

**FACTORS AFFECTING SAFETY ON CONSTRUCTION SITES. THE  
CASE OF PUBLIC FUNDED BUILDING PROJECTS IN MAKUENI  
DISTRICT, KENYA**

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**A Research Project Report Submitted in Partial Fulfillment of the requirements for  
the Award of the Degree of Master of Arts Project Planning and Management,  
University of Nairobi**

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## DEDICATION

This project report is dedicated to my late mother, Mrs Penina Akinyi Oluoch who sacrificed all the comforts in life for my well being. May God rest her soul in eternal peace. Further, I would also dedicate this study to my immediate family, my wife Carolyn Akirapa and baby Ivy Akinyi.

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## Acronym and abbreviation.

<b>PPE</b>	Personal Protective Equipment
<b>OSHA</b>	Occupational Safety and Health Act.
<b>FAOPW</b>	Factories and other places of work
<b>WIBA</b>	Work Injury Benefit Act.
<b>BOWEC</b>	Building operations and works of Engineering Construction.
<b>JBC</b>	Joint Building Council.
<b>FIDIC</b>	International Federation of Consulting Engineers
<b>MOPW</b>	Ministry of Public Works
<b>HSE</b>	House safety Executive.

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# CHAPTER ONE

## INTRODUCTION

### 1.1 Background of the study.

Safety and health of workers and the protection of environment have been of great concern during the recent years to many parties involved in the construction process in many countries around the world leading to a number of laws and regulations enacted by these countries following the recommendations of international organizations such as International Labour organization (ILO), world health organization, international organization for standardization among others (Richard et al, 2000). The International Labour Organization Conference of 1985 in Geneva stated that: “work should take place in a safe and healthy working environment and that conditions of work should be consistent with workers human dignity and that occupational health and safety policies must be established at both government and enterprise level.”

Construction industry plays a major role in the development of an economy; its contribution to the world's Gross Domestic Product is estimated at 9 % (Confederation of international Contractors Association-CICA). Despite the importance, the industry still continues to be one of the most hazardous industry within which to work (Alan and Tim, 2001). Worldwide every day some 6,300 people die as a result of work-related injuries or diseases – more than 2.3 million deaths per year (Lonyangapuo, 2011). According to Ahmad et al (2000), those who spend their working lives on construction sites have a 1 in 300 chance of being killed at work while the chance of being disabled by injury or serious illness is much greater than in most other industrial fields. In the UK, there have been significant reductions in the number and rate of injury over the last 20 years or more according to a report by HSE, (2011). In the report, construction remains a high risk industry and although it accounts for only about 5% of the employees in Britain it still accounts for 27% of fatal injuries to employees and 9% of reported major injuries.

The contractor who is under the supervision of the consultants is responsible for health and safety practices on site (Occupational Safety and Health Act (OSHA) 2007 (Repealed factories act chapter 514) laws of Kenya, Ministry of Public works (MOPW) conditions 2006,

Joint Building Council Conditions (JBC), International Federation of Consulting Engineers (FIDIC) conditions 2010) while Government agencies ensures adherence to by-laws, regulations and the principal act, being repealed factories act chapter 514.

According to James (1991), safety is a major concern in the construction industry and that while the potential for accidents exists in any business, the nature of construction increases the possibility of accidents. Wells (2003), stated that “20-40% of occupational fatalities occur in the construction sector implying that the construction site is a dangerous place to work”. Reports in the mass media and statistics from developed countries (Health Safety Executive Report-2011) indicate that construction industry is unsafe place to work in compared to other industries which employs even more people than construction industry. According to a paper presented to the ILO by Murie (2005), less than 20% of injuries on construction sites in Kenya are reported and the long term impact of occupational disease is scarcely reflected in the statistics( Most of the reported accidents are for those seeking compensation under WIBA - Work Injury Benefit Act-2007).

The legislative framework governing safety in industries has been in the form of principle act and enabling rules issued by the Minister for Labour. The Principal act has evolved from the factories act Chapter 514 laws of Kenya 1951 which was repealed to Factories and other places of works (FAOPW) act 1990. In 2007 it was repealed again to the current occupational safety and health act (OSHA) of 2007. The regulations enabling the act in construction industry still remains Legal Notice No. 40 of 1984-Building operations and work of engineering construction (BOWEC)

One of the key stakeholders in the construction industry in terms of building projects is the public sector. It is therefore important to consider factors affecting safety in this sector of the industry. A gap in the factors affecting safety in the public sector would therefore translate into a lack of knowledge in this aspect of the industry. This therefore calls for the need to have more information on this area. This study comes in to bridge this gap in knowledge by studying the factors affecting safety in public funded building projects in Makueni District.

## **1.2 Problem statement**

Accidents and fatalities in the construction industry are out of proportion to the percentage of people employed in the construction industry (Trevor, 1999). According to Trevor, (1999) many accidents are avoidable and many accounted for by the management failures. Section 6 of the occupational safety and health Act 2007(OSHA) requires employers to ensure that employees are provided with a safe working environment. The situation is however wanting and the employers (Contractors) have neglected the safety of workers and concentrated on profit maximisation (Lonyangapuo, 2011). The various conditions of contract in building works (JBC, MOPW and FIDIC) all have provision regarding safety of workers on construction site and places the duty of care on the employer/Main contractor.

In the previous studies, Nabayi (2008) dwelt on vulnerabilities to occupational hazards among workers, Mutuma (2000) focused on provision of personal protective equipments while Charles Maina (1989) dealt with safety administration under the factories act of 1951. Currently the principal act has changed to OSHA 2007, and does not expressly address safety in construction site in details. None of the above studies dealt specifically with factors affecting safety on building construction sites. This study therefore seeks to investigate factors affecting safety in construction sites: the case of public funded building projects in Makueni District.

## **1.3 General Objective of the study**

The purpose is to study factors affecting safety in construction sites, the case of public funded building projects in Makueni District.

## **1.4 Specific Objectives:**

- I. To investigate how personal protective Equipment (PPE's) affects safety on public funded building construction sites in Makueni District.
- II. To assess how contractor's safety policy affects safety on public funded building construction sites in Makueni District

- III. To establish how cost of safety affects safety on public funded building construction sites in Makueni District
- IV. To examine how enforcement of legal requirements affects safety on public funded building construction sites in Makueni District
- V. To examine how safety training affects safety on public funded building construction sites in Makueni District.

### **1.5 Research questions.**

- i) How does personal protective equipment (PPE) affect safety in a building construction site?
- ii) What is the effect of contractors' safety policy on safety in building construction site?
- iii) To what extent does cost effect safety in a building construction site?
- iv) How does enforcement of legal requirement affect safety on building construction site?
- v) How does safety training of workers affect safety on building construction site?

### **1.6 Importance of the study**

The study will be beneficial to the following stakeholders;

#### **Contractors:**

The principal law on safety bestows duty of care for the workers on the employer /Contractor (section 6 of OSHA (2007) and the standard conditions of contract (MOPW conditions Clause 11.3) also put the responsibility of safety of site on the contractor. The study therefore will be of importance to contractor since safety practices will eventually lead to reduction in compensation claims and other indirect costs. The indirect costs associated with accidents on construction site include: Uninsured property and material damage, delays, overtime costs and temporary labour, management time spent on investigation, loss of expertise etc (Allan, 2009).

### **Consultants.**

Knowledge on factors affecting safety will be of great importance to consultants at the design stage through the implementation of the project.

### **Risk managers/Insurance companies**

The companies that give insurance cover to construction workers have an interest in safety in the construction sites. The study will therefore be of importance to insurance industry whose interest lies in the reduction of claim which is a function of site safety.

### **Scholars**

The area of safety in construction is a neglected area and the institutions of higher learning training people in the construction industry have equally given it wide berth. The purpose of the study is therefore to ignite interest in the academia to incorporate safety modules in training of building construction professionals.

### **Policy Makers.**

The finding of study will be of use to the National council for Occupational safety and health (Which is about to be established), in fulfilling its mandate of the formulation and development of national occupational safety and health, policy framework among others.

## **1.7 Scope of Study.**

The study will be confined to Makueni District and projects limited to public funded projects. The study will focus on five areas and how they affect safety, these are: PPE's, Contractor's safety policy, Costs of safety, Enforcement of the regulation and by laws by government agencies, and training of employees on safety issues.

## **1.8 Limitation.**

The employer/contractor and the site foremen may be unwilling to freely give information on accidents on sites because it touches on the reputation of the company. However, this will be overcome by explaining to them that the data collected will be used for academic purposes

and not to assess the safety levels of companies. That the study will be beneficial to the contractors in managing their safety plans.

Another limitation of the study will be the geographical spread of sites to be visited with the furthest sites being 150Km apart. This challenge will be overcome by starting the journey to sites early and clustering the sites to be visited according to their proximity to one another. The challenge of language barrier especially for the unskilled workers will be overcome by the use of interpreters who understand the local language.

### **1.9 Assumptions of the study.**

The study will assume that the targeted population being professionals in the construction industry will be well versed with the factors affecting safety on construction sites and that they will be willing to give honest and detailed information. The representative sample picked is assumed to represent the whole population of Makueni county public funded building projects.

### **1.10 Definition of significant terms used in the study.**

**Safety:** According to Lewis dictionary of occupational and health environmental, - safety is a measure of the degree of freedom from risks or condition that can cause death, physical harm, equipment or property damage. This will be the definition of safety in this study.

**Health:** Relates to the physical and mental well-being of persons at work or those affected by work activities to the extent that they are exposed to Noise, dust chemicals or other dangerous material or processes (B. Cooke and P Williams, 2009)

**Welfare:** Relates to the provision of facilities for those at work so as to maintain their health and well being and includes provision of site accommodation and provision of first aid facility (B. Cooke and P Williams, 2009)



**Incident:** An occurrence of seemingly minor importance that can lead to serious consequences (Dictionary.com 2012). Allan (2009), notes that hundreds of incidents occur in the construction industry for every one that causes injury or loss, but all have the potential to do so.

**Accident:** It is an incident plus its consequences (injury). An accident is undesired event which results in physical harm and property damage. The persistence of unsafe situation (Acts and conditions at work place) creates a risk at the work environment and unless the unsafe situation is removed, an accident will eventually occur (Allan, 2009)

**Hazard:** The inherent property or ability of something (Act and conditions at work place) to cause harm- the potential to interrupt or interfere with a process or a person. (Allan, 2009)

According to Jim (1997), hazard is anything that can cause harm eg working at height, electricity chemical among others.

**Risk:** is the chance or probability of loss, an evaluation of the potential for failure (Allan 2009). According to Jim (1997), risk is the chance (Big or small) of harm actually being done.

**Occupational Health and Safety** According to Professor Lee Reynolds occupational health and safety, "is the discipline concerned with preserving and protecting human and capital resources in the workplace".

## CHAPTER TWO

### LITERATURE REVIEW

#### 2.1 Introduction

This chapter addresses and reviews past studies on the subject. It is organized into the general literature on safety, literature review according to the study variables that is; effects of PPE's, Contractors policy, cost of safety, enforcement of legal requirements and training on safety on building construction site.

#### 2.2 Safety in Building construction Industry.

Safety is concerned with the protection of workers, passersby, or visitors to the site from physical injury due to work activities such as moving plants and machinery, work at height, falling materials and tools, overturning of cranes or other lifting equipment. (Cooke and Williams, 2009).

“We all agree that the best and most effective way to do any job is the safe way” (Ezeji, 1997). The construction industry has a very poor safety record and reputation, it has a high potential for serious accidents due to the fact that many people are close together and engaged in activities in a proportionally limited zone and many unplanned activities are occurring and unexpected risks exist (Nasser, 2010). Construction is a hazardous profession, climbing high off the ground, digging deep trenches, handling large pieces of materials, operating large powered machines and working with hazardous substances put workers at risk (Frederick and Joyce, 2009)

According to Neale (1995), there is a tendency to blame external factors for the poor safety record, factors such as: the transient nature of the industry, the complete disregard for safety of its employees, the constantly changing hazard as the project progresses, and the need to use partially completed permanent structures or a regularly changing temporary platform to access work at a higher level. However, HSE's publication, Blackspart Construction concluded that 90% of the accidents were preventable and that for 70% of them, action by management could have saved lives. (Harlow, 1992: Neal, 1995: Cooke and William, 1998 and Allan, 2009).

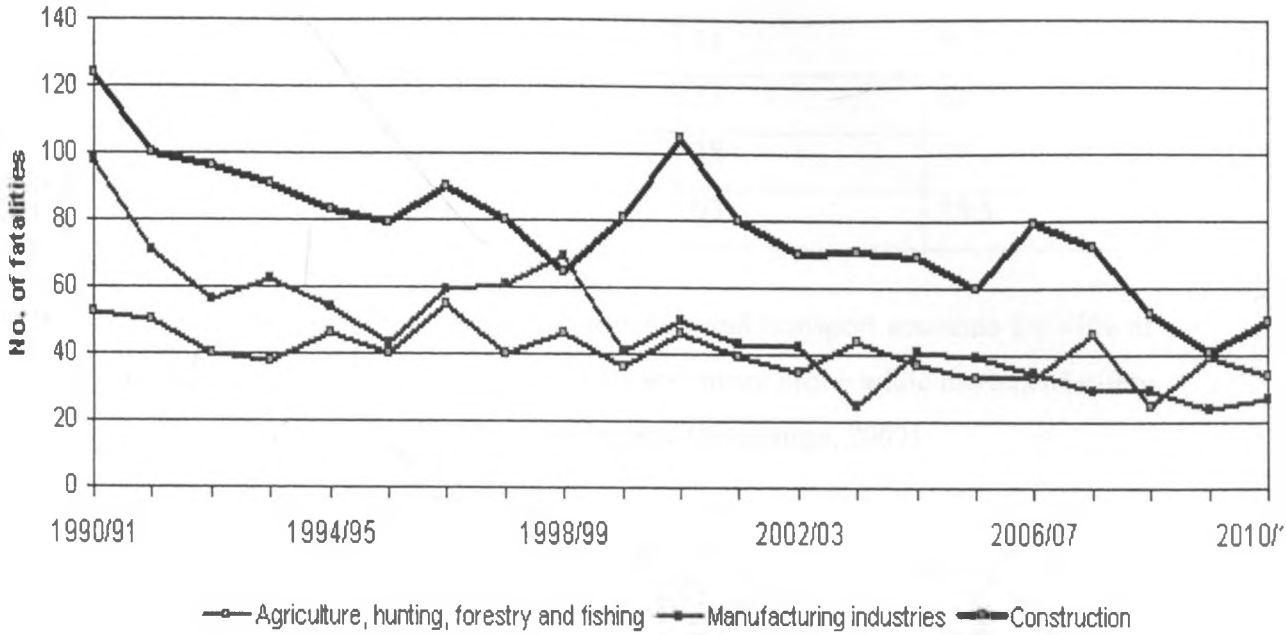
The principal reasons for fatal accidents within the construction process results from fundamental lapses in attention to health and safety and these are: a general lack of foresight to danger, absence of supervision, insufficient education and training for identifying and meeting potential hazards and a general lack of attention to details (Allan, 2009). In recognition to the safety concerns, many public agencies in the developed world include safety standards as part of the construction contract documents, which then become a contractual obligation as well as legal one (Fisk, 2000)

### **2.2.1 Comparative accidents statistics.**

The construction industry still clings to its infamous position as the industrial sector responsible for more occupational injuries and fatalities than any other (Richard et al, 2000). According to Eurostat, construction is the most dangerous line of land-based work in the United States and Europe. In most of North America and Europe, the only type of work that is more dangerous than construction is fishing. In the European Union, the fatal accident rate is nearly 13 workers per 100,000 as against 5 per 100,000 for the all sector average (Source: Eurostat).

In England, the construction industry has poor accident record. Figures released in 1992 showed that in an industry which employed 5.5% of the total industrial workforce, the construction industry was responsible for 11% of all accidents in all industries and 25% of all fatalities in all industries (Trevor, 1999). Accidents therefore are clearly out of proportion to the percentage of people employed. According to Trevor and Thomas (1999), research done shows that many of the accidents are avoidable and many are accounted for by the management failure. According to HSE 2010-2011 report, in UK, there have been significant reductions in the number and rate of injury over the last 20 years or more. Nevertheless, construction remains a high risk industry. Although it accounts for only about 5% of the employees in Britain it still accounts for 27% of fatal injuries to employees and 9% of reported major injuries.

Figure 2.1 Twenty year trend in worker fatalities.



Source:-HSE Report 2011

In the USA, construction employs in the region of 5% of the entire industrial work force, however the construction sector has generally accounted nearly 20% of all industrial deaths (Richard et al, 2000)

In Kenya, the available figures of reported fatal accidents in 80's are shown in table 2.1 below:

TABLE 2.1: NUMBER OF REPORTED FATAL ACCIDENTS OCCURRING IN KENYA

YEAR	Construction site	Other industries	Total death	% of site death
1982	26	15	41	63.4
1983	14	8	22	63.6
1984	35	3	38	92.1
1985	33	60	93	35.5

Source:- Factories Inspectorate, Ministry of labour

Data in the year 2003 indicates that mining, construction and transport accounts for 41% of accidents in Kenya, this shows that these occupations are injury prone while matters of safety are treated casually by both the employer and employees. (Nyakango, 2007)

### 2.2.2 The causes of accidents in Building construction site.

When an accident occurs, the tendency is to focus on the condition on the site at that time so that changes can be made to prevent future accidents:- faulty equipment replaced, barriers installed, protective personal equipment worn( Frederick and Nancy Joyce, 2009). According to Frederick and Nancy Joyce (2009), the two factors at the heart of site safety are; peoples actions and conditions on site. Unsafe acts and conditions cause accidents. Unsafe conditions on site are hazards that can cause injuries, these are: defective tools, unprotected openings, and improper storage of equipment and materials. Unsafe acts on site are hazards caused by actions of people on site, these actions can be categorized in 3 ways: things a person should have done (e.g. inform others about unsafe conditions), things a person should have done differently, and those that a person should have not done at all.

“If a person neglects to inform others about unsafe conditions, he or she is neglecting to act, if a person uses tools or equipment inappropriately or works at height without proper protection he or she is acting incorrectly. If a person proceeds into a hazard area despite warning signs, the person is acting when he or she should not have” (Nancy and Frederick, 2009). According to Richard et al (2000), the causes of accidents include: compressed project completion schedule, hazardous work situations and lengthy exposure to hazards like noise.

Major causes of death and injury in construction industry according to Neal (1995), are as shown in table 2.2 below:

TABLE 2.2: MAJOR CAUSES OF DEATH AND INJURY

Major Causes of death and injury	Examples from construction site
1. Fall from Height	Fall from scaffolding, maintenance cradle, falls from roof , ladders
2. Slips	Slips from roof, into trenches, over handrail, on oil, trips over materials and badly fitting scaffolding board
3. Being struck by moving object	Materials falling from height, e.g. off scaffold, material being handled by cranes
4. Electrical hazards	Excavating live cables, misuses of electrical power tools
5. Confined spaces	Drainage works especially maintenance, Basement excavations, underground storage tanks, large diameter piles inspection
6. Machines	Excavation pants, cranes

Summary: Fall accounted for 52.1%, Slips 24.0%, Machinery 3.4%, Moving object 20.5%  
 Source: R. Neal 1995.

### 2.2.3 Benefit of Safety programme.

There are many mitigating factors supporting the need for effective construction safety programme and these generally fall into humanitarian and economic categories (Ritz, 1994). In addition to the humanitarian aspects, there is also a compelling economic motivation in accident prevention which accrues to the contractor whose site has less or zero accidents (Richard, 1986).

According to Allan (2009), there are four main reasons why accident prevention in construction is worthwhile: Cost in human suffering, physical pain and handicap resulting from death and disability is impossible to quantify. Moral reasons for accident prevention stem from developing public awareness that something need to be done to raise the quality of life at work. There is a growing belief that it is morally unacceptable to put the safety and health of at risk for profit or any other reason. The legal reasons are contained in the statute. Civil law enables injured workers to gain compensation. And lastly the financial reasons for accident prevention ensure the continued financial and economic health of a business and avoid the costs associated with accidents. These include monetary loss to employers,

community and society from worker injury and ill health. Some but not all the costs are insurable and these are known as direct costs which include compensation, Indirect costs include uninsured property and materials damaged, delays, overtime costs, temporary labour engaged, management time spent on investigations, decreased output, and loss of expertise. Safety is also an important public relations tool, there being few other activities with such great potential for building goodwill, and good public relations have important financial and business implications for the contractor (Richard, 1986).

### **2.3 Review of literature according to the study variables.**

The study variables as outlined in the conceptual framework include: the dependent variable: safety on construction site and the independent variables: Personal protective equipments, contractor's safety policy, cost of safety, enforcement of legal requirements and training of workers on site safety.

#### **2.3.1 Safety on construction site**

Studies by HSE show that most accidents are due to the management failure. According to Neal (1995), senior managers(policy makers) of organizations with better than average safety; know about the accidents on their projects, evaluate construction managers on their safety records, ensures that they discuss safety with their construction managers on a regular basis and distribute accidents records from individual projects through the organization. According to Jaleski et al (2007), the improvement of safety performance is achieved through: Better safety records, expending greater monetary resources on safety, providing safety training, indoctrination of new foremen to company policies and guidelines, increasing number of meetings to discuss safety and increasing number of informal inspections to projects.

The ILO report 2005, on improving safety gave the following points as ways of improving overall safety performance; Effective communication; communicating effectively with workforce on accident prevention is often the key to a successful approach to safety improvement, Record keeping; Keeping records of the types of accidents that occur puts you in a better position to prevent them, Motivation of the workforce; measures such as safety bonus for worker or gangs with least accident record, and use of safety equipment; make sure

that safety equipment is available when and where it's needed, insist that its always used and take disciplinary action against workers who refuse to or frequently forget to use them.

### **2.3.2 Effect of personal protective equipment on site safety.**

Personal protective equipment (PPE) means all equipment designed to be worn or held by a person at work to protect against one or more risks, and any addition or accessory designed to meet this objective. They include: safety footwear, water proof clothing, safety helmets, gloves, goggles, high visibility clothing, personal fall restraint, and respirators (Allan, 2009). In addition to training, safety program identifies preventive devices that can be used on site to eliminate hazards, these measures can provide safe conditions for the workers and the more productive the worker will become. (Nancy and Frederick, 2009).

According to Nancy and Frederick (2009), the following are some of the common protective devices: Fall protection, this is required when workers are above six feet in areas with sides and edges, such as open sided floors, wall openings, roofing, hoist areas working surfaces with holes, edges of excavations, and formwork. Protections include, guardrail, safety nets, personal fall restraints, covers, and controlled access zones. Hard hats are the most common, along with safety goggles. Personal fall restraints are required for working on higher elevations. Fire protection, to keep flammables and combustibles from causing harm, they need to be kept in special containers. Fire extinguishers should be available as well. Signs, signals and barricades, these give information to workers and some time to the public about hazardous conditions when those conditions cannot be eliminated. Flag-waving garments, traffic control, visible signs and signals, and barricades are all examples.

In Kenya Section 101 of OSHA (2007), states that "Every employer shall provide and maintain for the use of employees in any workplace where employees are employed in any process involving exposure to wet or to any injurious or offensive substance, adequate, effective and suitable protective clothing and appliances, including, where necessary, suitable gloves, footwear, goggles and head coverings". While BOWEC 1984 in section 141 provides that; Every contractor shall provide adequate and suitable protective clothing for any person so employed who by reason of the nature of his work is required continue working in the open



air during rain, sleet or hail. And no person shall enter or work at a site unless he is wearing a safety helmet or safety cap of an approved type.

### **2.3.3 Effect of contractors safety policy on site safety.**

Communicating the safety practices and procedures developed by a business requires a powerful tool and this is the safety policy- the core document in the management of safety (Allan, 2009). Construction organizations which successfully achieve higher standards of health and safety practice invariably have in place clear and acceptable health and safety policies (Alan and Tim, 2001). According to Alan and Tim (2001), health and safety policy is a published statement reflecting organizations intentions in relation to the management of health and safety matters.

According to Neal (1995), safety policy as a statement by the corporate management regarding safety. A corporate safety policy will include;

- I. Policy statement-what the organization will do,
- II. Operations of the policy-explains how the organization will ensure that the policy is adhered to.
- III. Organization - states who is responsible for the safety at different levels of the organization and
- IV. Communication- explains how the policy will be communicated.

The best plan for accident prevention is to have a company safety programme. The goal of a safety programme is to achieve longer and longer periods of time without injury (James, 1991) One of the most important elements is to develop a good safety attitude among workers. Safety as an attitude starts with top management and is reflected on the job sites in many ways: through training, toolbox meeting, adherence to safety measures, maintenance of tools and equipment (Frederick and Nancy Joyce, 2009).

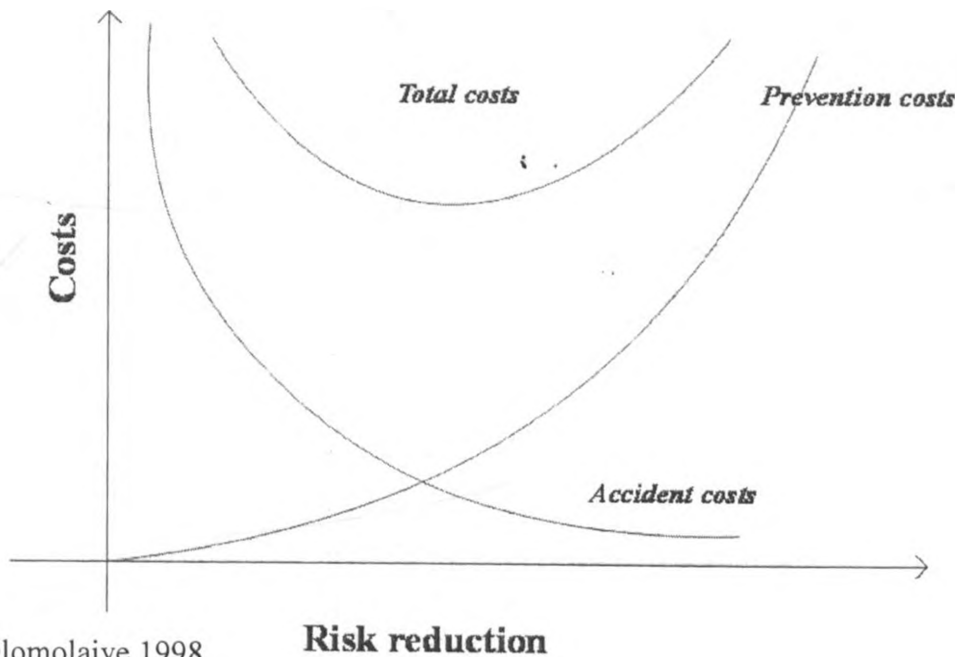
Canadian studies have shown that active involvement in safety management by most senior level in a construction company is directly correlated with reduction in numbers of accidents and injuries (Allan, 2009). A company safety programme also includes concern for safety of

the general public (safety barriers, fences and temporary protected walkways can be used to protect passersby from any danger at the construction site (James, 1991)

### 2.3.4 Effect of costs on building construction site safety.

According to Olomolaiye et al (1998), the cost of accidents is an economic incentive towards putting in place safety measures to minimize accidents

Figure 2.2: Costs and safety



Source: Olomolaiye 1998

In construction, the cost of accidents will fall as safety measures increases. As we reduce risks the accident costs will also be reduced, but we must spend money on accident prevention. According to Waldev (2011), incorporating health and safety into business could save employers unnecessary costs and increase their productivity helping them get ready for the forecasted economic growth.

### **2.3.5 Effect of enforcement of legal requirement on site safety.**

The factories act cap 514 which came into operation on September 1<sup>st</sup> 1951 was the general legislative order which governed the provision of safety and health work at places of work. The act contained statutes of general application to all industrial working places. On 15<sup>th</sup> February, 1984, rules of particular application to the construction industry were gazetted, the Factories (building operations and works of engineering construction-BOWEC). In 1990, the act was amended to Factories and other places of work act 1990 to accommodate places of work which are not factories. In the year 2007, it was further amended to occupational safety and health act (OSHA). The enabling rules for the building industry have remained BOWEC 1984 derived from factories act.

According to Country human rights report (2011), the Directorate of Occupational Safety and Health Services is understaffed. In its strategic plan for the year 2008-2012 the Ministry of Labour clearly states that the authorized establishment level of the Directorate is 168 but in-post there are only 79, creating a variance of 112( Country human rights report, 2010). This therefore incapacitates this department in terms of field inspections. In Kenya, developers are the greatest violators of the development control laws and regulations according to a report by Architectural Association of Kenya titled A study on development control frameworks in Kenya, 2011

### **2.3.6 Effect of safety training on building construction site safety.**

Lack of formal safety training is commonly considered the weakest part of accident prevention in construction industry (Neal, 1995). Training for health and safety is not an end in itself, it is a means to an end. Talking in general terms to employees about the need to be safe is not training (Allan, 2009). Safety training should begin with new employees and continue through the time he/she is with the company (Fellows et al, 2002). Safety training should be given to all employees regardless of previous experiences. One of the most effective means is the use of periodic safety meetings with the use of visual aids to dramatize the effect of poor adherence to safe procedures. Such meetings should be long enough to present the desired information and are often best undertaken in an informal setting where workers can contribute.

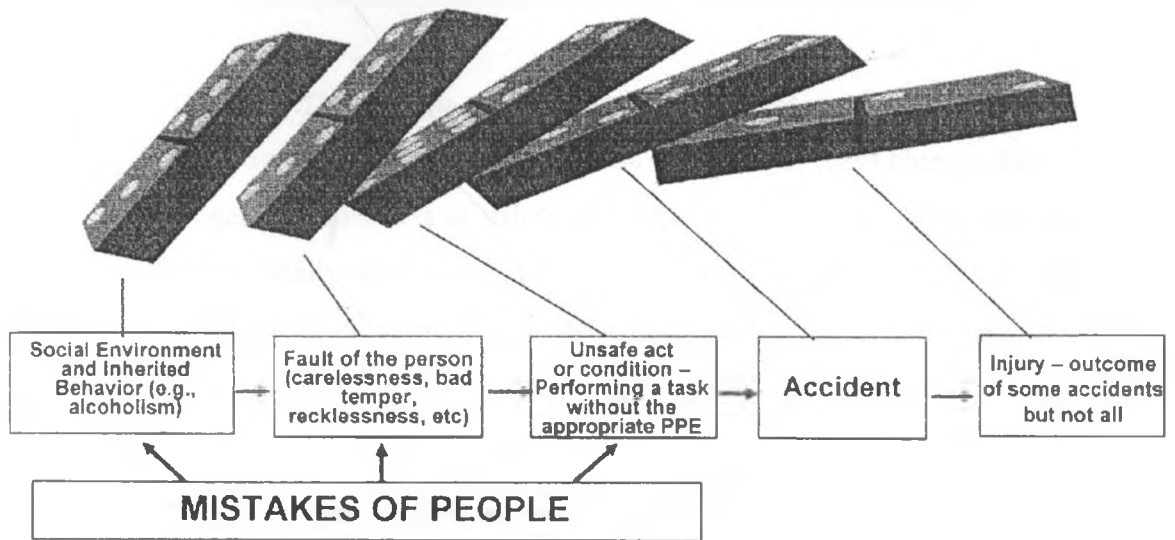
The following are some of the matters to be discussed in the training; Information on accidents that have happened elsewhere on similar sites, precautionary measures necessary on any new section of the work, reviewing first aid procedures, and pointing out any unsafe practices that have been noticed (Fellows et al, 2002). Three conditions need to be present for any safety training to be successful; the active commitment, support and interest of management, necessary finance and organization to provide the opportunity for learning to take place, and the availability of suitable expertise in the subject. Health and safety training is extremely important for the industry as it helps to provide a safer working environment for employees while boosting morale and increasing staff retention and profits ( Waldev, 2011)

#### **2.4 Theoretical framework.**

This research involves investigation of factors affecting safety in building construction sites. Lack of safety measures in sites leads to accidents and injuries. The main accident causation theory is the Heinrich domino theory developed in 1932 by H. W. Heinrich, a safety engineer and pioneer in the field of accident safety. According to Heinrich, an "accident" is one factor in a sequence that may lead to an injury. The factors can be visualized as a series of dominoes standing on edge; when one falls, the linkage required for a chain reaction is completed. Each of the factors is dependent on the preceding factor (Heinrich, 1959).

Heinrich's Domino Theory states that accidents result from a chain of sequential events, metaphorically like a line of dominoes falling over (see figure 2.3 below). When one of the dominoes falls, it triggers the next one, and the next...but removing a key factor (such as an unsafe condition or an unsafe act) prevents the start of the chain reaction. Heinrich, 1959 stated that "injury is the natural culmination of a series of events or circumstances which occur"

Figure 2.3- Heinrich's Domino Model of Accident Causation



Source - National Institute for Disaster management (NIDM)-New Delhi.

According to W.H. Heinrich (1932), who developed the domino theory, 88% of all accidents are caused by unsafe acts of people, 10% by unsafe actions and 2% by "acts of God".  
Heinrich's Dominos – The Process

- I. A personal injury (the final domino) occurs only as a result of an accident.
- II. An accident occurs (the second last domino) only as a result of a personal or mechanical hazard.
- III. Personal and mechanical hazards exist only through the fault of careless persons or poorly designed or improperly maintained equipment.
- IV. Faults of persons are inherited or acquired as a result of their social environment or acquired by ancestry.
- V. The environment is where and how a person was raised and educated.

The factors preceding accidents are the unsafe act, the mechanical or physical hazard, they should receive the most attention. Heinrich also felt that the person responsible at a company for loss control should be interested in all five factors, but be concerned primarily with accidents and the proximate causes of those accidents. Heinrich emphasized that accidents,

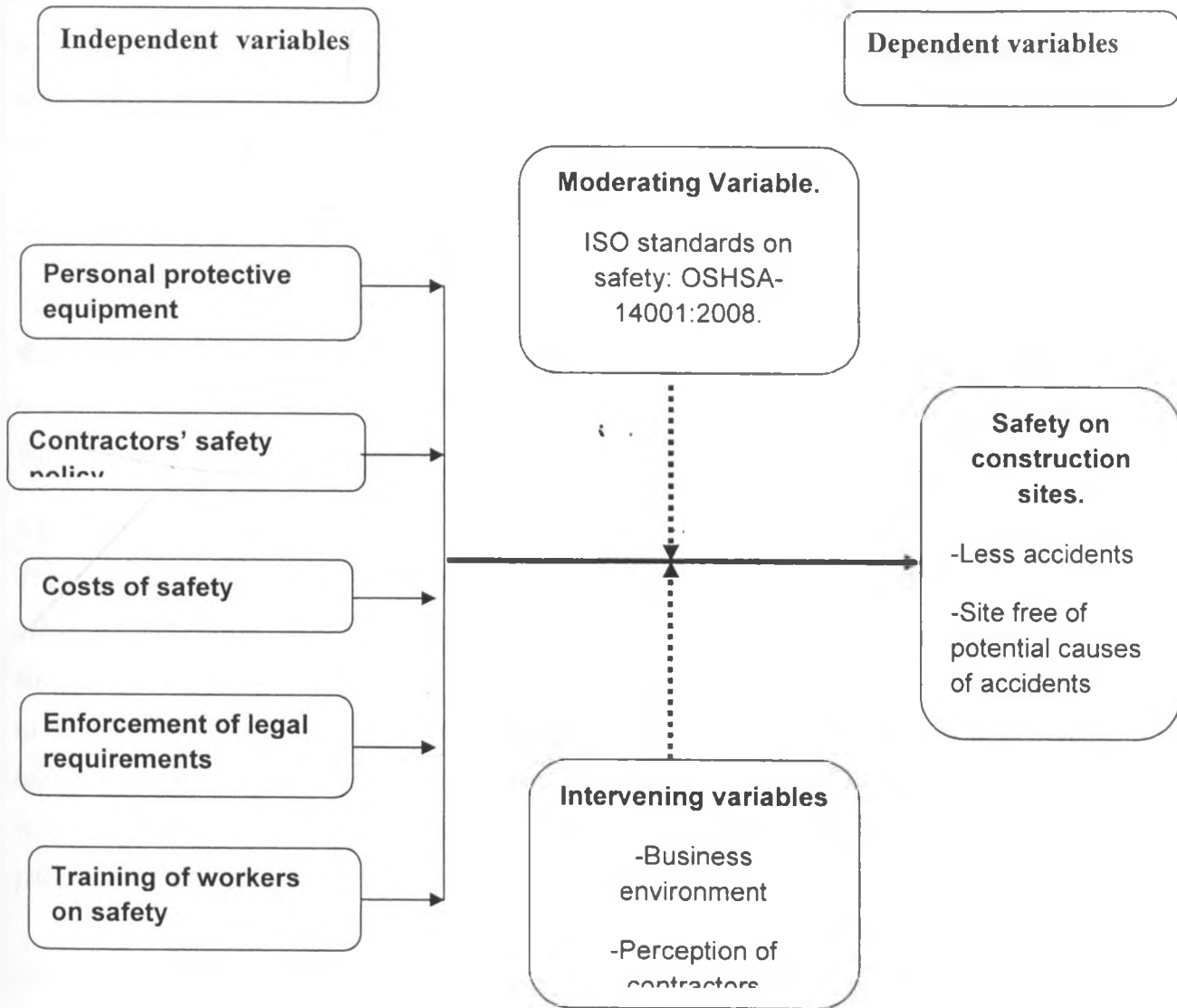
not injuries or property damage, should be the point of attack. An accident is any unplanned, uncontrolled event that could result in personal injury or property damage. For example, if a person slips and falls, an injury may or may not result, but an accident has taken place.

In Heinrich's Domino Theory, the corrective action sequences (The three "E"s) are: Engineering that is Control hazards through product design or process change, Education that is train workers regarding all facets of safety and imposing on management that attention to safety pays off and finally Enforcement that is ensure that internal and external rules, regulations, and standard operating procedures are followed by workers as well as management.

## 2.5 Conceptual framework.

Figure 2.4 below is the conceptual framework depicting the relationship between the variables.

Figure 2.4: Conceptual framework



Source: Researcher 2012.

The conceptual framework indicates the relationships among all the variable under study in a the schematic drawing. This study however will focus on the independent and dependent variable due to time limitations.

## **CHAPTER THREE**

### **RESEARCH METHODOLOGY.**

#### **3.1 Introduction.**

This chapter discusses the methodology which has been used in this study. This includes the research design, sampling strategy, data collection process, analysis and presentation. The chapter describes and justifies the selected approach, which will be applied in order to achieve the set research objectives.

#### **3.2 Research Design**

This research was conducted through a case study. Case study has been chosen as it enables the researcher to have an in-depth understanding of the study objectives. The design used made it possible to study factors affecting safety in construction sites; case of public funded building projects in Makueni district.

#### **3.2 Target population**

The total active public funded building projects according to records from county works office Makueni County is over 35 and five others were recently completed. However the study population included only sites which are nearing completion. The numbers of projects in this category as at the time of this study stood at 13. According to the clerk of works report reports in makueni county works office, these sites have an average of 7.5 construction workers grouped into foremen, skilled labourers and unskilled labourers. The total target population therefore is 98 workers

#### **3.4 Sample Size and Sampling Procedures.**

This study adopted a stratified sampling design to get the sample size. The population of the study was organized into 4 different strata namely; Kibwezi and Makindu, wote and Kathonzweni, Mbooni East and Mbooni west, Kilungu, Nzaui and Mukaa. Thereafter the sites falling in each strata were be subjected to a random sampling to arrive at the sites to be studied.



## Sample size (n)

The sample size of sites under study shall be 12 sites. This is calculated using Yamane Taro's (1967:886) simplified formula ( $n=N/1+N(e^2)$ , where n is sample size and N is the population and e is the error margin, thus  $n=13/(1+13(.05^2))$ ) to calculate sample sizes we get a sample size of 12. This formula assumes a 95% confidence level and P = 0.5 (being estimated variability/or distribution of attributes in the population) and margin of error e of +5% or -5%.

**Table 3.1: Distribution of sample in the strata.**

Category	Frequency/ Number of active sites(F)	Percentage	Sample size n 12/13xF
Kibwezi and Makindu	3	23.08	2.7= 3
Kilungu, Nzau and Mukaa	3	23.08	2.7=3
Wote and Kathonzweni	4	30.76	3.6=4
Mbooni East and West	3	23.08	2.7=2
Total	13	100	12

Source: Researcher 2012

Twelve (12) sites therefore were studied. Each site employs over 10 personnel (Skilled and unskilled workers) at the peak of construction and an average of 7.5 at all times (sample population of 84). For document review, recently concluded projects were analysed

### 3.5 Research Instruments.

Primary data was collected through questionnaires, Construction site observational checklist and focused group interviews involving site foremen, skilled labourers and contractors. The questionnaire consisted of both open and closed ended questions providing both qualitative and quantitative data. Secondary data was collected through document review of recently completed projects by the researcher.

### **3.6 Validity and Reliability of research Instruments**

Validity and reliability of research instruments concern how measures are connected to the constructs (Neuman, 2007). They will be checked and improved before collection of data from the field can commence.

#### **3.6.1 Validity.**

The bridge or relationship between the construct or variable of interest and the data. Validity in this study will be improved by comparing measures with other measures, or data that may be available from experts and also having objectives that are clearly defined and operationalized.

#### **3.6.2 Reliability.**

The reliability of measures obtained from the research instruments were improved through pilot study which was conducted involving two respondents from each strata. Adjustments to the instruments were then done using the result of the pilot study to enhance reliability of the tools. Further, the study used internal consistency technique to ensure reliability of data where a score obtained in one item is correlated with scores obtained from other items.

### **3.7 Data collection methods and procedures.**

All data and information obtained were treated with confidentiality and only used for academic purposes only, a fact that was explained to all the respondents. The researcher visited the respondents on site, introduced himself and the purpose of the research and requested the respondents to fill the questionnaires, which then collected the following day or two. The questionnaires were administered using drop and pick method. However, for respondents who could not read or write and/or understand English, the researcher and the research assistant administered the questionnaire, translating the content therein into Kiswahili. The data collection exercise took three weeks.

### **3.8 Data Analysis and Presentation**

When the filled questionnaires and checklists had been collected, data processing was then carried out: tallying, scoring and tabulation of data. The coded data were analyzed using quantitative and qualitative techniques. Descriptive statistics (measures of location, measures of central tendencies and measures of dispersion) and relational statistics (correlation) were be used to analyze the data. The results have been presented using tables, frequency distribution, histogram and bar graphs for easy understanding and interpretation. Qualitative techniques are also applied and results of qualitative analysis presented in prose.

### 3.9 Operationalization of variables.

Table 3.2 below is the operationalization of variables table.

**Table 3.2: Operationalization of variables**

Objective/Research question	Variables	Indicators	Measurements	Level of Measurement	Research Design	Data Collection method	Analysis
How does To PPE affect safety on building construction site?	Independent Variable Uses of PPE	PPE's on site Hand gloves Helmets	Number of PPE's on site	ordinal	Case study	Checklist and Questionnaire	Descriptive.
What is the effect of Contractors' safety policy on safety in building construction site?	Independent Variable Contractors safety policy	Existence of Safety Policy	Availability of safety policy	Nominal	Case study	Checklist and Questionnaire Document review	Descriptive Content analysis
To what extent does cost affect safety in a building construction site?	Independent. Variable Cost of safety	Expenditure on safety	Amount spent on safety in relation to project cost.	Ratio	Case study	Questionnaire	Descriptive
How does Enforcement of legal requirements affects safety on building construction site?	Independent. Enforcement of legal requirements	Letters of Approval. Visits by authorities	Availability of approvals granted. Visits by authorities	Nominal	Case study	Questionnaire. Document review	Descriptive. Content analysis
How does safety training of workers affect safety on building construction site?	Independent variable Training on safety.	Certificates	Number of hours or weeks of safety training	Ordinal	Case study	Questionnaire Document review	Descriptive. Content analysis
Safety on site	Dependent Variable. Site safety	-injuries -Level of exposure to risks	Number of injuries.	Interval	Case study	Document review Checklist	Content analysis Descriptive

Source: Researcher 2012

## CHAPTER FOUR

### DATA ANALYSIS, PRESENTATION AND INTERPRESENTATION.

#### 4.1 Introduction

This chapter presents the study findings. Descriptive statistics is used for facilitating meaningful analysis.

#### 4.2 Response rate

In this study, respondents were drawn from the building construction workers in twelve randomly chosen building construction sites of public funded projects in Makueni district. The following characteristics were considered: age, gender and experience in building construction industry. The results show that out of the 84 anticipated sample size, 73 respondents were analysed forming a 87% response rate. According to Babbie (2002), any response rate of 50% and above is adequate for analysis.

#### 4.3 Demographic characteristics

This section captures how building construction workers in public funded projects in Makueni district are distributed in terms of age, experience in the construction industry and gender.

##### 4.3.1 Distribution by age of respondents

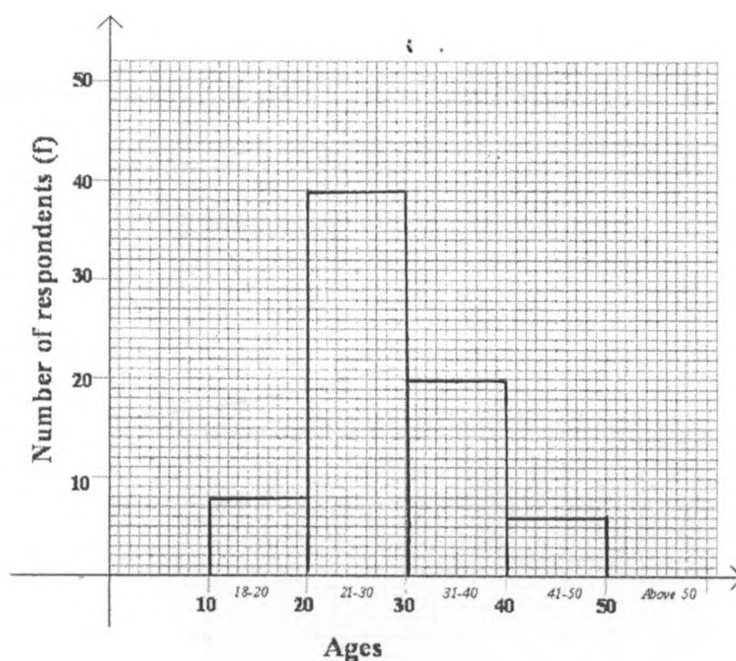
The ages of construction workers in public funded building projects in Makueni district are distributed as follows; the ages of between 18-20 formed 11.0%, between 21-30 formed 53.4%, between 31-40 formed 27.4% and between 41-50 formed 8.2% while none were above 50 years. Table 4.3.1 and figure 4.3.1 shows the distribution by age. The majority of construction workers lie between the ages of 21-30 years.

Table 4.3.1: Frequency distribution of respondents by age

Age	Frequency (f)	Cummulative frequency (Cf)	Valid Percentage (%)	Cumulative %
18-20	8	8	11.0	11.0
21-30	39	47	53.4	64.4
31-40	20	67	27.4	91.8
41-50	6	73	8.2	100
Above 50	0	73	0	100
Total	73		100	

Source: Survey data, 2012

Figure 4.3.1: Distribution of respondents by age.



Source: Survey data, 2012

#### 4.3.2 Distribution by work experience of respondents

The distribution of construction workers in public funded building projects in Makueni district by level of experience is as follows; those with less than 5 years experience formed 53.4%, those with 5-10 years formed 30.1%, those with 11-15 years formed 13.7%, while 16-

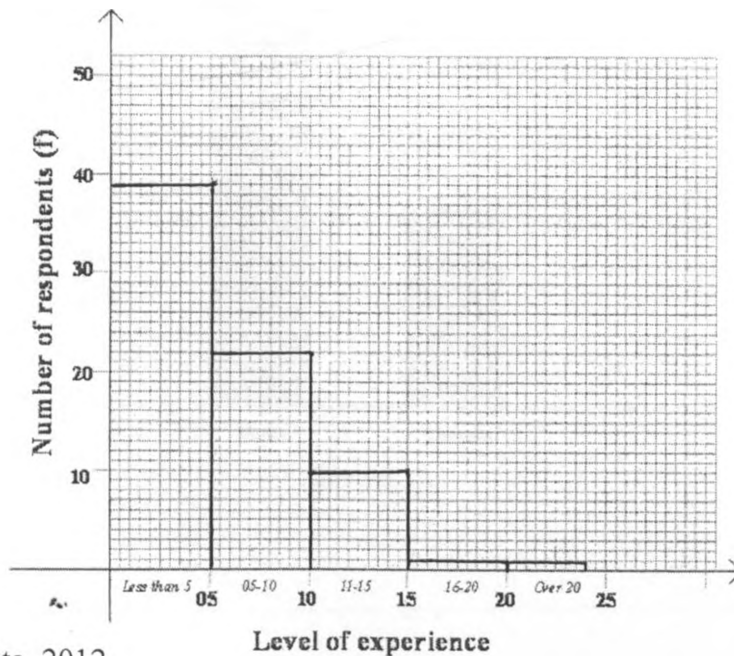
20 years and above 21 years each formed 1.4%. Table 4.3.2 and figure 4.3.2 shows the distribution of respondents by level of experience. The majority of construction workers in public funded projects in Makueni district have less than five year experience

Table 4.3.2: Frequency distribution of respondents by levels of experience

Level of experience	Frequency (f)	Cummulative frequency (Cf)	Valid Percentage (%)	Cumulative %
<5	39	39	53.4	53.4
5-10	22	61	30.1	83.5
11-15	10	71	13.7	97.2
16-20	1	72	1.4	98.6
>20	1	73	1.4	100
Total	73		100	

Source: Survey data, 2012

Figure 4.3.2: Distribution of respondents by levels of experience



Source: Survey data, 2012

### 4.3.3 Distribution by gender of respondents

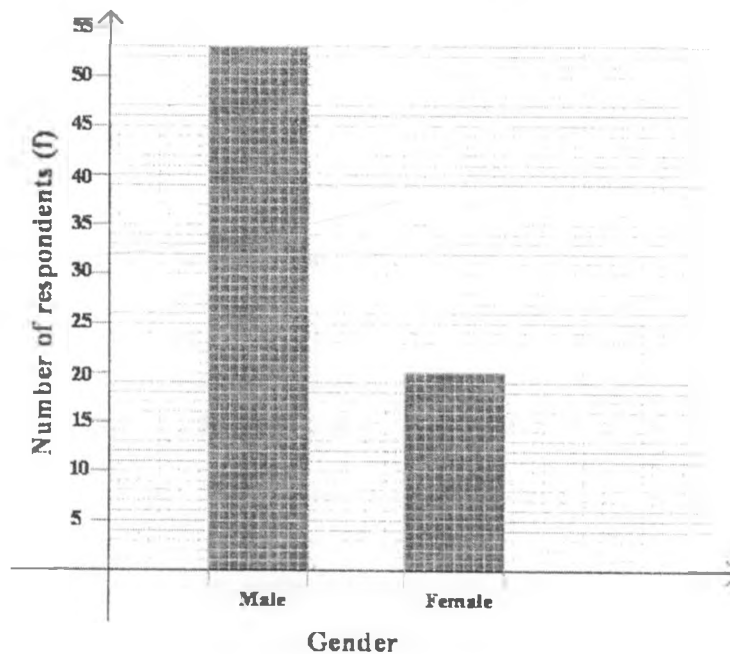
The data collected reveals that 72.6% of the respondents were male compared to 27.4% who were female. The frequency table for this distribution is captured in table 4.4.4 below while figure 4.3.3 is a bar-graph showing distribution by gender

Table 4.3.3: Frequency distribution of respondents by gender

Gender	Frequency (f)	Cummulative frequency (Cf)	Valid Percentage (%)	Cumulative %
Male	53	53	72.6	72.6
Female	20	73	27.4	100
Total	73		100	

Source:- Survey data, 2012

Figure 4.3.3- Distribution by gender



Source:- Survey data, 2012



#### 4.4 Variable.

The respondents graded statements using a Likert scale (Barnett, 1999) with a five response scale. The respondents responded in the following ways: (i) strongly agree, (ii) Agree, (iii) Undecided, (iv) Disagree, (v) Strongly disagree. The study adopted the scale as below:-

Scale	Response
5	Strongly agree
4	Agree
3	Undecided
2	Disagree
1	Strongly disagree

An average of 4 and above indicates strong agreement while below three is strong disagreement

(Kothari 2004)

#### 4.4.1 The extent to which personal protective equipment affects safety on site

The research question aimed at establishing the relationship between personal protective equipment and safety in building construction sites of public funded projects in Makueni district.

Table 4.4.1 below indicates the weight the respondents gave the effect of PPE's on site safety.

Table 4.4.1:-Table of Site by site scores on effect of ppe's on site safety

Site	S <sub>1</sub>	S <sub>2</sub>	S <sub>3</sub>	S <sub>4</sub>	S <sub>5</sub>	S <sub>6</sub>	S <sub>7</sub>	S <sub>8</sub>	S <sub>9</sub>	S <sub>10</sub>	S <sub>11</sub>	S <sub>12</sub>	Ave.
Average Score on likert scale	4.3	5.0	3.8	3.0	4.4	4.1	5.0	4.6	4.8	5.0	4.9	3.9	4.39

Source: Survey data, 2012

An average score of 4.39 on Likert scale indicates agreement with the effect of PPE's on site safety. The standard deviation ( $\sigma$ ) of the data set is 0.66 indicating a minimal variability or dispersion about the mean in the data set and giving a better measure of confidence in statistical conclusions.

The availability of PPE's in all the sites visited was as follows: 75% had overalls, 30% of sites, had helmets, 22% of the sites had safety goggles while None of the sites had hand gloves, safety footwear and first aid kit

Correlating site by site scores on PPE's with site by site scores on measures of site safety gives a Spearman's rank correlation coefficient of 0.29 indicating a weak positive correlation.

The Spearman's rank correlation coefficient is calculated as below

$$\rho = 1 - \frac{6 \sum d_i^2}{n(n^2 - 1)}$$

Where n-is the number of paired score site by site  
d- is the difference of paired ranks.

#### 4.4.2 The effect of contractors policy on safety in building construction sites

The research question aimed at establishing the relationship between contractors' safety policy and safety in building construction sites of public funded projects in Makueni district. Table 4.4.2 below indicates the weight the respondents gave the effect of contractors safety policy on site safety.

Table 4.4.2:-Table of Site by site scores on effect contractors' safety policy on site safety

Site	S <sub>1</sub>	S <sub>2</sub>	S <sub>3</sub>	S <sub>4</sub>	S <sub>5</sub>	S <sub>6</sub>	S <sub>7</sub>	S <sub>8</sub>	S <sub>9</sub>	S <sub>10</sub>	S <sub>11</sub>	S <sub>12</sub>	Ave.
Average Score on likert scale	4.3	4.8	3.8	3.3	4.4	4.3	5.0	4.9	4.6	5.0	4.6	4.3	4.44

Source: Survey data, 2012

An average score of 4.44 on Likert scale indicates agreement that is contractors safety policy does affect safety on site. The standard deviation ( $\sigma$ ) of the data set is 0.50 indicating a minimal variability or dispersion about the mean in the data set and giving a better measure of confidence in statistical conclusions.

Of the respondents sampled only 46.5% indicated that the construction companies they work for had safety policy in place.

Correlating site by site scores on contractors' safety policy with site by site scores on measures of site safety gives a Spearman's rank correlation coefficient of 0.52 indicating a moderately strong positive correlation.

#### 4.4.3 The extent to which costs affects safety in building construction sites.

The research question aimed at establishing the relationship between costs of safety and safety in building construction sites of public funded projects in Makueni district. Table 4.4.3 below indicates the weight the respondents gave the effect of costs of safety on site safety.

Table 4.4.3:-Table of Site by site scores on effect of costs on site safety

Site	S <sub>1</sub>	S <sub>2</sub>	S <sub>3</sub>	S <sub>4</sub>	S <sub>5</sub>	S <sub>6</sub>	S <sub>7</sub>	S <sub>8</sub>	S <sub>9</sub>	S <sub>10</sub>	S <sub>11</sub>	S <sub>12</sub>	Ave.
Average Score on likert scale	4.3	4.6	2.8	3.5	4.2	4.1	5.0	4.8	4.3	5.0	4.5	4.0	4.26

Source: Survey data, 2012

An average score of 4.26 indicates agreement that is costs do affect safety in building construction sites. The standard deviation ( $\sigma$ ) of the data set is 0.59 indicating a minimal variability or dispersion about the mean in the data set and giving a better measure of confidence in statistical conclusions.

Correlating site by site scores on costs of safety with site by site scores on measures of site safety gives a Spearman's rank correlation coefficient of 0.47 indicating a moderately strong positive correlation.

#### 4.4.4 How enforcement of legal requirement affect safety on building construction site.

The question aimed at establishing the relationship between enforcement of legal requirements especially safety inspections by ministry of labour and safety in building construction sites of public funded projects in Makueni district. Table 4.4.4 below indicates the weight the respondents gave the effect of enforcement of legal requirements on site safety.

Table 4.4.4:-Site by site scores-effect of enforcement of legal requirements on site safety

Site	S <sub>1</sub>	S <sub>2</sub>	S <sub>3</sub>	S <sub>4</sub>	S <sub>5</sub>	S <sub>6</sub>	S <sub>7</sub>	S <sub>8</sub>	S <sub>9</sub>	S <sub>10</sub>	S <sub>11</sub>	S <sub>12</sub>	Ave.
Average Score on likert scale	3.8	4.9	3.5	3.8	4.2	4.1	5.0	4.4	4.9	5.0	4.5	4.3	4.36

Source: Survey data, 2012

An average score of 4.36 indicates agreement. The standard deviation ( $\sigma$ ) of the data set is 0.55 indicating a minimal variability or dispersion about the mean in the data set and giving a better measure of confidence in statistical conclusions. 92.1% of the respondents indicated that they have never seen a safety officer from ministry of labour come to site to check on safety measures put in place as a legal requirement for all sites.

Correlating site by site scores on enforcement of legal requirements with site by site scores on measures of site safety gives a Spearman's rank correlation coefficient of 0.45 indicating a moderately strong positive correlation.

#### 4.4.5 How safety training of workers affect safety on building construction site?

The research question aimed at establishing the relationship between training on safety of construction site workers and safety in building construction sites of public funded projects in Makueni district. Table 4.4.5 below indicates the weight the respondents gave the effect of enforcement of legal requirements on site safety.

Table 4.4.5:- Table of Site by site scores on effect safety training on site safety

Site	S <sub>1</sub>	S <sub>2</sub>	S <sub>3</sub>	S <sub>4</sub>	S <sub>5</sub>	S <sub>6</sub>	S <sub>7</sub>	S <sub>8</sub>	S <sub>9</sub>	S <sub>10</sub>	S <sub>11</sub>	S <sub>12</sub>	Ave.
Average Score on likert scale	3.5	4.9	4.3	3.0	4.6	4.1	5.0	4.8	4.8	5.0	4.6	4.2	4.40

Source: Survey data, 2012

An average score of 4.40 on Likert scale indicates agreement with the fact that training on safety does affect safety in building construction sites. The standard deviation ( $\sigma$ ) of the data set is 0.60 indicating a minimal variability or dispersion about the mean in the data set and giving a better measure of confidence in statistical conclusions. 55.6% of the respondents

indicated that they have not had any formal training on site safety, while 44.4% have had formal training on site safety.

Correlating site by site scores on training of construction workers on site safety with site by site scores on measures of site safety gives a Spearman's rank correlation coefficient of 0.36 indicating a moderately weak positive correlation.

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## CHAPTER FIVE

### SUMMARY OF FINDINGS, DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS.

#### 5.1 Introductions

This chapter presents the discussion of findings, conclusions drawn and recommendations made there-to. The conclusions and recommendations drawn are focused on addressing the objectives of this study which were: to investigate how personal protective Equipment (PPE's) affects safety on public funded building construction sites in Makueni District, to assess how contractor's safety policy affects safety on public funded building construction sites in Makueni District, to establish how cost of safety affects safety on public funded building construction sites in Makueni District, to examine how Enforcement of legal requirements affects safety on public funded building construction sites in Makueni District and to examine how safety training affects safety on public funded building construction sites in Makueni District.

#### 5.2 Summary of findings

This section will summarize the study findings as per the study objective.

The first objective of the study was to investigate how personal protective Equipment (PPE's) affects safety on public funded building construction sites in Makueni District. The respondents gave a weak positive correlation between PPE's and safety on site. All the site visited did not have the following PPE's: Hand gloves, safety footwear and first aid kit. The PPE' which was most widely used in the sites visited was the overall.

The second objective was to assess how contractor's safety policy affects safety on public funded building construction sites in Makueni District. The study indicates a moderately strong positive correlation between contractors' safety policy and safety on site. However, only a small fraction of the companies have safety policy in place and display the same on site and or in office.

The third objective was to establish how cost of safety affects safety on public funded building construction sites in Makueni District. The study has shown that there is a moderately strong positive correlation between costs associated with safety and the overall safety on site.

The fourth objective was to examine how Enforcement of legal requirements affects safety on public funded building construction sites in Makueni District. The study has shown that there is a moderately strong positive correlation between enforcement of legal requirements and the safety on sites. The study also revealed that most of the sites have not been visited by the safety inspectors from ministry of labour.

The fifth objective was to examine how safety training affects safety on public funded building construction sites in Makueni District. The study has shown that there is a moderately weak positive correlation between safety training and the safety on sites. Majority of respondents have also not had any formal training on site safety.

### **5.3 Discussion of findings**

This section will look at research findings and compare with what other authors have published. The discussions are done according to the study objectives.

Effect of PPE's on site safety:- the respondents gave a weak positive correlation to the effect of PPE's on site safety. However studies discussed in the literature review did indicate that at the heart of site safety are "peoples actions and conditions on site" (Frederick and Nancy Joyce, 2009). Conditions include wearing of PPE's. The implication is that in public funded building projects in Makueni district, the use of PPE's on sites to some extent improves safety on building construction site.

Effect of contractors' safety policy on safety:- The respondents gave a moderately strong positive correlation between contractors safety policy and safety on site. According to Alan and Tim 2001, Construction organizations which successfully achieve higher standards of health and safety practice invariably have in place clear and acceptable health and safety policies (Alan and Tim, 2001). The goal of a safety programme/policy is to achieve longer

and longer periods of time without injury (James, 1991). This study therefore confirms the findings in the literature review. The implication is that contractors' safety policy is key in safety plans of a building construction site.

Effect of safety costs on site safety:- The study has shown that there is a moderately strong positive correlation between costs associated with safety and the overall safety on site. In literature review it was noted from Olomolaiye et al (1998) graph that as we reduce risks, the accident costs will also be reduced, but we must spend more on accident prevention. This study therefore confirms the findings in the literature review. The implication is that in order to increase safety on site, contractors must spend more on accident prevention.

Effect of enforcement of legal requirements on site safety:- The study has shown that there is a moderately strong positive correlation between enforcement of legal requirements and the safety on sites. However it is worth noting that almost all the respondents indicated that they have not seen the safety inspectors from ministry of labour visit their sites. According to Country human rights report (2011), the Directorate of Occupational Safety and Health Services is understaffed. In its strategic plan for the year 2008-2012 the Ministry of Labour clearly states that the authorized establishment level of the Directorate is 168 but in-post there are only 79, creating a variance of 112. This study therefore confirms the findings in the literature review. The implication is that as much as the role of inspectors is key to site safety, they are currently not adequate.

Effect of safety training on site safety:- The study has shown that there is a moderately weak positive correlation between training and the safety on sites. This is a contrast from the findings in the literature review whereby according to Waldev, (2011), Health and safety training is extremely important for the industry as it helps to provide a safer working environment for employees while boosting morale and increasing staff retention and profits. The implication is that in public funded building projects in Makueni district, safety training to some extent improves safety on building construction site.



## **5.4 Conclusions**

The main aim of the study was to investigate the factors that affect safety in building constructions sites in Makueni district. Five factors were investigated namely; use of PPE's, Contractors safety policy, costs associated with safety measures, enforcement of legal requirements and training on safety.

The author has compared the findings against the views of others within the context of literature review where the findings have either concurred strongly or mildly. The results based on the findings indicate the presence of varying degree of positive relationship in all the variables in this descending order: contractors' safety policy, costs associated with safety measure, enforcement of legal requirements training on safety and lastly PPE's.

To improve safety at construction sites, a clear, complete, and practicable safety plan, based on the company's safety policy, should be formulated since contractors' safety policy tops the list of factors affecting safety on building construction sites in Makueni District.

That to improve safety on site the contractors have to spend on safety measures including employing or engaging the services of safety professional. That safety inspectors from ministry of labour need to visit sites since the study indicates that there have been no visits to the sites by ministry of labour inspectors.

That training of construction workers on safety measures also improves safety on site and there is need to train them since the study indicates that majority of them have had no formal training on site safety. Lastly provision of PPE improve safety on site and there is a need to provide construction workers with them since the study indicates that majority of sites do not have wear safety foot wear, safety goggles, and hand gloves while there are insufficient number of safety helmets in the sites.

## **5.5 Recommendations**

In order to have safe sites in public funded projects in Makueni district, the contractors and the project managers should lay emphasis on development of contractors safety policy, costs

associated with safety measures, enforcement of legal requirements especially by ministry of labour safety inspectors, training on safety and use of PPE's in that order of priority.

The concerned ministry-Ministry of Labour should ensure that building construction sites just like any other place of works are regularly visited by the safety inspectors to ensure compliance with the existing laws and regulations. The newly created National construction authority with the mandate of registering contractors in the industry should include safety measures and records as one of the areas to be checked before registration is granted. More construction workers need training on site safety issues, to this end the proposed establishment of the Occupational Health & Safety Institute under the directorate of occupational health and safety ministry of labour to undertake research and training on matters safety should be fast tracked.

## **5.6 Recommendations for further research:**

Due to limited resources and time the study concentrated on public funded building projects in Makeni District only. Further research that encompasses a wider area and which includes building construction projects across all sectors of the industry is recommended in order to generalize for the entire building construction industry. Further research should also include other areas of safety not covered in this study such as the effect of proper use of machines, plant and equipment on safety.

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**APPENDIXES**

**APPENDIX I**

**Letter of Transmittal**

24<sup>th</sup> April 2012

To whom it may concern

Dear sir/Madam

**RE: Letter of Introduction.**

**Academic research titled: Factors affecting safety on construction sites: case of public funded building projects in Makueni district.**

I am a masters of arts - project planning and management student at the University of Nairobi conducting an academic research on the above subject. Site foremen, Skilled and non-skilled building construction workers have been identified as the respondents of the study.

I am therefore requesting for your support and cooperation in answering the questions honestly and completely. Note that the information given will be treated with confidentiality and under no circumstance will the information be used for upgrading or downgrading any construction company.

Thank you in advance



Oluoch Jared Otieno.

**L50/64268/2010**

APPENDIX II A

Questionnaire of the study

A STUDY OF FACTORS AFFECTING SAFETY ON CONSTRUCTION SITES: CASE OF PUBLIC FUNDED BUILDING PROJECTS IN MAKUENI DISTRICT

(Please tick response as appropriate, where explanation is requested kindly be concise)

SECTION A Demographic Questionnaire.

- 1. What is your age bracket? 18-20  21-30  31-40  41-50  above 50
- 2. Gender: Male  Female
- 3. Do you work in building construction sites? Yes  No.
- 4. If yes, for how many years?  
Less than 5 yrs  5-10 yrs  11-15 yrs  16-20 yrs  Over 21 yrs

SECTION B

- 5. Do you think Personal Protective Equipments affect safety on site? Yes  No   
If yes in what way.....  
.....
- 6. Do you think contractors safety policy affect safety on site? Yes  No   
If yes in what way.....  
.....
- 7. Do you think costs of safety affect safety on site? Yes  No   
If yes in what way.....  
.....
- 8. Do you think enforcement of legal requirements affects safety on site? Yes  No   
If yes in what way.....  
.....
- 9. Do you think training on site safety affects safety on site? Yes  No   
If yes in what way.....  
.....



**APPENDIX II B**

**Personal protective Equipment (PPE's)**

1. Have you ever used any personal protective equipment since the beginning of this project? Yes  No.
2. If yes, which of the following PPE's did you use?
  - a) Helmet
  - b) Safety foot wear
  - c) Gloves
  - d) Safety Google
  - e) Body Harness
  - f) Any other, please state.....
  - g) Not applicable

3.

Tick where appropriate	Strongly agree	agree	Undecided	Disagree	Strongly disagree
PPE's help improve safety on sites					

**Contractor's safety policy**

1. Does the construction company you work for in this site have a safety policy?  
 Yes  No.  I don't know
2. If yes, is it displayed on site and or the offices? Yes  No  N/A
- 3.

Tick where appropriate	Strongly agree	agree	Undecided	Disagree	Strongly disagree
Contractors safety policy help improve safety on sites					

**Costs of safety.**

1. Does the company you work for incur running costs on safety eg employment of safety officer whose work is to handle safety issues? Yes  No
- 2.

Tick where appropriate	Strongly agree	agree	Undecided	Disagree	Strongly disagree
Higher expenditure on safety measures improve safety on sites					

**Enforcement of legal requirements.**

1. Since the beginning of this project, have you been visited on site by safety officers from ministry of labour? Yes  No.
2. If yes how frequent? Once a month  Once in three months  Once in six months  N/A
- 3.

Tick where appropriate	Strongly agree	agree	Undecided	Disagree	Strongly disagree
Enforcement of legal requirement help improve safety on sites					

**Safety training.**

1. Have you ever been trained formally on site safety? Yes  No.
2. If yes, what was the duration of training? 1-4 days  5-7days  1-2weeks  more than 2 weeks  N/A
- 3.

Tick where appropriate	Strongly agree	agree	Undecided	Disagree	Strongly disagree
Safety training improve safety on sites					

### APPENDIX III

#### SITE SAFETY OBSERVATION CHECKLIST.

(Please tick where appropriate, where comments is requested kindly be concise)

1. Personal protective equipment(PPE)

Type of PPE	Not available	Available				Comments
		1-5	6-10	11-15	Over 15	
1. Safety helmet						
2. Hand Gloves						
3. Overall						
4. First aid Kit						
5. Safety foot wear						
6. Safety goggles						

2. Site safety measures/ housekeeping.

Safety measures/house keeping	Not available	Available			
		1-5	6-10	11-15	Over 15
1. Timber with protruding nails left lying on site					

Safety measures/house keeping	Not available	Some			
		1-5	6-10	11-15	Over 15
1. Number of tool not working					

- 3 Tool handling
- a. Kept in tools kits
- b. Scattered around the site.
4. Material storage
- a. Well stacked
- b. Scattered on site.
- 5 Material stacked more than 1.8m (a man's average height)
- a. Available
- b. Not available
6. Safety posters around the site
- a. Posted
- b. Not posted
7. Record of minor, major, fatal injuries and deaths if any

	Minor injuries	Major injuries	Fatal injuries	Deaths.
Numbers (Record the numbers)				

APPENDIX IV

SCHEDULE OF SCORES ON VARIABLES USING LIKERT SCALE

Independent variables.

Site	S <sub>1</sub>	S <sub>2</sub>	S <sub>3</sub>	S <sub>4</sub>	S <sub>5</sub>	S <sub>6</sub>	S <sub>7</sub>	S <sub>8</sub>	S <sub>9</sub>	S <sub>10</sub>	S <sub>11</sub>	S <sub>12</sub>	Ave.
Average Score on likert scale:													
PPE's	4.3	5.0	3.8	3.0	4.4	4.1	5.0	4.6	4.8	5.0	4.9	3.9	4.39
Safety policy	4.3	4.8	3.8	3.3	4.4	4.3	5.0	4.9	4.6	5.0	4.6	4.3	4.44
Costs	4.3	4.6	2.8	3.5	4.2	4.1	5.0	4.8	4.3	5.0	4.5	4.0	4.26
Enforcement of legal requirements	3.8	4.9	3.5	3.8	4.2	4.1	5.0	4.4	4.9	5.0	4.5	4.3	4.36
Training	3.5	4.9	4.3	3.0	4.6	4.1	5.0	4.8	4.8	5.0	4.6	4.2	4.40

Dependent variables.

Site	S <sub>1</sub>	S <sub>2</sub>	S <sub>3</sub>	S <sub>4</sub>	S <sub>5</sub>	S <sub>6</sub>	S <sub>7</sub>	S <sub>8</sub>	S <sub>9</sub>	S <sub>10</sub>	S <sub>11</sub>	S <sub>12</sub>	Ave.
Average Score on likert scale	3.0	2.5	3.0	3.0	4.0	3.0	4.5	4.5	3.0				3.39
Number of recorded accidents	4	6	-	1	1	-	1	7	3				3.29

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