USING SAFETY CLIMATE AS TOOL FOR IMPROVEMENT OF SAFETY PERFORMANCE IN CONSTRUCTION ORGANIZATIONS

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ABSTRACT

Data from a number of industrialized countries show that construction workers are 3 to 4 times more likely than other workers to die from accidents at work. In the developing world, the risks associated with construction work may be 3 to 6 times greater. Construction is one of the world's biggest industrial sectors, including the building, civil engineering, demolition and maintenance industries, and in Oman it accounts for approximately 10% of the total GDP. Statistics indicate that a total of 723,243 residents including 91% foreigners were working in 100,000 construction organizations in 2014 and was having second larger rate of occupational injuries after manufacturing industry with an estimated cost of 3,700,000 US$ per year. Construction workers are exposed to a wide variety of hazards on the job, including dusts and vapours, asbestos, awkward working positions, heavy loads, adverse weather conditions, work at heights, noise, vibration from tools, and therefore more closer to occupational accidents. In recent years the awareness of the importance for safety performance of organizational, managerial and social factors, has increased. Safety climate is an aspect of organizational climate, and offers a route for safety management, complementing the often predominant engineering approach. Safety climate investigations are more sensitive and proactive bases for developing safety, rather than reactive information from accident rates and accident and incident reports. Based on a thorough literature review, relevant safety climate dimensions including (1) management safety priority, commitment and competence; (2) management safety empowerment; (3) management safety justice; (4) workers' safety commitment; (5) workers' safety priority and risk non-acceptance; (6) safety communication, learning, and trust in co-workers' safety competence; and (7) workers' trust in the efficacy of safety systems, are identified and discussed. This paper further describes how construction organizations in Oman can improve their safety performance by using and assessing leading safety climate dimensions/ factors among their workers.

Keywords:*Construction safety, safety climate dimensions, safety performance, construction organizations*

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1. INTRODUCTION

Statistics published by the International Labor Organization (2015) indicate that at least 108,000 workers are killed on construction sites every year, a figure which represents about 30 per cent of all occupational fatal injuries. Data from a number of industrialized countries show that construction workers are 3 to 4 times more likely than other workers to die from accidents at work. In the developing world, the risks associated with construction work may be 3 to 6 times greater. Many more workers suffer and die from occupational diseases arising from past exposure to dangerous substances, such as asbestos. Construction is one of the world's biggest industrial sectors, including the building, civil engineering, demolition and maintenance industries. It accounts for a large proportion of GDP for many countries for example, 10 percent in the U.K., 17 percent in Japan, and 10 percent in Oman. Statistics published in the daily Times of Oman dated June 09, 2014, a total of 723,243.00 residents were working in the construction industry. In most developing countries, construction is among the fastest growing areas of the labor market, continuing to provide a traditional entry point for laborers. It is, however, one of the most dangerous industries. Construction workers build, repair, maintain, renovate and demolish houses, office buildings, factories, hospitals, roads, bridges, tunnels, stadiums, docks, airports and more. During the course of their work they are exposed to a wide variety of hazards on the job, including dusts and vapours, asbestos, awkward working positions, heavy loads, adverse weather conditions, work at heights, noise, vibration from tools, among many others. The causes of accidents and ill-health in the sector are well known and almost all are preventable. A report published in daily Times of Oman dated February 28, 2015 states that there is no official statistics of how many company workers get hurt in the course of their duties but according to the individual Health and Safety Environment's (HSE) records of top 10 contractors, more than 3,700 of them needed medical treatment in 2014. The injured workers who get hospitalized made up nearly 10 per cent of the total workers on this list. Sadly, about 18 per cent of them died either at the sites or in hospitals in 2015. In comparison to the previous year, 246 more workers got injured in 2014 but for obvious reason, company directors do not want this part of the record to be made public. The Public Authority of Social Insurance (PASI 2014) which registered only Omani nationals' reports shows that 401 cases of work related injuries were disbursed which cost a total amount of 406,000 OMR (105,1540 US$). The number of active insurees in the Social Insurance System was 197,510 in 2014; which gives a ratio of number of insurees and injuries cost as 1:0.49. If this is applied to the total workers working in the construction industry of Oman to get an idea of the cost involved in construction safety, gives a figure of 1,428,571 OMR (3,700,000 US$) per year. In construction organizations most of the workers are foreigners (92% of total work force) and as such they are not insured under the government authority. As per law of the country, construction organizations required to seek private insurance for their workers, however as the risk associated with construction workers is high their insurance premium is comparatively more. Construction organizations further bear high cost at the time of recruitment and pay for repatriation, compensation and replacement in case of accidents involving injuries and death. There is high potential for construction organizations to reduce the cost associated with accidents by improving safety culture through safety climate.

In recent years the awareness of the importance for safety performance of organizational, managerial and social factors, has increased. Safety climate is a subset of organizational climate, and offers a route for safety management, complementing the often predominant engineering approach. An understanding of the safety climate dimensions can be useful in improving the safety performance of an organization. In addition, safety climate investigations are more sensitive (e.g. multi-faceted) and proactive bases for developing safety, rather than reactive (after the fact) information from accident rates and accident and incident reports (Seo et al., 2004). Over the past century focus concerning factors influencing safety and safety improvements within industries has changed and expanded. Hale and Hovden (1998) describe three ages of safety: the technical age (1920's), the human factor age (1970's) and the management system age (1980's). The third wave or age of safety expanded the focus to include safety culture, and the concept of safety culture was first truly introduced and defined after the Chernobyl accident in 1986 (INSAG, 1992). Safety culture and safety climate are concepts that today attract much attention across a broad number of industries and sectors (Clarke, 2000). One of the reasons for this is that a rich safety culture and a mature safety climate are some of the most important factors in achieving a safe workplace. In order to improve the level of safety culture and safety climate it is important to: a) determine the current level of safety culture and safety climate, b) decide what level of safety culture and safety climate is needed, attainable

and wanted, and c) to create a plan to achieve the safety culture and safety climate that is wanted (AIChE, 2012). Safety climate may be defined as shared perceptions among the members of a social unit, of policies, procedures and practices related to safety in the organization. Researchers and practitioners have identified safety culture and safety climate as key to reducing injuries, illnesses and fatalities on construction worksites. Many construction contractors are trying to improve these indicators as a way to move closer to a goal of achieving zero injury worksites. This paper presents the initial research of how different safety climate could be used by construction organizations to improve their safety performance.

2. DEFINING SAFETY CLIMATE

Although there are several definitions suggested by different researchers from different thought and background, however recently in a workshop on ‘’safety culture and climate: bridging the gap between research and practice, held in Washington DC on 11-12 June 2013; Organizers distributed a handout containing 10 safety climate definitions obtained from both the peer-reviewed academic literature and from interviews recently conducted with contractors and safety practitioners. Seventy-two invited construction stakeholders representing the following constituency groups participated in the construction track (table No.1). Workgroups reviewed and discussed each definition and were asked to select one for safety climate and one for safety culture that they thought was most relevant for construction. Table No.2 shows the reported favourite definitions of safety climate from the workgroup.

Contractors	25 %
Employer Associations	12 %
Labor Organizations	14 %
Researchers/Academics	40 %
Consultants	6 %
Insurance Companies	4 %

Table No.1 Composition of Participants of Workshop from Different Construction Stakeholders

Safety Climate is a leading indicator. It reflects how well the espoused safety program is ultimately integrated into the organization to support safe effective practices at the point of operation.	33 %
Safety climate reflects shared perceptions of the relative priority of safety compared to other competing organizational priorities.	23 %
The safety climate is the environment in which a company puts its safety culture to work. Like providing the tools and equipment necessary, maybe the resources on our job sites to create that environment in which people are allowed to work safely.	19 %

Safety climate is the shared perceptions of organizational members about their work environment and, more precisely, about their organizational safety policies.	16 %
Safety climate is a subset of organizational climate that measures through members' perceptions the degree of congruence between an organization's espoused values and policies and enacted practices.	9 %

Table No.2 Top most favorite definitions of Safety Climate from different Construction Stakeholders

3. SAFETY CLIMATE DIMENSIONS/ FACTORS

Based on theory and empirical results from different sources, it is mandatory that to consider different dimensions of safety climate based on the perceptions of conditions contributing to individual motivation, as well as conditions influential to relational aspects of occupational safety. From the literature review, the leading safety climate dimensions are: Management safety priority and commitment to safety; Workgroup safety priority and commitment; Learning, communication and innovativeness; Management safety justice; Trust in management; Trust in co-worker safety competence; Trust in the general efficacy of safety systems; and Safety empowerment.

3.1 *MANAGEMENT SAFETY PRIORITY AND COMMITMENT TO SAFETY*

As the organizational priorities are largely communicated through the managers, manager behavior would be a main source of information. If managers are perceived to be committed to safety and to prioritize safety in relation to other goals, safe behavior would be expected to be rewarded, and thereby reinforced. From this it may be inferred that safety climate informs the individual on how to behave in order to maximize individual benefit. In this respect, it may be viewed to represent an individualistic perspective. Top management involvement in safety, and the priority of safety matters, were two of the themes identified by Zohar (1980) in the literature review undertaken to define the first safety climate scale. Brown and Holmes (1986) tested the safety climate questionnaire developed by Zohar (1980), and identified management concerns for employee well-being, and management activity in responding to this concern as two of three factors. Perceptions of management safety commitment and priority have been found to be the most commonly assessed themes in safety climate research (Flin et al., 2000). As a design criterion for the safety climate questionnaire that it should assess management safety priority as well as management commitment to safety.

3.2 *WORKGROUP SAFETY PRIORITY AND COMMITMENT*

Since being in equilibrium with the social environment contributes to a sense of security and reduces stress, shared perceptions of safety being valued and expected in the organization would also contribute to the development of workgroup norms favoring safety. Such norms would cue individual safety behavior, since individuals may expect safe behavior to be socially rewarded by the group. Clarke (2006b), in discussing the results of her meta-analysis of 19 safety climate studies, suggested that individuals feel more committed to the workgroup than to the organization, and hence that the workgroup is most powerful in the socialization of new members. Clarke suggested perceptions of workgroup norms to be highly decisive for group safety climate. The results of Dedobbeleer and Béland (1991) indicated that safety climate measures should cover conditions regarding management as well as the workgroup. Andriessen (1978) found Safety motivation to be strongly determined by leadership and safety standards of the leader, but also by group standards and group cohesion. Results by Watson et al. (2005) showed that an index of co-worker safety norms was negatively correlated with at risk behavior. Tucker et al. (2008) found that the effect of perceived organizational support for safety, on employee safety voice, i.e. the degree to which employees speak out in an attempt to change unsafe workplace conditions, was mediated through perceived co-worker support for safety. Support for specifying safety climate dimensions regarding not only managerial policies, procedures and practices, but also workgroup ditto, has also been presented by Melía et al. (2008). Seo et al. (2004), in their scrutiny of 16 safety climate scales, identified perceptions of co-worker safety support as one of five major dimensions of safety

climate covered in previous research. As a design criterion for the assessment that it should evaluate safety climate dimensions regarding both, but separately, management and workgroup policies, procedures, and practice. Safety priority and safety commitment should be assessed regarding both these levels. Norms of risk acceptance may play a negative role in relation to safety priority, and have been claimed to counteract active safety work (Murray and Dolomount, 1994; Pollnac and Poggie, 1989; Törner and Nordling, 2000). Therefore the safety climate Questionnaire must have an assessment of workgroup risk acceptance.

3.3 *LEARNING, COMMUNICATION AND INNOVATIVENESS*

Communication and social interaction are necessary means for the creation of social constructs such as organizational climate. Hofmann and Stetzer (1998) suggested that management encouraging open communication on safety, sends a strong signal on how safety is valued. Jeffcott et al. (2006) stressed the importance of learning for a positive safety culture, i.e. continuously gathering, analyzing and disseminating information in an environment valuing expertise and being based on trust, where operators can identify and are willing to report abnormal events and errors. Communication is thus not merely an exchange of information, but also a prerequisite for learning and for new, innovative ideas to emerge. Open and frequent communication between management and employees was one of the important safety themes identified by Zohar (1980) in his literature review. Perceived management openness, including a willingness to share ideas and information freely and accurately, is often put forth as an aspect or facet of management quality necessary for the development of trust in management (e.g. Clark and Payne, 1997), a dimension of safety climate discussed further below. Communication should, to be effective, take place not only as an interaction between management and employees e but also between employees. As a design criterion for the questionnaire that safety related communication (open and rich), learning, and innovativeness should be assessed.

3.4 *MANAGEMENT SAFETY JUSTICE*

Organizational citizenship behavior (OCB) has been defined as "individual behavior that is discretionary, not directly or explicitly recognized by the formal reward system, and that in the aggregate promotes the effective functioning of the organization" (Organ, 1997, p. 86). Actively taking responsibility for the safety of oneself and others and engaging in safety activities, could well be regarded as an expression of OCB. Organ (1997) suggested the antecedents of OCB to be "dispositions related to conscientiousness" and "any dispositions that can be confidently and empirically tied to a characteristic level of morale in the workplace" (p. 94). Fassina et al. (2008) based on a meta-analysis of 34 studies on the relationship between distributive, interactional and procedural justice on one hand, and OCB on the other, stated that all three justice dimensions correlated with OCB, but that the correlations with interactional (fair treatment by superiors) and procedural justice (fair procedures) were the strongest. It could thus be argued that employee safety responsibility and safety behavior would be positively influenced by management procedural and interactional safety justice, i.e. just treatment and procedures when handling accidents and near-accidents. As a questionnaire design criterion that perceptions of management interactional and procedural justice in regards to safety should be included.

3.5 *TRUST IN MANAGEMENT*

The theory of social exchange (Blau, 1986) further emphasizes the relational component of safety climate. According to this theory, behavior from one party benefitting a second party creates a mutual expectation that this will be reciprocated at some future time by the second party performing behavior that benefits the initiator. Another theoretical concept of relevance here is that of Perceived Organizational Support (POS) (Eisenberger et al.,1986). POS is based on the assumption that "employees in an organization form global beliefs concerning the extent to which the organization values their contributions and cares about their well-being" (Eisenberger et al., 1986, p. 500), and that such beliefs would increase the employees' affective attachment to the organization.. As this demonstrates caring for workers' health, it may be assumed that POS would also have a positive effect on safety climate which there is empirical support for. POS and high-quality leader member relations have been shown to have an impact on workers' safety commitment and safety communication (Hofmann and Morgeson, 1999), on safety climate (Wallace et al., 2006) as well as on lower accident rates (Hofmann and Morgeson, 1999;Wallace et al., 2006). Mayer et al. (1995) stated that trust encompasses a willingness to take a risk

in a relationship, and to be vulnerable to the other party. Cox et al. (2006), discussing trust in high reliability organizations, concluded that low trust relations can have negative impacts on an effective safety culture. Zacharatos et al. (2005) found trust in management, and safety climate to predict safety knowledge, safety motivation and safety behavior, as well as a lower rate of safety incidents. Burns et al. (2006) suggested that trust and distrust may be viewed as different constructs, both of which may have a positive impact on safety. It was concluded as a design criterion that the questionnaire should assess the employees' trust in management, and trust in management competence was chosen to represent it. However, the complex nature of trust in relation to safety, further stresses the importance of simultaneously measuring safety communication.

3.6 *TRUST IN CO-WORKER SAFETY COMPETENCE*

The workforce's perceptions of the general standard of workers' qualifications, skills and knowledge, was one of the six most common themes in safety climate research found by Flin et al. (2000). Co-worker safety competence was also one of the five dimensions of safety climate identified by Seo et al. (2004). As stated above, perception of competence is often suggested as one of the dimensions of trust. The complexity of trust should, however, be kept in mind. As Conchie and Donald (2008) pointed out, if there is blind trust in co-workers, double checking of safety critical tasks may be overlooked, and mistakes may pass undetected. The questionnaire should be designed to contain items assessing perceptions of trust in co-worker competence, but once again, the importance of open and rich communication, participation and empowerment, in order to counteract the development of blind trust, should be emphasized.

3.7 *TRUST IN THE GENERAL EFFICACY OF SAFETY SYSTEMS*

The importance of well-functioning safety systems was confirmed in an interview study with first-line supervisors and worker safety representatives in construction work (Törner and Pousette, 2009). It should be emphasized that safety climate is a social construct, and a climate measure of perceptions of safety systems should not be an "audit" on how such systems are implemented in the workplace under study (Hale, 2000), but rather aim at capturing perceptions of the efficacy for attaining a high standard of safety of a systematic approach to safety through well-developed safety management systems. Pidgeon (1998) expanded on this and stated that organizational culture plays an important role for how we structure our understanding of the world, and these understandings help us to acknowledge certain safety issues. At the same time they may turn our attention away from other equally important issues, so that hazards may "incubate" in the organization. In addition, trying to anticipate all possible risks, and trying to prevent them through elaborate safety management systems, may lead to rigid responses rather than resilience when non-anticipated events occur (Conchie et al., 2006; Pidgeon, 1998). This once again points to the importance of learning (e.g. Pidgeon and O'Leary, 2000) and open and rich communication in the organization. Hale (2000) advocated a creative mistrust in the risk control systems, as one of the dimensions of a good safety culture. He stated that believing that you have the ideal safety culture should be a warning that you don't, and instead it is sound to constantly question the quality of the safety culture. Hale stressed the importance of open communication and reflexivity. As a design criterion for the safety climate questionnaire that it should assess perceptions of the efficacy of safety systems, but that this should be assessed together with other aspects of safety climate.

3.8 *SAFETY EMPOWERMENT*

One way for managers to convey trust is by empowering the employees. Empowerment is a delegation of power, and as such it demonstrates that managers trust workers' ability and judgment, and that managers value workers' contributions. Empowerment would thus be expected to contribute to POS. In turn, empowerment would further strengthen social exchanges, and in conditions where safety is highly valued by the organization, empowerment would encourage reciprocation and reinforce safety behavior. Shannon et al. (1997), in a review of ten studies examining the relationship between workplace and organizational factors and injury rates, found that empowerment of the workers and delegation of safety activities, were consistently related to lower injury rates, i.e. the relation was significant in at least two thirds of the studies. In an interview study with first-line supervisors and workers' safety representatives in construction work, one of the main constituents of workplace safety, in their opinion, was cooperation across hierarchical levels and functions, and support for cooperation through empowerment, mutual trust and having a keen ear (Törner and Pousette, 2009). Results of Clarke and Ward (2006) showed a positive

relation between management tactics characterized by being consultative, by inspirational appeals and rational persuasion, and a good safety climate and safety behavior. They also found a positive correlation between coalition tactics and safety participation. Clarke and Ward suggested that these types of management tactics have a beneficial influence on perceptions of communication and perceptions of managers' competence in decision making, which supports development of trust and increases safety participation. As a design criterion for the questionnaire that assessment of management safety empowerment and encouragement of employee safety participation should be included.

4. PROCESS OF USING SAFETY CLIMATE FACTORS FOR SAFETY IMPROVEMENT

Safety climate factors can be measured among different categories of staff working in a construction organization or in a project undertaken by the construction organization which will reflect the safety climate of organization or safety climate of the specific project. After assessment of safety climate construction organizations will be able to identify and prioritize the weak areas for improvement. Safety climate leading factors can be reviewed on a five level scoring scale to assess what level of safety culture for that factor is achieved by a construction organization. Maturity level for all the factors can be classified as uniformed, reactive, complaint, proactive and exemplary. Table 3 presents different levels for demonstration of a leading safety climate factor ''management commitment to safety''. Construction organizations can make short term (1-2 months), mid-term (6-12 months) and long term (1-2 years) if the required level for the factors is not adopted.

Uniformed →	**Reactive** →	**Complaint** →	**Proactive** →	**Exemplary** →
Representation from management rarely comes to the actual jobsite. When they are present, they often act as poor safety role models by breaking organizational safety policies and procedures. Management does not participate in safety audits. If employees bring concerns to any level of management they are not acted upon.	Management gets involved only after an injury occurs. They often blame workers for injuries, leading to suspension or even termination. Safety rules are enforced only after an incident or when audit results are negative.	Management conforms strictly to OSHA regulations, never more or less. Safety compliance is based on owner or regulatory directives. Managers participate in safety audits.	Management initiates and actively participates in safety audits. Managers meet with workers to ask for advice and feedback regarding hazard reduction. Management conducts spontaneous site visits and recognizes workers for identifying hazards, working safely, and keeping co-workers safe. Leaders participate in safety program development and provide adequate resources to ensure a positive safety climate. The safety management system is reviewed annually to ensure effectiveness and relevance.	Management integrates safety into every meeting and engages in continuous improvement regarding safety conditions and hazard reduction. External audits are conducted to evaluate top management's involvement in safety. Managers are held accountable for safety expectations through annual performance evaluations. Safety trends are analyzed. There is a formalized process for corrective actions.

Table No. 3 Demonstration of a Leading Safety Climate Factor "Management Commitment to Safety" at Different Levels of Achievement (CPWR 2014)

5. CONCLUSION

The risk associated with construction workers is higher than other industries which results in more accidents and both organizations and individuals involved in accident suffer in different ways including financially. This paper presented the concept for construction organizations for improvement of safety performance through safety climate dimensions. Construction companies in partnership with workers are responsible for ensuring that jobsite hazards are eliminated, or at least minimized. These partnerships are most effective when they exist within a positive safety climate. The leading factors which contribute to safety climate are discussed and how these factors are measured within construction organizations are highlighted. Using these factors on a scoring scale can help the organizations to understand the level of their safety climate to predict the safety culture and safety performance. Construction is a leading and rapid growing industry of Oman, which is highly contributing to the country economy, needing to improve their safety performance. 92% of the total workforce in the construction industry are foreigners and in case of accidents construction organizations bear more financial cost such as for medical treatment, workers compensation, repatriation cost in case of death, replacement and delay in completion of projects. Assessment of safety climate will help construction organizations in Oman to develop short, mid and long term plans to improve their safety outcomes. As this is the initial report of the research in progress, the actual assessment of safety climate in selected organizations needs to be carried out so that it could be recommended to the other construction organizations confidently.

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