

Commissioning Basics for Owners

Frank A. Mauro P.E., LEED AP
Heapy Engineering LLC

Synopsis

As an Owner, have you ever asked yourself any of the following questions about Commissioning?

1. What is Commissioning?
How did our Industry develop the requirements for Commissioning services, and why is Commissioning necessary in today's projects?
2. Who is responsible for Commissioning?
Are "independent" commissioning services included in the basic AIA contract? And if they are not, who should do the Commissioning?
3. Who is qualified to Commission projects?
How can I know my Commissioning Authority, and be sure they have the experience and qualifications to do the Commissioning project that has been defined?
4. What is the Commissioning process?
Define and understand your process so you will know what you will get for your Commissioning dollar!
5. How to Determine the Commissioning fee?
After the Commissioning scope is defined, a task-oriented fee can be provided by the Commissioning Authority that will be appropriate and fair for both the Authority and the Owner.
6. What are the values and benefits of Commissioning?
Today I will share some of the stories and testimonials that all Providers have that will show you what can be accomplished by a good Commissioning project.

The information presented here has been gathered by Heapy Engineering over the years by a combination of experience and research. The 'experience' is based upon years of completing Commissioning and Trouble-shooting projects by Heapy Engineering. The 'research' combines ideas taken from ASHRAE, LEED, the Ohio Schools Facilities Commission (OSFC), BCA, AABC and additional information taken from the various Commissioning Organizations. Through these steps of discovery, this Process has been integrated with the expectations of Owners, and has been developed to this Conclusion.

About the Author

Frank A. Mauro P.E., LEED AP is a Senior Engineer and Project Administrator for Commissioning Services for Heapy Engineering LLC. Heapy Engineering is a 130 person Engineering firm with 8 separate design teams, one Resource and Training team, and a Construction Service team that provides, in addition to Construction Field Inspection, both LEED and normal Commissioning services and LEED administrative documentation.

Frank has a BS in Electrical Engineering from Purdue University in West Lafayette, Indiana. He is a Professional Engineer in the State of Ohio, and has also been licensed in the states of Minnesota, Illinois, and Michigan. He has received his LEED AP accreditation, and is presently involved in providing management of both LEED and normal Commissioning Services. He has served as past president for the Dayton Chapter of ASHRAE, has been involved with IFMA, IES, SAME and is presently a Central Regional Officer of BCA. Frank is now and has been a member of the City of Kettering, Ohio Planning Commission for over ten years.

Frank has served on the Dayton, Ohio Sinclair Community College MET advisory board since 1981, and has supported the college's efforts in obtaining and maintaining accreditation in the fields of Mechanical and Electrical Technology. He has also supported and presented topics at various Automatic Temperature Control seminars for the College. In the middle 90's Frank was part of a team organized by Sinclair Community College that wrote a book providing a vision regarding the importance of Technical Education in the future of a new and changing work force.

He has spent a majority of his 36-year career involved in Commissioning-type services. Frank's introduction to 'trouble shooting and commissioning' began with his role as a Sales Engineer and subsequent local Service Sales Manager for Johnson Controls Inc. where he became familiar with the techniques that are required to identify and resolve problems on HVAC and electrical/electronic systems. When he joined the ranks of the Engineering Design Community in 1985, he continued to provide Commissioning services to owners as part of his overall duties. Frank continues today to sell, manage and coordinate Commissioning projects for Heapy Engineering LLC (www.heapy.com). Frank can be contacted at Heapyfamauro@heapy.com.

What is Commissioning?

Commissioning in its most basic definition assures the owner that the building's systems operate as per the intent of the design scope. ASHRAE defines the Commissioning Process as "...a **quality-oriented process** for achieving, verifying and documenting that the performance of the facilities, systems, and assemblies meets the defined objectives and criteria."

LEED Reference Guide, Version 2.0, 2001, Credit 3, for Energy & Atmosphere, Additional Commissioning states, "commissioning is a process, not a technology that can be purchased." Elsewhere it is stated, "commissioning is 'functional testing', a process of verifying that building systems operate and function at a high performance level, as designed.

In all three quotations, Commissioning is defined as a process. A process is, literally: a sequence of events for which you are presented with options that will allow you to choose your own direction which, based upon your individual needs, will give you the final, desired product.

But, in order to choose the correct option, you must have a working knowledge of your project and needs, and of the steps that will allow you to proceed successfully.

Why is Commissioning Needed Today?

Originally the term 'commissioning' was applied to naval vessels. Before ships went out to sea, each ship was 'commissioned' in order to ensure that there would be no unexpected failures during operation. Each system was put through a series of functional tests to give them the best opportunity to succeed at sea.

Today, buildings are becoming more complex with many integrated systems that demand close coordinated interface in order to work properly and efficiently. Construction mechanics install the systems and then rely on equipment suppliers and sometimes service technicians to start-up their own particular individual equipment or systems. Each supplier will become focused on their product. Tight schedules and competitive bid-projects put pressures on construction coordination and final close out of the projects. It has become more difficult to finalize the project and meet the Owners Project Requirements (OPR). Over the past years it has become more obvious that another discipline was required to prevent this burgeoning problem; commissioning was introduced to fill this need and the discipline began to grow.

Various large, respected organizations began to recognize the importance of building commissioning and support or require its inclusion in projects with which they are involved.

- USGBC—LEED: Requires commissioning as a prerequisite to obtaining LEED certification. LEED also offers an additional credit point for a more intense commissioning that includes a Design Peer review of the Construction Design Documents. These commissioning requirements are defined in the LEED credit documentation.

- AIA Healthcare Construction Guidelines supports commissioning on the projects that they are involved with. This group recognizes the importance of systems that operate correctly and efficiently in the Healthcare setting.
- The Ohio School Facilities Commission (OSFC) recommends commissioning on all the schools that their funding supports. This recommendation is included in the May 2004 OSFC Design Manual. OSFC has had discussions about making commissioning a requirement with their projects.
- ASHRAE has written a support document called “Guideline 0—The Commissioning Process” that provides significant insight to a ‘cradle to grave’ commissioning process guideline.

Who is responsible for commissioning?

Let’s ask some questions!

- Are Commissioning Services different from Field Observation Services?
- Haven’t I already paid for Commissioning in my contract for A/E design services?
- How about in my Construction Manager’s Contract?
- How about in my Maintenance Contract?
- Can I have a successful project without Commissioning?

Answers: Yes! No! Maybe!

These aren’t just flippant answers. On some project they may all apply. Depending on how you structure your professional services contract for your project, you can have a different answer for each question. However, as confusing as it is to understand what you will get in your contract, it is recognized that in the basic AIA contract, commissioning as it is defined and completed today, is not the responsibility of the consultant or his field service department, and is normally not part of the basic consultant agreement.

Article 4 of the AIA Document-C141 reads: “...the consultant shall not be responsible for the contractor’s failure to perform the work in accordance with the requirements of the contract documents.”

In 2004, the AIA produced a commissioning document B211, to be used in conjunction with the appropriate basic contract form. This is another example of this new discipline being accepted into the realm of construction services as an independent process in the overall construction project.

How to Fill the Gap between Construction and Operations

When we take a look at an overview of the Project Partner Roles & Responsibilities Roles, the Construction Process in itself has a gap between the Design & Construction functions of the Project and the Building / Operations Functions of the finished product. This gap has grown as it has become more difficult for the Facilities Department to take over this new, complex project and make it operate effectively and efficiently. This gap must be filled by a service that coordinates, functionally-tests, and fine-tunes the systems, before they are turned over to the Facilities Department; that service is commissioning.

How to Choose a Commissioning Provider.

In order to choose the correct Commissioning Authority for your project, you must first know your project: what systems do you want to have commissioned?

If you are an owner who has completed many projects and your experience tells you what you want done, you may know what you want. What disciplines are involved? Roofing, wall penetrations, plumbing, HVAC systems, Electrical, or Technology and Sound systems are usual candidates. Is your project a LEED project with its special requirements? How about a school? Schools in Ohio - for example - have found that besides the typical Commissioning of HVAC systems, Technology and Sound systems have been having the most problems on building start-up.

If you are an owner who may be doing this as a single project, and you do not have the experience to make some of these decisions, work with your Project Manager and Commissioning Authority to determine the appropriate systems to be commissioned. If this is a LEED project, the LEED Accredited Professional (LEED AP) will determine the Credit Matrix and that matrix will determine what systems should be commissioned.

How complex is your building? How large is your project? Is it a lab with expensive animals that need their environment to be protected? Is it a pharmaceutical building with critical product? Or is it a medical office building where downtime or a delay in occupancy will cause a large loss of patient revenue? The type of building will dictate what extent of the commissioning process will be most beneficial to you.

Now that you understand your building, who is a qualified Commissioning Authority and how do you choose between the Providers to complete Commissioning for you?

There have been many types of contractors and suppliers who have entered into the field and now offer Commissioning Services.

Commissioning Companies

- Construction Manager
- Test and Balance Contractor
- Commissioning Only Firm—specializing in HVAC

- Commissioning Only Firm—with individual Commissioning technicians for each Discipline
- Full Service Design Firm
 1. Includes Commissioning Services
 2. Includes Design Services
 3. Includes LEED services
- Owner/In-House staff
- Independent 3rd Party Commissioning Provider
- Same Party Commissioning Provider

Each of these firms will have their individual strengths and weaknesses. Some organizations (OSFC for example) will allow only 3rd party / Independent Commissioning Authorities to Commission one of the buildings they support. Other Organizations (LEED for example) will allow same-party Commissioning Authorities as long as the Commissioning Authority is part of a different arm or division of the Design Firm.

Typically a commissioning provider will have technicians whose sole responsibility it is to commission projects. These technicians are able to concentrate on commissioning services and even though they may work on several commissioning projects, they normally will not have ‘too many hats to wear’ and can concentrate on the task of Commissioning.

What Qualifications Should They Have?

CERTIFICATION:

Presently there are several organizations that will provide a form of certification to a Commissioning Authority. These certifications are similar but not the same—each one is unique to the organization that defines the requirements for the certification. However, if your Commissioning Authority or Commissioning Authority Technician has a certification from a recognized organization an owner should—rather than dwell on the difference between the two—understand and appreciate that the Commissioning Authority has shown the professionalism and competency to work at improving their skills in order to obtain this certification. This attribute should be considered a ‘plus’ when making a decision about your Commissioning Authority. I went to a presentation in a large city recently where the presenter, a representative of the city—which had embraced commissioning—asked that all commissioning specifications should include a requirement for commissioning certification. When told that there was no one Certification Authority, he responded that it didn’t matter; include them all. Their city (as most public organizations) had open specifications. By requiring certification from any of the noted organizations, it would require the Commissioning Provider on their projects to perform to this level. Therefore, this specification item for certification would require any Commissioning Authority who wanted to bid their projects to gain the experience and knowledge that the city wanted from their Commissioning Providers.

SKILL SETS:

Your Commissioning Authority should possess some basic skill sets—working knowledge of Automatic Temperature Controls systems for example. On large projects, where there are many systems to be commissioned, you may want to consider using a provider that has several technicians that possess the various skills required for the different disciplines to be used. For example, you may want to commission ATC, electric power systems, and technology systems. One technician will not have all these individual skill sets, and the Commissioning Authority may not have all the disciplines in-house. Your Commissioning Authority may need to subcontract out some of the commissioning services on these various systems. Match your Commissioning Authority's abilities with the size and requirements of your project.

Note: Good 'pr' abilities are a plus on any project. The commissioning authority will become a major player in the resolution of problems—and you want the problems to be resolved, not expanded by the mishandling of the coordination of the issues with the commissioning team. A provider with a good sense of the construction process and public relations savvy is invaluable in providing the answer.

Know your project; know your Commissioning Authority. Then, combine the two and choose.

WHAT IS THE COMMISSIONING PROCESS?

Arguably the most difficult and complicated part of commissioning is the definition of the commissioning process and understanding what you will get for the fee. As one customer recently related to me, "...in my discussions with different Commissioning Providers, the only thing that was consistent was that they all spelled 'commissioning' the same way."

Let's briefly discuss a full commissioning process:

Scope Phase

Bring your Commissioning Authority on board early. A typical commissioning process will consist of five different phases. The Commissioning Authority will help you set the team and define what needs to be commissioned; they can become involved as 'another set of eyes' to help define issues that they have experienced and that can be avoided during design and construction.

The scoping phase is the time to define the Owner's Project Requirements (OPR). The Commissioning Authority should gather the team together, and set up the Preliminary Commissioning Plan for the owner. At this time, commissioning budgets can also be set.

Design Phase

The Commissioning Authority will now write the commissioning specifications, expand and finalize the Commissioning Plan and, if it is in the Commissioning Authority contract, will provide design review. (Note: LEED, for example, requires design document and construction document review in order to get an additional commissioning credit point.) The commissioning authority will have meetings with the commissioning/design team to clarify and define

everybody's involvement in the process. Test documentation should be developed and included in the commissioning specification so that the contractors will know what to expect during construction. Schedules should be defined by the construction manager so that the Commissioning Authority will have time in the construction schedule to complete the commissioning services.

Construction Phase

During the scope phase it was defined how the Commissioning Authority would interact with the construction team. Meetings were defined—pre-bid, progress meetings, etc and these defined meetings will take place according to this schedule. The Commissioning Authority will get involved with the contractors in order to ensure they are prepared to complete the work without excessive work or 'agony.' The Commissioning Authority will review submittals to become familiar with the equipment and 'sequences of operation' that will be involved in the project. The Commissioning Authority will also provide the required documentation to the contractors—documentation that must be completed as part of the contractor's commissioning requirements. At this point, the Commissioning Authority can start his field verification of the installation of the equipment, and the pre-functional checks. After identifying any issues, the Commissioning Authority provides an issues log to the CM, who will then have the Contractor make the corrections. The Commissioning Authority is now ready to complete the key step in the Process: Functional Testing.

Occupancy & Operation Phase

Functional Testing of the systems identified in the Commissioning Plan is the 'meat' of the Commissioning Process. The Commissioning Authority will field verify the operation of each commissioned system to be sure that they match the design intent and OPR. The technician will coordinate all applicable systems—for example, fire alarm with HVAC, or security with Life Safety. Again issues logs are developed, and the CM oversees the correction of the problems identified.

During this phase, the Commissioning Authority can also complete various other items, such as Training review and O & M verification. All these services should have been so defined in the Commissioning Authority's contract.

Continuous Commissioning Phase

It is during this phase that many additional items can be completed that will add value to the commissioning contract. For example:

- The Commissioning Authority can monitor the systems through a web-based Direct Digital Control system to check on the operation for the owner.
- There can be an 11 month walk-through of the systems to identify any issues before the warranty expires.
- The owner may want the Commissioning Authority to interact with the Physical Plant Department in order to help define a continuing maintenance plan.

- Develop a Re-Commissioning Plan.

If after discussing the process with your Commissioning Authority, you are still not sure about the product you expect to receive, ask the Commissioning Authority to show you a sample commissioning plan, and to even show you a sample of the final report that should be a part of your project. You are paying for this product—feel comfortable with the product that you are going to get.

WHAT IS THE VALUE OF COMMISSIONING—WHAT IS THE FEE?

There are various percentages that have been identified as applicable to the Commissioning Fee. These fees vary as much as the extent and complexity of the project, as well as the final product that will be produced. One set of estimates is as follows:

- Mechanical Systems: 1.5% to 2.5% of the Mechanical Budget
- Electrical Systems: 1.0% to 1.5% of the Electrical Budget
- Total PHE—1.0% of total PHE construction cost

These are rules of thumb that can include many different items, and can be changed according to what is to be done. Remember, you have just defined your project and you should know what to expect. Ask for a defined fee.

Here is a sample (attachment ‘a’) of how a fee worksheet may look for your project. This type of worksheet can be used to define and quantify the time involvement for the project. This will also help you understand what will be involved as a service. A ‘calculator’ such as this is usually used by the Commissioning Authority to set their fee, however, an owner, when comparing fees from several Commissioning Authority may ask for some sort of services break-out in order to identify the differences in price and services. In a market where the final product is not always clear, this type of summary sheet can help clarify the product that will be given to the owner by the Commissioning Authority.

BENEFITS OF COMMISSIONING

There have been many studies about the effectiveness of Commissioning. The J. Gregerson study that was completed in 1996 has been identified as typical of what most of these studies indicate—that there is a good payback or cost avoidance with a project that is commissioned properly. Here are some Case Studies:

- **Cost-saving retro-commissioning of a hospital’s systems.** A new customer asked to have their systems retro-commissioned. They also wanted help in identifying what seemed to be excessive energy use. One item noted was the crossed piping on cooling coils for 4 large Air Handling Units. For thirty years these AHU’s required that their entering Chilled Water Supply temperature be maintained at 42 degrees F, instead of a more typical 44 degrees, in order to maintain proper humidity. A new piping arrangement was identified as being beneficial, the piping was changed for about

\$2,900.00 per unit and the result was an energy cost avoidance or savings of \$12,000 per year.

- **Damage averted at a University:** At a large university, it was discovered during the functional testing phase that the sequence of operation on a large air handling unit actually opened the outside air dampers during the unoccupied mode—instead of closing the dampers. No cost avoidance dollars were assigned to this issue, but if the dampers had stayed open, and subsequently the coils were to freeze and burst, there would have been significant damage to the units and surrounding area.

Testimonials:

From an owner's representative:

I was somewhat doubtful that commissioning would be a benefit to [this project]. My first thought [before commissioning began], was that we would be paying for a service that should be provided by the contractors. Boy was I wrong! [The commissioning process] made a believer out of me. I can only guess at the difficulties and warranty problems that would have occurred had commissioning not taken place.

From a construction manager:

I have had no experience with Commissioning, but my impression was we would be paying for something the equipment installer should be responsible for. However, [after the project had started the commissioning process] my opinion [had] changed—I now believe commissioning is needed to receive the full benefit of today's complex equipment. I now know the difference between installers and technicians.

In conclusion let's summarize some benefits of commissioning:

- **Energy Savings: commissioning typically produces 10% to 30% energy cost avoidance**
- **Indoor Air Quality parameters verified**
- **Occupant comfort improved productivity**
- **Verification of Life Safety Systems**
- **Extend life of operating equipment**
- **Reduce risk of system failure/shutdown**
- **Smoother start-up and on-schedule occupancy**
- **Fewer complaints from occupants**

- **Assurance that O & M manuals are complete**
- **Training for Staff**

Thank you; and welcome to commissioning.