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A Study on Organizational Factors Contributing to Reduce Work-related Accidents in Zamyad Co., an Iranian Commercial Vehicle Manufacturing Company

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Abstract
One of the increasingly important organizational considerations involves occupational health and staff safety. Hence, it is crucial for the managers to identify the key organizational factors contributing to reduce work-related accidents. This study was conducted on 340 workers, employees, experts, supervisors, directors, and managers. The data evaluation involved a questionnaire while the analysis involved SPSS. Additionally, the Kolmogorov-Smirnov test, Pearson correlation, and Kruskal-Wallis test were employed. With regard to the main criteria, the HR training procedure had the highest effect while the HR hiring procedure had the lowest effect on work-related accidents. Considering that HR training procedure has the greatest effect on reducing work-related accidents, it is critical to continuously optimize the training courses; There by to curb the major work-related accidents.

Key words: *organizational factors, work-related accidents, Zamyad Co.*

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Introduction

The industrialization of human societies, construction of factories, and the invention of machinery and large-scale industries have led to dramatic transformation and progress. Furthermore, the fast growing technology in the world has posed certain threats and hazards against humans who have created them with their own hands (1, 12). Therefore, all industrial societies, especially in developing countries such as Iran, should take the essential safety measures and prevent occupational accidents and diseases in the workplace (2). According to International Labour Organization (ILO), occupational accident refers to an unplanned and unexpected event at the workplace, leading to death, illness or injury in one or more workers (15). In accordance with Article 60 of Iranian Labor and Social Security Law, work-related accidents occur when workers are doing their occupational tasks covered by insurance (14). According to ILO (2008), serious accidents related to occupational diseases and work-related accidents totaled 2.34 million cases per year, costing 4% of the global GDP. It was estimated that 2.34 million people died from work-related accidents and diseases in 2008, of which 2.02 million cases were related to various diseases and 321,000 cases were due to work-related accidents (14 and 15). On average, more than 6,300 work-related deaths have been recorded in the world every day. This is despite the fact that 98% of work-related accidents can be prevented. The number of occupational accidents over the past 20 years curtailed by 20% in Japan and Sweden and by 62% in Finland; Such remarkable reduction can be associated with work environments shifting from unsafe to safe (1 and 15). By investigating the accidents, it can be specified why and how they occur, and by using the data collected at the accident scene, similar or more dangerous cases can be prevented. On the other hand, the reduction of occupational accidents and injuries can enhance the efficiency of employees and managers, which ultimately ensures economic and social progress (6 and 16). Meanwhile, there are many solutions to the prevention of occupational accidents and diseases. In this regard, preventive or corrective actions will be a top priority since they impose minimum cost and financial burden on organizations (3 and 4).

For this purpose, the organizational, i.e. managerial, factors curbing or preventing workplace accidents at minimal cost and financial/credit resources (compared to the cost of technical and engineering solutions) (5 and 11) can be categorized into 4 parameters below and then examine their effects on the reduction of occupational accidents and diseases:

1. HR hiring procedure (e.g. planning, staffing, selection, and recruitment);
2. HR training (e.g. courses prior to and during recruitment and in-service training);
3. Compliance with technical protective measurements (e.g. legal requirements, regulations, rules and standards)
4. Managerial factors (e.g. planning, financing, leadership).

In an investigation conducted by SadeghiFard (2002) on the most important organizational factors contributing to reduce accidents and human errors at Bakhtar Regional Electricity Company, there was a significant relationship between organizational factors and the reduction of accidents and human errors. In their study on organizational factors reducing work-related accidents at workshops based in Mazandaran Province, Kiakjuri and Husseini (2011) identified a significant relationship between organizational factors and reduction in accidents. Ranjvar and Moazeni (2011) reported a significant relationship between factors involved in work-related accidents and designing/implementing safety measures. In their study on various management methods regarded as important components of safety programs, Ellison J. Veridenburg (2002) stated that performance-oriented practices can constantly predict events for employees (18, 20, 22).

Given the foregoing facts, occupational accidents and diseases have been imposing direct and indirect costs on Zamyad Co. Such cost will ultimately lead to lower productivity and financial losses (1 and 9). In this respect, various causes (direct, indirect or underlying) are associated with occupational accidents and diseases for personnel. Nonetheless, it is crucial to examine the organizational factors, and any effort to strengthen the organizational structures would curtail accidents and promote the culture of safety in the organization (8, 10, 26). According to statistics in 2015, a total of 271 occupational accidents occurred to human mistakes and errors at Zamyad Co. Moreover, about 10% of the company's population (2,900) suffer from occupational diseases. According to the same statistics and relevant calculations, occupational accidents waste about 0.1 of hours during a working day. The Financial and Insurance Departments at Zamyad Co. estimated the direct costs for occupational victims and patients to be roughly 2,000,000,000 IRR in 2015, which covers 0.66% of the company's net income (net income was about 300,000,000,000 IRR in 2015). Considering that Occupational Safety and Health Administration (OSHA) found it difficult to calculate the indirect costs (19 and 21) and the fact that the costs range from 1 to 20 times larger than direct costs, the declared cost statistics exceed far beyond those figures. Taking into account the indirect costs 20 times larger than the direct costs under OSHA estimations, 13.33% of net income at Zamyad Co. will be spent on the consequences of occupational accidents and occupational diseases (21 and 25). Accordingly, this study attempted to investigate a number of organizational criteria and sub-criteria reducing such accidents, and then propose a solution on how to identify and evaluate such criteria (13).

Methodology

This was an applied, descriptive-correlation survey research (17). The population consisted of 2,900 employees at Zamyad Co. including male and female contractors, workers, employees, experts, supervisors, directors, managers and deputies with various education levels ranging from diploma to Ph.D. According to Cochran's formula, 340 individuals were selected as a sample at an error level of 5%. The data collection tool involved a questionnaire with 40 items in 4 information categories on several variables: HR hiring procedure, HR training, compliance with technical protective measures, and managerial factors. Data were collected through a field and desk review of relevant literature on the statistics of accidents and indices available in the organization. Furthermore, the findings were analyzed in two phases, 1) the quantitative evaluation indices involved in accident at Zamyad Co were calculated and presented in statistics, 2) the results of descriptive and inferential analyses of organizational parameters contributing to lower accidents were examined through SPSS, Kolmogorov-Smirnov test, Pearson correlation and Kruskal-Wallis test (17).

The quantitative evaluation indices of events at Zamyad Co. in 2015 were calculated by the relationships between the following parameters, and the results were given in a separate section.

A) frequency rate of accidents in one year per million hours. According to experts, if the frequency of accidents in a factory or workshop is 0-10, then safety precautions are being taken appropriately (24). The frequency rate at Zamyad Co. in 2015 was calculated in the following:

$$F.R. = \frac{\text{Number of accidents in 2015} \times 10^6}{\text{Number of useful working hours in 2015}}$$

Based on the above formula, 271 accidents occurred during 2015, while the total useful working hours (Zamyad regular personnel and contractors) was 7,027,088 hours over the same year. Accordingly:

$$R. = \frac{271 \times 10^6}{7027088} = 3$$

B) Severity rate of accidents, according to the Sixth Statisticians International Conference, refers to the number of wasted days per 1,000 hours, i.e. days lost per 1,000 working hours. (24).

$$S.R. = \frac{\text{Number of days lost due to accidents in 2015 in 2015} \times 10^3}{\text{Total useful hours in 2015}}$$

Based on the above formula, a total of 6,698 hours were wasted due to accidents during 2015. Moreover, 765 days were lost due to accidents over the same year, while the total useful working hours (Zamyad regular personnel and contractors) amounted to 7,027,088. Accordingly:

$$S.R. = \frac{765 \times 10^3}{7027088} = 0.1$$

B) Severity; frequency rate

$$FSI = \sqrt{\frac{F.R. \times S.R}{1000}}$$

It was assumed to be 0.061 for the case study. Values of severity rate lower than 0.1 were desirable.

Findings

According to the calculations and online statistical analyses, the frequency rate of accidents at Zamyad Co. is higher than the normal rate (38.5>10), indicating an extremely high frequency rate of accidents in the company. The frequency and severity rates were nearly normal (1 and 10).

The results of descriptive statistics and demographic characteristics in Table (1) display the descriptive information on the population by respondents based on age, gender, education, organizational position, service division, and work experience.

Table (2) displays each variable evaluated by obtaining the mean values of corresponding items and the descriptive characteristics.

With respect to the significance level of less than 0.05 for all four variables (Table 3), the inferential statistical calculations were completed and data normalization was examined by rejecting the assumption of normal distribution in the population. Hence, the non-parametric tests could be used for testing the variables (17).

The correlation between the variables was estimated through Spearman correlation coefficient. The P-value was calculated first by arranging the degrees of importance among the subjects on every variable while mentioning their relative importance on other variables with no particular order. Then, the rank differences were squared and ρ-value was determined using the following formula:

$$\rho = 1 - \frac{6\sum D_i^2}{N(N^2-1)}$$

where Di represents the rank difference and N is the number of observations. This operation was handled in SPSS. If the ranks matched, Σ Di2 was equal to zero and ρ-value is identical to the unit value. If the figure from the fraction is 2, then there is a perfectly negative correlation between the two variables (1). If the numerator is 1, the ρ-value is zero, indicating that the two variables are completely independent, i.e. every number between -1 and 1 represents the type and extent of the relationship between the independent variable and the dependent variable. According to Table (4), each hypothesis was tested:

Hypothesis (1): The HR hiring procedure has a significant effect on the reduction of occupational accidents and frequency rate.

Given the significance level (P-value) in Table (4), this value is less than 0.05 for HR hiring procedure. Therefore, the null hypothesis is rejected and the alternative hypothesis is proven.

Hypothesis (2): The HR training procedure has a significant effect on the reduction of occupational accidents and frequency rate.

Given the significance level (P-value) in Table (4), this value is less than 0.05 for HR training procedure. Therefore, the null hypothesis is rejected and the alternative hypothesis is proven.

Hypothesis (3): Compliance with technical protective measures and occupational health

Gender	Frequency	Frequency percentage
Female	78	23%
Male	262	77%
Total	340	100%
Age	**Frequency**	**Frequency percentage**
Below 25	9	3%
25-35	205	60%
35-45	122	36%
45 and above	4	1%
Total	340	100%
Work experience	**Frequency**	**Frequency percentage**
Less than 5 years	80	24%
5-10 years	128	38%
10-15 years	68	20%
15-20 years	64	19%
Over 20 years	17	5%
Total	340	100%
Education level	**Frequency**	**Frequency percentage**
Diploma	26	8%
College associate	106	31%
Bachelor's degree	181	53%
Master's and above	26	8%
Total	340	100%
Organizational position	**Frequency**	**Frequency percentage**
Deputy and manager	4	1%
Director and supervisor	84	25%
Expert/specialist	137	40%
Employee and worker	115	34%
Total	340	100%
Organizational position	**Frequency**	**Frequency percentage**
Manufacturing and support	218	64%
Administrative and headquarters	122	36%
Total	340	100%

Table 1. Overview of respondents

Variable	Mean	Median	Standard deviation	Minimum value	Maximum value
HR hiring procedure	1.91	2.00	0.74	1.00	4.00
HR training procedure	2.47	2.00	0.83	1.00	5.00
Compliance with technical protective measures and occupational health	2.16	2.00	0.79	1.00	5.00
Compliance with managerial factors	2.09	2.00	0.70	1.00	4.00

Table 2. Overview of research variables

Variable	Kolmogorov-Smirnov statistic	Significance level
HR hiring procedure	2.072	0.003
HR training procedure	2.031	0.001
Compliance with technical protective measures and occupational health	1.976	0.010
Compliance with managerial factors	2.042	0.002

Table 3. Normal distribution of data examined through Kolmogorov-Smirnov test

has a significant effect on the reduction of occupational accidents and frequency rate.

Given the significance level (P-value) in Table (4), this value is less than 0.05 for compliance with technical protective measures and occupational health. Therefore, the null hypothesis is rejected and the alternative hypothesis is proven.

Hypothesis (4): Compliance with managerial factors has a significant effect on the reduction of occupational accidents and frequency rate.

Given the significance level (P-value) in Table (4), this value is less than 0.05 for compliance with managerial factors. Therefore, the null hypothesis is rejected and the alternative hypothesis is proven.

Since the organizational factors, i.e. HR hiring procedure, HR training, compliance with technical protective measures and occupational health and compliance with managerial factors, were considered four independent factors, the parameters associated with these factors were rated through Kruskal-Wallis rank test. Table (5) specified 5 top ranking factors.

Moreover, the Kruskal-Wallis value in Table (5) displays the significance level of standards at zero, which reflects the effects of main research criteria on the dependent variable, i.e. reducing the frequency rate of accidents at a confidence level of 95%. Figure (1) illustrates the rankings of main criteria through Kruskal-Wallis test.

Given that each sub-index of main indices is interdependent, they should be ranked through Friedman test (17). Therefore, each sub-index was ranked as follows:

Among the sub-indices of HR hiring, examinations and tests before and during recruitment and legal requirements had the greatest effects (ranking 7.96) on reducing the frequency rate of accidents. Compliance with safety precautions and occupational health in organizational substitutions (aimed at matching jobs and individual competencies) ranked the sec-

Variable	Spearman's correlation coefficient	P-Value	Results
HR hiring procedure	0.639	0.000	Positive significance
HR training procedure	0.793	0.000	Positive significance
Compliance with technical protective measures and occupational health	0.689	0.000	Positive significance
Compliance with managerial factors	0.690	0.000	Positive significance

Table 4. Hypothesis testing through Spearman correlation test

Variable	Ranking according to Kruskal-Wallis test
HR hiring procedure	73.09
HR training procedure	132.13
Compliance with technical protective measures and occupational health	102.16
Compliance with managerial factors	94.62
Significance level for the 4 criteria	0.000

Table 5. Ranking of the main research criteria through Kruskal-Wallis test

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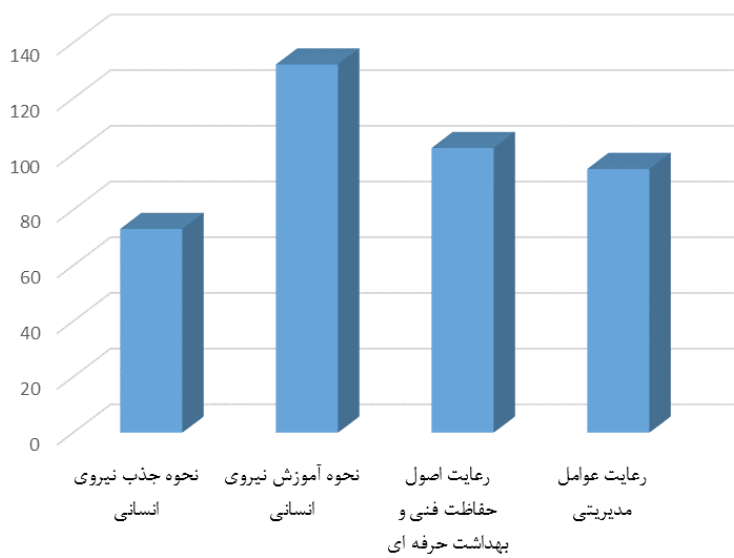

Figure 1. Ranking of the main research criteria through Kruskal-Wallis test

ond most effective factor (6.01). Compliance with laws and regulations for the classification of hard and hazardous jobs had the lowest effect among the HR hiring indices (3.91)

The link between the accidents at the workplace and inadequate safety training and occupational health had the greatest effect on reducing the frequency rate of accidents (8.93). The well-defined responsibility of monitoring over the efficient administration of training courses concerning occupational health and compliance with safety regulations had the smallest effects on reducing accidents with rankings of 4.09 and 3.93 respectively.

Among the sub-indices of compliance with technical protective measures and occupational health, knowledge of direct and indirect contractors with occupational health and safety rules (ranking 3.72) and the knowledge of safety regulations and legal requirements, technical safety and occupational health and familiarity with national and international standards related to occupational health and safety issues (ranking 3.76) had the lowest impacts on reducing the frequency rate of accidents. The link between the events at the workplace and inadequate knowledge of technical safety rules and regulations had the greatest effect on the dependent variable (9.58).

Among the managerial factors, the link between events at the workplace and inadequate knowledge of technical safety rules and regulations (9.70) had the greatest effect whereas familiarity with emergency situations and appropriate response (3.75) had the smallest effect on reducing the frequency rate of accidents.

Discussion

Given the statistics concerning work-related accidents and frequency rates at Zamyad Co., which are far higher than the optimum levels, four major organizational factors are involved in the occurrence of work-related accidents.

The first hypothesis suggested that there is a positive relationship between HR hiring procedure and the reduction of accidents at 0.639. In other words, HR hiring procedure has a positive relationship with work-related accidents and the reduction of frequency rate. Given the assumed significance level of 0.000, this relationship is true at a confidence level of 95%.

The results of Spearman correlation for the second hypothesis showed that HR training procedure has a significant relationship with the reduction of work-related accidents at a confidence level of 95%. The effect of HR training procedure on lower accidents and subsequently the frequency rate had a positive relationship at 0.793.

The Spearman test on the third hypothesis suggested that there is a significant relationship between compliance with technical protective measures and occupational health on the reduction of occupational accidents and incidents and frequency rate at a confidence level of 95%. The relationship of this parameter with reducing work-related accidents and frequency rate was positive at 0.689. In other words, compliance with technical protective measures and occupational health leave a direct effect on reducing the frequency rate of work-related accidents. The fourth hypothesis was similarly proven, i.e. the effect was significant at a confidence level of 95%.

The results demonstrated that compliance with managerial factors positively affected the reduction of frequency rate at 0.690. Furthermore, the highest positive correlation with the frequency rate of accidents was covered by HR training procedure, followed by technical protective measures and occupational health, compliance with managerial factors and HR hiring procedure.

Figure (1) prioritizes the main criteria and their relationships with the reduction of work-related accidents.

Conclusions

This study intended to examine the organizational factors contributing to reduce work-related accidents in in Zamyad Co., an Iranian Commercial Vehicle Manufacturing Company. According to the results, it can be argued that

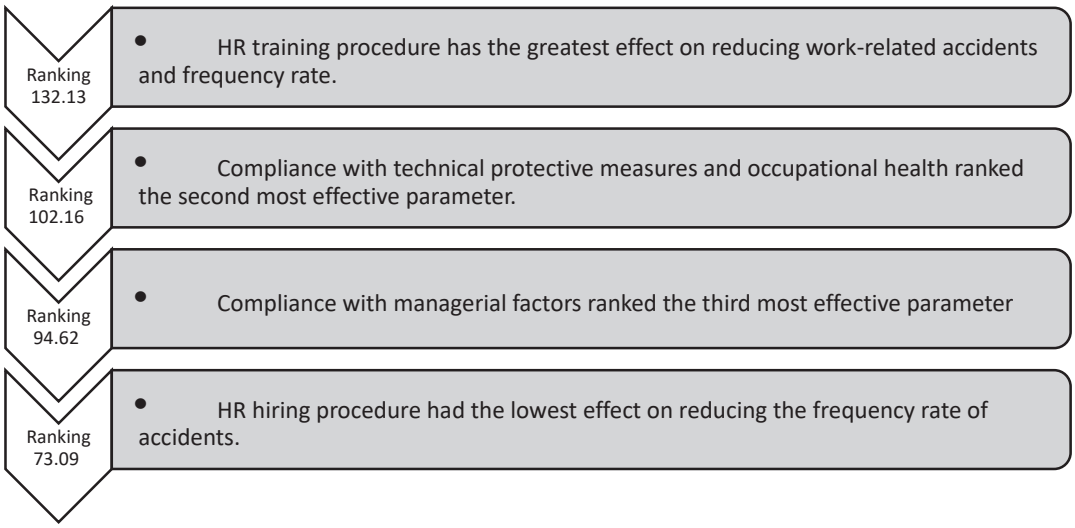

Figure 1. Ranking of the main criteria and the significance of relationships between the four parameters

there is a direct relationship between the independent organizational variables, i.e. HR hiring procedure, HR training procedure, compliance with technical protective measures and occupational health, and managerial factors, and the dependent variable (the frequency rate of work-related accidents). Moreover, it was proven that the organizational factors affected the frequency rate of accidents. Therefore, it is critical to adopt decisions in line with the improvement of organizational factors, which in turn can curb occupational accidents. Future studies are recommended to explore different organizational factors contributing to work-related accidents.

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