

# A business case for commissioning new hospitals

**B**uilding owners' recent interest in the U.S. Green Building Council's LEED Green Building Rating System has created a "buzz" about commissioning. But few know exactly what commissioning is and how it impacts hospitals.

First, the definition. Commissioning is a two-fold quality assurance process that monitors design and construction, and validates building systems' design and installation, ensuring they will operate as intended by the owner's project requirements (OPR).

The OPR document describes expectations for how the building will be used and operated. It includes goals, benchmarks, costs, and success criteria. Another document, the basis of design (BOD), outlines how the OPR will be met. The BOD details calculations, decisions, and product selection both in narrative form and as a list of items to be completed.

These two documents are important because often, building systems integration shortcomings are a result not of poor workmanship, but of not



**Tulsa Heart Hospital of St. Francis; Architect, Perkins+Will; commissioning, CCRD Partners**

understanding the design intent.

Mike Meteyer, Manager of HVAC for Marshall Erdman & Associates said, "The OPR coupled with the BOD coupled with the commissioning plan results in a tool that manages the expectations, scope and budget for an optimum quality assurance process."

## The Need for Commissioning

While the commissioning process seems like common sense, it is not necessarily common practice—especially for non-academic medical centers.

Owners often wonder why design professionals don't conduct commissioning as a part of their basic services. Years ago, commissioning was a common part of design services; owners could also handle it through in-house staff. However, as the construction industry slowed down in the 1980s, architects and engineers searched for ways to cut scope and fees to stay afloat. Likewise, owners cut staff that would otherwise have been available for commissioning.

Site visits and comprehensive reviews of installed systems also became logical targets for cutbacks. This reduction in scope persists today, preserving a culture that doesn't allow for the extensive field work and documentation that commissioning requires. Nevertheless, building systems have become more complex in the last 20 years. This makes it beneficial to have an independent set of eyes to look at the project.

Commissioning authorities are usually hired by, and report directly to, the owner. Because they have no direct financial stake in the project,

St Joseph's Hospital,  
Phoenix, Ariz.; Architect,  
Perkins+Will; commis-  
sioning, Kitchell CEM



The Children's Hospital of Denver, commissioning by Farnsworth Group.



they become a neutral party that seeks to resolve problems without assigning blame. A commissioning authority that is brought on board at the project's beginning can help all team members understand their roles.

Commissioning authorities often pick up on simple mistakes that can have huge impacts on a project's later stages. Such mistakes can include fans turning in the wrong direction, valves placed in the wrong location, or incorrect wiring. Most such problems are in HVAC—particularly air distribution—systems. However, commissioning is not (nor should it be) limited to HVAC components. All building systems that affect energy efficiency, water efficiency, indoor air quality, and occupant comfort should be commissioned. This includes electrical, plumbing, and architectural systems.

Lance Stewart, of the commissioning firm Farnsworth Group, recalls that on the Boulder Community Foothills Hospital project, commissioning resolved several issues before the hospital opened. For example, a power outage test revealed that the nurse call system was not connected to emergency power. This oversight was discovered because the commissioning process called for the generator to be run for half a day, allowing the call system's battery power to drain completely.

Commissioning covers more than installation and functional testing of

building systems. Another critical aspect is thorough training for the building's operators. This includes the development of detailed operations and maintenance manuals. In a commissioned building, the facilities manager receives a manual with instructions on how systems work together under various design conditions.

"When you spend \$25,000 on a car, you get a manual that gives detailed instructions on how to use the car. When you spend \$25 million on a building, you get a book of cut sheets. That's analogous to a car manual with a picture of a compressor rather than instructions on how to use the air conditioner," said John Boecker, partner at 7group, a multi-disciplinary consulting firm focused on sustainable projects.

Training can begin as early as the design phase. This was the case at

The Children's Hospital of Denver and the Medical Center of the Rockies in Loveland, Colo.

People with future maintenance and construction responsibilities participated in the design phase. They received ongoing training throughout the construction process, and were able to witness installation and functional testing of the equipment they would be operating. This broad approach allowed them to become familiar with their building's system before the building even opened.

Commissioning presents many other intangible benefits. Richard Beam, corporate utility manager for Providence Health System, found the process reduced punch list items and errors during start-up. Al Manshum, director of design and construction for Advocate Lutheran General Hospital in Park Ridge, Ill., had a similar experience. The hospital is seeking LEED Gold certification for its new bed tower.

While Manshum admits that LEED was the primary impetus for their pursuit of commissioning (it's required for certification), they found other compelling reasons to pursue it. These include his belief that the building will be occupied more quickly, fewer change orders will be made, and systems will function optimally on opening day.

"Even if it just saves us time at the end, it's worth it," Manshum said.

**Table 1: Problems identified by commissioning**

Problem Type	Example
Design	Incorrect equipment sizing
Installation	Construction debris blocking ventilation pathways
Software	Incorrect sequence of operations or control algorithms
Hardware/manufacturing	Incorrect sensors
Component failure	Faulty control boards in building automation systems
Start-up	Air in water systems
	Improperly adjusted daylighting controls

Source: Lawrence Berkeley National Lab, *The Cost-Effectiveness of Commercial-Building Commissioning*, 2004.

Lexington Medical Center,  
West Columbia, S.C.;  
Architect Perkins+Will;  
commissioning, Smith  
Seckman & Reid

### When Owners Resist

Despite the abundance of examples that show how commissioning saved money by identifying problems early, some owners and construction managers still resist the process. Beam feels this is tied to a belief that the service is what contractors are contracted to do. A common misconception is that commissioning is the same as testing and balancing. In fact, it is much more interactive.

During testing and balancing, contractors measure air and water flows for each individual system component. This testing is based on a full design load—a condition that only occurs during a handful of days throughout the year. During commissioning, conversely, the entire system is run through its paces during both warm and cool seasons to determine how well systems work together.

“Commissioning condenses the two-year period of getting to know the building down to four months, while the contractor is still engaged,” said Joseph Clair, managing engineer for the Chicago Public School.

Misunderstanding the scope of commissioning is only part of the problem. Some owners are scared away by the initial price of commissioning. A rule of thumb is that commissioning costs one-half to one-and-one-half percent of a new building’s construction budget. For complex buildings like hospitals, the price can run \$1.50 per square foot. However, the return on investment is significant. According to the Whole Building Design Guide, for every dollar spent in the first five years a building is commissioned, \$4 is saved. Moreover, savings increase as the commissioning scope becomes more comprehensive.

Lawrence Berkeley National Lab (LBNL) performed a meta-analysis of a number of commissioning studies. They found that for new buildings, commissioning median costs were \$1



per square foot with a simple payback of 4.8 years (all costs were normalized to 2003 dollars). This study concluded that commissioning was most cost effective for energy-intensive facilities like labs and hospitals. Payback for these facilities was less than one year.

### Cost vs. Benefit: The Value of Commissioning

A well-educated owner sees the value of commissioning. Michael Savone, commissioning director for The Children’s Hospital of Denver, recounts that the hospital used commissioning because they recognized a missing element in the traditional delivery method. He believes that for the commissioning process to be successful, the owner must be actively involved in the process.

The Children’s Hospital chose not only to hire a professional commissioning consulting firm to provide a structured process and technical expertise, but also identified internal staff to take

on commissioning responsibilities.

“This internal-external commissioning team approach is essential because commissioning is the owner’s process. It cannot be totally contracted away,” Savone said.

Savone’s internal-external team successfully identified planning, design, and construction issues that were either misaligned with the owners’ requirements, or had potential negative impacts on the life-cycle cost and use of systems or spaces. The entire project team participated in the evaluation and discussion of these issues to determine whether the construction documents or owner expectations needed to change. Making these determinations well in advance of project completion significantly reduced their financial impact. Based on the hospital’s experience with commissioning on this project, it will incorporate commissioning on all future projects earlier and more aggressively.

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Facilities managers also understand the value of commissioning because they work with building systems on a daily basis. Because commissioning addresses the building's long-term use—including how to fix or replace equipment when the need arises—it pays for itself via cost avoidance. Facilities managers know it is much more difficult to diagnose problems under normal operating conditions than during functional testing.

Joe Howard, director of facilities management for Boulder Community Foothills Hospital, believes that when commissioning is done properly, it can provide significant value in three areas:

- Observing original equipment acceptance and start-up.
- Ensuring that submittals match the specs and shop drawings.

- Supervising whole systems training.

In Howard's opinion, the cost of commissioning should be between 0.2 and 0.5 percent of the construction cost; anything more is a red flag. That said, he does not recommend commissioning for projects under \$50 million. Instead, for small projects, the facilities manager should add one commissioning person to the staff. Howard stresses that qualified facilities managers could do commissioning if they had the time.

Even contractors see the value of commissioning once they experience the process. Contractors typically assign warranty costs as a fixed percentage of construction, so fewer callbacks mean higher profits. Lance Stewart worked with one contractor who estimated that commissioning reduced his callbacks by 80 percent.

Commissioning identifies errors while they are small and easily fixed. Those same oversights can be very costly if they aren't discovered until the building is occupied—or if they're never noticed which could leave the building's performance indefinitely compromised. As environments dedicated to vulnerable populations, hospitals can't afford suboptimal operations. Given that returns through cost avoidance can take less than one year, there is no reason why all hospitals should not be commissioned. ■

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