

# Study of environmental, economic and technical factors in occupational hazards and accidents of the Gas Company of Isfahan

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Received for publication: 24 February 2014.

Accepted for publication: 16 May 2014.

## Abstract

This study aimed to investigate solutions to reduce incidents of Gas Company operating in the province of Isfahan. The population of the present paper is all employees of the gas company. This study used a questionnaire to collect data univariate statistics and regression t-test and Friedman ranking is performed. The AMOS software was used to investigate the hypotheses. The results were significant at 05.0, indicating that the poor state of the environment, protection unavailability, inappropriate gas company personnel training, compliance and ethics training factors, organizational factors and work-related accidents are related.

**Keywords:** Accidents, work accidents, organizational, environmental, financial, and technical factors, the availability of protective devices

## Introduction

Although mankind's achievements in new energies and his development of technologies in this field have made his life comfortable, a number of malign consequences accompany such technological prosperity. With the development of industries and technologies in the modern life, the increase in the number of occupational accidents and their consequential disabilities are such malign consequences that threaten human beings and laborers specifically (Seneschal, 2005). In old times, occupational hazards could be summarized as follows: falling from trees or heights, being hit or attacked by carnivorous and herbivorous. However, nowadays, due to the rapid growth in technological facilities in travel, electricity, heavy machinery and chemical substances, human beings are prone to become inflicted by a number of deadly accidents. Annually, accidents happen in millions, some of which

cause death or life-long disabilities. Generally, any kind of accident would result in grief and financial distress for the inflicted laborers and their families. Some believe is a phenomenon that cannot be predicted for its suddenness and an external force that cannot be controlled by the laborer causes. In other words, whatever deviates human beings from life's normalized path, causing financial, physical and psychological damages can be considered accident (Afshar Zade, 2006).

One of the social deviances that inflicted lots of societies, including Iranian society, is the issue of occupational hazards. Occupational hazards may threaten laborers' life, resulting in raw materials damages, hampering facilitated level of production, damaging machineries, polluting workstations and making them unbearable work places (Mohseni, 2009).

Statistical evidences suggest that in The United States of America in 2009, 88000 cases of accidents had deadly casualties 9900 laborers died that resulted in life long disabilities, costing 177 billion dollars, 35000000 efficient working days and 116400000 laborers for the government of The United States of America to compensate such losses. To put in another form, an average amount of three days wage for each laborer was lost for occupational compensation.

The study of occupational hazards in Iran depicts comprehensive financial and physical damages as well. In 2008, a general statistical study in the country depicted that 1399 cases of occupational accident took place in each month. 663 of these accidents that were reported to the department of social services happened in industrial workshops. If one considers 270 days, as the standard value for annual working days, 3 accidents per working day occurred in industrial workshops in Iran in 2009. This statistical fact depicts the huge amount of financial burden such losses has imposed on the social and economical infrastructure of the Iranian society (Gol Mohammadi, 2008).

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Therefore, due to importance of preventive procedures towards occupational hazards in the gas company, the necessity of studying the reasons and factors in generating occupational accidents and hazards and finding appropriate preventive procedures become vital. This study presents a number of preventive procedures after discussing simulated instances of a number of occupational hazards and accidents that occurred in working stations. The primary objective of such a pursuit is to reduce malign social and economical consequences in the provinces and their suburban areas. With widespread circulation of results of this study, the possibility of laborers and human resources in work stations utilizing such scholarly findings in their workplaces will be materialized. Through such scientific awareness, employers and employees alongside with government officials become aware of the degree of occupational hazards and their causes in workstations, their direct and indirect social and economical consequences and practical preventives of such accidents. By taking the issue of occupational hazards seriously, they utilize such preventive procedures, detracting the degree of occupational hazards and accidents and facilitating the efficiency of workstations. Ultimately, the country benefits from the positivity of such preventive procedures in detracting occupational hazards and accidents.

Annually, various research and scientific institutes and organizations embark on scientific activities and planning on the issue of occupational hazards and accidents in the world. One of such organizations is the International Labor Organization (ILO) that published a statistical report recently. This report enounces that annually, 120 million occupational hazards and accidents happen in workstations in the world, 210 thousand of which are deadly and severe in their consequences. Due to the importance of the subject matter, this study discusses simulated instances of occupational hazards and accidents that happened in the gas company, alongside with preventive procedures that have been suggested through time for controlling and detracting such malign occurrences. This study studies these issues as well:

The study of the relationship between inappropriate environment of workstations and occupational hazards

The study of the relationship between lack of accessibility to protective and preventive facilities and occupational hazards

The study of the relationship between lack of proper education for staffs of the Gas Company and occupational hazards

The study of the relationship between psychological and mental factors and occupational hazards

The study of the relationship between organizational factors and occupational hazards

## Approach and Scientific Review of the Research

According to the department of social services, “accident” is an unpredictable occurrence that is caused by (an) external factors, inflicting the insured or the policy holder physically or psychologically (Mir Sepasi, 2007).

According to the department of social services, “occupational hazard and accident” that inflicts the insured or the policy holder while he/she has been working or fulfilling his/her occupational duties. By “while in the working period”, this definition means to convey the period when the insured has been working in the workstation, in the sub-altern working structures or buildings or in outer space that is defined within the occupational environment. If he/she has been ordered to work in an outside area, building or structure by the employee, the probable accidents he/she is going to become inflicted from are considered “occupational hazards and accidents” as well (Mir Sepahi, 2007).

Shafiyee and colleagues (2009) in nominal study of occupational hazards of oil and gas masts in the northern branch of the gas company in 2009 depicted that these issues must be focused upon so that a better occupational condition can be provided for workers of such places: education of preventive procedures, providing an appropriate and facilitated environment with standard equipments for workers’ higher level of occupational concentration, periodical auditing of activities and facilities in occupational environment and providing safety maneuvers and making the conditions of occupational activities safer.

This study that has been mostly erected on the reports of occupational hazards in 2009 in the gas company depicted that most of the accidents were minor (over 83 % of the accidents) and August, September and October were the periods with which these accidents occurred in. Daily frequency of accidents was between 10 to 11 and 19 and most accidents were due to incautiousness (50 %). Lack of proper education for preventive procedures was the biggest initiator of such accidents and most workers bore injuries from their legs (39 %), heads (22 %) and arms (18 %) (Mohammad Fam, 2008).

Consequences of occupational hazards and accidents: most of the accidents resulted in minor injuries (46 % of the total number) and straining and

spraining (24 %) and fractures (16 %) were some of other instances of occupational consequences.

After a pilot test, the number of samples and observations were 195 and 3456. Analyzing compiled data with SPSS, a statistical software, Excel and statistical experiments depicted that 35.4 % of laborers' activities this study was concerned with were hazardous. In addition to this fact, this study by analyzing andante relationship between hazardous activities and occupational accidents through Regression Logistic confirmed that by a one increase in the degree of hazardous activities, the number of occupational accidents rise third time higher than their prior statistical value.

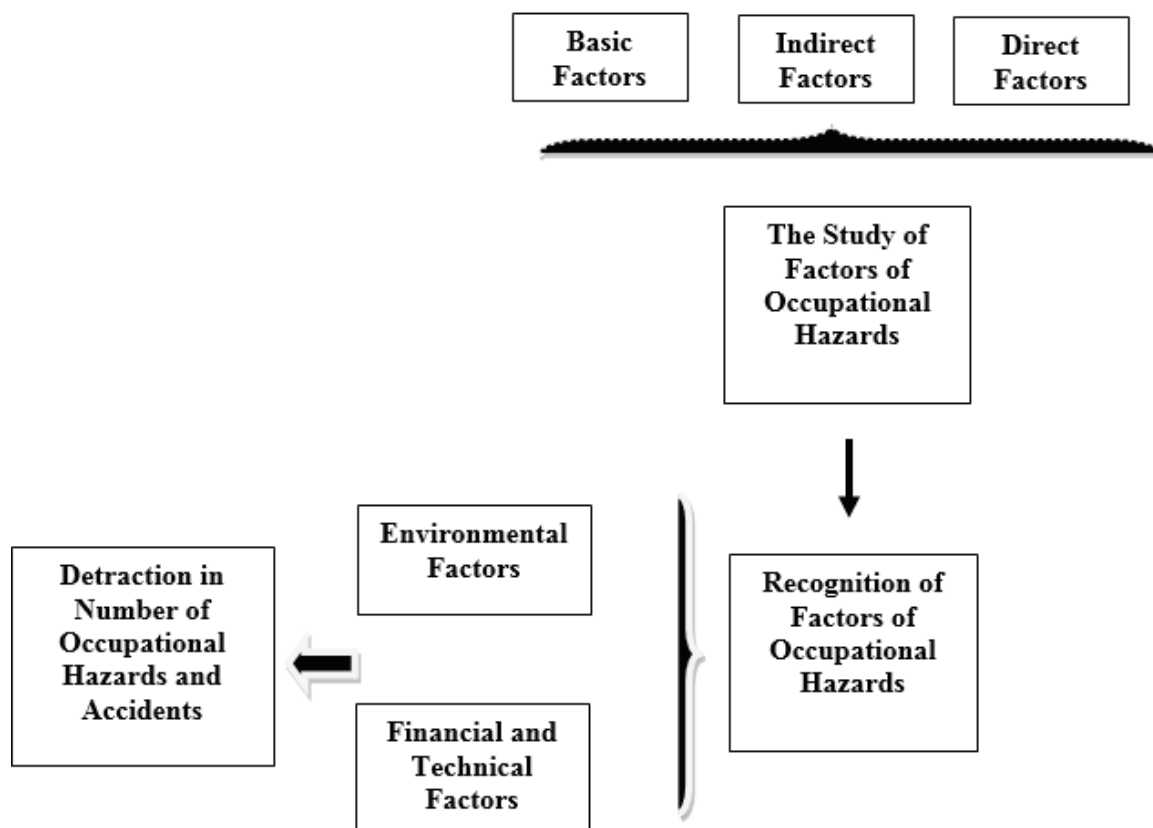
**Conclusion:** considering the direct relationship between hazardous activities in occupational environments and occupational accidents, detraction of such hazardous activities requires a considerable investment that can utilizes safety protocols hat have been based on behavioral standards. Such actions can substantiate the culture of occupational safety among employers and employees.

This study is a descriptive study that regards laborers of Iran Aluminum Factory in Arak its statistical population, whose statistical value reaches to 3945 people in 2008; the very year this experiment was performed. Analysis of 650 cases of accidents in this workstation was considered in this study. For data compilation, direct observation, analysis of official documents and

interviews were considered as the means for accomplishing such an objective. Other descriptive factors will be laborers' age, occupational precedent, type of occupation, marital status and prior disability. Besides, the location of workstation, possible occupational hazards and accidents and the period such malign accidents occurred, will be studied as well. The results of this study depict that 16.48 accidents occurred per day in this particular workstation, involving 100 laborers. The average rate of age and occupational precedent of involved laborers were 33.05 and 6.27 years. Most injuries were recorded for legs (31.7 % of the total rate of occupational accidents) and for arms (23.7 %). Most of the accidents occurred around 10 A.M. (10.9 %). Most injuries were due to straining (30.6 %), fractures (22.9 %) and burns (19.4 %).

**Conclusion:** according to the findings of the research, in order to detract the frequency and intensity of occupational hazards and accidents, it is suggested that in the studied workstation the necessity of planning and executing instructional courses for preventive procedures against occupational hazards must be taken into consideration seriously. Besides, hazardous conditions and utilization of standard equipment — which have been approved by standard criteria — must be promoted.

### Research Model



## Methodology

In this study, since the objective is to study preventive procedures against occupational hazards and accidents, scientific survey or what Miller called "personal interviews in statistics" is used as the scientific methodology of the study. Of course, qualitative methodologies have been utilized alongside with the main methodology of the study as well. In addition to these methods, for establishing the theoretical framework of this study and its scientific review, documentary method has been utilized alongside with aforementioned methods. Ultimately, it is worth mentioning to say that this study is practical in setting its objectives, epidemic in setting its scientific periods, deep and bathetic in setting its measures and expansive in setting its scope. Scientific surveys are primary practical methods for data compilation in this study since in the gas company of Isfahan; such surveys were performed in lesser extents, resulting in poor quality and quantity of scientific data banks. Therefore, by providing a series of scientific questionnaire, a series of accidental samplings were utilized in personal interviews with a number of staffs of the gas company so that occupational hazards and accidents can be analyzed.

The questions in the questionnaire were organizational and psychological. Beside, in this questionnaire, preventive procedures against occupational hazards have been divided into two groups:

A) The first part of the questionnaire includes organizational and personal questions such as age, sex, education, salary, occupational precedents and etc.

B) The second part of the questionnaire includes 41 questions that have been ranked ascen-

sion ally according to Quintuple Likert Scale. The first six questions discuss environmental factors, the next 10 discuss instructional factors, the next 9 consider governmental and organizational factors, the next 9 study financial and technical factors and the last 7 questions discuss ethical and psychological factors.

The validity of this study is content related validity. Finally, the questionnaire was sent to the critical experts and the consultatory board in this field so that their critical regard towards the fundamentals of this questionnaire can be implemented in making it better and more scientific. In order to assess the reliability of the questionnaire, Cronbach's Coefficient Alpha was utilized. According to this formula, the reliability of the questionnaire has been appointed 0.935, whose validity is defined in 0.05, confirming the general reliability of the experiment.

Statistical population of this study is contractive and official employees of the gas company of Isfahan in 2013, whose population was appointed 2600 employees. Utilizing Cochran's theorem, the general quantitative aspect of samples was appointed 335 members. In this study, simple random sampling is utilized in generating scientific samples.

## Data Analysis

As observed in the statistical findings of the study, it is deducible that by defining statistical significance around 0.05, null hypothesis will be undermined. Therefore, there is a direct relationship between circumstantial factors of occupational environments and occupational hazards and accidents.

**Table 1. The relationship between environmental factors and Occupational accident**

Average of Value Distribution	Significance Probability	Degree of Freedom	T-Test Statistics	Research Hypothesis
4.37	0.000	334	40.12	The relationship between circumstantial factors of occupational environments and occupational hazards and accidents

**Table 2. Factors related material and technical and occupational accident**

Average of Value Distribution	Significance Probability	Degree of Freedom	T-Test Statistics	Research Hypothesis
4.26	0.000	334	22.67	There is a direct relationship between financial and technical factors in occupational environments and occupational hazards and accidents.

According to computed statistical significance in the second hypothesis ( $\text{sig} < 0.05$ ) and the computed average ( $\text{avg} = 4.37$ ), the effectuality of his factor on occupational hazards can be observed and confirmed.

As observed in the statistical findings of the study, it is deducible that by defining statistical significance around 0.05, null hypothesis will be undermined. Therefore, there is a direct relationship between technical and economical factors of occupational environments and occupational hazards and accidents.

According to computed statistical significance in the second hypothesis ( $\text{sig} < 0.05$ ) and the computed average ( $\text{avg} = 4.26$ ), the effectuality of his factor on occupational hazards can be observed and confirmed.

### *Freedman's Ranking Experiment*

#### **Freedman's Ranking Experiment of Effectiveness of Environmental Factors in Detraction of Occupational Hazards and Accidents**

**Table 3. Environmental Friedman reducing work accidents**

Ranking Average	Questions
3.22	Proper Lighting in Occupational Environments
3.63	Occupational Discipline
3.01	Proper Ventilation in Occupational Environments
3.67	Elimination of Hazardous Factors
3.74	Efficient Working Temperature in the Occupational Environments
3.72	Lack of crowdedness in Occupational Environments

Significance Probability	Degree of Freedom	Statistical Report on Sequential Chi- Square Test
0.000	5	77.23

The results of the Freedman's experiment depict that the effectuality of all the six environmental factors are not equal. "Proper ventilation in occupational environments" with ranking average of 3.01 and "efficient working temperature in the occupational environments" with ranking average of 3.74 are the least and the most effectual factors in detracting occupational hazards and accidents.

### **Freedman's Ranking Experiment of Effectiveness of Economical and Technical Factors in Detraction of Occupational Hazards and Accidents**

**Table 4 Friedman materials and technical occupational accident**

Ranking Average	Questions
5.25	Utilization of Standard and Protective equipment
5.18	Accessibility to Protective equipment
4.9	Facilitation of Occupational Safety
4.43	Standard Working Tools
5.1	Audition on Utilization of Protective equipment
5.3	Individual Protective equipment
5.2	Utilizing Every Necessary Working Tool
4.57	Proper Interior Design of Workstations
5.25	Proper Utilization of Protective equipment

Significance Probability	Degree of Freedom	Statistical Report on Sequential Chi- Square Test
0.000	8	52.467

The results of the Freedman's experiment depicts that the effectuality of all the nine economical and technical factors are not equal. "Utilizing every necessary working tool" and "proper utilization of protective equipments" with ranking averages of 5.25 and "standard working tools" with ranking average of 4.43 are the most and the least effectual factors in detracting occupational hazards and accidents.

**Table 5 Regression**

Results	Significance Probability	Degree of Freedom	Statistics of (f) Test
Null Hypothesis	0.000	2	84.161

Significance probability of 0.05 confirms the appropriateness of embedded model.

### *Factorial Analysis*

#### **Environmental**

A comparative study of high degree of correlation between  $s_2$  and  $s_3$  parameters and low degree of correlation between  $s_1$  and  $s_5$ , confirms multi dimensional nature of environmental factors on the issue of occupational hazards and accidents.

**Table 6 Coefficients**

Results	T	Significance Probability	Beta	Coefficients
No Statistical Significance	4.187	0.000	---	Fixed Modality
Statistical Significance	7.324	0.000	0.335	Environmental Factors
Statistical Significance	8.910	0.000	0.408	Economical

Results	R	R
Aforementioned factors are in direct correlation with occupational hazards and accidents.	1	1

**Table 7 of Correlation Matrix**

	s1	s2	s3	s4	s5	s6	
Correlation	s1	1.000	0.527	0.406	0.391	0.005	0.239
	s2	0.527	1.000	0.423	0.493	0.079	0.369
	s3	0.406	0.423	1.000	0.388	-0.047	0.233
	s4	0.391	0.493	0.388	1.000	0.165	0.508
	s5	0.005	0.079	-0.047	0.165	1.000	0.117
	s6	0.239	0.369	0.233	0.508	0.117	1.000

**Table 8 KMO and Bartlett's Test**

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	0.769
Bartlett's Test of Sphericity	Approx. Chi-Square 430.971
	Df 15
	Sig. 0.000

Statistical value of KMO for this factor is 0.76 and statistical significance of Bartlett's test is appointed 0.0, depicting that the compiled data is suitable for factorial analysis.

The first block in the table contain 3 columns under the label of "Initial Eigenvalues" that includes eigenvalues for correlation matrix. This statistical fact confirms whether one factor should remain in the calculation scale of the study. Eigenvalues is residual parameter of the variance of the test that has been calculated 2.62 for the first factor. The statistical value of the variance of the test has been calculated 6. Considering these statistical facts, "variance percentage" will be a portion of the statistical value of the variance of the test, which has been calculated 43.66 %. In this study, only two residuals with statistical value of val.>1 have been observed that sustain 62 % of statistical value.

**Table 9. Total Variance Explained**

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.620	43.667	43.667	2.620	43.667	43.667	2.478	41.305	41.305
2	1.092	18.197	61.863	1.092	18.197	61.863	1.234	20.559	61.863
3	0.787	13.112	74.975						
4	0.613	10.223	85.199						
5	0.448	7.463	92.662						
6	0.440	7.338	100.000						

Extraction Method: Principal Component Analysis.

The second block in the table contains 3 columns under the label of “Extraction Sums of Squared Loading that includes uncirculated correlations. The third block with the label of “rotation Sums of Squared Loadings includes circulated correlations.

### Economical and Technical Factors

A comparative study of high degree of correlation and low degree of correlation confirms multi dimensional nature of economical and technical factors on the issue of occupational hazards and accidents.

**Table 10. Correlation Matrix**

	s26	s27	s28	s29	s30	s31	s32	s33	s34	
Correlation	s26	1.000	.186	.180	.057	.137	.056	.160	.061	.051
	s27	.186	1.000	.536	.086	.315	.097	.420	.168	.070
	s28	.180	.536	1.000	.108	.348	.149	.472	.117	.106
	s29	.057	.086	.108	1.000	.158	.029	.165	.042	.930
	s30	.137	.315	.348	.158	1.000	.164	.318	.152	.159
	s31	.056	.097	.149	.029	.164	1.000	.139	.070	.013
	s32	.160	.420	.472	.165	.318	.139	1.000	.100	.163
	s33	.061	.168	.117	.042	.152	.070	.100	1.000	.054
	s34	.051	.070	.106	.930	.159	.013	.163	.054	1.000

**Table 11. KMO and Bartlett’s Test**

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	0.649
Bartlett’s Test of Sphericity	Approx. Chi-Square 922.209
	Df 36
	Sig. 0.000

Statistical value of KMO for this factor is 0.64 and statistical significance of Bartlett’s test is appointed 0.0, depicting that the compiled data is suitable for factorial analysis.

Only two residuals with statistical value of val.>1 have been observed that sustain 48 % of statistical value.

**Table 12. Total Variance Explained**

Component	Initial Eigen values			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.612	29.022	29.022	2.612	29.022	29.022	2.401	26.677	26.677
2	1.747	19.413	48.435	1.747	19.413	48.435	1.958	21.758	48.435
3	.980	10.884	59.319						
4	.941	10.456	69.775						
5	.911	10.120	79.895						
6	.710	7.893	87.788						
7	.577	6.411	94.198						
8	.452	5.027	99.225						
9	.070	.775	100.000						

Extraction Method: Principal Component Analysis.

## Conclusions

**1. There is a direct relationship between circumstantial factors of occupational environments and occupational hazards and accidents.**

As observed in the statistical findings of the study, it is deducible that by defining statistical significance around 0.05, null hypothesis will be undermined. Therefore, there is a direct relationship between circumstantial factors of occupational environments and occupational

hazards and accidents. These findings are in harmony with Shafiyee's and colleagues' findings. In their nominal study of occupational hazards of oil and gas masts in the northern branch of the gas company in 2009, they believed that these issues must be focused upon so that a better occupational condition can be provided for workers of such places: education of preventive procedures, providing an appropriate and facilitated environment with standard equipments for workers' higher level of occupational concentration, periodical auditing of activities and facilities in occupational environment and providing safety maneuvers and making the conditions of occupational activities safer.

## **2. There is a direct relationship between technical and economical factors of occupational environments and occupational hazards and accidents.**

As observed in the statistical findings of the study, it is deducible that by defining statistical significance around 0.05, null hypothesis will be undermined. Therefore, there is a direct relationship between economical and technical factors of occupational environments and occupational hazards and accidents. These findings are in harmony with Shafiyee's and colleagues' findings. In their nominal study of occupational hazards of oil and gas masts in the northern branch of the gas company in 2009, they believed that these issues must be focused upon so that a better occupational condition can be provided for workers of such places: education of preventive procedures, providing an appropriate and facilitated environment with standard equipments for workers' higher level of occupational concentration, periodical auditing of activities and facilities in occupational environment and providing safety maneuvers and making the conditions of occupational activities safer.

These findings are in harmony with Barzi's and Abdullahian's findings in their research in 2004 that studied epidemically cases of occupational accidents in health care centers in Semnan province in 2004. They believed that there is direct correlation between occupational hazards and accidents and laborers' age, occupational precedent, type of occupation, marital status and prior disability. Besides, the location of workstation, the period such malign accidents occurred and accessibility to protective equipments can play important roles in such significant relationship between aforementioned descriptive factors and occupational hazards and accidents. Ultimately, it is deducible that by facilitating staff member of the gas company with protective equipments in a well constructed workstation, the degree of occupational hazards and accidents can be detracted.

## **Suggestion for Further Research**

According to computed statistical significance in the first hypothesis ( $\text{sig} < 0.05$ ), the computed average ( $\text{avg} = 4.37$ ) and statistical value for "t" (40.12) which is more than the statistical value in the table it becomes apparent that there is a direct relationship between occupational circumstances and occupational hazards and accidents. Therefore, it is suggested that by erecting warning signs in laborers' occupational environment, a considerable number of occupational accidents can be prevented.

According to computed statistical significance in the second hypothesis ( $\text{sig} < 0.05$ ), the computed average ( $\text{avg} = 4.26$ ) and statistical value for "t" (22.67) which is more than the statistical value in the table it becomes apparent that there is direct relationship between lack of accessibility to protective equipments and occupational hazards and accidents. Therefore, it is suggested that by holding regular safety committees, occupational health and standard procedures in occupational environments can be promoted among employers, employees and other occupational officials so that occupational hazards and accidents can be prevented.

As observed, apart from the complicated nature of the suggested model, the appointed variants have been studied properly. Nevertheless, concentrating on the issues that have been represented below can strengthen reliability and validity of the suggested model of this study, emphasizing its practical and conceptual aspects:

- Utilizing same studies in other companies with more populated statistical samples

- Utilizing same studies with more populated statistical population (provincial and national wide)

- Utilizing same studies with different research models and comparing results with the results of this study

- Utilizing more acute studies on various factors individually

- Utilizing appropriate sources on the subject matter that results in facilitation of theoretical framework and comparative pursuit of further studies with prior ones

- Spending a period of quality time in the intended statistical population and the intended statistical samples

## **Delimitation**

In any research, there exist a number of malign and uncontrollable factors that interfere in the natural flow of the scientific pursuit of the study, limiting the scope of the research. Such factors are considered



obtrusive elements in a scientific research that hinders – intensely or moderately the legitimacy of its results. In any case, scholarly efforts to detract such factors are underway in various scholarly fields (Seyd Abbas Zade, 2001). Of course, it is apparent that an ideal scientific atmosphere for a scholarly study is researchers' dream; however, accomplishing such atmospheres in sociological and psychological studies cannot be materialized. Having said these facts, this study is after recognition and detraction of such factors in its scientific pursuit. A number of such delimitations have been named below:

Limitation of actualization of results to the gas company

Limitation of bilateral cooperation from libraries and data banks

Lack of laborers' concentration due to the heavy bulk of occupational duties

Lack of accessibility to international data bases

Lack of time sufficiency

## Acknowledgment

The authors would like to thank Gas Company of Isfahan for their financial support on this project.

This Study has been funded, scientifically and financially, with generous supports of the gas company of Isfahan.

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