Sustainability and the second great lighting revolution

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Signify**

More and more companies are using the ESG model – environmental, social, and governance – to define their sustainability objectives and measure sustainable business value. [1]

The ESG model is especially useful to remind decision-makers that sustainability has several dimensions that extend beyond energy efficiency, including environmental stewardship, climate change mitigation, social responsibility, and ethical governance.

Facilities managers and building owners can often make quick but significant progress toward their sustainability goals with digital and connected lighting systems. While the majority of architects and workplace designers agree that space optimization and energy efficiency are two of the most important aspects of sustainability initiatives, most don't think of looking up, to the ceiling overhead – even though they might find many of the solutions they're looking for there.

In the U.S., lighting accounts on average for about 17% of a building's total energy consumption, more than any other end use, [2] so using LED-based, digital luminaires and controls instead of conventional incandescent and fluorescent luminaires has become something of a no-brainer for organizations who aim to minimize their environmental impact. Simply "LEDifying" the lighting in a building – replacing conventional light points with properly designed LED light points – can reduce lighting-related energy consumption by 50% or more [3].

The addition of standard controls, from motion detectors to simple timeline-based lighting schedules that lower lighting levels during non-working hours, can raise this number by one or two dozen additional percentage points.

The viability and energy advantages of LED lighting are now well understood, and have been for almost a decade already. The revolution has become the status quo. Even though much existing corporate real estate has yet to make the switch, industry analysts expect that 48% of all general illumination lighting will be LED-based by the year 2020, increasing to 84% by 2030. [4]

[1] See, for example, "ESG Incorporation" at the US SIF website:
     http://www.ussif.org/esg

[2] "Energy Use in Commercial Buildings." U.S. Energy Information Administration:
     **http://www.eia.gov/energyexplained/index.cfm/data/index.cfm?page=us_energy_
     commercial**

[3] "Top 8 Things You Didn't Know About LEDs." U.S. Department of Energy:
     http://energy.gov/articles/top-8-things-you-didn-t-know-about-leds

[4] "LED Lighting Forecast." U.S. Office of Energy Efficiency & Renewable Energy:
     http://www.energy.gov/eere/ssl/led-lighting-forecast

The illuminated IoT: the second great lighting revolution

But there's a second revolution underway, one that builds on the digital nature of LED lighting. This second revolution may be even more disruptive than the first, and may require an even more wholesale rethinking of lighting and its relationship to architecture, building management, and workplace design. As compensation, this second revolution promises to deliver benefits across the entire ESG spectrum.

This second revolution is the connected lighting revolution. Connected lighting is the convergence of digital lighting technology with information and communications technology. In practice, this means enabling LED luminaires with two-way data communications, usually over an IP connection, and deploying them in a building-wide system that includes sensors, location beacons, and wireless communications.

If you're conversant with the Internet of Things, this ought to sound familiar. A system of connected luminaires that can share data about their status and operations with a software management back-end is a good example of what GE has called the Industrial Internet of Things (IIoT). "The industrial Internet draws together fields such as machine learning, big data, the Internet of things and machine-to-machine communication to ingest data from machines, analyze it (often in real-time), and use it to adjust operations," runs the definition developed by GE's R&D division in the early 2010s. [5]

[5] Leber, Jessica. "General Electric Pitches an Industrial Internet," MIT Technology Review, 29 November 2012: http://www.technologyreview.com/s/507831/general-electric-pitches-an-industrial-internet

Making lighting operations optimally efficient

Connected lighting affords several advantages for more efficient lighting operations. Software-based lightpoint control gives building managers the ability to zone and group lights to whatever degree of granularity makes sense for the workplace layout, and change the zoning easily whenever the floorplan changes. Dimming schedules can also be much more granular, delivering light levels where and when needed. Since connected luminaires share data about themselves, they can be monitored in real-time, or near real-time. Building managers can receive automatic and data-rich alerts about outages and other service interruptions, making lighting system management much more efficient and cost-effective.

Sustainability advantages proliferate when the lighting system is reconceived as a convergence point for multiple building services, and as an enabling platform for smart applications that go beyond illumination. Connected lighting brings together many elements that are already present in corporate workplaces for other reasons, offering an apt and relatively easy pathway to advanced applications. Lighting is essentially everywhere that people are in a building, it already has power and, if it's LED, it's already digital. (LEDs are chips that sit on top of circuit boards, and LED luminaires typically have some computational capabilities on board – for instance, for power conversion, commissioning, and receiving and responding to lighting control commands.) A professional building likely already has an IP backbone that supports a ubiquitous IT network, and building service systems, such as HVAC, security, scheduling, and so on must already
be in place.

If IP communications are added to the electronics already on board in LED luminaires, the lighting system effectively becomes a distributed computing platform covering every area of the building that people work or go. This distributed, connected system can host sensors of every conceivable kind – motion, occupancy, proximity, daylight, temperature, humidity, you name it – without requiring building managers to install a separate physical and communications infrastructure. Similarly, the lighting system can host location beacons and wireless communications, for deploying indoor positioning and location-based services to users of the building's illuminated spaces.

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New connected applications

The applications enabled by such a "digital canopy" are legion. Sensor networks distributed throughout the building give facilities managers detailed data on occupancy patterns over time. Software-based dashboards and analysis of this data allows precise targeting of light levels and dimming schemes, ratcheting up the energy savings for lighting to 80% or more over conventional solutions.

This same detailed, historical occupancy data can also help building managers crack the space optimization nut. Because it can lower a company's real estate footprint and minimize the resources consumed in supporting its workforce, space optimization is often considered the Holy Grail for achieving environmental stewardship and climate goals, especially in the existing built environment. [6]

The biggest challenge facing organizations who want to optimize their workspaces is how to gather the relevant data. A sensor network that automatically gathers occupancy and activity data has obvious advantages over the traditional method – having people walk around with clipboards and make occasional eyeball assessments. In fact, only the sort of continuously collected, whole-area data that a sensor network provides offers the level of insight that organizations can use to implement effective space optimization measures. [7]

This is more than theoretical. With a connected lighting system, Deloitte, the flagship tenants at the hyper-sustainable office building The Edge, in Amsterdam, reduced the square meters per employee from 12.6 to 7.6 over the first twenty months of operation, saving the company over €3 million per year and allowing them to consolidate operations on three floors instead of the originally designated five. Reducing the overall real estate footprint in the building not only benefitted Deloitte with significant operational cost efficiencies, it also reduced their carbon footprint, allowing the company to support more employees while doing its part for the environment.

Connected lighting offers additional value when used as a convergence point for multiple building services. Akshay Thakur, Business Development Manager in the IoT/IoE Vertical and Solutions Group at Cisco, sees digital lighting as the first step to creating a "digital ceiling" – a secure infrastructure of intelligent illumination, sensing, and communication devices installed overhead and integrated into a common data network that manages all building services. According to Thakur, businesses must embrace digitization to achieve operational efficiencies via automation, deliver personalized employee experiences, and lead to innovation and new ways of working. [8]

[6] See, for example, MacDonald, James. "Space Utilization Metrics: The Who, What, Where and How." iOffice website, 1 April 2015: http://www.iofficecorp.com/blog/space-utilization-metricsthe-who-what-where-and-how

[7] See, for example, Dimick, Patricia. "How to Change and Optimize the Workspace with a Smart Office." Datafloq website, 30 April 2016: http://datafloq.com/read/how-change-optimize-workspace-smart-office/2033

[8] Remarks made by Akshay Thakur at the Philips Lighting speaker program, Light+Building, Frankfurt, Germany, 17 March 2016: http://www.youtube.com/watch?v=nSfaflGwDqw&feature=youtu.be&t=1s

Fulfilling social obligations as well as environmental goals

Deloitte increased its on-site workforce from 1,740 FTEs to 2,900 FTEs, while cutting the designated square meters per FTE almost in half – and they did so without compromising employee comfort and satisfaction. In fact, employee comfort and satisfaction increased, reflected in part by a fourfold increase in job applicants at the location over the time period measured. Personalization applications enabled by the connected lighting system – for instance, giving employees control over the lighting above their desks, as well as the local heating and cooling – allow Deloitte to offer its employees an attractive, responsive work environment.

Such connected applications help companies like Deloitte fulfill their social obligations, as well as their environmental goals. According to Prologis, a global leader in industrial logistics real estate in the Americas, Europe, and Asia, "being socially responsible includes providing a challenging and dynamic work environment that supports the professional development and personal lives" of workers. [9] A smart building, enabled by a converged connected lighting platform, can advise its occupants, rather than the other way around, creating an intelligent, streamlined work environment that can anticipate and seamlessly fulfill the needs and preferences of employees."

[9] "Colleague Engagement." Prologis website: **http://www.prologis.com/en/sustainability/social-responsibility/colleague-engagement.html**

How to do it

All well and good – but how does an organization implement a connected lighting system and the smart applications it supports? More urgently, how can an organization acquire and deploy the technology needed without breaking the bank?

As always, new builds and retrofits pose distinct challenges that must be addressed in different ways. While both require a new level of collaboration among architects, lighting designers, IT, HR, application developers, system integrators, and others, technology innovations and innovative business models clear the way for retrofitting existing workspaces. Power-over-Ethernet (PoE) enabled LED lighting fixtures are especially promising for lighting retrofits. Increasing PoE capability, combined with the ever-decreasing power requirements of LED luminaires, have made it viable to install and power professional lighting with only an Ethernet Cat 5 or better data cable, eliminating the need for electrical rewiring. This alone can bring the costs of a retrofit within budgetary limits.

Wireless and software-based lighting controls can also contribute significantly to the simplicity and low cost of a LED luminaire retrofits. Innovative communications capabilities, such as visible light communications (VLC), which uses the LED light beam itself to transmit location data that is readable by a smartphone camera, lay the groundwork for indoor location services with exactly zero additional investment in hardware and system management. Of course, if LED luminaires have the ability to share data as well as receive it, connected capabilities ride along with the luminaires "for free." Modular designs allow organizations to "snap in" sensors and other connected devices over time, ensuring the viability of the system as business objectives grow and change over time, while delivering all the illumination benefits of LED lighting right out of the gate.

Cloud-based lighting monitoring and management allow full-service lighting companies to offer lighting via innovative business models, such as Lighting-as-a-Service (Laas). LaaS service contracts typically differ from opportunity to opportunity, but the underlying instrument is typically a service-level agreement (SLA), in which the company pays for the light it uses, while the luminaire provider pays for installation and retains ownership of the lighting. The luminaire manufacturer uses its remote monitoring and maintenance solutions to hit performance targets spelled out in the SLA.

LaaS can knock down the barriers for entry for many organizations, eliminating upfront capital expenses entirely. Managed LED lighting is so inexpensive to operate relative to conventional lighting systems, which organizations can often use the savings to pay for the service contract. If the luminaire provider offers fixture re-use and reverse logistics at the system's end-of-life, a company can enhance its green stewardship by participating in the circular economy. Schiphol Airport, in Amsterdam, the Netherlands, did just this in 2016 with new connected lighting systems in its terminal buildings.

Data that supports ethics and governance

Another benefit of connected lighting that may not be quite as obvious as energy savings and operations efficiency is support for ethics and governance, the third leg of the ESG model. More and more frequently, organizations are being called on to demonstrate trust and business integrity to confirm long-term financial health. Data collected via connected lighting systems and the other smart services that these systems enable and host offers unprecedented transparency and insight into operations, supporting management accountability and proactive risk management.

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