

EMPOWER YOUR ANALYTICS WITH OPERATIONAL DATA
2019 OSISOFT NEW DELHI SEMINAR

Digital Transformation and Enterprise Infrastructure

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*OSIsoft, LLC.
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New Delhi, INDIA*

Takeaways – Digital Transformation & Enterprise Infrastructure

OT=Operations Technology

- Digital Transformation
 - Digital enablement
 - Automate or Change **business process** – the way of doing work
 - **People, Process**, Technology
 - **Collaborative** work environment
- Enterprise Infrastructure (**for OT data**)
 - Sensor data (SCADA, PLC,...), IoT data,...
 - Machine condition data – **vibration, oil analysis**, ...
 - Other metadata, contextual data, **any data to enrich sensor data...**
- PI System as the **foundational data infrastructure** for **operational excellence**
 - **Layers of Analytics** – Descriptive, Diagnostic, Predictive, Prescriptive
- New offerings
 - Edge Data Store (**EDS**)
 - OSIsoft Cloud Services (**OCS**)
 - OSIsoft Message Format (**OMF**)



OSIsoft Ranked Number One in IoT Platforms

The screenshot shows a Yahoo Finance news article. The main headline is "OSIsoft Ranked Number One in IoT Platforms for Industrial Applications in New Report". Below the headline is a sub-headline: "OSIsoft's PI System achieves top score over PTC, GE and others in annual PAC RADAR analysis for its capabilities, ecosystem and large installed base." The article text mentions that OSIsoft LLC was named Best in Class in the Platforms for IoT & AR in Europe 2019 PAC RADAR report from teknology, achieving a higher score than any other company in the survey. It also states that OSIsoft achieved an overall rating of 1.58 compared to an average of 2.24 for the industry.

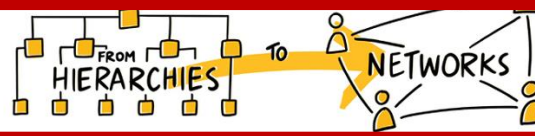
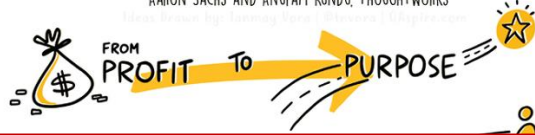
Index	Value	Change
S&P 500	2,970.27	+32.14 (+1.09%)
Dow 30	26,816.59	+319.92 (+1.21%)
Nasdaq	8,057.04	+106.26 (+1.34%)
Russell 2000	1,511.90	+26.54 (+1.79%)
Crude Oil	54.91	+1.36 (+2.54%)
Gold	1,493.50	-7.40 (-0.49%)

Source: <https://finance.yahoo.com/news/osisoft-ranked-number-one-iot-120000017.html>

Transformation - the Pattern and the Anti-Pattern

MINDSET SHIFTS for organization transformation

AARON SACHS AND ANUPAM KUNDU, THOUGHTWORKS



Ideas Drawn by: Tanmay Vora | @tnvora | QAspire.com

7 PITFALLS TO AVOID

during ORG. TRANSFORMATION

Anupam Kundu & Tarang Saxi - ThoughtWorks



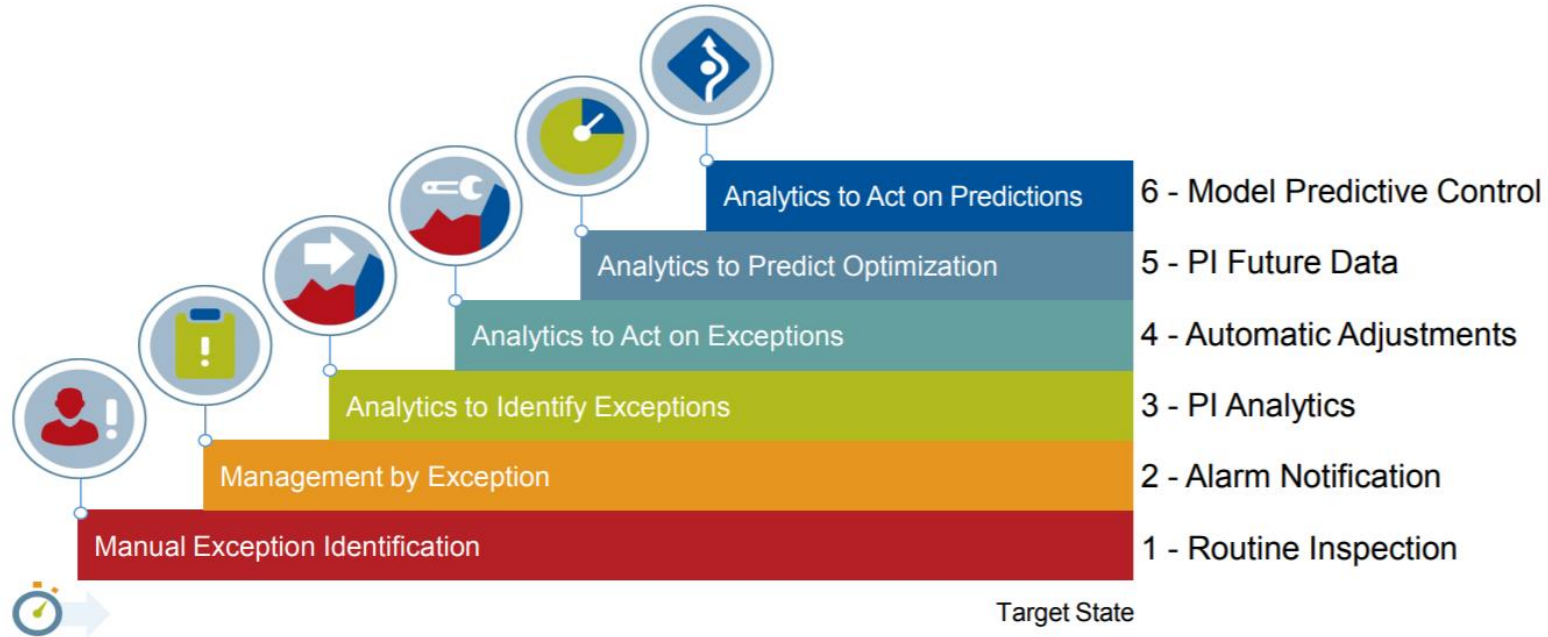
1. **NEGLECTING THE PEOPLE DIMENSION OF CHANGE**
2. **NOT MANAGING EXPECTATIONS ON THE TROUGH OF DESPAIR**
3. **PERSISTING WITH OLD WORLD MEASURES FOR NEW WORLD OUTCOMES**
4. **OVERRELIANCE ON CENTRALIZED CHANGE MANAGEMENT TO USHER CHANGE**
5. **FOCUS ON PUSHING CHANGE OUT INSTEAD OF GENERATING PULL**
6. **NOT PAUSING FOR CELEBRATION AND REFLECTION**
7. **LOSING FOCUS ON CUSTOMER WHILE UNDERGOING TRANSFORMATION**

Sketchnote by: Tanmay Vora | @tnvora | QAspire.com

<https://www.thoughtworks.com/insights/blog/unfinished-business-organizational-transformation>
<https://www.thoughtworks.com/insights/blog/seven-pitfalls-avoid-during-organizational-transformation>

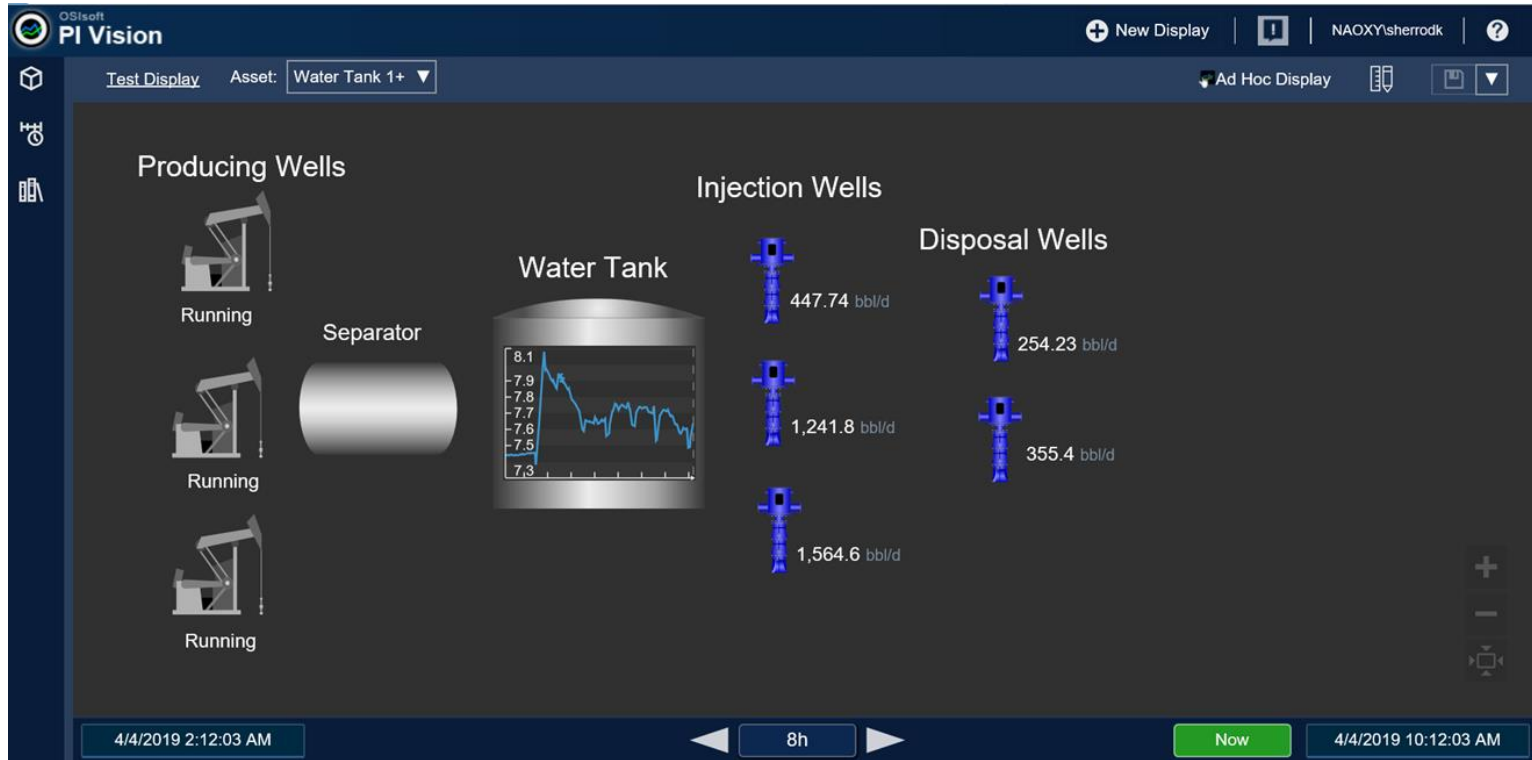
Transforming The Way We Think

From Digital Transformation to Full Field Analytics



<https://www.osisoft.com/presentations/from-digital-oilfield-to-digital-transformation-to-full-field-analytics/>


OXY - Water tank - Transformation from Manual to Automated



1 – Manual Exception Identification


6  Analytics to Act on Predictions

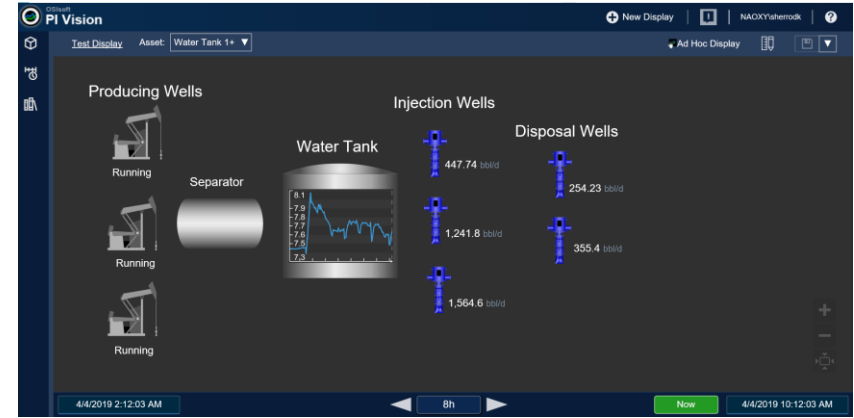
5  Analytics to Predict Optimization

4  Analytics to Act on Exceptions

3  Analytics to Identify Exceptions

2  Management by Exception

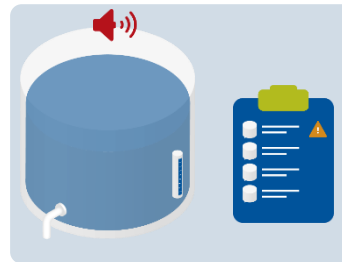
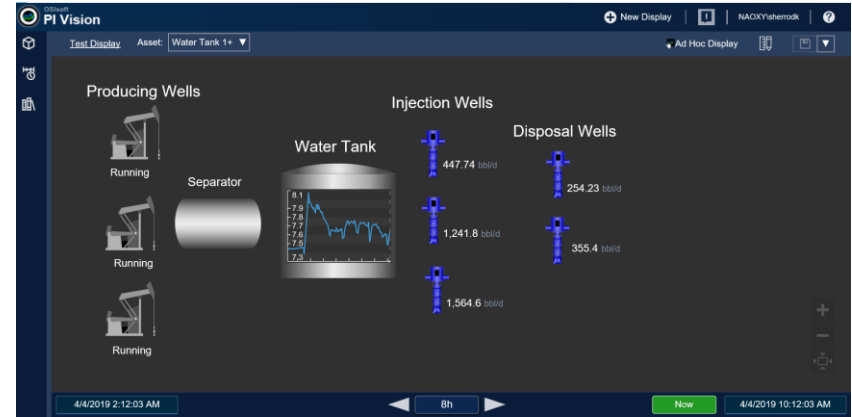
1  Manual Exception Identification



Manual high tank level
identified on daily route

2 – Management by Exception


- 6  Analytics to Act on Predictions
- 5  Analytics to Predict Optimization
- 4  Analytics to Act on Exceptions
- 3  Analytics to Identify Exceptions
- 2  Management by Exception**
- 1  Manual Exception Identification




Operator receives a high tank level alarm and goes to this facility first


3 – Analytics to Identify Exceptions

6  Analytics to Act on Predictions

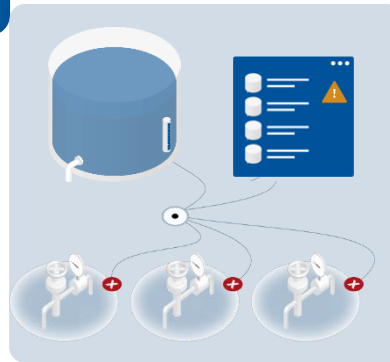
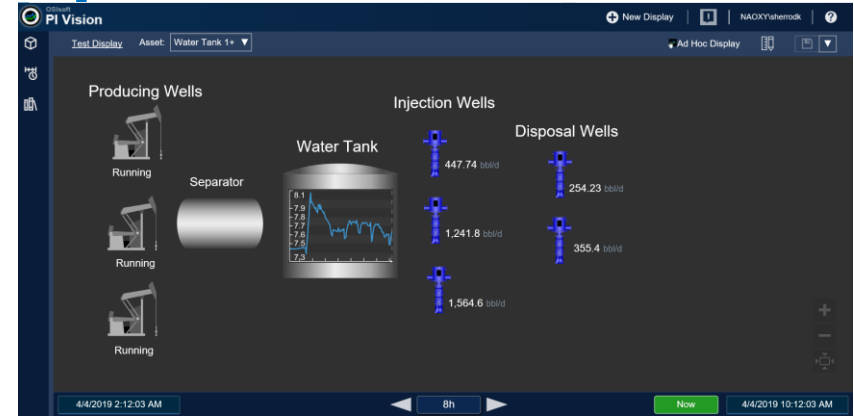
5  Analytics to Predict Optimization

4  Analytics to Act on Exceptions

3  Analytics to Identify Exceptions

2  Management by Exception

1  Manual Exception Identification





PI System Analytics identifies an exception - High water tank level & disposal wells not 100% open

4 – Analytics to Act on Exceptions

6  Analytics to Act on Predictions

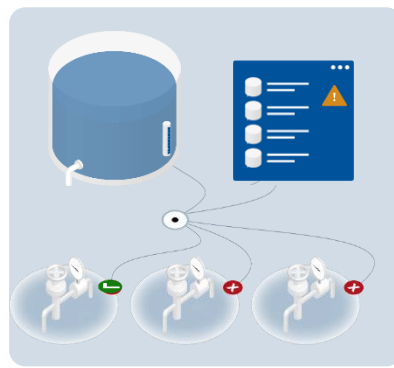
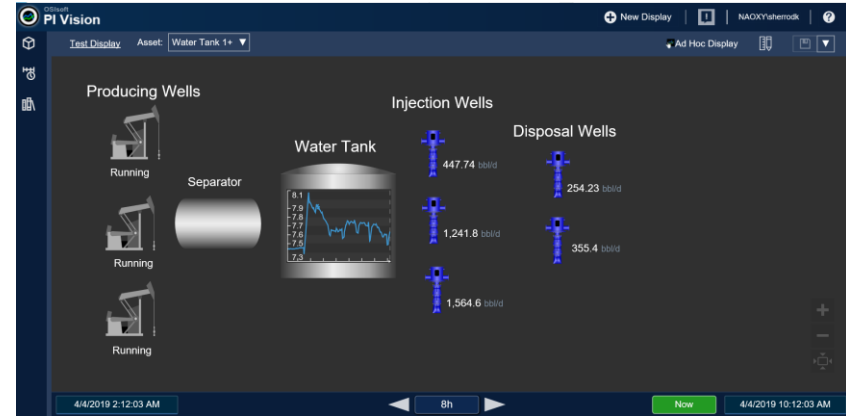
5  Analytics to Predict Optimization

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Automatic adjustment of disposal wells to reduce high tank level

5 – Analytics to Predict Optimization

6  Analytics to Act on Predictions

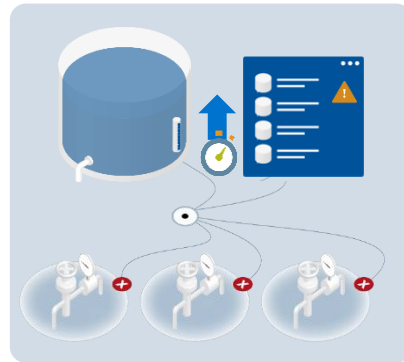
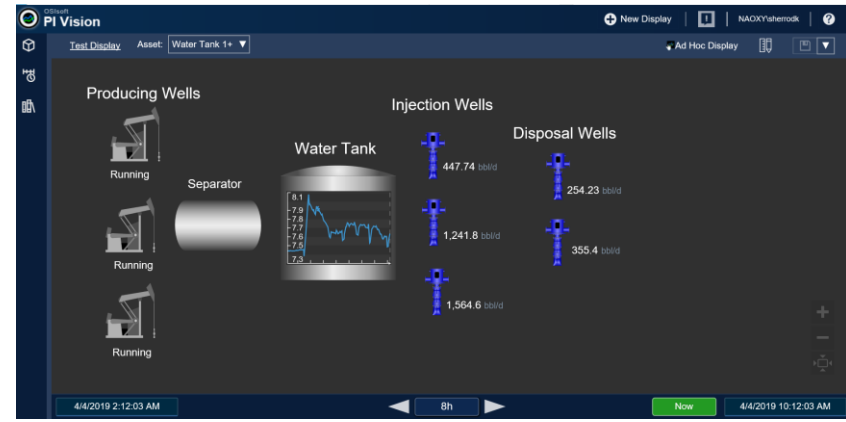
5  Analytics to Predict Optimization

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PI System Future Data predicts a high level, providing more time to respond

6 – Analytics to Act on Predictions

6  Analytics to Act on Predictions

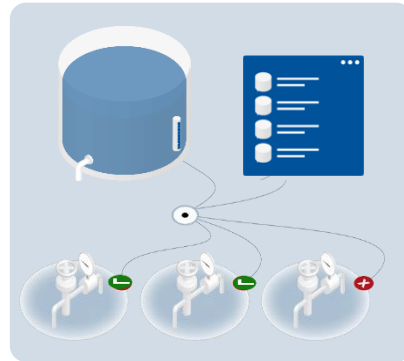
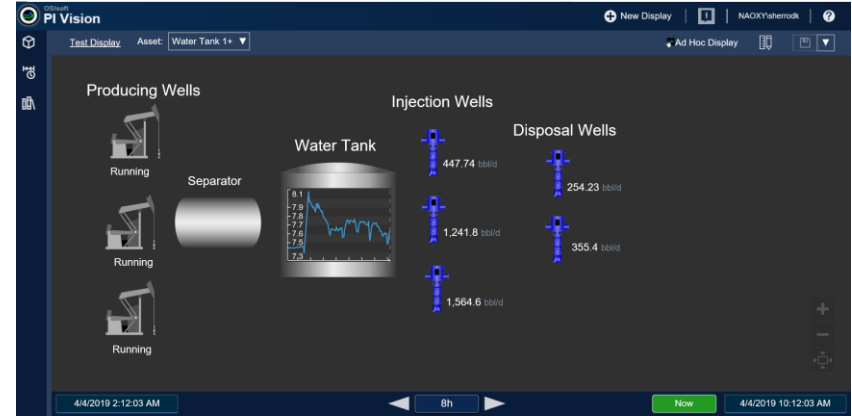
5  Analytics to Predict Optimization

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2  Management by Exception

1  Manual Exception Identification



Automatic adjustment of disposal and producing wells to maintain optimal tank level

Occidental Petroleum Levering the PI System to Drive Change



CHALLENGE

Transform the way we work

- Take advantage of the massive amounts of data we have in our PI systems to change our work processes

SOLUTION

Operate our fields more like a manufacturing plant using full field analytics

- Use PI data to be able to predict and prevent upset conditions

RESULTS

Increasing operational efficiency

- We're still early in the game, but we're making progress in transforming our operations from reactive to predictive and preventative

What can I do with PI System?

Asset Health



Process Optimization



Quality Tracking



Energy Efficiency



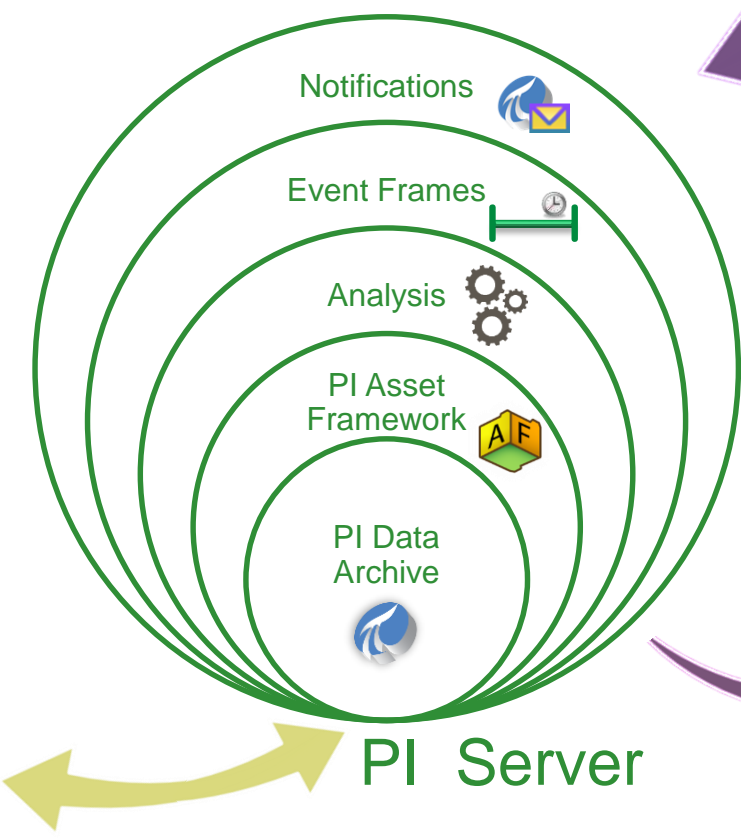
Regulatory Compliance



Safety & Security



The Modern PI System

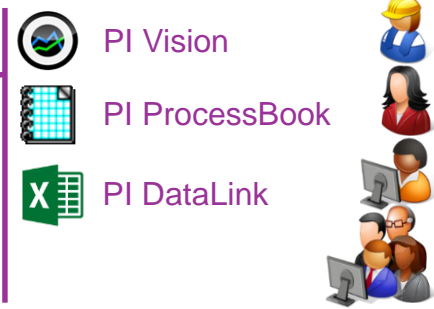


PI Integrators & PI System Access



1. Connect to relevant sources
2. Collect and archive data
3. Assign context (asset-based)
4. Add Analytics logic
5. Alert and notify
6. Visualize

PI Visualization Suite



A use case

Asset Health



Problem

Wind Farm can't meet generation targets

Why?

Wind Turbine availability is low due to curtailment and unplanned downtime

Target

Increase Wind Turbine availability to 95%

How?

Find biggest cause of lost production

Wind farm data model

File Search View Go Tools Help

Database Query Date Back Check In Refresh New Element New Attribute

Elements

- Elements
 - Generation
 - Equipment List
 - Fossil Generating Station
 - Matador 1 CCGT
 - OSIsoft Power
 - PowerCo
 - Solar Power Generation Fleet
 - Wind Power Generation Fleet
 - Wind Power Maintenance Crews
 - Windtopia
 - Big Buffalo Wind Farm
 - Black Mesa Wind Farm
 - GE05
 - GE06
 - GE07
 - Black Wolf Wind Farm
- Navigation Trees
- PI Data Archive
- Transmission and Distribution
- Weather
- Element Searches

- Elements
- Event Frames
- Library
- Unit of Measure
- Contacts

GE05

General Child Elements Attributes Ports Analyses Notification Rules Version

Filter

Category: Current Conditions		
Adjusted Wind Speed	16.756 m/s	
Air Density	1.2465 kg/m3	
Ambient Temperature	10 °C	
Calculated Ambient Press...	101.31 kPa	
Wind Deviation 1s	-18.683 °	
Wind Deviation 10s	-6 °	
Wind Speed	16.268 m/s	
Wind Speed 10 Min StDev	1.3006 m/s	
Wind Speed - 10 min roll...	6.704 m/s	
Wind Speed Forecast	6.8261 m/s	
Wind Turbulence	19.4 %	

Category: Energy&Power

Active Power	748.65 kW
Active Power - 10 min ro...	409 kW
Apparent Power	411.36 kW
Apparent Power - 10 mi...	411.36 kW
Combined Power Forecast	256.72 kW
Energy Delta - Hourly	0.20675 MWh
Energy Production - Daily	7.2824 MWh

Library

- HRH Temp Heat Rate Dev
- HRSG Information
- Manufacturer Power Curve
- Max Loads
- Metadata
- Meter Information
- Pole Transformer Locations
- PowerCo - Assets Identification
- Shifts
- Target AHGO Temperature
- Target RH Temperature
- Target RH Temperature Deg C
- Target Throttle temperature
- Unit Last Service Dates
- WindSpeedCurve
- Workorders
- Table Connections
- Categories
 - Analysis Categories
 - Attribute Categories
 - Element Categories
 - Notification Rule Categories
 - Reference Type Categories
 - Table Categories

WindSpeedCurve

General Table Define Table Version

WindSpeedCurve

Filter

	Wind Speed	Actual Power	TimeStamp
0	0	0	3/8/2017 ...
1	100	100	3/8/2017 ...
2	225	225	3/8/2017 ...
3	400	400	3/8/2017 ...
4	600	600	3/8/2017 ...
5	800	800	3/8/2017 ...
6	1000	1000	3/8/2017 ...
7	1100	1100	3/8/2017 ...
8	1200	1200	3/8/2017 ...
9	1300	1300	3/8/2017 ...
10	1350	1350	3/8/2017 ...
11	1400	1400	3/8/2017 ...
12	1425	1425	3/8/2017 ...
13	1450	1450	3/8/2017 ...
14	1500	1500	3/8/2017 ...
15	1550	1550	3/8/2017 ...
16	1600	1600	3/8/2017 ...
17	1625	1625	3/8/2017 ...

Elements

Event Frames

Library

Windtopia

Total Production 8,187.5 kW	Expected Production 7,878.5 kW	Turbines Available 100 %	Daily Revenue 2,789.2 \$
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Big Buffalo Wind Farm

Expected Power: 3,495.7 kW
Current Power: 3,559.6 kW

Actual Capacity Factor: 49 %

Availability Factor: 65 %

Black Mesa Wind Farm

Expected Power: 2,100.0 kW
Current Power: 2,091.1 kW

Actual Capacity Factor: 80 %

Availability Factor: 44 %

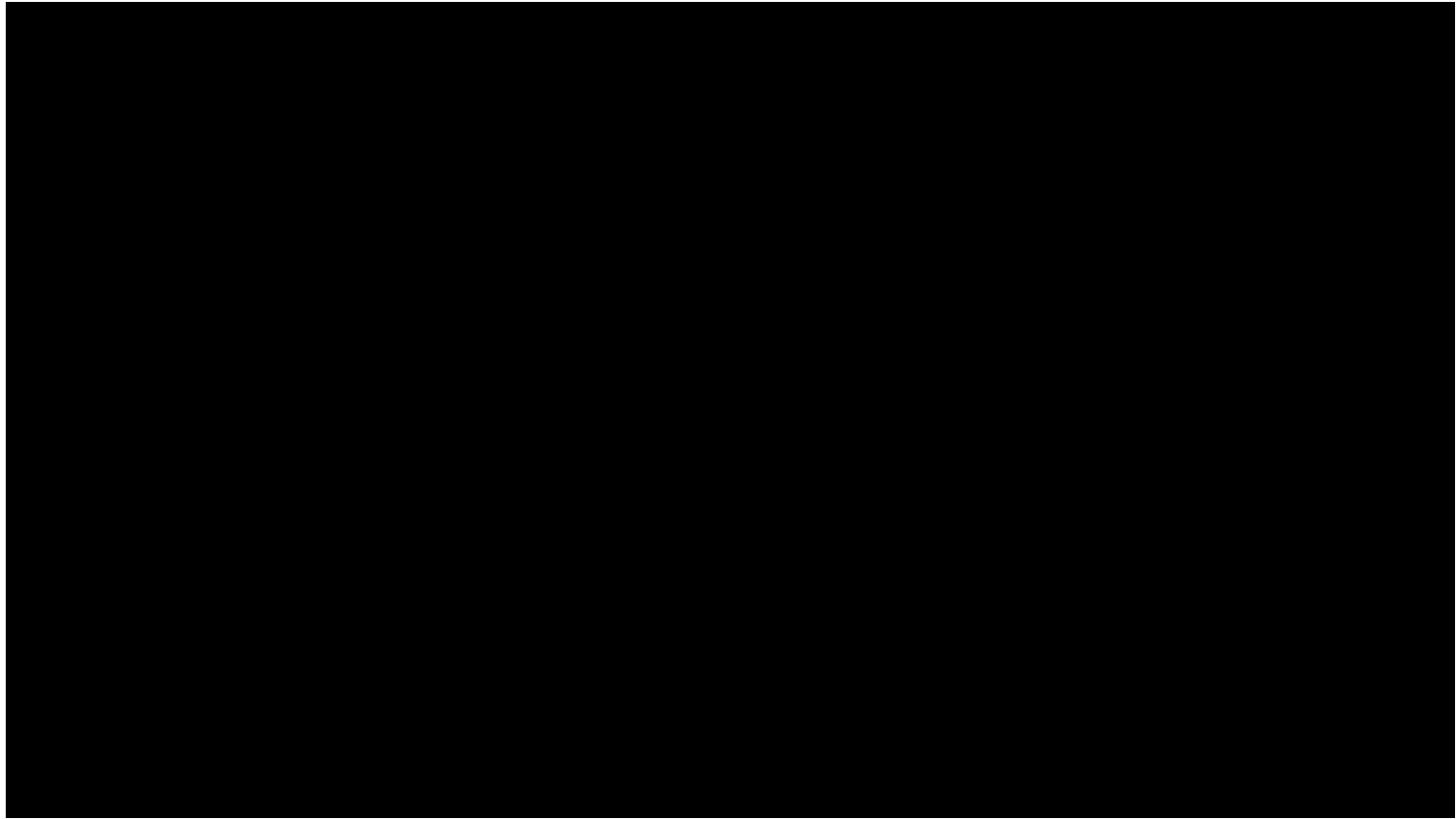
Black Wolf Wind Farm

Expected Power: 2,274 kW
Current Power: 2,136.9 kW

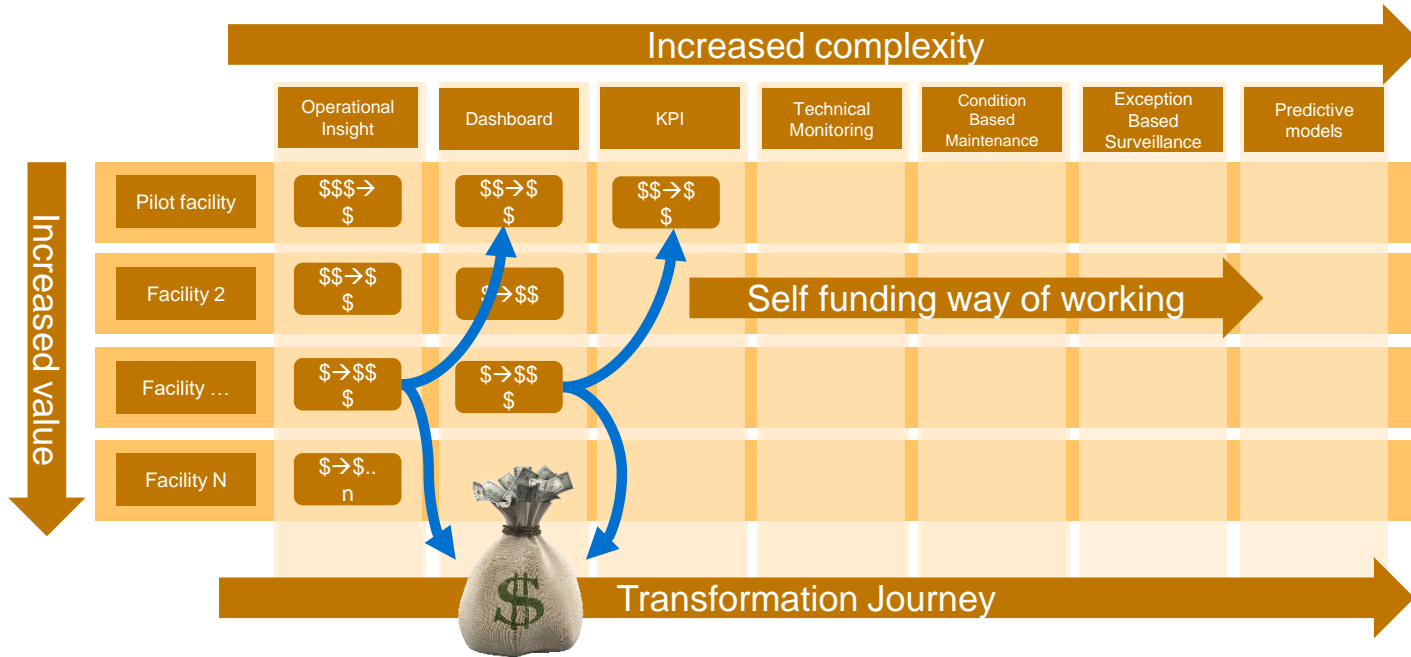
Actual Capacity Factor: 42 %

Availability Factor: 74 %

Wind Farm



Self funding deployment



Video – Power Generation Users



<https://www.youtube.com/watch?v=Em21-tG4UcQ&t=7s>

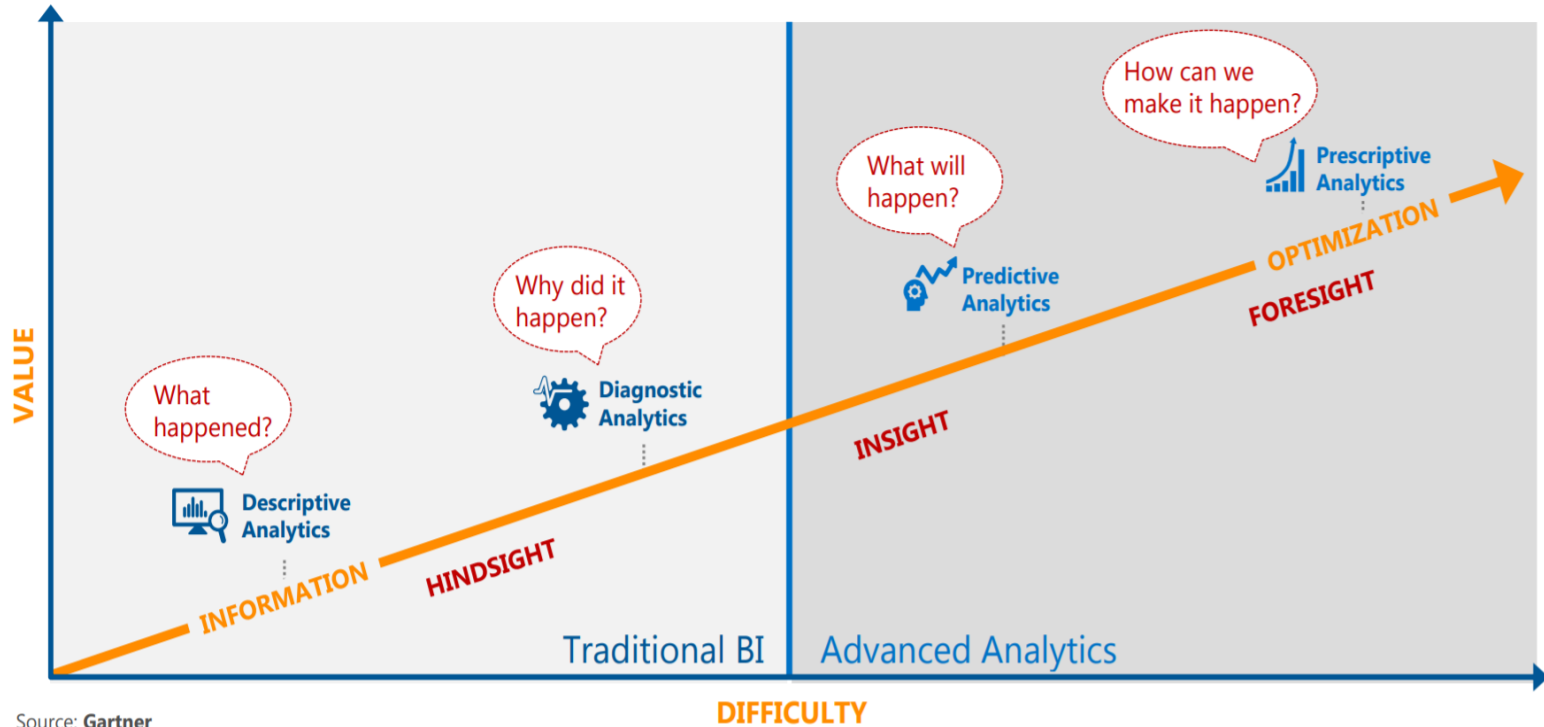
Takeaways – Digital Transformation & Enterprise Infrastructure

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- PI System as the **data infrastructure** for **operational excellence**
 - **Layers of Analytics** – Descriptive, Diagnostic, Predictive, Prescriptive
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OT=Operations Technology

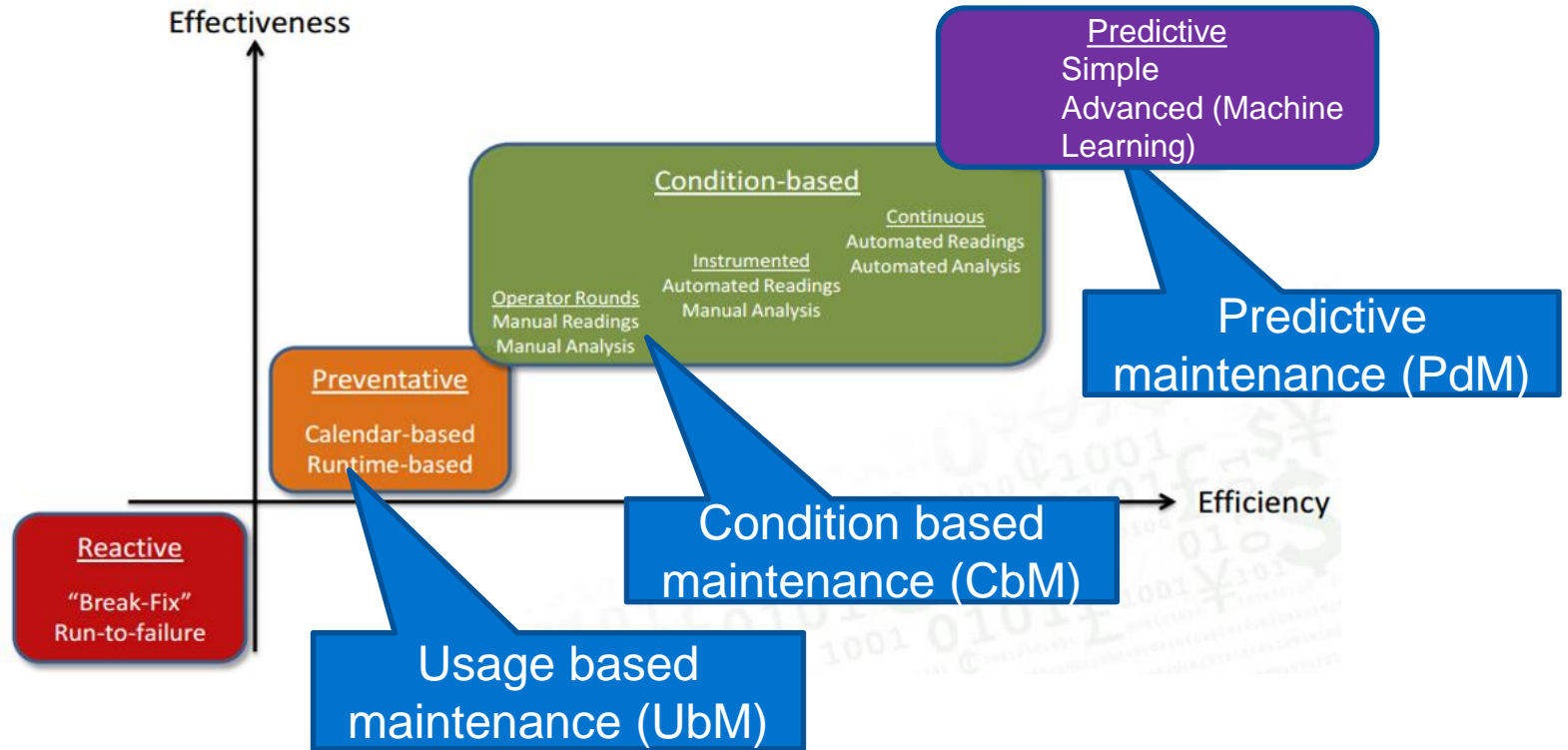
Layers of Analytics - Process Operations



Source: Gartner

<https://www.osisoft.com/presentations/pi-system-analytics--fit-for-purpose/>

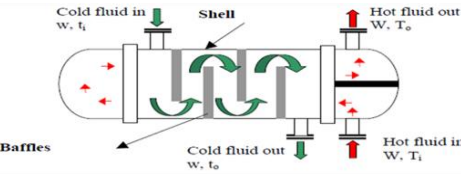
Layers of Analytics - Maintenance & Reliability



Descriptive Analytics – Asset Analytics

Heat Exchanger Fouling Calculations

- Configure calculations for transparency and scale
- Math, statistical, and time-based functions
- Integration with R/Python/MATLAB
- Testing and operationalization of predictive analysis models
- Condition-based notification
- Supports future data for forecasting



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 FOUING !!!
Warning is required!!

Calculation Steps:

1. Heat Duty, $Q = q_h + q_c$
 $q_h = W \times C_{ph} \times (T_1 - T_o) / 1000 / 3600$
 $q_c = W \times C_{pc} \times (t_o - t_i) / 1000 / 3600$
2. Hot Fluid Pressure Drop, $\Delta P_c = P_i - P_o$
3. Cold fluid pressure drop, $\Delta P_c = p_i - p_o$
4. Temperature range hot fluid, $\Delta T = T_1 - T_o$
5. Temperature range cold fluid, $\Delta t = t_o - t_i$
6. Capacity ratio, $R = W \times C_{ph} / W \times C_{pc}$ (or) $(T_1 - T_o) / (t_o - t_i)$
7. Effectiveness, $S = (t_o - t_i) / (T_1 - t_i)$
8. LMTD
 LMTD Counter current Flow = $((T_1 - t_o) - (T_o - t_i)) / \ln((T_1 - t_o) / (T_o - t_i))$
 LMTD Co current Flow = $((T_1 - t_i) - (T_o - t_o)) / \ln((T_1 - t_i) / (T_o - t_o))$
 Correction factor for LMTD to account for Cross flow

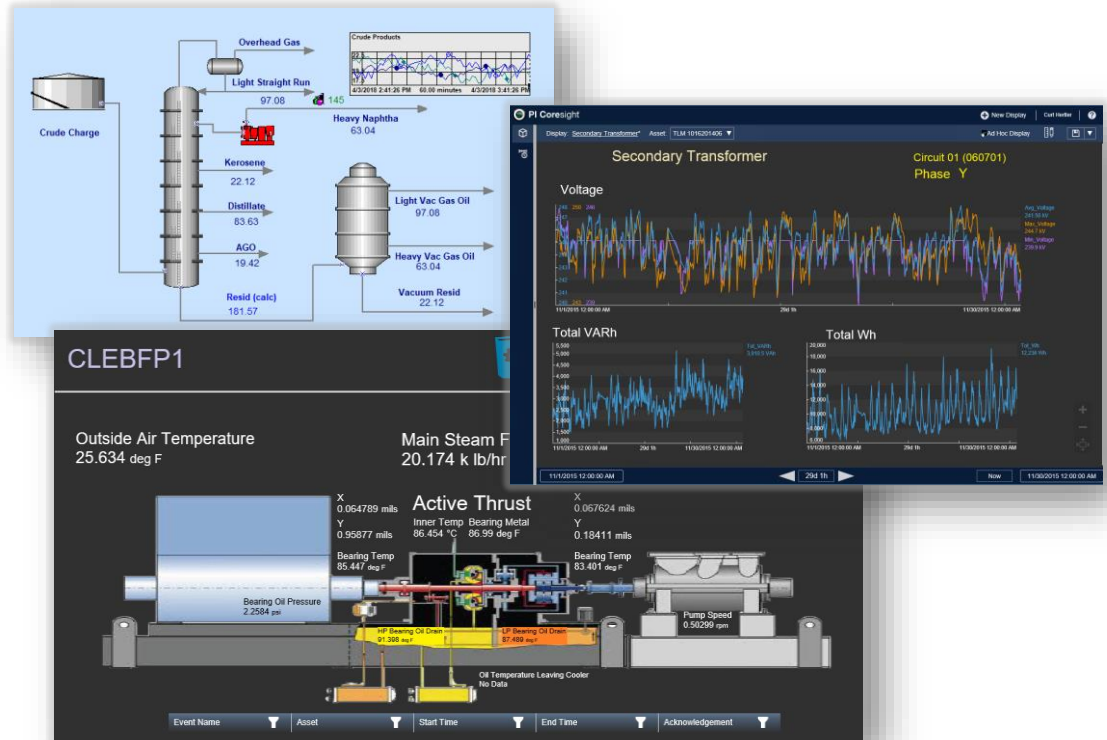
$$F = \frac{(R + 1)^{1/2} \times \ln((1 - SR) / (1 - S))}{(1 - R) \times \ln \left\{ \frac{2 - S(R + 1 - (R + 1)^{1/2})}{2 - S(R + 1 + (R + 1)^{1/2})} \right\}}$$
9. Corrected LMTD = $F \times \text{LMTD}$ Transfer Coefficient (U)

Example Element: Company\Refineries\Tyler_Refinery\3_Catalytic Cracking\HX-301

Name	Expression	Value	Output Attribute
qs	//Shell side heat duty "Shell Side Mass Flow"*"Hot Side Temperature Difference" *"Shell Side Heat Capacity"*3600		Heat Duty Shell Side
qt	//Tube side heat duty "Tube Side Mass Flow"*"Cold Side Temperature Difference"*"Tube Side Heat Capacity"*3600		Heat Duty Tube Side
Q	qs+qt		Map
R	("Hot Side Inlet Temperature"- "Hot Side Outlet Temperature")/("Cold Side Outlet Temperature"- "Cold Side Inlet Temperature")		Map
S	("Cold Side Outlet Temperature"- "Cold Side Inlet Temperature")/("Hot Side Inlet Temperature"- "Cold Side Inlet Temperature")		Map
LMTD	Roundfrac(("Hot Side Inlet Temperature"- "Cold Side Outlet Temperature")- ("Hot Side Outlet Temperature"- "Cold Side Inlet Temperature"))/Log(("Hot Side Inlet Temperature"- "Cold Side Inlet Temperature")/("Hot Side Outlet Temperature"- "Cold Side Inlet Temperature"))		LMTD
F	((R+1)*0.5*Log((1-S*R)/(1-S)))/((1-R)*Log((2-S*(R+1)*(R+1)*0.5))/((2-S*(R+1)*(R+1)*0.5)))		Map
LMTDcorr	F*LMTD		Map
U	Max(qs,qt)/("Area"*LMTDcorr)		Calculated Heat Transfer Coefficient

Diagnostic Analytics – Trending and Event Awareness

- Access to operational data in real-time with tools suited to Operations
- Supports ad hoc, self-service investigation

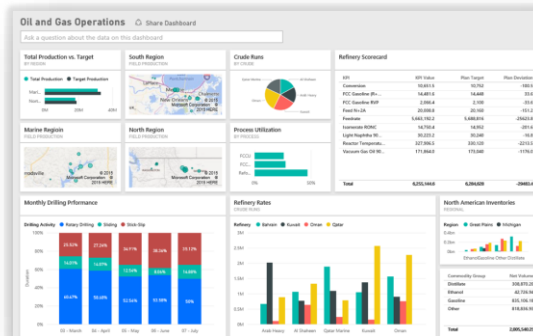


Diagnostic Analytics – Multidimensional Visualization, Dashboards

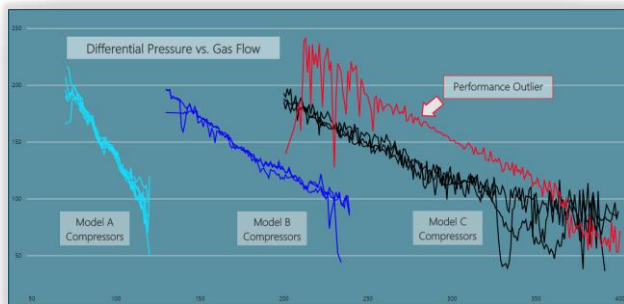
Business Analysis
Product inventories



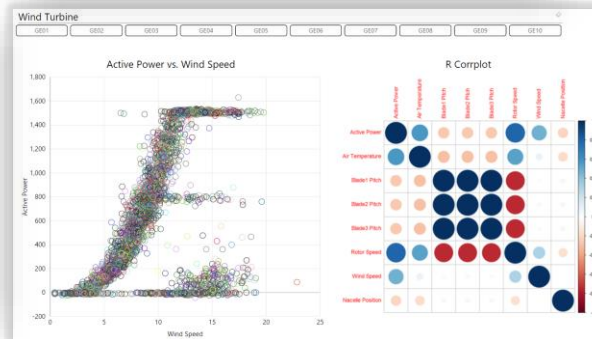
Dashboards
Collaboration



Asset Performance
Benchmarking



Analytics
Measurement Correlation



Predictive and Prescriptive Feed Drying Process

- Process and Regeneration Cycles

- Molecular sieve dryers remove water from hydrocarbon feedstock before entering reactor
- Proper regeneration is critical to avoid corrosion in acidic reaction
- Cyclic operation between **Process** and **Regeneration** cycles
- Regeneration cycle is indicated by high bed outlet temperatures

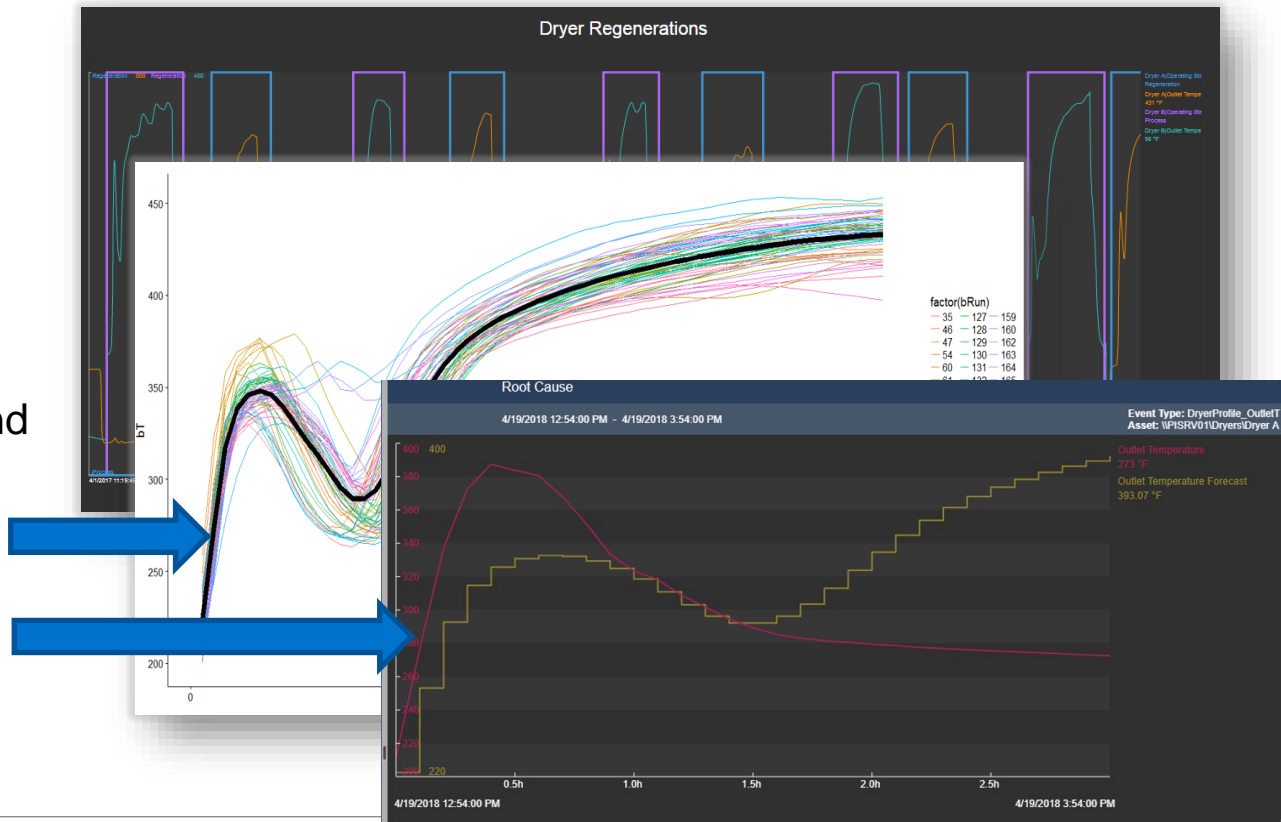
Dryer A Regeneration Dryer B Regeneration



Also see PI World 2018 - Layers of Analytics - Hands-on Lab

Predictive Analytics – Dryer Regeneration Guidance for Operations

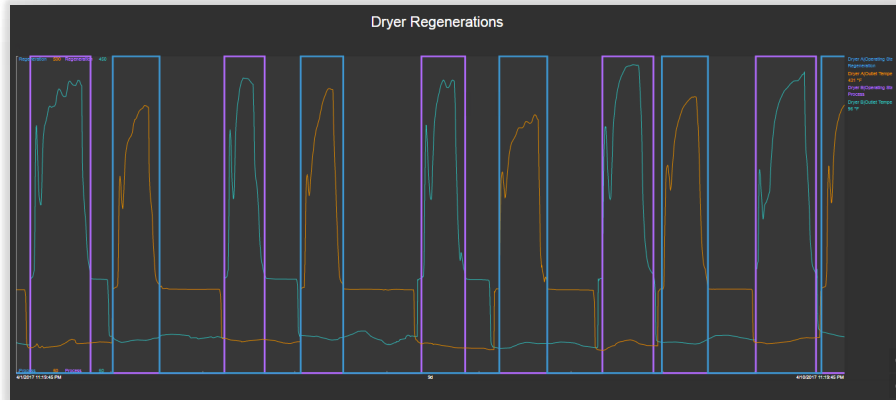
- During **Regeneration**, monitor bed Outlet Temperature against a modeled profile, notify operator of deviations
- Prepare data using AF Analytics and Event Frames
- Publish dataset for model development and training
- Develop model in R/MATLAB
- Operationalize model using AF Analytics and R/MATLAB



Feed Dryer Status – *Regeneration Event Frames*

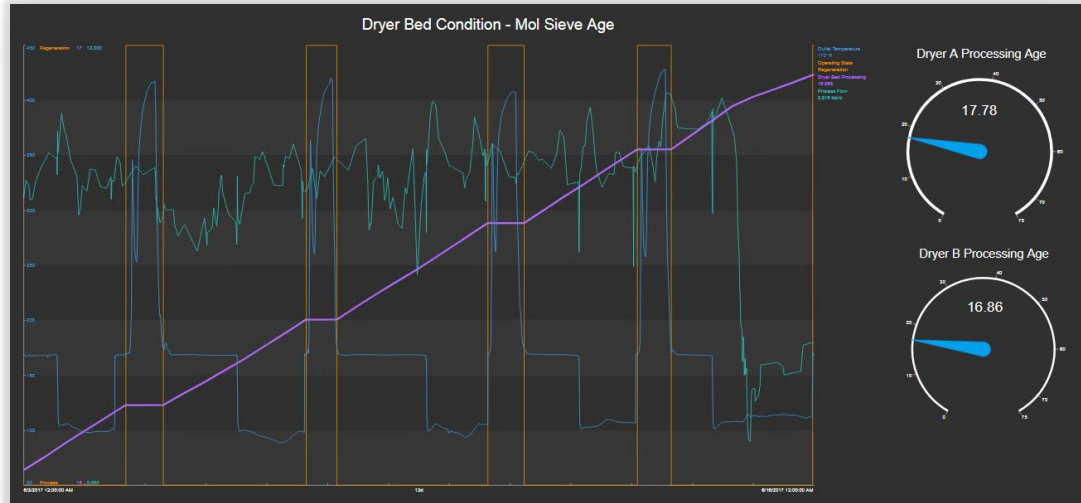
- AF Analytic defines the beginning and end of regeneration cycle
- Digital state for each dryer with Process of Regeneration states
- Start temp. = 170 F, End temp. = 175 F
- Confirm five hours since last regeneration to avoid short cycles caused by initial temperature fluctuation
- Backfill through 2017

```
If('Outlet Temperature' >= 'Outlet Temperature|Start of Regeneration Temperature'  
  And PrevVal('Operating State', '*-5h') = "Process")  
Then (If PrevVal('Operating State', '*')="Regeneration"  
      Then NoOutput()  
      Else "Regeneration")  
Else  
  (If('Outlet Temperature' <= 'Outlet Temperature|End of Regeneration Temperature'  
    And PrevVal('Operating State', '*-5h') = "Regeneration")  
    Then (If PrevVal('Operating State', '*') = "Process"  
          Then NoOutput()  
          Else "Process")  
    Else NoOutput())
```



Feed Dryer Bed Age – “Dryer Bed Processing Age”

- AF Expression analytic determines processing age of molecular sieve desiccant
- Enables bed balancing for maximum service
- Calculate Lifetime Total Dried Feed, converts total volume from a volumetric rate
- Processing age :
 - Lifetime Total Dried Feed
Loaded Wt. of Mol. Sieve
- Backfill through 2017



```
If ('Operating State' = "Process"  
    And Not(BadVal('Process Flow'))  
    And Not(BadVal(PrevVal('Process Flow','*'))))  
Then 'Lifetime Total Dried Feed' +  
    TagTot('Process Flow', PreviousProcessFlowTime, '*')  
Else NoOutput()
```

Dryer Regeneration – Publishing Summarized Dataset

- Leverage AF model to **Select**, **Shape** and **Publish** tabular views to a variety of endpoints
- Event Views publish Event Frame data in either **Summarized** or **Sampled** structures
- **Sampled** view combines aggregations taken over the Event Frames duration with Asset data sampled at intervals throughout the duration

The screenshot displays the 'Feed Dryer Regenerations' configuration window. It includes a 'Select Data' menu with options for 'Modify View' and 'Publish'. The 'Source Events' section shows the server 'CHERTLER7450' and database 'Dryers'. The 'Event Frames' section lists 'Dryer A' and 'Dryer B'. The 'Attributes' section lists various data points like 'Molecular Sieve Loading' and 'Regenerant Return Drum Pressure'. The 'Search Shape' section is divided into 'Event Shape' and 'Asset Shape', with red boxes highlighting these sections and red text labels 'Event Frame Attributes' and 'Asset Element Attributes' overlaid on them. The 'Matches' section shows a list of 52 matches for 'Dryer A Regeneration' with timestamps.

Dryer Regeneration - Sampled Event Publication

Interpolated Values – 6 min.

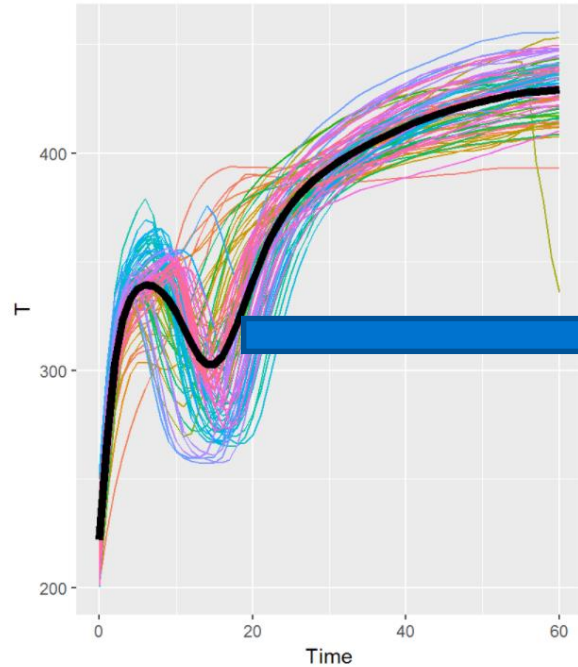
Event Frame Attributes\Features

Event Frame
Event Frame
Event Frame
Event Frame
Event Frame

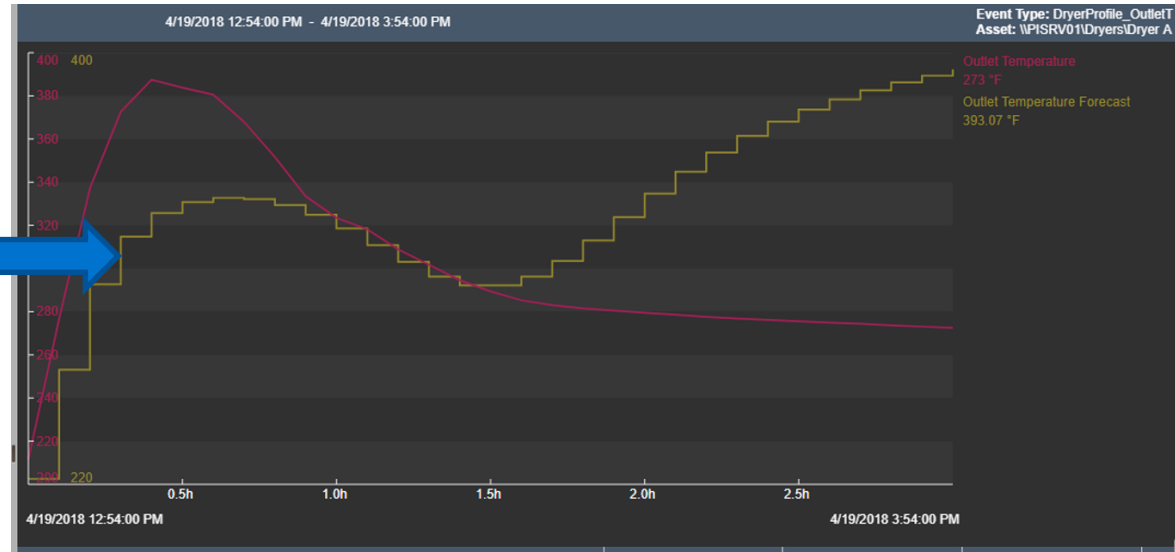
Dryer	Time Stamp	Duration	Elapsed Time	Dryer Pressure	Outlet Temperature	Regenerant Flow	Regenerant Tempe.
Dryer A	1/2/2017 12:00:00 AM	5.3	0	170.4697	436.9	603.2525	496.1
Dryer A	1/2/2017 12:06:00 AM	5.3	6	170.4824	437.8	603.6448	496.2
Dryer A	1/2/2017 12:12:00 AM	5.3	12	170.495	438.6	605.063	496.4
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 Regeneration 01-02-17 00:00	319.9179	229.7132	0.0005072668	4474.716
“	“	“	“	“
“	“	“	“	“
“	“	“	“	“
“	“	“	“	“
“	“	“	“	“
Dryer B Regeneration 01-02-17 07:00	357.6974	404.2589	0.05128649	2742.962
“	“	“	“	“
“	“	“	“	“
“	“	“	“	“
“	“	“	“	“
“	“	“	“	“
Dryer A Regeneration 01-02-17 19:00	332.5292	364.0818	0.1004348	5302.277
“	“	“	“	“
“	“	“	“	“
“	“	“	“	“
“	“	“	“	“
“	“	“	“	“
Dryer B Regeneration 01-03-17 08:48	357.8753	399.4613	0.1699348	6347.083
“	“	“	“	“
“	“	“	“	“
“	“	“	“	“
“	“	“	“	“
“	“	“	“	“

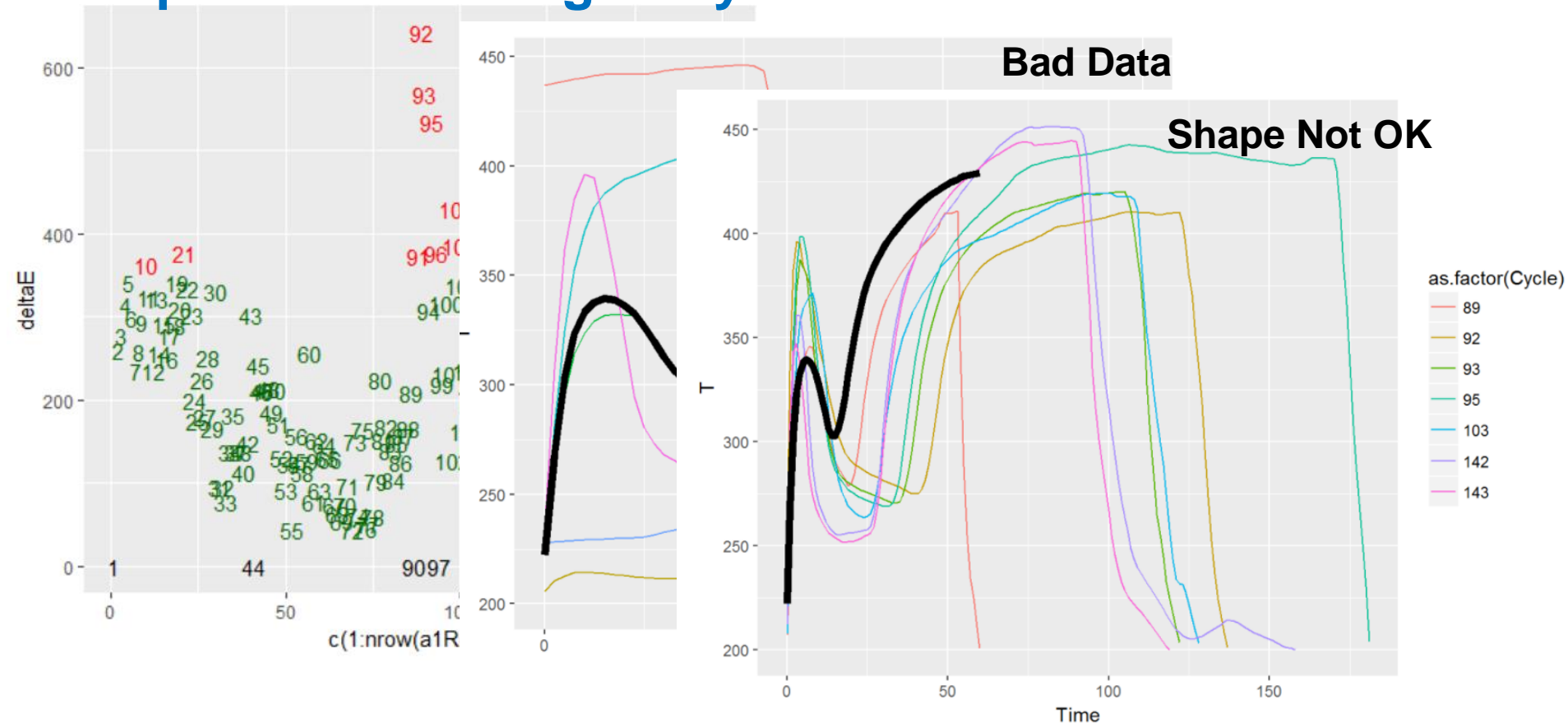
Operationalize - Expected Temperature Profile (Prescriptive)



via Future data tag



Shape Metrics - Regen Cycles Not OK or Bad Data



Shape Metrics - Operationalize the Model

Dryer A

General Child Elements Attributes Ports Analyses Notification Rules Version

File Message Help

Delete Archive Forward Respond

Add a new variable

Name
IdealData

MATLABEval

If (ArrayLength
(CurrentData, I

DeltaE

DeltaAUC

Scheduling: ● Event-

PI Vision

Events

Automatically refresh the list

< Top

DryerProfile_OutletT 2018-04-19 12:54:00.000

Root Cause
4/19/2018 12:54:00 PM - 4/19/2018 3:54:00 PM

Root Cause

4/19/2018 12:54:00 PM - 4/19/2018 3:54:00 PM

Event Type: DryerProfile_OutletT
Asset: WPIISR01(Dryers)Dryer A

Outlet Temperature
273 °F
Outlet Temperature Forecast
393.07 °F

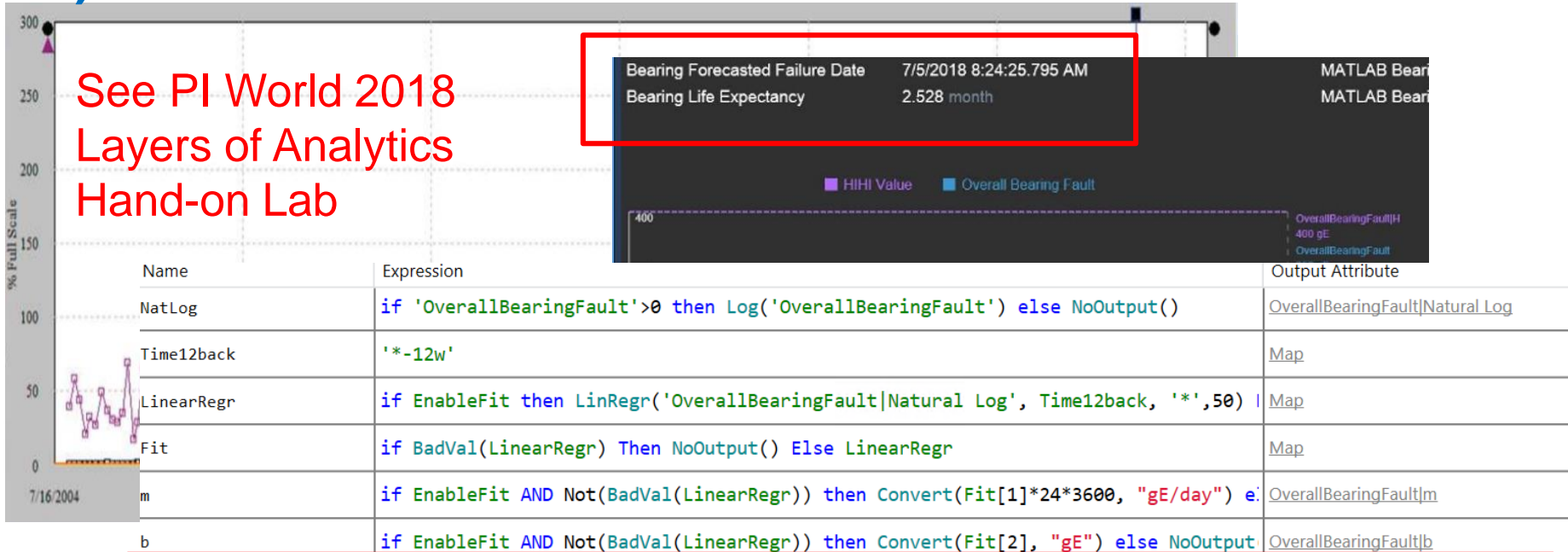
3 hours into the process

Trigger Attributes (2) Dryer A	Start Value	End Value	Units	
Dryer A DeltaAUC	907.46	909.95		
Dryer A DeltaE	352.81	352.79		

Event Attributes (3) Root Cause	Value	Units	
Root Cause Outlet Temperature	272.5	°F	
Root Cause Outlet Temperature Forecast	393.07	°F	

Maintenance – Predictive – RUL (remaining useful life)

See PI World 2018
Layers of Analytics
Hand-on Lab



rsquared	<code>if EnableFit AND Not(BadVal(LinearRegr)) then Convert(Fit[3],"ratio") else NoOutpu</code>	<code>OverallBearingFault r_squared</code>
LifeExpectancy	<code>if EnableFit AND Not(BadVal(LinearRegr)) and m>0 and rsquared>.400 then Convert(:</code>	<code>BearingLifeExpectancy</code>
ForecastedFailDate	<code>if EnableFit AND Not(BadVal(LinearRegr)) and m>0 and rsquared>.400 then TimeStamp</code>	<code>BearingForecastedFailureDate</code>

Takeaways – Digital Transformation & Enterprise Infrastructure

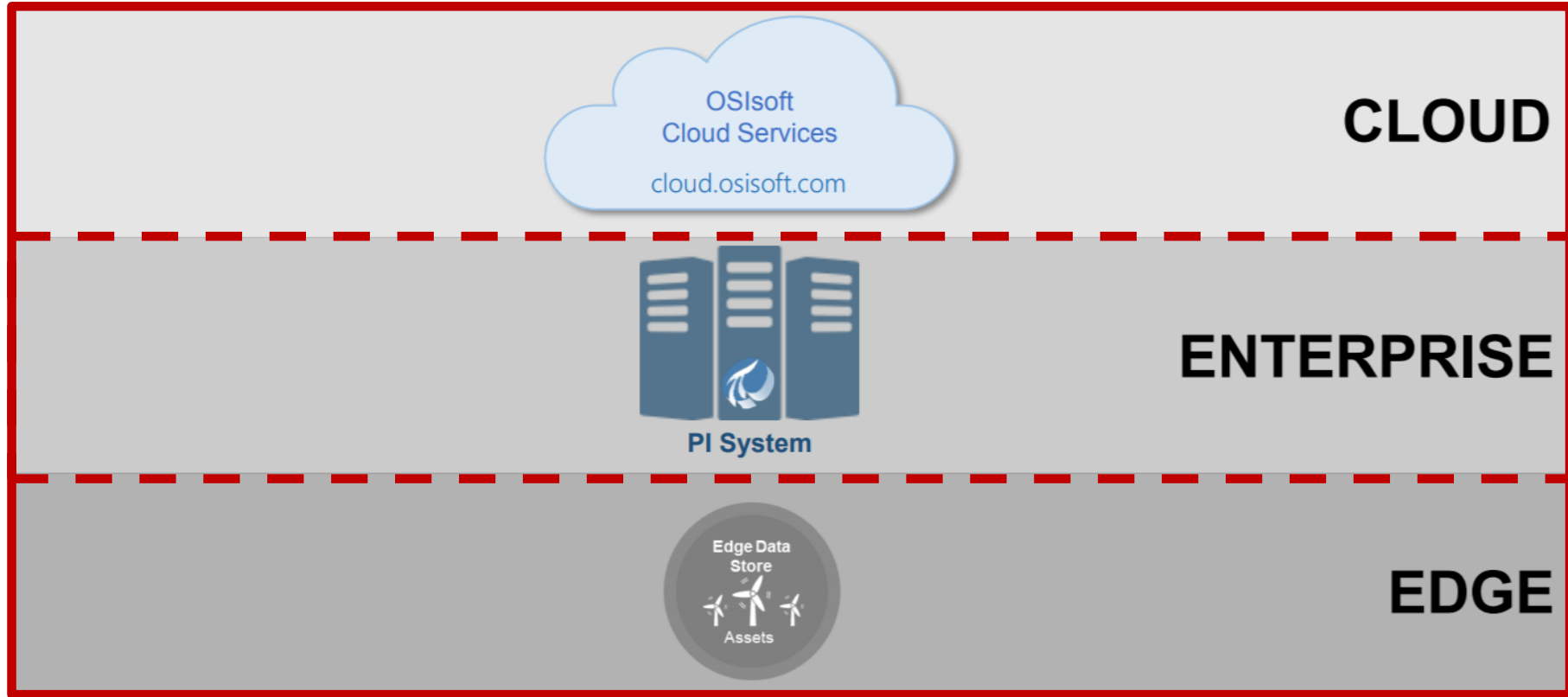
- Digital Transformation
 - Digital enablement
 - Automate or Change business process
 - People, Process, Technology
 - Collaborative work environment
- Enterprise Infrastructure (for OT data)
 - Sensor data (SCADA, PLC,...), IoT data,...
 - Machine condition data
 - Other metadata, contextual data, any data to enrich sensor data...
- PI System as the data infrastructure for operational excellence
 - Layers of Analytics – Descriptive, Diagnostic, Predictive, Prescriptive

- New offerings
 - Edge Data Store (EDS)
 - OSIsoft Cloud Services (OCS)
 - OSIsoft Message Format (OMF)



OT=Operations Technology

Extending the OSIsoft Data Infrastructure



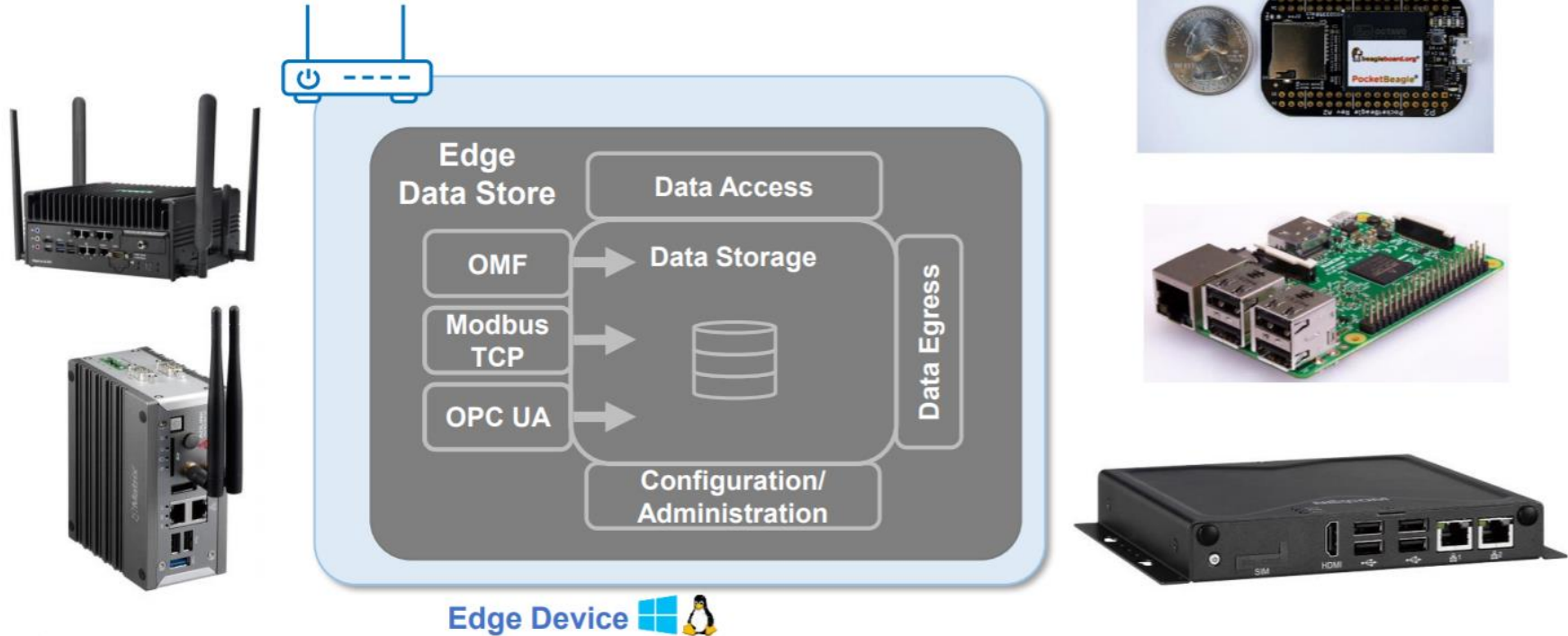
<https://www.osisoft.com/presentations/pervasive-data-collection-1x/>

Edge Data Store Design



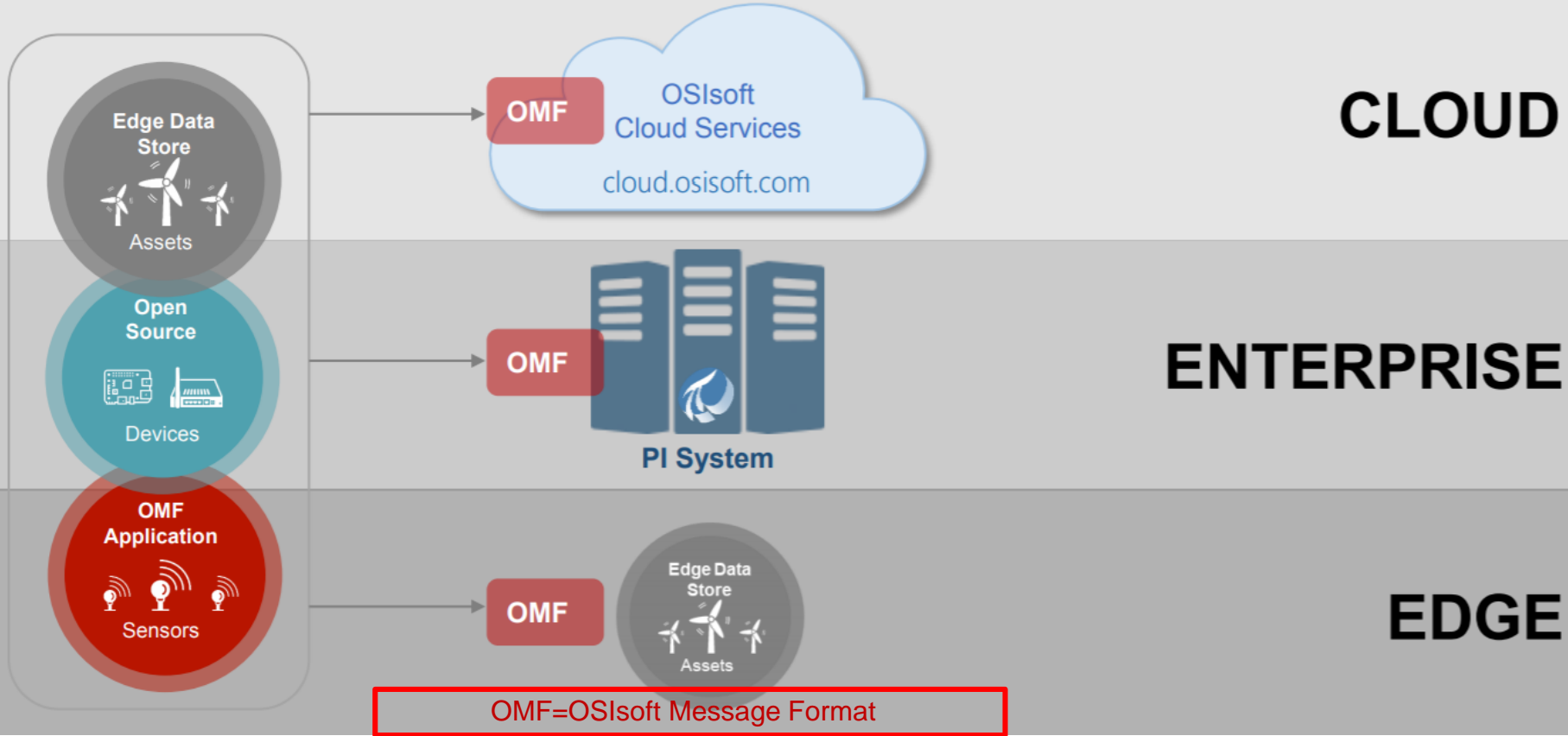
The Edge Data Store is a newly developed set of data collection, storage, access and transfer technologies, built to run on lightweight devices and interoperate with real-time, operational data sources.

Edge Data Store v1 Hardware Compatibility

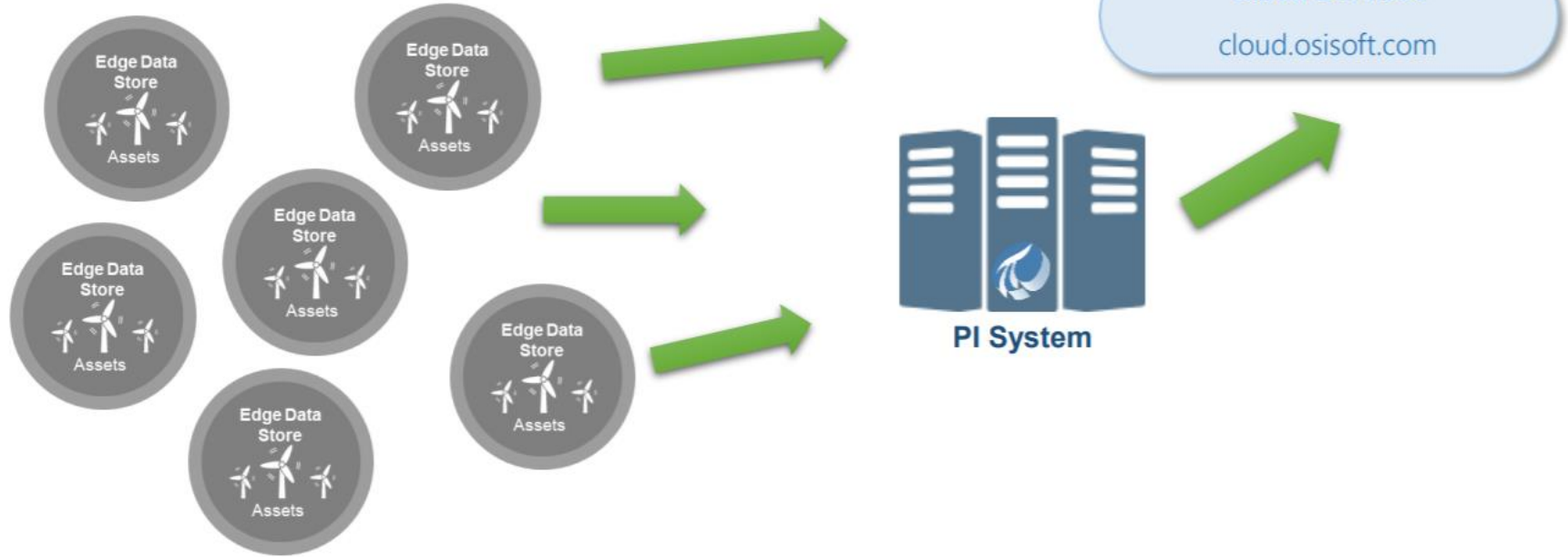


<https://www.osisoft.com/presentations/pervasive-data-collection-1x/>

Extending Connectivity to All OSIsoft Systems



Edge Data Store is Complementary



*Operational data is sent between Edge Data Stores and PI Systems
... and also between Edge Data Stores and OSIssoft Cloud Services.*

Gain Insights from Remote Assets



Edge – Beam Pump



EDGE

Mobile Worker Interface

CLOUD

PI Vision

SENSORS



10 Hz data



- High frequency data capturing

- Pump issues diagnostics

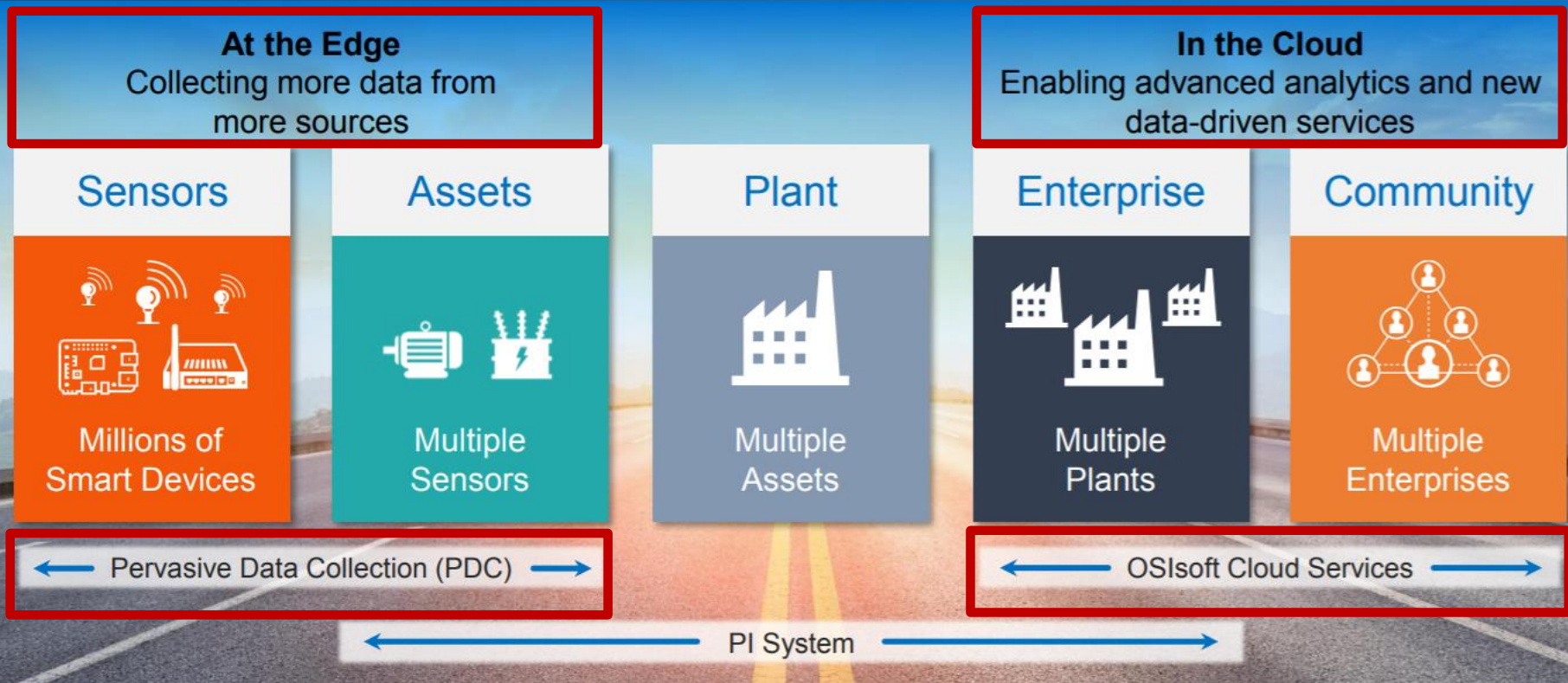
- Soft sensing: Dynamo graph from power meter replacing load cell and inclinometer

- Edge Analytics performed on industrial gateway

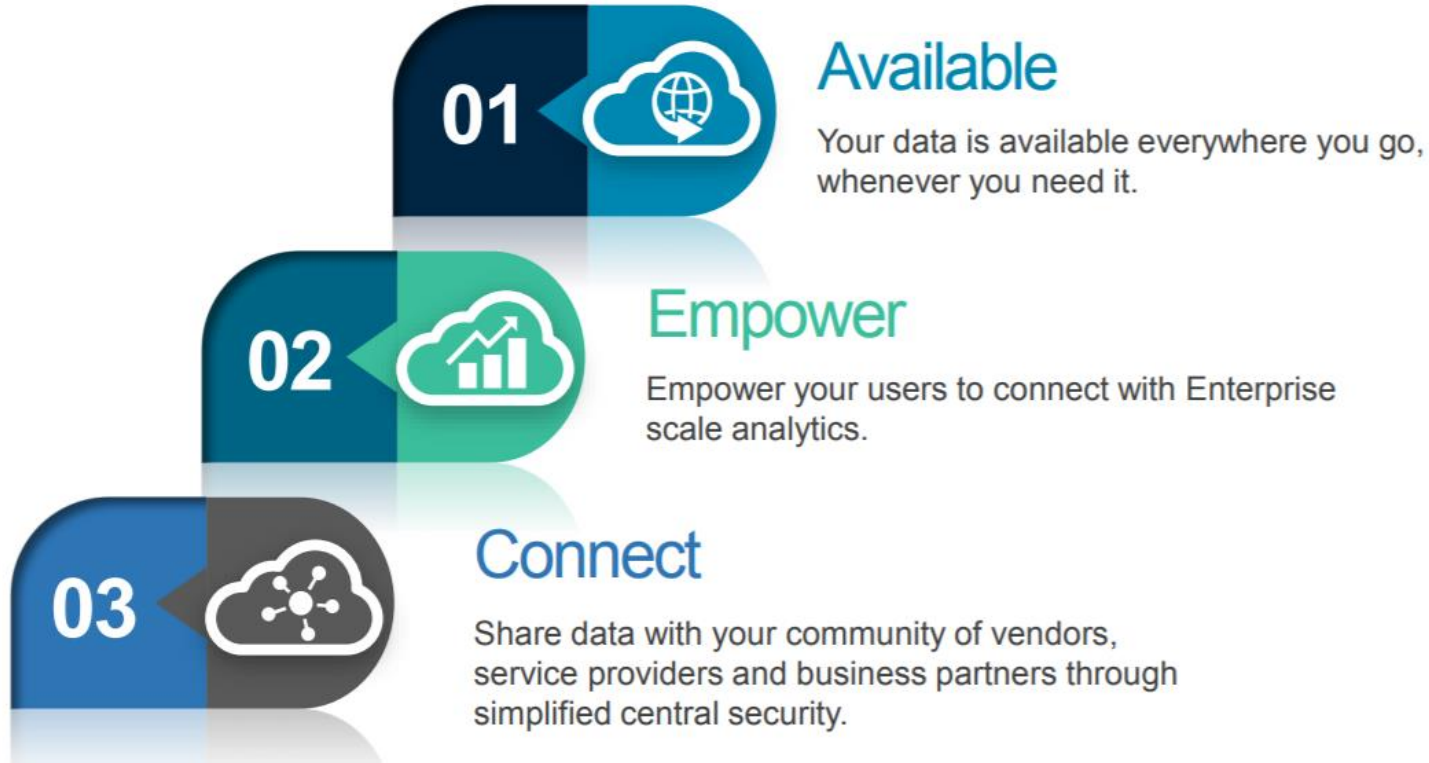
- Alarms transmission to office for further action

<https://www.osisoft.com/Presentations/Gather--Data-connectivity-options-for-the-PI-System-and-the-Cloud/>

Extending Your Data Infrastructure from Edge to Cloud



Why OSISoft Cloud Services?



<https://www.osisoft.com/presentations/cloud-services-1x/>

OSIsoft Cloud Services Design



OSIsoft Cloud Services is a newly developed, cloud native platform, built for real time operational data.

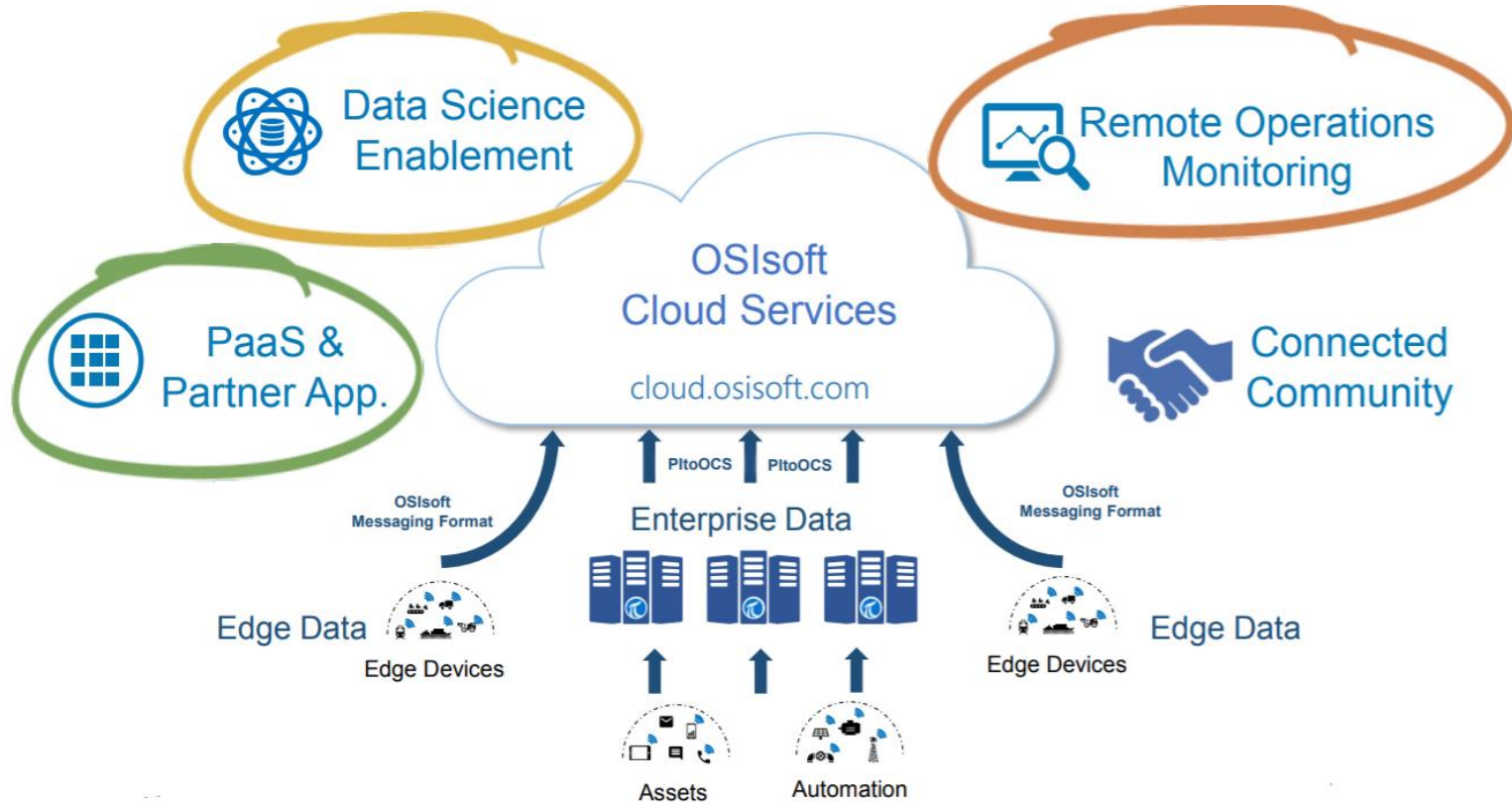
https://ocs-docs.osisoft.com/Documentation/OSIsoft_Cloud_Services.html

OSIsoft Cloud Services are complementary



Operational data is transferred between PI Systems and OCS
... and also between Edge components and OCS.

OCS – Initial Use Cases



OCS - Remote Operations Monitoring - Data Center Cooling Units

Operational Challenges of a Datacenter 

Facts

- 14 Sites
- 35+ Generators, 300+ CRACs, 5000+ Cabinets
- 24x7x365 On-Site Staff

Requirements & Objectives

- 99.9999% uptime SLA
- Keep our customers informed
- Maintain visibility into critical equipment
- Identify & troubleshoot issues quickly

<https://www.vxchnge.com/>

<https://www.osisoft.com/presentations/data-cleansing-and-anomaly-detection-made-easy-with-pi-system-and-osisoft-cloud-services/>

OCS - Remote Operations Monitoring - Data Center Cooling Units

Operational Challenges of a Datacenter 

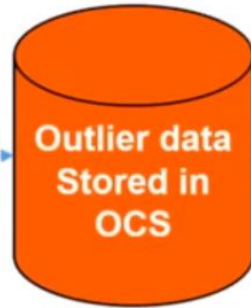
Business challenge : Find & label anomalies for which you can take action on

Facts

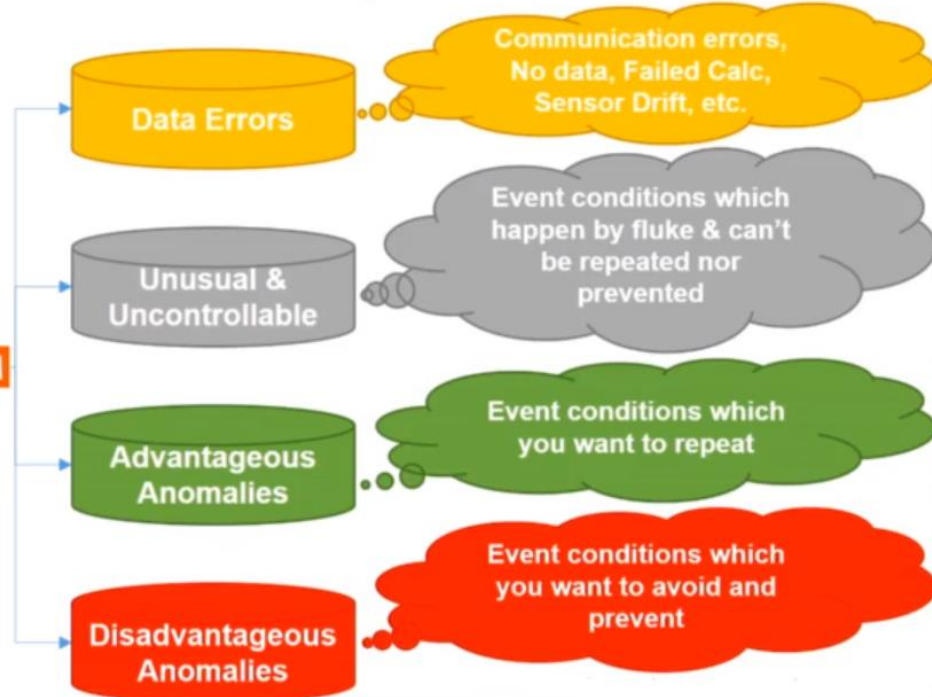
- 14 Sites
- 35+ Gbps
- CRAC Cabinets
- 24x7x365 Staff



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<https://www.vxchange.com/>

<https://www.osisoft.com/presentations/data-cleansing-and-anomaly-detection-made-easy-with-pi-system-and-osisoft-cloud-services/>

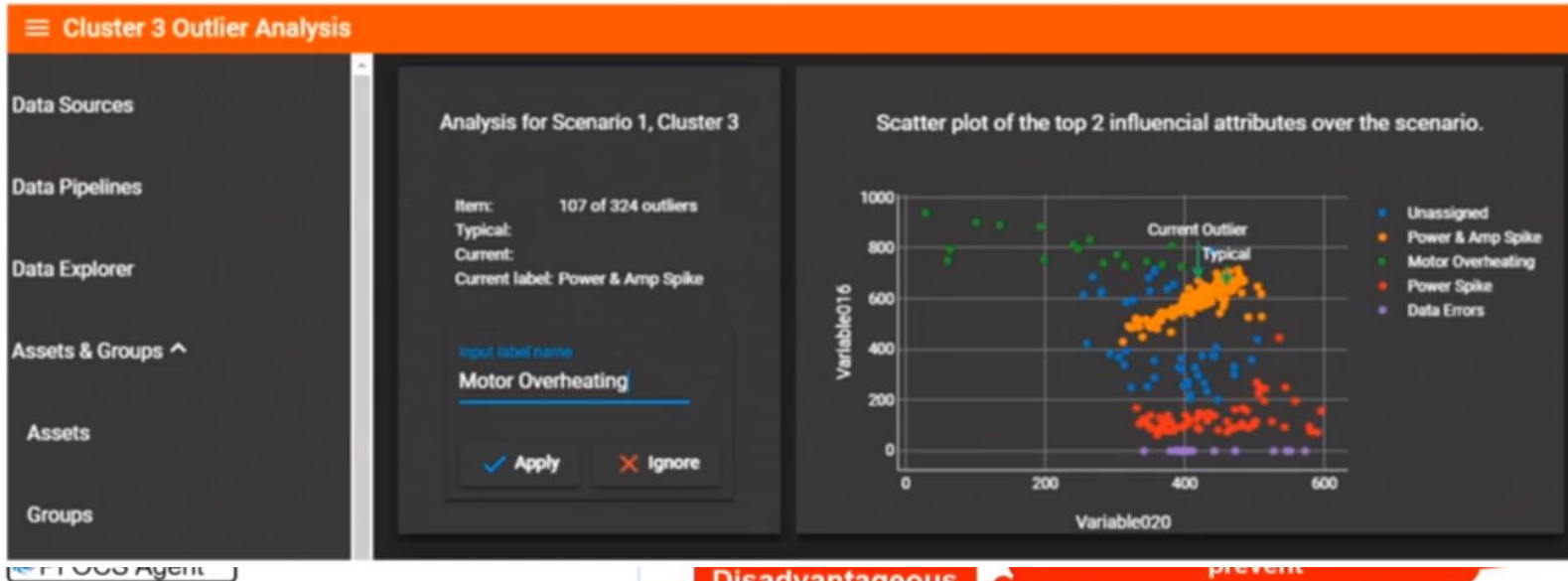
OCS - Remote Operations Monitoring - Data Center Cooling Units

Operational Challenges of a Datacenter 

Business challenge : Find & label anomalies for which you can take action on
“Motor Overheating” or “Power & Amp Spike” or “Power Spike” (...)

Facts

- 14 Sites
- 35+ GCRAC Cabinets
- 24x7x24 Staff



<https://www.vxchange.com/>

<https://www.osisoft.com/presentations/data-cleansing-and-anomaly-detection-made-easy-with-pi-system-and-osisoft-cloud-services/>

Takeaways – Digital Transformation & Enterprise Infrastructure

- Digital Transformation
 - Digital enablement
 - Automate or Change [business process](#)
 - [People, Process](#), Technology
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 - Sensor data (SCADA, PLC,...), IoT data,...
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OT=Operations Technology

Thank You

Next Steps:

- >Your Digital Transformation use case
- >PI Workshop
- ><https://learning.osisoft.com>
- ><https://pissquare.osisoft.com> (Community and Developer)