

## REVIEW ARTICLE

## INDUSTRIAL OCCUPATIONAL RISKS: APPLICATION STUDY IN RENEWABLE ENERGY COMPANIES

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### ABSTRACT

An organization's work environment is considered an essential factor in maximizing its value; therefore, a professional work environment ensures higher worker safety and fewer professional accidents by offering offices with suitable environment designs that contribute to maintaining the health and welfare of employees. Therefore, a new conceptual framework is introduced to identify the causes of sudden job accidents and their effect on employees' safety. This study develops an occupational safety model based on ISO 45001:2018 standards for optimizing the industrial professional work environment that seeks to adopt the Occupational Safety, Health, and Environment standards (OSHE) to reduce work accident risks like industrial companies of renewable energy and sustainability. This model identifies fundamental factors that have a risk level on workers' lives, which might expose staff lives to death, injury, and disability. These factors include the industrial professional environment, work accidents, current OSHE procedures, and the effectiveness of current health insurance.

Based on quantitative analysis methods to evaluate risk-based work accidents, this study proved a significant relationship between the characteristics of the industrial occupational environment in the selected factories and the increase in sudden work accidents. The main suggestion is that industrial company needs to adopt the OSHE ISO45001:2018 standards.

### KEYWORDS

OSHE, ISO-45001: 2018 Standards, Occupational Risk, Industrial Professional Environment, Environmental Sustainability, Occupational Health

## 1. INTRODUCTION

The work office environment is addressed within the social responsibility task in the industry sector to ensure the worker's safety and the reduction of professional accidents (Bautista-Bernal et al., 2021; Grishnova et al., 2021). A significant relationship between comfortable design for business offices and occupation satisfaction was revealed by Cheung (2022), leading to improved staff and organizational performance (Bodin Danielsson and Theorell, 2019). This includes a façade design for the building and its location, a spatial layout for indoor offices, office type, organizing the desk location, its distance from a window, window wall ratio, the comfort of one's furnishings, cleanliness, and the ratio of the available space (Bodin Danielsson and Theorell, 2019). The professional work environment is essential in maximizing the organization's value. This includes improving its performance, continuous quality improvement, productivity, and staff satisfaction (Basahal et al., 2022; Jaskiewicz and Tulenko, 2012; Chandrasekar, 2011). Therefore, most companies seek to offer work offices with suitable environment designs

that contribute to maintaining the health and welfare of employees (Cheung et al., 2022; Bodin Danielsson and Theorell, 2019).

The environmental management term was issued in 1995 by Porter and van der Linde (1995), proposing that most industrial companies are responsible for maintaining the environment and improving their business location to reduce environmental pollution, which may require the provision of financial investments (Guo and Jiang, 2022). Based on this, the managers must adopt various production strategies to address the critical issues that affect the operation or production that fit in with the standard professional work environment conditions (Wu et al., 2022; Mahmud et al., 2020). Then theoretical and practical studies focused on investigating companies' performance within various environmental techniques to reduce pollution and manufacture waste (Adomako and Tran, 2022; Watts et al., 2022; Vachon and Klassen, 2008; Fernández et al., 2003). Furthermore, the professional work environment is constrained by regulatory factors such as; productivity, the organizational structure, available resources, organizational change,

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and over time, opportunities for advancement are available to the organization within the competitive labor market (Gklati and Saiti, 2022; Bodin Danielsson and Theorell, 2019; Driskill, 2018).

Several factors affect the workplace environment, such as workforce turnover rate, illness, absenteeism, moving (Nagalingam and Sasikumar, 2019; Kujala et al., 2006), psychological problems, and job stress (Harrington, 2001). For example, in European countries, most employers spend approximately (40%) of their office hours, which may expose employees to psychological and social influences on a personal level or relationships with direct managers and coworkers (Bodin Danielsson and Theorell, 2019). Similarly, (46%) of female employees had been out of their office due to illness or being absent for more than 60 days due to the heavy workloads and the inability to accomplish complex tasks due to the physiological composition of the woman's body (Laaksonen et al., 2008).

Therefore, the above literature confirms the necessity of adopting safety standards to reduce the costs of work accidents in the electrical industries (Buica et al., 2012). It also can be applied in complex work systems like the hydroelectric generation sector (Vasilescu et al., 2012). Accordingly, this study suggests an active model for reducing work accidents in the industrial work environment, based on the evidence and experiences of experts and workforces in industrial companies of renewable energy and sustainability. That is considered an efficient and integrated method in conducting the internal health and safety audit process.

The rest of the paper is organized as follows: In Section 2, related literature on the safety issues for the industrial environment is presented. In Section 3, an effective occupational safety model that contributes to avoiding industrial work accidents is demonstrated. In section 4, a case study and results analysis and discussion are presented, followed by the conclusion and future work in the final section.

## 2. LITERATURE REVIEWS

This section focuses on the most related review and argument that contributed to the identified critical issues for the industrial environment. The occupational safety model proposed in this study includes industrial occupational environment, Industrial Occupations Risks, Occupational Safety, Health, and Environmental (OSHE) standards. It also suggests improving the environmental management system and applying occupational safety and health standards.

### 2.1 Industrial Occupational Environment

In the 1990s, the term environmental management had become more common. It solves issues and provides practical experience to governments and senior leadership. Despite this, there is still a need for more practical studies related to avoiding the risks of the business environment and maintaining the occupational safety of workers due to industrial pollution and professional risks experienced by employees during the performance of their jobs (Barrow, 2006). The importance of a positive business environment in maximizing corporate productivity was confirmed. This includes increased employee satisfaction, cooperation among colleagues, promoting organizational affiliation, increased job performance, development of innovation and career creativity, organizational commitment, and increased productivity, besides reducing the "bureaucratic pathologies" (Langer et al., 2019).

The work environment can be classified according to the governmental structure, size, office design, and product and/or service category. Frequently, there is a strong relationship between office design and employee performance. In this context, the first type is the office's environment is considered a comfortable workplace for the workforce. It has a good outlook, is clean, has an excellent location, and has a lower level of job risk. The second type is an external job location with challenging environmental conditions like dust and noise, breaking rocks, black coal- mines, etc. likewise, an underground workplace location often has an unfortunate characterize including its design, a severe shortage of harmful gases, and a lack of healthy air outlets and lighting (Lupu, 2012; Lupu et al., 2012). This exposes the workers to greenhouse gas emissions and higher temperatures during the

production, processing, transport, storage, handling, transportation, and fuel distribution. Besides, they deal with heavy equipment and work long hours within narrow and closed spaces throughout the work period (Lupu, 2012; Lupu et al., 2012).

Furthermore, the risks increase in the work environment that deals with chemicals and explosives, like arms factories. For these reasons, an industrial company needs to adopt a modern style in designing a work environment with a high level of risk for the employees' lives to reduce sudden job accident risks. These improvements must include the external work environment and not be restricted to organizational operating systems (Darnall et al., 2008). In this study, the work environment in the industrial companies of renewable energy and sustainability consists of multiple integrated factories with different operations processes and production lines. Therefore, this study attempts to develop the design of the internal work environment in a manner that is compatible with the nature of work. In addition, to provide a safe environment that reduces risks to workers. For example, in one of the selected factories, there is a production process dealing with chemical materials in the paint workshop, which has a high risk to workers' lives, e.g. Asthma, skin diseases, skin cancer, burns, poisoning, etc. Also, electrical stations are characterized by a very high risk due to their ability to explode during work or expose workers to electric shock.

### 2.2 Industrial Occupations Risks

Industrial corporations seek to improve their workplace environment to reduce sudden work accidents (Mkalaf and Al-Sabbagh, 2019). Work accidents are "a sudden event during a professional task, which may lead to physical harm or mental injury or caused death". It also includes all accidents that have occurred outside the office, acute poisoning, road accidents, transport, and if caused by third parties (Hola and Szostak, 2015). In European factories, risk management, job accident, and workplace prevention are considered a part of the social responsibility of the industry companies (Gander et al., 2011).

In the context of job accidents, the Aires et al. (2010) study highlighted critical findings that at least 60,000 workers die from workplace accidents each year. This means (person death: 10 minutes, and one out of every six mortal workplace accidents). Around 25%-40% of all deadly workplace accidents have been monitored at manufacturing locations. Based on the fourth European survey of work conditions, it has been reported that 35% of all industrial workplaces have a health risk, and 30% of industrial workers suffer from pains, backaches, and muscular-skeletal problems (Aires et al., 2010). As shown in Figure 1, Norazahar et al. (2014) indicated that 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 Deep-water Horizon explosion, (11) fatalities and several cases of injuries had reported due to insufficient emergency and well control monitoring training (Asad et al., 2018). It is challenging to determine deaths due to sudden work accidents due to the difference in the registration of death cases at work locations, where registration 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 six months in Poland (Hola and Szostak, 2015).

Accordingly, there are many reasons for sudden work accidents. The most important were as follows (Sarkis et al., 2010; Alamgir et al., 2007; Harrington, 2001; Islam et al., 2001):

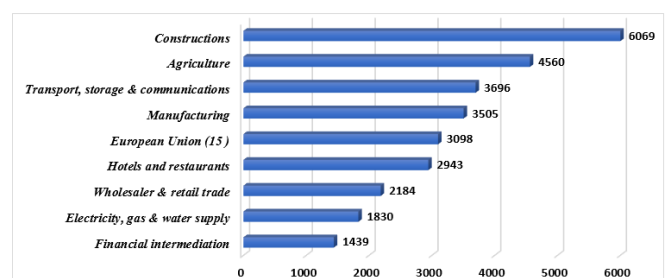


Figure 1: Rate of the Industrial Accidents in 2005(Aires et al., 2010)

- Gender, work accidents vary according to the working gender. It demonstrates 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.
- Age increased work accidents may be due to age, as elderly employees are more likely to existence injured during work due to their health conditions. Otherwise, Sámano-Ríos et al. (2019) found that young workers have the highest professional injury rates compared with older age groups, according to 39 studies that evaluated different interventions in the (environmental, individual behavior, and clinical).
- Human error is the main reason for work accidents due to Job stress, physical exhaustion, health issues, job challenges, and family problems.
- Overtime hours during official holidays and celebrations may confuse the employee. This leads to an inability to focus on their work due to the lack of balancing between the social responsibility towards family requirements and the performance of work duties. This may lead to psychological exhaustion, nervousness, anxiety, depression, and rather than stay on shift work.
- Stakeholder pressure pushes an organization to adopt different environmental practices to raise the benefits and reduce the negative impacts.

In summary, occupational safety and health program design is based on identifying the causes of these accidents. Workers must be recycled in proportion to gender if increasing work accidents due to gender. At the same time, is a need to increase professional training to reduce human errors during the operation of machines. In the future, this will increase the owner's profits and reduce compensation rates for work accidents.

### 2.3 Occupational Safety, Health, and Environmental Standards (OSHE)

In global industries, the term (OSH) is related to protecting employees from work accidents, research, and developing methods to improve the job environment, redesign workplace office, and personnel protection requirements (Sanchez et al., 2017). In the context of occupational safety and health OSH, previous studies have confirmed that the research at the OSH has progressed after 2001 due to the attempted industrial corporation to avoid work accidents and reduce the risk(Sanchez et al., 2017; Sousa et al., 2014). 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. Also, stress was 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 work (Goetsch, 2019). Usually, staff health may be influenced by the industrial work environment (Bodin Danielsson and Theorell, 2019).

Furthermore, Asad et al. (2018) study argued the need to optimize the OSHs in the industrial company. It identified that staff needs effective training programs on OSH, personal protection, and health awareness, special in oil and gas extraction industries. Its study establishes six procedures for adequate safety measures as follows (Blair and Toole, 2010), Modify OSH procedures vs (1) according to the characteristics and type of workplace environment, (2) using a risk assessment to prioritize safety procedures according to the level of its hazard, (3) balancing occupational safety procedures, (4) engage the employees to develop safety procedures (5) Adopting a comparison of organizational performance results with occupational safety procedures, and (6) Designing OSHE procedures which are close to the structure and organizational culture. The major causes of accidents and sudden perils at the drilling location. It is difficult to inform and report these accidents to the administration due to the lack of communication(Asad et al., 2018). For successful OSH, procedures must identify employees' behaviors, reflection, action, contemplation, and work issues. Based on the estimated production processes and feedback. So far, this study has selected the industrial companies of renewable energy and sustainability with an occupational safety and health department that currently applies OHS standers. To evaluate the effectiveness of

this section in applying occupational safety, health, and environment standards to reduce the rate of work accidents. Especially in external work accidents. That has contributed to the design of the conceptual and applied framework in the selected companies based on the study (Bodin Danielsson and Theorell, 2019; Asad et al., 2018).

### 3. METHODOLOGY

This study proposes an effective occupational safety model that contributes to avoiding industrial work accidents. This model was designed based on experts' and workforce's evidence and experiences in selected factories. This study targeted industrial companies for renewable energy and sustainability, including; electrical generators, medium voltage manufactory, low voltage manufactory, power supply manufactory, electronics manufactory, metal structure factories, electrostatic powder coating, and mechanical manufacturers and moulds, in addition to departments of the automation and control system, the environment and occupational safety, and maintenance. Out of 150 employees invited to practice in this study, 107 (71%) employees responded to this study. This percentage is acceptable for applied studies that the workplace environment has complexity characterized and the multiplicity of its work locations. The acceptable response rate was; (44%) for engineers, (30%) for the executive manager, and (26%) for other professional specializations. This study has designed an applicable conceptual model to analyze the risks associated with the industrial occupational environment, as demonstrated in Figure 1. It designs an applicable conceptual model to analyze the risks associated with the industrial occupational environment, as demonstrated in Figure 2.

The occupational safety model aims to improve industrial environment systems by identifying the work accident risks associated with an industrial environment. This model includes four variables: industrial occupational environment, Industrial Occupations Risks, Occupational health, safety and environmental standards, and health insurance. It is difficult to predict the potential work hazards in an industrial environment, although it is applied to occupational safety and health standards. So, this study has proven the necessity of determining the relationship and impact of these variables on increasing or reducing potential work accidents.

A quantitative and descriptive analysis is used to analyze participant responses. The quantitative statistical methods were used to analyze the collected data by a checklist, which is considered an effective method for examining the risk-based industrial work environment. It contributed to identifying critical factors that cause job accidents. The results were conducted by a correlation coefficient, linear regression, ANOVA, and T-test. So, the study variables were coded as dependent variables (Y= Industrial Occupations Risks), and independent variables were (X1= Industrial occupational environment, X2= OHSE standards, and X3= Health insurance).

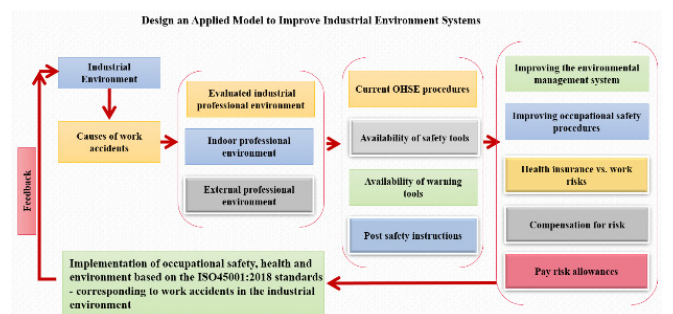
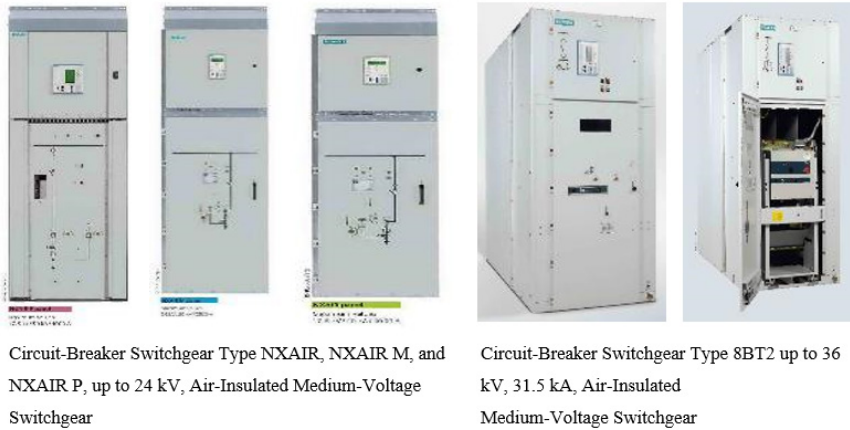


Figure 2: Design an Applied Model to Improve the Industrial Environment Systems VS Work Accidents

Where an investigation for optimizing the industrial environment by the following steps:

1. Evaluate the professional industrial environment. The work environment in industrial companies for renewable energy and sustainability is characterized by unexpected high risks, which may harm workers' lives, although these companies apply occupational



**Figure 3:** Shows Some of the Low and Medium Voltage Products

safety and health standards. It is classified into indoor and outdoor professional environments as it is difficult to successfully achieve the occupational health safety standards in the external work environment. The suitability of the work environment in the selected factories was also analyzed by available lighting in employee offices and industrial laboratories, the ventilation system, air conditioning, and heating system in the buildings, suitable rest areas like gardens for workers, comfort restaurants, and break coffees for workers, suitable electric lifts. This enables workers to move quickly between the factory buildings and facilities and offers suitable water supply devices in the office of workers and industrial factories.

2. Analyze the causes of workplace accidents based on these environments. Identified the influence of these accidents on the staff's lives based on the actual experiences of staff and work accident reports. The risks to staff lives include; injury, disability, death, burns, fractures, chronic diseases, carcinogenic diseases, and others.

3. Evaluate current occupational health and safety procedures used in selected factories. These procedures include testing the availability of safety requirements for protecting workers' lives like safety tools for workers, e.g. Ladders, and protective equipment for workers, including clothes, shoes, hats, and gloves. It also measures its effectiveness in reducing potential work accidents and the availability of warning tools in the manufactories locations like voice warnings, symbols, and signs in some of the factory's facilities. Post safety instructions and information periodically about safety procedures within workplace locations. Moreover, increasing the expertise and skills of employees through their participation in specialized training courses in occupational safety and health.

4. Evaluate the health insurance system used in selected factories. These tests included worker compensation, motivating employees, health insurance vs risk, annual health insurance, payment of the treatment expenses (full or partial), improved health insurance, and improving the risk allowance.

The study hypotheses are set to improve the industrial environment to avoid sudden workplace accidents and optimize the Occupational Safety, Health, and Environmental (OSHE) standards in the Renewable Energy and Sustainability Companies. The study hypotheses were:

H1: Did the current industrial work environment contribute to avoiding and predicting sudden work accidents?

H2: Did the current Occupational Safety, Health, and Environmental procedures contribute to avoiding and predicting sudden work accidents?

H3: Did the current health insurance system used in industrial companies contributes to avoiding sudden work accidents and its risk?

Furthermore, validity and reliability are significant for justifying and

demonstrating that the quantitative analysis methods used in this study are original and unique. Previous studies had been approved in the theoretical area. Research ethics approval was obtained to apply this study in the selected manufactories.

## 4. CASE STUDY AND RESULTS ANALYSIS AND DISCUSSION

### 4.1 Study Scope and Sampling

This study targeted Renewable Energy, and Sustainability Companies was established in 1988, consisting of six famous factories that are specialized and exported in the manufacture of low voltage switchgear, motor control center, power supplies, control panels, and printed circuit boards. Then, it has extended its product range to cover Medium voltage switchgear up to 33 kV, compact substations (KIOSK). In 2011, this company signed an agreement for technical cooperation and support for manufacturing (11KV/ 33KV) products, (NXAIR-11KV) products, and (8BT2-33KV) products with the German Siemens company. Currently, these companies target to reach total quality control by continuously improving their production process according to ISO 9001 recommendations. Also, it seeks to offer its clients an excellent quality/price ratio for specialized services, e.g. engineering designs for systems, installation supervision, and maintenance, after selling and providing clients with consulting services and technical support.

The electronics factory is implementing sub-activities to accomplish the task of electrical systems manufactured in the company. This includes the compilation of e-cards with one & double sides. Mosaic systems and electronic printed circuits (Mimic) with (Functional Tiles) method describe and display production processes in factories, laboratories, and control boards, signing and painting copper rods according to international standards. Manufacturing indicative signs with different sizes and materials (plastic, metal, wood, paper, and leather) using "the Silk Screen" or drilling by engraving machine.

Low Voltage factory was established in 1988 as one of the basic factories in this company, composed of engineers and technicians with experience with high electrical and low-voltage systems. This factory consists of three motor control, power systems, and self-control departments. The beneficiaries of the low-voltage plant products are the Ministry of Electricity, the Ministry of Oil, and the municipality Council.

Medium Voltage factory consists of three sectors, namely, 11KV Switchgear, 33KV Switchgear, and Compact Substation (KIOSK). It has highly specialized teams to install and operate the stations. It has a certification of ISO- 9001 for the year 2008. Figure 3 shows some of these products.

Automation & Control System was established in the early nineties. The target of its establishment was manufacturing control systems for programmed machines in productivity factories. Then it was expanded to include the work of modification and maintenance of programmed machines. After 2003 it had become oriented to develop the work of the

plant to include the operations of self-control (Automation) in addition to previous work and to serve the development and keep up with technological development for telecommunications, electricity, water, and sewer operations, including automation, design and manufacture and linking of (PLC) systems, as well as control and remote monitoring systems (SCADA) through (RTU) system. This factory consists of manufacturing, software, and on-site operating departments.

#### 4.2 Evaluated the work environment

Based on the evaluated causes and effects of sudden work accidents in the current work environment for the Industrial Companies for Renewable Energy. In this section, general descriptive statistics like "the Likert scale" were used to prove the first research hypothesis, whether the current industrial work environment contributes to avoiding and predicting sudden work accidents. A challenging working environment in workplace design, buildings, facilities, rest areas, and gardens had been examined.

Applied OHSE standards commensurate with the industrial environment's occupational risks. The results from the checklist show an increase in sudden work accidents due to the characteristics of the industrial environment. In total, 107 (71%) employees responded to this study, of 150 employees invited to practice in this study. This percentage is acceptable for applied studies that the workplace environment has complexity characterized and the multiplicity of its work locations. On average, (27%) of the respondents seem this procedure is suitable for them. In contrast, (13%) of the responses do not interact with the work environment. Nevertheless, on average (60%) of the responses to this study have suggested that most of these manufactories need to improve their current work environment as a result for the following reasons:

- (20%) due to lack of offering adequate lighting in employee offices and industrial laboratories, and
- (20%) due to a lack of offered an adequate ventilation system in the buildings.
- (17%) due to a lack of comfort and suitable rest areas like gardens for workers,
- (15%) due to a lack of adequate air conditioning and heating system,
- (13%) due to a lack of comfort and suitable restaurants and break coffees for workers,
- (9%) due to a lack of suitable electric lifts that enable workers to move quickly between the factory buildings and facilities, and
- (6%) due to a lack of offering adequate water supply devices in the office of workers and industrial factories.

#### 4.3 Current occupational safety, health, and environmental procedures

Similarly, this section proves the second hypothesis of whether the occupational safety and health procedures used in the selected industrial factories efficiently avoid sudden workplace accidents. Some activities are carried out outside the factory location, such as underground electrical cable installation, electrical power station installation, equipping governmental and private facilities with electrical stations, maintenance of electrical power stations located in external places, etc. Although, these industries are concerned with the realization of OSH procedures. This includes providing equipment and tools that contribute to protecting workers from work accidents. The worker's responses indicated that he suffers from the problematic conditions that characterize the external professional environment that risks the worker's health: high temperatures, exposure to electric shocks, and toxic and radioactive materials. On average, (61%) of workers stressed the need for more protective procedures to avoid sudden workplace accidents. Especially in external professional environments that have a high-level risk to the workers' life as a result of these reasons:-

- (70%) a lack of the available safety requirements for protecting

workers' lives.

- (67%) of the employees stress the need to publish more information periodically about safety procedures within his workplace location
- (67%) a lack of the available safety supplies in all factories locations to avoid sudden job accidents
- (63%) of the workers need a training course on OSHE.
- (54%) a lack of the available voice warning, symbols, and signs in some of the factory's facilities.

Moreover, (23%) of the workers' respondents do not have any experience or information about the professional safety procedures or their availability at their workplace, which displays a significant negative relationship.

#### 4.4 The influence of work accidents on employee lives

In general, industrial companies for renewable energy has a complex professional environment. This requires working in difficult climatic conditions, especially in external locations that are considered a reason for an increase in sudden work accidents and may expose the staff's lives to risk. This study proved a significant relationship between the characteristics of the industrial occupational environment in the selected factories and the increase in sudden work accidents. So, a sudden work accident investigation was obtained based on the experiences of engineers, managers, and operators who functioned in selected factories from 15 to 36 years. It can be concluded that 19% of the employees have experienced a severe accident during the machine's operation during work in such factories. Likewise, (52%) of the respondents indicated injured or dead workers due to sudden work accidents last five years. Most of their reports were as follows:

- (25%) of the workers has been exposed to injuries, identical bone fractures, wounds, electric shocks,
- (17%) of the workers' colleagues have deaths as a result of sudden work accidents,
- (19%) of the workers has been exposed to injuries while operating the machine
- (14%) of the workers has been exposed to pneumonia and asthma, diseases due to direct dealing with chemicals materials and industrial pollution,
- (12%) of the workers suffered from burn injuries categorized as the first and second degree, and
- (13%) of the workers suffer from depression and job stress.

However, (34%) of the respondents indicated a lack of work accidents at their workplaces because they work in managerial departments such as finance, marketing, media, legal, administrative, quality, administrative planning, development, etc., which is characterized as a low level of risk to the workers' lives. Identically, (14%) of the workers did not have any information about the rate of work accidents. 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.

#### 4.5 Investigate the causes of professional accidents

The study's primary objective is an investigation of the causes of professional accidents and their harm to staff lives. (1) Is there a relationship between occupational accidents and the current work environment. (2) Whether there is a relationship between occupational accidents and the correct implementation of occupational safety and health procedures. The results of the variance analysis between the study variables performance by descriptive statistics, coefficients correlation, ANOVA, and T-test. The variables were coded as dependent variables (Y= Industrial Occupations Risks), and independent variables were (X1= Industrial occupational environment, X2= OHSE standards,

Table 1: The Results of the Variance Analysis					
ANOVA					
Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	46.265	1	46.265	127.54	.000 <sup>b</sup>
Residual	38.090	105	.363	-	-
Total	84.355	106	-	-	-

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

Table 2: Clarify the Coefficients Correlation between Study Variables					
Model	Unstandardized		Stand.	t	Sig.
	Coefficients				
	B	Std. Error	Beta		
Constant	3.823	.575	-	6.643	.000
Work environment	-.313	.103	-.291	-3.043	.003
OSH procedures	.152	.116	.123	1.311	.193
Health insurance	.046	.078	.057	.590	.556
Constant	-.406	.356	-	-1.141	.256
X=X1+X2+X3	1.044	.092	.741	11.293	.000

a. Dependent Variable: Y= work accidents

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)
Work accidents	3.561	.892	1.000	.
X=X1+X2+X3	3.799	.633	.741	.000
Work environment	3.159	.832	-.283	.002
OSH procedures	3.869	.721	.137	.080
Health insurance	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)

and X3= Health insurance). Table 1 is shows the results of the variance analysis.

Table 1 clarifies the results of the variance analysis, indicating that work accidents impact 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<sup>2</sup> = 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 procedures, and health insurance, compared with (45%) for other variables that have not been discussed in this model.

In the framework of the work environment, the procedures of the safety, and health insurance. Moreover, the results obtained by the coefficient correlation have supported all these arguments as it proved that work accidents are more affected by the industrial work environment than other variables according to Beta (B = -.291, t = -3.043, p < 0.003), as shown in Table 2. Furthermore, descriptive analysis results to estimate the relationship between each work environment and worker safety was the relative importance of the independent variables that coded (X) was (77%), with (Mean = 3.779, SD = 0.632). 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 optimize their performance and productivity.

#### 4.6 Health Insurance

The health insurance system used in industrial companies may not contribute to avoiding sudden work accidents and its risk. Instead, it assists in treating or compensating those injured by a work accident. In developed countries, mainly identical Iraq industrial companies, the term health insurance is still theoretical. The study model is the installation that the most important occupational health and safety standards are the guarantees vs the occupational risks that workers are exposed to during work. So, this section aims to test the third hypothesis, "Did the current health insurance system used in industrial companies contribute to avoiding sudden work accidents and their risk?". The relative importance of the dependent variables coded the work accidents. Results performance by the descriptive statistics and coefficients correlation. The descriptive results of this study revealed a minor positive relationship between health insurance and work accidents, with (Mean =2.958, SD = 1.095), with (r = 0.005, p < .479).

On average (31%) of the respondents believe that the compensation system matches the level of occupational risks about its function. In particular, most professional jobs have the characteristics of official workplaces, such as administrative, legal, financial, and media jobs. Likewise, (22%) of the employee's responses indicated that they do not have enough information about health insurance and its benefits. (47%) The responses indicated that the current health insurance system in their factories needs to be improved. Figure 4 summarizes the most significant proposals to improve the health insurance system that workers want in their factories. The company's health insurance is incompatible with the risk of work accidents. Based on this improvement, compensation must be covered, which must be addressed according to the risk to employees' lives, the categories of the risk allowance system, and annual health insurance. Accordingly, the statistical analysis results have demonstrated validity, and the research hypotheses are accepted. The study's framework model also has been approved.

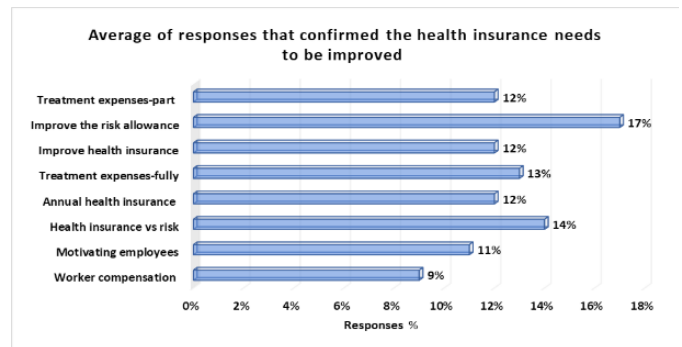


Figure 4: Average of Responses that Confirmed the Health Insurance Used Needs to be Improved

On average, the research hypothesis [H1] demonstrated there is a statistically significant correlation coefficient at the aggregate level (r = 0.741, p < 0.05) between sudden work accidents and the work environment, OSH procedures, and health insurance policy used at a selected industrial company. The second hypothesis [H2] was also accepted, as it proved 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.

#### 5. DISCUSSION

This study focused on the proven cause and effect of sudden job accidents in industrial corporations relative to the OSH procedures. The quantitative results indicated a strong correlation between work variables as well. It also indirectly contributed to avoiding the industrial occupation risks. In addition, this study found a negative relationship between the work environment and OSH procedures (r=-.032, p= 0.372). There is also a positive relationship between the work environment (r=.212, p=0.14).

Accordingly, the study results indicate that these relationships

between the variables may be invisible to the factory management. In improving OSH procedures, the significant result agrees with Blair and O'Toole's (2010) study that informed necessary to identify employees' behaviors and their reflections, including their actions, contemplation, 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 causes of sudden work accidents may be ignored when evaluating the effectiveness of occupational safety and health measures. For example, present studies have informed an increased risk of work accidents during the night shift and long working hours, displaying the peak work accident rates at around 1000, 1100, 1300, and 1600 (Harrington, 2001). This study might need a more advanced statistical analysis of the work accident, which involves more information about the actual working hours, confounding factors, affected accident statistics, and work activities schedule.

In the industrial sector, most individual-related risks occur due to employees' unsafe behavior or human error (Meng et al., 2019). It identifies a psychosocial risk factor that plays a significant role in issues related to facilities design, organization, and job management (Bergh et al., 2014). This risk can affect the quality of organizations' performance besides exposing the lives of individuals to risks due to the sudden breakdown of machines while providing service to customers (Mkalaf, 2020). So, it must inform and document all the non-specific risks in the safety database (Díaz-Soler et al., 2019).

Previous studies have proven that OSH 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, 160 million persons are suffering from work-related illnesses. Additionally, 270 million work-related accidents occur every year" (Nawwas et al., 2018). Nevertheless, some industrial organizations worldwide believe that using the OSH separately may lead to counterproductive results such as minimizing efficiency and effectiveness, increased costs of implementing safety measures, and unnecessary bureaucracy (Sui et al., 2018). Because the shareholders will be getting lower profits and returns due to increased investment in purchasing fixed assets, increased waiting time in production stages, lower staff performance, and lowest production quality (Mkalaf and Al-Sabbagh, 2019).

## 6. CONCLUSION AND FUTURE WORK

This study has established the appropriate methods to apply OSHE standard 45001 for "Industrial Companies for Renewable Energy and Sustainability". Therefore, it was selected eight industrial companies for renewable energy and sustainability" which concerned with implementing occupational health and safety standards, which sought to improve their current work environment to predict and avoid work accidents. That contributes to avoiding sudden work accidents that have risks to the employees' lives, adopting an occupational safety model based on analysing work accidents and identifying its risk to the employee's lives, and evaluating the current industrial environment. This model is applied in four stages, begins with the assessment of the current industrial work environment and its impact on reducing work accidents, analyzing the causes of work accidents, especially in the external work environment, and assessment of current occupational safety and health procedures used, and their impact on reducing work accidents in the industrial environment, compensation against work risks in Industrial environment and health insurance.

In industrial companies, this study has proven that applying occupational safety procedures is insufficient to reduce workplace accidents as its results confirmed that there are some faults in applying these procedures, especially in the external work environment. It is characterized by the difficulty of predicting potential work accidents despite taking all safety measures due to the challenges and constantly changing work environment. This confirms the need for these industrial companies to adopt safer methods to reduce workplace accidents.

Therefore, the critical result displayed that (19%) of staff have been exposed to a severe accident during their operating machines. Also,

there are (52%) of staff have been injured or died due to sudden work accidents last five years. On the other hand, Results indicated that adoption of the OSHE procedures could achieve several advantages for each of the industrial organizations, individuals, and communities, were as follows:

- Industrial organizations will be achieved several advantages, including the best OSHE performance due to the limitation of the operational risks, by adopting safer and healthier office and workplace designs. Which can help the administration follow the work risks inside and external workplace location and control, generate competitive advantages and promote companies' value.
- For an individual, its advantages are establishing a positive safety culture for the employees to optimize their performance by 50%, developing communication-related to inform the administration about work accidents in time. Improving work environment control systems allows recording more than 75% of work accidents.
- For community will leads to improve environmentally. In addition, it will enhance both the environmental and manufactories outcomes due to reducing the environmental effect, including reducing waste and preventing pollution ranging between 20%-40%.

On the other hand, several limitations faced this study, e.g. most work accidents are not recorded, especially in external work locations. Most diseases caused by work hazards in renewable energy and sustainability, such as asthma, skin diseases, depression, stress, etc., are not recorded and were classified as outside the scope of work accidents. In addition, no labor laws and regulations require the employer or factories' responsibility for occupational diseases afflicting the employee during his job. It is difficult for the external work environment to publish instructions and occupational safety procedures to workers. The workers need to constantly move between electric power locations during achieving their work or doing maintenance. Therefore, the skill of these workers is very weak to occupational health and safety requirements. As well as, most of the daily work accidents are not recorded and do not inform the factory administration.

Furthermore, most industrial companies refuse to provide researchers with data on work accidents because, like this study, it may affect their survival, growth, and competitiveness. Also, rarely applied research is concerned with analyzing the relationship between human errors and work accidents. This may be established as the main reason for increased work accidents. The most important recommendations of this study of the industrial organizations with different job characteristics, which has a factory chain located far away from the central factory. It needs to apply the occupational health, safety, and environment (OSHE) based on ISO45001:2018 standards, approving quantitative analysis methods in the analysis of risk-based work accidents, and adoption of the employee's health history and possible future diseases, in order to determine the extent of the possibility of exposure to diseases because of the impact of the work environment.

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