

# Analyzing the factors influencing occurrence of occupational accidents in fly-in / fly-out workers of a gas pipeline dispatching project

Arman Jahed<sup>1</sup>, Hanieh Nikoomaram<sup>1,\*</sup>, Farhad Ghaffari<sup>2</sup>

<sup>1</sup> Department of Environmental Management, Faculty of Natural Resources and Environment, Science and Research Branch, Islamic Azad University, Tehran, Iran.

<sup>2</sup> Department of Economics, Faculty of Management and Economics, Science and Research Branch, Islamic Azad University, Tehran, Iran.

## Abstract

**Introduction:** Prevention of occupational accidents is of a great importance. Analysis of accidents and their causes could prevent the accidents recurrence. The study objective was to investigate the causes of occupational accidents in a dispatching project.

**Material and method:** This research was a descriptive-analytic. Data were extracted from the reports of occupational near-misses and accidents recorded between ۲۰۱۳ and ۲۰۱۷ and analyzed using Tripod-Beta model. Then, direct, indirect and root causes of the accidents were identified. Based on the causes identified, a questionnaire was developed to analyze the workers' mental patterns in relation to the real causes, and Friedman test was used to rank the causes.

**Results:** The results showed the falling/dropped objects hit a person, inappropriate working conditions and lack of safety trainings were, respectively, the most important direct, indirect and root causes as per the analysis results. The leakage of flammable and explosive substances, hazardous conditions in the workplace and discrimination in rewards were the most important causes from the employees' views.

**Conclusion:** Identifying and ranking the most important causes of accidents would help to prevent the occurrence of similar events. Also, the analysis of the causes based on the employees' mental patterns could be effective in the prevention of accidents.

## Keywords:

Occupational Accidents - Accident Analysis - Fly-in / Fly-out Workers - Friedman Test

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\*Corresponding Author: Hanieh Nikoomaram,  
Email Address: hani.nikoo@gmail.com

## 1. Introduction

Human resources are considered as the most valuable asset in organizations, and the protection of their health and safety is one of the main concerns of managers [1]. Occupational accidents are regarded as one of the major issues in relation to workers' health and safety [2]. Such accidents normally have significant consequences [3]. Currently, work-related accidents stand as the third leading cause of fatality in the world and the second leading cause of death in Iran (after road accidents) [4]. Occupational accidents often have their warning signs before they occur. Therefore, by identifying and analyzing such indications and taking preventive measures, it would be possible to reduce the accidents occurrence.

Among the models and methods of accident analysis, the Tripod-Beta model has been proved to be a flexible tool which can be applied in different industries. The Tripod-Beta theory of the accident causations is based on the Swiss Cheese model, and unlike other accident analysis models, human factors are, to some extent, considered in this model [5].

The aim of this study was to analyze the factors affecting the occurrence of occupational accidents in order to reduce their occurrence and improve the health and safety of employees.

## 2. Material and Methods

The required data were extracted from the reports of occupational near-misses and accidents occurred in the workshops of a dispatching and telecommunication project of gas pipelines in Iran. The data included 125 reports registered during the period of 2013 to 2017. The work pattern of the workshops personnel were on a basis of fly-in/fly-out.

The accidents were analyzed using Tripod-Beta model and their occurrence causes were identified and classified in terms of immediate or direct causes,

preconditions or indirect causes and underlying or root causes. The Friedman test was used to rank the accident causes.

A questionnaire was then developed based on the identified causes to study and analyze the employees' mental patterns with regards to the accident causes. The Friedman test was used to rank the accident causes as per the workers' points of view. The results of the questionnaires were compared with the current situation, i.e. the reality.

## 3. Results and Discussion

According to the results, the identified causes of accidents occurrence were classified into 13 direct causes, 62 indirect causes and 27 root causes. Indirect causes were also grouped as unsafe actions (17 causes), unsafe conditions (24 causes) and human and occupational factors (21 causes). The designed questionnaire obtained the required reliability (the Cronbach's Alpha values of above 0.7 for all causes) and validity (the validity coefficients for each group of causes) were confirmed in the range of 75-100 as per the content validity quorum table [6]. Table 1 shows that the results of the Friedman tests were significant for direct, indirect and root causes at a confidence level of 99%.

According to the ranking results of the Friedman tests, the five causes with higher ranks are presented in Table 2.

The results indicated that the falling/dropped objects hit a person, inappropriate working conditions and lack of safety trainings were, respectively, the most important direct, indirect and root causes of the accidents as per the results of the accidents analysis. Also, the leakage of flammable and explosive substances, hazardous conditions in workplace and discrimination in rewards were the most important causes of the accidents from the employees' views.

#### 4. Conclusions

Site-based projects have a relatively poor safety conditions, and factors such as the priority given to projects progress, temporary nature of conducting tasks, physical distance of sites from the organization headquarter, etc. could increase the occurrence of accidents in such projects. Also, high risk and stressful working conditions mainly lead to increases in human errors, which themselves could cause occupational accidents. Therefore, employing trained and experienced personnel would play an important role in the safe and correct performance of activities.

It can be said that for the effective implementation of safety in site-based projects, there should be continuous monitoring of ongoing activities. Personnel awareness of the working instructions and procedures is also deemed necessary.

As per the study findings, the followings are recommended to reduce the occurrence of accidents in the dispatching project workshops and other similar workshops:

- Development of a competency (ability, knowledge and skill) management system for permanent staff;
- Development of a guideline for the employment of daily wage personnel in terms of their competency assurance;
- Increasing the awareness and knowledge of personnel and organizing practical training courses.

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**Table 1.** Friedman test results

Results of the accidents analysis from the employees' points of view				Results of the accidents analysis as per the registered reports			
Cause	Direct	Indirect	Root	Cause	Direct	Indirect	Root
n	80	80	80	n	125	125	125
Chi - Square	314.79	272.29	109.08	Chi - Square	180.42	1472.50	917.33
df	13	61	26	df	13	61	26
Sig.	0.000	0.000	0.000	Sig.	0.000	0.000	0.000

**Table 2.** The most important causes of occupational accidents

Results of the accidents analysis from the employees' points of view				Results of the accidents analysis as per the registered reports			
Description	Mean	Rank	Mean	Description			
Leakage of flammable and explosive gas, vapors and chemicals	10.62	1	8.85	Falling/dropped objects hit a person	Direct Causes		
Exposure to/contacting with toxic and chemical substances, acids, alkalis / poisoning due to inhalation of gases	9.71	2	8.74	Falling (from height / in a hole)			
Exposure to electrical currents	8.53	3	7.78	Crushing of body parts between tools and mechanical equipment			
Lack of oxygen in confined spaces	8.42	4	7.78	Exposure to/contacting with toxic and chemical substances, acids, alkalis / poisoning due to inhalation of gases			
Increasing of pressure due to the failures in pressurized vessels control systems	8.35	5	7.73	Colliding with moving / static objects			
Hazardous conditions in workplace	40.52	1	41.52	Inappropriate working conditions	Indirect Causes		
Excessive working hours / fatigue and insufficient rest	38.42	2	41.27	Lack of sufficient knowledge and awareness			
Lack of attention to emergency warnings and implementation of safety regulations	38.41	3	40.78	Lack of using personal protective equipment or using them incorrectly			
Job stress	37.86	4	40.53	Poor supervision			
Physical stress (weakness) or illness	37.85	5	40.28	Distraction / carelessness			
Discrimination in rewards	18	1	21.90	Lack of effective safety trainings	Root Causes		
Lack of effective emergency response management	16.21	2	19.53	Unsafe operating procedures			
Lack of effective safety actions	15.91	3	18.45	Lack of effective procedures: safety meetings, safety inspections, workplace housekeeping, etc.			
Lack of workplace hazards identification (occupational, environmental, etc.)	15.76	4	18.23	Lack of workplace hazards identification (occupational, environmental, etc.)			
Lack of effective safety trainings	15.08	5	15.86	Lack of planning and effective and regular implementation of safety inspections			