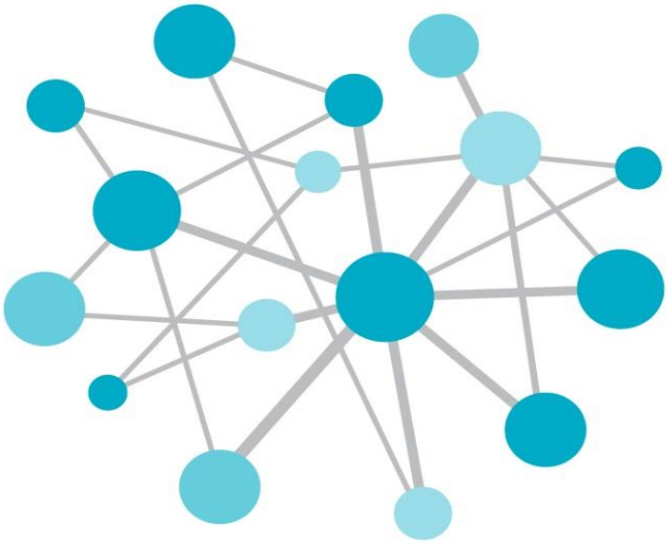


OSIsoft.

FEDERAL WORKSHOP 2014

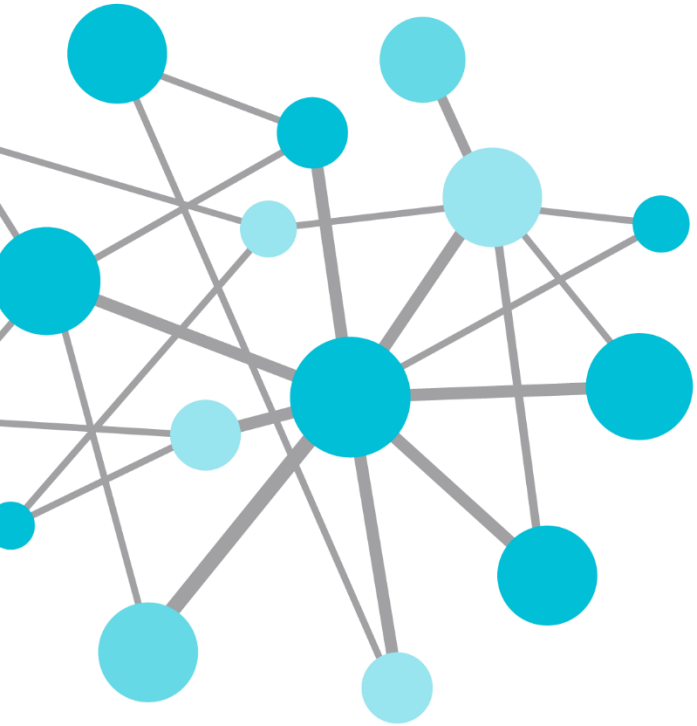
The Power of Data

DECISION READY IN REAL-TIME

Upcoming Federal Workshop:

October 29 - Washington, DC

JW Marriott, Pennsylvania Avenue, NW



Making it Visible

Success Stories from Microsoft, Carnegie Mellon, and UC Davis

Presented by **David Doll**
Strategic Alliance Principal

Background: Making it Visible

Evolution of “Visibility”

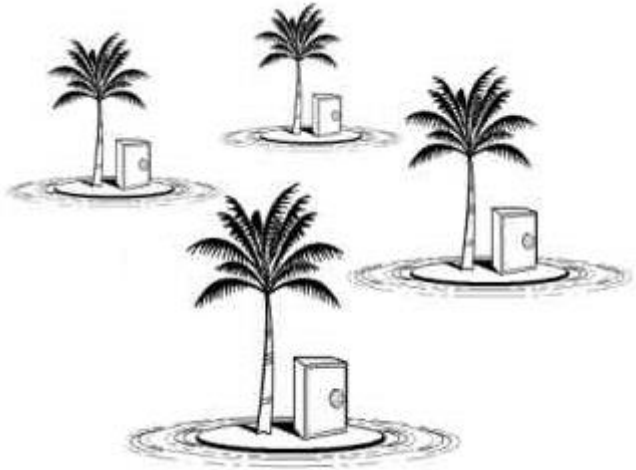
- Analysis after the fact
  - Why was that electric bill so high?
- Real-time analysis of data
  - Fault detection, smarter maintenance
- Predictive Analytics
  - Predictive Decision Making, Intelligent Maintenance

Making it Visible

Islands of data

Solution 1

Solution Ω



Solution B

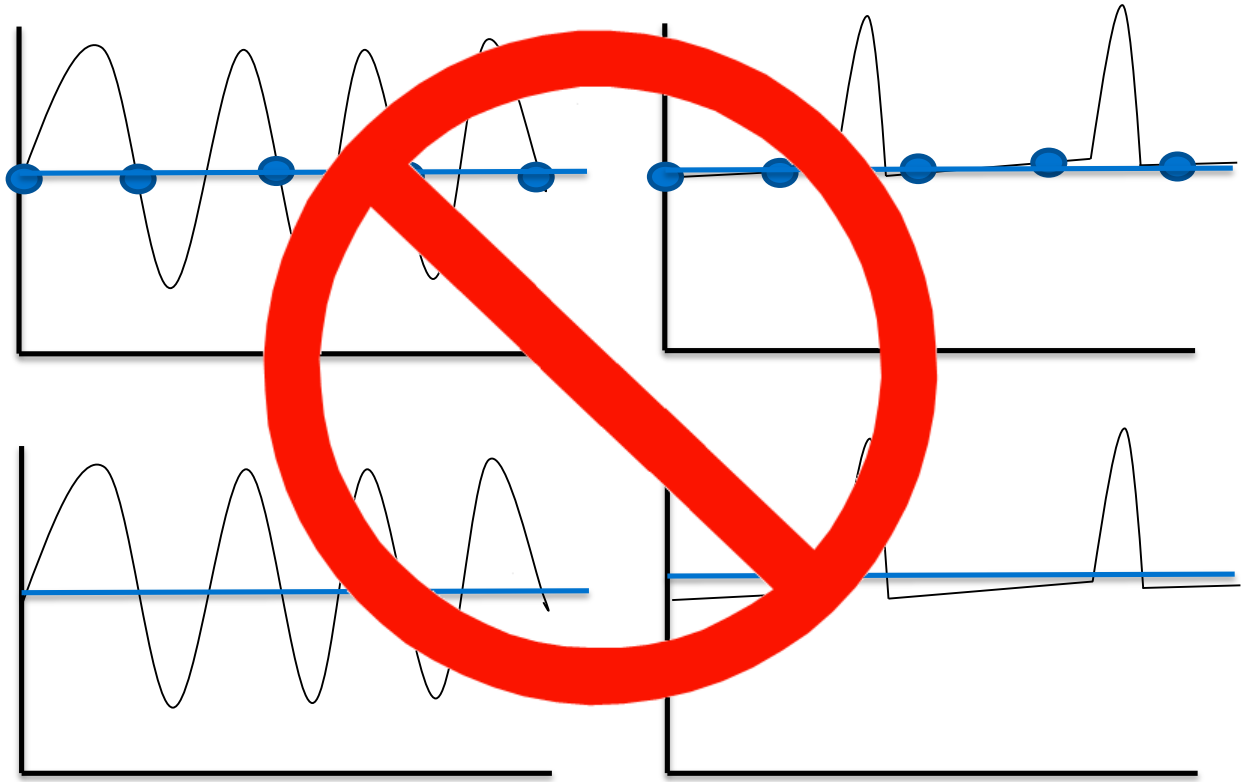
Solution #$%&

Making It Visible

Data that lies to you

Sampling

Averaging



Hiding In Plain Sight

Tables are dead

Sample #	MK1	MK2	MK3	MK4	MK5	MK6	MK7	MK8	MK11	MK12	Mean (n=12)*
Depth m	12	15	21	22	23	24	31	32	41	42	–
SiO_2	11.5	11.1	12.4	10.5	14.4	10.3	9.24	10.1		9.18	14±11
TiO_2	0.04	0.04	0.05	0.08	0.03	0.03	0.02	0.03		0.05	0.04±0.02
Al_2O_3	1.06	0.91	1.08	1.86	0.81	0.76	0.69	0.77	1.74		1.08±0.42
Fe_2O_3	0.42	0.29	0.40	0.93	0.27	0.20	0.11	0.1	0.48		0.04±0.22
MgO	0.46	0.43	0.50	0.89	0.33	0.33	0.30	0.	1.65	0.13	0.60±0.41
CaO	44.1	45.2	43.3	41.2	41.1	46.1	46.4	45	41.0	15.6	1.5±8.4
Na_2O	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0	0.04	0.03	±0.002
K_2O	0.20	0.18	0.20	0.20	0.20	0.20	0.20	0	0.40	0.20	0.30
Mn	108	85	80	77	88	84	99	77	101	96	125
Sr	350	329	211	220	170	188	180	210	130	112	148
Ba	300	300	300	1500	1400	1100	127	249	257	5700	557
Rb	3.0	180	2.0	4.0	3.0	4.0	1.0	2.0	2.0	4.0	3.0
$\delta^{18}O$	-7.61	-7.61	-6.87	-6.74	-6.69	-6.42	-6.15	-6.13	-6.04	-6.16	-6.16
$\delta^{13}C$	1.75	1.82	1.81	1.89	1.92	1.96	1.76	1.85	1.64	1.48	1.34
$^{86}Sr/^{87}Sr$	0.70684	–	–	–	–	–	–	0.70696		–	–
Mn/Sr	0.31	0.26	0.38	0.35	0.52	0.45	0.55	0.37	0.48	0.86	0.84
Sr/Ca	0.0011	0.0010	0.0007	0.0007	0.0006	0.0006	0.0005	0.0006	0.0007		0.0005
Mg/Ca	0.009	0.008	0.01	0.02	0.007	0.006	0.005	0.009	0.013	0.0	
Fe/Sr	8.39	6.16	13.3	29.6	11.1	7.44	4.27	5.00	9.60	25.8	

In Support of Generate and Sustain Integrated Forces ($ Thousands)	Current Estimated Cost	Cumulative Spending to March 31, 2008	Planned Spending 2008–2009	Forecast Spending 2009–2010	Forecast Spending 2010–2011	Future Years Requirements
...s/Utilities (Co... PI)	60,627	1,635	7,500	14,500	3,921	33,071
British C...						
Esquimalt - Fl... Breton (PI)	262,210	120,070	38,000	44,000	45,000	15,140
Esquimalt - Pat Bay 443 MH Squadron (OA)	152,940	0	2,800	1,200	16,000	132,940
New Brunswick						
Gagetown - Utilities Upgrade (PD/PI)	30,680	19,781	4,400	12,910	16,198	27,391
Newfoundland						
St John's - Pleasantville Consolidation (PD)	0,500	2,300	12,700	23,500	30,000	32,000
Ontario						
...ingston - RMC ...itories (PI)	69,826	44,204	1,130	9,618	14,874	–
... Joint ...tation Ce... (PI)	64,076	1,886	20,000	20,000	22,190	–
Trento... Relocatio...	381,132	4,365	24,748	17,004	65,200	269,815
Kingst... P...	144,965	4,419	4,576	28,893	22,077	85,000
...SE ...mmodation Phase 1 (PD)	70,121	841	12,400	15,870	32,950	8,060

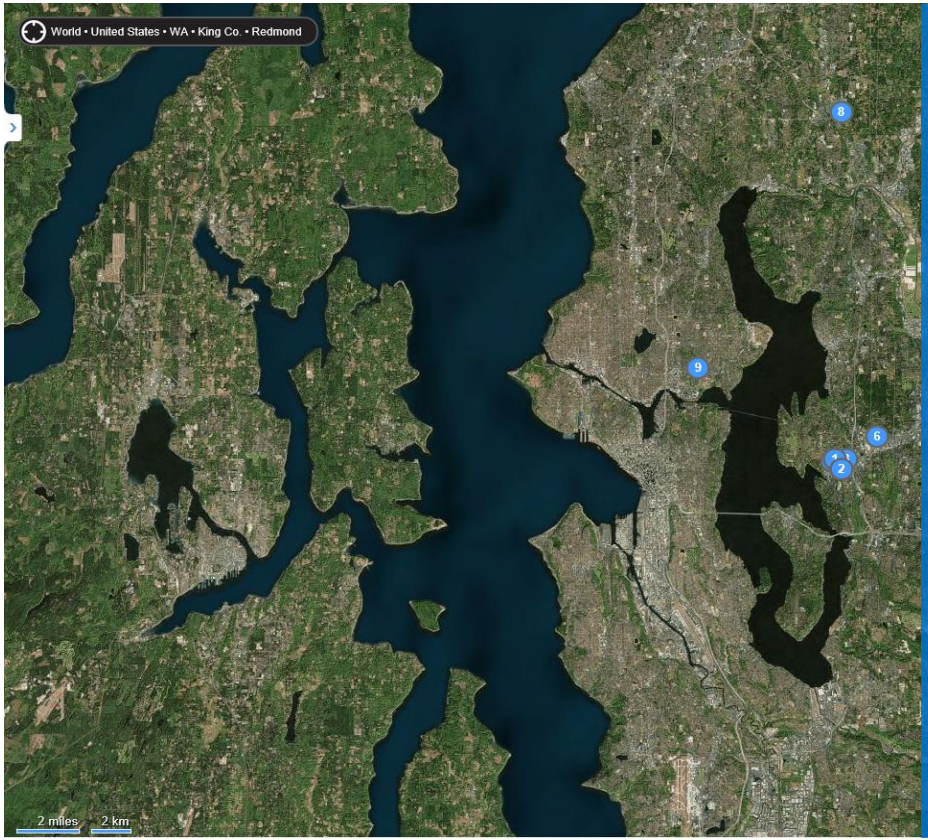
The Goal:

Turn Invisible Into Visible

Microsoft's Energy-Smart Buildings

Darrell D. Smith
Director of Energy and Building Technology
Real Estate and Facilities

Puget Sound Campus



145 Structures

15M ft² Office & lab space

500 Acres

Multiple Disparate building systems

100 Megawatt peak

$60M Annual utility spend

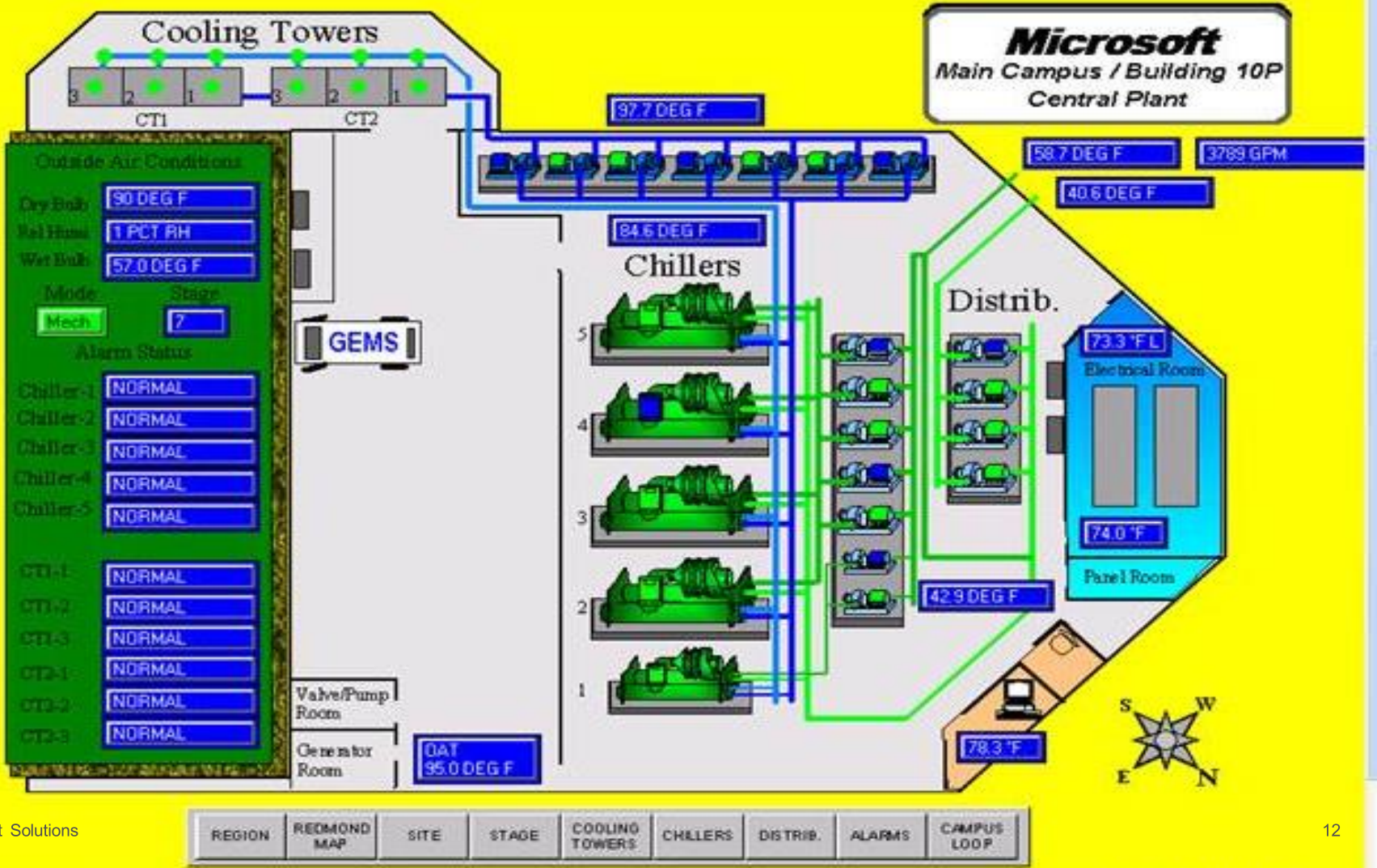
2M connection points

Connecting systems

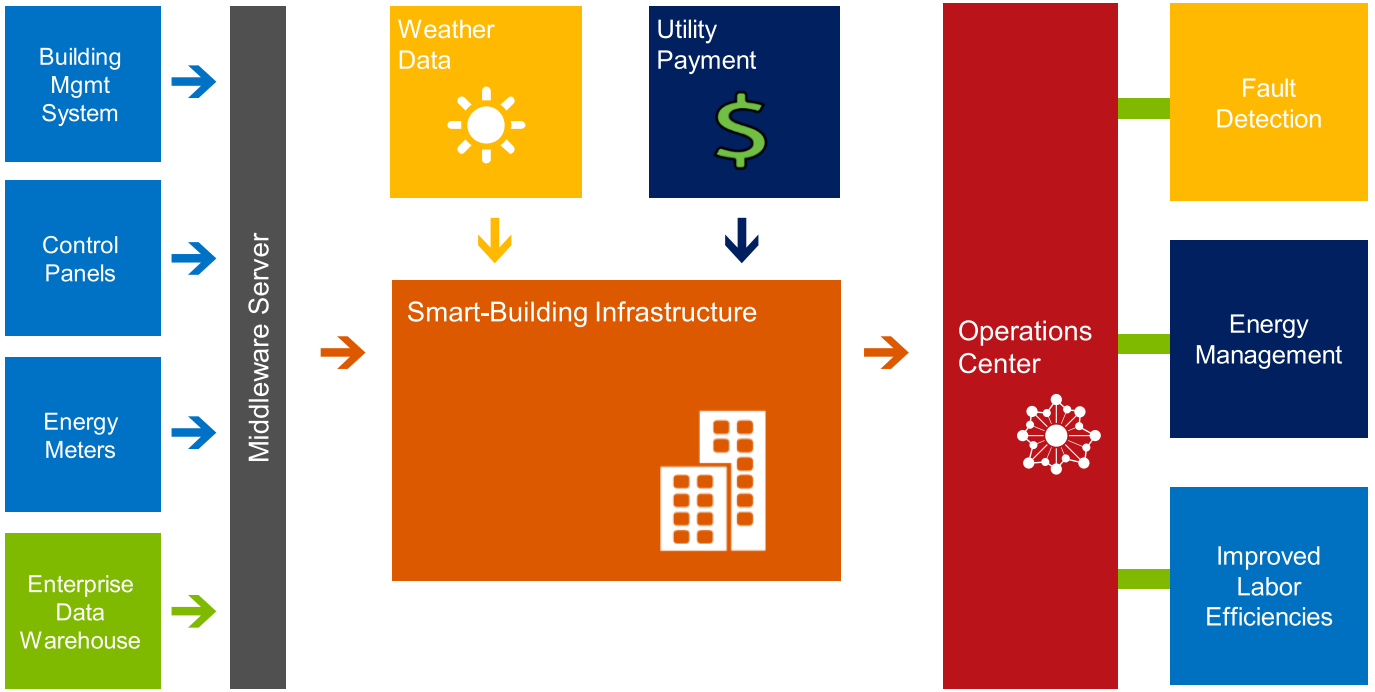
Fire/life safety	Security	Access
Elevators	Lighting	Energy
24/7 Monitoring	HVAC	Comms

Increase Building Efficiency

- Easier system coordination
- Lower energy consumption
- Reduced cost


Cooling Towers
CT1
CT2
Microsoft
Main Campus / Building 10P
Central Plant
97.7 DEG F
58.7 DEG F
3789 GPM
40.6 DEG F
84.6 DEG F
Chillers
Distrib.
Outside Air Conditions
Dry Bulb
90 DEG F
Rel Humi
1 PCT RH
Wet Bulb
57.0 DEG F
Mode
Mech
Stage
7
Alarm Status
GEMS
Chiller-1 NORMAL
Chiller-2 NORMAL
Chiller-3 NORMAL
Chiller-4 NORMAL
Chiller-5 NORMAL
CT1-1 NORMAL
CT1-2 NORMAL
CT1-3 NORMAL
CT2-1 NORMAL
CT2-2 NORMAL
CT2-3 NORMAL
Valve/Pump Room
Generator Room
OAT
95.0 DEG F
73.3 °F L
Electrical Room
74.0 °F
Panel Room
42.9 DEG F
78.3 °F
S
W
E
N
REGION
REDMOND MAP
SITE
STAGE
COOLING TOWERS
CHILLERS
DISTRIB.
ALARMS
CAMPUS LOOP

Architecture



Microsoft

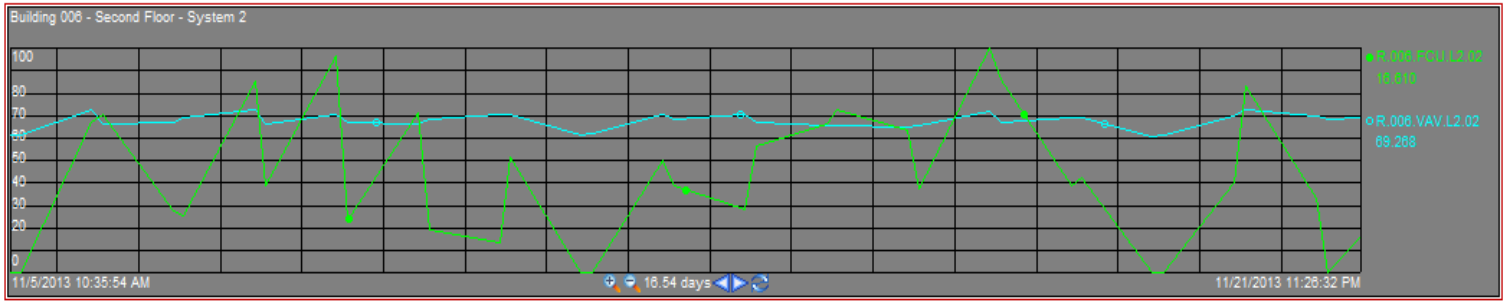
RE&F | Redmond | Redmond - Main | Redmond - Main - 006

Redmond Campus - Main - Building 6 - L2.02

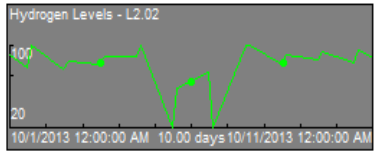
FCU

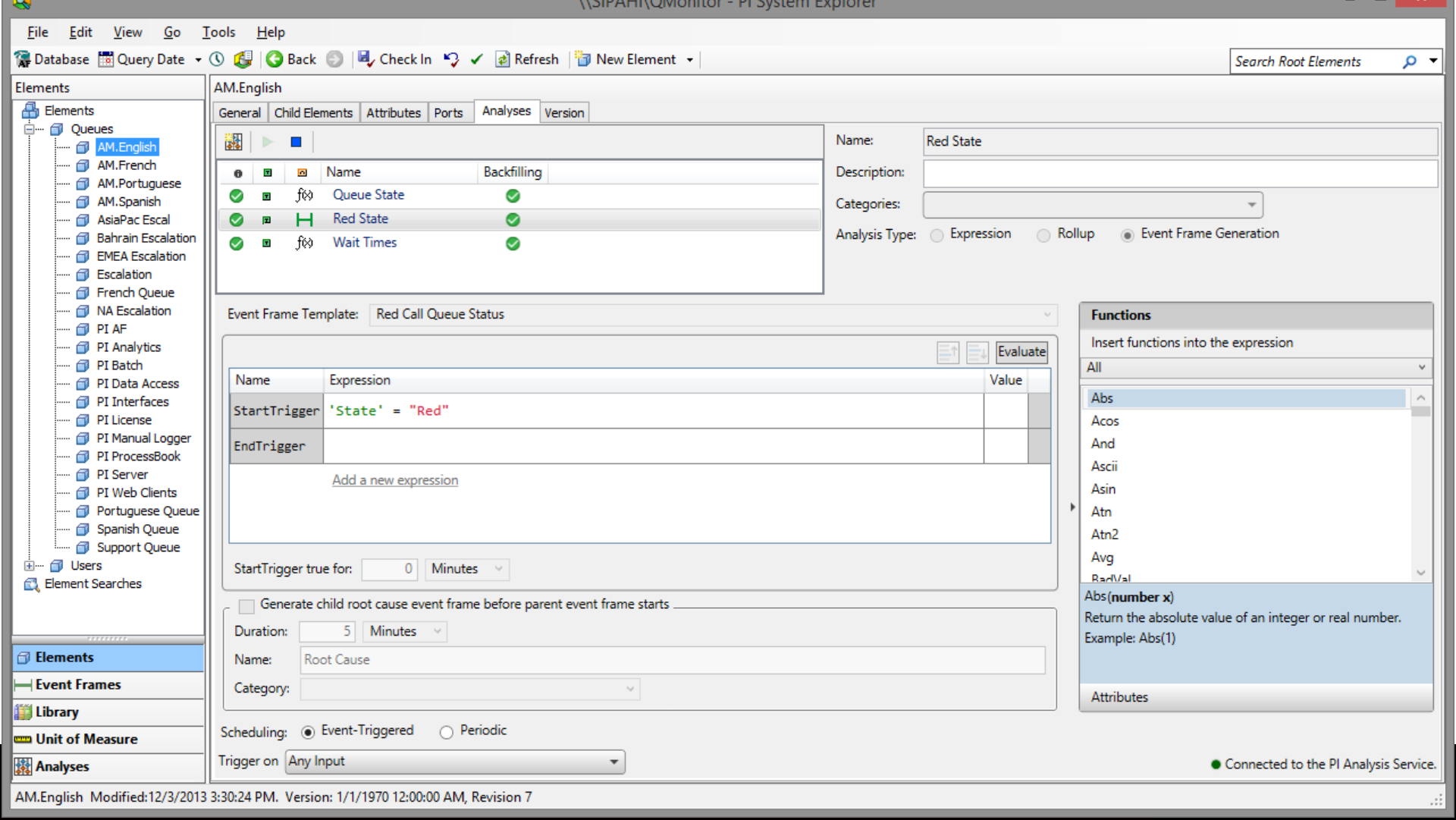
VAV

Ad-hoc Analytics

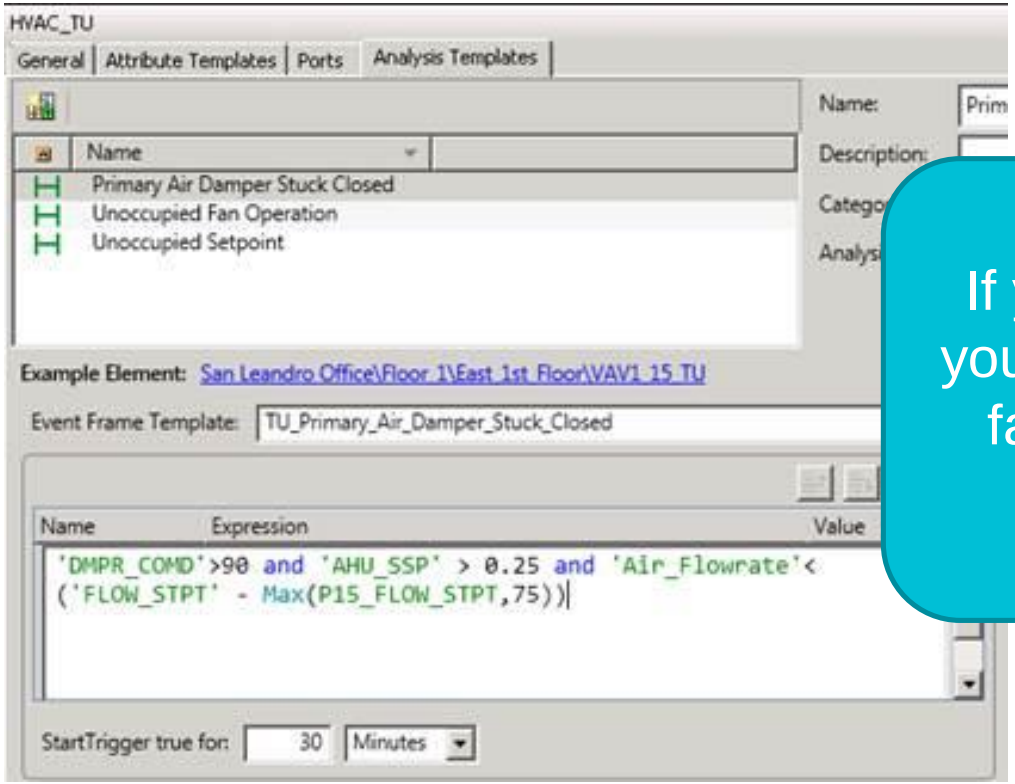


R.006.VSVAV.L2.01 69.7423	R.006.VSVAV.L2.15 77	R.006.VSVAV.L2.31 67.7	R.006.VSVAV.L2.45 66.4	
R.006.VSVAV.L2.02 65.9841	R.006.VSVAV.L2.16 79.3	R.006.VSVAV.L2.32 67.3	R.006.VSVAV.L2.46 88	
R.006.VSVAV.L2.03 65.2246	R.006.VSVAV.L2.17 65.6	R.006.VSVAV.L2.33 69.6	R.006.VSVAV.L2.47 65.8	
R.006.VSVAV.L2.04 82.5354	R.006.VSVAV.L2.19 66.2	R.006.VSVAV.L2.34 65.3	R.006.VSVAV.L2.48 69	
R.006.VSVAV.L2.05 82.8	R.006.VSVAV.L2.20 62.9	R.006.VSVAV.L2.35 64.5	R.006.VSVAV.L2.50 70.3	
R.006.VSVAV.L2.06 67.4	R.006.VSVAV.L2.22 65	R.006.VSVAV.L2.36 67.1	R.006.VSVAV.L2.51 65.4	R.006.VSVAV.L2.61 70
R.006.VSVAV.L2.07 68.2	R.006.VSVAV.L2.23 61	R.006.VSVAV.L2.37 75.8	R.006.VSVAV.L2.52 69	R.006.VSVAV.L2.62 68.3
R.006.VSVAV.L2.08 77.4	R.006.VSVAV.L2.24 63.5	R.006.VSVAV.L2.38 65	R.006.VSVAV.L2.53 70.3	R.006.VSVAV.L2.63 65.5
R.006.VSVAV.L2.09 81.3	R.006.VSVAV.L2.25 67.7	R.006.VSVAV.L2.39 64.3	R.006.VSVAV.L2.54 65.5	R.006.VSVAV.L2.64 65.7
R.006.VSVAV.L2.10 236.5	R.006.VSVAV.L2.26 69.6	R.006.VSVAV.L2.40 67.7	R.006.VSVAV.L2.55 69.6	R.006.VSVAV.L2.65 68.1
R.006.VSVAV.L2.11 73.4	R.006.VSVAV.L2.27 70.1	R.006.VSVAV.L2.41 64.7	R.006.VSVAV.L2.56 69.4	R.006.VSVAV.L2.66 68.3
R.006.VSVAV.L2.12 93.1	R.006.VSVAV.L2.28 64.4	R.006.VSVAV.L2.42 66.4	R.006.VSVAV.L2.58 68.3	R.006.VSVAV.L2.67 71.3
R.006.VSVAV.L2.13 61.7	R.006.VSVAV.L2.29 67.9	R.006.VSVAV.L2.43 64.5	R.006.VSVAV.L2.59 67	R.006.VSVAV.L2.68 68.1
R.006.VSVAV.L2.14 68.3	R.006.VSVAV.L2.30 67.5	R.006.VSVAV.L2.44 69.2	R.006.VSVAV.L2.60 67.9	R.006.VSVAV.L2.69 64.1




\\SIPAHI\QMonitor - PI System Explorer
File Edit View Go Tools Help
Database Query Date Back Check In Refresh New Element
Search Root Elements
Elements
Elements
Queues
AM.English
AM.French
AM.Portuguese
AM.Spanish
AsiaPac Escal
Bahrain Escalation
EMEA Escalation
Escalation
French Queue
NA Escalation
PI AF
PI Analytics
PI Batch
PI Data Access
PI Interfaces
PI License
PI Manual Logger
PI ProcessBook
PI Server
PI Web Clients
Portuguese Queue
Spanish Queue
Support Queue
Users
Element Searches
Elements
Event Frames
Library
Unit of Measure
Analyses
AM.English
General Child Elements Attributes Ports Analyses Version
Name Backfilling
Queue State
Red State
Wait Times
Name: Red State
Description:
Categories:
Analysis Type: Expression Rollup Event Frame Generation
Event Frame Template: Red Call Queue Status
Evaluate
Name Expression Value
StartTrigger 'State' = "Red"
EndTrigger
Add a new expression
StartTrigger true for: 0 Minutes
Generate child root cause event frame before parent event frame starts
Duration: 5 Minutes
Name: Root Cause
Category:
Scheduling: Event-Triggered Periodic
Trigger on Any Input
Functions
Insert functions into the expression
All
Abs
Acos
And
Ascii
Asin
Atn
Atn2
Avg
Abs(number x)
Return the absolute value of an integer or real number.
Example: Abs(1)
Attributes
Connected to the PI Analysis Service.
AM.English Modified:12/3/2013 3:30:24 PM. Version: 1/1/1970 12:00:00 AM, Revision 7

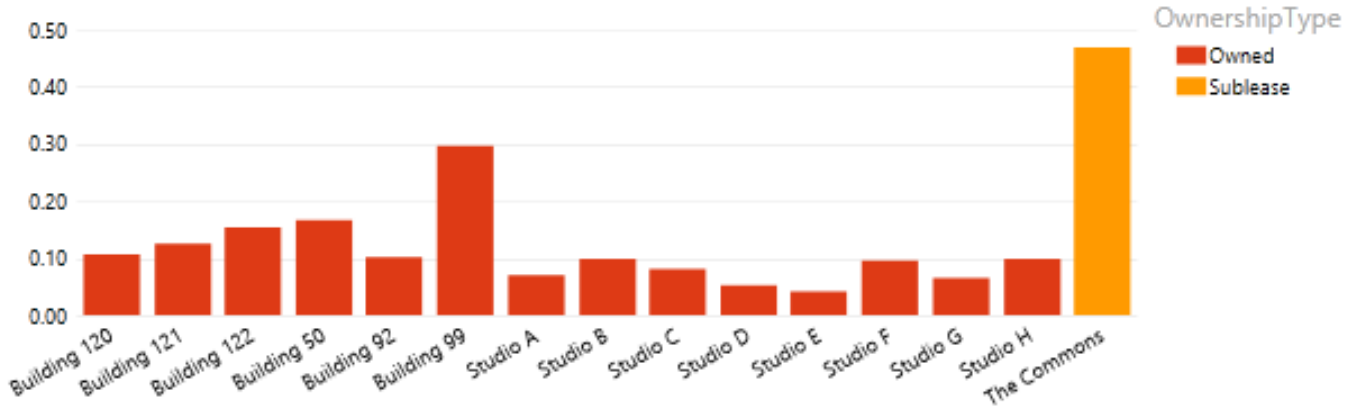
FDD with PI System Analytics

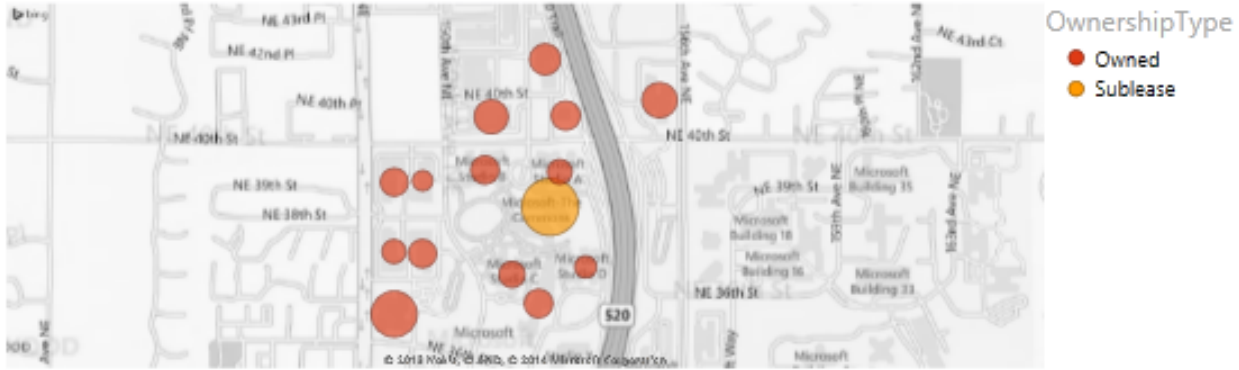


If you can use Excel, you can create alarms, fault detection, and custom analytics

Water Cost per SqFt

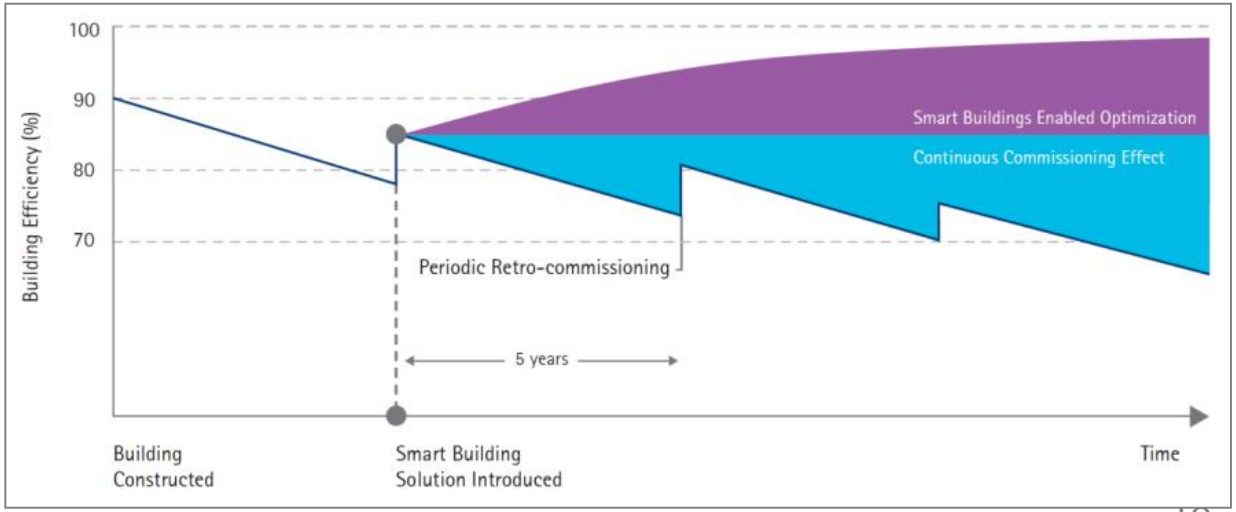
East | Remote | West



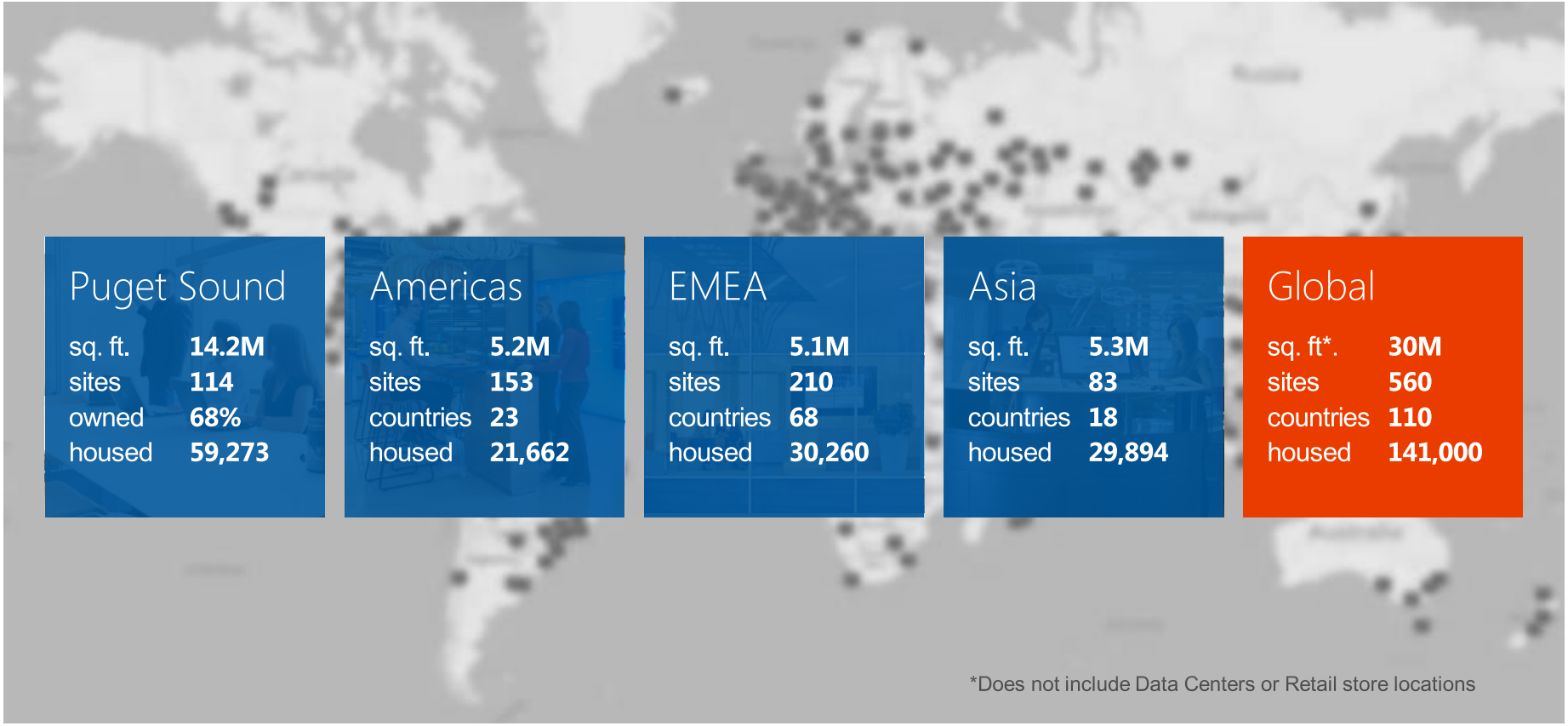


Results

- Replaces 5-year manual retro-commissioning cycle
- Payback in less than 2 years
- Shift from Analysts to Engineers
- >80% of issues resolved without sending a truck



Worldwide Real Estate Fleet



Building Intelligent Solutions

RE&F Summary

- Puget Sound Campus = vast set of buildings, equipment, and systems
- Using software as the common infrastructure
- Configurable FDD and Analytics
- Evolution from Reactive to Proactive maintenance
- Expanding to other systems and other campuses
- Goal to move toward user engagement

Carnegie Mellon University

Smart Campus, Smart City

Bertrand Lasternas
Researcher
Center for Building Performance and
Diagnostic, School Of Architecture

Background: Carnegie Mellon University

Founded in 1900 by Andrew Carnegie

12,991 Students (6223 undergrad)

5000 faculty / staff

CMU annual energy budget over $20M

That's over $1,600 per year per student!

Goal:

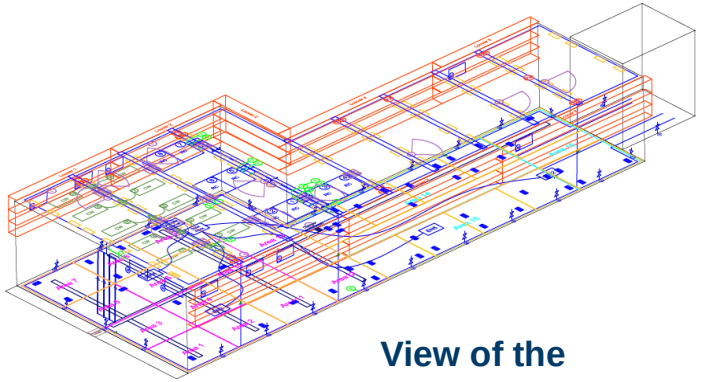
Improve by 30%

The Intelligent Workplace

The Robert L. Preger Intelligent Workplace, built in 1997, is a 7000 square foot living laboratory of office environments and innovations located on the campus of Carnegie Mellon University.

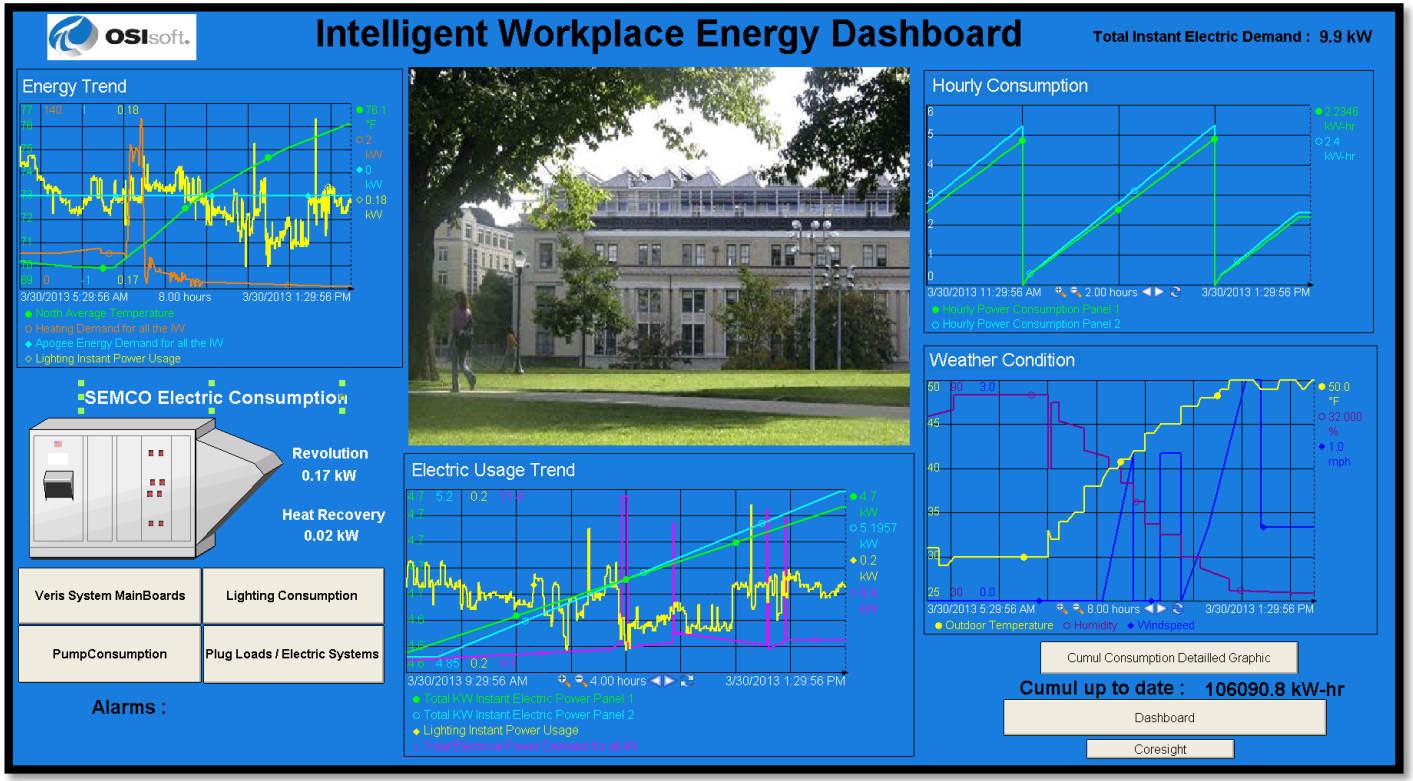
Test and Integration of several systems:

- **Heating**
- **Cooling**
- **Ventilation (mechanical and natural)**
- **Lighting, and day-lighting**
- **Electrical / Plug load**

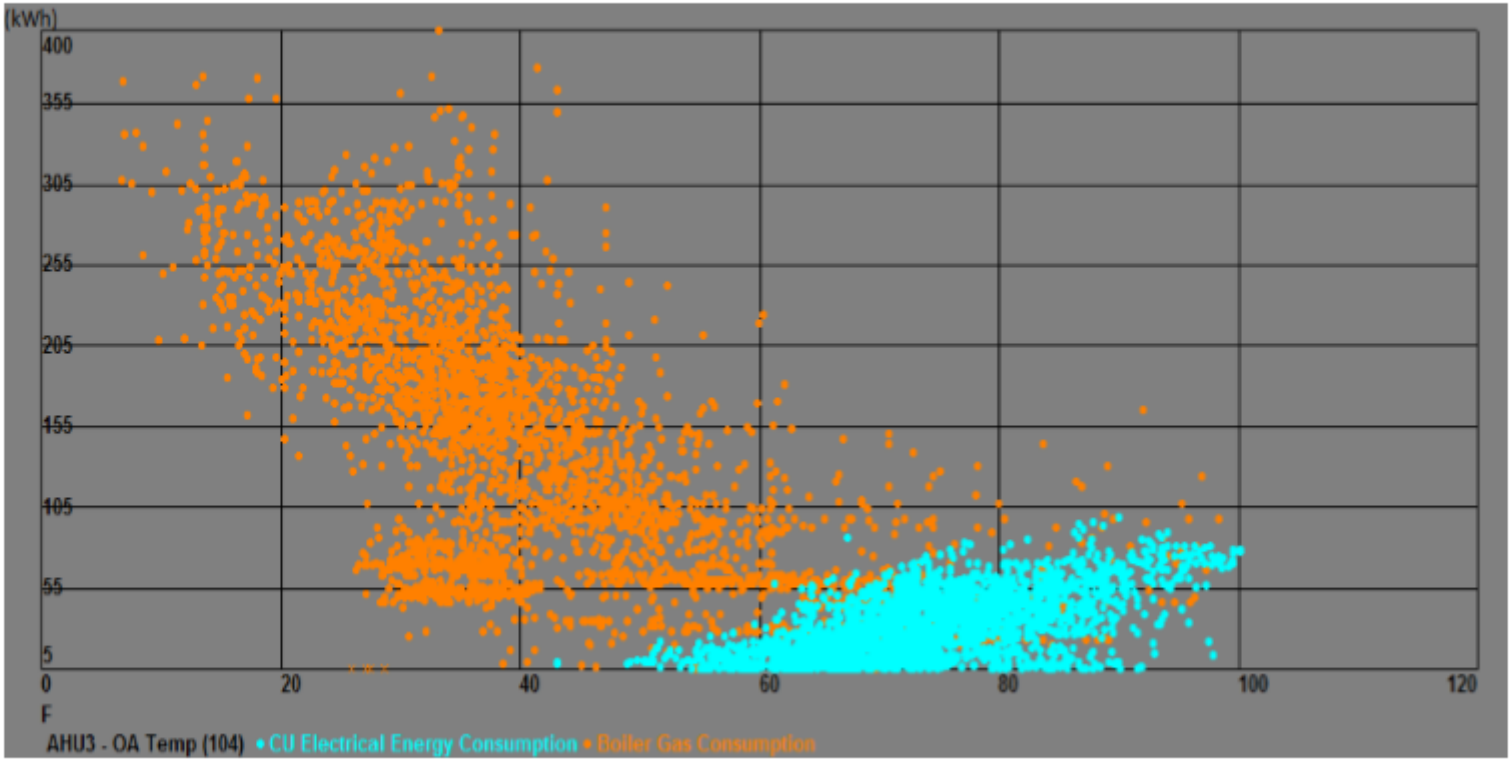


View of the sensors/actuators density 1500+

Facility Manager Interfaces



(ID-F) Data Analytics



Real Time Measured data for meaningful diagnostics

Public Interface

Real-time Dashboard on Touchscreen Displays

What we learned?

Integrate ALL information	Continuously monitor and diagnose building performance	Information needs to be accessible to the consumers (public, faculty, students)	Building occupants need control in order to change behaviors

Reduced Energy Consumption by 30%

Microsoft sees new Azure tool as a proactive trouble-shooter

Microsoft envisions a future where systems can predict malfunctions in devices and buildings before they occur. First step: a cloud-base beta in July.

by Charles Cooper @coo

Carnegie Mellon has been experimenting with the technology to collect sensor data from different buildings to measure water and energy use. "Within a couple of hours, they were able to connect streaming data that previously would have taken days and weeks, and now they could do it within hours for fault detection and diagnosis," said Prabal Acharyya of OSIsoft, an application developer who worked on this project with Microsoft. "It's a leapfrog development."

Summary

- CMU needed to reduce energy cost
- To do that, they needed visibility
- Lessons learned:
  - Integrate ALL information: Data and Context
  - Continuously monitor
  - Make it accessible and visible
  - Empower people with the ability to influence outcome

For More Information

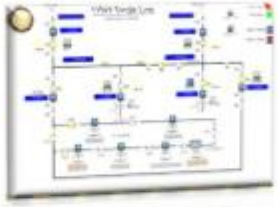
- Case Study on Microsoft.com
  - http://www.microsoft.com/casestudies/Case_Study_Detail.aspx?CaseStudyID=710000003921
- OSIsoft User Conference Presentation
  - http://www.osisoft.com/templates/item-abstract.aspx?id=11029
- Azure Machine Learning
  - http://www.cnet.com/news/microsoft-azure-predictive-machine-learning-beta-proactive-troubleshooter/

A Robust Data Management System for Integrating Campus Sustainability Goals

Presented by **Joshua Morejohn, PE**
David Trombly, PhD

UCDAVIS

UC Davis PI System



Substation Metering

Building Utility Metering

Heating & Cooling Plant Operations

HVAC Operations & Smart Thermostats

PI System

Water & Wastewater Operations

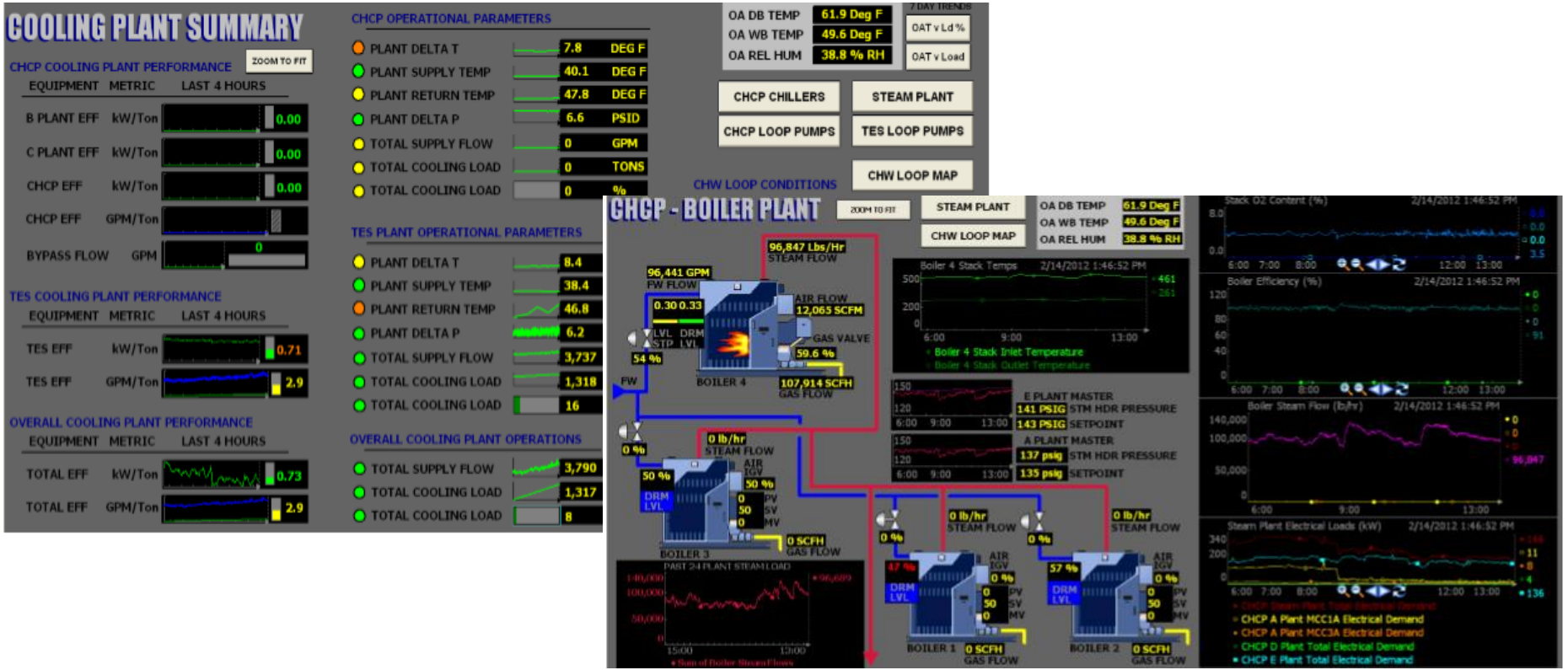
Interior Lighting & Occupancy

Exterior Lighting Controls

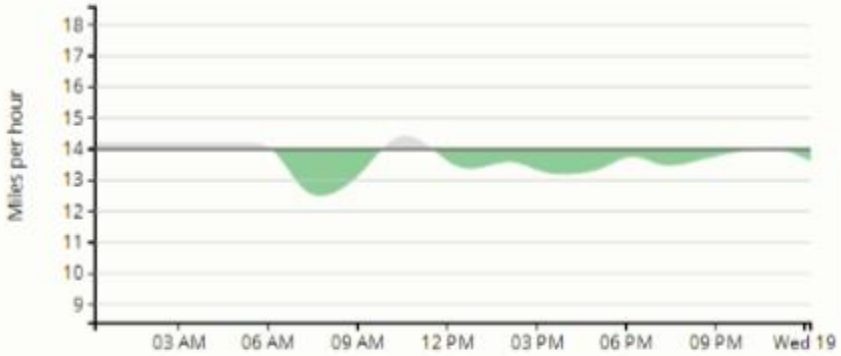
Building Level

Campus Level

Early Phases: Asset Efficiency and Operations



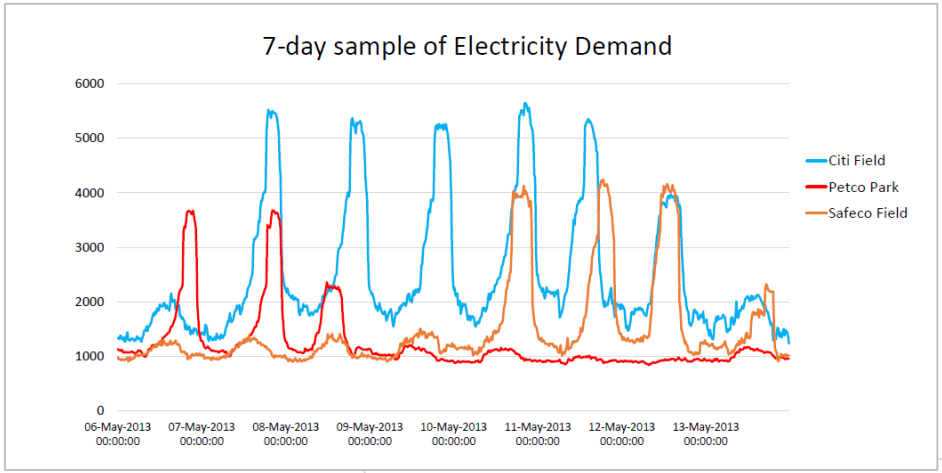
This graph is a comparison of your current energy demand and your daily goal. If your energy demand is below your goal and the area on the graph is green, you're doing great!

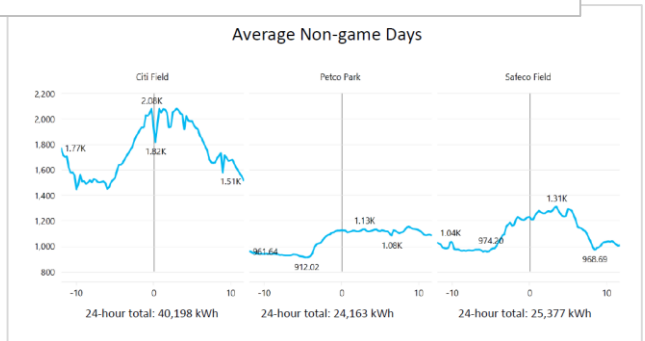


Other Case Studies

MLB: Self Service Intelligence

Insight into the simple things; like how much does it cost to open the roof?





"My PI System data feeds right into the Major League Baseball centralized data collection system that's tracking my water, gas, and electric and it's automated. ***That's going to enable 29 other teams to adopt the kind of behavior that's helped us return more than $1.5 million to our bottom line in just 4 years."***

- Scott Jenkins, VP Operations Seattle Mariners

PI System: A base for our Sustainability Goals

Part of our Sustainibility program "Brewing a Better Future"
is to reduce water and energy consumption in our

Results

Seville Brewery

	2010	2011	2012	LE'13	2014	2015
Volume produced kHL	4.113	4.091	3.888	3.778	4.000	4.100
Water Consumption (Hl / Hl)	4,08	3,84	3,74	3,60	3,58	3,55
Efficiency Savings (kHL)	1.399	982	389	529	80	123
Electricity Consumption (kWh/Hl)	7,67	7,62	7,49	7,30	7,28	7,25
Efficiency Savings (MWh)	329	205	505	718	80	123

Reducing 85%

and Benefits

- Continued progress water and energy efficiency of our brewery
- Achieve World Class Excellence
- Become the Benchmark

- Implemented The PI System as Energy&Water Monitoring and Reporting System
- Energy & Water Management

- Quick a
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- Anticipa
- Cost sa
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Reducing 89%

Wrap-up

What did we cover?

- Evolving from Invisible to Visible
  - Moving from Reactive to Proactive
  - Being able to see the past and the present in order to influence the future
- Avoid Islands of Data with a Data Infrastructure approach
  - Collect ALL of your data
  - Store ALL of your data
  - Use data in ways that are meaningful to you
  - Get creative in ways they resonate with each unique audience
- Analytics and Visualization are perpetually getting easier
  - With a data infrastructure, you can enable future ideas

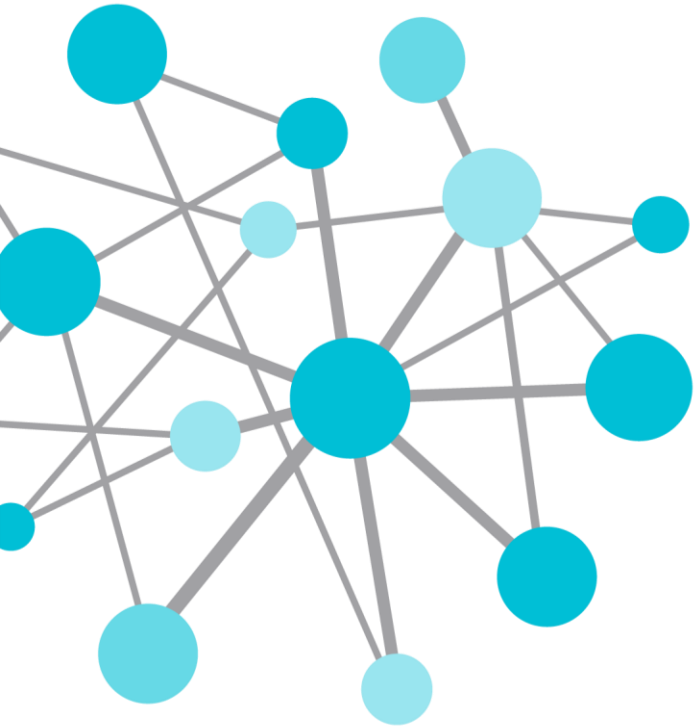
Contact Info

David Doll

ddoll@osisoft.com

Strategic Alliance Principal

OSIsoft, LLC



THANK YOU

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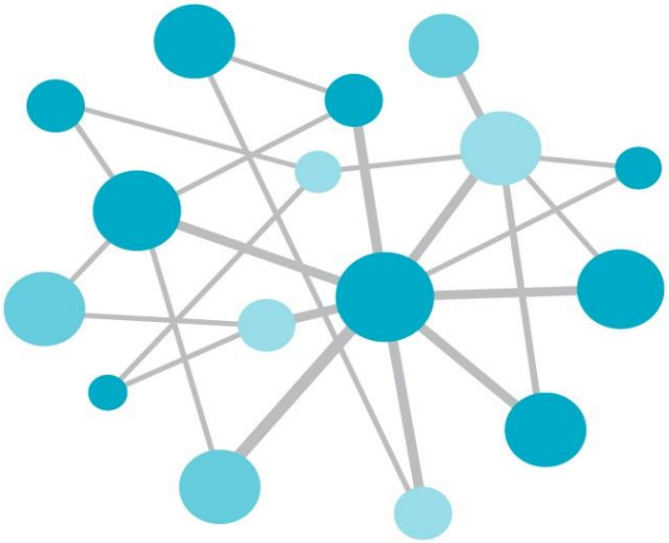

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The Power of Data

DECISION READY IN REAL-TIME

Upcoming Federal Workshop:

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