THE NATURE OF SAFETY CULTURE: A SURVEY OF THE STATE-OF-THE-ART AND PROMOTING A POSITIVE SAFETY CULTURE

Choudhry M. Rafiq[1] and Fang Dongping[2]

[1]PhD Candidate, (Tsinghua-Gammon) Construction Safety Research Center, School of Civil Engineering, Tsinghua University, Beijing 100084, China
[2]Professor, Director, (Tsinghua-Gammon) Construction Safety Research Center, School of Civil Engineering, Tsinghua University, Beijing 100084, China
Correspond to choudhry03@mails.tsinghua.edu.cn

ABSTRACT: This paper reviews the literature on safety culture focusing particularly on research carried out from 1998 onwards. The term 'safety culture' is clarified as it is typically applied to organizations, to safety and particularly to construction safety. Some clarifications in terms of levels of aggregation, positive safety culture and safety performance are provided by presenting appropriate empirical evidences and their theoretical developments. Safety culture is a subset of organizational culture that is thought to influence employees' attitudes and behavior in relation to an organization's ongoing health and safety performance. Implications for future research in the area are addressed, as safety culture has in recent years become the focus of much attention in all industries, and in the construction industry in particular.

Key words: Safety culture; Safety climate; Safety management systems; Construction safety.

1. INTRODUCTION

Safety culture is a concept that has attracted much attention across a broad spectrum of industries, including construction, railways, road transportation, and airlines, manufacturing, chemical and nuclear. Owing this, safety and accidents have been studied for the last two decades from many points of view, from engineering to social psychology [1] particularly in order to contribute to the reduction of work place accidents. Organizational culture is widely acknowledged as critical for an organization success or failure, for example a construction business. Peter and Waterman [2] were possibly the first to demonstrate that culture was a key for an organization's success.

Pidgeon and O'Leary [3] reminds us that events such as Chernobyl, the Challenger and Bhopal have highlighted the fact that in seeking the causes of many modern large-scale accidents we must now consider as key the interaction between technology and organizational failings. The question is: what is the most appropriate level at which to analyze the safety culture aspects of an organization? There are complicated issues in safety culture that must be addressed. For example, Guldenmund [4] reveals that there is no real consensus on how to describe the culture of an organization. Also, among the researchers there is an unresolved debate of whether an organization *has* a culture or *is* a culture. Even, there is no consensus on the definition of safety culture.

Many safety culture authors attempt to emphasize top-down control and change of cultures and this integrative approach is in line with scholars (for example, Zohar [5], DeDobbeleer and Beland [6], and Williamson et al. [7]). This paper reviews the existing literature on safety culture and provides some clarification in terms of definitions, empirical evidence and theoretical development. This article analyzes different schools of thoughts and views particularly in the background of construction safety perspective. Thus, the overall objective of this study is to review the safety culture from 1998 to onward as it is understood in safety field of all industries in general and the construction industry in particular.

2. SAFETY CULTURE

The concept of safety culture is derived from organizational culture and is not precisely defined. Table 1 lists the summary of prior safety culture research from 1998 to onward for most of the papers considered for this review. It is thought that the selected twenty (20) studies make this review a representative in the field of safety culture.

The Chernobyl accident in April 1986 provided evidence of technological vulnerability emphasizing the need to understand organizational safety. The term 'safety culture' was first introduced in INSAG's Summary Report on the Post-Accident Review Meeting on the Chernobyl Accident, published by the IAEA as Safety Series No. 75-INSAG-1 in 1986, and further expanded in Basic Safety Principles for Nuclear Power Plants, Safety Series No. 75-INSAG-3, issued in 1988 [8]. INSAG-3 [9] explains that safety culture is a sub-component of organizational culture, which alludes to individual, job, and organizational features that affect and influence safety.

The International Atomic Energy Agency [8] publication Safety Culture: A report by the International Nuclear Safety Advisory Group (INSAG-4) develops the concept of safety culture in details and defines 'safety-culture as that assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance.

Table 1: List and summary of prior safety culture and safety climate research

Reference	Summary of Research
Thompson et al. [10]	Exploratory research presenting a model developed in 1992 and confirmed in 1995 in the same organization that links management support, organizational climate, and self reported safety outcomes such as safety condition/safety compliance.
Kennedy and Kirwan [11]	The research presents an advance, which focuses on aspects of safety management practices called the Safety Culture Hazard and Operability (SCHAZOP), a qualitative analytical approach aims to identify detailed vulnerabilities and the means for their prevention.
HSE [12]	Health and Safety 'Climate Survey Tool' (produced by the UK safety regulators) provides to compile eventually a database of organization safety climate profiles for the purpose of making relative judgments. It helps one of what people think in one's organization about some health and safety issues and how to improve health and safety by involving employees in the process.
Hale [13]	A review of culture and the two workshops elaborating complicated concepts in details and suggests elements for a good safety culture.
Pidgeon and O'Leary [3]	A theoretical research which refers to, the pioneering work of Barry Turner whose book Man-made Disasters (Turner, 1978) was one of the first to draw attention to the organization processes deep into major accidents' elaborating good safety culture and learning from past incidents and mistakes.
Lee and Harrison [14]	Exploratory safety culture research addresses attitudes, perceptions and reported behaviors. The research provides impressive proof that 24 of the 28 scales they derive say something important about the risk of accident. Their paper looks at the issues of culture differences, not only between the three nuclear plants but also amid sub-populations within the power stations.
Grote and Kunzler [15]	The research first presents a socio-technical model of safety culture and then compares the findings of the developed questionnaires on perception and attitudes with the results of an audit using interviews, documentary information and observation. They show that the questionnaire produces parallel results to the audit while indicating understanding of safety management and safety culture in the company.
McDonald et al. [16]	The research through analysis of documentation and qualitative interviews, survey of safety climate and attitudes, expected response to incidents and compliance with task procedures, explores the relationships of different aspects of safety culture and safety management systems within the four aircraft maintenance organization and presents a revised model of safety management systems. The article indicates about sub-culture of technicians and concludes a differentiated aspect of safety culture.
Flin et al. [17]	A review of 18 surveys that identify the most common themes of safety climate in the industrial sector.
Glendon and Stanton [18]	The research presents the useful distinction between strategic top-down, functionalist perspective and data-driven bottom-up, interpretive approaches to culture. They favor the latter approach and also they put forward an ethnographic method to study culture in future.
Guldenmund [4]	An excellent review of 15 studies, which indicates the complexity of safety climate as a psychological construct and exposes the big 5 concepts as somewhat premature. He raises the question as to whether there is a distinct object, which can be called as safety culture. He prefers to postulate safety that the central object is organizational culture.
Clarke [19]	The article clarifies the term safety culture and proposes a theoretical model by which safety culture affects safety behaviors in organizations.
Cooper [20]	An excellent paper which presents a reciprocal model of safety culture (consisting of interactions between psychological-behavioral-situational variables) to understand the dynamic, multi-faceted, holistic nature of the same in an organization.
O'Toole [21]	The research identifies safety culture as a critical factor that sets the tone for importance of safety within an organization.
Maloney and Smith [22]	A conference paper, which presents two models i.e., modified behavior model and model of safety performance and also render issues of safety culture, safety climate and safety behavior.
Mohamed [23]	The research promotes adopting the balanced scorecard tool to benchmark organizational culture in construction. Selecting and evaluating measures in four perspectives: management, operational, customer, and learning enable organizations to pursue incremental safety performance improvements.
Richer and Koch [24]	The research discuss perspective of integration, differentiation and ambiguity in safety culture in the Danish manufacturing which according to them are multiple configuration of cultures.
Reiman and Oedewald [25]	The research presents a survey methodology for studying organizational culture in complex socio-technical systems taking a case study at a maintenance organization of a nuclear power plant in Finland.
Cooper and Phillips [26]	An excellent exploratory research that determines an empirical relationship between safety climate perceptions and actual safety behavior.
Fang et al. [27]	An exploratory case study to identify the dimensions of safety climate and also to improve the safety culture of the construction company.

The conclusion of the report (INSAG-4) concludes that safety culture is now a commonly used term and it is important to give practical value to the concept. An appendix containing 143 questions is included in the report, which increases its worth if safety culture is to be judged in a particular situation. The report presents the concept of 'safety culture' as it relates to organization and individuals, however, it provides no link between safety culture and measures of safety performance.

According to Lee and Harrison [14], safety management system is basically a social system, wholly reliant on the employees who operate it. Its success depends on three things; its scope, whether employees have knowledge about it and whether they are committed to make it work. The concept of safety culture has evolved as a way of formulating and addressing this new focus. In line with this the Advisory Committee on the Safety of Nuclear Installations [28] defines that "the safety culture of an organization is the product of *individual and group values, attitudes perceptions, competencies* and *patterns of behavior* that determine the *commitment* to and the *style* and *proficiency* of an organization's health and safety management."

Numerous definitions of safety culture exist in the academic literature and some are tabulated in Table 2 from the research carried out from 1998 onward. Among the selected studies since after 1998, only eight define safety culture. Most definitions are relatively similar in the beliefs perspective, as each is focused to varying degrees on the way people think and or behave in relation to safety. Definition adopted by Hale [13] and Cooper [20] are the most practical as they outlines the most explicit contents of safety culture. All these definitions tend to reflect the view that safety culture 'is' rather than something that the 'has'. Although definitions vary but there is a consensus towards safety culture being a *proactive* stance to safety is now almost universally accepted, if not always practiced [14].

Table 2: Source of safety culture definitions

Reference	Definition of safety culture
Kennedy And Kirwan [11]	Safety culture is an abstract concept which is underpinned by the amalgamation of individual and group perceptions, thought processes, feelings and behaviors which in turn gives rise to the particular way of doing things in the organization. It is a sub element of the overall organizational culture.
Hale [13]	The term safety culture refers to 'the attitudes, beliefs and perceptions shared by natural groups as defining norms and values, which determine how they act and react in relation to risks and risk control systems'.
Glendon and Stanton [18]	Safety culture comprises attitudes, behaviors, norms and values, personal responsibilities as well as human resources features such as training and development.
Guldenmund [4]	Safety culture is defined as: those aspects of the organizational culture that will impact on attitudes and behavior related to increasing or decreasing risk.
Cooper [20]	Culture is 'the product of multiple goal-directed interactions between people (psychological), jobs (behavioral) and the organization (situational); while safety culture is 'that observable degree of effort by which all organizational members directs their attention and actions toward improving safety on a daily basis.'
Mohamed [23]	Safety culture is a sub-facet of organizational culture, which affects workers' attitudes and behavior in relation to an organization's on-going safety performance.
Richter and Koch [24]	We define safety culture as the shared and learned meanings, experiences and interpretations of work and safety - expressed partially symbolically - which guide people's actions towards risk, accidents and prevention.
Fang et al. [27]	Safety culture is a set of prevailing indicators, beliefs and values that the organization owns in safety.

3. DISCUSSIONS AND FUTURE RESEARCH

Work place safety is a central concern in society and in organizations, yet there is no consensus amongst researchers on how safety culture is created, managed, and ultimately affects the performance of individual, groups and organization.

3.1 Concept of Safety Culture

The views taken by Guldenmund [4] that instead of safety culture organizational culture may be considered as the central theme and researchers should focus on how to measure it. According to Hale [13] in this case we may talk only about (organizational) *cultural influences on safety* and not *safety culture*. However, most publication including (IAEA [8], ACSNI [28]) quoted widely treat it as an entity.

Researchers sometimes use safety culture, safety climate and perhaps safety management interchangeably as the terms are not so clear-cut. Kennedy and Kirwan [11] reveal that safety management is regarded as the documented and formalized system (policy, procedures, training, instructions and resources, etc.) of controlling against risk or harm. However, how good the safety management systems of an organization is, the way it exists on paper does not necessarily reflect the way it is carried out in practice. This is where the concept of safety culture comes into picture. It is the safety culture of the organization which will influence the deployment and effectiveness of the safety management resources, policies, practices and procedures as they represent the work environment and underlying perceptions, attitudes, and habitual practices of the employees at all levels [11].

Safety culture and safety climate are distinct concepts and should be treated accordingly. A construction safety culture of an organization is one in which safety is regarded by everyone as being an issue which concerns every one. As a result, safety rules are understood and adhered to; all incidents are reported and investigated quickly for taking actions and learning. So, the safety culture may be defined as the product of *individual and group behaviors, attitudes, norms and values, perception* and *thoughts* that determine the *commitment* to and *style* and *proficiency* of an organization's *system* and how its *personnel act and react* in terms of company's *on-going safety performance.* This definition relates safety culture to personal and workgroup behaviors, attitudes and thoughts as well as to safety performance through the organization's safety management system. Attitudes indicate that how people view their work and work environment, and also value safe working practices. Behaviors can be measured by percent safe behaviors. Safety management system can be measured by safety audits and employees perceptions by safety climate.

3.2 Level of Aggregation and Validation

Coming to the issue of level of aggregation that at which level measurement and validation needs to take place in the study of safety culture. The most suitable reference is Zohar [29] that conditions determining the appropriate level of analysis require within-group homogeneity and between-groups variance. According to Cooper and Phillips [26] organizations' departments are the appropriate level of analysis and aggregation of individual perceptions. However, researchers need to pay attention whether the selected group or organizational level truly represents a natural group having a relatively homogenous culture. Researchers may not stress to develop a one common safety culture in an organization/corporation but perhaps concentrate on several good cultures (of workgroups) based upon different sub-cultures to complement each other.

About the question of validation, the confirmation of the scales to measure safety culture may be based on group performance. If culture is not there within the defined group to be investigated then what do you want to talk about safety culture and to search correlation for validation. Cooper and Philips's [26] paper is good example in this issue. For validation, accident rate (the past reality) should not be compared with present perceptions to avoid any comparisons of 'apples' and 'oranges'.

Safety culture models presented by authors for example socio-technical model of safety culture (Grote and Kunzler [15]), system based model of culture (HSE [30]), reciprocal model (Cooper [20]) show differences. Although it appears that there is no overall satisfying model of safety culture but the pressing issue of today is to develop a favorable safety culture. As in any organization, a positive safety culture will ascertain and reflect the effectiveness of a safety management system at any construction site.

3.3 Positive Safety Culture in Construction

Sawacha et al. [31] tried to identify factors affecting safety performance on construction sites. In their study, top management's attitude toward safety was found to be a significant factor in safety performance in the UK construction industry. Choudhry [32]) reveals that both management commitment and employee's support are critical to the success of the desired change. Hinze [33] describes that a safety culture begins at the top, and if it is pure, it will be felt at the level of workers.

The authors take the view that a positive safety culture in construction comprises five components which include *management commitment to safety, management concerns for the workforce, mutual trust and credibility between management and employees, workforce empowerment and lastly continuous monitoring, corrective action, review of system and continual improvements to reflect the safety at the workplace*. To promote a positive safety culture in an organization, a review from Vecchio-Sadus and Griffiths [34] is given below:

- *Management commitment*. Management plays a key role in promoting a positive safety culture in construction. It can be best demonstrated by allocating resources, time, walk the talk, inspections, completing actions, and by participating in risk assessments and consultative committee meetings.
- *Changing attitudes and behaviors*. Capitalizing on activities such as verbal instructions, training, and warning signs can enhance safe behaviors. But if the things are communicated in the way that the work is easier, and the task can be finished earlier and so rewarded with monetary incentive then sure, employees will be cutting corners, may not be obeying safety rules, not wearing personal protective equipment and ultimately not working safely. Long-term values include each employee being able to work without injury so she/he can continue to provide earning for the company and for her/his family.
- *Employee involvement*. For a positive safety culture, employees involvement, ownership and commitment is necessary, particularly empowerment promotes feeling of self worth, belonging and value. Employee should be involved in training, consultation about noise, machinery isolation, sound barriers, job rotation, PPE, and wearing different earmuffs.
- *Promotional strategies*. In order to enhance safety awareness amongst employees promotional strategies would include i) mission statements, slogans and logos; ii) publish materials (library, statistics, newsletters); iii) Media (posters, displays, audiovisual, e-mail, internet); iv) seminars and training (short talks, group meetings, training for personal fitness, hygiene, workplace stress and responsibilities towards safety including compliance with rules and regulation, hazard identification and risk assessment, incident investigation and job safety analysis); and v) special campaigns (health and safety week, health promotion, safety inductions, emergency response, incident reporting and investigation, risk assessment, introduction to existing health, safety and environment management systems).

Promoting management commitment and employees participation to safety can positively enhance the organization's safety culture in construction. When employees become more aware of their responsibilities for incident and injury prevention, they will exhibit more interest in maintaining a safe and healthy construction site environment. In construction, there is general agreement on the concept of safety culture, and some agreement on its attributes. Employees and the industries might benefit a lot if consensus could be developed on its measurable attributes.

3.4 Research Methodology in This Area

In construction, accident rate, compensation costs and related data are poor measures of safety performance mainly because such data ignore the inherent risk and can be under reported by some organization and over reported by others. Many authors (for example, Strickoff [35], Flin et al. [17], Mohamed [36], Cooper & Phillips [26]) advocate the use of proactive measures including safety culture and observed percent safe behavior that focus on current safety activities to ascertain system success rather than system failure and can be categorized into the below two approaches:

Reactive/Lagging Indicators. In recent years there has been a movement away from safety measures based on retrospective data or lagging indicators such as accident rates and compensation costs. Accidents and compensation costs tend to be reactive or after the event and relatively infrequent. This focus on safety results (Cohen [37]) often means that the success of safety is measured by level of system failure.

Proactive/Leading Indicators. Many modern approaches advocate the use of proactive measures or leading indicators such as measurement of safety climate (Flin et al. [17]), safety culture, hazard identification and or observed percent safe behavior (Strickoff [35], Cooper and Philips [26]). These approaches focus on current safety activities to establish success of the safety management system rather than the system failure.

A consensus view is that a multi-instruments approach should be adopted as tools to measure safety culture. So, researchers are still at the starting point with a long way to go before measurement of safety culture can truly begin to progress in a meaningful way to the benefits of its major stakeholders including employees, workers and concerned industries for example the construction industry.

3.5 Recommendations

Now-a-days organizations are increasing operating at a global level, with operations conducted against differing cultural backgrounds. Further cross-cultural research may be explored to strengthen safety culture.

4. CONCLUSION

This paper reviews the nature of safety culture and provides essential clarification in terms of its definition and level of aggregation. It further promotes a positive safety culture and discusses implications of research by providing appropriate empirical evidence and theoretical development. From this article, the following points may be extracted:

- Many organizations including construction companies around the world are showing an increasing interest in the concept of safety culture as a means to reduce the potential for disasters, accidents, incidents or near misses within their everyday tasks. Organizations find safety culture as a critical factor that sets the tone for importance of safety within their construction site environments.
- Definitions of safety culture has been clarified, as researchers investigating safety culture through safety climate measure, have a propensity to focus solely on the way people think (their beliefs, attitudes and perceptions) and do not represent various aspects of safety culture. Important related issues concerning safety environment, safety management system and safety behavior of people have a tendency to be overlooked. To eliminate injuries, save lives and advancing towards zero incidents; researchers need to pay more attention to this vital topic of safety culture in construction.
- On the level of aggregation this study concludes that organization's department or groups having relatively homogenous culture are the most appropriate level for analysis and aggregation of individual perceptions.
- In a positive safety culture, employees not only feel responsible for their own safety but they are responsible for their peers' safety, and the organizational culture supports them acting on their responsibility. Also a safety culture will ascertain and reflect the effectiveness of a safety management system at any construction site. The authors firmly believe that measurement of safety culture and safety performance is very challenging particularly in construction projects and therefore, researchers need to do more for the benefit of the industry and their employees.

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