Ten Errors to Avoid When Commissioning a Data Center

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Executive Summary

Data center commissioning can deliver an unbiased evaluation of whether a newly constructed data center will be an operational success or a failure. Proper execution of the commissioning process is a critical step in determining how the data center operates as an integrated system. The documentation produced as a result of commissioning is also the single, most enduring value added deliverable in a data center's operational life. This paper outlines the ten most common errors that prevent successful execution of the commissioning process.

Introduction

Data center commissioning is an insurance policy that helps to ensure the success of a data center design / build project. A proper commissioning exercise reviews and tests the data center's physical infrastructure design as a holistic system. Data centers are designed and built in order to address corporate business requirements. Commissioning validates the investment by providing a framework for successful operation of the data center.

Publicly traded companies should consult with their audit departments to determine whether they are required to enlist an independent commissioning agent to help manage the commissioning process. In most cases an independent commissioning agent is recommended because commissioning documentation can sometimes appear in publicly released corporate documents such as annual reports. These types of documents mandate impartiality.

The purpose of this paper is to highlight the ten most common errors that occur when organizations attempt to commission their data centers. This paper does *not* review the formal methodology required to successfully commission a data center. For details on the theory behind commissioning, including common inputs and expected outputs, please consult White Paper # 148 "Data Center Projects: Commissioning".

Error #1: Failure to Engage the Commissioning Agent Prior to Data Center Construction

The commissioning agent provides the fuel that makes the commissioning process run. The more knowledgeable the commissioning agent, the more value can be derived from the commissioning exercise. The commissioning agent needs to be engaged early in the process, weeks or months before the data center is constructed. Early involvement of the commissioning agent allows for the proper planning, helps in the coordination of vendor start ups, and lays out a comprehensive framework for testing.

Unfortunately, commissioning is sometimes an afterthought and the commissioning agent is hired at the last minute, just before the data center is scheduled to go online. This "after the fact" approach results in poor test scripting and unreasonably compressed time schedules. As a result of this short-sighted planning, data center performance after cutover is subjected to a higher risk of downtime.

Error Symptom	Consequences	Solution
Chaotic commissioning process with high degrees of stress and confusion.	Incomplete testing and poor communications between stakeholders, vendors and the commissioning agent.	Engage the commissioning agent under contract several weeks prior to construction of the data center.

Error #2: Failure to Align with Current Technology

Even an independent commissioning agent can incorporate outmoded testing procedures. Testing procedures need to take into account the technological age of the equipment being commissioned. Outmoded procedures are still regularly employed in numerous situations.

When commissioning a delta conversion on-line Uninterruptible Power Supply (UPS), for example, the commissioning agent may employ testing procedures that were originally developed for a traditional double conversion on-line UPS topology. This confuses the testing and command center teams since certain procedures will not make sense. The outdated procedures may also fail to test the critical functionality of the UPS's topology-specific interior design.

Error Symptom	Consequences	Solution
The data center experiences significant failures after the commissioning process.	Time delays if re-commissioning is required. Unanticipated downtime.	Employ updated testing procedures consistent with the technology generation of the equipment being commissioned.

Error #3: Failure to Identify Clear Roles for Commissioning Team Members

A commissioning team consists of multiple groups of people. The team can include IT, data center operations, facilities and business unit personnel from the owner side as well as architect / engineers, interior designers and consultants from the design team, sub-contractors, project managers and program mangers from the contractor team, product representatives from the suppliers and vendors and also the independent commissioning agent.

All team members should have clearly defined roles in the commissioning process. Various team members from the commissioning agent and owner side can form the command center group. Depending upon the size of the project, the command center can consist of one individual or can be represented by a team of multi-functional individuals. The principal responsibilities of the command center team include process safety, communications, documentation, and emergency response.

IT and facilities personnel are most often charged with performing the actual data center equipment commissioning tests, often working in conjunction with equipment vendor representatives. These groups must focus on safety and on executing procedures in the proper sequence.

Error Symptom	Consequences	Solution
Multiple individuals are attempting to fulfill the same role, or several individuals are taxed with too many responsibilities.	Invalid test results, delayed testing schedules, need to repeat tests, and possible injury.	Clear delineation of roles of vendors, consultants, commissioning agent, facility and IT staffs in terms of who performs which series of tasks.

Error #4: Failure to Validate the Commissioning Script

The commissioning script is the roadmap that leads the commissioning team through the process. The script consists of line by line procedures that are communicated by the command center and executed by the testing team. All members of the team work from the same script. The author of the script is the commissioning agent. He / she assembles the script based upon weeks of interaction with various equipment vendors and IT and facilities staff.

During actual commissioning, the commissioning agent acts as a conductor of an orchestra. The team members are all like musicians with special skills. The script can be compared to the sheets of music that all the musicians follow, line by line. The script needs to be rehearsed by all the players involved. Any deviation from the script places overall system performance at risk.

Error Symptom	Consequences	Solution
The script is unclear and is misinterpreted by various members of the team.	Commissioning tests experience a series of false starts and commissioning steps are incomplete.	Rehearse the script prior to commissioning with team members to make sure all procedures are understood.

Error #5: Failure to Survive Project Budget Cuts

Data center design / build projects represent a major capital investment to the owner and are crucial to the success of the business. As the data center launch date approaches, pressure increases to shorten time cycles and to cut costs.

Periodic reviews of the design / build project often result in outside groups unfamiliar with the project process, making recommendations on how to cut costs. Commissioning is often perceived as an easy target for cuts, particularly if the original construction schedule did not include time for commissioning tests. Sometimes, suggestions will be made to curtail the commissioning agent's contract and to compress the testing schedule or scope. Acquiescing to budget cuts as it pertains to commissioning will open the door to increased human error and downtime once the new data center is in operation. The long term negative consequences on overall performance will far outweigh the short term benefits of project budget cuts if commissioning is targeted.

Error Symptom	Consequences	Solution
Budget cuts under the guise of "value engineering" diminish the role of the commissioning agent.	Commissioning schedules are curtailed and this introduces additional opportunities for human error.	Incorporate commissioning budgets early in the project process and be prepared to often restate the benefits of commissioning.

Error #6: Failure to Simulate "Real World" Heat Loads

In the past, the proper tools did not exist for the commissioning agent to perform holistic integrated testing. Computer room air conditioners (CRACs), power, and site support systems were tested in a serial manner and notes were compared to validate whether one system would have an adverse impact on another.

The migration from mainframe to rack-based data centers has rendered this practice obsolete. The heat generated by higher density servers now has a major impact on physical infrastructure components which, in turn, support the uptime of the servers. For example, when commissioning an Uninterruptible Power Supply (UPS), the data center electrical load is often simulated by utilizing very large, exterior resistive heating units. These heating units often arrive on the back of flatbed trucks and are wired to the output section of the UPS.

The problem with this scenario is that only the UPS is tested, ignoring, for example, the cooling system. The UPS is not tested as part of an integrated system. Since one piece of equipment that generates heat can affect the performance of another piece of equipment in the data center, only a partial evaluation can be made as to how the data center will function once it is up and running. Unfortunately, racks, air conditioning, and power equipment must be installed and tested prior to the arrival of servers. This traditional approach of utilizing exterior resistive heating units is problematic from an integrated commissioning perspective.

However, new tools have been introduced that accurately simulate the heat generated by real, rack-based server loads. This artificial load is comprised of resistive heating units installed within the racks. These units mimic that rack's particular design load. With this artificial load installed and operational, the commissioning agent can now test UPS capacity, emergency power, cooling capacity and facility management along with a host of other subsystems in an integrated fashion.

Error Symptom	Consequences	Solution
"Best guess" analysis on how individual equipment components will impact performance and reliability of the data center as a whole.	Increased likelihood of costly downtime once the data center is operating.	Deploy tools that allow for genuine holistic testing and monitoring of the data center physical infrastructure.

Error #7: Failure to Identify Weak Links in the System

Numerous potential pitfalls exist which must be flushed out during the commissioning process. These weak links can exist in several layers of the physical infrastructure element.

The UPS integrated commissioning test, for example, will place critical stresses on the UPS batteries. Each test reduces the amount of battery charge available for future tests. After several tests that require the UPS to switch to battery, the overall amount of available battery runtime is severely reduced.

Each segment of the integrated commissioning test needs to take available battery run time into account. A best practice is to allow for sufficient battery recharge after a major power drain test.

Error Symptom	Consequences	Solution
Various component tests fail during commissioning.	Extra time is spent diagnosing the tests and the commissioning test schedule needs to be extended.	A checklist of anticipated functionality inputs and outputs should be derived for each critical component listed in the test schedule.

Error #8: Failure to Publish Emergency Operational Procedures

The members of the data center construction and commissioning team may not necessarily be the same individuals who are responsible for operating the equipment in the new data center.

Clearly viewable and accessible emergency operational procedures should be affixed to each piece of physical infrastructure equipment. This procedure should also apply to key non data center support rooms and to each Emergency Power Off (EPO) station. Examples of key non data center rooms include the generator room, the UPS room (if separated from data center), and the chiller and pump room. It is also a best practice to have a laminated set of "as built" drawings on the walls of each room to illustrate to all interested parties how the data center was originally configured.

Error Symptom	Consequences	Solution
Data center personnel have trouble determining cause and effect when they encounter physical infrastructure equipment failures.	Overall data center operating efficiency levels drop with an increased risk of downtime.	Post the emergency operational procedures during the commissioning process so that future data center operators are informed and aware.

Error #9: Failure to Consider the Impact of Human Fatigue on Test Results

Depending on the size of the data center design / build project, commissioning can be completed in a day, on a three day weekend, or can take several weeks.

Integrated commissioning is one of the most demanding steps in the data center design / build process. The employees involved work long and hard hours and are under constant high levels of stress. Many of the individuals involved are sleep deprived and perform the commissioning on weekends after having worked several weeks of extended hours. This scenario creates conditions that can lead to catastrophic human errors.

The commissioning agent needs to consider the fatigue level of the staff. Did certain individuals working on various tests just complete a full time shift? Will they be required to work around the clock? Does a backup plan exist for individuals who are required to work longer than normal working hours? Fatigue is the principal cause of human error during the commissioning process.

Error Symptom	Consequences	Solution
Commissioning staff are consistently logging 12 to 18 hour work days.	Employees will take shortcuts, or lose concentration resulting in personal injury or in the data center deployment being delayed.	Rotate staff during the commissioning process so that each individual has a backup who can step in and continue to perform the testing. Assure that work shifts are reasonable.

Error #10: Failure to Update Commissioning Documentation

Once the new data center is commissioned, data center operations staff personnel are likely to change over time. If the commissioning information is kept up-to-date, then the data center knowledge base remains with the company and not with the individuals. The commissioning documentation can serve as the principal source for training of new employees. In addition, the commissioning documentation can serve as a baseline to determine when management should consider upgrading or moving the data center.

Error Symptom	Consequences	Solution
Root cause analysis of data center failures is difficult or impossible to perform.	Operations continue without a high level of confidence that uptime will be maintained.	Establish a disciplined documentation update process to supplement the initial commissioning documentation.

Conclusion

Commissioning is a process that, if not properly managed, can lead to a series of problematic data center performance issues. Everything from the early selection of the proper commissioning agent to the thorough documentation of the commissioning test results can influence whether or not the data center meets the expectations of the business sponsors.

Commissioning requires a high level of coordination between vendors, facilities and IT department personnel, mechanical and electrical engineers, the commissioning agent, and others. It also requires a holistic implementation approach that begins early in the data center design / build life cycle so that a truly integrated series of tests can be performed.

This paper outlines the key errors to avoid so that the commissioning investment produces long term steady returns.

About the Author

Paul Marcoux is the Director of Education and Training at APC. His career has included senior positions in financial, healthcare and technology industries over a span of 25 years. He has provided design, engineering, and management services for over three million square feet of global IT spaces, from small LAN rooms to state-of-the-art 2N data centers. Paul also holds degrees in electrical and mechanical engineering.