

# Effective building control systems can have big impact on energy bills

By Chris Torline

## Control systems

for buildings are a very important factor in a properly operating retail store. However, control devices and schemes often receive far less attention than your hot new fixture package or that attractive mannequin in the front window. But, if you are like most people, that little white box on the wall is somewhat intimidating, which means that the building controls are typically left alone and forgotten until there is a problem in the store.

Historically, the primary component of a building control system was the pneumatic thermostat. This simple control device had only two settings to control: the mode was selected (heat, cool or off), and the temperature (adjusted by turning the face dial or by sliding the adjustable arm).

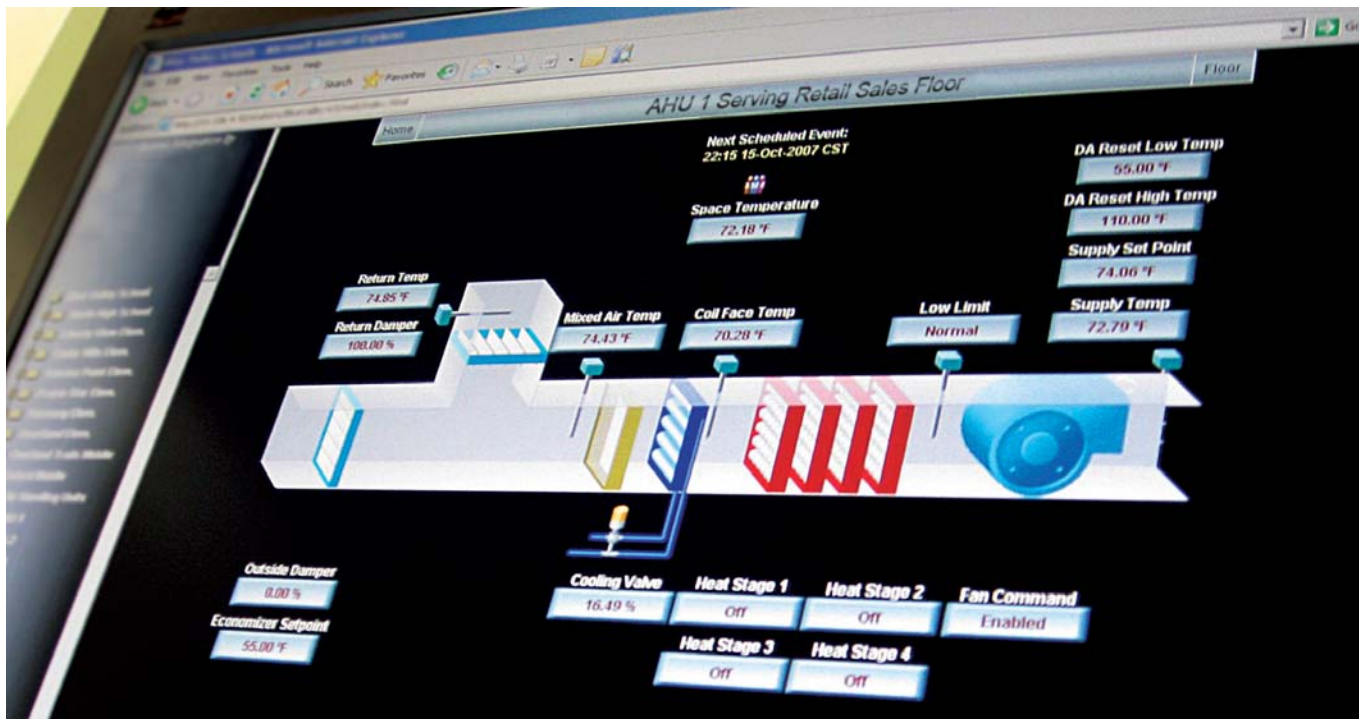
This device is now obsolete for any type of application. Electronic controllers are now affordable for retail store use, and energy codes require that you have the ability to

program the run times of your heating, ventilating, and air conditioning system and your lighting circuits. Modern control systems are also providing control in other areas of the store operation, including security systems, retail traffic counters, and kitchen equipment such as refrigerators and freezers.

Although control systems are not and should not be as visible as your showcased product, they are vital to the financial success of your store. Improperly designed control systems or inadequate maintenance of the system costs you money. Equipment run times are extended which increases maintenance costs, energy consumption of the system is higher, and uncomfortable conditions result in unhappy employees and reduced purchases by your customers.

### Common Control Problems

When troubleshooting a problem with your building



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system, the first place to look is the control system. It is very common that the controls are overlooked and hurried conclusions are made which results in a costly maintenance call, a delayed solution to the problem, and maybe even some cursing at your landlord's expense. The following items are some common control problems that you should be able to rule out at the first sign of a problem.

■ **Lighting system failures:** If you have circuits of lights that fail to turn on, the problem may be their controller. Check the circuit breakers, and also review the time clock or photocell controller if applicable. Likewise if the lights are on when they shouldn't be, review the settings of the time clock.

■ **Check temperature settings:** If your store is hot, first check the thermostat settings. Make sure that it is switched on to the proper mode — cooling or heating, and make sure the temperature is set where you want it. As simple as this seems, it is commonly assumed that there is a more severe problem with the system. Check all thermostats within your store, and ensure that there are no competing controls such as one unit set in the cooling mode and one unit set in the heating mode.

■ **Check scheduling settings:** Make sure to check the time settings on the thermostat as well. Is the unit in night setback mode during the day? Have daylight saving time and holiday store hour changes been correctly adjusted for? Is the unit allowed adequate time for building warm-up in the morning? If your store is uncomfortable every Friday at 5 p.m., the time scheduling of the unit is the correct place to look.

■ **Look at thermostat location:** In order for the thermostat to work properly, it must be able to take representative samples of the air conditions in the space for which that HVAC unit serves. The thermostat should never be exposed to direct sunlight. It should not be in close proximity to heat sources, such as computers, lights, steam presses, photo copier, the break-room microwave, plasma screens or other electronics. The thermostat should not be covered up by merchandise, such as behind a rack of clothes. It should not be located on exterior walls, or nearby an exterior door where it will be affected by drafts when the door is open; often the ideal location is usually about two-thirds of the distance back from the front of the store. The thermostat should also be within the area served by the HVAC unit it controls, free from any air migration from an adjacent unit that may impair a correct temperature reading.

■ **Check correct heat load zones:** At times it is difficult to work within the confines of the existing HVAC system when going into a leased space; or maybe the use and function of the different areas within the store have changed. The HVAC system must be designed to have the control capability to provide or remove the heat from each of the varying thermal zones. For example, an internet technology room may require cooling 24 hours a day yet the adjacent space may require heating due to an exterior exposure. These are two different thermal zones, and the system needs to have separate thermostats that control separate HVAC units, VAV boxes, volume dampers, or supplemental heaters to sat-

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isfy the requirements of the two spaces. Otherwise, only the room that contains the thermostat will be comfortable.

■ **Simpler issues:** Also be careful not to overlook the obvious, can the problem be just that the thermostat isn't working? Verify that the temperature that the thermostat is reading is reasonable. If you lower the set point, does the HVAC unit respond correctly and provide cool air? Verify that the thermostat has power and that there isn't a problem with the wiring connections.

■ **More complex issues:** There are many reasons why your control system may not be working, and if you have ruled out the previous items you may now need the assistance of an engineer to diagnose the problem. For example, your thermostat could have affected readings by a vacant adjacent tenant, or maybe the restaurant next door doesn't have proper make up air for their kitchen and is drawing your space negative, causing temperature problems.

## Advantages of a central EMS

As the capabilities of new digital controllers expand and as utility energy costs continually increase, many retailers are realizing the advantages of utilizing an energy management system. You may have noticed that there are many different names for these systems: building management control system, building management system, energy management control system, etc. Don't be confused with the name, they all refer to the building systems that control your HVAC, lighting, and/or other systems, and they have a front end which is the software package that you can view your building systems with. The term central as in a central EMS system refers to the system having the ability to control multiple sites from one central location.

The costs of purchasing an EMS have stabilized, which results in increased value since new digital controllers have much greater capabilities. This is similar to the history of other electronics: The cost for a good computer has been about \$1,000 for the last 10 years, yet a com-



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puter 10 years ago cannot hold a candle to capabilities of a computer purchased today.

Modern control systems can provide many highly technical advantages. The options are constantly evolving, and if you can think of something you want to do with your system, it can probably be done. Some very useful advantages of modern systems include:

■ **User-friendly front ends:** Old EMS interfaces were DOS-based, the control schemes were in cryptic programming languages that required technical expertise to understand. New systems are graphic with colorful floor plans, easy to read system schematics, and point and click navigation that allows anyone to understand the system.

■ **Web-based:** You should select a system that is internet-based so that it can be accessed from any internet terminal. This allows maintenance and review of the system in the home office, in different cities while traveling, or when you are at home and an emergency occurs.

■ **Open connectivity:** Traditional control systems have been limited by each vendor's proprietary software. This meant that you could not communicate with a certain brand of equipment unless you paid a hefty price for the interface. Make sure that your system operates via an open protocol such as LonWorks, BACnet, Modbus or Zigbee. This will allow you to connect to all of your equipment without expensive interfaces.

■ **HVAC control:** A central EMS can allow global control while still providing some local control. You can easily ensure that all HVAC units are efficiently setback during unoccupied periods, and you can allow a few degrees of override adjustment to store managers if you wish.

■ **Lighting control:** All circuits within lighting panels can be controlled, including interior lighting, store front display lighting, signage and parking lot lights. Additionally, the use of photocells can adjust lighting outputs so that lights adjacent to windows or skylights can be dimmed to conserve energy.

■ **Utility meter control:** You can monitor and log your own utility meters. This provides excellent information for troubleshooting issues and analyzing energy use. Money can often be saved by reviewing utility bills to correct any billing errors.

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■ **Automatic alarms:** The programming of a central EMS can be customized to provide nearly any service desired. An alarm can be generated based upon the criteria that you set, and this can flash a message on the screen, send an e-mail or call a cellular phone or pager. Different alarms can be programmed to cause different responses; you may only want to see on the screen when filters are dirty, but you may want a call 24 hours a day when your chocolate store loses temperature.

■ **Other systems:** Nearly any component within your store can have a controller interface installed so that information can be monitored and analyzed with your EMS. This can include kitchen systems, security systems, traffic counters, fire systems, indoor air quality, etc.

■ **Make coffee:** Well, actually you could connect your coffee maker to your EMS to ensure that you have a fresh pot brewed each morning.

## **EMS costs and savings**

In order to enjoy all of the benefits of a central EMS, you will need components installed in each store, and you will need a front-end interface. The cost of the installation will depend upon how

many and what types of devices you want to monitor or control. A basic installation for a retrofitted small store may include the following components:

■ Two smart thermostats for two HVAC units: \$400

■ Lighting panel with 12 circuits: \$1,400

■ Programmed controller with open connectivity: \$1,200

■ Labor to set up and install components: \$2,000

■ Total retrofitted installed cost: \$5,000

If the installation of these same units is done during the initial construction of your store, the installation labor would typically be offset by other control work. Therefore the cost of installing the EMS in a new store would be \$3,000.

The cost of the front end for the EMS is dependent upon the number of stores and the amount of programming required. There is typically a base cost of about \$15,000, which would be able to communicate with a large number of stores. If there are 100 stores controlled by the front end, the cost distribution is only \$150 per store.

For this small store example of about 5,000 square feet of area, utility costs at today's average rates may be about

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\$6,000 per year and normal maintenance calls would be about \$1,500 per year. If a central EMS is efficiently utilized, energy savings and maintenance savings of 20 percent could be expected. This is a \$1,300 savings that would go straight to the bottom line of the operating costs of your store.

A simple payback analysis for this example yields that the EMS installation for a remodeled store would be 3.8 years. If the system is installed at the time of initial construction the payback is only 2.3 years.

Although this calculation does not include the cost of the front end, it also does not include other benefits which although difficult to define yet they are real. How much does one afternoon of an uncomfortably hot store affect your revenue that day? Could it result in a loss of \$1,300?

The use of a central energy management system to monitor and manage your retail stores can be extremely effective. An EMS will control each store individually, but it can also provide access to all of your stores from a central location. This means that troubleshooting of problems, changes of control sequences, and maintenance of the control system can all begin from one person located at headquarters. This also provides your store managers a common point person to communicate issues through.

The other advantage of utilizing a central EMS is that ongoing system costs can be tightly controlled. The burden of setting the temperature and night setbacks can be taken off of the store managers, effectively eliminating inefficient operating of the lighting and HVAC systems. This can be a very significant difference in the energy costs of store operations, especially when energy use is optimized across an entire portfolio of stores. The effective use of a central EMS will also reduce maintenance costs of the equipment as equipment run times are reduced to the minimum needed. Systems containing expanded levels of control can also monitor the pressure loss of filters to optimize the scheduling of filter changes.

## Regularly review control setup

Whether the control systems in your stores are stand

alone programmable thermostats and lighting time clocks or consist of a sophisticated central energy management system, the key to optimizing the performance of the system is to give it the attention it needs. The most highly technical system available only operates as efficient as the programmer tells it to be. A digital control system that is programmed to turn off the cooling at 10 p.m. when the store closes at 9 p.m. is less efficient than having your store clerks turn it off when they leave.

Make sure that the people responsible for the systems are knowledgeable about the way the HVAC, lighting and other building systems operate, and make sure they

are properly trained in operating and maintaining the control systems. Ensure that their work load permits them ample time to dedicate to maintaining the control of your stores; giving your head of maintenance the title of energy manager will not be productive unless they are given the proper support and resources.

Comprehensive control systems are also a vital component when building a sustainable store, or when pursuing LEED certification. Use of an EMS can result in multiple energy efficiency points, and it can be part of a continuous commissioning plan. Improved occupant comfort and indoor air quality can also be incorporated. Consult with your engineering team on this.

With increasing focus on energy efficiency, global warming, sustainability and the cost of energy and labor, high-tech control systems are becoming more and more attractive for use in retail store chains. Now that the capabilities of the control systems are proving to have significant cost savings, the initial cost of installation is financially justified. When you are ready to evaluate your building controls, you need to understand what your current process is and then understand what capabilities would benefit you. Pay your controls some attention, and you will undoubtedly be rewarded with savings in maintenance, energy and aspirin costs.

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