Safety Cultural Assessment among Management, Supervisory and Worker Groups in a Tar Refinery Plant

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Abstract

Background: This study investigated the relationship between people's attitudes towards the safety culture and comparing its perceptions among three levels of refinery Personnel: top management, supervisory staff and frontline workers by conducting safety culture survey.

Methods: A questionnaire comprising general information and 59-safety attitude statement were distributed among 237 workers, 53 supervisors and 12 managers in Isfahan Tar Refinery in Iran.

Results: The 10 testable factors, including organizational and management commitment to safety and communication, Rule breaking, Training and competence, Pressure for production and safety, Communication, Personal involvement in health and safety, Accident/Incidents/Near misses, Organizational/management commitment to health and safety, Supervisors/Immediate bosses/Line managers, Health and safety procedures/Instructions/rules, Workforce view on state of safety culture, have high inter-correlations and the three groups of respondents hold quite different attitudes regarding safety culture.

Conclusion: These findings can give invaluable indication to the managers to have better understanding of safety culture in this industry.

Keywords: *Safety culture, Management, Attitudes, Iran*

Introduction

Each day, an average of 6,000 people die as a result of work-related accidents or diseases, totaling more than 2.2 million work-related deaths a year. Of these, about 350,000 deaths are from workplace accidents and more than 1.7 million are from work related diseases (1). Many of the safety conscious companies seem to have reached a point where they have applied most of the standard engineering approaches to improving safety in the workplace, and thus industrial risk managers and safety program officers have begun turning their attention to explore human, organizational, and other non-physical safety factors in the workplace with hopes to achieve further occupational injury reduction. Many high reliability industries around the world are showing an interest in the concept of ' safety culture,

as a way of reducing the potential for large scale disasters. This has been the case, about major industrial incidents in 1970s and 80s. The Chernobyl accident in April 1986 is considered as a turning point in research about safety culture. It provided evidence of technological vulnerability and emphasised the need to better understand organizational safety (2). Hinze advocated the idea that safety is no luxury but a necessity (3). In the recent years, many companies have got to recognize that establishment of a good safety culture can help controlling and reducing the costs and increase the efficiency of their ongoing operations in long term.

Organizational culture

Organisational culture has been defined as a complex framework of national, organisational

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and professional attitudes and values within groups and individuals function (4). According to Schein (5), organizational culture is understood to be deeply rooted assumptions about human nature, human activities and social relationships shared by members of an organization and their expression in values, behavioural patterns, and artefacts found within the organization. Part of that culture in hazardous industries relates to safety, which was defined by Reason as the "ability of individuals or organisations to deal with risks and hazards so as to avoid damage or losses and yet still achieve their goals" (6). The beliefs and values that refer specially to health and safety form the subset of organisational culture referred to as safety culture. This shows how a dominant organisational culture might influence safety (7). According to Reason (6), Uttal's (7) definition of organizational culture most closely captures its essence: "shared values (what is important) and beliefs (how things work) that interact with a company's people, organizational structures and control systems to produce behavioural norms (the way we do things around here)". Cooper (8) defines corporate culture as to reflect shared behaviours, beliefs attitudes and values regarding organizational goals, functions and procedures'. In short, organizational culture is the interaction between organizations and individuals, where employees' behaviour can change through mutual interaction. Richter and Koch (9) demonstrate that organizational culture is the shared understanding within a given organization.

Pidgeon and O'Leary (15) remind 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 that understanding the interaction between technology and organizational failings is a key.

Safety culture

The concept of safety culture is often presented separately from an organization's other characteristics, such as the work schedule, techno-logy, business strategy and financial decision-making. Reiman and Oedewald reveal that this conceptual separation of safety culture reduces the term to refer only to factors that are clearly connected with safety, such as safety attitudes and safety values. Although it has been widely used for many years (since the 1980s), the concept of safety culture is not precisely clear and it still remains largely "ill defined" (11), (12). But at the same time, there is no uncertainty over the relevance or significance of the concept (13).

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 was further expanded on in Basic Safety Principles for Nuclear Power Plants, Safety Series No. 75-INSAG-3, issued in 1988 (14). The report (INSAG-4) concludes that safety culture is now a commonly-used term and that it is important to give practical value to the concept. This concept of safety culture was introduced as a means of explaining how the lack of knowledge and understanding of risk and safety by the employees and organization contributed to the outcome of the disaster.

Since its introduction, a number of definitions of safety culture have been introduced. Two of the most prominent and most-commonly used definitions are The U.K. Health and Safety Commission, which describes safety culture as: "The product of individual and group values, attitudes, perceptions, competencies, and patterns of behaviour that determine the commitment to, and the style and proficiency of, an organization's health and safety management" (16).

And Advisory Committee on the Safety of Nuclear Installations (ACSNI) (yr), that describes safety culture as: "The safety culture of an organization is the product of individual and group values, attitudes, perceptions, competencies and patterns of behaviour that determine the commitment to, and the style and proficiency of, an organization's health and safety management".

Positive safety culture

Developing and maintaining a positive safety culture can be an effective tool for improving safety within any organization (17). Reason (18) considers an ideal safety culture to be "the 'engine' that drives the system towards the goal of sustaining the maximum resistance towards its operational hazards" (p. 294) Reason maintains this goal should be achieved irrespective of the organizations leader or current commercial concerns. What drives the system is a constant level of respect for anything that may bypass organizational safety systems. In other words, it is important to remember what can go wrong. It is very dangerous to think that an organization is safe because no information is saying otherwise. The challenge is how to develop a culture that is favourable to good safety performance. Hale (19) has listed a number of elements for a good safety culture, these include importance to safety; involvement of workers at all levels; role of safety staff; the caring trust (that all parties to have a watchful eye and helping hand to cope with inevitable slips and blunders); openness in communication; belief in safety improvements; and integration of safety into the organization.

Material and Methods

Summarizing the experience from the previous research works, a questionnaire survey was developed and conducted during the period of January 2007 to March 2007 for refinery personnel in Isfahan Iran. The targeted respondents are classified into three groups: top management, supervisory staff and workers. The questionnaires are divided into two parts; Part 1: general information and Part 2:59 attitude statements on a 1–5 Likert scale, ranging from strongly disagree to strongly agree. The first part of questionnaire is designed to identify safety-related characteristics, including education level, any involvement in site safety promotion activities and job position. The 59 attitude statements in second part of questionnaire were designed on the basis of the hypotheses set in this study and the questionnaires developed by the

Health & Safety Executive in United Kingdom HSE, [HSCST]

Loughborough Safety Climate Assessment Toolkit [LSCAT]

Computerised Safety Climate Questionnaire [CSCQ]

Offshore Safety Climate Questionnaire [OSQ99]

A total of 10 testable factors that summarized as groups of statements have been identified in Part 2 of the survey. These factors are described as follows:

Factor 1 (F1): Training and competence,

Factor 2 (F2): Pressure for production and Safety,

Factor 3 (F3): Communication,

Factor 4 (F4): Personal involvement in health and safety,

Factor 5 (F5): Accident/Incidents/Near misses,

Factor 6 (F6): Organizational/management commitment to health and safety

Factor 7 (F7): Supervisors/Immediate bosses/ Line managers,

Factor 8 (F8): Health and safety procedures/ Instructions/rules,

Factor 9 (F9): Workforce view on state of safety culture,

Factor 10 (10): Rule breaking

The ten factors/dimensions included in the questionnaire were already well-established ones derived form the literature. The parametric tests, independent sample *t*-test and analysis of variance (ANOVA), were employed to determine if any difference occurred in the sample would also reflect the same results in a real population or only occurred by chance. Inter-correlation between 10 testable factors was also conducted using Pearson correlation test. All data from safety culture were analyzed with Statistical Package for Social Sciences Version 11.0 (SPSS 11.0).

Results

A total of 301 refinery personnel responded in this survey, in which there were 11 managers, 53 supervisors and 273orkers within the three groups. There was no need to statistically determine a sample as all the staffs included in the study.

As confirmatory factor analysis (CFA) postulates a model (particular set of linkages between the observed variables and their underlying factors) and then test this model statistically examining the degree to which it fits with the available data, these data were subject to a confirmatory factor analysis.

Incremental fit indices measure the proportionate improvement in fit by comparing a target model with a restricted baseline model, usually a null model in which all the observed variables are independent.

The comparative fit index (CFI) was used as it is one of the best fit indices. A value of around 0.9 is accepted as indicating good model fit.

Table 1: shows each item with its standardized factor loadings, all of which were statistically significant at the 0.5 level

Item	Loading
Training and competence,	0.822
Pressure for production and Safety,	0.800
Communication,	0.807
Personal involvement in health and safety,	0.799
Accident/Incidents/Near misses,	0.724
Organizational/management commitment to health and safety	0.862
Supervisors/Immediate bosses/Line managers,	0.798
Health and safety procedures/Instructions/rules,	0.778
Workforce view on state of safety culture,	0.877
	0.795

Reliabilities of the safety culture survey

Before conducting the survey, a pilot study was carried out to check out the first draft of the questionnaire. 20 members of previously mentioned organization were randomly chosen to fill out the questionnaires. They were then interviewed and their feedbacks were collected. This made omission of some vague an ambiguous statements and converting a few other ones. Having designed the final version of the questionnaire, the internal-consistency reliability of the safety culture survey was tested with a coefficient alpha of 0.83. (α= 0.83)

Mean scores for the three groups of respondents with respect to 10 testable factors
Referring to Table 2, the range of mean scores of 8 testable factors got from all targeted respondents was from 2.06 to 3.95 (average scores= 2.47). For ease of comparison, the mean scores were resulted from the sum of scores by the numbers of statements for each testable factor. The overall results indicated that the management group got higher mean scores for each of the factors than the worker group, followed by the supervisory staff.

Table 2: Mean scores and Safety culture divergences for the three groups

Factors	Mean scores for management group (N=11)	Mean scores for supervisory staff group (N =53)	Mean scores for worker group (N =273)	Mean scores for all Respondents (N =301)
F1	3.87	2.25	2.34	2.38
F2	3.29	2.06	2.06	2.10
F3	3.6	2.22	2.52	2.51
F4	3.95	2.26	2.24	2.30
F5	3.80	2.03	2.34	2.34
F6	3.85	2.09	2.28	2.30
F7	3.43	2.35	2.85	2.79
F8	3.56	2.28	2.72	2.67
F9	3.11	2.24	2.82	2.72
F10	3.72	2.19	2.64	2.60
Average scores	3.61	2.19	2.48	2.47

Safety culture divergences among the three groups, thus, would be occurred. The degree of significance for their differences on each of the testable factors and the implications will be discussed in the section of ''safety culture divergences among three groups of respondents''.

Inter-correlation between 10 testable factors

All testable factors are positively correlated to and statistically significant with another one. Organizational/management commitment to health and safety has the most considerable correlations with other factors. This reinforced the idea that high organizational/management commitment to health and safety would be strongly associated with cultivating a positive and dynamic safety culture. Thus Since the extent of people's commitment to an organization has important implications on functioning of many aspects of organization life, each of which exerts effects on safety related issue to certain extent.

Safety culture divergences among three groups of respondents

In order to investigate safety cultural divergences between three groups of respondents, including managers, supervisory staffs and workers, ANOVA was used to carry out the analysis. The Tukey test was then used to examine which specific pairs of means are sig-

nificantly different with respect to 10 testable factors at 5% significant level.

The difference in the average scores of 10 testable factors for three groups of respondents has been shown in Table 2 before. To further investigate the safety culture divergence among the respondents, the corresponding F values and significant differences regarding each factor for three groups of respondents are tested. The results indicate that there is significant difference in all testable factors. This is in line with the hypothesis that there are differences in safety attitudes among the three workforce levels: top management, supervisory staff and workers.

The safety culture divergences for the three groups of respondents were further explored by Tukey test with respect to 10 testable factors. The results indicate that the management group and the worker group have significant difference in all testable factors. The significant difference is also found between supervisory staff group and worker group for all testable factors except F1, F2, and F4. There is also significant difference between management group and supervisory staff group in all testable factors. It demonstrates that safety culture divergences are mainly occurred between management and supervisory staff, and management and worker group respectively.

Discussion

The results from the Safety Culture Survey indicate that good organizational/management commitment to health and safety has the most considerable correlations with other safety culture factors. This is in line with the results from previous studies in this field. Dedobbeleer and Beland (20) in a review of safety climate surveys found evidence for two main factors, one of which they identified as management commitment. Thompson et al. (21) suggests that senior managers support safety through indirect means such as establishing safety policies and procedures, setting production goals etc. While supervisors act as the link between management and shop floor, they monitor worker compliance to safety and provide feedback to workers concerning their behavior.

The major drawback in relying on employees' perceptions of management commitment is that they may be subject to negative stereotyping by other staff, perhaps because of existing mistrust within the work place such as trade union and management disputes. Therefore, how management's attitudes are transmitted to employees needs to be considered to ensure that management commitment to safety is perceived by them accurately.

Fung (22) mentions a divergence among management, supervisory and worker groups respectively. The mean scores of this study have been reported as 3.25 for workers 3.44 for supervisors and 3.79 for managers. The same situation was also attributed to Cheyne and Cox (23) safety culture survey and Clark (10) in an automobile manufacturing plant and A SA EK (24) in Swedish air traffic control. However, in this study supervisors carried a more negative view on safety culture, which might be related to the fact that they normally assume overall responsibility for their subordinate. There also exists quite a competitive atmosphere between managers and supervisors, not letting them to get along with each other

Based on the findings, it is believed that if the more communication between the management team and supervisory and their subordinates (worker), the more organizational committed for their employees becomes. Gradually, a good safety culture can be built up within the organization and the employees, in turn, are willing to follow the guidance as stated in the safety policies (i.e., accident reporting system) set up by their organizations Glendon and McKenna (25) suggest that organizations with a positive safety culture are characterized by effective communication. The Cullen inquiry into Ladbroke Grove (26) also emphasized communications as a key task for management. The inquiry found that within the railway industry the quality and standard of safety meetings varied considerably. The inquiry stressed the importance of safety meetings and how they assist the two-way communication process between management and the workforce. The inquiry also recognized that effective communications make employees feel valued as well as fostering trust and respect between management and employees. Apart from these, peer group's pressure also influences their workmates behavior to one another. When more and more employees behave safely on their jobs, they will lead as good examples. It helps to raise the safety awareness for the rest of the employees. Furthermore, once the safety concept is established in the employees' minds, with an effective administration and management system of the organization, staff will have much more confident to tackle any obstacles and difficulties relating to safety issue.

Acknowledgments

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