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# Unlocking Smarter Solutions for Managing the Built Environment

By George Hawkinson, Richard Wendland and Marc Petock

**The built environment is increasingly dependent on sophisticated, connected controls for heating and air conditioning, energy management, lighting and many other systems. Unfortunately, many of these controls function in silos, with little interoperability and integration. A master systems integration strategy utilizing advanced controls platforms can give owners and operators the connectivity and access to the data they need to optimize operating costs, use energy more efficiently and address the pressing need to reduce carbon emissions.**

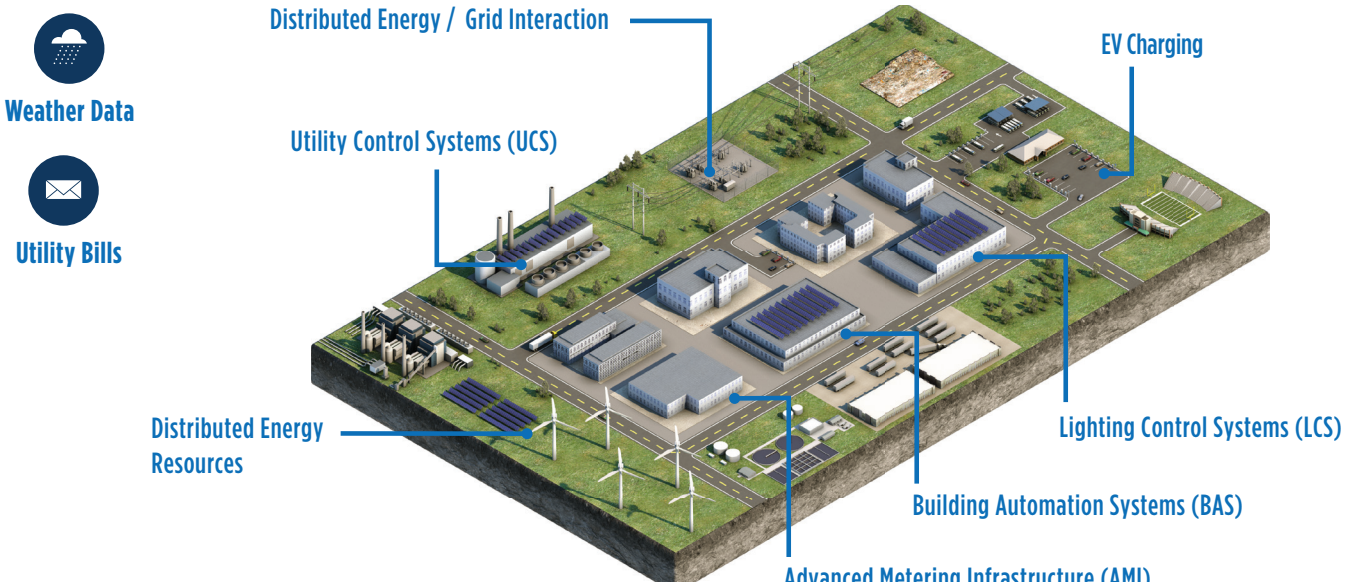
The term "big data" has been well understood for about two decades now as the amount of information generated from many sources has increased tremendously. There is no doubt that this data revolution has transformed every aspect of how companies make management decisions and operate their buildings.

Now we're in the next phase of this transformation as data is used much more effectively to manage our built environment. Rather than simply gathering staggering amounts of data from as many sources as possible, it's now imperative that the right data is gathered and then organized and defined for ease of use. Moreover, as data is increasingly relied upon for facilities management decisions, it must be checked and double-checked for accuracy and presented in a consistent and easy-to-understand format.

## The Journey From Smart to Smarter

The term "smart building" has always been subjective. A smart building is generally understood to be one outfitted with systems, sensors and devices that allow some level of automation and remote control of systems and equipment. However, it is possible to have a smart building that isn't very efficient.

Now, we're in a new era — on a journey from smart to smarter buildings, facilities and even entire campuses. With the smart building era now about 20 years old, the transition to the next era of smarter facilities and campuses is being defined by objective, quantifiable metrics aimed at demonstrating progress toward today's new imperatives of greater energy efficiency, lower operating costs and a more flexible, safer and healthier work environment with occupant comfort in mind.




Smarter facilities are enabled by more sophisticated technologies like the Niagara Framework — a proven system that is widely deployed in many buildings to help achieve the vision of making vital equipment and applications smarter. Niagara enables diverse devices and equipment to be connected, normalized and integrated so they become interoperable in a common environment and on multiple embedded platforms.

Lynxspring, a provider of building controls hardware and open-source software, is another contributor to this movement. Lynxspring provides a number of technology solutions to meet many challenges and offers a single, scalable and extensible platform that allows facility operators to achieve greater levels of efficiency, safety and peak performance. For smarter facilities, Lynxspring has a line of digital controllers that can be installed with plug-in capability, allowing operators to seamlessly control, manage and monitor equipment and systems.

The technology is only half the story, however. The entire vision can be optimized further through the commissioning discipline. Commissioning provides the human insight and expertise needed to understand whether the data being gathered, compiled and reported is accurate and consistent with the rules set by monitoring systems. This verification process also is important to be sure that applicable codes and standards are being met.

Emerging disciplines include monitoring-based commissioning (MBCx) and the evolution of retro-commissioning (RCx) to new practices and approaches. MBCx is an ongoing program that relies on setting up data aggregation and monitoring systems to give operators the visibility to see how their systems are performing in real time. An RCx program measures and analyzes the performance of equipment and systems after they have been operating for a certain number of years.

## Going Beyond Data Aggregation

A master systems integration effort addresses one of the greatest challenges facing facilities today — the inability to correctly interpret and analyze data generated by hundreds or even thousands of sensors and devices. Most equipment today is manufactured with controls technologies already embedded. Though the data may accurately reflect equipment temperatures, vibration and other performance factors, elevating that aggregated information to a layer where it resides in a format where it can be easily retrieved and interpreted is the challenge.

This challenge is compounded by the need to gain a realistic and accurate understanding of what the data is saying. Much of the embedded controls technology built into devices and equipment is able to get past this point of weakness if there is human intervention by professionals who have a solid grasp of applicable codes and standards and the ability to use that knowledge to accurately interpret what the data is telling them.

As data is aggregated, cybersecurity becomes even more vital. Systems like the Niagara Framework and Lynxspring are designed to address cybersecurity vulnerabilities caused by gaps in data connections, but human operators still must remain vigilant, monitoring any unusual activity within building systems and controls.

The technology may be the enabler, but decisions still must be made by humans with an eye toward the business impact of each course of action that may be available. The advanced technology available today is truly remarkable, but it is still only a tool. Realizing the value and benefits must come from understanding how the overall business or federal agency will benefit.

The challenges are centered around the same organizational issues — resources and people — that have always been present. Friction points such as budget shortfalls and the human inclination to resist change remain as the heavy lifts that must be accomplished to realize the potential of truly data-driven decisions.

Interconnection and Interoperability is the Key Benefit
A master systems integration bridges the gap between IT and OT. With huge volumes of data generated by thousands of sensors installed on equipment and systems, the imperative for quality and complete data has never been greater. That means sources must be connected and networked with robust defenses against potential vulnerability to cyberattacks.

The Niagara Framework is a widely accepted standard for cybersecurity and has been deployed by many federal agencies and branches of the military at bases and installations worldwide. This interconnected network lays the groundwork for interoperability that can someday lead to systems directed by artificial intelligence and machine learning (AIML) to drive predictive analytics that lead to even more efficient and optimized systems.

Interconnected and interoperable systems will help address management issues related to a shrinking and less experienced facility maintenance staff. In both the federal sector and private industry, maintenance has long been performed on preset calendars, often resulting in replacement of equipment or components before necessary. As maintenance is performed increasingly on a data-driven schedule, with analytics reporting the actual wear of filters, valves, fittings and many other items, replacements are made when actually needed, optimizing staff time and annual maintenance budgets.

## Six Value Propositions

Given the capital investments required to fund deployment of new control technologies, a return on investment must be demonstrated. These value propositions form the basis for justifying these investments:

- **Energy Efficiency**
  There is no real disagreement over the importance of more efficient energy usage in buildings as a strategy to reduce carbon emissions. In both the public and private sectors, significant capital is being invested in everything from more efficient heating, ventilation and air conditioning (HVAC) equipment to better windows, roofing systems and insulation. The next step is monitoring how the new equipment and materials are performing as measured by actual energy savings.
- **Risk Mitigation**
  With any investment, the risk of nonperformance must be addressed. Both MBCx and RCx programs will give facility owners and operators the insights they need to verify that the equipment, devices and materials that have been installed are performing at optimal levels. Both programs rely on data to establish trend lines of equipment performance, measuring any loss of efficiency. These insights help mitigate risks of equipment failure through establishing proactive maintenance schedules or timelines for equipment replacement.
- **Operational and Workplace Technology Convergence**
  In both the federal and private sectors, traditional OT systems are converging with related technology designed to optimize how building systems maintain the safety, health and comfort of its occupants. This trend has become especially important during the COVID-19 era. Both systems rely on data to identify patterns and trends, such as air quality and airflow and even predictive analytics that can be used to program setpoints for lighting and temperature controls based on occupancy levels at given times of day. Commissioning exercises are increasingly becoming part of the solution in creating setpoints for monitoring systems that could one day be controlled by AIML.
- **Cybersecurity**
  Increasingly, any system upgrade must factor in the need for enhanced cybersecurity. With new threats of attacks from cybercriminals and even adversarial nation- states seeking vulnerabilities to upload malware into operating systems, monitoring systems must reliably report data that alerts operators of any anomaly. With the installation of sophisticated platforms like Niagara Framework and Lynxspring, cybersecurity postures can be greatly enhanced.
- **Decarbonization and Net Zero**
  Though any reduction in energy usage should translate into lower carbon emissions, the need to measure and quantify actual reductions is becoming imperative. Interconnected systems that generate complete and usable data are the foundation for tracking and reporting trends in lower carbon emissions over time.

- **Maintenance Efficiency**
  Smarter data solutions are addressing the longstanding challenge of replacing equipment and components before really necessary because of preset maintenance schedules. With a dashboard reading real-time performance of indicators such as pressure differentials, for example, operators can see which systems are still within acceptable ranges, meaning the time and expense of replacement can be deferred. This can translate into significant savings, particularly if the maintenance requires a truck roll to a remote location.

## Federal Sector Leadership

In the federal arena, the Energy Act of 2020 (EA2020) is likely to serve as a catalyst for widespread transitions to master system controls. The EA2020 mandates a range of specific actions that must be taken by federal civilian agencies as well as the military to improve energy efficiency and implement a range of other initiatives that fall under the general category of sustainable practices. The sweeping scope of the EA2020 addresses energy and water efficiency improvements, reinvigorates the Better Buildings Challenge program, and advances sustainable practices on a number of fronts.

Though the act has no enforcement teeth beyond the federal sector, it is likely to foster an array of best practices that migrate to the private sector.

Data-driven solutions will be at the heart of efficiencies realized through this new federal mandate. For example, one leading element of the act is for federal facilities to develop an energy management information system (EMIS) to monitor actual levels of energy savings. Optimizing performance of HVAC systems is one obvious area the EMIS requirement will address, along with the performance of other equipment that consumes significant amounts of energy.

Automated fault detection and diagnostic (AFDD) systems are expected to serve as the foundation of an EMIS. Consisting of interconnected networks of sensors and other devices, AFDD systems feed continuing streams of data in real time to centralized controls programmed with analytics and diagnostic capabilities that let operators know if any piece of equipment is "faulting," or not performing at optimal standards. This data presents a picture of energy efficiency while also letting operators know if critical components are wearing out prematurely and needing replacement before a catastrophic failure. These programs will typically be supported by MBCx programs to provide an extra level of verifiability. In fact, MBCx receives a boost under the EA2020 because owner/operators who implement these programs can qualify for a waiver that exempts them from a requirement to perform retro-commissioning of their facilities every four years.

## Integrating Data for Marine Corps

A master systems integration performed by a Burns & McDonnell team for the U.S. Marine Corps at a large logistics and maintenance base in Georgia illustrates how better data visibility can yield numerous benefits.

Logistics Base Albany, located on 3,300 acres in a remote area of Georgia, was receiving data from hundreds of sensors installed on everything from HVAC equipment to energy meters. These controls already had Niagara Framework software embedded for connection, normalization, integration and interoperability of these pieces of equipment. However, there still was a need for a monitoring-based control system to tie all these data points together, giving base commanders the visibility they needed to determine if equipment failures were imminent or if other issues needed attention. A consolidated common-operating picture based on real-time operational data also helped commanders meet requirements to issue timely executive reports to the Pentagon that were needed for planning and budgetary decisions.

The monitoring system integrates with the Marines' open platform communications (OPC) infrastructure, feeding into a centralized display system capable of reading data, also called tags, from hundreds of endpoints. The monitoring system ingests data from endpoint sensors and now serves as the foundation for the Corps' first rules-based analytics system to identify equipment faults and provide diagnostics.

## Energy Efficiency for Defense Contractor

A recent AFDD project for a major defense systems manufacturer serves as another illustration of how better data visibility can translate into tangible benefits. A fault that indicates a piece of equipment is not performing optimally, generally means it is using more energy than necessary and that parts and components are wearing out prematurely.

Though these defense manufacturing facilities were still relatively new, the company was facing a mandate to meet rigorous new energy efficiency standards under the EA2020. Burns & McDonnell was engaged to begin the process of designing and installing an AFDD system as a first step toward a more comprehensive EMIS for all buildings on the campus.

The AFDD system will become a core element for a future campuswide EMIS, enabling a monitoring-based commissioning process that will allow all essential systems and equipment to be continuously monitored for efficiency. It is anticipated this MBCx capability will exempt the entire campus from a mandatory four-year retro-commissioning cycle that would otherwise be imposed by the EA2020.

## Two Drivers

This is an exciting time. Thanks to the convergence of technology, social imperatives and government action, we're reaching an inflection point at which owners and operators can realize the potential savings and efficiencies that can be achieved through advanced controls.

This technology did not just suddenly appear. It has existed for many years and is proven. It's really more that we've reached a position of more complete understanding, driven by two factors:

1. Owners can't put this off any longer. Carbon emissions reduction and demands for safer, healthier and more comfortable work environments are only two of many factors driving this transformation. Technology backed by the essential human element of commissioning programs will lead to unprecedented building efficiencies.
2. Owners realize that if they fail to move now, their operations may not survive.

As technology rapidly advances, the next era will be defined as one in which clear metrics will enable owners and operators to more easily understand how specific buildings or an overall campus is performing. The era of smarter buildings, facilities and campuses has arrived.

## About Burns & McDonnell

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