



Analytics And Its Use in Maintenance



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Traditional Maintenance

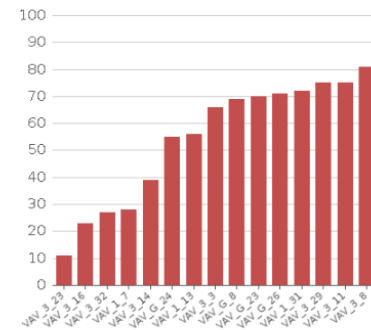
- Scheduled checking of equipment
 - Manual analysis of control
 - Manual checks performed
 - Time intensive tasks
- Equipment checked even if operating correctly



Data Driven Maintenance (DDM)

- Use time onsite more efficiently
 - Analytics can perform some maintenance checks
 - Use data to identify faults
- Target poor performing areas
- More time fixing, less time looking
- Average of 45% less time required

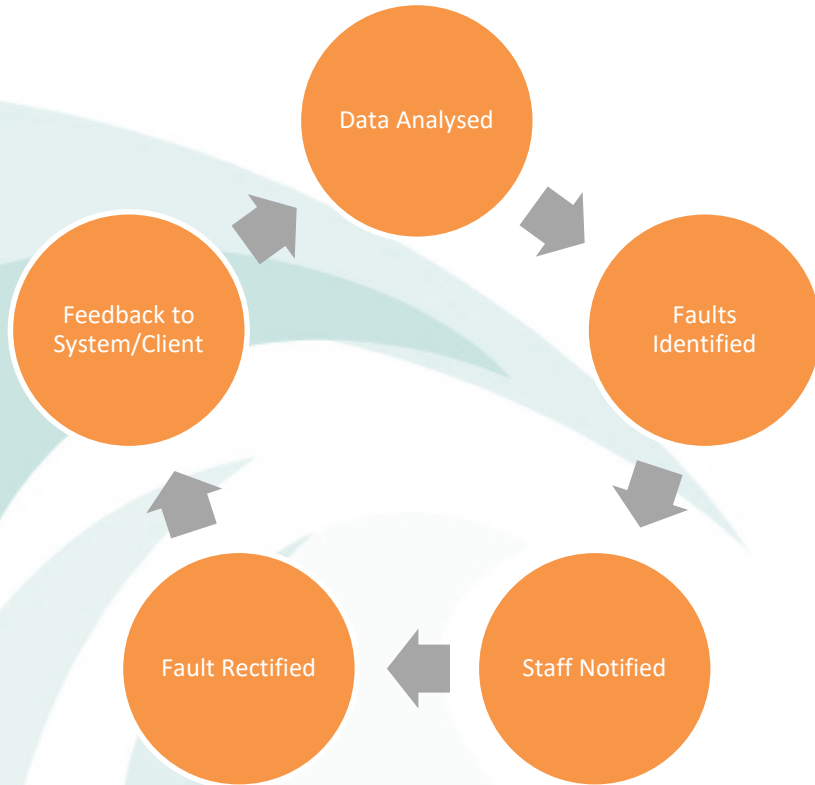
Bottom 15 KPI Scores



System	KPI
VAV_3_23	11
VAV_3_16	23
VAV_3_32	27
VAV_1_7	28
VAV_3_14	39
VAV_G_24	55
VAV_1_13	56
VAV_3_3	66
VAV_G_8	69
VAV_G_23	70
VAV_G_26	71
VAV_1_31	72
VAV_3_29	75
VAV_3_11	75
VAV_3_8	81

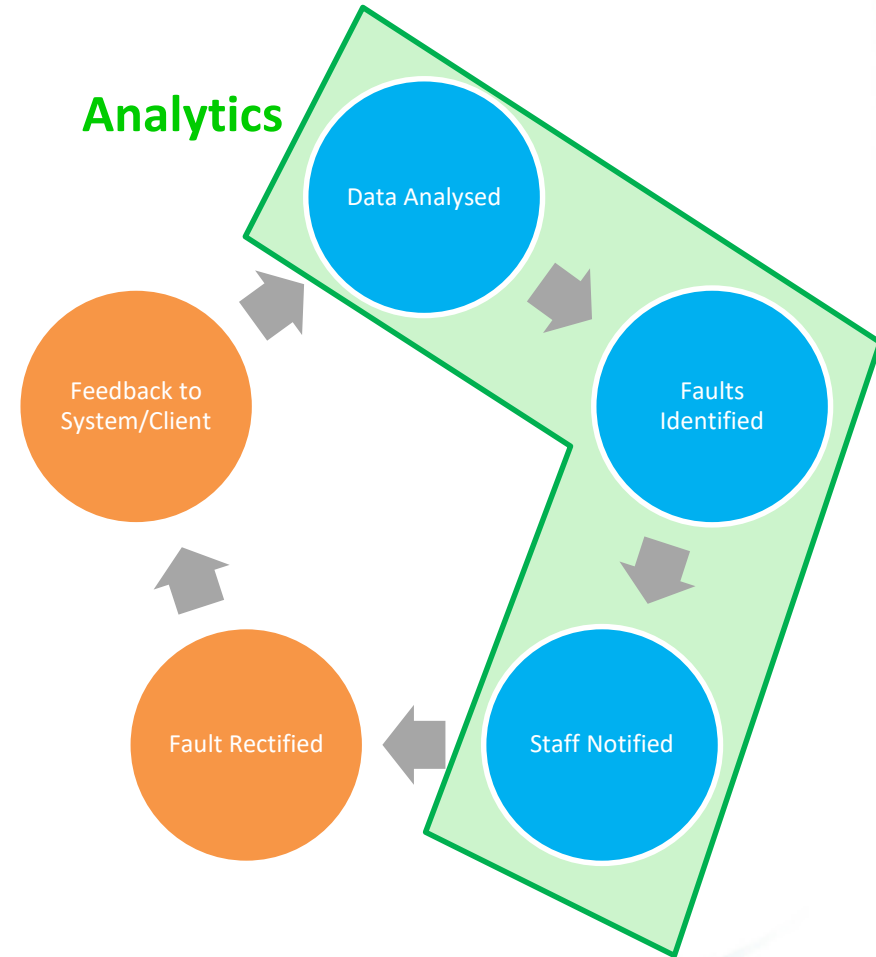


Data Driven Maintenance (DDM)



Traditional Maintenance

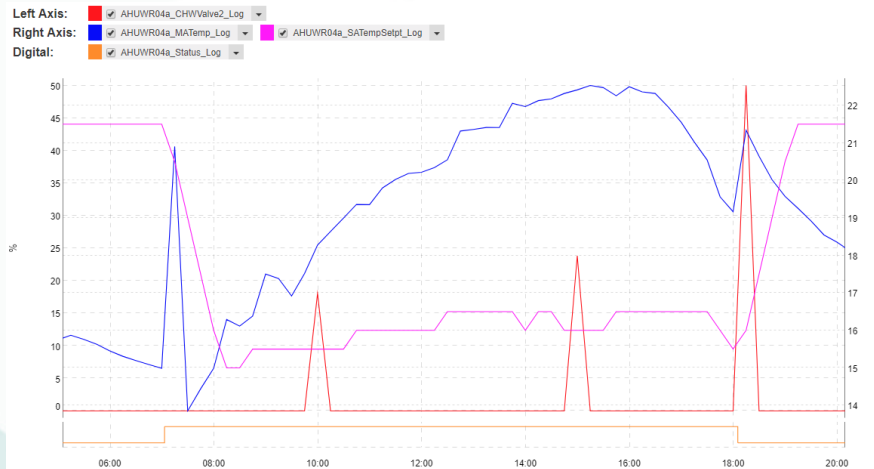
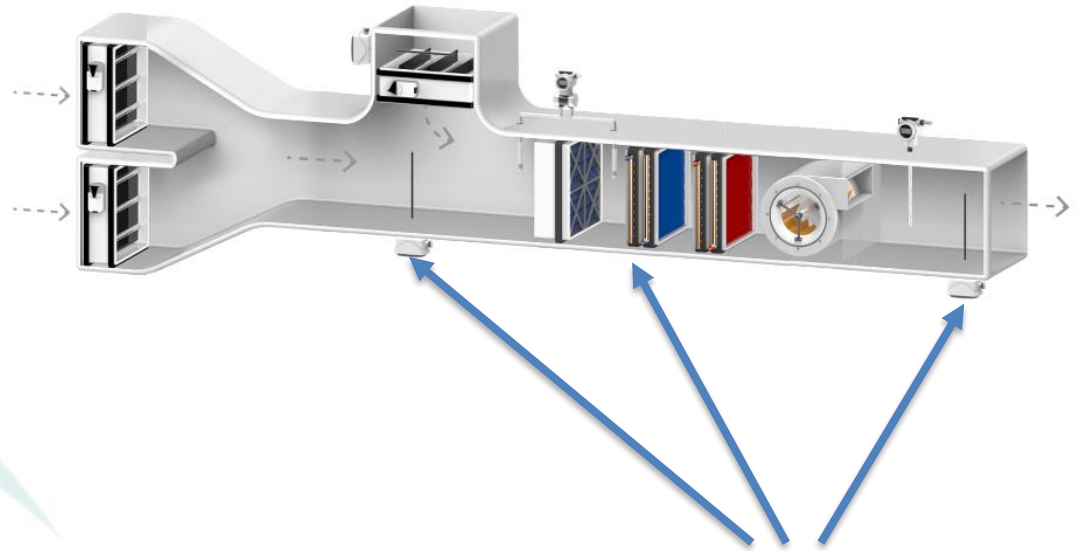
Analytics



Data Driven Maintenance

Example Fault

- Fault – Chilled water valve passing water
- We know there should be a small temperature differential with valved closed
- Test for an abnormal delta T when valve is closed

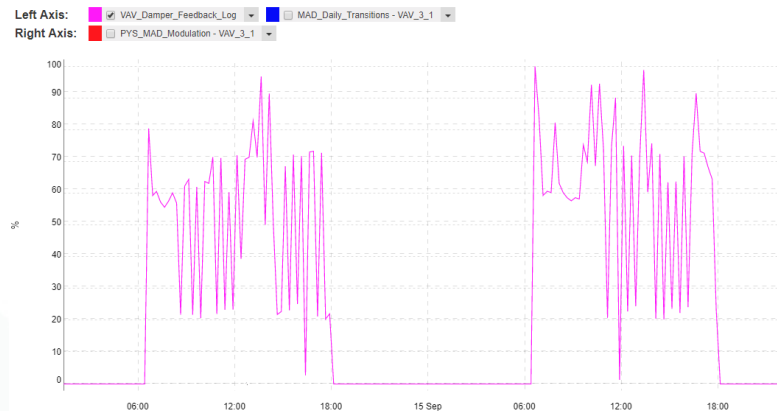
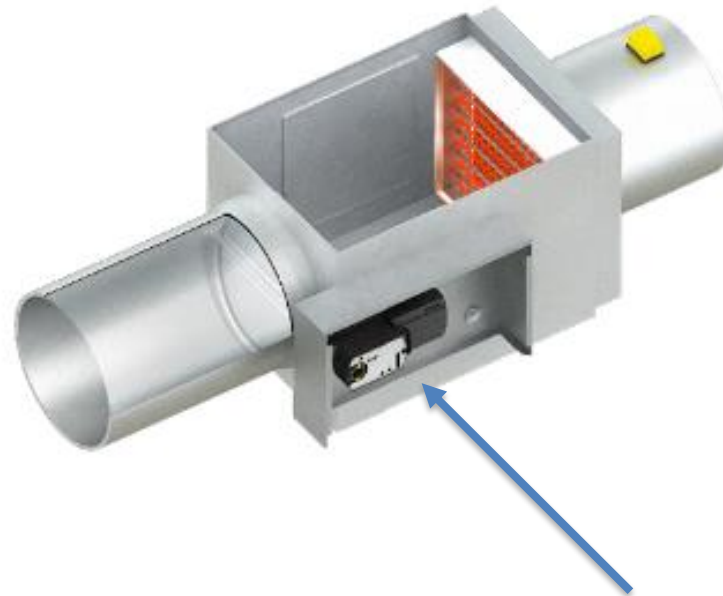


Check Delta T When valve is closed. When fault conditions are met for 'x' hours/day raise an alert



Example Fault

- Unstable VAV Airflow Control Loop
- Airflow might be within tolerance of setpoint, but equipment is working hard to maintain
- Excessive actuator modulation impacts its lifecycle



Count number of actuator modulations/day and alert when threshold is exceeded



DDM Model

Air Handling Unit Maintenance			
Task	Time (min)	Traditional	Analytics
Check chilled water actuator operation	5	✓	
Check hot water actuator operation	5	✓	
Check OA damper actuator operation	5	✓	✓
Check RA damper actuator operation	5	✓	✓
Check EA damper actuator operation	5	✓	✓
Check supply temperature control loop	10	✓	
Check supply pressure control loop	10	✓	
Check economy control strategy	5	✓	
Calibrate supply air temp sensor	15	✓	✓
Calibrate supply air pressure sensor	15	✓	✓
Calibrate mixed or return air temp sensor	15	✓	✓
Calibrate return air temp sensor	15	✓	✓
Verify operational hours	5	✓	
		115	75
		% less time	
		-34.78%	

VAV			
Task	Time (min)	Traditional	Analytics
Verify Damper operation	5	✓	
Check actuator is tight on shaft	5	✓	
Check pitot tubes	1	✓	
check room temperature control	5	✓	
check airflow control	5	✓	
Calibrate Room temp sensor	10	✓	✓
		31	10
		% less time	
		-67.74%	

Chiller/Boiler			
Task	Time (min)	Traditional	Analytics
Check supply water temp control	5	✓	
Verify staging	5	✓	
check pressure/flow control	5	✓	
Calibrate supply water temp sensor	10	✓	✓
Calibrate return water temp sensor	10	✓	✓
Verify operational hours	5	✓	
		40	20
		% less time	
		-50.00%	



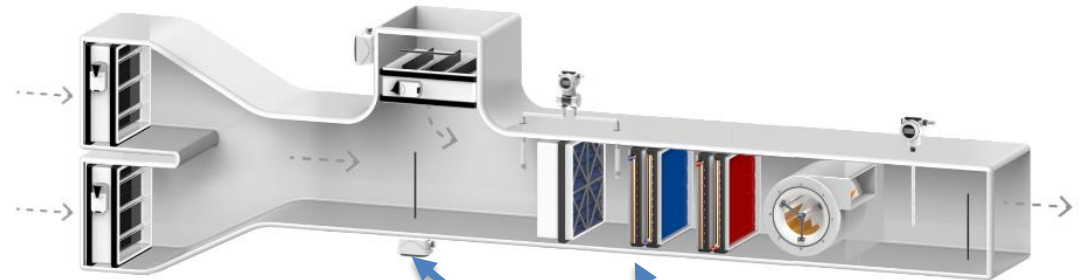
DDM Model

- An allocation of time on-site to check poor performing equipment.
Example: check the 'X' worst performing VAVs, AHUs
 - Perform some physical checks. Example calibrate sensors
 - On-site checks still need to be performed

<input type="checkbox"/>	Priority ↓	System ↑	Message ↑	Type ↑	Weekday ↑	Occurred ↑	State ↑
<input type="checkbox"/>	● High	OAF03	Status Mismatch	🔧	Tuesday	Aug 14, 2018 12:00 am	Active
<input type="checkbox"/>	● High	AC-1-1 (Type 2)	Supply air temperature sensor has failed	🔧	Monday	Aug 13, 2018 06:00 pm	Active
<input type="checkbox"/>	● High	AHU04	Suspect hot water valve is leaking	🔧	Monday	Jul 30, 2018 12:00 am	Active
<input type="checkbox"/>	● Medium	VAV_1_12	Damper is modulating excessively	🔧	Monday	Aug 06, 2018 12:00 am	Active
<input type="checkbox"/>	● Medium	VAV_2_17	VAV airflow sensor out of calibration	🔧	Sunday	Aug 12, 2018 12:00 am	Active
<input type="checkbox"/>	● Medium	VAV_2_26	VAV airflow sensor out of calibration	🔧	Tuesday	Aug 14, 2018 12:00 am	Active
<input type="checkbox"/>	● Medium	VAV_3_32	Damper is modulating excessively	🔧	Monday	Jul 16, 2018 12:00 am	Active
<input type="checkbox"/>	● Medium	OAF05	Fan state changes are higher than expected. Check and revise programming and sequence of operation to prevent unnecessary equipment cycling.	🔧	Monday	Aug 06, 2018 12:00 am	Active
<input type="checkbox"/>	● Medium	VAV_3_31	Damper is modulating excessively	🔧	Monday	Jul 09, 2018 12:00 am	Active
<input type="checkbox"/>	● Medium	VAV_G_2A	Damper is modulating excessively	🔧	Monday	Jul 16, 2018 12:00 am	Active



When It Becomes Too Much!!



- What happens when there is too much data?
- Its important to tune algorithms for the site.
- You don't need large amounts of algorithms

If $\Delta T < 0$ for 5 min/day raise an alert



Benefits and Pitfalls

Benefits

- Streamline maintenance
- Eyes on your building 24/7
- Catch issues before they become costly
 - Removes human error
 - Consistency of service
- Lower Energy Consumption

Pitfalls

- Analysis is only as good as the data it receives
- Data CANT identify all faults, human interaction is still needed
 - Can be more expensive



Big Data and Analytics

AIRAH Big Data & Analytics Special Technical Group

Membership is open to any financial AIRAH member.

If you are interested in being involved please email STGS@airah.org.au or call 03 8623 3000.