UPROOT COSTLY INEFFICIENCIES IN BUILDING SYSTEMS

Faults that building operators cannot see are costly and damaging to equipment

If your building is humming and your occupants happy, what could be wrong?

Even at such times, complex building systems may have undetected faults that erode performance, increase costs, and undercut your staff resources. You can eliminate such faults and waste with a maintenance program that uses data to address these three issues.

1. Detect and correct operational drift

When building systems have catastrophic failures—a sewer backup, a cooling tower disabled, an air-handling unit (AHU) inoperative—the cause may sometimes be recognized quickly (even if the repair takes far longer). Less easily diagnosed are multiple minor faults that collectively undermine system performance. Over time, the resulting operational drift—largely unseen—can be as costly to building owners as catastrophic failures.

Although full building commissioning can detect such faults, its value erodes over time as building systems grow older and a facility undergoes inevitable changes in operations and occupancy. Moreover, many new buildings are not fully commissioned before occupancy, and recommissioning of existing buildings is very rare. A survey of commissioning agents by the Northwest Energy Efficiency Alliance reported that while 71% of new buildings are commissioned during construction, only 1.2% of existing buildings are recommissioned.[1]

The consequences of building drift typically include higher energy costs, shorter equipment life, and thus greater replacement costs. Occupant dissatisfaction is also likely greater, with more complaints about indoor temperatures and equipment noise, both of which are known to reduce occupants' productivity.

To study the impact of drift, researchers at the University of Oregon identified a 60,000-square-foot campus building that had unusually high utility consumption for unknown reasons.[2] For a detailed assessment of the issue, the researchers collected data points from the building automation system (BAS). The data included fan runtimes and speeds, duct static pressures, system temperatures, etc.

For more on traditional building services vs. data-driven services, see **THE UNTAPPED POTENTIAL IN BUILDING SERVICES**.

Data analytics revealed a number of faults, including damper control, software programming no longer performing as intended, and sensor problems (failed, uncalibrated, or installed in incorrect locations). After addressing the faults and implementing continuous monitoring, the researchers found a 66% decrease in the building's electrical usage and 60% decrease in steam.

In addition, the building manager reported higher occupant comfort and fewer complaints about indoor temperature and equipment noise. The researchers noted that ongoing monitoring will prevent the building from drifting back to its underperforming state. (See graph below depicting the building's drift.)

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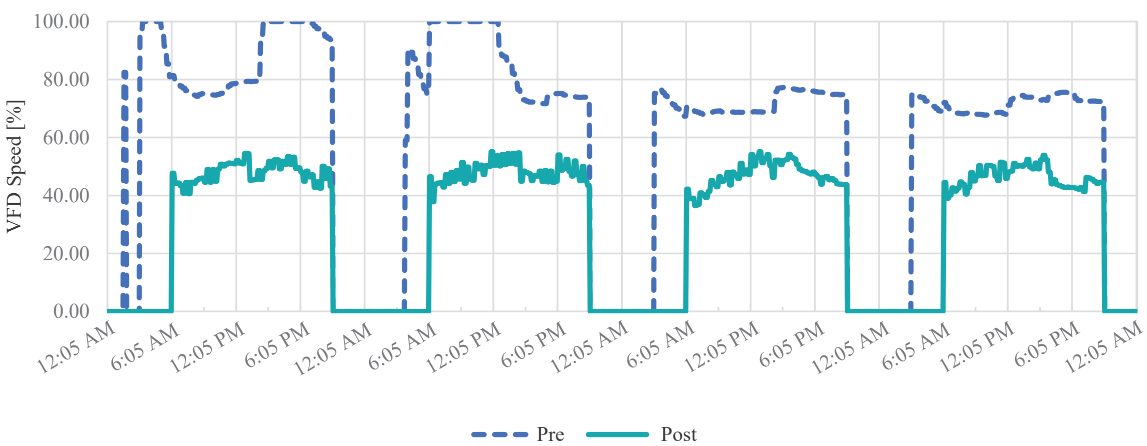
[1]Cadmus Group, *Commissioning Long Term-Monitoring and Tracking—2016 Square Footage Update*, https://neea.org/resources/commissioning-longterm-monitoring-and-tracking-2016-square-footage-update.

[2]Paul Ward et al, *Developing a Process for Continuous Commissioning*, https://ieeexplore.ieee.org/abstract/document/8591688

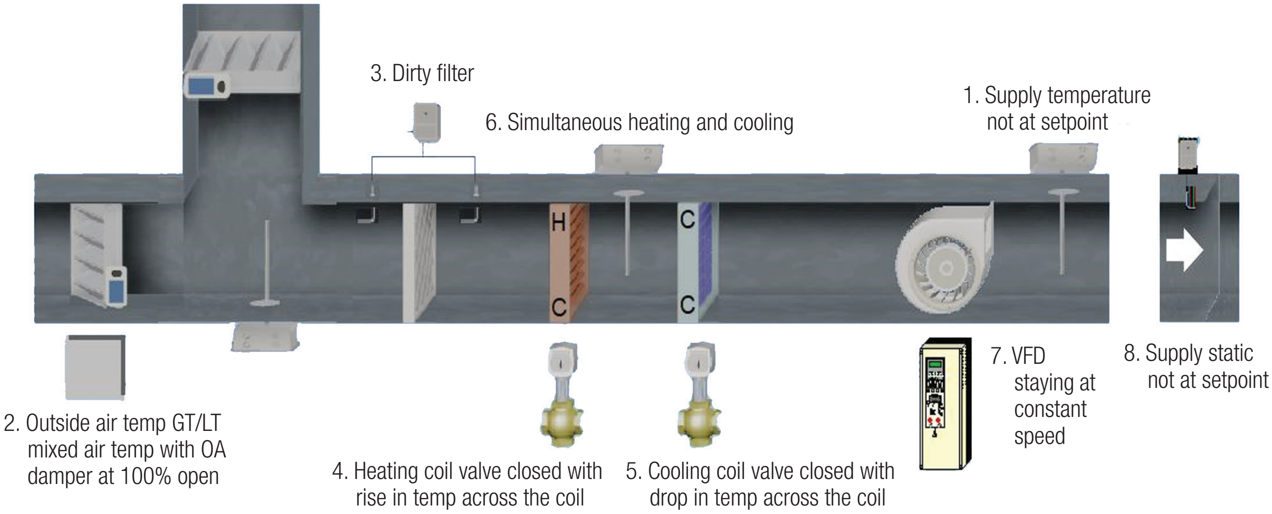
AFTER RECOMMISSIONING, ELECTRIC USAGE PLUNGES 66%

University of Oregon researchers found that continuous recommissioning of systems in a campus building delivered a 66% decrease in electrical consumption and 60% in steam. The graph shows the difference in fan running times during the pre- and post- commissioning periods. Without continuous systems monitoring, the building would likely drift back to its previous condition. Source: Northwest Energy Efficiency Alliance



AUTOMATED RULES FOR AN AHU

The diagram illustrates various checks and fault detection routines that can be done remotely on a daily basis using data from an AHU. By contrast, it would take a technician hours to accomplish the same checks just one time on one AHU.



2. Use automated monitoring to leverage staff resources and expertise

In-person preventive maintenance based on schedules or runtimes is a familiar element of traditional building services. The tasks are time-consuming for personnel, and as a result, are done at comparatively long intervals (if time permits). In-between such checks, equipment may fail and system performance drift for months or even longer without operators' awareness.

Data-driven maintenance automates many preventive maintenance tasks and performs them more frequently. For example, automated remote monitoring of an AHU might verify a function daily, while a technician would be available to do the same task only annually.

For more on the most cost-effective mix of building services for various building system equipment, see **HOW TO USE DATA FOR OUTCOME-BASED MAINTENANCE**.

But frequency is not the only benefit. The automated program has greater intelligence because it works from rules rather than laborious visual checking, recording, logging and documenting. For example, instead of a visual check of a filter, the automated rule detects changes in differential pressure over time. Instead of checking the correct operation of a device like a damper, the automated program detects anomalies—like a temperature rise or fall across a coil when a specific valve is closed—providing insight into potential problems.

With automated rules in place, preventive maintenance functions like a proactive sentry who is always on alert.

3. Stop the BAS from undermining performance with reactive responses

Your BAS has the ability to maintain setpoints for indoor comfort when equipment faults would otherwise threaten it. However, in compensating for faults, the BAS can undermine efficiency in ways that the building operator cannot recognize.

For example, if an outside air damper begins to leak, the BAS is designed to compensate, possibly by automatically adjusting cooling coil actuators to maintain the setpoint for supply air temperature. The root problem—the leaking damper—may not be flagged because the system is maintaining indoor comfort and avoiding occupant complaints. The damper fault may be detected during the annual, in-person inspection, but in the meantime, energy is being lost.

Automated monitoring detects deviations from optimal operation, putting the building manager in front of the failure curve. ■

For more information on the value of data-driven building services, click on other articles in this series.