Construction Quality Program Management

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Lieutenant General John W. Morris, a former Chief of Engineers for the U.S. Army Corps of Engineers, once wrote:

> *"Long after the airbases are built on time and below budget, all that the customer will readily remember is the quality of the airfield and its facilities."* *EP 5-1-5 Lessons Learned on Israeli Airbase Program, Sep 1982*

The overall purpose of a quality management program is to ensure that the project, when completed and placed into use, satisfies the goals of the owner and end user in the most cost effective manner. Like good design, good quality does not need to be expensive. A comprehensive quality management program takes place throughout the life of the project, from project initiation through closeout. Effective quality management is much more than just making sure the construction complies with the drawings; it also makes sure the criteria is correct before starting the drawings, and makes sure the drawings are correct before starting construction. Whether the procurement process is design-bid-build, design-build, or some other method, the principles remain the same.

The project owner, end user, design professional, and constructor all have important duties and responsibilities in an effective construction quality management program. The owner, though his actions more than his policies and procedures, must demonstrate achieving project quality is a priority. The owner and end user must balance their attention to cost, quality, and schedule so that the design professional, constructor, and other project stake-holders understand quality is just as important as time and money. The owner and end user must agree on project goals. The owner, end user, and design professional must express the project goals through clear functional and performance criteria. The design professional must produce efficient, cost effective designs that satisfy the functional and performance criteria. The design professional must produce clear, error-free contract documents that clearly communicate the design intent. The constructor must study the contract documents to ensure all components of the design are incorporated into the work. The constructor must establish and maintain programs to ensure all suppliers and trade contractors meet required standards.

Like safety, quality is good business. Good quality management programs lower overall project costs. An effective quality program will ensure that the project meets the project goals in the most cost effective manner. Project components that do not add value or that are in excess of project requirements are eliminated. Drawings and specifications that are complete, clear and error-free reduce the number of changes and claims. Doing the job right the first time reduces the amount of corrective rework. Project participants are proud of their results, which increases morale and employee retention. All of these benefits reduce project costs and improve the bottom line.

Key Elements of an Effective Quality Management Program

#1: Project Initiation Phase

- **Criteria Review** - An independent review of the functional and performance criteria compared to the goals of the owner and end user. The purpose of the criteria review is to confirm that the functional and performance criteria satisfy the specified and implied project goals, are affordable, and can be achieved within the time available. The criteria review is absolutely critical for starting the project correctly. Too often, the criteria review is completely neglected. Too often, implied goals are not readily apparent or are inconsistent. Project goals must include requirements for durability, maintainability, usability, functionality, and economic life. Too often, systems are over-specified for no reason. For example, if the expected service life of a facility is fifty years, there is no need for the roofing system to last one-hundred years. A thorough criteria review will expose inconsistencies and provide a forum for resolution.

  The criteria review also establishes owner and end user requirements for formal commissioning and certification. For example, the owner may desire that development of a mission critical data center follow guidelines established by the Uptime Institute™. The owner may desire the project achieve a certain U.S. Green Building Council LEED® certification. These requirements affect project goals and must be considered in initial planning.

  Owners and end users must allocate reasonable time for a thorough review of project criteria. Time must be available for technical analysis and for management decision making to resolve conflicts. The project should not proceed until there is substantial agreement and buy-in between the owner and end user concerning project requirements and criteria. Having clear project requirements is essential for the project to proceed smoothly.

#2: Planning Phase

- **Design Suitability Review** - An independent review of the initial design intent compared to the functional and performance criteria, and compared to relevant codes and standards. Prepared very early in the design phase, ideally prior to the end of schematic design. The design suitability review provides confidence that the project conceptual design will meet the performance and functional criteria, employs well-proven standards and best practices, and will satisfy applicable code requirements.

- **Design Peer Review** - An independent review of the design to determine if the design:
  - Employs the most cost effective and innovative materials, techniques, or methods,
  - Contains unnecessary redundancies,
  - Conforms to applicable legal requirements, or

- Contains ambiguities, errors or omissions.

The project schedule should include peer reviews at critical design milestones. Typical milestones include the end of design development, 50% construction documents, and 95% construction documents. The design peer review should examine the specifications and drawings at the same time. It is important that the design peer review be conducted by independent design professionals who are not associated with the original design team.

- **Cost and Constructability Review** - A review of the design by qualified construction and cost management professionals to determine:
  - If the project can actually be constructed in accordance with the drawings and specifications.
  - If there are better, more efficient, or more cost effective means and methods available.
  - If other, more cost effective means and methods can still meet the original functional and performance criteria.

  Cost and constructability reviews should be conducted by impartial, qualified construction professionals teamed with cost management professionals, NOT the ultimate constructor. While the ultimate constructor may be technically qualified, there exist potential conflicts of interest. Cost and constructability reviews should be conducted at the same intervals as design peer reviews.

#3: Execution Phase and Monitoring and Controlling Phase.

- **Trade Certification Program** - The constructor should establish and maintain a program to ensure that tradesmen possess the necessary skills and experience to perform assigned tasks. The constructor should determine the skill level of tradesmen through a testing and certification process. The constructor should maintain documentation demonstrating all tradesmen working on the project are technically qualified.

- **Submittal and Shop Drawing Review Program** - A program to ensure timely preparation, delivery, review, and approval of all submittals and shop drawings. The constructor must provide adequate time in the overall project schedule for review of shop drawings and submittals. The design professional must provide adequate staff to review submittals and shop drawings on a timely basis. The design professional and constructor must continually communicate on the status, and work to resolve any issues quickly. Procedures must be in place to assure approvals are granted prior to purchasing materials or beginning work.

- **Materials Testing Program** - The specifications must include specific material inspections and tests. The specifications should clearly identify whether the any inspections must be performed by an independent, licensed testing laboratory and whether the testing laboratory must be engaged by the owner or constructor. The constructor and design professional must review and take

appropriate action on the results of all material inspections and tests.

- **Contractor Rolling Inspection Program** - The constructor should establish and maintain a system of rolling trade inspections throughout the duration of the construction process. This includes code required special inspections. The constructor must coordinate the rolling inspection program with the materials testing program. The specifications should include other specific inspections and tests for each major definable feature of work in order to set an acceptable level of workmanship. Inspections for workmanship should be based on established industry standards or on specific owner/end user criteria.

  The constructor must tabulate all required inspections and tests, and schedule and conduct all inspections and tests as part of his overall project schedule. All inspections and tests must be thoroughly documented and reviewed by the design professional. The constructor must establish and maintain procedures to document, track, and correct all identified deficiencies.

  The rolling inspection program should be based on "prevention" instead of "correction." The constructor must ensure that
  - Trade contractors and constructor project management staff are familiar with the requirements of the specifications and any applicable standards.
  - Required preceding work is properly completed prior to beginning a new phase of work.
  - Required materials and tools are on hand and are in good working order.
  - Provisions have been made and are in place for any control testing or inspection.
  - Submittals or samples have been approved prior to starting work.
  - Tradesmen understand and can meet the required standards of workmanship.
  - Tradesmen are qualified and certified to perform the work.
  - Once standards of workmanship are established, follow-on work must continue to meet the established standards.
  - Required documentation is accurately completed and reviewed on a timely basis.

  The most effective rolling inspection programs are managed and supervised by constructor quality control staff who are independent from the project management staff. Like the constructor's safety program managers, the quality control staff must report to constructor executive management in order to avoid conflicts of interest. The project superintendent or production project manager should never also be the contractor quality control manager.

- **Commissioning and Start-Up Program** - The design professional, owner, end user, and constructor should establish and implement a commissioning and startup program. The depth of the program should be driven by criteria

established during the project initiation phase. For example, the commissioning program for an Uptime Institute™ Level IV standby power system supporting a mission critical financial data center would be much more rigorous and complex than the commissioning program for a less critical facility.

#5: Closeout Phase.

- **Substantial Completion Inspection Program** - The constructor must establish with the owner, end user, and design professional a program to confirm that all trade contractors have properly completed all work. Initiation of the substantial completion program must well-precede the date of substantial completion required by the contract documents. A proper substantial completion inspection program is a natural by-product of an effective rolling inspection program. If the rolling inspection program is effective, the substantial completion inspection should reveal very little remaining or improperly completed work.

- **Closeout Documentation Submittal Program** - At substantial completion and prior to final completion, the constructor must assemble, tabulate, organize and submit all as-built drawings, operations manuals, maintenance agreements, warranties, attic stock, training manuals, commissioning documents, certificates, and other documentation as required by the contract documents or regulatory agencies. The design professional must actively participate in the program to review the acceptability of all submittals. The owner and user must actively participate in training sessions.

- **Project Acceptance Program -** At substantial completion, the owner and user must be prepared to take full use and possession of the project. The owner and end user must have procedures in place to receive, catalog, and store attic stock, spare parts, and closeout documents. The owner and end user must have preventive and scheduled maintenance programs in place. The owner must be prepared to carry all applicable insurance. Owner or end user staff must be present and ready to assume responsibility for operating and maintaining the project.

- **Final Completion Inspection Program**. The constructor must establish with the owner, end user, and design professional a program that will confirm that all deficiencies identified during the substantial completion inspections are complete and that all missing closeout documentation has been submitted.

W. David Stoutamire, President, has led the planning and execution of major projects for Office Depot, Toyo Tire, Citrix, Royal Caribbean Cruises, the Georgia Institute of Technology, Equant, AGL Resources, the U.S. Army Corps of Engineers, and others. David can be reached at dstoutamire@sempaiservices.com.

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