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Safety Climate and Culture Review: A Case Study of Water and Power Project

Badr Almalki

Department of Environmental Science, Faculty of Meteorology,

Environment and Arid Land Agriculture, King Abdulaziz University,

P.O. Box 80208, Jeddah 21589, Saudi Arabia

Prof. Adel Zakeria

Department of Environmental Science, Faculty of Meteorology,

Environment and Arid Land Agriculture, King Abdulaziz University,

P.O. Box 80208, Jeddah 21589, Saudi Arabia

Prof. Mansour A. Balkhyour

Department of Environmental Science, Faculty of Meteorology,

Environment and Arid Land Agriculture, King Abdulaziz University,

P.O. Box 80208, Jeddah 21589, Saudi Arabia

Dr. Ijaz Ahmad (Corresponding author)

Green Environ Sol. Business Incubation Centre

International Islamic University, Sector H10

P.O. Box 1234, Islamabad 44000, Pakistan

E-mail: drahmadtarar@gmail.com

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Abstract

Systematic management of occupational safety and health (OSH) issues requires attention in many aspects like regulatory, technical, organizational and managerial. Approaching OSH from an organizational culture perspective can also facilitate achieving sustainable improvements in organizational OSH performance. OSH culture helps in seeing and organizing safety from different perspectives and should not be reduced to a matter of culture only. The knowledge, information and data gathered is expected to be very useful in the process of improving OSH-related procedures, practices and policies, eventually leading to enhanced OSH performance. This paper attempts to describe a cultural approach towards understanding organizational OSH. It will help the readers, professionals, authorities, and policy makers in understanding OSH from a cultural point of view, and how to assess this OSH culture as part of the of organizational improvement process. The aim is to disseminate latest information on this complex topic, trying to build a bridge between practice and research. The scientific literature shows these two terms, safety climate and safety culture, are often interchangeable, but they are distinct but related concepts. The word "safety culture" is a complex and persistent feature reflecting fundamental assumptions, expectations, norms and values, which are also represented by societal culture while "safety climate" best pronounces attitudes, beliefs, and perceptions of employees classically measured by surveys and observations. Safety culture measurement requires detailed investigation of how members in an organization interact to form a shared view of safety. This paper explores the ideas of an organization's safety climate and culture for the purpose of determining which is more advantageous for accurately describing a "state of safety". Preliminary results of a case study from a water and power project from Saudi Arabia has been added.

Keywords: Saudi Arabia, occupational health and safety, OSH, water and power plant, survey

1. Introduction and Literature Review

One of the main problems in the work place is the hazards which have the potential to cause serious harm or injury. These hazards exist in several forms such as chemical, physical, or electrical threats to a worker's well-being. In order to reduce these harmful events, organizations make significant efforts in the development of appropriate safety rules and regulations which help to control the hazards and reduce their severity and, if possible, remove them permanently from the work environment (Ahmad et al., 2016; 2017; 2018). In addition, government institutions enact regulations and laws, which require all organizations to comply to achieve occupational safety and protect workers in the work environment. However, industrial studies and reports have proved there are gross accidents, injuries, and fatalities in workplace despite the implementation of those systems (McKinnon, 2013).

The power and water plants are strategic projects and play an important role in economic and social life by providing electricity. The sustainable power generation and supply is necessary for many purposes and that is only possible by providing the highest standards of security, safety, and health to the employees of water and power plants. The power and water plants are much safer than they once were; however, employees still encounter enormous physical,

mechanical, slip, trip and electrical hazards. These hazards have the capacity to cause harm to employees and property (Cooper 2004; Power Engineering, 2006).

1.1 Safety Culture

The term safety culture can be defined as the parts of an organization's culture which relate to safety (Cooper 2004), normally an organization's safety culture is the same as its organizational culture. There is an expectation the organization's culture and safety position would be one and the same as safety should be a key driver in all organizational decisions and practices (Cooper, 2004). Safety culture of an organization is affected by external business and societal influences; like market conditions and changes in societal values, is also influenced by organizational culture (Cooper, 2004). Safety culture's purpose is to embody the company's value placed on safety and the extent to which workers take personal responsibility for safety actions in the performance of their job duties. Safety culture is often described as the 'personality' of an organization, as it is a shared value of safety between the organization and the employee. The safety climate is referred to as an organization's 'mood'.

1.2 Safety Climate

The organizational safety climate best pronounces the attitudes, beliefs, and perceptions of workers classically measured by surveys and observations. The concept of safety climate is to accumulate values, beliefs, and perceptions about safety that are shared at the workplace among employees (HSE 2013; Cooper & Philips, 2004). According to Health and Safety Executive Report the term safety climate is used to refer to employees psychological characteristics corresponding to their attitudes and perceptions concerning safety (HSE 2013).

1.3 Safety and Health Management

As a layer of protection, all organizations develop occupational safety and health management systems to fulfill the government requirements and to identify the hazards that arise from operation and maintenance activities (Crutchfield & Roughton, 2014). The occupational safety and health management system "is a term used to refer to a comprehensive business management system designed to manage safety elements in a workplace" (Horie, 2010).

Safety and health management is a complex, demanding and serious aspect of every business today. The impact of workplace accidents and exposures can adversely affect employees and their families, the business and its reputation. The costs associated with non-compliance can be enormous. As per National Safety Council (NSC), the cost of unintentional occupational injuries for 2013 was $820.6 billion, which includes estimated economic cost of fatal and nonfatal injuries, vehicle damage cost, fire losses, wages, productivities losses, medical expenses, administration expenses, and employee's uninsured cost coverage (NSC, 2015).

Organizations who seek to manage safety and health must examine incorporating safety and health into its core business. The simplest and most effective way is to implement a safety and health management system. The challenge with implementing any management system is

understanding how the system works for the organization and keeping it as simple as possible. Too often organizations fail to understand how a management system should work, and they spend too much time developing mountains of paperwork which add little value (Gallagher & Dan, 2015).

According to the Saudi Government Official Statistics of General Organization for Social Insurance, the number of injuries has been increased from 52467 to 82259 during 2013-2015 (GOSI, 2016). The Survey of Occupational Injuries and Illnesses (SOII) by Bureau of Labor Statistics, USA has reported nearly 3.0 million nonfatal workplace injuries and illnesses in private industry employees in 2014. It were found to be at a rate of 3.2 cases per 100 equivalent full-time workers (BLS, 2015).

1.4 Safety Culture Assessment and Management

Many studies were reviewed to assess the safety culture of an organization and/or to evaluate whether the measured safety culture has improved over time. The methodologies used in assessing the safety culture have been surveys, interviews, and observations. As indicated in the research, these approaches focus on the perceptions of the employees of the organization's safety culture. This implies, there are several different approaches to measuring safety culture in the company (Abdullah et al., 2016; Chib & Kanetkar 2014).

It has been observed many industries depend on lagging indicators in measuring safety such as the lost time accidents, process safety incidents, property damages, fatalities and workers compensation costs. The safety concerns of specific worksites cannot be identified by using only the lagging indicator approaches as it seems these measurements are not providing sufficient and useful information for those safety incidents, as well as, they do not provide a satisfactory means to evaluate risk exposure of employees (Jones, 2014). More cutting-edge approaches call for the use of greater proactive measures or 'leading indicators' such as measurement of safety climate (Abdullah et al., 2016). Such assessments emphasize activities to create the success of safety management rather than react to failures of the system.

The safety climate survey provides sufficient information about system issues before accidents and injuries result. In addition, the tool calls attention to trends in an organization's safety performance, which would identify information on which area the intervention program should be focused (Abdullah et al., 2016. The safety climate tool could provide benchmarking data to assist the organization’s performance in safety in comparison with other similar companies (Abdullah et al., 2016; Akalp et al., 2015; Chib & Kanetkar 2014; Bhattacharya, 2015; Boughaba, 2014). Benchmarking can be used as part of a commitment to continuous improvement for the organization in addition to routine methods such as surveys or questionnaires, observations and interviews or a combination of all (Abdullah et al., 2016).

1.5 Quantitative Approaches

The principal tool for measuring the safety climate is the use of survey (questionnaire) as most safety research reveals (Abdullah et al., 2016; Akalp et al, 2015; Chib & Kanetkar 2014; Bhattacharya, 2015; Boughaba, 2014). These surveys usually are comprised of questions that measure the participants perceptions, values, beliefs, and attitudes as well as the dimensions

of safety including management commitment and employees engagement (Abdullah et al., 2016; Akalp et al., 2015; Chib & Kanetkar, 2014; Bhattacharya, 2015; Boughaba et al., 2014). Moreover, as indicated by Zuschlag et al. (2016), hazards and risk evaluations are considered to be one of the quantitative measures to accurately assess the safety climate. The researchers recommended the survey to be followed by performing worker interviews in which the outcome of the interviews would illuminate the apparent processes behind the survey score and identify the root causes behind these scores.

One of the major benefits of the safety climate surveys is the usefulness of measuring the changes between pre and post interventions programs and constructing a comprehensive picture of the existing safety issues. However, the safety climate survey could have several limitations which include but are not limited to lack of understanding of the survey objectives along with other reasons such as fear of retaliation or blame and low levels of employee literacy because of language or education (Chib & Kanetkar 2014).

1.6 Qualitative Approaches

Qualitative approaches include field notes, process artifacts, interviews, focus groups, document analysis, case studies, site visit observations, and project records as additional qualitative data sources for assessing the context and mechanisms which all used to measure the safety climate of the organization (Abdullah et al., 2016; Akalp et al, 2015; Chib & Kanetkar, 2014; Bhattacharya, 2015; Boughaba et al., 2014). The qualitative methods are important in enhancing the programs outcome specially the intervention program (Abdullah et al., 2016). The quantitative survey approach provides a generic overview of the safety climate from the workers' viewpoint at a particular point of time for the organization. Qualitative approaches are designed to identify why that climate exists within the organization and provide rich, in depth, detailed information for the specific factors and dimensions of safety in the specific organization (Bhattacharya, 2015; Boughaba et al., 2014).

One of the most common limitations of the interviews is the lack of objectivity on the employee and researcher's part as the perceptions are shaped by the employees' feedback and how the researcher recorded the information. To avoid the biases the sampling should be carefully weighted toward selecting respondents who can provide insight (Akalp et al., 2015). A mixed-method approach consisting of document analysis, observations, registration of safety-related interactions, semi structured interviews, and a questionnaire requires the usage of more than one rater to test inter-rater reliability and coded subjects (Chib & Kanetkar, 2014; Bhattacharya, 2015).

Studies argue using face to face qualitative methodologies such as meetings, interviews, focus groups, and workshops, create a relationship between the researcher and participants, which in return encourage being open and honest, especially when the employees have believed the researcher is trustworthy. Additionally, the qualitative methods help more when there is a need to understand contextual factors in undefined areas that are considered superior to quantitative methodologies (Boughaba et al., 2014; Bhattacharya 2015).

2. Case Study of Shuaibah Water and Power Project

Saudi Arabia is one of the most productive energy and water desalination countries, due to the high and increasing demand (Ahmad et al., 2017). As per the Ministry of Economy and Planning, the growth rate of power and water was increased from 1.63% to 5.77% during 2013-2014 due to increased demand of electricity in different sectors (MEP, 2014). An environmental impact assessment (EIA) report, by United States (US) Energy Information Administration shows that the Saudi Government has planned to double its energy generating capacity of 55 GW (gaga watt) to 120 GW by 2032 (US-EIA, 2014).

In this study we conducted an assessment of safety culture in the Shuaibah Independent Water and Power Project, located 110 km (kilometers) south Jeddah, Saudi Arabia. Shuaibah Water and Power Company has a power capacity of 1,200 MW (megawatt) and water capacity of 800,000 m^3/d. It is a thermal plant (steam turbines) and the used fuel is HFO (heavy fuel oil). This newly established plant is running through a national operation and maintenance company "NOMAC" and the total manpower is 210 employees (NOMAC, 2016).

3. Methodology

For conducting this preliminary study, different safety culture survey tools were identified by an extensive review of literature (He et al., 2012; Wang and Sun 2012). Constructs identified in the initial observation, walk through survey, interviews and focus groups discussions formed the basis for developing tailored safety climate questionnaire specific to this plant. The questionnaire used for this study was tailored by consulting and reviewing many authentic available questionnaires like Health and Safety Executive Safety Climate Measurement Questionnaire, John Hopkins University Safety-Climate Questionnaire, National Aeronautics and Space Administration Safety Performance Survey, NORDIC Safety climate Survey (He et al., 2012; Wang and Sun 2012) Multilevel Safety Climate Scale which developed by Zohar (1980), Cox and Flin (1998), and DuPont Safety Perception Survey questionnaires (Wang & Sun, 2012).

To encourage participation and to raise awareness and understanding of the research project, the interviews and questionnaires were devised in written local language. Moreover, the researcher attended safety meetings, job-related training and site visits to gain an in-depth understanding of the job roles, and the safety challenges faced by the organization and its employees. A number of focus group discussions were conducted to identify workers' perceptions and attitudes towards safety, to identify factors that shape safety in the organization and to spot the possible solutions to issues and causes.

Semi-structured interviews were conducted with a cross-section of employees. Participants were selected based on their position within the company and the sample included, workers, supervisors, managers, section heads and team leaders. For the team leaders, due to their high number a purposeful sampling strategy was done, to select those who have a direct involvement in safety (He et al., 2012). The questions were divided into 7 main sections i) Safety Leadership ii) Prioritization of health and safety over production iii) Engagement and involvement iv) Two-way communication v) Employees learning and training vi) Blame

culture vii) Recognition and rewards.

4. Results and Discussion

4.1 Personal and Sociodemographic Characteristics

Table 1. Personal and Sociodemographic characteristics participants

Questions and description		%
What is your role?	Management	5
	Supervisor/ Team Leader	23.2
	Technician/ Operator	54.1
	Contractor	15.9
	Missing	1.8
Which department do you work in?	Executive Management	0.9
	Performance Assurance (PAT)	1.4
	Operations	45.5
	Maintenance	31.8
	HSE & Security	10.9
	HR/ Admin/ Legal	5.9
	Warehouse/ Store	0.9
	IT/ SAP	0.9
	Procurement/ Supply chain	0.5
	Not answered	1.4
How old are you?	Less than 25	2.3
	25-34	46.4
	35-49	32.3
	50-64	14.1
	Over 64	0.5
	Not answered	4.5
How long have you worked in this company?	Less than 1 year	7.3
	1 - 2 years	28.2
	3 - 6 years	37.3
	7 - 9 years	24.1
	10 years or more	0.5
	Missing	2.7
What is your type of work?	Management work	10
	Administrative work	21.8
	Field work	63.2
	Not answered	5
Have you had an accident at work in the last year?	Yes	1.4
	No	91.8
	Not answered	6.8
Total		100

Personal and sociodemographic characteristics of all the participating enployees are given in table 1. The highest participating employees were Technician/ Operator (54.1 %), along with others like managers (5%), supervisors (23.2%), and contractors (15.9%). The survey was carried out in almost all the departments: Executive Management, Performance and Assurance (PAT), Operations and Maintenance, Health Safety Environment and Security, Human Resource, Warehouse/ Store, Procurement/ Supply chain. The participant's age, job experience and their job role was also noted.

4.2 Organizational Commitment as an Indicator of Safety Climate and Culture

The results of the safety climate and culture assessment survey are given in the table 2. Different survey questions like communications, productivity, health and safety management, role of supervisors' etc. responses were recorded in the form of five point Likert scale.

Table 2. Indicators of safety climate and culture

Survey questions	Strongly disagree %	Disagree %	Neither agree nor disagree %	Agree %	Strongly agree %
There are good communications (e.g. toolbox talks, task briefings – tailor as appropriate) here about health and safety issues	1.8	5.5	9.5	68.6	14.5
Productivity/getting the job done (tailor as appropriate) is usually seen as more important than health and safety	10.9	50.5	13.2	20.0	5.5
Management always act quickly over health and safety concerns	2.3	7.3	11.8	63.6	15.0
Supervisors rarely check that people here are working safely	27.7	27.7	14.1	25.9	4.5
The plant/site (tailor as appropriate) encourages suggestions on how to improve health and safety	0.9	5.5	18.2	57.3	18.2
I do not think my supervisor does enough to ensure health and safety	17.7	35.5	14.1	29.5	3.2

Examining the efficiency of organizational commitment items before the intervention program revealed most of the respondents agree "There are good communications (e.g. toolbox talks, task briefings) here about health and safety issues" (14.5% strongly agree and 68.6% agree). Confirming this observation, more than 60% respondents disagree with the item "Productivity/getting the job done is usually seen as more important than health and safety", which implies "health and safety" has been given more priority and importance than the getting the job done.

Similarly, most of the respondents agree that "Management always acts quickly over health

and safety concerns" (15% strongly agree and 63.6% agree). Similarly, more than 54% respondents disagreed with the question item "Supervisors rarely check that people here are working safely", which also indicates promotion of the safety climate and culture by the organization. Most of the respondents agree "The plant/site encourages suggestions on how to improve health and safety" (18.2% strongly agree and 57.3% agree). Also, more than 53% disagree or strongly disagree with the safety climate and safety culture questionnaire item "I do not think my supervisor does enough to ensure health and safety".

5. Conclusion

Safety culture of any organization is influenced by organizational culture and is likely to depend on the types and magnitudes of risks that are involved in its work activities, which are also impacted by external businesses and societal influences. Safety culture embodies the value placed on safety by management and workers alike and the extent to which employees take personal responsibility for safety in an organization. A good safety culture may reflect and be promoted by factors like top management commitment to safety, realistic and flexible customs and practices, continuous organizational learning and analysis etc. The safety climate is referred to as an organization's 'mood', and factor analysis is the most widely used technique for its analysis to date. Current safety literature finds the concept of safety climate to be the accumulation of beliefs, values, and perceptions about safety that are shared within a particular group at any given time as manifested by recent or current events. A real case study has been added about the safety climate survey at a Saudi Arabian water and power plant. The case study results like "There are good communications" (14.5% strongly agree and 68.6% agree), "Management always acts quickly over health and safety concerns" (15% strongly agree and 63.6% agree), "The plant/site encourages suggestions on how to improve health and safety" (18.2% strongly agree and 57.3% agree) revealed the satisfactory situation of health and safety at the said plant. On the basis of case study findings, an effective and appropriate intervention program aiming at mitigating hazards and preventing injuries and accidents will be developed to further improve occupational safety and health situation at the workplace.

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