

Using Commissioning to Facilitate Owner Training and a Successful Turnover

Kent Barber, PE
Keithly Barber Associates (KBA)

Synopsis

The benefits of commissioning cannot be fully realized if buildings are not properly operated and maintained. The commissioning process can be utilized, however, to facilitate efficient turnover of a commissioned building for owner operation.

Individuals participating in the commissioning process learn important systems operating characteristics and information. Because of this, the participation of the owner's O&M staff in commissioning can greatly facilitate a smooth turnover from construction to efficient and effective long-term owner operation. The Systems Manual is also an important means of communicating commissioning knowledge for O&M staff, particularly when they are not able to participate in commissioning.

A good Systems Manual makes important systems operating characteristics and information available to systems operators after the initial commissioning process has been completed. The Systems Manual, however, is an unfamiliar document for many project teams and building operators. As a result, it may be underutilized or not used at all. Formal training on the Systems Manual can be combined with systems overview training to facilitate turnover of a new building, provide the O&M staff valuable knowledge for the first months of owner operation, and set the stage for long-term systems operation in accordance with the original design intent.

The commissioning process can also be used to facilitate occupant acceptance and appreciation for a new or renovated building. Training the occupants on the capabilities and limitations of the indoor environmental systems can reduce the potential for public perception that a new building is of poor quality or doesn't work. This is particularly true when the environmental systems are uncommon or innovative.

Performing a post occupancy review eight to ten months after the building is occupied provides a good opportunity to observe, through commissioning, that the O&M staff has successfully taken over operation of the building.

To summarize, the objectives of this paper are to illustrate that building turnover to the owner's O&M staff can be facilitated by participating in the commissioning process; discuss how Systems Manual and related training provided by the CxA can facilitate efficient turnover of a new building to the owner's operating staff; and suggest how training provided by the CxA can facilitate acceptance and appreciation of a new building by the occupants.

About the Author

Kent Barber, PE, LEED AP is the managing principal of Keithly Barber associates (KBA); a commissioning services firm based in Burien, Wash. Kent has been a commissioning services provider since 1992, and is a founding member of the Building Commissioning Association (BCA). He chaired the committee that developed the BCA's "Essential Attributes of Building Commissioning," a widely recognized benchmark for quality commissioning services. Kent has also developed commissioning guidelines and protocol such as the State of Idaho's guidelines for new building commissioning and retrocommissioning, and has been a leader in promoting and refining cost-effective proactive commissioning techniques. In over 15 years as a commissioning professional Kent has commissioned schools, universities, office buildings, healthcare facilities, laboratories, retail buildings, and correctional institutions. These projects range in size from a few thousand to hundreds of thousands of square feet, and have utilized many different project delivery methods including design/build, GC/CM and spec/bid/build. Prior to focusing his career on building commissioning, Kent's background included mechanical systems design and facilities consulting.

Critical & Underemphasized Building Turnover; Cx Can Help

"Sustainable" or "green building" organizations are helping to promote ever higher levels of new building efficiency and indoor environmental quality. The success of the U.S. Green Buildings Council's (USGBC) Leadership in Energy and Environmental Design (LEED) program demonstrates the impact that these organizations are having. Labs 21 and the Collaborative for High Performance Schools (CHPS) are examples of similar but more specialized programs. All of these programs utilize building commissioning to confirm that new buildings operate in accordance with the Owner's Project Requirements (OPR) and the design team's Basis of Design (BOD).

There has also been some emphasis on confirming that commissioned buildings continue to operate as intended. There is a growing recognition that buildings that don't continue to work right are not "green." To address this, *green building programs* and prominent commissioning guidelines typically promote reviewing building systems' performance nine to 12 months after a new building has been turned over to the owner. They may also encourage providing a means of measuring and verifying performance after construction.

The benefits of commissioning, retrocommissioning, recommissioning, and ongoing commissioning will never be fully realized, however, if buildings are not properly operated and maintained. The most efficient and healthy of buildings may quickly decline if the building operators and occupants do not understand the OPR, BOD, and functional operating characteristics of the systems. Recognizing this, *green building programs* and many commissioning guidelines encourage the development of a Systems Manual. Systems Manuals are intended to provide systems operators and future retrofit designers with critical information needed to maintain and operate the systems in accordance with the original intent. A good

Systems Manual describes the OPR, BOD and important systems' operating characteristics in a user friendly manner. Many building professionals believe in the premium value of a good Systems Manual and are surprised that providing a Systems Manual to the owner is optional under most "green building programs." As a result, many new buildings are not provided with Systems Manuals. Often when they are provided they are underutilized, or not used at all, because the project team and owner's operations and maintenance (O&M) staff aren't familiar with the purpose and intended use of the document.

The underutilization of systems manuals is a symptom of a widespread lack of emphasis on providing critical O&M documentation and training as part of turning over the building to the owner. The project team is often so focused on getting the building built that the transition to successful long-term operation is shortchanged. It's common for this to apply to designers, contractors, and even sustainability consultants and the owner's capital projects people. This is a critical shortcoming that must be resolved if people are serious about having buildings with high levels of indoor environmental quality and energy efficiency. The building commissioning process can be part of the resolution.

Fortunately there are owners and project teams that do employ successful procedures to efficiently turn new buildings over to the operators and user groups. Keithly Barber Associates has had the pleasure of working with some. In fact the firm has a client that won't allow their capital projects group to close a project until their operators formally accept the building. These turnover models involve the following key elements:

- Fully engaging the operating staff (and sometimes the user groups) in the commissioning process from the selection of the CxA, early in the project, through post occupancy commissioning.
- Clearly specifying, fully enforcing, and carefully documenting the receipt of turnover documentation and training requirements.
- Clearly identifying the importance placed by the owner on the Systems Manual and confirming that the Systems Manual responsibilities of the design team, CxA and contractor are clearly defined in their contracts.
- Providing systems overview training for the operators and utilizing the Systems Manual as the training reference.
- Providing training for the occupants on the capabilities and limitations of indoor environmental systems that are specialized, uncommon, innovative, or critical to the user group's mission.

Commissioning can play a major role in successfully implementing these important turnover functions. The following paragraphs describe how.

O&M Staff Participation in Cx Benefits Turnover

It is widely acknowledged that participating in commissioning activities such as installation review and functional testing is a fabulous way for the O&M staff to learn the details of the building systems. The knowledge gained clearly helps the O&M staff when they take over systems operation; however, the significant time investment deters many owners from taking

advantage of this great opportunity. Fortunately, providing a Systems Manual helps make up for this lost opportunity, as discussed in other parts of this paper. Involving the O&M staff in the earlier phases of project commissioning is also beneficial, and the time demands on the O&M staff are substantially less than for field verification and testing. The following paragraphs contain examples of how systems turnover may be facilitated by involving the O&M staff in the earlier phases of commissioning.

One of the most significant benefits of early O&M staff involvement is that the O&M staff is typically able to communicate the capabilities and limitations of the O&M resources better than anyone else. This is essential OPR and BOD level information that is overlooked surprisingly often; and yet, it is critical for the building systems to be consistent with the owner's O&M resources. Consider a highly energy-efficient design that requires fine tuning during the first year of operation. The design's potential for energy savings may not be realized if the O&M staff is so busy that it can't do the fine tuning. In the end, the staff may have to override some of the features that they can't tune, which could result in highly inefficient operation. It isn't necessary to look to highly sophisticated systems to see examples of this. Common energy saving strategies, such as resetting the duct static pressure setpoint to optimize VAV fan operation, are frequently rendered ineffective because they aren't monitored and fine tuned after occupancy. Another example from one of Keithly Barber Associates' projects involved a new LEED building that had to be maintained by a part-time O&M staff, based three hours drive from the site. Discovering this from the O&M staff during an OPR session significantly changed the list of systems that the engineer planned on considering.

The O&M staff may also be able to provide the specifications writers with important knowledge about the level of training most appropriate for their level of knowledge. In some cases the engineer's standard specification may not require enough training. A case in point might be a sophisticated staff that will provide full O&M on equipment than many faculties might have maintained under service contract. This staff is likely to require more detailed training and documentation. In other cases the staff may have already been fully trained on a system, such as an existing campus-wide automation system. In this case typical automation system training might be an unnecessary expense for the renovation of one of a campus building. Cases like these illustrate the value of involving the O&M staff in design phase commissioning, in order to help ensure that the contract documents address efficient owner turnover and important long-term O&M issues.

A final important point should be emphasized if design phase commissioning is to actually benefit the building turnover process. Though it's painfully obvious to state, project requirements and specification are of little value if they are not clearly communicated and enforced. Too often, sensible well-specified turnover requirements are conveniently overlooked in the haste to close-out the project. Efficiently turning a new building over to the O&M staff requires the project team and building owner to stand firm in enforcing the turnover requirements.

Systems Manual; a Bridge from Cx to O&M

As previously mentioned, installation review and functional testing provide the O&M staff with tremendous opportunity to learn the functional details of building systems before they take over operation. Unfortunately, this is an opportunity that is frequently passed up. Sometimes this is because the O&M staff is too busy, and sometimes the staff isn't hired until construction is nearly complete. A comprehensive Systems Manual is a good means of communicating operational information observed during commissioning to the O&M staff. As previously noted, however, Systems Manuals are often underutilized because project teams, owners, and O&M staff aren't familiar with the purpose and intended use of the documents.

This lack of Systems Manual understanding can be resolved by having the CxA provide Systems Manual training in conjunction with systems overview training. A good format for these sessions consists of a classroom session to introduce the Systems Manual purpose, content, and format; followed by an on-site walkthrough with the O&M staff. During the walkthrough the CxA summarizes the basis of design, walks through the basic configuration, and discusses operational characteristics while showing the trainees where to find the associated information in the Systems Manual. Video-recording maximizes the value of these sessions by providing CDs or DVDs that can be used for future reference and for training new O&M staff.

CxA Training Facilitates Occupant Acceptance and Appreciation

Another potentially useful, though rarely utilized, turnover tool is training for the building's users or occupants on the capabilities and limitations of the indoor environmental systems. Occupants that don't have this understanding may pressure the O&M staff to "fix" problems that don't exist, creating real problems in the process. Occupant training can be especially valuable if the systems are uncommon or innovative. For example, one of our LEED® projects involved a natural ventilation system. In summer, cool nighttime air is circulated to deliberately overcool the building in order to minimize high room temperatures during the warmer afternoon hours. The owner and occupants fully believed in the benefits of natural ventilation but didn't understand the overcooling strategy. Initially they arrived at work in the morning dressed in lightweight summer clothing. As they shivered away the first few hours they complained loudly about how poorly their new HVAC system worked. Once they understood how and why the system worked the way it did, they were happy to wear sweaters in the morning in exchange for cooler afternoon temperatures. Occupant training may also be advisable when the systems performance is critical to the successful use of the building by the occupants. Systems serving museums or labs are good examples of this.

Post Occupancy Review; Final CxA Confirmation of Successful Turnover

It is becoming increasingly common for commissioning plans to include post occupancy reviews. These are typically performed between eight and ten months after the building is occupied. The purpose is to assess how the systems have been operating during the first months of occupancy and identify warranty related issues before the warranty runs out. The post occupancy review is a good opportunity to observe through commissioning that the O&M staff has successfully taken over operation of the building. The following CxA services provide good indications of how effectively the systems are being operated:

- Redo trend log analysis performed as a part of the original functional testing plan; compare results to confirm that the systems continue to operate as they did at the conclusion of functional testing.
- Interview O&M staff regarding how well the systems have been operating; walk the systems with the O&M staff and review the condition; discuss O&M issues.
- Interview occupants regarding their satisfaction with the indoor environmental quality.

One Successful Cx Approach to Turnover

The following outline summarizes some of the effective ways in which our CxA firm has seen commissioning utilized to facilitate efficient turnover of systems operation to the O&M staff:

During Planning and Design

- Involve the O&M staff in establishing the OPR for service access to equipment, O&M documentation and training, and other O&M issues.
- Involve the CxA and the O&M staff in documenting Systems Manual Requirements in the OPR. Confirm the design team contacts support their involvement.
- Utilize the CxA design review with O&M staff involvement to confirm that BOD and plans and specifications address OPR requirements for O&M and the Systems Manual.

During Construction

- Involve the CxA and the O&M staff in regular site reviews to confirm installation in accordance with O&M needs.
- Involve the O&M staff in the CxA's installation review and functional testing.

At Turnover

- Confirm O&M documentation and training complies with the requirements of the project documents.
- Provide a Systems Manual and associated systems overview training; video record for future use.

At Post Occupancy Review

- Confirm systems continue to operate in accordance with the baseline documented during functional testing.
- Answer questions and provide additional information as requested by the occupants and O&M staff.
- Update the Systems Manual if appropriate.

Conclusion

The benefits of commissioning, retrocommissioning, recommissioning, and ongoing commissioning may be short lived if the O&M staff is not provided with the knowledge and documentation required to properly operate and maintain the building systems. The commissioning process can be utilized to facilitate efficient turnover of a new building for owner operation by: involving the O&M staff in the commissioning process; providing the O&M staff with a Systems Manual and related training; and facilitating acceptance and appreciation of a new building by training the occupants on the capabilities and characteristics of the indoor environmental systems.