



A Guide on How to Integrate Commissioning Into Your Building Project

How to Integrate Commissioning Into Your Building Project Guide

Copyright © 2017

Published by Fitzemeyer & Tocci Associates, Inc.

300 Unicorn Park Drive, 5th Floor
Woburn, MA 01801

All rights reserved. Except as permitted under U.S. Copyright Act of 1976, no part of this publication may be reproduced, distributed, or transmitted in any form or by any means, or stored in a database or retrieval system, without the prior written permission of the publisher.

Design by Fitzemeyer & Tocci Associates, Inc.
Visit our website at www.f-t.com

About this Guide

When building projects integrate commissioning, the result is a cost-effective, efficient building and happier occupants. Without commissioning, maintenance and repair costs go up. Commissioning is useful for all modern buildings, but it is only effective when building owners, designers, contractors, and facilities teams know what to expect and are committed to the process.

This guide answers the most frequently asked questions about commissioning:

- What is commissioning?
- What are the benefits of commissioning?
- When is the best time to commission?
- How to engage a commissioning agent?

Table of Contents



WHAT IS COMMISSIONING?

Chapter 1: *What Is Commissioning & Why Commission?*2

WHAT ARE THE BENEFITS OF COMMISSIONING?

Chapter 2: *Increased Value & Improved System Performance*5

Chapter 3: *Cost Savings & Other Benefits*6

WHEN TO COMMISSION?

Chapter 4: *When To Commission*8

Chapter 5: *What Happens When Owners Don't Commission?*10

HOW TO ENGAGE A COMMISSIONING AGENT?

Chapter 6: *What To Look For In A Commissioning Agent?*13

Chapter 7: *How to Hire A Commissioning Agent?*14



WHAT IS COMMISSIONING?

1

What is Commissioning and Why Commission?

The term commissioning originated with the U.S. Navy, where it refers to testing the systems onboard a new ship before it puts out to sea. In the 1960s and 1970s, the building industry adopted the term to refer to the quality assurance process for new building construction.

Early on, commissioning related to only the mechanical systems, but the role of commissioning has expanded with changes in technology. Today, commissioning can include the building envelope and a multitude of interrelated systems, such as electrical, plumbing, and fire protection. Savvy building owners recognize that commissioning is critical to successful, sustainable business operations.

During commissioning, an independent third party (a commissioning agent) confirms that a building's systems are designed and installed to achieve the expectations and intended performance criteria.

There are three market-driven reasons for commissioning a building project:

1. To address environmental concerns.
2. To ensure compliance with industry guidelines
3. To ensure full integration of complex building systems.

The Environment

Environmental concerns are a main motivator for building owners to seek out commissioning services. In fact, the majority of owners surveyed in 2013 by the Building Commissioning Association and PECL (a non-profit company that helps design and implement energy efficiency programs), cited voluntary green building certifications (68 percent) and their own environmental goals (64 percent) as the chief reasons for undertaking the commissioning process.

Modern construction and building design is heavily influenced by the need to build and operate with environmental performance in

"The role of
commissioning
has expanded
with changes in
technology."

mind. Designers, builders, and other construction professionals seek independent verification of their “green” buildings status through certifications, like LEED (Leadership in Energy and Environmental Design), Energystar, or Green Globes (design certification in Canada). Commissioning is either a requirement (pre-requisite) or listed as a best practice for many of these coveted certifications.

Commissioning provides significant advantages, even for building owners not seeking green certification. That is because commissioning can ensure a building’s systems are working as efficiently and effectively as possible, which reduces energy usage which results in cost savings.

Industry Guidelines

U.S. building codes do not specifically require commissioning, but most federal government agencies have formal commissioning requirements, including the General Services Administration, the Naval Facilities Engineering Command, and the U.S. Army Corps of Engineers.

The Facilities Guideline Institute also developed commissioning guidelines for the more complex buildings in the healthcare industry. The 2014 version of the Guidelines for Design and Construction of Hospitals and Outpatient Facilities now recommends minimum commissioning services for all new construction or modifications in areas critical to patient safety.

System Complexity

As building systems get more complex, the assurance of quality provided by commissioning becomes even more important. This is especially true for buildings with high expectation for control and performance, like pharmaceutical manufacturing, academic laboratories, or the healthcare industry. But, as systems are increasing in their complexity, maintenance teams are actually getting leaner—fewer people monitoring and maintaining systems.

Systems must be designed, installed, and calibrated to run as efficiently and effectively as possible to allow the leaning maintenance team and budgets to be sustainable. Commissioning ensures this level of efficiency and may forestall costly repairs and the inconvenience of prematurely failed equipment.

“Most federal government agencies have formal commissioning requirements.”

WHAT ARE THE BENEFITS OF COMMISSIONING?

2 Increased Value and Improved System Performance

There are significant benefits to commissioning building projects. It increases a building's value, improves system performance, and saves money.

Increased Value

Commissioning agents are experts in the systems and controls that allow a building to work as designed. As such, a commissioning agent can increase the value of a building project by acting as a second set of eyes for the building owner. The agent can also help the owner set realistic expectations, adjust those expectations when the budget requires it, and avoid having to fix or modify equipment at a later stage because it does not meet their requirements as an owner.

The commissioning agent also works with the engineers and facilities representatives to design or modify the project to provide solutions for problems and help the owner make adjustments to the budget when necessary.

Improved System Performance

Contemporary building controls are some of the most difficult systems in a project to install and configure. A system may be turned on and working, but performing inefficiently. It may meet temperature requirements of occupants, but not meet the energy efficiency specifications set by the owner. It may be operating effectively, but require more maintenance than expected.

An evaluation of any building system must consider this scale of operation—from non-operational to peak efficiency—and how it corresponds to the needs of both owner and occupant.

Commissioning agents recognize there is often a middle ground. They understand the intricate

relationship between equipment specifications, system configuration, field conditions, and the owner's requirements, and work with the owners and facilities teams to get the system working in the most efficient or cost-effective way possible and still meet the needs of the occupants.

In addition, commissioning can help business owners reap the value of systems over the life of the building. In the planning stages, commissioning agents help owners choose systems with lower long-term maintenance costs and higher return on investment. For example, they may highlight the benefit of choosing standard off-the-shelf filter sizes over custom sizes that require special orders or provide recommendations based on the previous success they have had with different equipment types and manufacturers.

During commissioning, the agent can develop a list of the major systems and expected life span. Such a list can help owners and operators plan and budget for preventative maintenance, renewal cycles, and reinvestments. Post-installation, commissioning agents can also create custom operational manuals with the end goal of improving performance. With this information, owners are better prepared for future problems and can mitigate maintenance-related disruptions.

There is also value in retro-commissioning existing buildings. How a building is operated and maintained changes throughout its life cycle, and a building may not run at peak efficiency as it ages. Retro-commissioning analyzes and tests the systems to bring the building back to full operations, improve comfort for occupants, and save energy and maintenance costs.

3 Cost Savings and Other Benefits

Cost Savings

Commissioning adds value by ensuring systems are built and operated to performance requirements. The operating cost savings flow from there—in terms of lower maintenance budgets, equipment upgrade and replacement costs, and ongoing energy and operational expenses. In fact, data from the Building Owners and Managers Association indicate that commissioning buildings can result in energy savings of 20–50% and maintenance savings of 15–35%. And according to the Whole Building Design Guide, in the first 5 years of occupancy, building owners can save \$4 for every dollar invested in commissioning.

Other Benefits

The benefits of commissioning do not end with cost savings. Commissioning agents can

- integrate the expertise of maintenance and technical staff into the design and construction phase,
- improve cooperation among the construction project team,
- build a knowledge base amongst the team about the building project,
- increase familiarity of the owner with new building systems,
- train facilities staff in systems operations and preventative maintenance,
- develop on-point messaging about how a building's green certification or energy efficiency fit within a corporate social responsibility program.

“Commissioning buildings can result in energy savings of 20-50%.”



WHEN TO COMMISSION?

4 When to Commission

Smart building owners integrate commissioning into building projects to keep costs in line, meet design intent and operational needs, and improve efficiency. Commissioning simply improves an owner’s chances of making necessary modifications and changes before problems negatively impact building operations and the bottom line.

Good	Better	Best
Commission during: Near the end of Construction	Commission during: Beginning of Construction	Commission during: Design Phase
Test systems for performance and efficiency	Monitor and review construction and systems installation	Help owner formulate project requirements
Ongoing review for completed and occupied building	Monitor and test systems throughout construction phase	Review design and engineering plans
	Final performance and efficiency tests	Monitor and review construction and systems installation
	Ongoing monitoring and reviews for completed and occupied building	Monitor and test systems throughout construction phase
		Final performance and efficiency tests; train building staff
		Ongoing monitoring and reviews for completed and occupied building

Although the ideal time to engage a commissioning agent is during the earliest design and construction stages (when it is easiest to make modifications), a building can be commissioned at any stage in its life.



When engaged early a commissioning agent can work with an owner to:

- Define project goals
- Establish system requirements
- Recommend standards and best practices
- Review design choices
- Identify potential problems

- Help manage construction process
- Track system performance throughout construction
- Train owners and facilities teams on systems
- Develop owner's operations and maintenance manuals.

Case Study: Recommissioning

In 2007, a hospital installed new air handling units as part of a large expansion project. Five years later, the hospital embarked on an energy efficiency and upgrade program, which included recommissioning the air handling units. Air stratification was tripping freeze stats and steam coil control problems were causing an artificial load on the chilled water plant, requiring it to operate year-round.

The scope of the recommissioning included physical changes in the air handling units and associated coils, pumps, valves and piping, as well as a modified sequencing and control strategy. The final element of the recommissioning involved functional testing of the upgraded systems and on-site training for basic maintenance and troubleshooting procedures on the upgraded equipment systems.

The recommissioning work resulted in lower consumption of both natural gas (therms/yr) and electricity (kWh/ yr). Based on current utility rates, the hospital is saving approximately \$58,000 per year and will realize payback for the investment recommended by recommissioning in less than 4 years.

5 What Happens When Owners Don't Commission?

Building projects that do not include commissioning often encounter higher costs, fail to meet the expectations of the occupant or owner, and suffer process inefficiencies.

Higher Costs

When building owners forego commissioning, they lose key oversight of the design, purchasing, installation, and set-up of key building systems. Problems can go unnoticed and lead to expensive mitigation efforts down the road.

During construction, a lack of commissioning may lead to extensive change orders, which result in project delays and increase construction costs. After occupancy, the lack of commissioning may lead to system or building downtime (to allow for repairs), the additional cost for replacement parts or new equipment, unbudgeted service fees, overtime for maintenance personnel, demolition and remodeling costs, and increased life cycle costs for equipment.

Failure to Meet Expectations

All owners have expectations for how their buildings will operate and serve occupants; however, problems can arise. A third-party review can ensure the project matches the original intentions and expectations. When a building is not commissioned from the earliest stages, systems and controls may fail to meet occupants' needs or fail to operate as intended.

Lessees and building occupants also have certain expectations for building operations. For example, school administrators expect the HVAC will work properly even on hottest days, and hospital administrators expect the air exchange rates are sufficient in an operating room to positively affect patient health. Whether they have a say in the design and construction process, or come in with expectations based on discussions with the building owner, building

“Problems can go unnoticed and lead to expensive mitigation efforts down the road.”

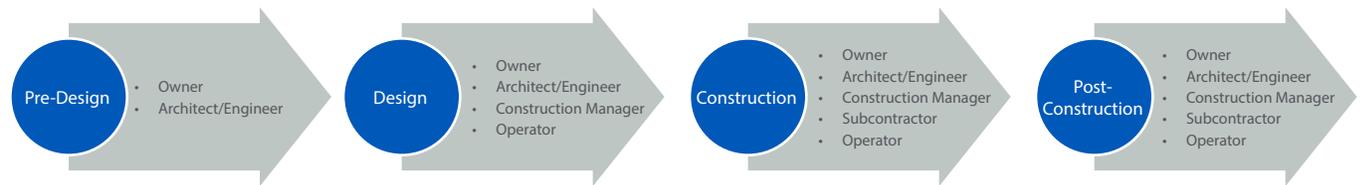
occupants need to know their they can use the space as they intend. Without commissioning they have no assurance that such needs will be met.

Process Inefficiencies

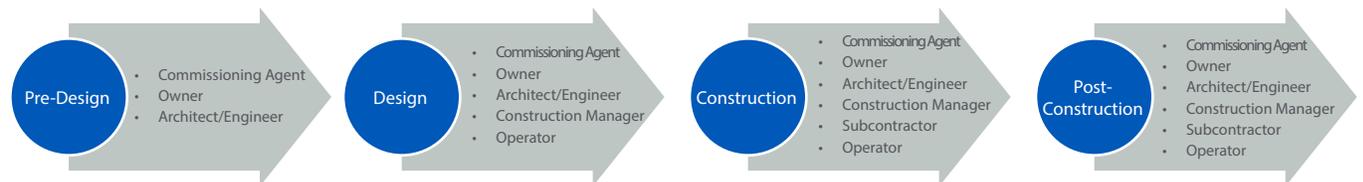
The process of constructing a building is intricate and sequential. How each system is installed affects the systems integrated with it. Unfortunately, the individual design of each system may not account for these interactions.

Without commissioning, we don't have the sufficient perspective into the design, installation, calibration, and testing of systems with an eye toward integration and efficient operations. The result can ultimately be systems that fail outright or deliver unintended results.

Traditional Design Process



Integrated Commissioning Process



Even buildings with relatively simple systems may operate inefficiently without a commissioning agent to oversee the process. According to a 2009 report by the Lawrence Berkeley National Laboratory, owners of commercial buildings lose almost \$1.0 billion to imbalanced airflow (\$0.7 billion) and improper controls setup (\$0.2 billion). Two problems that can be easily identified—and fixed—during the commissioning process.

HOW TO ENGAGE A COMMISSIONING AGENT?

6

What to Look for in a Commissioning Agent?

When looking for a company to provide commissioning services, be sure to consider the following factors:

Expertise.

Seek a commissioning agent with experience in the same type of project. This is particularly true in specialized industries like healthcare. The commissioning agent you choose must understand applicable regulations, system requirements and complexities, and the needs of the space functions and occupants. The best commissioning agents have both hands-on experience and design expertise. They can also see the “big picture” and still recognize the important details, like knowing the best equipment or installation techniques to meet your needs.

Strategic partner.

The right commissioning agent is your partner on the project, listening to your needs, communicating well, and running meetings effectively. Your commissioning agent provides you recommendations and advice, including identifying weaknesses in the project team that might negatively impact the project outcome. An effective commissioning agent adds to the solution and is proactive and diplomatic.

Solid processes.

Look for a company with a time-tested process that is also flexible enough to address unique requirements of your project. Commissioning agents may have a checklist of standard items to review, but they must be ready to tailor these to the current project with specific comments, annotations, and markups.

Experience.

Seek a company that has been commissioning for at least 10 years and has knowledge of the industry and market. Work with an agent who knows—from experience—what equipment works best, as well as what doesn’t work and why.

Services to Expect from a Commissioning Agent

1. *Design guidance and oversight*—works with the owner and design team to review and develop project plans.
2. *Specification development*—works with owner to develop project specifications for inclusion in contract documents and plan commissioning for the life of the project.
3. *Construction oversight*—reviews construction process on-site and in meetings with the team.
4. *Post-construction review*—conducts functional tests for systems and equipment and maintains documentation of deficiencies; includes training of facilities staff.
5. *Reporting*—writes final commissioning report and develops manual for building systems operations and maintenance.
6. *Follow-up commissioning*—returns to the site post-occupancy to review operations and building maintenance with occupants and facilities staff.

7

How to Hire a Commissioning Agent?

The commissioning agent is a key member of the building project team. That is why you need to hire the right agent for your project. The key is to start early—hopefully, as soon as the project is approved—and develop a strong request for proposal.

The Elements of a Sound RFP

A strong request for proposal includes these minimum specifications for commissioning services:

Pre-design

- Conduct kickoff meeting with owner and design team to discuss design intent.
- Provide templates and samples of owner's project requirements (OPR) to help develop project-specific OPRs.

Design

- Develop preliminary commissioning plan (to be updated throughout the project) to track key milestones.
- Review engineer's basis of design (BoD) and ensure it meets the owner's requirements.
- Develop and maintain non-conformance log to track all items, from pre-design to closeout.
- Develop and implement commissioning specifications.
- Provide equipment start-up documentation and/or review manufacturer's documentation.
- Develop functional testing procedures.
- Construction
- Conduct kickoff meeting with subcontractors to discuss commissioning scope and team roles and responsibilities.
- Conduct controls integration meeting with design team, contractors, and owner to discuss control scheme and related issues.
- Conduct site visits to review progress and milestones.
- Conduct spot check tests of water and air systems, and

"The key is to start early—hopefully, as soon as the project is approved."

review final testing report.

- Issue final report with commissioning specification, functional testing procedures, final commissioning plan, and final non-conformance log.

Post-construction

- Perform seasonal or deferred functional performance testing.
- Assist in resolving any warranty issues for commissioned systems.
- Plan a workshop to discuss lessons learned during the commissioning process.

Additional Services

Consider including the following additional services to the RFP:

Design

- Collect data to develop system manuals, preventative maintenance plans, operating plans, or energy management and resource plans.
- Conduct design reviews at design development and additional reviews during the construction development document phase.

Construction

- Review as-built drawings and operation and equipment manuals to ensure they are complete and clear and adhere to contract requirements.
- Create systems manual, preventative maintenance plan, operating plan, or energy management and resource plan.

Post-construction

- Perform post-occupancy review 10 months after the project is complete, and include interviews with facilities staff to identify operations issues.
- Review training procedures to ensure they are valuable to the facilities team and satisfy contractual obligations without inherent benefit to the owner.

Other Considerations

In addition to the scope and fields of a standard RFP (such as statement of qualifications, experience, and costs), consider the following:

- Initially issue a request for quotation (RFQ) to understand general price ranges or to get information to write a more detailed RFP.
- Request details about specific projects related to your project (such as healthcare or academic facilities), including information about the initial budget, total project costs, and scheduled and actual completion dates.
- Specify if you are looking for a commissioning agent that will contract project by project or serve as a “house doctor” and be available for ongoing services.
- Ask for the number of meetings included in the project, with a per-meeting breakdown of price.
- Specify technology capabilities to ensure agent’s ability to integrate with your teams.

Commitment and Communication

Commissioning is most effective when all members of the team know what to expect and are committed to the process. The owner’s role is to ensure that commissioning is included in project specifications and to communicate that commissioning is a priority to the project team, including designers, contractors, and facilities teams. The commissioning agent’s role is to ensure effective coordination between the design team, the owner, and facilities staff regarding questions about operations, sustainability initiatives, equipment and manufacturers, and building management system protocol.