

DESIGN

BUILD

OPTIMIZE

Smart Buildings

What's it Take
EFC 2019

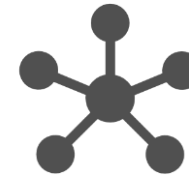
Jeremy Richmond, CEM, CMVP, LEED AP O+M
Smart Building Solutions Manager

MacDonald-Miller Facility Solutions

We Make Buildings Work Better



- **#1** Full Service Design Build Mechanical Contractor in the PNW
- Customer mix includes, CRE, Biotech, Retail, MUSH, Industrial, Manufacturing, Hospitality, Federal & DoD



- Over **10k** pieces of connected equipment
- Generating **30M** records daily
- **12k** pictures and videos recorded annually in Maclens



- Over **1k** employees from New Construction to Service
- **8** offices located throughout the Pacific Northwest
- Supporting **100M** SqFt nationally and internationally and **15** Maritime assets



- Over **140** data-enabled service technicians
- Providing mechanical service to over **5k** customers
- Connected building operations center providing remote support



Microsoft Partner





General Overview

Smart Buildings in Operation



- Reduce energy consumption
- Reduce operating costs
- Reduce capital costs



"We are able to achieve two key milestones. First is 15% in energy cost avoidance. We also saw an improvement of 15% for productivity in our FM facilities management processes." Gavin Teo, Manager Facilities and Estate Management

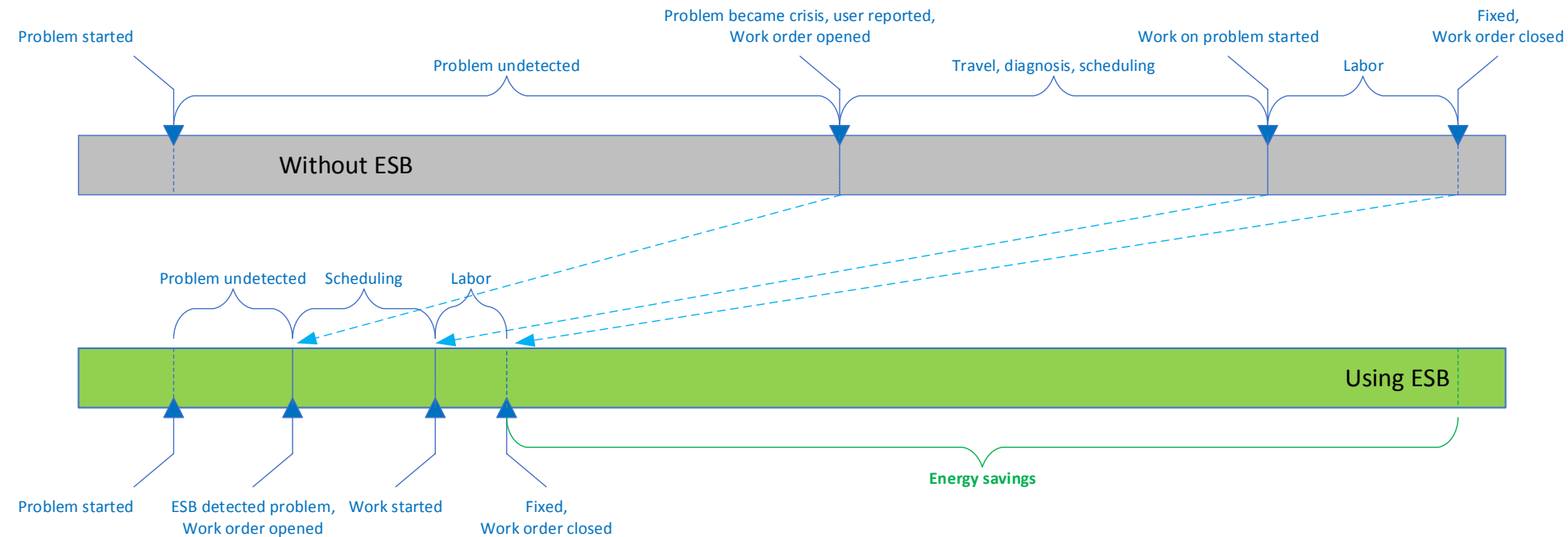
<https://www.youtube.com/embed/l684CGIVBNw?start=0&autoplay=1&showinfo=0>



Top reasons Smart Buildings save energy

Make the invisible visible

- Sub-threshold problems (e.g. leaking hot water coils causing chilled water system to turn on early)
- Systems tuned to provide short term relief, overriding routes designed for efficiency
- Mechanical issues preventing proper operations (e.g. stuck dampers restricting airflow)
- Systems competing against each other (e.g. simultaneous heating and cooling)



Smart Buildings Roadmap



Automation Systems

- HVAC Systems
- Central Plant Systems
- Utility Meters
- Lighting Control Systems
- Emergency & Backup Systems
- Weather Monitoring
- Electrical Distribution Systems
- Room Scheduling Systems
- Elevator Systems

Integrated Network

- Cabling Infrastructure
- Proprietary System Controllers
- Automation System Servers
- Equipment Integration
- Routers and Gateways
- Network Automation Engines
- Secure Architecture

Operations Center

- Alarm Monitoring
- Environment Monitoring
- Situational Awareness
- Issue Management
- Override Control
- Rapid Response
- Demand Response

Smart Campus

- Fault Detection & Diagnostics
- Energy Management
- Data Warehouse
- Analytics
- Stakeholder Dashboards

Work Smart

- Performance Based Maintenance
- Work Management System
- Mobility Solutions

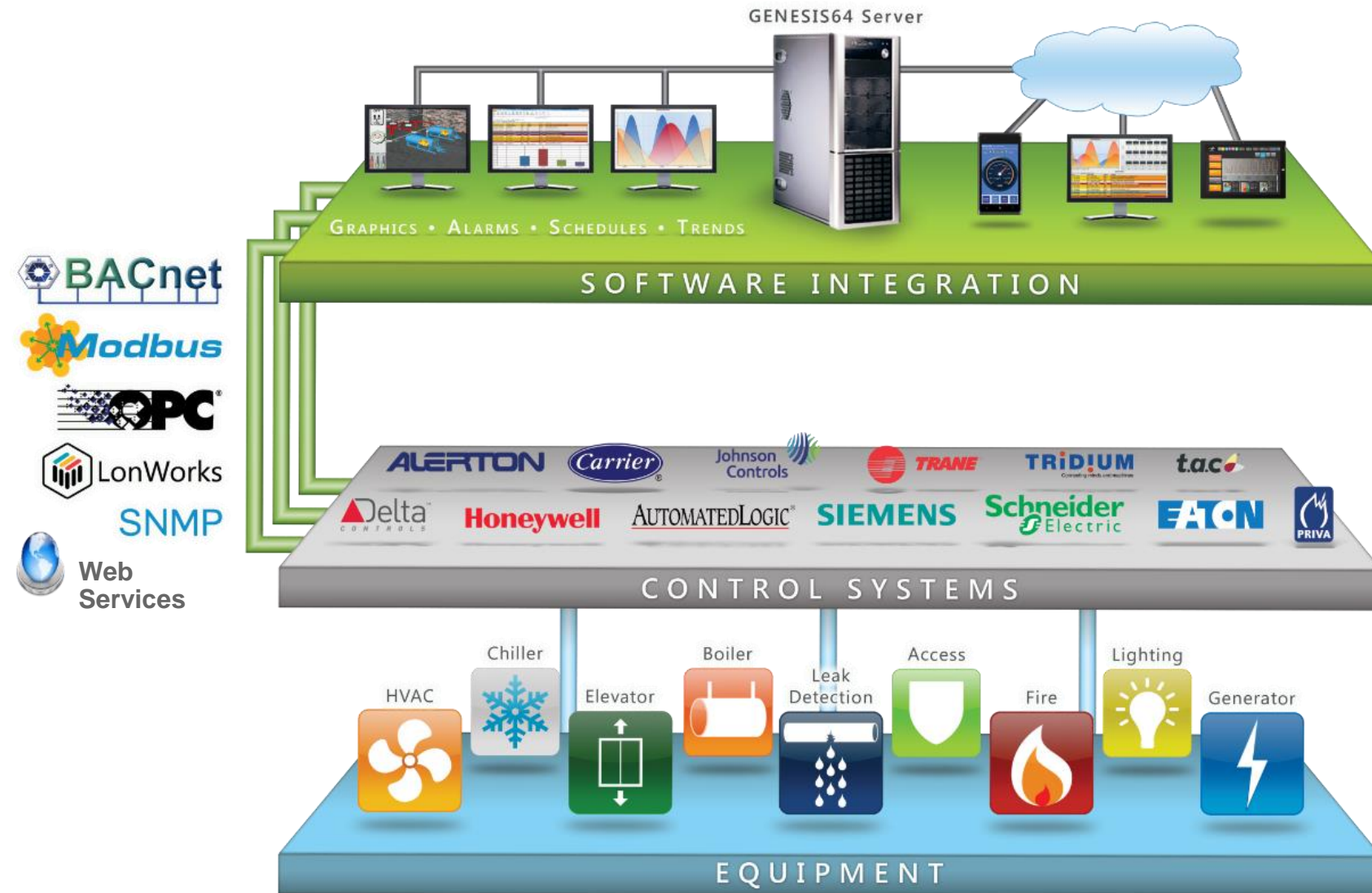


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Part 1: Automation Systems

CONNECTING TO ALL OPERATIONAL BUILDING & BUSINESS SYSTEMS



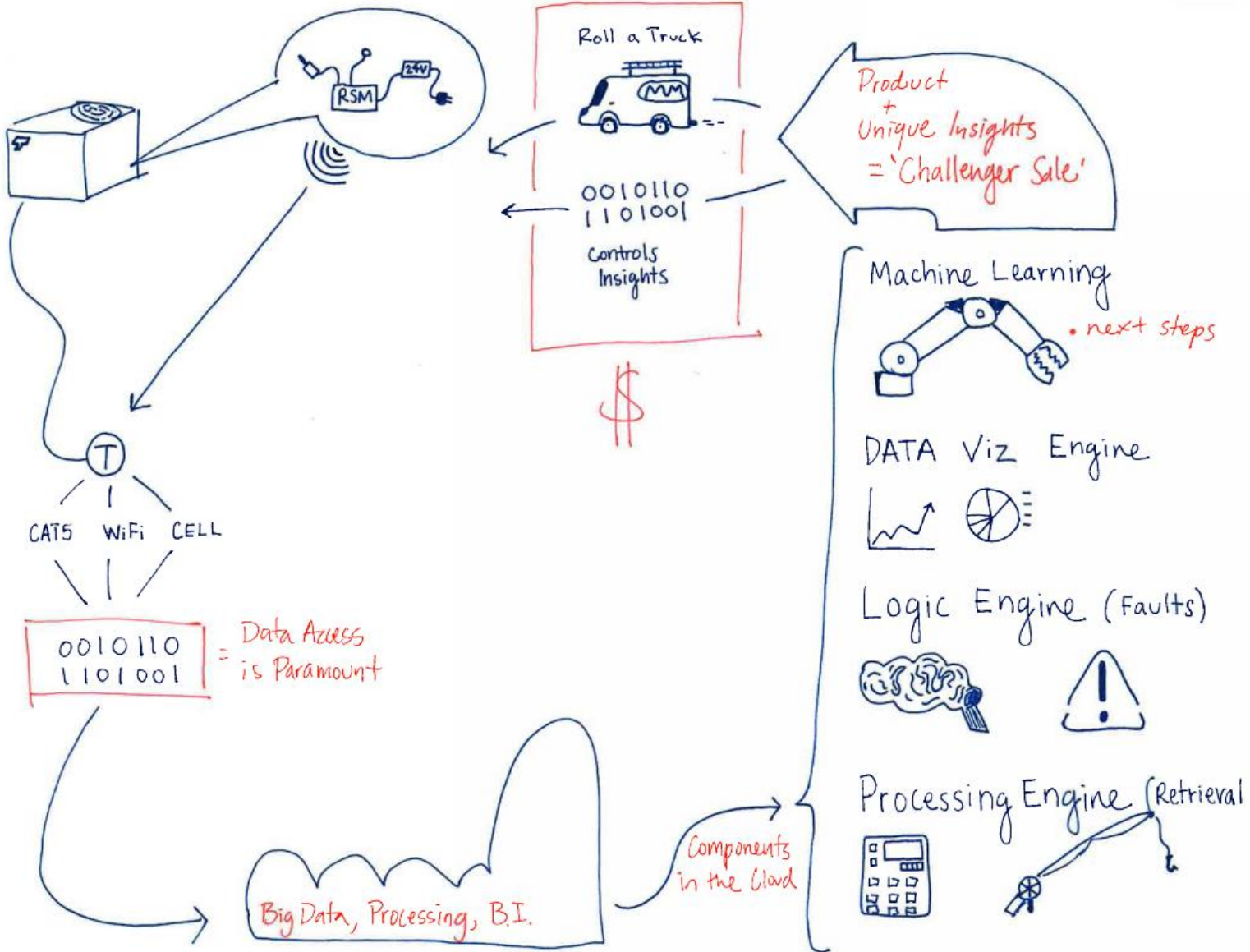
- **UNRESTRICTED LICENSING**
- **EMBEDDED PROGRAMMING AND ENGINEERING TOOLS**
- **MULTIPLE INTEGRATION PATHWAYS VIA INDUSTRY RECOGNIZED PROTOCOLS AND PUBLISHED APIS**
- **SMNP & WEB SERVICES SUPPORT FOR IT NETWORK INTEGRATION & CUSTOM APPLICATION DEVELOPMENT**
- **OPEN DATABASE CONNECTIVITY (ODBC) COMPLIANT**
- **ACCESS TO CORPORATE & LOCAL TRAINING AND TECHNICAL SUPPORT**
- **ADHERENCE TO RIGOROUS DATA SECURITY POLICIES**

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Process Flow



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Part 2: Integrated Networks

IoT & intelligent infrastructure

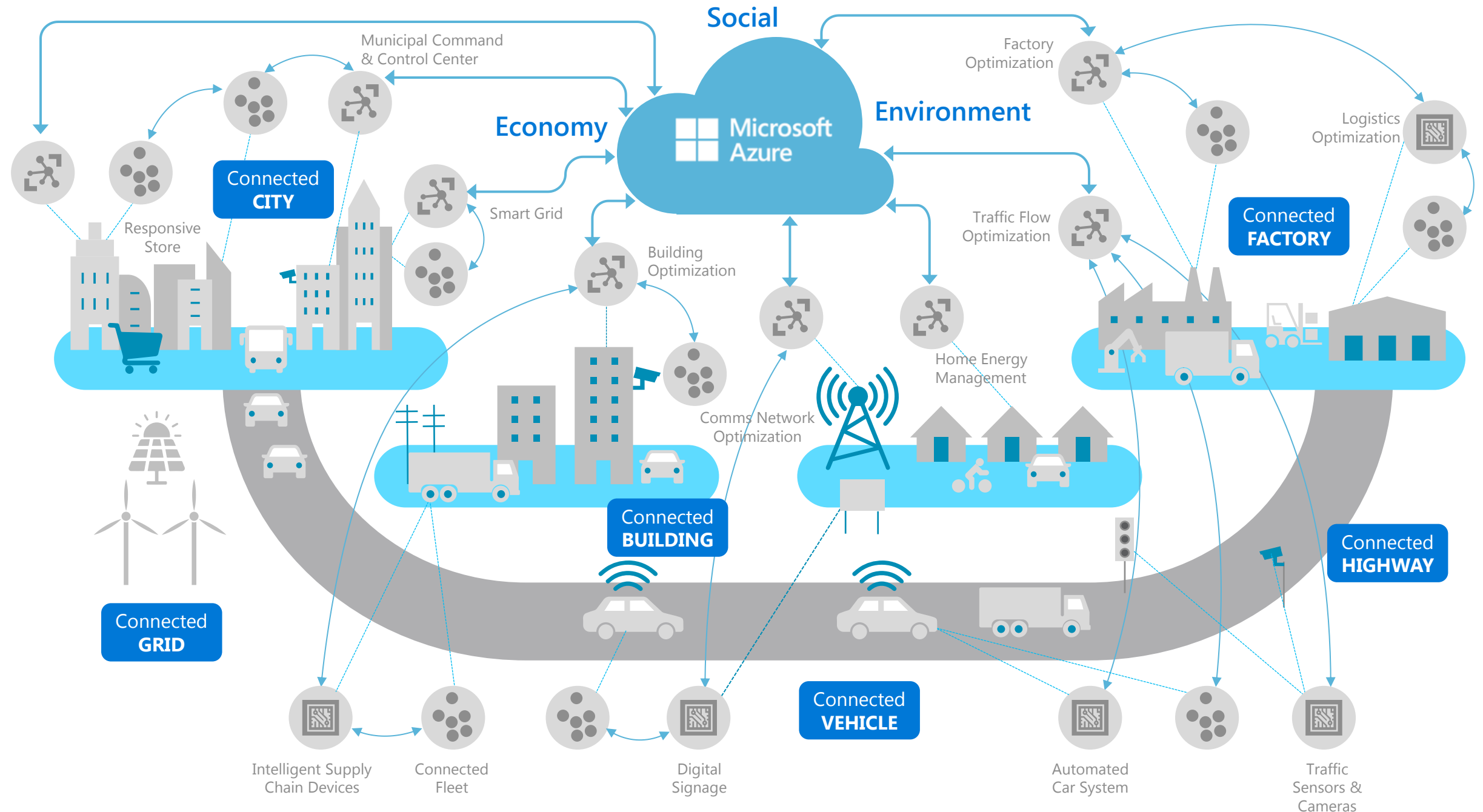
Transportation,
Traffic, Parking,
Vehicles

Housing,
Buildings

Energy, Water
& Utilities

Citizen
Engagement

Public Safety &
Security





Part 3: Operations Center

Services

EQUIPMENT HEALTH

comprehensive analytics in a digestible format

REMOTE EXPERT SUPPORT

leverage industry knowledge

CRITICAL EQUIPMENT EVENT SUPERVISION

the information you need when you need it

INSIGHT CONSULTATION

transforming data into meaningful action

AUTOMATED PERFORMANCE REPORTING

save time with digital inspections

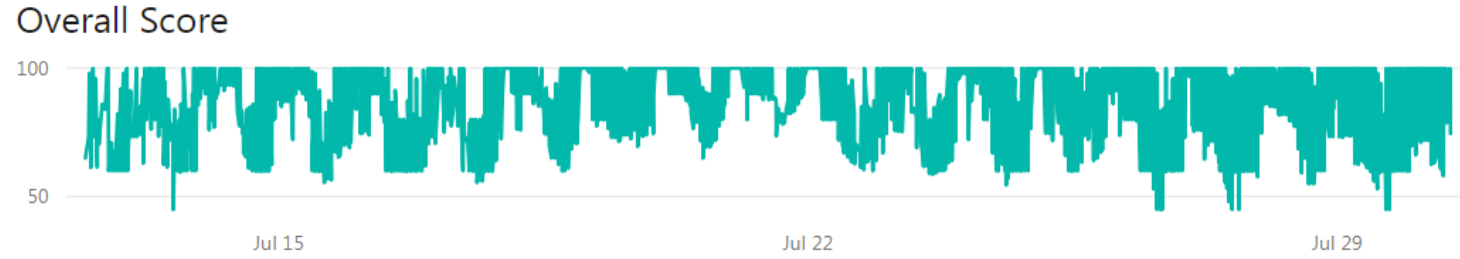
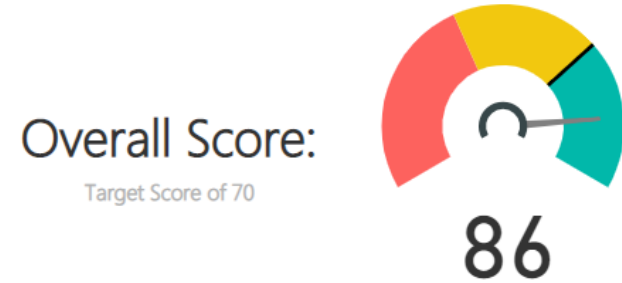




Part 4: Smart Campus

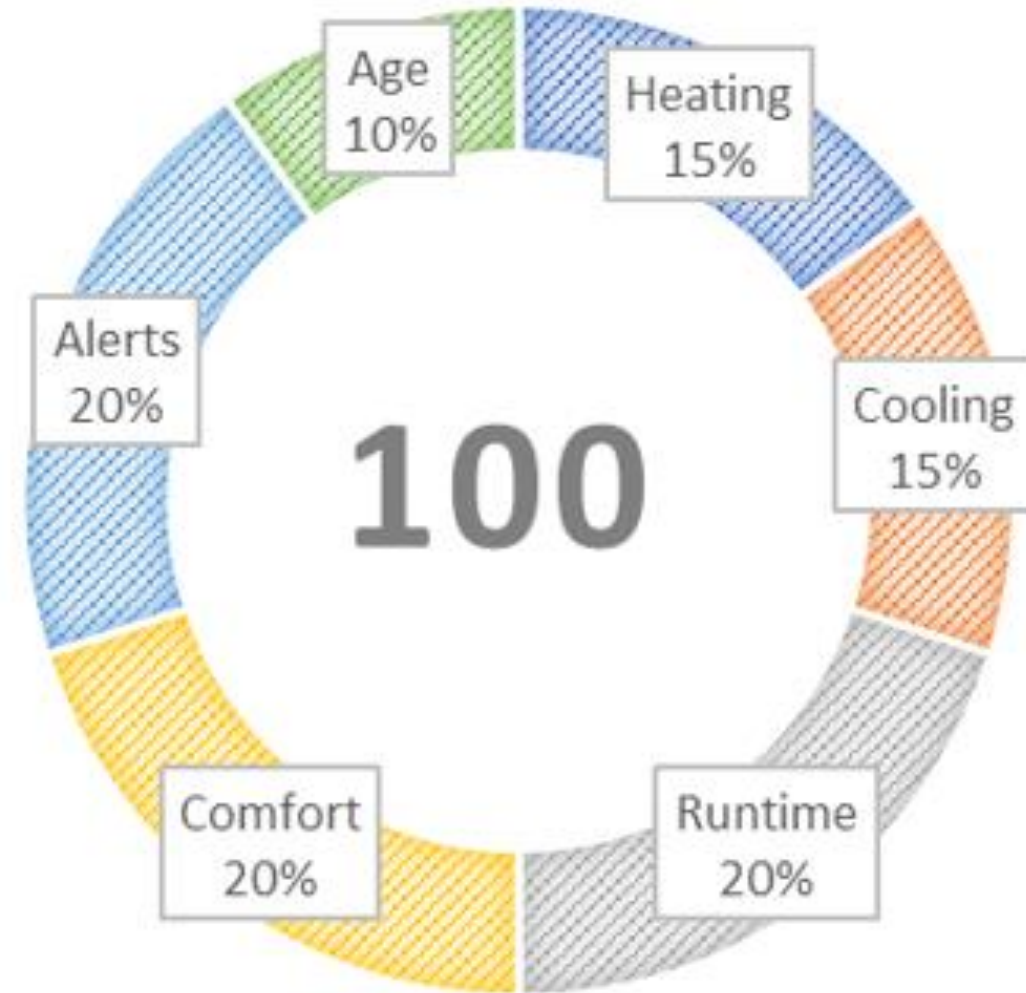
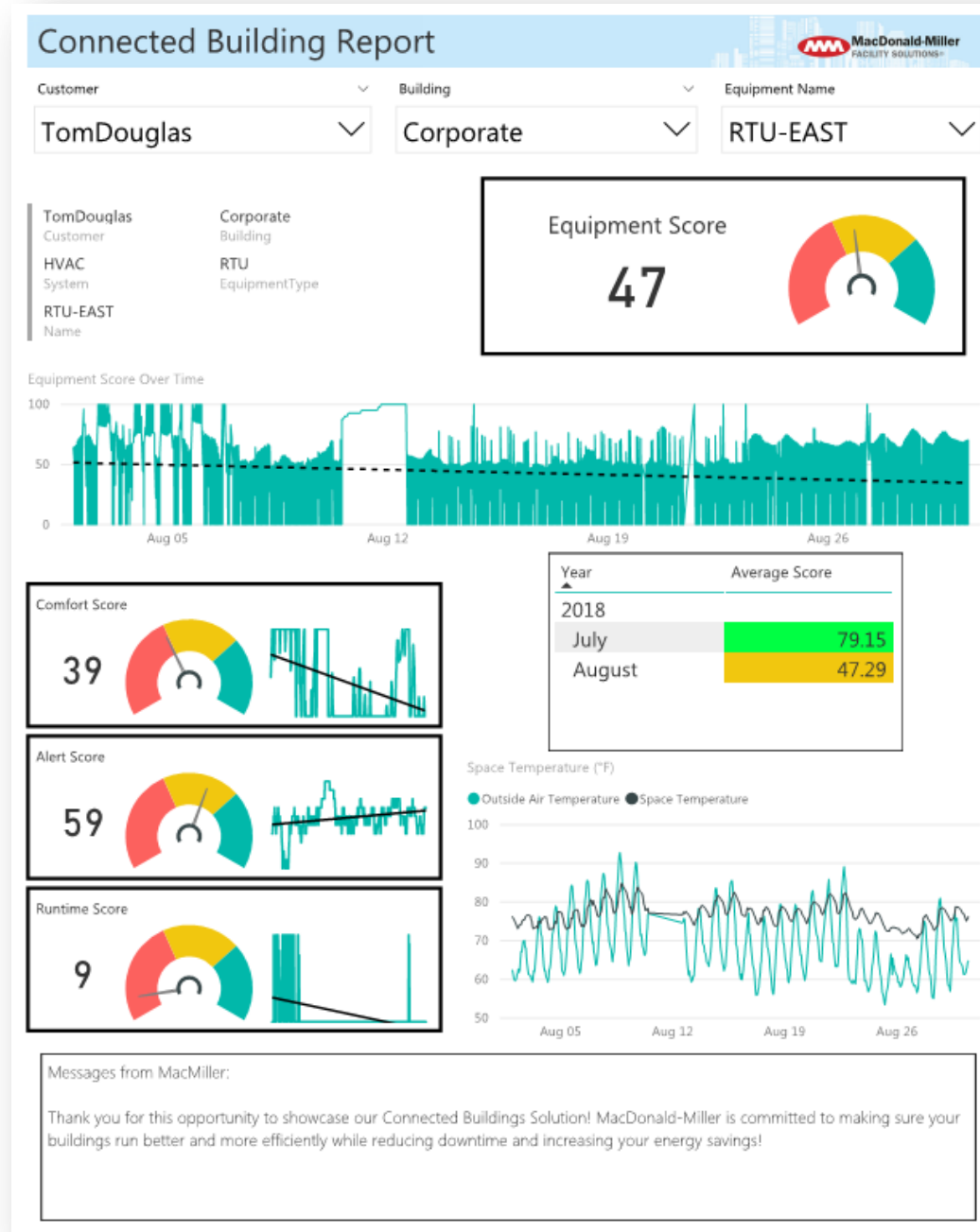
Single Unit

Customer: All Building: All

Customer	Equipment Type	Overall Score	Comfort Score	Cooling Score	Heating Score	Runtime Score	Alerts/Fault Score	Age Score
BigGreenMachines								
MainOffice								
AHU-1	AHU	95.66	99.70	82.54	100.00	91.72	100.00	100.00
AHU-2	AHU	98.57	99.83	94.00	100.00	97.45	100.00	100.00
ChefMightyMac								
DetroitAvenue								
RTU-EAST	RTU	80.55	89.44	57.47	100.00	46.12	100.00	100.00
RTU-WEST	RTU	96.63	98.45	95.87	100.00	88.56	100.00	100.00
GreenCuisine								
RTU-1	RTU	91.92	93.68	91.75	100.00	72.67	100.00	100.00
SmartCafe								
RTU-EAST	RTU	79.25	59.82	99.50	100.00	39.66	100.00	100.00

Score Details

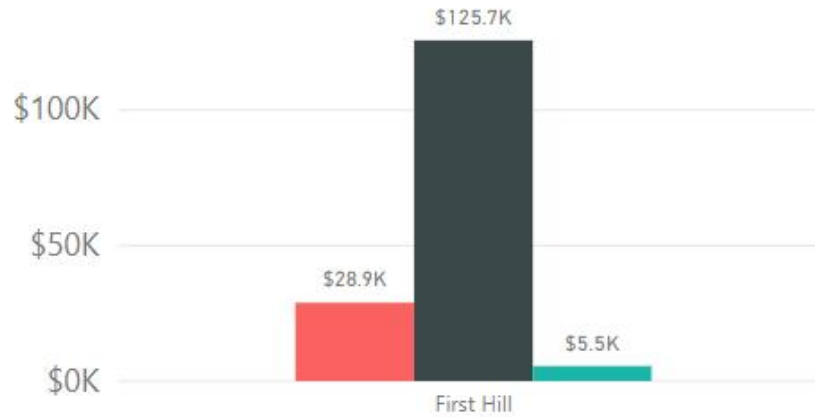


Campus

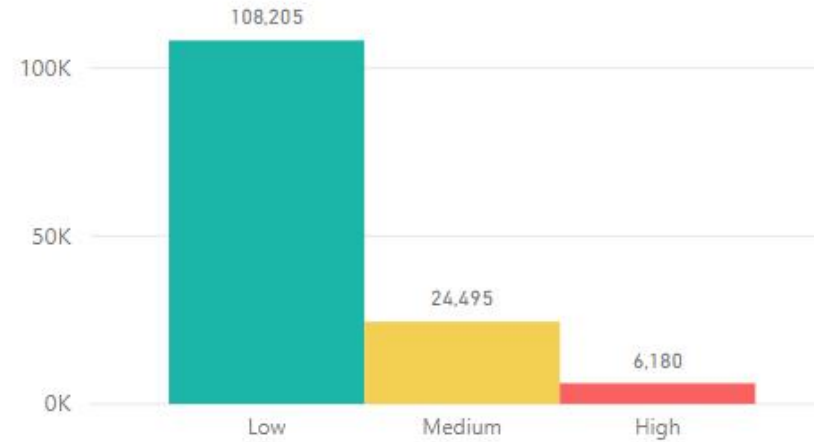
ABC Customer - Campus - 2019



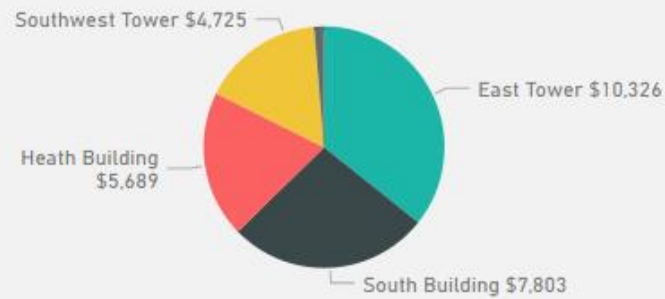
● Total Lost Opportunity YTD ● Annual Avoided Cost Potential ● YTD Avoided Costs



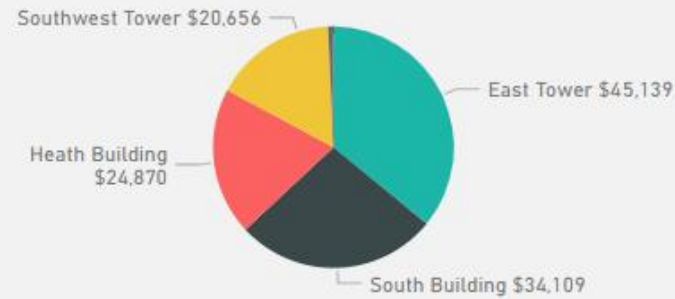
Fault Activity



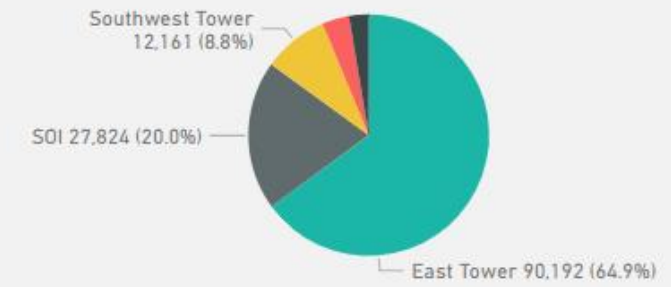
Total Lost Opportunity YTD by Building



Annual Projected Fault Cost if Faults are not Resolved



Total Faults by Building

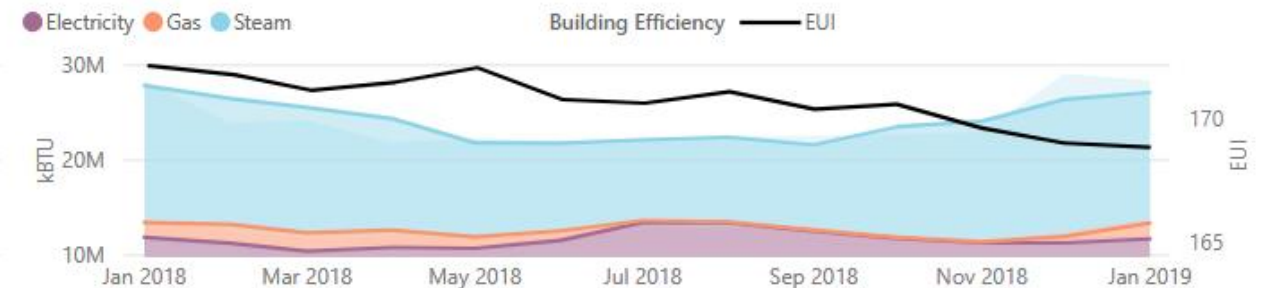


Project to Date Savings

● Electricity ● Gas ● Steam



Electricity, Gas and Steam Energy compared to Base Year with EUI 12-month Trend





Part 5: Work Smart

R25 Live Schedule Integration

HIGHLINE COLLEGE Welcome, Rich

[Home](#)
[Event Wizard](#)
[Events](#)
[Locations](#)
[Resources](#)
[Organizations](#)
[Tasks](#)
[Reports](#)
[Publisher](#)

TEST INSTANCE

Welcome to the future of room scheduling at Highline!

Powered by CollegeNET

MacDonald-Miller Event Search Sun Apr 21 2019 - Sat

Sunday	Monday	Tuesday	Wednesday	Thursday
April 21	22	23	24	25
				8:00 am - 10:00 am MMFS Test Event 25-1 MMFS Test Room 1 11:00 am - 1:00 pm MMFS Test Event 25-2 MMFS Test Room 1 12:00 pm - 2:30 pm MMFS Test Event 25-3 MMFS Test Room 2 3:00 pm - 4:00 pm MMFS Test Event 25-4 MMFS Test Room 2

HIGHLINE COLLEGE Welcome, Richmond, Je

[Home](#)
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[Locations](#)
[Resources](#)
[Organizations](#)
[Tasks](#)
[Reports](#)
[Publisher](#)

[Search For Locations](#)
[Pre-Defined Location Searches](#)
[Advanced Location Search](#)
MMFS Test Room 1

MMFS Test Room 1

[Details](#)
[List](#)
[Availability \(Daily\)](#)
[Availability \(Weekly\)](#)
[Calendar](#)

Starting Week: Sun Apr 21 2019 - Sat Apr 27 2019 Weekdays: All Days Number of V

	Sunday	Monday	Tuesday	Wednesday	Thursday
	4/21	4/28	4/22	4/29	4/23
6:00 AM					
7:00 AM					
8:00 AM					MMFS Test Event 25
9:00 AM					
10:00 AM					
11:00 AM					MMFS Test Event 25
12:00 PM					
1:00 PM					
2:00 PM					
3:00 PM					
4:00 PM					
5:00 PM					
6:00 PM					
7:00 PM					
8:00 PM					
9:00 PM					
10:00 PM					
11:00 PM					

R25 Live Schedule Integration

Schedules

[Create New](#)

Name	Occupied Value	Unoccupied Value	
AHU-1	1	0	Edit Details Delete
AHU-2	1	0	Edit Details Delete

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Schedule Details

Name AHU-1
Occupied Value 1
Unoccupied Value 0

Assigned Spaces

ID	Name
276	MMFS Test Room 1
279	MMFS Test Room 2

Events

Start Time	End Time	Value	Details
4/25/2019 8:00:00 AM	4/25/2019 10:00:00 AM	1	MMFS Test Room 1: (8:00 AM-10:00 AM) MMFS Test Event 25-1
4/25/2019 11:00:00 AM	4/25/2019 2:30:00 PM	1	MMFS Test Room 1: (11:00 AM-1:00 PM) MMFS Test Event 25-2 MMFS Test Room 2: (12:00 PM-2:30 PM) MMFS Test Event 25-3
4/25/2019 3:00:00 PM	4/25/2019 4:00:00 PM	1	MMFS Test Room 2: (3:00 PM-4:00 PM) MMFS Test Event 25-4

[Edit](#) | [Back to List](#)

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R25 Live Schedule Integration

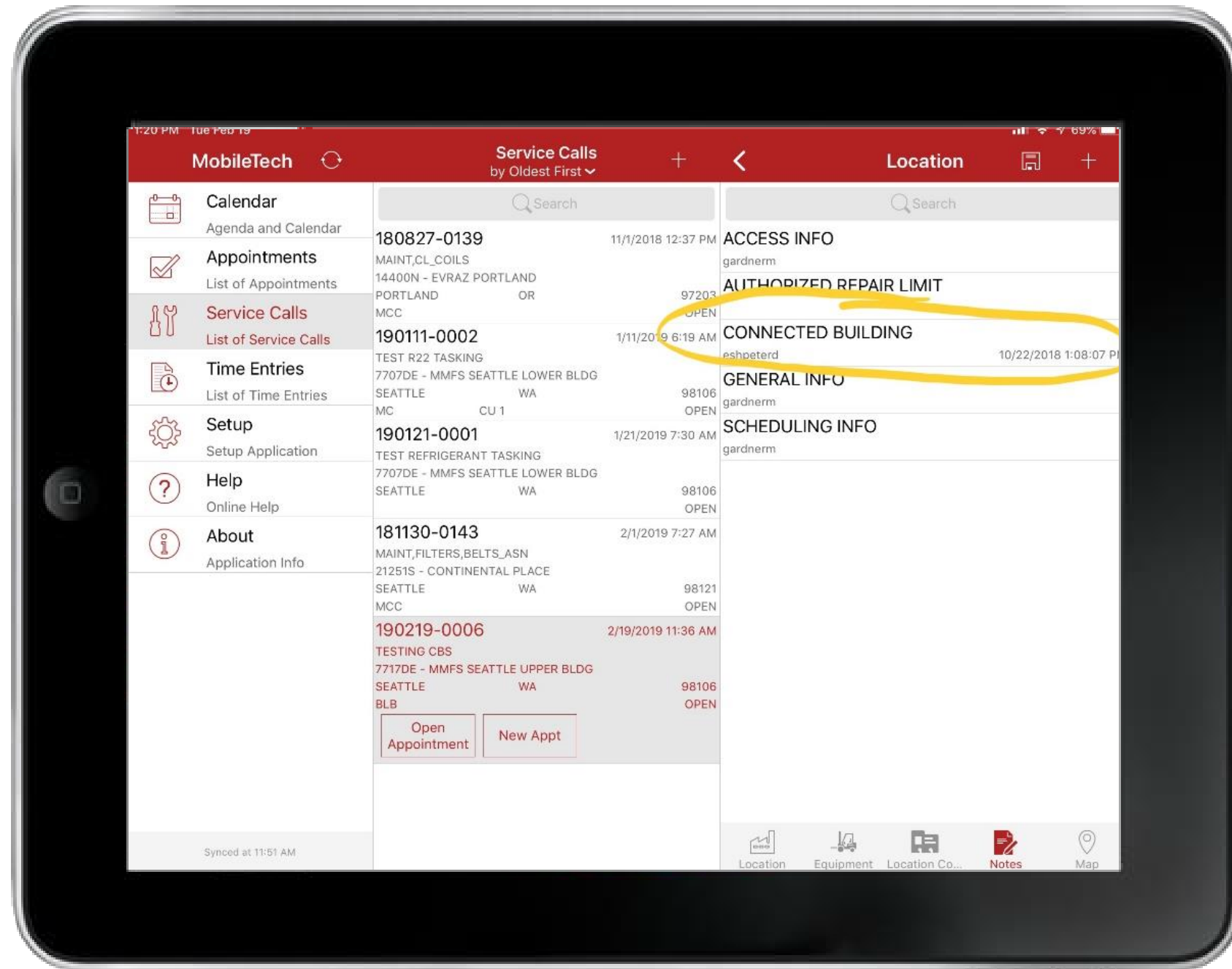
The screenshot shows the 'Event - Event' dialog box in the foreground, overlaid on a weekly schedule grid for 'AHU-1'. The dialog box contains the following fields:

- Show As: Light Blue Category
- Subject: Event
- Location: (empty)
- Start time: Thu, 11:00:00 AM
- End time: Thu, 2:30:00 PM
- Priority: 1
- Tag Value: 1

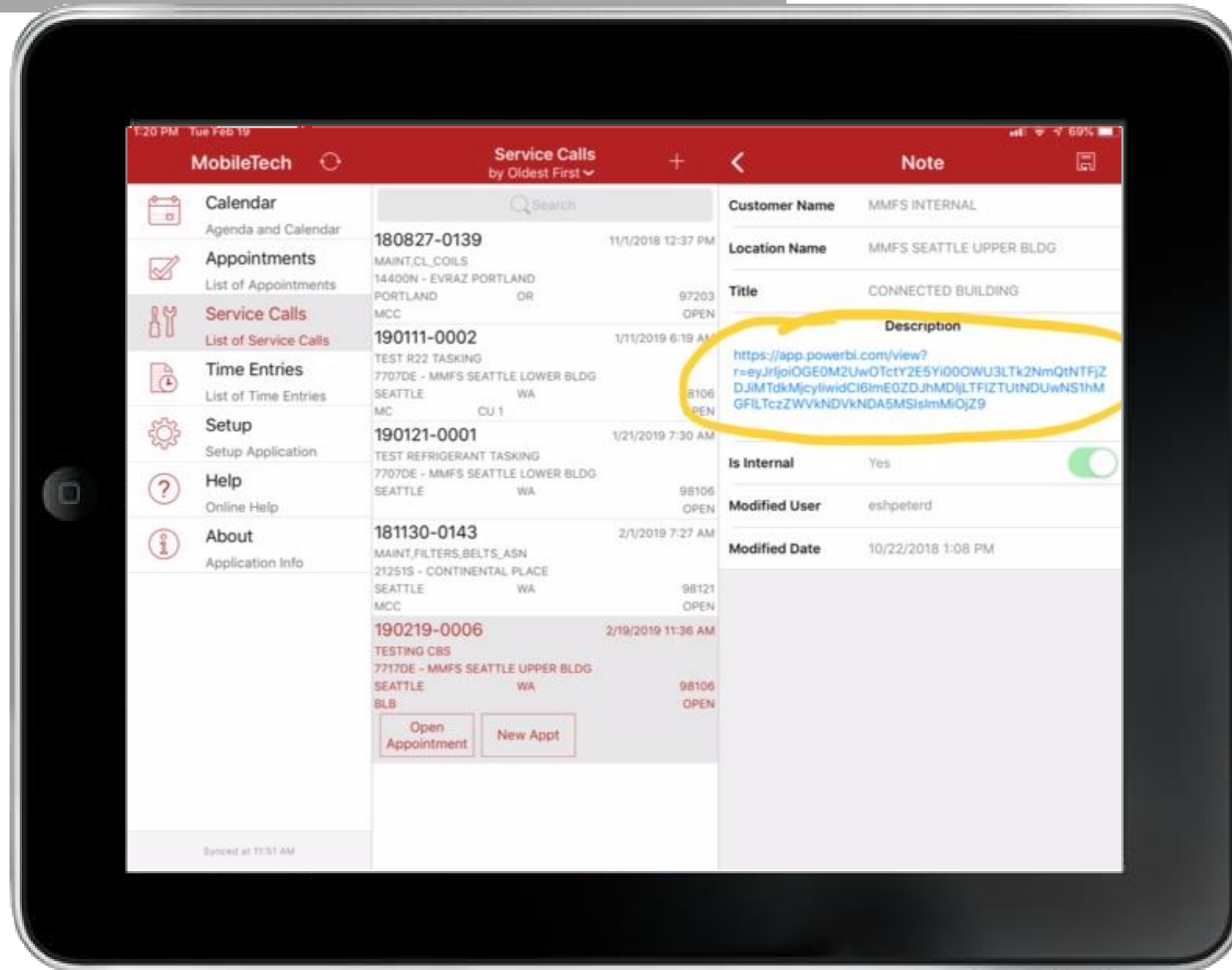
The schedule grid shows a weekly view with columns for Sunday through Saturday and rows for hourly slots from 2:00 AM to 11:00 PM. Three light blue event blocks are visible on the grid, corresponding to the event being configured.

The screenshot shows the weekly schedule grid for 'AHU-1_NextTimestamp'. The interface includes a left-hand navigation tree and a top menu bar with tabs for General, Weekly, Holidays, Exceptions, Preview, and Runtime. The schedule grid displays a weekly view with columns for Sunday through Saturday and rows for hourly slots from 12:00 AM to 9:00 PM. The grid is populated with light blue event blocks, indicating a live schedule integration.

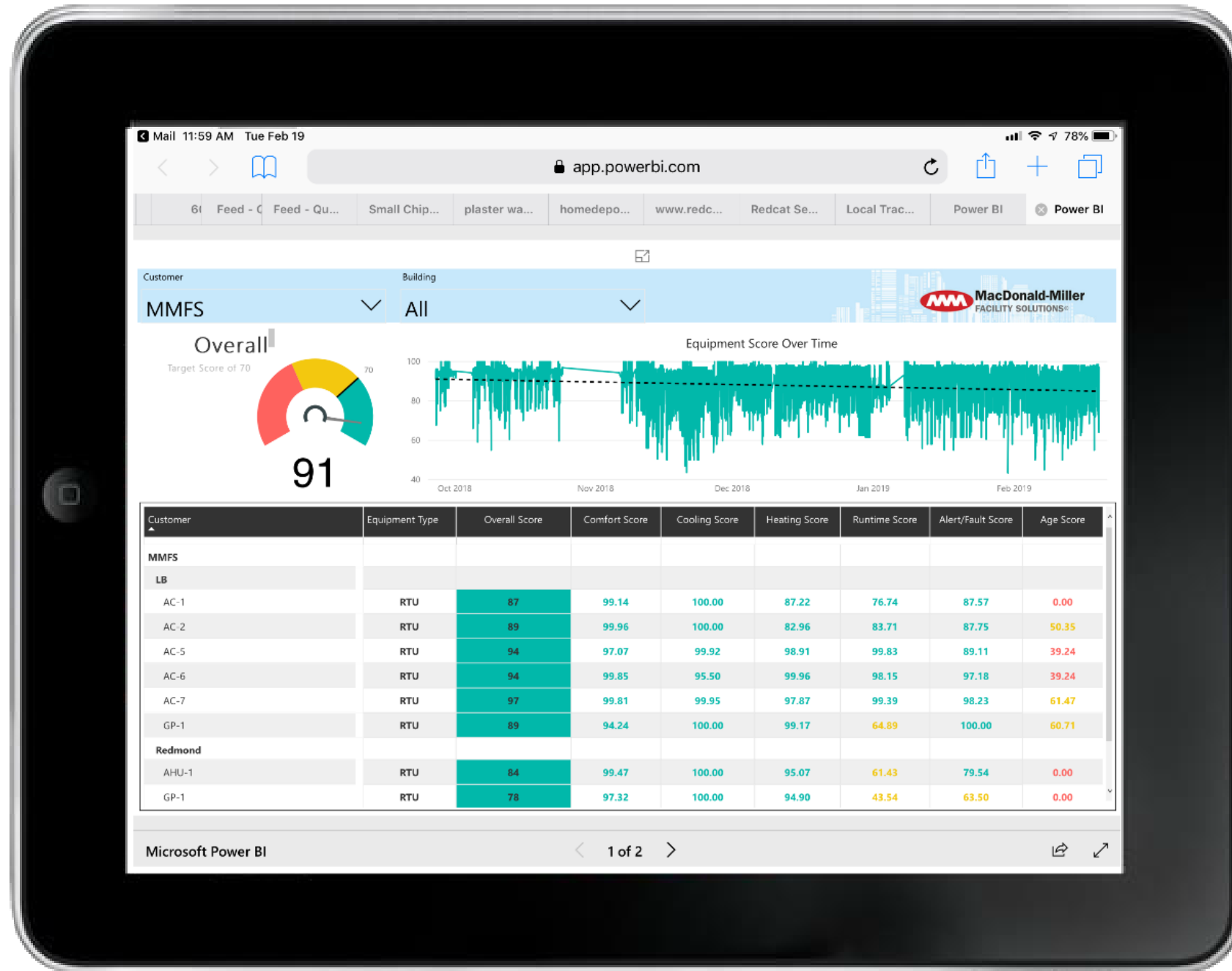
Integrated Maintenance



Integrated Maintenance



Integrated Maintenance





Part 6: Challenges

Talent Gap

Buildings are Smart and getting Smarter

- Information Technology is embedded in all new Building Automation Systems
- Internet of Things – Digital Twins
- Fault Detection and Monitored Based Commissioning
- Use of Edge Analytics

Resources

- Controls Apprenticeship program
- Educational programs South Seattle's Sustainable Building Science and Technology Degree program
- Building Operators Certification Program
- Smart Building Service Vendors
- Lawrence Berkley National Labs – Smart Energy Analytics Campaign

Maintenance Risks



Advanced Analytics – ML/AI

Existing point solutions

- Chiller optimization
- Building power consumption optimization
- Occupancy analytics
- Space utilization
- Workplace analytics

Future enhancements for comprehensive energy optimization

- Anomaly detection for reducing dependency upon SME for fault rule management
- Audio understanding and analytics
- Video analytics
- Enhanced insights from combining building telemetry and Field Service data

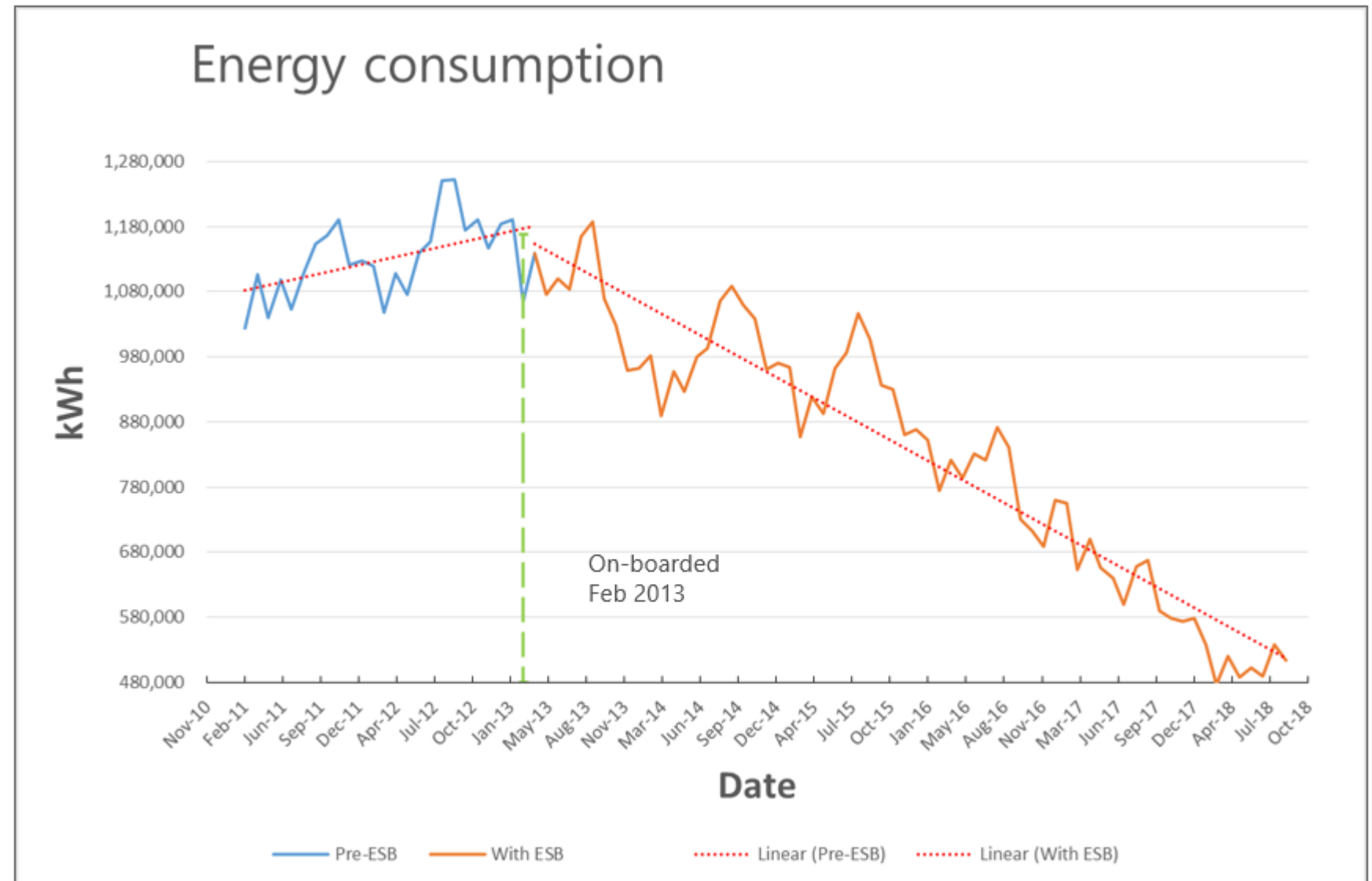


Part 7: Opinions to Facts



CASE STUDY **Microsoft – Advanta A**

- kWh flat or increasing before ESB installed
- kWh declines after ESB installed
- Takes time to optimize equipment schedules and configuration





CASE STUDY

King County Library System

KCLS Avoided Costs



Location Name

Select All

KCLS BELLEVUE

KCLS REDMOND

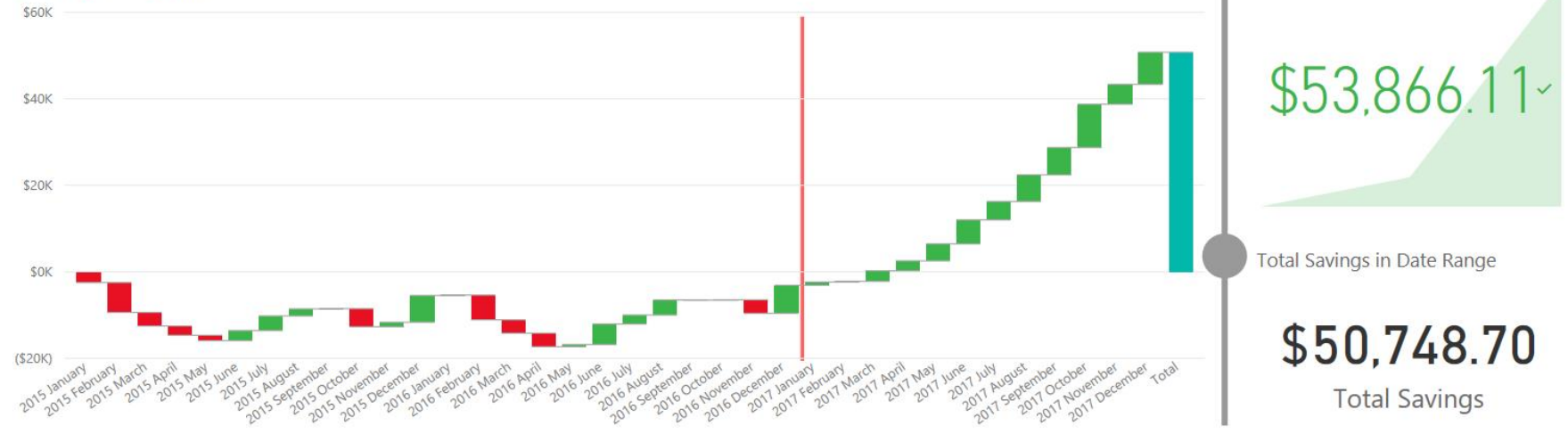
KCLS SERVICE CENTER

1/1/2015

12/31/2017

Savings by Year and Month

● Increase ● Decrease ● Total



- Incumbent Maintenance Provider
- Sensors and Calibration Top Savings

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CASE STUDY

RAYTHEON MISSILE SYSTEMS

Project Details

Number of Buildings: 53

Location: Tucson, AZ

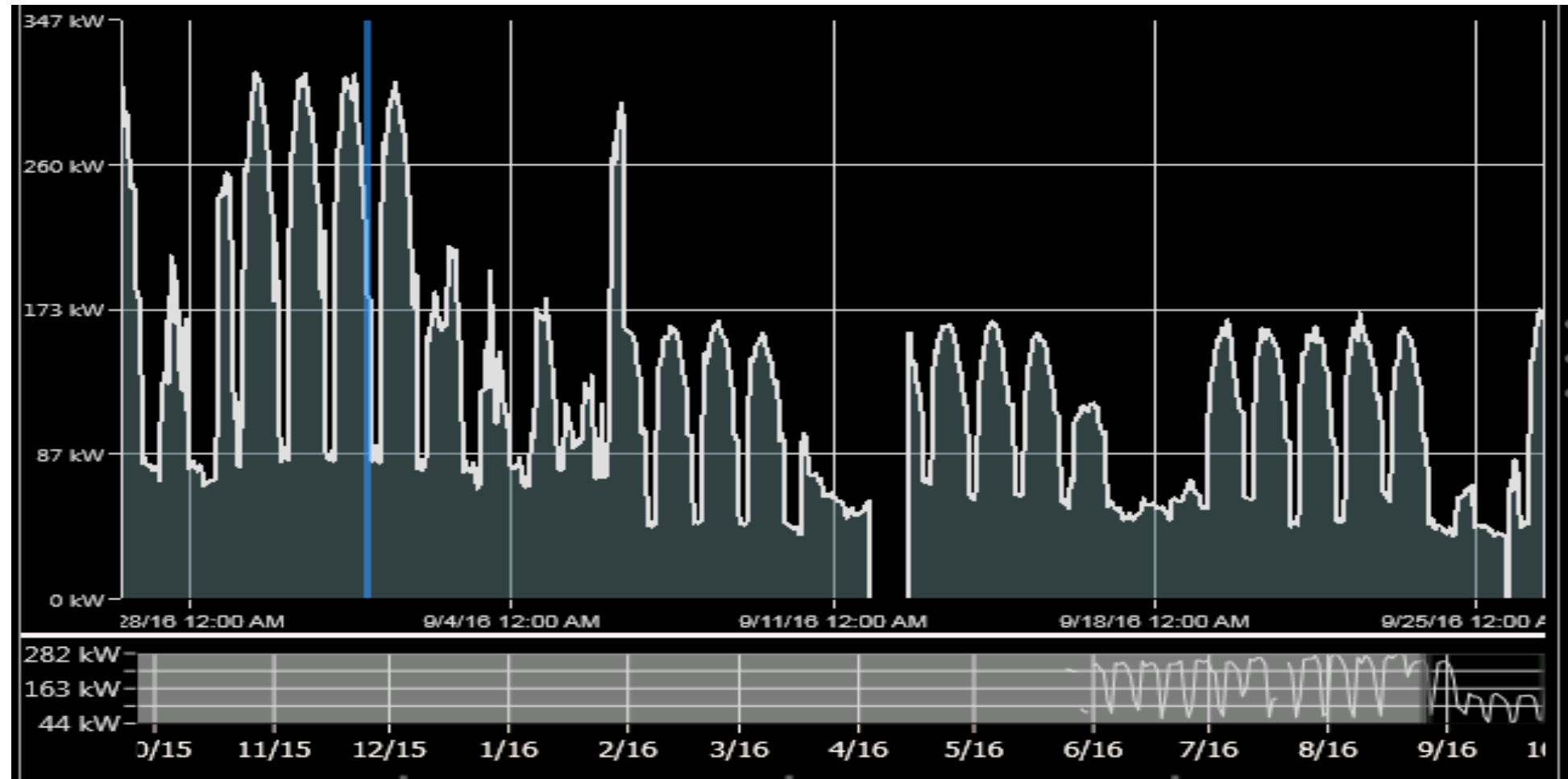
Savings to Date: \$115,000

Projected Savings: \$525,000

Start date: Oct 2015

Completion date: Feb 2017

Providing Planning Support
for ICONICS Deployment at
other RMS Campuses



Building 802: Screen Capture Dual Duct AHU

- Simultaneous heating & cooling fault identified due to improper VAV damper positions.
- Facility staff corrected BAS programming.
- Electric demand rate is \$21.98 per hour which results in \$106,420 a year in savings!

Smart Buildings

What's Inside



Proactive, prepared, and fully connected

THOUGHTS?

VISUALIZE

ANALYZE

MOBILIZE

CLOUD

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