WHITE PAPER

Analytics Software

"Find what Matters"

Environmental Systems, Inc.

Building Solutions. Building Performance.

We Have The Data: *"Lets Find What Matters"*

The past decade has seen dramatic advances in automation systems and smart devices. From IP connected systems employing a variety of standard protocols, to support for web services and xml data schemas, it is now possible to get the data produced by the wide range of devices in today's buildings.

The new frontier is to efficiently manage and analyze that data to *find what matters*.

The Challenge – Turn Data Into Actionable Intelligence

From building automation systems to electric meters, thermostats, appliances and even individual sensors – smart devices of all types are now capable of communicating valuable information about their environment and operation.

Access to this data opens up new opportunities for the creation of value-added services to help businesses reduce energy consumption and cost, to identify opportunities to enhance operations through improved control, and to justify and validate investments in energy savings measures.

Access to the data is just the first step in that journey, however. The new challenge is how to manage and derive value from the exploding amount of data available from these smart and connected devices.

Analyzing Operational Data

How do we let busy managers and operational personnel know that something is worthy of their attention? Is it possible to make sense of operational data with minimal, or no, human intervention? Can we impart our knowledge of equipment systems to software to enable it to find issues, patterns, and faults?

Analytics allows domain experts to capture their knowledge in "rules" that automatically run against the data produced by smart systems. Employing "semantic tagging", pattern recognition, functional rules processing and other techniques, the analytics engine provides the ability to automatically identify issues worthy of attention. The result –*the capability to show users what they need to know about the performance of their systems*.

Analytics works with data of all types – whether via a live link to an automation system or smart meter, connection to an SQL database, an import of historical data in Excel files, or a web service feed from a utility – analytics can consume, manage and analyze your data.

Delivering Business Value

Analytics sounds good right? But where does analytics fit in delivering tangible business value to your organization? Let's look at some specific use cases.

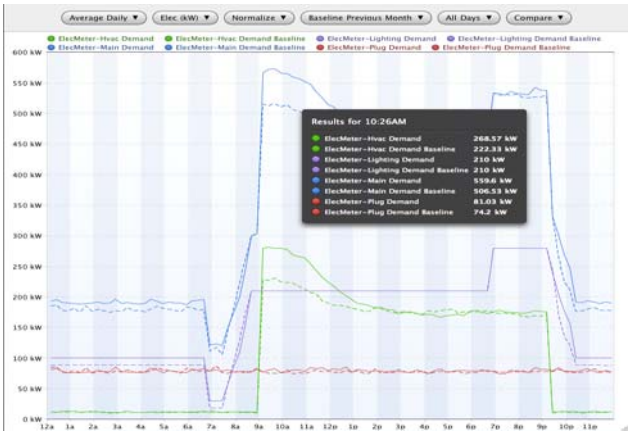
Example 1: Energy Management – Automatically identifying deviation from baseline energy consumption

Establishing a desired baseline or target for energy consumption is a key part of most energy efficiency projects, whether it is a lighting retrofit or replacement of HVAC equipment. We expect the project to result in a new lower energy consumption profile for the facility. This target is typically expressed as a design baseline. An important part of verifying the results of such a project is to track actual performance against this baseline. This can be done manually, but what if you had the ability to automatically compare energy consumption after the project against that desired operating baseline and be informed of all of the periods of time when electrical demand (or consumption) went above the baseline by more than 3% (or any amount of your choosing).

An analytics system can do this for you. It will find periods of time that deviate from desired operation and automatically inform you of the issue, delivering a clear, understandable display showing just when and where deviations have been found. No hunting for data – the system tells you that the condition has been found and a simple mouse click takes you to a details screen showing the issue, the time of occurrence, the duration and which sites or meters were found to be deviating from the desired baseline.

The results:

- *A dramatic reduction in the effort required to track results of the energy retrofits and ongoing performance of your facility.*
- *Continuous, automated oversight that will notify you any time the system deviates from the desired energy baseline, enabling you to take action to achieve and maintain expected energy savings.*
- *An automated tool to streamline and reduce the costs of Monitoring and Verification of energy savings projects.*



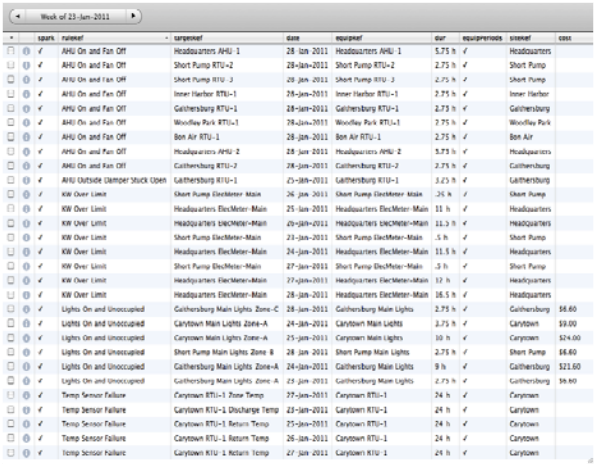
Example 2: Improving effectiveness and efficiency of maintenance operations by automatically identifying equipment faults

Broken or non-functioning sensors are a reality in building automation systems. But how do you find them. If they cause a major comfort problem you will probably get a phone call or complaint from occupants. Responding to the complaint will take time and effort, in addition to the work required to repair or replace the sensor.

An automated analytics system can watch all of your sensors, easily identify sensors that are not responding, and inform you with a concise report. You can easily see them by building, location, system name, etc.

The results:

- *An organized listing of problems that can be sorted by site, by issue, by date, by duration, or by calculated cost per event with a simple mouse click.*
- *Less time responding to complaints – more time devoted to actual equipment repair. Identification of faulty equipment before it results in occupant complaints.*
- *Improved energy performance by eliminating errant equipment operation due to non-functioning sensors or other components.*

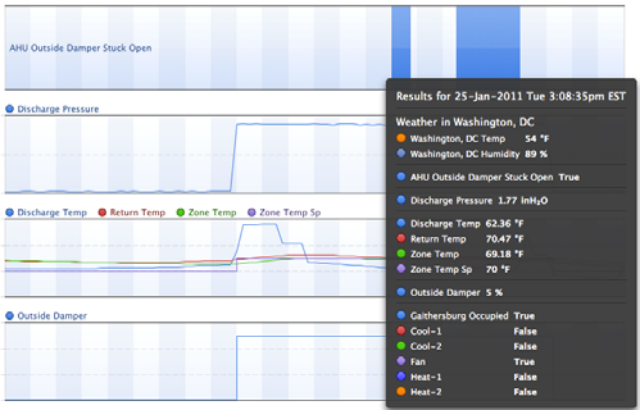


Another example of an issue that can easily go unnoticed, but cause significant energy waste, is malfunctioning outside air dampers. An outside air damper that is stuck open or closed or being controlled incorrectly so that it is open during periods of high humidity might not result in a noticeable comfort problem but will result in excess energy being used to cool or heat the building.

An automated analytics system can watch outside air, return air, mixed air, and discharge air temperatures and calculate the amount of outside air being introduced.

The results:

- *The system automatically identifies periods of time when mechanical cooling and economizer are operating simultaneously, or when outside air (above the minimum required) is being brought in during heating mode. Both of these conditions result in energy waste.*



Example 3: Finding Opportunities for Efficiency Improvements – Identifying systems that are not operating at top efficiency

All buildings are different and it can be very complex to achieve desired comfort conditions while using the lowest amount of energy possible. Watching the operating characteristics of all equipments systems in real time is nearly impossible to do manually. An automated analytics system does this for you.

As an example of finding inefficient equipment operation lets consider a central plant with a centrifugal chiller. Centrifugal chillers can be modulated through a wide range of capacity. The efficiency of the chiller in converting electrical energy into cooling varies based on that capacity however. Typically chillers see a significant drop off in efficiency when operating at capacities below 50%. It would be useful for building operators to know if their chiller(s) are operating at inefficient part-load capacity for extended periods of time. This may indicate the need to modify control sequences, stage the start-up of chillers in a different way, or the need for modifications to the design of the plant.

An automated analytics system can monitor chiller capacity and identify periods of time when it is operating below 50% or any other capacity limit desired. It will then automatically notify the operator and present them with a detailed summary of related information whenever that condition is identified.

The results:

- *Identify potential control issues – for example, in plants with multiple chillers are they being staged effectively?*
- *Identify the potential value of chiller plant upgrades – perhaps the installation an additional machine sized to handle part load conditions at higher efficiency would be financially beneficial. Or identify the potential to utilize free-cooling to satisfy periods of time with low cooling load.*
- *Understand how your cooling plant is really operating without having to invest extensive manual effort.*

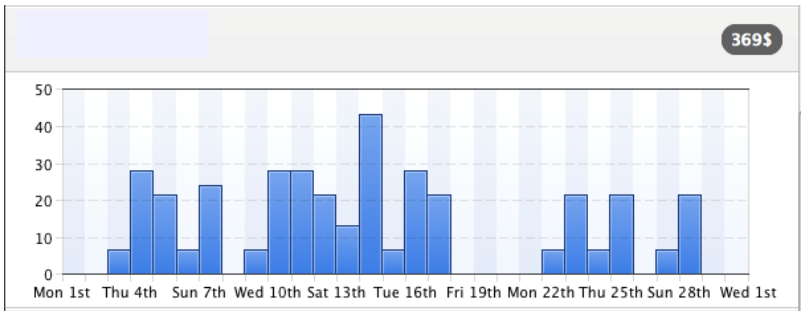
Example 4: Maintaining Service Level Agreements (SLA's)

It's common for building owners and operators to be required to maintain certain conditions to satisfy occupants, or meet the requirements of a facility management service level agreement contained in the lease. This is often referred to as an SLA. Ideally you meet your SLA not because you constantly respond to complaints, but because the building is operating within desired limits. Being "ahead of the game" is highly desirable.

An automated analytics system can watch all of the key elements identified in your SLA and automatically notify you when they deviate form their appropriate range. And it's easy to eliminate nuisance issue reports by adding time duration to the rules that look for deviations – for example, identify periods of time when temperatures go above or below desired range for more than 30 minutes at a time. When the system identifies a deviation, it provides a notification with a link to a comprehensive display showing location and duration of the issue. You will know where you key problem areas are and all related conditions.

The results:

- *Be informed of meaningful deviations from desired environmental conditions.*
- *Maintain a record of all such issues.*
- *Reports and displays give you a powerful tool to prove your success in maintaining SLA's.*
- *Associate cost with each occurrence of an issue*



Cost associated with Lighting Operating Outside of Occupied Periods

And Now for Some Questions

Some of the examples described above sound similar to alarms? Is there a difference?

There is a big difference between alarms and analytics. First of all, alarms require that you fully understood what you want to look for *at the time you programmed the system*. There are many inter-relationships between equipment systems that may not be known at the time the control system was programmed. For example, did you know that you would participate in a demand response program when the control system was originally programmed? Did you know that you would not want to generate an alarm in response to a temperature out of range when the building is participating in a DR event if the value stays within 2 degrees of normal value during the event?

The next question is capability. Can the system implement this type of sophisticated logic effectively? And if so how much effort does it require? Alarms are typically limit-based checks that perhaps include a minimum time duration before they trigger, but rarely implement more sophisticated logic. Alarms are also very local in nature, typically evaluating a single item or point. A local controller operating an air handler simply can't combine data from throughout an enterprise to discern relationships or patterns that are potentially important.

Alarms programmed into the individual controllers are also not well suited to exploration of data relationships that are a key part of analytics. For example, would you be able to justify the cost of reprogramming alarm logic into 1000 sites because you have an idea about a correlation that could be resulting in energy waste and want to test that theory? Or because you know you want to look for a condition that was not understood when the control system was programmed?

Large facilities with central plants further highlight this part of the challenge. In facilities with built up HVAC systems, there are a lot of interactions between the various systems that simply aren't fully understood until after the building is operational. And, these interactions may change over time as building use or other conditions change. A key part of optimizing facility operation is accepting the reality that we are going to discover new things over time. To take advantage of this reality we need tools that enable us to easily find those new patterns and then create analytic rules to automatically watch for those conditions. An analytics system allows you to easily test new ideas and identify new patterns and correlations in the data.

It's costly and complex to reprogram control systems, and data analysis situations that look for patterns among multiple different data items are not well served by alarms. And that is really the point – analytics are about data – you need data analysis techniques to do the job effectively. Control systems are typically limited in their data manipulation and analysis capabilities. An analytics system is a natural complement to a building control system.

What is the difference between analytics and information dashboards?

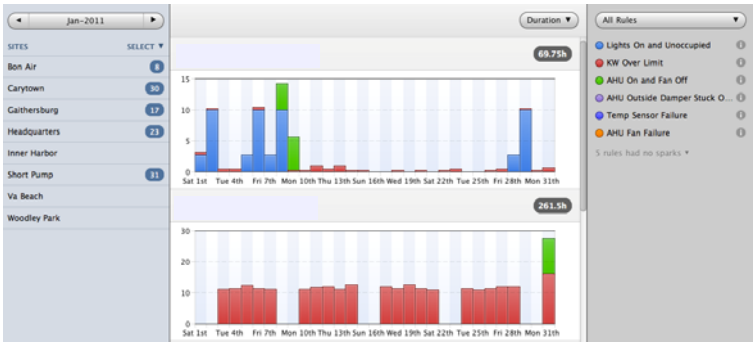
That's a great question because they are related yet very different. Here is a way to look at the difference – dashboards are tools to present information to users – pictures of equipment systems, graphs and charts of temperatures or dials showing energy consumption, etc. There is a lot of progress being made in improved presentation techniques to make dashboards more effective, but the process is still manual – the operator looks through displays to find things of interest.

Analytics on the other hand is the process of determining *what the operator should look at*. For example, do you have time to look through 100 graphics of equipment systems to see if everything is OK? Do you want to look at displays showing the value of hundreds of temperature sensors? Or would it be more effective to be directed to look at a display that only shows the temperature readings that are out of bounds? Or only the temperatures that have been out of bounds for more than 1 hour? Or only temperatures that are out of bounds by more than 2 degrees for more than one hour?

Analytics is about adding those additional factors that tell us that something really matters and is worth our time. That is the where the real value comes from – giving people the whole picture so the operator doesn't end up going on a wild goose chase simply to find that a condition is "acceptable" based on a combination of factors. *A good analytics solution tells you when to look, where to look, and why.*

Summary

With the progress made in building control systems and smart devices in recent years we can now take advantage of the data they provide to truly understand the operations of our facilities and equipment systems. Analytics is a tool to do that effectively and efficiently.



Analytics will help you to manage and reduce energy usage, highlight operational issues and improve overall facility operations, resulting in lower costs, greater occupant satisfaction and improved performance of your assets.

Analytics enables you to…

- Identify the issues that matter to your customers, tenants, and operations staff – directly helping you to improve operational efficiency and effectiveness.
- Turn operational data into actionable issues easily and efficiently – eliminate data overload for your operators.
- Turn your domain knowledge into a valuable library of analytics – leverage and automate your knowledge of buildings and equipment systems.
- Benefit from an ever-present virtual expert constantly watching the operation of your facilities – allowing you to respond quickly and knowledgeably when issues occur.

With effective analytics it's finally possible to *find what matters*.

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