Quality Management in Construction

An Expanding Role for SH&E Professionals

By Sathy Rajendran, Brian Clarke and Richard Andrews

The role of construction safety professionals has significantly expanded over the past decade. The industry employs thousands of safety professionals, most of whom work for contractors (general or subcontractors).

Prior to the 1980s, only a few progressive owners held employees and construction contractors who worked in their facilities to a higher level of safety performance than OSHA standards. Then came a real push for safety performance excellence as insurance carriers demanded that contractors provide their own full-time safety field supervision. In addition to the considerable efforts by safety-conscious owners, contractors, OSHA, insurers and other organizations, safety professionals have played a prominent role in the industry's safety improvement over the past 30 years.

The traditional approach to construction safety has been to 1) develop and implement company safety programs; 2) work with regulatory agencies to develop and implement safety rules and regulation; 3) encourage professional de-

IN BRIEF

- **This article examines the feasibility of integrating safety and quality management, the parallels between safety and quality management responsibilities, and the interrelationship between construction safety and quality.**
- **It also explores the role of safety professionals in field construction quality management and reviews what a construction safety professional needs to know to manage a field quality control program.**
- **Safety professionals can enhance their value in the workplace by managing their company's field construction quality control program.**

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velopment and continuing education; and 4) work as an expert witness or consultant when safety-related incidents lead to litigation.

Today, construction safety professionals also find themselves involved in insurance coverage and placement; employee discipline; labor relations; claims management; fleet management; crisis management and disaster recovery; business continuity planning; purchasing and contract reviews; subcontractor prequalification, selection and management; and permitting. These added responsibilities have made safety professionals assets to their organizations.

Now, SH&E professionals have an opportunity to help the industry improve quality management by preventing construction defect claims. This role would further increase safety professionals' value to their companies. However, to add value, construction safety professionals must understand the relationship between safety and quality management.

Construction Defect Claims & Their Effect on Construction Contractors

The insurance industry is experiencing a similar increase in losses as it did in the 1980s with worker injuries, but now the claims are related to construction defects. These defects are covered under an insured's general liability completed operations coverage.

Completed operations coverage is a section of an insured's general liability (GL) insurance policy and responds to property damage that occurs after substantial completion of the project for as long as the statute of repose in the jurisdiction where the project was constructed. In many states, this ranges from 6 to 10 years, while in other states it is longer than 10 years.

A construction defect claim is any claim for property damage that is progressive in nature, and arises out of the construction of any project and occurs after construction operations have been completed.

Defect claims are expensive. The U.S. insurance industry pays more than $5 billion annually to settle construction defect claims (Zurich Corp., 2011). This is approximately 0.5% of the value of the U.S. construction market, which was estimated to be slightly less than $1 trillion in 2010 (USCB, 2011). To put this into perspective, the average owner pays an additional 1/2 cent of every construction dollar to pay for construction defect claims and to bring their projects into conformance with project requirements.

The most common construction defect claims in commercial construction include:

- building envelope and structure;
- door, window and exterior wall deficiencies;
- roof leaks;
- damp-proofing and waterproofing deficiencies;
- deck and balcony deficiencies;
- foundation movement;
- infrastructure;
- drainage deficiencies;
- road and parking area deficiencies;
- electrical and HVAC deficiencies;
- plumbing and internal leaks (e.g., "wet walls");
- sound, vibration, odor, vapor transmission and code compliance deficiencies (Zurich Corp., 2010).

Approximately 75% of the claims involve water in some way (Zurich Corp., 2010). The causes of construction defect claims are well known, and their persistence continues to frustrate insurance carriers and contractors. According to one study, 54% of these claims are due to faulty workmanship or installation (Zurich Corp., 2011). Based on the authors' experience, other reasons for the recent increase in construction defect claims are varied.

- In the residential sector, developers are operating under limited liability companies that are dissolved upon project completion, leaving no entity to respond to warranty and construction defect claims.
- Homeowner associations are reacting as a group through lawyers rather than calling for and requesting repairs from the original contractors.
- Contractors are not installing products correctly or are allowing unauthorized substitutions without receiving appropriate approvals.
- Poor workmanship by craftspeople.
- Sites are not sufficiently supervised by third-party quality inspectors, or by the construction manager and/or general contractor.

Insurance companies are responding in various ways. Based on the authors' experience, these responses include:

- excluding residential projects;
- increasing deductibles;
- charging higher premiums;
- requiring a formal, written quality management program;
- only insuring its best contractors, leaving higher-risk contractors to seek coverage from high-risk, nontraditional insurance markets, which dramatically increases the cost of insurance.

These outcomes place a financial burden on contractors. As a result, they must ensure that they have proper quality management in place to avoid construction defect claims. A formal written quality management program is a perfect strategy to prevent such claims.

Furthermore, insurance companies that insure contractors have expanded their loss control and claims staffs in response to the increase in defect claims. In addition, insurance underwriters are asking contractors for written quality management programs (much like they asked for safety programs in the 1980s). As a result, a new position, the quality control manager, is gaining influence in the construction industry, and it is a role that many construction safety professionals could fill.

However, questions about the compatibility of safety and quality management must be answered first. Will the integration of quality and safety functions work? Do parallels exist between safety and quality functions? Does a relationship exist between quality and safety management?

Integration of Quality & Safety Management Systems

A precedent exists for integrating quality and safety management systems. OHSAS 18001:1999 was meant to be compatible with ISO 14001:1996 (en-

vironmental management) and the old ISO 9001:1994 (quality assurance) standards to facilitate the integration of quality, environmental and occupational safety management systems within organizations (Pheng & Pong, 2003). Pheng and Pong proposed a three-in-one approach that would integrate the three standards and would allow for comprehensive solutions to problems.

Further research supports the integration of safety, environment and quality systems in the construction industry. Koehn and Datta (2003) concluded that construction companies can develop a system that is effective in ensuring all three objectives. Furthermore, ANSI/ASSE/AIHA Z10, the first U.S. consensus standard for a safety and health management system, aims to use recognized management system principles of the plan-do-check-act process, compatible with quality and environmental management system standards such as ISO 9000 and the ISO 14000 series. Thus, the integration of quality and safety systems is feasible.

Interchanging Safety & Quality

Question: What do these statements about quality have in common?

- Quality is job one.
- Quality is an attitude.
- Quality is a journey, not a destination.
- Quality is everyone's job.
- Quality is a habit, not an act.
- There are no half measures in the pursuit of quality excellence—you have to do it all.
- Quality is a new way of thinking, being and doing.
- Quality is so important it pays for itself.

Answer: The word *quality* can be interchanged with *safety*.

- Safety is job one.
- Safety is an attitude.
- Safety is a journey, not a destination.
- Safety is everyone's job.
- Safety is a habit, not an act.
- There are no half measures in the pursuit of safety excellence—you have to do it all.
- Safety is a new way of thinking, being and doing.
- Safety is so important it pays for itself.

Parallels Between Safety & Quality

In the construction industry, many employers are already assigning quality management responsibilities to the safety department. The authors believe this is a natural alignment based on the parallels between safety and quality. According to Behm, Veltri and Kleinsorge (2004), several authors have made clear the relationship between quality and safety management.

For example, Manuele (1997) concluded that the word *quality* is interchangeable with the word *safety,* and his premise remains sound. To show how safety mirrors the quality function, Manuele inserted *safety* for *quality* in the following statement: "When quality (safety) is seamlessly integrated into the way an organization operates on a daily basis, quality (safety) becomes not a separate activity for committees and teams but the way every employee performs his or her job." For more on this idea, see the sidebar above.

Based on these parallels, the authors believe that construction safety professionals should execute quality functions in the field—both from a process perspective and a staffing perspective. For example, safety professionals could promote and audit quality management systems as part of their safety oversight responsibilities during jobsite visits.

Interrelationship Between Quality & Safety Management

Based on experience, the authors believe that quality and safety excellence are correlated. Analysis of historical loss information found that the safest construction contractors have the fewest construction defect claims and produce the highest construction quality (Zurich Corp., 2010). Companies with a track record of safety excellence tend to be better-managed companies with more sophisticated quality management programs as well (Zurich Corp.).

Construction defects due to poor quality management can be costly, including the potential for serious injury or death. One example is the 2004 partial collapse of Terminal 2E at the Charles de Gaulle Airport in France, which killed four people. The terminal's advanced design, which included a high, vaulted ceiling, left little margin for safety in the event that construction defects might compromise the structure.

Following a lengthy administrative review and inquiry, the collapse was attributed to several interconnected causes, rather than a single, overriding design or structural fault. A robust quality management system during construction might have identified and corrected design and construction shortcomings as they occurred, saving both money and lives. Therefore, it is advantageous for safety professionals to strive to improve construction quality as it ultimately leads to better safety performance.

Better-managed construction companies with robust safety and quality management programs also are more likely to deliver projects on schedule and on budget. This presents another opportunity for construction safety professionals to lend their expertise to quality improvement efforts. Construction safety professionals already know the processes, so they now need to learn the content to be competent in the quality management area.

Quality Management Education for Safety Professionals

Construction safety professionals need to know the following aspects of quality management if asked to manage a field quality control program:

1) quality management terminology;
2) benefits of quality management;
3) role of contractor selection;

Quality Management Definitions

Quality: Conforming to the plans, specifications and applicable codes and standards; conformance to the requirements (i.e., meeting the owner's requirements).

Quality control (QC): Individual activities, such as inspecting and testing, by which conformance to the project specifications is validated.

Quality assurance (QA): Activities that validate the effectiveness of the quality control.

Quality management system (QMS): The people and processes in place to ensure that construction meets the owner's requirements.

Quality management program (QMP): The people and processes in place to ensure that construction meets quality requirements.

Quality management plan (QMP): The project-specific plan to ensure that quality is outlined in a quality management program.

Quality management: The application of a quality management system in managing a process to achieve maximum owner satisfaction at the lowest overall cost to the organization while continuing to improve the process.

Total quality management (TQM): A term initially coined by the Naval Air Systems Command to describe its Japanese-style management approach to quality improvement. Since then, TQM has taken on many meanings. Simply put, it is a management approach to long-term success through customer satisfaction. TQM is based on the participation of all members of an organization in improving processes, products, services and the culture in which they work.

Conformance: The development and checking of products and other physical objects produced by a process to ensure that they do not violate a standard or other definition of the product.

Continuous quality improvement (CQI): Philosophy and attitude for analyzing capabilities and processes and improving them repeatedly to achieve the objective of customer satisfaction.

Cost of poor quality (COPQ): The costs associated with providing poor quality products or services. There are four categories of costs: internal failure costs (those associated with defects found before the customer receives the product or service); external failure costs (those associated with defects found after the customer receives the product or service); appraisal costs (those incurred to determine the degree of conformance to quality requirements); and prevention costs (those incurred to keep failure and appraisal costs to a minimum).

Noncompliance or nonconformance: A condition in the installation or function of a component, piece of equipment or system that does not comply with the contract documents (i.e., does not perform properly and is not complying with the design intent).

Note. *From* Sample Quality Management Manual—Comprehensive for General Contractors, *by Zurich Corp., 2012, Schaumburg, IL: Author.*

4) overall goals of a good field quality management program;
5) road to zero defects;
6) performing integrated quality and safety inspections;
7) quality management metrics;
8) sources of quality-management-related information.

Terminology

Quality management has different terminology than safety management. The sidebar on the left presents some key terms and their definitions as used in quality management. In the construction context, quality is determined by the owner's construction documents (e.g., plans, specifications, codes, other project documents). Combined, these documents define what the owner and designers have established as the project's requirements. Fulfillment of these requirements by designers and contractors of all tiers is what the owner believes it has purchased from the participants. Whenever a project's requirements are not met, owners feel shortchanged.

Benefits

Construction safety professionals need to understand the benefits of a quality management program. Similar to safety management, it is critical to convince upper management and other stakeholders of the benefits of quality management, which are many (Zurich Corp., 2011):

- better safety performance;
- reduces project costs and time to complete;
- reduces potential for construction defect claims and warranty callbacks;
- increases owner satisfaction;
- reinforces positive behavior and accomplishment for project team members;
- creates a high-performance team atmosphere;
- promotes a zero rework goal;
- minimizes rework and punch lists;
- promotes a culture of continuous improvement;
- reduces the cost of the contractor's or owner's insurance resulting in a competitive advantage over their competitors.

Contractor Selection

As with safety, project owners/construction companies benefit by working only with contractors that have a formal quality management program. Doing so will reduce project costs and completion time, while enhancing safety. In addition, a robust quality management program will likely reduce the potential for construction defect claims and warranty callbacks; this minimizes rework and punchlist items and reduces business interruption. The challenge for project owners is the relative scarcity of contractors and subcontractors with formal, written quality management programs.

Formal quality management programs benefit contractors as well. The program creates a high-performance team atmosphere and a culture of continuous improvement, which makes it pos-

Table 1

Examples of Construction Safety & Quality Professionals' Job Functions Parallels

Trade/phase	Safety professional function	Quality professional function
Site work	Confirm documentation of existing conditions to prevent property damage claims arising out of preexisting conditions.	Documentation confirms that existing conditions meet the contracts and specifications requirements.
	Perform utility locates to prevent utility impact incidents that can result in serious injury, fatality and property damage.	Perform utility locates to prevent damage, verify as-built drawings, and meet contracts and drawings requirements.
	Understand soils reports ensuring compliance of excavation slopes with soil type to protect workers against cave-ins.	Understand soils reports to meet design requirements for foundation.
Excavation	Ensure the presence of an OSHA competent person (typically field supervisor) to supervise excavation tasks.	Ensure the presence of qualified field supervisor (means and methods standpoint) to plan and execute excavation operations.
	Ensure that workers use proper lifting techniques to lift heavy rolls of vapor barriers/membranes. Ensure correct installation to prevent slip/trip hazards.	Confirm that waterproofing membranes and/or vapor barriers are installed per contract documents, and ensure that manufacturer's representative periodically inspects and provides reports.
Concrete	Ensure proper walking surface on the rebar bar mats with wire mesh for workers.	Confirm rebar and meshes are installed to meet the structural requirements.
	Ensure that the concrete surface has attained sufficient strength before allowing equipment traffic such as aerial lifts.	Ensure that all concrete testing (e.g., slump test) is performed to meet contracts and specifications.
Masonry	Ensure proper storage of masonry materials (e.g., concrete blocks) to prevent clutter that could lead to slips/trips. Ensure safe stacking height to prevent tilting.	Ensure that materials delivered meet project specifications and are stored off the ground and, where necessary, are protected (to avoid absorbing moisture) in accordance with manufacturer recommendations.
	Approve cleaning chemical's MSDS. Ensure proper pretask plans (PTPs) for the cleaning process to prevent any worker health issues.	Ensure that masonry-cleaning chemicals conform with project specifications to avoid damage. Splatters on finished surfaces are cleaned immediately.

PS EXTRA

View more examples comparing safety and quality professionals' job functions at www.asse.org/psextra.

sible to achieve a zero rework environment. As a result, a contractor's reputation for workmanship, efficiency and limited rework will lead to referrals from satisfied customers.

Goals of a Field Quality Control Program

Management commitment is critical to successfully implement a field quality control program. Both contractors and owners should understand the importance of doing it right the first time. This is the purpose of a quality management system. Everyone dislikes rework, and it increases worker exposure. The major goals of field quality control are to:

- prevent construction defects;
- ensure that work conforms to the contract documents and functional performance requirements;
- select qualified, quality-oriented subcontractors;
- ensure that workmanship required by the contract documents is performed by knowledgeable craftspeople;
- perform timely inspections and tests (e.g., contractor personnel, third-party personnel);
- minimize punch lists and rework during the project;
- achieve a zero punch list at substantial completion;
- preserve warranties.

The Road to Zero Defects

Construction safety professionals often apply zero accident techniques developed by the Construction Industry Institute (Hinze, Mathis, Frey, et al., 2001). To ensure quality and reach zero defects, a contractor can take several actions:

1) Know the customer.
2) Improve processes that define, produce and support products.
3) Acknowledge that processes are the problem, not people.
4) Gain control over processes by working with employees and managers to identify and eliminate process problems.
5) Review process performance and make adjustments.
6) Make every employee responsible for quality.
7) Provide training resources.
8) Measure/review process performance (metrics).

Safety & Quality Inspections

So, what quality management tasks would a construction safety professionals perform in the field construction? Similar to safety professionals, quality professionals perform daily/weekly audits to identify products not in conformance.

Some quality inspection guidelines include:

- Carefully inspect initial work activities to make sure crews are following instructions properly from the outset, taking a large number of photographs to document that the work performed conforms to project requirements.
- Verify that every piece of material delivered meets project requirements. Roughly 25% of construction defect losses involve the removal and replacement of incorrect materials.
- Conduct a preclosure inspection (e.g., walls, pipe chase, utility vaults), taking photographs to document that work performed meets project requirements before the work is enclosed by insulation or finish materials.

Table 1 presents a few examples of parallel safety and quality field functions; these are organized by typical construction trades or project phases.

As the roles for construction safety professionals continue to expand, quality management is a next logical step.

Quality Management Metrics

One key aspect of safety management is measuring performance using quantitative metrics such as the OSHA recordable injury rates, experience modification rate, and other incident rates such as lost-time injury rate and near-miss rates. Similarly, a quality management program's effectiveness must be measured. Several metrics can be used:

- frequency and severity of construction defect claims;
- number of defects observed during quality inspections;
- number of punch list items (nonconformance items);
- rework costs;
- frequency and severity of warranty callbacks;
- customer satisfaction and repeat business.

These quantitative metrics will help safety professionals track a project's quality performance.

Potential Downsides

Thus far, this article has focused on various benefits of taking on the quality management role. However, the task is not without challenges.

- Construction safety professionals already perform several additional tasks. This new role would divert more time and energy from their primary safety management responsibilities.
- Some companies have limited resources (including time and money) to devote to keeping safety professionals technically current on safety management issues. Quality management functions would offer similar challenges.
- Employers and their insurers must make sure employers' liability insurance coverage includes this new role of safety professionals.
- Only a limited number of workshops or seminars are available to educate safety managers on quality management functions.
- University safety degree programs need to include coursework that focuses on quality management, which is currently uncommon.
- Safety/quality professionals should ensure that their role in quality is not as a cop, but rather as a coach. Training workers is the key to reducing quality defects.

Conclusion

As the roles for construction safety professionals continue to expand, quality management is a next logical step. Construction safety professionals need not become experts on quality management, but they can develop the competencies to participate in and perhaps lead quality control field programs. The process of managing quality control is similar to the process of managing safety. By learning the content of quality management, safety professionals can deliver even greater value. **PS**

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