

Lighting Controls: Current Use, Major Trends and Future Direction

By Craig DiLouie, Lighting Controls Association

Lighting automation is now becoming the rule rather than the exception, according to a new market research study funded by The Watt Stopper and conducted by Ducker Research. The study found that lighting automation is being used in a majority of new construction and renovation projects in the office and school markets. Approximately 65% of these projects feature lighting automation.

The research was made available as part of the California Energy Commission's Public Interest Energy Research (PIER) Lighting Research Program—a two-year, \$5.2 million research and development program that creates new lighting technology and products that can save energy, reduce peak demand, and reduce pollution for the citizens of California.

The study also found that specifiers and users are very interested in the advantages of controls—primarily energy savings and energy code compliance—but seek simple, low-cost solutions.

Four popular control technologies—building automation systems, lighting control panels, occupancy sensors and daylighting systems—are regarded as effective and relatively problem-free. Occupancy sensors and scheduling systems dominate.

Major potential technology advances regarded as most desirable include standard protocols along with plug-and-play solutions and low-cost electronic dimming ballasts.

Standard protocols and low-cost electronic dimming ballasts were identified as technology advances that would have the greatest impact on lighting control application.

“The top trends in terms of importance to specifiers and end-users is the adoption of standard protocols to enable lighting components to talk to each other, as well as integration of lighting automation systems with building management systems,” said David Peterson, Director, Strategic Market Development for The Watt Stopper. “A significant upcoming trend is occupant control of lighting via personal dimming.”

The study

The California Energy Commission's Pier Lighting Research Program, in support of Project 5.4: DALI Lighting Control Device Standard Development, identified its first task to be research of the current use of controls, satisfaction with their use, and receptivity to a standard protocol and the benefits of facilitywide dimming.

The goal of Project 5.4 is to accelerate the use of fluorescent dimming in office and school applications, thereby reducing energy consumption and demand. Its objectives are to define customer needs for automatic control, manual overrides, central monitoring and reporting, load shedding, occupancy sensing and daylight controls in commercial office and school applications. The Digital Addressable Lighting Interface (DALI) protocol, enabling digital lighting networks to be constructed in which all components are interoperable and that provide facilitywide dimming, is therefore being studied.

A research effort was formed to address the above questions by talking to specifiers and users of controls. To accelerate the program, The Watt Stopper, a controls manufacturer, offered to share the results of a study conducted by Ducker Research, which

addressed many of these questions. That study, funded by The Watt Stopper, was based on telephone interviews of 158 facility managers, electrical engineers and architects.

What is the penetration of automated lighting controls?

Respondents indicate that, on average, more than half of all new commercial new construction and retrofit projects finished over the past two years feature automated lighting controls. In new construction projects featuring automated controls, more than 50% of the floor area is covered by automated lighting.

“The education market shows the highest adoption rate for automated controls, particularly colleges, universities and other higher education facilities,” said Peterson.

The rate of adoption in retrofit applications is somewhat lower across the board. The largest divergence between new construction and retrofit is in the study’s “other” category—library, retail, hospital, government, recreational, industrial. According to the study, nearly 80 percent of new construction projects completed by respondents in these applications over the past two years feature automated lighting controls, while less than half of retrofit projects included them.

Projects Utilizing Automated Lighting Control in Past Two Years				
	K-12 Educational	Higher Education	Commercial Office	Other*
New Construction				
% Penetration	65.0%	71.4%	61.8%	78.7%
Retrofit Construction				
% Penetration	53.1%	61.9%	57.5%	42.8%

*Other includes library, retail, hospital, government, recreational and industrial.

Floor Area Covered by Automated Controls in Projects Featuring Automated Lighting				
	K-12 Educational	Higher Education	Commercial Office	Other*
New Construction				
% Floor Area Covered	59.0%	57.6%	65.4%	62.5%
Retrofit Construction				
% Floor Area Covered	50.8%	45.2%	59.2%	45.8%

*Other includes library, retail, hospital, government, recreational and industrial.

What are the demand drivers?

The top five factors driving the use of automated lighting controls are:

1. Increasing energy savings
2. Complying with owner requests
3. Compliance with state and national energy codes
4. Providing occupant control capability
5. Obtaining utility rebates and incentives

Study respondents also cited “other” as a very important factor, indicating there are potentially many other factors driving the use of automated lighting.

“Energy savings is the primary driver with the owner having ultimate control,” said Peterson.

It is interesting to note that the ability to shed lighting in response to a utility request and to monitor lighting energy usage are not considered very important, nor is daylighting. Also of interest is growing demand for occupant control of lighting, validated in other studies conducted by the Lighting Research Center and the Light Right Consortium.

What methods are popular?

The study focused on three lighting automation methods: scheduling, occupancy sensors and daylighting systems.

Scheduling technologies include building energy management systems, time clocks and lighting automation panels. Survey respondents indicated that building energy management systems are most often used for scheduling (39%), followed closely by time clocks (35%) and also lighting automation panels (26%).

Building automation systems are traditionally associated with larger buildings of 100,000 sq.ft. and up. In smaller buildings, lighting control panels and time clocks are more likely to be adopted. This is likely due to initial cost and also because electrical contractors prefer standard devices with readily available parts and applications support, no PCs or special programming tools, and simple commissioning.

Occupancy sensors are, according to the study, the most popular automated lighting control solution for all major building types and are adopted by both large and small buildings. Scheduling systems are also somewhat popular, followed by daylighting systems, which are used much less frequently.

Incidence of Use of Various Lighting Automation Solutions			
	Scheduling	Occupancy Sensor	Daylighting Sensor
New Construction			
K-12 Education	48.0%	65.7%	10.5%
Higher Education	48.0%	75.4%	12.7%
Commercial Office	54.3%	61.7%	11.7%
Other*	58.0%	67.0%	20.0%
Retrofit Construction			
K-12 Education	35.2%	65.2%	11.4%
Higher Education	39.2%	72.3%	10.4%
Commercial Office	41.5%	59.7%	7.5%
Other*	58.0%	67.0%	20.0%

*Other includes library, retail, hospital, government, recreational and industrial.

How do the technologies rate?

Respondents were asked to rate each technology on a scale of 1-5 on how well it met energy savings expectations, and also how problem-free the performance of the various products have been since installation. A score of “1” meant it exceeded expectations; 3 meant it met expectations; and “5” meant it did not meet expectations.

Scheduling ranked the best in regards to meeting expectations and providing reliable performance; daylighting ranked the lowest in both areas. All technologies were rated as effective and relatively problem-free.

Technology	Expectations Score	Reliability Score
Scheduling using building automation system	2.22	2.09

Scheduling using lighting control panels	2.25	2.15
Occupancy sensors	2.56	2.42
Daylighting controls	2.95	2.55

The respondents were questioned about barriers to adoption of these technologies. For building automation systems, the primary barriers include initial cost and end-user lack of experience with the technology. Initial cost is the primary barrier to lighting control panels and daylighting controls. For occupancy sensors, false offs and delays is the largest barrier to use, along with initial cost.

What are the trends in the controls field?

The study identified five trends influencing the controls field and asked respondents to rate each trend on a scale of 1-5, from extremely important (1) to not important (5). These trends ranked:

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| 1. Standard protocols for lighting automation systems | 2.36 |
| 2. Integration of the lighting automation system with the building management system | 2.53 |
| 3. Increased need for enhanced occupant control of lighting | 3.04 |
| 4. Increased demand for flexible use of space | 3.06 |
| 5. Increased use of architectural daylighting design practices | 3.73 |

Respondents ranked standard protocols as the most important trend primarily for three reasons: The systems would work better together, specification would be made easier, and the process would be simplified and made more convenient. Standard protocols provide assurance that components of the lighting control system would work together, and also provide a common set of base functions and commands accessible to the building automation system.

“Most manufacturers have embraced the cause of interoperability as the best way to service the specifier and user,” said A. J. Glaser, president of the Lighting Controls Association and HUNT Dimming, a controls manufacturer. “Popular examples include 0-10 VDC and Phase-Control fluorescent dimming technologies. These open industry protocols ensure compatibility among the various lighting manufacturers, which provides additional choice to the specifier at the front end, while providing options to the owner as it maintains the installation into the future.”

The second major trend is integration of the lighting automation system with the building automation system. Respondents indicated this was desirable primarily because centralization provides easier operation of both systems; one technician controlling both systems also provides ease of operation; and higher energy savings can be achieved.

Regarding daylighting, respondents did not see this as a major trend and have not changed their practices because of it. Most agreed with the statement, “As architects begin to use more daylighting, it has an impact,” speaking in terms of the future noting that this will have an impact when architects begin to adopt it in greater numbers.

Occupant control was identified as a major trend; respondents were also asked another question related to price sensitivity to more sophisticated lighting options. A choice was provided: Given the installed cost for a traditional parabolic system is \$2.00 per sq.ft., which of the following three options would they elect to use to improve lighting quality?

#1	Use a direct/indirect fixture for \$2.50/sq.ft. installed	40.3%
#2	Integrate occupancy sensors for \$3.00/sq.ft. installed	31.3%
#3	Integrate occupancy sensors and provide personal dimming control for \$3.50/sq.ft. installed	25.4%

Option #1 was desirable to respondents primarily because it represented a lower initial cost. Option #2, however, was desirable primarily because it is “cost effective, a good value.” Option #3 was desirable primarily because it increased occupant comfort. The implication of the positive response to personal dimming control is that a significant segment of the market would pay a premium of \$0.50 per sq.ft. for it.

How will potential technology advances be received?

Respondents were read a list of potential advances in controls and asked whether these advances would help facilitate the use and application of control systems. They responded favorably to all, with the strongest interest being in low-cost electronic dimming ballasts, standard protocols and plug-and-play solutions.

	One-Stop Solution Such as Integrated Controls with Light Fixtures	Plug-and-Play Solutions	Low-Cost Electronic Dimming Ballasts	Addressable and Dimmable Electronic Ballasts	Industry Standard Communication Protocols
Yes	69.3%	77.8%	84.3%	62.2%	78.6%
No	29.9%	20.6%	15.0%	21.4%	21.4%
Unsure	0.8%	1.6%	0.8%	0.0%	0.0%
Total	100%	100%	100%	100%	100%

Later, when asked to rank these advances (scale of 1-5, from extremely important to not important), standard protocols ranked highest, then low-cost ballasts, then plug-and-play solutions.

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| 1. Industry standard communication protocols | 2.14 |
| 2. Low-cost electronic dimming ballasts | 2.23 |
| 3. Plug-and-play solutions | 2.41 |
| 4. One-stop solution such as integrated controls with light fixtures | 2.93 |
| 5. Addressable and dimmable electronic ballasts | 3.05 |

Standard protocols were regarded as desirable primarily because respondents felt that this would enable simpler, easier operation, while promoting competition among manufacturers to lower costs. The implication here is that there are currently problems with various control systems working together.

Low-cost electronic ballasts were desirable primarily because “cost effectiveness is always important” and because these ballasts are currently too expensive.

What are the implications for DALI?

DALI was introduced to the United States to provide assurance to both specifiers and owners that ballasts and controls from different manufacturers can function as a system. DALI-based control systems provide centralized control operating on a standard

protocol, provide daylighting and occupant control capabilities, enable application flexibility, and can provide significant energy savings.

To learn more about how DALI-based control systems work and their benefits, [click here](#).

<http://www.aboutlightingcontrols.org/education/dalibuzz.html>

“The study indicated that specifiers and owners are highly interested in the advantages of a standard protocol based on the belief that it will make control systems easier and simpler to specify and operate, while also promoting competition to reduce installed cost,” said Peterson.

While addressable and dimmable ballasts are not regarded as a high-impact technology trend, low-cost electronic dimming ballasts and standard protocols are regarded as having a high potential impact on specifier and owner choices. Occupant control of lighting (personal dimming) is also regarded as desirable, also enabled by DALI.

Respondents who regard addressable and dimmable electronic ballasts are primarily interested in flexibility to address changing office space needs and also, to a lesser extent, occupant dimming control to increase occupant comfort. Initial cost poses the greatest barrier to adoption.

“The real interest is in simple, reliable, affordable dimming controls for offices and schools, controls that can save money while increasing occupant satisfaction,” said Peterson. “DALI is a tool that can help achieve these objectives, but addressable, dimmable ballasts are still a relative unknown. Specifiers and owners want proven, tested products for their buildings. Our next step is to provide this proof while reducing the cost barriers.”