An Introduction to the Building Commissioning Process

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Agenda

• Gain an understanding of the building commissioning process
• Document the benefits of the commissioning process
• Identify some key attributes and deliverables of the commissioning process
• Introduce special applications of the commissioning process
The Building Industry is Broken

- Construction productivity is flat
- 30% of projects are delivered behind schedule
- Change orders account for 10% of final building cost
- 92% of owners state that design drawings are not sufficient for construction
What is The Commissioning Process?

- An owner driven process
- Composed of activities completed by the owner (or owner representative, third party provider) to verify quality
- Work and service is verified with statistical sampling, not inspection
  - Verify as we go - pre-design, design, construction, and the first year of occupancy
- Focus on the life of facility, not the first day of occupancy
- Uses a plan to achieve a quality project, reduce cost, and verify all activities during all phases of a building project
  - Improved quality results in lower project cost
The Commissioning Process vs. Commissioning

- **Commissioning Process**
  - The overall owner’s quality delivery process
  - Defined by ASHRAE Guideline 0-2013
  - Begins in pre-design and lasts through 1st year of operation

- **Commissioning**
  - Can be building commissioning or systems commissioning
  - Often limited in scope (FPT or start-up commissioning), and often performed by a sub to the general contractor (usually involves checklists and testing)
  - Still very common

The Commissioning Process

- Provides benefits to all size and complexity of projects (homes to multiple-building campus)
- Ideal for complex buildings and projects
- Ideal for implementing new concepts & technologies in buildings
  - Green/Sustainable
  - High-efficiency
  - Renewable energy
  - Designed for maintainability
- Works well for existing buildings
  - Change in use
  - Energy efficiency improvements
  - Indoor environmental quality
Why Do It?

- Balance the triple constraints of project management – cost, quality and schedule
- Productivity improves with increased coordination
- Quality improves with less rework
- Cost improves with fewer change orders
- More bang for your buck

Main Concept to Remember

The Commissioning Process is a Quality-Based Process
The Commissioning Process

- Every step was created for a reason: to improve quality in a common problem area.
- Not every project uses every step...
- ...and there can be more steps than shown here.
- Starts at project inception and continues through one year of operation.

Cx in Planning:

**Documenting the Owner’s Project Requirements (OPR)**

- OPR is the heart of the commissioning process.
  - Is a “living” document (updated as decisions are made).
  - Provides guidance throughout project for designers, contractors and O&M staff.
  - Defines how the owner will measure the success of the project.
  - Simplifies designers’ programming or pre-design effort.
Cx in Design: 
**Design Review**

- An independent quality review that verifies design drawings achieve the OPR
- Eliminates addendums and change orders
- A four-step process:
  1. Review for general quality
  2. Review for coordination between trades
  3. Detailed review of each discipline
  4. Review of the specifications

Cx in Construction Phase:
**Submittal Review**

- Independent review to verify submittals and substitutions meet OPR
- Accomplished concurrently with design team and owner review
- Input provided to design team for integration with their comments
Cx in Construction Phase:  
*Installation Quality Verification (via Site Visits)*

- Trades use checklists to avoid systemic errors
- Checklist completion and accuracy randomly verified during site visits by Cx Authority (CxA)
- GOAL: avoid rework
- Record documentation regularly verified by CxA
- Team meetings held to resolve quality issues and roadblocks
- Focus on trade coordination and achieving the OPR
- Site visit reports, meeting minutes, Issues log

Cx in Turnover Phase:  
*Systems (O&M) Manual*

- Contractors submit contents earlier (near the start of construction)
- Avoids last minute effort
- Focus is on systems, not just components
- Final review by CxA near end of construction
- Used as an integral part of the training sessions
Cx in Turnover Phase:  

Training

- Presented in small doses during construction and turnover
- Allows staff time to absorb info and think of questions
- Verified/witnessed by CxA
- Format is per owner preference, but must be detailed carefully in specifications
  - Number of hours per topic
  - Classroom and/or Walkthroughs
  - Hands-on and/or “What if” scenarios
  - Professionally videotaped

Train, Train, Train

- Demand adequate time for owner/operator training prior to building turnover
- Specify follow-up training
- The untrained operator always wins
Training

- First session, presented by Commissioning Authority, focuses on the Owner’s Project Requirements
- Second session, presented by the designers, focuses on the Basis of Design
- Third session, presented by contractors, focuses on equipment operation, maintenance, service

Cx in Turnover Phase:

**Functional Performance Testing**

- CxA writes tests, instructs the contractors and documents the results
- Verifies the OPR has been met, systems work seamlessly
- Tests all commissioned systems, like envelope, electrical, mechanical...
- The final report card for entire Cx process
  - GOAL: systems work properly _NOW_, not months later
  - Provides documentation of completion to both owner and contractors
Adaptable Process

• Every building and Cx project is different
• Scope of work will vary
  • Depends on size of project, system complexity, and budget
• Adapt the process to meet the project’s specific goals

Special Applications of the Cx Process

• Building Enclosure Commissioning
• Existing Building Commissioning
The Building Enclosure: Reasons for Concern

- Moisture in buildings can lead to health problems
- Moisture in buildings waste energy
- Moisture problems are expensive to fix
- Moisture problems are a professional risk
- Building enclosure failures are becoming more prevalent

Sustainability and Energy Security

- Sustainability will mean more engineered materials
- More engineered materials will mean more of a mold risk
- Sustainability and energy security will mean higher levels of insulation and tighter enclosures
- Higher levels of insulation and tighter enclosures will mean lower drying potential
- Lower drying potential will mean more mold
Relative Order of Importance

1. Water entry
2. Air leakage
3. Vapor diffusion
Water Entry Prevention

Most building failures are caused by excessive water leakage

“When water comes into buildings, it comes in through the cracks between the design and the construction professions”

William Rose, Water in Buildings
Hunting for Holes

• Where are the big holes in buildings? They are everywhere.....
• Common culprits:
  ✓ Parapets
  ✓ Car ports/canopies
  ✓ Cantilevers
  ✓ Dropped ceiling assemblies
  ✓ Elevator shafts/penthouses
  ✓ Window to wall assemblies
  ✓ Awnings
  ✓ Facades
  ✓ Covered walkways
  ✓ Anywhere a framing system joins a wall
  ✓ Electrical boxes
  ✓ Chases
  ✓ Service penetrations

Potential water leak sites

1. Scupper and downspout
2. Parapet cap flashing
3. Control joint
4. Wall-window interface
5. Balcony door threshold
6. Balcony rail attachment
7. Vent hood
8. Downspout attachment
9. Saddle detail
10. Deck drain
11. Junction between different materials
12. Window head
13. Window jamb
14. Windowsill
15. Overflow scupper
16. Planter
17. Wall-concrete slab interface
18. Balcony-wall interface
Types of Building Enclosure Testing

- Air Infiltration
- Water Penetration
- Water Absorption
- Condensation
- Structural Load
- Seismic Racking
- Thermal Performance
- Acoustics
- Accelerated Aging
- Adhesion
- Anchor Pull-out
- Infrared Thermography
- Whole Building Air Tightness
BECx Schedule
Schedule must accommodate the BECx Process

Existing Building Commissioning
Time to Re-Commission?

• Building renovated or remodeled?
• Unjustified increase in energy use?
• Energy use more than 10% higher than previous years?
• Systems are no longer integrated?
• Increase in comfort/IAQ complaints?
• Increase in nighttime or unoccupied energy use?
• Building staff aware of issues but lack the time or expertise to fix them?
• Controls modified or overridden to provide a quick fix to a problem?
• Frequent equipment problems/poor reliability?
• More than 5 years since last commissioning effort?
Similarities Between EBCx and Cx

• Heavily owner/user driven
• Team formation
• Working as a team to build quality into the building
• Determining functional needs and requirements
• Verification followed by functional testing
• Producing a report and a systems manual

Differences Between EBCx and Cx

• CFR is used in lieu of OPR
• There may not be any design plans or specs, or design team, present
• There will not be construction contractors to make repairs
• There will not be equipment submittals to review
• EBCx requires troubleshooting, investigation and problem solving skills
EBCx Benefits

- Improved system operation
- Improved equipment performance
- Increased O&M staff capabilities
- Increased asset value
- Energy savings
- Improved IAQ/IEQ
- Improved building documentation

EBCx Savings

- Both energy and non-energy savings
- Vary depending on building type, its location, and the scope of the EBCx process
- Savings can be significant
- Quick payback
• Questions?