

LD+A

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FIRST UP

- Editor's Note** 4
- Insights** 7
- Events** 9
- Ask an EP:** 10
Bernadette Boudreaux
- How They Did It** 11

IN THIS ISSUE

- Willard Warren** 12
The 50-year Prequel
 - Jess Baker and** 14
Andrea Wilkerson
The Quest for a Circadian Code
 - Jane Slade** 18
Quantifying Darkness
- ## PLUS
- IES Insider** 43
 - Products** 46
 - Ad Index/Classifieds** 51
 - Last Look** 52



Photo: Andrew Fane

FEATURES

22

THE FUTURE-PROOFED WORKPLACE

LED luminaires with sensors could be one tech tool for facilitating a safe return to the office

26

DON'T BE A TARGET

A simple building system—yes, lighting—can be the gateway to an IoT security crisis. Better industry standards can help avert disaster

30

SHAKY CONNECTION?

Five lighting designers address five topics concerning the uneven state of the smart-lighting market

36

CHICAGO STYLE

In its quest to transform its street lighting, the Windy City also found ways to create jobs and heighten safety

40

PROJECT IN PICTURES: ULSTER HOSPITAL

Wireless Bluetooth control enables a patient-centric experience for a hospital in Belfast

On The Cover

For connected lighting to gain traction, issues such as security and standards must be addressed. Still, opportunities are abundant.



EDITOR'S NOTE

One is the Loneliest Number

In 2019, I moderated a LightFair panel entitled, “Careers in Lighting: What’s Hot and What’s Not.” We closed the session with a lightning round. I asked the participants an either/or question—no waffling or hedging bets was allowed. The question was, “Which will create more jobs over the next few years: light and health or smart lighting?” There was no hesitation from the panel. All four replied “smart lighting.”

Two years removed from that panel, I wonder about that prediction. The DOE’s energy savings forecast published in December 2019 found that “only 1% of installed lighting systems are equipped to leverage connectivity between lighting devices and with other building systems for the purpose of realizing additional savings and value.” You could look at that two ways: The remaining 99% could represent a whole lot of job growth. Or, why so little traction for something that’s been hyped for years now?

We hope to provide a few answers in this issue. In our no-holds-barred roundtable (p. 30), five designers dissect a few of the issues that are hindering adoption of connected lighting, whether it’s return on investment, complex installation, maintenance concerns, or an owner’s lack of understanding of what benefits—beyond

tracking energy use—can be derived. Meanwhile on page 26, returning *LD+A* contributor Michael Skurla takes aim at another topic that can make owners skittish—IoT security, and how a breach of one building system can spiral into disaster.

“Our contributors this month didn’t just point fingers at the problem. They offered some remedies”

But as the saying goes, “Any &#! can knock down a barn, but it takes a good carpenter to build one.” By that I mean, our contributors this month didn’t just point fingers at the problem. They offered some remedies. In discussing the lack of industry standards, Ardra Zinkon, chair of the Society’s IoT Committee, emphasizes several key developments, including legislation in California requiring certain cybersecurity features on connected devices, and Design Lights Consortium’s requirement that manufacturers to report adherence to certain security standards within their products. Skurla closes out his article with a checklist of minimum requirements for safeguarding security.

From the cutting edge of technology standards ultimately emerge. Same as it ever was.

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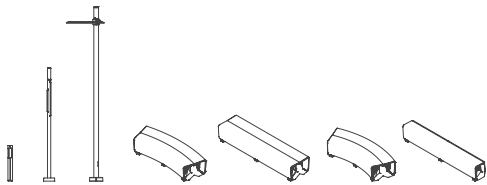
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Photo: Business Wire

Evaluating best practices for greenhouse lighting could advance crop production.

Get It Growing

Research trial aims to improve strawberry production with supplemental light

Strawberry season is in full swing, but that doesn't mean you can't end up with a bad batch. Luckily, research is underway to learn more about using LED lighting to produce consistent, high-yielding strawberry plants—during strawberry season and beyond.

Fluence by OSRAM has partnered with Delphy Improvement Centre in Bleiswijk, the Netherlands, to conduct the research, focusing on how the company's LED lighting solutions impact strawberry production in greenhouses.

Traditionally grown in outdoor fields, strawberries are temperature-sensitive crops, restricting growers in the northern hemisphere to limited seasonal production cycles. The research team aims to examine best practices for efficiently growing strawberries in a controlled environment by introducing supplemental lighting techniques that growers can replicate year-round.

According to Delphy, greenhouse growers have shown increasing interest in switching from legacy systems such as high-pressure sodium lighting to LED fixtures to analyze how various light spectra affect crop quality and consistency. "Growers are



(continued from p. 7)

searching for optimized lighting strategies and want to understand how their plants will react to artificial light,” says Lisanne Helmus, manager of research in greenhouse horticulture at Delphy. “We’re inspired to answer their questions and discover new developments in lighting technology that will impact the entire cultivation system.”

The trial results are expected to be published later this year—perhaps paving the way for fewer of those less-than-desirable cartons on our shelves, no matter the season.



Where The Sun Does Shine

It may be impossible to replace sunlight, but GE Lighting, a Savant company is taking a stab at it with its new “sun filled” LED bulb, introduced to help maintain the body’s circadian rhythm, which in turn can support energy levels during the day and restful sleep at night.

The bulb delivers

a high-CRI value of 97 to render colors that look much like they would appear in natural sunlight, and emits a spectrum that is closer to sunlight than ordinary LEDs by eliminating the 450-nanometer wavelength (the blue spike) present in many artificial light sources. Without the invisible blue-spectrum peak, there’s also no need to adjust the color temperature of your lights when you’re ready to unwind for the evening—an added perk for those who usually do so.

79%

Respondents who identified better lighting as a requirement for managing building performance and protecting occupant health, according to an Acuity survey of facility and sustainability leaders

Marsha L. Turner Steps Down as CEO of IALD

Marsha L. Turner stepped down as CEO of the International Association of Lighting Designers (IALD) and executive director of the IALD Education Trust in June after 18 years with the association. Ashley Robbins, IALD’s current chief operating officer, will be serving as interim CEO and interim executive director for the IALD Education Trust.

Under Turner’s leadership, IALD’s globalization flourished and the association’s Region and Chapter network grew from a handful of chapters into a robust international footprint of 30 regions and chapters globally. Membership in the association has also seen exponential growth over the last 18 years.

Professional education and advocacy became cornerstones of the IALD’s work under Turner. The Enlighten Conferences evolved from a single one-day conference to a fully developed suite of multi-day international conferences featuring internationally renowned speakers. Turner also helped establish the Certified Lighting Designer (CLD) credential, which is the first evidence-based certification in architectural lighting design.

THEY SAID IT...

“If we can continue letting the ‘thing’ become smart—letting the buildings learn—we will continue to adapt and truly realize what it means to be future proof.”

Tanuj Mohan, “The Future-Proofed Workplace,” p. 22



Cooper Lighting Solutions, a business unit of Signify, has won the **2021 ENERGY STAR Partner of the Year – Sustained Excellence Award** from the U.S. Environmental Protection Agency and the U.S. Department of Energy for the seventh consecutive year. This award recognizes continued leadership and superior contributions to ENERGY STAR.

MERGERS & MORE

- **WAC Lighting** has acquired 150-year-old **Schonbek Worldwide**, a leading brand of luxury crystal lighting, from **Swarovski Lighting, Ltd.**
- **GE Current, a Daintree company**, has acquired **Forum Inc.**, a Pittsburgh-based architectural linear luminaire company.
- **Roebing Capital Partners** has acquired Fairfield-based **Teron Lighting Inc.**

14.4%

Expected growth for the solid-state lighting source market over the forecast period 2021-2026, according to Research and Markets

2021 VIRTUAL EVENTS

August TBD:

LEducation 2021 will take place virtually. Organized by the Designers Lighting Forum of New York (DLFNY), the event will continue to provide a series of accredited conference sessions and seminars in a virtual format. Definitive dates and details are forthcoming. www.leducation.org

August 9-13:

The 2021 IES Annual Conference will be hosted in a virtual setting. The event will continue to provide a range of educational programming on the art, design, science and research of lighting relevant to lighting professionals, educators and related design disciplines. www.ies.org/ac

August 24-25:

Strategies in Light will be held online, with interactive webinars, panel discussions, and chat forums that enable attendees and exhibitors to network, exchange information and share ideas. The 7th annual Sapphire Awards will also be held virtually to recognize leading innovations in product development and design for lighting products and systems. www.strategiesinlight.com

2021 IN-PERSON EVENTS

September 21-22:

The first ArchLIGHT Summit will take place in the Dallas Trade Mart. The trade event and educational platform for architectural, specification and design communities will include accredited seminars, hands-on lab learning and panel discussions. www.archlightsummit.com

October 11-13:

The IES Street & Area Lighting Conference (SALC) will take place at the Marriott Marquis in Atlanta. With a primary focus of improving outdoor lighting, the conference program provides outdoor lighting training classes, seminars, networking sessions and an exhibit hall. www.ies.org/salc

October 25-29:

LightFair 2021 will take place at the Jacob K. Javits Convention Center. The event is the world's largest annual architectural and commercial lighting trade show and conference, with over 500 exhibitors, hundreds of industry-

related courses and networking opportunities with industry leaders. www.lightfair.com

November 10-11:

Enlighten Asia 2021 will take place in Tokyo. Organized by IALD Japan, the conference offers a platform for lighting professionals to exchange knowledge about architectural lighting and the built environment in Asia and beyond. Online and in-person experiences, and English translation and/or captions, will be available. www.iald.org

November 20-27:

Organized by the IES Fredericton Section, the Annual IES Maritime Regional Conference will take place at the Luxury Bahia Principe Ambar Resort in Punta Cana, Dominican Republic. In celebration of the conference's 65th year, the event will include educational and cultural content, as well as outings and activities. www.maritime.ies.org



ASK AN EP

BERNADETTE BOUDREAUX

The technical operations manager for the **DLC's Solid-State Lighting Program** plans to invest in the future by paying it forward

Why lighting?

Lighting is one of the fastest growing fields that encompasses technology as well as the creative side of design. This is rare in such an engineering- and science-heavy field. The speed of change and the depth of innovation keeps this industry exciting. In lighting, there are a lot of opportunities for EPs to claim their stake in the future.

Favorite project?

My favorite projects are those where I get to see the results of my work. As an automotive design engineer, projects became real when I saw a vehicle on the road. As a lighting design engineer, it was great to tell my family/friends to look at the



Since I have been fortunate to have great mentors/support, I intend to offer the same to the new generation

lighting at big-box stores and say that that I took part in the design. At the DLC, it is amazing to see how my work affects the environment. DLC's focus on energy efficiency has made me a proud environmental enthusiast. I am conscious of how my work and my personal life affect the world and impact Mother Earth. I am committed to being conscious of my ability to make change in my work life, industry commitments and personal life.

Best part of your job?

I am always learning. Working with the DLC affords me the opportunity to see how much lighting affects our environment and be more aware of all aspects of the industry. As a former lighting engineer at Acuity, I was focused on engineering and manufacturing. The DLC has broadened this scope; I am able to see impacts of lighting in respect to health, energy rebates, energy programs/codes, and the impact lighting has on a vast number of stakeholders. Having this broader perspective has afforded me more integrity in decision making.

Biggest obstacle you've encountered?

Getting into such a large industry and finding where I fit and what was available to me. I struggled to find out how to get involved and how to find the people, resources and organizations that I needed to align with. I am thankful for mentors, programs like the IES EP program, and great companies that I worked for that helped me eventually find my way.

Most important thing for the future of the lighting industry?

The engagement of EPs and new graduates is critical to the industry. EPs need to be on a path to leadership, as some of the current leadership will soon retire. EPs need to be introduced to available opportunities, and mentored/supported in activities that prepare them to lead the industry into the future and capitalize on all the great work our industry leaders have accomplished. All youth need to recognize lighting as a top emerging industry to explore for career/learning opportunities. To ensure the lighting industry stays on par with the aggressive growth, innovation and opportunities, we must invest in our future.

What's next?

In the future, I will be graduating from the EP program and intend to establish myself as an industry recognized resource in relation to the DLC and other energy- and diversity-related activities. Since I have been fortunate to have great mentors/support, I intend to offer the same to the new generation of EPs by sharing experiences, knowledge and resources. As a black woman, I also recognize the need for more diversity and inclusion, and I intend to be a change agent and very active in this arena for our industry. I want to be an example to EPs and to young brown girls that there is opportunity in lighting, and you can be successful. I hope to assist and work with various organizations to ensure there are processes/tools in place that ensure more groups will be included and supported.

The Emerging Professional column explores issues affecting younger lighting professionals and those new to the industry.

HOW THEY DID IT

EJA Lighting Design, Inc. used subtle accent lighting to maintain continuity between the exterior and interior of a residence in Kua Bay, Hawaii, and earn an **IES Illumination Award of Merit**.

Kua Bay Landscape Lighting Design

1. Under-eave downlighting and tree accent lights provide dimmable illumination to guide entry, while the lawn edge and steps are accented with warm glow lanterns.
2. To avoid view distraction, subtle lighting is layered over the stairs, trees, pool and patio. Additional eave downlighting and lanterns meld outdoor and indoor spaces.
3. Waterproof LED strips concealed beneath a metal lip graze the pool depths with light.



Photos: Patrik Argast



ENERGY

Willard Warren

Act One Setting the stage for LD+A's anniversary celebration

Next month, the IES will celebrate the 50th anniversary of LD+A, which introduced articles on “what’s new” and “how to do it” in lighting design, as well as more math-oriented articles. At that time in the early ’70s, the president of the IES New York City Section, Der Scutt, AIA, initiated a new column entitled “Saints and Sinners.” Scutt labeled as “sinners” the souvenir shop owners along Manhattan’s Fifth Avenue, who lighted their show windows with wall-to-wall bare, glary, fluorescent strips. He praised as “saints” the lighting designers who created the very fashionable show windows, especially during the year-end holiday season.

A few years later, Scutt, then with Swanke, Hayden and Connell & Partners, designed the classy Trump Tower, located next door to Tiffany & Co. on Fifth Avenue, and he resented the souvenir shops located along the street that cheapened the classy appearance of our elegant shopping avenue. Unfortunately, he didn’t live long enough to see his most famous tenant elected as the U.S. President.

By coincidence, the Lumen Awards had also just been established by IESNYC to recognize and honor the work of the Section’s lighting designers. The judges on that panel were Richard Hayden, AIA, and Susan Podufaly, AIA; lighting

designers Richard Kelly and Howard Brandston; interior designer Susan Forbes, who for years has taught her craft at the Fashion Institute of Technology; and myself.

In addition to studying the photos and texts submitted each year, we decided to personally visit all the best entries located in New York and ask out-of-town designers to check out the best projects in their areas. Back then, many photographs of buildings were manipulated, and we did not want to be victims of a skillful touch-up.

SCUTT ALSO JOINED FORCES with our panel to set the wheels in motion for credentialing within the lighting industry. At the time, the IALD had already been formed and Richard Hayden, a past president of the New York City Section, saw this as an opportunity to get members of both the IES and the IALD a certifying criteria for professional licensing of lighting designers. Hayden invited Lesley Wheel, one of the founders of the IALD, to meet with him, Scutt, Jules Horton and myself, to form a committee to approach New York State’s licensing board to accomplish that goal.

Hayden pointed out to Wheel that the New York State licensing board would create an exam similar to one that the four of us had taken in our fields, and



Scutt initiated the column ‘Saints and Sinners’ to critique design

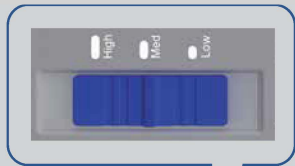
establish a required level of practical experience to become professionally licensed. Wheel listened patiently and replied: “That will not work for me because I couldn’t pass an exam like the ones you RAs and PEs passed because of the math involved, but I have done the lighting of a score of Sheraton Hotels all over the world, which the chain’s president describes as ‘welcoming’—and which none of you can do as well as I can. I certainly appreciate your suggestion and offer to help, but it doesn’t work for me.”

A decade later, the National Council on Qualifications for the Lighting Professions (NCQLP) created their “Lighting Certified” (LC) designation, which many IES and IALD Members have earned, but they also offered it to marketing people, which didn’t seem truly professional to many in the IES and IALD. However, Hayden’s advice was prophetic, because in the year 2000, Certified Interior Designers were licensed in New York State, due in large part to the efforts of our former panel member, Susan Forbes, CID.

Read the second part of this series celebrating LD+A’s 50th anniversary next month.

Willard L. Warren, PE, LC, Fellow IES, DSA, is principal of Willard L. Warren Associates.

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Jess Baker and Andrea Wilkerson

The Circadian Design Balancing Act Lessons from a pandemic-shortened office study

In 2019, a rare opportunity presented itself for lighting designers to specify a lighting system for a field study on dynamic office lighting. With the 2020 exodus of employees from open offices to home offices, the study was halted, but not before many lessons were learned. This column shares the insights gained while designing a code-compliant electric lighting system to meet circadian lighting recommendations with minimal glare and excellent color rendering. Unexpected hurdles made this balancing act even harder.

Cook County initiated this project to further understand how lighting could better support the well-being of its employees and planned to use the results to inform County lighting standards, as well as make a broader contribution to office lighting research. Cook County selected two middle floors of a 37-story office building in downtown Chicago for the study and chose Schuler Shook as the lighting designer, with Pacific Northwest National Laboratory (PNNL) partnering to assist with research.

The two floors had some private offices on the perimeter, but most of the floors were comprised of open offices. The research plan called for several conditions to be compared, so the lighting system had to be flexible enough to meet current IWBI WELL recommendations

and UL Design Guideline 24480. Despite floor-to-ceiling windows, daylight in the offices was limited due to adjacent high-rises, so designers planned to rely solely on the electric lighting system with daylight dimming. Another requirement was the ability to vary light level and spectrum throughout the day to meet circadian lighting recommendations while minimizing energy use. With all these requirements the lighting design team knew that this project would require a state-of-the-art tunable lighting system and was eager to find the perfect solution.

THE WELL AND UL CIRCADIAN lighting recommendations call for light levels at occupant eye-level that are higher than what is achieved when solely meeting IES recommendations for horizontal work plane illuminance. As a result, Schuler Shook wanted to use a family of multiple white-tunable luminaire types that provided bi-directional (direct and indirect) and asymmetric distributions. The direct component could deliver light on the work plane efficiently, while the indirect and asymmetric distributions could direct light on the ceiling and walls. The ambient component was needed to meet circadian light level recommendations while also meeting IES recommendations for contrast ratios



The design team knew that the project would require a state-of-the-art tunable lighting system

to minimize discomfort glare. Ceiling heights as low as 8 ft required more than the standard Lambertian (cosine) distribution to spread light throughout the office spaces while still meeting the energy code.

While the intensity of a light source is key to increasing the circadian metric values stipulated by WELL and UL, the spectral characteristics of the source also play an influential role (Safranek et al. 2020). The design team investigated spectrally optimized sources to provide more flexibility in balancing circadian recommendations with energy efficiency while maintaining color and visual quality. To optimize the spectra delivered by the system, the team initially explored tunable lighting systems with three or more channels. While initially optimistic, the designers realized they would have to make a trade-off after tirelessly searching for products. Multi-primary systems that can vary the spectrum independent of chromaticity did not have the optics necessary to create a non-Lambertian distribution. Products with the necessary optical distribution to meet circadian metrics and code only had two primaries, a warm and cool phosphor-converted LED, with chromaticity mid-range deviating considerably from the blackbody locus. Products with two-primaries can have fair color rendering mid-range,



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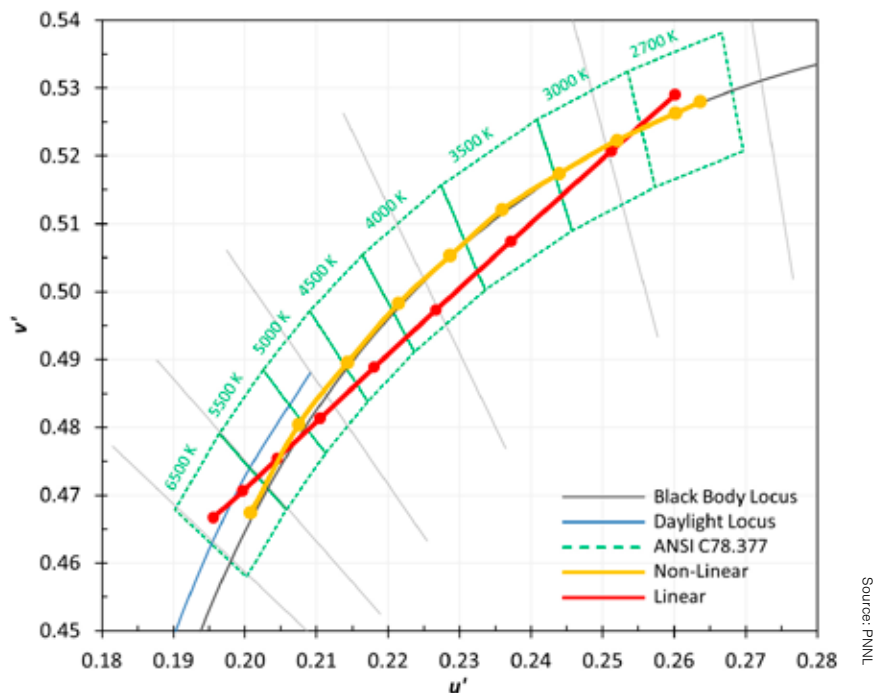


Figure 1. Examples of white-tunable products from prior CALIPER testing. Linear (two-channel) products can only mix to chromaticities directly between the two primaries, whereas products with more than two primaries (multi-channel) can be used to create mixes that can approximately follow the blackbody locus. Deviation from the blackbody locus and color rendering depend on the primaries selected for linear products.

with limited ability to optimize spectra for the recommended circadian metrics (**Figure 1**). As a third option, some lighting products alter source spectra to specifically account for circadian metrics. Unfortunately, these products provide limited spectral flexibility and available optical distributions for these products remained a hurdle, particularly in a linear form factor. Additionally, the criteria for this tunable lighting system included a slow, visible change in the color appearance of the light source throughout the day for biophilic and cueing considerations.

THE DESIGN TEAM'S EXTENSIVE SEARCHING and initial simulations resulted in only one suitable product solution: a 2700K to 6500K two-channel, edge-lit luminaire with an injection-mold-

ed optic providing a batwing distribution. Initial simulations by the designers showed that the targeted circadian metric values at the eye could be achieved for most workstations while also meeting IES recommendations for contrast ratios.

For the open-office areas, horizontal illuminance levels ranged between two-to-three times what the designers typically provide based on IES recommendations, with a subsequent increase in energy consumption. For many spaces, the connected lighting power density (LPD) was at or above the base allowance of the IECC-2018 code applicable to the project. Increased vertical surface illumination along with indirect lighting—both needed for an effective and comfortable lighting system—added to the challenge of complying with

code, and it was not possible to meet sustainability recommendations such as LEED.

There has been so much talk about tunable lighting, light and health, and circadian lighting recommendations, that it was unexpected to not find one product option that met all the criteria for this project and then to find only one that met most criteria. Due to the pandemic this project was never installed, so the research plan could not be completed, but the completed work highlighted the hurdles through design development. The challenges that come with bidding, installation and commissioning awaited the project. Once installed, the team hoped to better understand how occupants respond to dynamic (and high) light levels and color temperatures since this is a departure from what is typically deemed comfortable and aesthetically pleasing for office electric lighting systems.

Change permeates the current lighting industry—changing metrics, changing recommendations, changing technology and, perhaps even harder to predict, changes in commercial office spaces. While all these changes can be daunting, it is also an exciting time to be exploring the new features and potential of lighting systems.

Andrea Wilkerson is a senior lighting research engineer at PNNL, supporting the U.S. DOE Lighting R&D program.

Jess Baker, Assoc. IALD, LC, Member IES, is a senior lighting designer at Schuler Shook.



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WILDLIFE

Jane Slade

Darkness as a Beacon Two new metrics can help us remember the night

As a child, I remember first learning about the Impressionist movement through Vincent van Gogh's painting, *Starry Night*. We learned how at first his work was rebuked and then slowly people came around to revere it, and that of course, he never got to know. Van Gogh spoke freely of his love of the night, and the power it had to inspire his imagination, saying, "*for my part, I know nothing, but the sight of the stars makes me dream,*" and "*when I have a terrible need of - shall I say the word - religion, then I go out and paint the stars.*"

I remember studying those swirls of painted stars with my

younger eyes and feeling actual comfort that this freedom of expression came from an adult. People have felt inspiration from this work across the world, reproducing the painting in countless forms, in reverence to the imagination of Van Gogh's mind at that very moment of seeing the stars, an abandonment of reality into whimsy and delight, which is exactly the type of shift in perspective that the night sky provides. Looking at *Starry Night* now, I feel it is one of the most valuable and important examples of inspiration that was captured from the night sky.

At this moment in history, very few of us could take Vincent van Gogh's advice and go outside



At this moment in history, very few of us could take Vincent van Gogh's advice and go outside to paint the stars

to paint the stars. If most of us live in and around cities, then we live under skies classified as seven, eight or nine on the Bortle Scale, a nine-level classification of night sky visibility, with nine being the worst. In fact, one study showed that more than 80% of humanity lives under skies that are polluted.¹ We simply no longer have access to the night sky that Van Gogh painted. How do you measure this loss in inspiration? How do you measure the value of the night sky?

This year marks the 20-year anniversary of the Bortle Scale, a scale in pursuit of dark skies that was conceived and first published by astronomer John Bortle in February of 2001. It is also the 10-year anniversary of the Model Lighting Ordinance (MLO) in June, a document created through a collaboration with the Illuminating Engineering Society and the International Dark-Sky Association to assist communities in the development of more sustainable lighting standards. MLO Lighting Zones divide areas into 5 levels, LZ0 to LZ4, from darkest to brightest. This classification offers a feedback loop for communities to assess and understand their current lighting levels and guide future designs to their ideal, likely lower, lighting levels.



TO THIS DAY, THESE TWO FRAMEWORKS, the Bortle Scale and the MLO, are the nearest quantifications of darkness in use by the lighting industry, exposing a gaping hole in our analysis of darkness. While analogues do exist in astronomy, we simply do not measure or quantify darkness from the starting place of darkness. If we are not tracking darkness with metrics, we cannot bring it into our thoughts and processes to cultivate it. In a world that is being polluted with more light every day, we need to create metrics that enable a feedback loop to foster awareness in support of darkness.

For sustainable lighting practices, the Natural Daylight Cycle is our Rosetta Stone. This perennial balance of light and dark has entrained and tuned the behaviors of all living things on Earth and is the base model to lighting practices that support human activity with the least impact upon nature. In support of this natural balance, I would like to propose two new metrics. Akin to the measurement of energy with kilowatt hours, the metric **Unnatural Lumen Hours (ULH)** will measure and quantify lumens emitted outside the original balance of the natural daylight cycle, creating a feedback loop of understanding that quantifies impact. In addition, we can measure **Full Darkness Hours (FDH)**, periods of time that have been designed within the 24-hour cycle of our projects to remain at full darkness, providing a metric to quantify,

incentivize and support natural darkness.

To regain the natural night, we must also expand our design methods to better support darkness. One of the main mediums of design communication in lighting design is the creation of a “lighting design plan,” with illumination as the starting place of thought. Since natural darkness is exactly half of the natural daylight cycle, dovetailing our design practices with the creation of a new type of drawing, a “darkness design plan,” will balance the arc of thought to better reflect the natural proportion of light and darkness on the planet. Designing with darkness as a starting point is a valuable antidote to over-lighting and encourages a new type of exploration into the art and science of darkness.

We must also explore new methods in utilizing our existing technologies, such as redirecting the intended purpose of lighting controls. Originally, the use of controls boasted additional energy savings beyond LEDs, however this was often not enough to incentivize their adoption on projects. Perhaps we missed the most important incentive altogether, the invaluable benefits of darkness, for which modern synonyms include silence, spaciousness and restoration. Of all lighting technologies, lighting controls offer the most profound gateway to restore natural darkness by providing the ability to light for human activity and to be deci-

sive about lighting only what is needed through experimentation with adaptive lighting controls.

YET, THE GREATEST OBSTACLE TO DARKNESS remains the notion that more light is safer. While this can sometimes be true, this pervasive misconception is fraught with mistruths, unattainable safety, and contributes to the writing of rules and codes that enable light pollution. According to a 2015 study on street lighting in England and Wales, reduction in light levels held little correlation to increases in crime or traffic accidents.² If the correlation that more light is safer is at best weak, then we are gambling the immeasurable value of darkness and the night sky on terrible odds. What has the night sky inspired in humanity and what is humanity missing by not having access to the stars? How will the lack of darkness be reflected in the quality of our thinking? Perhaps this is acutely more dangerous than the risks of darkness.

We have come upon a unique problem of our time in that we never feel silence; we never feel darkness. We need to incriminate light. It must be debunked within the larger collective consciousness that light at night is not innocuous. It causes great harm upon the environment and the quality of our thoughts. In the dimmer shades of the natural daylight cycle, a more limitless mode of thinking takes place. We become cloaked in the dim light to rest and recover.

There is a departure here that we have stopped taking—to step away from the day and reflect, to feel our own thoughts and connection to the unseeable and the unknowable.

At this moment in history, we have blocked a view of the stars because of the way we utilize our lighting technology. The current mode of thought turns a

blind eye to the loss of the stars and to the wonder it provokes, disregarding the value of this natural resource altogether.

Maybe our story is not so different than the story of Vincent van Gogh's *Starry Night*. Perhaps people will look back on our time in history and liken us to the public who did not yet see the beauty of Van Gogh's work,

except in our case, it will be the night sky itself.

Darkness has been as much a part of our humanity as the light. It is a beacon all on its own, an invitation to wonder and thought that cannot be experienced in brightness. Yet, a return to natural darkness will not just happen; darkness is being subverted by our lighting practices with LEDs. We must reacquaint ourselves with the immeasurable value that darkness holds and cultivate it through new metrics and methods that inspire our thinking from darkness as a starting point. We could all experience the stars every single night if we designed this into our plans. We have all the tools to accomplish this; our lighting technology can support a view of the night sky and darkness. We are simply forgetting to remember the night.

Jane Slade, MID, LC, Member IES, is the specification sales manager for SpecLines in Massachusetts, a recent Richard Kelly Grant recipient and member of the IES Committee for Outdoor Environmental Lighting. For questions or comments, please email: jane@speclines.net.

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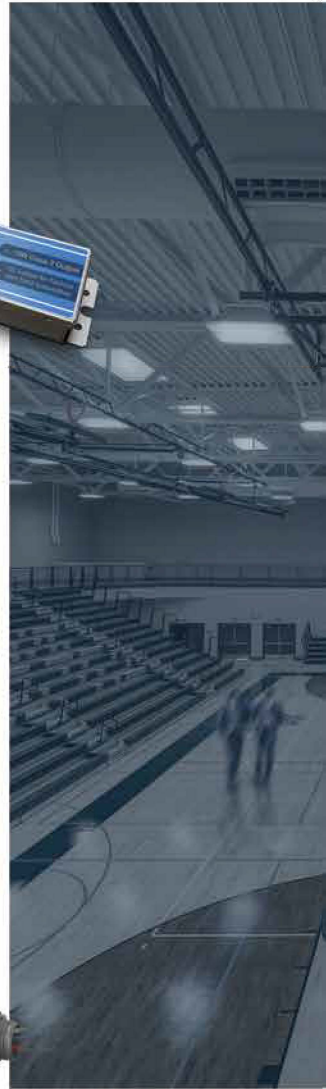
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Since the first COVID-19 vaccine was administered in the U.S. on December 14, 2020, and as more Americans get vaccinated, many companies and employees are now wondering about the post-pandemic office and the return to a new normal.

When can we return to work? How many people will be allowed in the office? What safety measures are in place to prevent the spread of COVID-19? What if I'm exposed to COVID-19 at the office? What will my schedule look like? There are many questions companies will need to answer and there are still many uncertainties. We are only starting to have a sense of how the post-pandemic workforce will evolve.

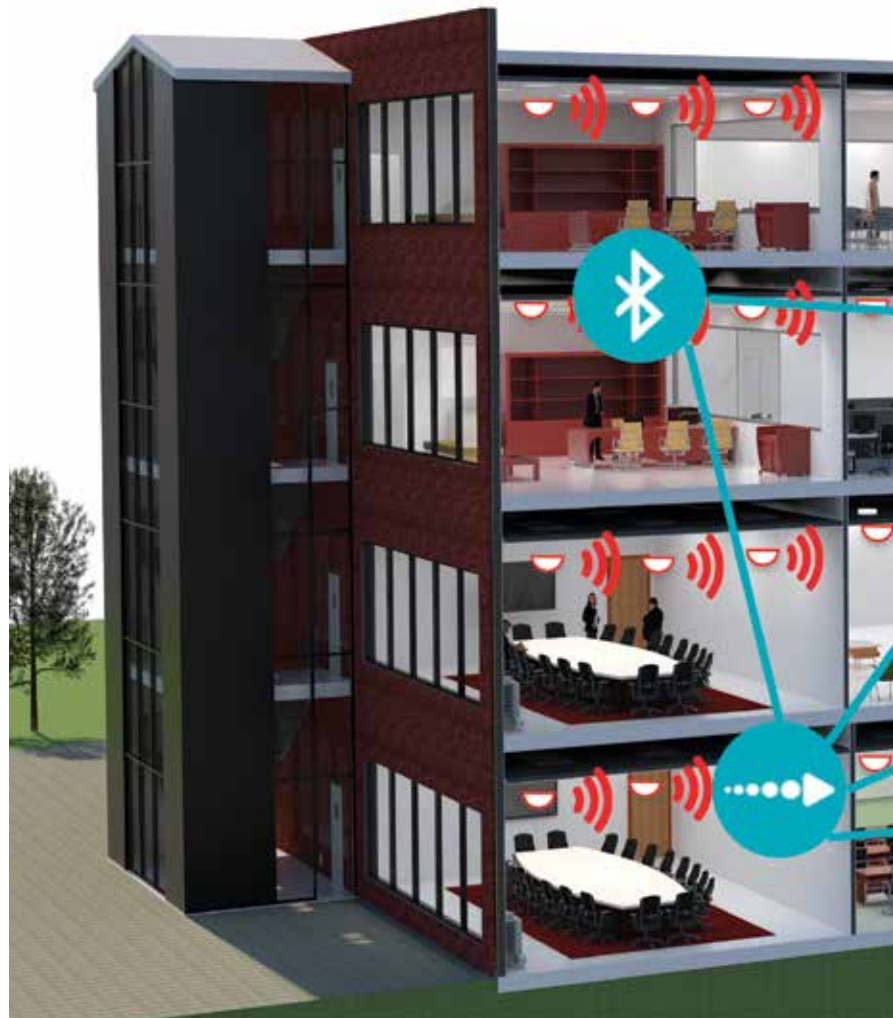
According to a Gallup poll, nearly $\frac{2}{3}$ of U.S. workers who began to work remotely during the pandemic have indicated they would like to continue doing so. On the other hand, the pandemic has also revealed the limitations of working remotely, from lack of social interaction to technology challenges. While many agree the office may never return to what we once considered "normal," the office will remain a critical component for companies, perhaps becoming a hub that offers an agile space for collaboration, connection and creativity.

Whatever the future holds as far as employee schedules, as employers look to make their workplaces safer, many are searching for best practices to help guide necessary modifications to physical offices. Part of that solution is right above us.

LED lighting, smart sensors and data can play a critical role in helping businesses solve tomorrow's biggest challenges, including challenges we never anticipated, and future proof buildings to adapt to evolving needs and environments. The solution has been years in the making.

The first half of the solution is LED lighting. Years ago, we discovered LED lighting was an ideal opportunity to introduce sensor grids into building infrastructure. LEDs are intrinsically direct current (DC) devices that only pass current in one polarity and are typically driven by DC voltage sources. The upgrade to LED lighting served as the launching pad for the introduction of Internet of Things (IoT) systems in commercial real estate.

Smart sensors are the other half of the solution. Software-defined smart sensors typically measure ambient light, occupancy, energy consumption and temperature, along with offering Bluetooth capabilities and wireless connectivity. Open-source data



THE FUTURE- PROOFED WORKPLACE

LED luminaires with sensors could be one tech tool for facilitating a safe return to the office

By Tanuj Mohan



and edge processing capabilities all help to future proof buildings, and never has that been so apparent as with the current global pandemic.

LED lighting and smart sensors have proven to be an ideal match. For years, lighting and commercial IoT systems have been playing a synergistic role with LED fixtures serving as the perfect location for IoT smart sensors. In turn, the sensors make each light individually intelligent, bringing programmability and energy savings benefits.

With the onset of the COVID-19 pandemic, everything changed. However, the solution remained the same: LED lighting, smart sensors and granular building data. The same data stream that provided information on how we utilize the office remained valuable and applicable especially during COVID-19 when physical distancing became the priority. Smart lighting and IoT systems were

already an exceptional tool for maximizing office real estate, and that same functionality is now being deployed to enable a safe return to work.

The new pain points that have emerged offer new possibilities too. We can now use IoT data to solve more and more pain points, and the future potential is virtually limitless.

Smart lighting plays a significant role in helping people return to the workplace safely. This has offered a new use-case and is a perfect example of why LED lighting featuring smart sensors is so important for companies. We are able to equip executives, facilities managers and building occupants with critical data to keep employees safe as well as help them be productive. These capabilities will only expand into the future, including new apps leveraging data streams and deeper integrations with



Photos: Jordi Anguera

24-HOUR COLLECTION

A connected lighting installation at a Barcelona office tower is a tool for both energy efficiency and employee comfort. Open 24 hours a day and housing start-ups and other companies, the space spans 2,500 sq ft over three floors in the Torre Glòries building. Merlin Properties chose Enlighted and European partner LEDS C4 to provide lighting control, connectivity and digital services solutions.

The building architecture presented challenges for lighting levels, as it features a double-glazed structure. The space, located on high-level floors of the office tower, has floor-to-ceiling windows that ensure natural light all day. As such, daylight entering the space created the need to comply with the Workplace Standard EN12464 on lighting comfort and glare for the workers.

To address extreme light levels that can affect employee comfort, LEDS C4 installed a system that can adjust for daylight harvesting and user occupancy. Because the space is rented by a range of customers, it was also necessary to have a way to control and analyze the degree of occupancy, allowing the space to respond to customer demands. In addition to the rental office space, common areas like meeting rooms, the atrium and dining areas needed lighting that could be automatically activated depending on occupancy.

Enlighted sensors in each luminaire (150 sensors in total) allow the facility to harvest available daylight and automatically adjust to varying lighting conditions. This measure helps save energy, while substantially reducing the glare and sharp lighting contrasts that would otherwise contribute to employee fatigue. The sensors allow each luminaire to operate autonomously and are self-regulating based on natural light and occupancy. Individual lights and groups of lights can be programmed to adapt to various uses of the space. In turn, the lighting can be customized with remote controls located in every room, with four default setups and fine-tuning buttons for every two workstations. Currently, the installation's key data points are energy savings, temperature, and real-time reports of the state of the lighting and how users move throughout the space.

Paul Tarricone

Using this data, building owners and operators can implement strategies to help reduce employee-to-employee contact and encourage physical distancing. Planners can see what is working and what is not, and continue to proactively and swiftly reduce contact risk. Additionally, the data identifies where people have been throughout the work day to focus cleaning and ensure and even validate that cleaning crews concentrate in these areas.

Smart lighting and IoT systems went one step further beyond physical distancing when we discovered the importance of contact tracing. The same asset tracking that smart lighting and IoT-based real-time location services provide can help to manage contact tracing, the process of the identification of individuals who may have come into contact with an infected person, and subsequent collection of further information about these contacts.

As we tested the process of contact tracing, privacy was taken very seriously. For example, depending on the organization, managers could issue a badge that tracks how an individual moves throughout the space, and identify where a person walked and what they might have touched along the way. An interaction with another person or a piece of equipment—a copy machine, a coffee maker, etc.—might warrant isolation and facilitate self-quarantine to help manage and prevent COVID breakouts in the building and among teams.

A light source once served only one purpose: to illuminate a space. It now brings entirely new meaning to building operations. This is a significant opportunity for those who design, specify and manage lighting systems to understand the full capability and benefits of an IoT sensory system.

The world of connected lighting and IoT is an adventure, and we find something new every day. Moving forward from the pandemic, we will continue to face new challenges, which can range from internal organizational challenges to outside issues that impact the workforce, at the office or at home. If we can continue letting the “thing” become smart—letting the buildings learn—we will continue to adapt and truly realize what it means to be future proof. ©

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other employee-facing applications and services.

With the pandemic, we witnessed how the IoT sensory system was truly learning, functioning as a human being with its brain. It helps to analyze current and past building data, including heat maps and motion trail patterns, to identify densely populated areas in the office, common traffic patterns and bottlenecks, and can even pinpoint what time these typically occur.

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DON'T BE A TARGET

A simple building system—yes, lighting—can be the gateway to an IoT security crisis. Better industry standards can help avert disaster

It is an odd time to be talking of 2013, but the timing couldn't be more apt. Between November 27 and December 18, 2013, one of the most significant financial data breaches in U.S. retail history occurred when Target Corp. had somewhere in the range of 40 million credit card and debit card numbers stolen along with a host of other personal records. Though not the most significant in size and scope for retail, the Target breach brought to the forefront, through their transparency and subsequent investigations,

**By
Michael
Skurla**

the risks associated with building systems and integration solutions. At the heart of it was the overall risk of connected business I.T. (Information Technology) and building O.T. (operational technology). The incident led to what was the largest effort by any retailer to reanalyze their security parameters and set standards that still would be considered a gold standard in retail.

The incident should have been a wake-up call to more than just retail. The “surface vector” of attack (or in more human terms, the point of initial penetration that led to a cascading of events and eventual loss of all the personal and credit card data) was that of stolen credentials related to a mechanical firm that had access to the system for remote management and monitoring integration. Reports suggest the credentials were obtained through a rudimentary email phishing scheme. Hence, a low-tech means of entry led to a high-tech problem. Years of investigations into this breach uncovered that several failures existed at the time that led to this incident.

- Improper network segmentation
- Poor credentialing of edge device security policies and capabilities
- Improper or inadequate training of employees about supply chain security

The now heavily productized term “IoT” was in its infancy in 2013, yet each one of these buckets stands the test of time in the age of IoT proliferation. A basic tenant of security design is to keep the attack surface small to limit the potential for unanticipated interactions (Sunil Cheruvu, 2020). By nature, IoT spreads this surface potential far and wider than was ever thought possible back in 2013. In its current state, IoT security is nebulous, undefined and often mysterious, but things are rapidly changing as IoT is the ripest vector for future attacks in all vertical markets given its exponential growth.

In the case of lighting, and its other building counterparts in the energy space, everything is now on the wire. Connectivity of building systems and solutions brings efficiency, automation, sustainability, management and convenience that we as humans have all grown accustomed to and now expect. The question remains how manufacturers can offer these vital cross-connected experiences without introducing security vectors for exploitation. Though security can be a deep topic, practices are emerging, and the manufacturers of building equipment are on the hook through legislation and simple responsibility to be a part of the solution.

To better manage the conveniences (and debatable necessity) of always-on connectivity and integration, building automation has moved to the “edge.” The term “edge” is often misunderstood; though it is heavily used in the I.T. space, it has not become as prevalent in the electronics and building community. In the I.T. world, the edge means something out in the field. It can be an entire building, shelter, or location in a network of other buildings, shelters, or locations that are often interconnected by networked means. Though in our context as a manufacturer of equipment, the term “edge device” is more prevalent. This could be a motion sensor, thermostat or light sensor to name just a few. At its lowest level, it’s a hardware device out there somewhere, but most importantly it is connected in this new world order by some digital means.

To further this definition, an “edge system” is typically what we would refer to as a building subsystem, or a digitally connected trade in the building. A Wi-Fi network in a building is an edge system, as is a networked lighting system, or an HVAC system controlled by a BMS. There can be dozens of edge systems in a building—all of them are talking and sometimes bridging communications to other systems or the outside world. The

edge system approach, however, is not completely clean. IoT has added devices to this mix that often are shared, or don’t fit into just one edge system. As sensors become Ethernet devices and sit on the TCP/IP stack with these edge systems, our surface area of attack grows.

In the current state of affairs in commercial buildings, we use a significant amount of Fieldbus protocols to connect things. Modbus, BacNet, DALI and the like. These Fieldbus protocols typically route to controllers that convert them into TCP/IP allowing communication to other systems or the outside world. Typically, devices on Fieldbus protocols are static, in so much as they are disconnected from the outside (except through the controller) and are rarely upgraded. However, the controllers they connect to function like gateways to the outside world, again further opening the surface area of an attack.

Taken from a security perspective, we have two ideas of solutions here that are assimilating over time into one: “brownfield” technologies relying on historic Fieldbus protocols, and “greenfield” technologies that have emerged and are backed by I.T. standards in the IoT space. Both, given the desire of communication, must speak to each other and likely to the outside world safely and securely. Daunting? Not as much as it seems, given the I.T. space has been working on this for decades.

There is clearly a tension between brownfield and greenfield solutions (Sunil Cheruvu, 2020), but this is also where IoT frameworks and platforms play an important emerging role in the combination of the two as a necessity. Greenfield devices and the associated gateways from brownfield solutions (existing or new) are the future of IoT, and the most serious vector for an attack. To date, little standardization has occurred at this level for security, however, this is changing rapidly.

In September 2018, California passed Bill SB-327 into law that addresses information privacy specifically pertaining to connected devices. Though subject to some debate, the law was a first step in defining a connected device as “any device, or other physical object that can connect to the internet, directly, or indirectly, and that is assigned an internet protocol address or Bluetooth address.” The bill requires manufacturers of connected devices to do away with default passwords that are often unchanged. The California legislation was clearly targeted at general IoT devices like

There can be dozens of edge systems in a building—all of them are talking and sometimes bridging communications to other systems or the outside world. The edge system approach, however, is not completely clean

smart locks and security cameras; however, the scope extends far beyond this into commercial systems, healthcare, and even automotive. SB-327 went into effect January 1, 2020 (Vigderman, 2020).

More recently, last December, the IoT Cybersecurity Improvement Act of 2020 was signed into law (US HR1668). Though geared toward federal government agencies, the bill requires the National Institute of Standards and Technology (NIST) to develop and publish standards and guidelines on the appropriate use and management of IoT devices controlled by any U.S. government agency. As part of the signed bill, following development of the standard (and to be clear, NIST hasn't done this yet), any federal agency would be prohibited from procuring, obtaining or using IoT devices if it is determined they do not meet the new standard. Given the proliferation of IoT devices, this NIST standard will have long ranging impacts on the development criteria of all types of devices and IoT solutions, and will have a meaningful impact in the lighting space within PoE lighting, networked lighting systems, and realistically any controller connecting to an I.T. or O.T. network.

Given what has emerged from the I.T. space, we can expect to see at least the following requirements emerge as a minimum from the NIST standard:

- **Physical security**—including but not limited to administrative ports, will be heavily scrutinized, down to USB ports and their intent. This also will have consequences on supply chain traceability (what is that chip doing, and how is it communicating to what?).
- **Data classification**—what data and interactions are considered “trusted” by devices to a network and how does a trusted relationship

exist with other devices and systems. Trusted relationships allow privileged interactions, changes and richer datasets. It's easy for a manufacturer to say all data should be “trusted” and not allow others to access anything, but this drives proprietary, something the market will not bear, and breaks the clear advantages of synergy between systems. There is a place for “untrusted” data interactions between disparate systems and devices in different scopes. This can come as data that is not considered privileged (e.g., the BMS system may not be trusted to change the dimming curve of a driver, but it would be beneficial for the driver to expose the energy consumption to allow the BMS to be an untrusted user of data).

- **Secure hardware booting**—the ability for devices to boot up, but verify they are booting from an authentic image, and still be upgradable from authentic sources for patches and enhancements.
- **Network management**—running only secure protocols (at a minimum secure socket layer, [SSL] encryption to and from devices), with ports open only for the services required with trusted authentication and ample encryption.
- **Credential management of subsystems**—through services such as LDAP or OAUTH allowing more secure management of user-rights, and authentication from centralized systems as part of a master I.T. security policy framework.
- **Standard practice mechanisms for networking professionals**—to manage and monitor equipment without proprietary software packages (SNMP and the like).

When I first started in lighting, the concept of networks was foreign. As with everything else, technology advanced, and networks became a staple, though often these networks were industry (brownfield) networks—DALI, DMX and the like. In the mid-2000s, particularly in entertainment lighting, Ethernet came into the picture. Yet these networks were highly isolated and air-gapped from other networks. A completely different network infrastructure was built. In fact, I.T. organizations wanted nothing to do with them. This proved to be shortsighted as connecting two networks only took a short patch cord, and suddenly you had a cross-connected mess and pretty tangible security. (VLANs have mostly eliminated the necessity of air gapped networks in practice.)

A shift has certainly occurred where I.T. and O.T. are fundamentally intertwined, and for good reason. Only by connecting systems is it possible to gain real insight into operation. The I.T. industry brings years of innovation in standards and capabilities of security that make this interweaving possible—safely and manageably. Far from a facility manager having to manage their own network, I.T. organizations are better equipped to secure and manage these networks in totality. Yet this drives different practices at the subsystem level, and interaction with I.T. resources far earlier in the design and implementation phase of projects. This has already changed how things like lighting systems and HVAC systems are deployed but will continue to evolve with the emerging standards.

Things are changing for the built world, and I.T. technologies driven by IoT are the path the world is on. Regulation is now catching up with the times, and it is in the best interest of our industry as a whole, even in the name of mitigated risk, to take steps to not be the next targeted vector in the news. ©

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SHAKY CONNECTION?

Five lighting designers address five topics concerning the uneven state of the smart-lighting market

By Paul Tarricone

Several years ago, *LD+A* sponsored a panel discussion at LightFair that touched on careers and growth areas in the industry. At the close of the session, the panel was asked to vote on which of the following two “hot topics”—light and health or connected lighting—would be the biggest job creator over the next few years. The panel’s vote was unanimous in favor of connected lighting. But as circadian strategies have taken hold and COVID-19 has created a potential niche market for germicidal lighting, one has to wonder how the vote would come out if taken today. Indeed, smart lighting application is still limited, as only about 1% of installed lighting systems are equipped to leverage connectivity between lighting devices and with other building systems, according to a December 2019 DOE study.

Ultimately, specifiers and their clients hold the key to connected lighting applications. With that in mind, we asked five lighting designers to comment on the state of play in IoT. Our panel consists of Ardra Zinkon, president/director of lighting, Tec Studio, and chair of the IES IoT Committee, Jered Widmer, a principal with The Lighting Practice, Susannah Gilbard, partner with Lightcraft Group, Kris Sandheinrich, a principal with KGM Architectural Lighting, and Seth Ely, senior lighting designer with Stantec.

How excited are your clients (e.g., end users, architects, et. al.) about IoT and connected lighting?



Zinkon: I think there is definitely intrigue about potential opportunities and the many

ways that connectivity can be leveraged as a feature. Because of the success of many of the smart home products on the market (like Amazon Alexa), clients understand the connectivity potential on a personal level.



Widmer: Most of the buzz that I've heard is from the end users (building owners, build-

ing management and developers). These folks tend to "get" more of the marketing for this technology and want to learn more—to figure out if it's right for them.



Ely: End users and owner occupants have expressed a great deal of excitement,

with portfolio owners leading the way in adoption.



Gilbard: For our firm it seems entirely dependent on what type of client. Archi-

tects and private firms are not asking at all. Every developer asks, but in the end, very few are really interested in pursuing.



Sandheinrich:

We work with a variety of clients, from private homeowners to large

developers. Most interest is coming from tech clients who have a strong interest in all things electronic being part of an integrated system with a variety of options for control. We are seeing interest from tech-savvy homeowners who are pushing for the smart home experience. The idea of lights turning on, sound systems playing music and doors unlocking themselves when we pull into our driveway is a great example of how smart homes can operate. Even simpler homeowners like the idea of being able to activate lights from the car so you can enter with a bag or two full of groceries and not have to reach for light switches.

Given the buzz around IoT and connected lighting, has interest to date met, exceeded or fallen short of your expectations?

Zinkon: Definitely fallen short.

There are added complexities and responsibilities that come along with IoT and connected lighting that make adoption slow. While clients are initially intrigued, they are not prepared to develop a sequence of events and/or analyze the data in order to take advantage of the benefits of connectivity (yet). In addition, with the many challenges owners face with the pandemic, different vertical markets are rethinking how they move forward with projects. It's interesting, because I think the connectivity that IoT offers could really be an asset for many of these markets during this unprecedented time.

Widmer: I think the interest in this technology is in line with what I would expect. While it has been around for a while in some form or another, it still hasn't matured in a way that is practical for some applications. Couple that with the lack of saturation with lighting manufacturers, and IoT and connected lighting has some limitations.

I think there is also a big learning curve that needs to be addressed in the AEC industry to fully take advantage of IoT and connected lighting. From the specification side, a lot of specifiers and design teams don't fully understand IoT and how to properly execute it on a project. When does IoT need to be brought to the table? What is the cost impact? Who needs to be at the table? On the installation side, a lot of contractors do not have the knowledge and training to properly price a project and then install the necessary infrastructure correctly. On the end-user side, a lot of facility folks don't have the proper staff, background or knowledge to ensure such a system can flourish in their building. There are still a lot of folks out there accustomed to maintaining older, simpler technology and the thought of a complex, inter-connected ecosystem is scary. Is it maintainable? What happens if it "breaks"? Can I fix it and maintain it?

Sandheinrich: In terms of the consumer, expectations are probably low on average and then spike for the tech-specific consumer. A lot of consumer demand is being met with the ability to download the right smart phone app and get user friendly controls of lighting and other electronic devices.

‘Technology manufacturers who are committed to proprietary programming versus open-source programming may eventually be left out in the cold. If my light fixtures can’t talk to my refrigerator, something is being left off the table’

Sandheinrich

Ely: Stantec has identified IoT and connected lighting as an area of significant growth, as a part of our smart buildings/smart cities strategy. Client interest has exceeded our expectations and we see significant growth opportunities, given the IoT and connected lighting’s potential to better support end users and create optimized facilities.

Gilbard: Most manufacturers taught the huge benefits of not having wire and conduit and homeruns to fixtures. Although the cost saved in wire and conduit to each fixture is significant, the huge amount of Cat5/6 cables in the ceiling, space for LAN room entry, rack space, some additional HVAC, and the fact that POE does not in and of itself save electricity, make the overall cost more or less the same. As the wattage of luminaires decreases through advances in technology and the POE run maximum wattage increases, I believe there will be more adoptees.

Is your firm already playing in this space? Or does it expect to in the future?

Widmer: Our firm is wading into the water. Our applications are mostly retail-based and we have

benefited from a lot of hand-holding with the manufacturers to understand how it works. Selecting a manufacturer early in the process that has a robust platform/solution and taking advantage of their resources has proven very helpful to learning how to properly execute the technology. Having an end user that understands what they are getting and how it will change their internal processes is also important. They need to have the capacity and willingness to adapt to fully take advantage of IoT and connected lighting benefits.

Sandheinrich: We certainly have seen an uptick in smart wireless lighting controls and in integrated control and wiring systems that reduce installation costs. POE for example can provide lighting power and control data over a simple cat 5 cable. Long-life batteries allow for wireless lighting controls and daylight/occupancy sensors that can be installed anywhere—even on glass. Smart wireless and integrated control systems are taking over for most projects from a 15-story TI office buildout to a smaller intimate restaurant.

Ely: Yes, Stantec has been engaged in IoT and connected

lighting in a wide range of project sizes and sectors. End users have come to expect increased connectivity and that includes the capabilities of IoT and connected lighting. As a result, the space is expanding across all budget ranges. For fully developed smart building integration, IoT and connected lighting provides a digital backbone that supports many sensor systems and use cases. For budget-driven projects, manufacturers are offering lighting control systems with scalable IoT capabilities or IoT capabilities managed by the manufacturer.

Zinkon: Our firm offers both lighting design and technology design (all low voltage systems), so we are well suited to tie the two disciplines together, we’ve had multiple preliminary discussions with design teams about this technology, but project owners have not yet pursued. We are located in the Midwest and until it starts to penetrate more specific vertical markets everywhere, we may still have some time before owners are willing to invest in this and for this trend to move forward full speed. I think part of the challenge is that the expectation (due to the success mentioned before with Amazon Alexa), many clients are not prepared for the full responsibility of the system or all the additional design integration that has to occur. They are on the “end user” side of that experience.

Gilbard: We have provided a few projects with POE and connected lighting—time and technology will tell.

What market sectors seem best positioned to leverage this technology?

Sandheinrich: Big tech for sure. How long until online retailers are tracking my movement and purchases in a big-box retail store? Specific to lighting—when technology can provide significant reduction in construction costs, everyone will get on board. Only when privacy concerns become an issue will there be push back on the technology.

Ely: IoT and connected lighting systems can significantly improve end-user productivity. For instance, nurses spend 40% of their time locating equipment and connected lighting could optimize the workflow if key pieces of equipment could be located using connected lighting systems paired with IoT sensors. In workplaces, similar infrastructure can increase employee efficiency in address-free workplaces and assist with wayfinding. Facilities management teams can leverage these systems to reduce response times and streamline procurement and back stocks. There are similar applications across all sectors. Because IoT and connected lighting bring physical assets into a digital environment, our relationship to these assets fundamentally changes.

From a broader smart cities perspective, these systems could be used to help citizens locate available amenities and track maintenance/service needs. There are also opportunities in transit as well. IoT and connected lighting can provide insights into how people use spaces for optimized service and routes, while maintaining privacy requirements.

To address issues relating to COVID-19, the integration of sensors within IoT and con-

nected lighting systems provides opportunities to support contact tracing and work creatively with mechanical system designs to support intelligent ventilation strategies.

Gilbard: We see a lot of interest from the higher ed sector and from manufacturing. Higher ed in particular would like their campuses to be fully connected and controlled from a common system. It's totally understandable and with one client to answer to, it's very doable.

Zinkon: Clearly retail is already taking advantage of the technology, I think there is strong evidence of a return on investment and therefore it is an easier cost to bear. We've actually completed a number of parking garages in the downtown Columbus, OH area over the past several years and the city is now adding

gest adopter of IoT and connected light, based on what I've seen and read. For both of these sectors, it offers a lot of benefits that can be quickly seen after installation. I think healthcare is also in a position to leverage this technology. The complex programming and functions of hospitals could reap a lot of reward from a properly integrated IoT solution. Couple this with the current trend/interest to implement tunable white and/or circadian lighting technology, healthcare facilities could more effectively execute both design strategies together as they upgrade facilities.

What has been the greatest obstacle to implementation so far?

Widmer: Knowledge and understanding—this is key to the entire process. From getting owners/end users on board and allow-

‘While the technology has been around for a while, it still hasn’t matured in a way that is practical for some applications. Couple that with the lack of saturation with lighting manufacturers, and IoT and connected lighting has some limitations’

Widmer

connected technology to assist travelers. Serving on the IoT committee, we have discussed endless opportunities and the varied markets for which it could be useful. We see the potential for application and benefits in so many ways moving forward.

Widmer: Big-box retail and smart cities have been the big-

ing the design team to properly specify/document the system, to ensuring the project is priced and installed correctly, and the end-users have the know-how to manage and maintain the ecosystem. I think there are still a lot of unknowns/uncertainties that cause a breakdown somewhere in the process and kills the idea of implementation.

Sandheinrich: Antiquated ways of thinking. Technology manufacturers who are committed to proprietary programming versus open-source programming may eventually be left out in the cold. If my light fixtures can't talk to my refrigerator, something is being left off the table.

Gilbard: The limitation of wattage on each Cat 5/6 cable. Until we can run perhaps (10) 30-W fixtures on one cable, the benefits for most clients are limited.

Ely: The obstacles to implementation include legacy practices and the lack of a standards-based approach within the IoT and connected lighting ecosystem. For design teams and end users, the process of bringing lighting onto the network

requires a significant change in design criteria and operational policies. For manufacturers and vendors, system performance and capabilities can be encumbered by legacy products that were created for non-networked environments. The same factors that have created the currently siloed building systems need to be managed to create an IoT and connected lighting platform that fully leverages its potential. Cyber security and data privacy require significant review based on a client's requirements. In the IoT connected lighting landscape, some manufacturers are better positioned than others to provide support.

Zinkon: I think the greatest obstacles are a mix of upfront cost and long-term management

for the client. It does require additional effort on the owner to manage the system and not all owners have the capacity to implement an IoT solution. The other concern that I feel obligated to mention is the lack of industry standards at this time and concern over data exposure, security and privacy. The state of California has passed legislation requiring certain cybersecurity features on connected devices, and the DLC allows manufacturers to report adherence to certain security standards within their products. I suspect additional legislation, standards and listings will be forthcoming and hopefully the work of the IES IoT Connected Lighting Committee can help design teams and owners better understand how to implement this new trend. ©

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For more information contact,
Marie Meacham, @ mmeacham@ies.org



Photo: Andrew Fane

CHICAGO STYLE

In its quest to transform its street lighting, the Windy City also found ways to create jobs and heighten safety

In 2017, the City of Chicago, acting through its Department of Transportation (CDOT) and Department of Assets, Information and Services (AIS), formally launched the Chicago Smart Lighting Program (CSLP), a four-year project to transform Chicago's street lighting system by replacing approximately 85% of the city's existing

**By
Steve
Taggart**

street and alley lights with smart LED lights. The technology upgrades occurring in Chicago will not only improve safety and reduce light pollution but will also save the city millions in energy costs and mitigate the need for ongoing lighting repairs. The CSLP is one of the largest LED conversion projects in the country and will create the nation's largest wireless lighting control network.

Plans for the CSLP have been a long time coming. In November 2015, Chicago started the procurement process to select a contractor to lead the light replacement project. After a 19-month vetting process, Ameresco, a clean technology integrator specializing in energy efficiency and renewable energy, was selected to provide smart-city solutions and upgrade Chicago's street lighting infrastructure.

By June 2017, Ameresco and its partners, Itron (formerly Silver Springs Networks) and John Burns Construction Company, commenced work. Once the project wraps up in September 2021, over 270,000 existing outdated high-pressure sodium (HPS) light fixtures will have been replaced with new energy-efficient LED lights, which consume 50% less electricity than their HPS counterparts. The city will also receive the following services: a

new Lighting Management System (LMS), infrastructure repairs, 311 integration, GIS integration, electric utility integration and rebate support, and job and system training.

Before any upgrades began, the team performed an extensive analysis of the state of the lighting fixtures and equipment. In total, Ameresco surveyed over 330,000 lights, which required photographing every light pole to assess each pole's condition. The survey was conducted to determine which damaged or deteriorated fixtures and poles needed replacement or repair. The survey was also used to reconcile the city's GIS asset locations to ensure all lights were properly identified and to establish a blueprint that would eventually become a digital map of the city's lighting progress that residents and visitors could track online.

Throughout the entire procurement and asset assessment process, the City of Chicago relied on input from its residents before any new technology was installed. CDOT conducted field tests and installed LED lights in seven neighborhoods, so Chicago residents—with a special emphasis on working families—could provide feedback on new lighting levels and how the new LED fixtures will add value to their communities. Instead of starting the project in areas of the city that experience high traffic volumes, the city began installations in underserved areas that often see higher rates of crime and safety concerns as a way to increase neighborhood security and equitable access to clean technology. The first area in Chicago to receive new lighting was on South Chicago Avenue from 79th to 83rd Streets. Since then, at least six work crews were dispatched per day to remove and replace lighting equipment across all 50 wards of Chicago.

Due to the sheer size of the project, the CSLP required an LMS vendor and node vendor to assist in the execution of work. The intent of the new lighting LMS was to enable remote monitoring and control of the city's lighting. The vendor implemented several smart-city solutions, including the installation of nodes on cobra head fixtures and ornamental fixtures, and in viaduct lighting controllers to monitor streetlight conditions. Additionally, Ameresco worked with a third-party vendor to design and develop an app, which would support the installation and maintenance of new lighting fixtures and nodes.



Before and after photos show the difference made by the LED streetlights.

One criterion the City of Chicago, CDOT and AIS prioritized when selecting Ameresco as its energy efficiency vendor was to find an organization that would utilize a diverse lineup of subcontractors and create job and training opportunities for Chicago residents. The Smart Lighting Program created many employment opportunities, especially for individuals from economically disadvantaged areas in Chicago. About 50% of the LED light installation work has been performed by residents and at least 10% of those workers are from economically disadvantaged areas. The project is exceeding its 26% Minority Business Enterprise (MBE) participation goal and is also achieving the 6% Women's Business Enterprise participation goal.

Nearly 50% of the workers assessing the smart lighting project have been graduates of Chicago Public Schools career and technical programs, City Colleges of Chicago construction technology training programs and/or programs for previously incarcerated individuals. At least 50% of new hires have been sponsored for union apprenticeship.

The company trained new hires on assembling the LED technology and decorative retrofits, as well as led maintenance workshops for managing the LMS system. This focus on local labor has resulted in approximately 45% of the fixtures being assembled within the City of Chicago by a minority-owned firm.

When undertaking such a massive infrastructure project, there were a number of logistical challenges that arose throughout the construction and installation. The first was managing the material supply. Ameresco was responsible for purchasing the lighting materials, as well as storing all supplies. With crews working in different locations across the city, the company had to ensure that correct lighting equipment was going to the right

Ameresco surveyed over 330,000 lights, which required photographing every light pole to assess each pole's condition

place and on schedule. Also, the new LMS system required several updates in order to support the high number of new connected devices.

The COVID-19 pandemic also caused unforeseen challenges, especially as it related to the manufacturing and delivery of nodes. The node lead time was extended to six to seven months. The pandemic forced teams to shift how they worked. Across neighborhoods and in warehouses, crews adjusted their workflow and the number of workers present so they could comply with safety and social distancing precautions while assembling and installing lights.

The biggest hurdle of the CSLP was modernizing the city's data systems and practices for monitoring outages that had been in place for years. Historically, the city has relied on a "paper and pencil" system to track and follow lights needing repairs and outages. Ameresco provided integration services allowing the LED streetlights to be monitored and controlled on smartphones. Several group training sessions were required to demonstrate the installation of new nodes and the removal of old, so that accurate information would be inputted into the LMS system and data integrity would be

maintained. To manage the extremely high amount of data, a new staff member was specifically hired to oversee the transfer of new data, invoicing and integration needs.

New processes were put in place so that services surrounding the newly installed technology could be fully integrated. Ameresco collaborated with Chicago's 311 system, AIS and CDOT's Division of Electrical Operations (DEO), and various partners to streamline and reconcile utility records and billing data. The LMS system was integrated with the City of Chicago's 311 and GIS systems to ensure the data integrity among all platforms.

Despite some logistical challenges, the CSLP is tracking well against its project timeline and is on schedule to be completed by September 2021. Once finished, the City of Chicago will receive a number of benefits. The new lighting fixtures effectively cut associated energy costs in half. These upgrades have made the city eligible for a projected \$35 million in energy efficiency rebates from ComEd. Over the next 10 years, it is estimated the CSLP will save taxpayers \$100 million through lower electricity costs. The program is also dramatically reducing Chicago's carbon footprint.

Beyond taxpayer dollars, the smart-city solutions provided will greatly benefit operations, work and life outcomes for the city and its residents. By integrating into Chicago's 311 system, the new LMS system will alert city officials in real time of outages and repairs, which will greatly reduce the amount of 311 calls the city receives. In years past, Chicago had relied on resident reporting of streetlight outages through the 311 system. Lastly, as more LED lights were installed across the city, the CSLP has greatly improved residents' overall quality of life and has bridged a gap in access to clean technology and energy. The new LED lights are improving streetscape visibility, leaving neighborhoods safer and more secure. ©

This article is adapted from the author's presentation at the 2020 IES Street & Area Lighting Conference.

THE AUTHOR | Steve Taggart is vice president of Ameresco.

THE IES INTERACTIVE ILLUMINANCE SELECTOR TOOL



This time-saving online tool is available only through The Lighting Library®. Designed with efficiency and professional practice in mind, all the illuminance criteria in the Applications Collection, plus parking lots and parking garages from the Roadway and Parking Facility Lighting Standard are contained in this feature.

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Application Task/Area	Task or Area	Veil. Risk: High Med Low	E _h C A T	E _h (Horiz.) Lux@m	E _h Max Avg Min	E _h Unif. (Max:Min)	E _h Unif. Ratio Basis	E _v C A T	E _v (Vert.) Lux@m	E _v Max Avg Min	E _v Unif. (Max:Min)	E _v Unif. Ratio Basis
COMMON APPLICATIONS												
<input checked="" type="checkbox"/> Administration ANSI/IES RP-10-20 Table A-1											Room/Area: <input type="text" value="Room/Area"/>	
<input type="checkbox"/> Copy rooms, print rooms ¹												
<input type="checkbox"/> General	A		M	100@0.00	Avg	3:1	Avg:Min	I	30@1.52	Avg		
<input type="checkbox"/> Machines	T		P	300@TS	Avg	3:1	Avg:Min	M	100@TS	Avg	3:1	Avg:Min
<input type="checkbox"/> Printed material inspection, review	T	H	R	500@TS	Avg	2:1	Avg:Min					

ILLUMINANCE TABLES CONTAINED IN THE INTERACTIVE ILLUMINANCE SELECTOR

COMMERCIAL, RESIDENTIAL, INDUSTRIAL

- Common Applications
- Educational Facilities
- Hospitality
- Houses of Worship
- Libraries
- Museums
- Residential (Indoor and Outdoor)
- Retail (Indoor and Outdoor)
- Theaters
- Healthcare:
 - Hospitals and Ambulatory Care
 - Residential and Long-Term Care
- Industrial:
 - Agricultural
 - Aircraft/Automotive
 - Electrical Generation Power Plants
 - Food Industries
 - Metals Industries
 - Miscellaneous Manufacturing and Services
 - Outdoor Mills and Plants
 - Textiles, Leather and Apparel
 - Wood and Paper Industries

LIGHTING OUTDOOR AIRPORT ENVIRONMENTS

LIGHTING FOR OLDER ADULTS AND THE VISUALLY IMPAIRED

PARKING LOTS AND PARKING GARAGES

SPORTS AND RECREATIONAL AREAS (Indoor and Outdoor)

PROJECT IN PICTURES

A Patient's Journey

Who says a hospital has to feel like a hospital? That was the question the design team working on the Acute Services Block at the Ulster Hospital in Belfast asked when crafting a lighting concept for the 32,000-sq meter (345,000-sq ft) space. The result is a design that borrows more from boutique hotels and flagship offices than a typical hospital. With wireless Bluetooth control, the lighting installation (ERCO) was carefully planned by **Cundall**, a building services consultancy, to complement the architecture and highlight the patient-centric experience.

Using texture, hierarchy and visual interest, Cundall emphasized the walls and their distinctive scalloping to create the feeling of a journey through the building. A variation in color temperature creates a subtle feeling of movement across the building as wards, clinical rooms and circulation spaces feature LEDs with a cool color temperature of 4000K, while the restaurant features a warm and inviting white at 3000K.

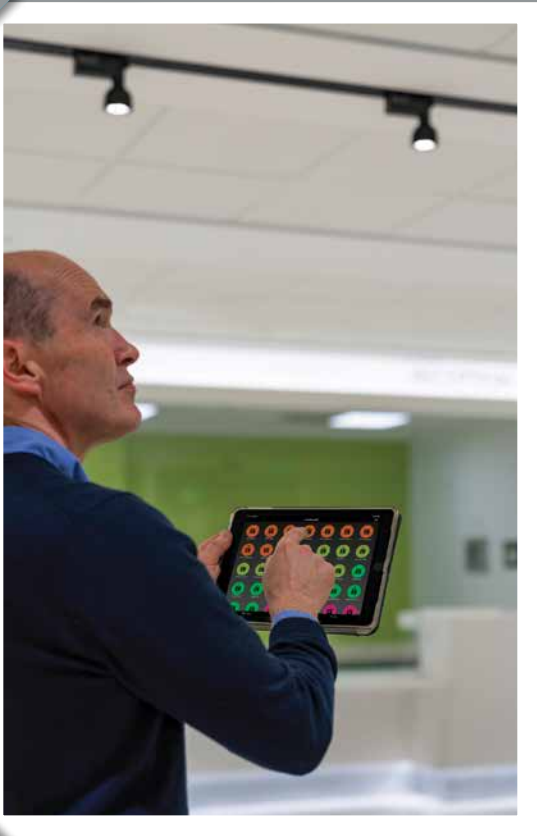
Photos: Zumtobel



⤴ A Bluetooth system allows sensors to monitor “out of bed” movement in **patient rooms** and alerts nurses when and if a patient has left their bed.



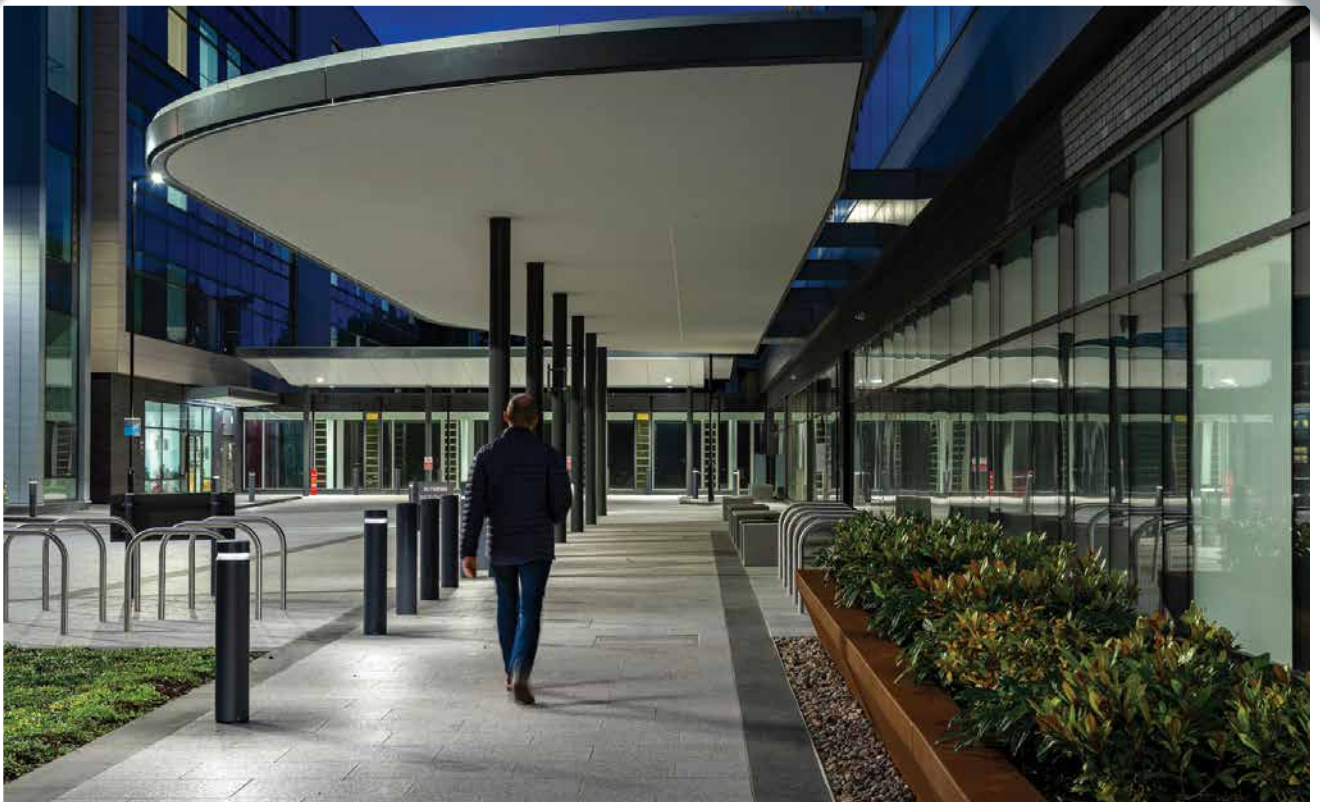
⤵ Linear recessed luminaires create a feeling of movement in the **hallways** while also minimizing glare, which can trigger reactions in susceptible patients.



“The project was highly versatile, with many different areas and with different requirements,” says lighting designer, Chris McAnearney (Cundall) of why **Bluetooth** fit so well into the lighting scheme. The lighting can also be controlled by a smartphone or tablet app using the Bluetooth Low Energy wireless standard.



⤴ A “**track and spot**” approach brings pools of light to café tables to create a more soothing environment.



⤴ Castor bollard luminaires guide visitors, staff and patients safely along **granite paths** to the entrance of the building.

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SIMULTANEOUS LOGINS TO LIGHTING LIBRARY®	10
USE OF IES UNIVERSITY MEMBER LOGO	

IES INSIDER

Staffing Changes at the Society



IES Executive Director **Timothy Licitra** has announced he will step down after accepting a new position at an engineering association in the New York Metropolitan Area. During his time as executive director, Licitra expanded the IES education program, and, coupled with the rollout of a new learning management system, enabled the IES to give members access to over 240 educational programs. Licitra also oversaw the establishment of a Global Access Affiliate membership program. He most recently led the organization in transitioning all of its nearly 100 lighting standards and guidelines to an interactive, digital platform now known as the Lighting Library®.



Brienne Musselman, who was instrumental in the development and implementation of the eLearning portal, has been promoted to director of education at the IES. In her new role, she will continue to oversee all of the IES's educational resources, while identifying opportunities for enhancing existing content, expanding offerings and partnering with like-minded organizations to deliver additional education. Musselman is also credited with co-

creating and launching Introduction to Lighting, a seven-module course that provides insight into the technology and practice of lighting

IES Teams Up for National Parks

The IES has joined forces with the National Park Service (NPS) to take on the challenge of improving outdoor lighting in national parks without affecting night sky viewing—the fastest-growing visitor activity in the parks. “Night sky viewing is incredibly popular, and America’s national parks offer some of the best views of night skies,” says Karen Trevino, the National Park Service’s chief steward of natural sounds and night skies.

In the coming months, National Park Service staff and IES Members will work to develop lighting standards and best practices for parks and other protected areas. The standards will be available to help incorporate night-sky friendly lighting into future construction projects for parks within the national park system.

“This partnership between the National Park Service and IES will promote a shared understanding of the importance of the natural night sky and the effects of light on national park resources and values including wildlife, cultural resources and values, wilderness character, and visitor experience and enjoyment of these same resources,” says Brian Liebel, IES Director of Standards and Research.

MEMBER MENTIONS

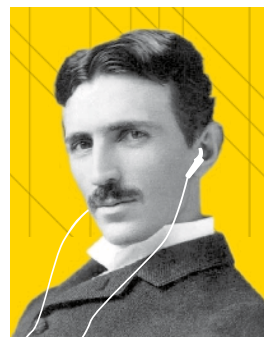


Robert Karlicek has been named co-director of the new Rensselaer Institute for Energy, the Built Environment, and Smart Systems (EBESS).



Ron Kurtz has joined Dark Light Design as principal in charge of the St. Louis office.

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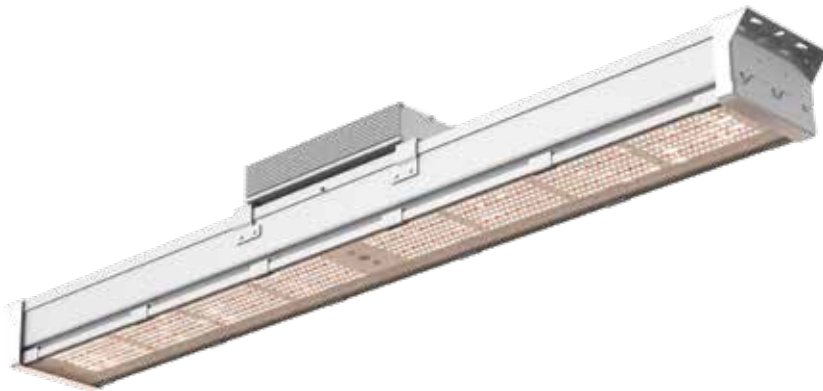
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Whether you are a manufacturer, utility company, distributor, sales agency, engineering firm, architectural firm, or any other professional or technical business that engages with lighting, each organization can pick and choose levels of benefits and discounts for their company employees directly—and in certain cases, non-employees’ partners, as well—furthering the reach to a larger group of professionals. The complete new Sustaining Membership structure (including the tax deduction levels) is listed at: www.ies.org/membership/ies-sustaining-membership.

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PRODUCTS



1.



2.



3.



4.

1. Barron Lighting Group announces the TERRA Linear LED Grow Light, a multi-application LED fixture featuring a low profile, making it ideal for greenhouse and warehouse grows. The 600-W light has a slim profile and small form-factor power supply providing minimal shadow and easy installation. A 120-deg beam angle provides even light distribution. A well-balanced red-to-blue full-spectrum provides deep canopy penetration and quality results. www.barronltg.com

2. Solid State Luminaires (SSL) introduces Lazer, a super-optic luminaire with a powerful white CCT fixture that delivers over 1 million

candela. Lazer has the capability to throw light over a distance of 980 ft. Installed via an integrated steel yoke mount, each end of the fixture has a 180-deg incremental adjustment for setting light direction. Typical applications include large buildings, arenas, towers, monuments, bridges, tunnels and more. www.solidstateluminaires.com

3. Schonbek introduces the Crystal Empire Rustic line of luminaires. Containing a 6-, 8- and 10-light pendant, the line features locally-sourced full-grain leather from the Appalachian region and bohemian crystal accents. The pendants are furnished with candleslips nestled

onto metallic silver backplates drawn together through crafted beams that connect to the fixtures' center. www.schonbek.com

4. LEDtronics announces the SLL002PH series streetlight. The luminaire follows a traditional cobra-head design while delivering energy-efficient, high-lumen output. The UL-listed light is lightweight and easy to install. It eliminates unwanted glare, light trespass, energy waste and skyglow. The fixture produces 8,800 lumens of 5700K cool-white light that conforms to the IES Type III (asymmetric) illumination pattern. www.ledtronics.com

IN ACTION

5.



6.



Photos: Stephane Groleau

5. MaxLite introduces the next generation of WallMax Open Face LED Wall Packs with field-selectable CCTs, wattages and field-installable controls as a flexible and future-ready outdoor lighting solution for electrical distributors and contractors. The wall packs are available in five wattages and outputs ranging from 3,300 to 14,000 lumens. All models feature field-selectable color temperatures (3000K, 4000K or 5000K).
www.maxlite.com

6. Ambientec announces TURN+, a contemporary lamp designed by Nao Tamura and inspired by natural light and the gentle, familiar lines of classic lanterns. TURN+ features an integrated touch sensor and two types of LED segments. The exterior is made of aluminum, brass or stainless steel and the diffuser is made of solid glass. Rechargeable and portable, TURN+ provides up to 500 hours of light.
www.ambientec.co.jp

FOR ALL OCCASIONS

When the city of Saint-Bruno-de-Montarville in Quebec, Canada, embarked on an infrastructure project to rebuild Montarville Street, it saw an opportunity to embrace universal accessibility. Adding a multipurpose path, widening the sidewalks and converting street lighting to LED, the city sought to underscore the importance of the neighborhood, which serves as the heart of community festivals.

Electrical engineers at Induktion switched up the look by staggering poles along the street in a zigzag formation. "It's very different than other lighting in Saint-Bruno, which gives the street the special look and feel we sought as people come together for the various events," says Guillaume Ferland, project manager at Induktion. Ferland chose a single head BVA luminaire (**Luminis**), with Type IV distribution so that each fixture would throw sufficient light to the roadway as well as the sidewalks on the opposite side of the street.

PRODUCTS

7. Armstrong Ceiling & Wall Solutions

announces Axiom Indirect Field Light Coves. The pre-engineered light coves provide control over finished aesthetics by offering a variety of options and sizes with both ceiling-to-wall and ceiling-to-ceiling coves. With pre-fabricated corners, the coves feature an adjustable trim clip that allows for a range of 0 to 3-3/4 in. to accommodate specialty panels. www.armstrongceilings.com



7.

8. Modular Lighting Instruments

announces expanded finish offerings for Duell and Trapz wall-mounted fixtures. The fixtures are now available in anodized silver bronze, anodized bronze, anodized champagne and anodized black outer finishes as well as black, champagne and aluminum inner finishes to suit a range of design aesthetics. www.supermodular.us



8.

9. Luminis

announces the availability of full color tuning for luminaires belonging to the Lumistik and Lumiquad families. A majority of bollards, columns, pendants and wall-mounted fixtures in the Lumistik family can be selected with RGBW. All acrylic diffuser models of columns and bollards in the Lumiquad collection are also applicable. With over 16 million possible hues, architects and landscape architects can utilize colored illumination to make a design statement, enhance building façades or highlight specific landscaping features. The illumination can also revert to white as required. www.luminis.com



9.



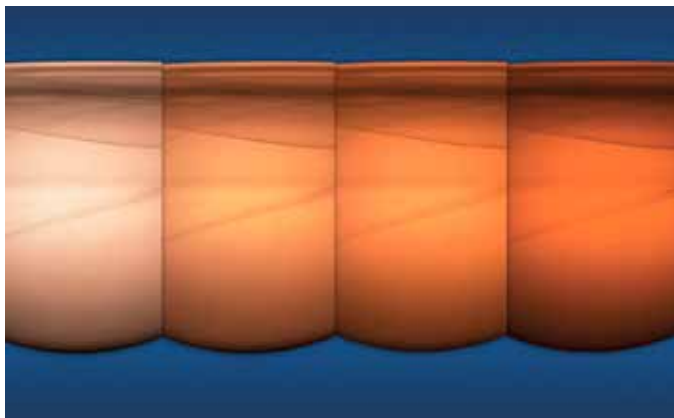
10.

10. Thorn Lighting introduces Beta, a flexible ceiling luminaire for multiple working environments. Featuring a CRI of 80+, Beta is available in a square version or a rectangular version. It can fit into multiple ceiling dimensions and can also be used for different ceiling types (lay-in, plasterboard), either surface mounted or suspended.
www.thornlighting.com



11.

11. EarthTronics introduces its high energy-efficient, color- and wattage-selectable Back Light LED Panel Series capable of adjusting light levels and color temperatures to fit different applications. The series includes 1x4, 2x2 and 2x4 panels that can be set to 3500K, 4000K or 5000K. Both color and wattage are adjusted at the point of installation with a switch on the driver housing. All models have a high color rendering of 80 plus.
www.earthtronics.com



12.

12. MetroSpec Technology announces FlexRad Dim2Tone, a flexible LED light engine that dims and changes color tone with a single dimming source, enabling smooth color transition through blending. The intensity and tone of the light source track with the dimming switch. Current technologies available for custom design in white and/or color CCTs include: a single row of emitters with two alternating LED color temperatures; a single row of emitters with a two-color temperature dual/die LED; and two rows of emitters with different color temperatures in each row.
www.flexrad.com

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LEARN NIGHT LIGHT: OBSERVE, DESIGN, REFINE

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Daytime



Summer



Fall



Renowned landscape lighting designer Janet Lennox Moyer shares multitudes of details she has learned over 45 years in the field in a new IES eLearning course, **Learn Night Light: Observe, Design, Refine.**

Through this immersive 10-session course, learn the lighting tools and techniques to create effects that produce useable, sustainable night systems and earn a CEU certificate of completion consisting of 10 CEUs / AIA LUs. By looking at the science and art of lighting, how humans perceive light, and how we use light to guide people through nighttime landscape spaces, this program will elevate understanding and expand creativity. *This course offering was made possible by Garden Light LED.*

Head to elearning.ies.org/p/learnnightlight

The companies listed below would like to tell you more about their products and services. To learn more, access the websites listed here.

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HE Williams Inc.	www.HEW.com	Cover 4	
IES Annual Conference	www.ies.org	29	
IES Career Center	www.ies.org	44	
IES Emerging Professional	www.ies.org	35	
IES Interactive Illuminance Selector Tool	www.ies.org	39	
IES Join a Committee	www.ies.org	34	
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IES Sustaining Membership	www.ies.org	42	
IES University Membership	www.ies.org	42	
Intense Lighting	www.intenselighting.com	15	
Intermatic Incorporated	www.intermatic.com	25	
IOTA Engineering, LLC	www.iotaengineering.com	21	
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Lumecon	www.lumecon.com	2	
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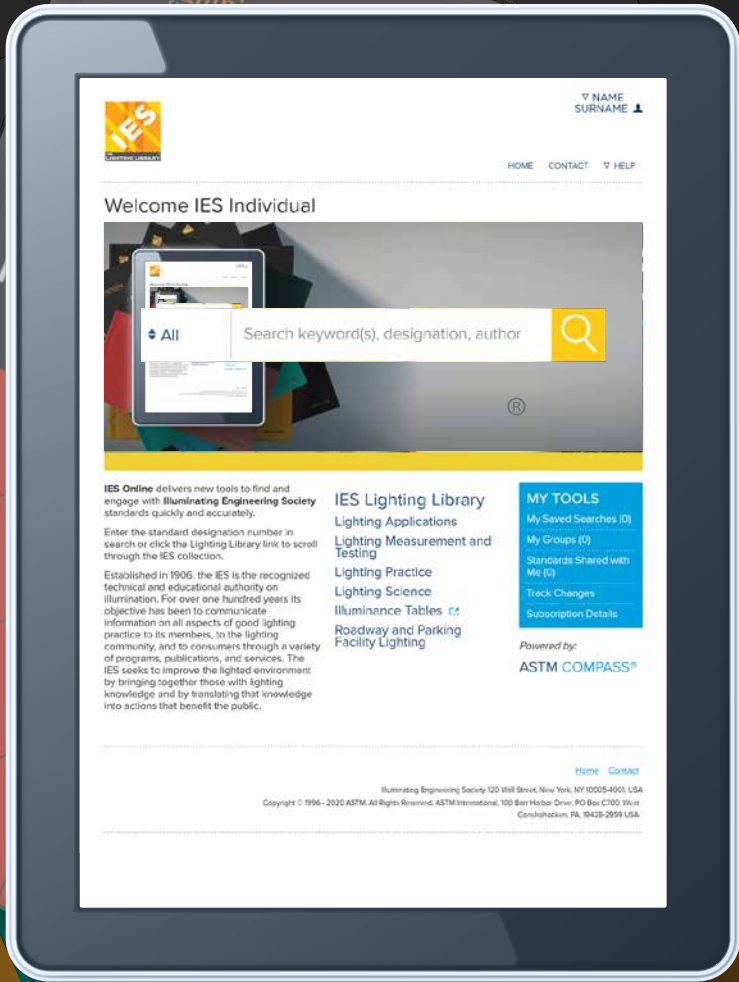


Designed by Nikken Sekkei to embody the spirit of Osaka, Japan's first W Hotel begins in its long arrival tunnel from the main entrance. Inspired by delicate blossoms and origami, more than 3,000 circles—laser cut into metal and folded randomly—are backlit by fixtures that change colors with the seasons and shift in intensity from day to night, creating an otherworldly portal as guests journey inside.

Photo: Marriott International

LAST LOOK

Tunnel Vision



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