

MINING FOR GOLD \$\$\$

USING TREND LOGS TO UNCOVER RETROCOMMISSIONING OPPORTUNITIES

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ABOUT THIS PRESENTATION

- ✍ WHAT ARE TREND LOGS?
- ✍ WHAT TO LOOK FOR WHEN SEARCHING FOR OPPORTUNITIES?
- ✍ HOW TO USE TREND LOGS

BUILDING AUTOMATION SYSTEMS (BAS)

- ✍ THE BAS CAN PROVIDE A WINDOW INTO THE REALITY OF HOW A BUILDING REALLY PERFORMS

TREND LOGS

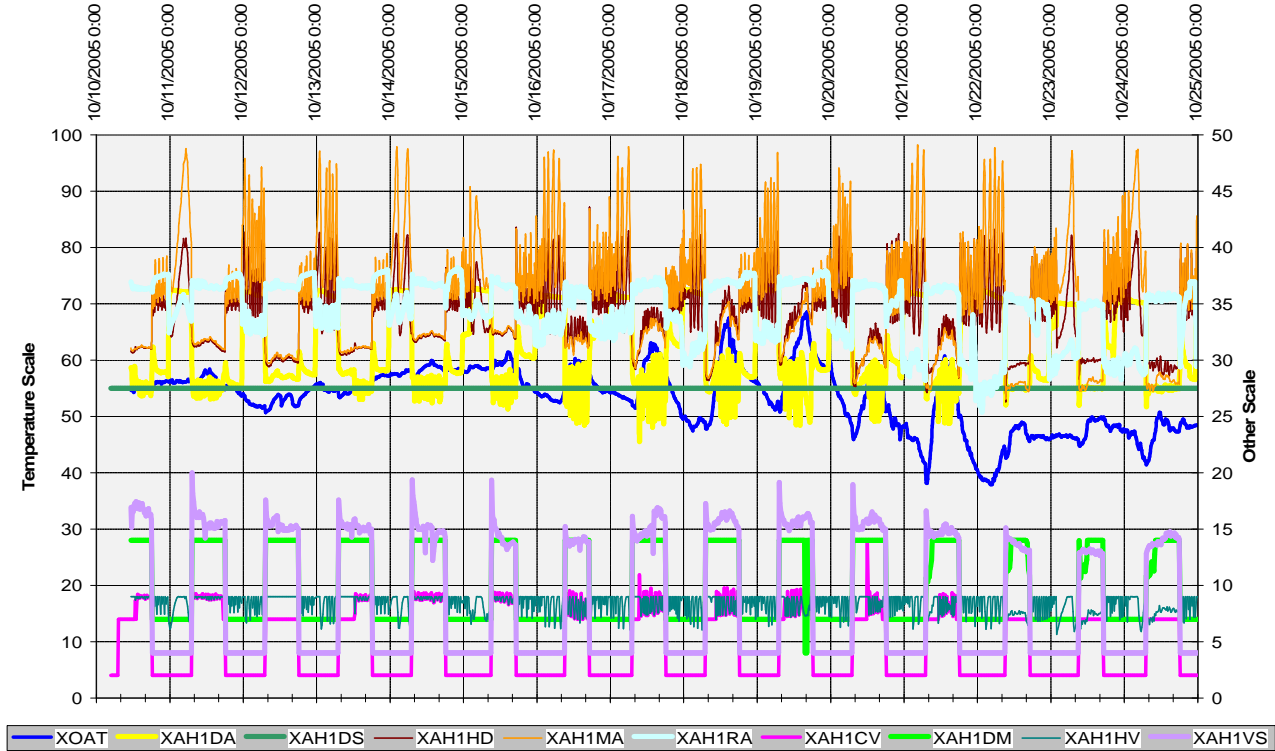
WHAT ARE THEY?

- TIME INTERVAL STAMPED DATA POINTS OF ACTUAL CONDITIONS AS READ AND RECORDED BY THE BAS
- USUALLY PRESENTED AS COMMA SEPARATED VALUES, EXCEL FILES, ODBC COMPLIANT DATABASES, OR GRAPHS

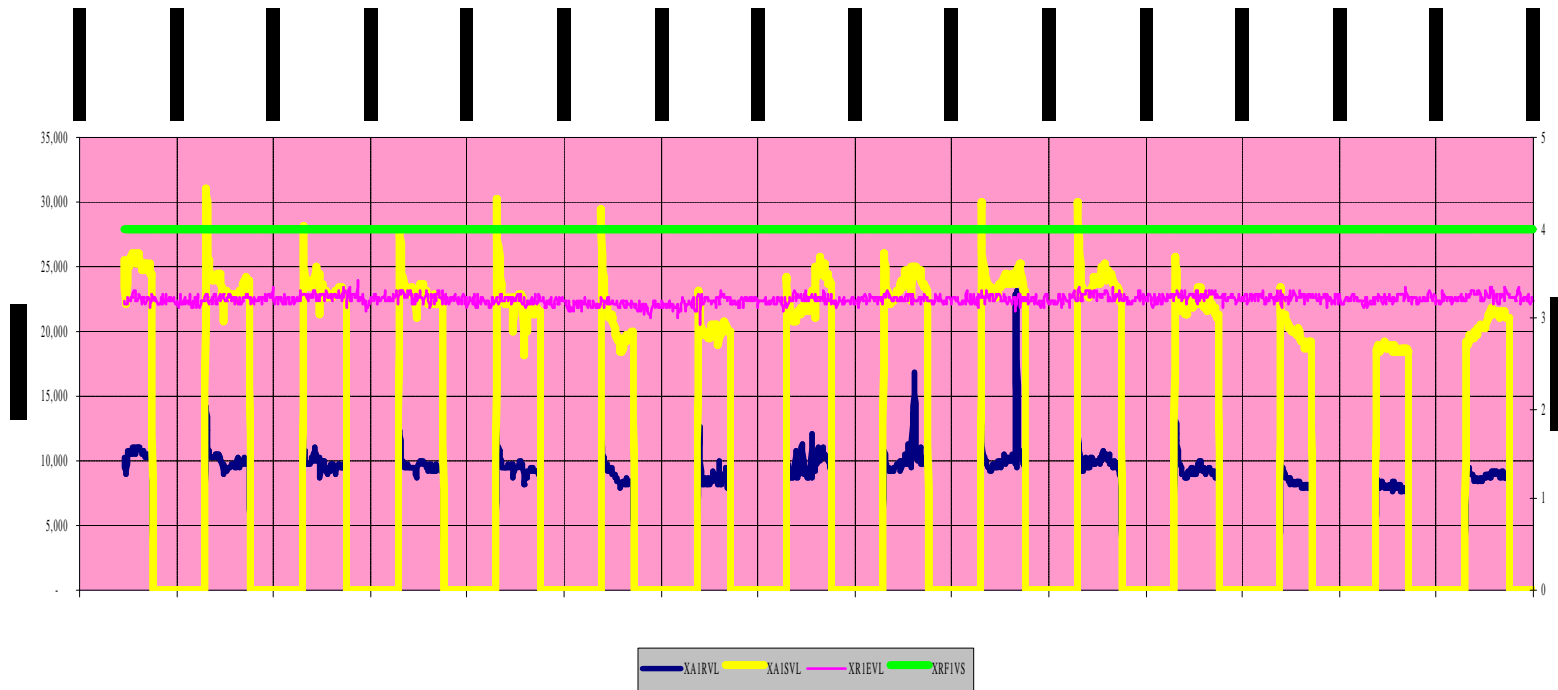
EXAMPLE DATA FROM TREND LOGS

Max	68.5	14.0	73.2	14.0	55.0	87.1	9.0	97.9	55.0	76.4	0.1	1.1	1.6	20.0	23,289	30,872	23,857		
Min	37.9	2.0	45.7	4.0	55.0	52.9	5.6	53.3	55.0	50.9	0.0	0.1	0.1	4.0	-	-	20,488		
	XOAT	XAH1CV	XAH1DA	XAH1DM	XAH1DS	XAH1HD	XAH1HV	XAH1MA	XAH1MS	XAH1RA	XAH1RV	XAH1SP	XAH1SV	XAH1VS	XA1RVL	XA1SVL	XR1EVL	XRF1VS	
10/10/2005 11:15	54.66	7	58.67	14	55	61.62	9	62.12	55	73.9	0.02	0.99	1.05	16.92	10,368	25,590	22,311	4	
10/10/2005 11:30	54.61	7	58.48	14	55	61.43	9	61.81	55	73.56	0.02	0.98	0.82	15.13	8,832	22,002	22,215	4	
10/10/2005 11:45	54.83	7	55.08	14	55	61.28	9	61.65	55	72.87	0.02	1	1.09	16.95	10,535	25,442	22,364	4	
10/10/2005 12:00	54.72	7	57.36	14	55	61.34	9	61.72	55	72.71	0.02	1.05	1.06	16.52	10,608	25,088	22,658	4	
10/10/2005 12:15	54.27	7	58.45	14	55	61.37	9	61.84	55	72.87	0.02	1.06	1.07	17	10,753	25,031	22,448	4	
10/10/2005 12:30	55	7	58.85	14	55	61.56	9	62.03	55	73.06	0.02	0.97	1.09	17.3	10,571	25,811	22,342	4	
10/10/2005 12:45	55.23	8.66	56.95	14	55	62.37	8.69	62	55	72.65	0.02	1.04	1.14	16.85	10,590	25,275	22,730	4	
10/10/2005 13:00	55.06	7	56.61	14	55	61.93	9	62.03	55	72.81	0.02	0.95	1.1	17.45	10,571	25,646	22,751	4	
10/10/2005 13:15	55.17	8.86	55.39	14	55	61.9	8.87	62.03	55	72.68	0.02	0.97	1.09	17.34	10,843	26,120	22,658	4	
10/10/2005 13:30	55.4	9.19	54.83	14	55	62.15	9	62.28	55	73	0.02	0.94	1.06	16.83	10,968	25,461	23,112	4	
10/10/2005 13:45	55.34	8.83	54.86	14	55	62.12	8.83	62.28	55	72.62	0.02	0.99	1.06	17.17	10,879	25,350	22,845	4	
10/10/2005 14:00	55.62	9.11	56.2	14	55	62.25	9	62.37	55	72.68	0.02	0.98	1.06	17.33	10,535	26,120	22,406	4	
10/10/2005 14:15	55.4	8.88	53.77	14	55	62.31	8.86	62.4	55	72.81	0.02	1.02	1.06	16.76	11,056	25,256	22,353	4	
10/10/2005 14:30	55.62	8.92	55.98	14	55	62.28	8.94	62.34	55	72.62	0.02	1.01	1.14	17.12	11,108	25,646	22,637	4	
10/10/2005 14:45	56.01	9.07	53.64	14	55	62.56	9	62.68	55	72.81	0.02	1.04	1.12	17.12	10,968	25,975	22,824	4	
10/10/2005 15:00	55.56	8.99	55.98	14	55	62.37	9	62.47	55	72.75	0.02	0.94	1.04	17.28	10,843	25,238	22,741	4	
10/10/2005 15:15	55.4	8.91	53.67	14	55	62.34	8.89	62.43	55	72.71	0.02	0.99	1.06	16.76	10,897	24,651	22,215	4	
10/10/2005 15:30	55.34	8.89	55.8	14	55	62.18	8.9	62.28	55	72.62	0.02	1.01	1.01	16.73	10,644	25,163	22,279	4	
10/10/2005 15:45	55.34	9.12	54.48	14	55	62.15	9	62.31	55	72.68	0.02	1.01	1.04	16.44	10,424	25,182	22,689	4	
10/10/2005 16:00	55.4	8.77	54.77	14	55	62.18	8.77	62.31	55	72.59	0.02	1	1.05	16.63	10,699	24,670	22,647	4	
10/10/2005 16:15	55.51	8.97	56.14	14	55	62.18	8.99	62.28	55	72.71	0.02	1.07	1.06	16.17	10,349	25,256	22,119	4	
10/10/2005 16:30	55.45	9.11	54.3	14	55	62.15	9	62.22	55	72.65	0.02	0.96	1	16.73	10,442	25,163	22,511	4	
10/10/2005 16:45	55.45	8.88	54.48	14	55	62.15	8.88	62.15	55	72.68	0.02	1.01	1.05	16.4	10,179	24,823	22,689	4	
10/10/2005 17:00	55.34	9.01	55.55	14	55	62.25	9	62.31	55	72.78	0.02	0.99	1	16.82	10,442	24,785	22,522	4	
10/10/2005 17:15	55.45	9	54.45	14	55	62.18	8.99	62.31	55	72.81	0.02	1	0.97	16.21	10,516	25,144	22,448	4	

EXAMPLE OVERVIEW GRAPH OF TREND DATA



More Trend Data



TREND LOGS

- ✍ VIRTUALLY ALL BUILDING AUTOMATION SYSTEMS HAVE TREND LOG CAPABILITY
- ✍ VIRTUALLY NONE HAVE TREND LOGS SET UP AND ENABLED!

BUILDING AUTOMATION SYSTEMS

- ✍ THEY ARE ESSENTIAL TO ACCOMPLISHING ***COST EFFECTIVE*** RETROCOMMISSIONING

WHAT TO LOOK FOR???

✍ DATA THAT DOESN'T MAKE SENSE!

OPPORTUNITY #1

SCHEDULING

- ✍ THE #1 RULE IN CONSERVING ENERGY IS TO SHUT EQUIPMENT OFF!
- ✍ OCCUPIED/UNOCCUPIED SCHEDULES ARE IN SYNCH WITH THE BUILDING OCCUPANCY?

SCHEDULING

- ✍ WHAT HAPPENS WHEN THE BUILDING GOES INTO UNOCCUPIED MODE?
 - WHAT ARE THE SETBACK/SETFORWARD SPACE TEMPERATURES?
 - ARE THE OUTSIDE AIR DAMPERS CLOSED?
 - ARE AIR VOLUMES MINIMIZED?
 - ✍ VAV
 - ✍ CV – Zone Isolation
 - ✍ Baseboard vs. Air

SCHEDULING

- ARE WE EMPLOYING ADAPTIVE OPTIMUM START/STOP?
- ARE EXHAUST FANS BEING SHUT OFF?
- IS THE LOWEST COST ENERGY COURSE BEING EMPLOYED?
 - ✍ GAS VS. ELECTRIC

OPPORTUNITY #2

SIMULTANEOUS HEATING AND COOLING

- ✍ NO RESET OF HOT DECK/COLD DECK AT AHU. THEREFORE UNNECESSARY REHEAT IS OCCURRING AT THE ZONE LEVEL OF CONTROL.
- ✍ POOR PLACEMENT OF TEMPERATURE SENSORS

SIMULTANEOUS HEATING AND COOLING

- ✍ CONTROL VALVE OVERSHOOT;
PREHEAT VALVE OVERSHOOTS,
COOLING VALVE OVERCOMPENSATES
AND REHEAT CORRECTS IT.
- ✍ HEAT/COOL RANGES ARE TOO NARROW
WITH NO DEADBAND OR, THEY MAY
EVEN OVERLAP.

OPPORTUNITY #3

DIS-A-POINTS

- ✍ LOOK FOR ACTUAL VS. SETPOINT OFFSET
- ✍ LOOK FOR SETPOINT VS. WHAT'S REALLY NEEDED
 - AHU DISCHARGE AIR TEMPERATURE
 - CHILLED WATER/HOT WATER TEMPERATURE
 - CONDENSER WATER TEMPERATURE
 - MINIMUM FAN/PUMP SPEED
 - VAV DUCT STATIC PRESSURE

DIS-A-POINTS

- ✍ WATCH FOR RAPID CYCLING OF VALVES AND HUNTING FOR SETPOINTS
- ✍ EMPLOY RESET SCHEDULES TO REDUCE ENERGY CONSUMPTION DURING NON PEAK PERIODS

DIS-A-POINTS

PAY ATTENTION TO GLOBAL POINTS THEIR INFLUENCE IS SIGNIFICANT

- ✍ OUTDOOR AIR SENSORS, ENTHALPY, STATIC PRESSURE, PRESSURE DIFFERENTIAL, ETC.
- ✍ LOOK FOR BOXES, VALVES, TEMPERATURES WHICH NEVER VARY AND FIND OUT WHY?
- ✍ USE COMPARATIVE SENSORS

PUTTING THE BAS TO WORK USING TREND LOGS

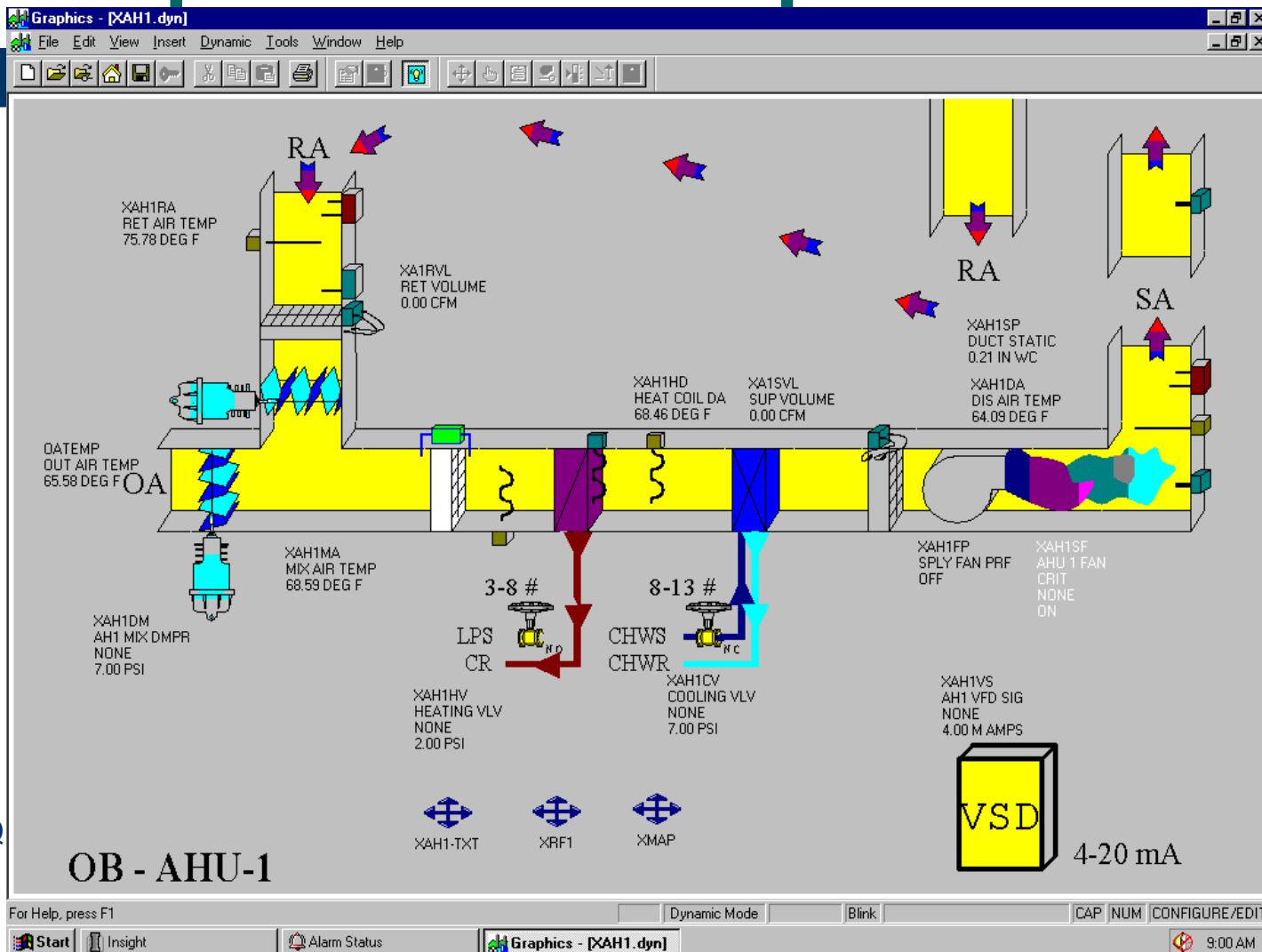
TREND LOGS

- ✍ TREND LOGGING IS A POWERFUL ANALYSIS TOOL BUT TAKES A HIGH LEVEL OF EXPERTISE AND EXPERIENCE TO FIND THE GOLD \$\$ IN AN EFFICIENT MANNER

GETTING STARTED

- ✍ GET FAMILIAR WITH THE SYSTEMS
- ✍ PRINT THE GRAPHICS – THESE SCREEN SHOTS USUALLY SHOW MOST SETPOINTS AND ACTUALS
- ✍ PRINT TIME OF DAY SCHEDULES AS A GROUP
- ✍ PRINT AN ALL POINTS LOG TO SEE WHAT'S CONNECTED
- ✍ PRINT AN ALARM REPORT
- ✍ PRINT A DISABLED LOG

Example Screen Snapshot



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GETTING STARTED

SEQUENCES CAN BE TIME SAVERS

- ✍️ OBTAIN ORIGINAL CONTROLS SCHEMATICS AND SEQUENCES
- ✍️ MANY BAS HAVE NOTEPADS WITH WRITTEN SEQUENCES

STEP 1 – CREATE A PLAN

- ✍ CREATE A TREND LOG PLAN TO DETERMINE WHAT NEEDS TO BE TRENDED AND HOW OFTEN
- ✍ DETERMINE LOGICAL GROUPINGS FOR SYNCHRONIZED COLLECTION OF DATA. THIS REDUCES DATA MANIPULATION LATER, AND IF POSSIBLE TAKES ADVANTAGE OF THE GRAPHING POWER OF THE BAS

TREND LOG PLANNING

- ✍ MAKE SURE TO THINK THROUGH WHAT YOU WANT TO SEE TOGETHER!
- ✍ GLOBAL POINTS ARE OFTEN CRITICAL PIECES OF THE PUZZLE WHICH NEED TO BE GROUPED WITH OTHERS
- ✍ MAKE SURE TIME STAMPS ARE SYNCHRONIZED!

TREND LOGS – STEP 2

- ✍ SYSTEM MEMORY MUST BE ANALYZED TO MAKE SURE IT HAS SUFFICIENT CAPACITY
- ✍ IN ORDER TO DO THIS YOU MUST DECIDE HOW MANY POINTS ARE TO BE TRENDED AND AT WHAT INTERVALS
- ✍ FOR EXAMPLE A SIMPLE VAV AHU WITH 10 FAN POWERED BOXES, EXCLUDING SAFETIES, WILL HAVE APPROXIMATELY 75 POINTS TO BE TRENDED

TREND LOGS

DATA ACQUISITION

- ✍ 75 POINTS TRENDED AT 5 MINUTE INTERVALS FOR A ONE MONTH PERIOD WILL RESULT IN 648,000 RECORDS. 5 AHUS WILL RESULT IN 3.2 MILLION DATA POINTS!
- ✍ TREND AT NO LONGER THAN 15 MINUTE AND NO SHORTER THAN 5 MINUTE INTERVALS

TREND LOGS – STEP 2

DATA ACQUISITION

✍ SO, WHAT HAPPENS WITH THIS MUCH DATA?

- IT SLOWS DOWN THE NETWORK AND CRASHES COMPUTERS THAT ARE NOT ROBUST ENOUGH
- IT HAS THE SAME EFFECT ON GOOD ENGINEERS, TOO!

TREND LOGS – STEP 2

DATA ACQUISITION

- ✍ THE QUANTITY OF DATA, PANEL MEMORY, FRONT END STORAGE MEMORY, AND TYPE OF NETWORK COMMUNICATION DETERMINE THE SYSTEM'S CAPABILITY
- ✍ ADJUST TREND LOGGING PARAMETERS TO WORK WITHIN THE CONFINES OF THE SYSTEM
- ✍ DETERMINE AND SCHEDULE DATA UPLOAD INTERVALS TO AVOID OVERWRITING DATA

TREND LOGS – STEP 3

INTEPRETING THE DATA

- ✍ DETERMINE HOW TO REDUCE THE DATA AND BRING A FOCUS ON TO PROBLEMS
- ✍ SORT DATA MATHEMATICALLY USING EXCEPTIONS AND VARIANCES
- ✍ PRIORITIZE BY SORTING ACCORDING TO HIGHEST PRIORITIES GIVEN TO THOSE VALUES WITH THE GREATEST QUANTITY OF EXCEPTIONS OR VARIANCES
- ✍ CREATE VIRTUAL POINTS BY MATHEMATICALLY CALCULATING THE MAGNITUDE OF VARIANCES AND THEN GRAPHING THEM OVER TIME

TREND LOGS – STEP 3

INTEPRETING THE DATA

- ✍ CREATE COMPARISONS BY CALCULATING EXPECTED RESULTS AND COMPARING TO ACTUALS, AND THEN ESTABLISHING VARIANCES
- ✍ FOR EXAMPLE, CALCULATE THE % OUTSIDE AIR BY TRACKING RETURN AIR, OUTSIDE AIR AND MIXED AIR TEMPERATURES
- ✍ THEN, CALCULATE THE VARIANCES FROM THE QUANTITY REQUIRED AS ESTABLISHED BY ACTUAL OCCUPANCY

TREND LOGS – STEP 3

INTEPRETING THE DATA

- ✍ THIS CALCULATION OF OA% CAN ALSO BE USED TO DETERMINE WHEN THE ECONOMIZER IS NOT FUNCTIONING PROPERLY BY COMPARING THE OUTSIDE AIR QUANTITIES TO MINIMUMS AND THEN CHECKING AGAINST ECONOMIZER ENALBE/DISABLE CONDITIONS

DEMO

✍ HERE ARE A FEW IDEAS ON WAYS TO
SPEED UP THE DATA ANALYSIS AND
DISCOVER OPPORTUNITIES