



A CAI E-PUBLICATION:

THE PROBLEM WITH CONSTRUCTION QUALITY

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Quality management in the mission critical construction industry is underperforming. The reader need look no further for the evidence to support this assertion than to the commissioning of a data center. Hundreds, and at times, thousands, of issues are found during the functional performance and integrated systems testing and nearly all can be traced back to human error during the construction period. ASHRAE claims commissioning is “a quality-focused process for enhancing the delivery of a project” and that “it is not an additional layer of construction or project management.”

Although this may be the vision and intent of commissioning, in practice, data center owners are relying on the commissioning authority as an additional layer to “catch” the problems missed during the earlier phases of construction. Owners need to reverse this trend and insist on building quality into the projects at the moment of construction. To accomplish this, they could take a couple of pages from the shipbuilding industry’s playbook.

One of the earliest recorded instances of commissioning is from a story found on a Babylonian tablet that dates to 2,100 B.C. It describes the completion of a large ship built in preparation for a great “deluge.” The author writes: “Eighthly, its interior I examined. Openings to the water I stopped; I searched for cracks and the wanting parts I fixed; Three sari of bitumen I poured over the outside; To the gods I caused oxen to be sacrificed.”

It seems even then, people dared not venture onto the sea until they had thoroughly tested the vessel for which they would rely upon for their safety and even their life (Skerrett, 1909).

Throughout history, the engineering and testing practices applied to ship construction have evolved as ships became more complex. And, at some point, ship owners and investors insisted that some form of testing and inspection be done as well to provide them a degree of confidence that their investment would not sink to the bottom of the ocean after launch.

Truly, ships are the original mission critical platform. So, we look to the United States Navy's fleet construction and modernization program for some answers to the problems of building and testing data centers today.

Shipbuilding quality has continuously improved over the ages driven from benign process improvements to responses to catastrophic events such as the loss of the submarine USS Thresher during sea trials (a ship's integrated systems test). The objective of today's shipbuilding program is very clear - deliver the vessel free from either contractor or government responsible deficiencies.

Data center construction programs have the same objective, but one essential feature differentiates the construction and commissioning activities on a ship from the data center - the quality management system.



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ORIGINAL MISSION
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WHAT DOES “QUALITY” REALLY MEAN?

The commissioning process assumes that owners, designers, contractors, and operations and maintenance entities are all fully accountable for the quality of their work (ASHRAE, 2013). But what does “quality” really mean? Of the many meanings, there are two that Dr. Joseph Juran (a leading thinker of quality management in the 20th century) believed were critical to quality management:

“Quality” means those features of a product or service which meet customer needs and provides the customer satisfaction. However, providing more and/or better quality features usually requires an investment and hence usually involves increases in costs. Higher quality in this sense usually “costs more.”

“Quality” means freedom from deficiencies—freedom from errors that require doing work over again (rework) or that result in field failures, customer dissatisfaction, customer claims, and so on. In this sense, the meaning of quality is oriented to costs, and higher quality usually “costs less.”

It would seem that these definitions stand in opposition to one another; however, to achieve quality leadership, Dr. Juran believed that both must co-exist because the major effect of the activities to achieve the first quality definition is increased sales (although often at increased costs) and the major effect of the actions to achieve the second quality definition is reduced costs.

To accomplish this, three important managerial activities must be present in the organization: Quality Planning, Quality Control, and Quality Improvement – commonly referred to as the Juran Triangle, these form the foundation of quality management (Juran & Godfrey, 1999). In comparison to the shipbuilding industry, data center construction quality management is essentially non-existent due largely in part to confusion between the goals of quality control and quality assurance.

Quality control and quality assurance have much in common and are easy to confuse. Each compares performance to goals and causes actions to be taken to correct any deviations. The critically important difference between quality control and assurance is that quality control has as its primary purpose to maintain control of the process. To accomplish this, performance is evaluated by an independent party whose sole function is to monitor either the work as it occurs or at the completion of the task to confirm results prior to proceeding onto the next task. The evaluation is performed using objective and precise standard spelled out in a work procedure or checklist. Any deviations are addressed when found versus later in the commissioning process.

Quality assurance's main purpose is to verify that control is maintained. And it is this subtle difference that distinguishes the quality management system when commissioning a ship versus commissioning a data center.

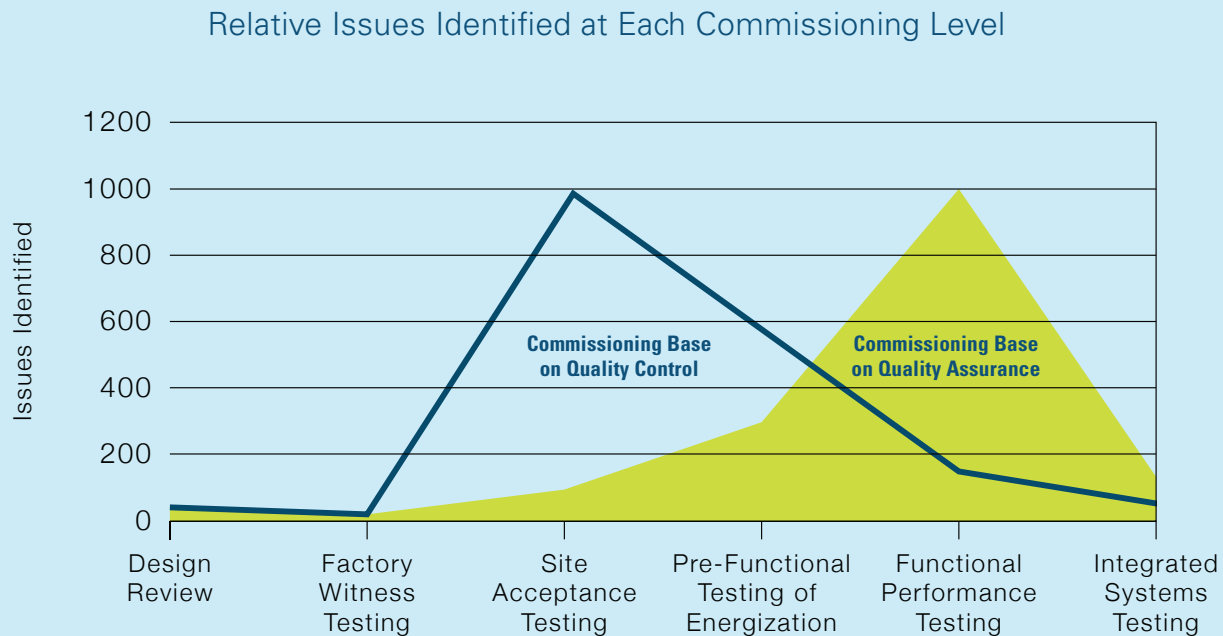
The important conclusion from this is that the various levels of commissioning as outlined by ASHRAE may need to be reconsidered for data centers and other mission critical construction programs.

The six commissioning levels are not as effective at eliminating deviations early in the construction program where they are easier to correct and are the least costly - instead, the ASHRAE commissioning levels may have created the opposite case due in large part to the construction industry's lack of quality control.



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CONTROL OF THE PROCESS.**

Consider the following figure that illustrates two quality management approaches that identifies a combined total of 1,000 issues in a hypothetical data center project:



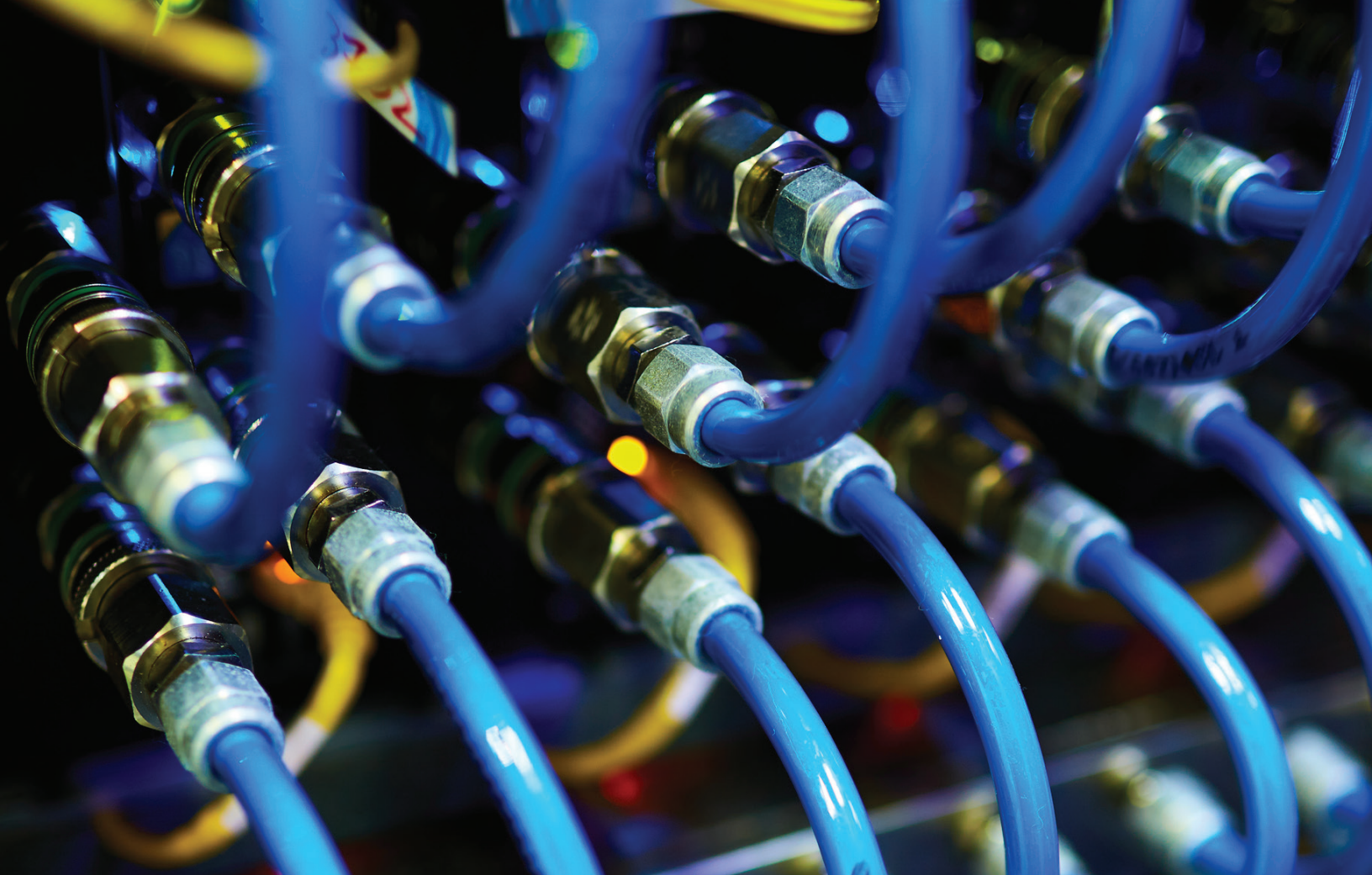
The green graph represents the current approach that yields that greatest number of issues identified during L4 and L5 testing when it is most disruptive to testing effectiveness and the project schedule. The blue graph represents an approach that establishes a quality control program that continuously evaluates the construction tasks to identify problems early and continuously throughout the construction program when issues can usually be corrected at a fraction of the cost and in a least disruptive manner prior to full functional and integrated systems testing.

An added effect of discovering and correcting issues early is that the solution can be applied to all phases of construction that remain thus reducing the overall deficiency count. To transition to an approach illustrated by the green graph, an owner can bring the CxA onboard to implement, deploy, and manage the owner's quality management system.

The method to accomplish this is the subject of a different white paper, but the results of an owner taking this step would revolutionize the data center construction industry.

In summary, almost all data center construction projects suffer from a construction industry that lacks solid quality control systems.

ASHRAE's guidelines are somewhat silent on this topic and do little to provide relief to owners that struggle with the traditional commissioning process. One solution is to bring the CxA on the construction team early to oversee the construction program's quality management function as the owner's independent representative.



The benefits of this approach are many but two are worth mentioning. One is this solution enables the independent development of quality control checklists in advance of the work that guides the worker in doing the job right the first time – a term frequently used is first time quality. These checklists can then be continuously updated during the construction period as problems are encountered which lowers the likelihood of finding repeat quality issues during L4 and L5 testing.

The second is the immediate benefit of having a CxA with the full knowledge and experience of managing all construction problems discovered and corrected to date. This knowledge would empower the CxA to focus on purely the functional performance of the data center while they conduct the full shakedown of the integrated systems - much like the shipbuilding industry performs today prior to delivering a ship free from deficiencies.





About the Author: Rich Tree

Rich is a hands-on senior consultant with 40 years of experience leading operational excellence efforts for organizations. His expertise includes supply chain management, asset management, reliability, organizational effectiveness, and human performance improvement. His leadership has consistently strengthened his clients' performance by improving leadership, teamwork, process efficiency, and eliminating waste. He guides customers to develop unified strategies that improve their Overall Equipment Effectiveness (OEE) through people and improved organizational systems. As a Lean Six Sigma certified operations expert, he is personally credited with the lean transformation of nine manufacturing sites, mentoring over 34 manufacturing sites in advanced lean operations, designing and implementing asset management strategies at 15 manufacturing sites, and coaching senior leaders to transform their organization. He has scaled up manufacturing in 18 different process manufacturing and life sciences manufacturing companies.

Rich is a veteran of the US Navy submarine and Naval Nuclear Power programs serving his country for 22 years. Before joining CAI, he held several key operations leadership roles in three manufacturing companies.