OCCUPATIONAL SAFETY AND HEALTH ISSUES AMONG CONTRACTOR WORKERS IN ROADWAY MAINTENANCE WORKS IN NYERI COUNTY, KENYA

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Occupational Safety and Health Issues among Contractor Workers in Roadway Maintenance Works in Nyeri County, Kenya

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DECLARATION

This thesis is my original work and has not been presented for the award of a degree in any other University.

Signature…….…….. Date…...…..……

Sophia Wanjiku Kariithi

This thesis has been submitted for examination with our approval as the University supervisors.

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DEDICATION

I dedicate this research work to the Almighty God who has brought me this far and to my family, the strong pillar behind my studies. Thank you for your support, patience and encouragement during the study period.

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LIST OF ABBREVIATIONS AND ACRONYMS

BPS	Board of Postgraduate Studies
CSHO	Compliance, Safety and Health Officer
DOSHS	Directorate of Occupational Safety and Health Services
EHS	Environment, Health and Safety
EPR	Emergency Preparedness and Response
FHWA	Federal Highway Administration
FOM	Field Operations Manual
GIIP	Good International Industry Practice
H&SA	Health and Safety Authority
IEET	Institute of Energy and Environmental Technology
ILO	International Labour Organisation
KeNHA	Kenya National Highways Authority
L&FS	Life and Fire Safety
MR&R	Maintenance, Repair and Renovation
MUTCD	Manual of Uniform Traffic Control Device
NACOSH	National Commission for Occupational Safety and Health
O&M	Operations and Maintenance
OSH	Occupational, Safety and Health
OSHA	Occupational, Safety and Health Act
PCMS	Portable Changeable Message Sign
PSCS	Project Supervision for the Construction Stage
PSDP	Project Supervision for the Design Process
PPE	Personal Protective Equipment
SI	Site Instruction
SLG CSCS	Signing, Lighting and Guarding at Road works Construction Skills Certification Course
SPSS	Statistical Package for Social Science
TTS	Temporary Traffic Sign
VOC	Vehicle Operating Costs

OPERATIONAL DEFINITION OF TERMS

Health This is freedom from the risk of illness (OSHA, 2007).

Risk This means the probability of occurrence of an adverse effect from a substance on people or the environment combined with the magnitude of the consequence of that adverse effect (OSHA, 2007).

Roadway This is the portion of a road which is provided primarily for the use of vehicles (Health and Safety Authority, 2009).

Safety This is freedom from the risk of injury (OSHA, 2007).

Workplace This includes, any land, premises, location, vessel or thing, at, in, upon, or near which, a worker is, in the course of employment (OSHA, 2007).

ABSTRACT

There is an inherent risk of injury, fatality or ill health in all occupations. The nature of the construction industry combined with the required physical demands and rigorous work processes, make it an industry that faces several safety and health issues and thus higher risk of ill health, injury or fatality. Many road maintenance operations are potentially dangerous both to the maintenance workers and to the road users. To reduce the risk of accidents where road works take place, it is necessary to apply adequate safety measures. This research work aimed at assessing the level of awareness of occupational safety and health issues in roadway maintenance works among road contractors, identifying the current safety and health practices in roadway maintenance works, and finally outlining the challenges, if any, that hinder good occupation safety and health practices in roadway maintenance activities. A checklist developed from the various rules governing construction and maintenance works was used to conduct workplace inspections. 100% sampling was done from the target population and questionnaires were administered to 122 workers of on-going class A, B and C road maintenance projects in Nyeri county during the data collection phase. Thereafter, the data was analysed using SPSS software, descriptive and inferential statistical analysis were carried out. In this study, males were found to have increased awareness about OSH issues than their female counterparts. Increase in age was found to have a positive correlation with awareness of occupational safety and health issues. Training on OSH had a strong positive correlation ($r=0.88$, $p=0.00$) with regards to OSH practices. Similarly, there was a correlation between knowledge on workman attire ($r=0.68$, $p=0.044$) and OSH practices. Knowledge on equipment handling also had a strong positive correlation ($r=0.72$, $p=0.00$) with regards to OSH practices. It was observed that majority (75%) of roadway maintenance works had no necessary warning and direction signs in place. Partial or lack of compliance of OSH as per the legal framework poses a serious risk to safety in roadway maintenance works. The study recommends that the Directorate of Occupational Safety and Health Services (DOSHS) undertake safety awareness programs within the road maintenance sector. DOSHS should also do inspection patrols to check that safety laws and regulations are being adhered to in road maintenance works. Each contractor should develop clear safety policy guidelines depending on the scope of work. This will help to ease the understanding of the safety requirements and consequently improve compliance.

CHAPTER ONE

INTRODUCTION

1.1 Background to the study

'Safety' is defined as freedom from the risk of injury and 'health' as freedom from the risk of illness (OSHA, 2007). A safe and healthy workplace is therefore one in which those hazards that pose a potential risk to the health and safety of workers and others in the workplace are eliminated or controlled effectively.

The goal of maintenance is to preserve the asset, not to upgrade it. Unlike major road works, maintenance must be done regularly. Road maintenance comprises "activities to keep pavement, shoulders, slopes, drainage facilities and all other road structures as near as possible to their as-constructed state". It includes minor repairs and improvements to eliminate the cause of defects and to avoid excessive repetition of maintenance efforts (Hadayeghi, Alireza & Brian, 2009).

With road maintenance operations being potentially dangerous to both the maintenance workers and to the road users, emphasis on safety and well-being is important. Maintenance works essentially need to adhere to the same safety and health regulations as are observed while carrying out construction works. This applies to both equipment and workers on site as also in relation to third parties such as traffic passing on the road and people and property in the vicinity of the work sites. Workers on site need to be instructed about potential hazards and be issued necessary protective gear, thereby reducing the risks of accidents (Health and Safety Executive, 2005). Many road maintenance operations are potentially dangerous both to the maintenance workers and to the road users. To reduce the risk of accidents where road works take place, it is necessary to install adequate safety measures.

Occupational safety and health deals with not only the health of the workers but also the overall well-being of the workers and their families. When managed well,

occupational safety and health will nurture an efficient workforce. Occupational safety and health may not be viewed as a mere management technique but it is also a legal obligation the employer has towards the workers based on several legislations in force by the Government of Kenya (Ministry of Transportation, 2014).

This research aimed at assessing the level of awareness of occupational safety and health issues in roadway maintenance works among contractors, finding out the current safety practices in roadway maintenance, and finally evaluating the challenges that hinder good occupation safety and health practices in short duration road work maintenance activities. All the above is aimed at enhancing safety and maximizing mobility, to protect both workers and the travelling public.

1.2 Statement of the problem

Workers on roadway construction sites face the risk of serious injury or death from passing motorists, construction vehicles and equipment. A previous inspection of roadway maintenance activities around Enterprise road, Nairobi by the research revealed little or no observance of safety and health measures despite the presence of heavy machinery, road construction workers and the travelling public. The most probable consequences of ignorance of safety on roadway maintenance work sites are, and not limited to, bodily harm, loss of life, destruction of property, emission of toxic fumes into the environment and subsequent legal implications. The need to obtain baseline information on safety awareness, current practices and any challenges that could hinder proper safety and health implementation on roadway maintenance worksites is among what motivated this study.

1.3 Justification of the study

In order to reduce the risk of accidents where road works take place, it is necessary to install adequate safety measures. Occupational safety and health deals with not only the safety and health of the workers but also the overall well-being of the workers and their families. Managed well, occupational safety and health will nurture an

efficient workforce. Occupational safety and health may not be viewed as a mere management technique but it is also a legal obligation every employer has towards the workers based on several legislations in force by the Government of Kenya. The study revealed the level of awareness of safety and health in road maintenance works, the current safety and health practices among road workers and the challenges that were experienced in implementing good safety and health practices in Nyeri County. The choice of Nyeri county for this research was guided by the KeNHA work plan of 2016/ 2017. Nyeri county had the highest number of roads scheduled for maintenance during the period that data collection was carried out (August – December, 2016). This provided important information that is the first step necessary to ensure that safety and health, which is a legal requirement, is implemented in every workplace for the well-being of the workers and also for continued productivity.

1.4 Objectives

1.4.1 Main Objective

1) To assess the occupational safety and health issues in roadway maintenance works in Nyeri county, Kenya.

1.4.2 Specific Objectives

1) To assess the level of awareness on occupational safety and health issues in roadway maintenance works.
2) To evaluate the current occupational safety and health practices in roadway maintenance works.
3) To explore the challenges to good occupational safety and health practices in roadway maintenance works.

1.5 Research questions

1) What is the level of awareness on occupational safety and health issues in roadway maintenance works?
2) What are the current occupational safety and health practices in roadway maintenance works?
3) What are the challenges to good occupational safety and health practices in roadway maintenance works?

1.6 Study scope

The study focussed on class A, B and C roads that were undergoing maintenance operations during the period of data collection in the geographical location of Nyeri county in Kenya. This scope was chosen because the three classes of roads are highly trafficked and therefore gave a good representation of what happens in other roads of lower classes.

CHAPTER TWO

LITERATURE REVIEW

2.1 Theoretical principles

2.1.1 Phases of roads development

The following is a brief description of the phases of infrastructure development with respect to roads and bridges.

2.1.1.1 Design and Construction

Design is a highly technical process requiring highly trained staff, especially when the technology involved is complex. The basic design is apt to be successful if presented and adapted through a process of consultation and active stakeholder participation at all stages. Cole (2001) notes a need for safety to be considered in all aspects of the design and construction process. According to Smallwood (1996), 50% of OSH issues are attributable to inadequate design. In view of this, the concept of considering safety in the design phases of construction is gaining momentum on a global scale (Behm, 2005). An expanding amount of literature suggests that design decisions and choice of technology for rural roads are more appropriate when made at the lower levels. There is also more incentive for communities to take responsibility for the construction phase if they have had significant involvement in the design phase (Gatambese, 2003). The role of different levels of institutions in construction is a function of the technological requirements of the task. Farm-to-market roads, which have less-exacting standards and can draw on techniques already mastered by local people, are more readily undertaken by local institutions than are inter-city highways. Largely, however, the local government, other local institutions and private enterprises have a critical role in infrastructural development because construction activities rely on local materials and familiar technologies (Donn, Hancher, Kenneth, Robin, Jonathon & Kristin, 2007).

2.1.1.2 Operations and Maintenance

Operation and Maintenance each has its particular activities, although they are usually grouped together in language and practice as 'O&M'. Most considerations affecting the role institutions play in maintenance (encompassing Maintenance, Repair and Renovation (MR&R)) are similar to those for construction. However, some MR&R factors deserve separate discussion. MR&R ranges from continuous (routine) to periodic (ad hoc or planned) activities. O&M are often undertaken as 'preventive maintenance', which is important but is commonly neglected. The latter deal with improving repair, rehabilitation or, if the deterioration is substantial, reconstruction, which may amount to deferred maintenance. Some forms of physical capital, such as bridges, need fairly continuous attention because any failure they suffer disrupts the working of the system and its provision of a crucial good or service. Others, such as roads and irrigation systems, are more subject to gradual deterioration and thus are more suited for periodic maintenance. Infrastructure that needs routine servicing must have institutional support, whether national or local (Donn, Hancher, Kenneth, Robin, Jonathon & Kristin, 2007).

2.1.2 Road Maintenance

Proper road maintenance contributes to reliable transport at reduced cost, as there is a direct link between road condition and Vehicle Operating Costs (VOC). An improperly maintained road represents an increased safety hazard to the user, leading to more accidents, with their associated human and property costs. Road maintenance activities are classified into four categories:

2.1.2.1 Routine works

Routine maintenance works are those treatments that are applied to a pavement, in order to keep the pavement functioning properly. These are works that are undertaken each year and are funded from the recurrent budget. They are works that are performed as a reaction to a specific distress. Routine maintenance is performed on pavements as they begin to show signs of deterioration, but is generally considered to be a wasted effort on pavements that are severely distressed.

An example of a routine maintenance activity is filling a pothole. This activity cannot be scheduled before the pothole appears and it should not be left unattended once the pothole has developed. However, if there are too many potholes present, a more comprehensive repair may be needed. In addition to pothole repair, routine maintenance treatments applied to pavements include edge patching, crack sealing and filling, and shoulder repair. Routine maintenance works are divided into two works types:

2.1.2.1.1 Routine maintenance off carriageway (Cyclic works)

These include all the non–pavement activities that are accomplished outside of the road surface, like clearing ditch and culvert cleaning, vegetation control/ grass cuttting, line-marking, road signs repair, guard rail repair and shaping of slopes.

2.1.2.1.2 Routine maintenance on carriageway (Reactive works)

These are works responding to minor pavement defects caused by a combination of traffic and environmental effects, for example, crack sealing, patching, edge repair; shoulders re-gravelling and grading.

2.1.2.2 Periodic works

These include activities undertaken at intervals of several years to preserve the structural integrity of the road, or to enable the road to carry increased axle loadings. The category normally excludes those works that change the geometry of a road by widening or realignment. Periodic works can be grouped into the works types of preventive, resurfacing, overlay and pavement reconstruction. Examples are resealing and overlay works, which are carried out in response to measured deterioration in road conditions. Periodic works should be carried out at regular, but relatively long, intervals. As such, they can be budgeted for on a regular basis and can be included in the recurrent budget. However, many countries consider these activities as discrete projects and fund them from the capital budget.

2.1.2.3 Special works

These are activities whose need cannot be estimated with any certainty in advance. The activities include emergency works to repair landslides and washouts that result in the road being cut or made impassable. Winter maintenance works of snow removal or salting are also included under this heading. A contingency allowance is normally included within the recurrent budget to fund these works, although separate special contingency funds may also be provided.

2.1.2.4 Development works

These are construction works that are identified as part of the national development planning activity. As such, they are funded from the capital budget. Examples are the construction of by-passes e.g. Southern bypass and Eastern bypass in Nairobi, or the paving of unpaved roads in villages (Ministry of Communication, Transport, Post and Construction, Lao PDR, 2007).

2.1.3 Classification of public roads in Kenya

2.1.3.1 International Trunk Roads (Class A) Roads

Class A roads include international trunk roads linking stations of international importance and intersecting international boundaries or terminating at international ports such as The Mombasa International Harbour. An example of a Class A road is A104 road which links the city of Mombasa to Uganda. When A104 road passes through Nairobi, it acquires three names, first one Mombasa Road, then Uhuru highway and finally Waiyaki way. Another example is A2 road which links Namanga - Nairobi to Moyale and Ethiopia. All class A roads are maintained by KeNHA.

2.1.3.2 National Trunk Roads (Class B) Roads

Road class B link nationally important centres, e.g. county headquarters. They also link important centres to the capital, to each other or the international road network. Examples are B1 that links Kericho to Kisumu and B3 that links Mai- Mahiu and Sotik.

2.1.3.3 Primary (Class C) Roads

These are roads that connect big towns to each other or roads linking to higher-level roads or centres. Examples include C98 linking Nairobi and Kangundo and is known as Kangundo road and C59 connecting Thika road and JKIA and is known as Outering road.

2.1.3.4 Secondary (Class D) Roads

These are roads that link locally leading centres to each other, or to centres that are more important or a higher-class road. Examples are D400 (Kasarani – Mwiki) and D408 (Westlands – Nyari Estate) (Kenya Roads Act, 2007).

2.1.3.5 Nairobi City County Roads

These are a separate class of roads only found in Nairobi. They include: NCC15 - Kimathi street, NCC29 - Luthuli Avenue, NCC7 – Parliament Road, V3025 – Ring Road Kilimani, Y1152 – River Road amongst others.

2.1.3.6 Constituency Roads

These are selected roads within a constituency and are maintained by the Constituency Development Fund. Examples are UUP03 – Githurai estate road, UUR5- South C sports club access.

2.1.3.7 Minor (Class E) Roads

Any links to a junior centre.

2.1.3.8 Special Purpose Roads (SPR)

These include Government Roads (G), Settlement Roads (L), Rural Access Roads (R), Sugar Roads (S), Tea Roads (T), and Wheat Roads (W).

2.1.3.9 Unclassified Roads (U)

All other public roads and streets are in this category (Kenya Roads Act, 2007).

2.1.4 Roadway as a Work place

By virtue of carrying out road maintenance activities in order to earn a living, the roadway work zones qualify as a workplace. A workplace is defined by Occupational Safety and Health Act as any land, premises, location, vessel or thing, at, in, upon, or near which, a worker is, in the course of employment (OSHA, 2007).

2.1.5 OSH stressors on roadway maintenance works

South Africa Department of Labour (1993) states that during construction and maintenance works employees can be exposed to the following stressors/ hazards and excessive exposure to these stressors may result in acute injury, chronic illness, permanent disability or even death.

Chemical - Dust (e.g. Asbestos /Silica/Hazardous Chemical substances), Fumes (welding fumes), Smoke, Mists (e.g. spray painting) and Gases.

Physical - Illumination (Poor/excessive lighting), Noise, Vibration, Temperature and Radiation.

Ergonomics - Heavy lifting, Un-natural posture and Repetitive motion.

Psychological - Shift work, bullying, distance from family and work stress.

Biological- Poor hygiene and snake bites (South Africa Department of Labour, 1993).

2.2 Legal Framework

This section outlines the applicable International Standards and relevant Kenyan regulatory framework that set the context within which the study was carried out.

2.2.1 Code of Safety and health in construction, ILO, 1998

The provisions of this code are considered as basic requirements for protecting workers' safety and health and should be applied to workers in construction sites as may be specified by national laws or regulations. It is divided into several sub-sections as outlined below:

2.2.1.1 General provision

The objective of this code, ILO (1998), is to provide practical guidance on a legal, administrative, technical and educational framework for safety and health in construction with a view to: Preventing accidents and diseases and harmful effects on

the health of workers arising from employment in construction; Ensuring appropriate design and implementation of construction projects; and Providing means of analysing from the point of view of safety, health and working conditions, construction processes, activities, technologies and operations, and of taking appropriate measures of planning, control and enforcement.

This code applies to:
Construction activities which cover: Building, including excavation and the construction, structural alteration, renovation, repair, maintenance (including cleaning and painting) and demolition of all types of buildings or structures; Civil engineering, including excavation and the construction, structural alteration, repair, maintenance and demolition of, for example, airports, docks, harbours, inland waterways, dams, river and avalanche and sea defence works, roads and highways, railways, bridges, tunnels, viaducts and works related to the provision of services such as communications, drainage, sewerage, water and energy supplies; and the erection and dismantling of prefabricated buildings and structures, as well as the manufacturing of prefabricated elements on the construction site. The code covers the following sections relevant to roadway construction and maintenance activities:

2.2.1.2 General duties

Listed under General duties are: General duties of competent authorities; general duties of employers; general duties of self-employed persons; co-operation and co-ordination; general rights and duties of workers; general duties of designers, engineers, architects; and general duties of clients.

2.2.1.3 Safety of workplaces

This includes general provisions; means of access and egress; housekeeping; precautions against the fall of materials and persons, and collapse of structures; prevention of unauthorised entry; fire prevention and fire fighting; and lighting.

2.2.1.4 Transport, earth-moving and materials-handling equipment

Under this, we have: general provisions; power shovels; excavators; bulldozers; scrapers; mobile asphalt layers and finishers; pavers; and road rollers.

2.2.1.5 Plant, machinery, equipment and hand tools

Included here is: general provisions; hand tools; pneumatic tools; cartridge-operated tools; electrical tools; woodworking machines; engines; silos; concrete work equipment; pressure plant; conveyors; crusher plants and power generators.

2.2.1.6 Health hazards, first aid and occupational health services

This section covers the following: General requirements; Occupational health services; first aid; hazardous substances; dangerous atmospheres; radiation hazards; heat stress; cold and wet conditions; noise and vibration; biological agents and additional provisions.

2.2.1.7 Personal protective equipment and protective clothing

General provisions and types of PPE are covered under this section.

2.2.1.8 Welfare

The welfare section covers: General provisions; drinking water; sanitary facilities; washing facilities; cloakrooms; facilities for food and drinks; shelters; and living accommodation (ILO, 1998).

2.2.2 Guidelines for working on roads, H&SA, Ireland, 2009

The purpose of this document is to provide practical guidance on the Safety, Health and Welfare at Work. It aims at all those responsible for the planning, designing,

implementation and maintenance of safe systems of work for all construction work on roads, including clients, designers, contractors, employees, the Project Supervisor for the Design Process (PSDP) and the Project Supervisor for the Construction Stage (PSCS).

This document states that all work activity on roads, including both construction and non-construction work, must be properly managed at all times. Examples of non-construction work on roads would include both litter picking and the manual or semi-manual sweeping of footways. As they are work activities, the hazards they involve must be identified and detailed risk assessments upon them carried out so that adequate and appropriate controls can be implemented to protect the safety and health of workers and road users. The outcome of a specific risk assessment will determine whether the selection of appropriate control measures for non-construction work activities on roads will include similar or identical controls to those involved in construction work.

Measures to protect all workers and road users should generally include the provision of suitable and adequate guarding with associated warning signs and, where necessary, appropriate lighting. Warning signs should be provided to 'warn and inform' all road users in advance of any hazard. All measures must take into consideration the needs of people with disabilities. These needs can be facilitated by signboards with symbols as distinct from text-only directional supplementary signboards.

This guideline also states that Construction work on roads will often involve several contractors carrying out different tasks or else working together on a single task. Nevertheless, whether performed by one contractor or many, the requirement remains that the full extent of the construction works must be supervised and coordinated. Signing, lighting and guarding at the road works must be supervised by a least one competent person. This person must have completed the Signing, Lighting and Guarding at Road works Construction Skills Certification Course (SLG CSCS) and possess a valid and relevant registration card. The Project Supervisor for

the Construction Stage (PSCS) must coordinate arrangements to ensure the provision of the Signing, Lighting and Guarding at Road works CSCS card holder(s) (sometimes referred to as the Temporary Traffic Operations Supervisor). The SLG CSCS card holder(s) (person(s) provided) must be named in the Employer's (Contractor's) own safety statement and in the Construction Stage Safety and Health Plan. The SLG CSCS cardholder has the responsibility for the implementation of the temporary traffic management plan on site during the construction work, including responsibility for installing, modifying, maintaining and removing the temporary traffic management arrangements. To meet the requirements of the role, a SLG CSCS cardholder must be available at short notice to deal with issues at the particular site locations (more than one cardholder may be required where shift work is involved). It is important that the signing, lighting and guarding aspects of the works are coordinated for the duration of the project. The requirement rests upon the contractor responsible for the signing, lighting and guarding and/or the CSCS card holder to liaise directly with the PSCS and, where required, with the Temporary Traffic Management Designer, with regard to the effectiveness of the temporary traffic management arrangements.

Site managers, foremen and employees still need to ensure that they remain vigilant and take reasonable care of their own safety and the safety of those around them (Health and Safety Authority, 2009).

2.2.3 Inspection and Citation Guidance for Roadway and Highway Construction Work Zones, U.S Department of Labor, 2012

This is the first OSHA instruction on inspection procedures in roadway and highway construction work zones. It was issued by the Occupation Safety and Health Administration in the U. S Department of Labour. This instruction is intended to help Compliance Safety and Health Officers (CSHOs) safely inspect roadway and highway construction work zones and to issue consistent citations for violations.

The purpose of this instruction is to provide general enforcement policy and guidance to assist OSHA compliance personnel in safely inspecting work sites where

employees are engaged in construction work on and near roadways or highways (hereinafter “work zones”), and in ensuring consistent enforcement of OSHA requirements. This instruction covers any construction activity on and near roadways or highways, such as road, highway, sidewalk, or utility construction, where public and/ or construction vehicular traffic exposes construction workers to struck-by hazards (U. S. Department of Labor, 2012).

2.2.4 The EHS World Bank Guidelines

World Bank Group (2007) states thatEnvironmental Health and Safety guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP). The Guidelines contain performance levels and measures that are generally considered achievable in new facilities at reasonable costs by existing technology. The EHS Guidelines for Road construction and maintenance works are the specific-sector guidance relevant to the works, providing an overview of the key environmental, health and safety topics that are particularly relevant to road construction works.

2.2.5 The Occupational Safety and Health Act (2007)

This is an Act of Parliament to provide for the safety, health and welfare of workers and all persons lawfully present at workplaces, to provide for the establishment of the NACOSH and for connected purposes. The Act has the following functions among others: Secures safety and health for people legally in all workplaces by minimization of exposure of workers to hazards (gases, fumes & vapours, energies, dangerous machinery/equipment, temperatures, and biological agents) at their workplaces; Prevents employment of children in workplaces where their safety and health is at risk; Encourages entrepreneurs to set achievable safety targets for their enterprises; Promotes reporting of work-place accidents, dangerous occurrences and ill health with a view to finding out their causes and preventing of similar occurrences in future; Promotes creation of a safety culture at workplaces through education and training in occupational safety and health.

Failure to comply with the OSHA, 2007 attracts penalties of up to KES 300,000 or 3 months jail term or both or penalties of KES 1,000,000 or 12 months jail term or both for cases where death occurs and is in consequence of the employer. The (OSHA) Act 2007 repealed the Factories and Other Places of Work Act. Anything done under the provisions of the Factories and Other Places of Work Act including subsidiary legislation issued before the commencement of the OSHA 2007 shall be deemed to have been done under the provisions of this Act. The Factories and Other Places of Work Act had over the years passed several subsidiary rules and regulations for effective implementation of the Act. All shall, as long as it is not inconsistent with OSHA 2007 remain in force until repealed or revoked by subsidiary legislation under the provisions of OSHA 2007 and shall for all purposes be deemed to have been made under this Act. These regulations include: The Factories (First Aid) Rules 1977; The Factories (Eye Protection) Rules 1978; The Factories (Building Operations and Works of Engineering Construction); The Factories and Other Places of Work (Health & Safety Committees); The Factories and Other Places of Work (Medical Examination) Rules 2005; The Factories and Other Places of Work (Noise Prevention and Control); The Factories and Other Places of Work (Fire Risk Reduction) Rules 2007; The Factories and Other Places of Work (Hazardous Substances) Rules 2007.

Other parameters within the Act relevant to this study include: Duties of employers, owners or occupiers of workplace; Establishment of safety and health committees; Annual safety and health audit of workplaces; Safety and Health obligations for persons who may come to premises for work and are not employees of that particular workplace; Reporting of any accident, dangerous occurrence or occupational poisoning caused in the workplace to the area Occupational Health and Safety Office. These incidents should be entered in the General Register. In case of fatal accident information to the area, Safety and Health Office should be within 24 hrs. and a written notice to the same within 7 days; The duties of manufactures, designers, importers and suppliers to ensure that all articles and substances for use at workplace are safe and will not cause injury to health and the environment; Duties of self-employed persons; Duties of employed persons.

Prohibition of interference or misuse of any appliance, convenience or any other facility provided to secure Safety, Health and Welfare at work by any person (occupier, self-employed person or employed); The administration of the Act is the responsibility of a Director and other appointed and gazetted officials (Occupational Safety and Health Officers); The registration of all workplaces by the Directorate of Occupational Health and Safety (DOHS) forming the basis of his work statistics. Under the Occupational Safety and Health Act, 2007, there is no specific area that deals with Road Safety by itself, an area noted with information gap that would do better if improved.

2.2.5.1 Machinery safety

Machinery safety covers the following: Safe use of machinery, plant and equipment; Prime makers and transmission machines; The maintenance, construction of fencing safeguards; The statutory requirements of various machines, plants and equipment (hoists and lifts, chains and ropes, cranes, steam receivers and containers, air receivers, cylinders for compressed liquefied and dissolved gases and refrigeration plants).

2.2.5.2 Chemical safety

Included under this section is: Handling, transportation and disposal of chemicals and other hazardous substances; Importance of Materials Safety Data Sheets (MSDS); Labelling and marking of chemical substances; Classification of hazardous chemicals and substances; Establishment and adoption of exposure limits on hazardous substances in a workplace; Control of air pollution, noise and vibrations; Redeployment on medical advice (OSHA, 2007).

2.3 Previous works relevant to the study

A study carried out in Canada by Aleks and Chris (2015) on the challenges in ensuring worker safety in active roadway work zones. The objectives of this paper

were to define short duration work activities; identify the state-of-the practice for short duration work zone safety standards; present the challenges associated with short duration work zone safety; and identify best practices, including technologies and processes, for improving safety and maximizing mobility, in order to protect both workers and the travelling public. A particular emphasis was placed on short duration work activities occurring on high speed, high volume roadways, i.e. freeways. The challenges outlined by this paper were that ideal temporary traffic control measures on freeways include temporary traffic barriers, temporary pavement markings, signed detours and variable message signs. These traffic control best practices provide positive protection of workers, positive guidance through and/or around the work zone, and advanced warning of changes to the road configuration. Although equally desirable in short duration work scenarios, these procedures, however, are generally best suited for long duration activities. It is generally impractical and cost-prohibitive to apply the above-mentioned examples of work zone protection strategies and advanced traffic control approaches to short duration work zones. The time required to setup traffic control devices can easily exceed the amount of time required to do the work.

The best practices identified in this study relating to short duration work on roads and highways were: Worker training; use of visible attire on site; work vehicle lighting; use of blocker vehicles or shadow vehicles; buffer space around the work area; variable message signs that are permanent or portable; traffic control equipment e.g. cones, drums, barrels; working during off- peak hours e.g. at night; use of police assistance; advocating for better work zone timing restrictions. The examples provided are generally considered cost-effective for short duration projects. Many of these practices are complementary or supplementary to local requirements.

This study also outlined that the feasibility new technologies can be determined by evaluating their applicability and cost-benefit ratio. Any implementation of new technologies will require some capital investment, but the notable improvement to worker and driver safety, as well more efficient takedown and set-up of traffic control equipment may reveal a short payback period for the initial investment. Some

examples of applicable new traffic control technologies are: intrusion alarms mounted on cones or drums, mobile barriers, automatic cone setter/ retriever.

The conclusion arrived at was that short duration work activities are not a valid excuse for lack of insufficient temporary traffic control. Safety should not be sacrificed.

A similar study was carried out in USA by Toivo (1993) on assessing the safety environment in work organization of road maintenance jobs. This study examined workers' responses to the safety environment in relation to organizational, individual, and situational factors in road maintenance jobs. A self-administered questionnaire including 80 variables was used to collect data from the workers. The study population consisted of 207 workers at nine work places. The survey response rate was 93% (193 workers). The attitudes of co-workers, and judgments and attentiveness had a statistically highly significant effect on the worker's own attitude. The attitudes of supervisors, attitudes of co-workers, and the manner of instructing had a statistically highly significant effect on the performance feedback. The workers felt that the establishment of safe work habits would be most affected by the road supervisor's management methods and feedback. A considerable proportion of the workers believed that risk taking was part of their job.

Five main conclusions emerged from the study as follows: The attitudes of co-workers and judgments and attentiveness had a statistically highly significant effect on the worker's own attitude; the importance of own professional skills had a statistically significant effect on the worker's own attitude.; The attitudes of supervisors, the attitudes of co-workers and the manner of instructing had a statistically highly significant effect on the feedback.; Judgments and attentiveness and errors of others had a statistically highly significant effect on the importance of own professional skills.; Own actions had a statistically highly significant effect on knowledge and instructions.; The workers tended to overestimate the hazards associated with traffic compared with the hazards of other working conditions.

Gannapathy, Subramaniam, Mohamad, Suaidi and Hamidon (2008) carried out a study on Risk factors in a Road construction site. The ultimate aim of this research was to implement technological approach, which will overwrite the conventional flagman practice in maintaining safety and smooth traffic flow on a road construction site. In the study, few factors made the proposed intelligent traffic light system reliable compare to the common flagman practice. The Intelligent Traffic Light is one of the best devices in work zone traffic control systems. This system can replace one or both flaggers during the lane closures for the construction. The study also found that the other advantage of this automated portable traffic light system is it reduces costs and increases safety by eliminating the need for human flagmen. This system is applicable on publicly and privately funded road construction projects that require overnight or 24-hour traffic control as well as in different weather conditions.

The conclusion of his study was that road safety signs are a simple tool used in influencing drivers on orientation and information waits ahead. New evolutionary road safety signs by using electronics devices in assisting road users are widely in practice, yet the conventional vertical road signs which are strategically placed along roads will be part of the road environment for many years to come. The modernization of safety signs on road construction site are foresee for generations by various authorizes in ensuring both public and contractors' safety. It is important when designing and installing a system to ensure it is visible at all times and to minimize fatal incidents. Although many authorities understand the road safety regulations as a tool to minimize fatal accidents in road construction sites, few have actually put it into practice. When a traffic control device or flagman is utilized at road construction site for control the traffic flow, a road user who drives a vehicle shall exercise extraordinary care to secure the mutual safety of all persons. Continuous monitoring and integrations of new technologies such as the intelligent traffic light system would provide a better and safer direction to both the contractor and public. The intelligent traffic light system would be a revolutionary solution towards all miseries. Such technological approach could save thousands of Dollars in damages and prevents loss of lives. As a public conscious researcher in minimizing

such miseries, stern punishment should be rewarded to those contractors who fail to comply the road construction safety regulation.

A study was carried out in Kansas by Yue, Mark, Umar, Kris, Megan and Yong (2009) on improving highway work zone safety. Highway work zones disrupt normal traffic flow and can create severe safety problems. The three primary objectives of this research project were: to determine the effectiveness of a Portable Changeable Message Sign (PCMS) in reducing vehicle speeds on two-lane, rural highway work zones; to determine the effectiveness of a Temporary Traffic Sign (TTS), (for example "Road Work Ahead"); and to determine motorists' responses to the signage. To accomplish these objectives, field experiments were conducted in Seneca and Hiawatha, Kansas, respectively. During the field experiments, an evaluation of the effectiveness of the PCMS was conducted under three different conditions: PCMS on; PCMS off, but still visible; and PCMS removed from the road and out of sight. The researchers also divided the vehicles into three classes (passenger car, truck, and semitrailer) and compared the mean speed change of these classes based on three different sign setups: PCMS on, PCMS off, and the use of the TTS ("Road Work Ahead"). A survey was also conducted at the experimental work zones to obtain a general understanding of the motorists' attitudes as they travelled through the construction areas.

Highway statistics data indicated that 91% of the Kansas public roadway miles are rural, and approximately 97% of the major rural roadways (interstates, principal and minor arterials, and major collector) are two-lane highways. Preserving, rehabilitating, expanding, and enhancing these highways require the construction of a large number of work zones. 63% of the fatal crashes and a third of the injury crashes of Kansas occurred in two-lane highway work zones. Based on the data analysis results, researchers concluded that the presence of the PCMS effectively reduced vehicle speeds on two-lane highway work zones. A slow speed is more likely to reduce the probability of a crash or the severity of a crash. In addition, researchers performed a univariate analysis of the variance test to determine if a significant interaction existed between motorists' responses and the sign conditions.

Based on the results, the researchers recommended some potential safety improvements. For example, the researchers recommended the implementation of an active PCMS in one-lane, two-way work zones. A review of the PCMS Handbook would also be instrumental given that some PCMS messages are more effective than others are, as presented in the literature review. If implemented in other work zones, the researchers suggested that the PCMS should be located 500 feet away from the first temporary traffic sign. This distance allows motorists enough time to respond to the PCMS and TTS warnings regarding the upcoming work zone conditions. Improvement of traffic control is the most direct method to reduce highway work zone crashes. Based on the characteristics of highway work zone crashes, the researchers recommended more effective speed control strategies. The high composition of crashes in high-speed zones and the dominance of rear-end collisions in injury crashes indicate a strong association between high speeds and work zone injury and fatal crashes. Therefore, controlling speeds is a key step towards improving work zone safety. The crash analysis results suggested a need of more effective and more strictly enforced speed control strategies in highway work zones in order to prevent high-severity crashes causing injuries and fatalities. most drivers reported that work zone signs that gave roadway statistics, such as accidents and fatalities, may help encourage safe work zone driving. This finding is also corroborated with data that suggested that most drivers underestimated accident rates in work zones. Thus, it was recommended that future signs contain some degree of information that provides drivers with empirical evidence of work zone hazards. It was noted that these signs should not contain too much information which could draw drivers' attentions away from their primary task of driving. Finally, the study recommended that future studies investigate the attitudes of motorists toward certain signs. As noted by the surveys, the presence of workers and warning signs are the two most important reasons why drivers observe work zone speed limits. Thus, the writer recommended that future research should continue to focus on improving driver awareness as vehicles enter work zones.

CHAPTER THREE

MATERIALS AND METHODS

This chapter outlines the methodology that was adopted for this study. The methodology involved collecting data from the target population. The data was then organized, collated, analyzed, interpreted and presented.

3.1 Study design

This research design was descriptive in nature because it involved observation and permitted the use of questionnaires administered to a sample. Descriptive research is suitable when one studies things as they are in the field and it gives views and feelings from the respondent (Babbie, 2002). The tools used to report summary data from the descriptive survey were measures of central tendency including the mean, median, mode, deviance from the mean, variation, percentage, and correlation between variables (Mugenda & Mugenda, 2012).

3.2 Study area and population

The study area was Nyeri County. Nyeri County is located in the former Central Province of the Country Kenya, about 150 kilometres north of Nairobi. It covers an area of 3,337 square kilometres. Nyeri shares its borders with five other counties; Kirinyaga to the East, Nyandarua to the West, Muranga to the South, Laikipia to the North and Meru to the North East.

The study population comprised of all the class A, B and C roads that were undergoing maintenance works during the data collection phase (August, 2016 to December, 2016) as per the KeNHA work plan of the financial year 2016/ 2017. The roads covered were two class A roads (Sagana – Marua; 37Km and Marua–Karishen; 12.9Km) which are part of Great North road linking Nairobi, Moyale and Ethiopia,

one class B road (Nyeri – Wiyumererie; 73Km) which is part of Nyeri– Nyahururu road and one class C road (King'ong'o – Kiganjo; 8.4Km).

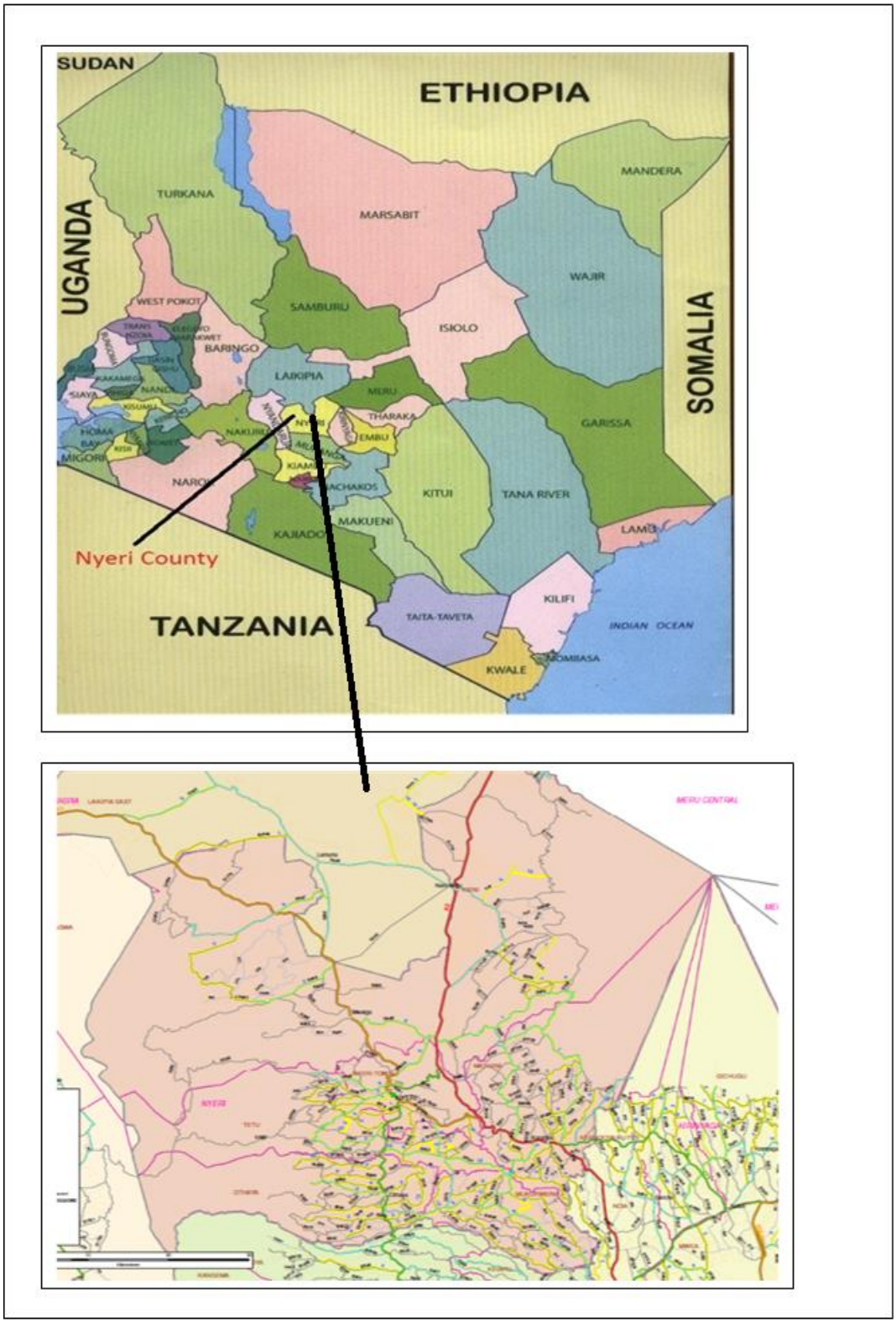


Figure 3.1: Nyeri county road network Source: (www.kerra.co.ke)

3.3 Sampling frame

A previous pilot study at Enterprise road by the researcher revealed active participants on a roadway construction/ maintenance site to be site agents, foremen, operators (plant and machinery), drivers and unskilled labourers (Bartlett, Kotrlik & Higgins, 2001).

3.4 Sampling method

Data was sampled from all the road maintenance works ongoing in Nyeri county in Kenya during the data collection period since road maintenance activities are temporary and short lived (Cochran, 1963). Purposive sampling was used to select roads under maintenance in Nyeri county. For the purpose of this study, only class A, B and C roads were considered.

3.5 Sample size determination

In determining the sample size, the researcher purposively narrowed down to all class A, B and C roads that were undergoing maintenance works in Nyeri county during the data collection phase (August, 2016 to December, 2016) as per the Kenya National Highways Authority (KeNHA) work plan of the financial year 2016/ 2017. All the roads under study were maintained by different contractors. All the contracted workers in the four roads under maintenance formed the sample.

3.6 Sample size distribution

The selected sample was from all categories of employees was as shown below.

Table 3.1: Sample size distribution

Strata	Population	Sample
Site Agents	4	4
Foremen	7	7
Operators	8	8
Drivers	11	11
Unskilled Labourers	92	92
Total	**122**	**122**

3.7 Research instruments

The measurement tools designed to obtain data from the research subjects were field observation by use of a checklist, questionnaires and a camera. No research assistants were present; data was collected by the researcher only.

3.7.1 Questionnaires

Two semi structured questionnaires were designed: One for the Management (questionnaire A) i.e. the site agents and the other for the foremen, operators, drivers and Unskilled Labourers (questionnaire B). The design of the questionnaire was in two main parts. Part one consisted of the general information covering areas like gender, age, job title, education level and experience level. Part two aimed at obtaining information from respondents on the level of awareness on occupational safety and health issues. Part 3 was open ended and aimed at getting to know any challenges the respondents face as they seek to implement safety measures in roadway maintenance works. The questionnaires were self-administered. The detailed questionnaires are in Appendix II.

3.7.2 Checklists

The observation checklist was developed in line with the safety legal requirements as referred to in the literature review. The target of the checklist was to check the

current practices hence compliance on safety matters concerning provisions of international and local legal framework in the construction industry. The data collected on the checklist made up the quantitative data while qualitative data was obtained from the general comments made by the researcher. A few activities were captured on camera as evidence observed on a real time basis as road maintenance activities were being carried out.

3.8 Data processing and analysis

The data collected from the field was analysed using Statistical Package for Social Sciences (SPSS) software and a trend / pattern of the results from the studied roads established. For the purpose of analysis using SPSS, the Likert scale was coded as Agree=1, Neutral=2, Disagree=3 and I Don't Know=4. The results were organised and presented in form of tables, bar graphs, pie charts among others. A thorough discussion of the results was done and a report of the research findings and finally recommendations drawn from the analysis of the findings made.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the findings of the study. It includes the response rate, characteristics of respondents and findings on the three research objectives.

Table 4.1: Response rate

Respondents	Questionnaires distributed	Questionnaires received	Response rate
Site agents	4	4	100%
Foremen	7	7	100%
Operators	8	7	88%
Drivers	11	9	82%
Unskilled Labourers	92	85	92%
Total	**122**	**112**	**92%**

Table 4.1 shows that the study had a high response rate on the questionnaire for site agents (100%) and the other questionnaire for other employees (94%). The average response rate was 92% that is well above the 70% threshold recommended by (Mugenda & Mugenda, 2012).

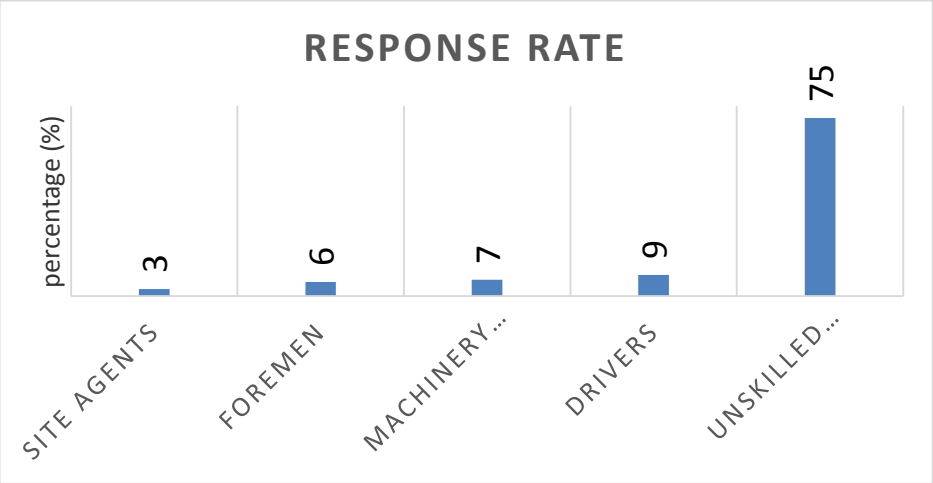


Figure 4.1: Distribution of respondents by job titles

Findings in Figure 4.1 show that 8% were drivers, 6% were foremen while an equal number (6%) were plant/ machinery operators. The construction workforce predominately consists of employees who are unskilled (Hislop , 1999).

4.2 Socio-demographic Characteristics of Respondents

4.2.1 Distribution by Gender

The gender distribution of respondents was assessed.

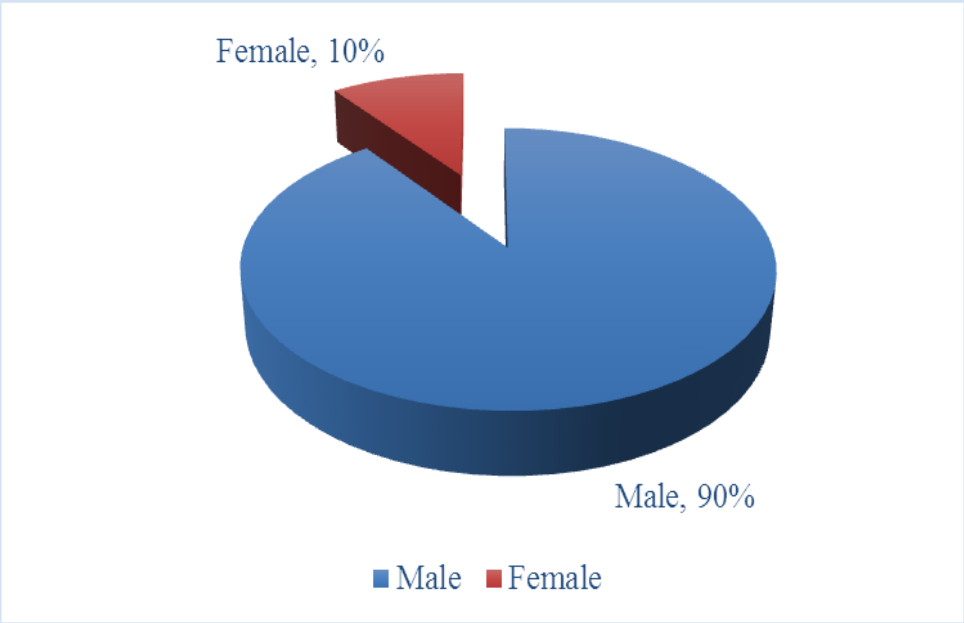


Figure 4.2: Gender distribution of respondents

Majority (90%) of the respondents in the study were male across all strata of the targeted population as shown in Figure 4.2.

4.2.2 Distribution by Age

Figure 4.3 shows the distribution of respondents by their age.

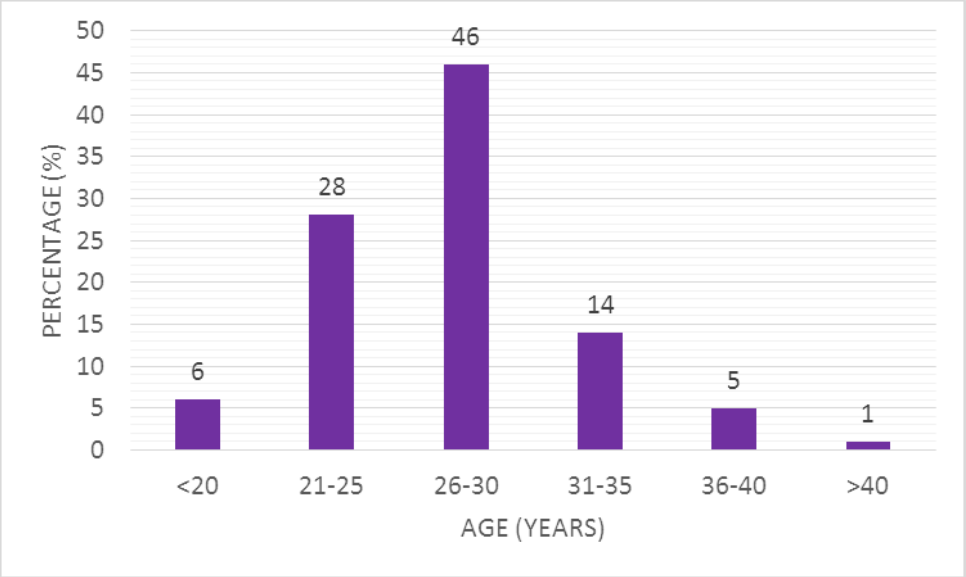


Figure 4.3: Age distribution of respondents

Findings in Figure 4.3 show that 6% of the respondents were aged below 20 years, 28% were aged between 21 and 25 years. The majority who made up 46% of the respondents were aged between 26 to 30 years old. The least represented were respondents aged above 40 years who only made up 1%. Productivity was highest among workers aged between 26 to 30 years old.

4.2.3 Distribution by education levels

The academic achievement of respondents was assessed.

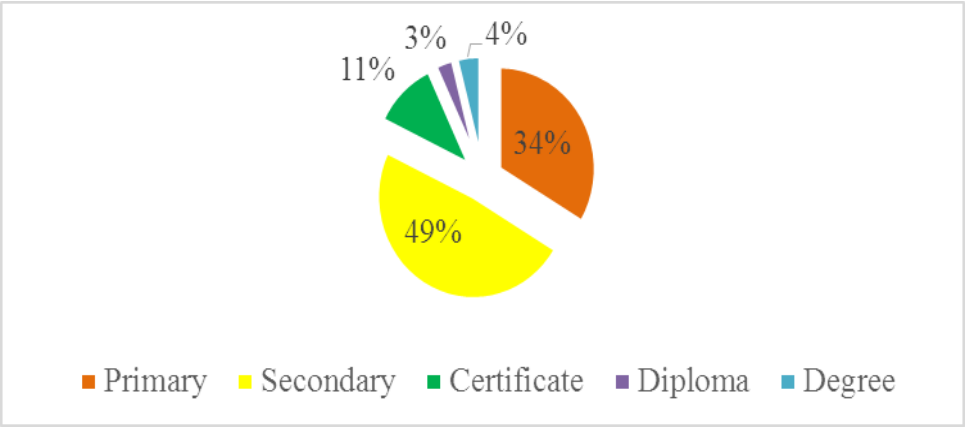


Figure 4.4: Respondents' education levels

Findings in Figure 4.4 show that 49% of the respondents had achieved secondary education, 34% had acquired primary education, 11% were certificate holders, 4% were degree holders while 3% were diploma holders.

4.2.4 Distribution by working experience

Findings in Figure 4.5 show the working experience of respondents in this study.

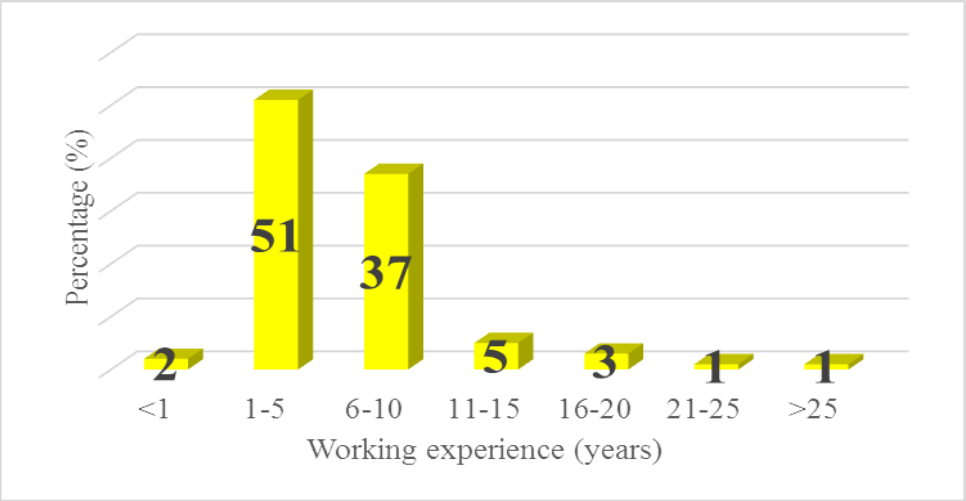


Figure 4.5: Working experience of respondents

Slightly over half (51%) of the respondents had an experience of between 1 and 5 years while 37% had an experience of between 6 and 10 years. In road maintenance, the mobility required of workers is high. Coupled with the fact that workers are usually contracted to multiple sites that are geographically dispersed, results in an industry with a high ratio of staff turnover (Kartam, Flood, & Koushki, 2000) hence the reason the majority of workers have a working experience of 1 – 5 years. The findings also show that 3% of the respondents had previously worked before for a period of between 16-20 years. Only 2% of the respondents had an experience of less than one year while the least represented were two categories where only 1% had an experience of between 21-25 years and experience of more than 25 years. Majority of the respondents were young people with 1 to 5 years of experience. Since most of the labour force was drawn from the immediate community, the respondents drawn from the 1 to 5 years' group showed easy availability as compared to other groups which indicates that most of them had no jobs and or current engagements. Hislop

(1999) found that the presence of new and unskilled construction workers increases the potential for accidents and injuries to occur.

4.3 Level of awareness on OSH issues

The study sought to assess the level of awareness on occupational safety and health issues in roadway maintenance works as the first objective. The findings are presented in this section.

4.3.1 Site agents responses on awareness of OSH issues

Site agents in the study were asked a number of questions relating to occupational safety and health issues to gauge their awareness on the same. The findings are presented in Tables 4.2 below.

Table 4.2 (a): Site agents responses on Transport Safety awareness

	Agree (1)		**Neutral (2)**		**Disagree (3)**		**Don't know (4)**		**Mean**	**Standard Deviation**
	F	**%**	**F**	**%**	**F**	**%**	**F**	**%**		
After the road maintenance activities, the road surface should be cleared of all loose screenings.	4	100%	0	0	0	0	0	0	1.00	0.00
Cones should be used to demarcate the work zone and the demarcation should include the approach area and the termination area.	4	100%	0	0	0	0	0	0	1.00	0.00

All (100%) of the site agents agreed to knowledge of the aspects of transport safety, which could be due to higher education levels as compared to other respondents.

Table 4.2 (b): Site agents responses on Machinery Safety awareness

	Agree (1)		Neutral (2)		Disagree (3)		Don't know (4)		Mean	Standard Deviation
	F	%	F	%	F	%	F	%		
Sensors and/ or cameras should be mounted on the rear of the equipment	4	100%	0	0	0	0	0	0	1.0	0.000
Working with defective equipment is not allowed under any circumstances.	3	75%	1	25%	0	0	0	0	1.50	0.707

100% of the site agents agreed that plant/ machinery rear should be mounted with sensors or cameras to allow for view of what is behind the machinery during movement and thus avoid accidents. 75% of the site agents agreed that defective equipment should not be found in use on site and the remaining 25% were neutral/ undecided on the issue indicating that they could allow or refute faulty machinery working on site depending on circumstances present.

Table 4.2 (c): Site agents responses on Ergonomics awareness

	Agree (1)		Neutral (2)		Disagree (3)		Don't know (4)		Mean	Standard Deviation
	F	%	F	%	F	%	F	%		
There is need for construction sensitive abilities monitoring at least once a year.	3	75%	0	0	1	25%	0	0	2.0	1.414
Continuous regular exposure to heavy lifting, un-natural postures and repetitive motions is harmful	3	75%	0	0	1	25%	0	0	1.50	0.707
Workers involved in operation of vibratory/ compaction equipment should be rotated	3	75%	1	25%	0	0	0	0	1.50	0.707

Concerning ergonomic awareness in table 4.2 (c), there was a 75% general awareness level from the Site Agents. 25% of the site agents disagreed that continuous heavy lifting is harmful to one's health. More than 50% awareness levels under ergonomics is satisfactory.

Table 4.2 (d): Site agents responses on Clothing and PPE awareness

	Agree (1)		Neutral (2)		Disagree (3)		Don't know (4)		Mean	Standard Deviation
	F	%	F	%	F	%	F	%		
There is need for flagmen to wear reflective attire and use STOP and GO signs	4	100%	0	0	0	0	0	0	1.0	0.00
It is necessary for all workers to be in reflective attire at the worksite.	4	100%	0	0	0	0	0	0	1.00	0.00
It is important to wear the necessary PPE when exposed to hazardous conditions	4	100%	0	0	0	0	0	0	1.00	0.00

All the site agent's responses agreed to 100% levels of awareness concerning PPE. It is expected that with such levels of awareness, the practices should be compliant with the OSH legal requirements.

Table 4.2 (e): Site agents responses on Construction Safety awareness

	Agree (1)		Neutral (2)		Disagree (3)		Don't know (4)		Mean	Standard Deviation
	F	%	F	%	F	%	F	%		
Crew sizes need to be increased to accommodate lookout personnel and to improve quality of work.	2	50%	2	50%	0	0	0	0	2.0	0.00
There is need for availability of first aid kits on site.	4	100%	0	0	0	0	0	0	1.0	0.00
There is need for a person responsible for handling first aid on site.	3	75%	0	0	1	25%	0	0	2.0	1.414
All injuries and accidents however minor should be reported to the supervisor	3	75%	1	25%	0	0	0	0	1.50	0.707
All maintenance workers should understand basic hand signals	4	100%	0	0	0	0	0	0	1.50	0.707
There is need for availability and selection of PPE.	4	100%	0	0	0	0	0	0	1.00	0.00
Every worker should take care of his/ her own safety.	4	100%	0	0	0	0	0	0	1.00	0.00
Every worker should take care of the safety of other workers	4	100%	0	0	0	0	0	0	1.00	0.00

Findings in Table 4.2 (e) show that (50%) of the site agents agreed that Crew sizes need to be increased to accommodate lookout personnel and to improve quality of work. However, an equal (50%) was neutral/ undecided. Nevertheless, the site agents agreed to the knowledge of most OSH matters that need to be taken to account during road construction and maintenance. This is an impressive trend considering that the site agents are in the management level among the respondents and are thus able to take the necessary action to ensure OSH awareness among other employees of various categories. 100% of the site agents agreed to be aware that every worker should take care of his/ her own safety. Ringen, Seegal and Englund (1995) state that any worker on an active site should be responsible for their own health and safety. Awareness marks the first stage towards proper OSH implementation in a work place.

The findings of this study are in compliance with the Guidelines for working on roads (S. I No.23 of 2008) which recommend that the full extent of the construction works must be supervised and coordinated by at least one competent person. The Site Agents were supervisory figures but they appeared on site once every while. At the same time, the findings disagree with the same instruction whereby it is required that the supervisor have some training in Safety matters. In this study, the site agents were found to be very well equipped with the technical knowledge and although they seemed to have some understanding on safety matters, they had never been trained on the same.

4.3.2 Foremen responses on awareness of OSH issues

Foremen were asked a number of questions in the study relating to occupational safety and health issues to gauge their awareness. The findings are presented in Tables 4.3 (a- d).

Table 4.3 (a): Foremen responses on Noise Safety awareness

	Agree (1)		Neutral (2)		Disagree (3)		Don't know (4)		Mean	Standard Deviation
	F	%	F	%	F	%	F	%		
High noise levels on site are dangerous to your health.	2	29%	1	24%	0	0	4	57%	3.1	1.197
With high levels of noise, one should wear earmuffs or earplugs.	4	57%	0	0	0	0	3	43%	2.2	0.909

29% of the foremen were in agreement that high noise levels are dangerous to one's health, 57% agreed that in an area with high noise levels, one should wear earmuffs and/ or earplugs.

Table 4.3 (b): Foremen responses on Ergonomic awareness

	Agree (1)		Neutral (2)		Disagree (3)		Don't know (4)		Mean	Standard Deviation
	F	%	F	%	F	%	F	%		
A lot of heavy lifting is harmful to your health.	3	43%	1	24%	0	0	3	43%	2.3	1.302
Long periods of vibration are harmful to one's health.	1	24%	0	0	4	57%	2	29%	3.4	1.56
Breathing in dust is harmful to one's health.	4	57%	3	43%	0	0	0	0	1.8	0.837

On ergonomics, 43% of the foremen were in agreement that a lot of heavy lifting is harmful to one's health, while an equal 43% did not know whether heavy lifting is harmful. 57% of the foremen disagreed that long periods of vibration are harmful to one's health. This shows that these foremen are not likely to rotate workers who work under vibrations because of ignorance that this could cause harm to the worker's health. This could cause the exposed workers to develop occupational diseases later in life.

Table 4.3 (c): Foremen responses on Construction Safety awareness

	Agree (1)		Neutral (2)		Disagree (3)		Don't know (4)		Mean	Standard Deviation
	F	%	F	%	F	%	F	%		
I know how to use a fire extinguisher.	0	0	7	100%	0	0	0	0	2.0	0.101
All injuries and accidents should be reported to my supervisor.	0	0	5	71%	0	0	2	29%	2.3	1.504
I understand the hand signals used to communicate on site.	3	43%	3	43%	1	24%	0	0	2.1	0.937
I have been trained on safety and health on site.	1	24%	2	29%	4	57%	0	0	2.8	0.837
I know how to use items provided by my employer	4	57%	3	43%	0	0	0	0	1.6	1.202

All (100%) of the foremen were neutral, they did not agree or disagree on their knowledge of how to operate a fire extinguisher. Only 24% of the foremen agreed to have been trained on OSH matters on site. 57% of the foremen disagreed to have previously had any OSH training on site. 29% of the foremen seemed not to know that all injuries and accidents should be reported to the immediate supervisor as per the OSHA (2007). 24% of the foremen disagreed to have an understanding of the hand signals used for communication on site. This shows that hand communication on site could easily be misinterpreted, which is potentially dangerous. In this study, the supervision role was carried out by the foremen who were always present on the ground during the ongoing works.

Table 4.3 (d): Foremen responses on Transport Safety awareness

	Agree (1)		Neutral (2)		Disagree (3)		Don't know (4)		Mean	Standard Deviation
	F	%	F	%	F	%	F	%		
The road surface should be swept clean after work has been done.	0	0	0	0	1	14%	6	86%	3.4	1.430
Cones should be used to demarcate the work zone and the demarcation should include the approach area and the termination area.	7	100%	0	0	0	0	0	0	1.00	0.00

Majority (86%) of the foremen did not know that the road is supposed to be swept clean of the loose screenings, which could well be a source of distractions and possible accidents to the motorists as they fly to the windscreens of vehicles. 100% of the foremen agreed that safety cones should be used to demarcate the working area to avoid trespass of traffic and thus protect workers in that area.

4.3.3 Machinery operators responses on awareness of OSH issues

Machinery Operators were asked a number of questions in the study relating to OSH issues to gauge their awareness. The findings are presented in Figure 4.6

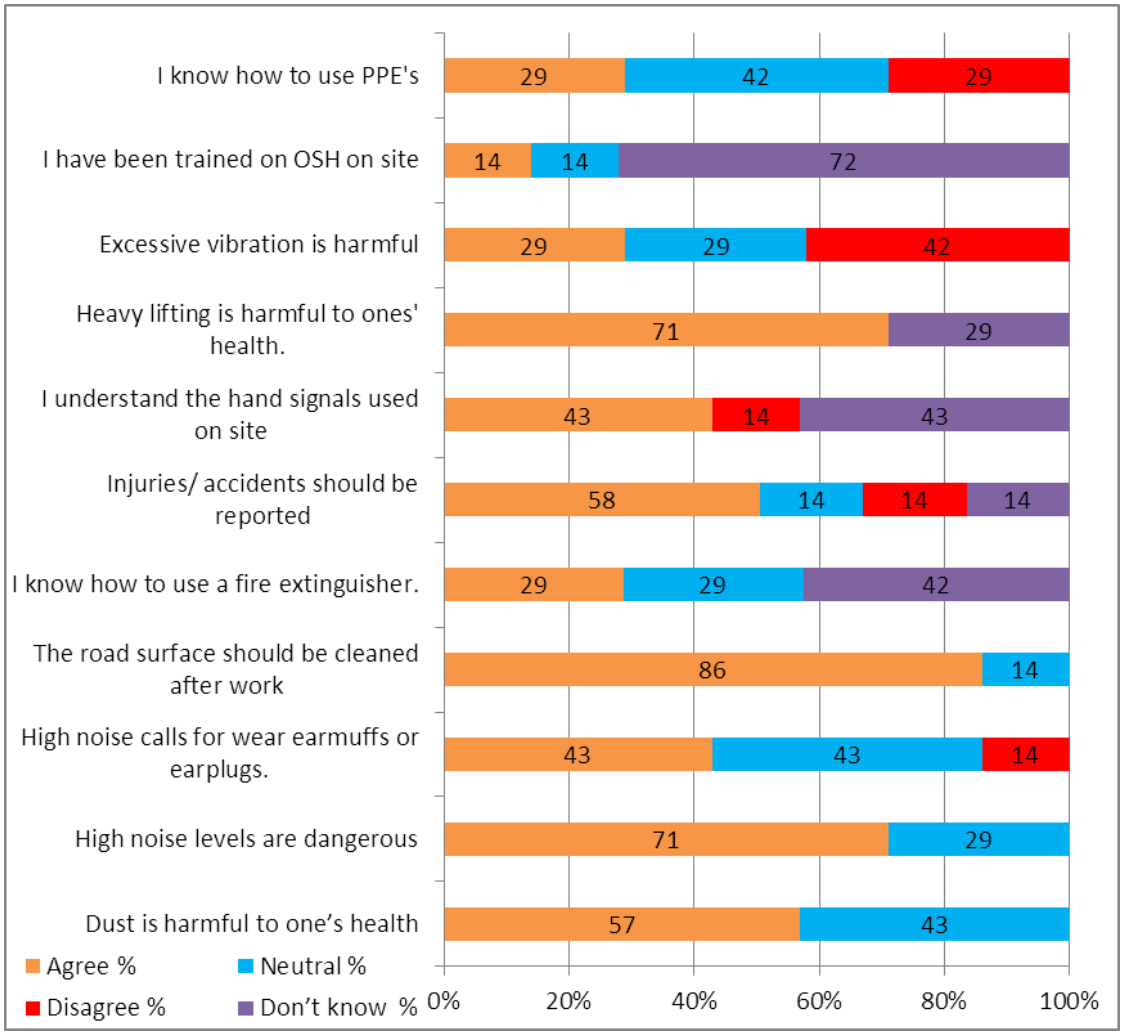


Figure 4.6: Machinery operators responses on awareness on OSH issues

Slightly more than half (57%) of the machinery operators responded in agreement to awareness that dust is harmful to one's health, 14% did not know that accidents and incidents should be reported to one's supervisor while 42% of the machinery operators did not know how to use a fire extinguisher. 42% of the operator's disagreed that excessive vibration is harmful to one's health while 29% disagreed to the knowledge of PPE use.

4.3.4 Drivers responses on awareness of OSH issues

Drivers were asked a number of questions in the study relating to occupational safety and health issues to gauge their awareness. The findings are presented in Figure 4.7

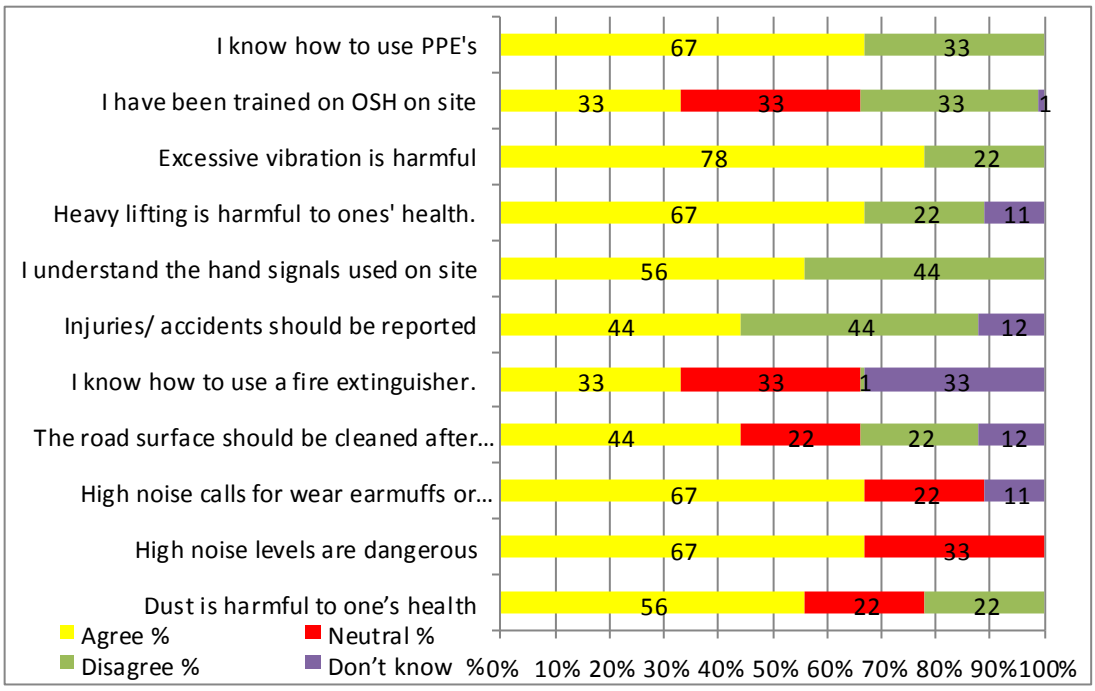


Figure 4.7: Drivers responses on awareness of OSH issues

The highest positive percentages (78%) of drivers were in concurrence that excessive/ long period vibrations are harmful to one's health. This could be that because automobiles are prone to a lot of vibrations and exposure to long driving hours to and from site could have caused them to experience harm and come to the realisation that vibrations are health detrimental. 67% of the drivers agreed to noise safety awareness. 11% did not know whether a lot of heavy lifting is harmful to

one's health. 33% of the drivers disagreed to have previously been trained on safety, also the same fraction disagreed to know how, and when to use PPE provided to them.

4.3.5 Unskilled Labourers responses on awareness of OSH issues

Unskilled Labourers were asked a number of questions in the study relating to occupational safety and health issues to gauge their awareness. The findings are presented in Figure 4.8 below.

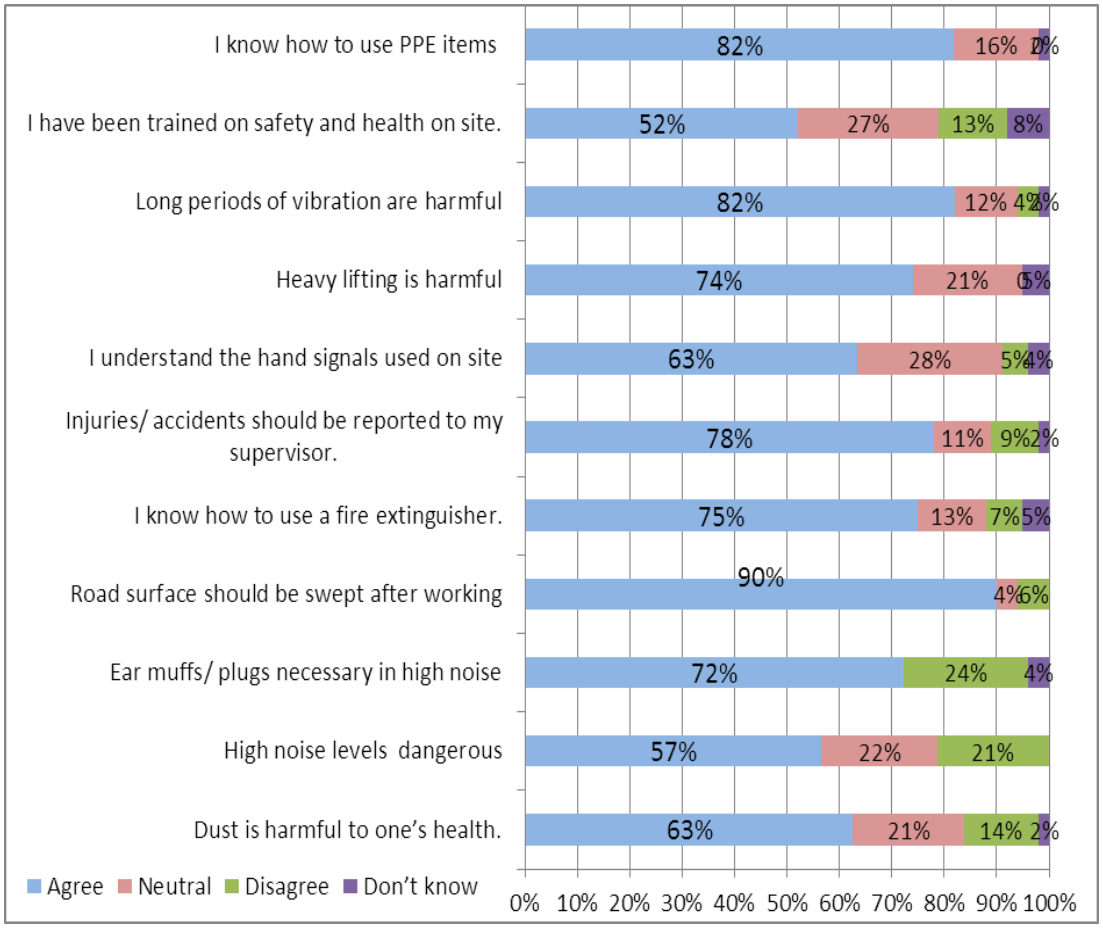


Figure 4.8: Unskilled Labourers responses on awareness of OSH issues

Most (82%) of the Unskilled Labourers reported to know how to use PPE items provided to them, a high of 78% agreed that all accidents and injuries should be reported to the immediate supervisor. 90% agreed that the road surface should be swept clean after working in that area is complete. 5% did not know that a lot of

heavy lifting is harmful to one's health and the same percentage also reported that they did not know how to use a fire extinguisher. 14% of the unskilled labourers disagreed that breathing in dust is harmful to one's health while 2% did not know whether breathing in dust is harmful to one's health.

4.3.6 Association between socio-demographic characteristics and awareness of OSH

Correlation analysis were conducted between the socio-demographic characteristics of respondents and their awareness of occupational safety and health issues.

Table 4.4 (a): Association between socio-demographic characteristics and awareness of OSH

Characteristic	Category	Awareness of OSH			Correlation coefficient (R)
		High	Moderate	Low	
Gender	Male	78%	20%	2%	r = -0.62, p = 0.001
	Female	32%	16%	52%	
Age	21-25	24%	30%	46%	r= 0.64, p=0.00
	26-30	66%	24%	10%	
	31-35	72%	20%	8%	
	36-40	82%	18%		
Education	Primary	30%	54%	16%	r= 0.87, p=0.047
	Secondary	44%	40%	16%	
	Certificate	54%	32%	14%	
	Diploma	68%	22%	10%	
	Degree	76%	24%		
Working experience	1-5	12%	44%	44%	r=0.71, p=0.00
	6-10	18%	50%	32%	
	11-15	32%	48%	20%	
	>20	48%	30%	22%	

Male staff were more likely to know about OSH issues than their female counterparts. Age had a strong positive correlation ($r=0.64$, $p<0.05$) with awareness of occupational safety and health issues. This means that increasing age was correlated with increasing with awareness. Education had a strong positive correlation ($r=0.87$, $p<0.05$) with awareness of occupational safety and health issues. The higher an employee's education was, the more likely it was that they knew about occupational safety and health issues. Working experience had a strong positive

correlation (r=0.71, p<0.005) with awareness of occupational safety and health issues. The more years worked in the in industry, the more likely the respondents knew about occupational safety and health issues.

All the socio-demographic characteristics had a positive correlation and P<0.05 at 95% confidence levels and this shows that their association to awareness of OSH issues was statistically significant. McCabe, Karahalios and Loughlin (2005) surveyed construction workers and supervisors and examined the impact of worker safety attitudes on construction safety outcomes. The research revealed that employee demographics influence safety attitudes.

4.3.7 Association between Work Category (Job Title) and Awareness of OSH

To assess the relationship between work category and awareness, chi-square tests were conducted between computed awareness scores and work category.

Table 4.4 (b): Association between Work Category (Job Title) and awareness of OSH

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5.827[a]	9	.757
Likelihood Ratio	8.615	9	.474
Linear-by-Linear Association	.099	1	.753
N of Valid Cases	105		

A positive correlation was arrived at which interprets that as the rank in work category increases, awareness of OSH will increase. The relationship was however not significant as p value> 0.05 (p = 0.757).

4.4 OSH Practices

The second objective of this study was to establish the current OSH practices in use. This was done through questionnaires presented to respondents while at the same time the practices were recorded by the researcher in the field through observation.

4.4.1 Site agents responses on OSH practices

Site agents were asked to comment about some occupational safety and health practices and how they were conducted in their company. The findings are presented in Figure 4.9

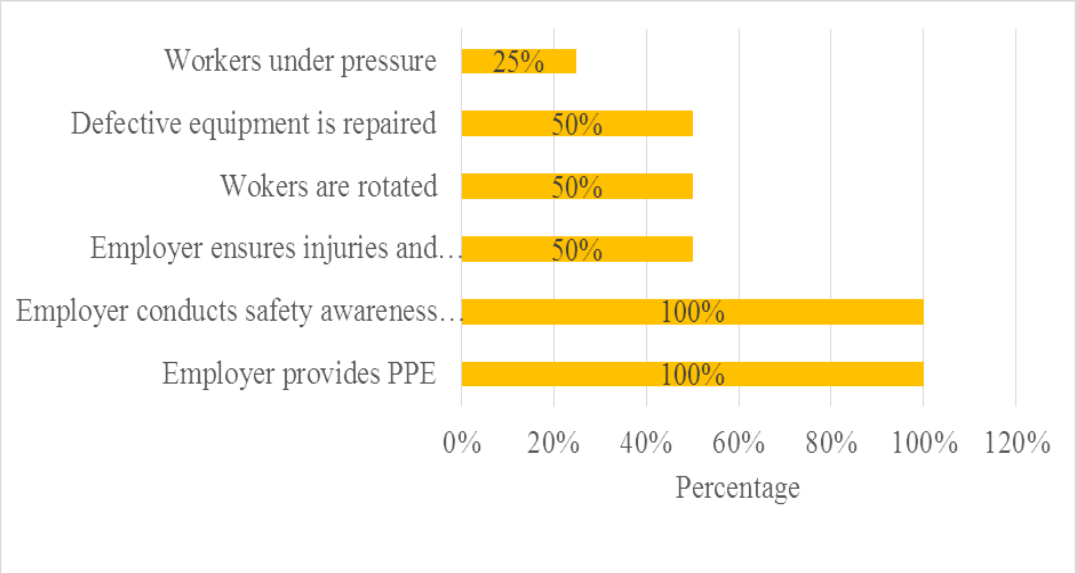


Figure 4.9: Site agents responses on OSH practices

In examining the role of management practice on safety across 98 worksites reporting severe and moderately severe injuries in South Australia. Gun and Ryan (1994) note that, under OHS legislation in most Australian states, management retains responsibility for identifying and controlling hazards at worksites and that organisations must develop procedures for conducting these tasks.

International Labour Organisation (1998) requires employers to ensure that health and safety practices are implemented, including the provision of safety tools such as first-aid facilities, protective gear and safety training. 50% of the site agents were working contrary to the provisions of GOK (2007) which requires that injuries and accidents be reported to the OSH officer in charge and that these incidents be entered in the General Register. Of all the four contractors, no one was found to be in possession of a general register. All the site agents (100%) reported that the employer conducts safety awareness to the employees and tat employer also provides

the necessary PPE. 50% of the site agents reported that workers are rotated regularly to ensure that they do not develop occupational related diseases due to long periods of exposure in high risk tasks such as operating of vibratory equipment, heavy lifting, etc. The researcher noted that most of the workers were not in proper protective clothing and thus highly exposed to risks on site.

Plate 4.1: Workers not in the required work–gear (PPE) on Nyeri – Wiyumiririe road

4.4.2 Foremen responses on OSH practices

Foremen in the study were asked a number of questions to describe OSH practices within their sites. The results are as tabled in tables 4.5 (a – f).

Table 4.5 (a): Foremen responses on Transport Safety practices

	Agree (1)		Neutral (2)		Disagree (3)		Don't know (4)		Mean	Standard Deviation
	F	%	F	%	F	%	F	%		
Cones are used to enclose the working area.	7	100%	0	0	0	0	0	0	1.0	0.982
Some space is left on both sides between the working area and the moving traffic.	7	100%	0	0	0	0	0	0	1.0	0.856

It was observed that the conventional vertical road signs which are strategically placed along roads was still in use and will likely be part of the road environment for many years to come. 100% of the foremen agreed to be practising transport safety to facilitate proper interaction between the construction workers and the moving traffic. As per the researcher's checklist, majority (75%) of roadway maintenance works had no necessary warning and direction signs in place. Signs were not clearly visible to approaching motorists in an equal number (75%) of roadway maintenance works.

Plate 4.2: On going surface dressing on King'ong'o – Kiganjo road. No traffic cones or flagmen present on site

Table 4.5 (b): Foremen responses on Machinery Safety practices

	Agree (1)		Neutral (2)		Disagree (3)		Don't know (4)		Mean	Standard Deviation
	F	%	F	%	F	%	F	%		
The machinery/ equipment have reverse alarms to warn people of backward movements.	5	71%	2	29%	0	0	0	0	1.55	1.040
There is normally space within every moving machine to avoid accidents.	6	86%	0	0	1	14%	0	0	1.71	1.081
Spoilt/ broken down equipment are not allowed for working on site.	3	43%	1	14%	3	43%	0	0	2.91	1.091

Majority (71 %) of the foremen reported that the machinery they use on site have reverse alarms to warn people of reverse movements. 43% of the foremen disagreed that faulty equipment are not allowed to work on site. This shows that accidents can easily be caused by these faulty equipment, which are not safe for use, the same way unroadworthy vehicles are prone to accidents.

Table 4.5 (c): Foremen responses on Construction Safety practices

	Agree (1)		Neutral (2)		Disagree (3)		Don't know (4)		Mean	Standard Deviation
	F	%	F	%	F	%	F	%		
Workers are increased when necessary	3	43%	3	43%	1	14%	0	0	2.00	1.040
First aid kits available	3	43%	1	14%	3	43%	0	0	2.98	1.235
There is presence of trained first aiders on site.	1	14%	0	0	6	86%	0	0	3.32	0.798
There is a fire extinguisher on site.	0	0	0	0	5	71%	2	29%	3.30	1.173
I take care of my own safety on site.	5	71%	1	14%	1	14%	0	0	1.41	0.7755
I take care of the safety of other workers around me.	4	57%	2	29%	0	0	1	14%	2.23	0.994

None of the foremen (0%) agreed to the presence of a fire extinguisher in the construction site. 86% of the foremen disagree to presence of trained first aiders on

site. This clearly shows that the contractors did not invest in safety while planning for the works because of poor enforcement of OSH laws from DOSHS. Lingard (2002) explored the effects of first-aid training on Australian construction workers' OHS motivation and risk-control behaviour. First-aid training was found to reduce worker self-other bias and lead construction workers to acknowledge that their own behavior is an important factor with respect to the avoidance of OHS accidents, injuries and illnesses. First-aid training was also observed to reduce individual perceptions that workers would miraculously be immune to accidents, injuries and illnesses. Additional benefits of first-aid training included increased and more realistic worker perceptions regarding the probability of accidents occurring (Lingard, 2002).

Table 4.5 (d): Foremen responses on Ergonomic practices

	Agree (1)		**Neutral (2)**		**Disagree (3)**		**Don't know (4)**		**Mean**	**Standard Deviation**
	F	**%**	**F**	**%**	**F**	**%**	**F**	**%**		
I experience body pains in the evenings after work.	4	57%	0	0	3	43%	0	0	2.17	1.082
The body pains reduce after sleeping and in the mornings.	5	71%	0	0	2	29%	0	0	2.23	1.125
Workers who operate vibrators are rotated to other jobs.	3	43%	1	14%	1	14%	2	29%	2.77	1.194

More than half (57%) of the foremen reported that they experience body pains after work while 43% disagreed to the same. In the same line 71% reported that the body pains reduce by the following morning, while 29% said the pains do not reduce even the morning after. The body pains could be as a result of long work hours which culminate in worker exhaustion, fatigue and burnout. This results in safety becoming neglected (Hislop, 1999). A hazardous work environment is often the result.Only 43% of the foremen reported to rotate workers who are operate vibratory equipment.

Table 4.5 (e): Foremen responses on Clothing and PPE practices

	Agree (1)		Neutral (2)		Disagree (3)		Don't know (4)		Mean	Standard Deviation
	F	%	F	%	F	%	F	%		
Flagmen wear reflective jackets and use STOP and GO signs to control traffic.	5	71%	0	0	2	29%	0	0	1.22	0.639
All workers have reflective jackets on site.	6	86%	0	0	1	14%	0	0	1.42	0.784

Most (71%) of the foremen reported that reflective jackets and traffic control signs were in use on site as required while 29% disagreed to the same. Similar to Gannapathy, Subramaniam, Mohamad, Suaidi and Hamidon (2008) findings in this research is that observation was made in that when a traffic control device or flagman is utilized at road construction site for control the traffic flow, a road user who drives a vehicle exercises extraordinary care to secure the mutual safety of all persons.

Table 4.5 (f): Foremen responses on Noise Safety practices

	Agree (1)		Neutral (2)		Disagree (3)		Don't know (4)		Mean	Standard Deviation
	F	%	F	%	F	%	F	%		
I have gone for hearing tests while working on site.	2	29%	0	0	5	71%	0	0	0.294	0.477
The hearing tests were facilitated by my employer.	0	0	0	0	5	71%	2	29%	2.94	0.491

Only 29% of the foremen reported to have previously attended hearing tests. This shows that the health of the working foremen is poorly monitored which is contrary to legal safety rules which recommend regular health checks to monitor a worker's health and hence find out if the working conditions are the cause to health deterioration.

4.4.3 Machinery operators responses on OSH practices

Machinery operators in the study were asked a number of questions to describe OSH practices within their sites.

Table 4.6 (a): Machinery operators responses on Transport Safety practices

	Agree (1)		Neutral (2)		Disagree (3)		Don't know (4)		Mean	Standard Deviation
	F	%	F	%	F	%	F	%		
Cones are used to enclose the working area.	4	57%	2	29%	1	14%	0	0	2.0	1.440
Some space is left on both sides between the working area and the moving traffic.	5	71%	0	0	2	29%	0	0	1.6	0.837

More than half (57%) of the machinery operators reported that safety cones were in use on site to enclose the working area while leaving some space between the working area and moving traffic to enhance safety and transition. 14% disagreed to the use of cones to enclose the working area. This shows that some contractors had no transport safety provisions on site and this presents a risk to both workers and motorists.

Plate 4.3: Measurements being taken by workers oblivious of the Physical and Chemical risks they are exposed to on Nyeri – Wiyumiririe road

Table 4.6 (b): Machinery operators responses on Machinery Safety practices

	Agree (1)		Neutral (2)		Disagree (3)		Don't know (4)		Mean	Standard Deviation
	F	%	F	%	F	%	F	%		
The machinery/ equipment have reverse alarms to warn people of backward movements.	6	86%	0	0	1	14%	0	0	1.4	0.937
There is normally space within every moving machine to avoid accidents.	6	86%	0	0	1	14%	0	0	1.2	0.937
Spoilt/ broken down equipment are not allowed for working on site.	5	71%	1	14%	1	14%	0	0	1.4	1.643

Majority (86%) of the machinery operators observed machinery safety practices of maintaining space within every moving machinery. This shows that they were well trained in their field of work and thus qualified to work on site while taking care of their safety and safety of other workers as well.

Table 4.6 (c): Machinery operators responses on Construction Safety practices

	Agree (1)		Neutral (2)		Disagree (3)		Don't know (4)		Mean	Standard Deviation
	F	%	F	%	F	%	F	%		
Workers are increased when necessary	5	71%	0	0	2	29%	0	0	2.8	1.428
First aid kits available	5	71%	0	0	1	14%	1	14%	2.1	1.021
There is presence of trained first aiders on site.	4	57%	0	0	3	43%	0	0	2.1	1.112
There is a fire extinguisher on site.	1	14%	1	14%	4	57%	1	14%	3.2	1.649
I take care of my own safety on site.	4	57%	1	14%	1	14%	1	14%	2.8	1.786
I take care of the safety of other workers around me.	4	57%	1	14%	1	14%	1	14%	2.6	1.434

Fire fighting equipment must be in place for employees to use without exposing them to danger, to extinguish a fire in its early stages (OSHA, 2007).

The equipment must be suitable to the risks and appropriate staff will need training and instruction in its proper use. Only 14% of the operators agreed to spotting a fire extinguisher on site.

Table 4.6 (d): Machinery operators responses on Ergonomic Safety practices

	Agree (1)		Neutral (2)		Disagree (3)		Don't know (4)		Mean	Standard Deviation
	F	%	F	%	F	%	F	%		
I experience body pains in the evenings after work.	4	57%	2	29%	1	14%	0	0	2.6	1.657
The body pains reduce after sleeping and in the mornings.	4	57%	0	0	3	43%	0	0	2.5	1.762
Workers who operate vibrators are rotated to other jobs.	3	43%	1	14%	3	43%	0	0	3.1	1.430

Slightly more than half (57%) of the machinery operators agreed that they experience body pains in the evening after work and that the body pains reduce after rest. 43% of the operators disagreed to the job rotation practice of workers who operated vibrators. It is worth allowing workers enough time to rest and rotating those who work in strenuous sections. Trethewy, Gardner, Cross and Marosszeky (2001) note that the likelihood of occupational accidents and injuries is exacerbated by work intensification and individual emotional responses, stress and fatigue.

Table 4.6 (e): Machinery operators responses on Clothing and PPE practices

	Agree (1)		**Neutral (2)**		**Disagree (3)**		**Don't know (4)**		**Mean**	**Standard Deviation**
	F	**%**	**F**	**%**	**F**	**%**	**F**	**%**		
Flagmen wear reflective jackets, use STOP, and GO signs to control traffic.	6	86%	0	0	1	14%	0	0	1.2	0.214
All workers have reflective jackets on site.	6	86%	0	0	1	14%	0	0	1.3	1.203

The responses from operators on PPE practices indicate that 86% of them had the required PPE on site and only 14% disagreed to having PPE and to having flagmen who control traffic having PPE too.Although the provision and use of safety equipment is considered a form of best practice with respect to OHS, it is necessary to understand the limitations and potential obsolescence of items of safety equipment before their use. Maintenance must also be conducted regularly on this equipment (ILO, 1998).

Table 4.6 (f): Machinery operators' responses on Noise Safety practices

	Agree (1)		**Neutral (2)**		**Disagree (3)**		**Don't know (4)**		**Mean**	**Standard Deviation**
	F	**%**	**F**	**%**	**F**	**%**	**F**	**%**		
I have gone for hearing tests while working on site.	2	29%	0	0	5	71%	0	0	3.1	1.076
The hearing tests were facilitated by my employer.	1	14%	0	0	5	71%	1	14%	3.3	1.642

Majority (71%) of the machinery operators disagreed to have had any previous hearing tests facilitated by the employer and this is against safety rules as per OSHA, 2007 Act that regular health checks should be carried out, hearing tests inclusive. Some of the best practices as identified by Aleks and Chris (2015) relating to short duration work on roads and highways are: Worker training; use of visible attire on site; work vehicle lighting; use of blocker vehicles or shadow vehicles; buffer space around the work area; variable message signs that are permanent or portable; traffic control equipment e.g. cones, drums, barrels; working during off- peak hours e.g. at night; use of police assistance; advocating for better work zone timing restrictions. As per the researcher's checklist in this study, most of these practices were noted to be in use in the different workplaces although at moderate or low levels of compliance e.g. 75% of the workers in this study were noted to be in reflective attire, while there was only 25% use of visible message signs to motorist. There were no ongoing works during off-peak hours.

4.4.4 Drivers responses on OSH practices

Drivers in the study were asked a number of questions to describe OSH practices within their sites

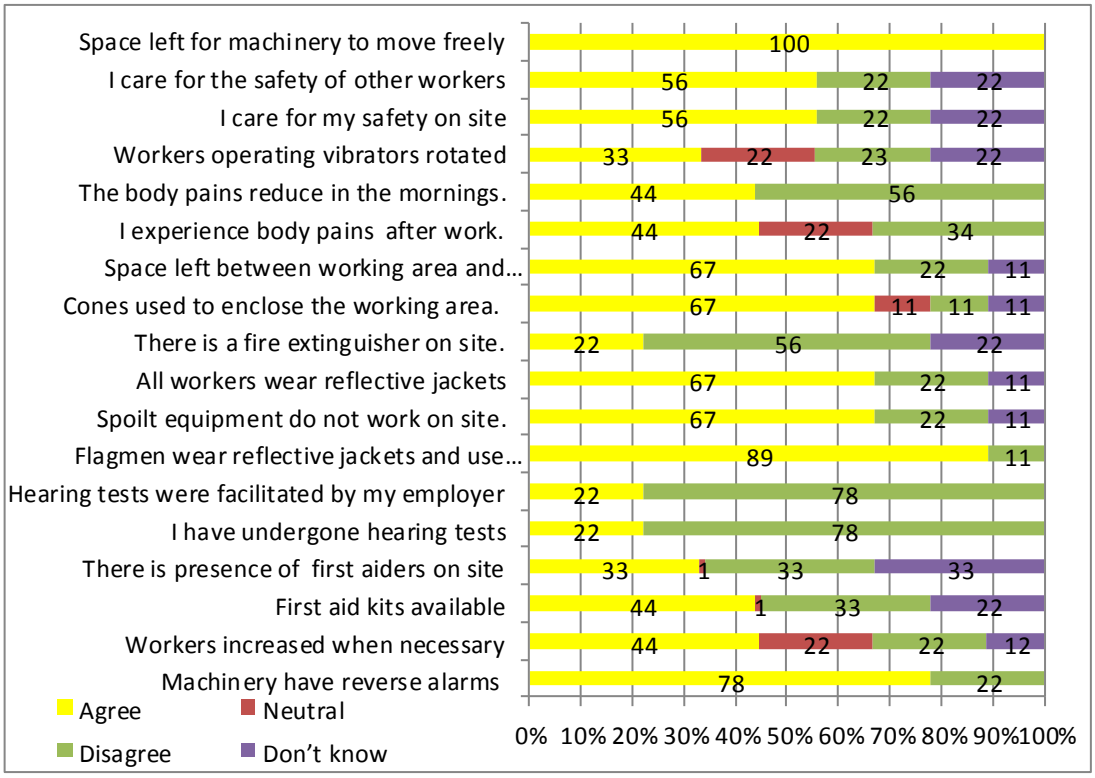


Figure 4.10: Drivers responses on OSH practices

A few (22%) of the drivers reported that spoilt equipment do not work on site safety practices in roadway works as recommended by ILO (1998). 44% said that they experience body pains after work. 33% disagreed to the presence of first aiders on site.

Deacon, Smallwood and Haupt (2005) suggest that it is in the interests of construction companies to examine the cost benefits of optimum worker health and conduct regular medical surveillance and management of worker health.

Plate 4.4: Installation of rubble strips on Marua -Karishen road. No safety cones and signage to protect workers from moving traffic

4.4.5 Unskilled Labourers responses on OSH practices

Unskilled Labourers in the study were asked a number of questions to describe OSH practices within their sites.

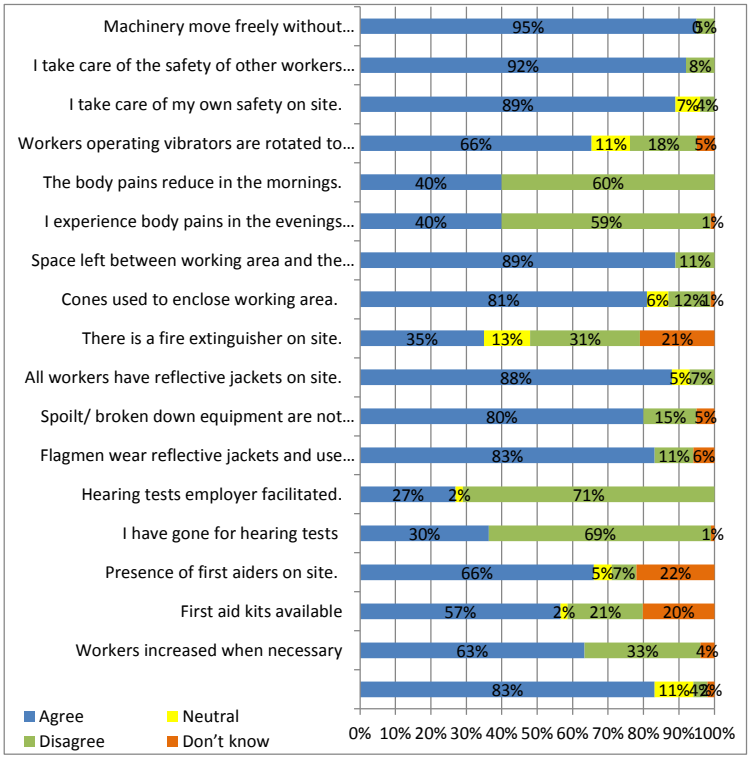


Figure 4.11: Unskilled Labourers responses on OSH practices

Most (89%) of the Unskilled Labourers reported to have a practice of taking care of their own safety on site while 92% reported that they take care of the safety of other workers around them. Teo, Ling and Ong (2005) investigated the safe work behaviour of onsite construction workers in Singapore. These authors identified two reasons for unsafe behaviour, i.e. lack of awareness and poor attitude towards safety.

Plate 4.5: Workers on site on Sagana – Marua road. No safety cones and safety signage to protect the working area

Plate 4.6: Exposed hands of an unskilled labourer on Marua – Karishen road. No PPE (gloves) provided

4.4.6 Association between respondents socio-demographic characteristics and OSH practices

Correlation analysis were conducted between the demographic characteristics and occupational safety and health practices.

Table 4.7: Association between socio-demographic characteristics and OSH practices

Characteristic	Category	OSH practices			Correlation coefficient (R)
		High	Moderate	Low	
Gender	Male	72%	20%	8%	r = -0.33, p = 0.401
	Female	44%	40%	16%	
Age	21-25	22%	20%	58%	r= 0.72, p=0.00
	26-30	30%	42%	28%	
	31-35	56%	32%	12%	
	36-40	72%	20%	8%	
Education	Primary	10%	12%	78%	r= 0.75, p=0.001
	Secondary	14%	28%	58%	
	Certificate	26%	28%	46%	
	Diploma	44%	40%	26%	
	Degree	58%	32%	10%	
Working experience	1-5	22%	18%	60%	r=0.82, p=0.030
	6-10	28%	22%	50%	
	11-15	44%	30%	26%	
	>20	62%	28%	10%	

Table 4.7 shows age had a strong positive correlation (r=0.72, p=0.00) with occupational safety and health practices. Education had a strong positive correlation (r=0.75, p=0.001) while working experience had a positive correlation (r=0.82, p=0.030) with occupational safety and health practices.

The association of age, education and working experiences with OSH practices was statistically significant at 95% confidence levels as $p<0.05$.

4.4.7 Association between OSH awareness and OSH practices

Correlation analysis were conducted between the awareness of OSH and OSH practices

Table 4.8: Association between OSH awareness and OSH practices

Knowledge	Category	OSH practices			Correlation coefficient (R)
		High	Moderate	Low	
Training on OSH	Agree	56%	40%	4%	r=0.88, p=0.00
	Disagree	22%	38%	40%	
	Don't know	18%	62%	20%	
Knowledge on workman attire	High	64%	22%	24%	r=0.68, p=0.044
	Moderate	40%	38%	22%	
	Low	32%	30%	38%	
Knowledge on equipment handling	High	68%	22%	10%	r=0.72, p=0.00
	Moderate	54%	34%	12%	
	Low	28%	48%	24%	
Knowledge on first aid	High	72%	22%	6%	R=0.56, p=0.417
	Moderate	54%	34%	12%	
	Low	16%	44%	40%	

Table 4.8 show that training on Occupational Safety and Health had a strong positive correlation ($r=0.88$, $p<0.05$) with OSH practices. Kartam, Flood and Koushki (2000) attribute the lack of training and orientation programs for new staff and ineffective hazard identification to poor Occupational Safety and Health practices. Similarly, knowledge on workman attire had a strong positive correlation ($r=0.68$, $p<0.05$) with Occupational Safety and Health practices. Knowledge on equipment handling also had a strong positive correlation ($r=0.72$, $p<0.05$) with occupational safety and health practices. In the same line, there was a significant relationship ($r=0.56$, $.p = 0.417$) between knowledge on first aid and OSH practices. Davis and Tomasin (1999) suggest that effective training in the construction industry encompasses one approach to improving safety.

4.4.8 Association between Work Category/Job Title and OSH Practices

To assess the association between work category and OSH practices, chi-square tests were conducted between computed OSH practice scores and work category.

Table 4.9: Association between Work Category/ Job Title and OSH Practices

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	6.242[a]	9	.715
Likelihood Ratio	9.144	9	.424
Linear-by-Linear Association	.105	1	.746
N of Valid Cases	99		

The study found that there was no significant relationship (p=0.715) between work category and OSH practices as p >0.05.

4.4.9 Protective items provided by employer

The study sought to establish the items provided to Unskilled Labourers, operators, drivers and foremen in compliance with occupational safety and health standards.

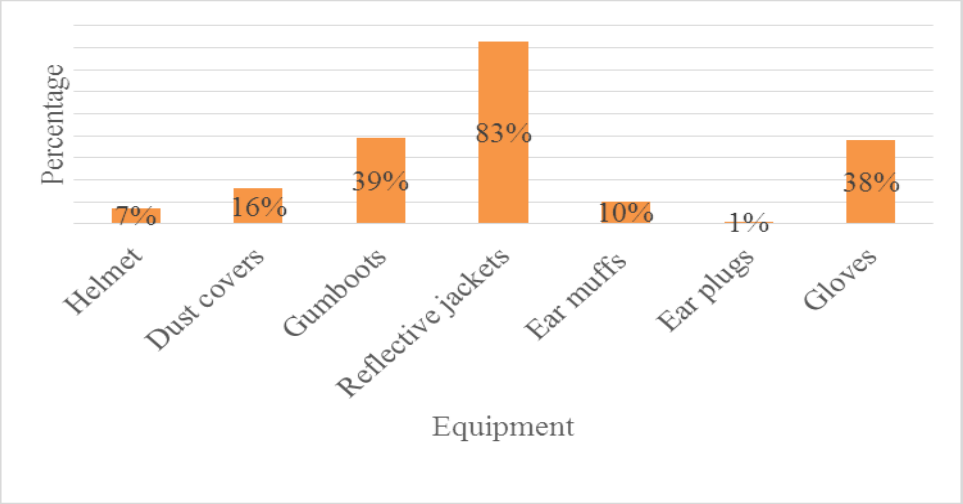


Figure 4.12: Protective items provided by employer

The findings of this study were not in full compliance with the legal provisions of ILO (1998) which requires that workers be provided with the necessary protective

clothing and work gear as per their exposure requirements. Some of the workers did not have the necessary reflective attire on where as it is a necessary safety requirement that all workers be in the required reflective attire at any work place.

Lin and Mills (2001) found that OSH is likely to improve if contractors are committed to ensuring that workers utilize the safety equipment provided.

Plate 4.7: Dust mask provided to protect from inhalation of fumes from the bitumen road tanker on King'ong'o – Kiganjo road

4.5 Challenges to good OSH practices in roadway maintenance works

The study sought to outline the challenges to good occupational safety and health practices in roadway maintenance works. This was done by asking the respondents in part three of the questionnaires through open-ended questions why they did not observe recommended OSH practices (Mugenda & Mugenda, 2012).

75% of the Site Agents reported that some motorists are rude, during traffic control some become impatient and choose to pass through the work zone. This was despite having traffic control flagmen on site and safety cones that demarcate the work zone.

50% of the Site Agents also reported that they are on constrained budgets so they sometimes overlook some safety requirements. Huang and Hinze (2006b) observed that safer projects generally allocated higher funds to safety by balancing safety and cost during tendering and contract negotiations, employing full-time onsite safety representatives, funding safety recognition programs, and supporting a safety orientation. With site agents overlooking safety requirements, the maintenance projects put both the workers and the motorists at risk of injury.

88% of the machinery operators reported that if the machine was reported to the management to be faulty but is workable, then it is ignored for repair. Comparison can be made to unroadworthy vehicles that are still found moving on roads.

Unskilled Labourers, Operators, Foremen also reported that some are not provided with the required PPE and are required to work. It is very difficult to get old and worn out/ damaged PPE replaced.

An average of 91% of the respondents (Site Agents, Foremen, Unskilled Labourers, Machinery Operators, Drivers) reported lack of any form of training in safety thus it was difficult to know what is required of them. This resulted in the attitude that safety matters are not important and thus the inadequate attention given to OSH rules at the roadway work places and during work procedures.

The researcher also established that a good percentage of employees who claim to have had safety awareness trainings previously did not also seem to employ what they gathered at the roadway workplace. This is because the workers intermingled with others who did not have any OSH training or knowledge and therefore the OSH practices were now brushed off by the employees who were less aware. This presents a challenge due to lack of uniformity. It is therefore recommended that trainings and/ or safety awareness campaigns be conducted to employees all together even though they might have been aware during recruitment that some workers are well versed

with OSH. This will ensure that all employees are on the same page regarding safety and thus uniform observation and practice of OSH. Periodic training/ refresher courses are also encouraged.

From the Site Agents responses, it was noted that most of the Unskilled Labourers who formed the highest percentage of respondents in this study (76%) are not interested in gaining knowledge even through short OSH trainings and/or briefings as they view this as a waste of time. Their only interest was to work and get remunerated at the end of the day. This can be attributed to the safety attitudes and low safety commitment of the management i.e. Site Agents. Siu, Philips and Leung (2003) observed that, where management possessed a low regard for safety, workers focused on being productive and generally disregarded safety as a priority.

There has not been any current or previous occurrence of death in the roadway workplaces that the respondents under study had been to and thus the laxity to employ good safety practices. This goes a long way to prove the Kenyan behaviour of waiting until an incident occurs for action to be taken alias '*The dead man syndrome'*.

The research also established from the site agent responses that there is no formal safety audit that had been carried out by any government officials whether in their current workplaces or previous roadway workplaces and thus the neglect to employ good OSH practices. This presents a challenge in compliance with OSH legal requirements because of lack of follow-up by the enforcers i.e. DOSHS officers.

In general, failure to comply with safety and health requirements came down to cost. If well budgeted for, OSH should be applied at all levels without any hitches. In addition, the safety culture is still not well established in the country and thus lack of adequate awareness and consequently practice by majority of the workforce in the country (Stellman, 2004).

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

This chapter covers the conclusion and the recommendation of the research study based on the research findings from the data collected.

5.1 Conclusions

The study established that there was a 90% level of awareness among the site agents while the employees (Foremen, Unskilled Labourers, operators and drivers) reported 38% average awareness levels on OSH issues present in road maintenance works. This goes out to show that with low levels of formal education together with lack of OSH trainings among workers, there is a low level of safety awareness. Society expects that the higher the level of education a person has, the more aware he/she is in all aspects of life. The study concluded that the level of awareness on OSH among the low cadre of employees was inadequate.

For the current OSH practices in roadway maintenance works, the site agents reported 62.5 % observance of OSH issues with regards to the current work practices while employees work practices only abided to OSH issues by a low of 38%. From the researcher's checklist, it was observed that for the way the maintenance work was conducted, there was a 50% compliance with OSH issues from the daily practices. These findings show that there is no compliance of occupational safety and health issues in roadway maintenance works in Nyeri county, Kenya.

The main challenge that hindered compliance with safety and health requirements was cost. Majority of the site agents reported that complying with various OSH requirements had cost implications, which the contractors did not want to incur. In addition to that, the temporary nature of the work makes it difficult to observe the safety rules because there is movement from one station of work to another every few hours and in very few cases every few days.

5.2 Recommendations

i. It is recommended that the Directorate of Occupational Safety and Health undertake safety awareness programs within the road maintenance sector.
ii. Directorate of Occupational Safety and Health should do inspection patrols to check that safety laws and regulations are being adhered to in road maintenance works around Nyeri county. Enforcement of the law should be followed up.
iii. Each contractor should develop clear safety policy guidelines depending on the scope of work. This will help to ease the understanding of the safety requirements and consequently improve compliance.
iv. The management of the contractors, in their planning activities should set aside a proper financial budget to cater for all OSH matters and requirements and thus ensure smooth working and also safety of all workers on site. This will ensure that cost is not a hinderance with regards to compliance with OSH requirements.

5.3 Areas of further research

Further research may be conducted on the following topic:

i. Assessment of the causes of accidents that have occurred on roads under Construction/ and or Maintenance in Kenya within a certain period.

REFERENCES

Aleks, K., & Chris , O. (2015). *Challenges in Ensuring Worker Safety in Active Roadway Work Zones.* Toronto: Applied Research Associates.

Babbie, E. (2002). *Survey Research Methods.* Belmont, CA: Wadsworth.

Bartlett, J., Kotrlik, J., & Higgins, C. (2001). Organizational Research: Determining Appropriate Sample Size in Survey Research. *Information Technology, Learning and Perfomance*.

Behm, M. (2005). Linking Construction Fatalities to the Design for Construction Safety Concept. *Safety Science* 43(8), 589-611.

Cochran, W. G. (1963). *Sampling Techniques.* New York: John Wiley and Sons.

Cole, T. (2001). *Overview of Private Meetings Held between the Honourable TRH Cole QC and Participants in the Building and Construction Industry.* Canberra: Australian Government Printing Service.

Davis, V., & Tomasin, K. (1999). *Construction Safety Handbook, 2nd ed.* New York: Thomas Telford.

Deacon, C., Smallwood, J., & Haupt, T. (2005). The Health and Well-being of Older Construction Workers. *International Congress Series,* 1280, 172-177.

Donn, C., Hancher, Kenneth, B., Robin, M., Jonathon , R., & Kristin , S. (2007). *Improve Safety of Workers During Highway Construction and Maintenance.*Kentucky: Kentucky Transportation Centre.

Fitzsimmons, Eric, Nicole, O., Shauna , H., Neal, H., & Tom, M. (2009). *Synthesis of Traffic Calming Techniques in Work Zones.* Ames, IA: Center for Transportation Research and Education, Iowa State University.

Gannapathy, V. R., Subramaniam, S., Mohamad, D., Suaidi, M., & Hamidon, A. (2008). Risk Factors in a Road Construction Site. *International Journal of Civil, Environmental, Structural, Construction and Architectural Engineering* .

Gatambese, J. (2003). *Investigation of the viability of designing for safety.* USA: The Centre to Protect Workers' Rights.

Gun, R. T., & Ryan, C. (1994). A Case-Control Study of Possible Risk Factors in the Causation of Occupational Injury. *Safety Science,* 18 (1), 1-13.

Hadayeghi, Alireza, & Brian M. (2009). *Improving the Safety of Mobile Lane Closures.* Washington DC: Transportation Research Board.

Health and Safety Authority. (2009). *Guidelines for Working on Roads.* Ireland: Health and Safety Authority.

Health and Safety Executive. (2005). *Respect for People - RfP: Code of Good Working Health and Safety Practices.* London: Health and Safety Executive.

Hislop , R. (1999). *Construction Site Safety: A Guide for Managing Contractors.* USA: Lewis Publishers.

Huang, X., & Hinze, J. (2006b). Owner's Role in Construction Safety: Guidance Model. *Journal of Construction Engineering and Management*, 132 (2), 174 - 181.

International Labour Organisation. (1998). Safety and Health in Construction; an ILO code of practice. Geneva: International Labour Office.

Kartam, N., Flood, I., & Koushki, P. (2000). Construction Safety in Kuwait: Issues, Procedures, Problems and Recommendations. *Safety Science,* 36(3), 163 - 184.

Kenya Roads Act. (2007) . Nairobi: Government Press.

Kisilu, D. K., & Tromp, D. (2006). *Proposal and Thesis writing: An Introduction.* Nairobi: Pauline's Publications Africa.

Lin, J., & Mills, A. (2001). Measuring the Occupational Health and Safety Perfomance of Construction Companies in Australia. *Facilities,* 19 (3/4), 131 - 138.

Lingard, H. (2002). The Effect of First Aid Training on Australian Construction Workers' Occupational Health and Safety Motivation and Risk Control Behaviour. *Journal of Safety Research*, 33(2),209-230.

MacNealy, & Mary, S. (1999). *Strategies for Empirical Research in Writing.* New York: Longman.

McCabe, B., Karahalios, D., & Loughlin, C. (2005). *Attitudes in Construction Safety.* San Diego, Carlifonia: ASCE Construction Institute (CI).

Ministry of Communication, Transport, Post and Construction, Lao PDR.(2007). *Country Paper ICT Statistics (Lao PDR).* Geneva: International Communication Union.

Ministry of Transportation. (2014). *Temporary Conditions.* Toronto: Ontario Traffic Manual.

Mugenda, O. M., & Mugenda, A. G. (2012). *Research Methods: Quantitative and* qualiative *Approaches.* Nairobi: African Centre for Technological Studies.

Mutai, B. (2000). *How to Write Quality Research Proposals: A Complete and Simplified Guide.* Edinburg: Thelley.

Occupational Safety and Health Act (2007). Nairobi: Government Press.

Ringen, K., Seegal, J., & Englund, A. (1995). Safety and Health in the Construcytion Industry. *Annual Review of Public Health*,16,165-188.

Siu, O., Philips, D., & Leung, T. (2003). Safety Climate and Safety Performance among Construction Workers in Hong Kong: The Role of Psychological Strains as Mediators. *Accident Analysis and Prevention*, 36(3), 359-366.

Smallwood, J. (1996). The Influence of Designers on Occupational Safety and Health. *In FirstInternational Conference of CIB Working Commission W99, Implementation of Safety and Health on Construction Sites*, (pp.203-213). Rotterdam: Technical University of Lisbon.

South Africa Department of Labour. (1993). *Occupation Hygiene in Construction Work.* Republic of South Africa: Department of Labour.

Stellman, J. (2004). *Encyclopaedia of Occupational Health and Safety, CD Version.* New Jersey: International Labour Organisation.

Teo, E. F., Ling, & Ong, D. (2005). Fostering Safe Work Behaviour in Workers at Construction Sites. *Engineering, Construction and Architectural Management,* 12(4), 410-422.

Toivo, N. (1993). *Assessing the Safety Environment in Work Organization of Road Maintenance Jobs.* Vantaa, Finland: Institute of Occupational Health, Department of Occupational Safety.

Trethewy, R., Gardner, D., Cross, J., & Marosszeky, M. (2001). Behavioural safety and Incentive Schemes. *Journal of Occupational Health Safety - Australia New Zealand*, 17(3), 251-262.

U. S. Department of Labor. (2012). *Inspection and Citation Guidance for Roadway and Highway Construction Workzones.* Washington D.C.: Occupational Safety and Health Administration, Directorate of Construction.

Wambugu, F. W., Mburu, C., & Gatebe, E. (2015). *Assessment Of Fire Safety Preparedness At Jomo Kenyatta International Airport Nairobi, Kenya.* Nairobi: Journal of Agriculture Science and Technology.

Work Injury Benefits Act, No. 13. (2007). Nairobi: Government Press.

World Bank Group. (2007). *Environmental Health and Safety (EHS) Guidelines. General EHS Guidelines.* Geneva: Occupational Health and Safety.

Kerra website (n.d.)https://www.google.com/search?q=www.kerra.coke&wdnwtto=1

Yue, L., Mark, C., Umar, F., Kris, F., Megan, M., & Yong, B. (2009). *Improving Highway Work Zone Safety.* Kansas: Kansas University Transportation Research Institute.

APPENDICES

CHECKLIST No.	

Appendix I: Observation Checklist

SAFETY AND HEALTH CHECKLIST FOR ROAD WORKS

The purpose of this checklist is to examine the safety practices in use at the time of roadway maintenance works.

Ongoing Roadworks

Location: …… **Contractor code**……

Date of on-site inspection:…… **Time:**…….....…

No.	Description	Yes	No	Comments
1.	Are all the necessary warning and direction signs in place?			
2.	Are the signs clearly visible to approaching motorists?			
3.	Are the flagmen wearing reflective attire and wearing traffic control signs (STOP and GO?)			
4.	Is there use of traffic cones to prevent vehicles from entering the worksite?			
5.	Are the vehicle paths through the work area clear to motorists?			
6.	Do the temporary detours cater for heavy vehicles to safely man oeuvre through the work area?			
7.	Is the pavement/ road surface free of loose screenings?			
8.	Are motorists informed of the need to slow down through the road works by speed restriction signs?			
9.	Are all the workers on the worksite in reflective attire?			
10.	Are the workers wearing the right PPE depending on condition of exposure e.g. dust mask, gloves, earplugs?			

11.	Do the equipment/ machinery have reverse alarms to alert workers on site of danger?			
12.	Is there a fire extinguisher on site?			
13.	Is there presence of a first aid kit on site?			
14.	Are the workers exposed to heavy lifting, un-natural postures and repetitive motions?			
15.	Are the workers involved in operation of vibratory/ compaction equipment rotated on a regular basis?			
16.	Do the sign boards have symbols and not text only to cater for people who do not know English?			
17.	Is there a correctly qualified personnel with valid documentation assisting in the implementation of health and safety at roadworks?			
18.	Is sufficient, clear and unobstructed space maintained at every machine while in motion to enable the work to be done without unnecessary risk?			
19.	Are persons below the age of eighteen years employed to perform work, which by its nature or its circumstances is likely to harm the person's safety or health?			
20.	Do persons under attachment/ internship only operate machinery under adequate supervision?			

Appendix II: Questionnaires

QN	

QUESTIONNAIRE (A) ON OCCUPATIONAL, SAFETY AND HEALTH ISSUES IN ROADWAY MAINTENANCE WORKS IN NYERI COUNTY, KENYA.

My name is Sophia Wanjiku Kariithi. I am a Masters student studying Occupational Safety and Health in Jomo Kenyatta University of Agriculture and Technology. You are invited to participate in a research study concerning Occupational, Safety and Health issues in roadway maintenance works. The need for your participation in this study is because the study is aimed at finding out the Occupational, Safety and Health issues present in roadway maintenance works which you are part of. The benefits of your participation is that your feedback will go a long way in helping the legal entities enforcers to improve governance of safety issues with a focus to ensure the best safety and health environment for all workers in roadway workplaces. Your participation is voluntary. You are free to refuse to answer any questions that you are reluctant and also free to withdraw in the process without any consequences although your full participation is highly encouraged. For any clarification, feel free to ask the researcher. There are no anticipated risks in your participation and you will not receive any payment for your contributions. Information obtained from this questionnaire will be treated with utmost confidentiality.

CONTRACTOR

Code:…… Road:…….

Part I: Personal Information

Gender: …… Job Title: ……

Age: 18 - 20 [ ] 31 – 35 [ ] 21 – 25 [ ] 26 - 30 [ ]

Level of education: Primary [ ] Secondary [ ] Certificate [ ]
Diploma [ ] Degree [ ]

Years/ Months of experience: <1 [ ] 1 – 5 [ ] 6 – 10 [ ] 11 – 15 [ ]
16 – 20 [ ] 21 – 25 [ ] > 25 [ ]

Part II

1 = Agree 3 = Disagree

2 = Neutral 4 = I Don't Know / N/A

Please answer the following questions by ticking your answer.

		I Agree	Neutral	I Disagree	I don't Know / N/A
1.	Sensors and/ or cameras should be mounted on the rear of the equipment/ plant/ machinery in order to detect objects and/ or people in blind areas.				
2.	Crew sizes need to be increased to accommodate lookout personnel and to improve quality of work.				
3.	There is need for availability of first aid kits on site.				
4.	There is need for a person responsible for handling first aid on site.				
5.	There is need for vision, hearing and other construction sensitive abilities monitoring at least once a year.				
6.	There is need for flagmen to wear reflective attire and use STOP and GO signs to capture the attention of oncoming traffic.				
7.	While on the worksite, working with defective equipment is not allowed under any circumstances.				
8.	It is necessary for all workers to be in reflective attire at the worksite.				

9.	After the road maintenance activities, the road surface should be cleared of all loose screenings.				
10.	It is important to wear the necessary PPE when exposed to harzadous conditions such as hearing protection when exposed to high noise levels, respiratory protection in the presence of toxic fumes e.g. from bituminous mixes and dust and head protection where there is danger of head injury.				
11.	All injuries and accidents however minor should be reported to the person responsible of administering first aid on site.				
12.	Cones should be used to demarcate the work zone.				
13.	Work zone demarcation should include the approach area and also the termination area.				
14.	All maintenance workers should understand basic hand signals for ease of communication at the worksite.				
15.	There is need for availability and selection of PPE such as gloves, safety glasses, reflective clothing, ear protection, respiratory protection and foot protection.				
16.	Continuous regular exposure to heavy lifting, un-natural postures and repetitive motions is harmful to one's health.				
17.	Workers involved in operation of vibratory/ compaction equipment should be rotated on a regular basis.				
18.	Every worker should take care of his/ her own safety.				
19.	Every worker should take care of the safety of other workers and anyone else surrounding him / her.				
20.	Training and supervision of inexperienced workers on matters of safety and health should be carried out.				

21.	Sufficient, clear and unobstructed space should be maintained at every machine while in motion to enable the work to be done without unnecessary risk.				

Part III

Are there any challenges that prevent you from ensuring that you follow safety rules?

If Yes,please note them down below

1. ……

……

2. ……

.....

3. ……

……

4. ……

…….

5. ……

…….

Thankyou for participating in this survey. Your input is highly valued.

QN	

QUESTIONNAIRE (B) ON OCCUPATIONAL, SAFETY AND HEALTH ISSUES IN ROADWAY MAINTENANCE WORKS IN NYERI COUNTY, KENYA.

My name is Sophia Wanjiku Kariithi. I am a Masters student studying Occupational Safety and Health in Jomo Kenyatta University of Agriculture and Technology. You are invited to participate in a research study concerning Occupational, Safety and Health issues in roadway maintenance works. The need for your participation in this study is because the study is aimed at finding out the Occupational, Safety and Health issues present in roadway maintenance works which you are part of. The benefits of your participation is that your feedback will go a long way in helping the legal entities enforcers to improve governance of safety issues with a focus to ensure the best safety and health environment for all workers in roadway workplaces. Your participation is voluntary. You are free to refuse to answer any questions that you are reluctant and also free to withdraw in the process without any consequences although your full participation is highly encouraged. For any clarification, feel free to ask the researcher. There are no anticipated risks in your participation and you will not receive any payment for your contributions. Information obtained from this questionnaire will be treated with utmost confidentiality.

CONTRACTOR

Code:…… Road:……..…….

Part I: Personal Information

Gender: …… Job Title: ……..……

Age: 18 - 20 [ ] 31 – 35 [ ] 21 – 25 [ ] 26 - 30 [ ]

Level of education: Primary [ ] Secondary [ ] Certificate [ ]
Diploma [ ] Degree [ ]

Years/ Months of experience: <1 [ ] 1 – 5 [ ] 6 – 10 [ ] 11 – 15 [ ]
16 – 20 [ ] 21 – 25 [ ] > 25 [ ]

Part II

1 = Agree 3 = Disagree

2 = Neutral 4 = I Don't Know / N/A

Please answer the following questions by ticking your answer.

		I Agree	Neutral	I Disagree	I Don't Know / NA
1.	Breathing in dust is harmful to one's health.				
2.	The machinery/ equipment have reverse alarms to warn people of backward movements.				
3.	Workers are increased when necessary to accommodate flagmen and to improve quality of work.				
4.	First aid kits available				
5.	There is presence of trained first aiders on site.				
6.	High noise levels on site is dangerous to your health.				
7.	With high levels of noise, one should wear earmuffs or earplugs.				
8.	I have gone for hearing tests while working on site.				
9.	The hearing tests were facilitated by my employer.				
10.	Flagmen wear reflective jackets and use STOP and GO signs to control traffic.				
11.	Spoilt/ broken down equipment are not allowed for working on				

	site.				
12.	All workers have reflective jackets on site.				
13.	The road surface should be swept clean after work has been done.				
14.	There is a fire extinguisher on site.				
15.	I know how to use a fire extinguisher.				
16.	All injuries and accidents should be reported to my supervisor.				
17.	Cones are used to enclose the working area.				
18.	Some space is left on both sides between the working area and the moving traffic.				
19.	I understand the hand signals used to communicate on site.				
20.	A lot of heavy lifting is harmful to your health.				
21.	I experience body pains in the evenings after work.				
22.	The body pains reduce after sleeping and in the mornings.				
23.	Long periods of vibration are harmful to one's health.				
24.	Workers who operate vibrators are rotated to other jobs.				
25.	I take care of my own safety on site.				
26.	I take care of the safety of other workers around me.				
27.	I have been trained on safety and health on site.				
28.	There is normally space within every moving machine to avoid accidents.				

29.	**Tick the items provided to you by your employer** Gloves Ear plugs Ear Muffs Reflective jacket Gumboots Nose and mouth dust cover Helmet				
30.	I know how to use all the items mentioned above.				

Part III

Are there any challenges that prevent you from ensuring that you follow safety rules?

If Yes, please note them down below

1. ……

……

2. ……

.....

3. ……

……

4. ……

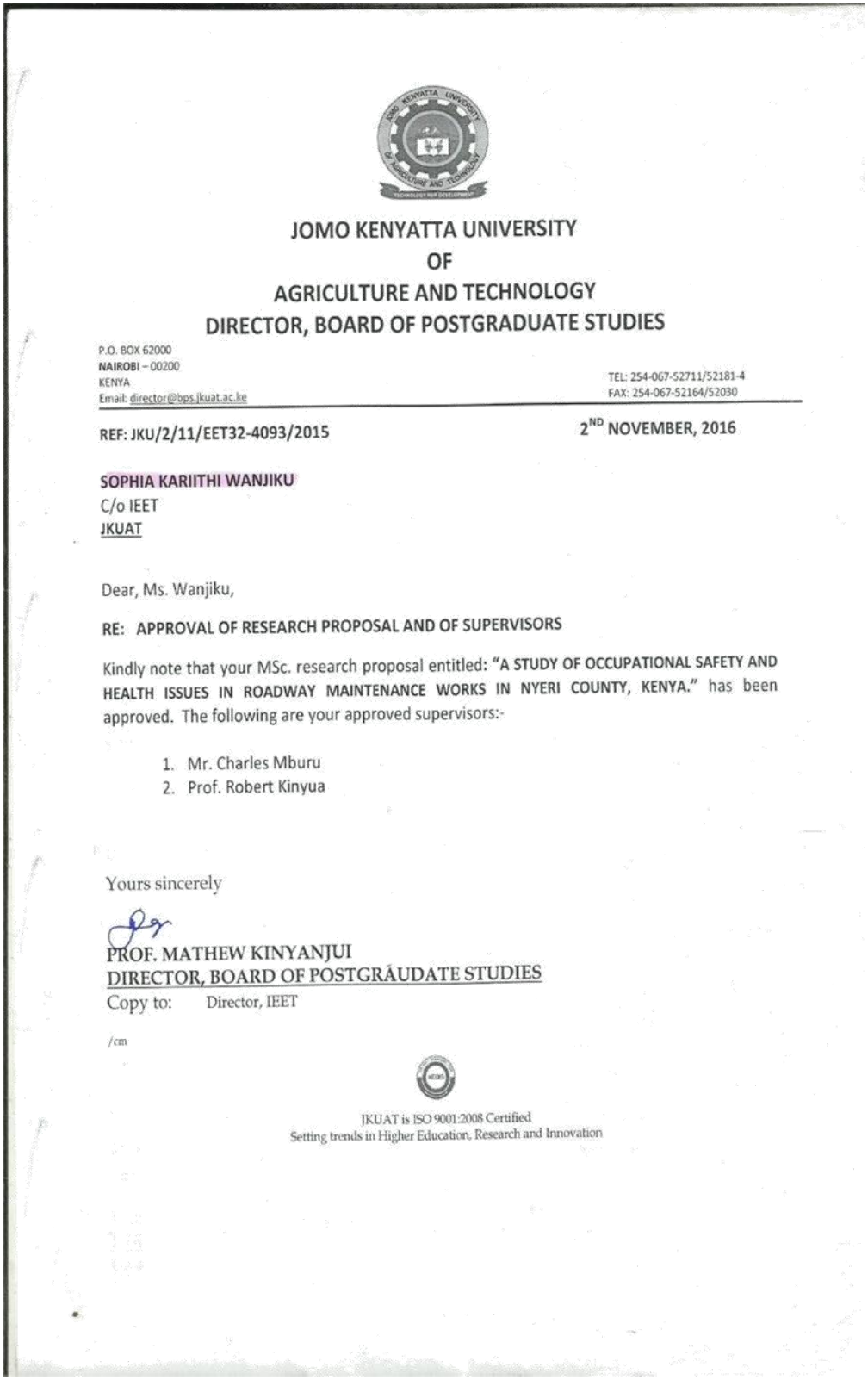
……

5. ……

……

Thankyou for participating in this survey. Your input is highly valued.

Appendix III: BPS Proposal Approval Letter



JOMO KENYATTA UNIVERSITY
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REF: JKU/2/11/EET32-4093/2015

2ND NOVEMBER, 2016

SOPHIA KARIITHI WANJIKU
C/o IEET
JKUAT

Dear, Ms. Wanjiku,

RE: APPROVAL OF RESEARCH PROPOSAL AND OF SUPERVISORS

Kindly note that your MSc. research proposal entitled: "A STUDY OF OCCUPATIONAL SAFETY AND HEALTH ISSUES IN ROADWAY MAINTENANCE WORKS IN NYERI COUNTY, KENYA." has been approved. The following are your approved supervisors:-

1. Mr. Charles Mburu
2. Prof. Robert Kinyua

Yours sincerely

PROF. MATHEW KINYANJUI
DIRECTOR, BOARD OF POSTGRADUATE STUDIES
Copy to: Director, IEET

/cm

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Appendix IV: IEET Data Collection Authorization Letter

JOMO KENYATTA UNIVERSITY
OF
AGRICULTURE AND TECHNOLOGY

INSTITUTE OF ENERGY AND ENVIRONMENTAL TECHNOLOGY

P.O. BOX 62000, Nairobi, Kenya. Tel: (067) 52251/52711/52181-4, Fax: (067) 52164 Thika, Email: director@ieet.jkuat.ac.ke

DATE: 15th August, 2016

TO WHOM IT MAY CONCERN

SUBJECT: EET32-4093/2015 –KARIITHI SOPHIA WANJIKU

The above named person is a postgraduate student at the Institute of Energy and Environmental Technology (IEET) in Jomo Kenyatta University of Agriculture and Technology. She is pursuing the Master of Science degree in Occupational Safety and Health and she is currently undertaking her research on ***"A study of occupational safety and health issues in roadway maintenance works in Nyeri County, Kenya".***

Any assistance given to her will be highly appreciated and the information given thereof shall be treated professionally and shall only be used for the purpose of producing the thesis. The student has undertaken to follow the research ethics as stipulated by the university.

Thank you for your assistance.

PROF. R. KINYUA
DIRECTOR, INSTITUTE OF ENERGY AND ENVIRONMENTAL TECHNOLOGY

Appendix V: Abstract from Journal Publication

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INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH & DEVELOPMENT DOI No. : 10.24940/ijird/2017/v6/i10/OCT17054 Page 58

Awareness of Occupational Safety and Health Issues on Roadway Maintenance Works in Nyeri County, Kenya

ISSN 2278 – 0211 (Online)

Sophia Wanjiku Kariithi
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Charles Mburu
Lecturer, Jomo Kenyatta University of Agriculture and Technology, Kenya
Robert Kinyua
Professor and Lecturer, Jomo Kenyatta University of Agriculture and Technology, Kenya

Abstract:
The nature of the construction industry combined with the required physical demands and rigorous work processes, make it an industry that faces several safety and health issues and thus higher risk of ill health, injury or fatality. Many road maintenance operations are potentially dangerous both to the maintenance workers and to the road users. This research work aimed at finding out the level of awareness of occupational safety and health issues in roadway maintenance works among road contractors. Questionnaires were administered to 122 contractor workers of ongoing class A, B and C road maintenance projects in Nyeri county during the data collection phase. Thereafter, the data was analysed using SPSS software, descriptive and inferential statistical analysis were carried out, data was presented in various forms and finally conclusions and recommendations were drawn. The targeted outcome of this research was that the results will provide important information that is the first step necessary to ensure that safety and health which is a legal requirement is observed at every workplace. The study has established that half (50%) of the site agents agreed that Crew sizes need to be increased to accommodate lookout personnel and to improve quality of work. However an equal number (50%) was undecided. The findings of this study contradict with the provisions of OSHA, 2007 which states that there should be creation of a safe culture at work places through education and training in OSH. 67% of the respondents disagree to have previously received any training on OSH. In this study, male staff were found to know more about OSH issues than their female counterparts. Age had a strong positive correlation (r=0.64, p=0.00) with OSH awareness at 95% confidence levels. This study recommends that follow-up be done to ensure at least one employee for every contractor who will be responsible for OSH. Contractors/ site agents should also ensure that all new employees are inducted on safety and that OSH trainings are carried out periodically.

Keywords: *Roadway maintenance, OSH Awareness, OSH legal requirements*