Building Optimization: Recommissioning Your Building to Deliver Peak Performance

Recommissioning uses simple solutions to improve building performance, value, and employee productivity.

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Make the most of your energy

Schneider Electric

Summary

I. Executive Summary

Every building undergoes changes over time. As departments are created and dissolved, people are moved around, spaces are repurposed, and interior structures are adjusted. While good for business, these changes can negatively impact building performance, resulting in lower productivity and higher energy and building maintenance costs.

To address this problem, many companies are “recommissioning” their buildings as a way to fine-tune and update building performance. This type of project is typically a small investment, yet often has a noticeable and immediate impact on the bottom line in terms of energy savings. In addition, enormous returns are realized by improving employee productivity, which studies show is correlated to building performance.

By following a proven process, building owners can optimize their facilities based on a sound understanding of what needs to be done, the associated costs, and the expected returns. For many building owners, the savings are significant.

Recommissioning can result in energy savings of **5 to 15%** with a typical **payback of less than 2 years**.

II. Ensuring Building Performance

In today's fast-moving business environment, buildings are constantly changing. Employees are frequently added or moved. New departments are opened and old ones closed. Over time, entire sections or floors may be repurposed--from storage to office space, from office space to assembly. And in buildings where spaced is leased to businesses, tenants come and go. All of these changes involve minor or major construction and changing partitions, phones, power and Internet lines, and other infrastructure that support a business.

This constant change is a significant challenge to facility managers who are expected to ensure optimal operation of high-performance buildings. Indeed, even seemingly harmless changes in building use and occupancy can contribute to indoor air-quality problems, uncomfortable environments, and higher overall energy costs.

For these reasons, building owners are increasingly using a technique called "recommissioning" to keep their buildings finely tuned. Through recommissioning, it is possible, with minimal expense, to bring a building to the best possible operation level, resulting in improved comfort and energy savings of 5 to 15%!

III. What is Recommissioning?

In it simplest terms, recommissioning is defined as a recalibration of a facility's operating systems. In practice, recommissioning is a holistic, systematic approach to identifying and implementing operational and maintenance improvements to ensure continued performance. Also known as "retrocommissioning," it ensures that building systems are functioning and optimized to work together. Whether it is done once a decade or once a year, commissioning can result in significant benefits, some of which show up directly on the bottom line.

IV. Benefits of Recommissioning?

The basic question every building owner faces is simple: do the benefits of recommissioning outweigh the costs? In other words, will recommissioning pay for itself? Of course the answer depends on each individual situation, and only a professional assessment can provide the answer for a specific building. But in many cases, recommissioning reduces energy cost and returns the investment very quickly.

A 2004 study from Berkeley National Labs analyzed results from 224 buildings across 21 states, representing 30.4 million square feet of commissioned floor area (73% in existing buildings and 27% in new construction). These projects collectively represent $17 million of commissioning investment. The new-construction cohort represents $1.5 billion of total construction costs. For existing buildings, median commissioning costs were $0.27/ft^2, with a median whole-building energy savings of 15%, and payback time of 0.7 years. For new construction, median commissioning costs were $1.00/ft^2 (0.6% of total construction costs), yielding a median payback time of 4.8 years, excluding quantified non-energy impacts.[i]

Tenant satisfaction and productivity

Employee productivity is one of the most important metrics of building performance, for two reasons. First, employee salaries are usually the largest operational expense in a building. Therefore, any increase in productivity has a visible and often dramatic impact on company (and building) value.

Second, many studies have linked air quality and temperature to employee productivity. For example, according to a report[ii] entitled, *Control of Temperature for Health and Productivity in Offices*, there is a 2% drop in productivity for each degree above 78°F. A similar reduction in productivity occurs when the temperature drops below 72°F. Thus, temperatures between 72°F and 78°F are considered the comfort zone.

For building owners, this represents a huge opportunity. William Pape, the cofounder of VeriFone, reported that 18 months after VeriFone employees began working in a building retrofitted to cut indoor pollutants and improve indoor environmental quality, absenteeism rates were down 40% and productivity was up by more than 5%. Pape notes that healthy workplaces have "done more to boost productivity than all the bandwidth in the world."[iii]

Gary Jay Saulson, the Senior VP and Director of Corporate Real Estate for PNC Realty Services, describes the benefits of the LEED Silver PNC Firstside Center building in Pittsburgh as follows, "People want to work here, even to the point of seeking employment just to work in our building. Absenteeism has decreased, productivity has increased, recruitment is better and turnover less." After moving into the new Firstside facility, two business units experienced respective reductions in voluntary employee terminations of 83% and 57%. When compared with a control group that experienced an 11% reduction, the outstanding improvement is evident.[iii]

Direct cost savings

Perhaps the most direct and quantifiable benefit of recommissioning can be seen in reduced energy and demand costs. One study of 44 recommissioned buildings found attractive return-on-investment (ROI) based on energy savings alone. In this study, the project costs were moderate—ranging from $10,000 to $80,000—yet the returns were dramatic, delivering total energy savings of 5 to 15% of the total energy bill.[v]

Other perceived benefits for high-performance buildings include an increase in building values, improved ROI, increased occupancy, and potentially higher rent rates. A guide published by Portland Energy Conservation, Inc. and the Oak Ridge National Laboratory cites the following additional benefits of recommissioning[vi]:

- Identifies system operating, control, and maintenance problems.
- Aids in long-term planning and major maintenance budgeting.
- Reduces energy waste and ensures that energy-using equipment operates efficiently.
- Reduces maintenance costs; reduces premature equipment failure.
- Provides complete and accurate building documentation, expedites troubleshooting, and reduces maintenance cost.
- Provides appropriate training to operating staff to increase skill levels; increases staff effectiveness in serving customers or tenants.
- Reduces operational risk of the building.

For every degree

below **72 F**
or
above **78 F**

2 percent

Drop in workers' poductivity

Additional Benefits:

- Increased building values
- Improved ROI
- Increased Occupancy
- Higher rent rates

V. The Best Candidates for Recommissioning

Any buildings that have undergone changes, or whose systems have not been examined for many months or years, are obvious candidates for recommissioning. Surprisingly, the best candidates for recommissioning may be those buildings that have a computerized energy management control system (EMCS) in place; the investment in technology has already been made, but is often underutilized. Surveys find that frequently staff lack training, equipment does not function properly, or building owners do not take advantage of all the capabilities available.

The recommissioning process is an opportunity to leverage these systems, understand and document their capabilities, and create truly optimized buildings. In addition, recommissioning is an opportunity to train the staff how to use the powerful tools that are available to diagnose and troubleshoot HVAC and other systems, so that building owners can gain long-term value from their EMCS investment.

VI. The Recommissioning Process

The benefits of recommissioning are clear. What about the process? How does a business reach the goals of recommissioning with minimal disruption and cost? Experts recommend the following seven-step process:

1. Assess the site.
2. Complete simple repairs.
3. Conduct testing and data logging if needed.
4. Develop comprehensive list of deficiencies and repairs.
5. Prioritize improvements.
6. Implement improvement.
7. Verify results.

Following these steps ensures that goals are defined, the easiest changes are made first for rapid ROI, and the bigger changes are properly prioritized and measured.

Site assessment

While there are many books and documents available on the process of recommissioning, it is best to begin with an assessment of the site with your current Energy Management System (EMS) or Building Management System (BMS) provider. They will identify simple and inexpensive items that may increase the operation of the building and have short paybacks.

> A site assessment with your EMS/BMS provider can identify **simple, inexpensive solutions with quick paybacks.**

Some items that your EMS/BMS provider may review include the following:

- Overall building energy use and demand, and areas of highest energy use and demand
- Current design and operational intent and actual control sequences for each piece of equipment included in the project
- Equipment nameplate information and equipment condition issues (broken dampers, dirty coils, sensor calibration, etc.)
- Current schedules (set-point, time-of-day, holiday, lighting, etc.)
- The most severe control and operational problems

- Location of the most comfort problems or trouble spots in the building
- Current O&M practices

The deliverables for the assessment should also include steps 2--4:

- Suggest simple repairs with associated costs.
- Identify testing and data-logging that may be needed.
- Identify list of deficiencies and repairs with costs, if available.

These steps are easy to take, and should be part of any comprehensive assessment. For example, the assessment should be able to identify simple measures to take, such as: functional testing of equipment, trend-logging temperature sensors to identify problems, and portable data-logging for short term diagnostics like investigating a reset schedule or graphing outside air temperature against hot water supply temperature.

Prioritization

After establishing the list of potential improvements for the building, it is important to prioritize. There is no general guideline here. The value of any improvement will depend on the specific circumstances of a building and the goals of the owner. Remember to look not only at the cost of each improvement, but also the potential energy savings. Some improvements may cost more, but will deliver larger energy savings and comfort enhancement.

Many recommissioning improvements are straightforward and the facility manager can have instant confidence in the improvements of the measure. However, some improvements—such as advanced energy conservation measures and equipment replacements—may need an energy analysis to investigate.

Implementation

The implementation of recommissioning measures may be completed by in-house staff, the BMS provider, or third-party contractors. For example, simple schedule changes and set-point adjustments may be implemented by in-house staff, but more complex programming changes can be contracted to the BMS provider through an annual service contract or a project purchase order. Other building improvements, such as lighting changes, mechanical system upgrades, or electrical system measures may need other third-party contractors. No matter which implementation approach is selected, it is vital to have a comprehensive approach to the building and to work with a partner that you trust.

Some examples of recommissioning measures that may be suggested are:

- Replace, calibrate, or relocate space temperature sensors.
- Reset original or create energy-focused time schedules.
- Verify all previously implemented energy efficiency control strategies such as optimum start, resets, and load control.
- Verify space temperature set-points, as well as plant and system set-points.
- Verify operation of lockouts and overrides.
- Replace or repair non-functioning dampers.
- Add actuator and dampers where needed.
- Add programming to allow automatic startup of chillers and boilers.
- Add points to EMS to allow energy- and demand-tracking on the entire building as well as specific equipment.
- Add trending capabilities for diagnostics and troubleshooting.
- Investigate sizing of pumps for relocating.
- Test and verify operation of valves.

- Install pressure and temperature gauges on chillers, boilers, and pumps for maintenance and troubleshooting.
- Extend training of facility staff.
- Review and update energy management system documentation.

Verify results

The options for result measurement range from simple calculation to whole-facility measurement and monitoring. In all cases, it is important to balance the cost of measurement with the benefit of the information. For example, advanced metering and monitoring increases cost but also adds benefits such as verified results and operational data to identify further measures. Selecting the appropriate method of calculating energy, operational, and maintenance cost reduction depends on the long-term goal of the building and energy management programs.

Advanced metering/monitoring provides verified results and operational data.

Also, it is important to remember that while some results of recommissioning are easy to measure—such as lighting changes—whereas others are not. Recommissioning may involve many operational changes which, while generating significant energy, operational, and maintenance savings, may be difficult to measure and verify. Be sure to work with your BMS or EMS partner at the beginning of the projects to establish measurement methods that you can have confidence in.

VII. Success Story: North Andover

Originally constructed as a mill, One High Street in North Andover, MA is now the headquarters of the global Schneider Electric's automation business. The site now consists of 370,000 sq. ft. of office, light manufacturing, and warehousing space. There are multiple tenants who sublease their space from Schneider Electric, with a total of 850 occupants.

Changes in operation and construction over the years led the building complex to struggle with high energy costs and an uncomfortable environment, and so an energy project was undertaken that included recommissioning.

The result—improved comfort of occupants and reduced energy costs. Additionally, many recommendations for capital improvements were identified that have improved the building's operation, increased comfort, and continued reduced energy-use over time.

VIII. Success Story: St. Agnes Academy

Pressure from parents and students to be more environmentally friendly motivated St. Agnes Academy in Houston, Texas to embrace an action plan to practice good stewardship and deliver commitment to a "green" initiative.

TAC helped the academy implement a comprehensive energy project. In addition, TAC also modified system control sequences to optimize for energy, making it easy for the staff to change set-points while preventing overheating or overcooling and controlling demand. Other measures included optimizing chiller operations, air-handling units, and outside-air intake.

IX. Conclusion

Over time, changes in building occupancy and use can significantly impact energy costs, as well as employee comfort and productivity. By undertaking a modest recommissioning project, building owners can upgrade facility performance dramatically to achieve reduced energy costs, improved comfort, and increased employee productivity. For many facilities, the savings can be as high as 15% of the total energy bill.

An energy or building management partner can help facility owners assess the current performance of their buildings, correct simple problems, and develop a plan for enhancing performance and measuring the results. Properly done, a recommissioning project will not only pay for itself, but will add significantly to the bottom line.

[i] Mills, E. (2004). *The Cost-Effectiveness of Commercial-Buildings Commissioning: A Meta-Analysis of Energy and Non-Energy Impacts in Existing Buildings and New Construction*. Berkeley, CA: Lawrence Berkeley National Laboratory.

[ii] Seppanen, O., Fisk, W. J., & Faulkner, D. (June 2004). *Control of Temperature for Health and Productivity in Offices. Espoo, Finland:* Helsinki University of Technology: Institute of Heating Ventilating and Air Conditioning & Berkeley, CA: The Lawrence Berkeley National Laboratory: Environmental Energy Technologies Division.

[iii] Pape, W. (June 1998) "Healthy, Wealthy, and Wise." *Inc.*, No. 2, pp. 25 - 26.

[iii] Green Building Alliance. (2002). *Shades of Green: 2002 Report of the Pittsburgh Green Building Alliance*. Pittsburgh, PA.

[v] Energy Innovators Initiative. (2005). *Recommissioning – The Optimization of a Building Systems' Operation*. Canada: Office of Energy Efficiency of Natural Resources.

[vi] Hassl, T. & Sharp, T. (April 1999). *A Practical Guide for Commissioning Existing Buildings*. Portland, OR: Portland Energy Conservation, Inc. & Oak Ridge Tennessee: Oak Ridge National Laboratory.

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On October 1st, 2009, TAC became the Buildings Business of its parent company Schneider Electric. This document reflects the visual identity of Schneider Electric, however there remains references to TAC as a corporate brand in the body copy. As each document is updated, the body copy will be changed to reflect appropriate corporate brand changes.

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