Commissioning to Improve Building Performance

Commissioning of new and existing buildings is an important tool for improving building energy performance. Building owners can realize higher occupant satisfaction, lease rates and property values while reducing utility bills. Energy savings are often in the 10-20% range. Localities can benefit from improved building stocks and tax revenues from higher valuations. Enhanced energy reliability and reduced pollution emissions also result from the energy savings achieved.

Strengthening commissioning requirements for federal, state and local public building could save significant taxpayer money. State and local measures to encourage or require commissioning of non-public buildings can provide substantial economic, energy and environmental benefits.

What is Commissioning and Retrocommissioning?

Commissioning (Cx) is a quality assurance process that extends from building design through construction to occupancy and operation. The intent of Cx is to assure that systems are correctly installed and adjusted for optimal operations and that building staff are prepared to operate and maintain the building and its systems properly.

Retrocommissioning (RCx), sometimes called **existing building commissioning (EBCx)**, is the commissioning of existing buildings after they have been in use. RCx may be performed on a building never previously commissioned or it may be a **recommissioning** of a building to "tune up" its systems to bring it back to specifications or to adjust for changed equipment, occupancy or uses. RCx includes an analysis of building operating protocols, adjustment or calibration of systems, and any needed cleaning and repairs. Properly performed, RCx also includes documentation and training so building operators can maintain improved performance.

In a comprehensive whole building RCx, all building systems are evaluated and adjusted. However, sometimes owners opt to recommission specific systems, such as lighting; heating, ventilation and air conditioning (HVAC); building envelope; or fire protection systems.

The commissioning practitioner, referred to as the commissioning authority or commissioning agent (CxA), should serve as an independent, objective advocate for the building's owner. The CxA must combine strong architectural/engineering knowledge and project experience with good communications and interpersonal skills in working with owners, designers, contractors, building operators and occupants. A number of relevant professional credentials have emerged.

As sensors, controls and modeling software advance, such terms as **ongoing**, **monitoring-based**, and **Continuous Commissioning**® (the last being a trademarked term of the Texas A&M Engineering Experiment Station) are entering the lexicon, offering the potential for ongoing optimization of building systems via building management systems.

Why Cx and RCx are Important

Buildings are complex to build and operate. For a new building, Cx is part of a risk management strategy to better assure owners that systems were installed properly and meet specifications. Builders and installation contractors benefit from quality assurance and a reduced need to address problems under warranty after the building is occupied.

Even when initially commissioned, building performance usually degrades over time, leading to greater energy waste, reduced occupant comfort and increased maintenance requests. Mechanical systems can fall out of adjustment. Preventive maintenance may not be performed fully and on schedule. Maintenance may attend to an

immediate problem or occupant complaint without addressing root causes or considering impacts on building performance as a whole. Building and equipment modifications and changing building uses may warrant reexamination and readjustment of building systems through RCx.

RCx can restore high performance. It should include system documentation and building operator training so that RCx benefits persist longer. Even so, over time buildings will often again fall out of adjustment or their uses will change so they no longer operate optimally. In order to assure long term high performance, buildings should undergo periodic RCx or should move toward monitoring-based commissioning systems to optimize building performance on an ongoing basis.

A Lawrence Berkeley National Laboratory study found Cx delivering normalized median energy savings of 13% in new construction and 16% for existing buildings. The normalized median cost of Cx was $1.16 per sq. ft. for new buildings (0.4% of construction costs), yielding a 4.2 year payback from energy savings, and was $0.30 per sq. ft. for existing buildings, yielding a 1.1 year payback.[1] The Pacific Northwest National Laboratory reports that its RCx-related "re-tuning" approach offers 5-20% energy savings in large commercial buildings.[2]

The Cx process can also provide non-energy benefits, helping building operators meet occupant needs for comfort, specialized systems (for example, in health care and laboratory facilities), indoor air quality, safety, security and water efficiency.[3]

Commissioning Impediments

Cx and RCx remain relatively new approaches, not widely understood in much of the buildings sector. Despite positive cost-effectiveness data, upfront costs and uncertainty of savings that could be realized may dissuade building owners from having Cx or RCx performed. Builders may convince project owners that the quality assurance provided by an independent CxA is unneeded. Owners may mistakenly believe that installing efficient equipment is sufficient; not realizing that such equipment will not deliver efficiency if poorly adjusted or operated. Owners who have had an initial Cx performed may not appreciate the value of periodic RCx as buildings age, operator personnel turn over and building uses change.

Budgetary and administrative barriers can exist, including corporate distinctions between capital and operating budgets. Operations and maintenance (O&M) contracts may not provide incentive for contractor cooperation in RCx projects.

The commissioning profession also has some limitations.[4] There is a shortage of qualified CxAs. There are varied and uncoordinated industry standards and credentials. Owners may not completely distinguish full RCx and its benefits from other more limited services such as energy audits, boiler tune-ups and HVAC system balancing.

Cx, RCx and Policy

In recent years, interest in using policy to improve the energy performance of commercial, institutional and large multifamily buildings has grown. Building energy codes for new construction and major alterations are advancing. Various utility, state and local programs support building energy audits and retrofits. Public buildings, such as those built for the U.S. General Services Administration and for California state government, may be subject to initial construction Cx requirements. However, thus far, not many policies and programs address RCx or ongoing performance optimization.

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[1] Evan Mills, *Building Commissioning: A Golden Opportunity for Reducing Energy Costs and Greenhouse Gas Emissions*, July 21, 2009, Lawrence Berkeley National Laboratory, http://cx.lbl.gov/documents/2009-assessment/LBNL-Cx-Cost-Benefit.pdf.
[2] Pacific Northwest National Laboratory, "Re-Tuning Commercial Buildings," June 2010, http://www.pnl.gov/buildingretuning/.
[3] Alliance to Save Energy, *Report on the Workshop on Commissioning of New and Existing Buildings*, May 21, 2010, http://www.ase.org/sites/default/files/workshop_summary_report.pdf.
[4] Ibid.

For a number of years, federal buildings have had to have periodic energy and water evaluations or audits.[5] Energy and water efficiency system upgrades that are implemented must be commissioned but whole building RCx is not required. Also, while evaluations may identify RCx as an energy or water efficiency measure to be undertaken, there is no explicit requirement for buildings to undergo periodic RCx or to implement ongoing commissioning systems. The state of California enacted requirements for state buildings larger than 50,000 sq. ft. to be retrocommissioned and undergo recommissioning every five years.[6]

Some utilities, such as Commonwealth Edison (Ill.), CenterPoint Energy (Tex.) and Pacific Gas & Electric (Calif.), are supporting commercial building RCx through their ratepayer-funded energy efficiency programs.

An exciting development is the growing number of U.S. cities that are enacting building energy auditing, benchmarking and disclosure requirements.[7] These policies, sometimes complementing other policies (such as for submetering of tenant space) and private initiatives (such as use of energy-aligned or green leases), begin to address ongoing building energy performance. Of the cities enacting such policies, only New York City has an explicit requirement for periodic RCx of applicable buildings.[8] The voluntary Leadership in Energy and Environmental Design (LEED) certification program and model International Green Construction Code (IgCC) also include Cx and RCx provisions.

There is significant opportunity for policies to further encourage and even require RCx and to incentivize continual optimization of building systems through ongoing commissioning. The scope for energy savings and multiple other benefits to property owners, managers, tenants, and communities is large.

Selected Additional resources

SEE Action Network, Retro-Commissioning for State and Local Governments and Retro-Commissioning for Regulators of Ratepayer-Funded Programs

The Building Commissioning Association (BCA) is a major organization of commissioning professionals, providing best practice guides, handbooks, process templates, training and certifications and other resources.

The California Commissioning Collaborative links to the California Commissioning Guides, tools and templates, cases studies and tips on selecting a CxA.

The Federal Energy Management Program commissioning page provides links to resources, including online training, oriented toward federal energy managers but applicable more broadly. Its Continuous Commissioning Guidebook is a resource on implementing ongoing processes to resolve operating problems, improve comfort, optimize energy use, and identify retrofits for existing facilities.

The Whole Building Design Guide Building Commissioning page provides a commissioning overview and links to numerous pertinent resources, including standards, guides, organizations, studies and training resources.

[5] Energy Independence and Security Act of 2007, Sec. 432.
[6] Department of General Services, "The Governor's Green Building Executive Order and AB 32: Green California Goals and Accomplishments," March 2011, http://www.documents.dgs.ca.gov/dgs/pio/green/highlights.pdf.
[7] Alliance to Save Energy, "NYC, DC, SanFran, Austin & Philly: Cities Use Local Policy to Make Buildings More Efficient," 2012, http://www.ase.org/resources/cities-use-local-policy-make-buildings-more-efficient.
[8] Alliance to Save Energy, "New York City: Energy-Efficient Building Policy," 2012, http://www.ase.org/resources/new-york-city-energy-efficient-building-policy.