www.burnsmcd.com

Retro-Commissioning: Why, When and How?

WHITE PAPER

Authors:

Brian Lindstrom, PE, DCEP
National Director of Commissioning
Burns & McDonnell
210 S. Clark St., Suite 2235
Chicago, IL 64114
312-608-9826
blindstrom@burnsmcd.com

David Meyers, AIA, CxA, PMP, LEED AP
Manager of Commissioning
Burns & McDonnell
425 S. Woods Mill Rd.,
Suite 300
Chesterfield, MO 63017
314-682-1500
dcmeyers@burnsmcd.com

If you are the owner or a facility manager of a building that was not originally commissioned, efficiency issues with your facility will cost you a significant amount every year in lost energy and sub-optimal building performance. That waste is permanent — and unnecessary. Fortunately, the retro-commissioning (RCx) process provides a path to resolve these issues and produce a return that pays for itself.

Do you remember the television show, "The Six Million Dollar Man"? It was about a pilot who barely survives a devastating plane crash. His mangled body is rebuilt using cutting-edge technology. He emerges "better, stronger and faster" than he was before. The series follows him on death-defying adventures using the abilities granted by his new bionic implants. RCx enhances your existing building in the same way: making its systems more efficient and reliable. It is part of a continuum of processes that optimize a building's systems throughout its life cycle, from the design phase onward. These processes include:

New construction commissioning — This begins when the building is just an idea, a drawing or a schematic and is typically just called commissioning (Cx). It is a systematic process of verifying and documenting that a facility and all of its systems and assemblies are planned, designed, installed, tested, operated and maintained to meet the owner's project requirements (OPR). Ideally, the commissioning process begins in pre-design, continues into the warranty period for a minimum of one year after construction, and ensures operations personnel are properly prepared.

Recommissioning — Also known as ongoing Cx. The Cx process is repeated after a project has been commissioned previously. This may be a preferable option as system performance drifts and/or technologies change and advance over time, making it possible to restore the efficiency of a previously commissioned building and potentially enhance optimization further.

Retro-commissioning — When the Cx process begins after a building has been built but has not been commissioned, a building's processes and systems are tested and tuned to perform optimally for the current facility requirements. Low-cost and no-cost improvements such as energy conservation measures or reliability enhancements are also recommended, implemented and then commissioned to ensure proper performance.

Monitoring-based commissioning — Innovative commissioning techniques combined with new technology integrate energy management, utility and building automation data with analytical and diagnostic algorithms that identify actual energy savings and performance enhancement opportunities in real time and in an ongoing basis. MBCx seeks to resolve performance issues as they surface and continually refine facilities so that greater than design performance — technical potential — is achieved over time.

Retro-Commissioning: Why, When and How?

WHITE PAPER

Commissioning first gained prominence in the late 1970s and early 1980s. The Walt Disney Co. included commissioning in the design, construction and startup of Epcot Center in 1981. In 1984, the University of Wisconsin-Madison began to offer classes in commissioning, and in 1989, the University of Michigan established a commissioning group as part of its institution. And in 1994, Executive Order 12902 established that a commissioning program is required for all federal agency buildings. Commissioning has become an integral piece of sustainable building practice, and some level of functional commissioning is required for a building to attain Leadership in Energy and Environmental Design (LEED) certification from the U.S. Green Building Council.

Why Retro-Commission?

RCx generates a monetary and emotional return on investment through the energy savings, increased reliability and decreased liability that accompanies the optimization of an existing building's processes, assemblies and equipment. Once the energy savings begin to be realized, there is a payback period that represents the amount of time before retro-commissioning pays for itself and begins to produce a return.

A study published by the Lawrence Berkeley National Laboratory in 2004 called "The Cost-Effectiveness of Commercial Building Commissioning: A Meta-Analysis of Existing Buildings and New Construction in the United States" found that the payback period for a retro-commissioning project is normally no greater than two years and is sometimes less than a year. The value of retro-commissioning in terms of energy savings is typically between 11 cents and 72 cents per square foot. The value in terms of non-energy savings is typically 10 cents to 45 cents per square foot. Non-energy savings opportunities include the extended life of building equipment, improved occupant productivity, improved safety and reduced liability, first-cost reductions, and fewer change orders and warranty claims. If your facility has 100,000 square feet, retro-commissioning creates an opportunity to produce up to of $117,000 in combined energy and non-energy savings.

When Retro-Commissioning Pays Off

The study aggregated the results of RCx for 100 buildings and found that the resulting electricity savings ranged from 5 percent to 15 percent; gas savings ranged from 1 percent to 23 percent. The dollar amount of savings had a median of $45,000 and went as high as $1.8 million. The payback period for these results ranged from 0.2 to 2.1 years. Larger buildings tend to have shorter payback periods, especially buildings with more than 100,000 square feet. Payback periods are also shorter for facilities with typically high energy costs, such as laboratories and data centers.

articles@burnsmcd.com

For the owner or operator of an income-producing property such as an office building or an apartment complex, RCx creates the opportunity to augment the value of assets by increasing net operating income. This is because buildings that have been retro-commissioned can be more comfortable than those that have not. The increased comfort of a building may help retain occupants and attract new ones — and allow higher rental rates so that the payback period is decreased correspondingly to the increased revenue.

Regardless of whether a property produces income or not, retro-commissioning will produce a benefit for the bottom line by increasing energy efficiency and enhancing building performance.

Systems that can be retro-commissioned include, but are not limited to:

- Mechanical
  - HVAC
  - Chilled water
  - Hot water
  - Steam
  - Piping
  - Plumbing
- Electrical
  - Generators
  - Switchgear/transformers
  - UPS systems
  - Grounding/bonding
  - Lighting and lighting control
  - Photovoltaic
  - Electrical metering
- Fire and life safety
  - Fire suppression
  - Fire alarm
- Integrated systems
  - Building automation
  - Direct digital controls (DDC)
  - SCADA
- Specialty systems
  - Security
  - Voice/data
  - Automated manufacturing
  - Airport baggage handling
  - Nurse Call
  - Wastewater treatment
  - Fuel cells

articles@burnsmcd.com

  - Renewable energy
  - Vertical and horizontal transport
  - Combined heat and power (CHP)
- Building envelope
  - Wall assemblies
  - Fenestrations (windows and doors)
  - Roof construction
  - Waterproofing

The costs of retro-commissioning are unique to each situation, but variables include:

- Rates of the retro-commissioning service provider
- Complexity of the project
- Sophistication and number of systems to be retro-commissioned
- Facility square footage
- Age and condition of existing equipment
- Knowledge of on-site staff
- Extent of current operations and maintenance (O&M) program

Implementing Retro-Commissioning

There are four basic phases of the retro-commissioning process, according to Portland Energy Conservation, a nonprofit organization dedicated to sustainability:

Planning — The building to be retro-commissioned is selected and goals are defined. The commissioning authority (CxA) is chosen and assembles a team to develop a retro-commissioning plan that includes projected costs and savings. The scope of work is negotiated between the commissioning authority and the owner and provides an outline of the procedures to be carried out, a schedule of activities, the defined roles of each team member, and forms to document the team's activities.

Investigation — Once the project plan is in place, the CxA surveys the facility occupants, O&M staff and building's systems to identify their purposes and how they are operated and maintained. The service CxA performs functional testing, looks for efficiency issues and then determines the most cost-effective potential improvements. An ideally performed investigation effort includes a high degree of O&M staff involvement so that small repairs and tune-ups can be made to provide an immediate return on investment through energy and performance enhancements as well O&M staff systems training. At the end of the investigation phase, the CxA reports the findings to the owner, who then chooses which changes to implement.

articles@burnsmcd.com

Implementation — Once the owner selects the opportunities to pursue, the retro-commissioning team implements those changes. The team verifies that the measures are performing as expected. This verification serves as a benchmark to track the systems' performance after retro-commissioning is complete and when ongoing commissioning is enacted.

Hand-Off and Implementation of Persistence Strategies — At the end of the process, the CxA commissions the implemented changes and produces a final report to document final conditions meet the new facility requirements. The building's O&M staff is trained in sustaining the efficiency of the building's processes. A closeout meeting is held with the owner. At the end of the retro-commissioning process, persistence strategies such as ongoing commissioning and monitoring based commissioning should be discussed to maintain the benefits of retro-commissioning throughout the building's life cycle.

Conclusion

Retro-commissioning processes yield a facility capable of performing more efficiently at lower costs than it had previously, in the same way that the Six Million Dollar Man emerged from the laboratories able to do things better, stronger and faster than ever before. Putting a building through the retro-commissioning paces increases reliability and makes it a more desirable asset.

The potential savings for building owners and operators can be substantial and pay for processes in less than two years, in most cases. As the Lawrence Berkeley National Laboratory study indicated, the larger the building, the faster the payoff. RCx is also often most beneficial for facilities saddled with high energy costs — and the best potential for improvement.

articles@burnsmcd.com

Additional Resources

- The Building Commissioning Association (BCxA), www.bcxa.org
- Associated Air Balance Council (AABC) Commissioning Group, www.commissioning.org
- Association of Energy Engineers (AEE), www.aeecenter.org
- The American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE), www.ashrae.org, and ASHRAE Guideline 0, https://www.ashrae.org/education--certification/instructor-led-courses/commissioning-process--guideline-0
- The National Institute of Building Sciences "Whole Building Design Guide," www.wbdg.org
- The U.S. Green Building Council (USGBC), www.usgbc.org
- The National Association of Energy Service Companies (NAESCO), www.naesco.org
- The U.S. Department of Energy (DOE), www.energy.gov

Biographies

Brian Lindstrom, PE, DCEP, is the commissioning practice leader at Burns & McDonnell. He has commissioned more than 19 million square feet of complex and critical facilities valued at more than $8 billion and been responsible for retro-commissioning more than 10 million square feet of existing space worldwide. He is a registered professional engineer, certified data center energy practitioner and earned his bachelor's degree in mechanical engineering from Kansas State University.

David Meyers, AIA, CxA, PMP, LEED AP, is a certified commissioning authority who has overseen commissioning of construction worth more than $4.4 billion and has been responsible for the retro-commissioning of more than 8 million square feet of existing building space. He earned his Bachelor of Science in business from Miami University and his Master of Architecture from Washington University. He is involved with the American Institute of Architects, a member of the Architectural Review Board in Kirkwood, Mo., and a member of the Project Management Institute.

articles@burnsmcd.com