Conceptual Model of Safety Culture for Construction

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Abstract

An organization’s safety culture has been identified as a significant determinant of a firm’s safety performance. Previous research into safety culture in construction has lacked a fundamental conceptual model of safety culture in construction that reflects the bifurcated nature of a construction firm into home or corporate office and project sites. This paper presents a conceptual model of safety culture in construction based upon the Schein’s model of organizational culture, Schneider’s model of organizational climate, and Cooper’s work on safety culture. The model incorporates the importance of viewing a construction project as a temporary, multi-organization. It also distinguishes organizational safety climate and workgroup safety climate.

Keywords: Safety culture, safety climate, conceptual model

1. Introduction

Characteristics of Construction

The development of a conceptual model of safety culture in construction requires an understanding of the characteristics of construction to understand why the concept of safety culture in construction is different from that of other industries. These characteristics are:

- In other than very small construction firms, there are two distinct parts of the organization: an office component responsible for obtaining and administering projects and performing corporate functions. There is also a field or project component responsible for performing the actual construction work. The office work environment is relatively free of hazards. The significant hazards and risks of construction are in the field. Therefore, the focus of construction safety culture must be on the construction project. However, the home office, particularly firm executives, will influence the safety culture of the project. The mechanisms by which the home office influences the safety culture of the project and the extent of that influence must be examined.
A construction project is a temporary system (Bryman, et. al. 1987) established for the express purpose of constructing a facility. When that facility is completed, the project organization is disbanded. A construction project may also be termed a multi-organization (Cherns and Bryant, 1984) in that a project may involve designers, consultants, general and/or prime contractors, specialty subcontractors, fabricators, and material suppliers. Each of these has the potential to expose workers to a wide range of hazards or to protect them from those hazards. The project participants perform a variety of roles and are involved in the project at different points in the project’s life-cycle and for differing durations. The critical issue for safety in this temporary, multiorganization is how to develop an integrated safety culture that minimizes the construction workers’ exposure to hazards and related risks. The compressed timeframe exacerbates the task of culture creation given that many of the project participants may have little shared experience.

The term project safety culture may be a misnomer because the duration of most projects is far too short to develop cultures of their own. Thus, Schein’s (2010) analogy of culture as an iceberg is particularly relevant to construction. In terms of the project, the cultures of the owner, general contractor/construction manager, and the subcontractors lie below the surface. What can be seen above the surface are, in Schein’s terms, the behaviors and artifacts of the project, i.e., the project’s climate.

In building construction, the prime contractor (the contractor with whom the owner has a contract) typically self-performs less than 20% of the total project with the remainder being performed by specialty subcontractors. In industrial construction, the prime contractor, in many cases, performs all of the work on the project using workers directly hired by the contractor. The task of creating an integrated, unified project safety culture on projects with extensive subcontracting is very different from doing so on a project with no subcontracting.

In a 2009 decision, the Eight Circuit Court of Appeals in Solis v. Summit Contractors, Inc. and Occupational Safety and Health Review Commission 558 F.3d 815 (8th Cir.2009) affirmed the application of the Occupational Safety and Health Administration’s (OSHA) “multiemployer worksite doctrine” to general contractors and other employers (construction managers) who exercise control over construction worksites. These employers are considered “controlling employers” in that they have general supervisory authority over the worksite including the power to correct safety and health violations or require others to do so. Thus, the general contractor/construction manager may be held liable for safety violations and, therefore, has a vested interest in the development of an effective, integrated safety culture on the project as opposed to a collection of independent safety cultures, one for each employer on the project site.

Construction differs from manufacturing in terms of the roles of personnel in the design and transformation processes. As Stinchcombe (1959) states “Mass production may be defined by the criterion that both the product and the work process are planned in advance by persons not on the work crew.” In the construction craft organization, the architect and/or engineer define the product to be constructed while
the craft workers who will perform the work, plan the work process. He further states, “In construction all these characteristics of the work process are governed by the worker in accordance with the empirical lore that make up craft principles. These principles are the content of the workers’ socialization…” However, given the changes in construction (e.g., extensive deskilling) over the past thirty years, the extent to which the construction worker exercises control over the means and methods to be employed in constructing a project must be empirically determined.

- A primary goal of a construction project manager should be to develop an integrated project safety culture that creates the safety environment needed to achieve zero incidents. The project safety culture will emerge from the interaction of the constituent cultures and the leadership of the project management team. Because the industry is characterized by personnel moving between projects and companies, a group’s safety culture is a “learned product of group experience” (Schein, 2010) as to what worked in solving problems on the projects and within the various groups and organizations. The extent of congruence between the cultures of the various groups and organizations within a project (managers, engineers, superintendents, foremen, and craftworkers as well as contractors and construction managers) must be examined.

2. **Conceptual Model of Safety Culture for Construction**

**Corporate Office Safety Culture**

Figure 1 presents a model of corporate office safety culture and safety management system.

![Figure 1 – Corporate Office Safety Culture and Safety Management Systems](image)

Construction organizations may be viewed as consisting of three groups:

- Permanent core organization – executives, engineers, professionals, etc. who have varying lengths of tenure with the organization but are considered permanent employees.
• Quasi-permanent project management team – project managers, engineers, superintendents, etc. who are responsible for getting a project built within specified criteria. The members of this team are quasi-permanent employees in that they remain employed by the firm as long as the firm has sufficient project work. Absent that work, the members are released and rehired when additional work is obtained.

• Temporary supervisory and craft personnel hired on an as needed basis for a project.

The initial assumptions, beliefs, and values of the organization are brought to the organization by its founders. Over the life of the organization, those individuals in the permanent core interact with one another in a reciprocal influence process in the tacit or basic assumptions, beliefs, and values held by each person are shaped by experience with the result that a set of assumptions, beliefs, and values, shared by the members, emerges. These reflect the members’ experiences as to what works in providing a safe work environment and may be termed the Emergent Safety Culture (ESC).

The Emergent Safety Culture is manifested in the organization’s Company Safety Management System (CSMS). This system represents the espoused values of the organization and is a statement by the organization as to its values and how those values are to be embodied in the organization’s policies, procedures, and practices. The elements of a Safety Management System were identified in a National Safety Council publication (Czerniak and Ostander 2005) and by others (Cooper & Phillips, 2004). These elements are incorporated into Reason’s (1998) five levels framework in Table 2.

<table>
<thead>
<tr>
<th>Level</th>
<th>Safety Management System Elements</th>
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<tbody>
<tr>
<td>Strategic</td>
<td>• Managerial Leadership and Commitment</td>
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<td>• Accountability</td>
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<td>Tactical</td>
<td>• Assessments, audits and continuous improvement</td>
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<td>• Organizational communications and system documentation</td>
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<td>• Risk Assessment &amp; Risk Management</td>
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<td>Operational</td>
<td>• Hazard recognition, evaluation and control</td>
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<td>• Workplace design and engineering</td>
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<td>• Employee involvement &amp; participation</td>
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<td>• Employee training</td>
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<td>Behavioral</td>
<td>• Operations &amp; Third Party Services</td>
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<td>• Motivation, behavior and attitudes</td>
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<td>Defensive</td>
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<td>• Community Awareness &amp; Emergency Preparedness</td>
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<td>• Operations Integrity Assessment &amp; Improvement</td>
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Table 2 Safety Management System Elements in Reason’s Framework
The Emergent Safety Culture can be assessed by mapping it on the Company Safety Management System (Johnson and Scholes 1993) along the following dimensions:

- **Routines** - how people routinely behave towards each other in relation to safety; and, what routinely occurs with regards to safety management.
- **Rituals** – how the organization reinforces safety behavior.
- **Stories** – the messages transmitted by employees’ stories about safety.
- **Symbols** – the symbols used to communicate the importance of safety to employees.
- **Power** – the beliefs about safety held by the company’s leadership and how it is translated into practice.
- **Safety Structures** – the formal and informal safety mechanisms are in place.
- **Safety Controls** – what the organization measures, monitors, and reinforces.
- **Relative Importance of Goals** – the relative importance of efficiency goals (e.g., schedule, budget, & quality vs. safety goals).
- **Beliefs and Values** – the beliefs and values that guide safety thinking.
- **Underlying Assumptions** - a summary description of the company’s actual safety philosophy.

The Company Safety Management System (CSMS) cannot be developed in a vacuum. Two external entities may exert influence: (1) regulatory agencies such as the Occupational Safety and Health Administration, which impose a minimum set of requirements and (2) the firm’s insurance companies who may require additional or more extensive elements in the CSMS to address issues of specific concern.

Because construction companies undertake projects to make money, the CSMS does not remain on a shelf in the home office but is taken out to the field by Project Management Teams (PMT). The PMT is charged with getting the project built within specified criteria such as budget, schedule, quality, and safety. As a result of feedback from the Project Management Teams, the CSMS is adapted to the requirements of the projects and becomes the Project Safety Management System (PSMS). The CSMS, which is developed at the corporate level, is modified to reflect project requirements to become the Project Safety Management System (PSMS).

The Client may impose more stringent requirements than those contained in the CSMS because the client, for a variety of reasons, desires a more rigorous system.

The PMT assigned to a project brings the PSMS document to life by implementing the policies, procedures, and practices, spelled out in the document, thereby transforming the paper document into people and processes. In doing so, the PMT may adapt, modify, or even ignore elements of it. It may establish differing priorities for certain elements than those established in the PSMS. In the interest of improved safety, the PMT may change elements. The PMT must also consider the Client’s requirements, which may necessitate additional policies and procedures. The goal is not to have a safety management system, but a safety management system that works. Thus, the firm’s PSMS becomes the project’s Enacted Project Safety Management System (EPSMS).
Project Safety Culture

The Project Safety Culture Model is presented in Figure 2.

Construction work is performed by craft workers under the supervision of trade supervisors or foremen. These individuals are hired on a temporary basis to execute the work. This work is performed within a context consisting of: (1) task demands - the worker’s perceptions of the physical and mental activities that must be performed to complete the task and (2) work setting, which has three dimensions (Riemer, 1975). These are: (1) structural components, which include the setting, i.e. the project site, the specific work location within the site, and the inanimate physical objects and their arrangement and the people within the setting as objects; (2) dynamic components that are the people within the site as actors; and (3) coordinating dimension, i.e. the location of activity within the coordinates of time and space.

Project Safety Climate (PSC) must be examined at two levels: (1) organization level – worker perceptions of the policies and procedures employed on the project and management practices with regard to safety and (2) group level - worker perceptions of their specific supervisor & the supervisor’s expectations for safe behavior and his/her safety practices (Zohar and Luria, 2005; Lingard, et.al., 2009). In construction, workers have discretion as to the methods to be employed in the performance of a task. Tasks are rarely performed by a single worker; the workgroup has an influence on its members in terms of safe performance of assigned tasks. Thus, the workgroup must be considered as an element in safety climate. Worker perceptions of his/her workgroup, the expectations the workgroup has for safe behavior, the workgroup’s perceptions of the risk involved in their work activities, the workgroup’s practices with regard to safety, and the level of peer pressure exerted by the workgroup for compliance with group safety practices.

In addition, the worker’s life experiences influence how the worker perceives the situation. The worker’s perceptions are influenced by his/her history of injury, propensity for risky behavior, perception of risk in the work, and motivational state and desired rewards. The worker’s perceptions of the contextual elements are taken into account in making the decision to engage in safe or unsafe behavior.
Culture provides a framework within which individuals decide how to behave. The product of safety culture can be defined as “that \textit{observable} degree of effort by which all organization members direct their attention and actions towards improving safety on a daily basis (Cooper 2000).” Thus, behavior, which is observable, is the product of safety culture and provides the best indication of the nature of that culture. Behavior must be examined in two distinct categories:

- Task-specific behavior – behavior with the objective of task performance and includes performance of all activities required to complete the task in a safe manner. Examples are wearing PPE, tying off when working at heights, wearing hearing protection when breaking concrete, etc. This behavior is typically addressed within a behavior observation system. Observers assess behavior in terms of whether it is safe or unsafe. For example, “When working at heights, workers are using safety harnesses with a double lanyard or using tool bags to life tools and small equipment.” The percentage of workers observed using the safety harness with a double lanyard is tracked as the Percent Safe. The goal of the behavior observation program is to increase the Percent Safe to 100%.

- Safety-specific behavior
  - Behavior that reflects a commitment to safety as an active citizen of the project community. This has been termed citizenship behavior (Hoffmann, et.al., 2003) and includes behaviors such as volunteering for safety committees, making safety-related recommendations about work activities, and getting involved in safety activities to help my crew work more safely.
  - Behavior on the part of supervisors that reflects commitment to safety such as discussing safety performance with employees on a one to one basis, developing plans for corrective actions, and assisting an observer in providing team feedback.

This behavior results in Safety Outcomes, i.e., the lagging indicators, of the safety process, which: safe completion of the activity, near miss, accident, injury (nonfatal or fatal). Behavior and Safety Outcomes provide feedback to craftworkers, supervisors, project management personnel, and corporate office personnel to provide learning.

\textbf{Operationalization of Project-Level Model}

A worker makes the decision whether to perform a job safely within the context of the cultural milieu in which he/she functions. Safety culture can be viewed as the product of goal-directed interactions between people (psychological), jobs (behavioral) and the organization (situational) (Cooper, 2000) as shown in Figure 3.
Context: the worker is assigned (1) to perform a task, which demands specific actions by the worker and (2) to perform the task within a specific setting.

Situation: all work on the site is to be performed in accordance with the tenets of the Enacted Project Safety Management System, which reflects the organization’s safety culture, i.e., how things are to be done. The extent to which the EPSMS is implemented and followed may be determined through a system audit that yields a percentage score. Project management designs the EPSMS and, through their actions, implements it.

Person: The worker is influenced by three elements: The first is the individual’s Knowledge, Skills, & Abilities, which are specific to the task and job for which the worker is employed. These are acquired through a technical socialization process reported by Riemer (1975). As a result of this process, which may involve formal off-the-job training, formal and informal on-the-job training, and experience, there is a relative fit between the person and the job. The second element, psychological factors, encompasses factors that are inherent to the person as well as those that are a response to the person’s off the job and on-the-job experiences such as injury history and perception of risk in the work. An inherent factor is the individual’s personality and, in particular such dimensions as propensity for risky behavior. Off the job factors are influences on the person’s mindset such as relationship with spouse and children, time demands, health, etc. On the job factors involve the person’s reaction to the job and the organization and include such factors as motivational state and desired rewards, organization commitment, goal commitment, goal conflict, role ambiguity, job-induced stress, and job satisfaction (Cooper and Philips, 1995). It also includes the project’s Safety Climate, which operates on two levels: project-wide and the workgroup.

People act based upon their perceptions, which are influenced by the worker’s capabilities and psychological state of mind, of a situation; therefore, safety climate is believed to have a significant influence on a group member’s behavioral decision-making. The strength of the workgroup’s safety climate influence on worker decision-making relative to that of the organization’s safety climate must also be considered.

Behavior: As a result of the influence of the situation and the psychological factors, the worker makes a decision as to whether to engage in particular behaviors. As stated above, the product or result of a particular safety culture may be defined as that
“observable degree of effort through which all organizational members direct their attention and actions towards improving safety on a daily basis” or, in other words, behavior. Safety behavior can be divided into the three categories discussed above: compliance, citizenship, and leadership. The three behavior measures can be converted into a percentage score.

An overall measure of safety culture can be calculated as follows (Cooper 2008):
Safety Culture Score = (Safety Management System Audit Score + Safety Climate Survey Score + Safety Behavior Score)/3.

**Product of Safety Culture**

The product of safety culture can be defined as “that *observable* degree of effort by which all organization members direct their attention and actions towards improving safety on a daily basis (Cooper 2000).” What is observable, and, therefore, evidence of safety culture, is behavior. It is useful to distinguish between required and discretionary behavior. The task-specific and leader behavior discussed above can be considered as required job behaviors while the safety-specific behavior can be considered discretionary. The required behaviors are assessed and included in the Safety Behavior Score in the above equation.

Discretionary behavior has been termed citizenship behavior. Hoffmann, et. al. (2003) developed a 27-item safety-specific citizenship behavior scale that can be utilized in two ways. Craft workers can be surveyed to determine which of the behaviors are considered to be a core element of their job. The number of behaviors considered to be core elements should be related to the strength of the safety culture such that the stronger the safety culture, the greater the number of core elements. The frequency with which a worker engages in each of the behaviors should also be related to safety culture strength. Supervisors can assess workers on this frequency; the stronger the safety culture, the greater the frequency of engaging in these behaviors. An index of safety-specific citizenship behavior can be created such that this index score is a function of the safety culture score.

### 3. Conclusion

This paper presents a conceptual model of safety culture for construction organizations that reflects the influence of the corporate or home office on the project safety environment. The model addresses the influences on worker decisions regarding safe behavior. It provides the framework for extensive study of safety culture and the factors that influence it.
4. References


Solis v. Summit Contractors, Inc. and Occupational Safety and Health Review Commission 558 F.3d 815 (8th Cir.2009)

