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Intelligent

for Reducing Energy, Facility-Management Costs

Automation systems increase customer satisfaction by fixing problems before they occur

With energy prices rising significantly faster than inflation, facility energy costs per square foot have nowhere to go but up. Between 2000 and 2005, the price of crude oil rose from $26 per barrel to $53 per barrel[1]—a 100-percent increase in just five years. During the same period, the average price for natural gas rose more than 40 percent.[2] While electricity prices have kept pace with inflation, deregulation means they likely will fluctuate faster in the future. Unless facility managers take action to keep costs manageable, budget targets will be impossible to hit.

In 2000, a typical North American facility cost $6.16 ($6.84 in 2005 dollars) per rentable square foot to operate.[3] These costs could be broken down into three categories: utilities (44 percent), maintenance (35 percent), and janitorial (21 percent)[3]. Clearly, the greatest savings opportunities are represented by cost reductions and/or improving efficiencies associated with utilities and maintenance. Traditionally, facility managers have tried to reduce utility and maintenance costs by reducing the number of employees and/or upgrading energy-consuming devices. Unfortunately, with the economic slump that began in 2000, most facility managers already have reduced maintenance staff to the lowest level possible. Further reductions in personnel costs likely will result in unacceptably long response times to problems and/or eventual equipment failures because of insufficient maintenance. Stuck between a proverbial rock and a hard place, what other options are there for facility managers?

IMPROVING FIELD-TECHNICIAN AND CALL-CENTER PRODUCTIVITY

Fortunately, a new generation of automation systems—called extended energy-management systems or enterprise-energy-management systems (EEMS)—that can help reduce costs for both utilities and maintenance is available. What is an EEMS, and how can facility managers use it to reduce costs? Essentially, an EEMS is a computer system that uses the Internet to connect all major energy-consuming devices in a facility or group of facilities. Using an EEMS, a facility manager can monitor and, if appropriate, even control lighting

Tools

and HVAC systems remotely. Consumption and control parameters can be trended and compared to reveal waste. Service personnel can check on and respond to calls from a central location, reducing travel time and the number of unnecessary trips.

Figure 1 shows how an intelligent system works with the local building-management system (BMS). As this figure illustrates, an EEMS connects meters and a BMS through the Internet to a central computer system and data warehouse. Facility managers, building managers, financial managers, and field technicians can use any device with Web access to monitor and, given sufficient privileges, control a building environment.

Most large facilities and campuses have centralized call cen-

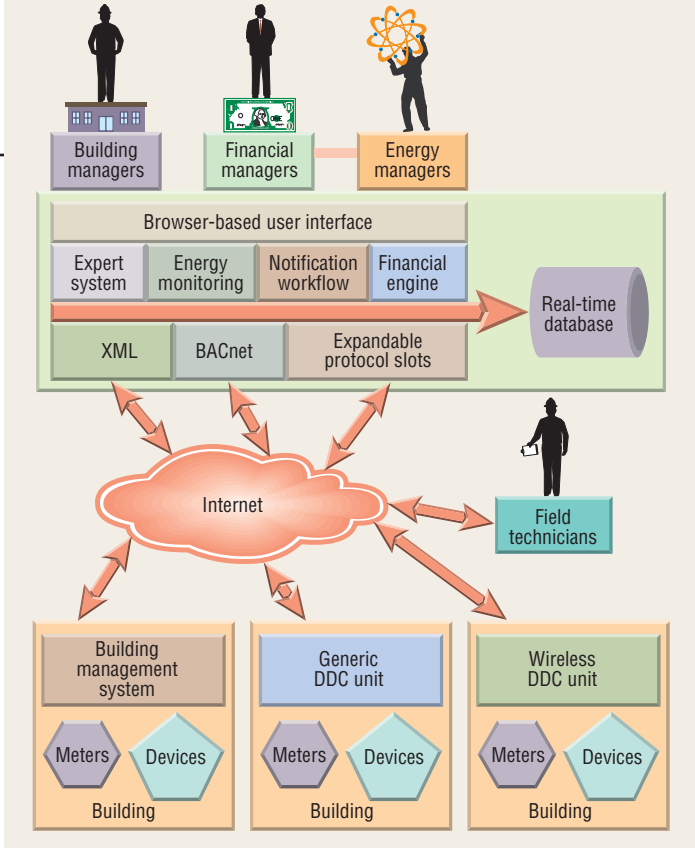

FIGURE 1. How an intelligent system works with a building management system.

ters to respond to customer calls. Without an EEMS, all a call center can do is make a note of the problem and promise to send a technician to take a look. Even in a medium-sized facility, it likely will take a technician 15 min to get to a thermostat and make an adjustment, unless he or she just happens to be sitting at the BMS's head end. Add 15 to 20 min for a change to take effect, and a minimum of 30 min will pass between the time a call arrives and the time a tenant's complaint is addressed. With a large facility or campus, travel times can be even longer, so the best a call center can say is, "Thanks for letting us know. We'll get someone out there to take a look at it when we can." In these situations, no one is satisfied.

Now consider a call center where operators have Web access to a BMS. Instead of waiting until a technician is available, an operator can inspect conditions in a tenant's area immediately and, if appropriate, adjust control parameters. The operator now can inform him or her: "I see that the temperature in your area is a little bit higher than usual. Hang on while I make some adjustments. You should notice a difference in about 15 to 20 min." Customer satisfaction increases, and complaints decrease.

As many technicians know, zone temperatures often turn out to be within acceptable limits. The complaint often turns out to be a false alarm or a reflection of the fact that not everyone can be pleased all of the time. Without an EEMS, a call-center manager has to schedule a technician visit. With an EEMS, a trip may be eliminated. By spending less time traveling between locations, diagnosing problems, and tuning control parameters, facility managers effectively can manage larger areas and more buildings with fewer technicians, which can result in big savings. A study of call-center efficacy indicated that 15 to 20 percent of all calls are HVAC-related.[4] If even 25 percent of those calls can be resolved remotely, a call-center budget can shrink 3 to 5 percent.

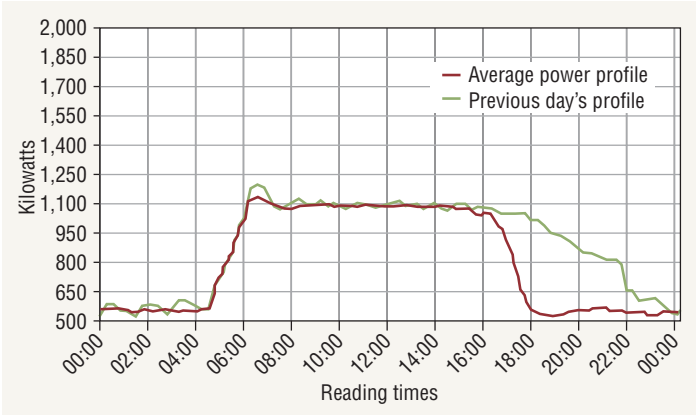

FIGURE 2. A change in power consumption.

Call-center and field-technician activities do not involve merely changing set points in response to calls. Many routine diagnostic activities also can be done remotely. If cooling coils are drawing more power than usual, it may be time to clean the coils. If Zone 5 is the only zone in the area reporting an abnormal temperature it may be time to replace a thermostat. What about lights? With an EEMS and digital addressable lighting, a technician often can identify ballasts and bulbs that need replacing remotely. Additional savings can be realized by ensuring technicians have the right parts before visiting a facility and by discovering and addressing problems before tenants complain.

BEYOND MONITORING: RECOMMISSIONING

When a facility manager recommissions a building, he or she carefully monitors conditions in key areas, adjusts schedules and control points, and looks for optimal settings that preserve customer comfort while minimizing costs. This work, while effective, requires effort and time. Once commissioning activities end, settings drift away from optimal. For example, a field technician responding to a call forgets to use a temporary override on a supply-air-temperature (SAT) set point. A schedule gets changed so an accounting department can work late at the end of a quarter. Before long, a system no longer is in balance, and energy expenditures go up. By some estimates, it takes only three to five years for energy expenditures to increase by as much as 15 percent.

At a call-center, 15 to 20 percent of requests are HVAC-related.

But what if a facility manager could detect changes faster? The most advanced EEMS produces specialized reports and includes expert systems-programming logic, effectively permitting managers to efficiently recommission buildings continuously.

Let us look at a previous example: a schedule change. With all data in a centralized location, it is a fairly easy matter for an EEMS to compare current power consumption to a weather-adjusted average-consumption pattern. Figure 2 shows the results of a schedule change. The fact that the previous day's profile is dramatically different than the average is a clear indication that a schedule was changed and equip-

ment is running longer.

So what is an expert system, and how can it help? Basically, an expert system is a collection of simple rules that have been programmed into a computer. The rules typically apply "if/then" logic to a problem to determine or recommend a solution. Humans use expert reasoning all the time. For instance, *if* I have a flat tire, *then* I should change it. With a computer, rules and solutions have to be broken down in much greater detail, but the idea is the same.

When an energy manager recommissions a building, he or she routinely uses if/then reasoning to determine optimal set points. For example, if a BMS was able to maintain desired space temperature and air turns using 1.5 in. of static pressure, then static pressure can be reduced to 1.2 in. By repeatedly measuring a building's space temperature, an energy manager gradually can reduce duct static pressure until he or she finds the lowest static pressure that maintains comfort for all tenants.

An EEMS can perform the same monitoring, calculations, and adjustments needed to find optimal duct static pressure over and over again. By performing calculations several times a day, a system continuously adjusts to changing conditions. Instead of a single optimal set point, an EEMS finds the most appropriate setting for each situation. Every facility manager knows a building is not immobile. The same static pressure and SAT set points that worked well on a cloudy Monday morning do not work as well the following sunny Tuesday afternoon. What works in winter does not work in summer. With automatic continuous recommissioning, a facility manager saves money not just by saving energy, but by reducing programming costs because there is no need to program in seasonal, or outside-air-based, set points. An EEMS finds appropriate points based on actual building conditions.

An advanced EEMS can include many hundreds of rules and standard solutions based on collective experience of the best energy and facility managers in the world.

As we saw earlier, optimal settings can change over time, or BMS programming can be changed so control points no longer are optimal. Perhaps a previously unused area becomes occupied. Perhaps a new building goes up across the street, shielding a building from afternoon sun. Ideally, a facility manager rapidly could determine a new "optimal" setting. Unfortunately, it is not cost-effective for an energy manager to tune a building every day, or even once a quarter. That is where an advanced EEMS comes in handy. A computer does not get tired of observing set points, fan speeds, space temperatures, etc. This means that as conditions change, an EEMS adapts. An advanced EEMS can include many hundreds of rules and standard solutions based on collective experience of the best energy and facility managers in the world. The end result—rising energy costs—is held in check without sacrificing tenant comfort.

CONCLUSION

Without sacrificing tenant satisfaction, an EEMS reduces overall facility-management costs by:

- Improving call-center productivity.
- Improving field-technician productivity.
- Reducing energy expenditures.
- Allowing continuous recommissioning

Further EEMS functions are tools to enter into demand-response contracts with a utility or tariff engine to translate energy savings into dollar savings. Remember that rock and a hard place mentioned earlier? With an advanced EEMS, the rock just got a lot smaller.

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