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The Changing Face of *Smart* Buildings:

The Op-Ex Advantage

The technology is finally here —and so is the business case for smart buildings

Pacific Controls, a Dubai-based software company, recently installed a smart building management system in Cisco's Middle East headquarters. The system manages the building from remote servers, using software that constantly generates algorithms that indicate if building temperature, cooling and energy use are straying from benchmarks. The database is in Amsterdam and the proxy server is in Bahrain. This truly global system delivers surprising speed and security, but, for many observers, its most important feature is its investment payback—which was realized in less than two years.

"We not only find the faults, but monetize them"

In New York City, Malkin Holdings, a Manhattan-based real estate company, worked with Jones Lang LaSalle (JLL), a global real estate services firm, along with other partners to narrow down 70 energy-saving ideas to 17 practical projects that could be implemented. Iterative use of the energy model further winnowed the list to eight projects that would generate the most advantageous return on investment for Malkin's signature property—the Empire State Building.

This marquee project received considerable attention because it was an integrated energy retrofit of a significant building, according to Dan Probst, who heads JLL's technical operations. Less visible, says Probst, were the many smart building components installed in the iconic structure.

"Smart building lighting controls and digital read outs of energy performance are installed throughout the tenant space," says Probst, "complete with strategies to engage tenants and employees in their energy use." The project team balanced the goal of carbon footprint reduction with revenue enhancements to reduce energy use by 38 percent, saving $4.4m annually within a three-year payback.

In Redmond, Washington, Microsoft created its own smart building management platform to manage its sprawling campus headquarters. The system, which manages the property's 2m bits of operational data, initially compressed five years of budgeted upgrades into one year using net savings of $1m—mostly because the system detected errors that human eyes missed.

"We not only find the faults, but monetize them," says Darrell Smith, operational supervisor at Microsoft's

real estate facilities division. Other large, multinational companies are also testing the smart building waters to realize lower operational expenditures.

A large, global financial services firm recognized that its branch bank facilities, numbering in the thousands, generally had very few building automation systems and could not be remotely monitored and controlled. The firm began by installing low-cost wireless sensors and controllers to enable remote monitoring and control of HVAC and lighting systems. The resulting energy savings have averaged 13 percent annually, while savings from fewer maintenance technician visits have added another 5 percent in overall operating expense savings in two years. This initial success has led to a much broader and deeper global roll-out for both large and small buildings within the bank's corporate real estate portfolio.

Procter & Gamble, after an initial pilot project involving more than 3m sq. ft. of office, laboratory and research and development (R&D) space, shaved 4.4m kW off energy use just by optimizing building systems already in place.

You don't have to look too hard to see the arrival of a new era—the convergence of building science, big data analytics and IT telecommunications to make buildings smarter. The era of smart buildings is a manifestation of a much larger megatrend in the "Internet of Things" or the "machine to machine" (M2M) revolution, in which machines can interact with one another to transmit data and to act on that data without human intervention. Today's smart building systems can automatically interact and adjust themselves without human intervention.

The same technology that is harnessing the predictive power of big data to help solve congestion problems in cities, for example, or achieve small, but powerful, efficiency gains across very large fleets of commercial jets, is now being deployed in buildings. This technology can link entire portfolios of buildings and their automated systems with far-flung remote operations centers where facilities experts can analyze ongoing data streams from building equipment and optimize each building system's use of energy, electricity and water.

Smart building technology, while requiring some capital expenditure (cap-ex), is helping to reduce operational expenditures (op-ex) on the other side of the ledger. The resulting savings, according to two major corporate energy management studies done last year by The Economist Intelligence Unit (EIU) and Deloitte, have become increasingly essential to remaining financially competitive in the global marketplace.

The opportunities and the challenges of smart buildings

The technology to enable this competitive edge is already at hand. The Internet and significant price reductions in IT components have made smart building management services much more affordable, creating a strong business case for owners and investors to install building automation systems and engage smart building management services to optimize building performance. For example, the cost of wireless sensors has dropped below the $10 per unit cost threshold, making installation of a smart building management system much easier and more affordable than in the past. Smart buildings, with their automated systems, generally cost less to operate than buildings with legacy systems and thus offer a long-term op-ex advantage.

The "big data" revolution, a step change in digital memory and data storage, has occurred alongside significant advancements in energy storage. Moreover, the deployment of smart meters, embedded micro- and nano-controlled systems and radio frequency identification (RFID) technology is transforming buildings from power grid-dependent into grid-supporting generators that ultimately could transmit power rather than only consume it.

Investors in commercial property are beginning to see the upside of smart building technology. Christopher Wilson, managing director at LaSalle Investment Management, is confident that operational savings from smart building technologies play into an overall competitive strategy that will help his company's bottom line. "We believe that our buildings will be seen as more competitive," he says. "They will lease faster because of lower operating expenses than their peer set and will command better pricing on sale."

This view is consistent with five related studies in a 2011 *Green Building Market and Impact Report* from the U.S. Green Building Council, which found that Leadership in Energy and Environmental Design (LEED) certified buildings command rents an average of 17 percent higher than non-LEED buildings and sale price premiums of 8.5 percent to 25 percent.

A new look at smart building deployment reveals significant operational savings. A 2012 report, *United States Building Energy Efficiency Retrofits: Marketing and Financing Models,* published by The Rockefeller Foundation and Deutsche Bank Group's DB Climate Change Advisors, estimates that $289bn worth of building efficiency investment would produce savings in excess of $1trn in the United States alone, with every dollar invested in energy efficiency producing three dollars of operational savings. The arrival of the op-ex advantage suggests a new way of assessing opportunity within the smart building sector.

This growing reappraisal of the op-ex savings is happening, in part, because technological advances have finally converged with long-existing and significant opportunities for improving efficiency in space heating, cooling and building maintenance. Operations of commercial, residential and industrial buildings account for 40 percent of global energy consumption and 33 percent of global carbon dioxide equivalent (CO_2e) emissions. The U.S. commercial real estate sector alone consumes at least $179bn in energy annually. Some say that figure is far higher.

Casey Talon, analyst with International Data Corporation (IDC), says commercial and industrial energy use amounts to $202bn, 30 percent of which is wasted. Redirecting that energy spend to building efficiency, of which the smart building sector is a part, has allowed some corporate decision-makers to gain the reputational advantages of doing the right thing by the environment while also gaining significant performance and productivity improvements.

Smart building technology investment trends

Recent projections suggest that smart building investment will more than triple from $5.5bn in 2012 to $18.1bn in 2017. Yet, misperceptions about smart building technology persist. Indeed, a recent study by the EIU found that two-thirds of U.S. respondents overestimated the cost of making energy-efficiency improvements and only one-fifth had an accurate perception of those costs. These misperceptions have led many decision-makers to assume that installing smart building systems is too complex or too expensive. Others incorrectly believe that human error (the failure of employees to comply with smart building measures, for instance) will trump any technological deployment.

These misperceptions lag behind the realities of the modern smart building universe. In fact, a strong business case can now be made for smart building systems. By beginning with strategically selected component systems, many companies are already seeing impressive returns on investment (ROI), often within two years. Fast break-even on investment is the new reality, and many financial "carrots" are creating new incentives for property owners to convert their building systems to smart technology. Several emerging regulatory and consumer trends may soon serve as incentivizing "sticks." Indeed, for smart building pioneers, the deployment of smart building technology is the right strategy for embracing and profiting from trends in the built environment that are here to stay.

The case for selective deployment of smart building technology

To make a building smart, companies need not engage in a total overhaul. Instead, selective deployments of smart building technology are often a popular and effective alternative.

Third-party smart building management experts can help survey a company's building stock to identify and prioritize legacy building equipment that will produce a significant ROI if upgraded to automated systems that will generate performance data for remote monitoring and control. These relatively small and incremental upgrades give owners control of their investments in smart systems.

Smart building management services can be scaled up or down according to how much facility data analysis and reporting the owners and investors want. Affordable wireless sensors for gathering and transmitting building systems data circumvent the need for costly hardwiring and renovation. The fees for smart building management services are not fixed—they are priced per number of wireless sensors and data points tracked. Post-installation service additions can measure progress and ensure that energy and emissions goals are met.

"The process of moving to a smart facility is iterative," says IDC's Talon. "Where is your building today? How big is it? What's the infrastructure?" Smart buildings provide facilities managers with streams of data that strengthen the argument for operational changes.

Such buildings, says Probst, turn green ideas and healthy building operations into energy cost savings by spotting classic inefficiencies. "Systems set up to provide 'free' cooling using outside air rather than running HVAC chillers or compressors on cool days are often a classic failure point," he says. "If the dampers designed to provide cool outside air for conditioning purposes are stuck closed and the compressors continue to run, everyone inside the space is still happy from a temperature standpoint, but you are using too much energy to run the compressors unnecessarily and unknowingly."

A smart building management system, combining data analytics with facilities management experts, can detect such breakdowns immediately and even send an alert for a facility management professional to address issues that otherwise would go undetected for months.

None of this, of course, removes facilities management (FM) from the equation. Rather, smart building technology helps increase FM productivity. Allowing machines to monitor machines 24 hours a day releases building engineers to address

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more pressing tasks with greater worker efficiency, thus adding to portfolio value.

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Talon argues that the change to “smart” problem detection affects mindset more than head count, especially for smaller work places that share maintenance staff. “These systems become valuable on the personnel side when you have mobile or centralized maintenance,” she says, “because the steady diet of facts encourages engineers to consistently tend to a property’s health. Here, facts replace guesses.”

The carrots:

Incentives for the adoption of smart building technology

The current state of financing for smart building and energy efficiency presents a market poised to scale up significantly.

While investment in energy efficiency retrofits in 2011 was no more than $20bn, it could reach nearly $300bn over the next ten years, according to the EIU. A growing mosaic of options, incentives and strategies is likely to increase with time. Yet, the most attractive features of smart building adoption may well be the affordability of IT components and the relatively short payback period. Most projects break even in two years or less, according to Brian Dauskurdas, director of global energy solutions at Lutron Electronics. "By utilizing a single network in the building, the client realizes significant cost savings amongst all smart building solutions.

"Prices for lighting control systems have significantly dropped," he continues. "Intelligent ballasts and drivers that cost $120 four years ago today sell for $50." Other component prices have fallen as well, he says. Occupancy sensors that used to be $120 are now $85, and, at $50, wireless sensors are becoming commonplace for new and existing buildings and bring significant labor savings. According to Dauskurdas, the overall cost per square foot for lighting controls in an office space has dropped by half or more, depending on your lighting control strategies.

Smart building management technology can be deployed in any building with at least some automated, computer-controlled systems. A total or even partial retrofit may not be necessary to boost building performance. Partial deployment thus becomes a powerful point of leverage for fast payback on the initial investment.

The near-term outlook, moreover, suggests promising financial models that can also scale up. Energy service agreements (ESAs) and the related managed energy service agreements (MESAs), for instance, allow building owners to make energy efficiency upgrades without using their own capital. They typically are employed in larger projects up to $10m and, according to a Rockefeller Foundation report, have the most potential to scale up quickly without regulatory or legislative requirements or subsidies.

Other promising financial models include, for example, most forms of off-balance-sheet finance and on-bill loans and payments. These financial models are increasingly being used in the renewable energy sector, putting the initial cost of efficiency retrofits on the backs of participating utilities. Customers pay back their loans through a preset rate of electricity. Many states offer Property Accessed Clean Energy (PACE) financing, in which municipal bonds are issued and

repaid by property owners who use the bond proceeds for energy retrofits. PACE Environmental Upgrade Charges (EUC) financing allows private banks to lend money to property owners for energy efficiency retrofits.

Legislative measures in the U.S. Congress could encourage the aggregation of project financing across and within sectors. For instance, using green banks and large mortgage organizations would allow for more efficient allocation of capital. According to the EIU report, *Achieving scale in the US: A view from the construction and real estate sectors*, the mood for such measures is shifting favorably toward the smart building sector.

The U.S. Senate's Energy Savings and Industrial Competitiveness Act (Shaheen-Portman bill, S. 761) includes provisions on industrial energy efficiency deployment "to establish or expand programs to promote the financing of energy efficiency retrofit projects for private sector and commercial buildings." The bill comes with measures, according to an analysis by the American Council for an Energy-Efficient Economy (ACEEE), that would save roughly 9.5quadtrn British thermal units (BTUs) between 2014 and 2017, or about one-tenth the annual energy use of the United States.

While such measures must, of course, face the exigencies of Congress, the legislative case for the powerful multiplying effects of the op-ex advantage (one dollar of cap-ex invested equals three dollars of op-ex saved) favors efficiency measures in the broader push toward job creation. Indeed, the Rockefeller Foundation estimates that efficiency measures would help create more than 3.3m new direct and indirect jobs in the American economy. In light of the potential to create new jobs, energy efficiency measures are a practical, common sense approach to issues of energy, emissions, job growth and economic competitiveness. The smart building sector will likely continue to be a compelling solution to such pressing challenges.

Knowledge is power:

Utilities' role in creating incentives for smart buildings

The electricity grid is participating in the M2M revolution. The old one-way-street model of the relationship between power-generating utilities and power-using ratepayers is rapidly shifting to a new two-way model in which ratepayers are not only utility customers, but also are providers of valuable services that utilities will increasingly need.

With buildings accounting for 65 percent of all electricity consumption in the United States, according to figures from the U.S. Environmental Protection Agency, it's no surprise that electricity is on the minds of building managers and owners. Nine out of ten such decision-makers in the buildings sector cite a focus on reducing electricity costs as their single most important goal, according to Deloitte.

Innovations in electronic control systems, sensors and communications enable interconnectivity between devices and systems in homes and buildings. Because a "negawatt," or watt conserved, is cheaper than any watt of new power generated—and because electricity cannot be cost-effectively stored at grid scale—utilities are finding ways to "shave" demand at peak times.

As an example, utilities are giving residential and commercial customers reduced rates, or incentives, to opt into demand-response programs that allow utilities to use next-generation M2M smart grid technology to make momentary adjustments in electricity loads in response to demand. An adjustment could include, for example, shutting off a hot water heater for five minutes—a minor change that a customer would not notice. But multiply that five minutes by hundreds or thousands of households, or many dozens of large commercial buildings, and the utility suddenly has available a giant reserve of electricity.

M2M smart grid communication can also be applied to large-scale electricity consumers. From the perspective of the utilities, single-building and multiple-building owners alike could present considerable opportunity to reduce the load on the grid during peak periods of electricity use.

According to a recent study by the Electric Power Research Institute (EPRI), demand-response and smart building technologies create an entirely new landscape in which "commercial buildings are increasingly able to provide a range of grid-supportive functions." In this new emerging two-way partnership, "it is expected that an increasing portion of commercial and industrial customers will be able and willing to contribute services to the grid."

Large commercial buildings will likely

interact directly with regional transmission organizations (RTOs) such as PJM Interconnection, which coordinates wholesale electricity for 13 states using economic demand-response programs. Smart buildings will thus provide additional capacity to the grid during times of need. Such buildings will also be well-positioned to respond to newer services as the markets evolve. Utilities will have an incentive to offer adjustable rates to smart building owners in exchange for their participation as "grid-enabling" partners.

"Smart buildings are a diamond in the rough," says EPRI's senior project manager, Ram Narayanamurthy, "potentially supporting a future flexible grid and improving its reliability and efficiency through their capability to communicate, use, store, generate and manage energy."

In this new relationship in which demand response meets capability, utilities recognize the service that smart buildings increasingly provide. For such service, utilities and grid operators will help for smart building owners tailor building operations to adjustable rates that translate into the op-ex advantage in electricity budgets—exactly where so many building owners and investors are looking to save the most. Utilities are recognizing the value of this new emerging partnership.

Jones Lang LaSalle's IntelliCommand℠

Procter & Gamble Case Study

Harnessing powerful data analytics with smart building technology to save energy

As one of the world's largest consumer product companies, Procter & Gamble (P&G) is committed to applying innovation and advanced data analytics to its real estate operations—just as it does with its products. After committing to the departmental goal of reducing energy usage by 20 percent by 2020, P&G's Global Business Services looked to every aspect of its operations for efficiency improvements. Working as P&G's outsourced real estate services provider, Jones Lang LaSalle (JLL) proposed that P&G become the first company to pilot JLL's new smart building management platform, IntelliCommand™.

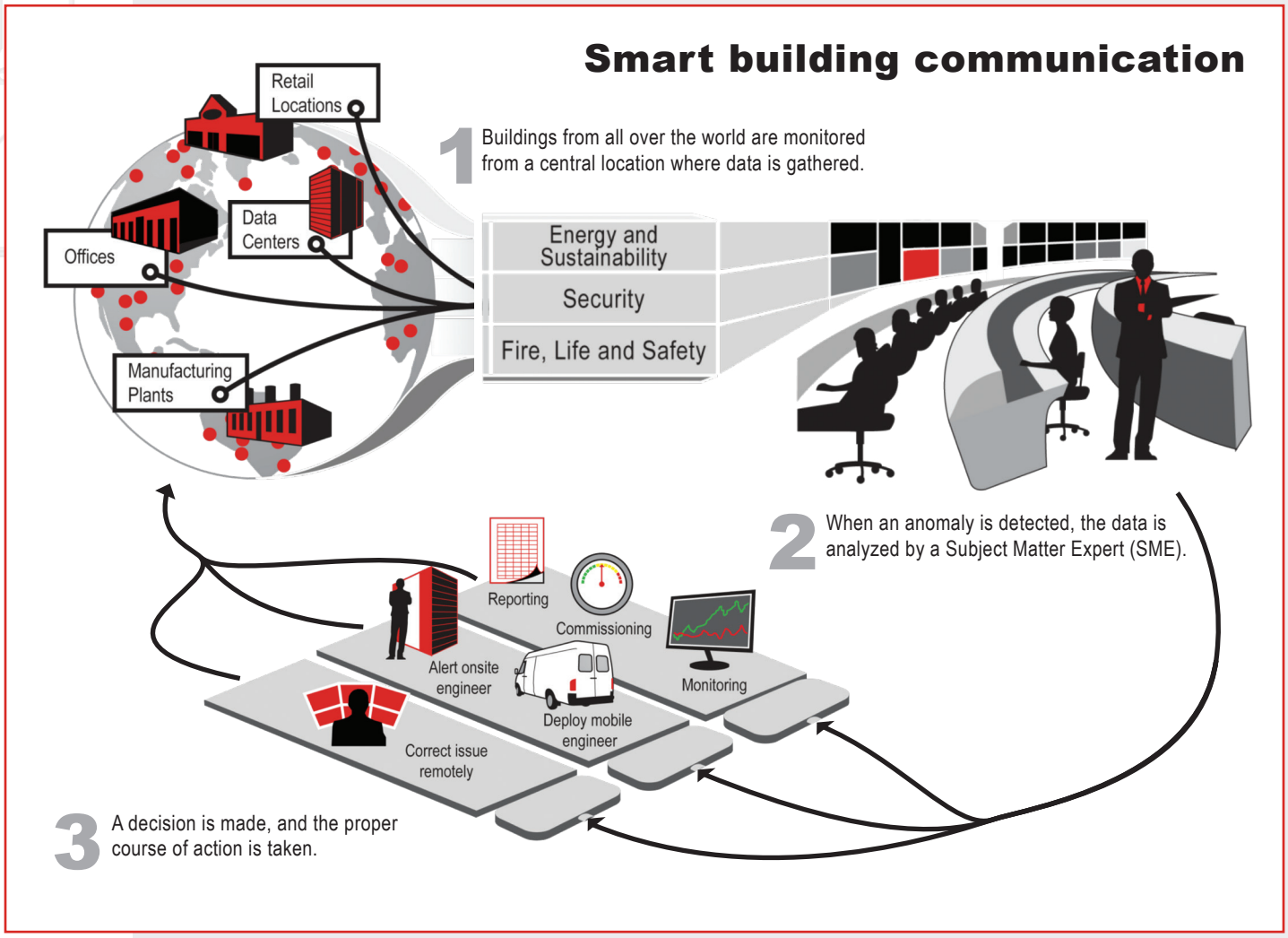
P&G's immediate goal was to apply IntelliCommand's proprietary data analytics capabilities to inform its real estate decision making and produce significant facilities energy cost savings within one year. The premise was that IntelliCommand's combination of cloud-based, smart-building management technology and JLL's team of facilities management professionals would provide P&G with around-the-clock, real-time facilities management.

Powered by Pacific Controls technology, IntelliCommand combines remote facility monitoring and control across multiple locations. Using wireless sensors, it sends data from various building automation systems to a remote "command center," where facilities operations experts use sophisticated data analytics to spot anomalies that indicate that a building system is not running efficiently. The system tracks data around the clock, allowing facilities experts to make constant adjustments, in a process called "continuous commissioning," to fine-tune building performance and address equipment issues before serious—and costly—problems arise.

12 key sites, dozens of lessons learned

With these goals in mind, P&G deployed IntelliCommand across 12 buildings totaling 3.2 million square feet of space in diverse facilities. The pilot sites included P&G's global headquarters campus in Cincinnati; its global healthcare headquarters facilities, including numerous laboratories; a key technical center; and a major mixed-used complex including offices and R&D operations.

With IntelliCommand, managers were able to identify problems that manual inspections could not detect. For example, IntelliCommand's data analytics flagged a temperature anomaly indicating that a heater was operating when not needed. Another anomaly revealed room-to-room temperature differences that indicated malfunctioning dampers, triggering unnecessary air-conditioning, and, elsewhere, thermostat default settings that needed adjustment.



As P&G learned, one advantage of today's smart building management technology is that its ability to fine-tune building performance exceeds human capabilities.

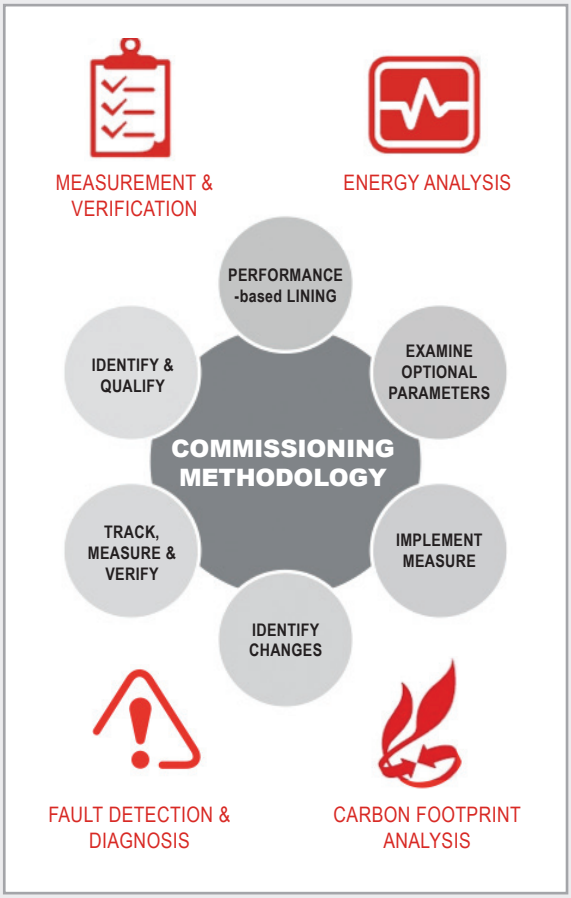
By constantly gathering data from various building automation systems, IntelliCommand extended the resources of facilities staff and ferreted out energy-wasting equipment issues that would have otherwise gone undetected.

Savings discovered, efficiencies revealed

Even in a facility spanning more than 1m sq. ft. across eight wings, IntelliCommand pinpointed miscues. For instance, IntelliCommand achieved 8 percent savings simply by reducing HVAC activity on nights, weekends and holidays. At a P&G technical facility, IntelliCommand's fault detection function enabled staff to identify and repair several recurring problems. Using these findings, the facilities team analyzed comparable data across the entire12-building pilot portfolio and made strategic adjustments across all properties.

Ultimately, the pilot produced results more quickly and decisively than anticipated. Within a year, P&G reduced the pilot facilities' energy costs by 8 to 13 percent, eliminating 4.4m kW of energy usage simply by optimizing building processes. Moreover, using IntelliCommand enabled P&G's facilities staff to acquire new training in best practices for applying data analytics to facilities management.

This holistic facilities management supports P&G's departmental goals of reducing energy use by 20 percent by 2020, using data analytics to support decisionmaking and adopting sustainable business practices throughout its operations.



The sticks:

The new regulatory environment for smart buildings

Creating incentives works the other way, too, of course—with a nudge from a stick. New local and federal government regulations, including mandatory energy consumption disclosure in some cities, are pushing building managers in the direction of smart buildings.

"Mandatory performance disclosure, as a means to encourage greater market transparency, is the first step to promoting energy efficiency performance in our buildings," says Wilson of LaSalle Investment Management.

Many others are similarly inclined. In the EIU's survey, 75 percent of global energy management decision-makers said energy efficiency regulations are beneficial but that lack of enforcement is a major barrier. This suggests that deeper, faster and more widespread adoption of energy-efficient practices would occur in the building sector if mandatory benchmarking, certification, performance reporting and other regulatory measures were in place.

That trend is already happening. Two wide-scale and mandatory building certification programs have emerged recently in Ireland and in Portugal as a result of the European Directive on Energy Performance of Buildings. Both initiatives resulted in building certification programs to drive national energy policy and promote energy-efficient market transformation.

In the United States, many cities are taking the regulatory initiative to encourage energy-efficient buildings. Eight major cities, including Boston, New York and Philadelphia, have established building energy benchmarking ordinances requiring thousands of commercial, residential and municipal buildings to track, verify and publicly report their energy consumption.

Cities have plenty to gain by putting such measures in place. New York City's suite of energy efficiency ordinances and laws is expected to generate net savings of $7bn and create more than 17,000 construction-related jobs over ten years.

Indeed, it may be that cities will become the real drivers of smart building efficiency regulations, with the occupants of efficient, or smart technology-enabled properties, serving as powerful market voices. Justin Snoxall, head of the business group for the UK property investor and developer British Land, says that energy and efficiency certification requirements can be an important marketing tool. "We have found that, particularly with our office portfolio, many occupiers have chosen our spaces in part because of their sustainability credentials."

The stick doesn't just apply to businesses, but also to people. Government regulations

will only go so far if building occupants don't begin to appreciate the value of a smart building. Along with the new generation of buildings comes a new generation of building occupants, with new work schedules and expectations for what a building should be and should do—or not do. Senior building management executives interviewed for the EIU survey said that clean, green buildings have the marketing advantage.

Shifting patterns of use and expectations from occupants will likely favor smart building deployment, according to Nicola Villa, managing director and global lead, big data and analytics, Cisco Consulting Services, and head of the Smart Working Environments group.

Villa predicts that companies will increasingly rely on mobile workers and that smart buildings will be able to adapt more readily to these shifting, multiple-use work environments. "In the past three years, we have seen the end of the old office," he says.

The move away from the old office, the trend for employees to connect from anywhere, or to bring their own devices to custom-fitted work settings, will bring about profound changes in how owners lease space. Demand for more flexible leases and for more network sophistication that can adapt to changing work patterns is likely to play to the advantage of smart building owners.

"Aggressive brokers will research the operating system of a building when negotiating a new lease," says Probst, "and smart building owners will have an advantage there."

Large residential communities will likely use smart building features to attract premium rent—as shown by a 7,000-acre master planned community developed by the Tailstock Group. The Lake Nona project in Orlando includes a broadband-linked set of homes, medical facilities, schools, constant camera surveillance of "safety" playgrounds and other amenities. These features of the emerging connected lifestyle will be reflected in lease agreements.

Smart buildings will increasingly play to trends in system reliability. When it comes to providing power, continuous, automated, interconnected systems across different buildings in various locations will eventually provide, in effect, a de facto microgrid, according to Jim Sinopoli, managing principal of Smart Buildings, LLC. This will become a key attraction for commercial users and tenants. A microgrid with multiple power-generation sources and smart building functionality "offers diversity and therefore greater reliability," notes Sinopoli.

A significant human behavior component will improve the effectiveness of any scalable smart building deployment. Smart building systems enhance the ability of landlords to engage with tenants and to tap into their growing desire to have less of an impact on the environment. For instance, real-time energy displays enable tenants to better monitor and control their energy consumption. The displays can also motivate tenants to improve their performance over time or to compete with other tenants in the building.

One can see this in action at Fraunhofer CSE's Building Technology Showcase, a 13-story, 100-year-old former warehouse in Boston that houses Fraunhofer's building science research facilities; it has been designed to consume half the energy of a comparable structure. The building science education agenda is front and center in

"Behavioral change is a huge component that we haven't even scratched the surface of"

the lobby of the building, where iPads with augmented reality applications allow visitors to see into the building's structure. Pointing an iPad at a wall reveals the internal smart building technology at work, with stats to show real-time energy gains in lighting, cooling and heating, water use and energy generation.

It's a simple but powerful idea that could easily be translated beyond the "showcase" or "special exhibit" realm and brought, in some useful and appealing form, into every lobby of every smart building. Fraunhofer's lobby exhibit points toward the need, as the behavior and human dimensions specialist Susan Mazur-Stommen calls it, "to invent traditions," habits and attitudes that support the new smart building environment.

"Creating a physical routine that someone can act out without thinking through is how we drive a car," says Mazur-Stommen. "Are there analogs to driving in the maintenance of a commissioned building?" How smart building engineers envision these new habits and how building managers and residents do so is, of course, an ongoing area of study. Yet, as smart building technology becomes increasingly ubiquitous, the investors and building managers who have worked to teach their residents to modify behavior are already ahead of the curve.

A 2013 Massachusetts Institute of Technology (MIT) study of smart building features and energy/occupancy mismatches noted that human behavior plays a large role in building efficiency. An example given by Rex Britter, research scientist at MIT's SENSEable City Laboratory: when many people are in a very big room, the occupants can adjust the thermostat over a wide range to get the room to a comfortable temperature. If only a few people are present in a large room, however, their ability to regulate the temperature is more restricted. If small groups simply learned to use small rooms, occupancy and energy use would be better matched and less energy would be wasted.

Smart building designers and owners will need to take these everyday behavioral challenges into account in their planning. "Behavioral change is a huge component that we haven't even scratched the surface of," says Prudence Robinson, a SENSEable City Lab research fellow. "This is an area with lots of opportunity to do research—and enormous potential for making a real difference."

Increased occupant awareness is certainly helpful, but isn't always necessary. In fact, smart building systems will more likely achieve energy efficiency savings regardless of clients or tenants. A randomized, controlled study done over six weeks in the winter at the headquarters of the Organization for Economic Co-operation and Development (OECD) in Paris recently showed that building occupants did not notice a 1-degree reduction per day in remote-controlled thermostat settings. "Small reductions in the defaults of office thermostats," the study concluded, "can lead to lower temperature settings by occupants in the winter heating season, which, when scaled up to the whole building, should translate into lower energy use." While tenants' knowledge of smart building operations will always remain important, the seamlessness and automated nature of smart building technology is really the key to op-ex savings.

Conclusion

Smart building technology offers a landscape of powerful, scalable e-market opportunities, especially in light of improved near-term and long-term trends in technology, finance, regulations and policy. The near-term business case for op-ex savings is bolstered by the energy-savings potential of strategically chosen, selective deployments of some smart building features. Limited investments in smart building systems offer the greatest ROI, especially when used in conjunction with smart building management systems.

Longer-term market changes, moreover, are already in play. The business environment is ripe for the arrival of consistent, widespread regulatory policies addressing energy efficiency. Financing mechanisms already exist that can be scaled up for wider smart building technology deployment for property owners seeking energy retrofits. Moreover, electricity markets and tenant expectations will continue to shift in favor of smart building deployment and ownership. The market evidence suggests that the profound opportunities for savings will, against a backdrop of energy efficiency imperatives and emerging technology, make smart buildings an agile and powerful asset class that is strategically aligned with shifting patterns of tenancy and use.

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