# Technical Commissioning Delivers a Functional Building

There are two basic approaches to the work of Building Commissioning:

1. **Technical Approach**

   Commissioning Agent (along with Cx technicians from the Cx firm) conducts all commission work on-site.

2. **Process Approach**

   Commissiong Agent MAY witness checks and tests or may just compile results. Contractors are responsible for performing commissioning checks and tests of their own work.

At Cooper Commissioning, **we strongly recommend the technical commissioning approach** over the process approach. To understand why, one does have to get into the details a bit! We invite you to look at page 2-3 for a table summarizing the services offered by the two approaches, pages 3-4 for issues we find in our work, and pages 5-6 for excerpts from specifications for a process Cx approach with annotations to highlight things to look out for (and issues we saw with this spec in general!).

**COST:**

**It may be the case that the fee you see for a process approach is lower than a technical approach. However, if the process Cx approach is taken, several other contractors will need to increase their fees to account for the Cx burden placed on them.**

- **Technical Approach –** Cx Agent performs all Cx work. Contractors only address deficiencies, at no additional cost to the Owner.

- **Process Approach –** all involved contractors must account for time to complete the Cx work. This results in 4 to 6 contractors (MEP, TAB, TC, Cx) charging the Owner for Cx time, making the real cost of the process approach much higher than only the Cx Provider's fee. In addition, a process approach misses issues that will need to be addressed later, further increasing its true cost.

**Abbreviations used:**

Cx = Commissioning

CCx = Our firm, Cooper Commissioning

MEP: Mechanical, Electrical, Plumbing

TAB: Testing, Adjusting, and Balancing

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| **Technical Cx Approach as done by Cooper Commissioning** | **Process Cx Approach – does it offer the same service?** |
|---|---|
| Independent 3rd-party Cx Agent with no affiliation to any other firm in the construction industry. | **Possibly** – many Design and Engineering firms have their own Cx division. |
| Experienced Cx Agent. At CCx our Owner and your Cx Agent is Andy Cooper with 18 years full-time Cx experience. | **Possibly** – if part of a design or engineering firm we find it is often a single employee whose role isn't solely Cx work. |
| Cx Agent/Specialist Writes all Prefunctional Checks, Functional Tests, & Integrated Tests. These are customized to each individual project with additional information gathered from contractors and the design team as needed. | **Typically, yes** - The writing of project specific prefunctional checks, functional tests, and integrated tests still largely remains under the Cx Agent's scope. However, if the Cx Provider is a part-time division within another company, they may lack experience in writing these documents and may defer a portion of this to the division contractors. |
| Cx Agent spends significant time on the job site during all phases of construction for observations, trouble-shooting, checks, tests, and re-tests. | **No –** [1]The Cx Agent will not spend as much time on-site under a process approach. They may spot-check completed commissioning check sheets from the Contractors. Sampling/spot checking rates can vary widely. |
| Cx Checks, Tests, and Re-tests can be performed efficiently because only the Cx Agent (and their in-house technicians(s)) need to be onsite for testing. | **Possibly** – [2]Depending on whether the Cx Agent is present for all testing is dependent on the Cx Agent's discretion. If the Cx Agent is not present for testing, that **often leads to a situation where contractors test their equipment individually and a coordinated testing of equipment interactions and integrations is not performed. Between coordinating schedules and siloed testing, significant issues can potentially go unnoticed.** |
| Cx Agent/Specialist performs all Prefunctional Checks. | **No** – this is left to the contractors. |
| Cx Agent performs all Functional Tests. | **Possibly** – see above[1,2]. |
| Cx Agent performs all Integrated Tests. | **Possibly** – see above[1,2]. |
| Cx Agent uses NEBB certified and annually calibrated equipment to verify sensor functionality. | **Possibly** – division contractors don't often have this equipment. Depending on how project specifications are written, we have seen it called for the Contractors to supply the tools and equipment for testing. |
| Cx Agent provides user-friendly Cx software to follow-up on issues log items with division contractors. | **Possibly** – often email or general construction management software is used. |
| **Table continued on next page →** | |

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| **Technical Cx Approach as done by Cooper Commissioning** | **Process Cx Approach – does it offer the same service?** |
|---|---|
| Cx Agent re-tests deficiencies to ensure they are corrected. | **Possibly –** Again, depending on how much involvement the Cx Agent has will vary between what is specified and the Cx Provider. |
| Cx Agent tracks issues to resolution so that the Owner has few if any issues to address after Cx is complete. Cx Agent communicated with contractors(s) responsible to see issues are resolved. | **Possibly** – often a report is produced, including an outstanding issues log, and it is up to the Owner/facilities staff to track issues to resolution. |
| Contractors are required to correct Cx-identified deficiencies at no additional cost to Owner. | **Possibly** – depending on the how the specifications are written, the Owner may be billed for time. |

## Easy Fixes: Common Items Requiring Contractor Remediation with Retesting by CCx

| **Selected checks/tests** | **Examples of issues routinely discovered by CCx** |
|---|---|
| | |
| **Prefunctional Checks:** | |
| Physical condition of equipment. | Incorrect mounting, vibration control not installed, inadequate service clearance, damaged equipment/filters. |
| Installation of adjacent piping and ductwork. | Insufficient insulation, incorrect valves/dampers installed, missing valves/dampers/testing ports, inadequate clearance for TAB. |
| Visual check of control devices. | Wiring not complete, control device mounted in a way that will impede function (incorrect location or orientation). |
| | |
| **Functional Verifications:** | |
| BAS Graphic Accuracy | Missing graphics, missing points, thermostats mis-mapped. |
| Sensor Accuracy | Missing sensors, inaccurate/malfunctioning sensors. |
| Valve and Damper Function | Valves/dampers that won't open/close completely, valves/dampers wired backwards. |
| | |
| **Integrated Functional Testing:** | |
| Alarms and Safeties | Alarms not generated as required in sequences, alarms not pushed through to main screen and/or not logged. |
| Enable/Disable (based on): OAT, Schedule, Sensor Input, and/or Occupancy | Manual overrides affecting system performance, equipment fails to follow schedule/mode as programmed. Trending not set up to record data as required. |
| Temperature and Humidity Control | False loading (hot or cold) resulting in overly cooled or heated spaces, dehumidification modes not activating, units not modulating as required in sequences. |
| Fan Speed Control | Unit not following sequences as required (sensor or programming issue), supply and exhaust fans not coordinated as required. |
| Building and Zone Pressure Control | Building/zone/room severely over/under pressurized due to sensor or programming issues. |
| Energy Recovery | Energy recovery device running at incorrect time/conditions. |
| Space $CO_2$ control | Units not responding to increased $CO_2$ levels due to sensor or programming issues. |

COOPER COMMISSIONING

# Technical Commissioning Delivers a Functional Building

## Not-So-Easy Fixes: Complex Problems Requiring Input from Multiple Parties.

| General Case: | Recent Example: |
|---|---|
| Complex Issue Identified (usually during our functional testing). Often there is some disagreement among the contractors about who is responsible for addressing an issue.<br>↓<br>Andy communicates individually with all involved contractors, Design Team, and Owner to determine if convening a meeting with all parties and/or further testing with relevant contractors on-site is needed.<br>↓<br>Andy convenes and facilitates meeting(s) to gather input from all parties and record the decision-making process. This can involve the design team approving changes with Andy reminding the design team that any reduction in equipment, monitoring, or performance should come with an appropriate cost-reduction for the Owner.<br><br>This step can also involve additional testing to identify defective manufacturing. **Manufacturers aren't keen to replace defective equipment without detailed documentation of rigorous testing that completely eliminates any other source of system problems.** | Our functional testing identified the supply and return piping to an AHU were backwards due to a mix-up when tying into existing mains. In addition, a number of inputs for the BAS were missing due to sensors not being installed (and related controls programming missing).<br>↓<br>Andy spoke with the Architect, Engineer, and the Owner and it was decided an in-person meeting was the best route to address these issues.<br>↓<br>During this meeting, the following decisions were made:<br>**1.** The piping would be drained down during the next appropriate weather conditions; the piping would be fixed to match design, **at no additional cost to the Owner.**<br>2. The representatives of the contractors and design team felt that fewer sensory inputs would not significantly affect the function of the building. **However, Andy suggested to the group that the Owner was paying for all of those inputs, and so if they were not going to be installed perhaps a reduction in the fee was appropriate?** It was then decided that all inputs would be installed per the original design. |
| *Possible consequences of **not** fully addressing complicated issues during construction, acceptance, and warranty phases:*<br>- Owner and Occupant frustration.<br>- Cost to repeatedly call contractors back to the site if past warranty period.<br>- Damage, potentially major, to the newly finished building.<br>- New spaces and/or equipment being entirely unusable. | *What if this hadn't been addressed at this time?*<br>- It is unlikely the issues with the reversed piping would have been identified at all. All other contractors involved had already done their own final checks. Without our thorough functional testing, identifying this root cause of building issues would be almost impossible. **In every season, this would have wasted significant energy.**<br>- It is unlikely the sensors and related programing would have ever been installed. **This may have resulted in a system that was difficult to monitor and control.** |

Excerpts from Cx specifications that describe a process Cx approach - annotated with the problems we see.

SECTION 019113 – HVAC AND ELECTRICAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

This document was not made part of the spec document. Also this section should refer to BCxA, IECC, NEBB, and ASHRAE at a minimum.

1.1 RELATED DOCUMENTS

A. Owner Program Requirements and Basis of Design

Contractors need to take this account in bidding. But Cx was barely mentioned in other division spec sections.

1.2 GENERAL DESCRIPTION

A. Commissioning is the process of verifying and validating that all building Systems are installed and perform interactively according to the design intent; that Systems are efficient and cost effective to operate and meet the Owner's operational needs; that the installation is adequately documented; and that Operators are adequately trained. It serves as a tool to minimize post-occupancy operational problems. It establishes testing and communication protocols in an effort to advance the building Systems from installation to full dynamic operation and optimization.

B. Commissioning provider shall work with the Contractor and the Engineer to direct and oversee the Commissioning process. Contractors and subcontractors shall:

1. Utilize Procore collaboration software to maintain an Observation Log, Equipment installation and Start-Up status.
2. Interface with the commissioning process using Procore web interface and/or an Apple iPad.
3. Generate a Commissioning Plan including schedule.
4. Integrate commissioning activities into the general construction schedule.
5. Provide commissioning specifications.
6. Attend commissioning kick-off and coordination meetings.
7. Verify that applicable Equipment and Systems are installed according to the contract documents, manufacturer's recommendation, and industry accepted minimum standards and that they receive adequate operational checkout by the installing contractors.
8. Verify and document TAB is complete and accurate.
9. Verify and document proper performance of Equipment and Systems.
10. Verify that O&M documentation left onsite is complete.
11. Verify that the owner's operating personnel are adequately trained.
12. Assist Commissioning Provider with any documentation needed for their Final Commissioning report.

Procore is not an ideal choice for Cx work. Cx provider should provide Cx platform for all parties.

This is what commissioning IS. Based on this spec, all the Cx provider is doing is compiling a report?

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5. Commissioning Coordinator (CxC): The individual within each of the various parties that is designated the point of contact for that party relative to commissioning activities.
6. Commissioning Plan: A Contract Document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process. It also describes the FPTs that will be performed during the Acceptance Phase. The Contractor must have an understanding of commissioning process and the Contractor requirements within the plan.
7. Commissioning Team (CxT): The parties involved in the commissioning process for any given System. The CxT will include a core group involved with all Systems. The core group will typically include the CA, the PCM's CxC and the Owner's CxC. On any given System, the CxT will also include the CxC for the Contractor(s) responsible for the System or Equipment.

This should not be a necessary role. This is what the Cx Provider should do.

How many CxCs is this?! Cx responsibility is distributed to too many parties here.

Excerpts from Cx specifications that describe a process Cx approach - annotated with the problems we see.

B. Coordination Between Testing Parties

1. Factory Start-Ups: For many Systems and Equipment, Factory Start-Ups are specified. The Contractor is responsible for providing onsite support for the Factory representatives. These Factory Start-Ups will be reviewed and checked during FPT. All costs associated with the Factory Start-Ups are included with the bid unless otherwise noted. Contractor shall make notification of when Factory Start-Ups are occurring and coordinate these with witnessing Parties. The CA and CxT members may witness Factory Start-Ups at their discretion. Aspects of FPT accomplished during the Factory Start-Ups may be accomplished and approved by the CA if they meet the intent of the FPT. It is assumed that the Factory representatives budget the appropriate numbers of trips to support initial Start-Up, resolving Equipment issues, TAB and training.
2. Independent Testing Agencies and Special Inspectors: For Systems where contractor's independent testing agencies or special inspectors are specified, the cost of this testing is included with the bid unless otherwise noted. Much of the testing performed by these independent agencies or special inspectors will cover aspects required in the Start-Up Procedures and FPTs.
3. Contractor, testing agencies, and special inspectors shall coordinate with the CA so that the CA can support the testing (when necessary), witness the testing, and approve the applicable aspects of the FPTs. The Contractor should not start up Equipment or Systems without CA approval.
4. The CA may independently spot-check work of the testing agencies or special inspector if the tests were not witnessed. However, it is not the intent for the CA to re-accomplish testing by others that is specified in the construction specifications.

This should be required if the Owner wants start-up verification.

Vague statements make it difficult to solicit accurate bids.

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1.7 COORDINATION MANAGEMENT PROTOCOL

A. Coordination responsibilities and management protocols relative to commissioning are initially defined below but will be refined and documented in the Commissioning Plan. Contractor shall have input in the protocols and all parties will commit to scheduled obligations. The CA will record and distribute.

1. Submittals and Shop Drawings: PCM shall distribute the submittal log to the CA. CA shall review the submittal log and communicate which submittals need to be forwarded.
2. CA Review Comments for Shop Drawings: An email reply is sent directly to the PCM, A/E, and Owner by the CA. The Owner and A/E will consider and incorporate at their discretion.
3. Deficiencies Identified by the CA: When the CA identifies a Deficiency, the CA shall make a good faith assessment of responsible parties. Those parties, as well as the Owner and PCM shall be notified of the perceived Deficiency. This communication is "FOR INFORMATION ONLY" and is not a direction to resolve the Deficiency or to take any action. Contractor may elect to accept responsibility and resolve the Deficiency. If the Contractor contests either the Deficiency or responsibility for that Deficiency, Contractor shall respond to that Deficiency indicating disagreement. If responsibility is not agreed to via the commissioning dialogue, PCM shall issue a work directive or RFI via the normal contractual channels to resolve the issue.

Deficiencies found by the Commissioning Authority SHOULD be a directive to the responsible contractor to resolve it. (In this spec, this statement is contradicted in a later section that all deficiencies shall be remedied.)