BUILDING performance LAB

AUDITING (WITH) BAS

AEE-NY APRIL 2015

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CUNY BUILDING PERFORMANCE LAB
THE CITY COLLEGE OF NEW YORK

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BAS IN NYC BUILDINGS

- BAS in larger commercial-institutional buildings – est. 3,000-5,000 in NYC
- Two basic forms of infrastructure
  - Digital overlay on top of pre-existing pneumatic controls
  - Direct digital control (DDC)
- Interoperability protocols
  - BACnet – dominant protocol
  - Modbus – plays an increasingly minor role
  - LonWorks – becoming a “legacy” protocol
- Multiple vendors, long history with multiple generations
  - Early systems were fully proprietary

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BAS IN THE ENERGY AUDIT PROCESS

- Use to view and understand major HVAC system components
  - Basic practice of reviewing “screens” with operating engineers
  - View real-time operating conditions
- Trend logs for understanding control sequences
  - Often requires specialized knowledge of specific vendor systems
  - Data storage limitations
  - Data acquisition facilitated by interoperability protocol

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AUDIT OF THE BAS

- Need to systematically understand what any given BAS can do
  - Standardization, automation, compliance
  - For audit purposes, retro-commissioning, ongoing commissioning and controls optimization
- Tool Development: BASAT (Building Automation System Assessment Tool)
  - Audit of available data points (sensors, actuators)
  - Structured spreadsheet to assess capabilities
  - Identification of “key sensors” (LL87 requirement)

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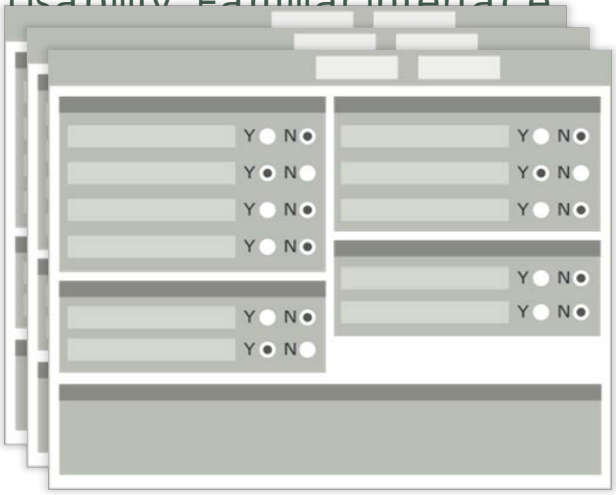
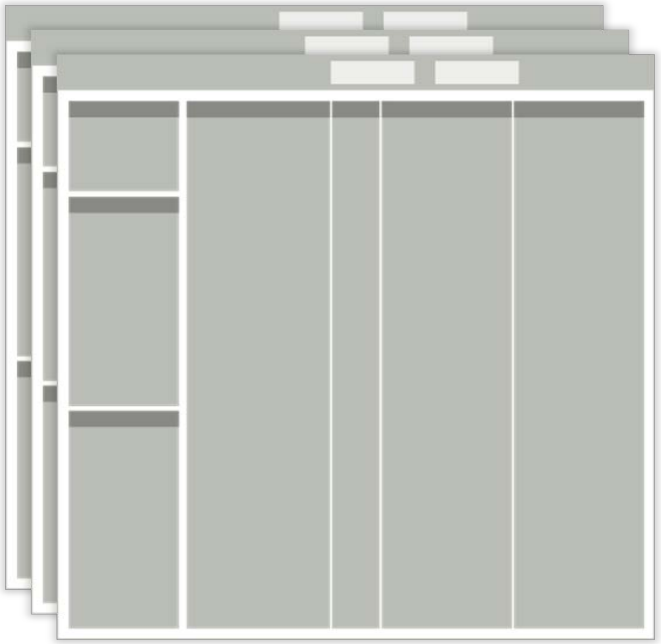
BASAT FRAMEWORK

- Organization: Structured spreadsheets
- Usability: Familiar interface



Inputs



Outputs

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BASAT INPUTS

Unit ID
Identifies unit being assessed

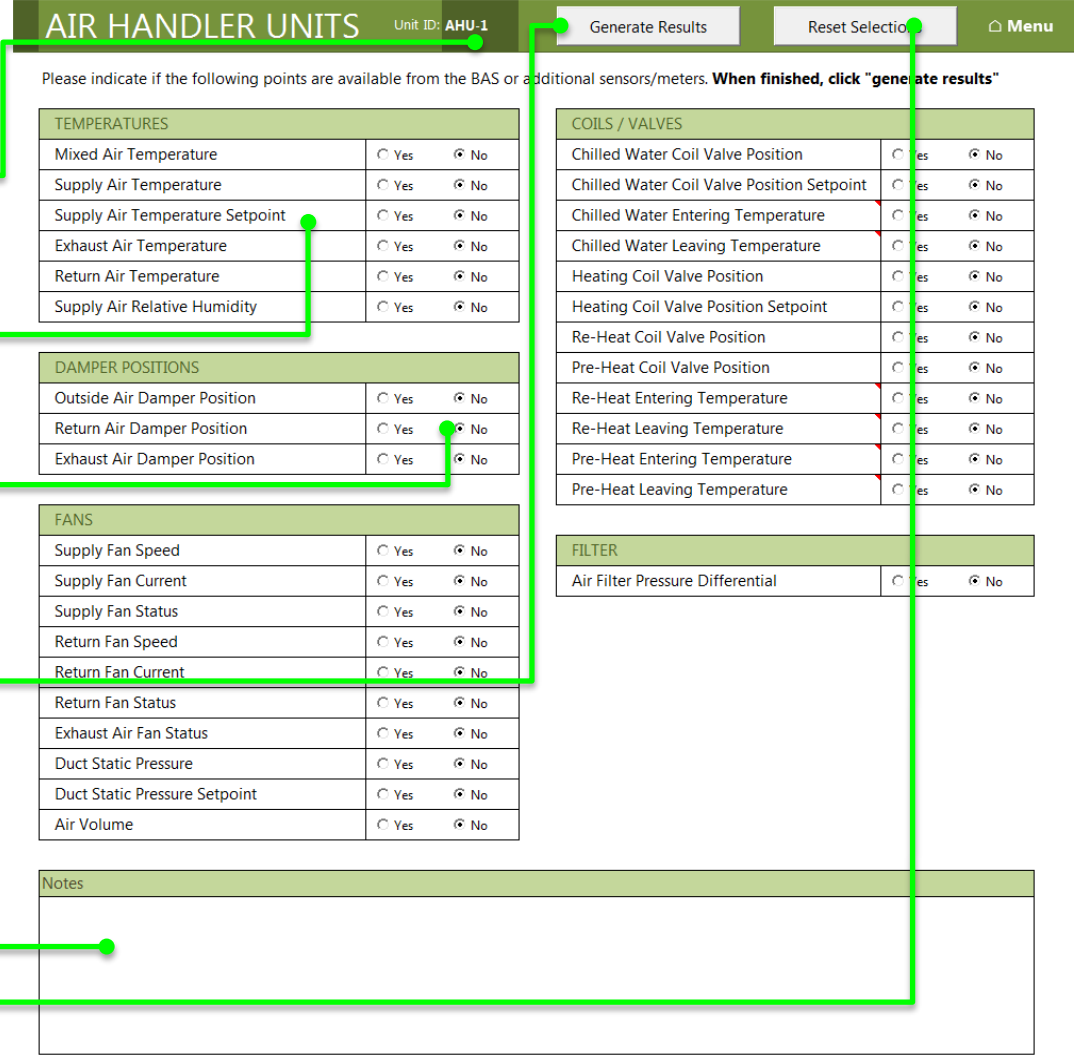
List of Point Names
List of points being audited by BASAT

Yes/No Radio Buttons
Indicate availability of points from BAS front end

Generate Results
Run the embedded (VB) logic and populate results sheets

Notes
Any pertinent information for the system being surveyed

Reset Selections
Clear selections and notes



BASAT SYSTEMS AND PROTOCOLS

- Systems
  - Ambient
  - Zone
  - Cooling Plant
  - Heating Plant
  - Air Handlers
- Protocols
  - Building Re-tuning
  - LEAN Energy Analysis
  - Local Law 87
  - Demand Response

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BASAT OUTPUTS

Unit ID(s)
Identifies unit(s) being assessed

Building and BAS Info
Summary of BAS and building info

Data Points Available Now
List of points marked available (Yes) on input sheet

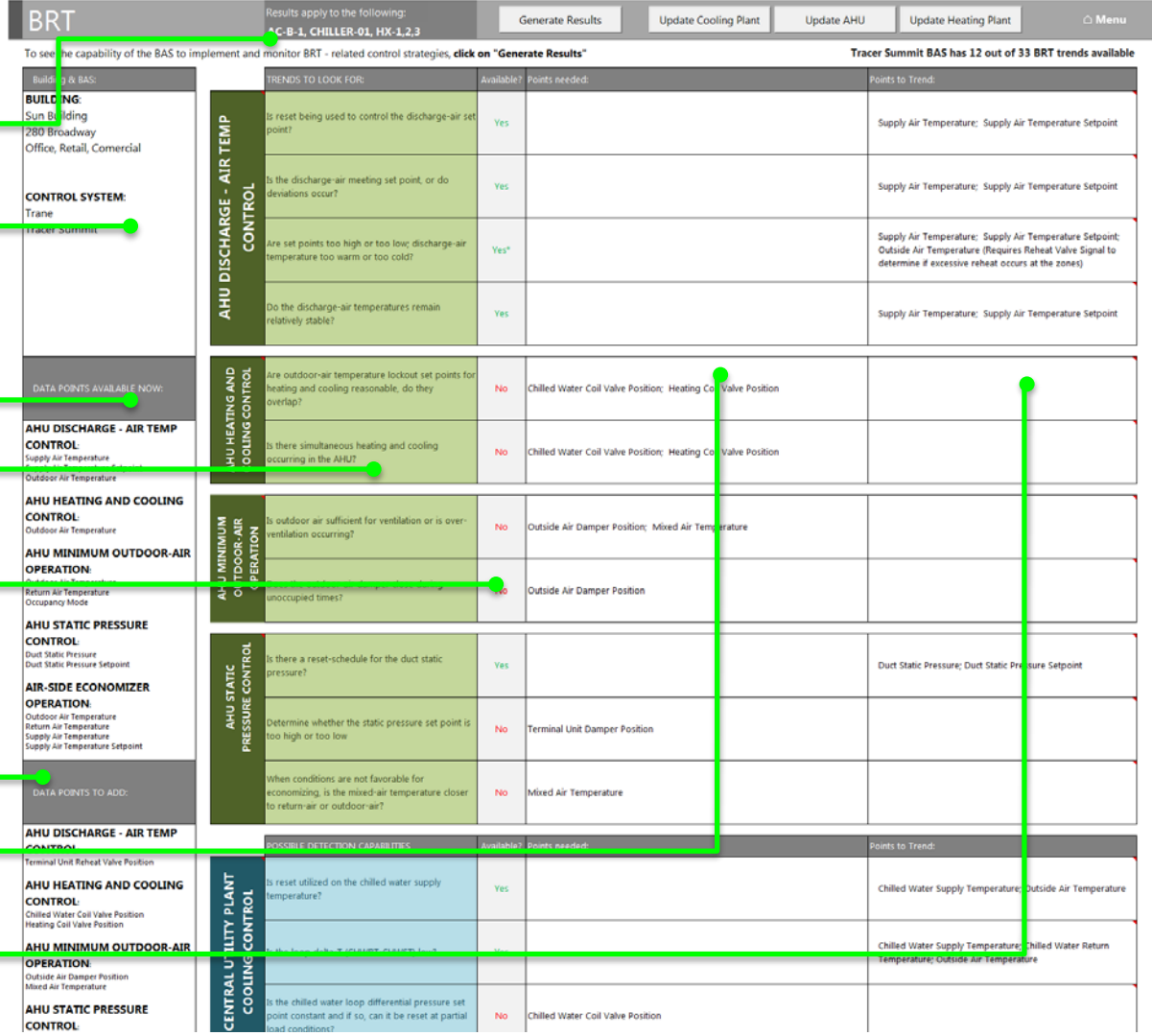
Capabilities List
List of potential BAS capabilities

Availability of Measure or Trend
Indicates whether BAS capability is present
based on currently available points

Data Points to Add
List of points not available

Additional Data Points Needed
Per-measure list of points missing and needed to implement specific measure or trend

Points to Trend/Notes
Specific points to trend and what to expect from the time series plot



BASAT OUTPUTS: SAMPLE

Sample output from Building Re-tuning (BRT) protocol section

	TRENDS TO LOOK FOR:	Available?	Points needed:	Points to Trend:
AHU MINIMUM OUTDOOR-AIR OPERATION	Is outdoor air sufficient for ventilation or is over-ventilation occurring?	No	Outside Air Damper Position; Mixed Air Temperature	
	Does the outdoor-air damper close during unoccupied times?	No	Outside Air Damper Position	
AHU STATIC PRESSURE CONTROL	Is there a reset-schedule for the duct static pressure?	Yes		Duct Static Pressure; Duct Static Pressure Setpoint
	Determine whether the static pressure set point is too high or too low	No	Terminal Unit Damper Position	

IDENTIFICATION OF KEY SENSORS

Point Statistics

- Can be used to prioritize the addition of missing/unavailable sensors to the BAS
  in relation to a particular protocol (DR, BRT, LL87)

Point Name	Equipment/Section	BRT	LL87	LEAN	DR	TOTAL
Supply Air Temperature Setpoint	AHU Temperatures	0	6	0	1	7
Zone Occupancy Status	Zone	0	5	0	1	6
Supply Air Temperature	AHU Temperatures	0	4	0	1	5
Chilled Water Coil Valve Position	AHU Coils/Valves	0	3	0	1	4
Duct Static Pressure	AHU Fans	0	3	0	1	4
Terminal Unit Reheat Valve Position	Zone	0	3	0	0	3
Chilled Water Supply Temp.	Chilled Water Loop	0	3	0	1	4

There are six Local Law 87 measures that require a Supply Air Temperature Setpoint

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FACILITIES ASSESSED

NYC DCAS

- Manhattan Civil Court
- Manhattan Municipal Building
- Queens Supreme Court
- Queens Civil Court
- Bronx Hall of Justice
- 280 Broadway
- Brooklyn Family Court
- Q102

CUNY

- John Jay College
- City College of New York
- Medgar Evers

Commercial Real Estate

- 1500 Broadway
- 1740 Broadway
- 888 7th Avenue
- 330 Madison Avenue
- 111 8th Avenue

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CASE STUDY: 1500 BROADWAY

Cooling: Steam Absorption Chillers

Heating: District Steam; HW loop for interior and perimeter induction units

Air side: Perimeter and interior Chilled Water AHUs

BAS: Andover (Schneider Electric)

- Found that setting up trends in the BAS was possible, however operators were not aware of capability
- BAS lacked functionality to set up programmable setpoint resets and setbacks
- Recommended the addition of:
  - Chilled and Condenser Water Flow sensors (needed to indicate condenser or evaporator fouling as well as setpoint tracking issues)
  - Mixed Air Temperature sensor (allow for calculation of Outside Air Fraction

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CASE STUDY: 1740 BROADWAY

Cooling: Steam Absorption Chillers

Heating: District Steam; HW FCUs

Air side: Interior, Perimeter and Lobby CHW AHUs

BAS: Andover (Schneider Electric)

- Site survey was carried out with two goals in mind:
  1. Identify the types of equipment and sensors the controlled by the BAS
  2. Provide insight on possible BRT measures that could be performed
- Recommended the addition of:
  - Mixed Air Temperature sensor
  - Outside Air Fraction (calculated virtual point)

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CASE STUDY: 111 8TH AVENUE

Cooling: CHW provided by central plant; condenser water supplied by secondary loop from PHX system

Heating: District Steam and electric reheats

Air side: CHW and DX AHU units; perimeter FCUs

BAS: Three BASs: Trane, Alerton, Siemens (not connected)

- Found that the following trends were available on the Alerton BAS:
  - Discharge-Air Temperature Control
  - Static Pressure Control
  - Zone Heating & Cooling Control
  - Occupancy Scheduling
  - AHU Heating and Cooling Control
- Demand Response: Found that the Trane BAS is capable of automatic, semi-automatic and manual DR strategies

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BASAT: BENEFITS IN ENERGY AUDIT PROCESS

- Faster understanding of BAS capabilities in its current state
- Easier identification of additional sensors/actuators required for effective upgrade
- Leads to more systematic acquisition and use of data
- Enables lower level (less experienced) audit engineers to work more effectively with BAS
- Connects the audit process to retro-commissioning
- Connects the audit process to ongoing commissioning and control improvements

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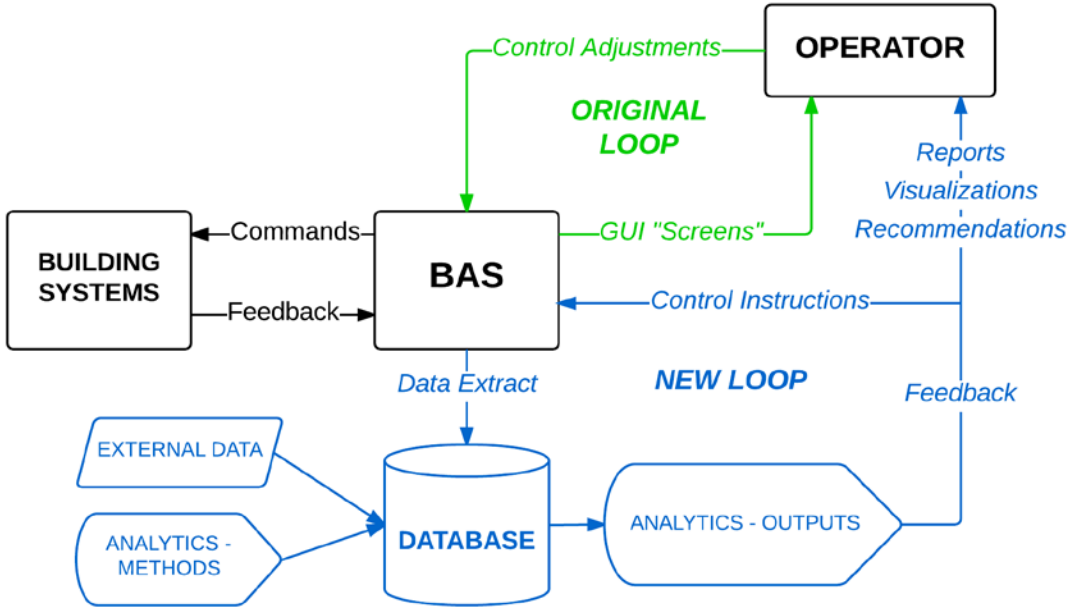
BASAT: PART OF INDUSTRY EVOLUTION

- Emergent Paradigm for using Big Data for buildings – data extraction from BAS and new feedback loop
- SAAS providers; NYSERDA programming
- BASAT to assess "readiness" of BAS for new process-information flow



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BASAT: FUTURE ENHANCEMENTS

- More agile framework; additional systems, measures, trends
- Prioritization or ranking of capabilities and recommended actions based on energy and cost savings potential
- Cost analysis of sensor/actuator upgrades
- Test for alarms by exception
- Built-in simple, common calculations
- Part of BAS product suite for more complete analysis
- Ability to communicate directly with BAS to automate trend log setup

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DEMONSTRATION

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Advancing energy-efficient building practices through research, outreach, and training.

CIUS The City University of New York

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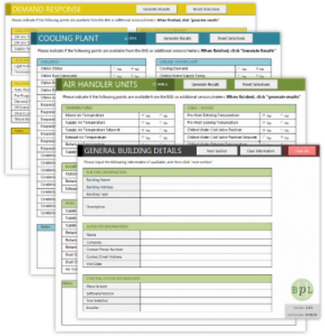
Building Automation System Assessment Tool (BASAT)

Downloads: BASAT 2.6 | BASAT 2.6 User Manual



The rapid advancement of building automation devices, coupled with the importance of improved environmental performance, has led to the installation of building automation systems (BAS) in an increasing number of buildings. The Building Automation System Assessment Tool (BASAT) created by the CUNY Building Performance Lab seeks to provide a basis for a standardized approach to evaluating existing building systems relative to desired BAS functionality and performance goals.

BASAT is a software tool that helps building owners, consultants and contractors uniformly assess building automation system infrastructure by classifying the availability of system capabilities based on specific combinations of sensors, actuators and points found during a survey of the BAS interface.

BASAT can provide insight into any specific controls optimizations of, or measures that can be realized with, the current BAS configuration; as well as an indication of the possible measures given additions of specific sensors, actuators and points to the BAS. The tool consists of the following:

- Input sections in the form of survey lists, in which the user selects the availability of sensors based upon examination of the BAS front-end and operator knowledge of the system
- System-, equipment-, and protocol-specific results sections in which the results of the survey are computed based on a decision matrix that determines the availability of measures, control strategies and controls optimizations.

www.cunybpl.org

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QUESTIONS?

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