Predictive Factors of the Exceptionally High Number of Industrial Accidents at Work in Greece: A Statistical Analysis of Sample Survey Results

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Abstract

The strong commitment of the management of a company to the maintenance of a safe work environment is an important stimulus for its workers to be loyal to the company and to make every effort to keep the company profitable.In this paper we investigate by a sample survey in a sample of 763 workers who work in heavy industries in Greece the factors which contribute to the occurrence of accidence at work. An exploratory factor analysis ,Reliability Analysis and Multinomial Logistic Regression revealed the following factors which increase the frequency of occurrence of accidents at work:

Exposure of the workers to physical or technical dangerous conditions at work, lack of inspections by the Government's Safety Inspectors , lack of training programs designed by the company in order to protect the workers from harmful machinery and to show to them the proper use of tools, lack of proper maintenance of machinery and negligence in the part of the company in following the recommendations of safety inspectors. Cronbach"s Alpha for the variables of the questionnaire referring to the factors contributing to the occurrence of accidents is 0,81.A Multinomial Logistic Regression with dependent variable the question: did you have in the past an accident at work ,was carried out and revealed that the independent variables: lack of inspection of the machinery of the company, lack of proper training procedures for the workers of the company, inadequate work experience of the workers, lack of proper supervision and nature of work ,were statistically significant.The sample survey was carried out in January of 2013 and it shows that the Safety Inspectors, which were public employees, should make every effort to keep, with their efficient inspection visits, the industrial base of this country functioning properly in order to decrease the unemployment level in times of deep financial , social and political crisis in Greece.

Key Words : accidents at work,industrial companies,safety inspectors,Logistic Regression,Factor Analysis,Cronbach"s Alpha.

1. Introduction

The aim of the present paper is to identify and study predictors of work related injuries in a sample of 737 workers in Greece.

The Health and Safety Executive (2014) of the British Statistical Service, estimates that Greece has the lowest percentage of businesses with a health and safety policy in place(figure 1)and the workers in Greece think at percentage of39%, which is the fourth highest in EC that their health or safety is at risk because of their work.The fatal injury rate from accidents at work,excluding road traffic accidents, is 0,9(per 100,000 workers) in Greece ,whereas the European mean rate is 1,5,(EUROSTAT,2012). In United States and elsewhere,several researchers have recently attempted to estimate the magnitude and the related costs of occupationally-related mortality (Leigh et al.,1997),(Nurminen and Karjalainen,2001).

Considering the United States,(Leigh et al.,1997) estimated that 65,800 deaths per year can be attributed to occupational injury or illness with a total cost to society of over $23 bilion. Hence ,it is very important to examine the causes of work related injuries (WRI) and to discuss measures preventing accidents at work. Despite the high rates of work related accidents ,research is limited in this area which aims at identifying the likely causes of WRI.

Steenland et al.(2003) discuss the magnitude of United States Mortality from selected causes of death associated with occupation. They conclude that occupational deaths are the 8th leading cause of death in the United States after diabetes(64,751) but ahead of suicide(30,575) and greater than the annual number of road traffic accidents.

Bull et al.(2002) identify the significant health, environmental and safety(HES) factors in small enterprises as follows: personal protection devices and safety equipment on machines . They conclude that safety inspection of machinery is the most effective means of attaining the desired result of reducing work related injuries.

Hofmann and Stetzer (1998) identify the lack of safety climate and communication as the underlying causes of accidents at work. They conclude that larger organizational factors –such as safety climate and communication about safety measures between supervisors and workers can influence the interpretation of information emerging from investigations of the special circumstances in which work related accidents occur.

Frone (1998) ,investigates the work related accidents among young employees and identifies 5 general categories of resk factors,as follows: demographic elements of the employees,personality, employment,health and substance use. According to Frone (1998) the statistically significant risk factors for WRI were gender,negative affectivity, job tenure, exposure to physical hazards, excessive workloads, job boredom, poor physical health and on-the-job use of substances.

Salminen et al. (2013) compared organizational and individual factors as predictors of workplace accidents frequency. They conclude that the influence of organizational factors is stronger than that of individual factors. Individual factors were gender, age, education , marital status and job tenure. The injury risk of males was 3.3 times higher than that of females. Men had more serious injuries than women as the risk of fatal injuries is 13 times higher for males than for females (Salminen, Saari, Saarela,and Rasanen ,1992). Organizational factors were job satisfaction, (Locke,1976). Perceived organizational support (POS) refers to the impression of workers about their managements' or organizations' contributions and concern for their well being(Aselage and Eisenberger,2003).There is a positive association between supportive perceptions and workers' level of job satisfaction, safety performance, organizational involvement and affective commitment (Michael et al.2005;Gyekye and Salminen,2007).POS refers to the support of supervisor and co-workers and it is an important factor of accident frequency.(Rhoades and Eisenberger,2002).Salminen et al.(2013) develop a theoretical model about the relationships between organizational and individual factors related to occupational accidents.

DeJoy et al.(2003)identify three factors of safety climate: environmental conditions, safety-related policies and programs and general organizational climate. They

conclude that safety climate is a leading indicator of the safety level of the organization or the workplace.(Mearns and Flin,1999).

Zolnierczyk-Zreda et al.(2014) support by a large cross-sectional study the view that mental ill health is the most frequent cause of long-term sickness absence and disability retirement in Denmark and long working hours are the cause of mental ill health. They advocate that even 'moderate overtime'(41-48 workhours/week) are the source of both anxiety and depression.

Gimeno et al.(2004) investigate the relation between occupational and organizational factors and work related injuries(WRI) among Hospital employees in Costa Rica.They find that workers exposed to chemical and physical hazards have higher WRI rate than non-exposed workers.

Dembe,et al.(2004) consider the association of the factors :overtime and long work hours and WRI.They support the view that long hours and shift work are increasing the liklehood of a WRI.

Roelofs et al.(2011) report that Hispanic workers in construction projects have higher rates of injury than workers of other ethnicities. They conclude that the key to fewer WRI is better training of supervisors and workers and better enforcement of workplace standards.

In this paper, we find two new variables that contribute significantly to the increase of WRI in Greece: Few and not properly organized safety inspections of workplaces by the Government Inspectorate and no compliance of the companies concerned with the recommendations of the safety inspectors because of the high costs for keeping a safety environment. These conclusions are the results of detailed statistical analysis of a sumple survey among 763 workers in Greece during January 2013. We should point out that the Greece is in the middle of a deep financial ,social ,political crisis which has a further result of a health and workplace safety crisis. In Chapter 2,we describe the method of research through a questionnaire. In Chapter 3 we present the statistical analysis of the results of the sample survey. In Chapter 4, we discuss our findings and in Chapter 5 we present the final conclusions of the sample survey.

2. Method
   2.1 Sample and Procedure
   We have carried out a sample survey among 763 workers in Greece, trying to identify the predictors of Work Related Injuries(WRI). 259 respondents were women and 498 were men. 6 respondents did not answer the question referring to Gender. Their age was as follows: 261 were 17-29 years of age,221 were 30-39 years of age ,178 were 40-49 years ,86 were 50-59 years

of age and the rest of the workers were either less than 17 years of age or more than 59 years of age.Most of the workers(670) were Greek,49 workers were from Albania ,14 from Roumania,7 from Boulgaria and the rest from African Countries. The statistical analysis of the questionnaires has been carried out with the help of SPSS 21.0,(Pallant,2007).

3. Statistical Analysis

3.1 . χ2 tests of independence

We perform χ^2 tests of independence in order to test the hypothesis:

H0 : The variable :did you have in the past a Work Related Injury(WRI)

Is independent of the variable V_K

H1 : : The variable V :did you have in the past a Work Related Injury(WRI)

Is dependent of the variable V_K ,

Where

$V_{K (K=1,.....n)}$ is a demographic variable or a variable related to the characteristics of the organization, or the personality of the worker or the safety conditions of the environment or the regulations of the government concerning WRI's.

The following table shows the results of the X^2 tests :

Table 1. χ^2 tests of independence. X^2 statistic, Degrees of Freedom, p-value, Level of significance: 0,05.

Variable V_k	Variale V: did you have in the past a work related injury ?	X^2 Statistic	Degrees of Freedom	p-value
Demographic				
1.Gender		23,53	1	0,000
2.Age		5,37	5	0,370
3.Nationality		19,37	10	0,040
Employment				
4.Number of Workhours per week		30,23	8	0,000
5.Nature of work		61,70	17	0,000
6.Organization providing Job		115,60	14	0,000
7.Heavy workload		23,99	1	0,000
8.Exposure to Physical or Technical		33,23	1	0,001

hazards				
9.Unhealthy work		23,08	1	0,000
10.Existence of Safety Equipment		22,10	2	0,000
11.Supervision		7,70	4	0,100
12.Job boredom		32,87	4	0,000
13.Knowledge of nature of work		8,37	4	0,050
14.Supervisor conflict		24,40	4	0,000
15.Coworker conflict		22,63	4	0,000
16.Work and study conflict		19,47	5	0,002
17.Job satisfaction		16,78	3	0,001
Personality				
18.Lack of concentration		23,31	3	0,001
Health				
19.Depression		29,21	3	0,001
20.Feeling of helpless person		25,53	4	0,001
21.Lack of sufficient sleep		12,20	3	0,007
22.Work and family economic problems conflict		3,67	1	0,050
Drink consumption				
23.Consumption of alcoholic drinks on-the-job		18,26	5	0,003
Safety Regulations and Market Categories				
24.Market Category of Business		43,45	21	0,003
25.Frequent		9,84	5	0,080

safety inspections from government inspectors				

It is interesting to note that when there is 1 inspection per 2 months from the safety inspectors ,the percentage of workers who did not have a WRI in the past in a private company which is a gymnasium is 80%, whereas the percentage of workers who had a WRI under the same conditions is only 20%.

3.2 Nonparametric Spearman Correlations

The following table shows the Spearman Correlation Coefficients between the each one of the 25 variables of section 3.1 and the variable: Did you have in the past a WRI?

Table 2. Intercorrelations ,Level of significance:0,05

Variable V_k	Variable V: Did you have in the past a WRI?	correlation	p-value
Demographic			
1.Gender		0,177	0,00
2.Age		0,009	0,810
3.Nationality		0,064	0,078
Employment			
4.Number of Workhours per week		0,086	0,019
5.Nature of work		0,046	0,211
6.Organization providing Job		-0,195	0,000
7.Heavy workload		0,183	0,000
8.Exposure to Physical or Technical hazards		0,213	0,000
9.Unhealthy work		0,178	0,000
10.Existence of Safety Equipment		0,167	0,000
11.Supervision		0,058	0,116

12.Job boredom		0,105	0,004
13.Knowledge of nature of work		0,109	0,003
14.Supervisor conflict		0,173	0,000
15.Coworker conflict		0,129	0,000
16.Work and study conflict		-0,136	0,000
17.Job satisfaction		-0,106	0.000
Personality			
18.Lack of concentration		0,150	0,000
Health			
19.Depression		0,030	0,413
20.Feeling of lelpless		0,179	0,000
21.Lack of sufficient sleep		0,109	0,003
22.Work and family economic problems conflict		0,070	0,055
Drink consumption			
23.Consumption of alcoholic drinks on-the-job		0,065	0,074
Safety Regulations and Market Categories			
24.Market Category of Business		-0,070	0,058
25.Frequent safety inspections from government inspectors		-0,193	0,000

3.3. Factor Analysis

The 25 items of the Questionnaire for identifying the predictors of WRI, which are shown in Table 1 were subjected in Principal Component

Analysis(PCA) USING spss Version 21. Prior to performing PCA the suitability of data for Factor Analysis was assessed.Inspection of the Correlation matrix revealed the presence of many coefficients of .5 and above. The Kaiser-Meyer-Olkin value was 0,77, exceeding the recommended value of o,6(Kaiser,1970,1974) and Bartlett's Test of Sphericity(Bartlett 1954) reacing statistical significance,supporting the factorability of the correlation matrix.

Principal Components Analysis revealed the presence of five components with eigennvalues exceeding 1, explaining 17,14%,9,03%,7,14%,5,79% and 5,23% of the variance respectively.

We name the five components as follows:Personality Characteristics,Workload-age,Job conditions of organization,Communication of Workers,Safety Inspections-Alcohol Consumption.

Table 3,contains,the factors,the variables which belong to each factor and all the dimension coefficients:

Table 3. Pattern Matrix for PCA with Oblimin Rotation of five Factor solution of the Questionnaire variables, with factor loadings of each of the variables.

Item	Factor 1 Personality	Factor 2 Workload-Age	Factor 3 Job conditions of Organ.	Factor 4	Factor 5
Personality Characteristics	0,735				
Feeling of unworthy person	0,640				
Feeling helpless	0,574				
Boring job	0,723				
Depression	0,563				
Lack of sleep	0,697				
Job satisfaction	-0,531				
Workload-Age					
Work experience		0,855			
age		0,829			
Workload		0,556			
Job conditions of Organization					
Unhealthy work			-0,738		
Exposure to hazards			-0,714		
Communication					
Supervisor conflict				9,730	

Coworkers conflict				0,593	
supervision				0,581	
Safety Inspections and measures					
Safety inspections					-0,556
Alcohol consumption					-0,517

3.4 Logistic Binary Regression

Direct Logistic Regression was performed to assess the impact of a number of factors on the likelihood that respondents would report that they had a work lelated injury(WRI). The model contained nine independent variables(few and unorganized safety inspections, safety environment,exposure to physical or technical hazards,heavy workload,supervision,supervisor conflict,coworkers conflict,no worth feeling and workin who reported and didg in shifts). The dependent variable is: Did you have in the past a WRI?. The full model containing all predictors was statistically significant,χ^2(32,N=640)=154,88, p<0,0001,indicating that the model was able to distinguish between respondents who reported and did not report that they had a WRI.The model as a whole explained between 21,5% (Cox and Snell R Squared) and 30,7% (Nagelkerke R Squared) of the variance in frequency of WRI , and correctly classified 76,4% of cases. As shown in the following Table 4 all nine independent variables made a unique Statistically significant contribution to the model(existence of WRI or not in the past)The strongest three predictors of reporting a WRI were : insufficient supervision, with Odds Ratio (3,08),small number of safety inspections by the government appointed inspectors, with Odds Ratio (3,61) and coworkers conflict, wth Odds Ratio (2,74).As regards safety inspections, the Odds Ratio (3,61) means that respondents who were working in a work environment with few and not organized safety inspections were over three times more likely to report a WRI than those who were working in a workplace with sufficient safety inspections and follow up of the inspectors' advices,controlling for all other factors in the model.

Table 4. Logistic Regression Predicting Likelihood of Reporting a WRI

INDEPENDENT VARIABLE	B	S.E.	WALD TEST	DF	p	EXP(B) Odds Ratio	95% C.I. For Odds Ratio	
							Lower	Upper
Few Safety	1,286	,441	8,497	1	,004	**3,61**	**1,52**	**8,59**

Inspections								
Safety Equipment	,815	1,050	,603	1	,437	2,260	,289	17,682
Exposure to physical or technical hazards	1,012	,229	19,600	1	,000	2,751	1,758	4,306
Heavy Workload	,576	,230	6,266	1	,012	1,779	1,133	2,792
Supervision	1,125	,393	8,196	1	,004	3,080	1,426	6,652
Supervision Conflict	1,125	,393	8,196	1	,004	3,080	1,426	6,652
Coworkers conflict	1,010	,419	5,801	1	,016	2,746	1,207	6,247
Feeling of no worth	1,397	,586	5,682	1	,017	4,042	1,282	12,746
Work schedule in shifts	2,502	1,076	5,408	1	,020	,082	,010	,675

3.5 Discussion

The results of this paper add to the growin body of evidence indicating that the causes of work related injuries(WRI) are both due to organization characteristics and to worker peculiarities. The most important organizational characteristics which can be a cause for an accident in the workplace are: Small number of safety inspections, Safety equipment creating a safety environment ,Overtime work, Exposure to physical or technical hazards, Insufficient supervision and peculiar work schedule due to working long hours in shifts. The causes of WRI due to worker characteristics are: Supervisor conflict, Coworkers conflict,Feeling that the work is of no value. Two causes have the greatest Odds Ratio : Lack of safety inspections(OR: 3,61) and feeling that the work of employees is of no value(OR:4,04) and subsequently that the workers themselves are melancholic because of the prevailing impression that their work is no worthy. Many authors have indicated that overtime work is a cause for accidents(Dembe,et al.,2006, Spurgeon et al.,1997).

The new finding of this paper is that the lack of safety inspections is an important cause of WRI. Possible explanations for this situation are the following: Today, in Greece, there is a considerable shortage of staff in many public organizations because of the Economic Crisis of the country. The number

of employees in many public organizations has been reduced considerably. The same happens in the Public Service of the Inspectorate of the workplace in the Ministry of Employment. On the other hand, because of widespread corruption ,the recommendations resulting from the few safety inspections are not followed from the employers, who manage not to get or to pay any fine from the State.

It is a striking result that in a steel works factory in the district of Elefsina, Athens, when there is one visit per month from the safety inspectors , there are no WRI at all, whereas the percentage of WRI when there is one visit from the safety inspectors per two months is 4,3% and the percentage of WRI when there are rarely visits of safety inspectors climbs to 65,2%.

Another result of the economic crisis is that the companies ,because of high costs, do not install safety equipment and do not organize any systematic training programs for their workers in the use of safety equipment.The following table indicates that there is a statistically significant association between the nature of work in different companies and the likelihood of a WRI.

Table 5. χ^2 test between category of company and likelihood of having a WRI.

COMPANY CATEGORY	Did you have in the past a WRI?		Total
	No	Yes	
Steel Factory	4,8%	3,2%	8%
Gymnassium	3,8%	18,3%	22,1%
Textiles company	0,8%	8%	8,8%
Taxi company	2,3%	4,6%	6,9%
Fast food company	1,9%	1,9%	3,8%
Public Hospital	3,8%	5%	8,8%
Import of Medicines Company	1,5%	2,3%	3,8%
Construction Company	1,5%	8%	9,5%

A finding of this paper is that many companies prefer not to declare the WRI to the Ministry of Employment because of suspicion of imposition of fines or of visits by the safety inspectors.

We found that males are more likely to have an WRI (34% of male workers had a WRI) than females (17,5% of females had an WRI).

3.6 Policy Implications

Important policy measures which must be taken in order to reduce the number of WRI are the following:

a. Increase of frequency of visits by the safety inspectors.
b. On-the-job-training of the workers.
c. Installation of safety equipment.
d. Psychological support to the workers.
e. Training of the supervisors.
f. Meritocracy in the system of distribution of wages.

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