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Do more with less: Moving power and building management to the cloud

by Markus Hirschbold and Grant Reig

Executive summary

Building owners and operators are facing growing demands for buildings that are more sustainable, resilient, efficient, and people-centric. New cloud-hosted power and building management applications can help meet these business, regulatory, and occupant requirements with a scalable solution that minimizes the costs of on-site IT services, computing hardware, and software. Additionally, cloud-hosting secures data storage, simplifies remote operations and cross-team collaboration, and enables facilities with limited resources to engage expert advisory services.

Introduction

From large education and government campuses, to healthcare facilities, to office complexes, hotels, industrial facilities, and retail chains, it is no longer enough for organizations to manage buildings under the old paradigm of doing the minimum possible to keep operations running. It is now recognized that a building's infrastructure affects every facet of occupant and operational performance over its entire lifecycle.

The Schneider Electric framework for 'Buildings Of The Future' defines a new operational paradigm in which all facilities are more sustainable, resilient, hyper-efficient, and people-centric. The digitalization of electrical and HVAC systems – including associated energy and power management system (EPMS) and building management system (BMS) software – has given facility teams the data, insights, and control needed to achieve these outcomes.

However, many organizations do not have the budget available to purchase and maintain the required on-site EPMS and BMS software and computing hardware. They may also not have the people, time, or expertise to take full advantage of these applications.

The answer to these challenges comes from a new breed of EPMS and BMS solutions that are making the transition to the cloud. In this paper we will discuss:

1. How digitalization is helping building owners and operators meet the challenges of today and tomorrow.
2. The parts of EPMS and BMS functionality that are moving to the cloud.
3. How migrating EPMS and BMS applications to the cloud is helping organizations reduce costs while increasing resilience and scalability.
4. How cloud-based EPMS and BMS enable a portal to valuable, and flexible advisory services.

Figure 1

The vision for 'Buildings Of The Future' defines a new operational paradigm, in which all facilities are more sustainable, resilient, hyper-efficient, and people-centric.

How digitalization enables power and building performance

Resilience, occupant health, and controlling CapEx and OpEx are now top concerns for real estate executives (see Figure 2). This will require end-to-end digital workflows. The technology to support this transformation is available today. Fully digitalized electrical distribution and HVAC systems – including IoT-enabled connected sensors, meters, and control devices – deliver timely, relevant energy and operational data to EPMS and BMS applications. These apps turn 'big data' into actionable insights for better-informed decisions, more responsive facility teams, and more effective automated actions.

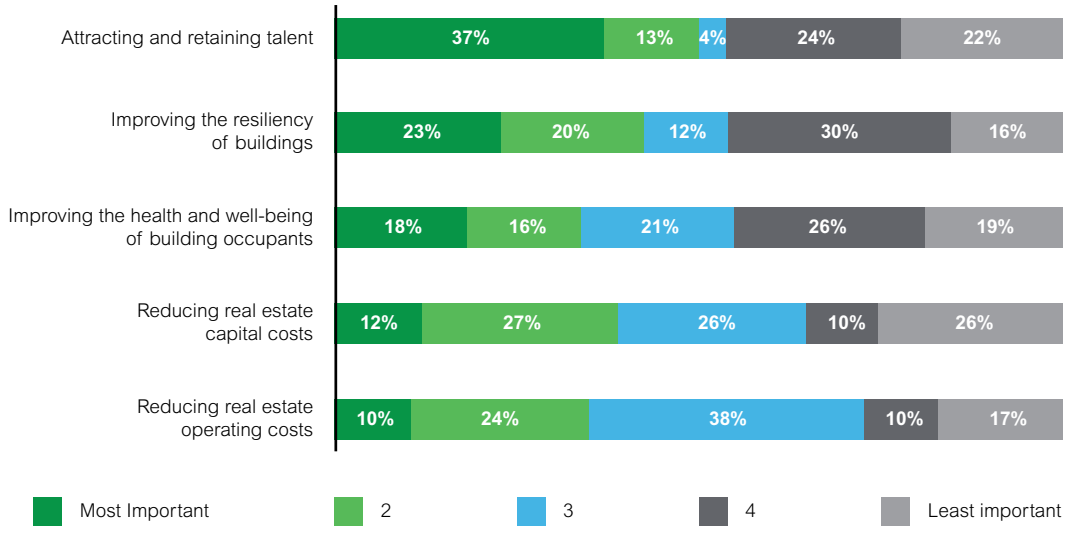

Figure 2

Real estate management objectives by importance for next 3 years.

Global Corporate Survey 2020: Smart Building Technology Budgets, Priorities & Preferences [Verdatix]

Open platforms enable cyber secure access to all key stakeholders, as well as integration of EPMS, BMS, and other complementary applications including space management, security, mobile employee engagement, and more. This new level of reach and unification is already helping many organizations to:

- Uncover energy waste, operational inefficiencies, and other opportunities to optimize energy consumption and costs, while predicting energy needs and supporting active energy management, energy reporting compliance with standards (e.g., ISO 50001), facility-to-facility performance benchmarking, and validation of savings.
- Optimize maintenance using condition-based equipment monitoring and analysis to support predictive maintenance.
- Adapt the workplace to changing needs by identifying and reallocating unused resources (e.g., desks, meeting rooms, amenities) based on real usage and headcount, and have the agility in the building infrastructure to integrate new services like electric vehicle charging stations.
- Improve the indoor environment by feeding real-time data on occupancy, people flow, temperature, humidity, volatile organic compound levels to the BMS for automated response, and using space management to help ensure safe distancing.

For any business, employees are the most valuable asset, as reflected by typical per square foot costs of $3 for energy, $30 for space, and $300 for each person. It is critical to business success to keep occupants healthy and productive.

"A surprising way to cut real estate costs", JLL, 2016

- Give occupants a personalized, connected experience including app-based access control, building navigation, and comfort control.
- Increase resilience by receiving early notification of reliability risks to mission-critical power and HVAC systems, to isolate their root causes faster, and being able to manage multiple sources of supply, including backup generation when needed.
- Better protect occupants from electrical fire risks while facility teams are safeguarded during operation and maintenance procedures.
- Use mobile access to bring the most relevant data to those that need it, to help personnel work more efficiently, help desks and technicians collaborate more easily, and to improve emergency preparedness by enabling facility management teams to perform more than 70% of building operations remotely.[1] The recent pandemic is driving many firms to invest in the technology needed to achieve this capability.

However, to get the most from the newest power and building capabilities requires a team capable of understanding, and acting on, the intelligence provided. It has also traditionally required that computers, data servers, and software be hosted on-site at each facility, maintained by local engineering and IT staff.

Facing resource and budget limitations

In the post-pandemic 'new normal,' organizations will continue to face an increasing manpower challenge. They are losing electrical systems and building management expertise as experienced people retire, or as workforces are reduced. Firms owning or managing multiple facilities face the greatest difficulties when resources become more limited.

The pandemic has made physical distancing and infection control a top priority initiative for organizations.

Global Corporate Survey 2020: Smart Building Technology Budgets, Priorities & Preferences [Verdatix]

In addition, a facility manager typically has expertise in either electrical systems or building management systems, not both. Yet they have become a 'jack of all trades,' and the pandemic has forced many to take on an increasing workload that can include workplace safety and infection control. If an organization hires new facility staff, this new generation of facility professionals will have expectations for having access to digital diagnostic tools to compensate for a lack of long-term experience.

There is also the cost consideration of purchasing and maintaining power and building management software and hardware, especially for organizations responsible for multiple facilities. In a time when organizations are facing increasing competition and limited budgets while needing to maximize shareholder value, there are continuous efforts in finding ways to cut operational costs.

Ultimately, COVID-19 has brought all eyes onto facilities management, offering personnel an opportunity to take career-defining actions. These actions will be enabled by first overcoming the resource and cost constraints noted above by taking advantage of the transition of EPMS and BMS to the cloud.

[1] "3 Ways That Digital Tools Help Building Owners...," Schneider Electric, 2020

What can be moved to the cloud?

Electrical system connected devices & assets

- Sensors (e.g., thermal)
- Meters (e.g., energy, power quality)
- Protection (e.g., smart circuit breakers)
- Control (e.g., automatic transfer switch)
- Power generation (e.g., standby, renewable)
- Power correction (e.g., harmonic filters, power factor correction)

Typical power management system capabilities

- Real-time monitoring of the entire electrical system
- Alarming on risk conditions
- Advanced analytics (e.g., energy, power quality, sequence of events)
- Reporting (e.g., energy, power quality)
- Control functions (e.g., for load management)

In recent years, power management and building management systems have become more connected and more capable. Though EPMS and BMS architectures are similar in many ways, there are also a few key differences that should be understood before we look at the benefits of transitioning some functionality to the cloud.

The traditional EPMS architecture

Energy and power management systems take advantage of the data from the many types of devices and energy assets common throughout facility electrical distribution systems (see sidebar).

Most electrical switchgear sales will include communicating meters and breakers. If not, an electrical system can easily be modernized, often with IoT-enabled devices that make connections simple and affordable.[2] Data transfer from large numbers of devices to the EPMS software may also require a few routing devices.

EPMS software has typically been hosted on a computer inside the facility, with data stored on a local server. This is often referred to as 'edge' based computing, as the application is running in close proximity to the electrical distribution system and loads. EPMS software can include a wide range of functionality (see sidebar).

Access to EPMS functionality has typically been through one or more local workstations, as well as web browser-based mobile access. However, this mobile access often requires the support of a corporate IT team to enable and maintain.

The traditional BMS architecture

Building management systems are also highly connected systems. In the past, 'dumb' buildings were limited to simple HVAC control, i.e., turn the heat on and off. The smart BMS equipment of today is highly focused on extensive data aggregation, organization, and integration. This enables a new level of optimized building performance.

Architectures will vary depending on the type of building, but a modern, flexible BMS will often comprise a multi-tiered, multi-server solution that enables wide connectivity and integration, with extensive data analysis, automation, and management capabilities.

[2] White paper - "Bringing critical power distribution out of the dark and into a safer, more reliable, and efficient future," Schneider Electric, 2019

Building management system connected devices and systems

- Sensors and meters (e.g., temperature, humidity, flow, energy)
- Controls (e.g., blower, damper, heat on/off, cooling)
- Systems (e.g., lighting control, fire safety)
- Security and access control

- Automation server – These are essentially industrial computers located on-site that connect with a variety of devices and systems (see sidebar). Each automation server runs specialized, automated control logic that continuously monitors the conditions of every building space and the performance of the HVAC system. If needed, the algorithms will decide on a required action, and then output control signals to bring parameters into specification. Beyond control logic, an automation server will typically include trend logging and alarm supervision. Multiple, distributed automation servers extend reach as well as provide fault tolerance, with each server able to run autonomously.
- Enterprise server – An enterprise server collects, aggregates, and archives site-wide data from all automation servers, as well as property information and user activity logs. It also acts as a central configuration, control, and monitoring point for the facility management team, with facility-wide views of alarms, events, and trends. An enterprise server can integrate other data inputs, such as weather forecasts, enabling more complex building performance optimizations. Similar to EPMS software, enterprise server software has typically been hosted by an on-site computer and data server, with access via workstations and mobile devices.

Critical versus non-critical functionality

Most of us take advantage of cloud-hosted applications every day, for example online banking and cloud-based point of sale systems. These business systems can provide services in this way because cloud servers and the Internet have become more reliable for many kinds of applications. This is also true for a large range of power and building management functions.

"Organizations are increasingly using cloud services for new initiatives or to replace existing systems, meaning that spending on traditional IT solutions are being reallocated to the cloud."

Gartner, October 2020

However, some critical and time-sensitive EPMS and BMS functionality should remain on-site – at the 'edge' near the electrical and HVAC infrastructures – to ensure the highest reliability and responsiveness. This includes functions requiring short-term decision-making and locally-controlled actions. See Table 1. These functions may not operate reliably 24/7 if they are dependent on a cloud connection and a network outage were to occur (for example, due to a natural disaster), whereas engineers will still have application access if an on-site computing system is backed up by an uninterruptible power supply (UPS).

Less time-sensitive or non-critical EPMS and BMS functionality can be elevated to the cloud. Table 1 lists typical critical and non-critical functions.

Table 1
Critical versus non-critical EPMS and BMS functions

Critical, time-sensitive EPMS and BMS functions	Non-critical EPMS and BMS functions
Protection functions by circuit breakers, which typically require response in the millisecond range.	All EPMS functions for non-critical sites, including alarm management and analytics for non-critical events.
High-speed data capture by meters and breakers, including transient detection, sag/swell, etc.	All BMS global oversight functions typically provided by the enterprise server, including holiday schedules, user administration, global setpoints, etc.
Critical automation and control, such as managing multiple incomers, on-site generation, load shedding (e.g., for demand control) or controlling building temperature and ventilation (i.e., functions typically provided by automation servers).	Cloud-based data storage to simplify engagement of contracted services to support facilities with limited resources. Examples: • Metering and reporting services to help comply with guidelines or regulations (e.g., ISO, IEC, NEC, etc.). • Advisory services to help isolate internal issues that might have caused an outage by performing deeper EPMS or BMS analyses, and to coordinate with facility team and service contractors.
Local alarm annunciation and analytic tools for critical-power facilities, such as industrial plants with continuous processes, hospitals, data centers, etc., to help on-site engineers perform immediate troubleshooting.	Non-critical functions for critical facilities - Even in cases where mission-critical aspects of EPMS and BMS are maintained in-house, some functions can be outsourced to remote service teams, as noted above.

Reducing costs while increasing resilience and scalability

In a cloud-based EPMS and BMS architecture, all non-critical functionality is managed and maintained in the cloud by the solution provider (see Figure 3). The actual hosting service is typically a large provider with data centers that can offer a high level of guaranteed uptime and reliability.

A secure gateway is used to send data from the facility to the cloud at regular intervals or, in the case of critical alarms or events, on demand. Data access is offered through a web browser-based user interface. EPMS and BMS functionality can often be offered through a single, unified interface for greatest efficiency and potential for cross-team collaboration.

Multiple facility personnel are able to securely view and manage the electrical and HVAC infrastructures of one or more facilities. With advanced user management, there is the ability to limit and extend user rights to different stakeholders.

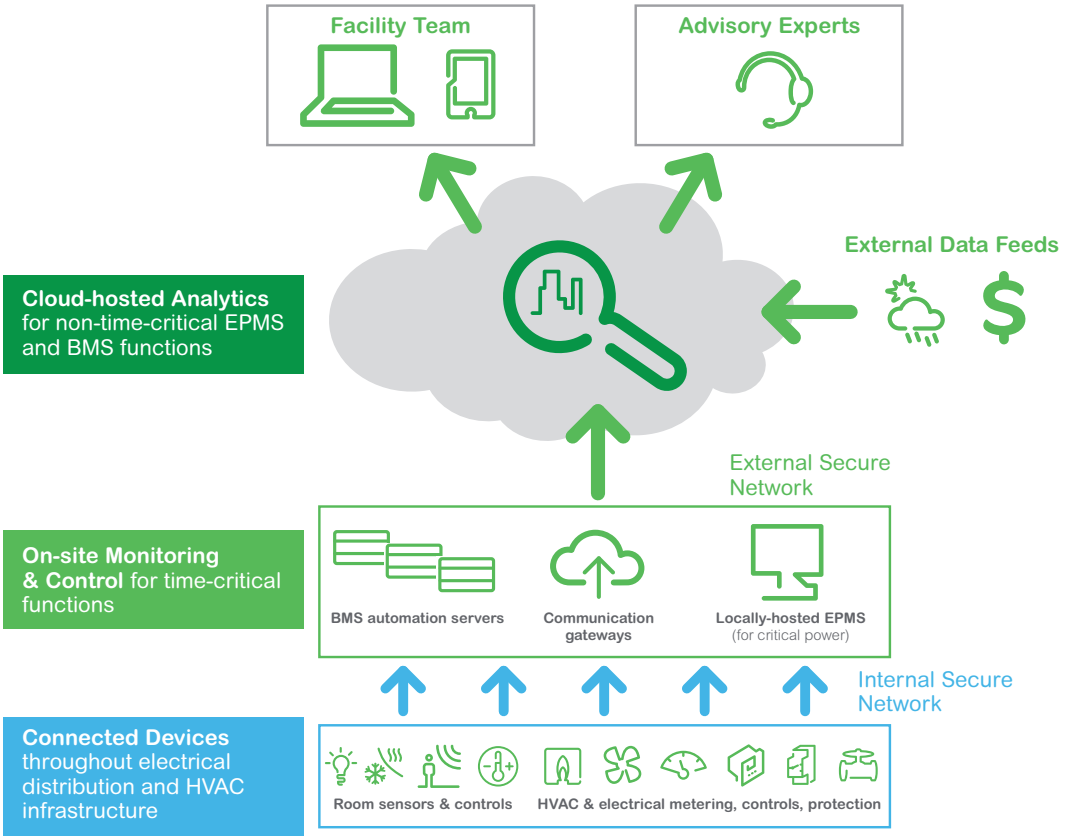

Figure 3

Cloud-based EPMS and BMS architecture

OpEx versus CapEx

A cloud-hosted model for EPMS and/or BMS means not having to host processing and a database on-site. This avoids the capital expense of having to maintain an on-site computer, a server, and software. Cloud-based EPMS and BMS are typically purchased on a subscription basis, such as a monthly fee. The subscription will normally include the on-site gateway and maintenance/upgrade of the gateway as necessary. Therefore, the cloud-based functionality of the EPMS and BMS become an operating expense instead of CapEx. The cloud service fee offsets on-site IT costs, while avoiding on-site equipment installation and integration (that delays application startup), and hidden IT chargeback costs for facility operations departments that are already constrained by tight budgets.

There is also no need to update any software – including EPMS and BMS applications, virus protections, firewalls, operating system, etc. – as software is updated automatically by the solution provider. Further, there is no additional cost for application upgrades, as upgrade costs are typically included in the subscription fee.

Beyond core application upgrades, the cloud also makes it simpler to subscribe to (or cancel) additional modules of functionality or services, without needing to install or uninstall software. This also enables a simpler platform for third-party application development. For example, a technology or service partner can develop a custom analytic or reporting module adapted for specific user groups, and seamlessly integrate it with the EPMS or BMS applications.

Case Study: Cloud-managing thousands of Nordic sites

A cloud-hosted BMS platform is serving a variety of clients representing real estate, educational and industrial markets, and other segments. Most of the thousands of sites are managed by clients with large portfolios of small to medium-sized buildings. The solution gives each client secure browser-based remote access, monitoring, and control of their sites, with the option to add on professional services to support monitoring, analytics, and field maintenance.

Due to the many financial and operational benefits, Schneider Electric is experiencing a high demand for such cloud-based solutions in many parts of the globe (see sidebar case study).

Greater data resilience

A facility's EPMS and BMS data is safer in the cloud. Large cloud providers are investing millions every year into cybersecurity with best-in-class cloud systems designed using Secure Development Lifecycle methodologies that help ensure security is incorporated from the beginning. As noted by Microsoft, "the most reputable [cloud] providers have created many systems and controls to keep your content safe, secure and private."[3] Having data uploaded to cloud-based data storage means data will be offsite and automatically backed up, maximizing data resilience. And, whereas connected devices – such as sensors, meters, breakers, building controls, etc. – have very long lifespans of 20+ years, computers and software do not. With cloud-based computing, hardware and software is continuously updated to help ensure longevity of service.

Assured cybersecurity

A cloud-based EPMS and BMS architecture includes a continuous connection between the facility and cloud servers through a secure gateway. This connection is constantly monitored for threats by both systems and people. All virus protection and any required updates for information security will be comprehensively managed. As security patches become available, EPMS and BMS apps will be immediately updated. This can be an advantage over apps hosted on-site at facilities, for which facility IT staff may not have the time to manage updates as frequently.

Reduced IT support

Without local EPMS and BMS computers and data servers to manage and maintain, a facility will not need the time, expertise, hassle, and cost of an IT team to support such equipment.

In addition, remote data access is simplified. As noted previously, it is becoming increasingly important for facility management teams and corporate offices to have secure remote access to EPMS and BMS dashboards, alarms, and analytic views. This enables anyone, from wherever they are, to check on building performance and to resolve issues faster. Shared access also enables collaboration between facility teams and contractors.

Previously, remote EPMS and BMS access has typically been supported through Internet-connected systems, using a secure VPN connection, which can be complicated to install, setup, and monitor. This kind of connectivity requires the support of an IT team. In contrast, a cloud-hosted EPMS-BMS using modern IoT protocols makes access simpler by not requiring VPN, while still being secure. And there are typically no additional costs for this access. IoT architectures also enable the easy use of mobile technologies, including 4G and 5G today, and emerging low-power WAN technologies in the near future, to connect to the cloud which can simplify connectivity options in some installations.

[3] "Are your files secure in the cloud?," Microsoft, September 2020

Case Study: Managing energy from the cloud

A major U.S.-based healthcare corporation is using a scalable, cloud-based power management solution for multiple hospital sites. The platform is helping them uncover energy waste, identify and analyze issues requiring corrective action, accurately calculate project costs, benchmark performance, and achieve significant cost avoidance.

Increased scalability

A cloud-based platform offers greater flexibility, allowing new building sites to be quickly and easily added on demand, creating a single enterprise-wide data repository for multiple facilities (see Figure 4). This enables simple access to multiple facility views, building-to-building performance comparisons, and more. It can also help to simplify integration with external data feeds, such as weather, grid energy pricing, etc.

In addition, a cloud-based solution offers simpler, centralized user management. Appropriate role-based access rights can be given to different groups or individuals, with views and detail customized to each. For example:

- C-level personnel see enterprise-wide, multi-site performance, benchmarking, etc.
- Each facility manager and engineering team see a single-facility view
- Contractors get limited access to equipment data

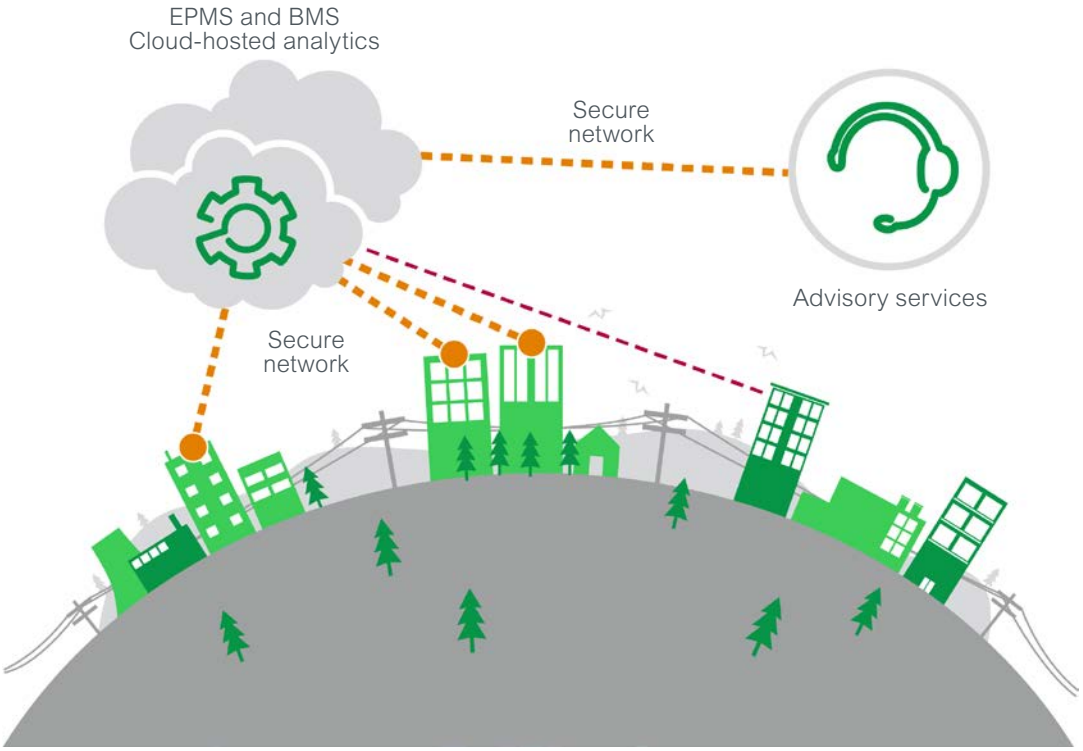

Figure 4

Cloud-based power and building management for multiple facilities.

A portal to valuable, flexible advisory services

While migrating EPMS and BMS data and functionality to the cloud offers a range of advantages for users within an organization, it also enables access to a growing range of expert advisory services. Services combine cloud-based analytic tools with teams of advisors experienced in both power and building management. Service providers can include EPMS or BMS solution vendors, electrical or mechanical engineering companies, systems integrators, electrical or HVAC contractors, or facility management services.

Such services give organizations the ability to evolve from a 'do it myself' to a 'do it for me' approach, in which a third-party services team is able to take over some of the management of the electrical distribution and HVAC infrastructures. For facility teams with limited resources or expertise, this can provide significant gains in productivity by having outside services augment internal resources. Such cloud-hosted solutions are also ideal for services firms responsible for the entire facility management requirements of an organization's portfolio of buildings. It also helps organizations get the maximum value from their power and building data, through the extended analytics, reporting, and integration offered by expert services.

Solution providers will often offer services that can be mixed and matched, depending on the needs of the organization, with the flexibility to add or change aspects of the services in future as needs change. For example, a critical facility team may wish to maintain some or all of their EPMS and BMS functionality on-site to ensure real-time responsiveness, while a remote services team takes on other responsibilities, such as more advanced power quality analysis or energy management.

Case Study: Blackstone Group, USA

The world's largest alternative investment firm, with over $311B of assets under management, is using cloud-based advisory services to help monitor energy spend across a diverse array of companies to make better estimates of investment profitability. Expert advice on energy management is also helping the firm drive more energy efficient practices, resulting in a $60M savings over 4 years.

Cost savings of advisory services

Engaging expert advisory services can be more cost-effective than employing on-site personnel for specialized tasks. Rather than having a full-time power quality expert, energy manager, or building manager on-site, hiring a 'fraction' of an expert may make more financial sense. The service provider can be hired to augment on-site staff based on the internal demand for a certain skill, without the long-term commitment of a permanent employee.

Here is one way to look at the financial benefit. The loaded labor rate of an in-house employee is on average 50% lower than the charge out rate of a third-party service provider. But, the benefit of hiring a third-party service provider is that they are specialists in the field and more efficient (i.e., higher productivity for a given task). This, in itself, can level the playing field for the higher hourly cost.

Advisory service examples

The breadth of available advisory services continues to grow. Table 2 lists only a few examples. Some or all of these may be offered as 'outcome-based' services (i.e., performance contracts) that assures specific performance levels for things like power availability, safety, energy efficiency, etc.

Table 2
Typical expert advisory services for power and building management.

Advisory Service	Description
Preventive maintenance	Perform maintenance on a regular schedule based on specifications and recommended practices for servicing equipment (e.g., replace UPS batteries every X years). Issue, assign, and manage work orders. Use automated reporting tools to perform regular required testing on generator sets. Advisory services help you keep track of your schedule, and coordinate getting service done.
Predictive maintenance	Perform condition-based monitoring, based on asset diagnostics, including self-diagnostics. This will help anticipate the failure of an asset to avoid an unplanned outage. Examples of tools used are breaker aging analytics and continuous thermal monitoring. Advisory service offers the analytics and expertise to provide insight and coordinate response with appropriate teams.
Proactive monitoring	Perform 24/7 monitoring and regular system health checks on electrical and HVAC infrastructures and all critical assets. Use analytics, alarm management and other tools to monitor building equipment performance, watch for risks, and find opportunities for cost avoidance. The advisor will then immediately consult with the facility team and coordinate any required service.
Remote assessment and monitoring	Generate comprehensive reports to give the facility team a complete picture of systems and assets, including all KPIs.
Energy and sustainability	Can include monitoring and maintenance measured against a model to alert on deviations to isolate equipment failures or performance degradation. Can also include microgrid-as-a-service, auditing, consulting, improvements, and upgrades.
Cybersecurity	Follows a comprehensive set of cybersecurity standards and best practices, going beyond the link from device-to-cloud to include risk assessment, design, and testing that bridges the entire process from concept to long-term support (e.g., patch management).

Case Study: Marriott, Greater China

As the largest hotel chain in the world, Marriott is focusing on building sustainable hotels in a rapidly expanding hospitality market in China. Scalable, cloud-based advisory services are delivering regular reporting on sustainability. This has helped the firm reduce their carbon footprint as well as achieve up to 15% in energy savings.

Case Study: Global Restaurant Chain

For one of the world's largest fast-food restaurant businesses, cloud-based monitoring and advisory services are helping drive the use of BMS for better decision making across its international stores. Services enable 24/7 energy management and refrigeration cabinet monitoring, helping protect food stock as well as supporting a pilot initiative that aims to ultimately achieve net-zero energy for all locations.

Next steps

1. Consider how new cloud-based EPMS and BMS solutions fit with the current and future goals of your business and facility operations.

2. Choose a solution partner with experience in both EPMS and BMS domains, and with industry-wide experience with similar types of organizations and facilities as your own. This will enable cross-building benchmarking against other companies and industry standards.

3. Choose a platform that offers the breadth of functionality discussed in this paper, the potential to offer a unified portal to EPMS and BMS analytics, and open integration with other applications (e.g., security, space management, etc.).

Conclusion

Digitalization of facility electrical and HVAC systems has been the first important step in helping buildings become more sustainable, resilient, hyper-efficient, and people-centric. The use of energy and power management and building management systems is critical to achieving these outcomes; however, many organizations continue to face budget and resource challenges that limit their ability to take full advantage of these solutions.

The emergence of cloud-based EPMS and BMS applications is helping organizations avoid the costs of maintaining hardware and software on-site, while opening a portal to advisory services that can augment on-site staff with 24/7 monitoring, analytic, and maintenance support. Cloud-based platforms are especially powerful for businesses that own or manage large portfolios of small and medium-sized facilities.

About the authors

Markus Hirschbold (P.Eng., CEM, PMP) is responsible for offer creation of EcoStruxure Power, the IoT-connected solutions of Schneider Electric, designed to improve every aspect of power distribution systems. He has held various key positions in R&D, Services, Power Quality, Project Management, and Offer Marketing in over two decades of tenure at Schneider Electric.

Grant Reig is the director of product management for Building Management Software at Schneider Electric Industrial Services. Grant has nearly 20 years of product management experience in both startup and large scale companies driving innovation, strategy and execution. Grant holds a bachelor's degree in Electrical Engineering from Bucknell University as well as a High Tech MBA from Northeastern University.

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