Energy-Smart Campus Operations
MAKING INFORMED DECISIONS

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MacDonald-Miller
FACILITY SOLUTIONS

ENERGY-SMART CAMPUS OPERATIONS
MAKING INFORMED DECISIONS

Energy Smart Buildings

Visualize real-time energy dashboards, scorecards and building metrics to make fast decisions by connecting devices, systems and people. Turn **Big Data** into actionable information.

Fault Detection and Analytics

Analyze and predict equipment faults with real-time continuous commissioning solutions. Reduce energy costs and improve occupant comfort levels with Fault Detection and Diagnostics **(FDD)**.

Mobile Productivity

Mobilize your work force and deliver information to smartphones, tablets or browsers. Using an **Azure**-based cloud solution, securely connect to building metrics, anytime, anywhere.

Building Automation & Network Design Principles

Information Dashboards & Mobility

Fault Detection, Diagnostics & Reports

Utility & Carbon Emissions Management

System Integrator Qualifications

Case Studies

King County

- We spend ~$28,000,000 on natural gas and electricity annually

- Facilities encompass a large geographic area

- 350+ facilities totaling more than 6 million square feet

- Wide variety of facility types

- Wide range of ages amongst assets

- Disparate metering and building operating systems

King County's Path Forward

Our pathway towards meeting the future energy consumption targets…

Main Action Areas

1. Construction / Engineered Improvements and Building Renovations

2. Optimizing Existing Building Systems

3. Production & Operational Practice Changes

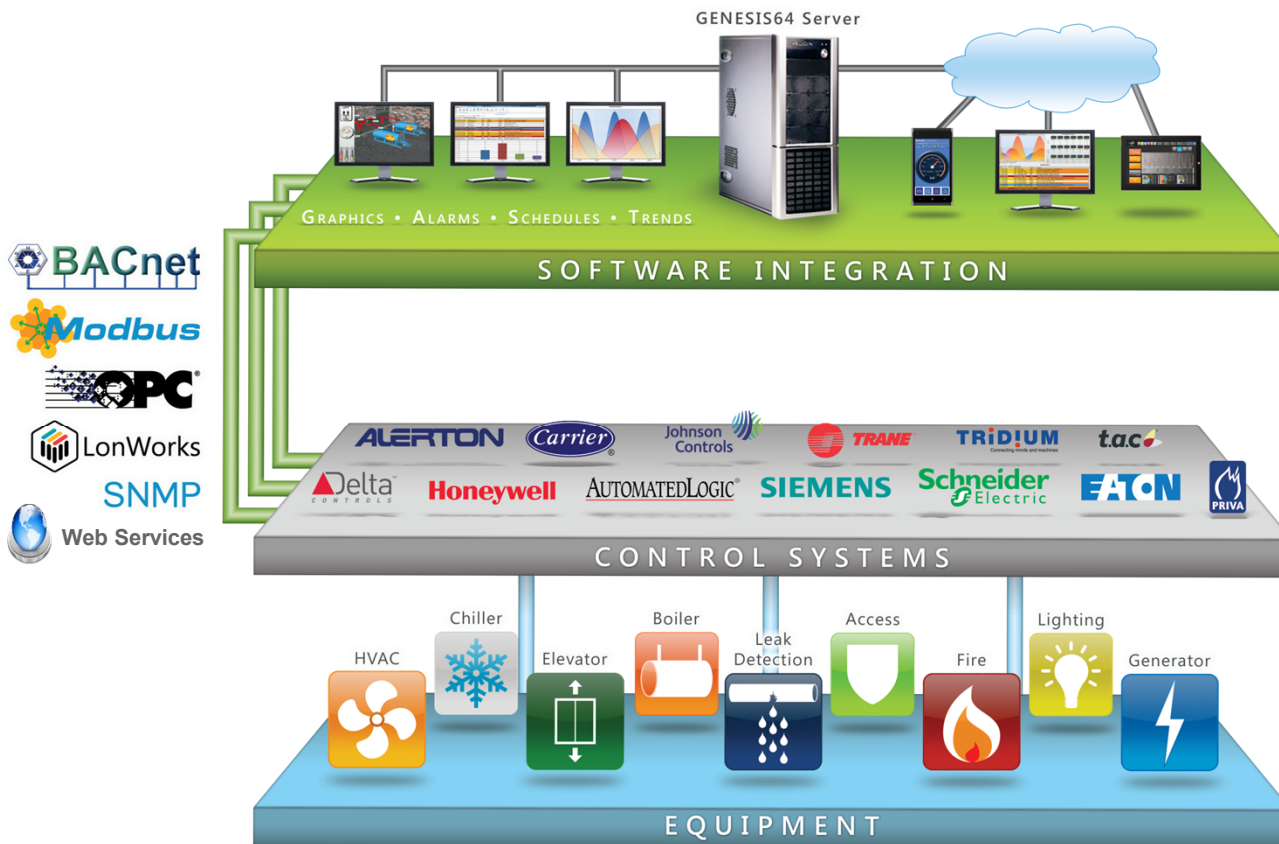4. Employee Education and Involvement

King County's Pilot Program

Smart Campus Solutions

- Bridges all 4 action areas, large geography, disparate systems, connectivity & data management

- Leverages existing people and assets
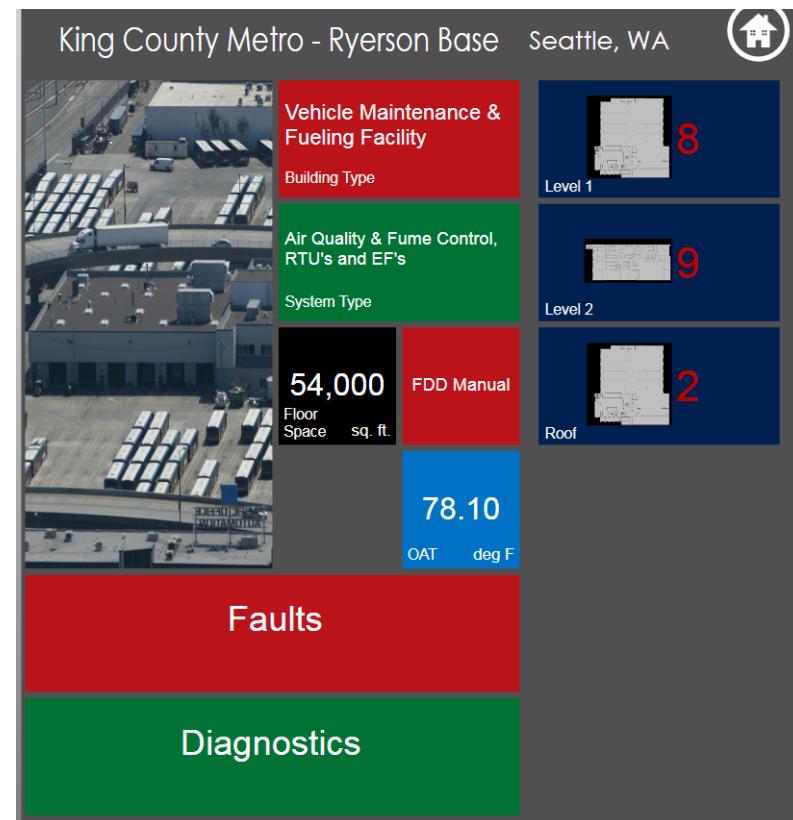
CONNECTING TO ALL OPERATIONAL
BUILDING & BUSINESS SYSTEMS

Unrestricted licensing

Embedded programming and engineering tools

Multiple integration pathways via industry recognized protocols and published APIs

SMNP & Web Services support for IT network integration & custom application development
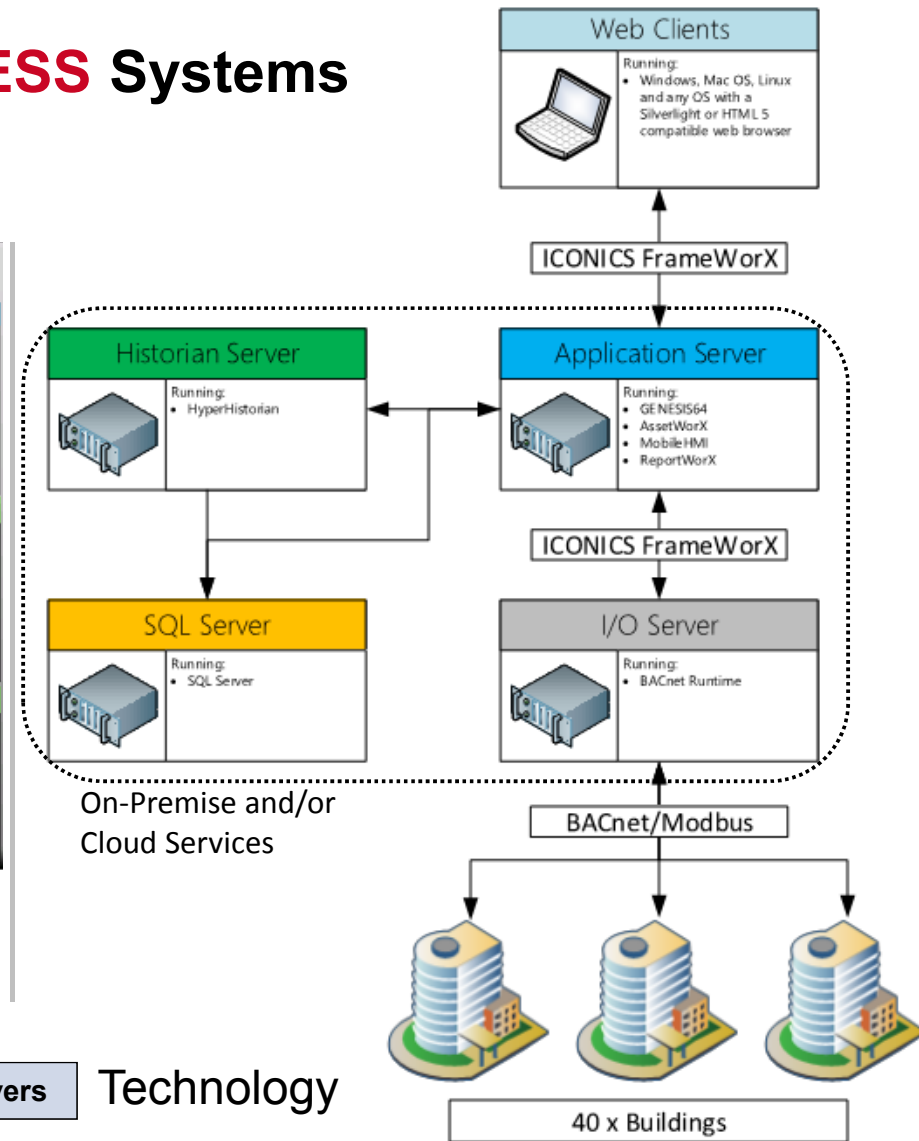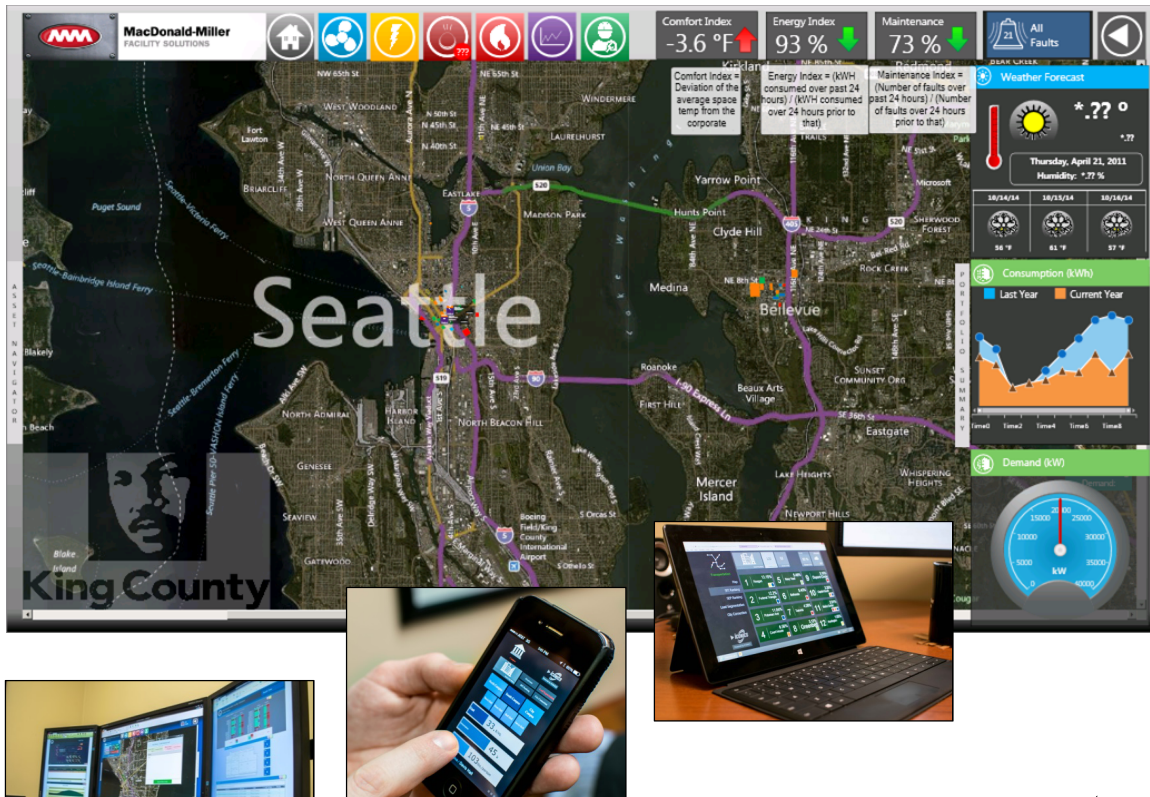
Open Database Connectivity (ODBC) compliant

Access to corporate & local training and technical support

Adherence to rigorous data security policies

Connecting To All BUILDING & BUSINESS Systems

IoT INTERSECTS BUILDING INTELLIGENCE

Building Intelligence ← delivers ← Technology

Web Clients

Running:
- Windows, Mac OS, Linux and any OS with a Silverlight or HTML 5 compatible web browser

ICONICS FrameWorX

Historian Server

Running:
- HyperHistorian

Application Server

Running:
- GENESIS64
- AssetWorX
- MobileHMI
- ReportWorX

ICONICS FrameWorX

SQL Server

Running:
- SQL Server

I/O Server

Running:
- BACnet Runtime

On-Premise and/or Cloud Services

BACnet/Modbus

40 x Buildings

INFORMATION DASHBOARDS
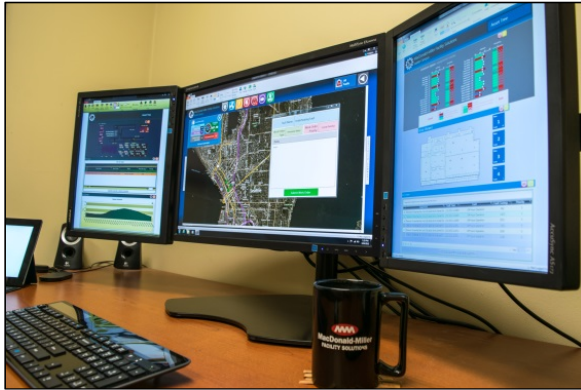
MANAGE WHAT YOU CAN'T SEE…

ANYTIME, ANYWHERE, AT ANY LEVEL

INFORMATION DASHBOARDS
WHENEVER & WHEREVER YOU NEED IT
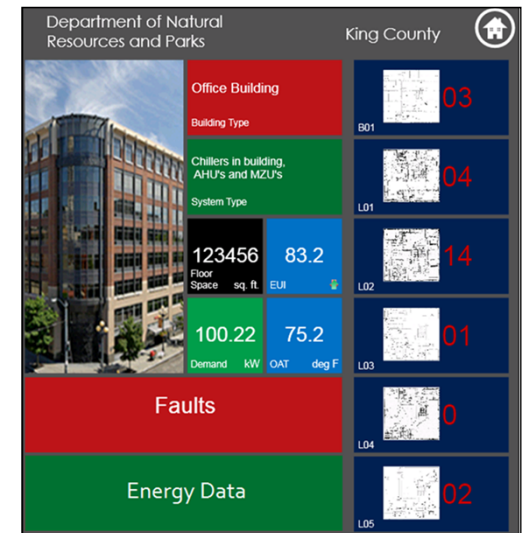
Information Dashboards	
Flexible construction of a building specific dashboard	✔
Support the integration of Building Operations, Continuous Monitoring, Historical trending, and Energy data, into any customer defined dashboard	✔
User specific/user group specific information display and/or owner dashboard customization	✔
Allowance for connecting information to a GIS system (ESRI, BING, Google)	✔
Capable of connection or link to operations and maintenance documentation	✔
Determination of key performance indicators (KPIs)	✔

Mobility	
Accessible by mobile and tablet technology (Apple, Microsoft, Google, Amazon)	✔
Accessible via all current Web Browser platforms	✔
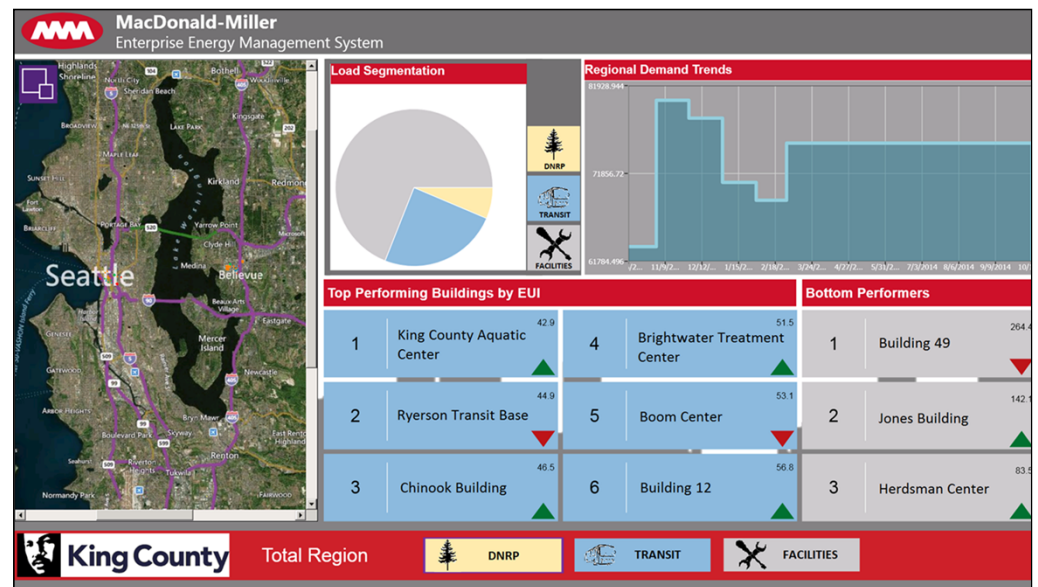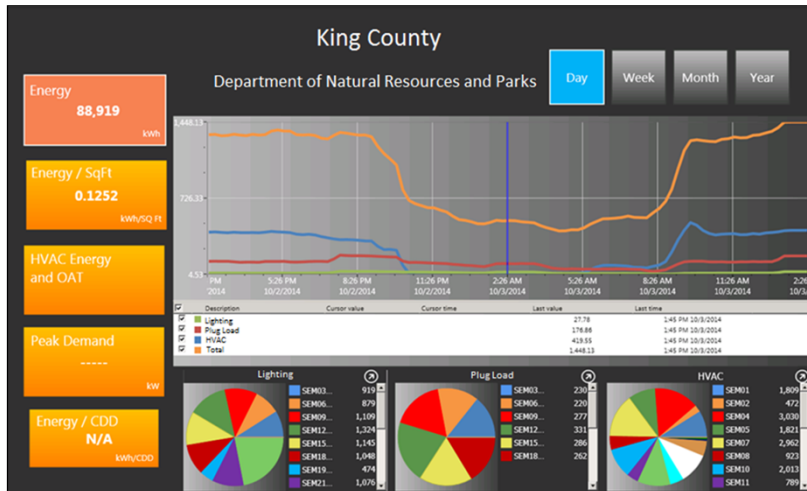
INFORMATION DASHBOARDS
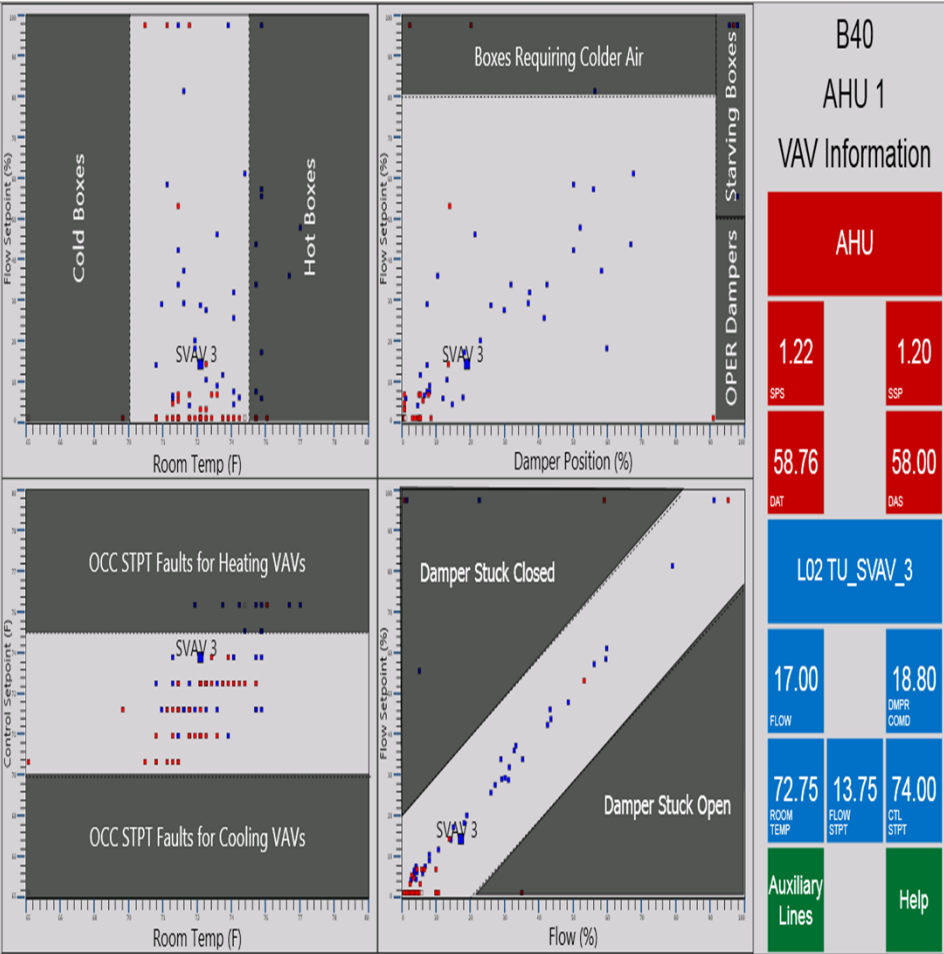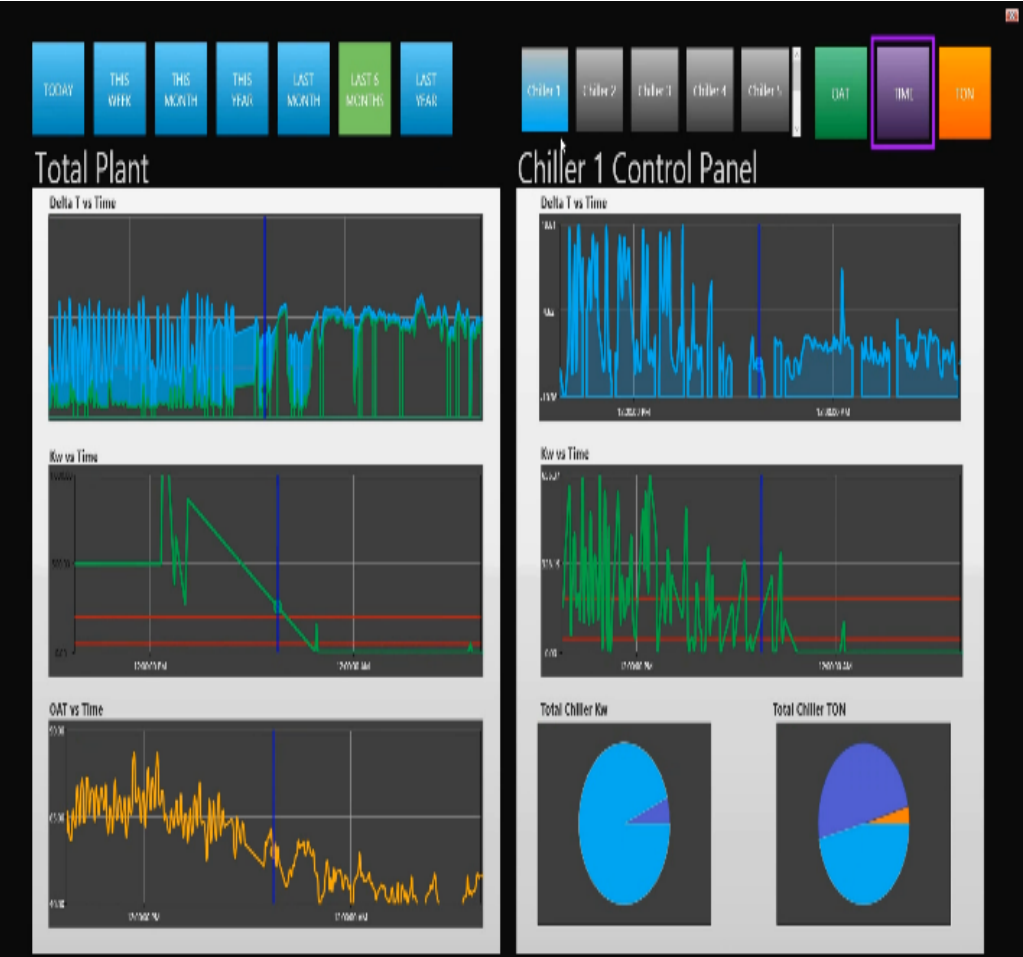
FAULTDETECTION

INFORMATIVE REPORTS

Technician's MobileHMI

Edison North

Top 10 Faults

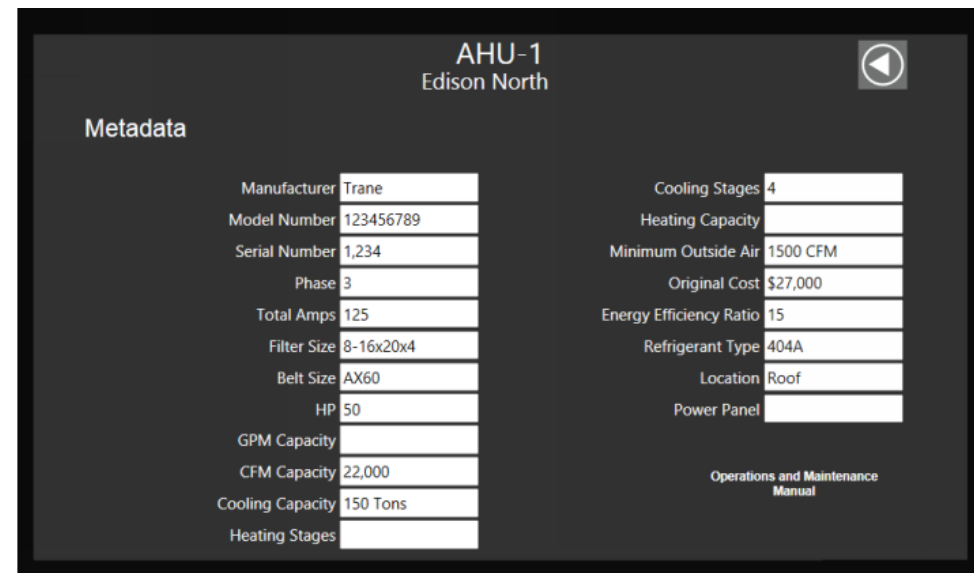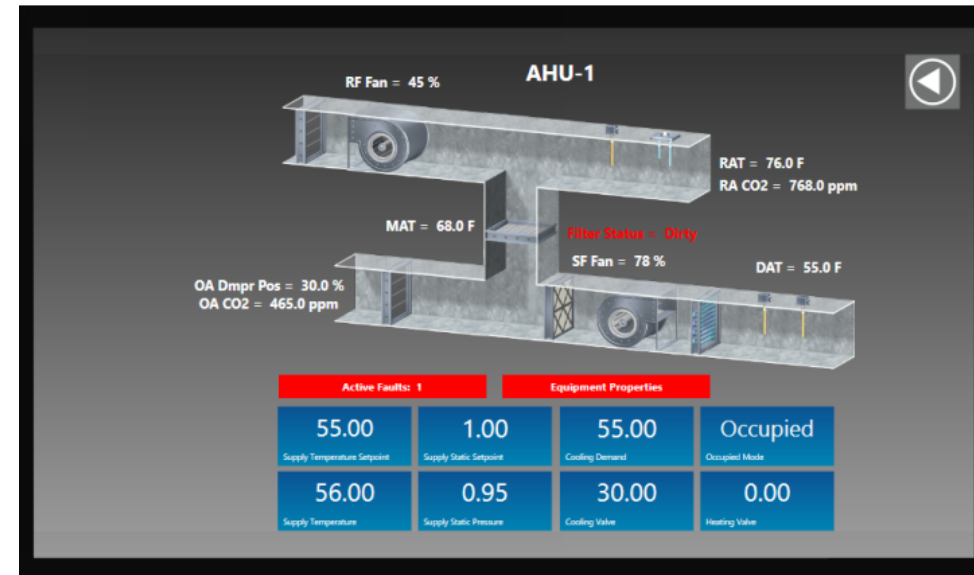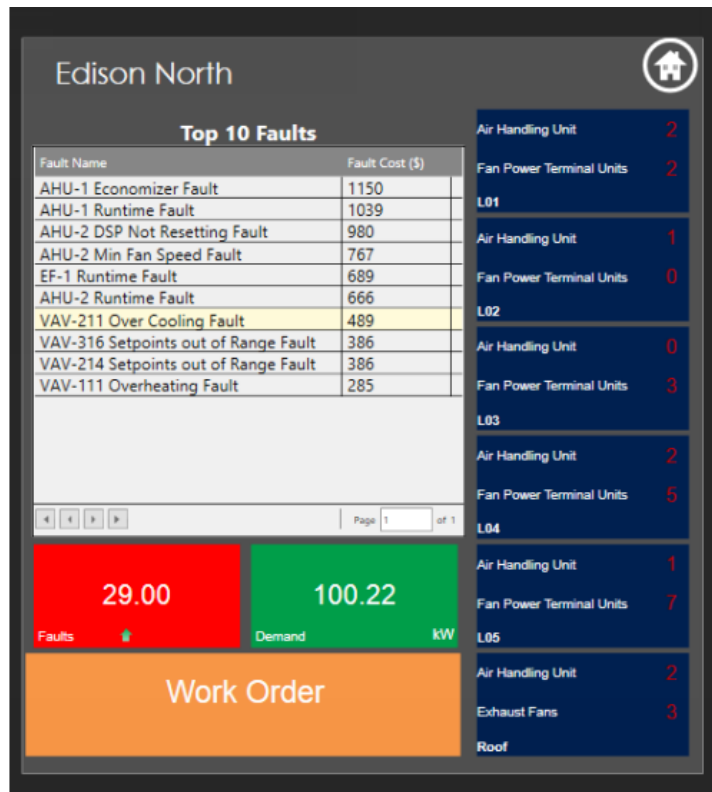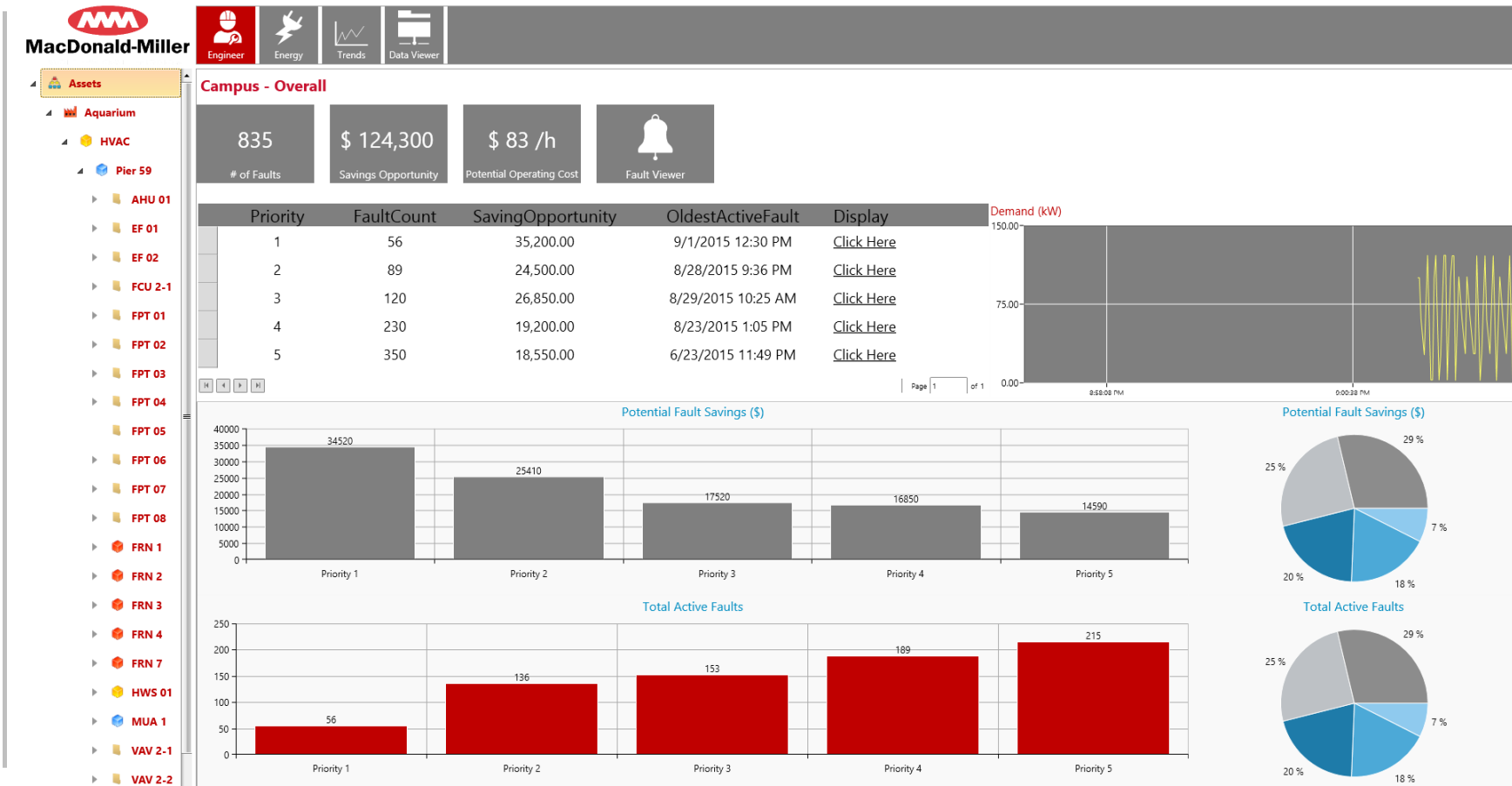| Fault Name	Fault Cost ($)
AHU-1 Economizer Fault	1150
AHU-1 Runtime Fault	1039
AHU-2 DSP Not Resetting Fault	980
AHU-2 Min Fan Speed Fault	767
EF-1 Runtime Fault	689
AHU-2 Runtime Fault	666
VAV-211 Over Cooling Fault	489
VAV-316 Setpoints out of Range Fault	386
VAV-214 Setpoints out of Range Fault	386
VAV-111 Overheating Fault	285

Page 1 of 1

29.00	100.22
Faults	Demand kW

Work Order

L01
Air Handling Unit 2
Fan Power Terminal Units 2

L02
Air Handling Unit 1
Fan Power Terminal Units 0

L03
Air Handling Unit 0
Fan Power Terminal Units 3

L04
Air Handling Unit 2
Fan Power Terminal Units 5

L05
Air Handling Unit 1
Fan Power Terminal Units 7

Roof
Air Handling Unit 2
Exhaust Fans 3

AHU-1

RF Fan = 45 %
RAT = 76.0 F
RA CO2 = 768.0 ppm
MAT = 68.0 F
Filter Status = Dirty
SF Fan = 78 %
DAT = 55.0 F
OA Dmpr Pos = 30.0 %
OA CO2 = 465.0 ppm

Active Faults: 1		Equipment Properties	
55.00	1.00	55.00	Occupied
Supply Temperature Setpoint	Supply Static Setpoint	Cooling Demand	Occupied Mode
56.00	0.95	30.00	0.00
Supply Temperature	Supply Static Pressure	Cooling Valve	Heating Valve

AHU-1
Edison North

Metadata

Manufacturer	Trane	Cooling Stages	4
Model Number	123456789	Heating Capacity	
Serial Number	1,234	Minimum Outside Air	1500 CFM
Phase	3	Original Cost	$27,000
Total Amps	125	Energy Efficiency Ratio	15
Filter Size	8-16x20x4	Refrigerant Type	404A
Belt Size	AX60	Location	Roof
HP	50	Power Panel	
GPM Capacity			
CFM Capacity	22,000		
Cooling Capacity	150 Tons		
Heating Stages			

Operations and Maintenance Manual

FAULTDETECTION
INFORMATIVE REPORTS

FAULTDETECTION
INFORMATIVE REPORTS

FAULTDETECTION

EMPOWERING FACILITY TEAMS WITH
KNOWLEDGE BY MAKING THE INVISIBLE VISIBLE

Know what is broken before a technician is deployed

- Effectively utilize and assign staff
- Have the right tools for the job, the first time
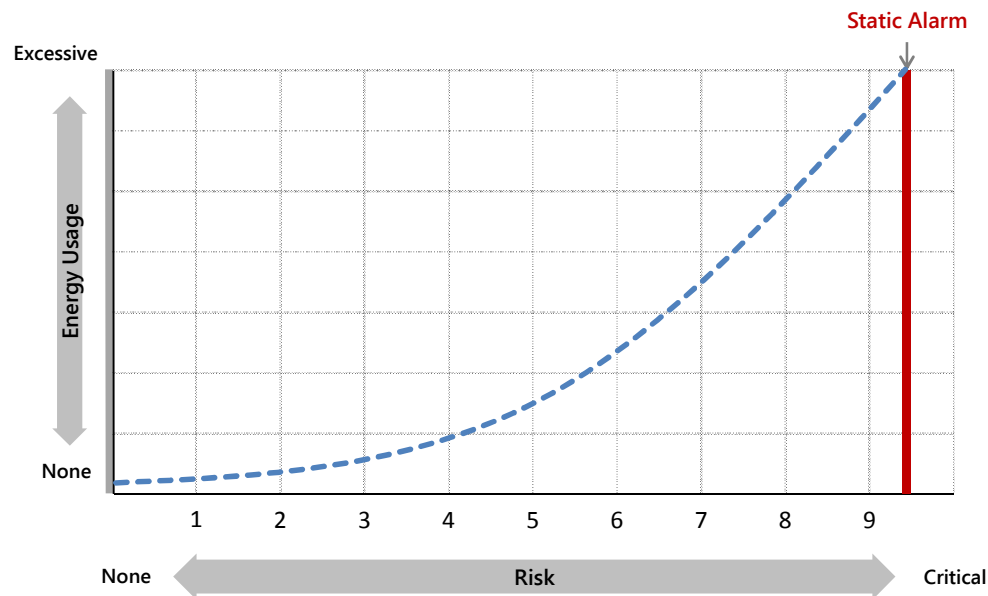
Prioritize repairs by monetary assessment

- Is there is a need to perform maintenance ahead of schedule?
- Is it time to replace the equipment?

ALARMS vs FAULTS

TRADITIONAL BAS ALARMS

ACTIVATE WHEN SYSTEMS REACH CRITICAL STATUS

Fault Diagnostic:
None

Static BAS Alarm:
Low MA Temperature

Space Temp:

70° F

Static Alarm
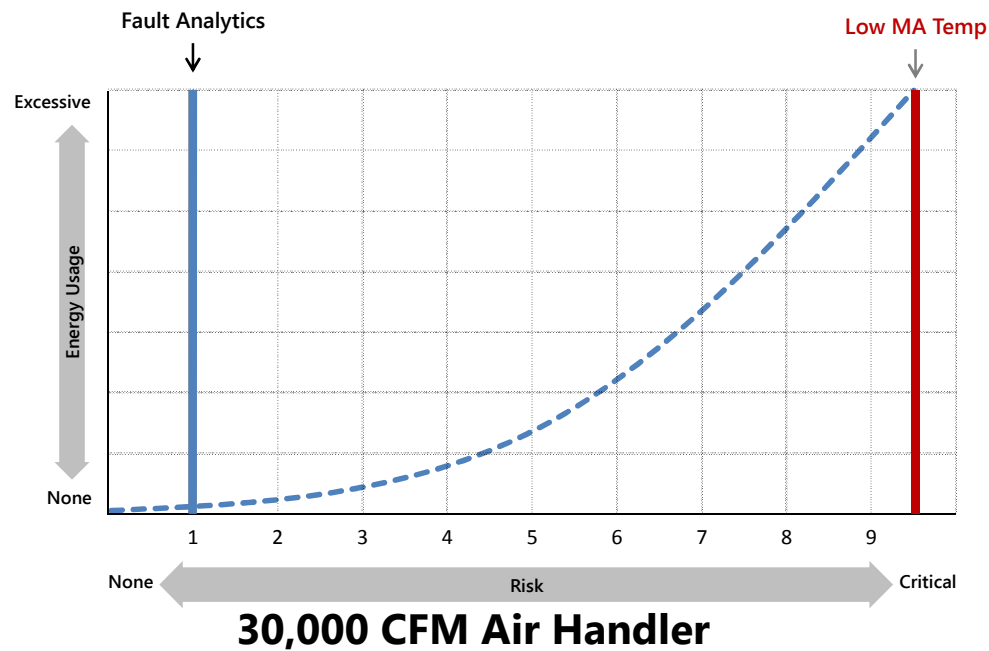
Excessive

Energy Usage

None

None ← Risk → Critical

1 2 3 4 5 6 7 8 9

30,000 CFM Air Handler

Energy Cost:

Optimal	**13,750 $/year**
Actual	**30,300 $/year**
Variance	**16,550 $/year**
Increase	**120%**

ALARMS vs FAULTS

FAULT DETECTION & DIAGNOSTICS

PRIORITIZES CORRECTIVE ACTION BEFORE A BAS ALARM

Fault Diagnostic:
Failed OA Damper

Static BAS Alarm:
None

Space Temp:

70° F

Fault Analytics

Low MA Temp

Excessive

Energy Usage

None

None ← Risk → Critical

1 2 3 4 5 6 7 8 9

30,000 CFM Air Handler

Energy Cost:

Optimal	**13,750 $/year**
Actual	**24,620 $/year**
Variance	**10,870 $/year**
Increase	**79%**

Know your system is working properly, in real time

- Night walks

- Override Reports

- Controls Maintenance

- Spending hours looking through trendlogs

- Watching the utility bill

Condition Based Maintenance

FAULTDETECTION
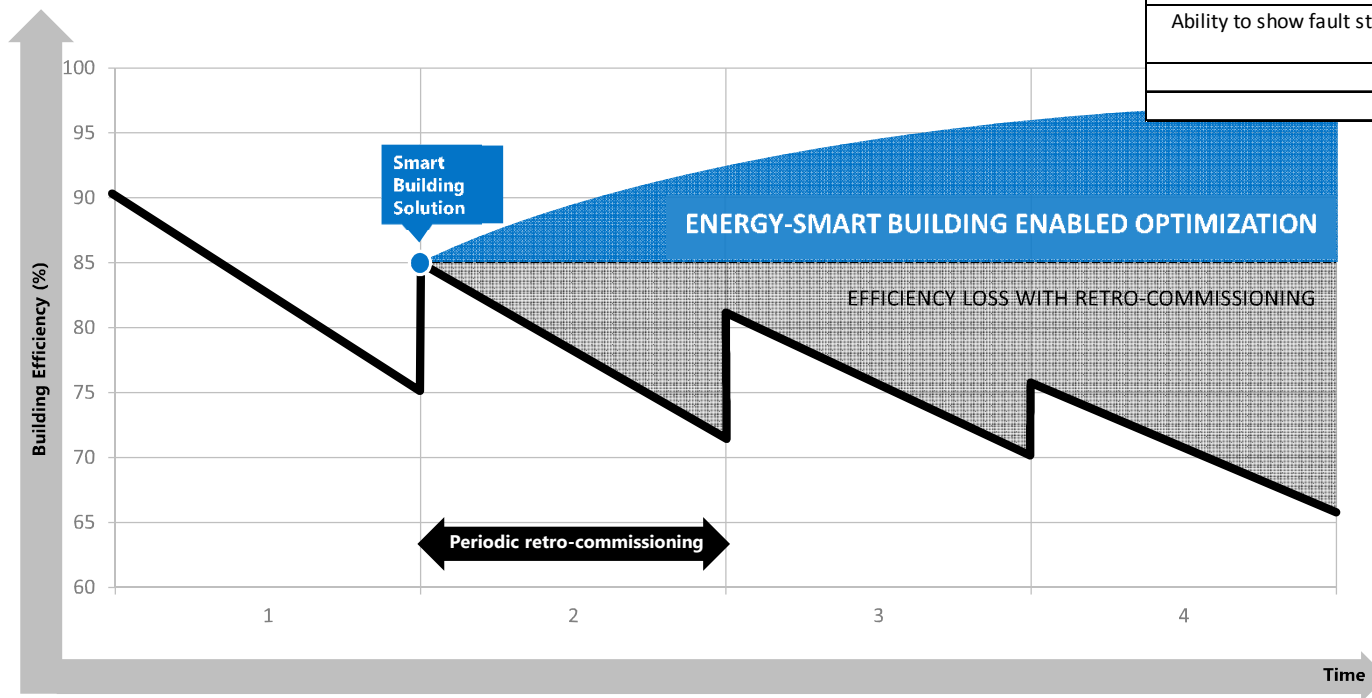## INTUITIVE RULES-BASED DEVELOPMENT TOOLS

FAULT DETECTION AND DIAGNOSTICS
CONNECTING EQUIPMENT TO ANALYSIS SOFTWARE FOR REAL TIME PERFORMANCE MANAGEMENT
RESULTS IN PRODUCTIVITY GAINS OVER TIME

Fault Reporting	
Fault priority reports by custom priority and/or costs savings potential	✔
Ability to create custom reports	✔
Ad-hoc reporting	✔
Automatic daily, weekly reports	✔

Fault Detection & Diagnostics (FDD)	
Fault detection / diagnostics	✔
Pre-developed (canned) algorithms	✔
Allowance for flexible and customized fault rules by customer or system integrator	✔
Ability to define custom priorities of faults identified	✔
Monetization of faults with respect to utility cost avoidance	✔
Ability to show fault status indication (active, inactive, closed etc.) which can be changed by user	✔
Ability to add user comments per fault	✔
Ability to integrate into a CMMS software	✔

Smart Building Solution

ENERGY-SMART BUILDING ENABLED OPTIMIZATION

EFFICIENCY LOSS WITH RETRO-COMMISSIONING

Building Efficiency (%)

100
95
90
85
80
75
70
65
60

1   2   3   4

Periodic retro-commissioning

Time

MONITORED-BASED CONTINUOUS COMMISSIOING

UTILITY & CARBON EMISSIONS MANAGEMENT
INSTANTLY ACCESS & NORMALIZE

Utility & Carbon Emissions Management	
Customizable utility analytics and reporting templates, M&V Tracking	✓
Energy (Natural Gas, Electricity, Steam, etc.) and water meter integration for realtime management	✓
Batch import of existing meter data	✓
Direct connectivity with weather station reporting burrows for continuous updating	✓
Direct connectivity with EPA Energy Star Portfolio Manager for automatic updating	✓
Customizable financial reporting on energy and equivalent carbon savings	✓
Standard and fully configurable cost, consumption and carbon reports	✓
Utility reporting normalization for variables such as weather, utility rates and building occupancy	✓

ICONICS

Administration   Preferences   Help

Portfolio Energy Use

ReportWorX
- Enterprise
  - 11 - Past Month Usage Comparison
  - 12 - Past Week Usage Comparison
  - 13 - Fault Comparison
  - 14 - After hours Usage Comparison
  - 15 - Comfort Comparison Report
  - 16 - Energy Cost Comparison
  - 17 - Energy Target Comparison
  - 18 - CAM type kWh Comparison
  - 20 - Energy Cost Per Hour
  - Portfolio Energy Use
- Region
- Shopping Center

Execution Options: Importance Normal   Execute

Select a Start Date: Wednesday, October 01, 2014

Select an End Date: Thursday , October 31 , 2014

King County

Portfolio Energy Use

			Start Date:	10/1/14 12:00 AM
			End Date:	10/16/14 6:52 PM
			Region:	Region 1
			Sampling Interval:	Monthly

Site	Size	Energy (kWh)	Cost ($)	Energy Int. (kWh/sf)	Cost Int. ($/sf)	Norm. Energy Int. (kWh/sf)	Norm. Cost Int. ($/sf)
Chinook	292,171	389,708	$31,176.61	1.334	$0.11	129,903	$10,392.20
Ryerson	53,442	57,937	$4,635.00	1.084	$0.09	19,312	$1,545.00
East Base	57,283	54,122	$4,329.78	0.945	$0.08	18,041	$1,443.26
Bow Lake	78,000	85,548	$6,843.87	1.097	$0.09	28,516	$2,281.29
Brightwater	15,000	16,439	$1,315.10	1.096	$0.09	5,480	$438.37
KCLS	103,655	112,750	$9,020.01	1.088	$0.09	37,583	$3,006.67

Fitbit for CAMPUSES

BUILDINGS

CAMPUSES
Private
Public

DISTRICTS
Cities
Counties
Utilities

ENERGY-SMART CAMPUS OPERATIONS
MAKING INFORMED DECISIONS

THOUGHTS

?

VISUALIZE   ANALYZE   MOBILIZE   CLOUD