Best Practices for Making Advanced Analytics Relevant

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OSIsoft

Workbench for Relevant Operational Analytics

Data Engineering and Preparation

- PI System offers distinctive features for preparing time-series data for advanced analytics, e.g. asset context, process context and feature generation.

Access, Analysis and Model Enablement

- PI System provides multiple data access methods, meeting needs of data engineers or scientists.

Testing, Evaluation and Operationalization

- Asset Analytics plays an essential role in testing and evaluating developed models.
- PI Vision and Future Data support model integration and socialization for gaining relevance within Operations.

Accountability

- PI System provides verification of improvement benefits

Data Engineering and Preparation

Real Time Data is Different

- Transactional data is recorded in a tabular format with values associated by columns in each row.
- Real-time data is recorded with only time context, i.e. value and timestamp.
- Full-featured “observations” are required for analytics.

	leakno	compute_0002	city	grade	read_locat	map	plat	block	date_reptd
1	7800201621	00201621	San Jose	3	Under Drway o/m	3411	F07	040	11/28/2000 14:00:00
2	7801200081	01200081	Santa Clara	3	o/m in s/e cor of Humbolt Ave	3411	B08	010	1/5/2001 11:00:00
3	7801200091	01200091	Santa Clara	3	o/m 2' into property	3411	D06	028	1/4/2001 01:30:00
4	7801200121	01200121	Santa Clara	2	o/m, 3' from sidewalk	3411	D06	012	1/16/2001 10:00:00
5	7801200841	01200841	Santa Clara	3	1% o/m under concrete pkstrip at e/end of drway	3411	A07	028	8/27/2001 11:00:00
6	7801200851	01200851	Santa Clara	3	1% under drway at curb & Gutter	3411	A08	015	8/28/2001 10:00:00
7	7803200121	03200121	San Jose	3	1575 Parkveiw Ave.	3411	H07	044	3/23/2003 09:48:00
8	7803200461	03200461	Santa Clara	3	1% in svc tee area o/main	3411	C07	026	11/10/2003 07:33:00
9	7806200241	06200241	Santa Clara	3	s/w cor Princeton Wy x Princeton Ct on main	3411	C07	012	2/6/2006 13:15:00
10	7806200271	06200271	Santa Clara	3	S/E cor Homestead x Lawrence Exwy valve frme&cover	3411	C07	016	2/7/2006 11:40:00
11	7806200351	06200351	Santa Clara	2	O/M @ svc tee (Longside)	3411	C08	037	2/16/2006 10:00:00
12	7806200441	06200441	Santa Clara	3	over main next to srvc tee	3411	D07	048	3/8/2006 13:00:00
13	7806200481	06200481	Santa Clara	2	on main or tee	3411	D08	052	3/10/2006 09:45:00
14	7806200491	06200491	Santa Clara	2	on main ovr sewer not venting to house	3411	D08	053	3/10/2006 10:00:00
15	7806200501	06200501	Santa Clara	2	btwn #s 3145 & 3155 Mauricia Wy on main or tee	3411	D08	008	3/10/2006 11:25:00
16	7806200511	06200511	Santa Clara	3	on tee S/O driveway	3411	D08	056	3/10/2006 14:00:00
17	7806200541	06200541	Santa Clara	3	on tee	3411	D08	049	3/15/2006 13:30:00
18	7806200561	06200561	San Jose	2	ovr main btwn Greendale & Auburn on Albany	3411	E08	014	3/16/2006 13:45:00
19	7806200611	06200611	Santa Clara	3	15' from drway about 15" in parkstrip @svc tee	3411	F07	041	3/22/2006 13:45:00
20	7806200641	06200641	Santa Clara	3	3% OVER MAIN NEXT TO SEWER	3411	G08	012	3/23/2006 14:00:00
21	7806200651	06200651	San Jose	3	on main or srvc tee	3411	F08	072	3/24/2006 11:15:00
22	7806200681	06200681	Santa Clara	2+	5" in parkstrip fr/swk over tee on main 6' from...	3411	G07	006	3/28/2006 13:40:00
23	7806200701	06200701	Santa Clara	3	36' EO W p/l Olympus. 2% In water box	3411	G08	053	3/28/2006 13:00:00
24	7806200711	06200711	Santa Clara	2	F/O o/main (under tree)	3411	H06	023	3/29/2006 11:00:00
25	7806200721	06200721	Santa Clara	2+	o/svc/tee about 3' from drway in parkstrip	3411	G07	014	3/29/2006 13:10:00

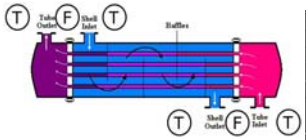
56.902 03-SEP-2016 11:23 AM

Prepare Operational Data for Experimentation

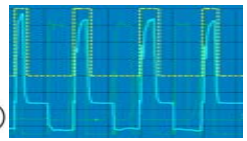
- Sensor data unevenly timestamped
- Domain experts supply known relationships and impacting features
- Features and labeled events are added by backfilling in Asset Analytics
- Benefit for Operations and advanced analytics
- Prepared features persist for model operationalization and notification

63.781 3/9/16 11:19 AM → 56.902 3/9/16 11:23 AM → 58.341 3/9/16 11:41 AM

Operational Context



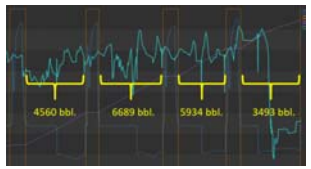
Asset



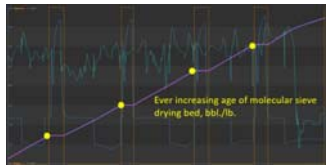
Process Actions

$$H = z + \frac{p}{\rho g} + \frac{v^2}{2g} = h + \frac{v^2}{2g}$$

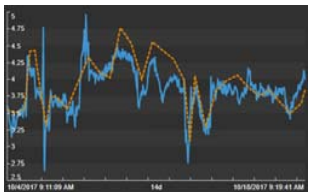
First Principles



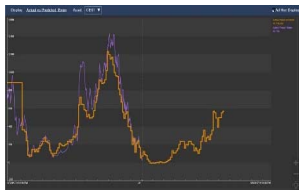
Aggregations & Experimentation



Operational Relevance



Predictive Results

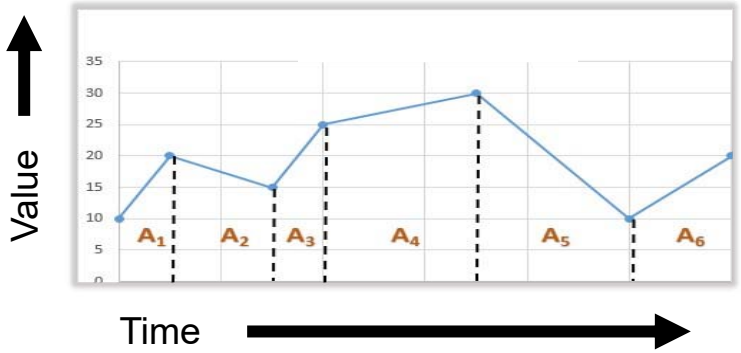


Future Data

Notification

Aggregations and Units of Measure Observance

Unevenly Spaced Events



Correct: Time-weighted
Average = 20.208

Incorrect: Arithmetic

$$\frac{10 + 20 + 15 + 25 + 30 + 10 + 20}{7} = 18.571$$

Measured Rates Converted to Totals

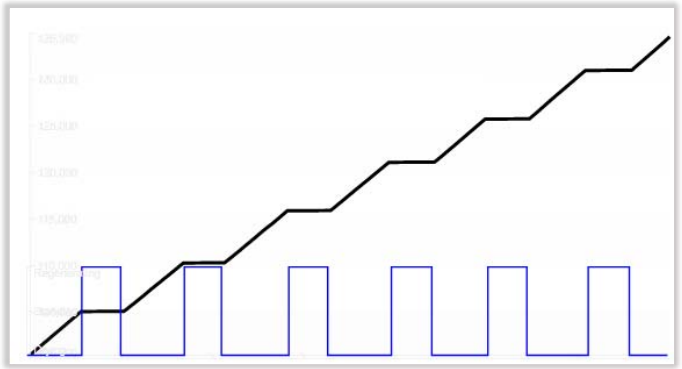
Time Stamp	Value	Units	Gallons	
7/5/2017 8:00	8,828.5	gal/d	0.0	
7/5/2017 8:20	8,845.1	gal/d	122.8	
7/5/2017 8:40	8,861.6	gal/d	123.1	
7/5/2017 9:00	8,894.8	gal/d	123.5	
7/5/2017 9:20	9,045.2	gal/d	125.6	
7/5/2017 9:40	9,171.3	gal/d	127.4	
7/5/2017 10:00	9,199.9	gal/d	127.8	
	62,846.4		750.2	gal

Correct: Unit Conversion
Total = 750.2

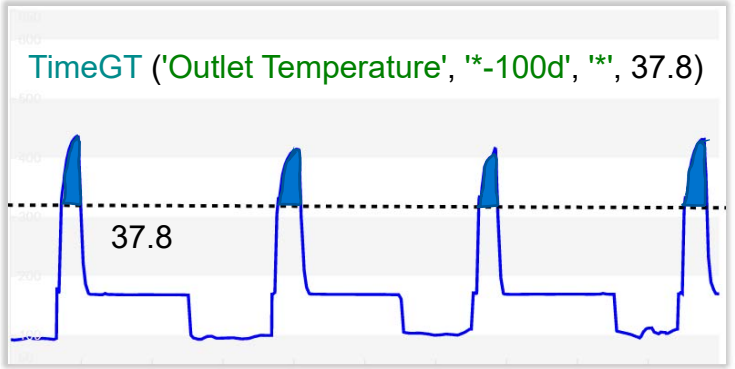
Incorrect: Arithmetic
Sum = 62,846.4

Time at State and at Conditions, Dynamics

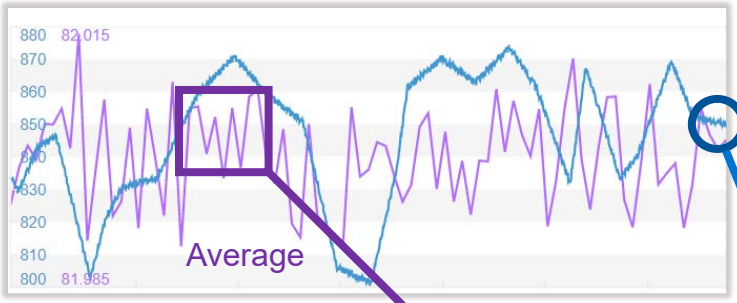
Asset Runtime



Exposure to Conditions

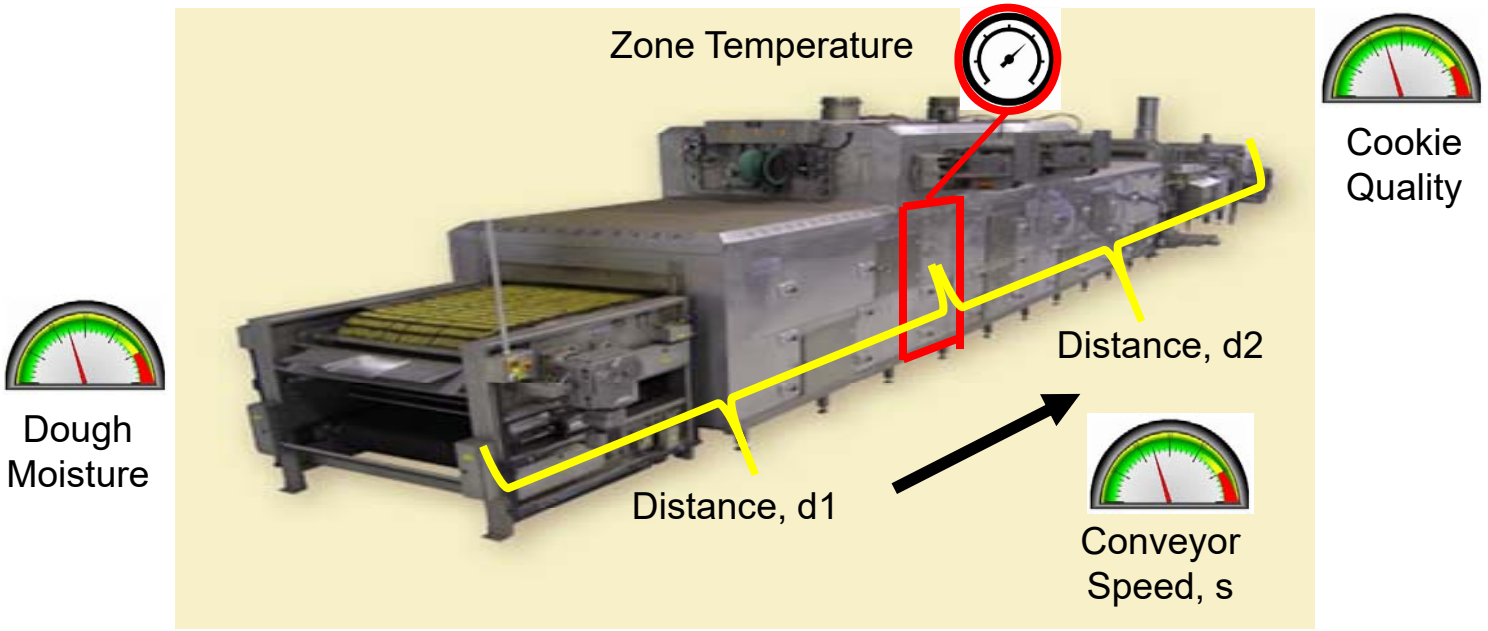


Process Dynamics



15-Mar-20 3:57 AM	Pump 6	**75.68**	**853.4**

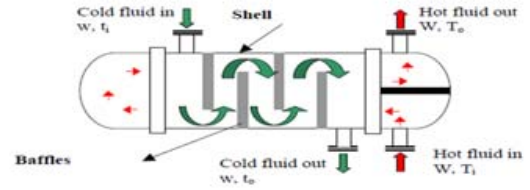
Dynamics: The Way the Cookie Crumbles



Modelling Phase	Moisture	Temperature	Quality
Training Observations	* – (d1 + d2) /s	* – d2 / s	*
Prediction	*	* + d1 / s	* + (d1 + d2) /s

First Principles Analytics - *Asset Analytics*

- *Configure* calculations for **transparency** and **scale**
- Math, statistical, logical and steam table functions
- Predictive algebraic analytics
- Future data for forecasting
- **Backfill ! Backfill ! Backfill !**

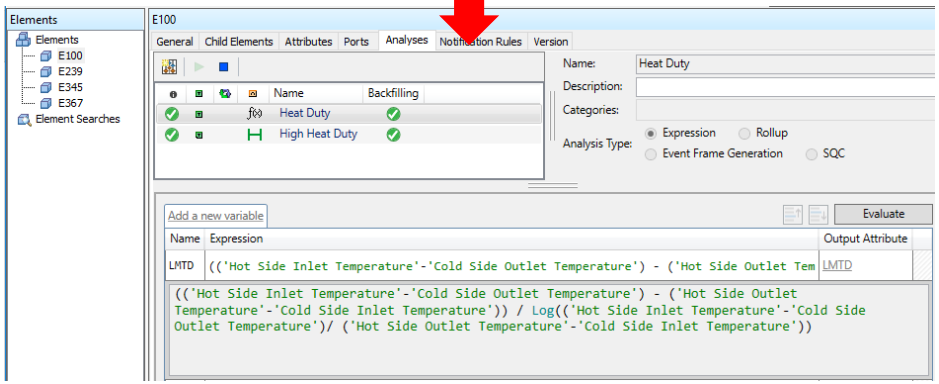


Heat Exchanger Key Performance Indicator:

Overall heat transfer coefficient

$$U = \frac{Q}{A \times \text{Corrected LMTD}}$$

***RULE:** IF the heat transfer coefficient is decreasing, THEN the **Heat Exchanger FOULING** !!! Cleaning is required!*

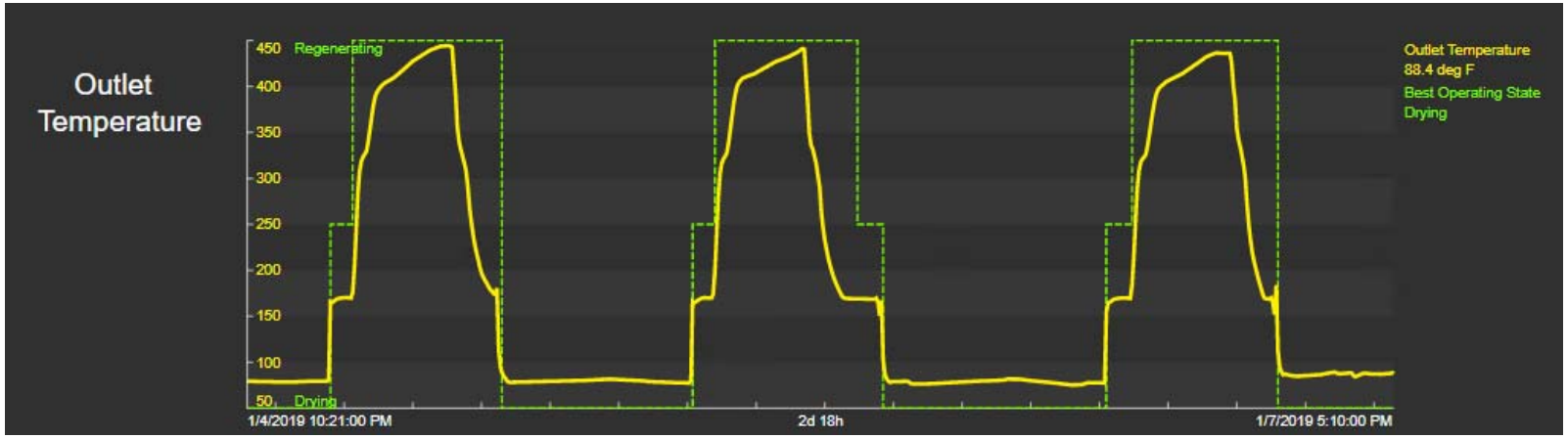


Label Time Ranges of Interest – *Event Frames*

Event Frame Search Results 1

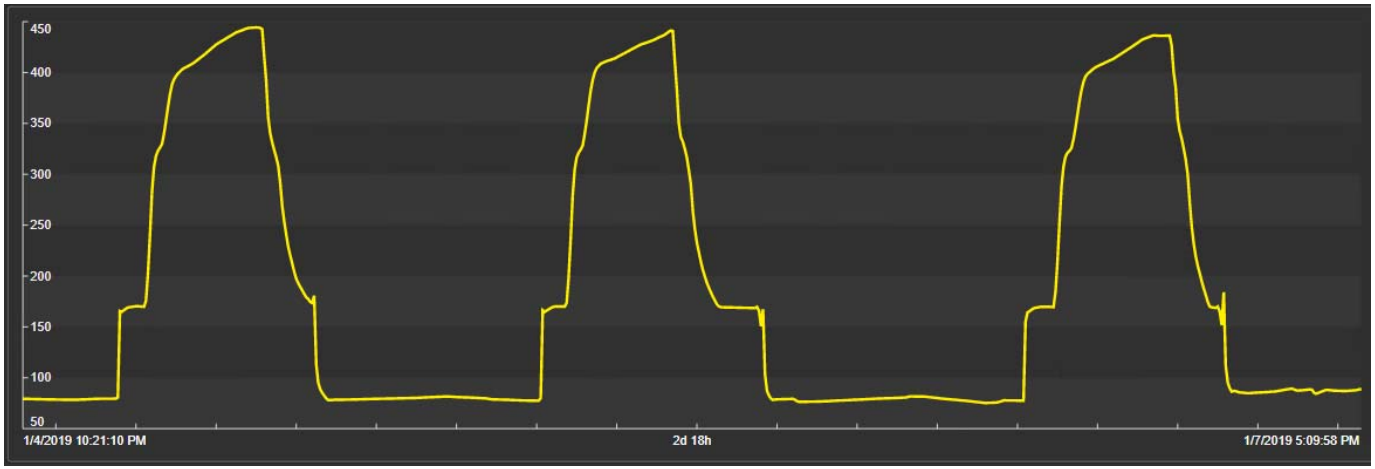
Filter

Name	Duration	Start Time	End Time
Dryer A Regeneration Cycle 01-04-19 03:06	9:54:00	1/4/2019 3:06:00 AM	1/4/2019 1:00:00 PM
Dryer A Regeneration Cycle 01-05-19 04:30	8:42:00	1/5/2019 4:30:00 AM	1/5/2019 1:12:00 PM
Dryer A Regeneration Cycle 01-06-19 01:36	8:18:00	1/6/2019 1:36:00 AM	1/6/2019 9:54:00 AM



Framing Rule from Outlet Temperature Pattern

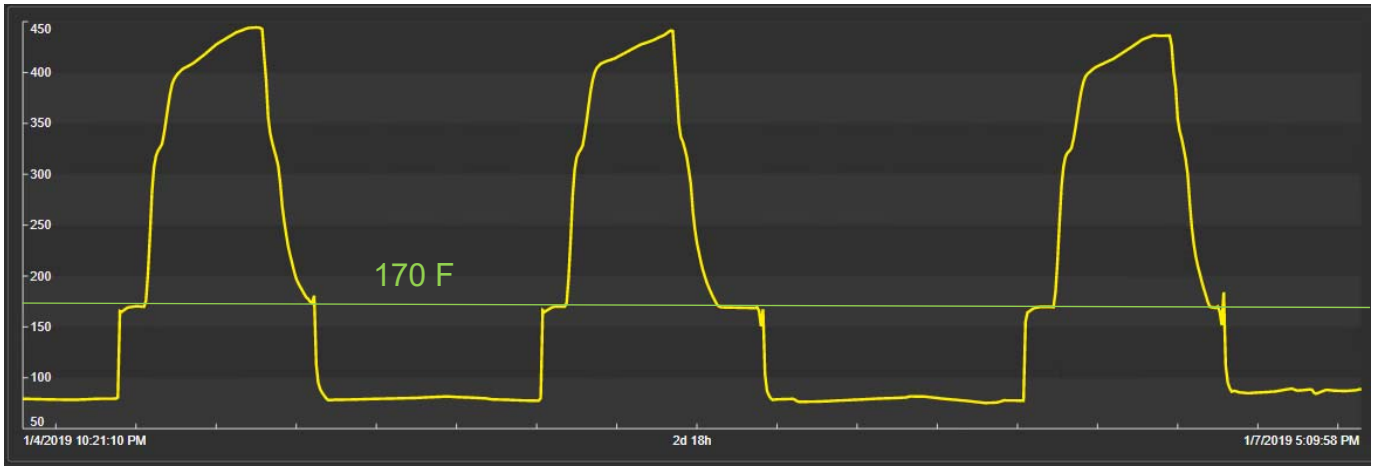
Data Engineering Process



Framing Rule from Outlet Temperature Pattern

Data Engineering Process

First Backfill



Asset Analytics

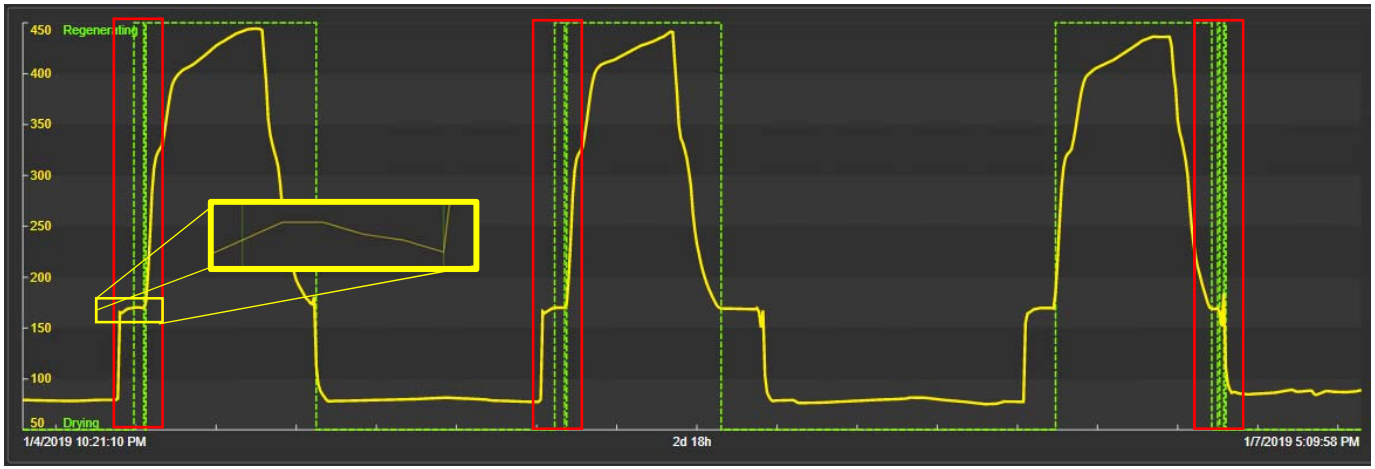
If 'Outlet Temperature' >= 170
Then "Regenerating"
Else “Process"

Framing Rule from Outlet Temperature Pattern

Data Engineering Process

First Backfill

- **“False Starts”**



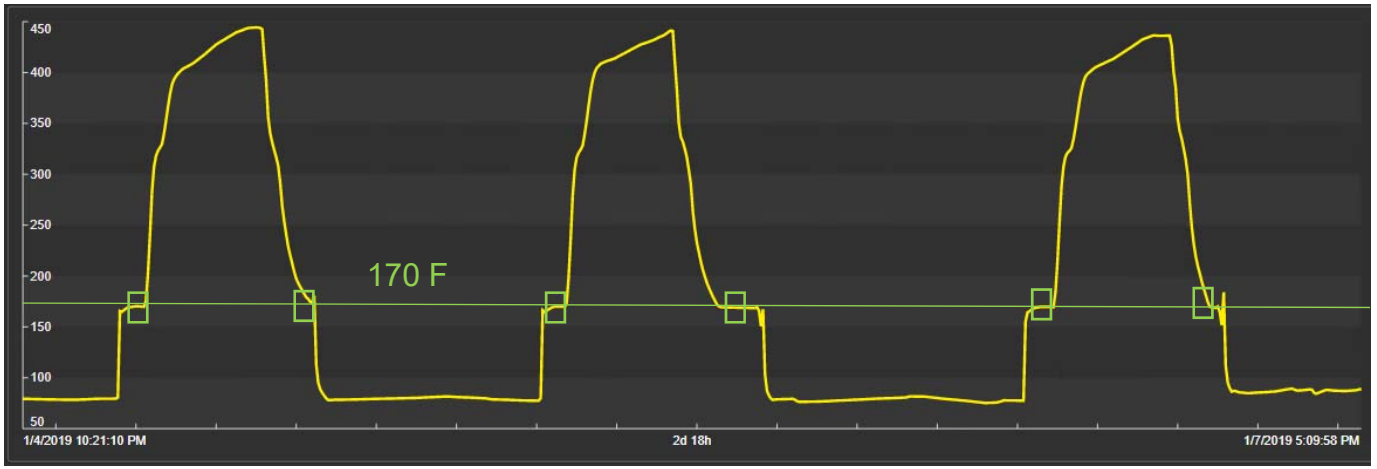
Framing Rule from Outlet Temperature Pattern

Data Engineering Process

First Backfill

- “False Starts”

Second Backfill



Asset Analytics

```
If TagAvg('Outlet Temperature','*-1h','*') >= 170
Then "Regenerating"
Else “Process")
```

Framing Rule from Outlet Temperature Pattern

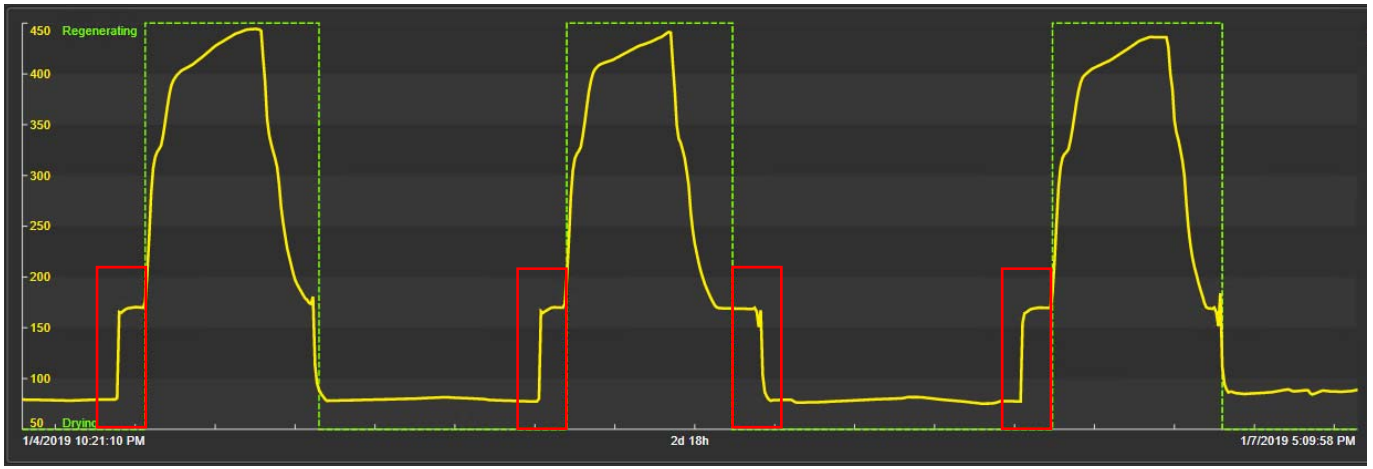
Data Engineering Process

First Backfill

- “False Starts”

Second Backfill

- **Missing third “Standby” State**



Framing Rule from Outlet Temperature Pattern

Data Engineering Process

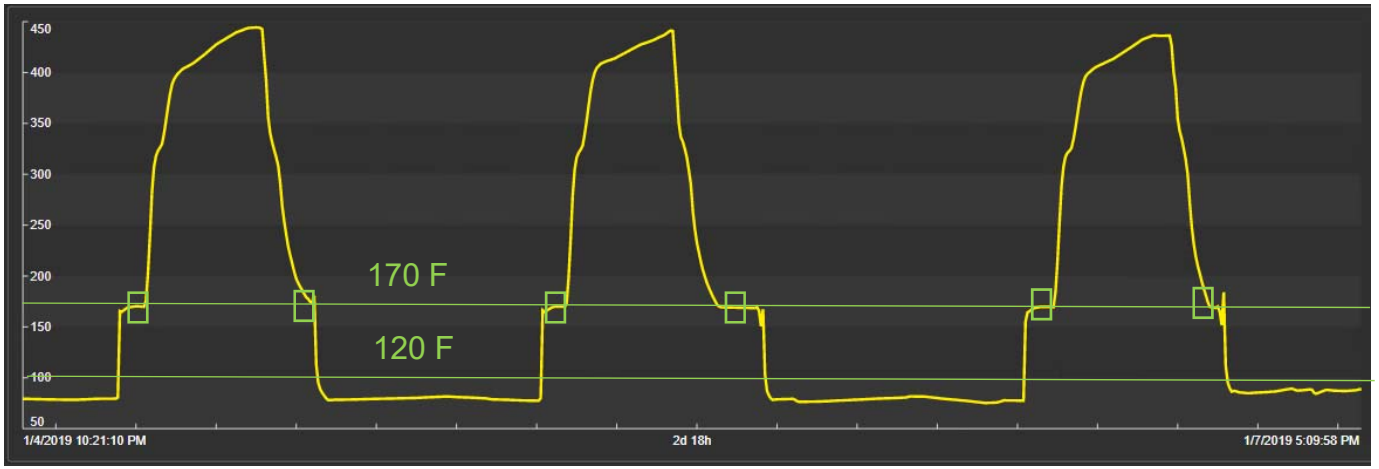
First Backfill

- “False Starts”

Second Backfill

- Missing “Standby” State

Third Backfill



Asset Analytics

```
If TagAvg('Outlet Temperature','*-1h','*') >= 170
Then "Regenerating"
Else (If 'Outlet Temperature' >= 120
 Then "Standby"
 Else “Process")
```

Framing Rule from Outlet Temperature Pattern

Data Engineering Process

First Backfill

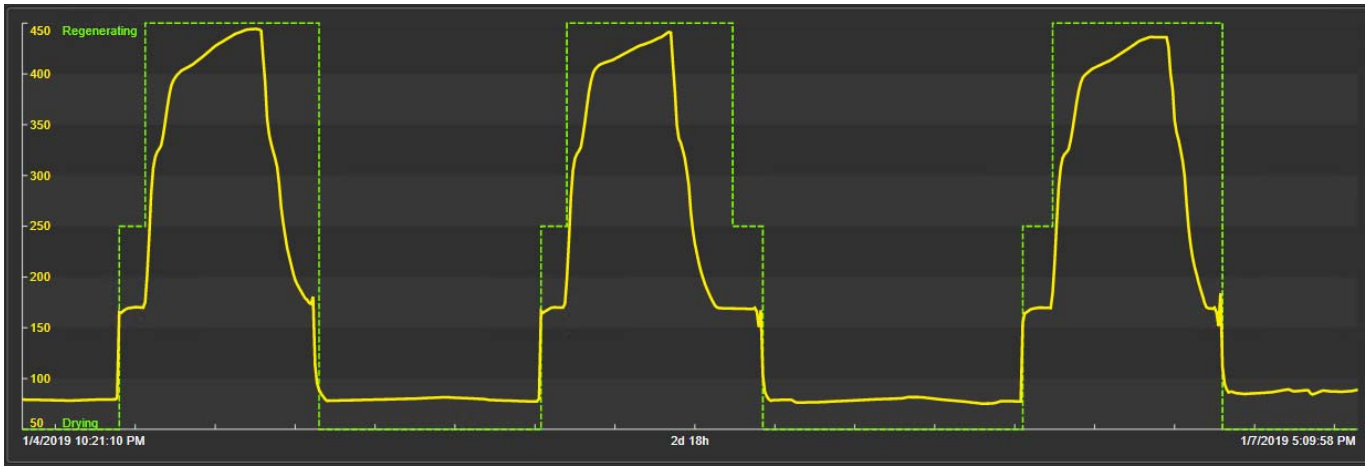
- “False Starts”

Second Backfill

- Missing “Standby” State

Third Backfill

- **Use it !**

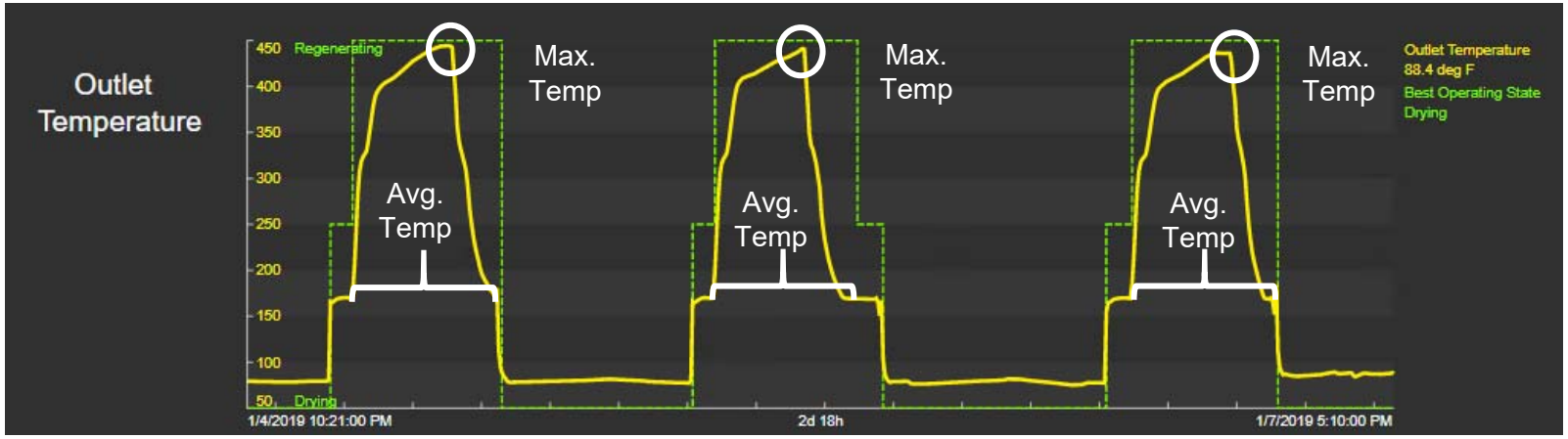


Complete Observation with Event Frame Attributes

Event Frame Search Results 1

Filter

Name	Duration	Start Time	End Time	Avg Outlet Temp	Max Outlet Temp
Dryer A Regeneration Cycle 01-04-19 03:06	9:54:00	1/4/2019 3:06:00 AM	1/4/2019 1:00:00 PM	324.4 deg F	444.3 deg F
Dryer A Regeneration Cycle 01-05-19 04:30	8:42:00	1/5/2019 4:30:00 AM	1/5/2019 1:12:00 PM	346.9 deg F	444.3 deg F
Dryer A Regeneration Cycle 01-06-19 01:36	8:18:00	1/6/2019 1:36:00 AM	1/6/2019 9:54:00 AM	339.0 deg F	441.3 deg F

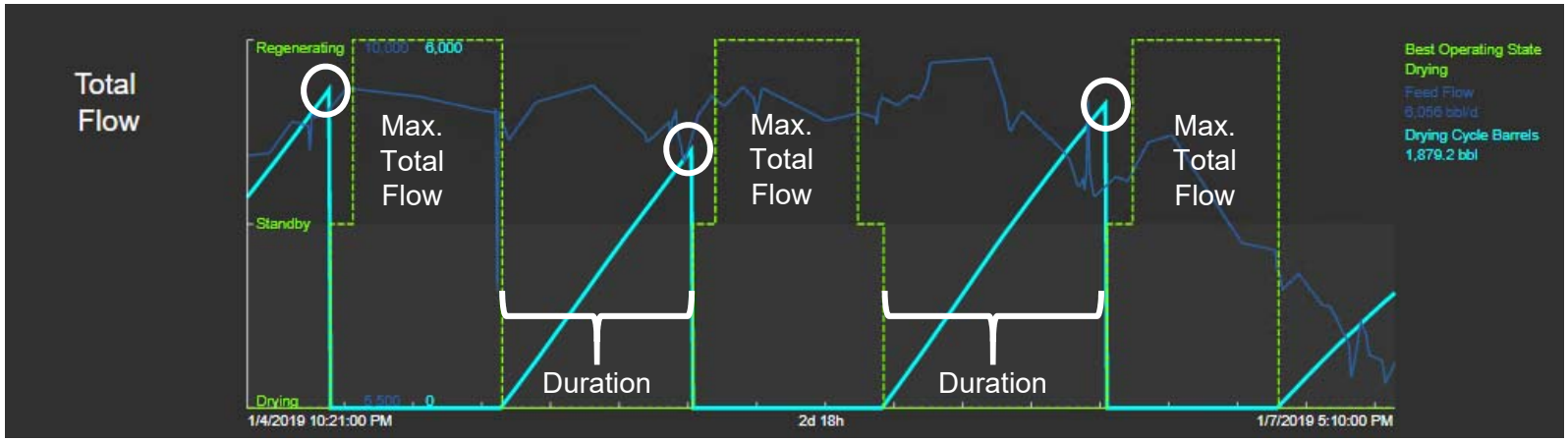


Complete Observation with Event Frame Attributes

Event Frame Search Results 1

Filter

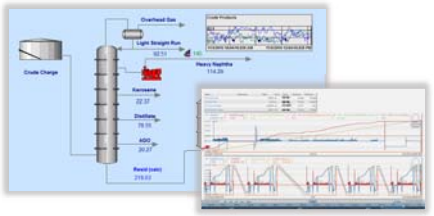
Name	Duration	Start Time	End Time	Avg Outlet Temp	Max Outlet Temp	Drying Cycle Duration	Drying Cycle Barrels
Dryer A Regeneration Cycle 01-04-19 03:06	9:54:00	1/4/2019 3:06:00 AM	1/4/2019 1:00:00 PM	324.4 deg F	444.3 deg F	13.8 h	5259.6 bbl
Dryer A Regeneration Cycle 01-05-19 04:30	8:42:00	1/5/2019 4:30:00 AM	1/5/2019 1:12:00 PM	346.9 deg F	444.3 deg F	14.0 h	5189.7 bbl
Dryer A Regeneration Cycle 01-06-19 01:36	8:18:00	1/6/2019 1:36:00 AM	1/6/2019 9:54:00 AM	339.0 deg F	441.3 deg F	11.1 h	4207.6 bbl



Access, Analysis and Model Enablement

Enabling Analytics for Operational Intelligence

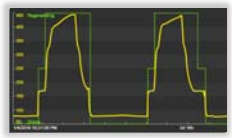
Real-Time Decision Analysis



Diagnostic
Trending & Awareness

$$Q = \frac{\Delta P_{DD} * kh}{141.2 \mu B_0 \left\{ ln \frac{r_e}{r_w} - \frac{3}{4} + S \right\}}$$

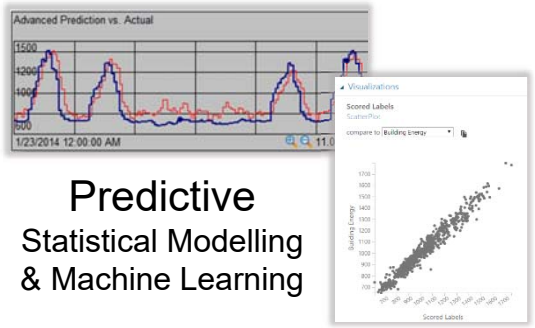
Descriptive
Condition & Performance



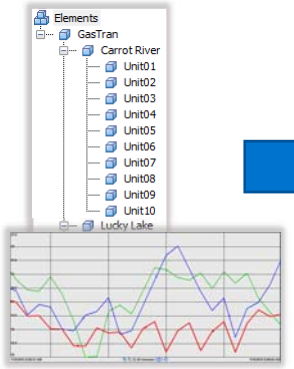
Event Frames

Retrospective & Predictive Analysis

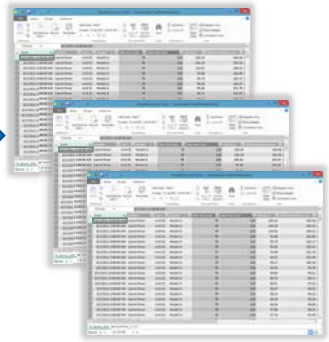
Visual
Dashboards &
Multidimensional Assessment



Predictive
Statistical Modelling
& Machine Learning



Time, Event and
Asset Context

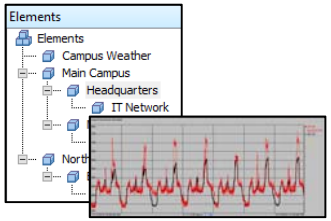


Tabular
Context

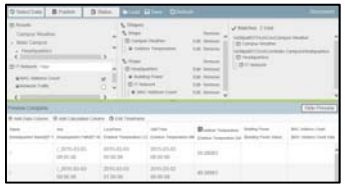
Common Ground between Technological Contexts

Open Data Access for Advanced Analysis Tools

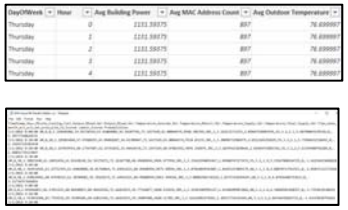
Self-service access for Everyone



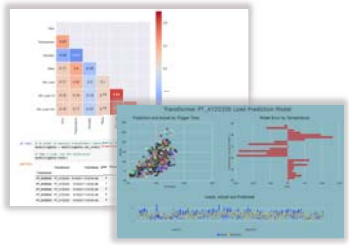
PI System



PI Integrator for Business Analytics

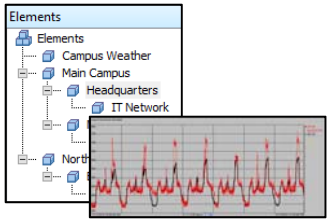


MS SQL or .csv File
Azure or AWS



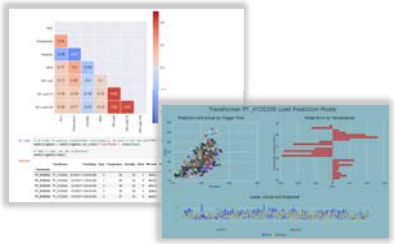
Python,
Power BI,
etc.

Direct programmatic access for Data Engineers and Scientists



PI System

- **PI SQL Client* (OLEDB)**
- **PI OLEDB Enterprise**
- **PI Web API and AF SDK**



Python,
Power BI,
etc.

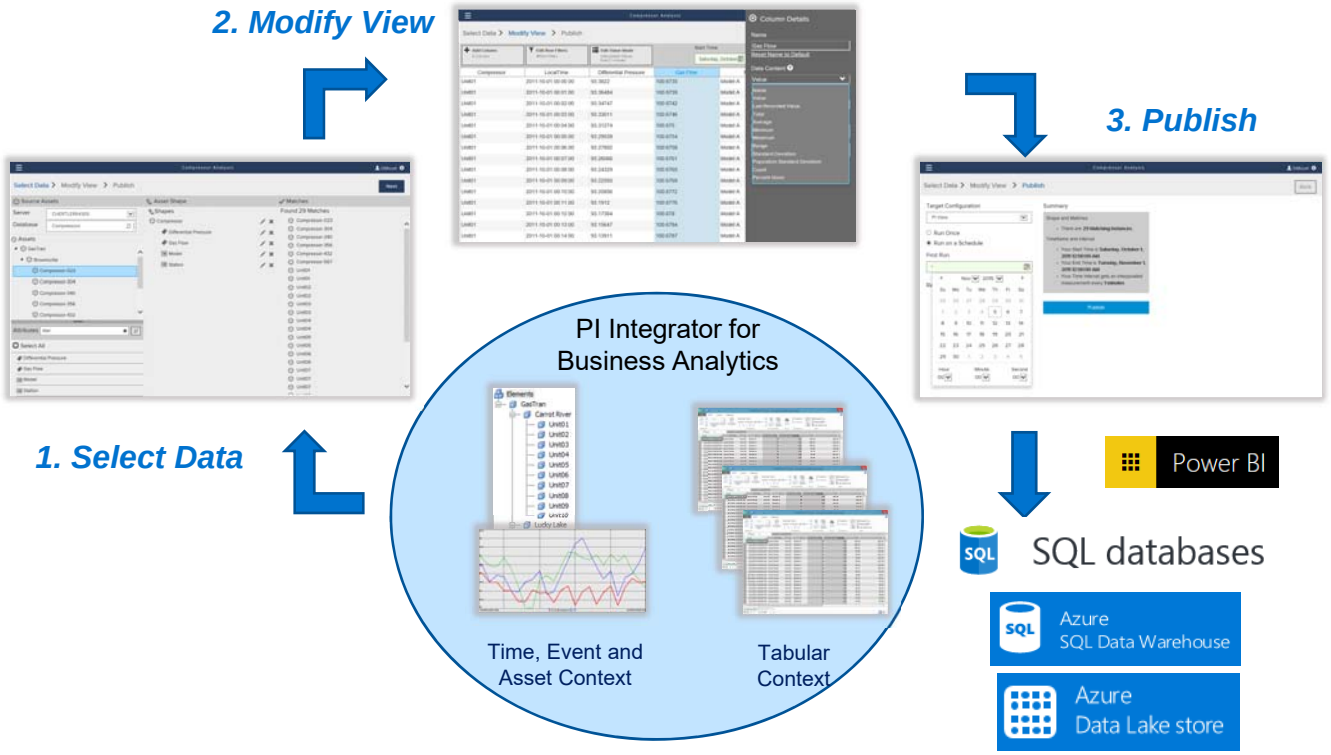
* Requires RTQP option in PI Server 2018

PI Integrator for Business Analytics

Easy, scalable way for users to create contextualized views of operational data.

- **Select** assets and their attributes from an AF hierarchy.
- **Modify** view by setting time range, row interval, and column aggregations.

  Add filtering rules to "cleanse" data.
- **Publish** once or on a scheduled bases.

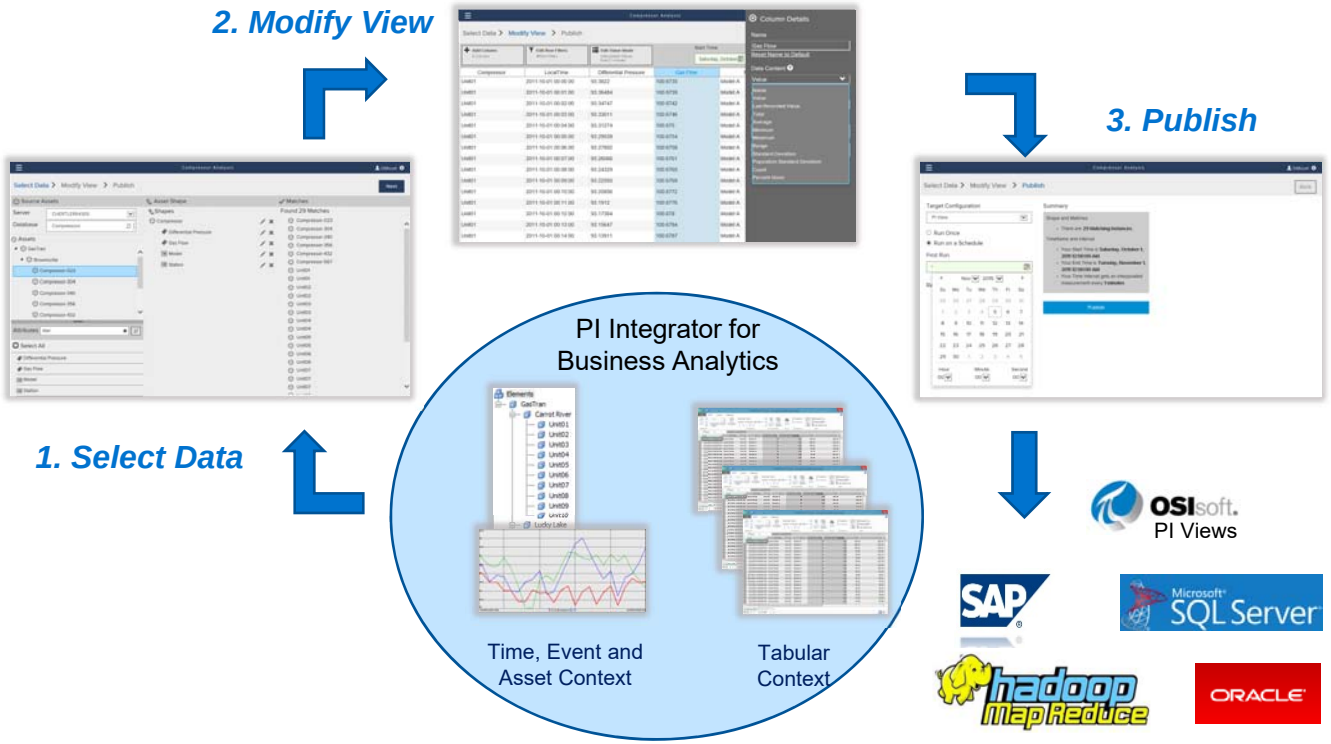


PI Integrator for Business Analytics

Easy, scalable way for users to create contextualized views of operational data.

- **Select** assets and their attributes from an AF hierarchy.
- **Modify** view by setting time range, row interval, and column aggregations.

  Add filtering rules to "cleanse" data.
- **Publish** once or on a scheduled bases.



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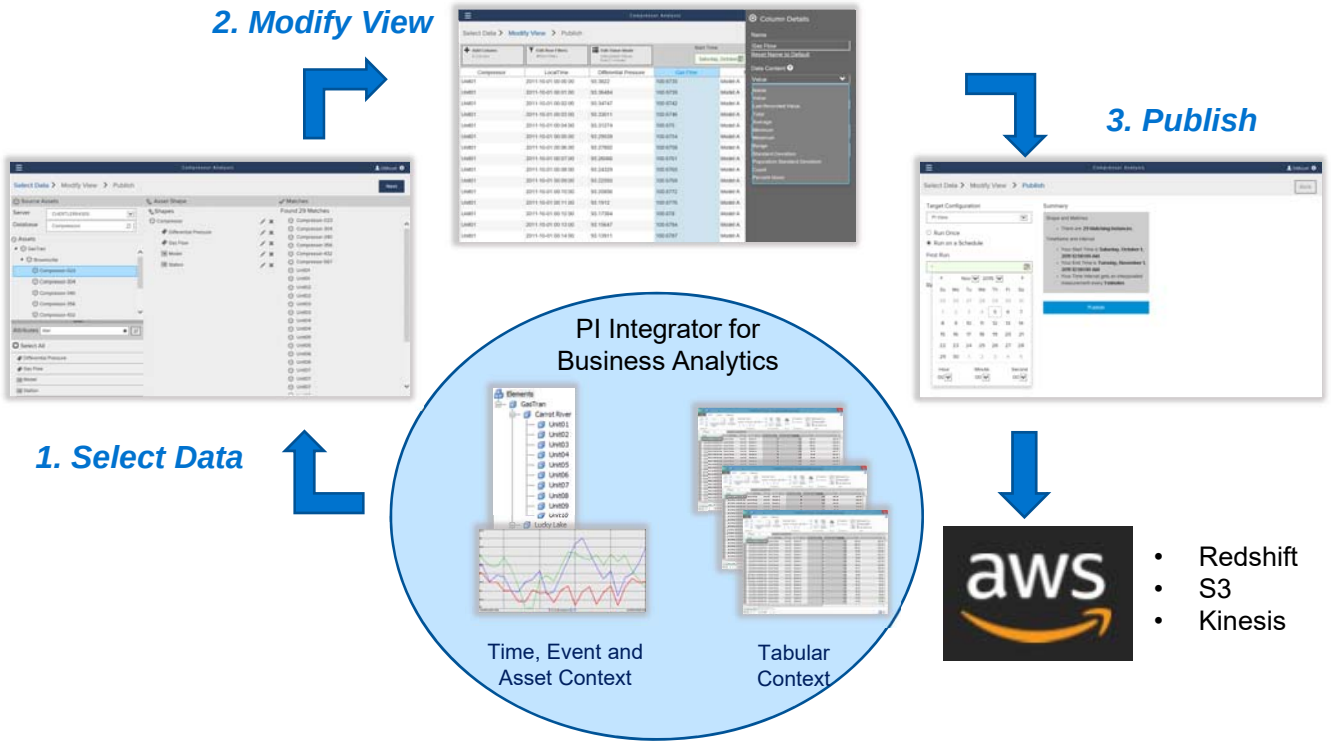

PI Integrator for Business Analytics

Easy, scalable way for users to create contextualized views of operational data.

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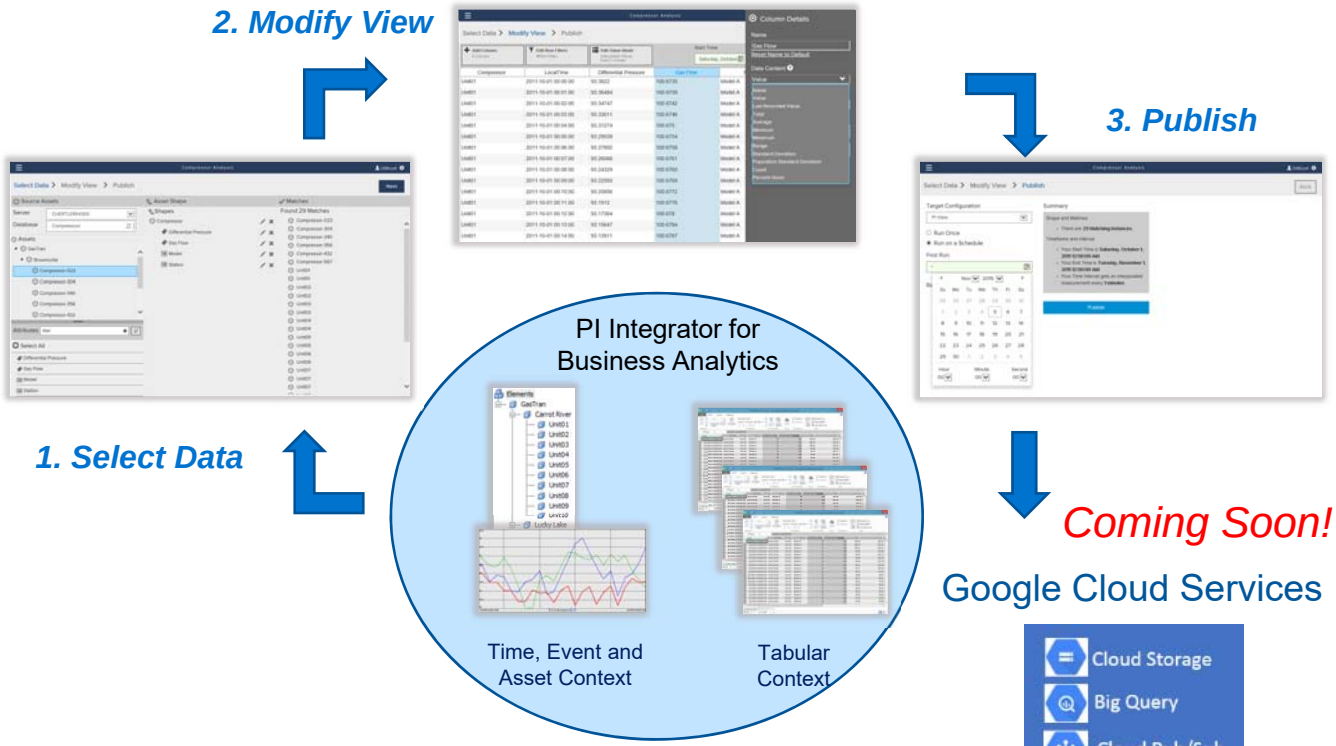
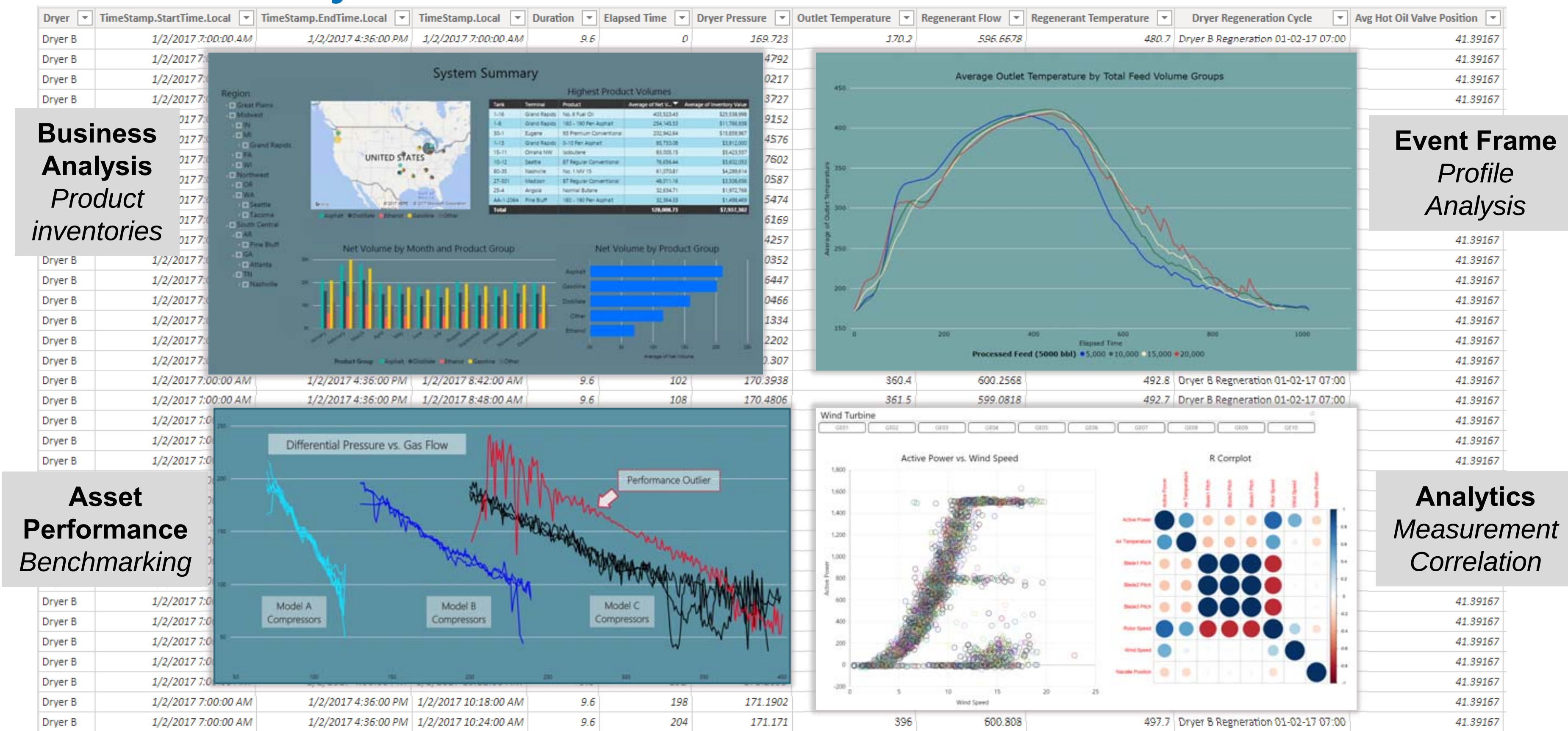


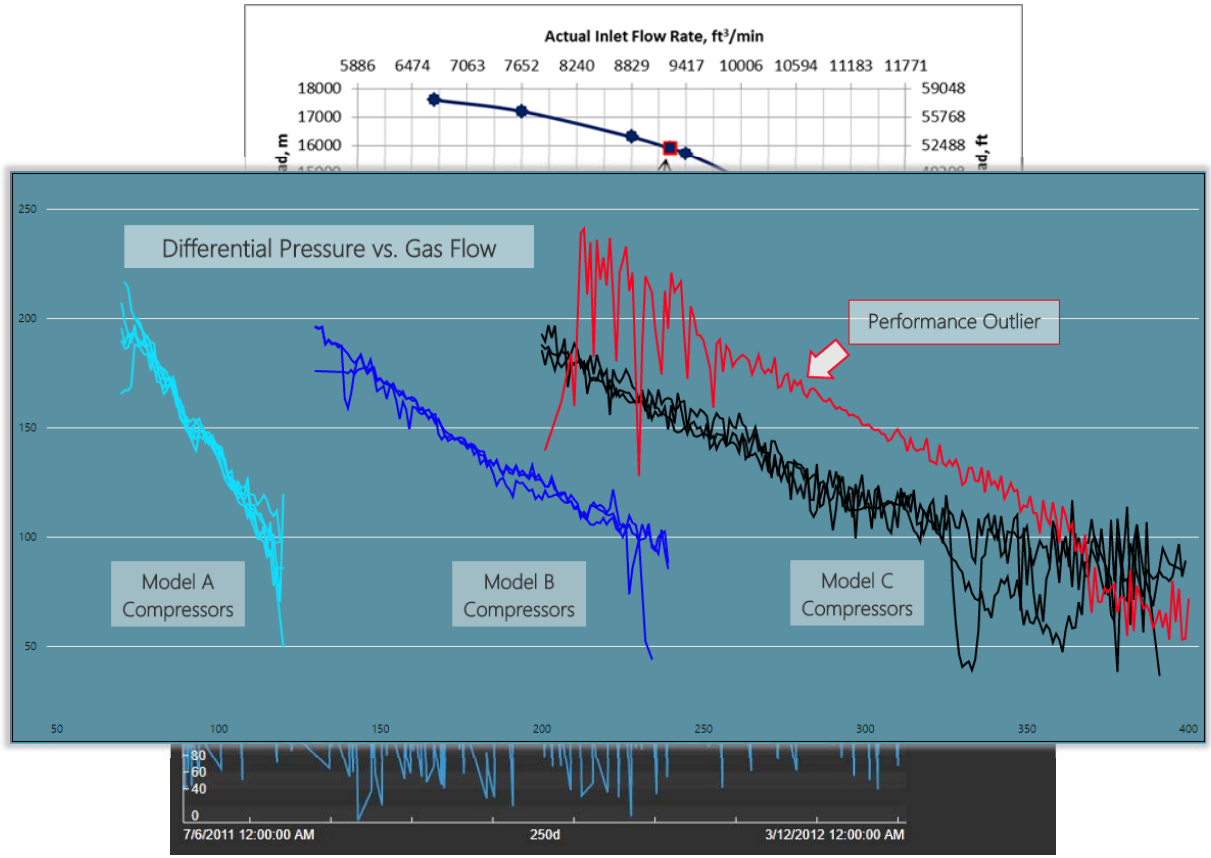
Visual Analytics – Multidimensional Tools



Visual Analytics – Asset Benchmarking

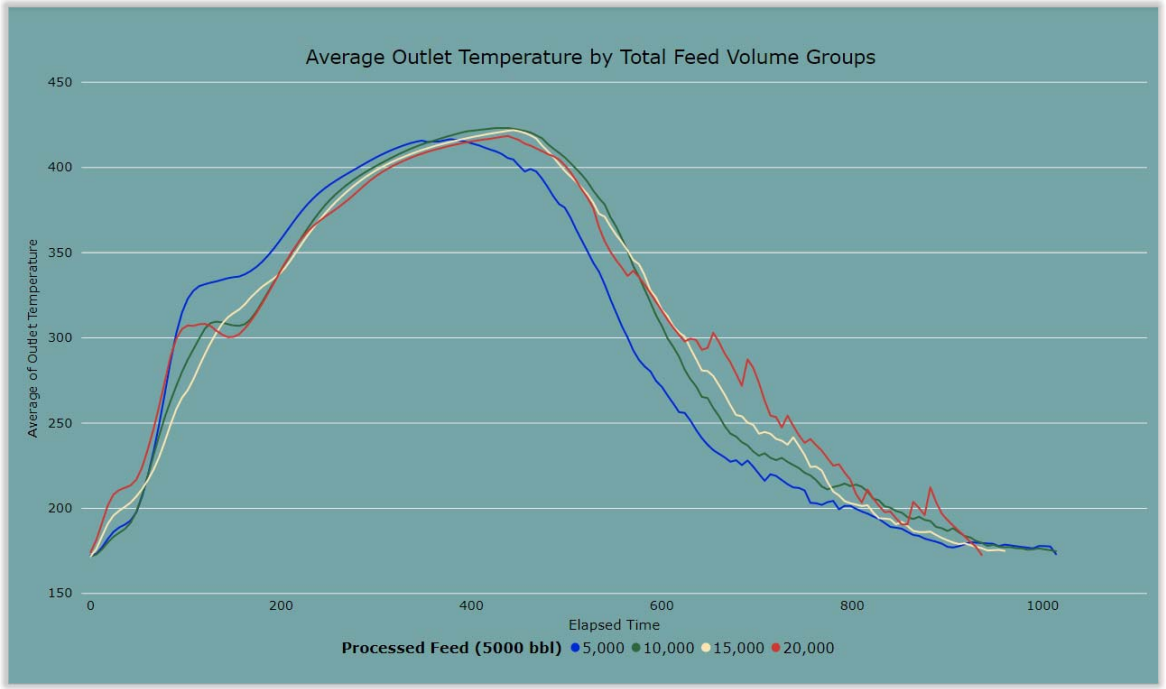
Benchmark **all** similar assets against know performance characteristics.

- Real-time trend of one asset is essential for current operation.
- Different tools required to analyze groups of assets.
- PI Asset Views summarize months of actual operations exposing actual performance profile.



Visual Analytics - Event Frame Evaluation

- Sampled Event View dataset imported into Power BI.
- Shows 200 Event Frames grouped by Event Frame Attribute.



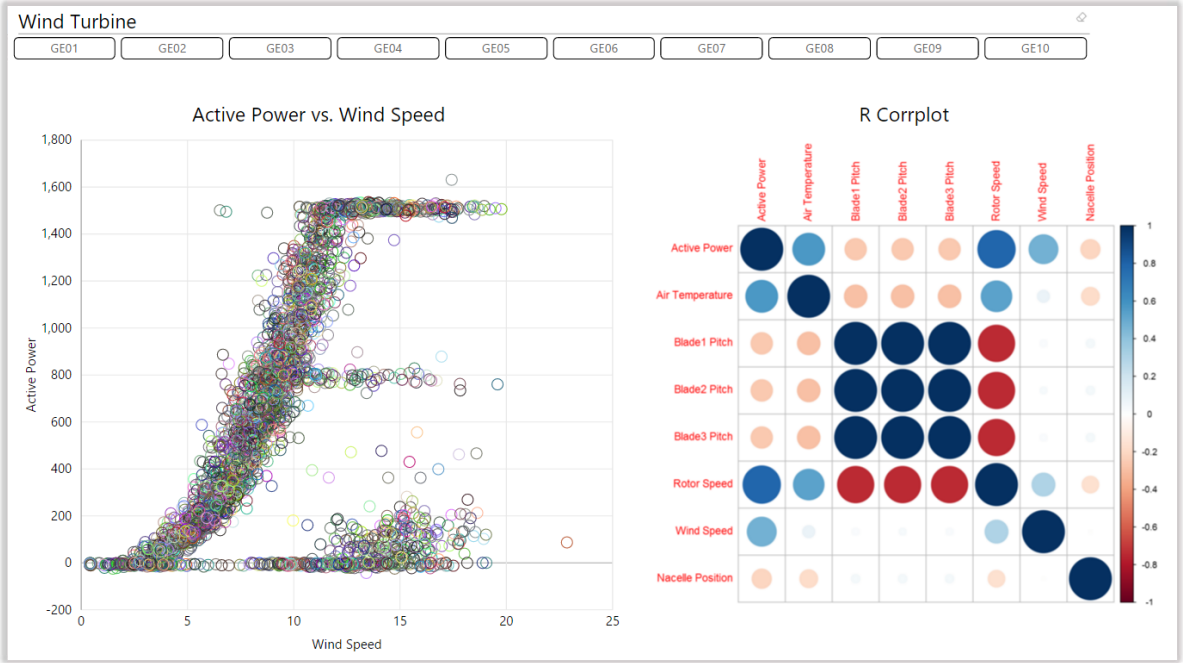
Sampled Event View

Dryer	Time Stamp	Duration	Elapsed Time	Dryer Pressure	Outlet Temperature	Regenerant Flow	Regenerant Temp
Dryer A	1/2/2017 12:00:00 AM	5.3	0	170.4697	436.9	603.2525	496.1
Dryer A	1/2/2017 12:06:00 AM	5.3	6	170.4824	437.8	603.6448	496.2
Dryer A	1/2/2017 12:12:00 AM	5.3	12	170.495	438.6	605.063	496.4
Dryer A	1/2/2017 12:18:00 AM	5.3	18	170.5076	439.5	599.6411	496.8
Dryer A	1/2/2017 5:18:00 AM	5.3	318	204.1571	173.8	314.5962	287.9
Dryer B	1/2/2017 7:00:00 AM	9.6	0	169.723	170.2	596.6678	480.7
Dryer B	1/2/2017 7:06:00 AM	9.6	6	170.4792	170.3	598.8013	484.8
Dryer B	1/2/2017 7:12:00 AM	9.6	12	171.0217	170.4	597.2024	487.9
Dryer B	1/2/2017 4:36:00 PM	9.6	576	168.8051	174.9	896.8521	173.8
Dryer A	1/2/2017 7:00:00 PM	11.3	0	169.5046	170	596.4086	425.6
Dryer A	1/2/2017 7:06:00 PM	11.3	6	170.3642	170.1	598.5709	442.7
Dryer A	1/2/2017 7:12:00 PM	11.3	12	170.2456	170.2	600.7331	466.3
Dryer A	1/3/2017 4:54:00 AM	11.3	594	167.147	196.4	547.8572	173.4
Dryer B	1/3/2017 8:48:00 AM	9.3	0	169.3378	170.2	592.8909	491.6
Dryer B	1/3/2017 8:54:00 AM	9.3	6	168.1517	171.1	617.2303	490
Dryer B	1/3/2017 9:00:00 AM	9.3	12	167.7706	205.2	617.502	488.7

Dryer Regeneration Cycle	Avg Outlet Temp	Avg Regen Temp	Dryer Processing Age	Total Processed Feed
Dryer A Regneration 01-02-17 00:00	319.9179	229.7132	0.0005072668	4474.716
Dryer B Regneration 01-02-17 07:00	357.6974	404.2589	0.05128649	2742.962
Dryer A Regneration 01-02-17 19:00	332.5292	364.0818	0.1004348	5302.277
Dryer B Regneration 01-03-17 08:48	357.8753	399.4613	0.1699348	6347.083

Visual Analytics - R and Python Integration

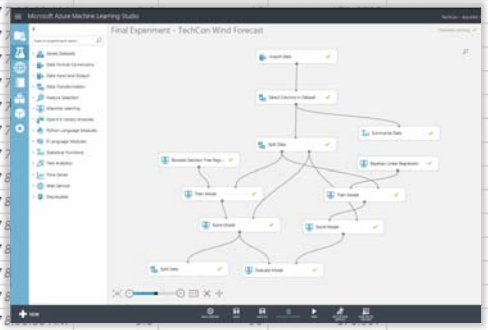
- Ad hoc, multidimensional front end for driving R and Python scripts.
- R “corrplot” to identify correlated variables.
- Identify data to be used for predictive model training.



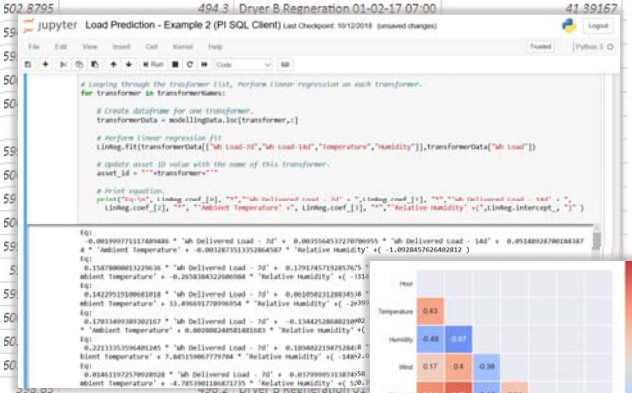
Advanced Analytics – R Studio, Python, Azure ML, GCP

Dryer	TimeStamp.StartTime.Local	TimeStamp.EndTime.Local	TimeStamp.Local	Duration	Elapsed Time	Dryer Pressure	Outlet Temperature	Regenerant Flow	Regenerant Temperature	Dryer Regeneration Cycle	Avg Hot Oil Valve Position
Dryer B	1/2/2017 7:00:00 AM	1/2/2017 4:36:00 PM	1/2/2017 7:00:00 AM				170.2	596.6678	480.7	Dryer B Regneration 01-02-17 07:00	41.39167
Dryer B	1/2/2017 7:00:00 AM	1/2/2017 4:36:00 PM	1/2/2017 7:06:00 AM				170.3	598.8013	484.8	Dryer B Regneration 01-02-17 07:00	41.39167
Dryer B	1/2/2017 7:00:00 AM	1/2/2017 4:36:00 PM	1/2/2017 7:12:00 AM				170.4	597.2024	487.9	Dryer B Regneration 01-02-17 07:00	41.39167
Dryer B	1/2/2017 7:00:00 AM	1/2/2017 4:36:00 PM	1/2/2017				170.5	596.2487	490.4	Dryer B Regneration 01-02-17 07:00	41.39167
Dryer B	1/2/2017 7:00:00 AM	1/2/2017 4:36:00 PM	1/2/2017				170.6	598.5866			41.39167
Dryer B	1/2/2017 7:00:00 AM	1/2/2017 4:36:00 PM	1/2/2017				170.6	603.9441			41.39167
Dryer B	1/2/2017 7:00:00 AM	1/2/2017 4:36:00 PM	1/2/2017				170.4	600.8838			41.39167
Dryer B	1/2/2017 7:00:00 AM	1/2/2017 4:36:00 PM	1/2/2017				170.7	608.4194			41.39167
Dryer B	1/2/2017 7:00:00 AM	4:36:00 PM	1/2/2017				184.2	502.8795	494.3	Dryer B Regneration 01-02-17 07:00	41.39167
Dryer B	1/2/2017 7:00:00 AM	4:36:00 PM	1/2/2017				228.2	59			
Dryer B	1/2/2017 7:00:00 AM	1/2/2017 4:36:00 PM	1/2/2017				288	59			
Dryer B	1/2/2017 7:00:00 AM	1/2/2017 4:36:00 PM	1/2/2017				336.1	50			
Dryer B	1/2/2017 7:00:00 AM	1/2/2017 4:36:00 PM	1/2/2017				348.3	50			
D			1/2/2017				353.8				
D			1/2/2017				356.9	59			
D			1/2/2017				358.2	50			
D			1/2/2017				359.3	59			
D			1/2/2017 8:42:00 AM	9.6	102	170.3938	360.4	50			
D			1/2/2017 8:48:00 AM	9			361.5	59			
D			1/2/2017 8:54:00 AM	9			366.2	5			
D			1/2/2017 9:00:00 AM	9			375.3	59			
D			1/2/2017 9:06:00 AM	9			381.2	50			
D			1/2/2017 9:12:00 AM	9			384.4	50			
D			1/2/2017 9:18:00 AM	9.6	138	170.8479	381	50			
D			1/2/2017 9:24:0								
D			1/2/2017 9:30:0					601.3831	495.2	Dryer B Regneration 01-	
D			1/2/2017 9:36:0					603.5257	494.2	Dryer B Regneration 01-	
D			1/2/2017 9:42:0					601.0414	495.8	Dryer B Regneration 01-	
D			1/2/2017 9:48:0					601.0293	496.4	Dryer B Regneration 01-	
D			1/2/2017 9:54:0					599.6898	495.6	Dryer B Regneration 01-	
Dryer B	1/2/2017 7:00:00 AM	1/2/2017 4:36:00 PM	1/2/2017 10:00:0					597.3913	495	Dryer B Regneration 01-02-17 07:00	41.39167
Dryer B	1/2/2017 7:00:00 AM	1/2/2017 4:36:00 PM	1/2/2017 10:06:0					600.9988	495.5	Dryer B Regneration 01-02-17 07:00	41.39167
Dryer B	1/2/2017 7:00:00 AM	1/2/2017 4:36:00 PM	1/2/2017 10:12:0					600.9352	495.9	Dryer B Regneration 01-02-17 07:00	41.39167
Dryer B	1/2/2017 7:00:00 AM	1/2/2017 4:36:00 PM	1/2/2017 10:18:0					600.8716	496.4	Dryer B Regneration 01-02-17 07:00	41.39167
Dryer B	1/2/2017 7:00:00 AM	1/2/2017 4:36:00 PM	1/2/2017 10:24:00 AM	9.6	204	171.171	396	600.808	497.7	Dryer B Regneration 01-02-17 07:00	41.39167

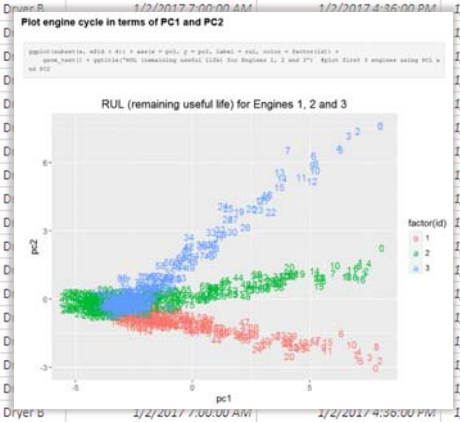
Azure ML



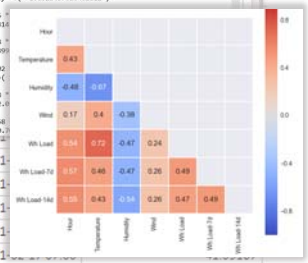
Python in Jupyter Notebook



R Studio



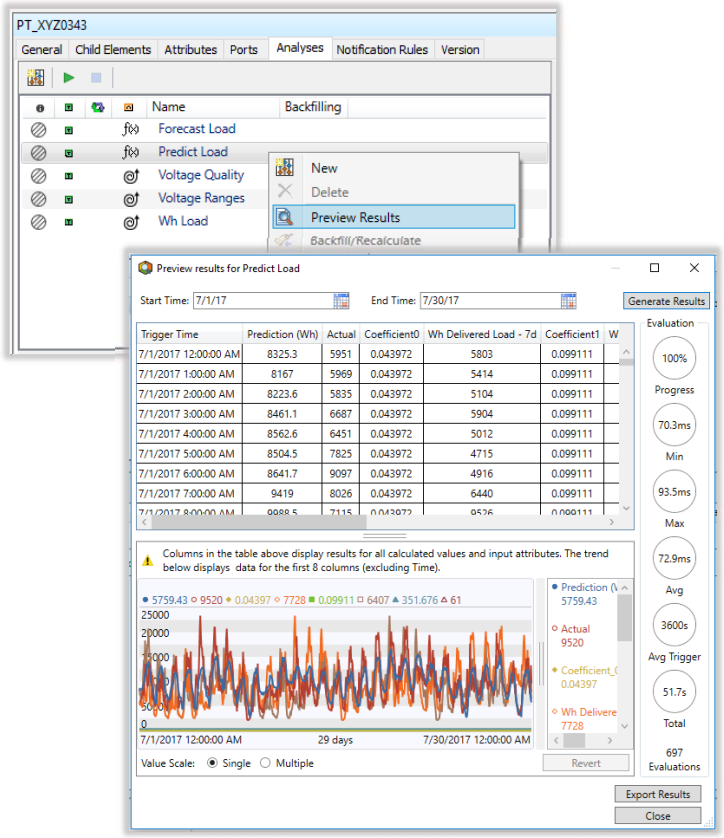
Google Cloud Platform
(Coming Soon!)



Testing, Evaluation and Operationalization

Testing and Evaluation: Asset Analytics

Preview Results feature of Asset Analytics generates model results without posting values to PI Points



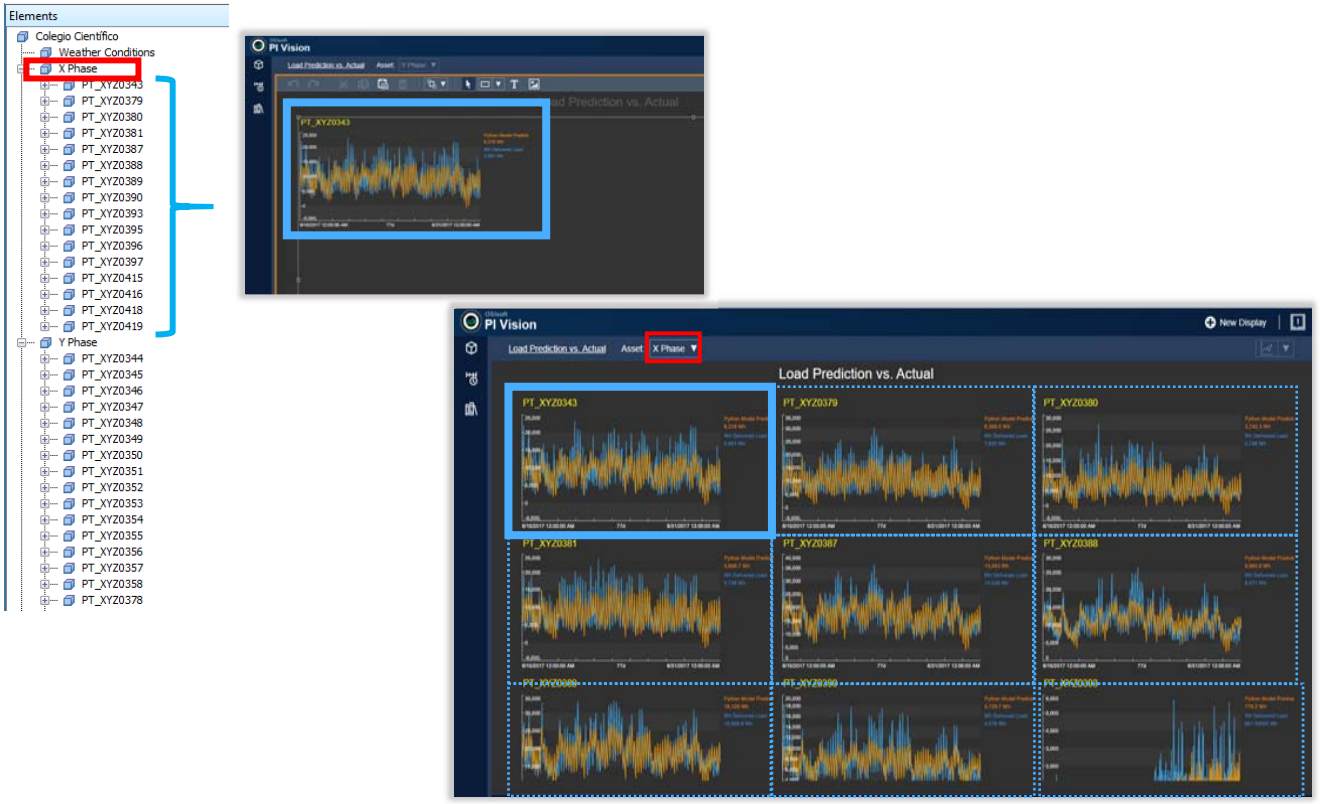
	A	B	C	D
1	Trigger Time	Prediction (Wh)	Actual	
2	7/1/2017 0:00	8325.3	5951	
3	7/1/2017 1:00	8167	5969	
4	7/1/2017 2:00	8223.6	5835	
5	7/1/2017 3:00	8461.1	6687	
6	7/1/2017 4:00	8562.6	6451	
7	7/1/2017 5:00	8504.5	7825	
8	7/1/2017 6:00	8641.7	9097	
9	7/1/2017 7:00	9419	8026	
10	7/1/2017 8:00	9988.5	7115	
11	7/1/2017 9:00	10458	11052	
12	7/1/2017 10:00	11710	13563	
13	7/1/2017 11:00	11126	11933	
14	7/1/2017 12:00	11666	11642	
15	7/1/2017 13:00	12935	10199	

Export results for analysis in Excel.

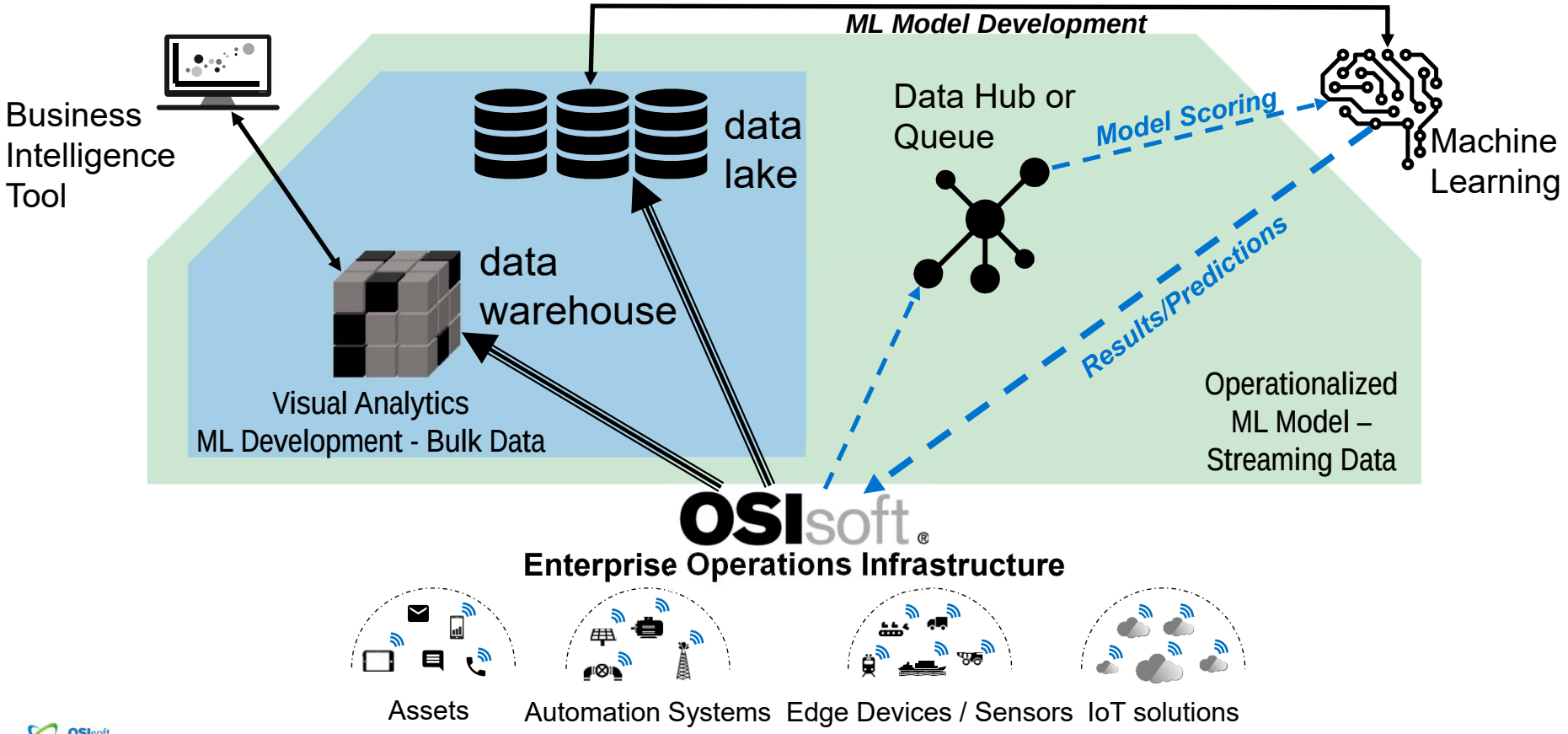
Testing and Evaluation: Model Prediction vs. Actual

Backfill
model results
into PI Point

PI Vision Collections
to inspect
model results



Operationalize - Advanced Analytics Patterns

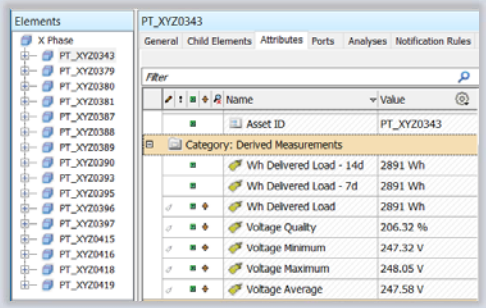


Example 1 – Expression-based Model

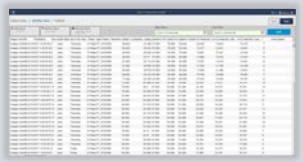
PI World 2019 - “Exploring AF Analytics for Advanced Analysis and Prediction”

Modelling

AF Asset Model



PI Integrator for BA



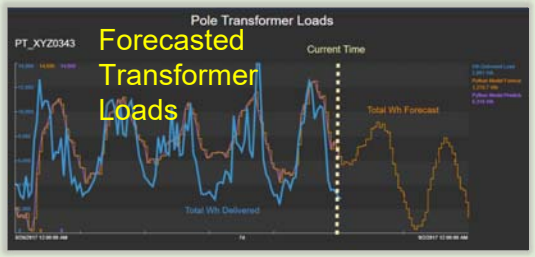
PI SQL Client

.CSV, MS SQL, Azure, AWS, etc.

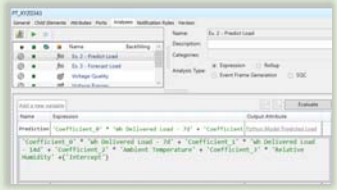
Python\Jupyter

Expression Coefficients

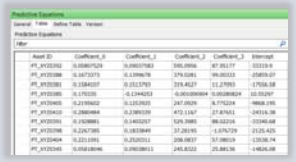
Operationalize



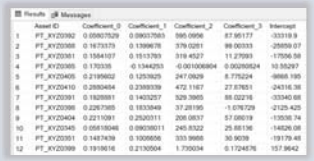
PI Archive, PI Future Data & PI Vision



Asset Analytics



AF Table (Linked)



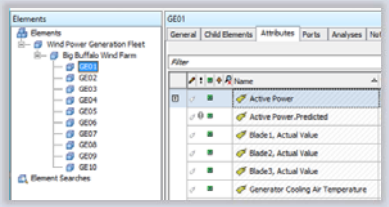
MS SQL

Example 2 – Web Service Endpoint Model

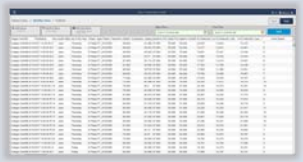
PI World 2017 - “Create and Operationalize Forecasting Models with the PI Infrastructure and Azure Machine Learning”

Modelling

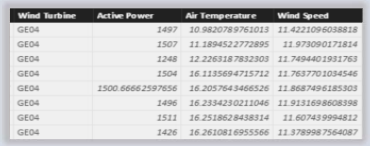
AF Asset Model



PI Integrator for BA (Standard)



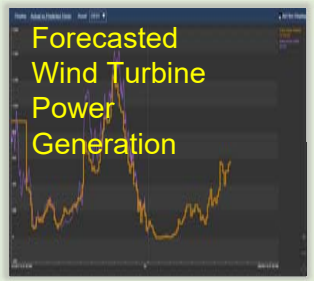
Azure SQL



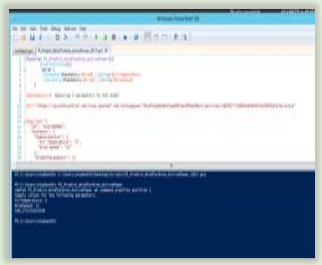
Wind Turbine	Active Power	Air Temperature	Wind Speed
GE04	1497	10.9820789761013	11.4221096038818
GE04	1507	11.1894522772895	11.973090171814
GE04	1248	12.2263187832303	11.749440193176
GE04	1504	16.1135694715712	11.7637701034546
GE04	1500.66662597656	16.2057643466526	11.8687496185303
GE04	1496	16.2334230211046	11.9131698608398
GE04	1511	16.2518628438314	11.607439994812
GE04	1426	16.2610816955566	11.3789987564087

Azure ML

Operationalize

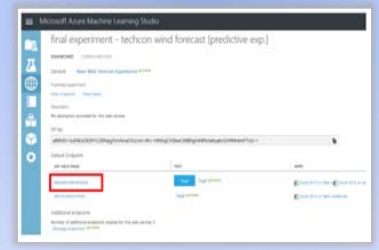


PI Archive, PI Future Data & PI Vision



Windows PowerShell

PI Web API



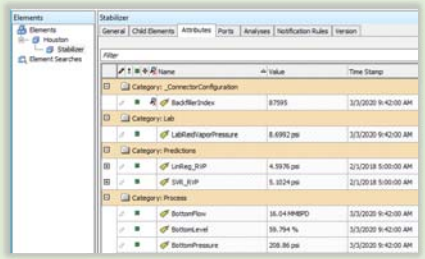
Azure ML Web Service

Example 3 – Streaming Analytic

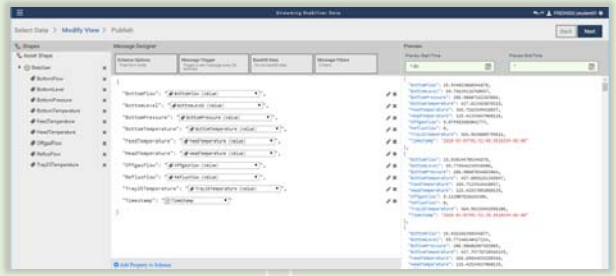
PI World 2018 - “Apply Predictive Machine Learning Models to Operations”

Operationalize

AF Asset Model



PI Integrator for BA (Advanced)

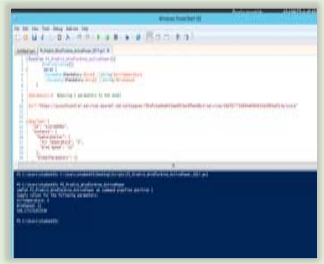


Kafka Broker

Kafka Consumer

Kafka Producer

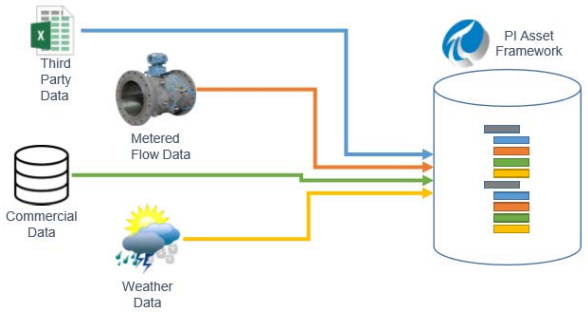
PI Archive, PI Future Data & PI Vision



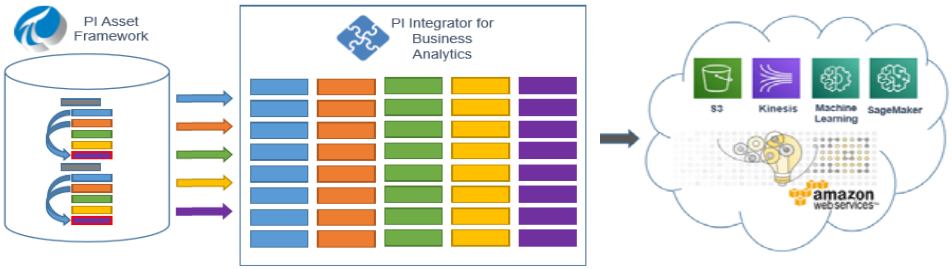
Python\Jupyter
PI Web API

TransCanada – Gas Pipeline Demand Forecasting

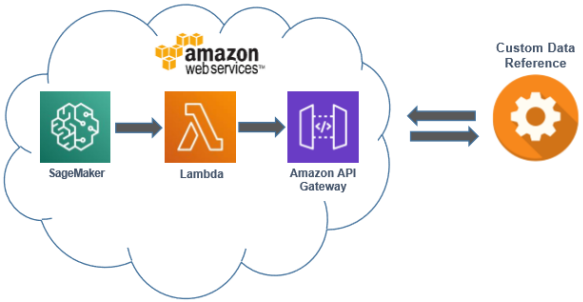
Navigating the Sea of Data



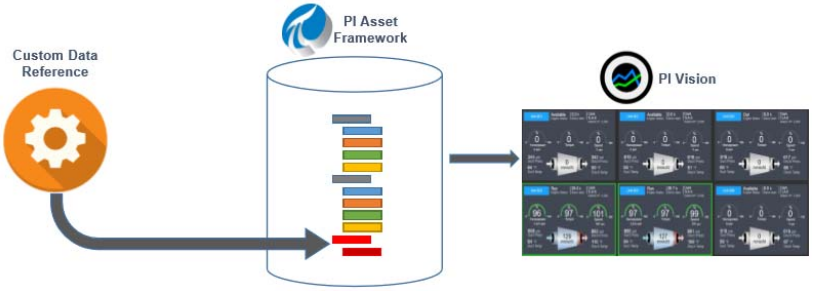
Feeding the Machine



Automating the Demand Forecast

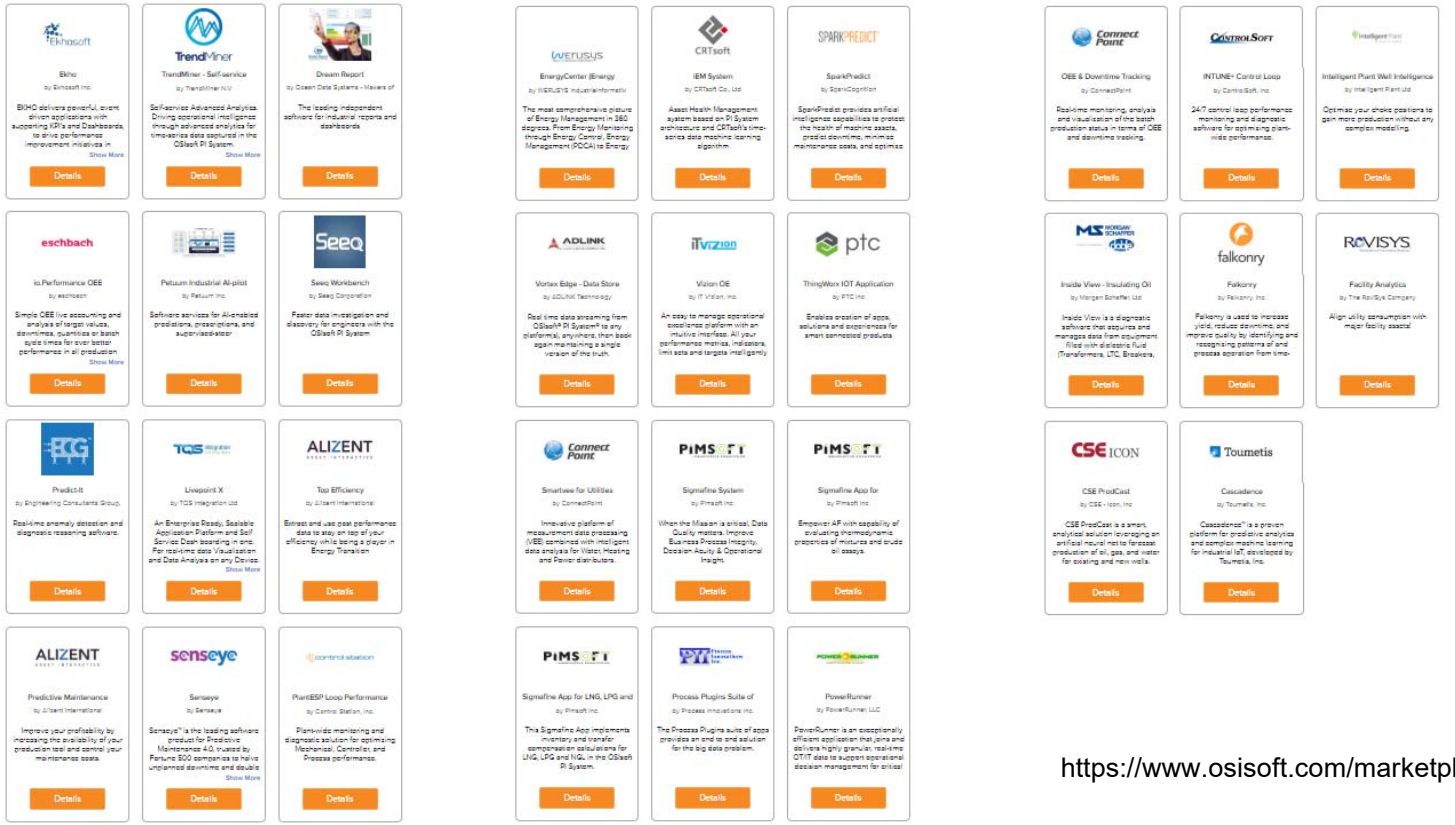


Consuming the Results



https://www.osisoft.com/Presentations/TransCanada-s-Journey-to-Advanced-Analytics---Integrating-TransCanada-s-PI-AF-with-AWS-Machine-Learning/

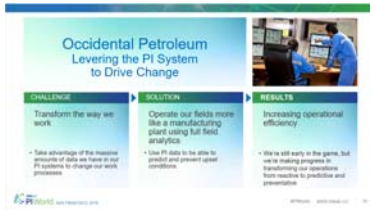
OSIsoft Partner Ecosphere – “Advanced Analytics”

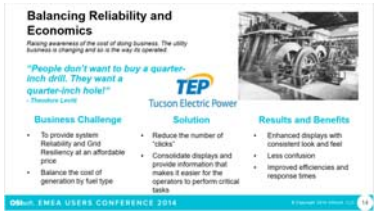


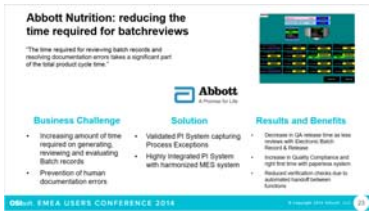
https://www.osisoft.com/marketplace/

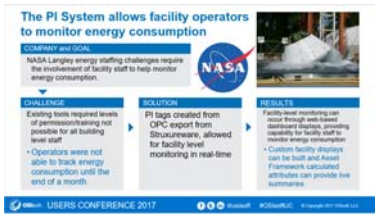
Accountability

“PI Don’t Lie”









Workbench for Relevant Operational Analytics

Data Engineering and Preparation

- PI System offers distinctive features for preparing time-series data for advanced analytics, e.g. asset context, process context and feature generation.

Access, Analysis and Model Enablement

- PI System provides multiple data access methods, meeting needs of data engineers or scientists.

Testing, Evaluation and Operationalization

- Asset Analytics plays an essential role in testing and evaluating developed models.
- PI Vision and Future Data support model integration and socialization for gaining relevance within Operations

Accountability

- “PI don’t lie.”

Contact Info

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Questions?

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