

PI 101: Academic Symposium

Stuart Collins – Product Marketing Manager

March 23, 2017

Live Polling in this
session:

PolLEV.com/stuartc

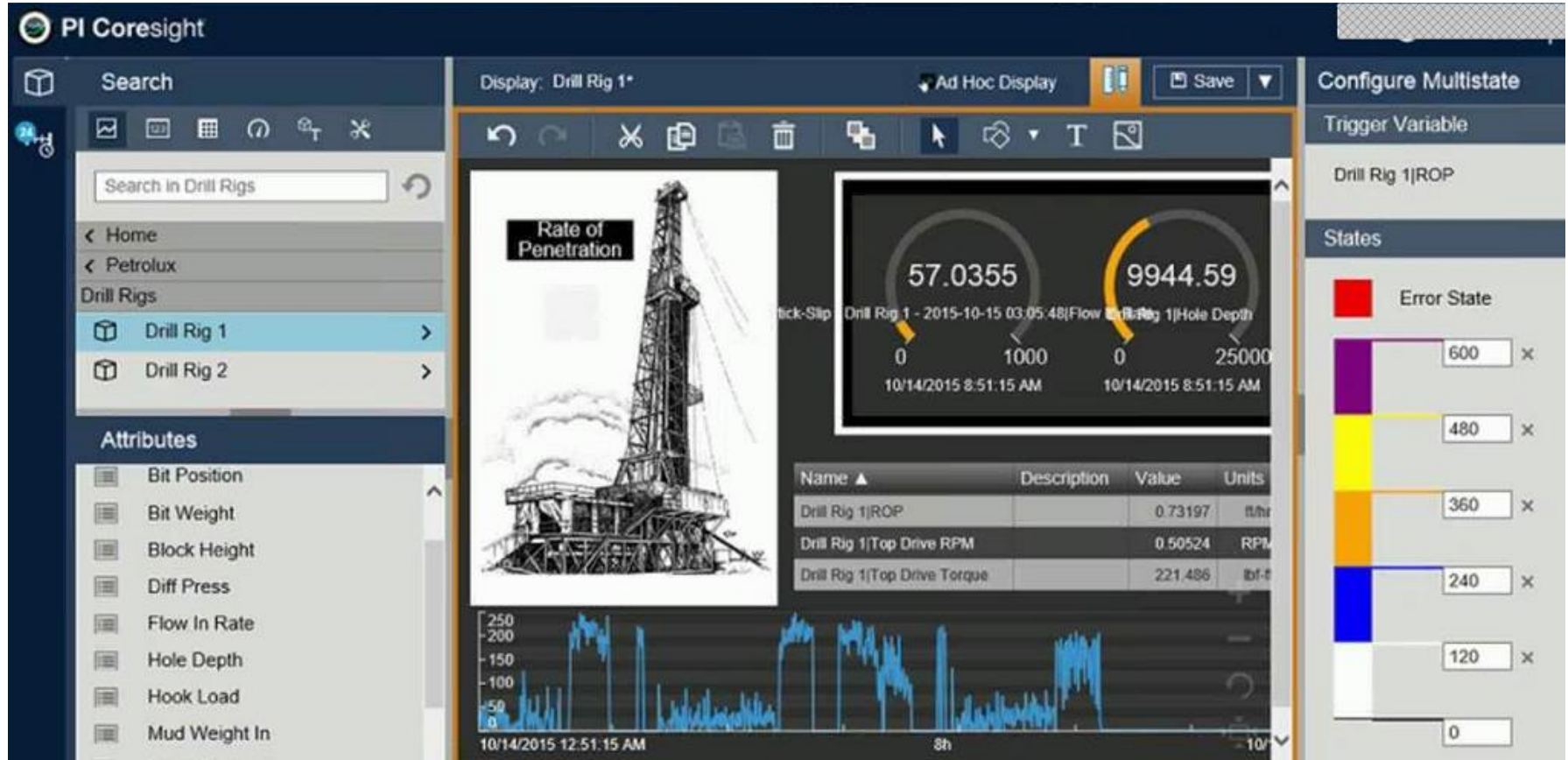


*We believe **People with Data** can change the world*

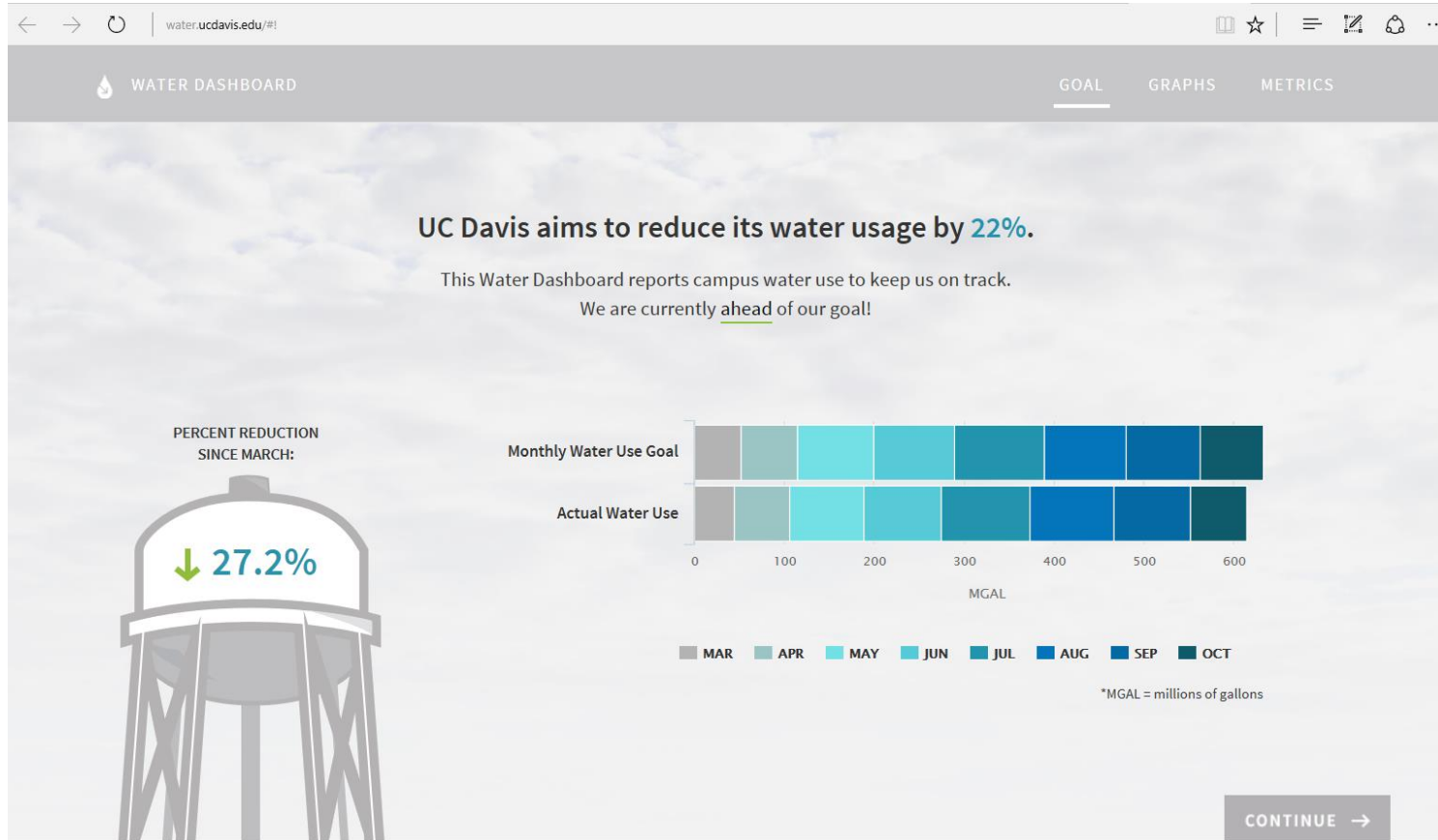
What is the PI System?



An example dashboard from the PI System



PI System in use at UC Davis



PI appears across industries



Power & Utilities
45.0%



Oil & Gas
18.6%



Chemicals & Petrochemicals
13.4%



Materials, Mines, Metals & Metallurgy
6.9%



Pharma., Food & Life Sciences
5.7%



Pulp & Paper
5.2%



Discrete Manufacturing
2.4%



Others
1.6%



Critical Facilities, Data Centers & IT
1.2%



What is the PI System?

The PI System is a data infrastructure software suite, primarily build for industrial use cases

1

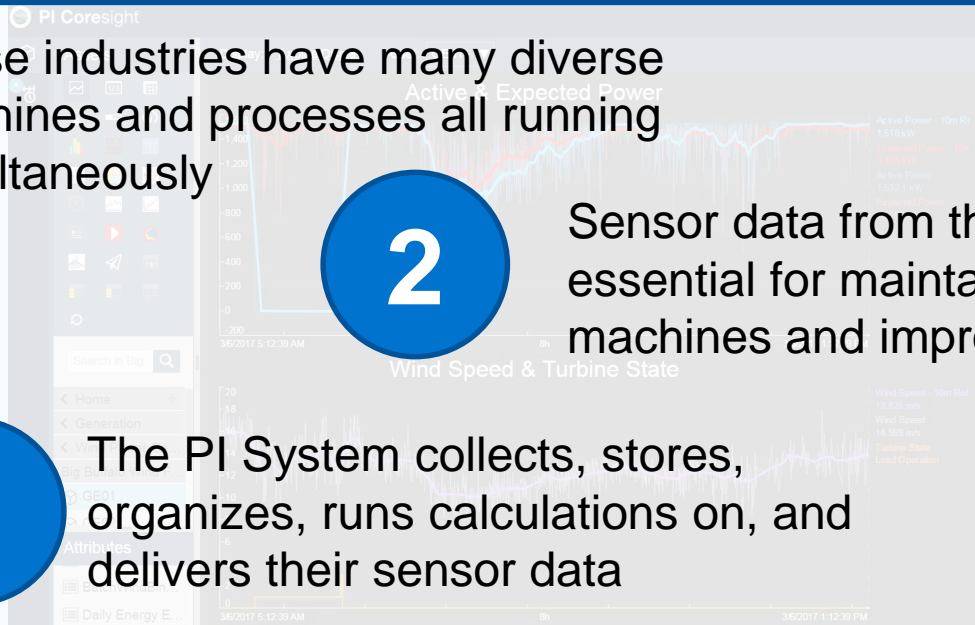
These industries have many diverse machines and processes all running simultaneously

2

Sensor data from these machines is essential for maintaining their machines and improving their process

3

The PI System collects, stores, organizes, runs calculations on, and delivers their sensor data



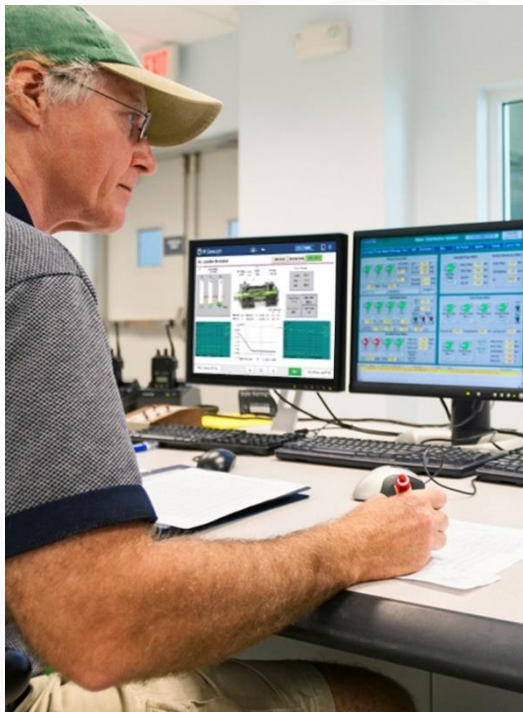
The demands of industry created a strong PI System

Demand from industry

Resultant Database



PI System native visualization tools

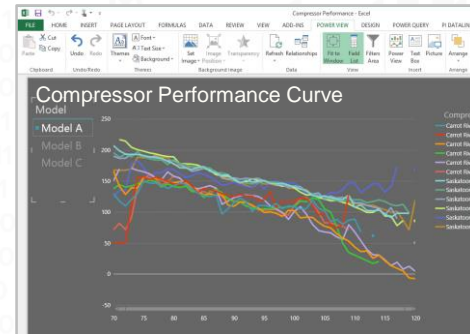


Process Displays



Mobile

Daily Operations Report					
From	Building	Alarms and Status		Building	CCM04
24/Nov/18 00:00:00		Total Alarms		4	Building Information
27/Nov/18 00:00:00		Total Warnings		4	Occupancy
		Electric Demand			Energy Production
		Peak	Max	Min	Max
0:00	0:00	100.00	100.00	100.00	100.00
1:00	0:00	100.00	100.00	100.00	100.00
2:00	0:00	100.00	100.00	100.00	100.00
3:00	0:00	100.00	100.00	100.00	100.00
4:00	0:00	100.00	100.00	100.00	100.00
5:00	0:00	100.00	100.00	100.00	100.00
6:00	0:00	100.00	100.00	100.00	100.00
7:00	0:00	100.00	100.00	100.00	100.00
8:00	0:00	100.00	100.00	100.00	100.00
9:00	0:00	100.00	100.00	100.00	100.00
10:00	0:00	100.00	100.00	100.00	100.00
11:00	0:00	100.00	100.00	100.00	100.00
12:00	0:00	100.00	100.00	100.00	100.00
13:00	0:00	100.00	100.00	100.00	100.00
14:00	0:00	100.00	100.00	100.00	100.00
15:00	0:00	100.00	100.00	100.00	100.00
16:00	0:00	100.00	100.00	100.00	100.00
17:00	0:00	100.00	100.00	100.00	100.00
18:00	0:00	100.00	100.00	100.00	100.00
19:00	0:00	100.00	100.00	100.00	100.00
20:00	0:00	100.00	100.00	100.00	100.00
21:00	0:00	100.00	100.00	100.00	100.00
22:00	0:00	100.00	100.00	100.00	100.00
23:00	0:00	100.00	100.00	100.00	100.00
24:00	0:00	100.00	100.00	100.00	100.00
25:00	0:00	100.00	100.00	100.00	100.00
26:00	0:00	100.00	100.00	100.00	100.00
27:00	0:00	100.00	100.00	100.00	100.00
28:00	0:00	100.00	100.00	100.00	100.00
29:00	0:00	100.00	100.00	100.00	100.00
30:00	0:00	100.00	100.00	100.00	100.00



Spreadsheets

3-layer data infrastructure

Collect

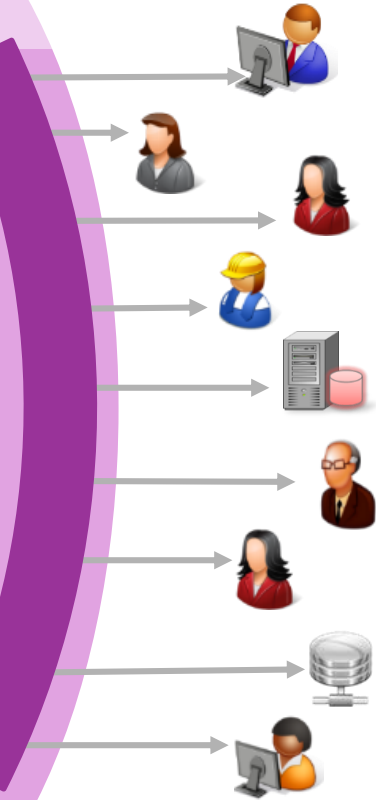
Manage
Enhance

Deliver

PI Interfaces,
PI Connectors

PI Server

To Users
and Systems





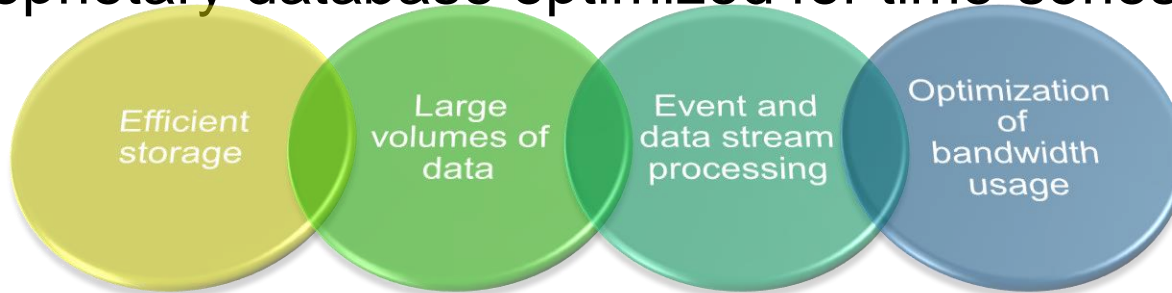
PI Data Archive (Time-Series Database / “Historian”)

- Real-time data stream/sensor reading → PI Tag

TAG	TIME	VALUE	STATUS
TIC1001.PV	23-MAY-16 11:01:02	12.3	GOOD
LIC30211.PV	23-MAY-16 11:01:03	198.4	GOOD

....

- Proprietary database optimized for time-series data



Sensor data fits best in a time-indexed database

Time-index

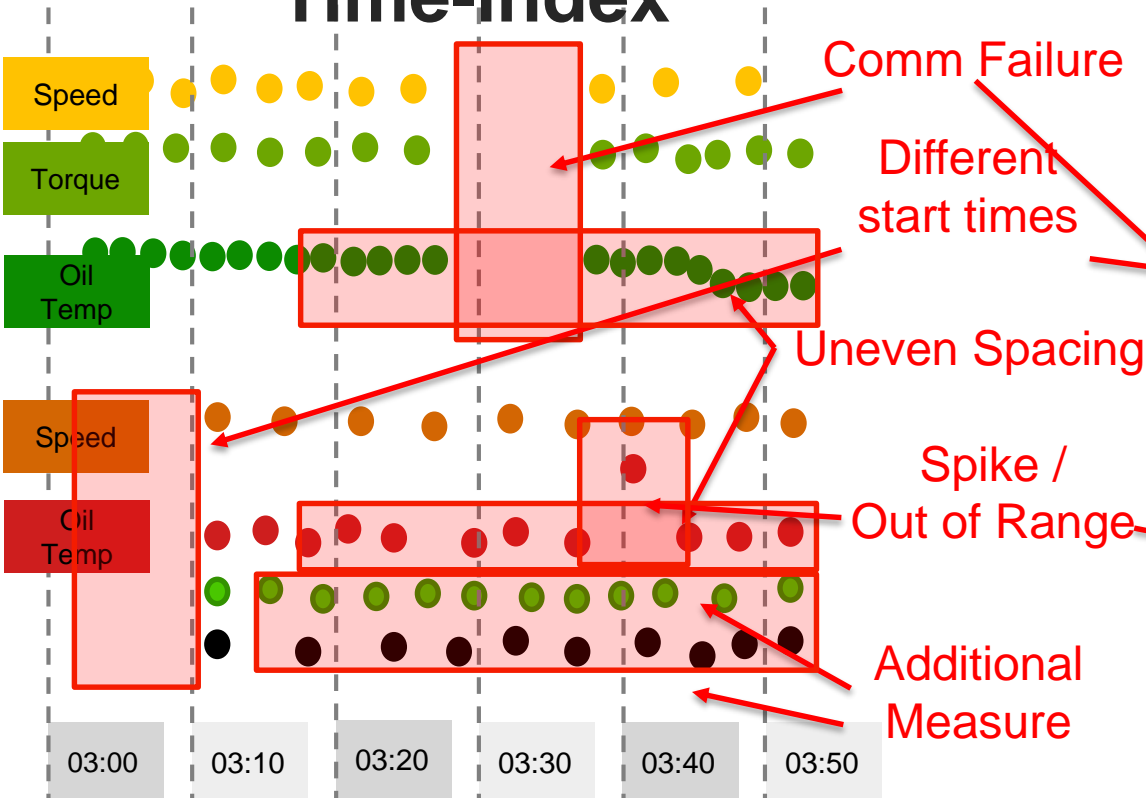


Table-index

	Speed	Torque	Oil Temp	Speed	Oil Temp
03:00	9.8	25	50	X	X
03:10	10	24	50	10.0	60
03:20	10	25	50	10.2	60
03:30	X	X	X	9.8	60
03:40	9.9	25	50	10.0	120
03:50	9.9	25	45	10.1	60

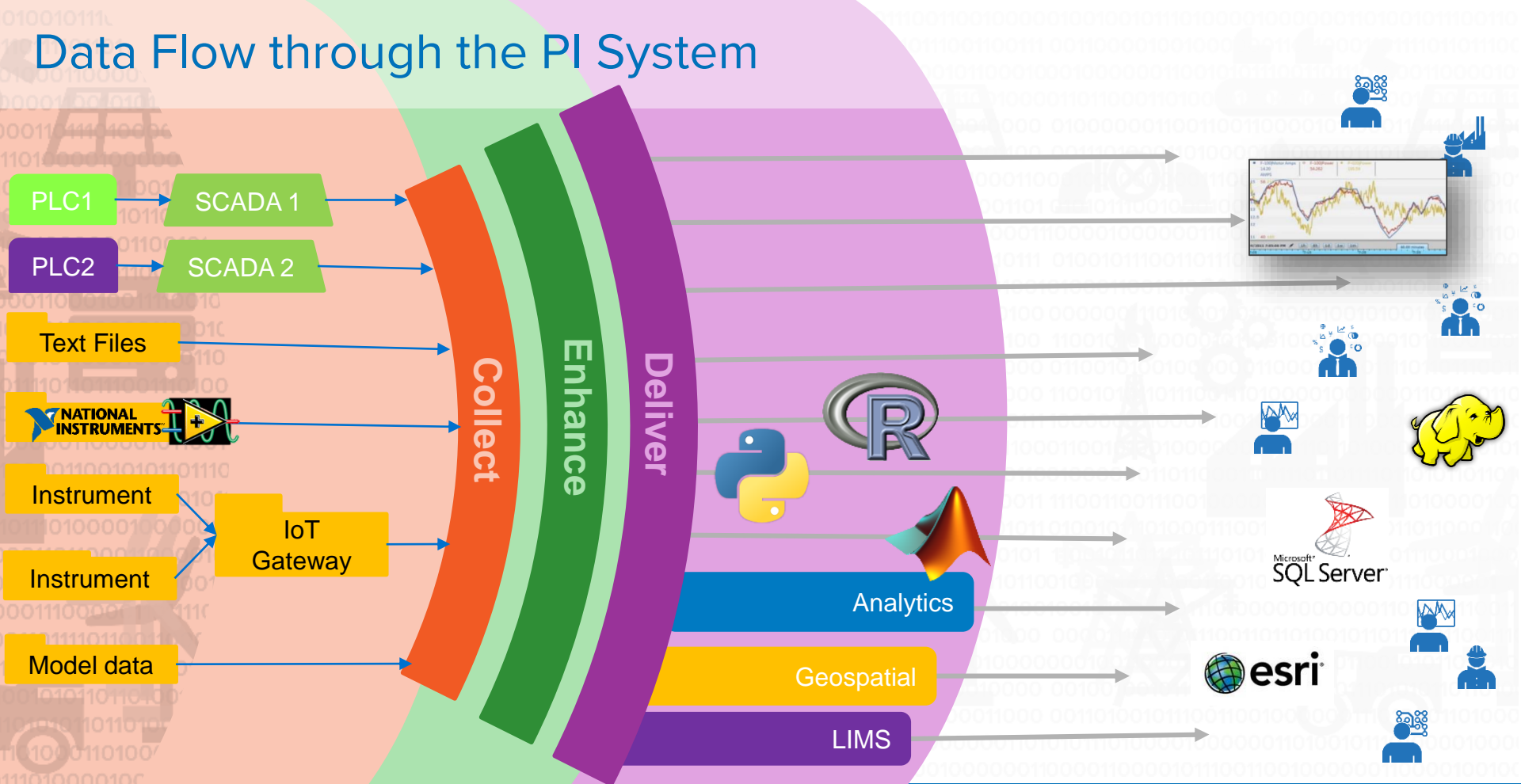


Questions Interlude

Next: PI System for a lab



Data Flow through the PI System

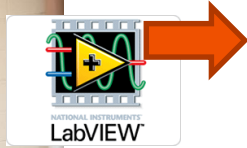


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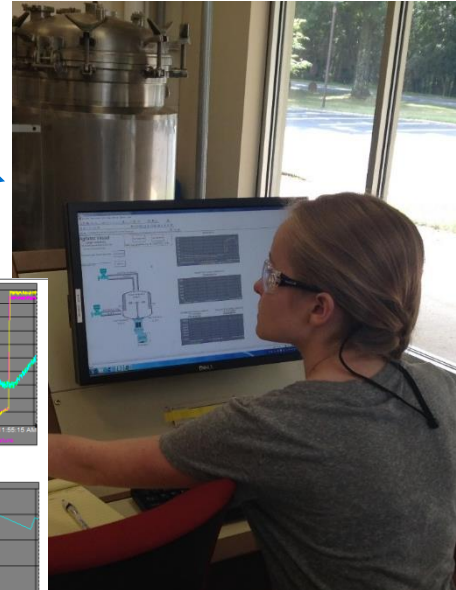
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NI Example - Lehigh University – Agitated Vessel Heat Transfer



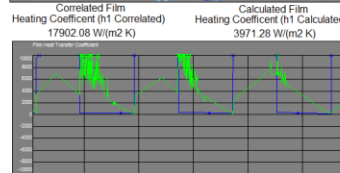
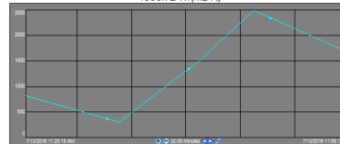
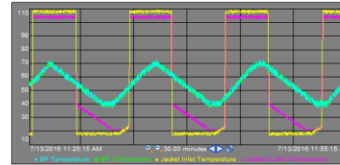
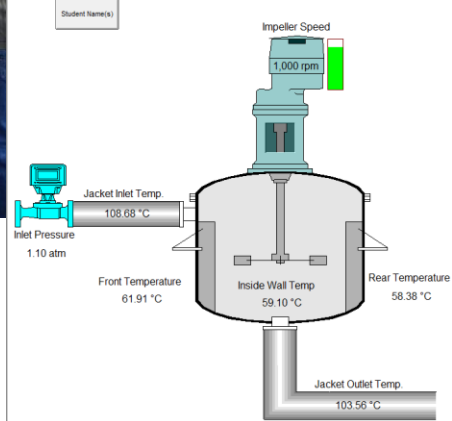
PI Server



Agitated Vessel

Lehigh University
Chemical Engineering Unit Ops Lab
Jul 13, 2016 11:55:15 AM
Student Name 1 and Student Name 2

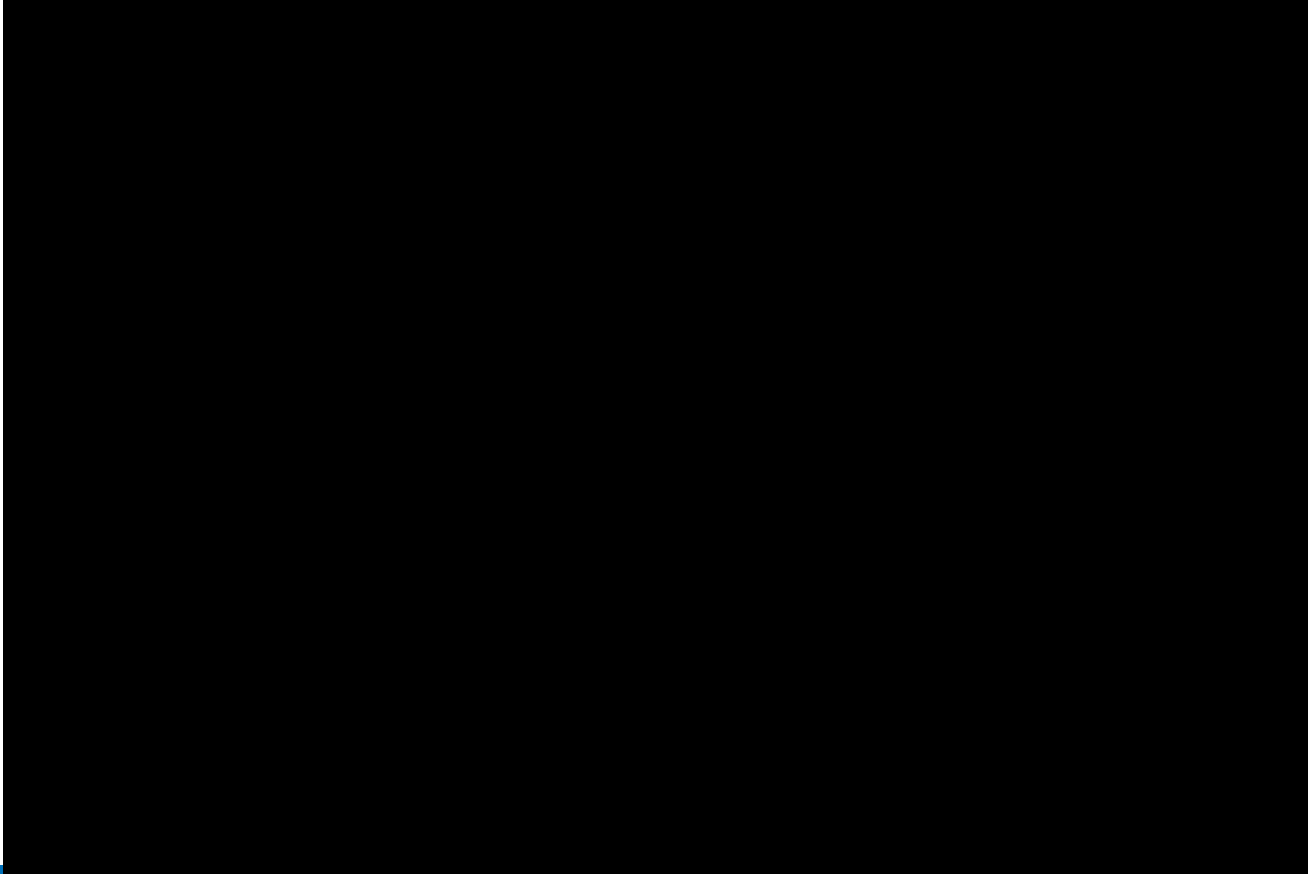
Start Data Collection Stop Data Collection
Data Capture Stopped: Jul 12, 2016 12:14:58 PM



PI-to-MATLAB demo



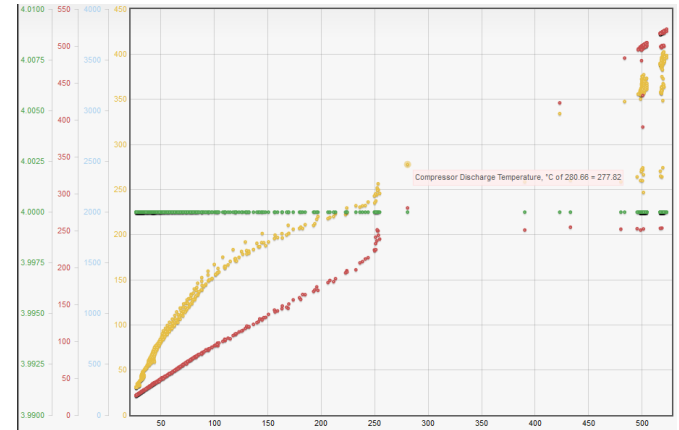
PI-to-MATLAB demo (embedded)



Possible uses for lab classes:

- Move beyond the **operations** of Unit Operations Lab
 - Pre-lab data investigation and planning
 - In-lab real-time visibility
 - In-lab real-time calculations
 - Post-lab data to student lab report

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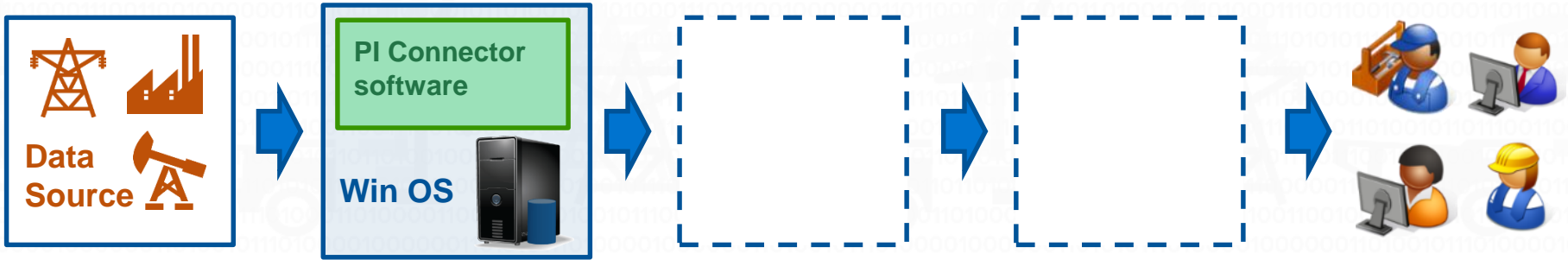


Coming Summer 2017: Academic Community PI Server

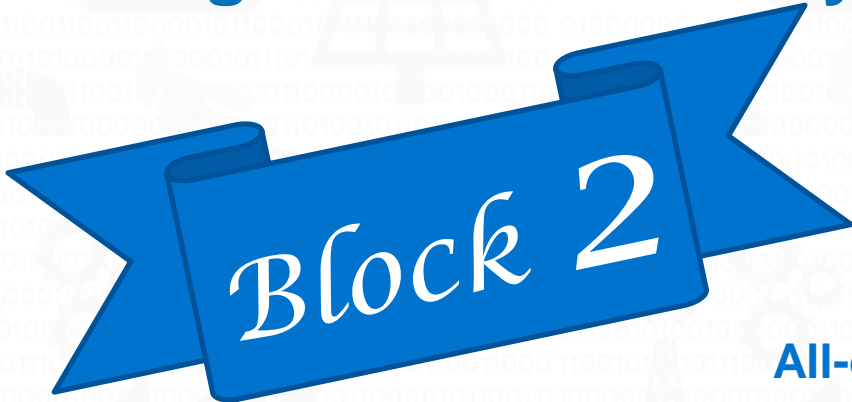


Building blocks of a PI System: Block 1

Block 1



Building blocks of a PI System: Block 2



All-on-one installations possible

VM and Cloud server hosting possible



Building blocks of a PI System: Block 3

Block 3

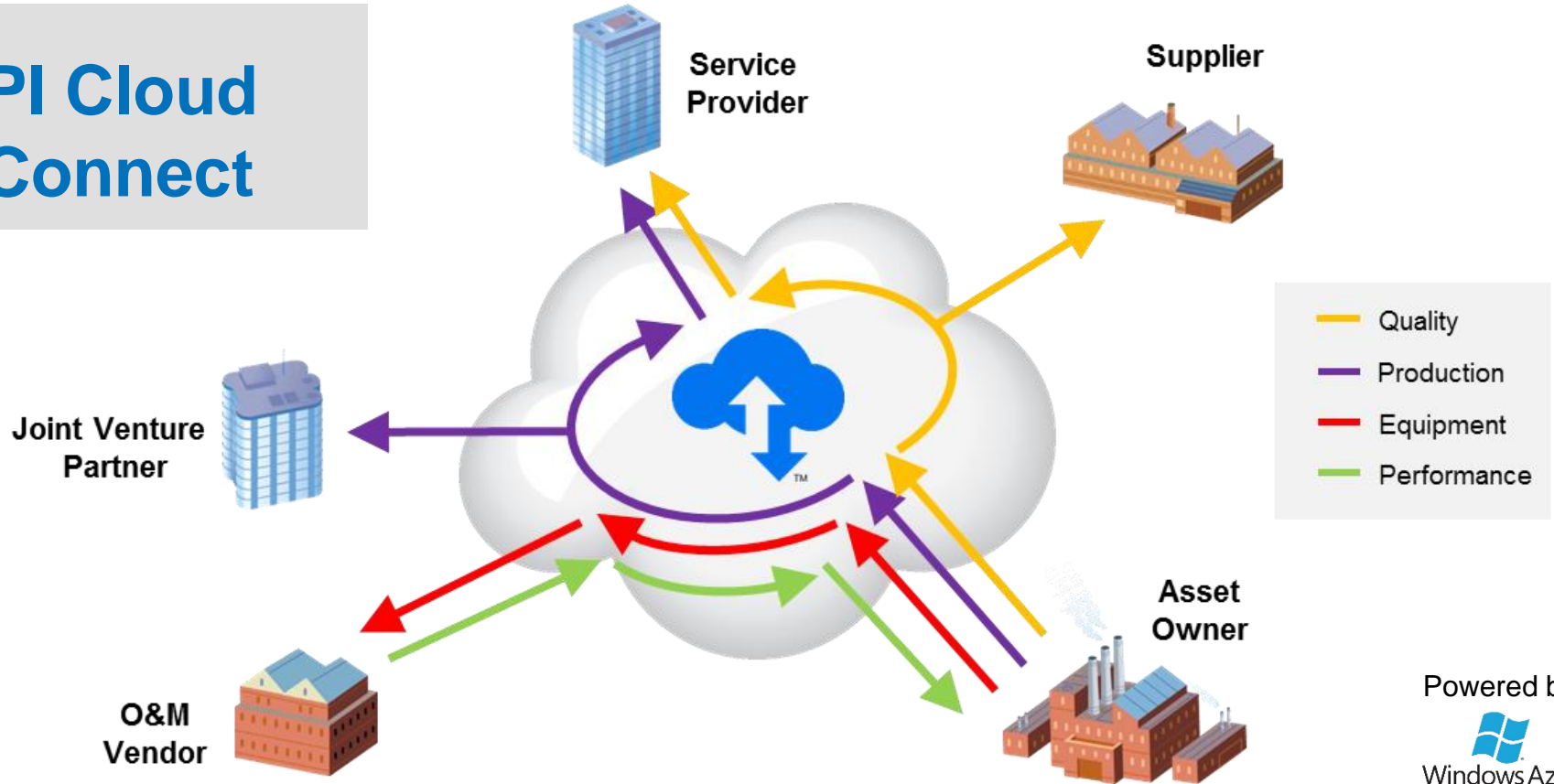


Questions Interlude

**Next: sharing data with
collaborators**



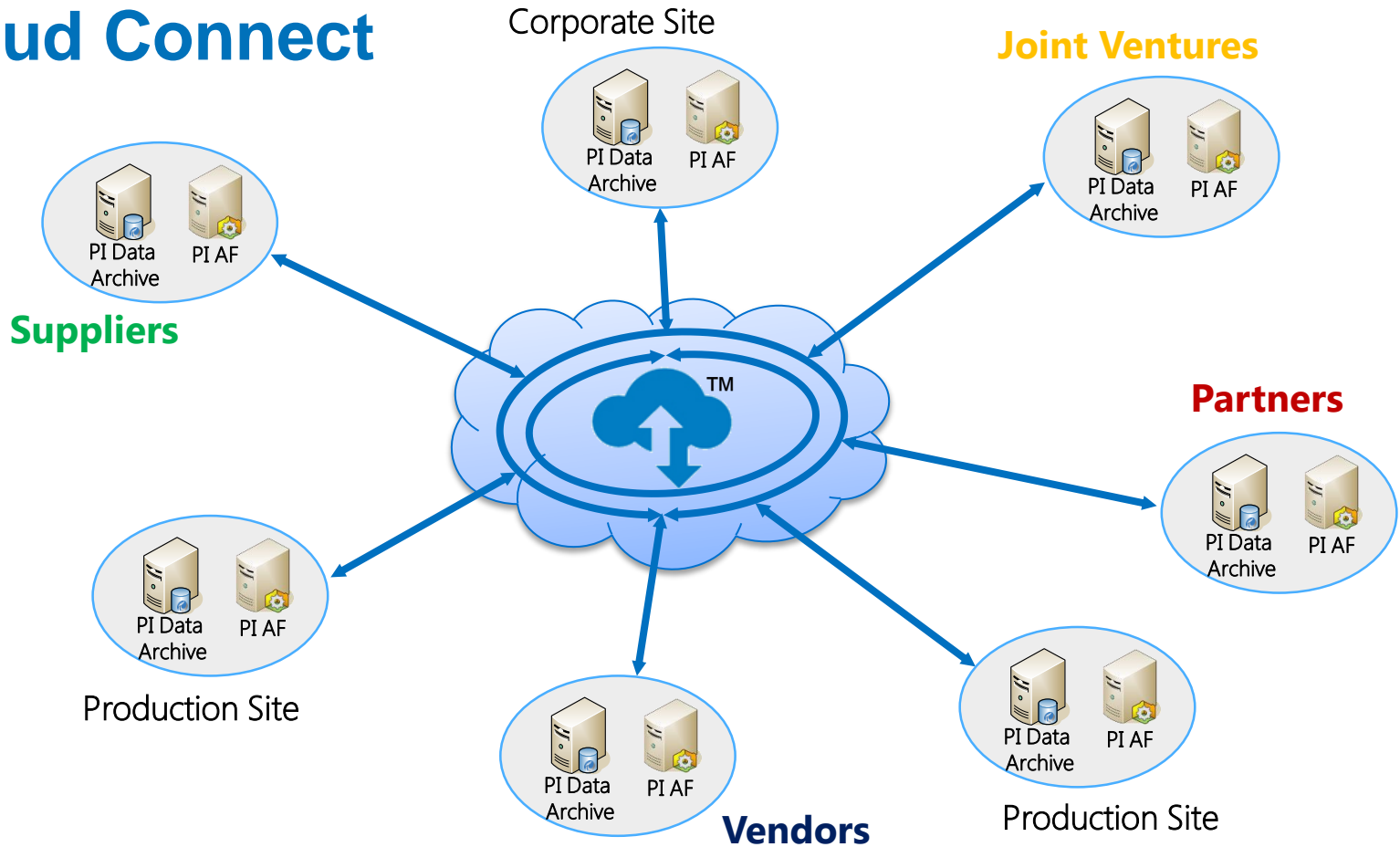
PI Cloud Connect



Powered by:



PI Cloud Connect



Powered by:

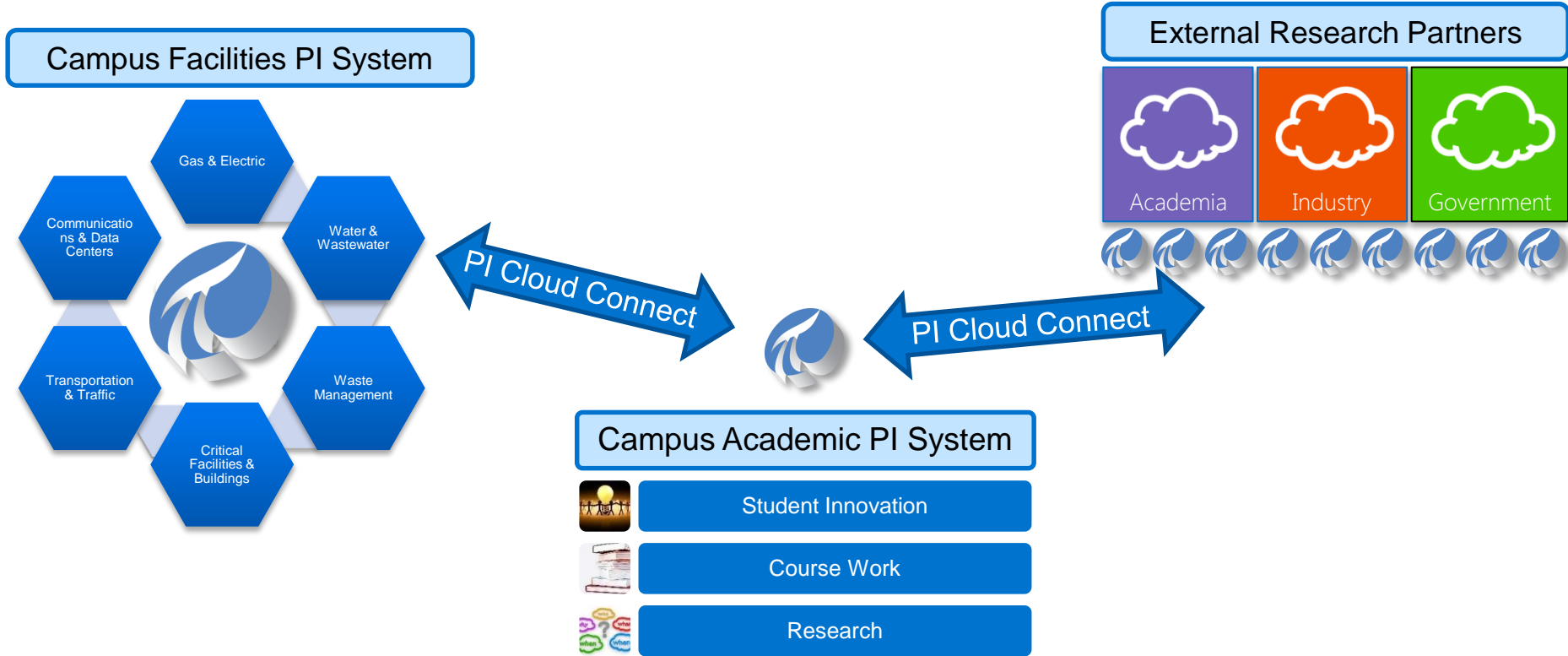
Windows Azure



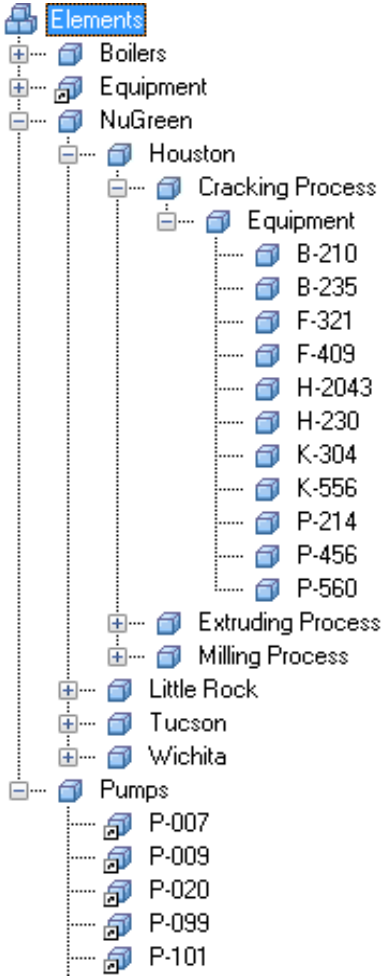
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PI Cloud Connect shares data internally and externally



Organize and compare device data



Analyses

- Efficiency analysis
- Key Performance Indicators (KPI)

Events

- Downtime
- Startup
- Failure

Notifications

- High speed
- Rotor failure
- Low pressure

Time-series

- In-Flow
- Pressure
- Vibration data

Asset details

- Name
- Model
- Manufacturer

External data

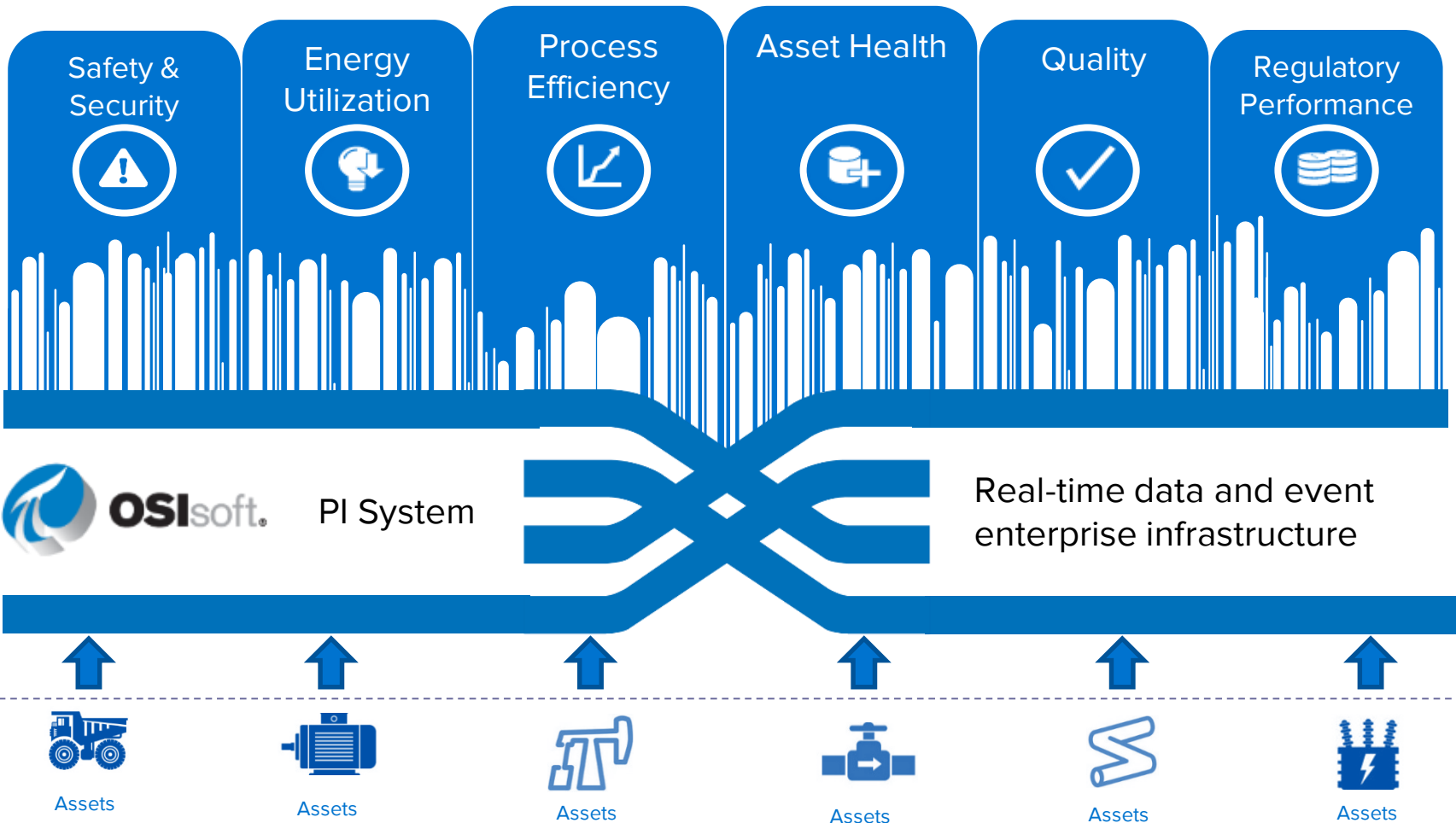
- Performance curves
- Last maintenance date
- Design documents
- Best operating procedures



Questions Interlude

Next: using data





PI Coresight – dashboards, monitoring & diagnosing

PI Coresight

Search

Display: Drill Rig 1*

Ad Hoc Display

Save

Configure Multistate

Trigger Variable

Drill Rig 1|ROP

States

Error State

600 ×

480 ×

360 ×

240 ×

120 ×

0

Rate of Penetration

57.0355

9944.59

0 1000 0 25000

10/14/2015 8:51:15 AM 10/14/2015 8:51:15 AM

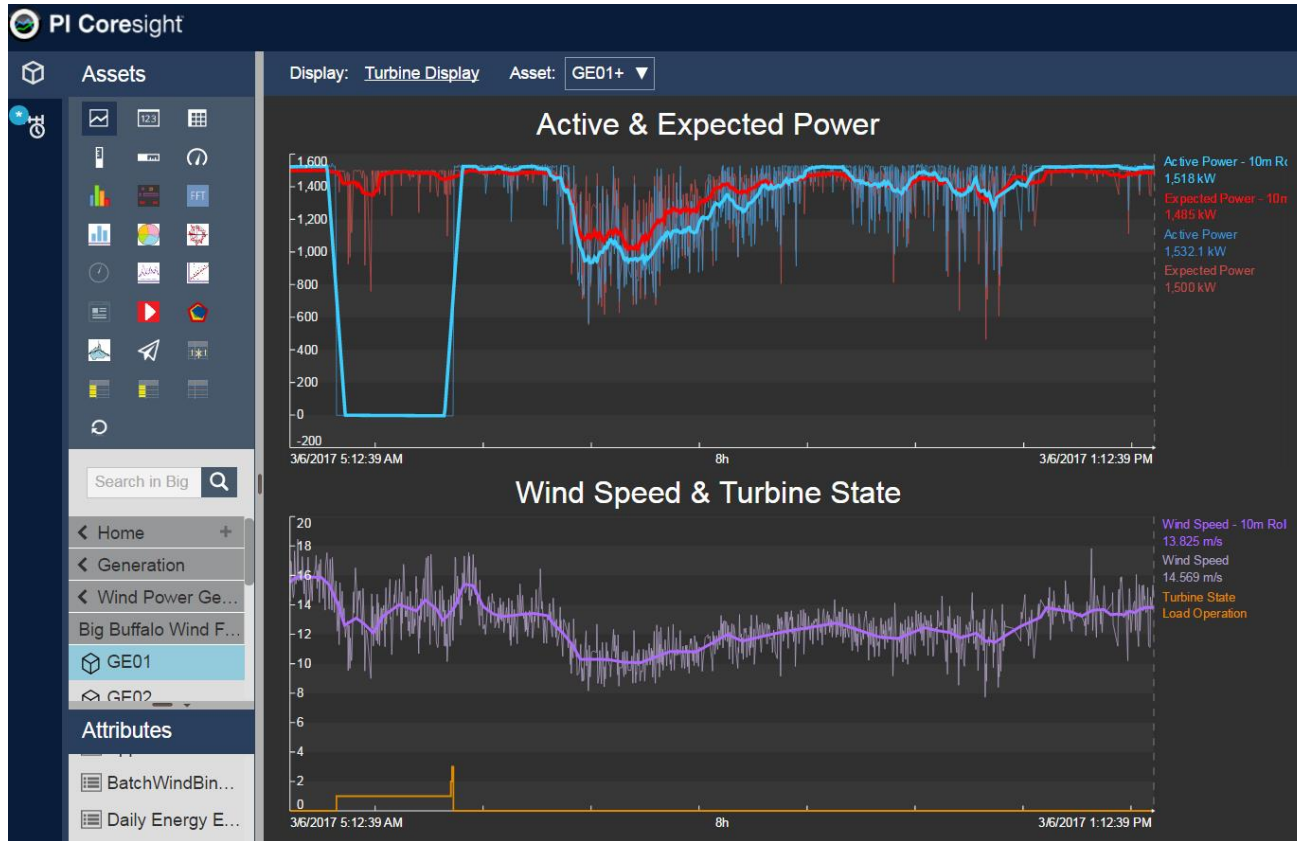
Name	Description	Value	Units
Drill Rig 1 ROP		0.73197	ft/hr
Drill Rig 1 Top Drive RPM		0.50524	RPM
Drill Rig 1 Top Drive Torque		221.486	lbf-ft

250
200
150
100
50
0

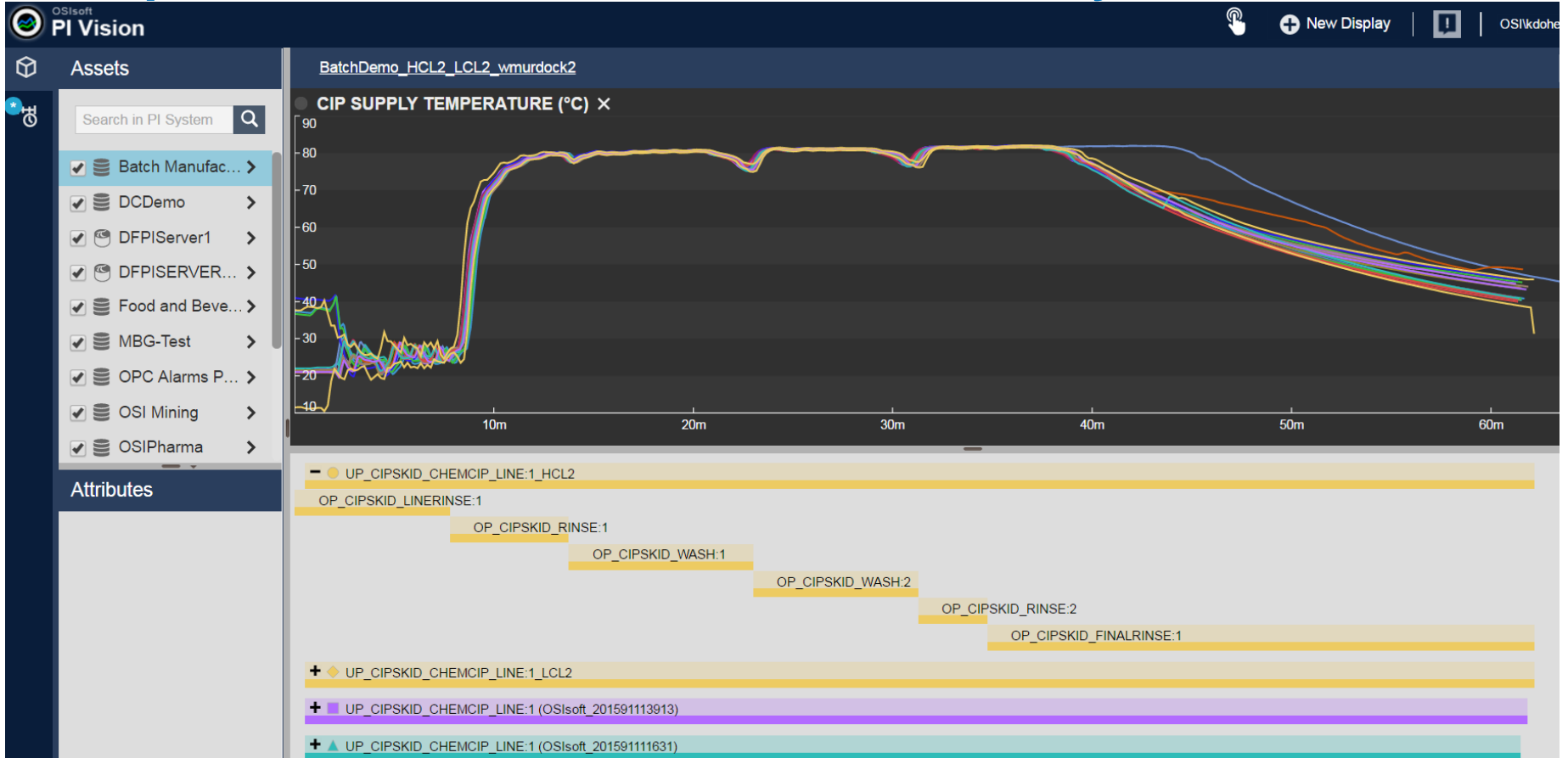
10/14/2015 12:51:15 AM

8h

Compare modeled and predicted datasets against live sensor data



Compare similar events with event overlays

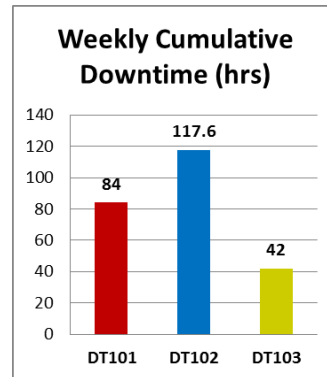
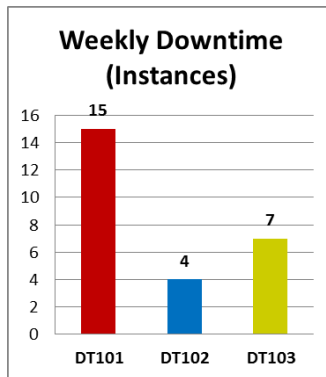


Simplify Data Analysis

myEvent

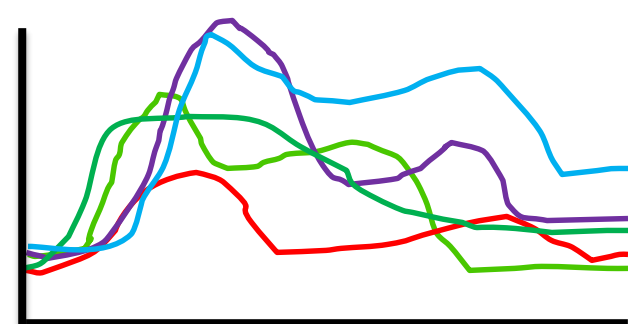
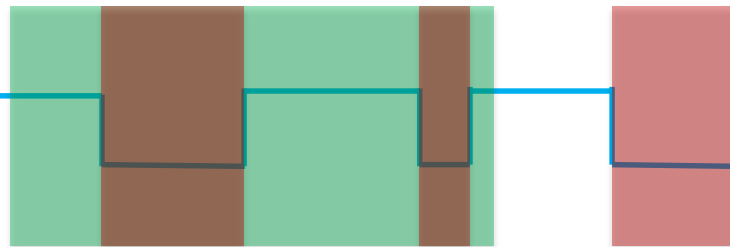


Perform Asset Comparisons



Downtime Events for Product XYZ

Product XYZ (1)
Downtime (2)



Name	Temp.Max
EF1	122.47
EF2	109.34
EF3	112.73
EF4	98.61
EF5	125.24

Perform Event Comparisons

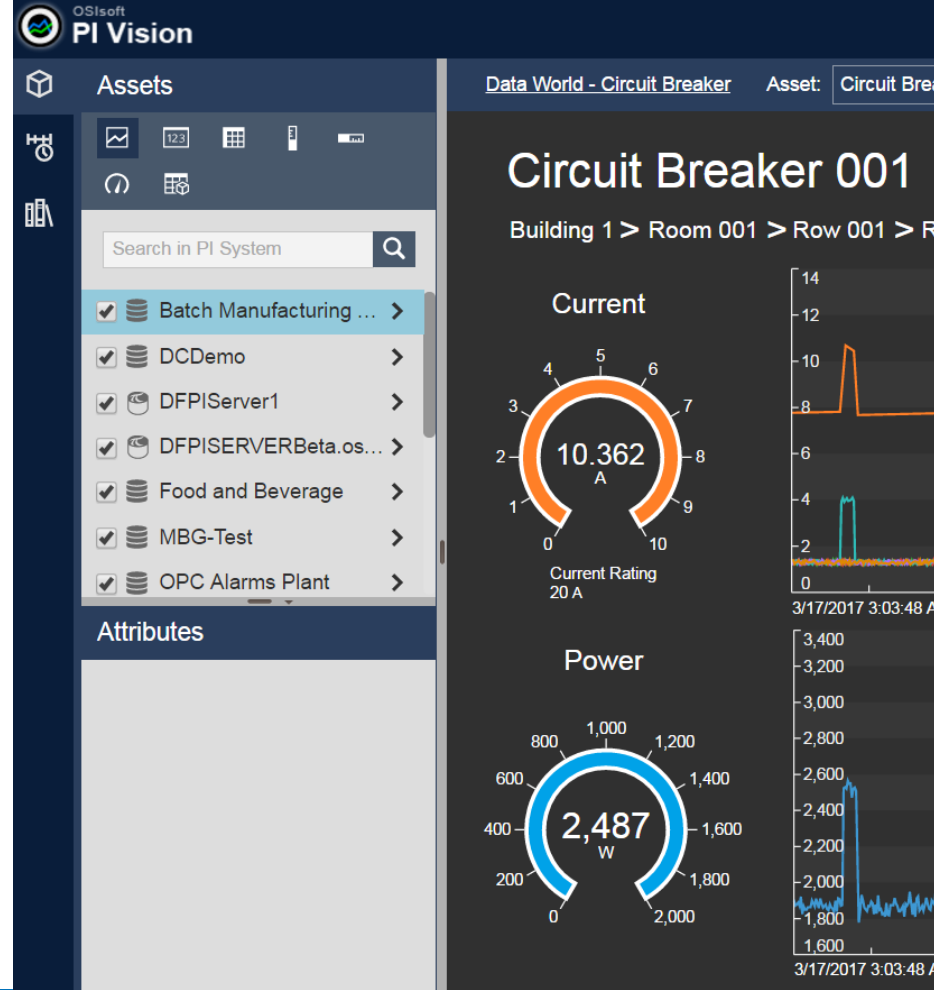
Discover Event Interrelationships



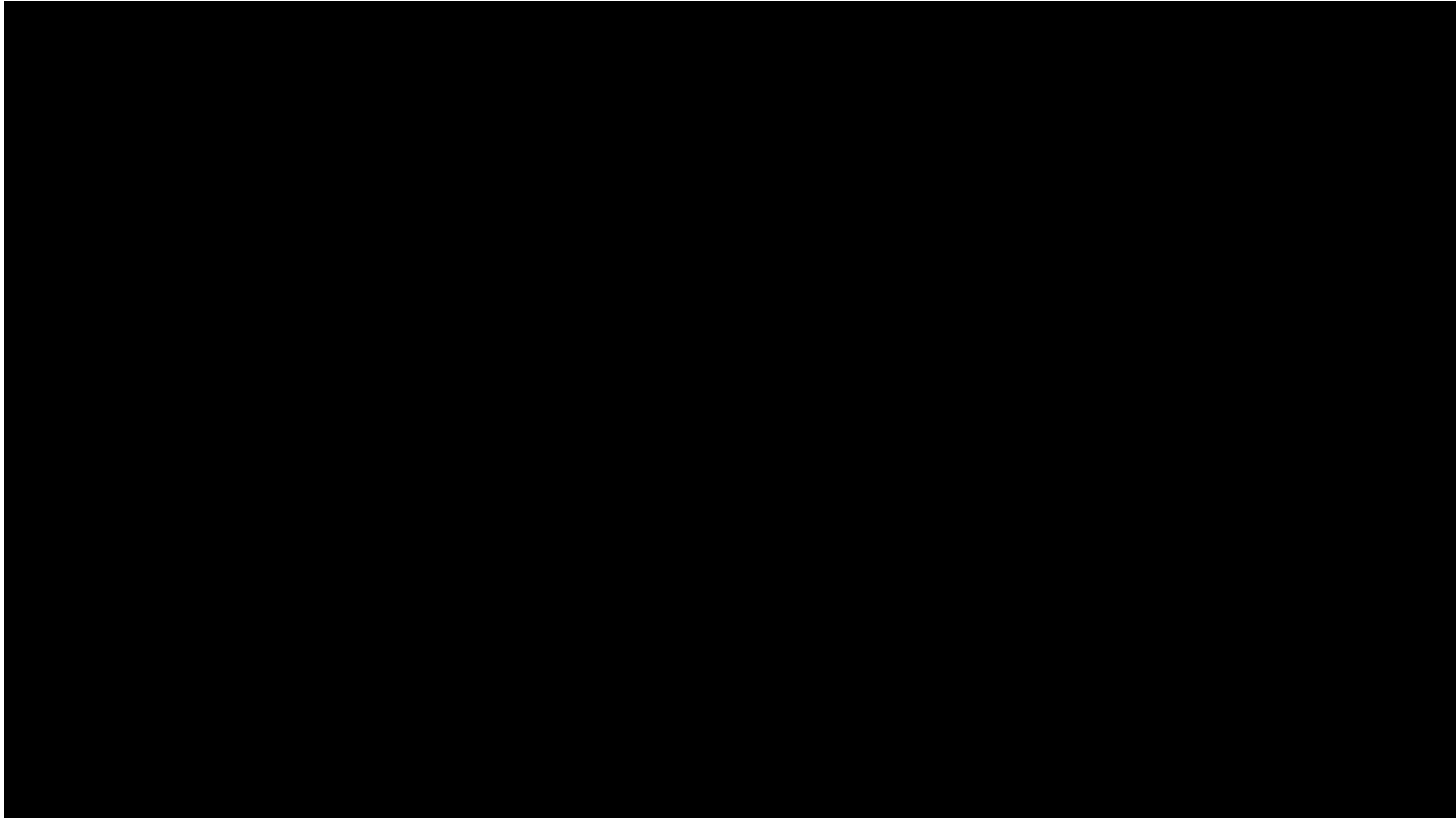
PI Visualization

Modern and intuitive web tool:

- **Efficient search**
- **Rapid screen creation**
- **Intuitive learning** of its functionalities
- Facilitated **collaboration** and **sharing of insights**



PI DataLink – sensor data to spreadsheets



PI DataLink – sensor data to spreadsheets (embedded)

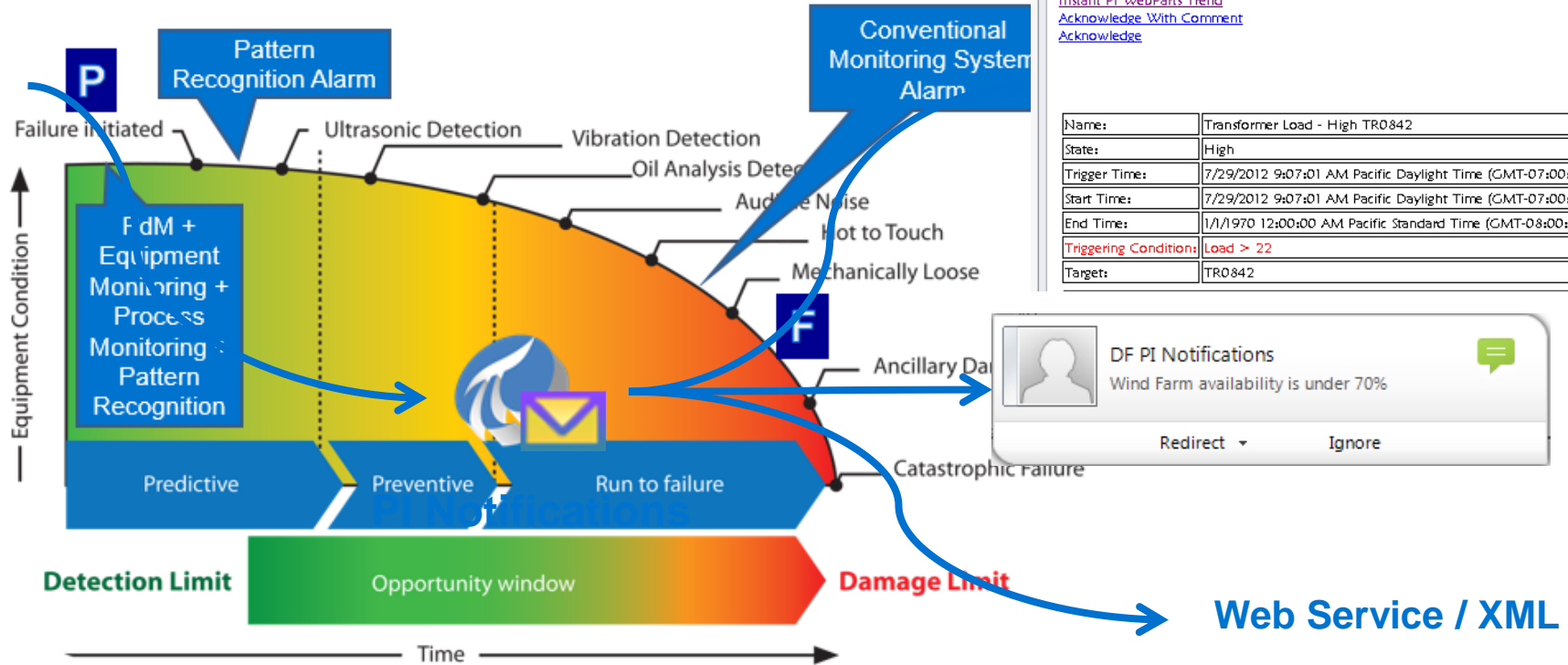


PI DataLink

- Integrates with **Microsoft Excel**
- Enables access to PI System data
- Allows **summary calculations** and **filtering** of the data
- Access to **Excel functionalities**

	A	B	C	D	E
	Du	09-May-2012 09:00			
	Au	10-May-2012 09:00			
Date	BA:CONC.1	BA:LEVEL.1	BA:PHASE.1	BA:TEMP.1	
09-May-2012 09:00:27	43.93	3.60	Phase3	2.12	
09-May-2012 09:00:57	0.00	2.93	Phase3	1.41	
09-May-2012 09:17:27	6.37	11.64	Phase1	10.32	
09-May-2012 09:29:27	19.39	21.89	Phase3	17.91	
09-May-2012 09:52:57	24.68	37.74	Phase4	27.53	
09-May-2012 10:01:27	40.86	34.79	Phase5	46.73	
09-May-2012 10:21:27	44.23	0.16	Phase1	7.09	
09-May-2012 10:21:57	0.00	0.24	Phase1	6.60	
09-May-2012 10:37:27	6.16	10.97	Phase1	8.88	
09-May-2012 10:55:27	23.30	27.33	Phase3	20.18	
09-May-2012 11:17:27	29.37	39.17	Phase4	33.67	
09-May-2012 11:23:27	42.29	35.50	Phase5	45.63	
09-May-2012 11:42:27	46.19	0.47	Phase1	8.45	
09-May-2012 11:42:57	0.00	0.52	Phase1	7.94	
09-May-2012 11:56:57	4.39	6.63	Phase1	6.95	
09-May-2012 12:14:27	21.23	25.19	Phase3	21.46	
09-May-2012 12:34:57	28.39	41.40	Phase4	31.31	
09-May-2012 12:43:57	42.42	40.52	Phase5	45.62	
09-May-2012 13:03:27	46.09	7.94	Phase1	6.73	
09-May-2012 13:03:57	0.00	7.38	Phase1	6.24	
09-May-2012 13:20:27	6.10	12.22	Phase1	12.22	

Trigger-based Notifications



From: PINotAdmin
 To: Mariana Sandin
 Cc:
 Subject: Transformer TR0842. Load is in high alarm

[Instant PI WebParts Trend](#)
[Acknowledge With Comment](#)
[Acknowledge](#)

Name:	Transformer Load - High TR0842
State:	High
Trigger Time:	7/29/2012 9:07:01 AM Pacific Daylight Time (GMT-07:00:00)
Start Time:	7/29/2012 9:07:01 AM Pacific Daylight Time (GMT-07:00:00)
End Time:	1/1/1970 12:00:00 AM Pacific Standard Time (GMT-08:00:00)
Triggering Conditions:	Load > 22
Target:	TR0842

Image from <http://www.emisoftech.com/Site/Solutions/EMICBM.html>

Questions Interlude

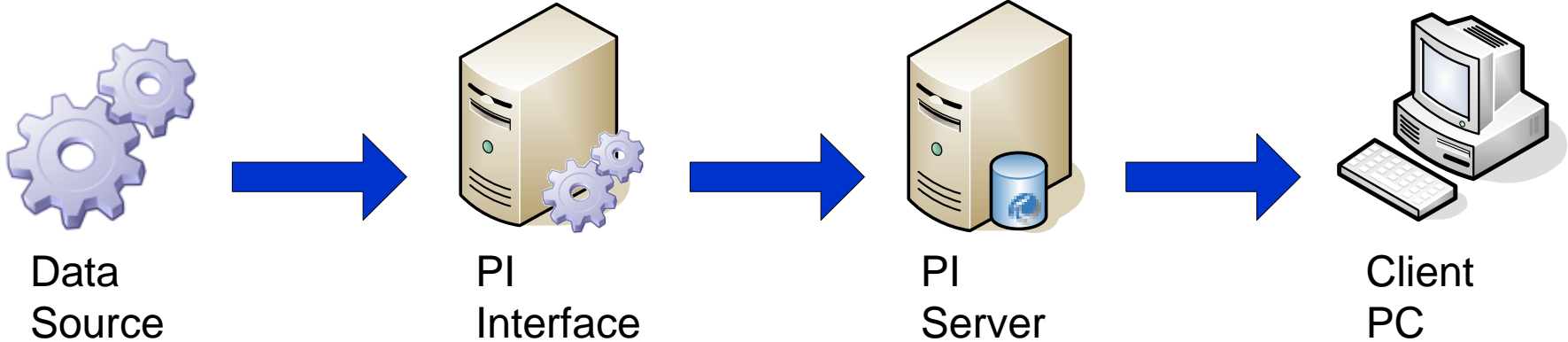
PI System Design & Security



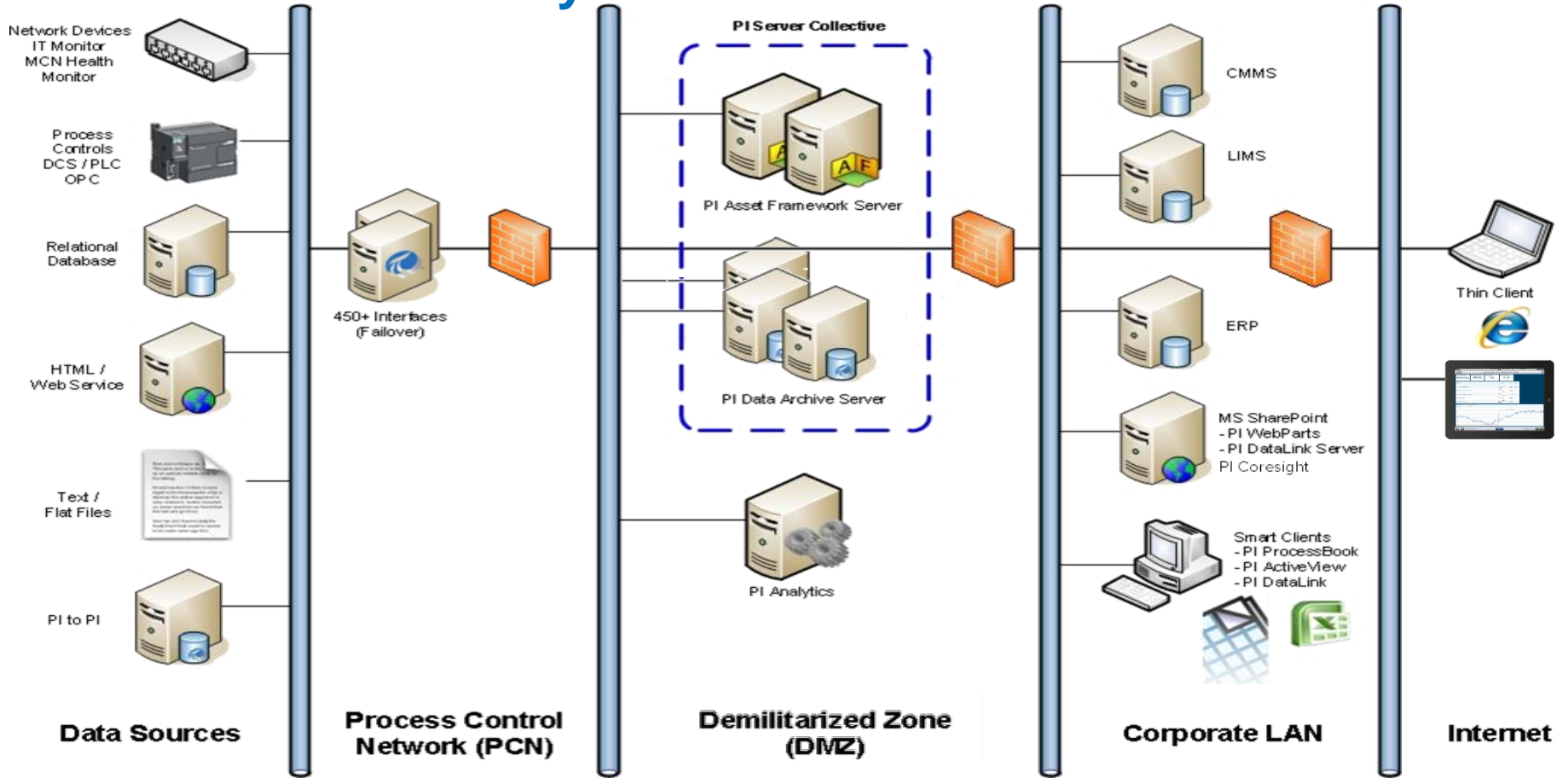
This session: PI Visualizations



Most Academic PI Systems



Most Industrial PI Systems



PI System Infrastructure

