



Monitoring-Based Commissioning:

What's the Hype All About?

Building owners and operators face a myriad of decisions when it comes to optimizing their building's efficiency. Grand, capital projects loom large, but it's the low-hanging fruits that often result in the greatest payback over time.

As AI and IoT become increasingly integrated into the building systems repertoire, new and emerging technologies will further advance measurable efficiency goals. How will you vet each new system? Which will be fads, and which will prove to be a long-term success?

One proven strategy is building commissioning (Cx), used by many existing buildings to cut energy waste by 5 to 15% every few years in order to correct performance degradation that happens over time. Wouldn't it be ideal to prevent this degradation before it happens?

Enter: MBCx.





What is MBCx?

Monitoring-Based Commissioning, or MBCx, is a service and proactive, preventative maintenance tool that continuously improves building operations over time.

Leveraging automated fault detection and diagnostics (AFDD) software, which provides actionable information on building faults and opportunities for continued systems optimization in real-time, MBCx has been proven to:

- Reduce building energy consumption and cost, including operations and maintenance
- Improve occupant comfort
- Prolong mechanical equipment life by implementing low-cost operational improvements

I have a BAS. Isn't that enough?

A building automation system (BAS) controls the building's equipment to satisfy existing parameters. These may or may not take into consideration an equipment's optimized state. AFDD software integrates into the BAS and identifies anomalies in the operation of building equipment that aren't detected by the BAS.

What's the ROI?

Conservatively, MBCx reduces operational costs in new and existing buildings by 3 to 5% annually. Many facilities realize a savings of 10 to 20% between 6 months and 5 years.

Which buildings are best positioned for MBCx?

Owner-occupied buildings and multi-building campus systems are ideal candidates for MBCx. MBCx begins as a service with a contracted provider, with the ultimate goal of educating the onsite operations team so they adopt the AFDD software for ongoing analytics and optimization.

The Measurable Benefits of MBCx



Energy.

MBCx reduces building energy demand and consumption. Additionally, because AFDD analyzes the building's data continuously, this job is no longer required of the operations team.



Comfort.

Every 5 to 15 minutes, the AFDD software is looking at every data point in the entire building. It's ensuring that MEP systems are maintaining the desired threshold of comfortability. If a terminal box isn't maintaining a required set point, if it's over or under-shooting, the AFDD software will alert the operations team. MBCx is known to reduce HVAC-related occupancy complaints by as much as 40%.



Operations & Maintenance.

MBCx takes a proactive – not reactive – approach to O&M. MBCx can lead to a reduction in hot and cold calls, and therefore, O&M costs because the operations team is able to focus on more pressing issues.



Efficiency.

MBCx ensures a building's MEP equipment is operating at an optimized state.

Getting Started with MBCx

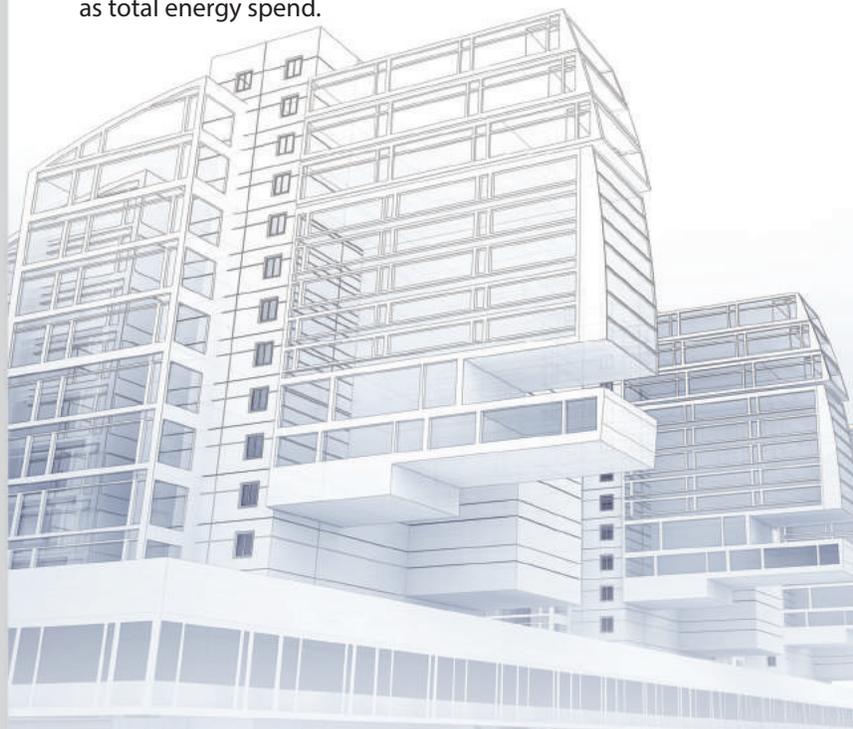
Getting started with MBCx requires three things: an engaged building operations team, a look into the local utility program to help offset costs and an understanding of the building's annual energy spend.

- **Engage the building operations team early and often.**

The facility manager, asset manager, owner and operations team are the ultimate stakeholders of MBCx adoption. Because the end goal is to train the operations team to facilitate MBCx long-term, they must be committed to taking action on identified issues. Don't waste the time and money required to set up MBCx without an operations team that can follow through on implementation.

- **Look at the local utility incentive program.** Major municipalities and others committed to energy reduction and benchmarking have programs with access to federal funds, state grants and utility incentives to offset the first costs of MBCx. Where formal programs don't exist, municipalities and utilities are usually willing to entertain a pilot program when you work with an approved MBCx service provider.

- **Understand the annual energy spend.** Your MBCx service provider will ask for the last 36 months of utility data to create an accurate baseline of building energy consumption. They'll look at both consumption and demand costs as well as total energy spend.



What is automated fault detection and diagnostics?

Automated fault detection and diagnostics is not new. It has been an area of active research in building HVAC systems for the last three decades, specifically at the Lawrence Berkeley National Laboratory (LBNL). According to LBNL, anywhere between 5 and 30% of a building's energy use is wasted due to faults and errors in operations.¹

In a qualitative model-based AFDD software system, rules are created around data. For example, if sensors are uncalibrated, then x fault is triggered. If the sensors are not reading values, then y fault is triggered. Both signal something is wrong; each containing its own unique fault.

AFDD software will automatically detect deviations from expected building operations and trigger a fault if a rule is broken. Most important, AFDD software provides a diagnosis for root cause analysis. The goal of this "smart" alarm is to pinpoint the fault and suggested resolution at the moment it's happening.

AFDD Software Considerations

As the active "ingredient" in MBCx, AFDD software overlays a facility's BAS. A vast number of AFDD providers offer both open protocol and platform-specific products. Building owners and operations personnel responsible for AFDD implementation will want to study the following considerations when choosing the right AFDD software for each facility.

Integration ■ *Is the software capable of integrating with my BAS?*

BAS systems speak dozens of proprietary protocols and languages. Ease of integration will depend on the language and flexibility of your system. Approach each one uniquely to determine how to accomplish AFDD integration successfully. Extracting the data can be difficult for older, legacy systems. Get pricing from multiple vendors, seeking out all potential avenues.

Data Mapping ■ *Is the data mapping automated or manual?*

Solutions that feature automated data mapping can reduce first costs significantly. Conversely, if the data mapping is manual, then the first cost will be increased. With thousands of data points across a facility, those that are already correctly named in the BAS can utilize the same naming conventions in the AFDD software. If back-of-house naming conventions are not in order, automated data mapping won't help, and all data points will have to be identified, including their points of origin.

Customized AFDD ■ *Can users create customized fault rules?*

Some AFDD solutions have standard black box rules. Yet the biggest benefit comes with the ability to customize its points. With customizable AFDD software, engineers will review the building's designed sequence of operations and create rules around them. When something changes and equipment is operating out of the "rules" created for it, a fault will be generated. Remember, when the sequence of operations changes, the rule needs to change as well. For example, if the space function changes, i.e. a variable speed drive is added to a motor, or VFD systems are upgraded, rules should be changed to match the new sequence of operations. In another example, if lease negotiations change for operating set points, i.e. the building lease says it operates at 71-73°F year round, and the lease agreement changes to operate at 73-75°F, the fault rules must change accordingly as well.

Reporting Functionality ■ *How are reports and diagnostics generated and who are they sent to?*

Some software will provide the ability to customize reports, some will only offer standard reports. Consider who

¹ Granderson J, et al. 2018. Commercial Fault Detection and Diagnostics Tools: What They Offer, How They Differ, and What's Still Needed. Lawrence Berkeley National Laboratory. LBNL Report Number 10.20357/B7V88H

within the organization needs to see the data collected and faults generated when creating key performance indicators, or KPIs. The CFO may want certain reports, the operations manager others. Ask: How is the information delivered to the end user? What level of customization is desired?

Prioritization ■ *Does the solution provide a good work flow to manage actionable data?*

The ideal solution for your facility needs to be able to prioritize your most important items from an operations and energy efficiency standpoint. Building operators need to see actionable data and manage it accordingly. What is available will depend on the flexibility of the AFDD tool. If you care most about comfortability, for example, then you can set that to be a critical rule. Some software options will allow prioritization and some will feature automated prioritization without taking into consideration user input.

Security ■ *Can the software vendor adhere to your IT security requirements?*

Your AFDD system will either be cloud-based, or internal to your building, without the ability to access it remotely. Make sure you work with software vendors to keep IT systems security a top priority. The AFDD software will be tied to the BAS network. Some BAS networks are tied to the company's network, some are separate. Companies in tune with current cyber risks will have a separate network for their BAS.

Pricing Model ■ *One time purchase, SAAS model, maintenance fees included, etc.?*

AFDD software is usually SAAS model based, with licensing renewal required each year. Pricing is based on square footage of the facility, ranging anywhere from \$10K-\$150K. In this case, just because a solution is more expensive, doesn't mean it's a superior product. In fact, there are a few cost effective solutions that are more advanced than their costly competitors.

It's also important to consider the three-fold, total cost of MBCx: the cost of the AFDD software, the MBCx service provider and the implementation of ongoing changes by a contractor. While low hanging fruits, or operational changes with less than an 18-month payback, are recommended and the ROI is typically only between six months and five years, MBCx engagement can carry a high first cost.

Data Ownership ■ *Client, vendor or service provider owned?*

Typically, both the software provider and the building owner/operator both maintain access to the AFDD data. The building owner needs to understand this. There are few new AFDD solutions for building owners who do not want software providers to have data access.

Additional Features ■ *What additional features are offered to compliment the AFDD?*

Ancillary items can be added to a facility's software program, including meter analytics, automated system optimization and resolution cost.

The Next Frontier

Research has shown that MBCx, with its ability to leverage AFDD software and smart analytics, is key to getting ahead of operational errors and faults through detection, a function that ultimately leads to a reduction in building energy consumption and cost, an improvement in occupancy comfort and prolonged mechanical equipment life.

As the natural next step in a building's leap toward intelligence, MBCx is the ideal vehicle to pick the low hanging fruits continually that will keep your building in an optimal state for as long as possible.

Case Study I



Kerry Ingredients, Inc.

Beloit, WI | 320,000-sq.-ft. | Completion: March 2019

7% annual energy savings:

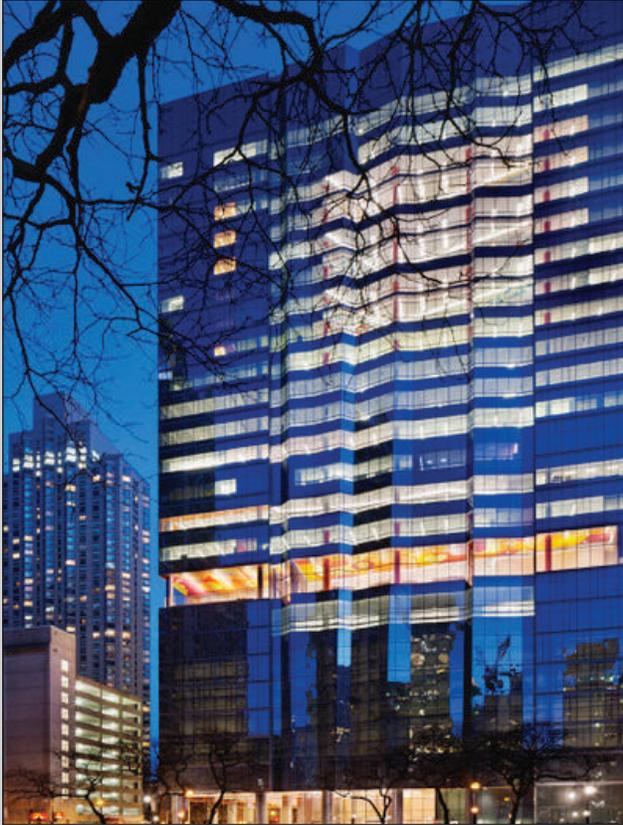
- 1,044,307 kWh
- 136,213 therms of natural gas
- \$171,172 energy costs

Payback timeline: 0.45 years

Kerry Ingredients, Inc., a global public food company, engaged MBCx in their Beloit, WI-based North American HQ – a mixed-use facility featuring office, food processing and distribution spaces. Kerry's unique space required custom MBCx, a challenge ESD was game for. ESD's MBCx team partnered with CopperTree Analytics to apply an AFDD software solution designed to continually monitor operational anomalies, deviations from optimal conditions and opportunities to improve energy or operational/maintenance efficiency in real-time. ESD oversaw the implementation of MBCx, providing continued and increased visibility into measures, and ultimately delivering an annual savings of: 1,044,307 kWh, 136,213 therms of natural gas and \$171,172 in energy costs. Kerry Ingredients leveraged a local Focus on Energy utility program – a first MBCx project for the utility – which offset nearly 40% of the project's costs.



Case Study II



Shirley Ryan AbilityLab

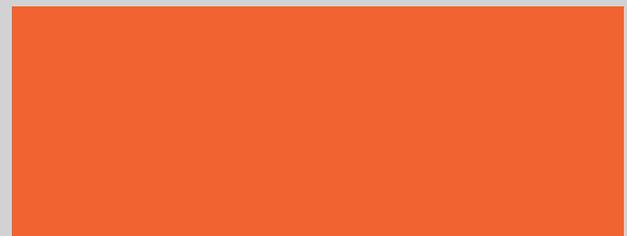
Chicago, IL | 1,200,000-sq.-ft. | Completion: March 2019

6% overall annual energy savings with:

- 1,253,621 kWh
- 101,830 therms of natural gas
- \$116,573 energy costs

Payback timeline: 6 months

Shirley Ryan AbilityLab, Chicago's leading rehabilitation research hospital, is one of the first in the country to demonstrate success when MBCx is applied to new construction. Just six months after the facility was built, Shirley Ryan engaged ESD in an 18-month project to achieve the following: increased efficiency of MEP operations; enhanced occupant comfort; reduced operations and maintenance costs and reduced energy demand and cost. Being a newly-constructed building made this both a challenge and a unique success. AFDD software was customized to identify potential energy and operational improvements of which ESD provided the data analysis, implementation oversight and measurement and verification required. The result was a 6% annual energy savings, including: 1,253,621 kWh, 101,830 therms of natural gas and \$116,573 in energy costs. Shirley Ryan's MBCx program is a first for the local ComEd Energy Efficiency Program. The resulting efficiencies demonstrated that there is still potential to improve operations in a new building.



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