There's an App for That:
Can Mobile Technology Impact Behavior?

The City University of New York

BUILDING performance LAB

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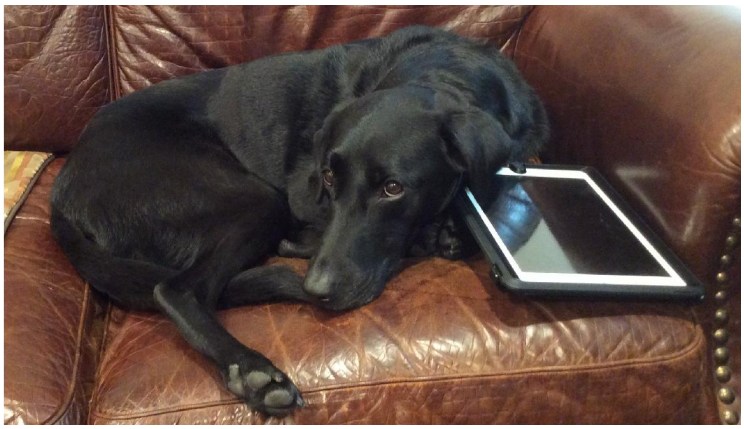
We've trained over 2,000 building operators and other facility personnel

- CUNY BPL's mission: to advance **high-performance building operations** and practices in existing commercial and public buildings
- Primary client: **NYC Department of Citywide Administrative Services** with NYC client agencies (e.g., FDNY, DOE, DSNY, HHC)
- **4,000 municipal facilities,** many different building typologies
- DCAS's **Energy Management Institute** is the gold standard of energy-related municipal training programs (e.g., BOC, CEM, BRT)
- Applied research: paid internships for CUNY undergrad and grad students, train in **energy data analysis and Building Re-tuning**

BREAKING NEWS:
You **can** teach an old dog new tricks



NYC's aggressive climate goal targets 80% GHG reduction by 2050

No- and low-cost O&M changes in NYC municipal buildings are estimated to yield **10-15% annual energy savings.**

NYC EEOM's **3 Key Objectives:**

- Repair, **maintain and operate** existing equipment as efficiently as possible
- Provide management **oversight, accountability and transparency**
- Increase training and outreach to improve skills and **raise energy awareness**

As much as 40% savings reported for O&M improvements

"One of the **most cost-effective** methods for ensuring reliability, safety, and energy efficiency."

Studies report **significant savings,** without major capital outlay

- **3-40%** savings, with an average of 15% (FEMP 2008)
- 10% savings deemed **"conservative estimate"** (FEMP 2002)
- Equipment retrofits cost 20x more than low-cost O&M measures, **for equal savings benefit** (FEMP 2007)
- **5-20%** savings reported in O&M site assessments study (PECI 1999)

October 2016 is National Energy Action Month!

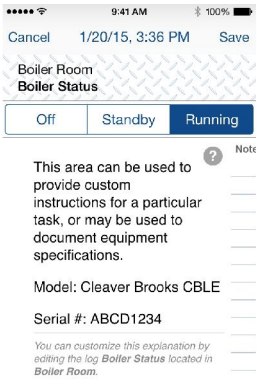
We work to "Increase training and outreach to improve skills and **raise energy awareness**"…

– but how do you move **from awareness to action?**

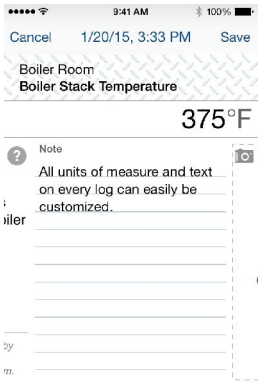
You can't be there all the time, to prompt building operators to look for opportunities…

– but what if you could??

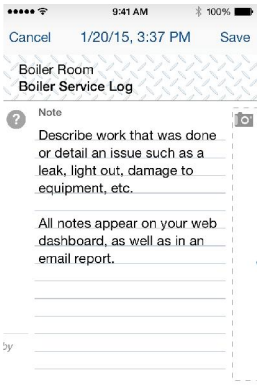
The idea for LogCheck was born in the boiler rooms of New York City



-Equipment Statuses
-Pass/Fail Inspections



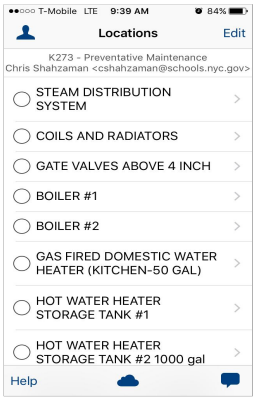
-Meter Readings
-Temps. & Pressures
-Valve Positions



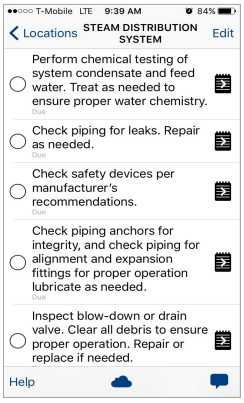
-Misc. Note

It works because it's simple

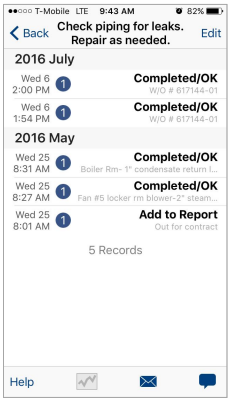
Locations



Logs



Records



Let's take a quick look at LogCheck in action…

Can a technology app improve O&M behaviors that affect energy efficiency?

Research Question
Does the use of a technology app, that allows for easy viewing of O&M data and prompts certain O&M activities, positively influence implementation of O&M practices that are believed to save energy?

Methodology

- Examine behavior change within building operator population
- Before-after experimental design
- Measures:
  - Pre and post surveys – frequency with which operators perform certain O&M tasks and perception of their role in energy efficiency
  - LogCheck usage logs
  - Assessment of whole facility energy impact (PM score)

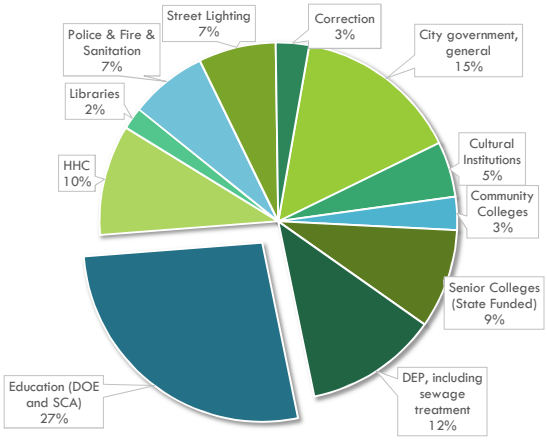
8 key behaviors were identified around energy efficient facility operations

Key Behavior	Energy Savings Method
1. Measure key parameters	May support energy reduction through aiding identification of increased energy use leading to corrective action. Also important for measuring savings.
2. Identify and promptly repair system leakage	Reduces energy use through minimizing leaks, and, in the case of steam system, by ensuring that steam traps are operating properly.
3. Control space temperatures to avoid overheating	Reduces energy use through preventing overheating in spaces that require heat (closing open windows, checking for proper operation of heating equipment, etc.)
4. Reduce unnecessary heating	Reduces energy use by reducing heating in spaces when they are not in use through scheduling and zone control of the HVAC systems.
5. Optimize boiler and/or RTU start and stop	Reduces energy use by increasing boiler cycle length.
6. Minimize boiler cycling	Reduces energy use by reducing boiler cycling. The cycling process results in heat loss.
7. Maintain boiler efficiency	Reduces energy use by optimizing stack draft to prevent heat loss, and monitoring stack draft for optimal scheduling of boiler cleanings.
8. Adjust temperatures and/or flow resets on hot water systems	Reduces energy use by reducing pumping.

Public Schools account for 27% of NYC's $771m Heat, Light & Power budget

Fast Facts:

- In NYC, buildings account for **75%** of carbon emissions
- Public schools account for **40% of municipal building stock**
- HLP budget for NYC schools: **$208 million**
- **HUGE** opportunity for energy savings and GHG mitigation

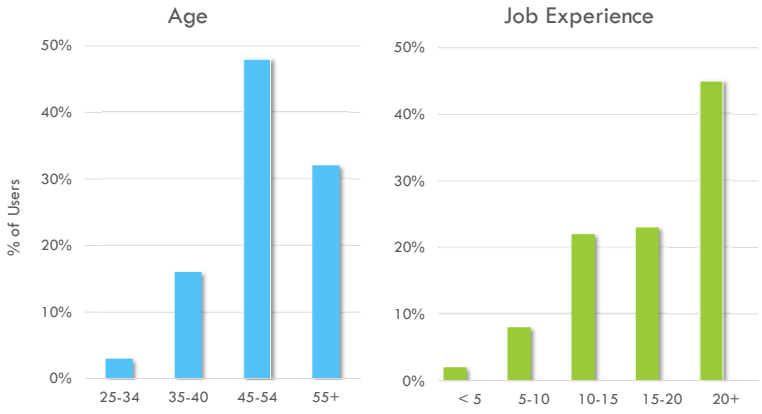


FY17 NYC Municipal Utility Energy Budget

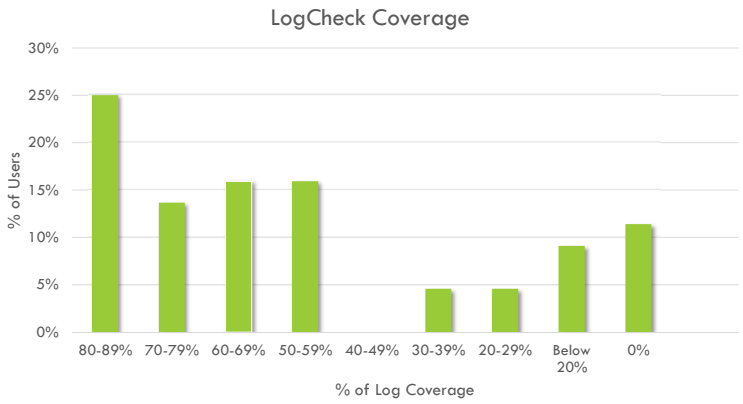
Our initial sample was 334 operators from mid-sized schools

- 1,200 school facilities, 1,000 Custodian Engineers, **nearly all BOC-1 certified**
- Unique study sample due to **relative homogeneity** in building use and occupancy schedule
- Size limitation (100-200k sf) further served to **minimize variation** in type and complexity of mechanical systems and CE's experience level
- Study period: **Heating season** – Nov. 2015 – Apr. 2016
- 204 **pre survey** respondents out of 334 (61%) (Control)
- 44 **LogCheck users** (target was 50) (Treatment)
- 175 **post survey** respondent pool (30 lost due to attrition)
- 158 **post survey** respondents out of 175 (90%)

Most respondents were 45+ and the majority had 20+ years of experience



Nearly 40% of LogCheck users had at least 70% average log coverage



Preliminary analysis of pre and post surveys points to positive change

Key Behavior 4: **Reduce Unnecessary Heating**

Tasks

4.1 Operate manual zone valves to close off unused spaces

4.2 Check building exhaust fan start and stop times

4.3 Record building exhaust fan start and stop times

4.4 Assess and, as necessary, adjust exhaust fan start and stop times

4.5 Check operation of major AHUs

4.6 Record operation of major AHUs

4.7 Assess and, as necessary, adjust operation of major AHUs

Preliminary analysis of pre and post surveys points to positive change

Key Behavior 4: **Reduce Unnecessary Heating**

	Net Change in Behavior						
Frequency	**4.1**	**4.2**	**4.3**	**4.4**	**4.5**	**4.6**	**4.7**
Daily	0%	24%	19%	41%	29%	27%	22%
Weekly	0%	-3%	0%	4%	-1%	0%	10%
Monthly	-3%	-10%	0%	-4%	-24%	-5%	-13%
Seasonally	14%	-7%	-10%	-14%	8%	3%	-23%
Annually	0%	0%	0%	0%	0%	0%	0%
Never	10%	-10%	-2%	-25%	4%	-21%	7%
N/A	0%	7%	-7%	-1%	-16%	-4%	-4%

Our first behavioral project brought challenges and taught us a lot

- CUNY IRB was willing to waive consent, but NYC DOE IRB required consent, which complicated the process
- Internal NYC DOE survey system used for pre survey, so researchers had no control over survey timing, reminders, etc.
- Long lag in pre survey responses led to 8-month delay that made treatment group recruitment more difficult
- Even though Initial training was held at union HQ, there were still significant no-shows, and multiple additional trainings required
- Post survey sent via SurveyMonkey, so researchers had more control
- DSF helped facilitate post survey through supervisors; dramatic improvement in response rate and timing

We hope to impact O&M practices and building operator training initiatives

- We hope to contribute significant generalizable knowledge about the human side of "green O&M" implementation and about the processes needed to encourage positive behavior change toward energy efficiency in large institutional settings
- Filling these gaps in knowledge is important as a return on the training investment, as well as in energy and resultant cost savings to buildings
- We hope to inform O&M practices in NYC municipal facilities and perhaps even at the national level, with the BOC training program
- We've already seen an impact, as NYC DOE embarked on their own LogCheck pilot a few months ago, and are seeing an increase in operator and supervisor accountability

QUESTIONS?

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