Effect of Awareness about Health, Safety and Environment Management System on Safety Climate and Risk Perception in Oil Refinery Employees

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ABSTRACT

Aims Health, safety and environment is an integrated and convergence system and also a synergistic arrangement of human resources, facilities and equipment. This study aimed to determine the relationship of safety climate and perception of risk with the awareness level of HSE management system among oil refineries employees.

Instrument & Methods This cross-sectional study was performed at 2016 in all Kermanshah Oil Refinery employees. "Demographic characteristic", "safety climate", "perception of risk" and "awareness of the HSE management system" questionnaires were used for data collection. Data was analyzed in SPSS 22 statistical software using Pearson correlation and ANOVA tests.

Findings The average of total awareness of HSE was 20.85±4.82. The average of safety climate was 157.04±22.42. The average of perception of risk was 3.45±0.84. There was a significant relationship between awareness of HSE management system and safety climate (r=0.219; p=0.001), but there was no significant relationship between awareness of HSE management system and perception of risk (r=0.137; p=0.128). The relationship between perception of risk and safety climate was significant (r=0.651; p=0.001).

Conclusion Oil refinery's employees have the moderate awareness of HSE management system, high perception of risk and positive safety climate. By increasing the perception of risk and safety climate, the safety performance of the refinery staffs increase.

Keywords Health; Environment and Public Health; Safety; Risk Reduction Behavior

CITATION LINKS

[1] Linking construction fatalities to ... **[2]** Factor's analysis-based studies on construction ... **[3]** A preliminary validation of a new measure of ... **[4]** Strategic performance evaluation of ... **[5]** Workplace injuries and illnesses in ... **[6]** Injury ... **[7]** European Comparisons: Statistics of ... **[8]** Safety climate as an indicator to ... **[9]** Introduction to Environmental ... **[10]** Achieving a total safety paradigm through authentic caring ... **[11]** The role of HSE Management System to ... **[12]** Multicriteria analysis with fuzzy ... **[13]** Health, safety and environment ... **[14]** Study of the Continuous Improvement Trend for ... **[15]** A tool to assess aspects of an ... **[16]** Thirty years of safety climate research: Reflections and ... **[17]** Constructing Safety: Influence of Safety Climate and ... **[18]** Exploratory analysis of the safety climate and ... **[19]** Cross-cultural comparisons of traffic ... **[20]** A group size effect on personal risk ... **[21]** Safety climate, attitudes and risk perception in ... **[22]** Influence of national culture on ... **[23]** Safety Climate Survey in ... **[24]** The relationship between safety climate and ... **[25]** A study of the lagged ... **[26]** Risk perception and safety in ... **[27]** The complexity, stability and ... **[28]** Nursing ... **[29]** Psychometric ... **[30]** The effect of job safety analysis on ... **[31]** Survey of factors affecting risk perception and ... **[32]** Validity and Reliability of the ... **[33]** Risk perception and safety on ... **[34]** Risk perception and ... **[35]** Risk perception and safety on ... **[36]** Associations between risk perception and ... **[37]** Employee risk perception related to offshore oil platform ... **[38]** Exploratory study on safety climate in chinese manufacuing ... **[39]** The relationship between safety climate and injury rates acroos industries: The need to adjust for ... **[40]** Investigation of the Safety Climate among Workers in Sirjan GolGohar Mining and Industrial ... **[41]** Towards more effective methods for changing perceptions of noise in the ... **[42]** National culture and safe work behaviour of construction workers in ... **[43]** Risk perception following exposure to a job-related electrocution accident: The mediating role of perceived ... **[44]** Safety climate in OHSAS 18001-certified organisations: Antecedents and consequences of ... **[45]** An analysis of safeness of work environment in ... **[46]** A multilevel model of safety climate: cross-level relationships between organization and ... **[47]** Exploratory study on safety climate in ... **[48]** Climate quality and climate ... **[49]** Causal relations between ... **[50]** Safety climate, perceived ...

Introduction

In modern management, human resources are the backbone of sustainable development [1]. In order to achieve the developed global industry level, various ways are considered, but regardless human resources, progressing towards optimal consequences and appropriate system designing doom to fail [2]. Advanced organizations in competitive world should pay special attention to the employees' health, safety and environment (HSE) to improve the level of customer's satisfaction [3]. One of the most important issues, which encourage companies toward establishing and improving HSE, is out breaking of the basic expectations of stakeholders in this field [4]. Accidents imposes approximately 142.2 billion dollars financial loss per year to the United States economy and about 4 million non-fatal injuries and 5734 deaths in 2005 occurred in this country [5, 6]. These injuries also cause 80 million days of work absence [6]. In 2003, 4664 work-related deaths and accidents were recorded in European Union every 5 seconds and one death in every 2 hours [7]. In Iran, 30 billion dollars financial loss is imposed and 1891 deaths occur due to work-related accidents, annually [8].

Today, HSE factors are important issues for customers, employees and shareholders [9]. The main objective of implementing the HSE management systems is ensuring the establishment of these elements in the strategy of the organization [10]. Special attention of oil, gas and petrochemical large corporation in the world to HSE management system is due to its importance in designing and development of products, services and processes [11]. Considering HSE needs to assess the number of accidents, severity of accidents, safety trainings, safety requirements, having safety system, and so on [12]. The ultimate goal of the HSE management system is people, property and environment protection [13]. HSE is an integrated system, which tries to create a healthy, pleasant and joyful environment, free of accidents, damage and waste by convergence, arrangement and synergism of human resources and facilities [14].

Safety climate, which is used to describe a staff's common vision of how to manage safety in workplace [15], refers to the perceived level of safety in a particular time and place, relatively unstable and is subject to current environment components change or current circumstances [16]. Safety climate importance is concerned with its ability to predict the safe behavior [17]. Based on this capability, safety climate has shown its ability in important safety results such as perception of risk, accidents and injuries [18]. Perception of risk is a subjective assessment of the likelihood of experiencing a hazardous event and the severity of the consequences of an accident if takes place [19]. Individual perception of risks is related to the sensory evaluation of the likelihood or magnitude of damage [20].

In a workplace, employees' risk judgments that are related to safety climate and other social and organizational factors that are important for safety must be considered [21]. Ali has shown that Pakistani workers' intentional behaviors have an integrated association with accountability and safety management as well as the perception of workers and safety attitudes and behavior has a significant relationship with management performance in the field of safety [22]. Jafari *et al.* have also shown a strong correlation between awareness and recognition of safety regulations and safety climate scores [23]. Adl *et al.* show that the safety climate can be used as an indicator for occupational health and safety management system performance. The advantage of using safety climate than audit tools is its performance in a shorter time [8]. Many studies have confirmed the relationship between safety climate and safety behavior [24, 25].

This study aimed to determine the relationship of safety climate and perception of risk with the awareness level of HSE management system among oil refineries employees.

Instrument & Methods

This cross-sectional study was performed at 2016 in all Kermanshah Oil Refinery employees (headquarters and staffs). The sample size was determined in 95% confidence interval equal to 255 people, which were selected by simple random sampling.

"Demographic characteristic", "safety climate", "perception of risk" and "awareness of the HSE management system" questionnaires were used for data collection.

The perception of risk questionnaire, that was used in the oil industries in 1996 [26] contains 14 questions on industry's risks. Each question is scored from 1 to 5 and the total amount is calculated as the average of all questions scores. 0 to 1 indicates the very low perception of risk, 1.1 to 2 low, 2.1 to 3 moderate, 3.1 to 4 high and 4.1 to 5 very high. The safety climate questionnaire of Loughborough University [27] contains 43 questions in a 5-degree Likert scale. If statistical scores are equal to or higher than the average (129≤) the climate is positive and if it is lower than the average (129>) the climate is negative for each subject.

The awareness level of the HSE management system questionnaire includes 7 items in a 5-degree Likert scale (very low to very high) and the researcher designed this questionnaire inspired by the health, safety and environment self-assessment system of Safety and Health Administration in Victoria, Australia [28]. If the score obtained 29 to 35 the awareness level is very high, between 22 and 28 is high, 15 to 21 is medium, 14 to 8 is low and 1 to 7 is very low. The content validity of the questionnaire was approved by 10 experts. The calculated correlation coefficient for a number of factors in the test and retest obtained 0.98 [28]. The Cronbach's alpha coefficient was also calculated as 0.9 [29].

Data was analyzed in SPSS 22 statistical software using Pearson correlation and ANOVA tests.

Findings

The average age of the employees and their job experience in the oil refinery industry was 36.9±7.5 and 9.6±2.1 years, respectively. 68.8% of samples were married and 56.1% had a bachelor degree. The average hours of HSE training at the beginning time of hiring was 49.1±15.3 hours. Most of the surveyed persons (17.6%) were firefighters and the highest type of employment was official (43.1%). In the year to the time of study, 19 accidents had happened to workers.

The average of total awareness of HSE was 20.85±4.82. One staff (0.4%) was in very low class, 19 staffs (7.5%) were in the low class, 121 staffs (47.5%) were in the middle class, 99 staffs (38.8%) were in the high class and 15 staffs (5.9%) were in the very high class (Figure 1).

Figure 1) The average scores of participant according to 7 surveyed items of HSE Management System awareness

Items	Scores
Leadership and commitment	3.31±0.84
Policy and strategic objectives	3.48±0.93
Organization, resources and documentation	2.90±0.87
Risk assessment and management	2.79±0.86
Designing	2.82±0.88
Implementation and monitoring	2.76±0.88
Audit and review	2.79±0.95

The average of safety climate was 157.04±22.42. 229 cases (89.9%) were at positive safety class and 26 cases (10.2%) were at negative safety climate class. The average of perception of risk was 3.45±0.84. No staff was in the very low class, 6 staffs (2.4%) were in the low class, 85 staffs (33.3%) were in the middle class, 95 staffs (37.3%) were in the high class and 69 staffs (27.1%) were in the very high class (Figure 2). There was a significant relationship between awareness of HSE management system and safety climate (r=0.219; p=0.001), but there was no significant relationship between awareness of HSE management system and perception of risk (r=0.137; p=0.128). The relationship between perception of risk and safety climate was significant (r=0.651; p=0.001).

Figure 2) The average scores of participant according to 14 surveyed items of perception of risk

Items	Scores
Falling from height	2.96±1.18
Lack of using personal protective equipment	3.23±1.26
Skin contact with chemicals	3.42±1.01
Inhalation of chemical vapors	3.48±1.06
Electrocution	3.47±1.11
Firing	3.52±1.07
Explosion	3.51±1.08
Trapping organs between devices	3.43±1.11
Contacting with the hot surface	3.51±1.04
Falling pieces on foot	3.43±1.08
Damage to the eye	3.50±1.02
Tripping on the floor of the working site	3.34±1.08
Exceeded volume	3.38±1.10
Back pain and repetitive movements	4.16±0.83

Discussion

According to the findings in terms of awareness level of the HSE management system, the most awareness belonged to the 2nd scope (policy and strategic objectives) and the lowest level of awareness belonged to 6th scope (implementation and monitoring). One of the reasons that increase the awareness toward policy and strategic objectives is that,

the panel of the HSE policy installed in all refinery units and in view of all employees, and notify to staff directly and indirectly about organization health, safety and environment policy. However, the staff had relatively low awareness with other HSE management system areas, because the refinery HSE unit does not involve staff in other areas. If the HSE unit involves staff in the implementation of HSE process, also supervisors stress on the policy, annually or monthly lecture of CEOs and other executives will further increase staff awareness about different areas of the HSE management.

The highest perception of risk score relates to the 14th scope (back pain and repetitive motion) and the lowest score relates to 1st score (falling from height). One of the reasons that increase the perception of risk in terms of lower back pain and repetitive movement areas is that many employees have ambulatory jobs, so it can cause the employees suffer from musculoskeletal disorders and back pain. Jafari et al. have shown that implementing job safety analysis increases the perception of risk among subjects and such perception of risk is evident in the answers given to the questions in the perception of risk questionnaire [30]. Jahangiri et al. have shown that 3.7% of people in the refinery had a moderate perception of risk and 96.3% had a high perception of risk associated with their workplace respiratory hazards [31]. Yousefi et al. have shown the average perception of risk score in construction workers 6.77±1.57 [32]. In Rundmo, the Norway Beach workers feel less safety than contact with falling objects and slipping [33] and Arezes & Miguel believe that perceptions of risk are a predictive factor in workers' safety behavior [34].

Rundmo [35] has reported less safety toward explosion, fire and leakage of toxic gases than the Flin et al. [26]. Rundmo knows the reason of less sense of security to events such as explosion, firing and leakage of toxic gases the workers' focus in terms of the consequences of an accident than the likelihood of its occurrence [36, 37]. So our study was confirmed based on differences in perception of risk on demographic and job variables, education level, work experience, hours of safety training and HSE at the time of employment and the number of observed events.

Assessing the safety climate in a Nemours of studies have been evaluated; Ma & Yuan have studied China industry and have reported the total average of safety climate 3.6 [38]. In another study by Smith et al. in the United States' industry, 3.75 was obtained for safety climate and suggests that the safety climate in this industry is too weak [39]. A study by Zare et al. have also shown that the total safety climate score is 6.35 on a scale of 1-10, which is a relatively favorable safety climate score [40], which was consistent with the results of this study. So the safety climate of Oil Refinery staff was on a positive level.

The infringement factor had the least relationship with other factors and had the significant relationship with safety training. This may reflect the fact that safety training and safety procedures and safety rules can reduce the infringement. Those with high awareness of the HSE management system had the highest perception of risk, which is seems quite logical. Williams & Purdy have shown that even when workers had greater awareness and understanding about workplace hazards, it does not mean that they apply more protective measures [41]. Arezes & Miguel have found that perceptions of risk are a predictive factor in the safety of the workers' behavior [34]. Mohamed et al. also state that attitudes affect the safety attitude of construction workers and effect their perception of risk [42]. Rundmo has shown that the risk perception of an individual is associated with physical and organizational working conditions [35]. A study by Greening has shown that the relationship between mental simulation hypothesis and perception is very strong, which reflects the subjectivity of perception of risk is [43], while awareness of the HSE management system is theoretical.

In this study, there was a significant relationship between the level of safety awareness of HSE Management System and safety climate. In justification, it can be said, because the safety climate assessment is a theoretical estimation of surrounding risk, could have a significant relationship with the awareness of HSE Management System. Those with high awareness of HSE management system had the highest safety climate, which seems quite logical. Ali has shown that workers' intentional behaviors have a severe association with accountability and safety

management [22]. Fernández-Mu˜niz *et al.* have shown that management commitment, especially communication, affects the safety behavior and safety performance, employee satisfaction and the enterprise competition [44]. These findings, especially when risk mitigation and improved performance in these organizations be considered are more important, which was consistent with our study. Kwon & Kim have shown that safety knowledge, safety compliance, safety attitude and safe working environment were the main factors affecting the safety climate [45]. The results of these studies underscore the validity of assumptions regarding the level of awareness of HSE management system with safety climate that achieved in our study.

There was a significant relationship between perception of risk and safety climate. Insights and attitude toward safety is influenced by the perception of risk, management, rules and safety procedures. Several studies suggest the use of safety climate score in comparison between various industries [46-48], and reviewing the literature suggests that there is a positive correlation between such insights and safe behavior of employees. The study of Jahangiri *et al.* reports that perception of risk of 77.6% of surveyed persons are high, but only 48.5% of them had the high safety attitude [31]. Tholén *et al.* have shown that personal perceptions of safety climate affect safety behavior, but evidence was found that shows the atmosphere safe behavior affects safety [49]. Rémi Kouabenan *et al.* have also shown that first-line managers who had better safety climate are more involve in safety management. Therefore, safety climate affects safety management intervention [50].

Answering the questions that affect a person's mental state can affect the results of the study, which is outside the control of the researcher. Like other studies, questionnaires, apathy and reluctance by some respondents filled in the questionnaire. Focusing on HSE, e.g. OSHA training courses and NEBOSH, is suggested. Promoting the company employees on safety issues related to their chosen field, not only helps better understanding the risks, but also makes them aware that managers are concerned about their health and safety. It seems that Safety Management System requirements, in principle, should be revised.

In line with the safety audit, documented and implemented program must be developed.

Conclusion

Oil refinery's employees have the moderate awareness of HSE management system, high perception of risk and positive safety climate. By increasing the perception of risk and safety climate, the safety performance of the refinery staffs increase.

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