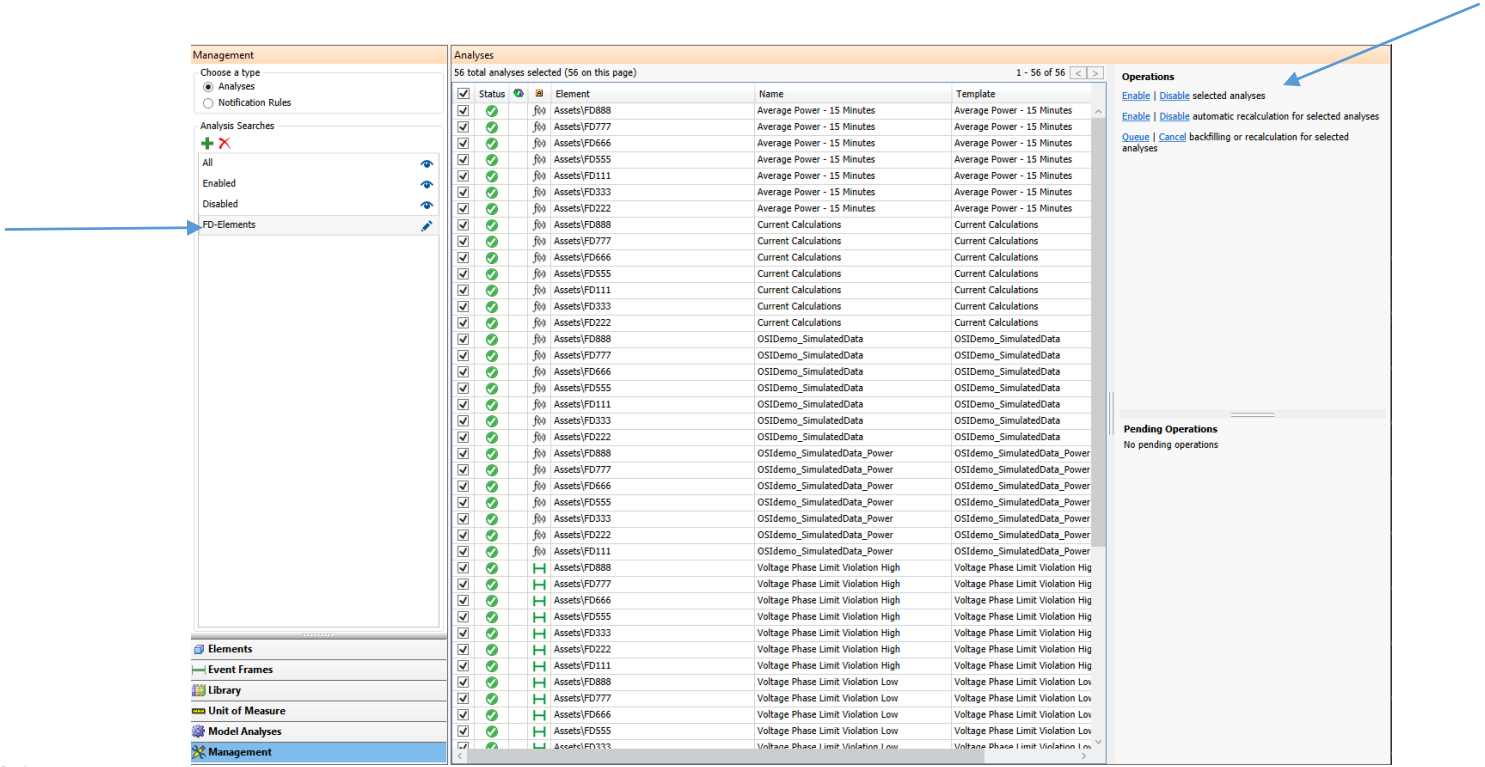
Bulk Operations



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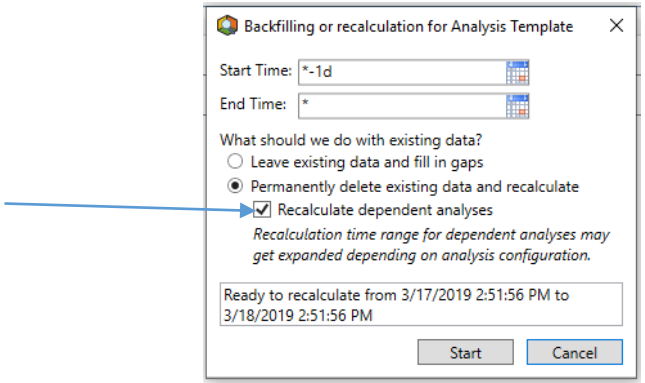
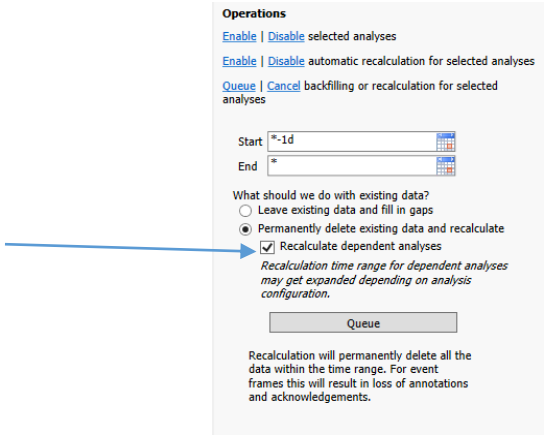
Recalculation/Backfilling

- Real-time vs Recalculation: Independent workers.
- Recalculate dependent analyses:





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Auto-Recalculation

- Enable auto-recalculation when:
  - Out of order data is expected and
  - It is required to recalculate past data.
- Don't enable auto-recalculation when:
  - Past data shouldn't be modified
  - Past data from dependent calculations shouldn't be modified.

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Auto-backfilling

- Enable Auto-backfilling to fill gaps automatically between service restarts.
- Analyses are queued for backfilling at start of service.

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Change Management

- Consider setting up Dev or Test environment
  - Allows for experimentation while developing calculations
  - Many engineers could be writing calculations
  - Frequent changes can cause some churn for the production system
  - Easier to isolate issues

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High Availability

- PI Analysis Service supports failover using Windows Server Failover Clustering (WSFC)
- Use buffering for writing PI Point outputs (PI Buffer Subsystem)

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More Resources

- Contextualize: Rolling out Asset Framework (PI World 2019, Day 3 Best Practices)
- PI Square

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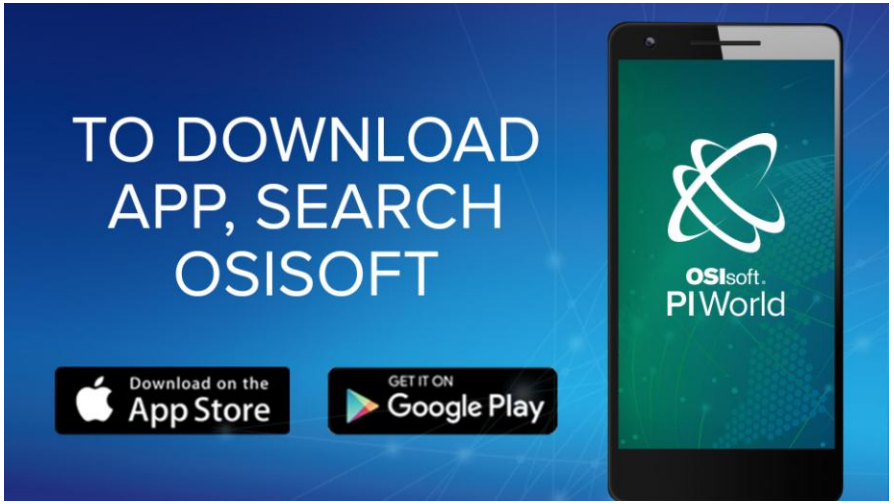
Questions?

Please wait for the **microphone**

State your **name & company**

Please remember



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