MONITOR-BASED COMMISSIONING (MBCX)

A Whitepaper

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Monitor-Based Commissioning: A Whitepaper

BACKGROUND

The term commissioning comes from shipbuilding. A commissioned ship is one deemed ready for service. Before being awarded this title, however, a ship must pass several milestones. Equipment is installed and tested, problems are identified and corrected, and the prospective crew is extensively trained. A commissioned ship is one whose materials, systems, and staff have successfully completed a thorough quality assurance process.

Building commissioning is applying this thorough, systematic testing to new buildings. When a building is initially commissioned it undergoes an intensive quality assurance process that begins during design and continues through construction, occupancy, and operations. Commissioning ensures that the new building operates initially as the owner intended and that building staff are prepared to operate and maintain its systems and equipment.[i]

Monitor-based commissioning (MBCx) is the continuous application of the commissioning process to a building or energy system. MBCx is a sophisticated, web-based platform that combines building data from a wide variety of sources to better manage building performance and efficiency. MBCx is implemented via software tools that compile and analyze real-time building energy system data, identify performance issues, assist with equipment commissioning, and optimize system operations.[ii]

Definitions

Commissioning: A systematic process of ensuring that all building systems perform interactively according to the design intent and the Owner's operational needs. The process evaluates building equipment, subsystems, operation and maintenance (O&M) procedures, and performance of all building components to ensure that they function efficiently, and as designed, as a system. Single instance commissioning typically occurs with a newly constructed building or major building addition and is applied from project inception to initial occupancy.

Retro-commissioning (RCx): Retro-commissioning is a form of commissioning that is applied to buildings that have either not been commissioned or have been previously commissioned but have since been modified or reprogrammed without additional commissioning. It basically baselines the building again looking at all elements of the building improving the overall operation and maintenance of the building. This may be needed when buildings are adapted, additions are made, and/or considerable time has passed. Retro-commissioning may resolve problems that occurred during design or constructions and bring the building back to its original or desired performance. RCx is the starting point for the building improvement process.

Recommissioning: Recommissioning is another type of commissioning that occurs when a building that has already been commissioned undergoes another commissioning process. The decision to recommission may be triggered by a change in building use or ownership, the onset of operational problems, or some other need. Ideally, a plan for recommissioning is established as part of a new building's original commissioning process or an existing building's retro-commissioning process.

Monitor-Based Commissioning: Advanced testing that uses AI-based technology to focus on building operations, energy performance, and end-user comfort. This approach can immediately alert to deficiencies and/or proactive prevent them.

APPLICATIONS

Monitor-Based Commissioning (MBCx) occurs during or after a building has been commissioned or retro-commissioned. Once a building has been physically and systematically set to its optimal performance, MBCx enables that building to continue to operate at an optimal level, while simultaneously testing and monitoring for deficiencies and failures, as well as proactively providing feedback to prevent deficiencies and/or failures.

When MBCx is integrated as part of a continuous building improvement process, it accesses and analyzes data from multiple sources to identify faults or issues. It then prioritizes those deficiencies and helps identify resolution paths.

Utilizing MBCx can be an effective method to sustain performance gained from energy conservation measures (ECMs), keep energy consumption low, and minimize system problems that may be caused by performance deterioration and changes to building operations over time.

TIMING

To use MBCx as a tool to measure specific metrics, a baseline of performance must be established in order for MBCx to be implemented.

The most proactive programs commission their buildings continuously (ongoing commissioning or monitor-based commissioning), using and trending data from their building management systems, installed meters and sensors, and even utility data. In these cases, commissioning never really stops, as analysis is conducted continually to detect impending failures, abnormalities, and efficiency opportunities.

COMMON PROBLEMS IDENTIFIED BY MONITOR-BASED COMMISSIONING

- Electric and gas meters with inefficient nighttime operation
- Simultaneous heating and cooling
- Excessive lighting
- Temperature sensors with faulty thermostats
- Broken VAV actuators on air dampers and hot water valves
- Non-delivery of chilled water
- Unnecessary chiller operation due to disabled chiller lockout
- Manual overrides (equipment/setpoints not modulating)
- Systems running outside of operating hours

TYPICAL ACTIVITIES

Monitor-Based Commissioning has two elements: the initial system set-up and the ongoing monitoring.

Turnkey System Set-Up

- Analytics Engine setup
- Name mapping [aliasing]
- Relationship mapping [hierarchies]
- Custom equipment performance tests
- Custom cloud-based analysis service
- Fault detection capabilities
- Energy impact summary
- Occupant comfort impact summary
- Fully customizable testing configuration
- On-site or cloud-based solution with email reporting
- Custom integration into building systems for active feedback

Ongoing System Monitoring

Systems

- Test and inspection of all alarms for critical items
- Verification of point mapping
- Schedule review and adjustment
- Alarm and trend review
- Graphic review

Equipment

- Test network continuity
- Review onboard operating system function
- Firmware revisions and security patches
- Onsite / offsite data backups
- System maintenance and updates

Reporting

- Provide regular reporting of all controllers and devices evaluated
- Provide regular corrective action report for system deficiencies

ENERGY SAVINGS

Typically, MBCx customers can achieve 7 - 15% energy savings from three primary sources of improvement:

- Savings from persistence and optimization of savings from RCx thanks to early identification of recurring problems through metering and trending. Several studies have shown that RCx savings can degrade without an explicit effort to monitor and maintain them.
- Savings from measures identified through metering and trending during the initial commissioning effort i.e., measures unlikely to be found from traditional testing methods alone, such as poor control of chilled water distribution to air handlers, unnecessary chiller operation due to disabled chiller lockout, and poor VAV zone control due to inoperative actuators on air dampers and hot water valves.
- Continually identified new measures. With continuous monitoring, MBCx can identify new problems that emerge after the initial retro-commissioning investigation stage, such as inefficiency initiated by change in building use, addition of new systems or processes, and changes in functional requirements that affect energy systems.

These savings estimates are in alignment with findings from several industry studies:

- A meta-analysis of three decades of studies for MBCx demonstrated a 9% median whole-building savings.[iii]
- A paper published by the Lawrence Berkeley National Laboratory (2019) calculated an 8% median site energy savings based on data from 550 buildings where MBCx was implemented and a median simple payback of 3.2 years for 52 utility sponsored MBCx projects.[iv]
- Pacific Northwest National Lab Retuning program reported 15% median energy savings across 24 projects.[v]
- GSA's MBCx program demonstrated a 15.9% whole-building energy savings.[vi]

OPERATIONAL SAVINGS

Beyond energy efficiency, MBCx is most valuable for the operational efficiency it delivers.

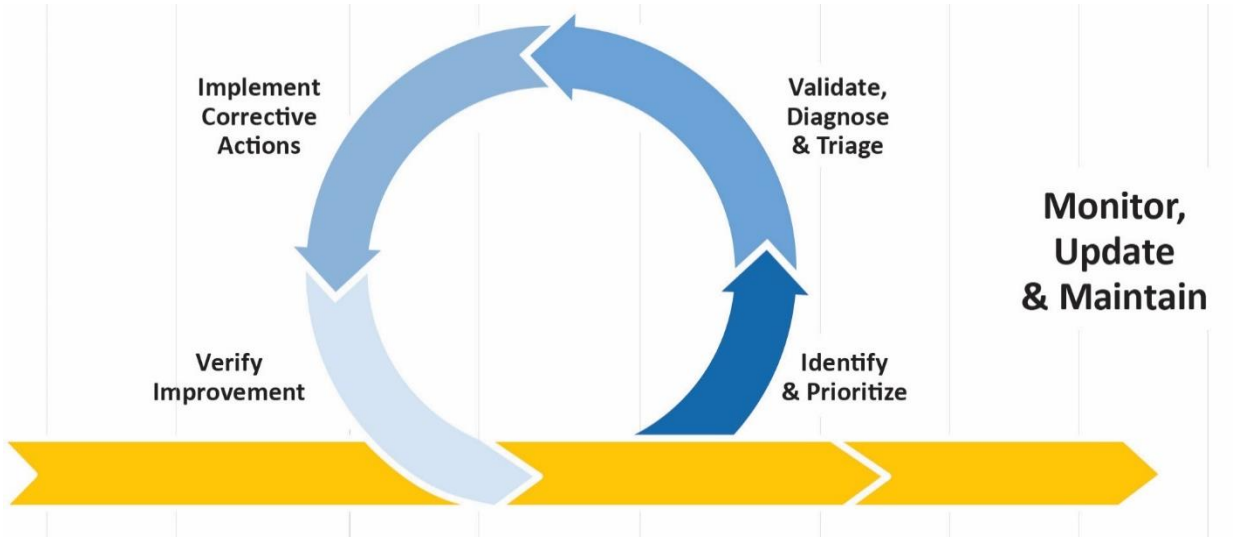
- **Saves Time.** MBCx allows facility managers to evaluate the performance of their building systems using a robust scoring and prioritization system for the millions of data points streaming through a facility. Through the MBCx platform, facility managers see trends in energy use, diagnose problems, and discover savings opportunities both immediately and long term.
- **Minimizes Downtime**. MBCx immediately alerts for anomalies thereby minimizing /preventing downtime.
- **Prevents Problems**. Because MBCx identifies anomalies, it can proactively identify potential problems, so issues can be resolved before they occur.
- **Extends Equipment Life.** By establishing baseline performance, MBCx alerts to lower-performing equipment and can connect with third-party systems to issue maintenance / service tickets.
- **Focuses Resources**. MBCx enables a single pane of glass view that highlights the poorest performing devices and ranks the performance of all buildings, so that efforts can be prioritized.

OTHER BENEFITS

- Improve occupant comfort and productivity
- Customized process testing for critical functions
- Continual monitoring of all equipment 24/7/365
- Plan for and dispatch maintenance and repairs
- Gain visibility for capital planning
- Develop a gateway to machine learning and automated intelligence
- Optimize facility performance over time

PROCESS

MBCx leverages existing organizational data points and standard operating procedures, while also creating additional operational processes that detail how the onsite staff and MBCx operations team will review the MBCx reports, dashboards, and RCx faults for improvement opportunities, take action to implement the improvements, verify that the improvements were successful, and communicate the results to key stakeholders.[vii] Additionally, the MBCx software is flexible enough to be reconfigured to address the current needs of the everchanging state of the building.



Identify and Prioritize
The MBCx software is used to identify improvement opportunities, which are compiled in a tracking system and prioritized based on qualitative or quantitative metrics such as calculated energy savings, operational/occupant impact, and criticality. When the MBCx software platform is first rolled out, this process of identification and prioritization is typically led by the subcontractor responsible for installation and deployment of the platform.

Validate, Diagnose, and Triage
The MBCx provider then uses the platform and underlying systems to confirm the validity of improvement opportunities, determine root causes, and triage into implementation categories.

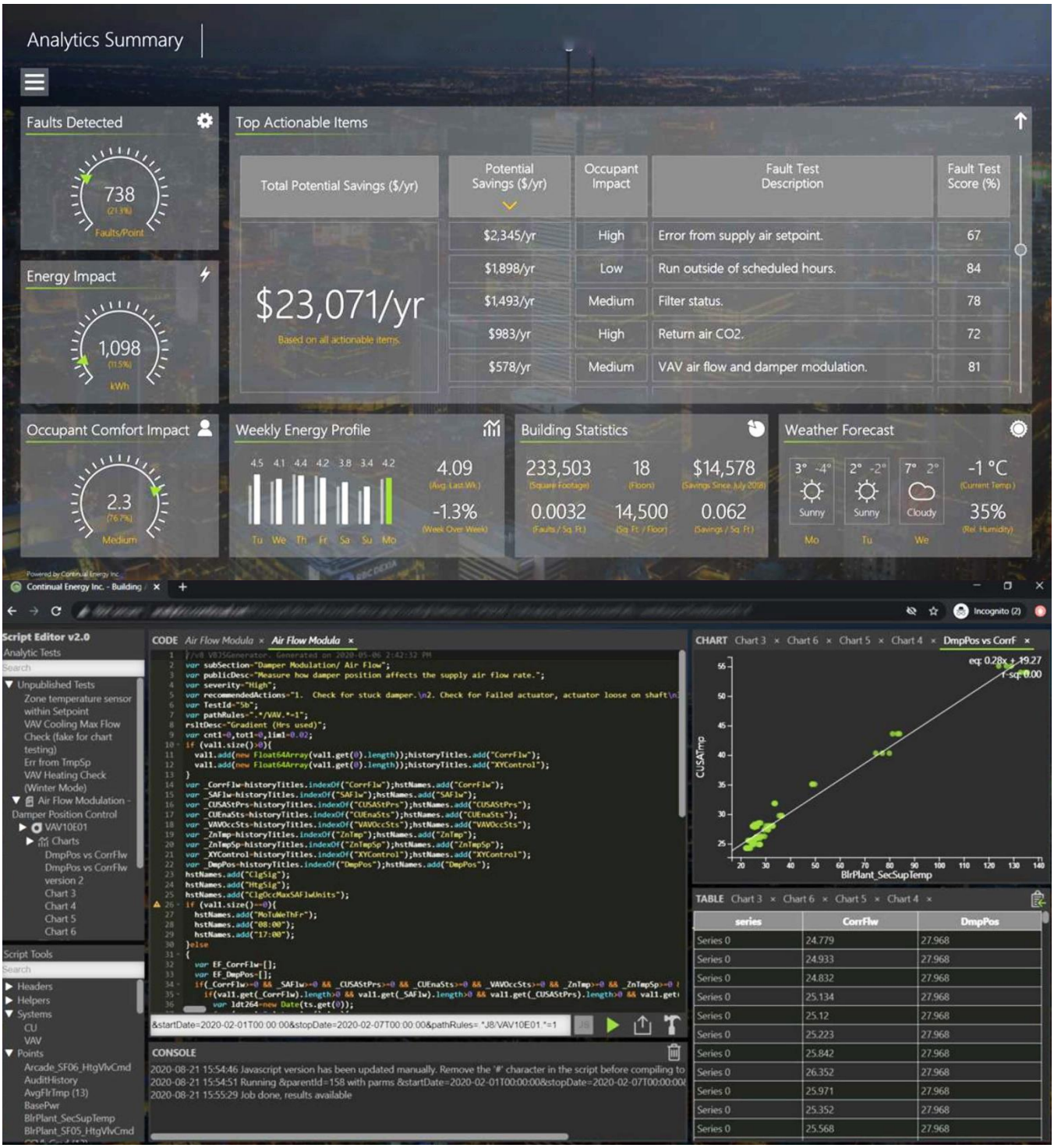
Implement Corrective Actions
Selected improvement opportunities are implemented. The MBCx provider develops recommendations for the steps to complete implementation and the MBCx provider or customer representative is responsible for ensuring implemented measures are functioning as designed via the MBCx platform.

Verify Improvement
Once measures are implemented, the MBCx provider uses the platform to verify energy and cost savings. M&V capabilities can be used to automatically or manually quantify energy and cost savings and create savings reports.

Monitor, Update, and Maintain
While the process steps above are typically executed at weekly, monthly, or quarterly intervals, ongoing monitoring, updates, and maintenance tasks support the overall MBCx process. The organization should keep team members trained on the MBCx process with a focus on how to interpret the information.

REPORTING EXAMPLES

Physical deliverables within the monitor-based commissioning program reside within the MBCx software platform and manifest as highly customizable dashboards, testing, and reports.



REBATE PROGRAMS

Rebate programs vary based on the specific utility company. Customers should reach out to their specific utility company or check the utility company website for rebate program guidelines and requirements.

SOURCES

CM3 Building Solutions: Optimization Services Team

[i] Haasl, T., and K. Heinemeier. 2006. "California Commissioning Guide: New Buildings" and "California Commissioning Guide: Existing Buildings". California Commissioning Collaborative.
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[vii] Energy.Gov, July 2021. “Enhancing Performance Contracts with Monitor-Based Commissioning.”