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Integrated Lighting Controls

Integrated lighting controls offer facility managers energy efficiency, streamlined operations and overall better building management.

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Building automation systems (BAS) and lighting control systems offer facility managers flexibility, efficiency and greater control over building systems. Integrating the two systems can offer improvements in all those areas. However, maximizing the benefits of lighting control and building automation requires an integrated system that allows the two components to share data and control systems based on an overall perspective of the building and its systems. A truly integrated system allows for the building automation system to take data from one component, such as lighting control, and use it to manage overall building systems.

This white paper examines integrated lighting controls and shows how they can be used to increase energy efficiency, improve operations and lead to better building management.

Topics addressed include:
- Integrated lighting control and BAS
- Energy management based on data shared between lighting control and BAS
- Strategies for successfully integrating BAS and lighting control
- Lessons learned from successful integration projects

building OPERATING management

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With lighting controls, facility managers can use schedules to prevent unnecessary lighting at any time of day. Integrating the controls gives the BAS that ability as well.

Integrating Lighting Controls

As facility managers look for new ways to improve energy efficiency, streamline building operations, and improve occupant comfort, building technologies are evolving to help meet those goals. One building system with the potential to offer greater opportunities in these areas is lighting controls.

That may seem surprising, given that lighting controls have been a part of efficient building operations strategies for some time. But the difference now and in the future is that integrating lighting controls into the building automation system (BAS) can offer facility managers the flexibility they need to meet ever more demanding energy efficiency and efficient operations goals.

“Lighting controls themselves are not mechanical controls as we have historically known them, and mechanical controls as we have historically known them are not lighting controls," says Jim Benya, principal, Benya Burnett Consultancy. "The two worlds have good reason to stand separately apart. They don't have a lot to say to each other, but in the future, they will."

The difference between lighting controls in the traditional sense and integrated lighting controls comes down to one word: communication. While lighting controls share some information with the BAS, they are basically stand-alone systems that control the lights and ignore everything else.

Without integrated lighting controls, the BAS and the lighting controls can only share so much, which limits how efficiently the systems can work in tandem. From an operations standpoint, this has been acceptable, because lighting and lighting controls strategies are very much driven by the particulars of each control zone.

"Lighting controls tend to be space-by-space specific, and there isn't a lot that's got to go all the way up to a brain to figure out," Benya says. "If I design the automated daylight harvesting controls for the lighting in a room, my daylight sensor's in the room; the brains that decide whether the lights should be on or off — motion sensors, usually — are in the room; the dimming gear is in the room. What outside the room is going to influence us?"

When those lighting controls are integrated with the BAS, then not only do outside influences start to come into play, but the lighting controls are often initiating the dialogue. Whether it's energy efficiency, component performance, demand response, or working in tandem with other building systems, information sharing and improved data reporting offer a number of new tactics for facility managers.

With new projects, says David Mead, building performance specialist, WSP Flack + Kurtz, fully integrated systems can track, not only overall energy use, but also how much energy is being used in a zone, or even by a luminaire. “That can translate back to light levels and anything else you want to look at,” he says.

For facility managers looking to take the next step in better building performance, integrated lighting controls can offer a number of benefits. But there are some things to keep in mind, including an understanding of how the systems must be built.

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Integrated Controls Help Keep The Bow Efficient

In many lighting controls integration projects, the ultimate goal is to simply make it easier for the systems to function. That's the case at The Bow, the Calgary high-rise that is home to the headquarters of EnCana Corporation.

The building, which has 55 occupiable floors and more than 1.9 million square feet of usable space, also has several thousand address points on its building management and lighting controls networks. This leads to a number of challenges, including simply managing network traffic.

To help streamline the amount of traffic and ensure more efficient operation, the controls for the blinds were integrated into the building management system (BMS). By doing so, the blinds could respond to the information from the weather stations and other sensors that was already coming into the BMS, as opposed to that information having to travel from the BMS to the lighting controls, then being used to manage the blinds.

"It was easier for us to take all the information and just control their blinds than for them to take all the information from the building — all the sensors on the roof, in the atriums, everything — and pull it into the system and control their blinds," says Cameron McFadden, account engineer, Siemens.

With integration becoming a more common request, that means more points and more addresses being managed by one system, which McFadden says leads to another thing to keep in mind. Naming conventions can vary pretty widely between vendors, so a longer name in one system could get truncated in another, leading to confusion about what a particular name is identifying. To avoid this, settle on a convention that will work on all systems before beginning the work of addressing components.

Building Blocks

The first step to building a successfully integrated system is to remember that while lighting controls are powerful in their own right, they are a system within a whole building infrastructure. So, to integrate them successfully, the starting point is the BAS, which will be the foundation for the integrated system.

There are a couple of reasons for this. The first is that BAS systems can already manage a wide array of systems — everything from HVAC to security — so operators and engineers are familiar with using a central point to gather data from a wide range of building operations. This is another point in favor of integration; being able to manage and monitor lighting through the same dashboard as other building systems streamlines building operations and management.

“When I’ve chatted with building systems folks, building engineers who have the screens up in their offices, basically what I hear is they want it all on one screen,” says Jonathan Plumpton, vice president, lighting design group, WSP Flack + Kurtz. “They don’t want to have to switch between two or three different programs to get it all, even though they’ve essentially bought separate systems. They want to have the simplicity to pull it up all on one screen.”

The second reason to make the BAS the foundation for integration is that if there is a roadblock in the integration process, then it’s generally easier and cheaper — although not necessarily easy or cheap — to replace or modify lighting controls than it is a BAS. Or, if absolutely necessary, certain functionality can be dialed back so that the lighting controls are partially integrated, such as using the BAS to manage schedules and on/off commands based on occupancy, but keeping the daylight harvesting controls separate.

While it may seem like the solution to building a bridge between the lighting controls and the BAS is simply to use an open protocol such as BACnet, it’s a little trickier than that, says Jack Althoff, owner representative, ProJeX, Inc. First, both systems have to speak not only the same language, but the same dialect. For example, when looking to use BACnet to integrate controls, are you going to use BACnet/IP or BACnet MS/TP? Will you use the lighting controls schedule, or the BACnet schedule? Do the lighting controls you want to use support BACnet’s alarming object, or do you need another solution for alarm management?

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These questions — and others — show the importance of a well-thought-out plan for the integration project, says Althoff. While an open protocol offers much more flexibility than a closed protocol, there's no guarantee that it will work well with other systems, so be sure to explore what you can and can't do to get the systems communicating with each other. In other words, unless you need to come up with a workaround because you have two existing systems that you need to keep in place, determine how the lighting controls will communicate with the BAS before beginning a project to integrate them.

"I've seen daylight harvesting components added to existing systems that didn't communicate and ended up being very expensive to correct," says Althoff. "They plug in, but they don't always play nice."

Energy Efficiency

One of the biggest advantages of lighting controls is energy efficiency; the same can be said for BAS. So being able to integrate the two can lead to increased efficiency, but there are a few things facility managers need to know to maximize that benefit.

The first is what Benya describes as one of the driving forces behind interest in integration. Time-of-use pricing for electricity is becoming more common; this year, Southern California Edison, one of the nation's two largest utilities, will move all its customers to time-of-use pricing.

What that means is that instead of electric bills being calculated as simply rate times kilowatt hours — with additional charges for peak usage — rates will vary based on the time of day. Commercial customers will have an incentive to cut or shift as much usage as possible during the times of the day when the rates are highest.

But there are limits on just how much electricity use can be cut in a commercial building during business hours. Computers have to be on, HVAC has to provide a certain level of occupant comfort, and certain building functions such as security and fire/life safety have to be powered.

HVAC, through the BAS, can be adjusted to use less energy during peak times, for example, by raising temperature setpoints a degree or two higher during the summer when it's hottest outside. But the one system that can offer the most flexibility is lighting, because it's the one system that can be dimmed. And, in conjunction with daylight harvesting, it can often be turned off entirely during the times of high demand; these abilities make lighting a good place to look for energy efficiency, Benya says.

"The reason lighting is so important now is that if I turn your lights down 50 percent, you'll notice, but you won't freak out," he says. "If I turn your computer down 50 percent — I can't. I've got to turn it off."

Harvard's Fay House Goes Integrated

At Harvard University's Fay House, home of the administrative offices for the Radcliffe Institute for Advanced Study, a renovation project was used as an opportunity to overhaul the lighting, HVAC, and building management systems in an effort to improve building operations.

As part of that, the lighting controls were integrated with the BAS via BACnet, with the emphasis being on using lighting controls to drive HVAC schedules. The lighting controls report occupancy status to the BAS, which then adjusts the HVAC and other building systems accordingly.

"We're not doing what the typical thing would be, which is controlling the lighting or turning it on or off," says Larry Stangel, area technical manager, Siemens, which provides the building's BAS. "We're monitoring the status points, and when that thing goes occupied, we basically turn all our stuff on."

To do this, the two systems need to communicate. While that may sound easy, Stangel says that during the early stages of the project, there were some failures at communicating through BACnet that forced multiple tries at getting communication online. While it was all eventually worked out, it showed the importance of clear specifications early in the process, Stangel says.

"Anytime we do system integration, upfront design and communication between us, the customer and the other vendor, that's always the most important thing," he says. "Know what you're going to do, how you're going to achieve it, then be on the same page with the vendor."

The reason this matters for integration is that by combining lighting controls with BAS, facility managers can oversee all energy use from a central point, as well as taking advantage of data sharing to push for improved efficiency.

Traditionally, lighting controls have been stand-alone systems that communicated basic information to the BAS. That's not necessarily going to change as the systems become more integrated; lighting controls will still continue to be a system apart from the base BAS.

But what is changing — and will continue to change — is how the systems communicate and what is done with the data that the lighting controls system shares. As lighting components such as electronic ballasts and communicative ballasts become more able to provide information, and as systems offer greater communication with one another, it

In conference rooms, sensors can report occupancy status to both lighting and HVAC control systems, which adjust accordingly.

offers more options for widespread control of operations, says Althoff. With time-of-use pricing, this communication can help tightly manage usage at any given point during the day.

"There's a lot more data getting out of [ballasts] than there was before," says Althoff.

For example, the norm in non-integrated systems is for occupancy sensors to check occupancy status, then turn off lights as warranted. But in an integrated system, not only could the lighting controls adjust the light levels as necessary, they could report the occupancy status to the BAS, which would then adjust the HVAC to match the setpoints for a certain status of the room.

So, if someone enters a conference room, integrated lighting controls raise the light levels to a preset point as well as reporting to the BAS that someone is in the room; the BAS then adjusts the HVAC to warm or cool the room as needed.

This idea can work on a whole building basis as well. If the building is set to start up at 7 a.m., but the CEO comes in at 6:30 a.m. one day, then lighting sensors can light the way to the executive suite and the BAS can adjust the temperature in that area. Then, when 7 a.m. rolls around, the rest of the building can be started as normal. This is just one example of how advances in overall building technology and efficiency offer greater opportunities for two major building systems to work in tandem, because both lighting and HVAC not only consume a lot of energy, they have a major effect on occupant comfort.

"In the past, there's been very little that they could exchange intelligently with one another and have any significant benefit over standing alone," says Benya. "That's going to change now that we're designing buildings more efficiently."

Another area where integrated controls can lead to energy savings is demand response. Some buildings are already set up to respond to demand response calls automatically; for example, when the utility sends out a call, the BAS responds by dialing back the HVAC and letting the temperature rise a small amount on a hot summer day.

By integrating lighting controls, the BAS can automatically manage both HVAC and lighting, shedding load from both systems to achieve a greater reduction in use overall than one or the other can achieve on its own. With integration, this can all be done automatically, allowing for a faster response and less need for oversight to respond to a demand response call. To Benya, this is one of the key reasons to integrate lighting controls, because it requires communication with a system outside of the lighting controls.

There's one more energy efficiency benefit as well, and it's one that sometimes gets overlooked. Lighting plays a role in temperature in the building. This is helpful in cooler climates or during the winter because it helps warm the building, but in the summer, being able to dim or turn off lights completely puts less of a demand on the HVAC to keep the building cool.

Operational Benefits

In addition to energy efficiency benefits, integrating lighting controls into the BAS can lead to more efficient operations overall. By having a system that can manage everything — or close to it — facility managers can oversee building systems without having to use separate programs or gather data from different reporting tools. In addition, facility managers can track lighting energy use without having to install separate meters.

This integrated management and reporting can help keep a tighter rein on building operations and ensure that you're getting the performance you're paying for, says Mead.

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"A lot of systems haven't actually performed as expected, especially when it comes to energy," he says. "They might function when they're first commissioned, but people tend to override things or maybe they never were commissioned properly, so none of that's really communicating and performing as needed." Without the energy monitoring, it was impossible to track performance, so facility managers didn't really know what was going on.

Better building operations extend beyond the facilities department as well. Of course, actually operating the building is the key role of facilities, but another function is setting up the building in a way so that occupants can do what they need to do in the course of a day.

Integrated controls can help with this by offering more flexibility in light levels and scheduling. While one department may want high light levels from 7 a.m. to 6 p.m., another department may prefer lower light levels and only need light at all until 5 p.m. And in the case of something like a sales team, their space may only be occupied a fraction of the time, so lights can be turned off entirely for much of the time and brought up when meetings are being held or staff is in the office. In addition, lighting components such as occupancy sensors that can report back to the BAS help manage light levels during times when a department or a certain area of the building is unoccupied. If everybody in accounting goes to lunch at noon, the controls can turn off the lights and adjust the HVAC accordingly, then reset when occupants begin re-entering the space.

Going hand-in-hand with this is the ability to offer users individual control of light levels, which Plumpton says are often determined by the type of occupant in the space.

"Certainly the tech industry is filled with bright young people who are very used to working in lower light levels," he says. Giving occupants the ability to control light levels from their own device provides them a degree of control and interaction with the building that otherwise is not available.

Much of this, of course, can be done with standard lighting controls. But what integration offers is the ability to combine all of these different methods of control into one central system that allows for flexibility on both the part of the end user and the facility manager. Another area where integration can support better building operation is in tracking how the building is being used. With lighting components that can report occupancy or vacancy, the BAS can track how often Conference Room A or Lighting Zone 5 is being used and provide facility managers with information that allows them to get a better handle on how occupants are working within the space. In some cases, facility management teams are developing operating algorithms based on data reporting that gives them a fine-grained look at how the building is being used, says Mead.

"Just because you have the data doesn't mean it's being used, and that's something we're seeing as there's a lot more information flowing," he says.

Getting It Right

In a fully integrated controls system, lighting controls and BAS can work together to offer greater benefits than they can on their own.

But, as with most building systems, facility managers need to keep a close eye on how the building is being operated to maximize those benefits.

Integration can help overcome — or at least mitigate — some of the common operating mistakes such as HVAC setpoints and light levels being overridden for events, then never being put back. By reporting occupancy status, light levels and HVAC settings for an area, the controls can at least give building operators a report that the space is being treated differently than it should.

But, no matter how good the controls, the human factor still matters. Integrated controls can offer a cornucopia of information, but acting on that information is what raises a building to a higher level of performance.

Part of acting on that information is understanding that while efficiency is an admirable goal, it's not the only benefit from integrating controls. Being able to give users more control can not only help meet efficiency goals — as one example, users who have individual light controls in their space tend to actually use light levels below what the facilities team expects to be used — but can help occupants embrace what's going on in the building and contribute to its success.

"How you interface between the user controls and the automation is a very delicate balance," says Mead. Facility managers don't want the users to feel that the building is ruling their lives and forcing them to do things they don't want to do, but at the same time, it's important to ensure that the building is hitting its performance targets, so that the organization is getting the expected return on the investment in sophisticated controls, says Mead. "There's a real art to that in operation."

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