Guide to Quality Management Auditing in the Concrete Industry

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This guide provides the background and methods for conducting an audit of an organization's quality management system. Such an audit can assess the organization's commitment to quality management and conformance to standards, codes, and contract requirements. Audits can also identify portions of the quality management system that need correction or improvement.

Keywords: audit; nonconformance; opportunity for improvement; process audit; quality management system; quality manual.

CONTENTS

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CHAPTER 1—INTRODUCTION AND SCOPE

1.1—Introduction

An effective means of determining an organization's commitment to quality management is an audit, whether the organization is involved in design, construction, inspection, testing, or other operations. Before procurement, an initial audit can evaluate operations of a supplier or subcontractor. During the course of a project, an audit can verify an organization's quality management, efficiency, and conformance to contract, codes, procedures, and standards. By looking closely into a supplier's operations and asking key questions, a customer can be assured that what is presented or proposed in the bid, proposal, promotional literature, or quality plan is consistent with the supplier's capabilities and methods in their normal course of business.

Furthermore, an organization can assess the effectiveness of its own quality management system and, thereby, its internal performance, efficiency, and conformance by conducting an internal audit. The results of such an audit can be the basis for determination of capabilities, self-declaration of conformance to a standard, and discovery of opportunities for improvement.

This guide incorporates some of the principles contained in ISO 19011:2011, which can be used as reference should the auditor determine that ISO 19011 is applicable.

The level of expectations can vary depending on the needs of the client and what the client determines as adequate. A high order of performance can be determined by using the criteria established in ISO 9001:2008, in which case it is recommended that ACI 121R be used as a guide to determine the level of performance as it applies to the concrete industry.

The questions presented herein are intended to cover a broad range of issues, and some organizations may not be able to respond to them affirmatively. That does not necessarily indicate the organization is not a good choice for the task, as the questions themselves are not necessarily the criteria for acceptance or rejection. In the absence of well-defined criteria, as would be required by contract, code, or self-proclaimed conformance, there is no right or wrong answer, only the facts, which are to be interpreted by the party requesting the audit. The quality management system capabilities encountered can range from the simple and basic to the robust. The level of quality management necessary to perform the task is determined by the party requesting the audit.

1.2—Scope

This guide is intended for use in the concrete construction industry. Recommendations and practices presented are intended to be nonmandatory and only meant as guidance. This document is not intended to offer guidance in initiating a quality management system or to serve as a standard for third-party registration audits.

This guide addresses several disciplines within the concrete construction industry with questions specific to those disciplines. It begins with the principles and objectives of audits, followed by audit protocol, methods, techniques, and competency of auditors. Chapter 7 covers common processes of quality management typical to all industries with an emphasis on their application within the concrete construction industry. Chapters 8 and 9 cover the processes for design and construction. Processes are presented with background information, their impacts on operations, common pitfalls, and sample questions to prompt audit investigations and discussions. For someone not familiar with quality management considerations for a certain discipline within the industry, this guide provides background and a starting point with some of the appropriate questions to ask.

The application of this guide is suited for assembling a list of good practices to use in an audit procedure that is commensurate with the size and complexity of the organization's assigned or proposed task. Its application is also relevant to audits of large organizations with more complex systems and the resources to support them.

CHAPTER 2—DEFINITIONS

ACI provides a comprehensive list of definitions through an online resource, "ACI Concrete Terminology," https://www.concrete.org/store/productdetail.aspx?ItemID=CT16.

as-built drawings—generally considered a revised set of drawings provided upon completion of a project, which reflect changes made in the drawings during the construction process; responsibility for providing the drawings, the level of detail required, the liability for the accuracy and completeness of the information provided, and the legal definition differ by the governing bodies of the geographic area and the agreement with the entity purchasing the service. Also known as "record drawings".

audit—systematic, independent, and documented process for obtaining evidence and evaluating it objectively to determine the extent to which criteria are fulfilled.

auditee—organization (or person representing the process) that is being audited.

auditor—person with the competence to conduct an audit; also indicates the lead auditor when an audit team is led by one person.

audit criteria—set of policies, documented information, or requirements used as reference against which audit evidence is compared.

audit plan—description of the activities and arrangements for an audit.

audit program—set of one or more audits planned for a specific time frame and directed toward a specific purpose.

audit scope—extent and boundaries of an audit.

back-checker—architect or engineer within the architect-engineer organization that ensures that all corrections have been addressed; can be one and the same with the checker.

CADD manager—person responsible for the overall management of the computer-aided design and drafting (CADD) portion of the project.

CADD manual—manual, usually written by the CADD manager, that coordinates and standardizes the CADD operation and style.

checker—architect or engineer within the architect-engineer organization who performs quality control by detailed examination of the calculations, specifications, and drawings.

compliance—adherence to laws or regulatory requirements.

conformance—adherence to standards, procedures, specifications, or work methods and instructions.

corrective action—efforts made to eliminate and prevent recurrence of the cause of a detected nonconformity or other undesirable situation.

deficiency—physical work item or condition identified by project personnel that is not in conformance with the construction documents and that has a predetermined remedial action by means of existing specification, previously closed nonconformance report, or by an accepted repair procedure (also known as a "minor nonconformance").

disposition—process of identifying a proposed correction for a nonconformity to bring the item into conformance with project requirements.

external audits—generally second- and third-party audits.

findings—results of the evaluation of the collected audit evidence against audit criteria.

first-party audits—conducted by, or on behalf of, the organization itself for management review and for process improvement and for conformance, and may form the basis for an organization's self-declaration of conformity.

hold point—point in a process where it cannot proceed further without a specified inspection, test, or acceptance.

inspection and testing plan—list of the elements of the project and the required testing and inspection for each one.

internal audits—generally known as first-party audits.

lead auditor—auditor in charge of the audit team.

nonconformance—product, material, or process that does not meet established standards or criteria.

opportunity for improvement—documented notification to the auditee that may be issued by the auditor when, by adopting an improvement to the process, the system is thought to have an increased ability of fulfilling a requirement.

placing drawings—drawings used by reinforcing steel installers to place reinforcing steel (refer to *CRSI Manual of Standard Practice* [CRSI 2009]).

preventive action—elimination of the cause of a potential nonconformity or other undesirable potential situation.

preventive action request—notification to the auditee issued by the auditor when a process is seen to be in danger of delivering a nonconforming product.

procedure—document that explains the process for achieving a task and typically addresses who, when, where, what, and why associated with the process and may contain one or several work methods.

quality management procedure—procedure that details the methodology for a particular process related to the quality management system (also known as "quality management procedures").

quality management system—management system to direct and control an organization with regard to quality (also referred to as "quality system").

quality manager—person responsible for the oversight of the quality management system to include coordination, quality control activities, reviews, auditing of the processes, and recognition of opportunities for improvement.

quality manual—document or set of documents specifying the quality management system of an organization.

quality plan—document specifying which procedures and associated resources should be applied by whom and when to a specific project, product, process, or contract.

quality policy—overall intentions and direction of an organization related to quality as formally expressed by top management.

resolution—proposed or approved correction for a nonconformance or deficiency to bring the item into conformance with project requirements.

root cause—initiating cause of either a condition or a casual chain of events that leads to an undesirable outcome.

second-party audits—conducted by parties having an interest in the organization, such as customers.

sign-off—to concur with the contents of a document by signature or initial and date.

supplier—entity that provides a service or a product to the organization; this can be internal or external to the organization, or in a contractual situation sometimes called a contractor or subcontractor (also referred to as "vendor")

surveillance audits—spot or random checks to ensure that systems presented in previous audits or plans are in use and functioning adequately.

third-party audits—conducted by external, independent auditing organizations.

traceability—ability to follow the history, origin, application, destination, or location of a product or components through documentation.

validation—process of assuring that the design meets the customer's needs.

verification—assurance that all the requirements are met.

witness point—location in a process wherein a specific position, role, or inspector should be given adequate notice of the scheduled inspection or test.

work method—document that details how a specific task is to be completed (also known as "work instructions").

CHAPTER 3—PRINCIPLES OF AUDITING

To ensure that audits are conducted in a professional, honest, and objective manner, ISO 19011:2011 provides auditing principles. These principles should produce information that is valuable and relevant and ensure that different auditors use the same criteria and evaluate data in a consistent, unbiased manner.

a. Ethical conduct is the overriding attribute of an auditor from which all other principles should branch. Auditors need to be honest, maintain the integrity and confidentiality of information gathered, exercise discretion, and be sensitive and respectful to the organization's culture. Audits need to be directed toward a win-win objective recognizing that an audit is an information bridge between the auditor and the auditee. Audits should be implemented as tools to enhance the relationship between parties and benefit both.

b. Fair presentation refers to the obligation of reporting objectively and without bias. This principle includes unbiased reporting of any obstructions or differences of opinion encountered during an audit. Personal preferences should be avoided; auditor should refer to applicable standards, procedures, or specifications.

c. Due professional care includes the application of diligence and follow-through in all matters related to the audit. The auditor should be well prepared; have adequate knowledge and competency regarding the subject; have a clear picture of what they are looking for; and provide relevant, meaningful results.

d. Independence requires audits to be performed by auditors that have no vested interest in the subject activity, be it through financial incentive, supervisory affiliation, or other relationship detrimental to impartiality. An auditor should not be subordinate to the auditee unless hired as an independent consultant to conduct internal audits. This structure will allow auditors to remain objective and report the audit findings in an impartial manner.

e. An evidence-based approach means the information gathered during the audit is verifiable. Auditors should collect authentic, factual information in the form of documents, data, and samples. Conclusions cannot be based on suspicions, assumptions, or conjecture.

CHAPTER 4—COMMONLY EMPLOYED QUALITY MANAGEMENT SYSTEMS

Quality management systems range in scope and complexity, depending on the organization size and their particular needs. Small locally-based contractors may have self-invented, undocumented systems. Large international contractors have typically used ISO-based systems. Note that many of these systems use common tools. The choice of tools and level to which they are applied varies. Brief descriptions of systems that may be encountered follow.

4.1—Simple, self-invented systems

Some variation can be expected in the way quality management is handled in smaller companies. Firms without a structured approach may have little experience with established quality management standards and simply use a measure of common sense in setting up their processes. It is beneficial to have written procedures, as they standardize operations, specify documentation, assign responsibilities, facilitate training, and provide a point of reference should operations need modification or improvement. These organizations may or may not have written procedures and may not need them considering the level of sophistication required by their customers and the scale of the work.

4.2—Contractually-based systems

Other companies may employ systems based on agency or owner requirements, perhaps driven by specifications that are focused on a particular aspect of the work, such as batch control, placement, and inspection without consideration for the other supporting processes to be found in a total quality management system. Examples are state department of transportation systems that focus on inspection and testing and the Construction Specifications Institute Series 01-40-00 specifications, which are usually written to an owner's requirements. There is no single approach to a quality management system, and in the absence of mandated requirements, organizations can tailor a quality management system to their particular needs.

4.3—Systems modeled after ISO formats, current and noncurrent

Common to agency and government work are systems based on the ISO 9000 series. Starting in 1987, the International Standards Organization (ISO), in conjunction with local organizations such as Canadian Standards Association (CSA), the American National Standards Institute (ANSI), and the American Society for Quality (ASQ), has issued the ISO 9000 series of standards to define the requirements for a quality management system and the elements that make it compliant with the ISO standard in effect at the time. Firms are allowed to register as compliant with the current standard if they are found compliant by an ISO-authorized third party known as a registrar. There have been several revisions since 1987 as explained in the following. Registration is typically granted for a 3-year period. Firms who wish to retain their registration need to be registered to a revised standard within 3 years of its issue.

4.3.1 *ISO 9001-1994*—This is a standard that is out of date and has been withdrawn from the ISO standards. It was composed of 20 elements of quality management, which have specific requirements.

Although the standard has been withdrawn by ISO, many of its elements are still practiced in various quality management systems in use. As stated, many tools (internal and external audit, for example) are common to various quality management systems. ISO did not invent them; they simply defined them in a standard.

The advantage of ISO 9001-1994 was its simplicity; its concepts were easy to implement by organizations. It addressed quality management elements separately and did not focus on planning processes and their interrelationships. It could require more effort in defining the procedures that were used to build the processes because the standard required a procedure for each element regardless of how essential or nonessential it was to the process. Some processes do not require all the elements.

ISO 9001:1994 is considered obsolete and new registrations are made to the current ISO standards. The tools presented in ISO 9001:1994, however, still remain as the framework for quality management specifications and systems in some spheres such as state department of transportation design-build contracts and manufacturing organizations that are comfortable with its use.

4.3.2 *ISO 9001:2000 and ISO 9001:2008*—ISO 9001:2000 and its update, ISO 9001:2008, were the next generations of standards after the ISO 9001:1994. They both differ from ISO 9001:1994 in that ISO 9001:2000 and ISO 9001:2008 principles are based on processes. Both set requirements for processes and their interrelationships with other processes that intersect with them. In general, nested within those requirements are the applicable parts of the original 20 elements originally found in ISO 9001:1994, but they now take a subordinate role in the control and improvement of processes. ISO 9001:2000 and ISO 9001:2008 also expanded the process requirements to include continual improvement and customer satisfaction, which ISO 9001:1994 did not specifically address.

The ISO 9001:2008 standard requires, as a minimum, the following be maintained for a quality management system to be compliant:

a. Written quality policy and quality objectives
b. Quality manual, which includes:
1. Scope of the system with any exceptions
2. Description of the processes and interactions it addresses
3. An addressing of each of the ISO 9001 requirements
4. Documented procedures as a minimum as follows:
i. Control of documents
ii. Control of records
iii. Internal audit
iv. Control of nonconforming product
v. Corrective action
vi. Preventive action

ISO 9001:2000 has been withdrawn. ISO 9001:2008 has recently been replaced by ISO 9001-2015, yet is acceptable for existing registrations until September of 2018.

4.3.3 *ISO 9001:2015*—In 2015, the present standard, ISO 9001:2015, was released. Registered organizations have 3 years to update to the new standard. The new standard took a departure from the ISO 9001:2008 in clause numbering sequence and some modification of concepts. The focus remains high level and is based on quality management principles: customer focus, leadership, engagement of people, process approach improvement, evidence-based decision-making, and relationship management.

The changes are as follows:

a. The clause numbering sequence was reorganized to comply with the High Level Structure per Annex SL, Appendix 2, of the ISO/EIC Directives, Part One. The intention is to align the clauses of the new standard with those of other ISO Standards such as ISO 14001 and ISO 27001. The alignment of these clauses facilitates the structuring and monitoring of these respective management systems either in parallel or in combination.

b. There is no longer a requirement to align the clauses of the quality management system with those of the standard, providing the requirements are met. This allows organizations to structure their systems in a manner more familiar to them and more closely aligned with their processes.

c. The use of ISO terminology is no longer mandatory. Organizations can use terms familiar to them and better fit their operations when structuring systems.

d. Risk-based thinking is specifically required as a quality management tool to support and improve the process approach. It is used to replace preventive action as a requirement.

e. Greater emphasis has been placed on leadership.

f. Emphasis is placed on understanding the context of the organization. This can be understood to be the business environment the organization operates within and includes internal and external factors as well as the expectations of interested parties. Internal factors would be how the organization is staffed, who is responsible for what, communication between departments, and integration of processes. External factors would include strategic planning, market development and research, domestic and international economics, and politics. Interested parties are customers, shareholders, partners and suppliers, public agencies, competitors, and society.

4.4—Other systems that may be encountered

It is not within the scope of the guide to list every method of implementing a quality management system. As stated, all systems use common tools. The following are some systems an auditor may encounter in the concrete industry.

4.4.1 *Six Sigma*—Six Sigma is a statistically-based quality management system that focuses on elimination of defects and removal of waste. It was developed in the 1980s to improve production control. Six Sigma principles operate under the DMAIC (Define, Measure, Analyze, Improve, and Control) cycle. There is no certification for organizations as there is for ISO. Individuals are certified to one of six levels of competency from White Belt up to Black Belt. While there is no sole certification body, several organizations have developed programs for Six Sigma certifications. The criteria for certifications may vary for one certifier to another. The American Society for Quality is one of the major certifying bodies and requires a written examination and provision of an affidavit for the required levels of experience.

4.4.2 *Nuclear Regulatory Commission (NRC) 10CFR-50*—Understandably, more stringent quality management practices are applied to construction of a nuclear power facility. In the United States, licensing is obtained by compliance with 10CFR50:2015, Appendix B, which is composed of 18 quality management requirements, listed and expressed in