Chapter one

INTRODUCTION

1-1 Background of the study:

Health and safety is relevant to all branches of industry and particularly important for the construction industry. It has always been a major issue as it is considered as among the most exposed sectors when it comes to occupational accidents. Although tremendous improvements have been made in health and safety performance in some countries, the construction industry continues to lag behind most other industries. This has been the experience within most countries. The reality is that the construction industry continually has injury and fatality statistics that make it one of the most dangerous industries in which to work predominantly in developing countries.

It was recognized that the culture in the industry generally was not conducive to health and safety. Although previous studies have reported the contribution of construction project features to accident causation and the extent of their contribution, the insight into the health and safety (H&S) risk implications remains an elusive issue which needs elucidation. The nature of the construction work is dangerous and risky which make safety and health are issues to be considered and advocated the idea that safety and health of persons are no luxury but a necessity.

1-2 The Statement of Problem

Safety and health are always been a frequent issue in the construction industry due to its unique and dangerous nature. When there is a single contractor on site it would be easier to identify the responsibilities of the safety and can be managed. But in case of many contractors and absence of the main contractor would create new hazards on site.

1-3 Significant of the Study

Humanitarian concern, economic considerations and legal considerations are the main reasons which make the safety and health are important. So, injuries, illnesses, or damages due to accidents in construction industry are often costly in regard of financial and human terms.

When hiring many contractors to do symmetrical job in limited area make a cross of work through authorities and boundaries of site of each contractor, which generate another sort of construction hazards.

So, it's important to evaluate the safety regulations control the work environment.

1-4 Aim of Study

The aim of the study is to evaluate the regulations which followed in the construction safety and health performance when constructing residential complex.

1-5 Objectives and Design

Improved construction safety and the resulting cost benefits require more awareness and understanding by owners of:

- The economic impact of accidents and accident insurance costs on project costs.

- Criteria to be used in the evaluation of contractor safety performance.

- Criteria to be used to enhance contractor safety performance.

The study aims to:

1. Evaluate the existing safety procedures, regulations, policies, and accident prevention methods related to the construction of residential complex;

2. Understand the safety problems and danger of injuries that occur in concrete building construction in the Housing and Development Fund residential complex;

3. Identify the roots of problems in constructing residential complex; and

4. Recommend potential solutions and safety programs, estimating their likely effect on accident reduction and project progress.

1-6 Questions of the Study

- Does the Housing and Development Fund have regulations or policies applied on residential complex construction?
- How can they manage the risks when there are many different contractors in one construction site?

1-7 Rational of the Study

Recently, the Housing and Development Fund in Sudan steered toward ownership the people ready housing instead of empty areas.

1-8 Limitation of Study

The study is limit to companies work as contractors in constructing residential complex for the Housing and Development Fund (Al-awdaa project).

1-9 Basic Assumption of the Study

The study aimed only the contracting companies approved by the Housing and Development Fund to construct the residential complex.

1-10 Methodology of the Study

The study methodology will include steps, which can be summarized in the following points:

First, collect data via a questionnaire survey to assess the safety and health performance of construction companies and govern authorities, and to evaluate the factors that affect the safety and health performance identified in the literature review.

Second, perform analysis of data using appropriate statistical techniques.

Third, ranking results in relation to their importance, and testing the results for the degree of agreement.

Forth, Report and discuss results and major findings to introduce conclusions and recommendations.

1-11 The Organization of Study

This study is divided into five chapters, references and appendixes. It includes the following:

- Chapter One, presents an introduction to the study which includes: the background, the statement of the problem, significance, aim, objectives, questions, rational, limitations, assumptions, methodology, and the organization of study

- Chapter Two, presents the literature review which includes the history of safety and health performance in worldwide, in the Middle East, and in Sudan. Further, it includes the studies and researches which had been made to identifying the factors affecting the safety and health performance in the construction industry and in constructing residential complex.
- Chapter Three, discusses the study methodology which includes: information about the study design, study location, study population, pilot study, and the questionnaire design.
- Chapter Four, presents and discusses, the statistical data analysis of the results obtained from the questionnaire survey, and the tables and graphics deduced from statistical analysis and statistical results.
- Chapter Five, summarizes the results and major finding, to present the conclusions, recommendations of this research, and a proposal of future works.

Chapter Two

Literature Review

2-1 Introduction

First part of this chapter, describes the stages which health and safety issue came through since the early beginning. Moreover, it shows the performance of health and safety in the Middle East and then in Sudan. Second part demonstrates the factors affecting health and safety performance in construction of residential complex.

2.2 Health and safety definitions

Before a detailed discussion of health and safety issues can take place, some basic occupational health and safety definitions are required as well as the legal framework for health and safety because it seems important to have a clear understanding of the nature and working conditions in the construction industry and safety organizations to develop an efficient tool for health and safety issue.

Health is the protection of the bodies and minds of people from illness resulting from the materials, processes or procedures used in the workplace.

Safety is the protection of people from physical injury. The borderline between health and safety is ill-defined and the two words are normally used together to indicate concern for the physical and mental well-being of the individual at the place of work.

Welfare is the provision of facilities to maintain the health and well-being of individuals at the workplace.

Environmental protection is the arrangements to cover those activities in the workplace which affect the environment (in the form of flora, fauna, water, air and soil) and, possibly, the health and safety of employees and others. Such activities include waste and effluent disposal and atmospheric pollution.

Accident is defined by the Health and safety Executive (HSE, 2003) as ‗any unplanned event that results in injury or ill health of people, or damage or loss to property, plant, materials or the environment or a loss of a business opportunity'. In the UK, the Health and Safety Executive (HSE) is responsible for the enforcement of the Health and Safety at Work (HSW) Act and carrying out the day-to-day work to enable the Health and Safety Commission (HSS) to carry out its functions. The HSC is responsible for the promotion of the HSW and encouraging research, training, providing an information and advisory service. Other authorities define an accident more narrowly by excluding events that do not involve injury or ill-health.

However this research will always use the Health and Safety Executive definition.

Hazard and risk (Keng, 2004) is the potential of a substance, activity or process to cause harm. Hazards take many forms including, for example, chemicals, electricity and working from a ladder. A hazard can be ranked relative to other hazards or to a possible level of danger. A risk is the likelihood of a substance, activity or process to cause harm. A risk can be reduced and the hazard controlled by good management. It is very important to distinguish between a hazard and a risk as the two terms are often confused and activities such as construction work are called high risk when they are high hazard. Although the hazard will continue to be high, the risks will be reduced as controls are implemented.

The level of risk remaining when controls have been adopted is known as the residual risk. There should only be high residual risk where there is poor health and safety management and inadequate control measures.

2-3 History of Safety and Health

From early beginning till 1916, all works were under "the common laws", which made the employees were responsible about themselves and the risks of their works. After 1916, the workers' compensation law was deemed by the government which enforces the employers to be responsible for their workplaces' safety and health. Subsequently, the employers required to provide and pay for medical care and lost wages due to on-the-job incidents. This is a moral responsibility before it is a duty (Reese 2003). However, as the law enforce the employers to pay for injuries occurring on the work place, it will be better financially to stop the injuries from happening at first place. Eliminating the hazardous that exist in the work places was the first step to make an organized industrial safety movement. During the first twenty (20) years of the safety movement, the death rate declined significantly, (Petersen, 1971).

On April 1971, Occupational Safety and Health Act (OSHAct) became effective and applied to more than five (5) million businesses including sixty (60) million workers in U.S.A (Hammer & Price, 2000). Occupational health and safety (OHS) management protects the safety, health and welfare of people at the workplace. The International Labour Organization (ILO) and the World Health Organization (WHO) have shared a common definition of occupational health. The definition reads: "Occupational health should aim at: the promotion and maintenance of the highest degree

of physical, mental and social well-being of workers in all occupations; the prevention amongst workers of departures from health caused by their working conditions; the protection of workers in their employment from risks resulting from factors adverse to health; the placing and maintenance of the worker in an occupational environment adapted to his physiological and psychological capabilities; and, to summarize, the adaptation of work to man and of each man to his job" (Guidotti, 2011). Safety defined as the condition of being protected against any type of events (accidents) which could be considered non-desirable by controlling hazards to achieve an acceptable level of risk. Accident defined as some sudden and unexpected event taking place without expectation that causes injury, damages or death (Mwombeki, 2005).

In construction project management, it is well known that each construction project is unique. So, the occurrence of accidents is varying from project to another which means that: one site could be more dangerous than the other (Seixas, et al, 1998). For example, in United Kingdom (U.K), it was reported that in 2011 -2012, the construction industry had (49) fatal injuries accounts (28%) of fatal injuries of the industry sections. There were (2230) reported major injuries and (5391) reported over (3day) injuries. Even those numbers are lower than previous years, but still consider to be very high compared to another industry. Falls were the main cause of fatalities accidents. However, handling was the main cause of over three day injuries (HSE, 2013).

Table 2-1 The most common causes of injuries in U.K. - 2011-2012

Injury Kind	Fatalities	Major Injuries	Over Three Day Injuries
Falls	51%	29%	10%
Being struck by a falling/moving object	16%	13%	12%
A collapse	10%	-	-
Being hit by a moving vehicle	4%	-	-
Electricity	10%	-	-
Slips, trips and falls on the level	-	25%	23%
Handling	-	11%	31%

HSE 2013

Likewise, the working environment is constantly changing and inherent risks change daily (Jannadi & Bu-Khamsin, 2002).

Several organizations are setting guides, standards, regulations, and training for safety and health in the construction industry which can be implemented internationally or nationally according to the publishing organization and the local authority. For example of the organizations which are responsible for safety and health practices:

- In U.S.A: Occupational Safety and Health Administration (OSHA) for setting standards. The National Institute for Occupational Safety and Health (NIOSH) responsible for conducting researches and studies.
- In U.K: National Examination Board in Occupational Safety and Health (NEBOSH). The Institution of Occupational Safety and Health (IOSH) is an organization for health and safety professionals. International Institute of Risk and Safety Management (IIRSM) is a professional body for health and safety practitioners.
- In Asia Pacific Region: Asia Pacific Occupational Safety and Health Organization (APOSH) is an organization dedicated to promote occupational safety and health practices.
- In Australia: The Safety Institute of Australia (SIA) is professional body for health & safety professionals aims to develop, maintain and promote a body of knowledge that defines professional practice in Occupational health and safety (OHS).

The variance in occupational health and safety standards between different countries has been cited as a major route of the international transfer or acquisition of health risks (Alleyne, 1997).

2-4 Construction Safety and Health in the Middle East

Generally, the Middle East has the same safety and health conditions as those in developing countries. However, no one can deny that there are safety and health improvements in the construction industry for the last few years.

In the Kingdom of Saudi Arabia (K.S.A), the construction industry had (48%) of all occupational injuries in 2011. Further, (29%) of construction injuries were due to falling, while (32%) were due to struck by a falling/moving object (GOSI, 2011).

In Egypt, (33%) of construction injuries were found because of falling in 2008. Further, it is found that the work models used in construction firms in Egypt have a noticeable difference between those in the EU and U.S.A (ElSafty, et al., 2012).

A study of the Egyptian construction industry concluded that safety programs applied by contractors operating in Egypt were less formal and the accident insurance costs were fixed irrespective of the contractor 's safety performance (Hassanein & Hanna, 2008).

In Kuwait, it was found that tools accidents had (16.9%) of injuries and fall from ladder or scaffolding contributed (23.3%) of total construction injuries in 1999 (Al-Tabtabai, 2002). However, in 2007 it were found that falling were the major type of accident (33.2%) followed by being struck by falling/moving object (25.2%), then misuse of tools had (18.1%) (Al-Humaidi & Tan, 2010). It were observed that the problems arise due to: disorganized labour; poor accident record keeping and reporting system; the extensive use of foreign labours; the extensive use of subcontractors; lack of safety regulations and legislation; the low priority given to safety; the small size of most construction firms; competitive tendering; and severe weather conditions during the summer. Moreover, one of the most prevailing problems in Middle East countries is that workers and engineers receive almost no safety training and are mostly uninformed about the company's safety programs or policies, (Kartam, et al., 2000).

2-5 Construction Safety and Health in Sudan

Sudan hasn't signed most of international agreements (Khartoum work shop 2012), but in 1949 the Low of Craftsmen and Factories has been published which has been edited in 1976 as Industrial Craftsmen Law and then the Roster of Occupational Health. And, the Work Low has published in 1997 and combined with other laws which modified in 2011, (Ministry of Work).

Only few studies had been conducted in the construction industry about health and safety performance in Sudan. 77.33% of companies have no records of accidents; (Aljaaly, 2005).

2-6 Factors Affecting Safety and Health Performance

Extensive systems made by international organizations to identify the factors which affect the safety and health performance in construction industry as follow:

2-6-1 Complexity of the Design

Despite the fact that safety and health of workers considered to be the sole responsibility of the contractor, safety and health performance are largely dictated by designers' decisions. Designers shall take into their consideration how the project components will be assembled and how construction tasks are undertaken.

That is why it is very important that designers shall address the safety and health requirements into the design and before the project commence, (Hinze & Wiegand, 1992). In the other hand, safety and health performance improve when designers aware to the safety consequences of their design decisions. This leads to a reduction in injuries and associated costs and a decrease in redesign costs and in operating costs for special procedures and protective equipment.

2-6-2 The Type of Owners

Owners have a direct economic stake in the safety and health performance of their contractors because accident costs are an expense to the contractor and are passed on, one way or another, to the client. Moreover, owners have extended known an ethical duty to provide a safe work environment to reduce injuries. Therefore, owner can achieve this duty by signing contractors who have a record of good safety and health performance. Also, owners can take processes to accomplish better safety and health performance such as: provide safety and health guidelines that the contractor must follow;

Implement, the use of work permit systems for potentially harmful activities; Oblige the contractor to elect a responsible supervisor to coordinate safety in the workplace; Discuss safety at owner contractor meetings; Conduct safety audits during construction; Enforce prompt reporting and full investigation of accidents, (Report-A-3, 1982). (Hinze & Gambatese, 2003), concluded in their research in the USA that safety and health performance have better records when the owner is a private organization.

2-6-3 Weather conditions

Extreme weather conditions have direct effect on safety and health performance.

Sudan exposes to an extreme hot weather in the summer time as temperature reaches to 50 degree at sometimes.

Heat stress is a serious issue which has a remarkable effect on workers' health. In the USA, Occupational Safety and Health Administration (Federal OSHA) had recorded the heat-related fatalities between 2008 and June 2013. The record shows that in construction industry and its related works had (50) heat-related fatality cases out of total (96) cases, (OSHA 2013). There are signs for heat stress like: nausea, headache, fatigue, excessive thirst, profuse sweating, confusion, painful large muscle cramps and loss of consciousness. Those signs of heat stress can lead to heat cramps, heat exhaustion, or heatstroke, which if untreated or sufficiently severe, may lead to death, (Brake & Bates, 2002).

Moreover, the wind might cause disturbance in construction sites. A high speed wind can go along with sandstorms which eventually affect visualization and may lead to accidents. Further, workers who are directly exposed to wind like crane operators, scaffolders, or even who work on roofing, may get hurt if the appropriate precautions are not taken. So it is important to check the weather conditions in the working area several times a day to establish a wind speed at which work shall be suspended, (Neitzel, et al., 2001).

2-6-4 Project Cost

Under the traditional building procurement system, there is reason to explore substitute materials, procedures, and safety routes as a result of professional charges being interrelated to the final cost of the project. However, the cost of the time consumed in exploring substitutes may not be recovered from the owner under such procurement and contractual arrangements, (Wells, 1986).

In one hand, the construction industry tends to have a low awareness of the long term advantages of safe practice, while the tendering procedure frequently gives little consideration to safety, resulting in cost and corner cutting. On the other hand, competitive tendering usually results in the choice of the contractor who is ready to take the major risk or who has made the major mistake. Further, because of economic rewards and motivations to build more cheaply in the short-term, one of the first areas, unluckily, to experience cost cutting to recover the affordability of tenders is that of safety and health, (Porteous, 1999); (Site-Safe, 2000).

Decent codes and standards can improve construction safety and health at least cost. Then again, poor codes and standards can contribute to increased costs and disputes with slight impact on construction safety. These costs

and disputes arise from interruptions in construction progress, penalties for these interruptions, economic losses, personal injuries and fatalities. Research has shown that safe workplaces and workers increase productivity accompanied by reduced costs and increased profitability, (Levitt & Samelson, 1993); (Hinze, 1997).

2-6-5 Project Duration

Tight project schedule had high rank on safety performance of the project. Moreover, an impractical schedule can deeply affect the success of project objectives in terms of cost, quality, environment and safety. When accidents happen or conflictions between construction programs arise, the project schedule can be even more delayed. Apart from the actual costs acquired about injuries and fatalities, the national economy of any country suffers a massive indirect cost and loss of productivity due to the number of workdays lost as a result of occupational injuries and deaths, (Report-A-3, 1982). In addition, speed of work and target deadlines for the completion specified job, creates more injuries, (Hinze & Raboud, 1988).

2-6-6 Safety and Health Policy

A policy is an administrative belief used to set a path in an organization. It can be a sequence of actions and effective decisions. Variables correlated to organization policy are the most main group of factors affecting the safety performance in construction industry.

2-6-7 Accidents / Incidents / Near Miss Report

Managers can count on accident and incident reports broken down by single projects, which facilities evaluation among projects on the basis of accident frequency or any other measure of accident rate. This way, managers are kept knowledgeable about where accidents are occurring so that they can dedicate their responsiveness to problem areas, (Hassanein & Hanna, 2008). An accident is any unplanned event that results in injury or ill-health of people, or damage or loss to property, plant, materials or the environment or a loss of a business opportunity, (Hughes and Ferrett 2008).

2-6-8 Evacuation Plan / Fire drill

Evacuation plans are established to guarantee the safest and the most well organized evacuation time of all expected occupants of a structure.

However, a fire drill is a technique of practicing the evacuation of a structure for mainly a fire or any other emergency. Prior to construction starts, the contractors must take into consideration the possible risks that may arise on the construction site. Contractor's fire marshals should be aware of the fighting equipment available on the site and be familiar with its use, (Hislop, 1999)

. The evacuation plan shall include: site plans indicating assembly points, locations of fire hydrants and portable fire extinguishers, normal routes for the access of fire department's vehicles, emergency egress or escape routes, and procedures for counting the occupiers after the evacuation has been completed.

2-6-9 Risk Assessment

Several stakeholders are involved in the construction activities, long working hours, and the interaction between organizational and technological complexity generates enormous risks, (Zou, et al., 2007). Since construction activities are subjected to a lot of risks, it becomes vital that these risks essential to be assessed and managed through a structured risk assessment process. Risk assessment reflects the likelihood and severity that harm will occur from an identified hazard, so that appropriate controls may be taken based on the probability and severity of the potential hazard, (Colling, 1990). Risk assessment is a structured approach for identifying, evaluating and controlling hazards in the workplace (Chapman & Ward, 2004) with a view to reaching a better performance of no harm to people or damage to assets.

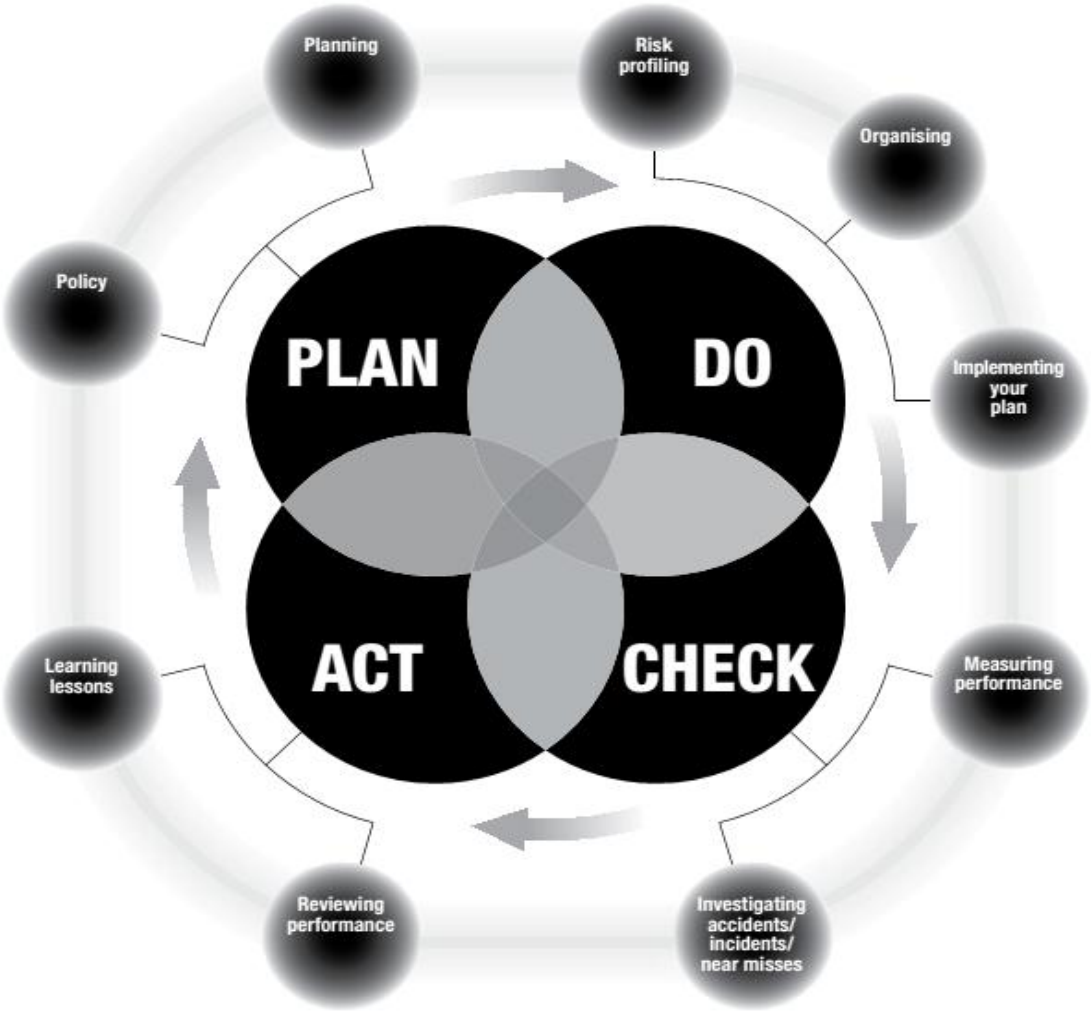


Figure 2-1 HSE 2013 MANAGEMENT FOR HEALTH AND SAFETY

2-6-10 Safety and Health Training

It is well recognized in the construction industry that training shows a significant role for enhancing the workers' safety and health performance. Training usually initiates with worker orientation and continues as workers need to become more educated about certain features of the work they are performing. For example, the training which is provided to certify the persons who are responsible for erecting or supervising the scaffolding, as it considers to be the most risky job in the construction sites. These training sessions can be conducted through various techniques like worker orientation, safety induction, toolbox talks, or communication programs. It may include topics such as worker rights and responsibilities, falls from elevation, hot work, Electrical safety, personal protective equipment, first aid and emergency procedures, confined space entry, and a

wide assortment of other topics, whether to be presented updated information or just to be provided as a refresher on a subject, (Hinze & Gambatese, 2003). Further, education and training sessions help workers to perform various activities efficiently. It also helps to establish a positive attitude towards safety and incorporates safety into production and quality goals, (Kartam, et al., 2000).

2-6-11 Personal Protective Equipment (PPE)

There are two categories of PPE. The first must be used safety helmet; safety shoes; and appropriate clothing. The second category depending kind of work, like eye protection, protective gloves, ear protectors, and the safety harness, (Jannadi & Bu-Khamsin, 2002). However, the law does not identify when or where the PPE should be worn; it leaves them to the contractors' decision. Climate plays an enormous role in the use of PPE. Hence, if construction workers are not satisfied with the PPE they have been provided, because it's uncomfortable, feels unsafe or slows productivity, then they are less likely to use it which dramatically increases the probability of injuries and illnesses, (Kenrick, 2012).

It is common in the construction industry that PPE means safety of workers. However, safety is all about how to create the appropriate environment in the workplace that PPE only to be considered as extra protections for the worst scenario might occur.

2-6-12 Emergency Planning and Procedures

Effective emergency planning needs the workers to be aware about the emergency procedures before a crisis occurs. It is the contractor's duties to ensure that all workers are aware about the proper response to fire and other serious emergencies.

One of the most factors affecting safety performance is emergency/disaster planning and preparation, (Jannadi & Bu-Khamsin, 2002). The emergency can be brought under control using the resource and procedures for the emergency response in place for the workplace, (Hislop, 1999).

2-6-13 Safety and Health Inspections

Safety and health inspections are a method by which management can become familiar with the nature of safety and health conditions on sites. Workplace safety and health inspections by competent persons are useful in terms of reducing work injuries, (Hinze & Gambatese, 2003). Further,

companies who implement safety and health inspections have fewer accidents than companies that do not perform inspections, (Reese, 2003).

2-6-14 Safety and Health Management Meetings

Regular safety and health meetings are essential for communicating safety and health data to all stakeholders. When the employee is convinced that his employer is concerned about the workplace safety, the employee will conform to safety and health guidelines and execute the work in a safe way, (Fang, et al., 2004).

Moreover, the projects that practice sophisticated schedules and those which included the owner for coordination meetings are having safer performances, (Hinze & Raboud, 1988).

2-6-15 First-Aid Arrangements

First-aid is a provision of primary care for an injury as it is regularly carried out by trained first aider to an injured person until definitive medical treatment can be reached if required. It is essential for each construction site to have the appropriate first aid arrangements. However, these arrangements would not eliminate the hazards but only to reduce the potential risk on the injured person which might be exposed. The first aid arrangements vary from construction site to another depending on the size and the workforce of the project.

2-6-16 Welfare Facilities

Work in the construction industry is demanding; it involves much manual or physical activity. It is also hazardous and dirty. Good welfare facilities not only improve workers' welfare but also enhance efficiency. Welfare facilities such as the provision of drinking-water, washing, sanitary and changing place, restrooms, smoking areas, first-aid arrangements and assistance in transport from place of residence to the work site and back, all support to reduce exhaustion and improve workers' health. So, the contactor needs to arrange for suitable welfare facilities for his workers' usages, prior starting the construction activities. Therefore, decent work-related welfare facilities improve workers' health and morale and their efficiency, resulting in enhanced productivity and better work relations, (ILO, 1995).

2-6-17 Safety Signals, Signs and Barricades

It is essential in all construction sites to have a uniform signaling system to be understood by all stakeholders to prevent danger. The symbols of signals should be appeared at suitable spots and also should be available in a safety booklet.

However, it is the contractor responsibility to ensure that all stakeholders are aware about all signals that they should recognize, (Tam, et al., 2003).

Warnings in the forms of signs and symbols have been recognized as one of the effective tools to influence behavior and develop the risk awareness of stakeholders.

Understanding signs will provide valuable information in refinement the safety and health management strategies for the construction industry. Safety signs usually contain four components: signal words, hazard statement, noncompliance statement and some instructions. Moreover, colors of warning labels should attract the attention of viewers. Different signal colours characterize different ranks of risk because of the consequences of cultural effect or physiological reactions. Usually, red characterizes the highest rank of hazard, followed by orange, yellow, green, blue and white, (Edworthy & Adams, 1996). In addition, warning labels should have signal words, such as danger, caution and instruction, to recognize the ranks of hazard. Usually, danger represents the highest rank of hazard, caution points to an intermediate rank and instruction indicates the lowest rank, (Chapanis, 1994).

The Work at Height Regulations 2005 applies to all work at height where there is a risk of a fall liable to cause personal injury. The scaffolding needs to be checked prior to being used for the first time, following exposure to weather conditions, after substantial addition, dismantling or other alteration and at intervals not exceeding (7) days from the date of last inspection. So it was essential to produce a special signal system to be recognized by scaffolding users. The Scafftag system ensures all workers understand the current status of the structure. A Scafftag should be fitted at all ladder access thereby communicating a safety message to all.

2-6-18 Work environment

Normally, authority guidelines effectively address the work environment and procedures to ensure a better level of protection. However, it is not just

a matter of meeting minimum standards and codes lay down by authority. It requires stakeholders to go further and place their own standards and increase the responsibilities and the involvement of all parties, (Lorent, 1999).

A better working environment can be produced by setting a tide site. Aspects of a tide site that need to be identified are contain the following: access and traffic routes, material and storage handling, site offices and services, the construction plant, production workshops, services and facilities, and the site attachment.

The high quality work environment will improve the housekeeping and reduce the accident frequency rates. Also, poor housekeeping and the untidy construction sites had the largest contributing factors to accidents, (Site Safe, 1999).

2-6-19 Reward and Punishment System (Incentives)

Incentives are one of the factors that motivate workers to perform in an anticipated manner to safety and health rules on site. It can be viewed a psychological approach that rewards workers for their adhered routine on site, (Chan, et al., 2010). Incentives program consists of three (3) main features: monetary, nonmonetary, and disciplinary action. Monetary and non-monetary are forms of reward which capable to improve safety and health performance as it encourages workers to monitor their own safety behavior. However, disciplinary action is a form of punishment to the worker who violates safety instructions on the site. So the combination of reward and punishment can be considered as a strategy that teaches safe behaviors among workers on site, (Teo, et al., 2005).

But safety in fact, is something that should be valued and harnessed, not to be paid for.

2-6-20 Role of Government and Engineering Societies

The government and the engineering societies should play a key role to apply the safety and health guidelines by endorsing standards and codes to protect the workers and properties. These guidelines should be officially obligate the companies to adhere them with suitable firm fines for non-compliance.

Government shall conduct a periodically site inspection through an experienced safety engineers and subjecting the contractors to a warning or fine for unsafe conditions or hazards existing on a workplace. Moreover,

the engineering societies shall help to extend engineering knowledge by developing the awareness of safety and health issues among engineers, (Fang, et al., 2004).

In developing countries, there are no strong labour unions like industrial countries have, which own the power to defend on their labours and to enforce contractors to provide safe working conditions and safety tools to their labours. So, it is normally labours in developed countries have to obey and accept the company offer even it is not enough, (Kartam, et al., 2000). In addition, it was found in the developing countries that labour laws are not strictly enforced as contractors tend to ignore the basic safety regulations, (Koehn, et al., 1995).

Chapter Three

Research Methodology

3-1 Introduction

This chapter discusses study procedure and the method used to conduct the study related to its objectives that has been presented in Chapter one. The method used in this study is quantitative. The methodology that was adopted for this study is the questionnaire survey. The information or data gathered using questionnaires focus on selected project reversed to the Housing and Development Fund.

This chapter describes the methodology that was used in this study. The adopted methodology to accomplish this study uses the following techniques: review of literature related to safety and health performance, the information about the study design, study location, study population, pilot study, questionnaire design, and statistical data analysis.

3-2 Study Design

The first stage of the study is to identify the aim of this study and to highlight the problems statements and establishment of clear objectives is also specified within the study plan. The second phase of the study included a summary of the comprehensive literature review.

The third phase of the study included a pilot study which was conducted to assessment of the factors affecting safety and health performance in construction projects in Dubai. The fourth phase of this study focused on the modification of the questionnaire, throughout the feedback obtained from the pilot study. The purpose of the pilot study was to test and prove that the questionnaire contents are clear to be understood by respondents. So, it was vital to guarantee that all information received from experts would be valuable in achieving the objective s of the study.

The fifth phase of the study focused on distributing questionnaire. This questionnaire was used to collect the required data in order to achieve the objectives of the study. One Hundred (100) Questionnaires were distributed targeting the contractors who are classified under first, second, and third categories in the building works.

The sixth phase of this study was the analysis and discussion of the collected data.

The final phase of the study includes the conclusions and recommendations.

3-3 Study Location

This study was conducted in state of Khartoum in Alawda Residential complex only. It is located in the strict of western soba. The questionnaires were distributed to cover the all companies who represent contractors.

3-4 Study Population

This study targeted contractors in Al-Awdaa residential complex project. Numbers companies are 16 contractors.

3-5 Sample Size

The sample size is the whole study population.

3-6 Questionnaire Design

According to the literature review all the information that could help in attaining the study objectives were collected, reviewed and formalized to be suitable for the study.

The questionnaire design was composed of two parts. Unrequired personal data and repeated questions were avoided. The questionnaire was delivered with a covering letter which clarified the purpose of the study, the way of responding, and the security of the information to reassure high response.

Part 1: This part is divided in four sections as follow:

Section 1: General information about the company and current project.

Section 2: number of the manpower who concern about safety and health in the construction site.

Section 3: statistics about accidents and frequent of occurrence.

Section 4: Authority performance.

The purpose of this part is to collect data and statistics which to be compared with the safety and health regulations and to measure the safety and health performance of construction companies and authorities, Which in return will cover the first objective of the study.

Part 2: This part includes the list of the factors affecting the safety and health performance in the construction industry. For each factor there is a question or more, to measure the degree of impact on safety and health

performance in construction project which will cover second objective. The degree of impact is constructed on a five-point Likert scale.

Despite its importance, construction sites are considered risky with frequent and high accidents rates and ill-health problems to workers, practitioners and end stakeholder

Chapter Four

Data Analysis

4.1. Introduction

This chapter analyzes the results of collected data of the questionnaire. The chapter includes the analyses of; the description of company and the project information; safety and health manpower; accidents causes, outcomes, and reasons; authority rules and actions; evaluation of factor affecting safety and health performance; and analysis for agreement of ranking.

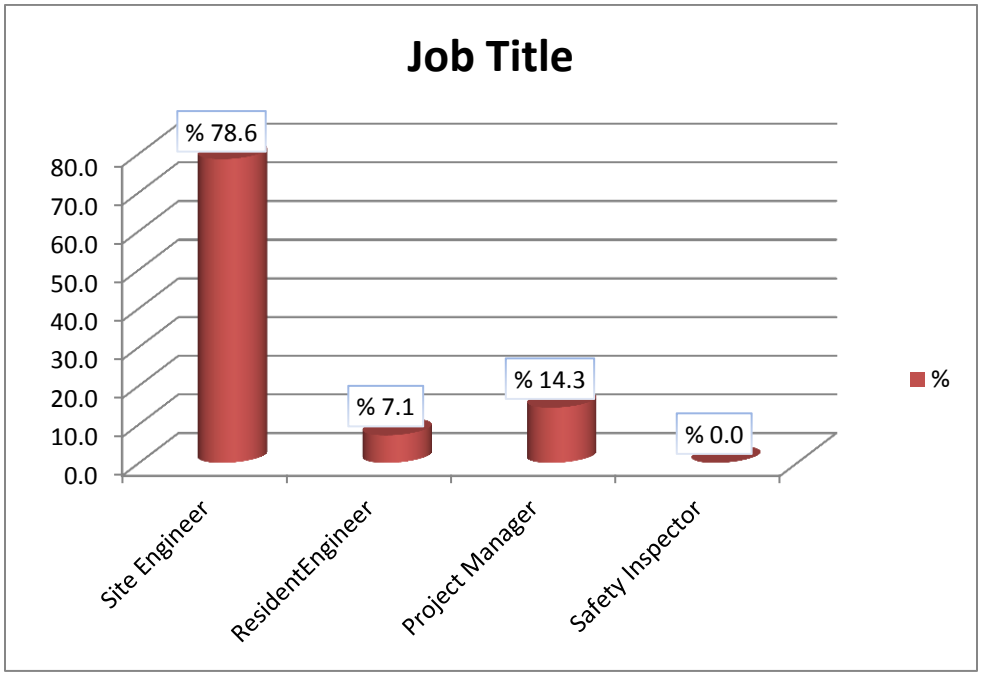
4.2. Population's respondent and project information

This section presents the description of the respondents who participated in this study. The results collected from the questionnaire shows the (14) companies participated in the study located in the scheme out of (16) companies.

4.2.1 Job Title of Respondents

From result, (31%) from the respondents were Resident Engineer, (0%) were Safety and Health Mangers, (78.6%) were Site Engineers, and (14.3%) were Project Managers, see (Figure 4-1). That shows there are no safety specialist on site but safety responsibility goes to site engineers.

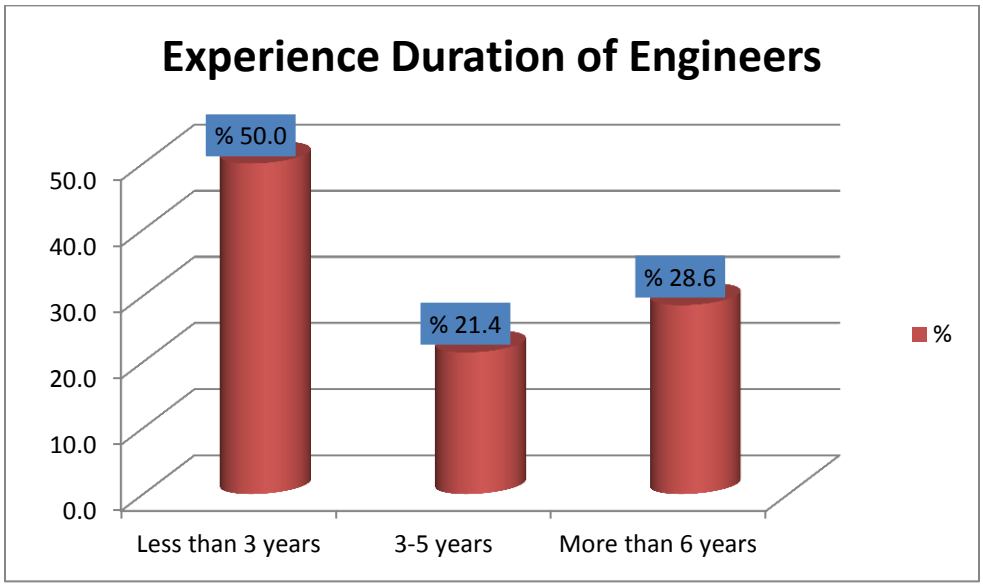
Figure 4-1-



4.2.2. Working Experience of Safety Inspector

Working experience is measured in the number of years an engineer has been working in the construction industry. (28.6%), of the engineers have been practicing the construction business in the local market for more than 6 years. And, (21.4%) have been working between 3-6 years. However, (50%) of the engineers have less than 3 years' experience. See (figure 4-2).

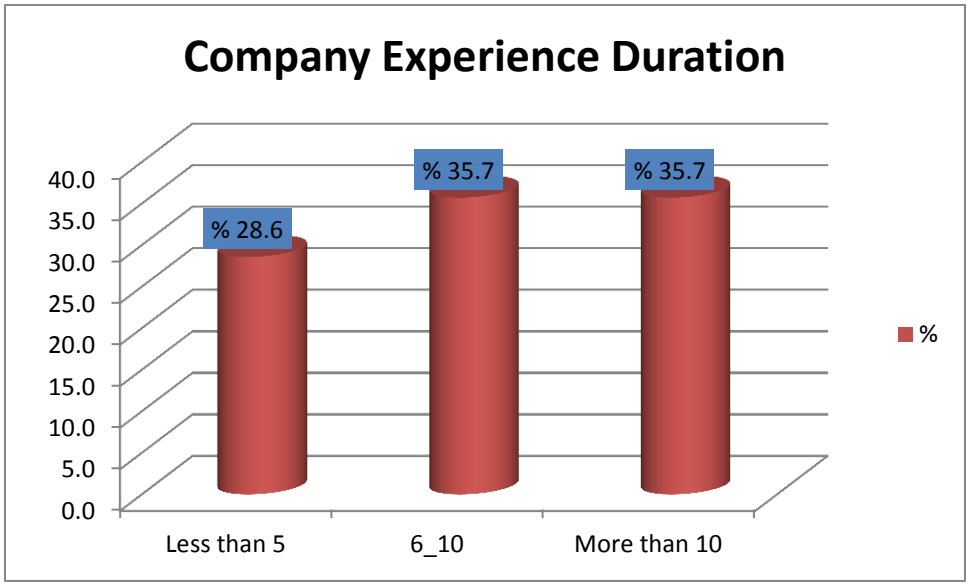
Figure 4-2



4.2.3. Working Experience of Company

Working experience is measured in the number of years a company has been working in the construction industry. (35.7%), of the companies have been practicing the construction business in the local market for more than 10 years. And, (35.7%) have been working between 5-10 years. However, (28.6%) of the companies have less than 5 years' experience. See (figure 4-3).

Figure 4-3

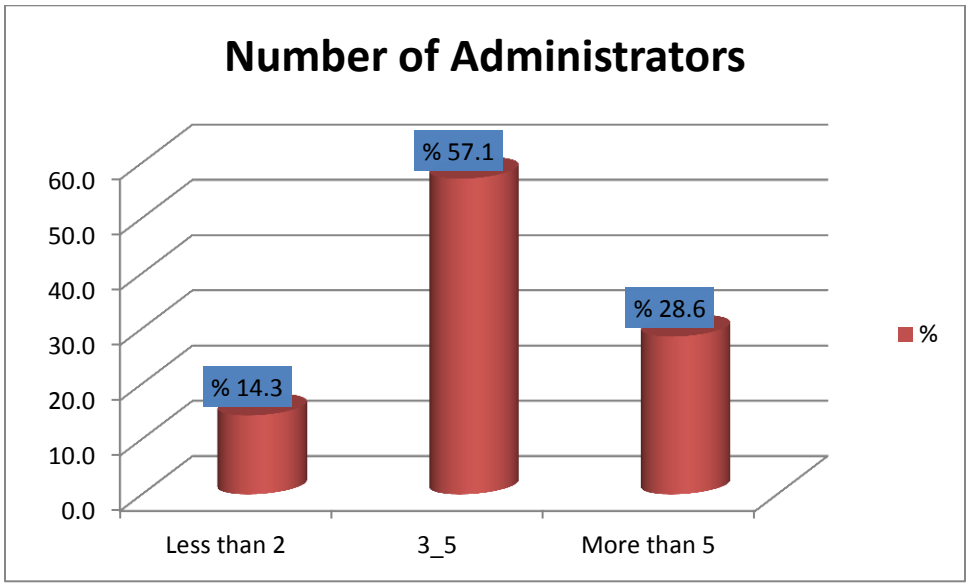


4.2.4. Total Number of Employees

4.2.4.1. Administration

(14.3%) of the companies have 2 or less administrators on site. (57.1 %) of the companies have between 3_5 administrators on the site. However, (28.6 %) of the companies have more than 5 administrators on the site. See (figure 4-4-a).

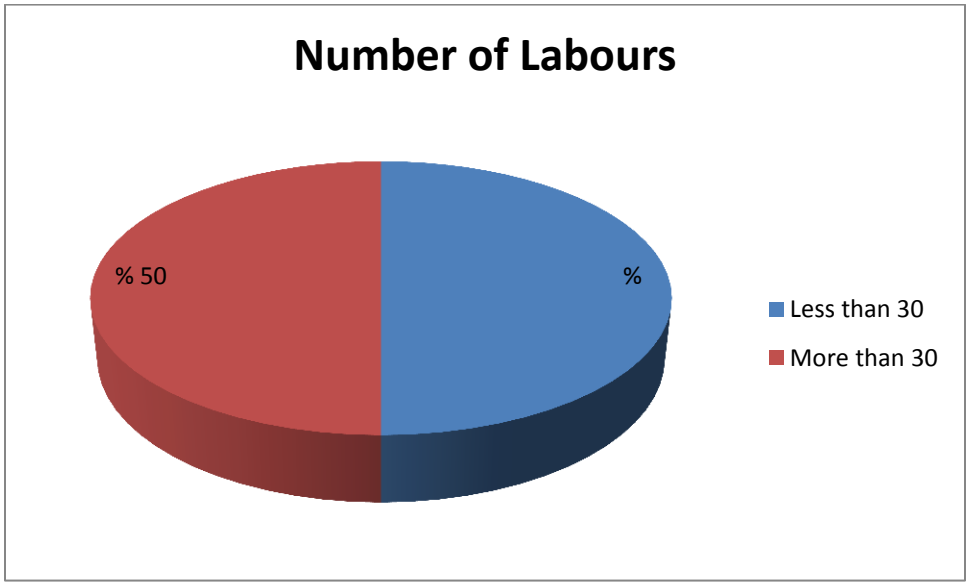
Figure 4-4-a



4.2.4.2. Labours

(50%) of companies have less than 30 labours on the site per working day. Otherwise (50%) of companies have more than 30 labours on site per working day. See (Figure 4-b).

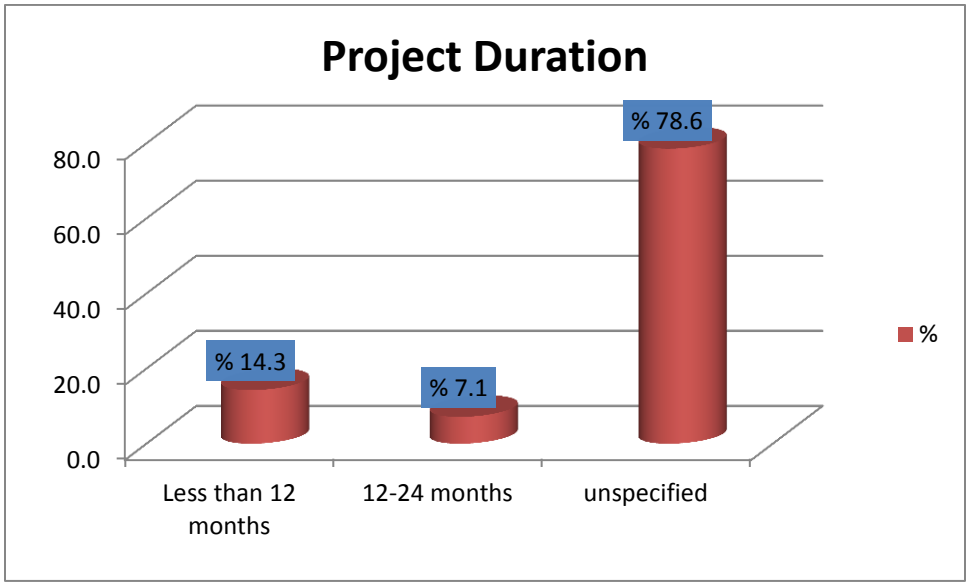
Figure 4-4-b



4.2.5. Duration of Construction (Month)

The construction duration is the time required to complete the project. More than (78.6%) of the sample are executing projects with unspecified duration. The reason for the project to have unspecified construction duration is due to the fact that either the project has unstable fund or the projects are delayed or, it can be both. However, when the duration is specified, it has long duration depending on the project size. (14.3%) of companies have project duration less than 12 months. And (7.1%) of the companies have project duration ended at 24 months, see (Figure 4-5).

Figure 4-5



4.3. Safety and Health Manpower Authority Rules and Actions

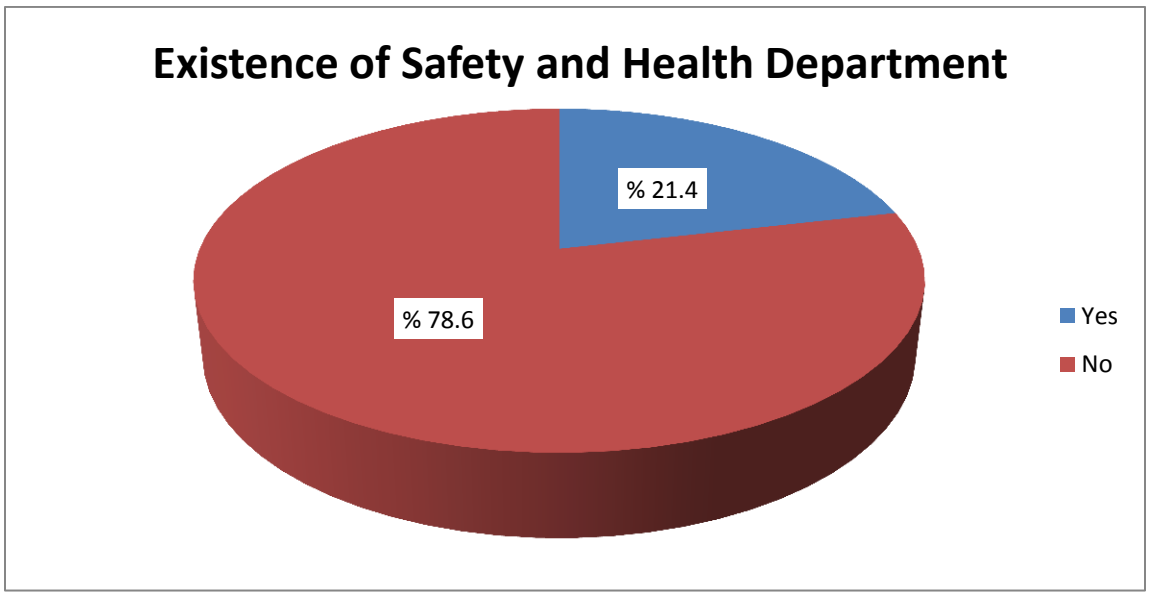
4.3.1. Safety and Health Administration Staff

All who are concern about safety and health issues on construction projects either from the management or workers are having responsibilities and duties which to be performed. It is vary from company to another or authority to other, the number and the category of the certified safety persons required, but still the aim is the same.

4.3.1.1. In the company

The question was about the existence of safety and health department in the company. (78.6%) of the surveyed companies don't have, (Figure 4-6).

Figure 4-6

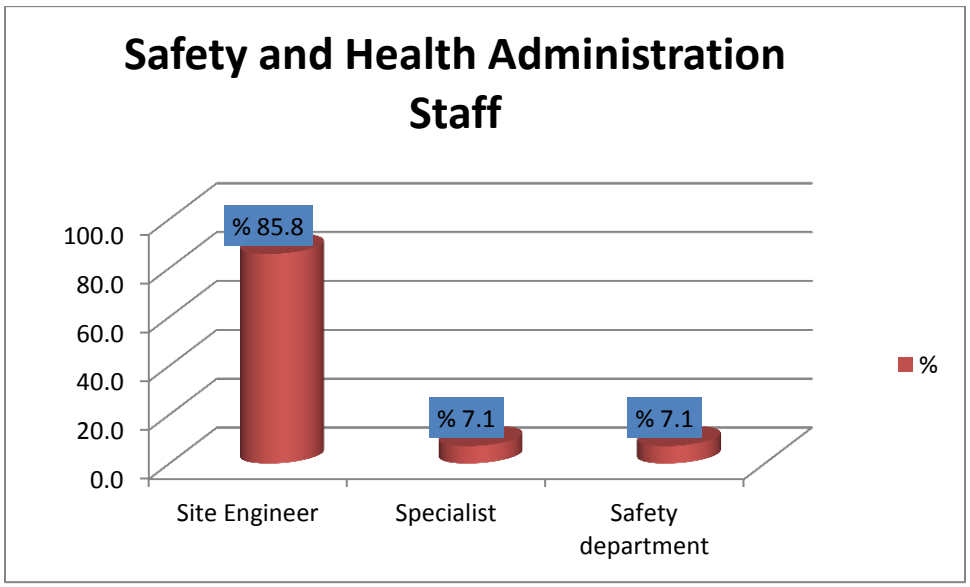


4.3.1.2. On site

The surveyed sample shows that (7.1%) of the sample have safety and health department on site.

However, (7.1%) have at least one safety advisor or officer and, (85.8%) only stand on site engineers. The distribution of safety and health administration staff is further illustrated in (Figure 4-7).

Figure 4-7



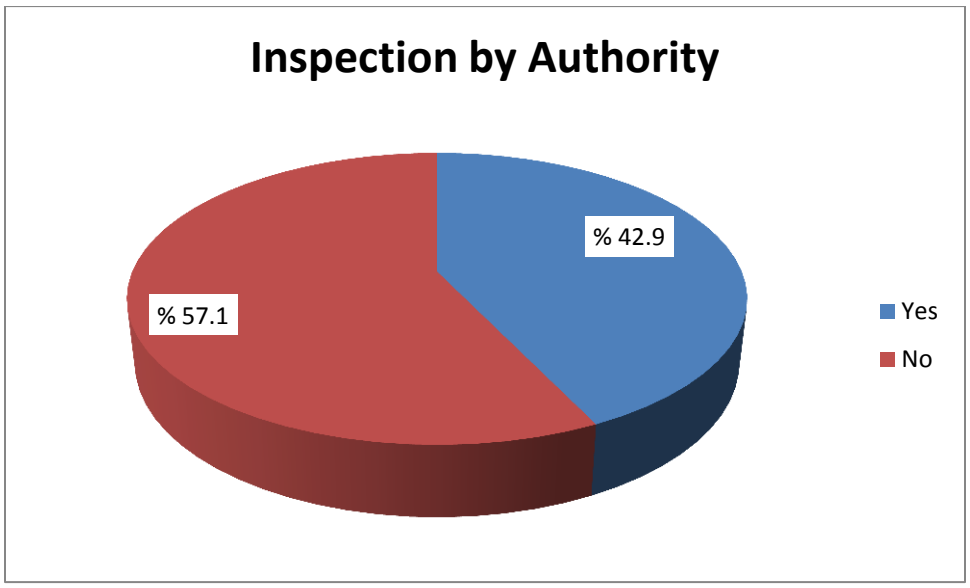
4.3.2. Authority Rules and Actions

Authority plays very important role in implementing safety and health regulations especially in the developing countries as illustrated in the literature. The actions which should be taken by authority as follow:

4.3.2.1. Safety and Health Inspection by Authority

It was found from the survey that (42.9%) of the respondents agreed that the author have periodically inspection, while (57.1%) don't, see (figure 4-8).

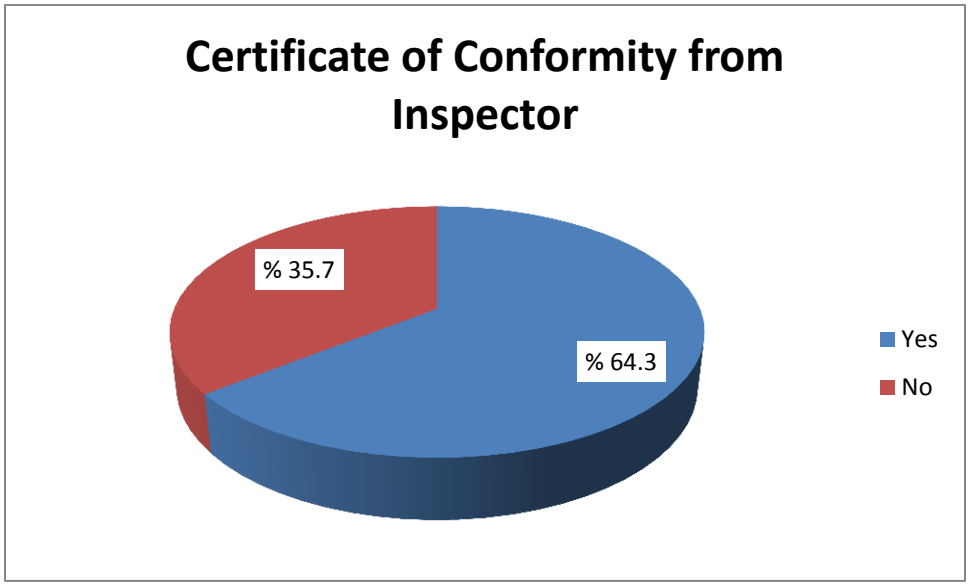
Figure 4-8



4.5.2. Safety and Health Certificates to Work by Authority

Sometimes it is required to obtain approval by the authority to start some activities at the work place. Procedures are varies depending on the project size and under which authority the project is located. (Figure 4-9) shows that (64.3%) of surveyed companies have obtained safety and health approvals before commencement of the activities.

Figure 4-9

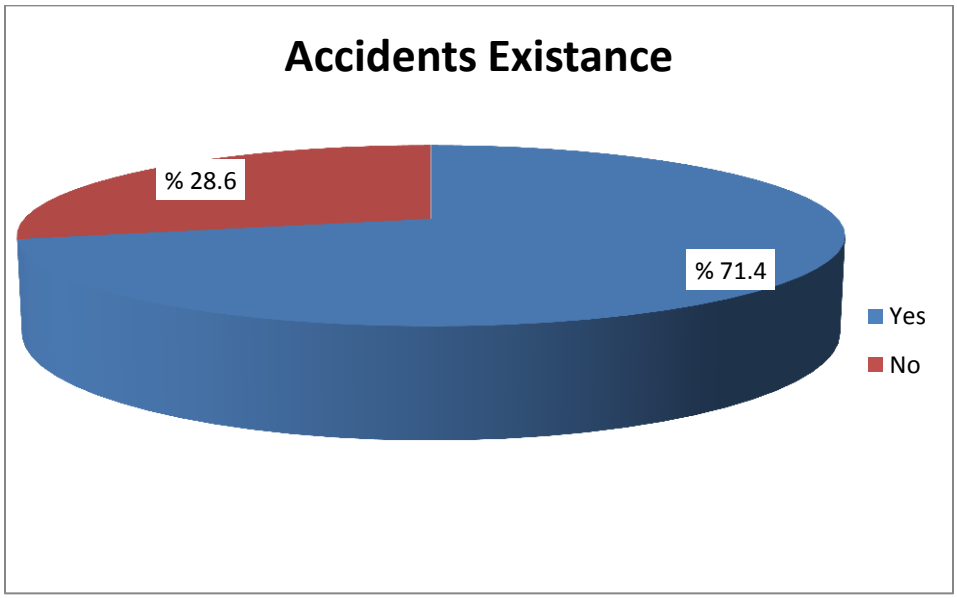


4.4. Accidents Causes, Outcomes and Reasons

4.4.1. History of Accidents

Perhaps the worst nightmare for construction companies is the accidents specially fatality accidents due to the consequences of outcomes of such accidents. It was observed from the surveyed companies, that 71.4% of companies faced incidences during the project, see (Figure 4-10)

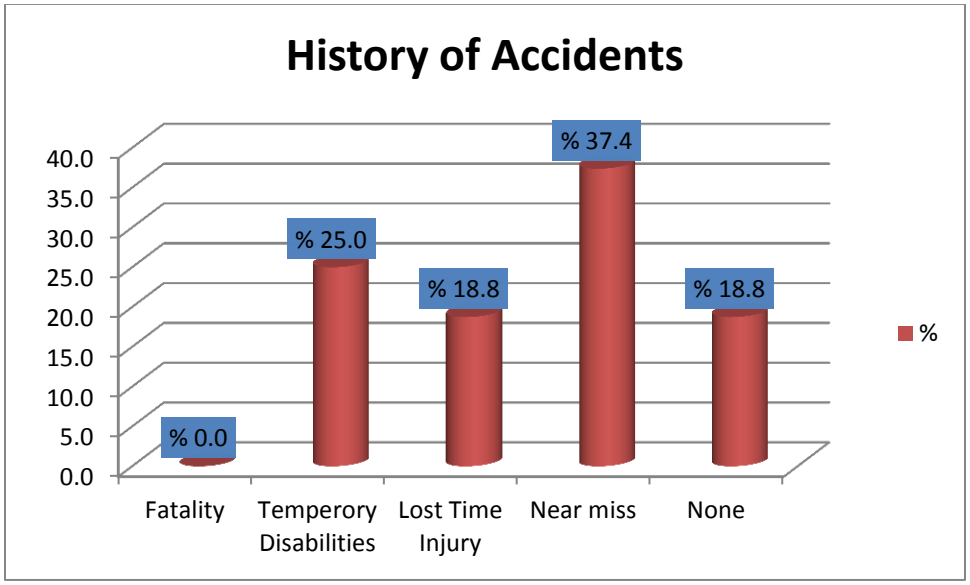
Figure 4-10



4.4.2. Treatment Outcome Details

There are four types of treatment outcomes when the accident occurs. First, fatality which is death due to work related injury or illness. Second, temporary disability when the injured or sick person requires treatment from professional not first aider and can't return back to work for at least 15 days. Third, lost time injury (LTI) when the injured or sick person cannot perform his work the day after the accident. Last, near miss is the accident which could happen. It was found that (100%) of the respondents agree that they don't have fatality as outcome of accidents. However, (25%) had rated temporary disability as the highest treatment outcome in case of accidents. The lost time injury has record (18.8%). (37.4%) of respondents record near miss, and (18.8%) of surveyed companies haven't any record. The distribution of the respondents rates are indicated in (Figure 4-11)

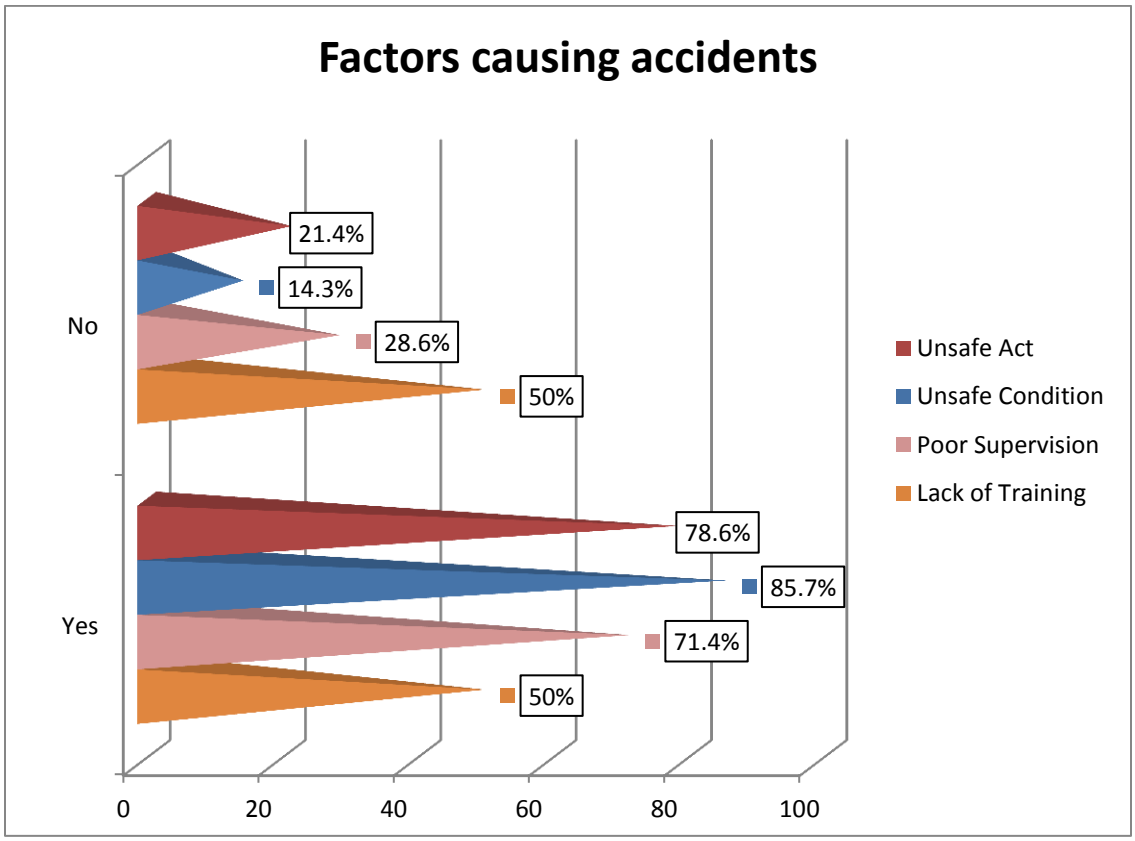
Figure 4-11



4.4.3. Causal Factors Causing Accidents

After analyzing the questionnaire, it was found the rate of the casual factors causing accidents (lack of training, poor supervision, unsafe conditions, and unsafe act) are vary among companies. However, unsafe conditions had significant total rate (85.7%) of the reasons causing accidents followed by unsafe acts due to negligence of regulation (78.6%) then poor supervision (71.4%) and at the bottom lack of training which are illustrated in (Figure 4-12).

Figure 4-12



4.6. Evaluation of Factors Affecting the Safety and Health Performance

Part (2) of the questionnaire includes the list of factors affecting safety and health performance in the construction industry. It contains twenty factors which had been discussed in the literature review. Table (4.1) shows the rank of factors effect on safety and health performance. Complexity of Design, Risk Assessment, Safety and Health Training, Safety and Health Inspection, Welfare Facilities and Safety signal come in first rank, Project Duration next followed by Role of government and Engineering Societies and so on.

Table 4.1 Chi-squire and ranking of safety and health performance factors

Factor	**Chi-squire**	**Rank**
Complexity of Design	0.000	1
Type of Owner	1.143	8
Weather Condition	4.571	14
Project Cost	4.571	14
Project Duration	0.214	6
Safety And Health Policy	1.143	8
Accidents / Incidents / Near Miss Report	7.143	17
Evacuation Plan	2.571	10
Risk Assessment	0.000	1
Safety And Health Training	0.000	1
PPE	2.571	10
Emergency Plan And Procedure	2.571	10
Safety And Health Inspection	0.000	1
Safety And Health Management Meeting	4.571	14
First Aid Arrangement	7.143	17
Welfare Facilities	0.000	1
Safety Signals	0.000	1
Work Environment	2.571	10
Reword And Punishment System	7.143	17
Role Of Government And Engineering Societies	0.286	7

Chapter Five

Conclusions and Recommendations

5.1. Conclusions

The main conclusions of the results are:

- (0%) of the respondents were from the safety departments of the companies, which grantee that those companies have no professional safety department. But that not mean that are not have safety departments.
- The distribution of the respondents was relatively close among different categories and governs authorities which can reduce the risk of wrong answers of the study. (35.7%) of companies have more than (10) years of experience in the local market which made them familiar with safety and health regulations of the country.
- All surveyed companies have at least one person who is responsible for monitoring and implementing safety and health best practice as per regulations.
- The majority of treated injuries are categorized under temporary disabilities cases. Further, the majority of respondents agreed on the unsafe conditions are the main reason which is responsible for the accident occurrence, followed by lack of training then unsafe act.
- The ranking of the factors affecting safety and health performance are varied among companies and categories. It can be noticed that safety and health policy had the eighth ranking position for the companies, which indicates that safety and health policy isn't understandable and recognizable by the companies. Further, risk assessment had the first ranking position in the companies which means that risk assessment is essential to maintain the safety and health performance. In addition, safety and health inspection had the first ranking position also, which shows that safety and health inspection for the work place is vital to improve the safety and health performance

5.2. Recommendations

Based on the conclusions, and the results found from this study, the subsequent points can be recommended:

- As the unsafe conditions is the main reason which is responsible for the accident occurrence, the construction companies need to increase the inspections by safety and health supervisors.
- More efforts need to be done by the construction companies and the different authorities to improve awareness and the training for the workforces. In addition, an adequate budget for safety and health provision should be stated in all construction contracts which should be approved by all parties and to monitor the spent of the budget.
- Safety and health policy and risk assessment are very important issues need to be addressed properly to the companies and to be well understandable of their importance.
- Regular safety and health inspections need to be conducted by the authority's competent person to monitor the performance of safety and health at workplaces, and to notify the construction companies about any violations need to be rectified or noncompliance of regulations
- The quantitative appraisal of safety and health performance should be applied for construction companies to permit comparing different companies performances.

5.3. Future studies

- Research can be conducted to measure the accidents frequency rates (AFR) and safety performance attitude scores (SPAS).
- Research can be extended to include other projects of the housing and development fund to check the safety and health performance for construction companies. Further extent can identify the regulations and performance among authorities.

- Research can be conducted to compare the construction safety and health performance in projects of the housing and development fund with other invested residential projects.
- Research can be conducted to realize the role of the owners and the consultants to avoid or mitigate the accidents in construction sites.
- Research can be carried out to evaluate the cost of safety and to compare this cost with the cost of accidents to inspire the construction companies to take safety and health issues seriously.

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Appendix

Appendix A – Sample of Questionnaire Used For the Survey

بسم الله الرحمن الرحيم

استبيان عن ضوابط السلامة و الصحة المهنية في مشاريع المجمعات السكنية

المحور الاول

1.1. معلومات تعريفية

1.1.1 الاسم:..... (اختياري)

1.1.2 اسم الشركة: .....

1.1.3 المسمى الوظيفي:.....

1.1.4 سنوات الخبرة:.....

1.1.5 سنوات عمل الشركة:.....

1.2. عدد العاملين بالموقع:

1.2.1. عدد الاداريين:

1.2.2. عدد العمال :

1.3. الحوادث بالموقع:

1.3.1. هل وقعت حوادث بالموقع؟

☐ لا ☐

1.3.2. نوع الحوادث و عددها:

نوع الحادث	مميت	اعاقة دائمة/ جزئية	اعاقة ل 3 ايام	قاربت الحدوث
العدد				

1.4. معلومات ادارية:

1.4.1. هل يوجد تأمين على المواد و الاليات بالموقع

1.4.2. هل يوجد تأمين على العمال

1.4.3. هل يوجد قسم للصحة و السلامة بالشركة

1.4.4. مشرف السلامة بالموقع:

مهندس الموقع مشرف متخصص لجنة سلامة

المحور الثاني

1. هل تم ادراج ضوابط السلامة في تصميم المشروع:
   نعم لا
2. هل يهتم المالك باجراءات السلامة بالمشروع
   نعم لا
3. هل يتم العمل في الموقع ما بين الساعة 12 ظهرا و 2 بعد منتصف النهار
   نعم لا
4. هل تم ادراج تكاليف السلامة في التكلفة الكلية للمشروع
   نعم لا
5. كم كانت تكلفة الحوادث في الموقع؟
6. ماهي المدة التي يتم فيها اكتمال الموقع؟
7. هل توجد شهادة سلامة بالشركة
   نعم لا
8. هل توجد انشطة ذات خطورة بالموقع
   نعم لا
9. هل توجد رقابة على الانشطة ذات الخطورة
   نعم لا
10. هل توجد رقابة على العمال الموجودين في منطقة الانشطة الخطرة
    نعم لا
11. هل توجد مناقشات لتحديد المخاطر لكل نشاط
    نعم لا
12. هل تم تدريب المهندسين و العمال تدريبات سلامة
    نعم لا

13. هل توجد معدات حماية شخصية للعاملين بالموقع

نعم ☐ لا ☐

14. هل توجد خطة طوارئ بالموقع

نعم ☐ لا ☐

15. هل توجد مناقشات لتحديد مسئوليات السلامة بالموقع

نعم ☐ لا ☐

16. هل توجد اجتماعات بخصوص السلامة بين اطراف التشييد

نعم ☐ لا ☐

17. هل يجد شخص متخصص للاسعافات الاولية

نعم ☐ لا ☐

18. هل توجد اماكن مخصصة للعمال

نعم ☐ لا ☐

19. هل توجد علامات ارشادية بالموقع

نعم ☐ لا ☐

20. هل توجد فواصل امان بالموقع

نعم ☐ لا ☐

21. هل توجد مداخل منفصلة للعمال و الاليات كل على حدا

نعم ☐ لا ☐

22. هل تفرض عقوبات على من يخالف اجراءات السلامة بالموقع

نعم ☐ لا ☐

23. هل الزمت الجهات الاستشارية ادارة الموقع بعمل اجراءات السلامة

نعم ☐ لا ☐

و شكراً

اسم الباحث: اسمهان احمد علي
جامعة السودان للعلوم و التكنولوجيا
ماجستير هندسة التشييد

Questionnaire about the regulations of health and safety on construction of residential complex

Part one:

1.1 Introductory information:

1.1.1 Name: …….

1.1.2 Company name: ……

1.1.3 Job title: ……

1.1.4 Personal experience duration: …….

1.1.5 Company experience duration: …….

1.2 Labours and employee on site:

1.2.1 Administrator's number: ……

1.2.2 Labours number: ……

1.3 Accidents on site:

1.3.1 Were there any accidents on site?

Yes ☐ **No** ☐

1.3.2 Type of accidents and number

Type of accident	Fatal	Permanent disorder	Temporary disorder	Near miss
No				

1.4 Administration information:

1.4.1 Is there any insurance on materials and equipment on site?

Yes ☐ **No** ☐

1.4.2 Is there any insurance on labours?

Yes ☐ **No** ☐

1.4.3 Is there health and safety department in the company?

Yes ☐ **No** ☐

1.4.4 Health inspector on site:

Site engineer ☐ **Health and safety specialist** ☐

Health and safety commission ☐

Part two:

1. **Have the regulations of health and safety inserted in project design?**
   Yes ☐ **No** ☐
2. **Does the client concern about health and safety procedures on site?**
   Yes ☐ **No** ☐
3. **Are there tasks between 12 midday and 2 afternoon?**
   Yes ☐ **No** ☐
4. **Has the safety cost included in total cost of the project?**
   Yes ☐ **No** ☐
5. **How much was the cost of accidents?**
6. **How long does the project take for completion?**
7. **Is there any safety certificate in the company?**
   Yes ☐ **No** ☐
8. **Are there dangerous tasks on site?**
   Yes ☐ **No** ☐
9. **Are there monitoring on dangerous tasks?**
   Yes ☐ **No** ☐
10. **Are there any monitoring on labours who exist on danger zone?**
    Yes ☐ **No** ☐
11. **Are there any discussions to identify risks for every task?**
    Yes ☐ **No** ☐
12. **Have the staff any safety training?**
    Yes ☐ **No** ☐
13. **Are there PPE on site?**
    Yes ☐ **No** ☐
14. **Is there an emergency plan on site?**
    Yes ☐ **No** ☐
15. **Are there any discussion to identify the responsibilities of safety on site?**
    Yes ☐ **No** ☐

16. Are there meetings between construction parties?

Yes ☐ **No** ☐

17. Is there special person for first aid?

Yes ☐ **No** ☐

18. Are there any facilities?

Yes ☐ **No** ☐

19. Are there safety signs on site?

Yes ☐ **No** ☐

20. Are there any safety boundaries?

Yes ☐ **No** ☐

21. Are there separate entrance for plants and labours?

Yes ☐ **No** ☐

22. Are there any punishments for who violate the safety procedures?

Yes ☐ **No** ☐

23. Does the consultant bind the contractor to follow safety procedures?

Yes ☐ **No** ☐

Thanks for cooperation

Asmhan Ahmed Ali
Sudan University of Science and Technology
Master of Construction Engineering

Appendix B – RII Calculation Details

Have the regulations of safety included when the project has designed?

	Observed N	Expected N	Residual
Yes	7	7.0	.0
No	7	7.0	.0
Total	14		

Test Statistics

	Have the regulations of safety included when the project has designed?
Chi-Square	.000
df	1
Asymp. Sig.	1.000

Does the client concern the safety procedure in project?

	Observed N	Expected N	Residual
Yes	9	7.0	2.0
No	5	7.0	-2.0
Total	14		

Test Statistics

	Does the client concern the safety procedure in project?
Chi-Square	1.143
df	1
Asymp. Sig.	.285

re they working between 12 midday till 2 afternoon

	Observed N	Expected N	Residual
Yes	11	7.0	4.0
No	3	7.0	-4.0
Total	14		

Test Statistics

	Are they working between 12 midday till 2 afternoon?
Chi-Square	4.571
df	1
Asymp. Sig.	.033

Hass the cost of safety inserted into the total cost of the project?

	Observed N	Expected N	Residual
Yes	3	7.0	-4.0
No	11	7.0	4.0
Total	14		

Test Statistics

	Hass the cost of safety inserted into the total cost of the project?
Chi-Square	4.571
df	1
Asymp. Sig.	.033

How much was the cost of accidents on site?

	Observed N	Expected N	Residual
None	1	3.5	-2.5
Less than 500	1	3.5	-2.5
More than 500	1	3.5	-2.5
Unspecified	11	3.5	7.5
Total	14		

Test Statistics

	How much was the cost of accidents on site?
Chi-Square	21.429
df	3
Asymp. Sig.	.000

How long the project will complete?

	Observed N	Expected N	Residual
One year	2	4.7	-2.7
2 years	1	4.7	-3.7
Unspecified	11	4.7	6.3
Total	14		

Test Statistics

	How long the project will complete?
Chi-Square	13.000
df	2
Asymp. Sig.	.002

Is there safety policy in the company?

	Observed N	Expected N	Residual
Yes	5	7.0	-2.0
No	9	7.0	2.0
Total	14		

Test Statistics

	Is there safety policy in the company?
Chi-Square	1.143
df	1
Asymp. Sig.	.285

Is there task with danger?

	Observed N	Expected N	Residual
Yes	12	7.0	5.0
No	2	7.0	-5.0
Total	14		

Test Statistics

	Is there task with danger?
Chi-Square	7.143
df	1
Asymp. Sig.	.008

Is there monitor for the dangerous tasks?

	Observed N	Expected N	Residual
Yes	10	7.0	3.0
No	4	7.0	-3.0
Total	14		

Test Statistics

	Is there monitor for the dangerous tasks?
Chi-Square	2.571
df	1
Asymp. Sig.	.109

s there an observation on labours in dangerous zone

	Observed N	Expected N	Residual
Yes	11	7.0	4.0
No	3	7.0	-4.0
Total	14		

Test Statistics

	Is there an observation on labours in dangerous zone?
Chi-Square	4.571
df	1
Asymp. Sig.	.033

s there discussions to identify risk on every task?

	Observed N	Expected N	Residual
Yes	7	7.0	.0
No	7	7.0	.0
Total	14		

Test Statistics

	Is there discussions to identify risk on every task?
Chi-Square	.000
df	1
Asymp. Sig.	1.000

Have the crow trained for safety?

	Observed N	Expected N	Residual
Yes	7	7.0	.0
No	7	7.0	.0
Total	14		

Test Statistics

	Have the crow trained for safety?
Chi-Square	.000
df	1
Asymp. Sig.	1.000

Are there personal protective equipments for labours?

	Observed N	Expected N	Residual
Yes	4	7.0	-3.0
No	10	7.0	3.0
Total	14		

Test Statistics

	Are there personal protective equipments for labours?
Chi-Square	2.571
df	1
Asymp. Sig.	.109

Is there emergency plan on site?

	Observed N	Expected N	Residual
Yes	4	7.0	-3.0
No	10	7.0	3.0
Total	14		

Test Statistics

	Is there emergency plan on site?
Chi-Square	2.571
df	1
Asymp. Sig.	.109

Are there any discussions to specify safety responsibility?

	Observed N	Expected N	Residual
Yes	7	7.0	.0
No	7	7.0	.0
Total	14		

Test Statistics

	Are there any discussions to specify safety responsibility?
Chi-Square	.000
df	1
Asymp. Sig.	1.000

Are there safety meeting?

	Observed N	Expected N	Residual
Yes	3	7.0	-4.0
No	11	7.0	4.0
Total	14		

Test Statistics

	Are there safety meeting?
Chi-Square	4.571
df	1
Asymp. Sig.	.033

Is there specialist for first aid?

	Observed N	Expected N	Residual
Yes	2	7.0	-5.0
No	12	7.0	5.0
Total	14		

Test Statistics

	Is there specialist for first aid?
Chi-Square	7.143
df	1
Asymp. Sig.	.008

Are there any facilities?

	Observed N	Expected N	Residual
Yes	7	7.0	.0
No	7	7.0	.0
Total	14		

Test Statistics

	Are there any facilities?
Chi-Square	.000
df	1
Asymp. Sig.	1.000

Are there any safety signs on site?

	Observed N	Expected N	Residual
Yes	7	7.0	.0
No	7	7.0	.0
Total	14		

Test Statistics

	Are there any safety signs on site?
Chi-Square	.000
df	1
Asymp. Sig.	1.000

Are there any safety boundaries?

	Observed N	Expected N	Residual
Yes	4	7.0	-3.0
No	10	7.0	3.0
Total	14		

Test Statistics

	Are there any safety boundaries?
Chi-Square	2.571
df	1
Asymp. Sig.	.109

Are there separate entrance for plants and labours?

	Observed N	Expected N	Residual
Yes	4	7.0	-3.0
No	10	7.0	3.0
Total	14		

Test Statistics

	Are there separate entrance for plants and labours?
Chi-Square	2.571
df	1
Asymp. Sig.	.109

Are there any punishment for who violate the safety procedures?

	Observed N	Expected N	Residual
Yes	2	7.0	-5.0
No	12	7.0	5.0
Total	14		

Test Statistics

	Are there any punishment for who violate the safety procedures?
Chi-Square	7.143
df	1
Asymp. Sig.	.008

Are there any punishment for who violate the safety procedures?

	Observed N	Expected N	Residual
Yes	2	7.0	-5.0
No	12	7.0	5.0
Total	14		

Test Statistics

	Are there any punishment for who violate the safety procedures?
Chi-Square	7.143
df	1
Asymp. Sig.	.008

Does the consultant bind the contractor to follow safety procedures

	Observed N	Expected N	Residual
Yes	6	7.0	-1.0
No	8	7.0	1.0
Total	14		

Test Statistics

	Does the consultant bind the contractor to follow safety procedures
Chi-Square	.286
df	1
Asymp. Sig.	.593