

Evidence-Based Workplace Accidents: A Case Study at The Industrial Company

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Abstract— This study aims to evaluate the effect of optimizing the work environment in reducing the percentage of job accidents in industrial companies. Based on adopting efficient occupational health and safety procedures. Also, it had identified factors that have a risk level upon the staff lives. This study had targeted eight various electronics and mechanical industrial factories. Quantitative statistical methods had used to analyzed data collected by the questionnaire. A conceptual framework had formulated to identify the causes of the sudden job accident and its effect upon worker safety. It includes “Four variables” were the current work environment, work accidents, occupational health and safety procedures, and health insurance. The main suggestion is the industrial company needs to adopt the OHSE standard 45001. Based on quantitative analysis methods to evaluate the level of risk-based work accidents.

Index Terms— Occupational Health and Safety, Risk-based work environment, Work environment, Job accidents, Improving quality, safety procedures, Industrial company

1 INTRODUCTION

Work environment management is considered an important factor that contributes to maximizing the value of the organization. This includes improving its performance, quality, increasing its productivity, and staff satisfaction [9], [19]. In 1991, the term environmental management has appeared first time by Porter (1991) study that argued the need for industrial organizations to adopt the idea of environmental responsibility by maintain the environment and improve the workplace to reduce environmental pollution. At the time, most of the organizations believe that improving environmental performance needs to financial investment. The managers must adopt various production strategies to address the critical problems that affect the operation or production under normal workplace environmental conditions. Then theoretical and practical studies focused on investigating an organization's performance within various environmental techniques to reduce pollution and waste [13], [37].

The workplace environment is constrained by organizational factors such as; the organizational structure, organizational performance, lack of resources, the classification of dysfunctions, the frequent rapid organizational changes, the overtime, and lack of opportunities for career advancement [7], [12]. In general, there are several factors that affect the workplace environment. For example, increasing the workforce turnover rate, absenteeism, illness, and request to change the job place [20], [29]. Likewise, (46%) of female employees had out of their office due to illness or absent for more than 60 days due to the heavy workloads, and the inability to accomplish difficult tasks due to the physiological composition of the woman's body [21]. In addition to often of the staff had suffered from psychological problems and job stress [16].

The workplace environment plays a fundamental role in maintaining the health and welfare of employees. There is a strong relationship between office design, job satisfaction, and performance improvement. For example, in the European countries, most of the employer spends approximately (40%) at the office hours, which may lead to exposing employees to psychological and social influences on a personal level, or relationships with direct managers and coworkers [7]. For this reason, it's important to adopt safety standards in reducing the costs of work accidents in electrical industries [8]. It also considered an efficient and integrated method in conducting the internal health and safety audit process, and it applies to complex work systems in the hydroelectric generation sector [37]. Globally, the work environment is addressed within the social responsibility task at an industrial organization to ensure the worker's safety and the reduction of job accidents. For this reason, this study had applied based on staff experiences about the effect of improving the industrial work environment in reducing workplace accidents

2 METHODOLOGY

This study selected eight various industrial factories was; Electrical generators, structures plant, low voltage plant, medium voltage plant, electrostatic powder coating, power supply plant, electronics plant, and mechanical manufacture. In addition to the automation and control system, the environment and occupational safety, and maintenance departments. The percentage of participants in the questionnaire were (40%) of engineers, (33%) of the executive's manager, and (27%) from various other professional specializations, as shown in Fig. 1. The quantitative statistical methods used to analyse the collected data by a survey questionnaire. A questionnaire form had designed based on “Four” main factors, which has a direct impact on identifying the main causes of sudden job accidents. Based on an evaluation of the effectiveness of the chosen industrial work environment. The questionnaire included (25) questions related to key study varia-

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bles; (1) work accidents (2) the current work environment, (3) occupational health and safety pro-cedures, and (4) the health insurance. A questionnaire mod-el considered an effective tool in examine the risk-based in-dustrial work environment. Its contributed to identified a critical factors that cause job acci-dents. A quantitative and descriptive analysis is used to ana-lyse participant respons-es. The correlation coefficients and linear regression were obtained using SPSS v. 23 programs. In addition, previous studies had approved in the theoretical area. Research ethics approval obtained to apply this study in the selected indus-trial, interview managers and staff.

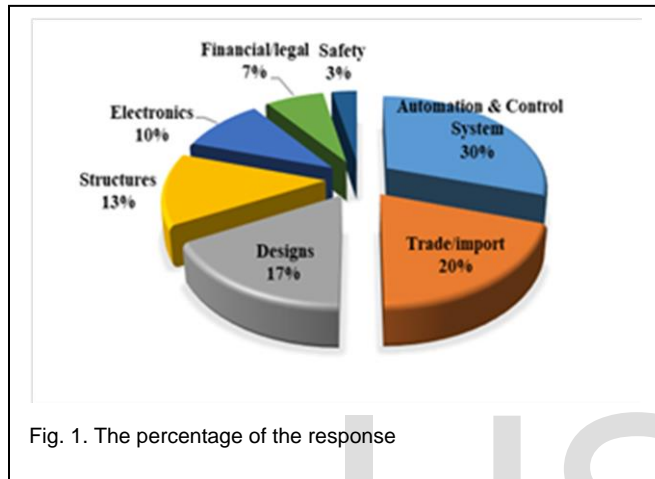


Fig. 1. The percentage of the response

3 THEORETICAL BACKGROUND

3.1 Workplace Environment

In 1902, Pearson study had confirmed the importance of the positive work environment in increasing the organiza-tion's performance. This includes rise employee satisfac-tion, coop-eration among colleagues, promoting organiza-tional affilia-tion, increased job performance, developing in-novation and career creativity, organizational commitment, and increased productivity. Beside on reducing the "bureau-cratic patholo-gies" [22]. Then, in the 1990s, the term envi-ronmental man-agement had become more common. It's focused on solving issues and providing practical experi-ence to governments and senior leadership. In spite of this, it's still a need for more practical studies related to avoiding the risks of the work envi-ronment and maintaining the oc-cupational safety of workers as a resulting of industrial pol-lution and professional risks experienced by employees dur-ing the performance their jobs [4].

3.2 Risk-Based Work Environment

The work environment can be classified according to the or-ganizational structure, size, office design, and the type of product, or service. Frequently, there is a strong relationship between work office design and employee performance. In this context, the first type is the official workplace environ-ment that has a good outlook, comfortable, clean, nice loca-tion, and a lower level of job risk. The second type is an ex-ternal job location with difficult environmental conditions like

dust and noise, breaking rocks, and black coal- mines, etc. likewise, an underground workplace location often has an unfortunate characterized include its design, a severe shortage of harmful gases, and a lack of healthy air outlets and lighting [23]. Thus lead to exposing the workers to greenhouse gas emissions and higher temperatures during the production, processing, transport, storage, handling, transportation, and distribution of fuel. Besides, they are dealing with heavy equipment and working long hours within narrow and closed spaces throughout the work peri-od [24]. Furthermore, the level of the risks is increasing in the work environment that dealing with chemicals and explo-sives like arms factories. For these reasons, an industrial company needs to adopt a modern style in designing a work environment that has a high level of risk for the employees' lives to reduce sudden job accident risks. These improve-ments must include the external work environment and not being restricted to organizational operat-ing systems [10].

3.3 Work Accidents

Currently, industrial companies seek to improve their work environment to reduce the percentage of sudden work acci-dents [28]. Work accidents defined as "a sudden event during carrying out a professional task, which may lead to physical harm or mental injury or caused death". It also includes all accidents that have occurred outside of the office, acute poi-soning, road accidents, transport, and if caused by third par-ties [17]. In European factories, risk management, a job acci-dent, workplace prevention is considered as a part of the so-cial responsibility of the industry companies [14]. In the con-text of job accidents, the Aires et al., (2010) study had high-lighted critical findings was at least 60,000 workers' death by workplace accidents each year across the world. This means (person death: 10 minutes, and one out of every six mortal workplace accidents). Around 25%-40% of all deadly work-place accidents occur has monitored at the manufacturing lo-cations. Based on the fourth European survey of work condi-tions by OSHA (2007) had reported, 35% of all industrial workplaces have a health risk, and 30% of industrial workers have been suffering from pains, backaches, and muscular-skeletal problems [1], as shows in Fig. 2.

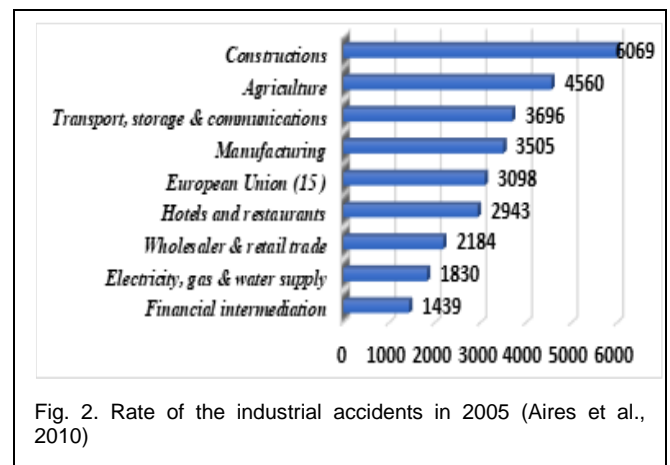


Fig. 2. Rate of the industrial accidents in 2005 (Aires et al., 2010)

Likewise, Norazahar et al., (2014) study indication, in the Gulf of Mexico more than 1200 oil and gas drilling crew were injured and 41 were dead, as reported by the US Federal statistical report in the year 2006-2010. In the BP Deepwater Horizon explosion, (11) of the fatalities and several case of the injuries had reported due to insufficient emergency and well control monitoring training [3]. It is difficult to determine deaths due to sudden work accidents due to the difference in the registration of death cases at work locations. Where, a registering of the victim's death due to workplace accidents within; one day in the Netherlands, 30 days in Germany, 1.5 years in Spain, and 6 months in Poland [17].

Accordingly, there are many reasons for sudden work accidents. The most important were as follows [2], [16], [18], and [33]:-

1. The human error indicated as main reasons for work accidents due to the Job stress, physical exhaustion, stress, health issues, job challenges, and family problems.
2. Overtime hours during official holidays and celebrations may confuse the employee. Which leads to an inability to focus on their work. Because of the lack of balance between social responsibility towards family requirements and the performance of work duties. Thus may lead to psychological exhaustion, nervousness, anxiety, depression, and rather than stay on shift work.
3. Gender, work accidents vary according to the working gender. Its demonstration that women workers may experience injuries during work rather than men due to the physiological nature of a woman's body, health status, pregnancy, or a mother with children. Therefore, Japanese companies often prefer working women to be single.
4. Age, increased work accidents may be due to age, as the elderly employees are more probable to existence injured during work due to their health condition. Otherwise, Sámano-Ríos et al., (2019) had found that young worker has the highest professional injury rates compared with older age groups, according to evaluated 39 studies, which had evaluated different intervention on the (environmental, worker behavioural, and clinical).
5. Stakeholder's pressure that pushes an organization to adopt different environmental practices to raise the benefits and reducing the negative impacts.

3.4 Occupational health and safety

In the context of occupational safety and health (OSH), previous studies have confirmed that the research at the OSH has been progressed after 2001 due to the attempted industrial company to avoid work accidents and reduce its risk [32], [34]. In global industries, the term of occupational safety and health (OSH) related to protecting employees from work accidents, The research and development methods toward improving job environment, redesign workplace office, and personnel pro-

tection requirements [32]. In general, safety and health are also concerned with injury, disease, toxic materials, and the risk to humans' lives by a sudden accident or other dangerous hazards. Employees may suffer due to psychological and physiological problems. As well, stress had classified as a category of risk that may lead to work accidents, resulting in exhaustion, trouble and nervousness that causes a lack of focus during performing their work [15]. Usually, staff health may influenced by the industrial work environment [7].

Furthermore, Asad et al., (2018) study had argued the need to optimize the OSHs at the industrial company. It identified staff needs effective training programs at subject OSH, personal protection, and health awareness, special at oil and gas extraction industries. The major causes of accidents and sudden perils at the drilling location. It is difficult to inform and report these accidents to the administration in time due to the lack of communication [3]. For successful of the OSH procedures are required to identify employees' behaviours, their reflection, action, contemplation, and their work issues. Based on the estimated production processes and feedback. Its study establishes six procedures for effective safety measures as follows [6]:-

1. Modify OHS procedures vs for separate workplace locations.
2. Using a risk assessment to prioritize safety procedures by severity.
3. •Make simpler by limiting the total number of safety procedures used at any time.
4. Engage employees meaningfully in the development of safety procedures and related safety objectives.
5. Use a thoughtfully chosen mix of performance and outcome procedures.
6. Design the OHS procedures vs a specific effect of the safety culture.

4 RESULTS

This study attempted to evaluate the effect of improving the industrial work environment in reducing rates of sudden work accidents. The results established based on analysis of the cause of the sudden work accidents and its influence upon the employee's safety. A theoretical framework has formulated to clarifying the major causes of the sudden work accident, and its effect upon the workers' safety. Its include "Four variables" were; (1) the current work environment (2) work accidents (3) occupational health and safety procedures, and (4) the health insurance. The percentage of participants according to professional specialization was engineering (40%), administrative (33%), and others (27%). This study was targeted eight different industrial factories like electrical generators, structures plant, low voltage plant, medium voltage plant, electrostatic powder coating, power supply plant, electronics plant, and mechanical manufacture. In addition to the automation and control system, the environment and occupational safety, and maintenance departments. The research hypotheses have a proved. The relationship between these variables has obtained by using quantitative analysis methods such as descrip-

tive analysis, the correlation coefficient, and multiple linear regression.

4.1 Occupational Health and Safety Procedures

In this study, most of the selected industrial factories have difficult working environment conditions. There are also some of the activities carried out outside the factory location. Although, these industries are concerned with the realization of occupational health and safety procedures. This includes providing equipment and tools that contribute to protecting workers from work accidents. However, some of the workers' responses who is work at the factory's external location, or those whose work with the environment has problematic conditions as high temperatures and dealing with chemical materials and electrical that has a risk upon the worker's health, they reported may needs more procedure. Whereas, on average, (66%) of workers 'responses have indicated that (OHS) procedures to reduce the possibility of work accidents is applied in their industrial plants. This was as follows:-

- (13%) Safety instructions are clear to all employees,
- (15%) Availability of safety requirements like (tools) for workers,
- (14%) Safety requirements are available in all plants locations,
- (13%) of the workers had a training courses on occupational safety produced, and
- (11%) The voice warning, symbols, and signs are available at their location.

The following Fig. 3 shows the possibility of work injuries during a production process.



Although this result appears is relatively acceptable, but, there are (13%) of workers who stressed the need for more protective measures to reducing work accidents especially in external job locations that have a high-level risk upon the workers' life. Moreover, (22%) of the workers' responses do not have any experience or information about the professional safety procedures or their availability at their workplace. Which displays a

negative significant relationship. Their advice can presented as follows:-

- (10%) a lack of the available voice warning, symbols, and signs in some of the factories facilities
- (7%) of the workers needs a training courses on occupational safety produced
- (7%) of the employees stresses the need to provide more information periodically about safety procedures within his workplace location
- (5%) a lack of the available a safety supplies in all factories locations to avoid the sudden job accidents.
- (6%) a lack of the available a safety requirements for protecting workers life's.

4.2 Evaluated of the work environment

A quantitative investigation used to evaluate the causes and effects of sudden work accidents by the current work environment. The results show an increase in sudden work accidents due to the characteristics of the work environment for the surveyed factories. It is found there is a negative significant correlation ($r = -0.283$, $p < 0.002$). This means the current work environment needs to be improved the in order to reduce the rate of sudden work accidents. As, the work environment in these factories has a critical characterized. A challenging working environment in the context of workplace designing, buildings, facilities, rest areas, and gardens had been examining. On average, (61%) of the responses seem this procedure is suitable to him. While, (13%) of the responses does not interact with the work environment. Nevertheless, on average (26%) of the responses to this survey has suggested most of these manufactories needs to improve its current work environment as a resulting of the following reasons:-

- (7%) due to a lack of suitable electric lifts that enable workers to move easily between the factory buildings and facilities,
- (7%) due to a lack of offering adequate water supply devices in the office of workers and industrial factory.
- (4%) due a lack of comfort and suitable restaurants and break coffees for workers,
- (3%) due to a lack of comfort and suitable rest areas like gardens for workers,
- (3%) due to a lack of adequate air conditioning and heating system,
- (1%) due to lack of offering adequate lighting in employee offices and industrial laboratories, and
- (1%) due to a lack of offered an adequate ventilation system in the buildings.

4.3 The influence of work accidents upon employee lives

As apparent from these results, the current work environment that has a difficult climate may, it is one of the reasons for the sudden increase in work accidents. Which is probable that the lives of workers will expose to work risks. Participation in this questionnaire completely answered questions related to the average of the impact work accidents on the lives of workers during the past five years. Actually, (6%) of the workers had been injuries due to work accidents during the operation of

the machines throughout the period of his work in this factory. Likewise, (50%) of the responses indicated there were some of the workers has been injuries due to sudden work accidents last five years as appeared in the Fig. 4.

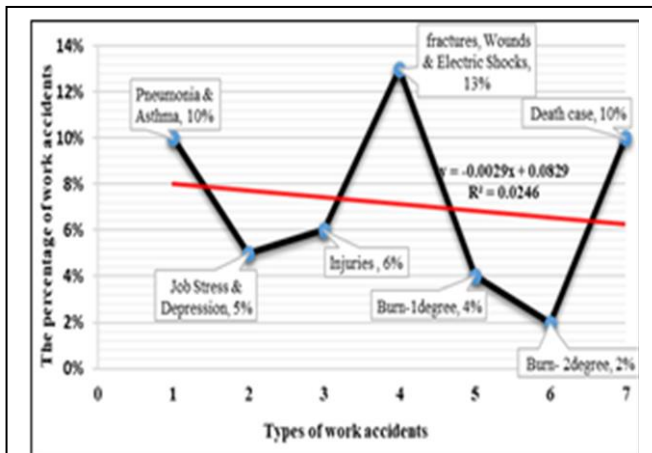


Fig. 4 The percentage of work accidents in industrial factories during five years

This result expected, according to their approved experiences that its range being from (27% was 15 years, 15% was 25 years, 11% was 30 years, and 4% was 36 years) of respondents who have worked in these factories. Most of their reported were as follows:-

- (13%) of the workers has been exposed injures identical bone fractures, wounds, and electric shocks,
- (10%) of the workers has been exposed to pneumonia and asthma, diseases due to direct dealing with chemicals materials and industrial pollution,
- (10%) of the workers' colleagues have been deaths as a resulted of the sudden work accidents,
- (6%) of the workers has been exposed injuries while operating the machine,
- (6%) of the workers suffered from burn injuries categorize as the first and second degree, and
- (5%) of the workers suffer from depression and job stress.

However, (31%) of the responses indicated a lack of work accidents at their workplaces. Because they works at the managerial departments such as finance, marketing, media, legal, administrative, quality, administrative planning and development, etc. Which, it is characterized has a low level of risk upon the workers lives. This is because of the nature of the work that only needs small stationery, paper files, and office equipment such as a photocopy or computers. Identically, (19%) of the workers did not have any information about the rate of work accidents.

4.4 The causes of work accidents

As it appears from Table 1, the results of the variance analysis

indicated that work accidents has impact by each the work environment, occupational safety measures, and health insurance policy. Based on the value ($F = 127.536$, $p < 0.000b$), which is considered a highly significant value. A value ($R^2 = 0.548$) gives a clear description for this model. This means (55%) of work accidents are affected by the changes in the work environment, professional safety procedure, and health insurance, compared with (45%) for other variables that have not discussed in this model.

TABLE 1
THE RESULTS OF THE VARIANCE ANALYSIS

ANOVAa					
Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	46.265	1	46.265	127.54	.000 ^b
Residual	38.090	105	.363		
Total	84.355	106			

a. Dependent Variable: Y, and b. Predictors: (Constant), x

Moreover, the results obtained by the coefficient correlation have supported all these arguments. As it proved that work accidents is more affected by industrial work environment rather than other variables according to Beta ($B = -291$, $t = -3.043$, $p < 0.003$) as shows in Table 2.

TABLE 2
CLARIFY THE COEFFICIENTS CORRELATION BETWEEN STUDY VARIABLES

Model	Unstandardized		Stand.	t	Sig.		
	Coefficients						
	B	Std. Error	Beta				
1	Constant	3.823	.575		6.643	.000	
	X1	-.313	.103	-.291	-3.043	.003	
	X2	.152	.116	.123	1.311	.193	
	X3	.046	.078	.057	.590	.556	
2	Constant	-.406	.356		-1.141	.256	
	X	1.044	.092	.741	11.293	.000	

a. Dependent Variable: Y

Furthermore, descriptive analysis results to estimate the relationship between each of work environment and worker safety were the relative importance of the independent variables that coded (X) was (77%), with (Mean = 3.779, SD = 0.632), in framework of the work environment, the procedures of the safety and health and the health insurance. This result indicates that most of the employees in these industrial factories are interested in continuous improvement in their work environment, which can help them to optimize their performance and productivity.

TABLE 3
CLARIFY THE DESCRIPTIVE RESULTS BASED ON THE CORRELATIONS BETWEEN THE STUDY VARIABLES

Descriptive Statistics		Correlations		
Vs	Mean	Std. Deviation	Pearson Value (Y)	Sig. (1-tailed)
Y	3.561	.892	1.000	.
X	3.799	.633	.741	.000
X1	3.159	.832	-.283	.002
X2	3.869	.721	.137	.080
X3	2.958	1.095	.005	.479

Where; N= 107

**Correlation is significant at the 0.01 level (2-tailed)

*Correlation is significant at the 0.05 level (2-tailed)

4.5 Health Insurance

The health insurance system used in industrial companies may not contribute to avoiding the sudden work accidents and its risk. Rather, it assistances in treating or compensating who is injures by the work accident. In developed countries especially identical Iraq industrial companies, the term health insurance still theoretically. The relative importance of the dependent variables coded the work accidents. As, the descriptive results of this study were approved a very weak positive relationship between health insurance and work accidents, with (Mean =2.958, SD = 1.095), with ($r = 0.005$, $p < .479$). On average (35%) of the responses, believes that the compensation system is matching with the level of occupational risks with regard to its function. In particular, the majority of professional jobs have the characteristics of official workplaces, such as administrative, legal, financial, and media jobs. Likewise, (21%) of the employee's responses indicated that they do not have enough information about health insurance and its benefits.

Actually, (44%) of the responses indicated that the current health insurance system applied in their factories needs to be an improvement. The Fig. 5 summarizes the most important proposals to improve the health insurance system that workers want in their factories. The health insurance used by the company is incompatible compared with the risk of work accidents. Based on, this improvement must to be covered compensation, which must address according into the level of the risk upon employees' lives, the categories of the risk allowance system, and annual health insurance. Accordingly, the results of the statistical analysis have demonstrated the validity and acceptability of the research hypotheses. The study's framework model also has approved.

Based on, this improvement must to be covered compensation, which must address according into the level of the risk upon employees' lives, the categories of the risk allowance system, and annual health insurance. Accordingly, the results of the statistical analysis have demonstrated the validity and acceptability of the research hypotheses. The study's frame-

work model also has approved. On average, the research hypothesis [H1] demonstrated there is a statistically significant correlation coefficient at the aggregate level is ($r = 0.741$, $p < 0.05$) between sudden work accidents and the work environment, OHS procedures, and health insurance policy used at a selected industrial company. The second hypothesis [H2] also had accepted, as it proved there is a statistically significant effect factor ($p = 0.000$) with correlation is significant at the 0.01 level. Which confirmed an increase in sudden work accidents was due to the characteristics of the current work environment, OHS procedures, and health insurance.

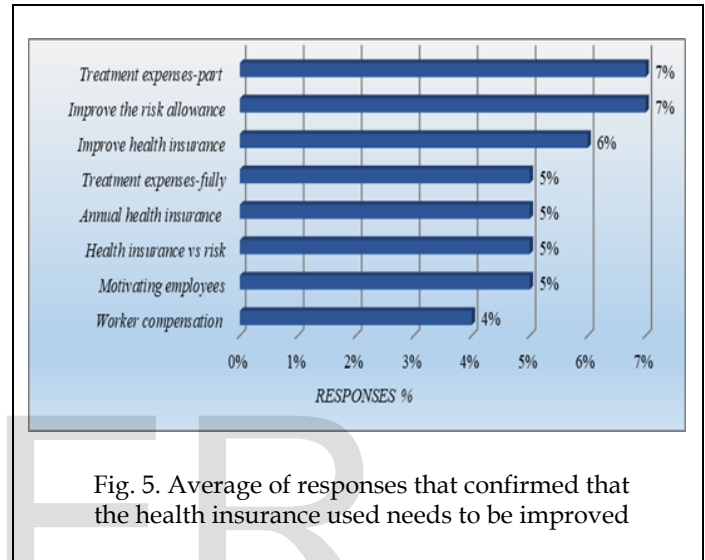


Fig. 5. Average of responses that confirmed that the health insurance used needs to be improved

5 DISCUSSION

This study focused on finding the established causes and effects of sudden work accidents in industrial companies in relative to the OHS procedures. Quantitative results of this study indicate there is a strong correlation between work variables as well. It also indirectly contributed to the inability to avoid sudden work accidents. In addition, this study found a negative relationship between the work environment and OHS procedures ($r=-.032$, $p= 0.372$). As well, there is a positive relationship between the work environment ($r=.212$, $p=0.14$). Accordingly, the results of the study indicate that these relationships between the variables may be invisible to the factory management.

In the context of the improving OHS procedures, the significant result is agree with Blair and O'Toole (2010) study that informed necessary to identify employees' behaviors and their reflection includes their action, contemplation, and their work and family issues based on the estimated production processes and feedback. Where there is difficulty in assessing and measuring the rate of industrial accidents related to job stress. Like these, important caused of sudden work accidents maybe ignored during the evaluation of the effectiveness of occupational safety and health measures. For example, present studies have informed an increased risk of work accidents on the

night shift and with long working hours. As, its display the peak work accident rates at around 1000, 1100, 1300, and 1600 [16]. Like this study, maybe need a more complex statistical analysis of the work accident, which involves more information about the actual working hours, confounding factors, effected accident statistics, and work activities schedule process.

In the industrial sector, most of the individual-related risks had occurred due to the unsafe behaviors of employees or human error [26]. It identifies a psychosocial risk factor that plays a significant role in underlying factors related to facilities design, organization, and job management [5]. This risk can affect the quality of organizations' performance beside to expose the lives of individuals to risks due to the sudden breakdown of machines while providing service to customers [27]. So, it is required to inform and documenting all the non-specific risks at the safety database [11]. Previous studies have proven that OHS procedures may be insufficient to avoid sudden work accidents, especially in industrial companies such as electric, oil, drilling, and mechanics (source). Likewise, "The International Labor Organization reported issues in 2017, across the industrial world, there were 160 million persons are suffering from work-related illnesses. Additionally, 270 million work-related accidents occur every year" [30]. Nevertheless, some industrial organizations across the world believe using the OHS separately may lead to counterproductive results such as to minimize efficiency and effectiveness, increases costs of implementing safety measures, and unnecessary bureaucracy [35]. Because, the shareholders will be getting the lower profits and returns due to increased investment in purchasing fixed assets, increased waiting time in production stages, lower level of staff performance, and lowest production quality [28].

6 CONCLUSION

This study has evaluated the level of work risks- related to employee safety in eight industrial facilities. As it has selected eight factories concerned with implementing occupational health and safety standards. Results indicate that adoption the OHS procedures can achieve several of the advantage for each of the industrial organizations, individuals, and communities, were as follows:-

- For the industrial organizations will be achieved a several of advantage includes a best OHS performance due to limitation of the working risks by adopting safer and healthier office and workplace designs. Which can help the administration to follow the work risks inside and external workplace location and control. Generating competitive advantages and promoting companies' value.
- For an individual is advantages are establishing a positive safety culture to the employees to optimize their performance. Developing communication related with informing the administration about the work accidents in time.

- For community will leads to improve environmental. In addition, it will enhance both of the environmental and manufactories outcomes due to reducing the effect of environmental including reducing waste and preventing pollution.

The most important recommendations are of this study of the industrial organizations that have different job characteristics. Which has a factory chain located in faraway from the central factory. It needs to apply the occupational health, safety, and environment (OHSE) standard 45001. Approving quantitative analysis methods in analysis risk-based work accidents. Adoption of the employee's health history and possible future diseases. To determine the extent of the possibility of exposure to diseases because of the impact of the work environment.

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