

17th NATIONAL CONFERENCE ON BUILDING COMMISSIONING



EFFICIENCY • PERSISTENCE • PERFORMANCE

Owner/Operator Involvement in Cx Cx to Facilitate Owner Training & Turnover

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Solutions for Better Buildings

AIA Quality Assurance



Learning Objectives

- 1. Understand how turnover is critical to long term Cx success**
- 2. How Cx can be utilized to facilitate turnover by:**
 - a. Involving owner's staff in the Cx process**
 - b. Providing a Systems Manual & systems training**
 - c. Incorporating a TOP checklist into the Cx Process**
 - d. Training new building occupants on the capabilities and characteristics of the indoor environmental systems**
 - e. Assessing turnover success at post-occupancy review**

Turnover; Critical & Underemphasized

Who are you?

- CxAs
- Architects
- Design Engineers
- Contractors
- Owner's construction management staff
- Facilities & O&M staff

Turnover; Critical & Underemphasized

Turnover Definition

- The process of turning the building over to the owner
 - Typically from the contractor
 - At the end of construction
 - Before the building is occupied

Turnover; Critical & Underemphasized

Turnover

- Simple definition
- **VERY IMPORTANT PROCESS**

Turnover; Critical & Underemphasized

Why is it so important?

Because:

- An inadequate turnover is a setup for inappropriate, ineffective, inefficient & poor building O&M
- Caused by failure to provide adequate O&M resources along with the building

Turnover; Critical & Underemphasized

Why is it so important?

Because:

- Inadequate O&M leads to systems that don't function correctly over time, even if they've been properly designed, built & Cx 'd
 - buildings that don't work right

Turnover; Critical & Underemphasized

Why is it so important?

Because:

- Buildings that don't work right after turnover
 - Don't satisfy the owner's needs
 - Aren't socially responsible
 - Aren't "Green"
- Regardless of design awards, certifications or plaques on their walls

Turnover; Critical & Underemphasized

A Good Turnover process is Critical

In order to avoid

Good Buildings

– well designed, well built & well Cx'd –

That Don't Work

Turnover; Critical & Underemphasized

Effective Turnover Process

- Should include turning over all the project specific resources
 - Documentation
 - Training
 - Equipment

needed to operate & maintain the systems per OPR, BOD & Cx FPT baseline

Turnover; Critical & Underemphasized

Lets discuss critical turnover components

- Documentation
- Training
- Equipment

Starting with documentation

Turnover Documentation

Effective Turnover Documentation Characteristics

- User friendly
- Systems level knowledge
- Thorough design & construction history
 - Facilitates understanding why the systems are designed and installed the way they are
 - Provides knowledge about methodology used, which may prove useful during troubleshooting

Turnover Documentation

Commonly limited to:

- As-built plans
- O&M manuals
 - May include construction reports

Turnover Documentation

Complete Turnover Documentation

- As-built plans
- O&M manuals
- Construction test plans & reports
 - i.e. hydronic system flushing plans, duct testing results, TAB agenda
- OPR & BOD
- Commissioning records
- Systems Manual

Turnover Training

Now what about training?

Turnover Training

Turnover Training - Traditional

- Contractor provided
- Typically manufacturer oriented
- Equipment & component focused
 - Equipment overview/walkthrough
 - Equipment O&M training
- Lacks project-specific systems level training

Turnover Training

Project-Specific Systems Level Training

- Project-specific system oriented training is needed to understand
 - Understand how the systems are intended to function
 - How the systems interact with one another
 - The overall affects to the building of making changes to or not maintaining specific components, equipment and systems

Turnover Training

Project-Specific Systems Level Training Includes

- Systems level operator training
- Building occupant/user training

Turnover of Critical O&M Equipment

What is project specific O&M equipment?

Turnover of Critical O&M Equipment

Project specific O&M equipment includes

- Project specific test & calibration equipment
- Critical, hard to obtain, or commonly needed spare parts

Turnover of Critical O&M Equipment

Project specific test & calibration equipment

- Not found in typical O&M tool box or workshop
- Examples include
 - gas sensor calibration kits,
 - flow meter ΔP curves
 - control system interface devices such as laptops with interface software

Turnover of Critical O&M Equipment

Critical, hard to obtain or commonly needed spare parts

- Critical if failure shuts down the building functionality; i.e. some lab environmental systems, key life safety components
- Hard to obtain if sources are limited or remotely located; i.e. custom or foreign manufactures
- Commonly needed due to
 - frequent failure; i.e. room temp sensors in high traffic areas
 - or owner's preferences; i.e. maintenance SOP to swap out water source heat pump for maintenance

How can Cx facilitate turnover?

How do we utilize Cx obtain the key turnover components?

- documentation,
- training
- equipment

How can Cx facilitate turnover?

Consider:

- Owner Cx participation
- Systems Manual & training
- Turnover process/package (TOP) documentation
- Occupant training
- Post-Occupancy Review

How can Cx facilitate turnover?

Lets start with

the benefits of Owner participation
in the Cx process

Benefits of Owner Cx Participation

Widely accepted by Cx experts

- Owners benefit from participating in Cx
- The project benefits from owner engagement

Why?

Benefits of Owner Cx Participation

Building O&M Staff & Occupants add value to design & construction

- OPR information directly from users and operators
- Operators provide maintenance oriented shop drawing and installation review



- Results in a product more likely to provide user & operator satisfaction

Benefits of Owner Cx Participation

Cx helps building operators & occupants understand the building

- Operators & users exposed to OPR → BOD → CDs → building development process
- Installation review and functional testing expose operators to systems configuration and performance
 - Equivalent to years of normal operating experience

As a result

- They understand the building

Benefits of Owner Cx Participation

Unfortunately, **participating in installation review and functional testing** is:

- **Time intensive** – not all owners can afford
- **Not always possible** – operating staff may not be hired until turnover

However;

Benefits of Owner Cx Participation

Fortunately Cx can facilitate turnover at project closeout and post-occupancy

- The Cx process can also facilitate via:
 - Systems Manual
 - Turnover package review
 - Occupant training
 - Post-occupancy review

Let's talk about how

Systems Manual; Bridge from Cx to O&M

Let's start with the Systems Manual

And how to use it as a bridge

- From systems commissioning to operation

Systems Manual; Bridge from Cx to O&M

Systems Manual; relatively new concept

- Let's review that concept

Systems Manual concepts

- 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.

Systems Manual concepts

- A good Systems Manual describes the OPR, BOD and important systems' operating characteristics in a user friendly manner.

Systems Manual concepts

- A comprehensive Systems Manual is a good means of communicating operational information observed during commissioning to the O&M staff

Systems Manual; Bridge from Cx to O&M

Systems Manuals are underutilized

- Project teams, Owners & O&M staffs lack familiarity with purpose, use & maintenance
- Inexperienced manual developers may not provide a user friendly document
- Often considered optional
 - LEED programs are an example

Systems Manual; Bridge from Cx to O&M

Awareness & training are the keys to effective Systems Manual utilization

How do we accomplish this?

Systems Manuals; Awareness & Training

- Early in design:
 - Make team aware of the concepts and value
 - purpose, content & use
 - Document the OPR for
 - purpose, content & use
 - Team responsibilities
 - Facilitates cost effective development

Systems Manuals; Awareness & Training

- Throughout design & construction design:
 - Confirm construction documents support SM OPR
 - Confirm contractor submittals support SM OPR
 - Compile SM as documents are submitted
 - Complete SM at turnover rather than post-occupancy

Systems Manuals; Awareness & Training

At construction closeout/turnover:

- Provide a hands-on session to familiarize O&M staff with manual
 - purpose,
 - content
 - use
 - Navigation through the document
 - Keeping it updated

Systems Manuals; Awareness & Training

At construction closeout/turnover

- Systems overview/walkthrough
 - Systems Manual as training manual
 - Systems Manual cross-referenced during walkthrough

Systems Manuals; Awareness & Training

At construction closeout/turnover

- Video-recording systems manual/overview training sessions maximizes value
 - Future referencing and refresher training
 - Training of new employees

CxA Role in Final Turnover Process

How can Cx be utilized to facilitate final owner acceptance?

CxA Role in Final Turnover Process

How can Cx be utilized to facilitate owner acceptance?

Traditionally –

- make recommendations or provide information to owner regarding:
 - Systems performance
 - Systems acceptance
- Based on
 - prefunctional testing/ system readiness review
 - functional performance testing

However →

CxA Role in Final Turnover Process

Importance of turnover

for long-term Cx success suggests that –

- confirming a complete turnover package for Cx'd systems should be added to the Cx process.

CxA Role in Final Turnover Process

Turnover Package (TOP) Checklist

- Cx process confirms that:
 - Turn Over Package (TOP) requirements are specified
 - TOP activities and deliverables are scheduled
 - TOP checklist is completed to methodically document requirements completion

CxA Training to Facilitate Owner Acceptance

How can Cx facilitate acceptance & appreciation of the building by the users and occupants?

CxA Training to Facilitate Owner Acceptance

Building Occupant/User Training Subjects

- OPR & Design goals
- Systems capabilities
- Reasonable occupant/user expectations
- Occupant/user responsibilities

CxA Training to Facilitate Owner Acceptance

Building Occupant/User Training

- Especially valuable when indoor environmental systems are
 - specialized, uncommon or innovative
 - critical to the user group's mission

Post-Occupancy Review, Final Confirmation

Post-occupancy review –
the turnover final exam

Post-Occupancy Review, Final Confirmation

Final CxA systems assessment

- Systems performance after 8 to 12 months is an indicator of turnover success.

Post-Occupancy Review, Final Confirmation

Final CxA systems assessment

- Post-Occupancy review provides an opportunity for follow-up
 - Systems level operator training
 - Building occupant/user training
- Answer questions and provide additional information as requested by the occupants and O&M staff

A Successful Cx Approach to Turnover

Real World Application Cx to Facilitate Effective Turnover

Observations from past success stories

A Successful Cx Approach to Turnover

Planning & Design Phase – OPR

Involve operators & occupants in developing & confirming OPR for:

- System Capabilities
- O&M access and preferences
- TOP content
- Systems Manual content and configuration

Confirm contacts support AE involvement

A Successful Cx Approach to Turnover

Construction Phase –

Involve the CxA and the O&M staff in

- regular on-going site reviews to confirm installation in accordance with O&M needs.
- Cx installation review and functional testing as a learning experience

A Successful Cx Approach to Turnover

At Turnover – TOP scheduling & checklist

Confirm O&M documentation and training:

- Fully identified & scheduled
- Checklist completed

A Successful Cx Approach to Turnover

At Turnover – Systems Manual & Training

- Manual purpose, content, use & maintenance
- Associated systems overview training
- Video record for future use

A Successful Cx Approach to Turnover

At Turnover – Occupant Training

- Systems capabilities
- Occupant responsibilities

A Successful Cx Approach to Turnover

At Post-Occupancy Review – Systems

- 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

Conclusions

Effective turnover is critical for long term functionality

- The benefits of commissioning, retrocommissioning, recommissioning and ongoing commissioning may be short lived if turnover is neglected

Conclusions

The commissioning process can be utilized to facilitate efficient turnover of a new building for owner operation

Thank You

Best to You in Your Work

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