A Survey of Health, Safety and Environment (HSE) Management and Safety Climate in Construction Sites

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***Abstract*—The principles of health, safety and environment (HSE) in different development activities, including construction, are constantly gaining in significance. This study aims to evaluate the condition of HSE management and safety climate in construction sites. In this descriptive-analytic study, 111 male employees are randomly selected. To determine HSE condition and management and safety climate condition, the NOSACQ questionnaire was used. The collected data are analyzed using SPSS. Based on data analysis a significant relationship between the mean scores of safety climate, job groups and HSE management system with job groups, education and experience ($P<0.05$) was found. The study results show that HSE management and safety climate in sites are relatively acceptable, that the perception of safety had no special association with age, work experience, education and that the creation of a safety climate depends on the people high in the hierarchy.**

Keywords-Health; Safety and Environment (HSE); Safety climate; Construction site.

I. INTRODUCTION

With the development of technology and wide application of different harmful materials, the role of human resources in industrial environment is much emphasized [1]. This however has been a result of heavy human, economic and environmental damage [2]. Besides the obvious benefits, industrialization may also lead to an increase of accidents and this is especially true in developing countries where for preventive safety principles, working hour standards and using suitable individual protection are often neglected in an attempt to further increase productivity [3]. Iran has also followed the development and industrialization route [4, 5] and thus the significance of safety culture has increased. Various definitions of safety culture have been presented (e.g. [3, 6]). As safety is a sub-set of safety culture, we investigate the perceptions of employees about the work place, interest of management to safety and measurements of safety and participation in risk control [7]. One of the present issues regarding human resources is the high rate of financial and life damage. Work accidents are one of the most important health, social and economic factors in industrial and developing communities and are the third mortality cause in the world [8-10]. In recent decades, organizations have attempted to reduce these life and financial damages and these efforts mostly focus on safety culture, a term firstly employed with HSE management in organizations, companies and big industries [10]. However, reaching an satisfying level of safety has not been easy [11, 12].

Many researchers and scientists have defined safety climate and extended its concept. In [7], authors considered safety climate as an individual feature of combination of two factors of management commitment to safety and participation of employees in safety. In [11], safety climate is considered as the temporary image of culture reflecting in common perception of employees of organization at a certain time. Regarding the construction industry, despite its progress and the use of new construction methods, Health, Safety and Environment (HSE) has not progressed considerably [11]. The managers of construction projects often view safety as a cost in contradiction with production and ignore it [13]. The evaluation of the relationship between safety climate factors and risk perception of risky situations among construction workers showed that there was a positive relationship between the attitude of workers in the construction sector and their perception of risk and safety rules [14, 15]. The mental climate has been shown to have a direct and indirect relationship with safety behavior, safety motivation and safety knowledge [16]. Work place stress (working hours, job requirements, job control and ambiguity in job) has been associated directly with accidents and quasi-accidents [17-18]. In a study used to evaluate safety performance of employees in road construction companies, contradictory results were found as there was no relationship between safety climate and measured safety behavior [19]. This study attempts to evaluate the condition of Health, Safety and Environment (HSE) and safety climate and their relationship with age, work experience and marital status in construction sites and present some recommendations to improve each factor and reduce risks.

II. RESEARCH METHODOLOGY

To determine safety, health and safety climate, the selected population in the study is personnel working in active construction sites of Tehran city as managers, engineers,

technicians, workers. The samples are selected randomly among the workers of the construction sites of district 22 of Tehran city. The Nordic Occupational Safety Climate Questionnaire (NOSACQ) was employed. This questionnaire consists of 50 items by which people attitude to safety at work place is determined. These questions cover 7 dimensions (factors) of safety climate as ability and priority of safety management, power of safety management, justice of safety management, commitment of workers to safety, lack of risk acceptance and priority of safety by workers, communication of co-workers with each other and learning safety issues and trust of workers to the effectiveness of safety systems. The respondents to questionnaire stated their agreement to the questions in four-item Likert scale. Value 1 indicates "total disagree" and 4 as "totally agree".

The measure of data collection of safety management, health and environment was designed using HSE questionnaire. This questionnaire consists of 63 items at five-item Likert scale. Value 1 indicates totally disagree and 5 indicates totally agree. Seven parts of this questionnaire include leadership and commitment, strategy, organizing, risk assessment, planning, execution and monitoring and audit. The reliability of HSE management questionnaire is secured by Cronbach's alpha coefficient. Total Cronbach's alpha of questionnaire is 0.96 and shows good reliability of the HSE management system questionnaire. The questionnaire results were processed in SPSS. Descriptive statistics as central measures and dispersion, Tables and statistical charts were used. For data analysis (to determine the relationship between quantitative and qualitative variables) Chi-square test and one-way variance analysis (ANOVA) test are used.

III. RESULTS

In this study, 111 questionnaires were answered. In the present study, 100% of people are men, 44.1% have an education level above Diploma and 72.1% are married. Detailed results are shown in Tables I-IV. ANOVA test and LSD showed significant relationship between the groups {work experience less than 5 years} and {work experience more than 10 years}, with p-value=0.006 and the groups {work experience less than 5 years} and {work experience 5-10 years} with p-value as 0.04. However, between the scores of Safety, Health and Environment and the number of hours worked per month, marital status, having a second job, working shift the incident was not statistically significant ($p>0.05$). Based on data study of the mean and standard deviation of Table II, safety climate among construction workers was achieved in Tables III-IV. The one-way analysis of variance (ANOVA) and LSD test showed that there was significant correlation between the safety condition scores, with groups of employees ($p=0.02$) and the second jobs of employees ($p=0.04$),. However, the mean total score of safety condition, education, age, work experience, hours worked per month, marital status, having a second job, an accident and work time staff was not statistically significant ($p>0.05$). Pearson correlation coefficient between the average scores of HSE with safety condition in employees of construction sites of Tehran city was 0.335, ($p=0.001$).

TABLE I. FREQUENCY OF QUANTITATIVE AND QUALITATIVE VARIABLES IN WORKERS OF CONSTRUCTION SITES OF TEHRAN

Variable	Mean	Standard Deviation	Minimum	Maximum
Age (year)	34.17	8.75	19	65
Work experience (year)	7.64	6.42	1	30
Work hour per month	214.65	51.56	80	400
Mean safety climate	3.29	0.24	2.62	3.96
HSE mean	3.64	0.51	2.52	5
Total scores of safety climate	164.25	12.38	131	198
HSE sum of squares	228.09	33.25	125	315

TABLE II. SAFETY, HEALTH AND ENVIRONMENT SECTORS

Health, Safety and Environment management sectors	Mean	Standard Deviation
Leadership	3.78	0.64
Strategy	3.77	0.64
Organization	3.64	0.58
Risk management	3.8	0.71
Planning	3.37	0.64
Execution and monitoring	3.56	0.61
Audit	3.67	0.55

TABLE III. SAFETY CLIMATE DIMENSIONS OF EMPLOYEES OF CONSTRUCTION SITES OF TEHRAN CITY

Safety climate dimensions	Number of items	Mean	Standard Deviation
Ability and priority of management	9	3.28	0.34
Power of safety management	7	3.30	0.4
Justice of safety management	6	3.26	0.35
Commitment of workers to safety issues	6	3.14	0.37
Lack of acceptance of risk and priority to safety by workers	7	3.56	0.5
Communication of co-workers with each other and learning safety issues	8	2.89	0.27
Trust of workers to effectiveness of safety systems	7	3.65	0.44

TABLE IV. SAFETY CLIMATE SCORE IN JOB GROUPS OF EMPLOYEES

Dimensions of safety climate	Engineering	Administrative	Servant, operator, technician
Ability and priority of management	3.22	3.27	3.32
Power of safety management	3.15	3.35	3.38
Justice of safety management	3.17	3.17	3.33
Commitment of workers to safety issues	3.10	3.01	3.2
Lack of acceptance of risk and priority of safety by workers	3.51	3.44	3.63
Relationship of co-workers with each other and learning safety issues	2.84	2.93	2.91
Trust of workers to effectiveness of safety systems	3.57	3.73	3.67

IV. DISCUSSION

In the present study, total people are men. The age mean of participants is 34.17 and people have relatively low work experience. 44.1% of people have an education level above Diploma and 72.1% are married. The dimension of workers trust to effectiveness of safety systems had the highest score. Thus, to improve safety system of site, improvement of safety systems and periodical evaluation are necessary. The results showed that the perception of personnel of safety of environment had no special association with age, work experience, education. The score of safety climate among age, work experience and education showed no significant difference. The study in [20] showed that education and work experience had no significant relationship with any of the dimensions of safety climate. The study showed that of safety climate dimensions, safety management power had significant relationship with job group and education and it showed that engineers with higher education based on different managerial positions and safety management had high power in creating safety climate. Another dimension of safety climate is non-acceptance of risk and prioritization of safety as associated with age and work experience and based on the young participants and no high experience, safety issue is not considered well and prioritization of safety issues is considered not vital.

The mean score of safety climate among job groups had significant difference. In [22], it was stated that planners of safety climate should consider that in some cases, improvement of safety climate in a special group needs intervention in another group. Thus, in interventions on groups with low score of safety climate, considering important factors of such phenomenon should be considered. The results showed that the mean score of HSE management was 3.65 and it is ranging from "No Idea" to "agree". The element of risk assessment of HSE management system had the highest mean 3.8 which means that assessment of HSE is performed regarding activity, services and development of useful measurements to reduce risk and events at work place. Then leadership and strategy and audit with 3.78±0.7, 3.77±0.64, and 3.67±0.55 had the highest mean of HSE management system elements. Among HSE management systems and age, marital status, there was no significant relationship found. HSE management system had significant relationship between job groups, education and work experienced.

V. CONCLUSION

This study focus on the aspects of Health, Safety and Environment (HSE) management and safety climate in construction sites. 111 male workers from construction companies active in Tehran, Iran were randomly selected to answer the NOSACQ questionnaire. The collected data are analyzed using SPSS. Results are shown in detailed and further discussed. The study results show that HSE management and safety climate in sites are relatively acceptable. Further, the results showed that the safety perception of personnel had no special association with age, work experience, education. However, it was shown that the creation of a safety climate heavily depends on the people high in the hierarchy (engineers with higher education based on different managerial positions).

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