

The Biggest Myth About Data Center Commissioning

Did you only check the box?



Check the Box or Check the System?

Done, but not done right.

It's an all-too-familiar story these days. A project is over-budget and out of time. Commissioning has to be done – either because the client knows it's a good idea, because it's a required regulation or mandate, or because someone on the team understands the benefits of commissioning – but there's not enough time or money to do it right.

As a result, commissioning becomes a “check the box” service, either as a way to gain a few LEED points or to fulfill a requirement. It may be done. You checked the box. But was it done right?

The myth that “Commissioning is Just a Checklist Item” does more harm than good to your future data center. My goal today is to educate you on the value a third-party commissioning authority can add to a project.

I hope you enjoy this paper and find it useful.

A handwritten signature in blue ink, appearing to read 'Jeff Nichols', with a long, sweeping underline.

Jeff Nichols, PE, LEED AP, CEM, CPMP
Vice President of Engineering
Engineering Economics, Inc.

Acknowledgements

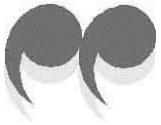
This white paper was supported by multiple personnel at Engineering Economics, Inc. (EEI) and we would like to take a moment to recognize those who provided insight and expertise that greatly assisted in the creation of this paper.

EEI would like to specifically thank Chris Ieradi and Jeff Nichols for assistance with the technical portions of this paper. We are also grateful to Kristen Stevens, Hillary Hanson, and Blake Hickok for their constructive comments and edits.

Commissioning a Data Center

The world runs on data.

According to Europe's biggest mobile voucher app, [Vouchercloud](#), humans create over 2,500,000,000,000,000 (2.5 quintillion) bytes of data every day. Every minute, there are nearly 204,000,000 emails sent, 12 hours of footage uploaded to YouTube, 277,000 tweets, and 216,000 Instagram posts. And 90% of the data generated is unstructured, meaning it is in the form of tweets, photos, purchase histories, and service logs.



Every minute, there's nearly 204,000,000 emails sent, 12 hours of footage uploaded to YouTube, 277,000 tweets and 216,000 Instagram posts.

The sum of the total data held by the biggest online storage and service companies is estimated at 1.2 million terabytes ([source](#)).

With 2.5 quintillion bytes of data – or more! – moving around every day, we need large data centers to host, protect, and back up that data. And while there are a thousand threats to this priceless data, critical system failure is a preventable one.

In the early days of data centers, commissioning was performed by the contractor and the start-up technician. Installing engineers had few processes to follow, but they would still identify issues and hopefully correct them before the facility went live.



But sometimes the issues were not found or fixed. And the owner would discover the problem after everything was live. When a facility is mission critical, overheating can go from problem to catastrophe in moments. It hurts not only the equipment, but also the bottom line.

Data center construction has come a long way since the dotcom era of the 90s. As a conscientious consumer, you are aware of the issues that may arise during the design and construction phases of new data center builds. You may surmise that problems are inevitable when building a mission-critical facility. And if inevitable, you may question the value of commissioning and simply view it as only a “to-do” item to be checked off the list.

The Biggest Myth: Commissioning is Just a Checklist Item

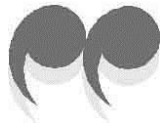
There is nothing more satisfying than checking something off a list.

The gratification of knowing something is finished, combined with the physical action of acknowledging it has been completed, evokes a feeling of accomplishment.

And when an owner has thousands of things to do, especially when going through the design and construction of a mission-critical facility, checking something off the list becomes even more satisfying.

The new codes, regulations, and laws requiring that commissioning activities be completed have become overwhelming for many, adding time to the schedule and cost to the budget. It sounds a lot easier and more cost-effective to simply hire a firm that can walk around your facility and say that they verified that the systems and equipment are working per the design intent.

But commissioning can add so much more value to a project than just another completed checklist – and the earlier a commissioning authority is engaged, the better the value.



Commissioning can add so much more value to a project than just another completed checklist – and the earlier [they] are engaged, the better the value.

The Value of a Third-Party Commissioning Authority



A good third-party commissioning authority should act as the owner's champion. Their personnel should have the knowledge to test for issues, have in-depth experience with design and equipment, and be savvy with the construction process.

So how do these competencies translate to value for a project?

Knowledge in Service Industries

Third-party commissioning authorities typically hire personnel who come from service industry backgrounds.

Example service industry backgrounds can include:

Electrical

- Electrical Critical Power Technician
- UPS
- Generator/ATS
- Switch Gear/Distribution

Electrical Acceptance Testing

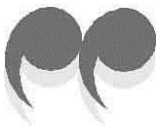
- NETA Testing
- Infrared Thermography
- Power Quality
- Electrical Maintenance

Mechanical

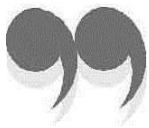
- Building Automation Engineer
- HVAC/Chiller/CRAC Technician
- Test and Balance Technician

The value in hiring an experienced commissioning professional is that they know the design, operation, and maintenance issues to look for and understand the right way to test and commission the systems.

While a design engineer may have similar abilities and knowledge, commissioning professionals are dedicated to ensuring constructed systems work as designed and understand the ongoing operational and maintenances issues that follow construction. The hands-on field experience of knowledgeable commissioning professionals can complement the design engineer's expertise while adding a team member that understands design and can communicate with the design professional at their level.



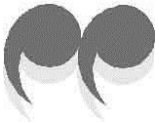
The value of hiring an experience commissioning professional is that they know the design, operation, and maintenance issues to look for.



Experience with Design

A well-versed commissioning authority will have a team that is specifically experienced with systems design, not just installation or troubleshooting. Commissioning engineers know which systems work best in various environments because they have actually commissioned the results. Using their lessons learned together with design skills/experience, they can consult with the design team on best practices during the design phase and help troubleshoot design-related issues.

The value in hiring an experienced team is that they can also develop testing and commissioning specifications and plans that are not the cookie-cutter documents design engineers typically get from manufacturers.



... Commissioning authorities can be technical resources, working with the design team to solve complex issues with very little impact to the schedule.

Additionally, experienced commissioning authorities can be technical resources, working with the design team to solve complex issues with very little impact to the schedule. Design reviews completed by the commissioning authority can identify numerous issues which may seem small, but add up to big problems. One of the best values of an experienced commissioning authority is their ability to propose a solution and work effectively with the team to finalize the resolution.

Typical projects can see numerous design/specification issues. Data center projects can have more –over 100 individual issues – of design log items to address. These projects are much more complex and have more concerns than a typical project. In a data center, the equipment itself (performance and testing requirements), sequence of operations, reliability/redundancy, and operations ease are the most common issues commented on.



Construction Process Savvy

This one should be a no-brainer.

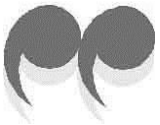
A commissioning authority who is familiar with the ins and outs of the construction process is a huge boon to a project. They can help with scheduling, procedure development, installation, testing, training, and warranty issues, as well as reducing future operations risks.

Schedules

Schedules are tight during construction. There are thousands of things that need to be done, and having one issue can impact the schedule for months to come.

A construction-savvy commissioning authority adds value to a project by knowing exactly what resources are needed and what equipment needs to be commissioned. They can also represent the client to ensure accountability for meeting the schedule and by verifying that the work marked as completed is actually done.

It has been found that a precedent style schedule works best. If you work from commissioning backwards, it will assist in the construction of the facility, help to streamline the end result, and better assure that the facility readiness will meet the schedule.



Proper planning and usage can help an Owner ensure there are no “gotcha” moments when IT installs their equipment.

Project Procedure Development

Procedure development for data centers includes prefunctional tests, functional test procedures, and integrated systems testing.

A third-party commissioning authority adds value to the procedure development process by developing tests to ensure proper installation (for prefunctional tests); performance, optimal sequence of operations, and potential failure scenarios at the component level (for functional test procedures); and incorporating the many levels of redundancy and potential system failures as a real-world scenario (for integrated systems testing).



These procedures can also be used as a great facility training tool and the basis for Standard Operating Procedures.

Using load banks is the best approach to simulating the client’s actual operating load. Proper planning and usage can help an owner ensure that there are no “gotcha” moments when IT installs their equipment. The most effective (but costly) method is to have racks installed, engage rackmounted load banks within the server racks to simulate real-world operations, and then coordinate integrated testing through all of the potential losses of equipment or utilities.

Installation

Value during the prefunctional phase is all about finding the issues before the systems are actually installed. A third-party commissioning authority with the knowledge of how equipment is supposed to be installed can catch small errors before they become bigger problems. Additionally, they can perform intricate inspections of the equipment prior to energizing, which reduces pencil whipping or shortcuts taken by onsite technical staff.

During this phase, a commissioning authority adds value to a mission-critical project by witnessing all testing and reviewing the results to ensure the equipment is really ready for functional testing.

Testing

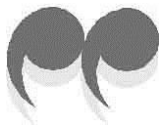


When a third-party commissioning authority is directing the functional testing and integrated systems testing, they are able to test not only the design specification, but also the intent. Their prior knowledge of how the systems are supposed to work lets them

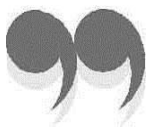
perform tests that will prove that the equipment meets the specifications and submittals.

Construction-savvy commissioning authorities can identify and document issues just like a check-the-box commissioning agent, but the real value comes from the ability to provide solutions that expedite resolution, tracking the issue to ensure they are not lost or forgotten, and verifying issue resolution. They can provide a final technical sign off that the system is tested and complete for all scenarios and sequences.

The number of issues on any given data center project can be huge! We have documented hundreds of issues requiring resolution on recent projects. If issues are not identified during the standard start-up, how will the system operate when turned over to the facility team?



The number of issues on any given data center project can be huge! We have documented hundreds of issues to resolution on recent projects.



Training

Training current and future maintenance staff on new systems is a challenge. Experienced commissioning authorities bridge the gap of training by giving maintenance staff training on the whole system, not just the individual parts as may be provided by the manufacturer.

Some commissioning authorities are even willing to provide recorded video training to future-proof the training process. This is of paramount importance to a data center for the transition to facilities.

The commissioning authority also will train facilities personnel while commissioning the systems, giving valuable hands-on training to the future operators. Remember, it is very important to have a well-trained data center facility engineering staff. This might be one of the few times they experience hands-on training in the operation of critical systems. As just one simple example, the infamous EPO (Emergency Power Off) button. How many times, if ever, will there be a chance to practice the complete shut-down of the data center for an emergency?

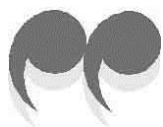
Warranty Issues

Manufacturer warranties expire. A third-party commissioning firm can be engaged during the warranty phase to test the systems and interview the facility personnel to identify issues before the warranty expires, thus reducing future costs.

Projects can be exceptionally designed, but things occasionally change between design and warranty. Sometimes it is something as simple as systems being constructed in one season and performing differently the next. Or it might be something a little more subtle and hard to find, such as a sensor that does not work as intended.

Systems and equipment need time to break in, just like in a car. A good commissioning authority knows how the system operated when initially tested and can compare that to later performance.

If any warranty phase issues are identified, they should be corrected before the warranty expires. Commissioning authorities test, verify,



Projects can be exceptionally designed, but things can change between design and warranty.



and help resolve these issues, which can be done at no cost to the owner.

Reducing Future Operation Risks


A commissioning authority can reduce future operation risks by providing all of the previously mentioned services, as well as Methods of Procedures (MOP) and Standard Operating Procedures (SOP). These documents incorporate the operations of the systems, but also the risk associated with each step, the estimated time required to complete specific tasks, and the most important safety steps needed.

The risk management team will appreciate these documents and is the best way for an owner to describe what they want to do with their data center operations/maintenance. An owner's executives, IT managers, facility personnel, and contractors will be on the same page. That is great value!

A commissioning authority also executes the procedures for the team and trains the facilities personnel until they are comfortable to execute procedures themselves. Maintenance staff might not originally be comfortable with operating critical equipment in a brand new facility. Owners can find comfort in knowing their facilities have the ability to save costs by performing operations completely in-house. There is no waiting for a service contractor to come out and fix something that is wrong.

Additionally, value is often found in engaging the commissioning authority to oversee major system operations, cut overs, and system upgrades.

Since the commissioning authority has developed the technical documents (Specifications, Pre-functional, and Functional Test Procedures) for the construction of the facility, who better than them to develop the step-by-step procedure for an owner's staff to use in the future?



Since the commissioning authority has developed the technical documents... who better than them to develop the step-by-step procedures?



When to Engage a Commissioning Firm

Engage a commissioning firm early in a project.

An experienced commissioning authority will deliver value to an owner throughout the construction process from design through to warranty. The relationship established will be a resource for the life of the facility. They will be the owner's champion and help ensure the owner gets the best value for every design, construction, and operation's dollar spent, while also helping ensure the personnel safety and reliability of the systems – especially the mission-critical ones.

[A good commissioning firm] will be the owner's champion and help ensure the owner gets the best value for every... dollar spent.





Your Advocate and Champion

I hope you enjoyed this white paper and feel equipped to explain to others the value that a thorough commissioning authority can bring to a project.

As Vice President of Engineering at Engineering Economics, Inc., I have been involved in the successful delivery and operations of multiple data center projects over the years. I can share many stories of well-designed projects gone wrong, from simple fixes to incredibly complex issues that could have caused catastrophic failure if left unidentified. I would love to tell you about them.

If you would like to chat, either about commissioning for data centers in general, or about the value my team could bring to your next project, please feel free to contact me. My telephone number is 206.622.1001 or toll free at 800.869.6902. I can also be reached via email at Jeff.Nichols@eeiengineers.com.

I appreciate your time and good luck on your future projects!

A handwritten signature in blue ink, appearing to read 'Jeff Nichols', with a long, sweeping underline.

Jeff Nichols, PE, LEED AP, CEM, CPMP
Vice President of Engineering
Engineering Economics, Inc.