



# CxA Gap Session

April 25, 2017  
2:00 p.m. – 4:30 p.m.

## Instructors:

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AIA Provider Number 50111116



## Course Description

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This session and short quiz, focused on existing building and ongoing commissioning, fulfills an important ANSI recertification requirement for CxA's certified prior to April 2016. [The other option is to retake the CxA examination.] The session is offered free of charge to ACG-certified individuals, however for planning purposes you must register in advance.

Credit(s) earned on completion of this course will be reported to **AIA CES** for AIA members. Certificates of Completion for both AIA members and non-AIA members are available upon request.

**CES** for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product.

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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

This course is registered with **AIA**



# Learning Objectives

At the end of this program, participants will be able to:

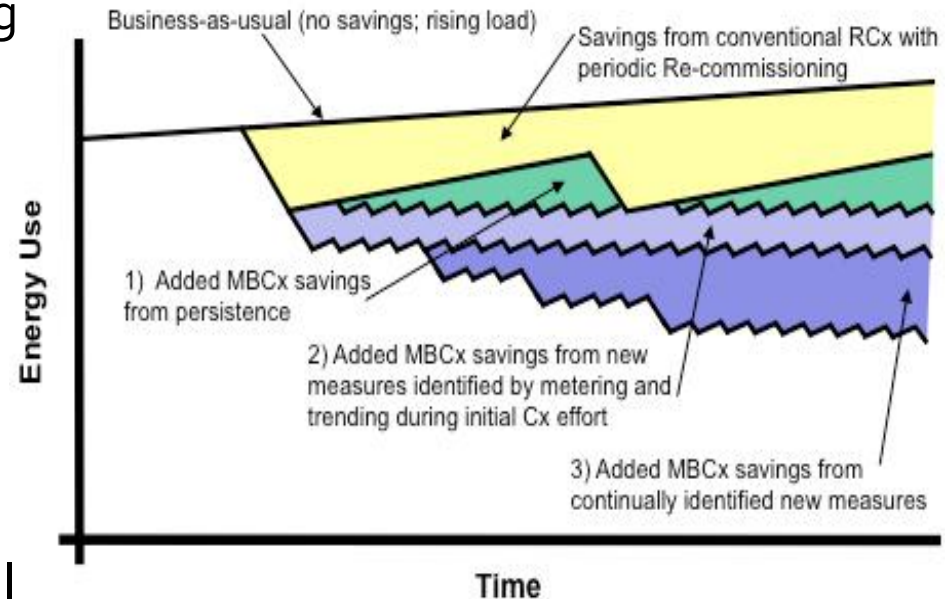
- Distinguish the key differences that distinguish existing building commissioning from new construction commissioning.
- Describe the process, documentation and deliverables that are essential to the delivery of quality existing building commissioning services.
- Explain the process of key elements of ongoing commissioning, and how it is similar to the post-acceptance phase of new construction commissioning.
- Describe the elements and process of creating a systems manual for a commissioned project, and its role in ensuring that benefits persist.

# Existing Building Commissioning

# Existing Building Commissioning Process

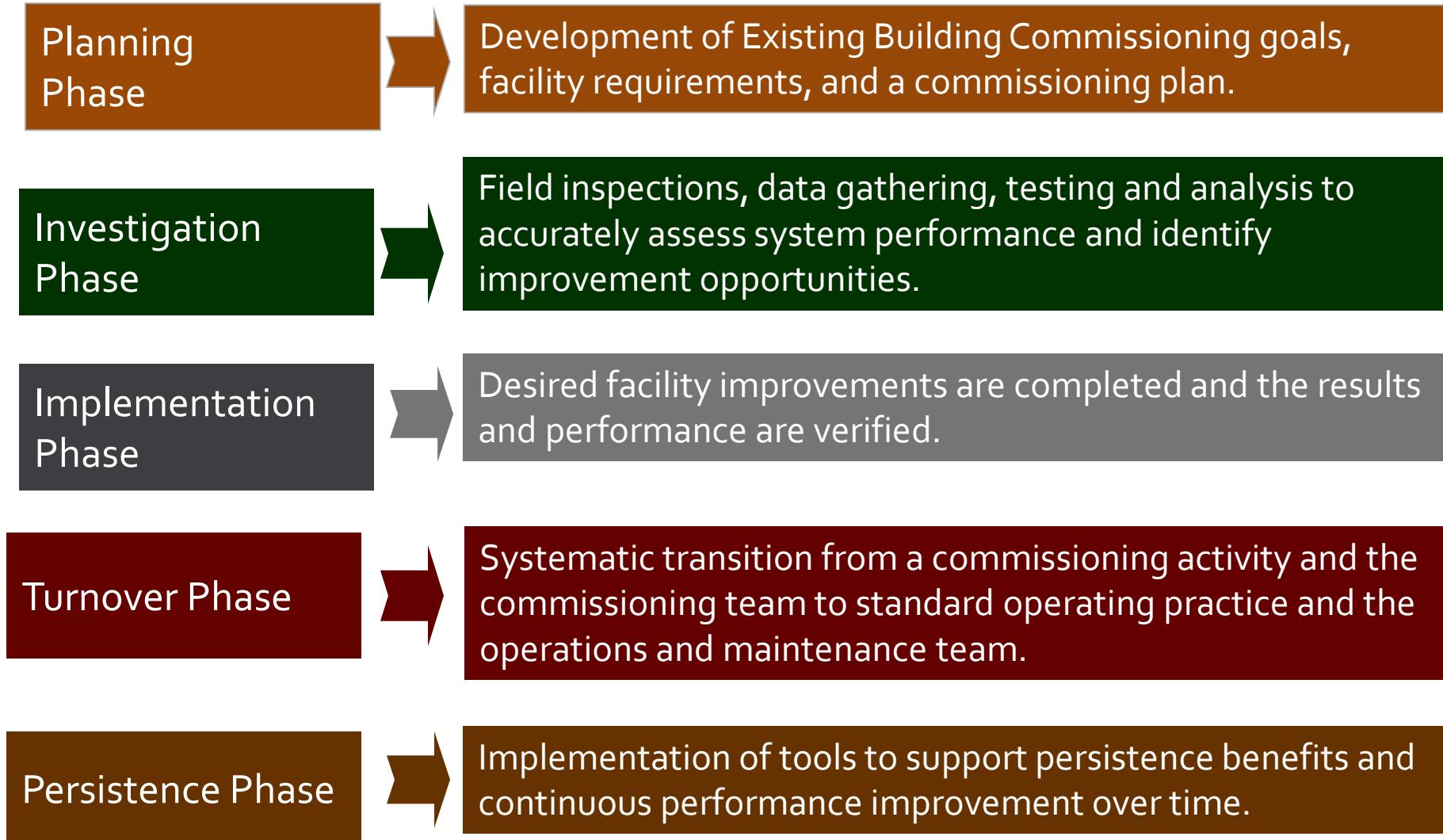
# What is Existing Building Commissioning (EBCx)?

- Existing Building Commissioning (EBCx)
  - Retro-Commissioning (RCx)
  - Re-Commissioning (Re-Cx)
  - Ongoing Commissioning
  - Monitoring-Based Commissioning (MBCx)
- EBCx benefits include energy consumption and environmental emissions reductions, improved indoor environmental quality, risk mitigation and water conservation.



Source: Lawrence Berkley Lab's 2009 study

# EBCx Process





# EBCx Process Overview

- Select an Appropriate Project
- Determine Project Scope
- Benchmarking
- Prepare a CFR
- Conduct a Systems Assessment
- Prepare Investigation Phase Report
- Oversee Implementation Of Corrective Measures
- Conduct Performance Verification



# EBCx Process Planning Phase

- **Select an Appropriate Project**
  - Facility questionnaire to Owner and O&M staff
  - RCx Agent work with Owner to select best building candidates
  - Weigh occupant complaints
  - Consider work order frequency
  - Energy consumption compared against similar facilities
  - Tailor RCx scope to meet the Owner's needs and budget options



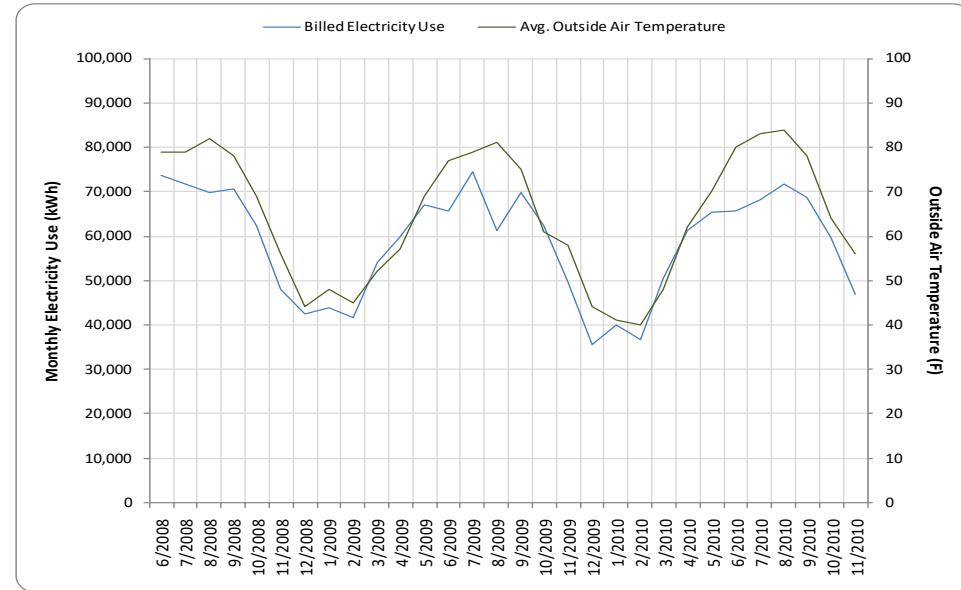
# EBCx Process Planning Phase

- **Set Project Objectives**
  - The planning process phase is about defining the goals and objectives for the project.
  - Determine scope of the project or an outline of the procedures and processes to be implemented.



# EBCx Process Planning Phase

- **Documentation Gathering**
  - Utility data
  - Design documents
  - Work order history
  - TAB report (if available)
  - O&M manuals



# EBCx Process Planning Phase

## Benchmarking

- Building Based:
  - Annual Utility Consumption from Billing
  - Calculate EUI (energy use per SF)
  - Compare to databases available
- Use EUI to identify Existing Building Commissioning EBCx potential and best candidates for EBCx
  - Consider any unique differences in your building systems or equipment as compared to typical buildings in the benchmark database



**Planning  
Phase**

Investigation  
Phase

Implementation  
Phase

Turnover Phase

# Current Facility Requirements

- CFR defines the current operational needs and requirements of the facility.
- Needs are defined with realistic, but specific targets:
  - Space Allocation
  - Energy Use Expectations
  - Temperature/Humidity
  - Hours of Operation
  - Lighting Levels
  - Pressurization
  - Referenced Standards
- CFR often different than the original design requirements

| CURRENT FACILITY REQUIREMENTS  |                        |
|--|------------------------|
| GEORGIA INSTITUTE OF TECHNOLOGY BRITTAIN DINING HALL RETRO-COMMISSIONING | <b>EpstenGro</b>       |
| ATLANTA, GA  | High-Performance Build |
| JUNE 27, 2014  |                        |
| <b>a. BUILDING OCCUPANCY REQUIREMENTS</b>                                |                        |
| a. Occupant Count:   |                        |
| i. Dining Area: 200 (confirmed with GT count data)                       |                        |
| ii. Serving: 50 (confirmed with GT count data)                           |                        |
| iii. Kitchen: 25   |                        |
| iv. Laundry: 12 (confirmed with GT count data)                           |                        |
| v. Flex Space:   |                        |
| vi. Conference/Meeting Space: Square footage/10 = Max Load               |                        |
| b. Occupancy Schedule  |                        |
| i. Weekdays: 7 AM – 8 PM   |                        |
| ii. Weekends: SUN 11 AM – 8 PM   |                        |
| iii. Summer: Closed  |                        |
| <b>b. FUNCTIONAL USES</b>  |                        |
| a. Dining Area   |                        |
| i. Space Condition Parameters:   |                        |
| a. Cooling: 75   |                        |
| b. Heating: 70   |                        |
| c. Adjustment Range Allowed:   |                        |
| d. Relative Humidity: 50%  |                        |
| ii. Pressurization:  |                        |
| 1. Positive with respect to serving area, kitchen area, and outside      |                        |
| iii. Lighting  |                        |
| a. Fixtures: Re-lamped with CFL in 2012                                  |                        |
| b. Switching: Timer  |                        |
| b. Serving Area  |                        |
| i. Space Condition Parameters:   |                        |
| a. Cooling: 75   |                        |
| b. Heating: 70   |                        |
| c. Adjustment Range Allowed:   |                        |
| iv. Lighting   |                        |
| a. Fixtures: Replaced during renovation                                  |                        |
| b. Switching: Timer  |                        |

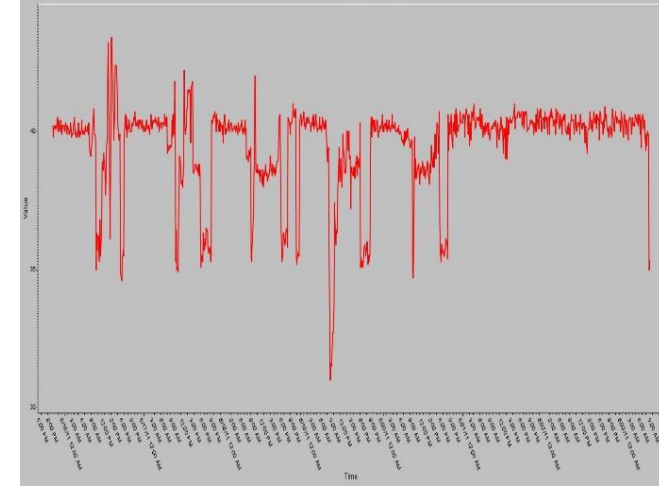
# EBCx Process Planning Phase

- **Develop Existing Building Commissioning Plan**
  - After reviewing the building documentation and gaining a clear understanding of the project goals, develop the Existing Building Commissioning (EBCx) Plan
  - Owner and Owner's staff must have input and review
  - Clearly identify roles and responsibilities and layout the intended Investigation Phase schedule



# EBCx Process Investigation Phase

- **Perform a System Assessment**
  - Setup trend data and/or launch dataloggers
  - TAB measurements (sampling)
  - Perform System Functional Testing
    - HVAC and controls
    - Lighting
    - Plumbing
  - Perform Simple Repairs
  - Develop and Maintain Master Findings List





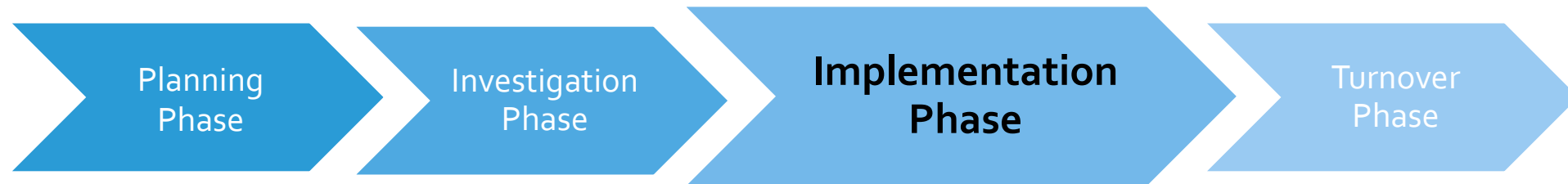
# EBCx Process Investigation Phase

- **Investigation Phase Report**
  - Executive Summary
  - Systems Summaries
  - Findings
  - Recommendations
    - FIMs and ECMs
    - Organized by priority
  - Cost estimates for each FIM and ECM
  - Simple payback calculations for ECMs
  - Appendices (CFR, Master List, trends, calculations)



# EBCx Process Implementation Phase

- Develop Implementation Phase Cx Plan
- Implement FIMs and/or ECMs
- Verify the Selected Improvements



# EBCx Process Implementation Phase

- **Recommended Corrections And Improvements**
  - The owner selected measures could be implemented by the EBCxA, the building staff, or by subcontractors.
- **Oversee Implementation Of Corrective Measures**
  - Putting the selected processes into place and verifying that the retro-commissioning process implemented works as intended.
- **Conduct Performance Verification**
  - Verify performance of systems over time against the baseline established from benchmarking and/or energy modeling.



# EBCx Process Turnover Phase

- Develop Final Report
- Compile a “Systems Manual”
- Develop a Re-Commissioning Plan
- Provide Training
- Hold Close – Out Meeting
- Implement Persistence Strategies



## EBCx Process Turnover Phase

- The hand-off process is started after all approved measures have been completed.
- During this phase, final reporting will be conducted and the facility staff will be trained.
- Persistence strategies (possible on-going commissioning) should be identified so that ongoing activities can be adopted to ensure that the benefits last.
- Compile a complete systems manual



## Post Acceptance Phase/Ongoing Cx Overview

- Correct unresolved deficiencies and conduct required re-tests
- Carry out specified off-season testing
- Perform specified post-occupancy monitoring
- Review usage changes
- Update commissioning documentation



# Post Acceptance Phase

## Correct unresolved deficiencies:

- Unresolved RTF (Resolution Tracking Form) issues
- Uncompleted CM/Owner punch lists
- Conduct required re-tests
- Outstanding or additional training



# Post Acceptance Phase

## Carry out specified off-season testing:

- Coordinate with Owner, O&M team
- FPTs per the Commissioning Plan
- Choose near-design day
- Build on completed FPTs
- Utilize BAS trending PRIOR to testing





# Post Acceptance Phase

## Post-occupancy monitoring:

- Scheduled site visits
- Remote (web) monitoring
- Warranty items
- Owner conference
- User conference



# Post Acceptance Phase

## Review usage changes:

- Computers / office machines
- Furniture placement
- Occupancy change
- Closet to office
- Energy saving methodology



# Post Acceptance Phase

## Update commissioning documentation:

- Resolved issues
- Off-Season tests
- Usage Changes
- Provide additional volume for Cx Report



# Post Acceptance Phase

## Continuous / Ongoing Commissioning Plan:

- Encourage O&M team to repeat BLANK FPTs, ISTs seasonally, major renovations
- Document modifications
- Part of PM Plan



# Systems Manual

## Acceptance Phase

### Definitions (from ASHRAE 202)

***Systems Manual:*** the Owner shall require, by agreement, the development and delivery of a project Systems Manual and that deliverables be provided for the Systems Manual in accordance with Chapter 14 of this standard. The Owner shall ensure that specific entities are designated for the development and assembly of the Systems Manual and the Facility Guide.



# Acceptance Phase

**"Systems Manual: should include (but not limited to the following:**

- *Executive Summary*
- *Facility Design and Construction*
- *Building, Systems, and Assemblies Information for Cx'ed Systems*
- *Facility Operations*
- *Training*
- *Final Commissioning Report"*

*Source: (ASHRAE 202-2015)*



# Acceptance Phase

## Systems Manual:

- Executive Summary
  - Brief written description of system operations
  - Reference BOD, FPTs, submittals to support development





# Acceptance Phase

## Systems Manual:

- Facility Design and Construction
  - Copy of OPR
  - Copy of BOD
  - Copy of design and record documents
- Extract only those that pertain to that particular system you are writing



# Acceptance Phase

## Systems Manual:

- Building, Systems, and Assemblies Information for Cx'ed Systems
  - Copy of Building and Equipment Specifications
  - Copy of Approved Submittals including Final Sequence of Operations
  - Copy of Warranties
  - Contractor and Supplier Listing and Contact Information
- Extract only those that pertain to that particular system you are writing



# Acceptance Phase

## Systems Manual:

- Facility Operations
  - Operating Plan
  - Building and Equipment Operating Schedules, Set Points, Ranges and Limitations
  - Commissioned Systems Control Sequences of Operation
  - Emergency Shut Down Actions



# Acceptance Phase

## Systems Manual:

- Training
  - Copy of Training Plans
  - Copy of Training Materials
  - Training sign-in sheets



# Acceptance Phase

## Systems Manual:

- Final Commissioning Report
  - Copy of Final Cx Plan
  - Copy of Design Review and Submittal Review Comments
  - Copy of Testing and Start up Reports, evaluation checklists, and testing checklists completed for Commissioned Systems and Assemblies
  - Copy of all Cx Progress Reports
  - Copy of Issues and Resolution Logs
  - Item Resolution Plan for open items.



# Acceptance Phase

## Systems Manual:

- Assembly of the Manual is NOT solely the CxA responsibility
- Develop a Responsibility Matrix and include in the Cx Plan

| Component   | Responsible Party |
|---|-------------------|
| System Descriptions   | CxA               |
| Basis of Design (Final)                                     | A/E               |
| Owner's Project Requirements (Final)                        | Owner             |
| Cx team Contact List  | CxA               |
| Warranty Letters  | GC/CM             |
| Substantial Completion Certificate                          | GC/CM             |
| Recommended Re-testing Schedule                             | CxA               |
| Recommended Sensor and Actuator Calibration Schedule        | BAS Contractor    |
| OIIBS - Narrative   | CxA               |
| OIIBS - BAS graphics  | BAS Contractor    |
| OIIBS - Sequence of Operations                              | BAS Contractor    |
| OIIBS - Original Set-Points                                 | BAS Contractor    |
| OIIBS - Trends  | BAS Contractor    |
| Approved Submittals   | GC/CM             |
| Final TAB Report  | GC/CM             |
| Install Manual and Parts List                               | GC/CM             |
| Maintenance Schedules                                       | GC/CM             |
| Completed FPT   | CxA               |
| Blank Functional Performance Test - Final Ready for Testing | CxA               |



# Acceptance Phase

## Systems Manual:

- LEED v2.0 Guideline provides good guidance on Systems Manual components
- Work with Owner
  - Define usage requirements
    - Electronic delivery
    - Web-based
    - How will it be stored or referenced by the O&M team in the building?
  - Have they received SOMM's previously? Do they have a standard or a preference you should follow?

