



5 - 8 DECEMBER 2022
DUBAI WORLD TRADE CENTRE

ENHANCEMENTS IN TECHNOLOGY FOR FM

Firas Obeido Tamimi



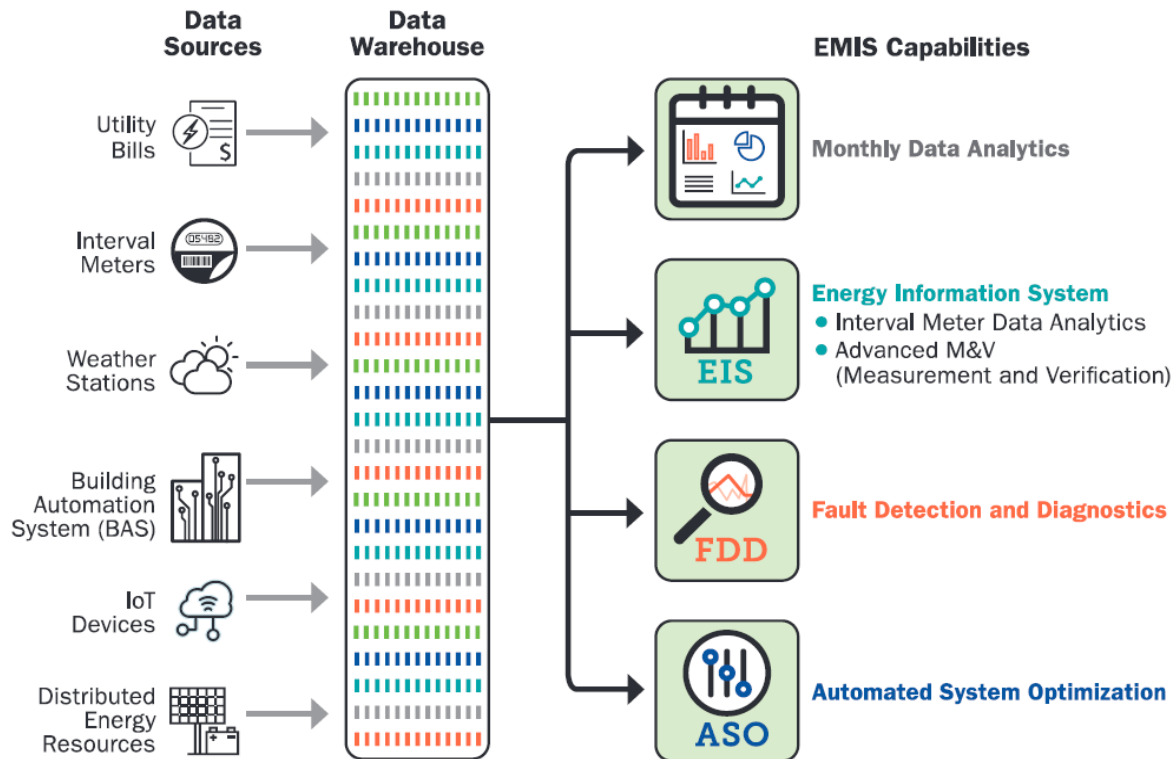
Intelligent Energy Management & Smart Buildings

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The future of Smart Buildings



Org.

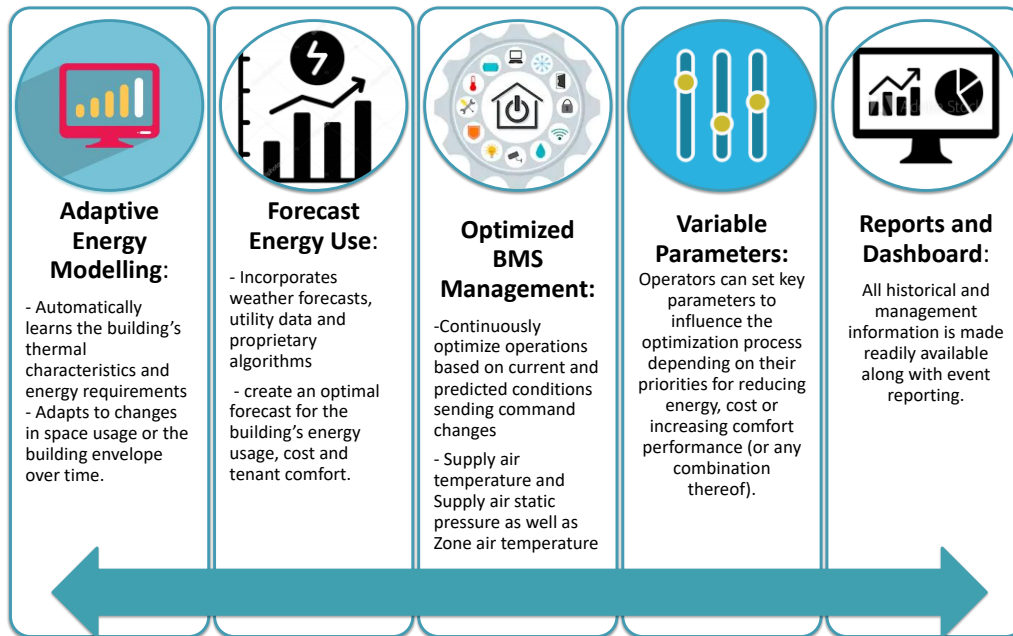
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Figure 1: Data inputs and key capabilities of EMIS

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The future of Smart Buildings

Intelligent Building Analytics Platform



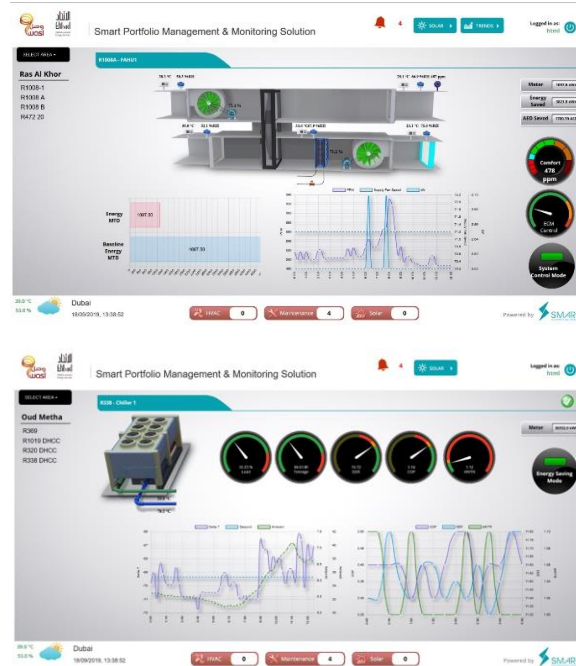
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Automated System Optimization (ASO)

- HVAC
- Indoor air-quality monitoring
- HVAC predictive maintenance
- Indoor temperature optimization
- Outdoor environmental monitoring
- Operational optimization
- Energy consumption optimization



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IOT 7 Layer



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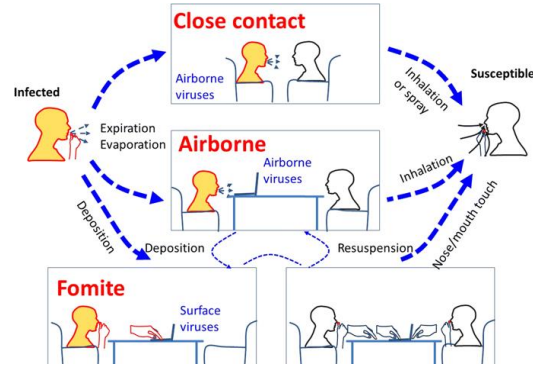
Indoor Air Quality Comfort & Welbeing

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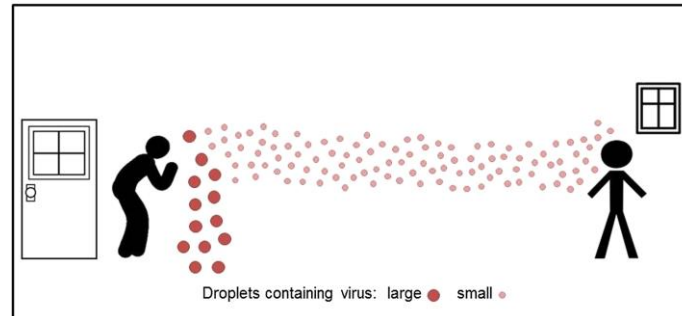
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Airborne Viruses Transmission



For the Airborne Transmission Mode: Where particles will typically have dimensions less than $10\text{ }\mu\text{m}$, decreasing the concentration of these particles can be achieved by diluting them with fresh air provided by the ventilation process



Air Quality Index AQI



AQI Basics for Ozone and Particle Pollution

Air Quality Index Levels of Health Concern	Numerical Value	Meaning
Good	0 to 50	Air quality is considered satisfactory, and air pollution poses little or no risk.
Moderate	51 to 100	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.
Unhealthy for Sensitive Groups	101 to 150	Members of sensitive groups may experience health effects. The general public is not likely to be affected.
Unhealthy	151 to 200	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.
Very Unhealthy	201 to 300	Health alert: everyone may experience more serious health effects.
Hazardous	301 to 500	Health warnings of emergency conditions. The entire population is more likely to be affected.

Five major pollutants

EPA establishes an AQI for five major air pollutants regulated by the Clean Air Act. Each of these pollutants has a national air quality standard set by EPA to protect public health:

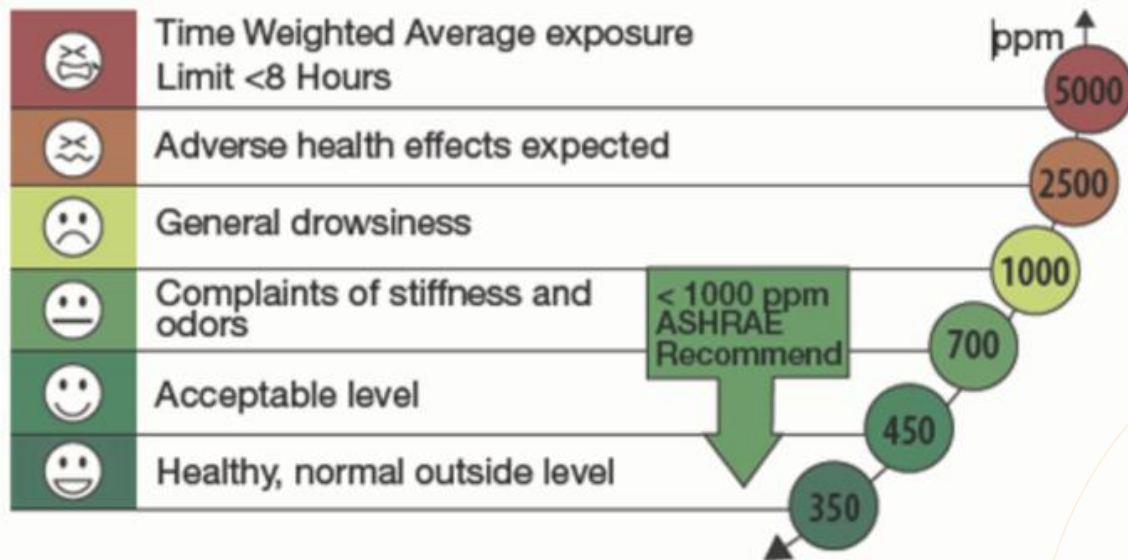
- ground-level ozone O₃
- particle pollution (also known as particulate matter, including PM_{2.5} and PM₁₀)
- carbon monoxide (CO)
- sulfur dioxide (SO₂)
- nitrogen dioxide (NO₂)

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CO2 Exposure time & effect on health



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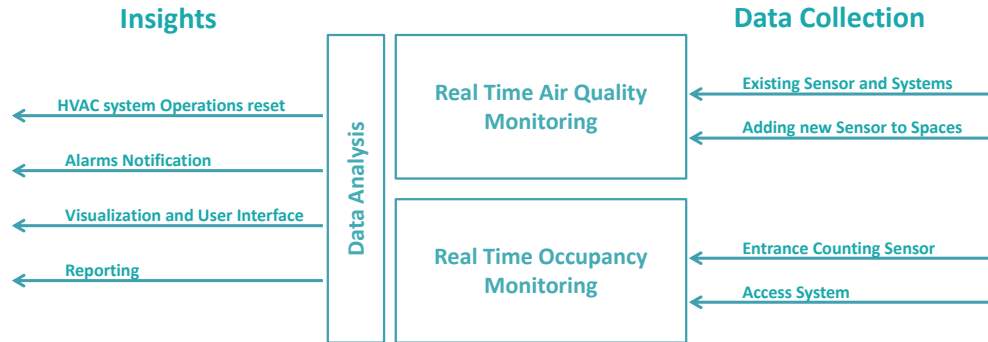
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Safe/ Healthy Building Management



Safe Building Management System

It's a custom IoT application comes as a fast response to the current situation of the COVID 19 outbreak and the importance of social distancing and air quality management which have an important role in putting this viral infection into control



To Keep Customer and Employee Safe and within Regulations

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To Slow the Spread of COVID-19 & Viruses/ Bacteria

To Ensure that the Air Quality and Occupancy Level within safe Limits



CO₂

O₃

PM_{2.5}

PM₁₀

CO

SO₂

NO₂

AQI

Occupancy Level

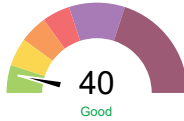


Conference

Pharmac

Supermarke

MAXIMUM
3 Persons



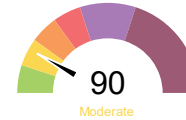
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MAXIMUM
1 Person

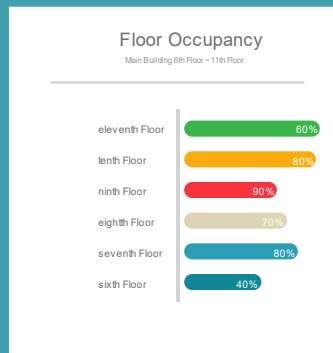
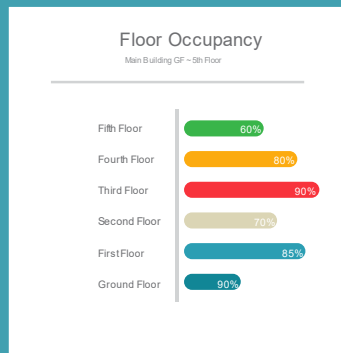
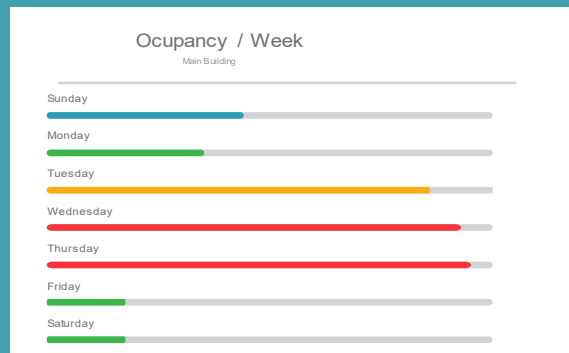
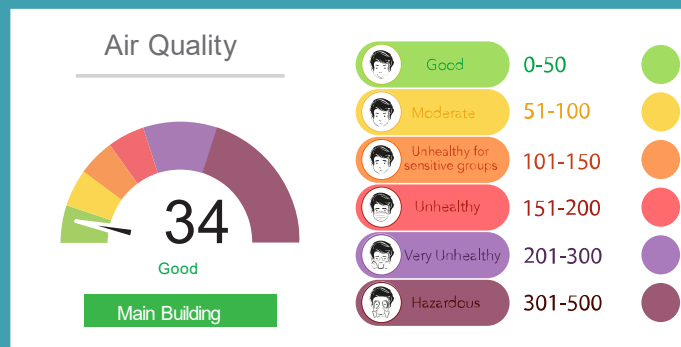
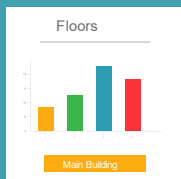
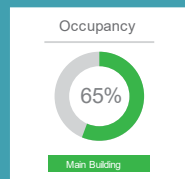
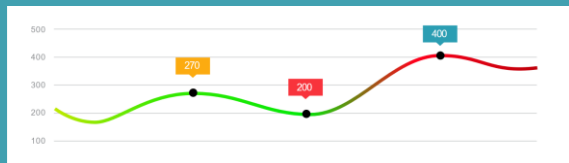


MAXIMUM
20 Persons



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Dashboard



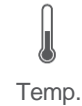
Active Workspace Management

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Active Workspace Management

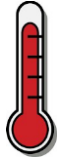


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Active Workspace Management



Temperature - local and occupant height. IR and air temperature sensors.



Occupancy detection - algorithm uses PIR motion, audio, and IR sensors



Full BLE communications available - integrate with iOS and Android easily



Humidity - Relative humidity at ceiling and also at occupant height



Audio out - customize sounds play through integrated speaker



Dual ethernet ports - supports BACnet, MQTT, and REST interfaces



Light intensity, RGB components, and colour temperature all reported



IR interface - control AV and other equipment directly



EnOcean radio supports connectivity to self-powered wireless sensing solutions for batteryless applications.

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Active Workspace Management



Occupancy
PIR | Audio | IR



IR | Thermistors



IR Blaster



Humidity



Light Color
Light Intensity



Audio Level



Bluetooth
Beacon



Urban Design
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Active Workspace Management



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APM 4.0: ASSET PERFORMANCE MANAGEMENT

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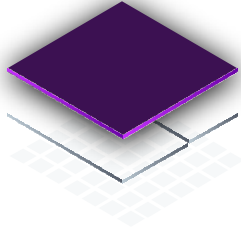
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APM 4.0: ASSET PERFORMANCE MANAGEMENT



Connected
asset



APM

OT/ IT

Technology

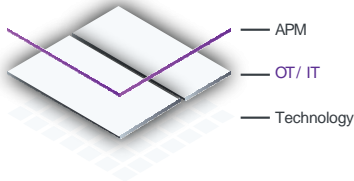


APM
Asset Performance
Management

Safety, Environment, Cost,
Performance, Condition



Connected
person



OT
Operational
Technology



Sensor



Edge



Networking
& power



Industrial Internet
of Things (IIoT)



IT
Information
Technology



Analytics



EAM



Mobile & AR

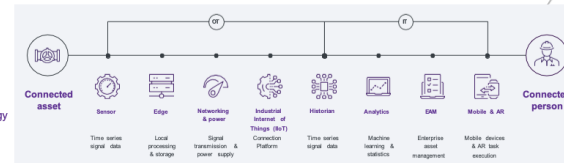
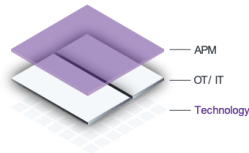
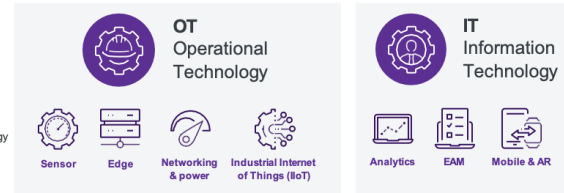
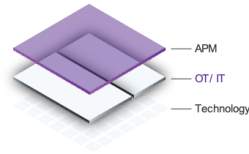
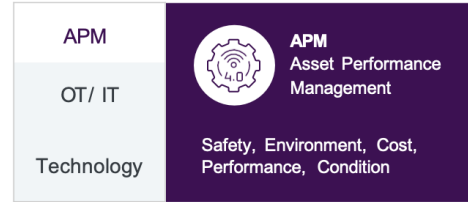
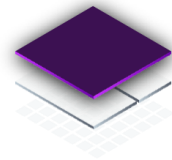
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APM 4.0: ASSET PERFORMANCE MANAGEMENT

Use Operational Architecture to Execute



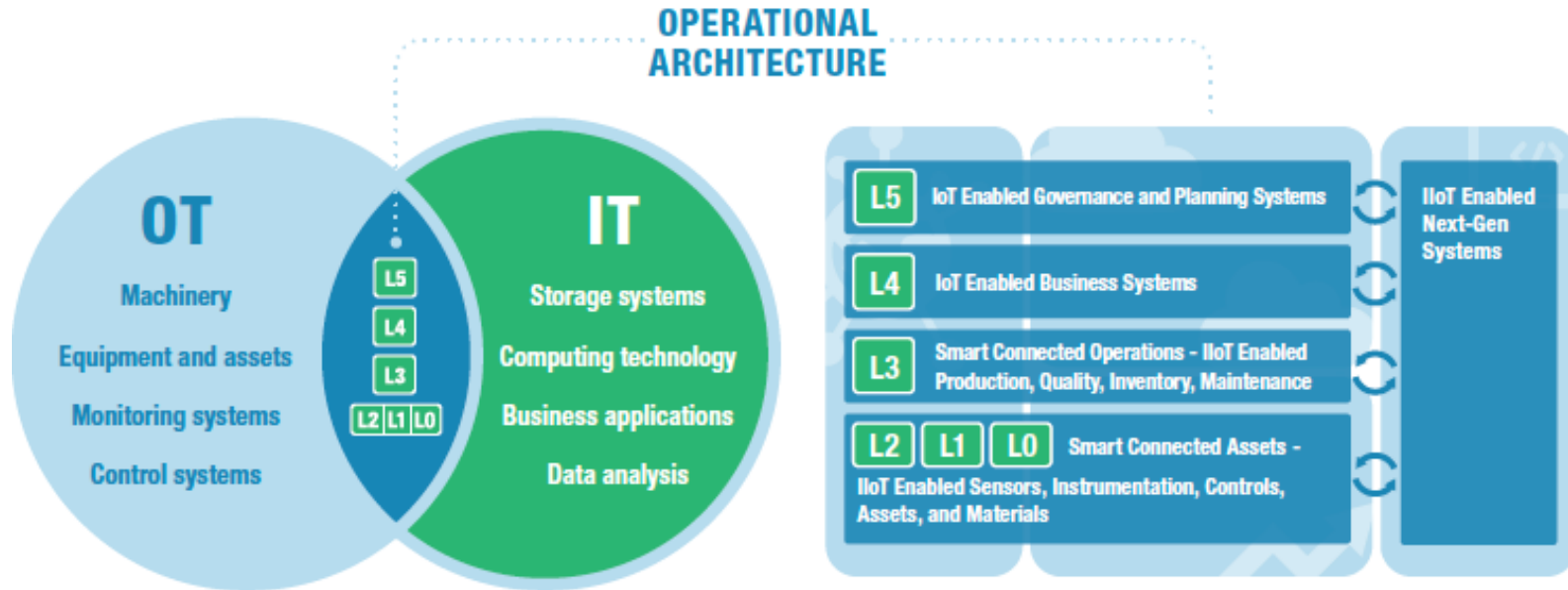
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APM 4.0: ASSET PERFORMANCE MANAGEMENT

Use Operational Architecture to Execute



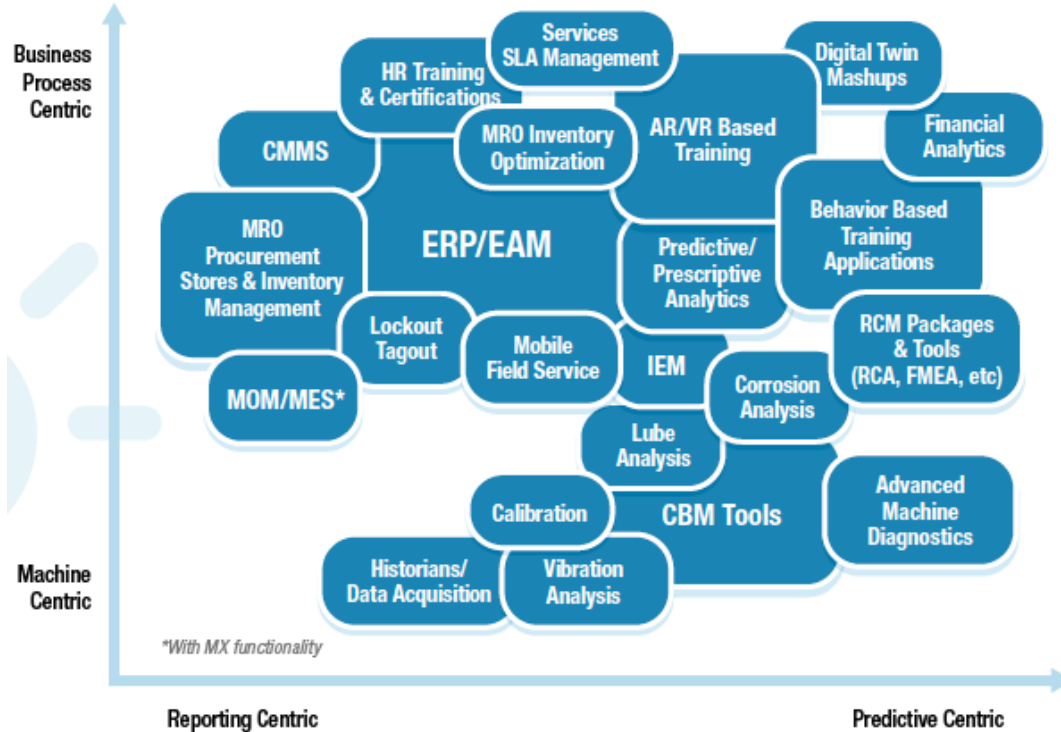
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APM 4.0: ASSET PERFORMANCE MANAGEMENT

REDEFINING ASSET LIFECYCLE FOR
INDUSTRY 4.0

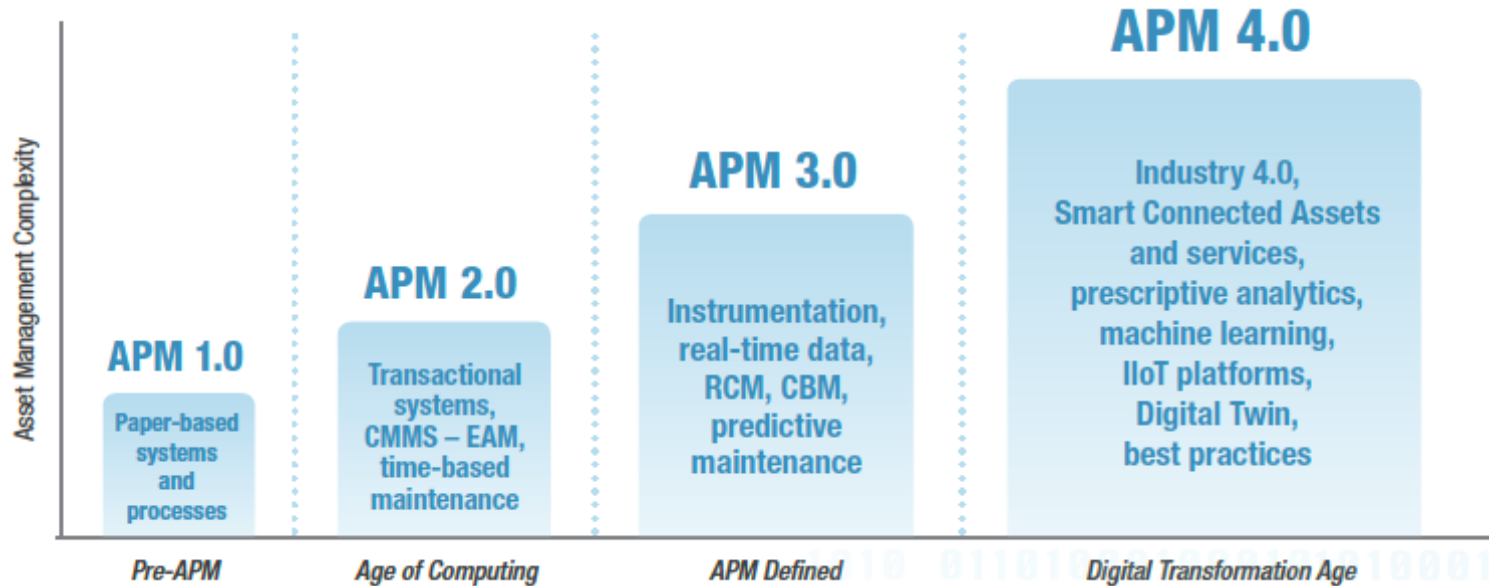


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APM 4.0: ASSET PERFORMANCE MANAGEMENT

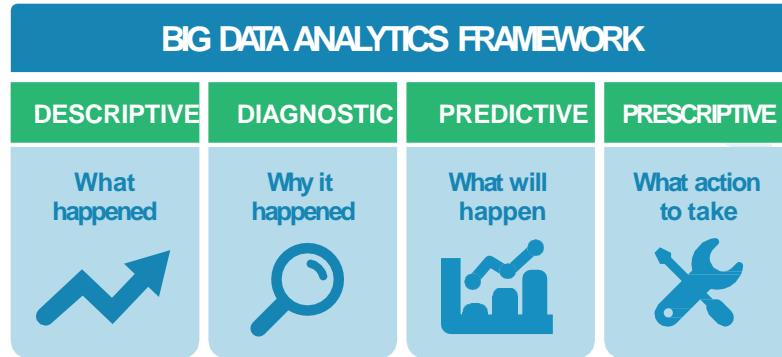
Industry 4.0 Demands a New Approach to
Asset Performance Management



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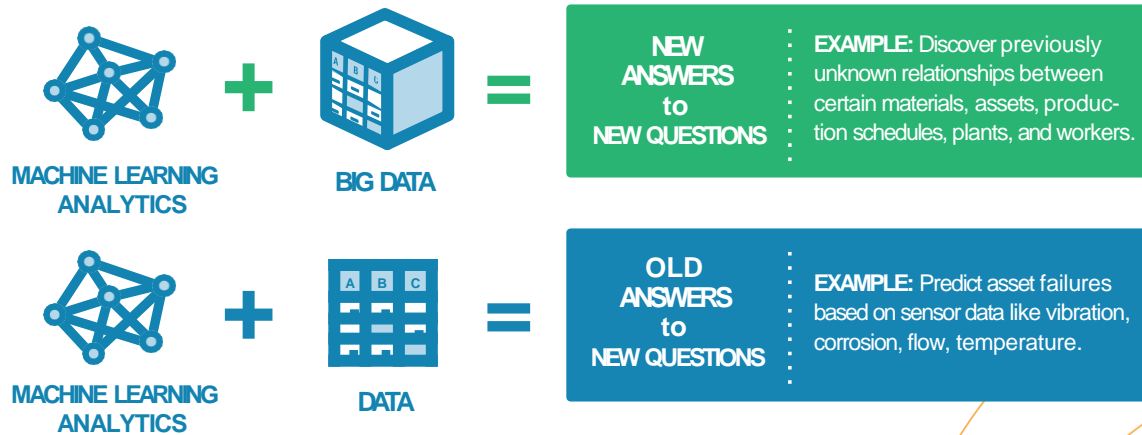
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Remote Monitoring and Monitoring Based Commissioning (MBCx) & Condition Based Maintenance

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EFs Checklist



	EF_1A	EF_1B	EF_2A	EF_2B	EF_4A	EF_4B	EF_5A	EF_5B	EF_6
Confirm Proper Operation of Hardware									
Abnormal data	✓	✓	✓	✓	✓	✓	✓	✓	✓
Missing data	✓	✓	✓	✓	✓	✓	✓	✓	✓
Failed sensors	✓	✓	✓	✓	✓	✓	✓	✓	✓
Measure not meeting Command	✓	✓	✓	✓	✓	✓	✓	✓	✓
Confirm Proper Sequence of Operations									
For each pair 1 EF must be ON at a point in time	✓	✓	✓	✓	✓	✓	✓	✓	✓

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Fault 10

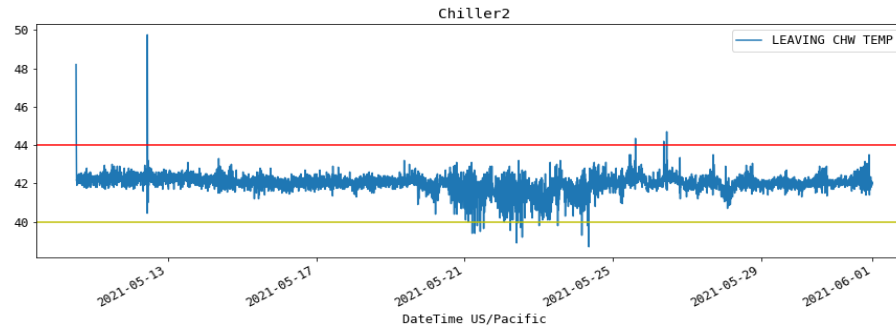
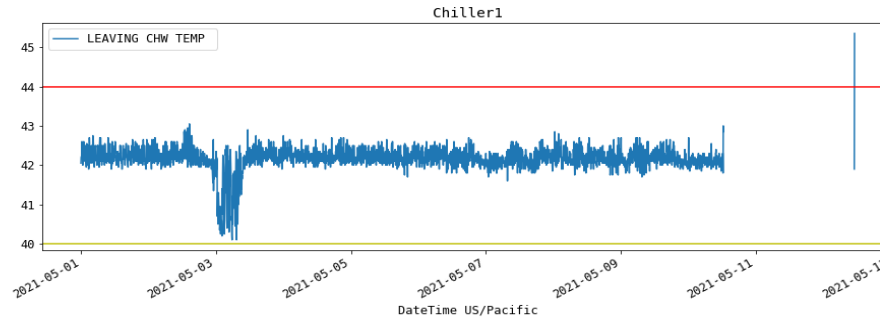
Evaporator Outlet Sensor Temperature is constant at 42 F



Urban Design
& Landscape



	mean	std	min	25%	50%	75%	max	Threshold	Fuzzy	Fault %
Chiller_01	42.18	0.3	40.1	42.05	42.2	42.3	45.35	42	+/-2	0
Chiller_02	42	0.46	38.7	41.85	42.05	42.25	49.75	42	+/-2	0



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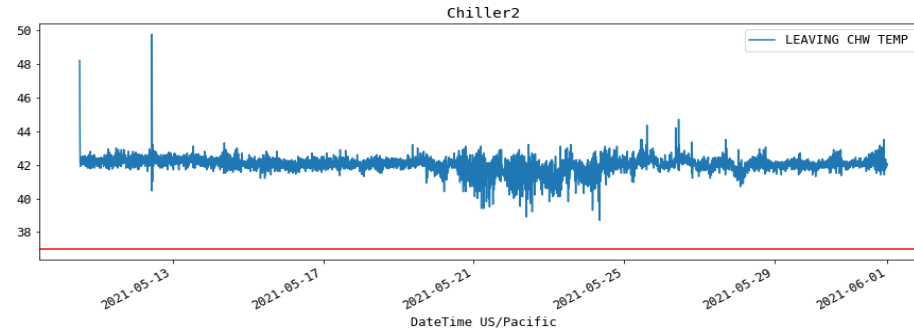
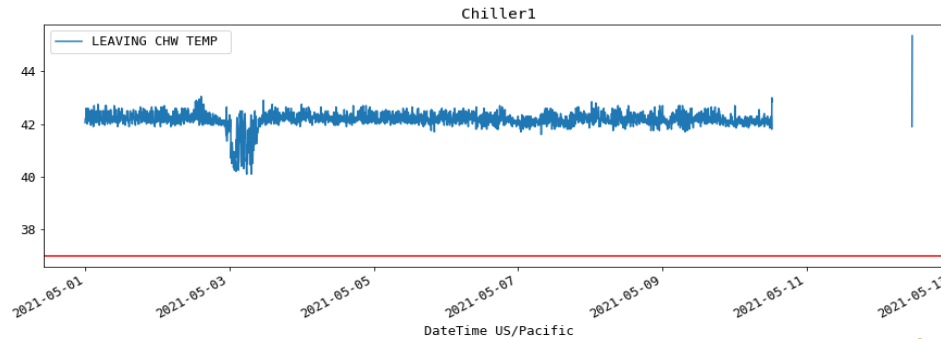
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Fault 9

Evaporator Outlet Sensor Temperature should remain higher than 37 F otherwise the chiller will stall

	mean	std	min	25%	50%	75%	max	Threshold	Fault %
Chiller_01	42.18	0.3	40.1	42.05	42.2	42.3	45.35	37	0
Chiller_02	42	0.46	38.7	41.85	42.05	42.25	49.75	37	0



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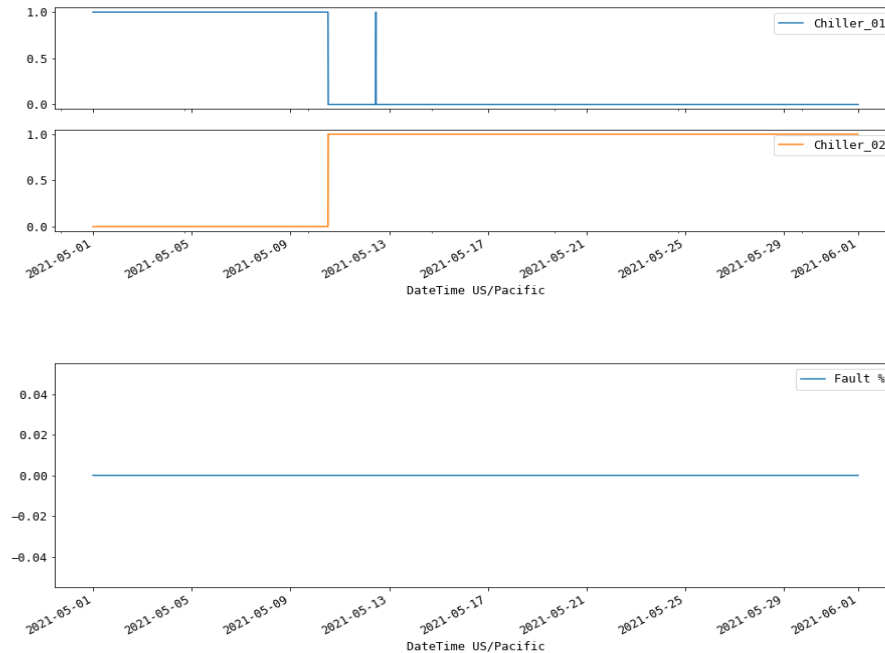


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Fault 12

Chillers shall operate in a lead/lag configuration and should rotate weekly

	Fault %
Chiller_01	0
Chiller_02	0



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Chillers Checklist



	Chiller_01	Chiller_02
Confirm Proper Operation of Hardware		
Equipment turning ON and OFF as commanded	✓	✓
Evaporator Pressure Exceeds Minimum (34 PSI)	✓	X
Condenser Approach Exceeds Maximum (3 °F)	✓	X
Evaporator Approach Exceeds Maximum (2.5 °F)	✓	X
Evaporator Approach going Negative	✓	⊖
Oil & Sump Pumps Differential Exceeds Minimum (30 PSI)	✓	✓
Oil Temp Out of Range (110 °F - 160 °F)	✓	✓
Evaporator Outlet Temp Exceeds Minimum (37 °F)	✓	✓
Confirm Proper Sequence of Operations		
Evaporator Outlet Temp meets SP (42 °F)	✓	✓
Confirm Lead / Lag	✓	✓
Confirm proper equipment schedules	X	X

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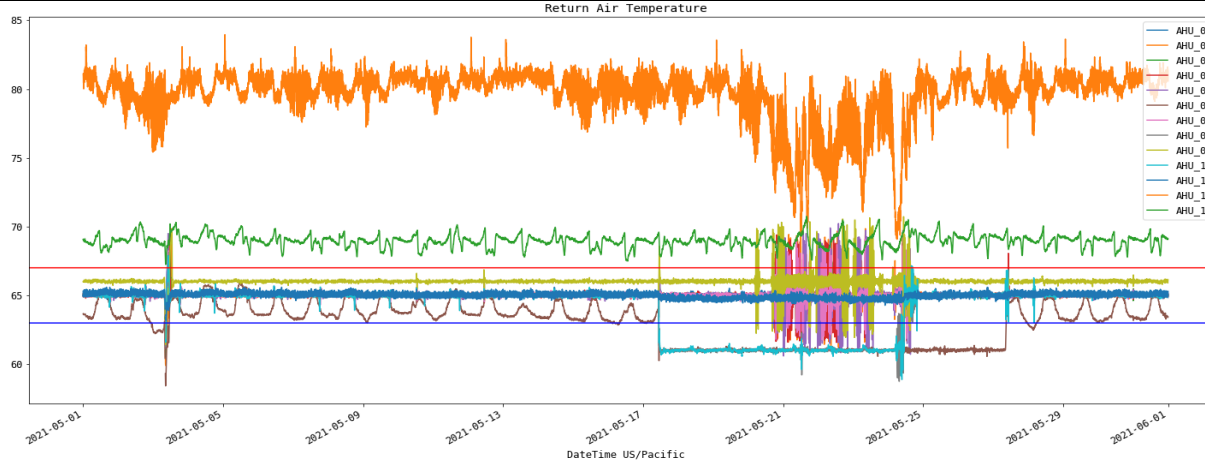
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Fault 2

Supply Air Temperature Set Point is based on a return air sensor temperature set point of 61 F when RH < 55%



	mean	std	min	25%	50%	75%	max	median	threshold	fuzzy	rolling window	Fault %
AHU_01	65	0.23	62.27	64.93	64.99	65.05	68.42	64.99	65	+/-2	30	0
AHU_02	65	0.48	59.88	64.94	65	65.06	69.85	65	65	+/-2	30	0
AHU_03	65	0.32	60.53	64.95	65	65.05	70.19	65	65	+/-2	30	0
AHU_04	65	0.44	61.18	64.93	65	65.07	69.43	65	65	+/-2	30	0
AHU_05	65	0.58	60.57	64.93	65	65.07	70.22	65	65	+/-2	30	0
AHU_06	62.96	1.48	58.39	61.06	63.38	63.97	66.06	63.38	65	+/-2	30	35
AHU_07	65	0.38	61.29	64.93	65	65.07	69.09	65	65	+/-2	30	0
AHU_08	64.1	1.69	58.72	64.86	64.97	65.03	68.14	64.97	65	+/-2	30	23
AHU_09	66	0.5	61.41	65.94	66	66.06	70.71	66	65	+/-2	30	1
AHU_10	64.1	1.69	58.85	64.79	64.97	65.03	67.88	64.97	65	+/-2	30	23



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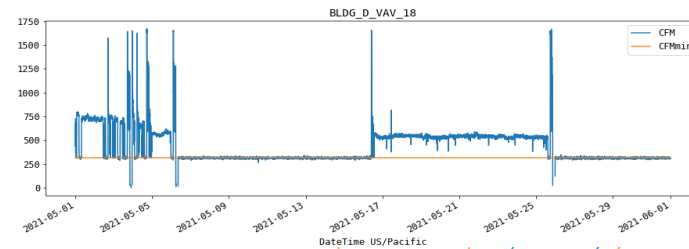
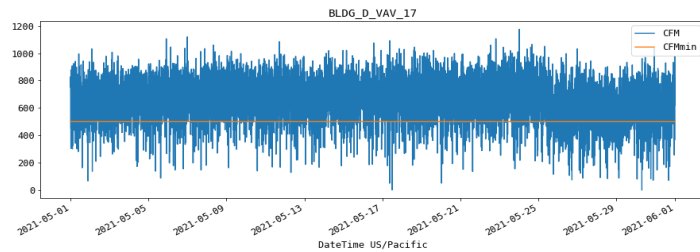
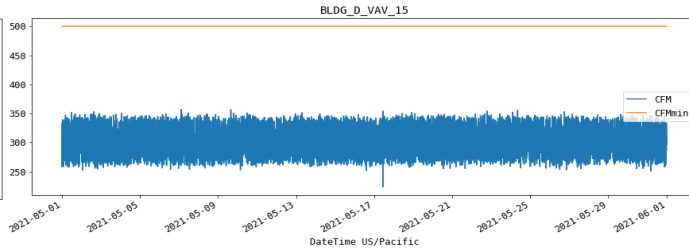
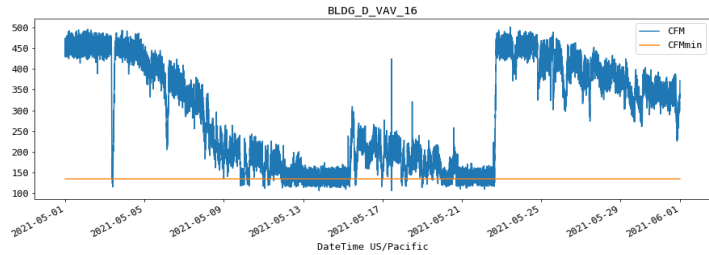
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Fault 1

VAV cfm should not exceed CFM Max threshold - VAV cfm should not drop below CFM Min threshold

Talks

Urban Design
& Landscape



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VFDs Checklist



	AHU_1_SF				AHU_2_SF		AHU_3_SF		AHU_4_SF		AHU_5_SF		AHU_6_SF	
	1	2	3	4	1	2	1	2	1	2	1	2	1	2
Confirm Proper Operation of Hardware														
Abnormal data	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Missing data	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	X
Failed sensors	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Measure not meeting Command	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	NEI
	AHU_7_SF		AHU_8_SF		AHU_9_SF		AHU_10_SF		AHU_11_SF					
	1	2	1	2	1	2	1	2	1	2	3	4		
Confirm Proper Operation of Hardware														
Abnormal data	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Missing data	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Failed sensors	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Measure not meeting Command	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
	AHU_12_SF				AHU_13_SF		AHU_14_SF				AHU_15_SF			
	1	2	3	4	1	2	1	2	3	4	1	2	3	4
Confirm Proper Operation of Hardware														
Abnormal data	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Missing data	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Failed sensors	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Measure not meeting Command	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
					EF				HWP					
	1A	1B	2A	2B	4A	4B	5A	5B	6	1	2			
Confirm Proper Operation of Hardware														
Abnormal data	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
Missing data	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
Failed sensors	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
Measure not meeting Command	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			

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Continuous Life Cycle Reports



Summary of FAHU-B1 Monthly Checkup Report

System	Pass / Fail	Remarks
Air Temperature Sensor	Fail	On coil air temperature sensor shows error
Air Relative Humidity Sensor	Pass	RH Sensor showing correct values within the expected range
Demand Control Performance	Pass	Co2 values shows values in expected range, fans are controlled adequately to reflect the control of fresh air.
Cooling Performance	Fail	Supply temperature is closely tracking the setpoint. Setpoint temp not following the logic.
Heat Recovery Wheel Performance	Fail	Performance not evaluated due to error in the on coil temperature.
Electrical Power Parameters	Pass	Voltage, current and power shows values in expected range. Unbalanced within allowable limits

Main observations

ID No.	Main observed faults / alarms OR Recommendation to Improve efficiency / Process	Impacts of the observation	Actions	Actions to be done by
4.4.1	On coil air sensor readings out of range. (sensor failure)	Sensor fault affects saving calculations	Check the oncoil air temperature sensor; Check the sensor connection and sensor reading	SmartAE O&M team
4.6.2	Phase C ranging between 4 and 4.5 Amp. (abnormal)	Reduce the motor life	Check phase C cable and check the motor winding	FM Team
	Amp unbalance ratio > accepted limit	Reduce the motor life		
5.4.1	No direct relation between Co2 sensors value and the demand	Fans almost kept running at constant speed.	Co2 sensors should be moved to another areas to detect the demand	SmartAE O&M team
5.4.3	Now heat recovery wheel operated based on the FAHU unit operation	Increasing in the consumption of the HRW motor	It is recommended to reprogrammed the unit to be operate based on a difference in temprature between fresh and return.	SmartAE M&T team

- Energy Saving Issue

- Equipment performance issue

- Comfort Issue

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THANK YOU

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