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Autonomous Building Operations

The Next Step in Building Automation

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CEO's Introduction

Building Automation Systems (BAS), in one form or the other, have been around for decades offering Facilities Managers (FMs) with tools to monitor and control commercial buildings. Technological advances in the form of sensors and control networks have made buildings more complex to maintain using today's "passive" BAS solutions.

FMs face many challenges in their effort to maintain their fleet of high-performance commercial buildings at peak efficiency. These challenges include staff retention and training, achieving energy cost reduction commitments and satisfying demanding building occupants.

Fortunately, advances in machine learning algorithms, offers new opportunities for BAS to evolve to support true Autonomous Building Operations. Bandora's mission is to simplify building operations and maintenance for FMs by boasting the building's intelligence.

We believe that Artificial Intelligence (AI) is the final link needed to deliver the inherent promise of BAS. In an Autonomous Building, AI provides real time command and control of a building's management system leaving staff and management to spend more time on saving energy and optimizing occupant comfort.

Overview

With the advent of the new advances and techniques in Information and Communications Technologies (ICT), every place, everything and everyone can be connected and communication between them can be non-intrusive but meaningful. This is the technological basis created by the Internet of Things (IoT).

The high volume of data that is generated by today's high performance commercial buildings can be leveraged to create a new generation of intelligent and efficient building management systems that operate autonomously.

Big data analytics helps us to leverage the large amounts of data produced by the IoT-based ecosystems to provide insights that help explain, expose and predict future building behavior. Specifically, in the field of smart buildings it is increasingly possible to apply machine learning algorithms to generate behavioral building models for solving problems like underperforming energy efficiency initiatives and comfortprovisioning.

Prediction of energy use in buildings has received a remarkable amount of attention from researchers, as an approach to reduce energy consumption, which is intended toconserve energy and reduce harmful greenhouse gases.

The prediction of energy usage in buildings and modelling the behavior of the corresponding energy system, are complicated tasks due to influential factors such as weather variables, building construction, thermal properties of the physical materials and occupants' activities Furthermore, there are several nonlinear inter-relationships among the involved variables, often in a noisy environment, which amplify the difficulty in identifying the precise interaction among them.

Chapter 1

Automation Transition

Building Automation and Controls (BAC), in simple terms, is analogous to the brain that controls the body. In this sense, it is the system that controls the building. Most commercial, institutional, and industrial buildings built after 2000 include a BAC. Many older buildings have been retrofitted with a new BAC, typically financed through energy and insurance savings, and other savings associated with pre-emptive maintenance and fault detection. A building controlled by a BAC is often referred to as an intelligent building, "smart building". Commercial and industrial buildings have historically relied on robust proven protocols (like BACnet, ModBUS, LonWorks, KNX, DALI, etc.).

Today these technologies mainly focus on HVAC systems and they can be applied in varying degrees of integration and sophistication. Detailed analyses have shown that Building Energy Management Systems (BEMS) are among the set of cost-optimal measures that will produce economically viable energy savings.

Thus the BAC can:

- Allow visualization of energy consumption in a building;
- Identify the effect of compliance with an order and automatically reduce energy consumption in response;
- Optimize the use of energy sources;
- Respond on the basis of occupation and behavior;
- Contribute to temporarily reduce the use of electricity in buildings and homes when the grid is close to capacity (if combined with demand response schemes, BACs with the ability to adapt the energy consumption of buildings to the network).

As a result, these technologies minimize building lifetime costs while ensuring occupant comfort.

BAC's Energy Savings Potential:
26% in educational institutions and hospitals
27% in residential buildings
41% in hotels and restaurants
49% in retail and commercial buildings
52% in offices and auditoriums

Chapter 2

Challenges

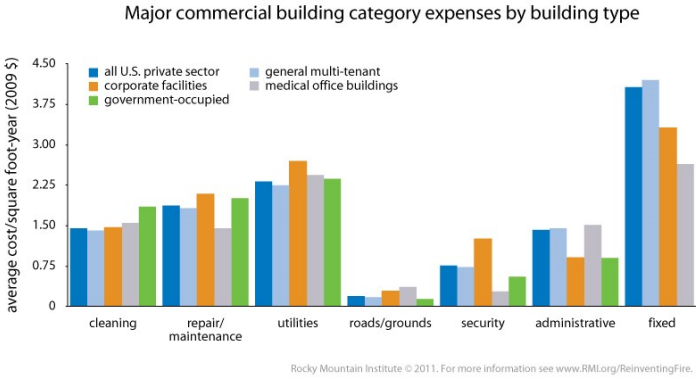
According to the Building Owners and Managers Association (BOMA), the Most common challenges that building owners face include:

- Increasing costs
- Deferred maintenance issues
- Increasing complexity of building systems
- Aging infrastructures
- Occupant comfort issues

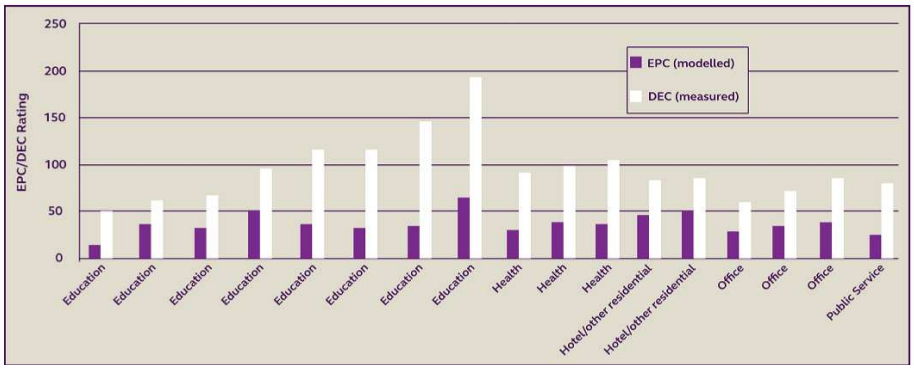
Most building's expenses break down into a similar distribution - largely fixed costs, followed by utility bills, repairs and maintenance expenses (R/M). On average, building owners spend 22% of their operating costs on energy and water. Corporate facilities typically spend slightly more on utilities ($2.70/sqf.y), while general multi-tenant buildings spend less ($2.25/sqf.y).

Many operators, when assessing only the value of energy bill reductions, will choose not to invest in energy retrofits.

With industry shifts and automation, it is a difficult thing to understand how people will make a living. Where does the ordinary individual go to find work? Our answer is clean energy. If oil and gas jobs begin to thin out, it will be an excellent opportunity to start clean energy projects.



Display Energy Certificates (DEC) ratings, based on measured energy use from bills, are often triple the modelled Energy Performance Certificate (EPC) ratings



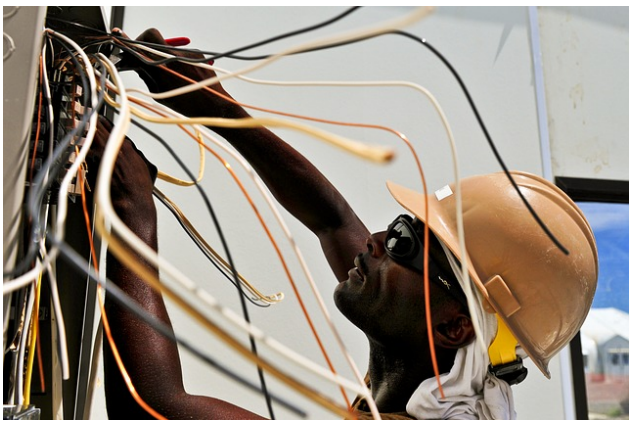
In addition to development of thermal comfort models, some researchers also have been studying occupant-responsive HVAC control to take thermal comfort into account:

- Development of a personal thermal comfort system (PCS) and create such low-energy PCS as micro-zones and integrate them into centralized HVAC system in open plan office environments;
- Introduction of a knowledge-based approach for improving HVAC system operations through coupling personalized thermal comfort preferences and energy consumption patterns. In their approach, zone temperature set points were selected through solving an optimization problem for energy, with comfort, indoor air quality, and system performance constraints taken into consideration.

A report from the British governmental innovation agency, INNOVATE UK, concluded that modern non-domestic buildings use 3.5 times energy than the designed and rarely they reach the expected performance level. Energy Performance Certificates (EPC's) do not reliable predict actual energy use in buildings – and there is very little correlation between EPC's and Display Energy Certificates, which record the actual energy use.

Chapter 3

The Facility Manager Role



Facilities Managers (FMs) are responsible for the maintenance and upkeep of an organization's buildings, ensuring that they meet legal requirements and health and safety standards. FMs operate across different business functions, working on both a strategic and operational level. Generally speaking, the role of the facility manager is to ensure that the facility is operating as it should on a daily basis by completing daily inspections and conducting proactive and reactive maintenance.

Today's facility managers are so much more than janitors and electricians, they have become an increasingly valuable human asset for their role in business growth. Developments in technology, increasingly smart buildings and the use of tablets and smartphones in day-to-day work have resulted in a mountain of data.

Chapter 4

The ability to understand, correlate and use effectively all information is the next big challenge. The modern facility manager must fulfill their customer needs and innovate their practices to stay competitive in the facility management industry.

It's not only about the amount of information to be processed, it´s also the time to process all data and act according the best practices. Modern facility managers must change from a reactive role and be prepared to face daily changing challenges. Facility Managers must evolve from passive supplier to proactive strategic partner, be focused on value creation – not just cost savings, develop sustainable solutions, leverage technology and empower service deliveries with data.

In conclusion, Facility Managers must be focused on deliver personalized services.

Short Comings

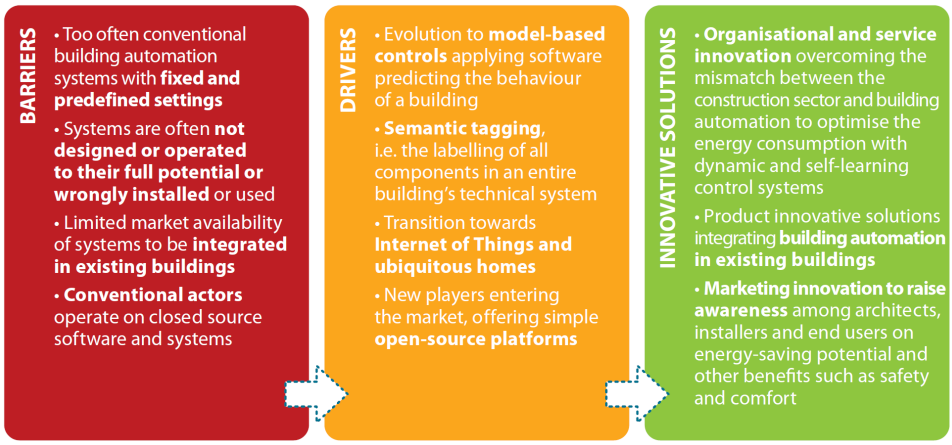
Three main areas of transition can be identified in these different systems:

- Model-based controls
- Semantic tagging
- Smart building applications

All of these changes focus on dynamic or even self-learning control systems. Instead of static, predefined parameters for control, the system itself can define and steer the relevant parameters (e.g. optimal temperature, heating time, light lumen, operational-time installations, overheating protection), in a specific moment, and based on occupation, (predicted) inside- and outside temperature and so on.

The final energy use in a building is generated through a combination of building envelope characteristics (incl. design and orientation), installations (incl. renewable energy) and user behaviour.

Outlining the innovation of 'Building automation and control technologies' (Source: BPIE)



Conclusion

In commercial buildings, connected devices as part of the building IoT are growing exponentially. Humans simply don't have the capability or time to sift through all the data these connected devices generate and react within a reasonable amount of time. Bandora.OM leverages machine learning, allowing buildings to practically run themselves over time. Bandora Systems cloud O&M solution, Bandora.OM leverages Artificial Intelligence to provide real time command and control of a building's energy system. Facility Managers can spend more time on occupants, and less time manually running a building.

Autonomous Building Operations is the logical next step in smart buildings management. Bandora.OM is a non-intrusive cloud platform that gathers information from all systems inside a building, such as BMS, meters or sensors. Bandora.OM recognizes the strategic importance of occupant comfort in determining building performance and integrates occupant's comfort as part of the ecosystem it creates. With the ability to analyze and process huge amounts of data in real time, daily operations such as changing heating, cooling and lightning systems settings can be automated. It can also predict the expected equipment malfunction date, accordingly with the energy consumption pattern, allowing Facility Managers to focus in value creation: more energy savings, less complaints, more productivity with less resources. Bandora.OM is BMS and IoT device agnostic and is designed to complement and not replace, an existing investment in building automation technology. As a cloud-based system, Bondora.OM's Machine Learning and Predictive Analysis algorithms enable one building to benefit for all buildings connected to the system.

The idea of a commercial building being run optimally by a computer is something every Facility Manager can relate to. Leveraging Artificial Intelligence to enable Autonomous Building Operations is not science fiction its science fact and another example of the growing role of the next generation of computer systems in moving automation forward.