

Case Report

**The Effect of Human Factors on the Occurrence of Events
(Case Study: Factory Construction Project)**

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ABSTRACT

Every day thousands work incident occurs in the world. Defective equipment and poor working environment and workers' mistakes and violations are the main causes of these accidents. By help of the accident investigation we can specify how and why the accident occurred. Using the information collected in the investigation of the incident, more serious incident or occurrence of similar events can be prevented. The main cause of the accident investigation is to prevent the recurrence of similar cases (Malakouti et al. 2012). This study, aiming to specify the impact of human factors including age, education, educational level, fatigue, marital status and work experience in the occurrence of events, was conducted as a case study in the project to build a steel plant. In this study information of 160 individual, which were considered as injured in this time period, were collected as case group. Then they were compared with a group consist of 320 individuals were not injured as control group. Logistic regression was used to evaluate the model. The goodness of fit was reviewed using the chi-square test and Hosmer-Lemeshow test. And then to investigate the significance of the relationship between human factors and events, logistic regression was used. According to the results, in significant level of 0.05, it was determined that education, training and age was significantly associated with incident. The variables marital status and work experience have no significant relationship with the occurrence of accidents. Education and age variables are inversely related with occurrence of accident, which means that with increasing of education and age the incidence of accident reduces. The fatigue factor has been highest rate of incidents during the hours of 10 am to 12 noon that based on observed analysis it is due to fatigue from a busy work environment and the high volume of diverse activities and operations at these times.

Keywords: unsafe practices, human factors, accidents, steel.

INTRODUCTION

Every year, various research institutions around the world are proceeding to plan and implement research activities on the studies of occupational accidents. Among these organizations is the International Labor Organization that in his provided the statistics reports that each year in the world, 120 million occupational accidents occur in the workplace, of which 210 thousand are about important and catastrophic events. Despite the fact that occupational accidents can enter fatal impact to the economy of nations companies and

individuals, but unfortunately still have been ignored. Topic of accidents is human errors and mistakes of the phenomenon of the Industrial Revolution (Mohammadfam et al., 2008). Some events cause widespread human injury and serious social and industrial damage that by reducing the working efficiency will have a significant impact on productivity and production. And more important is the social adverse effects and consequently the resulting psychological effects on the work force. Reduce injuries and

occupational accidents, increase the efficiency of employees and managers, ultimately, economic growth and social prosperity. The first step towards prevention of work-related accidents, investigate the causes of it and evaluate the performance of related organizations and institutions (Amiri et al., 2014). Prevent work-related accidents and illnesses in the workplace in all industrial societies, especially in our developing countries, should be a high priority. So preserving and protecting the human and material resources of the country and ensuring the health of workers, entrepreneurs and employers, both in regard to human capital and to avoid waste of material resources is of paramount importance. Therefore, it seems that there is no legal basis for any shortcomings, but overall work-related accidents in Iran compared with other aligned countries have a partly unacceptable increase. The reasons for the accident investigation are as the following:

-The prevention of similar incidents in the workplace

-The estimation direct and indirect costs of work-related accidents

-Compliance with safety regulations to reduce accidents

- Reason, agent and responsible for the accident and failure percentage (Alizadeh et al., 2014).

Accidents have always been major damage on industry that Reduce their occurrence always been a concern of managers and industrialists. In this regard, experts have done several researchers. Of course, to find and provide effective solutions in order to reduce accidents, need to have some understanding of their reasons they were felt. After reviewing various causes of accidents at work, it was determined that the accident occurred due to unsafe acts of human factors and unsafe conditions in the workplace that share of these reasons respectively accounted for 88 and 10 per cent of causes of these accidents (Kakaei et al., 2012). Then, other researchers have tried to examine each of the etiologies. Especially reasons of unsafe acts committed by human factors, led

researchers to think. A group of researchers conducted studies on human error and its role in the events (Heidari, 2004). In the present study the effect of human factors on the occurrence of the events are examined.

HISTORY

-Khalegi et al. (2003) in an article entitled "provide an analog model to promote and spread the culture of safety" stated that safety culture as a branch of HES culture and the use of technology can have effective position for the most important and most valuable part of an organization's, human. In recent years researches on the great events has shown, despite using all of the engineering factors and extreme protection, the potential for accidents in industry exists in the form of an incomplete behavioral culture. So planning and conducting safety culture projects need to observe the cultural factors and lack of paying attention to culture, we will have wasting resources, low efficiency and reluctance personnel. In his research, utilizing the experiences of developed countries, he provides an analog model to promote and spread the culture of safety. This model explains the duties of senior and junior managers and professionals at various levels, to promote the culture of safety and adherence to the principles of the HSE.

-Heidari, (2004) has done a project in an article entitled "The Role of human error affecting on work-related accidents and impact of education and participation of workers' behavior on the incidence and severity of accidents at Petrokaran Company aimed to reduce the risk of workplace damages. The results showed significant relationship between the accident with age, experience and education at significant level of $P \leq 0.05$ and no significant association between marital status and number of dependents with accident at significance level of $P \leq 0.05$ was observed. While between accident and units of employment, place of accident, night and day, day of the week and months of the year, a significant relationship at the significance level $P = 0.01$ was

observed. Existence of significant association between the occurrence of events and level of education in this study were not unexpected. In this study, education, correction of unsafe conditions, evident monitoring of workers' behavior is in order to express management's commitment to safety.

-Mehrabi Tavana, Pourtaghi, Sadeghi Alavi, Habbi, Valipour, & Qureshi, (2005) in an article entitled "Factors epidemiological study of work-related accidents (IRGC) in Tehran in 2005" showed that age of 47% of all accidents were between 20-18 years, and working hours 10-6 has 25% of with frequency in working hours, and in the months of the year, May was the highest rate of accident by 21%. Not graduated people with 68% and married people with 71% contributed a lot in creating recurring events.

-Hosseini (2010) in an article entitled "Study of organizational factors in reducing work-related accidents in the workplace," revealed that there is Significant at a confidence level of 99% between attraction variables and the rate of incident repeat. And in indicated the confidence level there is a significant relationship between manpower training and repetition factor of incident.

-Shirali et al. (2013), in an article entitled "Human errors detected by the analysis of human errors and the classification system" stated that most human errors, causing the accident on first level is skill-based errors, on the second level physical environment, third level is inadequate supervision, and fourth level is resource management.

- Ching study showed that attitudes to driving safety directly affect risky behavior. Also personality traits can indirectly affect driving safety of drivers through the impact on attitudes to risky behaviors. So often solutions, relies on advertising and safety training people to have changes in attitudes and behaviors. Therefore, considering the high number of accidents is essential to have educational programs about safety issues for drivers.

- Michael Lynn and Paul Salmon and colleagues conducted a study in 2011 that it became clear, of

263 incidents between 2007 and 2008 in Australian mines were analyzed by HFACS, organizational process with 65% was the most common factor associated with instructions (poor knowledge of the guidelines, lack of instructions), hazard identification and risk assessment. In the level 3 of current study, inadequate supervision with 38% the most and regulatory violations with 1.2% had the least impact. So that the investigation showed lack of adequate oversight of safety officials, failure to comply jobs with the employed individual, insufficient education, the use of inexperienced workers to work more than the physical capacity of individuals and not to be forced to use personal protective equipment were including factors affecting insufficient monitoring and task management, such as aspects of risk management, the operation conditions, compliance with workers, including factors related to the planning of the operation.

THE METHOD OF CONDUCTED RESEARCH

This is a practical scientific research which the researcher does not have any role in the outcome, but by providing one main hypothesis and some subsidiary hypothesis, the acceptance or rejection of them are examined. The next step is to determine the causes of the accident. Among the various events, events that are due to human factors will be determined and finally the role of the human factor in accidents is determined. The method is inferential statistics that relations between human factors such as age, experience, fatigue, training, education, and marital status with occurrence of accidents is analyzed using logistic regression. The goodness of fit was reviewed using the chi-square test and hosmer-lemeshow test. At first information on the number of 2760 people from April 2014 to October 2014, employed in the project, were retrospective conducted then information of 160 individual, which were considered as injured in this time period, were collected as case group and they were compared with a group consist of 320

individuals were not injured as control group. After collecting data using a form designed by researchers, analysis was done by Logistic regression chi-square test and hosmer-lemeshow test in spss software version 19.

In this study, all workers employed in the construction of steel plant during the Persian date March 2014 to September 2015 were studied for 18 months. This research as incidence study was retrospective conducted on the number of 2760 people from April 2014 to October 2014, employed in the project. . At first, incidences of occupational accidents were evaluated. For this, the study showed that reports of events include information such as: staff training, age, marital status, education level, work experience and time of accidents. To analyze the data, according to a review accident reports, 6 human factor as factors effective in occurrence of accidents were identified and extracted and classified. . Age of victims in four groups, education and work experience, each, in three groups and marital status were classified into two groups.

The amount of man-hours of training, divided into four groups and time of accident were classified into six groups. Then, data were examined, using

descriptive statistics. And finally the two groups were compared. The target population included all full-time workers in those industries during the period under review in this study. Variables in this study included demographic factors (age, work experience, education, marital status) and environmental factors (time of the incident) and occupational factors (the training) that were analyzed after collection by SPSS software version 19. Analysis was also done by Logistic regression, chi-square and Hosmer-Lemeshow test. In this study, by using library studies, information on indicators related to human factors and events will be collected then the field data for the respective industry indices will be studied. . Then, through the appropriate application relationships between dependent and independent variables are examined.

Since to examine the effect of fatigue on accident, compare the evidence in this regard is not possible, descriptive statistics were used, that relationship between the hours of fatigue-causing events and operating status in employment activities such as swarm of operating personnel, noise pollution, busy work environment, reducing staff and descriptive accuracy were evaluated.

Table 1. Summary descriptive tables Data

characteristics	Scale	Frequency (percent)	Frequency control (percent)
Age	<30	94(58.8)	161
	30-40	42(26.3)	123 (38.4)
	41-50	19(11.9)	30(9.4)
	51.60(50.3)	5(3.1)	6(1.9)
Marital status	Married	100(62.5)	242(75.6)
	Single	60(37.5)	78(24.4)
work experience	0-10	131(81.9)	278(86.9)
	11-20	24(15.0)	36(11.3)
	12-30	5(3.1)	6(1.9)
Man-hours of training	Less than one hour	35(21.9)	24(7.5)
	1 to 3 hours	113(70.6)	149(46.6)
	2 to 4 hours	11(6.9)	97(30.3)
	More than 4 hours	1(0.6)	50(15.6)
Education	without diploma	86(58.3)	95(29.7)
	diploma	62(38.8)	171(53.4)
	graduated	12(7.5)	54(16.4)
Time of accident	Before 8	7 (4.4)	-
	8 -10	41 (25.4)	-
	10-12	51(31.9)	-

12-14	20(12.5)	-
14-16	23(14.4)	-
After 16	18(11.3)	-

In Table 1 the results of analysis by age group, education, work experience and etc. are expressed. Tables' survey shows that most accidents occurred less than thirty years old people (58.8%). Accidents in the younger age groups could be due to less work experience, little experience and lack of adequate skills in the use of the equipment. Also, the greatest events have occurred in the following categories without diploma, married, work experience less than 10 years and also most accidents has happened during the hours of 10 am to 12 noon. After analysis and data extraction, using a logistic regression model, the contribution of each independent variable in the model and the statistical significance was determined. An omnibus test result shows statistical significance of logistic regression model. The test is

Table 3: Hosmer-lemeshow Test

	chi-square	P
Model	6.318	0.388

After reviewing the goodness of fit using logistic regression, a significant independent contribution of each variable is determined. In this test, Wald test is used for the significance of each independent variable. The results of Tables 4 and 5 we see that the variables of education, training are significantly involved in the model. The age in the first two groups (persons under 30 years and those between 31 and 40 years) there is a significant relationship. But there is no significant relationship among all other age groups. Variables marital status and work experience have no meaningful contribution model. To determine the

Table 4: variables in the model

Independent variables	P	Odd ratio
Education	0.000	
Education (group 1)	0.004	0.499
Education (group 2)	0.000	0.190
Age	0.003	
Age (group 1)	0.001	0.426
Age (group 2)	0.973	1.013
Age (group 3)	0.338	1.989
Education	0.000	

investigating the matter which model to explain how much power and efficiency. According to the chi-square statistic model is acceptable at the 5% significance level. Omnibus test results can be seen in Table 2

Table 2: Test Omnibus in model coefficients

	chi-square	P
Model	127.945	0.000

The other model is to determine to what extent the model in anticipation of weak groups. This can be analyzed by Hosmer-Lemeshow. According to Table 3 can see that the result is not meaningful $p = 0.388$. Therefore, in terms of fitting the model is not weak. If the results are significant, meaning that it does not fit the model.

proportion of each independent variable we refer to odds column ratio. If the odds ratio of these variables is greater than 1, indicates a direct relationship and if less than 1 indicates an inverse relationship with the dependent variable. According to this column variables education is inversely proportional to accident. Also comparison of persons under 30 years and those between 31 and 40 years is inversely related, which means the probability of an accident in the following thirty years, higher than the probability of an accident in the group 31 to 40 years.

Education (group 1)	0.016	0.469
Education (group 2)	0.000	0.062
Education (group 3)	0.000	0.013

Table 5: External variables model

Independent variables	P
Marital status	0.398
Work experience	0.080
Work experience (group 1)	0.108
Work experience (group 2)	0.362

CONCLUSION

The date March 2014 to September 2015 a total of 2760 employees of steel Company construction project 160 incidents were recorded and reported. Accordingly, the annual incidence of accidents in this study was 1.4 per 100 workers. Control the number of injured is 320 personnel that were selected from among 2,600 randomly. Analysis was done by Logistic regression chi-square test and Hosmer-Lemeshow test in SPSS software version 19. Also according to the results, logistic regression analysis was revealed significantly level of 0.05. The results showed that education, training significantly involved in the model. The age in the first two groups (persons under 30 years and those between 31 and 40 years) there is a significant relationship. But there is no significant relationship among all other age groups. The variables marital status and work experience are not significant in the model. Education is inversely proportional to accident. Also comparison of persons under 30 years and those between 31 and 40 years is inversely related, which means the probability of an accident in the following thirty years, higher than the probability of an accident in the group 31 to 40 years. . Since to examine the effect of fatigue on accident, compare the evidence in this regard is not possible, descriptive statistics were used, that

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relationship between the hours of fatigue-causing events and operating status in employment activities such as swarm of operating personnel, noise pollution, busy work environment, reducing staff and descriptive accuracy were evaluated. The fatigue factor has been highest rate of incidents during the hours of 10 am to 12 noon that based on observed analysis it is due to fatigue from a busy work environment and the high volume of diverse activities and operations at these times.

SUGGESTIONS

-Creating educational programs and hold regular jobs and training to fit different people project that In this regard shall be provided appropriate educational content and tailored to community education.

- The use of persons under 30 years in activities that ultimately have little or medium risk and special surveillance on their performance.

- Recruiting high school diploma in low-risk activities and special surveillance on their performance and provide training on a broader level with very simple to these people.

- Distribution of activities at different times of the day.

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