

Effects of Administrative Interventions on Improvement of Safety and Health in Workplace: A Case Study in an Oil Company in Iran (2011-2015)

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Abstract: Interventions like training courses can lead to the promotion of HSE performance and subsequently reduce work-related accidents, injuries and deaths from adverse effects of development of oil industry. This study aimed to investigate the effect of administrative interventions on safety and health among workers of PERLIT Company in phase 19 of South Pars, Iran. This descriptive-analytical study was conducted in the PERLIT Company during 2011-15. The study population consisted of all employees of the company from January 2011-2015 (1800 staff). Various HSE performance indicators like Lost Time Injury (LTI), Lost Time Injury Frequency (LTIF) and Frequency-Severity Index (FSI) were studied. Interventions like registration of anomalies and short specialized training courses had been done for these 4 years. Collected data were analyzed using Pearson correlation test through SPSS V16. In this company, 3171 TBM was conducted in 4 years and 77135 anomalies and 10 LTI were reported, respectively. LTIF was reduced from 1.5-0.3. As well as FSI, ASR and AFR showed lower amounts at the end of 4th year. The results of Pearson correlation test showed a significant correlation between anomalies and LTI, specialized training courses for HSE staff and LTI as well as Tool Box Meeting (TBM) and LTI. The results of this study showed that increasing the number of HSE training courses for staff, organizing specialized training courses for HSE personnel and increasing the numbers of hazard identification centers can be a valuable step to improve HSE performance and safety culture in oil and gas industries.

Key words: Safety, injury, intervention, anomaly, culture

INTRODUCTION

Besides the positive and valuable effects of industry and technology development, it can cause adverse health effects and some complications such as accidents, deaths and injuries associated with work-related accidents (Ghamari *et al.*, 2013). Humans have an important role in the production cycle (Barkhordari *et al.*, 2011). Deaths and injuries from work-related accidents can cause disinvestment hardware, loss of human life and years of

work and finally increase in associated costs. Therefore, control of work-related accidents rate in the production chain have always been one of mankind's continuous efforts (Ghamari *et al.*, 2013).

Nowadays, occupational accidents are one of the main public health problems and in Iran accidents are the second reason of cause of death after cardiovascular diseases (Ardalan *et al.*, 2009). Safety climate is a main important for industrial for aspect by Khandan *et al.* (2012, 2013).

According to data from the American association of safety there are about 2200 deaths and 220,000 disabling injuries as a result of occupational accidents, annually, which can cause considerable costs (Poursoleiman *et al.*, 2015a).

In developing countries, due to excessive pressure on workers to increasing the amounts of production and regardless of preventive safety, standards for working hours, workers training and use of proper personal protective equipment workers are exposed to high risks (Ghamari *et al.*, 2013). However, morbidity and mortality associated with work is not only adversely affects the workers and their families but also increase social costs due to loss of human force and use of medical services (Sepehr *et al.*, 2014). Several studies have investigated accidents in Iranian industries. The study entitled Epidemiology of occupational accidents in Semnan between 2002 and 2006 was conducted and reported 3.8 accidents per 100,000 workers (Poursoleiman *et al.*, 2015b). Middle Eastern countries are major oil and gas producing countries in the world and amongst these countries; Iran also has a large number of oil and gas projects. Oil and gas industry is one of the industries that involve a wide range of high risk activities that have many risks and safety problems in the whole world.

The results of various studies indicated that the initial priority to create a positive safety culture is education (Wang *et al.*, 2012). As well as the results by Poursoleiman *et al.* (2015a) showed that the implementation of HSE system was significantly correlated with frequency-severity index, accident severity rate, lost days, minor accidents and total incidents. The implementation of health, safety and the environment management system caused a reduction in accidents and its consequences and most of the safety performance indices in the all processes of petrochemical company (Hudson, 2007).

With regard to the development and construction of large amounts of oil and gas facilities and refineries in Iran and depending on the industry type and its requirements, the use of personnel and staffs in variety of these industries is essential.

As previously mentioned, oil and gas industry involve a wide range of high risk activities and for this reason it can cause the high rate of work-related accidents, then the need to examine the issues of Safety, Health and Environment (HSE) it seems really necessary.

On the grounds that the health, safety and environment management system is a training-based system and implementation of that can cause a reduction in accidents and its consequences, it can be said that managerial interventions such as short training course

can also affect work-related accident rate and another HSE performance indicators like lost time injury, lost time injury frequency and frequency-severity index. Thus, this study aimed to investigate the effect of administrative interventions on safety and health among workers of PERLIT Company in phase 19 of South Pars, Iran

MATERIALS AND METHODS

This descriptive-analytical study has been conducted in an operational company (PERLIT Company) located in South of Iran during 2011-15. The company works as one of the main companies of phase 19 in economic region of South Pars in the field of civil, mechanical, electrical and instrumentation and installation of industrial plants of gas refineries.

The study population consisted of all personnel of the company from January 2011-2015. The average number of the company's personnel during the 4 years was 1,800 individuals. OSHA offers a wide selection of training courses and educational programs to help broaden worker and employer knowledge on the recognition, avoidance and prevention of safety and health hazards in their workplaces. OSHA also offers training and educational materials that help businesses train their workers and comply with the Occupational Safety and Health Act. Administrative interventions are set of interventions that lead to reduce the exposure of workers to occupational risk factors and create a safe workplace. Some of these interventions are including: reducing the duration of exposure to the risk factors, work-rest cycles, training, etc. In this study, administrative interventions refer to training course and Tool Box Meeting (TBM) that is conducted for four continuous years. The managers are responsible for planning, funding supervising and evaluating the interventions. The company has 60 employees in the Health and Safety Environment (HSE) department. Training courses were given to HSE's personnel weekly and workers participated in the HSE short training courses daily. These courses were organized by HSE's personnel and topics such as working in a safe way, the use of personal protective equipment, proper use of tools and etc. Interventions in this study are training courses that are conducted by HSE's personnel daily.

In this company, the Anomaly Report System is implemented and all anomalies in these 4 years are recorded. HSE's staff assessed front lines of works continuously. If there were anomalies (acts and unsafe conditions), they initially tried to rectify the situation, otherwise they would fill registration form and report anomalies to the relevant department for reform and appropriate measures.

In this study, records of accidents were collected by OSHA incident report form 301 over 4 years. All other recorded data in the HSE department of PERLIT Company over 4 years was analyzed to doing this study. The HSE staffs have recorded in formation about every work-related death and about every work-related injury or illness that involves loss of consciousness, restricted work activity or job transfer, days away from work or medical treatment beyond first aid. As well as, they also have recorded significant work-related injuries and illnesses that are diagnosed by a physician or licensed healthcare professional. For recording these information OSHA incident report form 301 had been used.

Using data obtained from incident report form and calculations of total work hours per year, safety performance indicators such as events time, Moderate person-Hours of Working (M/HW), Lost Time Injury (LTI), Lost Time Injury Frequency (LTIF), Accident Frequency Rate (AFR), Accident Severity Rate (ASR) and Frequency-Severity Index (FSI) was calculated and reported based on the formulas listed as: Moderate person-Hours of Working (M/HW):

$$M_{HW} = \text{Number of personals} \times \text{Working hours}$$

Lost Time Injury Frequency (LTIF):

$$LTIF = \frac{\text{Lost time injuries number} \times 200,000}{M_{HW}}$$

Accident Frequency Rate (AFR):

$$AFR = \frac{\text{Number of lost time cases} \times 200,000}{\text{Number of employee labor hours worked}}$$

Accident Severity Rate (ASR):

$$ASR = \frac{\text{Total number lost days} \times 200,000}{\text{Number of employee labor hours worked}}$$

Frequency-Severity Index (FSI):

$$FSI = \sqrt{\frac{FR \times SR}{1000}}$$

As well as, some variables such as numbers of Tool Born Meeting (TBM) and recorded anomalies (failure to comply with conditions and unsafe acts) gathered from company documents. Recorded and non-recorded data were including and excluding criteria of this study, respectively.

After gathering all data and check the normality of them, they were analyzed using Pearson correlation test and descriptive statistics tests through SPSS V16.

RESULTS

In this study, recorded data from total numbers of 1800 individuals from all working area such as HSE, scaffolding, storage, transportation, technical services and etc. in PERLIT Company were collected and analyzed. The mean age of all studied individuals was 31 years. Total numbers of 550 individual from all studied staff were single and 1250 of them were married. Due to hard working condition of these industries, there is no job for the woman to do. Thus in this study all of the recorded data were related to the man. Other demographic data from January 2011-2015 is presented in Table 1.

This study has been conducted in four continuous years. In this company total moderate hours working was 12.142.000. In total, 3171 TBM was conducted in 4 years and 77135 anomalies were reported. Results of the company's HSE performance indicators in separation of each year are presented in Table 2.

Table 1: Descriptive statistics of date related to studied workers (January 2011-2015)

Variables	N	Variables	N
Marital status		Job department	
Single	550	HSE	60
Married	1250	Scaffolding	320
Gender		Electricians	50
Female	0	Operation	390
Male	1800	Unloading	80
Education level		Welding/cutting	110
Lower diploma	650	Transportation	90
Diploma	710	Technical services	130
BSc	420	Storage	50
Higher BSc	20	Administrative	270
Work experience (year)		Others	70
<1	340	Shift working	
5-1	630	Day	1650
10-5	480	Night	150
15-10	210	Total number	1800
≥15	140	of staffs	

Age (year); mean = 31

Table 2: Frequency of HSE performance indicators (January 2011-2015)

Variable									
Years	MHW	LTI	LTIF	AFR	ASR	FSI	TBM training	Professional training	Reported anomaly
2011	304.01	0	0.0	23.0	0.0	0.0	23.000	0	200
2012	3.287.550	3	0.9	11.0	20.4	0.5	131.000	21	1.785
2013	4.650.990	7	1.5	12.3	63.0	0.9	452.000	46	25.882
2014	3.899.450	1	0.3	9.2	5.4	0.2	2.719	176	49.468
Total	12.142.000	10	-	-	-	-	3.171	243	77.135

Due to lack of evidence in 2011, the amount of recorded data was less than expected

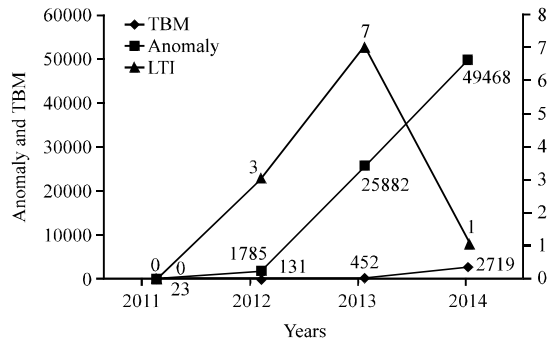


Fig. 1: The relationship between TBM and anomalies with LTI during January 2011-2015

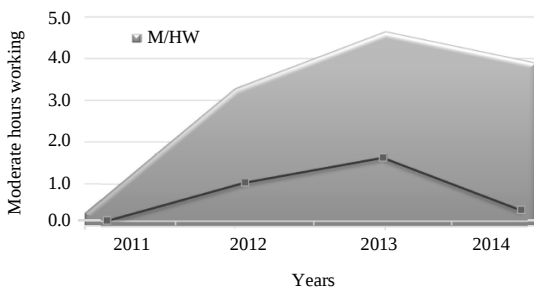


Fig. 2: M/HW and LTIF curve in PERLIT Company (January 2011-2015)

Based on the Fig. 1, an increase in Lost Time Injuries (LTI) by 2013 is obvious in PERLIT Company. Thus, since 2013 company's manager decided to take control on control the rate of accidents by providing Tool Born Meeting (TBM) and increase focus on hazard (anomalies) identification occurred in the company.

Relationship between anomalies and Lost Time Injuries (LTI) was studied by Pearson correlation analysis at a confidence level of 95%. The results showed that anomalies correlates significantly with and Lost Time Injuries (LTI) ($r = 0.452$ and $p < 0.05$). Thus, an increase in the rate of anomalies reported by HSE' personnel at different sites of the company will lead to increase of accidents rate.

Pearson test also showed an indirect significant relationship between TBM and LTI ($r = -0.501$ and $p < 0.05$). It means that LTI will decrease with a raise in TBM.

Also, findings showed that there is a positive significant relationship between professional trainings of HSE's staff and LTI ($r = 0.415$ and $p < 0.05$). Thus, an increase in number of professional trainings courses for HSE's personnel lead to the lower LTI. The relationship between TBM and anomalies with LTI during January 2011-2015 is presented in Fig. 1.

As shown in Fig. 2, LTIF had experienced an increase between 2012-13 (0.9 and 1.5, respectively) but it was reduced sharply to 0.3 in 2014. Since, the beginning of the January 2011 by the end of January 2015 there was no lost time injury in the company during 5,347,660 M/HW it's a wonderful record.

DISCUSSION

Human resources are the most important strategic resource of any organization. Therefore, to assess HSE culture and performance and to make safer and healthier workplace, HSE performance indicators have been investigated in PERLIT Company operating in South of Iran.

The results of this study can help in the prevention of future accidents and diseases and promote HSE culture and performance in the country. Results also showed that there was a significant relationship between TBM and LTI and increase in training led to lost time injuries reduction. The results showed that anomalies was correlated significantly with lost time injuries. As well as, Pearson correlation test showed an indirect significant relationship between TBM and LTI. Insufficient training, individual errors, lack of support and lack of control are most important reasons of anomalies that can lead to injuries and subsequently to LTI. In this company, TBM eliminates the reasons of the anomalies because workers before the start of their duties are familiar with how to do the work properly. Thus, TBM can reduce the numbers of anomalies and subsequently reduce the amount of LTI. Hence, TBM cause the reduction of LTI indirectly.

Wang *et al.* (2012) conducted a study on the effect of HSE management system in the construction of oil and gas projects. One of the main results was that 76.41% of accidents were due to unsafe behavior. Implementation of HSE management system in this industry for 3 years and planning to control this behavior had reduced the Accident Frequency Rate (AFR) and Lost Time Injuries (LTI) subsequently (Wang *et al.*, 2012). As well as Hudson (2007) showed that using HSE management system implementation in the oil and gas industry, safety performance indicators such as Lost Time Injury Frequency (LTIF), AFR and ASR were reduced significantly with the implementation of the safety management system. The results of these studies are similar to results of present study. All of this study showed that training course is of high important positive effects on safety performance indicators because HSE management system that is implemented in the studied industry is a training-based system.

Findings also showed that there is a positive significant relationship between professional trainings of

HSE's staff and LTI. Thus, an increase in number of professional trainings courses for HSE's personnel lead to the lower LTI. Increasing in HSE's staff awareness and scientific capabilities make them a professional instructor that can ready workers for do their task standardly thus, it can cause a reduction in the anomalies. Reduced anomalies can reduce the LTI.

In a study conducted by Eng and McVittie in a construction industry there was a direct association between training and reducing disabling accidents. In the Omidvari *et al.* (2015) study, conducted in the food industries, It has been shown that implementation of safety management systems, planning and activity in the standard manner has caused a significant drop in indices such as ASR, AFR, FSI. Also, the effects of training on the reduction of disabling accidents emphasized by some organizations, companies and other institutions (Bird *et al.*, 1974). In this study, despite the differences in industries, it has been shown that training courses can cause a significant reduction in safety indicators. Work-related accidents in the workplace can increase worker stress and one of the high important outcomes of Tool Born Meeting (TBM) and safety management system is reduction of work-related accidents and subsequently can causes job stress reduction.

In this regard, it is essential need for effective management to accommodate with rapid change and growing as well as to conducting training courses to ensure the safety of staff. Providing the required safety in the workplace is teamwork action and all individual have equal responsibility to provide safety. So, the implementation and periodic review of safety requirements and comply with the standards is of particular importance. Considering the incident severity and incident frequency, technical safety training courses, regular inspection of sub-activities, creating a suitable and safe occupational environment, making employers to employ professional safety personnel and certain constant supervision can decrease the number of accidents (Ansarimoghaddam *et al.*, 2016).

It is suggested that LTI reduction and enhancing safety attitude in the industrial sector can be beneficial for different industries (Bird *et al.*, 1974; Rundmo *et al.*, 1998) showed an increase in production and a minimum number of accidents for a positive attitude toward safety. The results of studies of the safety culture in the UK oil and gas industry showed that implementation of a continuous educational program can increase the awareness and attitudes of staff and the improved attitude causes an increase in the level of safety culture index and improve these indicators in many organizations and thus, reduce

the accidents rate and unsafe behaviors (Stranks, 2007) that these results have been confirmed in this study.

CONCLUSION

The results of this study showed that increasing the number of HSE training courses for staff, organizing specialized training courses for HSE personnel and increasing the numbers of hazard identification centers can be a valuable step to improve HSE performance and safety culture of workplace in the oil and gas industries. Also, it can be concluded that the mentioned training courses can reduce safety performance indicators of events, its outcomes and lost time injuries. These training courses can help employers and workers from various aspects such as reduce the lost days and compensation costs as well as the safety and health of workers, respectively. We believe that to effectively develop workplace interventions that lead to improved health and safety of workers, we need to replicate, customize for different industries and better understand the processes that are at play. Information on how to develop effective strategies to reduce or eliminate safety risks in the workplace is much more scarce, ambiguous and inconclusive. We believe that the findings from this research suggest that an intervention focused on short training courses for training of workers can improve a critical area of employee health and this positive effect suggests that a continued strengthening and targeting of the intervention could expand the impact to further improve employee health and safety. Also, engineering intervention will be done for ergonomics and shift work for improved safety in night work (Karchani *et al.*, 2011).

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