Energy Efficiency through Advanced Diagnostics

The Arrival of Automated Continuous Commissioning: How to Optimize Operational and Energy Efficiency for Commercial Facilities

A White Paper by Scientific Conservation, Inc. (SCI) Introducing SCIwatch™

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Introduction

Perpetually maintaining a high level of operational efficiency for mechanical and electrical systems has until now, eluded most facility owners and managers. We are now evolving from time-based preventive maintenance to "just in time" automated continuous commissioning (ACC) and diagnostics. This white paper discusses how this state-of –the-art approach enables large numbers of building systems to be continuously monitored, evaluated and maintained while minimizing user interaction. It will also explain how ACC delivers actionable information to facility operations managers and service providers. This white paper will also explain how ACC's proven process can minimize operating costs, enable facility managers to make much more informed and timely decisions on how best to prioritize maintenance and track the performance of the maintenance staff and outside service providers.

Mechanical and electrical systems operating in commercial facilities are often complex and are made more so because they must perform in ever changing environments. Over time these systems tend to degrade as they provide service to the building. Compounding this issue is the fact that often times a small degradation in a system's operational efficiency precedes a major costly failure. Until now, facility owners have had no simple tool that gives them the view they need to catch these degradations when they occur.

Operational efficiency is defined here as the total cost to deliver the required environmental conditions called for by the space being conditioned. This efficiency includes both the energy and operational costs associated with the long term operation of equipment. By considering both factors, the operator will truly know if the operational efficiency is being maintained or is deteriorating.

The SCIwatch Platform At-a-Glance

SCI has developed the most sophisticated methods available to access the BAS data from the site. Connecting directly to the BAS or through a low cost data management appliance, the company's SCIwatch™ system – the industry's first software-as-a-service platform delivering automated continuous commissioning - logs all available data points, setpoints,

control points, sensor inputs/outputs and schedules. This data is collected at a rate that a) will not impede the operation of the BAS (something we monitor for continuously) and b) is at a sampling rate with a minimum frequency of at least once every 15 minutes. The frequency of data sampling is one of the determining factors governing the time it takes to fully identify all possible anomalies.

SCIwatch draws in both BAS and data from weather data sources into its data warehouse. To accurately determine the cost of anomalies, mechanical and electrical equipment specifications are identified and maintained. This is done using a configuration tool that draws a connection between the system, the relevant BAS points and the key operating information. Knowing in advance that most facilities lack the necessary number of sensors that are required by competing solutions in order to provide value, SCIwatch uses advanced mathematical modeling to offer customers instant insight into how their systems are operating without additional sensor cost.

With new policies revolving around cap and trade, SCIwatch offers highly accurate baselines for facilities. This is done by using all of the available data streams coupled with complex mathematical modeling techniques to generate an energy demand profile for the facility. This profile usually predicts power consumption with an accuracy of greater than 98%. This tight operational tolerance is unique in the industry. It compares to a 10% tolerance for a typical building simulation (such as DOE-2, or Tracer) and is far more accurate than typical single and multivariate regression.

The resulting model can then be used for a variety of customer benefits that include:

- Tracking the performance of any operational changes to the building
- Tracking the degradation and subsequent improvement of operational efficiency as SCIwatch identifies (and the service provider fixes) and monitors the performance of each mechanical and electrical system.
- Serving as a source of carbon trading information

SCIwatch maintains a diagnostics engine that performs hundreds of analyses on the dataset. These diagnostics address mechanical, electrical, sensor and system issues that are performed

continuously. It uniquely calculates the energy waste costs for the associated anomalies it discovers. Unlike diagnostics that look at "snapshots" of data, SCIwatch identifies *all* potential anomalies because it performs diagnostics continuously to capture system performance. This is particularly important since many anomalies are found while the systems are in unoccupied or "dark store" conditions.

The analysis starts with simple comparisons (e.g., "Does the BAS' outside air sensor match the data from the weather feed?"), progressing with increasing complexity to neural models predicting each asset's operational efficiency. *A list of some of these anomalies can be found in the attached appendix*. By examining changes in the performance of these systems SCIwatch provides alerts as anomalies are occurring. SCIwatch also calculates the energy and monetary loss associated with unresolved anomalies. The anomalies are then ranked by severity, importance to user, or cost, all set by the customer.

The customer user interface is provided through any standard web browser. As part of the user interface, the customer can dispatch those anomalies that require attention to various users, assign regional distribution and give restricted access to service providers for any sites the customer wishes them to view. Anomalies are automatically prioritized based on energy savings and time in the queue. Customers can adjust priorities "on-the-fly". The dispatch element of the interface allows technicians to "accept" the dispatch and report on the disposition or assign it to someone else. To complete this operational loop, SCIwatch monitors not only the reporting process but the actual anomalies to confirm that the anomaly is resolved. Technicians are only allowed to place work order tickets into a pending mode upon completion of their repairs. The tickets close automatically when diagnostics are re-run and confirm the problem has been solved. A help feature allows technicians the opportunity to see how similar problems were solved by other technicians.

Conclusion

What sets SCIwatch apart in the increasingly competitive energy efficiency market are its ACC capabilities that operate within a SaaS framework to simplify deployment and reduce licensing costs. SCIwatch takes raw information from energy management systems and converts data into actionable tasks prioritized by cost savings. The "continuous" element of

the solution provides ongoing measurement of changes in each mechanical and electrical system's health on a 24/7 basis, and does so remotely and non-intrusively. As a result, SCIwatch persistently determines the root of systemic operational problems, predicts operational deterioration and quantifies its associated cost. SCIWatch performs over 100 functions to pinpoint myriad small but additive anomalies such as failed/out of calibration sensors, simultaneous heating and cooling, leaking control devices, etc. (See your SCI representative for a comprehensive list.) Moreover, included in the functions are unique tests to identify insidious operational patterns in major pieces of equipment that, when caught early, can avoid very costly maintenance—oscillating chillers, for example—which lead to premature thrust bearing failure and repair costs in the tens of thousands of dollars with weeks of down-time.

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