Session 2.9: Practices & Methodologies for Green Building Management (2)

Green + Smart Buildings

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ABSTRACT

'Green' is becoming increasingly synonymous with 'Smart.' There are several reasons for this including: the prevalence of IoT solutions, and the need to ensure that so-called green or high performance buildings will perform to the design or predicted performance once they are up and running. Proper transfer of design information into the operational environment, sophisticated, smart controls and monitoring, and properly trained operational workforce helps to maintain performance and achieve the desired carbon and energy savings.

This paper will examine the typical causes of t building performance slippage and remedies including deployment of ongoing commissioning enabled by big data analysis diagnostics, smart building solutions and appropriate staff training.

Keywords: *smart building, green building management, high-performance building, post occupancy evaluation*

1. HOW TO ADDRESS THE CARBON PROBLEM

It is well known that in order to combat climate change and keep the temperature rise below 2deg C, we need to cut our carbon emissions approximately by 50% for existing buildings and get to carbon neutrality for new construction by 2030. The various conservation efforts around the world show painfully modest reductions of 10 to 15%, often followed by regression due to the performance slippage. Net-zero buildings and certification schemes such as BREEAM, LEED or Green Globes are laudable; however their overall impact is miniscule. While these provide valuable insights into how buildings impact the environment, they are not effective enough to impact the vast majority of the building stock [1]. Something else needs to be done.

An effective approach to meet the carbon challenge can only come through a combination of measures, supported by technology. We need a robust solution on a large number of buildings, effective monitoring and analytics of building operations, advanced proactive maintenance, well trained building operators, and building owners and corporate Chief Executive Officers (CEOs) who are attuned to the ways that buildings impact both the environment and the productivity of the occupants. This would help them to make the right investment decisions on needed building improvements and ways to engage building occupants. With this, SMART will become synonymous with GREEN.

1.1 How to meet deep reduction targets and combat performance slippage

We are the first generation undergoing the transformation of paper based data into electronic bits - a similar revolution to Gutenberg - yet much of our energy data processing is still based on spreadsheets. Any data analyst will affirm that no data is perfect, but big data analysis can provide sufficient degree of granularity to identify likely trends. The mandatory reporting requirements in several jurisdictions are an example of utility metadata that will make it relatively easier to benchmark and establish reasonable targets.

A novel approach to data analysis, successfully tested in Cambridge, addresses districts (rather than individual buildings) and helps to uncover patterns in the data. Developed by the Department of Urban Studies and Planning jointly with Department of Civil and Environmental Engineering at the Massachusetts Institute of Technology (MIT), an algorithm evaluates buildings' energy consumption performance based on energy bills, building footprint and physical attributes of heat loss. The data then undergoes statistical analysis to establish, at the district scale, the energy consumption/carbon emissions and potential savings [2]. This can then be related to regional, and national goals.

Rather than using a shotgun approach, this results in a clearer understanding of what type and where specific energy and carbon reduction programs would be most effective. (See Figure 1-Representation of the energy saving potential of Cambridge buildings)

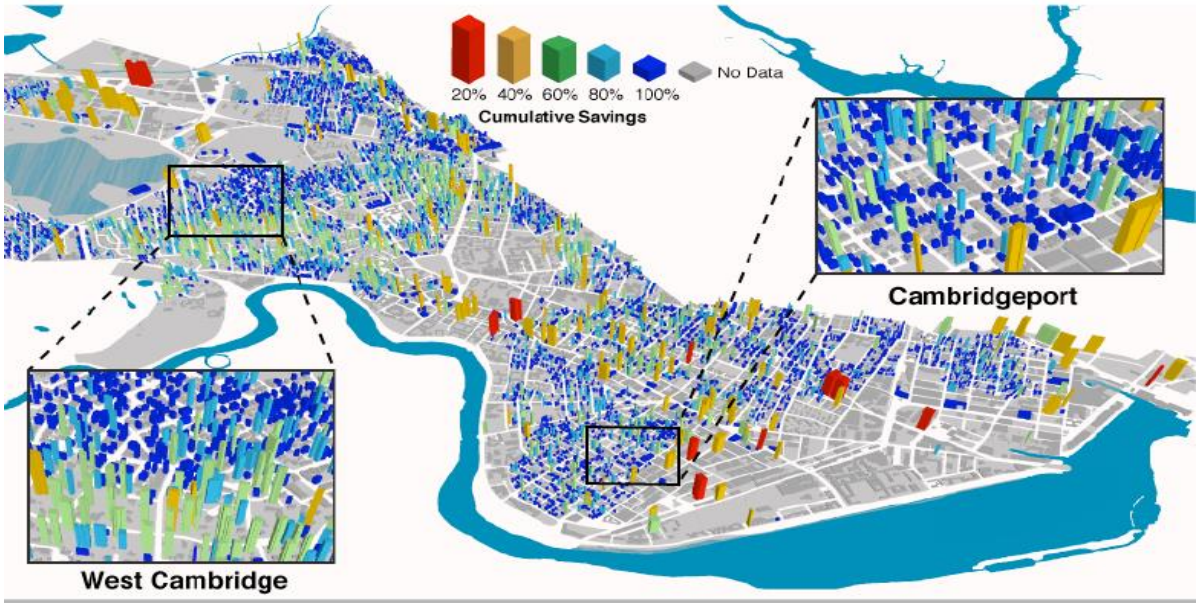

Figure 1: Representation of the energy saving potential of Cambridge buildings

Once areas or buildings with the highest energy improvement potential have been identified, it is much easier to contact the owners of those buildings and discuss with them, one-on-one, their business objectives for those properties. Thousands of energy audits are done each year, yet most of them end up on a shelf with no action taken because they do not fit the organization's business case or investment strategies.

Northwest Energy Efficiency Alliance (NEEA) [3] has identified the barriers to significant progress: First, a lack of understanding of the different drivers depending on whether the decision-maker is a large investor/owner, a Real Estate Investment Trust (REIT), a third party property manager or a smaller independent. Second is the excessive "noise" in the system from service providers, vendors and "helpful" organizations. A third barrier relates to scale. The energy savings gains of individual buildings are often too small to attract the attention of corporate real estate portfolio decision makers.

To achieve results, improvement strategies must be geared to the specific drivers for various types of organizations and decision makers. The building must have a certain business condition such as sufficient long lease with desirable tenants or long ownership pattern to be a good candidate for improvement investment.

1.2 Smart building solutions

Whether a building is new or existing, post occupancy studies [4] indicate what some of the reasons are that buildings are not performing as designed:

- Building occupancy is changing faster than anticipated.
- Building are designed with features that are beyond the capacity and training of the building operations management to use.
- Complex and innovative systems that may require several years to refine and understand.
- Lack of commissioning

Clearly there is a need for greater preparedness of the building operators as well as predictive maintenance or commissioning. Building operators training is of paramount importance. Training courses such as Building Operator Certification® (BOC) give operators the means to run their buildings more efficiently [5].

There are several studies which indicate that commissioning is cost-effective. For example Lawrence Berkeley's "Building Commissioning Golden Opportunity for Reducing Energy Costs and Greenhouse Gas" identifies a 16%

median whole-building energy savings in existing buildings and 13% in new construction, with payback time of 1.1 years and 4.2 years, respectively [6].

Typically issues addressed by commissioning are:

- Equipment running in excess of scheduled operations-overage
- Simultaneous Heating and Cooling
- Economizer Malfunction
- Leaky Valve
- Night Setback
- Morning warm-up
- Space temperature variations
- Optimum Start-up/Stop
- Duct Static Pressure Reset
- Chiller Analysis

The challenge of commissioning or retro commissioning is that it is time consuming and costly. Also, no sooner has retro-commissioning been completed, the building begins to slip out of calibration and savings achieved start to evaporate. Because today's buildings are so complex, even small problems or operational variances can escalate into large performance issues. A typical facility will become 3-5% less efficient every year without intervention. Also, as operations staff try to fix one problem at a time, soon they cannot see the forest for the trees.

This is where smart building solutions can help. Thanks to the diagnostic capabilities of smart buildings, performance optimisation is ongoing. Smart buildings also free the building operator staff from running around trying to catch up with problems, so that instead, they may proactively prepare themselves for the task ahead.

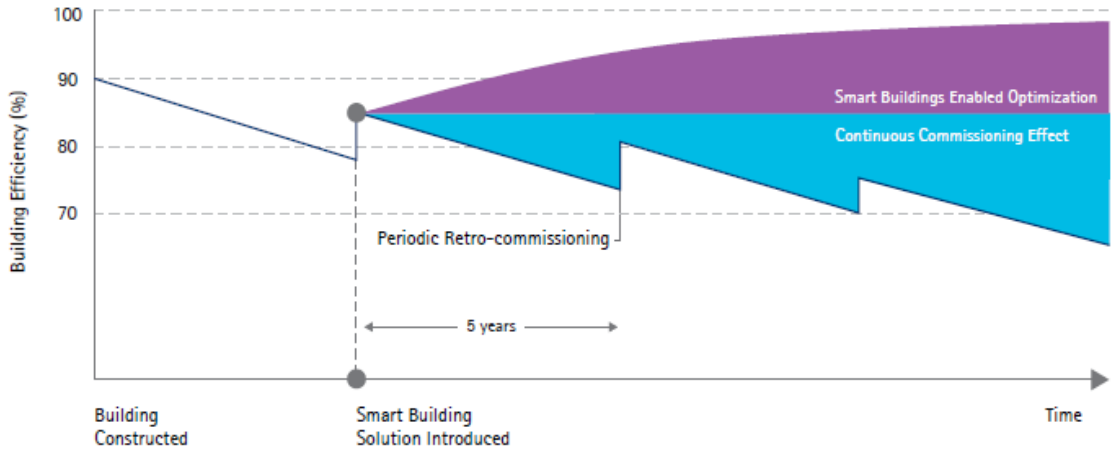

Figure 2: Ongoing, smart commissioning versus a traditional retro-commissioning approach

2. SMART + GREEN BUILDINGS

In one example of a more comprehensive smart building solution, data is collected from buildings of all types: retail, high rise office buildings, industrial or manufacturing, and critical environments such as hospitals or data centres. The extracted data captures the performance of the building systems such as HVAC and lighting, but can be also extend to other systems, such as elevators, security and life safety. The data are pulled from the site to the cloud, where they are analysed through a series of fault detection and diagnostic algorithms and rules engines. This automated analysis is further enhanced by subject matter experts operating 24/7 in a command centre.

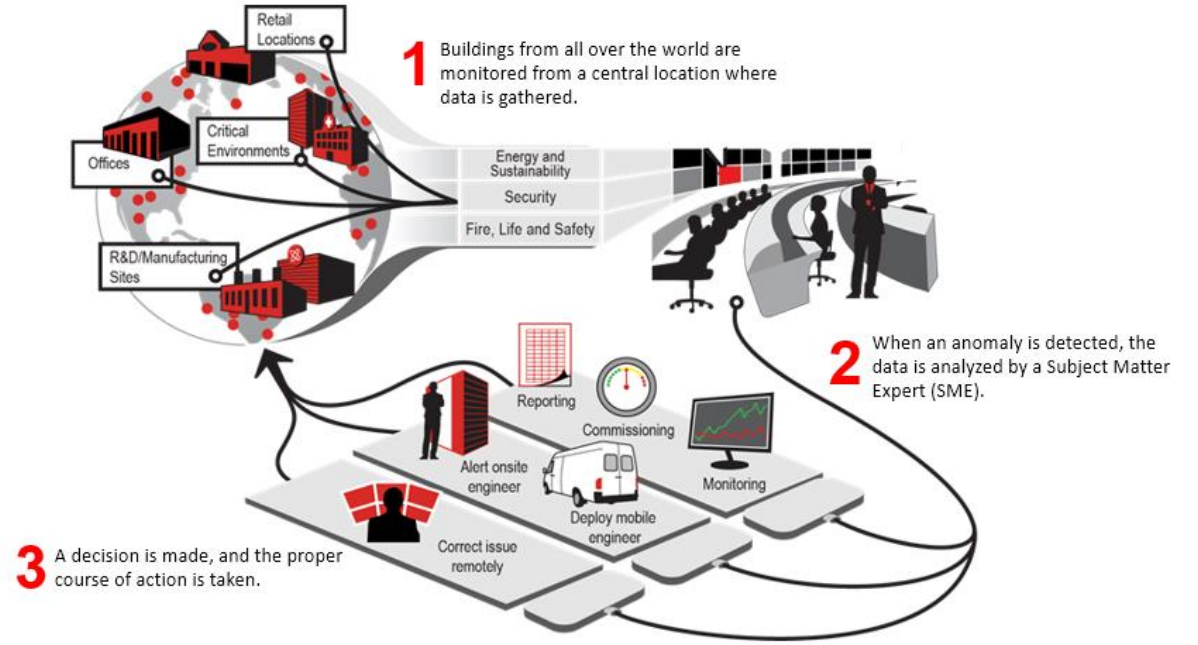

Figure 3: Smart building concept.

Issues and problems are identified and then corrective work orders are dispatched to building operating teams. This process provides building technicians with concrete, actionable intelligence that they can use to reduce energy costs, fix problems before they occur, and keep their properties running smoothly. Finally, these corrections within the building can be independently verified because all the data is available for review. Building engineers no longer need to wonder if they have fixed the problem.

Smart energy monitoring and ongoing commissioning systems already show a great promise. For example Procter & Gamble implemented such a system at four sites, comprising twelve buildings totalling 300, 000 m2 (3 million SF). The project produced combined savings of over $2.8 million in just 11 months (3 months overall ROI) more quickly and decisively than anticipated. Within a year, P&G reduced the facilities' energy costs by 8 to 13 percent, eliminating 4.4 million kWh of energy usage simply by optimizing building processes. In another example, in just three short months, a pharmaceutical company realized 3% reduction in utility cost at their corporate headquarters in New York, using this smart technology. Examples such as these now abound [7].

As mentioned, "smart" is now becoming synonymous with green. With a converged building services network, it is now possible to provide interoperable control systems which not only address the green aspects of the building (energy and water use, HVAC operation and lighting), but also the smart aspects such as connectivity, security and workplace productivity). These buildings are more efficient, easier to operate and maintain and provide a lower overall Total Operating Cost ("TOC").

Continental Automated Buildings Association (CABA) calls these "bright green" [8] - buildings that use both technology and processes to create facilities that are safe, healthy and comfortable, and enable productivity and well-being for occupants. The buildings self–report timely, integrated system information for owners so that they can make intelligent decisions regarding their operation and maintenance. They have an implicit logic that effectively evolves with changing user requirements and technology, ensuring continued and improved intelligent operation, maintenance and optimization. Bright green buildings are designed, constructed, and operated with minimum impact on the environment, and an emphasis on conserving resources, using energy efficiently and creating healthy occupied environments.

The collective impact of smart buildings will be much more noticeable at the district or portfolio scale and eventually at the smart city scale. Such undertakings will not be an easy task and will require an understanding of the business objectives of individual building owners to develop effective drivers, corresponding strategies, incentives and programs for a district.

3. CONCLUSION

To be effective, carbon reduction measures must be done on a larger scale, combining measures such as monitoring and analytics of the building operations, advanced proactive maintenance, well trained building operators, and buy-in from the building owners and corporate Chief Executive Officers (CEOs).

Smart building approach is especially helpful with operational improvements such as performance monitoring and ongoing commissioning. These technologies exist but have not been deployed to their full effect.

Smart and green building technology offers 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 is bolstered not only by the energy savings potential but even more so by workplace productivity gains from the strategic deployment of certain smart and green building features.

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

REFERENCES

[1] Yudelson, J. (2016) Reinventing Green Building | New Society Publishers. Available at: http://www.newsociety.com/Books/R/Reinventing-Green-Building.

[2] Abdolhosseini Qomi, M.J, Noshadravan, A, Sobstyl, J, Toole, J, Ferreira J, R. J-M. Pellenq, R.J-M, Ulm, F-J,§,1 and Marta Gonzalez,M. Data Analytics for Energy Efficient Retrofits of Cities. Available at: http://humnetlab.mit.edu/wordpress/wp-content/uploads/2010/10/70008_0_merged_pdf_1268810_nrhjqt.pdf

[3] Northwest Energy Efficiency Alliance (NEEA): Commercial Real Estate (CRE) Market Test Assessment: Understanding Delivery, Partnership Strategy and Program Channels (no date) Available at: http://neea.org/docs/default-source/rfp-documents/42623-neea-rfp.pdf?sfvrsn=2

[4] Do our green buildings perform as intended? (2014) Available at: http://iisbecanada.ca/umedia/cms_files/Conference_Paper_1.pdf

[5] Why BOC? - NEEC building operator certification. (2016) Available at: http://www.theboc.info/why-boc/

[6] Mills, E. (2009) Building Commissioning: A Golden Opportunity for Reducing Energy Costs and Greenhouse Gas. Available at: http://cx.lbl.gov/documents/2009-assessment/lbnl-cx-cost-benefit.pdf

[7] The Changing Face of Smart Buildings: The Op-Ex Advantage, JLL White paper (2013) Available at: http://www.us.jll.com/united-states/en-us/research/

[8] Convergence of Green and Intelligent Buildings (2008) Available at: http://www.caba.org/resources/Documents/bgb-final.pdf