

Existing Building Commissioning Helps Ensure Facilities Are Performing as Designed

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Introduction

Each year, the arrival of spring brings to mind the task of spring cleaning. This periodic process of clearing away clutter, fixing broken items and getting rid of dust and grime provides the feeling of bringing a living space back to its original order and design. Just as homeowners benefit from this recurring cycle of evaluation and improvement, so, too, can building owners and managers follow a similar process for commercial buildings and facilities to help ensure a building environment is meeting current needs.

With increasing pressure to drive down costs, eliminate waste and improve customer satisfaction, commissioning is even more viable as a tool for the building professional.

The existing building environment directly and indirectly impacts the health, safety and productivity of occupants and operations, which makes the performance of a facility an important consideration. At a time when many building owners and managers are faced with higher expectations and fewer resources, making smart investments of time and funds to improve and ensure the “health” of a building is more relevant than ever.

The basic underlying principle of building commissioning is just that - testing and inspecting systems, equipment, operations and controls to make certain they are working optimally, both in terms of effect and costs to achieve that effect.

There are various types of commissioning, and numerous terms used to describe these

evaluation processes. Commissioning often refers to the thorough quality assurance process that happens with new buildings. Existing building commissioning (EBCx) - often referred to as retrocommissioning - involves going through the existing building systems and checking functionality in order to bring systems to an optimized state based on current key performance indicators. Unlike ongoing or monitoring-based commissioning, this systematic process has a defined start and end. The project and process variations of existing building commissioning are aimed at making sure equipment and systems perform together effectively and efficiently to meet operating requirements and expectations.

Conducting a retrocommissioning project allows for a controlled, often lower cost of entry, with the results often solidified and extended by implementing the same principles on an ongoing basis.

For many, this is not news. Retrocommissioning has been around for more than two decades and much has been written about the process, the paybacks and the best practices. However, with increasing pressure in ever more competitive markets to drive down costs, eliminate waste and improve customer satisfaction, commissioning (and specifically retrocommissioning) is even more viable and worth re-examining as a tool for the building professional.

Reasons to consider existing building commissioning

While retrocommissioning is a process designed to optimize the existing building or building operations for the current uses of the building, it often results in both direct and indirect benefits.

The impact on energy costs is often the first benefit discussed, and for good reason. The process helps find and eliminate waste in the building, which can result in lower utility bills and reduced greenhouse gas emissions. Based



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on studies of large groups of buildings, retrocommissioning typically costs about 30 cents per square foot and results in average energy cost reductions in the 16 percent range. Buildings that have 24/7 operations see even higher returns, according to a 2009 study of 643 buildings by Lawrence Berkeley National Laboratories. Payback for the investigation and implementation is typically less than two years and often less than one year.

Commercial buildings represent just under one-fifth of U.S. energy consumption, with office space, retail space and educational facilities making up about half of commercial sector energy consumption, according to the U.S. Department of Energy. Reducing greenhouse gases by even 10 percent in commercial and industrial buildings would result in an estimated \$20 billion in savings and reduced greenhouse gases equal to the emissions from 30 million vehicles, according to the EPA.

Improving energy efficiency and reducing emissions are issues that building owners will increasingly face, as more municipalities and states incorporate energy efficiency goals and reporting requirements against benchmarks into building codes and other regulations.

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Other benefits of a successful retrocommissioning process can go beyond direct benefits such as reduced energy costs. Building owners and managers also can see reduced maintenance costs, fewer trouble calls, and extended building and equipment life. The most dramatic impacts - and the hardest to quantify - come from improving work environment factors such as ventilation, indoor air quality and environmental comfort.

Today's advantage over earlier practitioners is the growing body of knowledge that demonstrates and sets ranges on

expectations of these benefits. Getting the temperature in the "right" range for workers showed a better than 40 percent error reduction and 150 percent output increase, measured by data on typing tasks.¹ Daylighting - sometimes just a function of opening blinds or repairing blinds so they can open - has been correlated with a 15 percent increase in productivity.² Proper ventilation may increase productivity by as much as 11 percent.³

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Although the energy impact remains the easiest to measure quantitatively and is often enough to justify the investment in existing building commissioning, the impact of the building environment is difficult to dismiss in the context of organizational purpose and metrics.

Study the return on investment

Some building owners may feel they don't have the time, resources or funding to undertake an existing building commissioning. However, they should consider the additional time, resources and money they may be spending on maintenance, energy costs and lost productivity when a retrocommissioning process is not completed.

A real-world example that illustrates the potential for retrocommissioning success can be found in Minnesota's Public Buildings Enhanced Energy Efficiency Program. The program launched in 2009 to offer retrocommissioning services to all state-owned facilities to support the state goal of a 1.5 percent annual reduction in energy use in buildings. The Minnesota program provided resources focused on solving problems in existing buildings and improving building performance and occupant comfort.

The centerpiece of the program was an energy investigation similar to a level-three American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

1 As found in a 2004 ergonomics study conducted by researchers from Cornell University: <http://www.news.cornell.edu/stories/2004/10/warmoffices-linked-fewer-typing-errors-higher-productivity>

2 According to research from the Lighting Research Center at Rensselaer Polytechnic Institute: <http://www.lrc.rpi.edu/resources/newsroom/pdf/2003/Daylighting&productivity.pdf>

3 According to a series of case studies on the impact of natural ventilation on productivity: <http://www.scribd.com/doc/91899/Natural-Ventilation>

audit. On a moderate-to large-sized building of a few hundred thousand square feet, such a study results in a few million data points about the building.

Energy savings for buildings in the program averaged 7.3 percent, and were as high as 27 percent in some facilities. Since the program launched, organizers also noted a behavioral change; program results show that facilities where tenants were engaged in the effort saved more money in energy costs. The entire pool of buildings studied, which was about 30 million square feet, now uses about 15 percent less energy than in 2009.

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The persistence of savings that can result from existing building commissioning is within the control of building owners and managers, because regular feedback and monitoring helps ensure continued performance. The more the results and benchmarks are monitored and the plan followed up on - and the more the stakeholders are engaged in the findings and solutions - the more successful a project is likely to be.

Another factor to consider when calculating the return on investment is the incentive programs and financing for retrocommissioning offered by many government entities and most major utility providers. Such programs can help pay for at least part of the process for an existing building commissioning. Online resources and tools also are available to help get the process started and

find financial incentives. The website dsireusa.org is one such site to check for resources or guidance.

Analyze which buildings are well-suited for retrocommissioning

In many situations, especially with large building portfolios, it's important to triage the buildings to know which ones may provide the greatest return on investment through a retrocommissioning process. Ideally, benchmarking the energy performance of the numerous buildings in a portfolio will precede any retrocommissioning effort, to help identify the largest energy consumers and worst-performing facilities. Interval energy meter data continues to become more accessible and can reveal even more insight than benchmarking from utility bills early in the planning process.

Other issues to consider are the age and condition of the building and its equipment, any existing known comfort problems, utility costs and the availability of energy incentive programs.

Indicators that a building is a good candidate for retrocommissioning include: an unjustified high energy use index or unexplained increases in energy consumption; persistent or premature failure of building equipment or control systems that require additional maintenance; and excessive occupant complaints about temperature, airflow or comfort.

Existing building commissioning may not solve all of the issues, but the process will likely be the most cost-effective first step for facilities where most of the equipment or systems are outdated or at the end of their useful life and need to be replaced. Whether the facility will continue to be used for its current purpose in the coming few years is another question to consider.

Re-engaging in existing building commissioning every three to five years is often the time period



recommended for best effect. Alternatively, when the purpose or use of the building or the interior spaces changes, getting the environment right from the beginning is recommended best practice.

Tips for successful existing building commissioning

There is a large body of work describing existing building commissioning processes and practices. Sources range from the Building Commissioning Association to the Federal Energy Management Program (FEMP) to Portland Energy Conservation Incorporated (PECI). The consensus devolves to four main phases that help produce successful outcomes: planning, investigation, implementation and hand-off.

The planning phase starts with selecting the facility or project and defining the project objectives. Assembling a retrocommissioning team, documenting current operating conditions and requirements, and any initial site walk-through also happen in the planning phase.

Gathering data that is as granular as reasonably possible will help focus the effort in this phase. Most building automation systems (BAS) can provide a wealth of information about system performance to help define the biggest problem areas in a building. Utility providers often have data much more granular than the utility bill, and operations and maintenance summaries and staff interviews can be key to understanding existing operations and challenges. This information helps in developing the retrocommissioning plan and determining which systems to examine to what degree and with what expectations of performance.

The next step is the investigation phase. This involves reviewing facility documentation, performing diagnostic monitoring and functional tests, and also performing simple repairs that can be done without a large investment. The information from these tests and reviews can be



used to develop a master list of findings, followed by prioritization and selection of the operational improvements to be conducted or deselected for the next phase: implementation.

The implementation phase starts with development of the plan for performing the actions selected from the investigation phase, followed by implementation of the selected improvements. Verifying the results of the implementation is also important to the process.

The final step - the hand-off phase - includes developing a final report and compiling a systems manual. Providing training for building maintenance and operations staff helps ensure the initial improvements and possible savings will persist after the project is completed. Monitoring and verifying the results will help document energy savings and provide the basis and support for establishing a regular schedule for existing building commissioning follow-up.

Making the benefits last

The value of existing building commissioning has been demonstrated again and again, but a common stumbling block for many building owners and managers is failure to actually take action once planning and investigation is complete. Often, this inaction is a result of a lack of institutional support or resources - including time, personnel or funding.

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Building top-down support for the process within the organization helps make continued follow-up more likely. Measuring the improvements, and making sure they are empirical and objective, is another key to realizing the continued benefits of the process.

A transparent process that is continually visible also contributes to regular monitoring and helps positively impact the level of stakeholder buy-in and participation. Such visibility can be had for a low investment, such as posters, banners or social media promotion, but have a large impact on increasing stakeholder buy-in.

Continued monitoring is made easier with available technology that may not even require being on-site to gather data. Energy dashboards and data analytic tools can provide information on exactly which systems are not falling in line with the plan.

Using the recommended process and following up with continued monitoring and stakeholder participation can enhance the results of existing building commissioning. The process remains a viable tool - even more relevant in today's environment - that can help business owners and managers set and achieve key performance indicators for expected operations and, in the process, improve occupant comfort and reduce energy usage and costs.

About the Author

Terry Bickham is currently serving as an Energy Services and Solutions Consultant at Trane/Ingersoll Rand. Over the last three decades he has driven success with start to finish energy projects in leadership roles for both technical/operations programs and teams. Focused around energy and operational performance, his experience spans business development, sales support, project engineering, offer development, financial modeling, risk management, client relationship excellence, construction and commissioning as well as continuing operations management. Engagements have spanned industrial, food and beverage, healthcare, K-12, institutional, government and other sectors. He has been both an internal resource as a corporate energy manager overseeing 36 plants in four countries and helped clients through design build own operate (DBOO), performance contracting, existing building commissioning (EBCx), service contracts, new construction and retrofit projects.

Bickham has been the national services director for an energy services company, an energy engineer and trainer with a number of firms, as well as energy manager for a multi-national plastics firm. He holds a degree in engineering from the U.S. Naval Academy.



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