

Vulnerability Measures of Health and Safety on Confined Building Construction Sites in Dar-Es-Salaam, Tanzania.

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Abstract: *Health and safety continues to be a priority issue for those who work and manage the building construction industry across the world, due to the critical and aggravating menace of occupational hazards, and accidents plaguing the industry. The issue becomes particularly difficult with confined sites. Within the health and safety management framework, vulnerability pertains to risk consequence analysis. This concept originates from the idea that risk is the production of hazard and vulnerability. This research seeks to make contributions to the body of knowledge by identifying vulnerable measures of health and safety on confined building construction sites. The study was limited to some selected 15 construction firms in Kariakoo and Posta, Dar-Es-Salaam, Tanzania. A sample of 15 case studies, was selected using purposive sampling technique. The findings of the study were analysed and presented using descriptive statistical methods. The study revealed that, confined building construction sites are situated with so many occupational hazards which may result into greater risk consequences making them more vulnerable to health and safety; workplace Occupational Health and Safety policies and procedures on confined building construction sites are not adequate; workers' awareness of workplace Occupational Health and Safety rights and responsibilities on confined building construction sites is not adequate; and workers are not empowered to participate in health and safety workplace policy formulation on confined construction sites. Conclusions and recommendations were made towards the accomplishment of the research objectives. The study concluded that vulnerability of health and safety on confined construction sites in Tanzania construction industry is due to inadequate Occupational Health and Safety policies in the workplace, unawareness of workers of their rights and responsibilities and workers not being involved in workplace policy formulation. It is recommended that the government should amend the existing construction industry policy to incorporate specific provisions about health and safety issues on confined construction sites, amend/reformulate the existing Occupational Safety and Health Act of 2003 to add new policies specifically for occupational health and safety on confined construction sites, establish Health and Safety Executive(HSE) department within construction organisation. For construction firms, it is recommended formulation of written workplace policies and procedures, formulation of Health and Safety Executive(HSE) department and sufficient allocation of budget for health and safety issues only. Lastly, is for workers to ensure cooperation that workers must oblige fully with the employer in any step that employer takes or proposes in order to ensure safety.*

Keywords: Vulnerability, Measures, Health and Safety, Confined Sites, Dar-Es-Salaam, Tanzania

1. Introduction

Tindiwensi,(2000),[60], reports that; on reviewing the construction industry in the modern era, there is an increase on development and Brownfield reconstruction within urban site environments, and the practice is quickly becoming the norm in the industry. Besides, Bidy,(2009),[8], researchers have shown that urban centers are not expanding outwards towards green field sites, but are being redeveloped from within. Even, Singer,(2002),[54], underlines that; in the inner city, confined site building construction is quickly becoming customary in today's construction industry. According to Pinfold & Fapohunda,(2014),[49], confined space, congested access, and the proximity of an over-crowded public place pose challenges when it comes to inner city construction. The continued growth of inner city construction coupled with the mounting costs of land in the urban centers puts pressure on inner city construction management. The complex nature of construction in urban centers requires innovative methods for site management. Thus, many construction firms in South Africa are required to be innovative and strategic when it comes to improving building production processes in confined sites.

Also, due to the increased complexity of construction

projects coupled with the increased spatial restrictions present on-site (Remington & Pollack,2007),[51], effective management of onsite personnel is one of the most costly resources, is essential due to a significant percentage attributable to a projects overall cost, attributable to the personnel on-site[71]. Again, the personnel as per Egan,(1998),[20], are one of the most important and prominent resources in construction industry requiring effective management, and they must be protected against occupational injury, illness, and workplace fatalities which have recently become important public health concerns. Globally, 2.3 million deaths a year, are attributed to occupational injury or work-related diseases, (ILO,2014), [36], in which Boden et al.,(2001),[10], reports that; the consequences of work-related injury and illness extend beyond individual workers, exacting important social and economic costs from families, businesses, and economies. In conjunction with other factors, a limited spatial environment has been identified as one of the core contributing attributes resulting in accidents on-site,[35]. One such environment which excels in this regard is that of urban, inner city, confined construction sites caused by the continued development of urban, inner cities along with the verticalisation and modernisation of existing structures,[25]. The prevalence of such confined site environments is set to

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continue for the foreseeable future,[64],[65]. Atkins,(2003) & Winch,(2010),[7],[71], affirms that; with confined site construction, one of the core attributes is the intrinsic lack of space in which project management professionals, must successfully manage and deliver projects, while site operatives must carry out activities safely. The effective management of this inherently hazardous environment is essential and therefore, appropriate strategies must be identified to enable its effective management by site management professionals. Identifying appropriate strategies in the supervision of an inherently diverse and problematic environment such as that of an inner city confined construction site, on-site professionals can strive to achieve an unblemished health and safety record particularly with regards to the construction of complex structures within a spatially limited environment.

Moreover, hazards that a worker is exposed to, are linked to their risk of work injury. Keyserling & Smith,(2007),[38], reports that; general acceptance that lead to increased risk of injury are broader than simply unsafe conditions in the workplace and unsafe actions taken by workers. Vulnerability assessment is one of the constituent pieces of risk assessment, and is used to support risk management decisions; and it is meant to identify system's weaknesses. This study defines vulnerability as exposure to on-the-job hazards in conjunction with inadequate access to resources to mitigate the effects of these hazards. Specifically, this study explores how three interconnected but conceptually distinct types of vulnerability are associated with work characteristics. The three types of vulnerability examined arise from protective Occupational Health and Safety(OH&S) policies and procedures, awareness of employment rights and responsibilities, and empowerment to participate in workplace policy formulation on confined construction sites. This work has the potential to contribute to the development of more appropriately tailored primary vulnerability prevention initiatives for health and safety on confined construction sites. Mosha & Mosha,(2012),[46], also outlines that; Tanzania's construction industry has been, and continues to experience a considerable growth in construction activities especially in Dar-Es-Salaam, in which there is an increased development in the inner city. As a result, spatially restricted environments enhance propensity for increased accidents and incidents.

1.1. Problem Statement

It is the requirement in all countries, to have a safe construction and healthy working environment in the building construction industry. The issue becomes particularly difficult with confined sites, which are characterized with spatial restrictions that result into adverse working environment for personnel and operations of other resources. Spillane at el,(2011),[58]; reports that; several critical issues regarding health and safety on confined building construction sites have been highlighted, and they include; lack of space, increased management of personnel and overcrowding of the workplace, which imply to greater possibility of risks. These issues prompts the need to work on vulnerability of health and safety on confined sites. Within the health and safety

management framework, vulnerability pertains to risk consequence analysis. Though there are common similarities on vulnerability measures taken in building construction sites, managing or dealing with vulnerable confined building construction sites is more challenging compared to unconfined building construction sites.

This study therefore focuses on identifying vulnerability measures of health and safety on confined building construction sites, through identifying the common vulnerable health and safety hazards on confined building construction sites; exploring the adequacy of workplace OH&S policies and procedures on confined building construction sites; evaluating the adequacy of workers' awareness on workplace occupational health and safety (OH&S) rights and responsibilities in confined building construction sites; examining workers' empowerment to participate in health and safety workplace policy formulation on confined building construction sites; and suggesting vulnerability measures to improve occupational health and safety(OH&S) on confined building construction sites in Dar-Es-Salaam, Tanzania. Kariakoo and Posta Areas in Dar-Es-Salaam were used as case studies, due to being one of the most confined area. The study will promote and help to expose, the unsafe practices on confined building construction sites in Dar-Es-Salaam, Tanzania, as well as create health and safety awareness, alongside being beneficial to the building construction industry in Tanzania for the actors such as architects, quantity surveyors, civil engineers, project managers, main building contractors and regulatory bodies.

2. Literature Review

The Literature review on vulnerability measures of health and safety on confined building construction sites in Tanzania, base on findings from past research works, books, journals, and seminar papers; gives a brief understanding on the meaning key terms like; confined site; health; safety; risk; hazards; confined site construction; and vulnerability concept, as far as the study is concerning. It also gives a brief understanding on occupational accidents and diseases report in Tanzania; as well as health and safety on confined building construction sites. Furthermore, it enlightens on the conceptual framework of the Occupational Health and Safety(OH&S) vulnerability, detailing; the types of hazard potential faced by the workers; safety policy; workplace/organisation vs. level of protections and policies; workers' awareness on occupational hazards; rights and responsibilities of employees in health and safety issues; workers' empowerment to participate in workplace policy formulation; and how to mitigate vulnerability. The literature also points out the health and safety legislations in Tanzania, featuring the Occupational Safety and Health Act of 2003; the Contractor's Registration Board Act of 1997 amended in 2010 (CRB); and the Construction Industry Policy of 2003. Additionally, it details more on concept of health and safety measures. Finally, it gives the measures on promoting occupational health and safety, on vulnerable confined building construction sites.

2.1 Confined Sites

Spillane et al.,(2011),[58], defines a confined building construction site; as a site where permanent works fit the site footprint, extending to levels above and/or below ground level, leaving spatial restrictions for other operations (e.g. personnel, plant and material movements, materials storage and temporary accommodation etc.), and it requires effective resource co-ordination beyond normal on-site management input. Most confined building construction sites, have no storage facility, office accommodation, latrines, area for plants, and even circulation space. They are gradually obtained as the new building arises. Section 2.6 further elaborates on how features of confined building construction sites jeopardize efforts to minimize vulnerable Occupational Health and Safety(OH&S) hazards.

2.2 Confined Site Construction

Confined site construction differs from standard, spatially unrestricted construction projects mainly due to one characteristic –space. In the case of confined site construction, this environment is different. Inner city, urban developments are often characterised by the lack of space in which project management professionals must successfully construct often intricate structures, with little room to safely co-ordinate the works. Tindiwensi,(2000),[60], reports that; in the vast majority of cases, the building structure occupies the majority of the site, leaving limited space to accommodate the various activities and facilities required to complete the project work. Moreover, Spillane et al.,(2009), [58], affirms that; confined building construction sites varies against the unconfined building construction sites by having less health and safety. With regards to research on health and safety, the vast majority of literature reviews the topic in relation to spatially enriched construction site environments, (Haslam et al., 2005),[26],. In such cases, the vast majority of research fails to adequately develop strategies to mitigate the problems prevalent,[41]. Again, Lambeck & Eschemuller, (2008),[41], reveal some of the problems associated with health and safety on confined construction sites but the overall result lacks solutions on how to effectively resolve the issue.

2.3 Health

Health is the general condition of a person in mind, body and spirit, usually meaning to be free from illness, injury or pain. WHO,(2006),[72], defines health in its broader sense in 1946 as "a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity". In this study health means being free from injury or pain which can be caused by building construction activities.

2.4 Safety

Safety is related to external threats, and the perception of being sheltered from threats. According to the business dictionary, safety is defined as a relative freedom from danger, risk, or threat of harm, injury, or loss of personnel

and/or property, whether caused deliberately or by accident. Safety can also be defined as the control of recognized hazards to achieve an acceptable level of risk. In this study, safety means freedom from danger, harm, and injury to the person involved in construction activities.

2.5 Risk

According to Haimes,(2009),[24], risk is traditionally defined as a measure of the probability and severity of adverse effects. The general concept of all definitions of risk provides that risk is a danger of unwanted and unfortunate events. For the purpose of this study, risk is a probability of occurrence (likelihood) of an event and the magnitude of its consequence,[45].

2.6 Hazards

A hazard is the potential for harm. In practical terms, a hazard is often associated with a condition or activity that, if left uncontrolled, can result in an injury or illness. HSE,(2004),[30], define hazard as any source of potential damage, harm or adverse health effects on something or someone under certain conditions at work. Basically, a hazard can cause harm or adverse effects (to individuals as health effects or to organizations as loss of property or equipment). In this study, hazard means anything which has the potential to cause harm to people on construction sites.

2.7 Vulnerability Concept

Crichton,(1999),[16], defines risk; as the probability of a loss, which depends on three elements: hazard, vulnerability and exposure. Changing any one of these three elements changes the risk consequence. According to Agarwal & Blockley,(2007),[1], risk is the production of hazard and vulnerability. To illustrate, hazard is the earthquake, exposure is the facility on earthquake zone and vulnerability changes due to the design, construction and maintenance of the facility. It is clear that the combination of a hazard with a vulnerable system results in disasters. Ezell,(2007),[22], narrates that; vulnerability is often confused with risk. However, vulnerability concept has several distinctions from risk and management of vulnerability is based on a different perspective than the traditional risk management. Vulnerability is the concept of being susceptible to a risky situation, whereas risk is used for defining the severity of consequences within a scenario. Brooks,(2003); Ezell,(2007), [11],[22], highlights that; while risk management is applied to estimate the likelihood and consequences of risks, vulnerability management is used to define the characteristics of a system that will change the possibility for harm. Likewise, Zhang,(2007),[73], accounts that; project vulnerabilities exist before the occurrence of risk events, but they will not become significant until the risk event occurs. For instance, the existence of an escalation clause will not become momentous until there is a change in inflation. Vulnerability is a function of internal properties of a system. In spite of not being a function of severity and probability of occurrence of a risk event, some characteristics of a system will make it more vulnerable to certain risks,[11]. For

example, if the project's construction technology is complex and if the company does not have enough experience than the risk of project, failure will be high.

Table 2.01: Definition of Vulnerability in the Literature

SN.	Author(s)	Definition
01.	Agarwal & Blockley, (2007),[1]	" Vulnerability is a particular form of hazard- a hazard which is internal to the system".
02.	Allen,(2003), [4]	Vulnerability refers to "the set of socio-economic factors that determine people's ability to cope with stress or change".
03.	Blaikie et al. (1994), [9]	Vulnerability is "the combination of characteristics of a person or group in terms of their capacity to anticipate, cope with, resist, and recover from hazard impacts that threaten their life, well-being and livelihood".
04.	Buchanan, (1991), [12]	" Vulnerability refers to the scale and complexity of the problems facing the project manager, the degree of uncertainty and risk involved, and to the anticipated degree of contention and resistance which the change is likely to generate".
05.	Alwang et al.,(2002),[5]	Vulnerability is "the probability of experiencing a loss in the future relative to some benchmark of welfare". " Vulnerability refers to the relationship between adverse results, risk, and efforts to manage risk".
06.	Buckle et al.,(2001), [13]	" Vulnerability is a measure of the exposure of a person to a hazard and indicates the type and severity of the damage that is possible".

Source: Author,(2017).

In this study, the "vulnerability" term is used to describe all the factors that make the system more susceptible to damage in case of a risk occurrence and risk consequence is accepted as a function of event risk and vulnerability.

2.8. Occupational Accidents and Diseases Report in Tanzania

An Occupational Health and Safety (OH&S) audit conducted in Tanzania in 2012 revealed that fatality rates differ sector-wise ranging between 0.12% to 24%, the construction sector being the lead, followed by transport and mining. URT,(2015) asserts that; most construction projects in Tanzania were observed to be below standards because of corruption, and this has been the cause of the increasingly frequent building collapses that have occurred in recent years. Diseases and illnesses as a result of occupational hazards are another concern among workers in many workplaces. Moreover, lack of advanced diagnostic tools and expertise worsen the situation. Currently there is no national system in place for recording, compiling, and reporting occupational accidents and diseases. This leads to absence of information to enable implementation of necessary interventions for improving occupational health and safety in the country.

Table 2.02: Fatality rate by Construction sector

SN.	Sector	Total Employed	Number of Fatal Injuries x 1000	Fatal by Rate (%)
01.	Construction or Building	151,600	36	23.73

Source: URT,(2017).

2.9. Health and Safety on Confined Building Construction Sites

On analyzing the various literature available on health and safety on building construction sites, the majority of sources fail to acknowledge the increased managerial burden on health and safety in relation to confined site construction. ILO,(1995),[33], briefly illustrates the potential problems, as a result of working within confined sites, but only gives a concise summary of available strategies. Sanad et al.,(2008), [52], indicates and underlines the importance of an appropriately designed and managed site layout, to ensure that adequate levels of health and safety are reached. This design is mainly illustrated in cases where space is available to all concerned. Again Cooke & Williams,(2004),[15], highlights the importance of an effective and well-designed building construction site layout, but give little emphasis of the importance of such practices in confined site locations. Furthermore, Leung & Tam,(2010),[43], indicates the importance of the site characteristics in relation to numerous points, one of which is the safety of those on-site and the resulting management of this parameter.

Other such instances where health and safety issues arise are due to the close proximity in which personnel have to work, [57]. Overcrowding of the workplace can be a risk factor, particularly in cases where the programme of works is accelerated or already congested. HSE,(2003),[28], identifies over-crowding of building construction sites as a major factor, and that better management is essential to overcome this issue. In external research commissioned by HSE,(2009), [29], it furthers this point by highlighting that poor co-ordination can cause over-crowding on building sites which can result in operatives sustaining trips and falls in the workplace. As a result, it can be concluded that there is a vast amount of literature on health and safety on-site, but little information regards confined building construction sites and the increased risk posed to employees and the associated public. On a number of occasions, a number of pieces of literature have identified key facets with regards to confined site construction but failed to delve into the core issues pertaining to the relevant context in review. Thomas et al.,(2005),[61], identifies the importance and resulting consequence of over-crowding at work. Also Sowman,(2006) [57], identifies the importance of over-crowding. Therefore, on reviewing the literature on the subject, a number of authors identify numerous issues which relate to confined site construction but each fail to relate and discuss the resulting issues within this particular context.

2.10. A Conceptual Framework of Occupational Health and Safety (OH&S) Vulnerability.

The assumption in developing a conceptual framework of Occupational Health and Safety(OH&S) vulnerability is that the dimensions that lead to workplace injury (increased OH&S vulnerability) are broader than simply unsafe conditions in the workplace and unsafe actions taken by workers, [38]. As such, the following are conceptualized and related dimensions, as the key features of the concept of OH&S vulnerability.

2.10.1. Types of Hazard Potential Faced by the Workers

A hazard is generally defined as a source of potential damage to a worker. Various researchers have divided health and safety hazards into two categories, namely the physical injury hazards and the ill-health hazards,[48]. Hazard of physical injury include death consequences. Murie,(2007),[48], insists that; hazard of ill-health can only be notified after a long period and shall cause sickness or death after a certain period of time. Generally workplace hazards are categorized into six groups as indicated in the table below;

Table 2.03: The six(06) types or groups of hazards

SN.	Types of Hazards	
01.	Mechanical Hazard	Confined space, equipment related injury, slips & trips, falls from height, falling on a pointed object
02.	Physical Hazard	Noise, vibration, magnetic fields, lightning, electricity, radiation,
03.	Biological Hazard	Bacteria, Virus, insects, animals, birds, plants, animals, humans
04.	Chemical Hazard	Acids, bases, explosives, heavy metals, particulates, ignitable, fumes
05.	Psychosocial Hazard	Stress, violence, bullying, sexual harassment, mobbing, burnout,
06.	Ergonomic Issues	Musculoskeletal disorders, improper setup of workstation, repetitive movements,

Source: Canadian Center for Occupational Health and Safety(OH&S),(2009).

The following are common hazards on building construction sites irrespective of the physical injury or ill-health problems. In the building construction sites, workers are often exposed to hazards such as manual lifting, carrying or pushing items heavier than 20kg at least 10 times during the day, doing repetitive movements with hands or wrists at least 3 hours during the day, performing work tasks or using work methods with which workers are not familiar, interacting with hazardous substances such as chemicals, flammable liquids and gases, working in bent or twisted or awkward work exposure, working at heights above the ground, working in noise levels that are so high that you have to raise your voice when talking to people less than one meters away and experience being bullied or harassed at work.

2.10.2. Safety Policy

Hassanein,(2007),[27], presented the results of a postal survey of contractors in Singapore, in which the findings revealed that; "site accidents are more likely to happen when there are inadequate company policies". The health and safety policy statement should contain the aims which are not

measurable, and objectives which are measurable of the organization or company. Aims will probably remain unchanged during policy revisions, whereas objectives will be reviewed and modified or changed each year. The statement should be written in clear and simple language so that it is easily understandable,[32]. The following points should be included or considered when a health and safety policy statement is being drafted; the aims should cover health and safety, welfare and relevant environmental issues, the position of the senior person in the organization or company who is responsible for health and safety (normally the chief executive), the names of the health and safety adviser and any safety representatives, a commitment to the basic requirements of the health and safety at work Act (access egress, risk assessments, safe plant and systems of work, use handling, transport and handling of articles and substances, information, training and supervision), using a safety committee or plant council and specific policies of the organization (violence to staff).

Muiruri, & Mulinge,(2014),[47], states that; site managers should have a written safety policy for their enterprise setting out the safety and health standards which it is their objective to achieve. The policy should name the senior executive who is responsible for seeing that the standards are achieved, and who has authority to allocate responsibilities to management and supervisors at all levels and to see they are carried out. Construction safety policy therefore is something that must be developed by each site manager and operating company prior to starting any construction job. Once developed the development safety plan should be placed into a training program that's needed to be participated in by every site worker previous to partaking in any job found on the positioning irrespective of the roles simplicity. The absence of site meetings as established in the study implies that workers are not given a forum learn about various risks on the sites and supervisors equally do not have opportunities to communicate important health and safety matters to the workers. Site meetings are one of the ways of sensitizing workers on their health and safety in the site and should therefore be held frequently.

2.10.3. Workplace/Organisation-Level Protections and Policies

This dimension deals with workplace-level procedures in place to protect workers. It acknowledges that, understanding Occupational Health and Safety(OH&S) risk needs to take into account both the potential for, and protection from exposures occurring within the workplace,[42]. Examples include the systematic delivery of training on OH&S and worker rights, the labelling of hazardous materials within the workplace, the provision of safety equipment (e.g. safety guards for machines or personal protective equipment) and procedures to identify and replace defective equipment and collect and act on information about near miss incidents. This dimension would also include specific policies or supports that address power differentials within the workplace such as the presence and effectiveness of OH&S or representative within the workplace, or the active collection of OH&S concerns from employees.

2.10.4. Workers' Awareness of Occupational Hazards

Ajzen,(2002),[2], narrates that; based on theoretical framework in health behaviour research, awareness is a key component of motivation to engage in health enhancing behaviours, or avoid unhealthy behaviours. As such, when workers are made aware of the hazards in their workplace, this will – in part – likely serve as a motivator to use personal safety protections (e.g. if workers are not provided with information on why or when safety protections should be used, it is unlikely they will use them, even if they are regularly made available). Further, increased knowledge of legislated rights and responsibilities related to Occupational Health and Safety(OH&S) among workers, and supervisors has been suggested as an important factor driving management and workers collaborations to improve OH&S and reduce injuries.[21]. Examples of this dimension include if workers feel they are aware of the hazards involved in their job as well as those within their workplace.

2.10.5. Rights and Responsibilities of Employees in Health and Safety Issues

Downey et al.,(1995),[18], identifies the following as employees' basic rights under the joint responsibility model; The rights to know about workplace safety hazards, the right to participate in the occupational health and safety process; and the right to refuse unsafe work if they have "reasonable cause" to believe that the work is dangerous. "Reasonable cause" usually means that a complaint about a workplace hazard has not been satisfactorily resolved, or a safety problem places employees in immediate danger. If performance of a task would adversely affect health and safety, a worker cannot be disciplined for refusing to work.

2.10.6. Workers' Empowerment to Participate in Workplace Policy Formulation

This dimension deals with an individuals' capacity to protect themselves from hazards at work. Examples include if workers feel to make suggestion about workplace health and safety policies, if they are often asked for inputs in workplace health and safety policies, able to correctly use provided protective equipment (equipment fit, instructions for use etc.), if they feel empowered to refuse unsafe work, or if they feel they can ask questions to their employer about perceived hazards in the workplace. Although, these dimensions are related to each other, it is clear that, they are conceptually distinct and important to measure separately. For example, two workers may be exposed to the same level of hazard potential, but if one is employed in a workplace with active policies and procedures to control these hazards they would be less vulnerable to workplace injury. According to Occupational Health and Safety(OH&S) vulnerability is defined as the exposure to workplace hazards, in combination with inadequate workplace policies and procedures and/or low OH&S awareness and/or a workplace culture that discourages workers' participation in policy formulation. While it is acknowledged that, measures are currently available that capture elements on each of these dimensions (e.g. available measures of safety climate often capture information on workplace policies and procedures), the uniqueness of this measure is that, it seeks to measure these

dimensions separately, and then combine these dimensions to better understand OH&S vulnerability.

2.11. Reducing Vulnerability

Reducing vulnerability is an important way of managing risk, but any reduction in the impact of a risk is not related with reducing the vulnerability of system. Sarewitz et al.,(2003); Agarwal & Blockley,(2007),[53].[1], narrates that; risk response strategies developed through a risk-based approach will be enough to cover the cost of extreme events, however the success of this application does not depend on reduction of vulnerability, For example, theft of materials at site will cause both time and money loss. Insurance, as a risk response strategy, will prevent cost overrun. However, insurance will not change the vulnerability of system. Vulnerability can only be reduced by improving site conditions, such as building secure storages at site. It is a fact that, the relation between risk and vulnerability is not inter-changeable. In other words, reducing vulnerability will always reduce risk outcomes, however reducing the risk outcomes will not always mean reduced vulnerability,[53]. Besides, Zhang,(2007),[73], insists that; a vulnerability parameter cannot generate a risk consequence without a risk event, however, a risk event may lead to a risk consequence on its own. Vulnerability is the condition or inherent characteristic of a system which influences the amount of damage. For example, project size will not cause any risk. However, in case of any change in quality of a material, project size will change the degree of cost overrun.

2.12. Health and Safety Policy and Legislations in Tanzania

Tanzania has had several initiatives on preparing, and enacting the policy and legislations enlightening on health and safety issues, as indicated below:-

2.12.1. The Construction Industry Policy of 2003.

URT,(2003),[66], stipulates in the part of performance constraints that; the inefficient and deteriorated state of the construction industry with poor performance has detrimental effects to the development of the industry. Weaknesses, problems and constraints hampering the performance and development of the industry include; Poor working environment, including low standards of safety and occupational hazards on construction sites; as well as Weak and non-facilitative policies and regulatory framework. The policy direction insists on promoting the application of technologies and practices, which are cost effective and affordable having, regard to poverty eradication, environmental protection, human health and safety, and the special circumstances of vulnerable groups.

2.12.2. The Occupational Safety and Health Act of 2003.

URT,(2003),[68], reports that; the Occupational Health and Safety Act 2003 is the main legislation governing occupational health and safety practices in Tanzania. It requires all workplaces to be registered under OSHA so that they can be identified and recognised (section 16(1) and rules section 5 (1)). The act requires all employers (the employer is

the contractor) to conduct risk assessment and communicate to workers what hazards exist and the control measures. Employers are also required to provide welfare facilities such as sanitary, convenient and safe drinking water, washing facilities, places for sitting and first-aid facilities. It requires all organisations to have in place an effective health and safety policy, to appoint health and safety officers and workers' health and safety representatives at workplaces with more than 20 employees, and to establish health and safety committees where there are more than 50 employees. The Act requires employers to conduct thorough pre-placement, periodic and exit occupational medical examinations for fitness of employment. The Act also has a penalty if one does not follow the regulations, such as a fine less than five million Tanzanian shillings or imprisonment for a term not exceeding six months. In case of death or serious injury, because of default by the employer, he/she is liable to a fine of not less than TZS 10,000,000/= equivalent to USD 6250/= or imprisonment for a term not exceeding two years or both.

2.12.3. The Contractor's Registration Board Act of 1997 reviewed 2010.

URT,(2010),[67], narrates that; the Contractor's Registration Board (CRB) was established by section 3 of the Contractors Registration Act No.17 of 1997 in Tanzania, which was amended and new act was formulated in 2010. The mission of CRB is to regulate and develop a competitive and sustainable contracting industry with capable contractors who deliver quality work and observe safety when pursuing economic growth. The key functions of the board are to register, regulate and promote the activities and conduct of all contractors in Tanzania. Clause 4(m) of the Contractors Registration Act, 2010 that established the Contractors Registration Board clearly mentions that one of the functions of the board is to ensure that all construction sites have health and safety procedures it is a requirement that the construction project must be registered under the CRB. The act requires all construction sites to be boarded, all employers to maintain at every construction site an accident register book, in which all accidents and incidents are recorded, to provide appropriate safety gear to every person on site, to provide fire-fighting equipment on site and to provide welfare facilities such as clean, safe and sufficient drinking water, water for washing, toilets and changing rooms. The Act also provides a penalty if one does not follow the regulations on health and safety.

2.13. Concept of Health and Safety Measures

According to Murie,(2007),[48], health is an employee's freedom from physical or emotional illness. The provision of any health program will vary according to the location and size of the organization, the kind of work performed, and whether employees include women as well as their proportion in various age brackets. Furthermore, Reese,(2003),[50], asserts that; an ideal health program would include the following features; stated health and medical policy, adequate health facilities according to size and nature of the organization which may include first aid and an emergency dispensary, a registered nurse and a doctor or part time services of a doctor, medical consulting services

periodic examination of employees exposed to health hazards in and out patient schemes, medical insurance covers for immediate defendants. Additionally, Armstrong,(2010),[6], claims that; safety is the protection of employees from injuries due to work related accidents. These accidents are unplanned and uncontrolled events which can result in damage both human being and property. Since organizations provide the work and the physical plant, office, or establishment, it should be committed to doing everything either reason to protect employees from risks associated with spending their working days in those premises.

Under OSHA, employers must keep records of any occupational injury and illness resulting in death, lost work time, or medical treatment and retain these injuries and illness must be recorded on OSHA forms and posted annually on an employee bulletin board for all to see. These records must also be made available to OSHA compliance officers, and annual summaries must be prepared. According to Dessler,(2008),[19], OSHA primary responsibility for enforcing OSHA rules and regulations is to develop occupational standards, grant variances to employers, and conduct workplace inspections and issues citations and penalties. According to ILO,(2011),[34], a hazard is the intrinsic property or potential of a product, process or situation to cause harm, adverse health effects on someone or damage to something. It can come from a chemical (intrinsic properties), working on a ladder (situation), electricity, a compressed gas cylinder (potential energy), a fire source or more simply a slippery floor. Risk is the likelihood or probability that a person will be harmed or experience adverse health effects if exposed to a hazard or that property will be damaged or lost. The relationship between hazard and risk exposure, whether immediate or long term needs to be ascertained.

2.13.1. Measures to Promote Occupational Health and Safety

Hinze & Raymond,(2003),[31], details that; a safety performance measure is only appropriate when it prevents injuries from occurring at the construction site. Also Fang et al.,(2004),[23], asserts that; an effective management should be employed to ensure safety performance at construction sites. It is revealed that onsite health and safety management is essential in identifying major hazards relating to construction work. Lingard & Rowlinson,(1998),[44], tales that: a behaviour based methodology to health and safety management has been promoted by many researchers and has been confirmed to improve effectively the performance of safety in industrialised settings.

Toole,(2002),[62], proposed that; there should be a balanced agreement regarding the role of designers, contractors, engineers, consultants and subcontractors in ensuring safety at the construction site. Proper assignments of responsibilities should depend on each personnel's ability to improve safety control measures. Hinze & Raymond,(2003),[31], posited that; a survey should be conducted on the perception of workers and management on the safety of construction project. Sorensen et al.,(2007),[56], insists that; innovative methodologies are needed for the promotion of health and

safety at the worksite. He added that novel approaches will be particularly suitable for workers who often change their jobs and thus have inadequate access to promotional health and safety initiatives.

3. Methodology

The methodology and research design used in this study was case study survey, in which apart from literature review; instruments like questionnaire and interview were used by approaching various building contractors and their workers carrying out building projects in Kariakoo and Posta areas. The case study was employed because it can bring an understanding of a complex issue or object, and extend experience or add strength to what is already known through previous research, and it emphasize detailed contextual analysis of a limited number of events or conditions and their relationships. This study is limited to the occupational health and safety in confined building construction sites; its features, awareness, policies, procedures, workers employment rights and responsibilities in the workplace particularly on confined building construction site in Dar-Es-Salaam, Tanzania. It covered building contracting firms. The study was carried out in Dar-Es-Salaam, Tanzania due to time limit; financial difficulties; and majority Building Contractors Firms being located in the region. The study considered only the local building contractors registered under Class I to Class V. Furthermore, the information regarding to local building contractors was collected from Contractors Registration Board(CRB).

3.1. Data Collection Methods

In general the data collection process through this method was quite successful. Multiple sources of evidence were used to collect data. Literature was reviewed to determine the vulnerability measures of health and safety on confined building construction sites in Tanzania as detailed in the literature review part. Moreover, questionnaire survey was used to collect primary data from CRB, local building contractors, building construction workers, in which the respondents answered the questions on their own,[63]. Some of the questions were close ended and others were open ended to the respondent to attest their own opinion, and give more information. Furthermore, secondary data concerning the vulnerability measures of health and safety on confined building construction sites, was collected from literature review via published and unpublished books, journals, articles and papers. The questions were on seeking on the views on the common hazards on confined building construction sites; vulnerability of confined building construction sites, to health and safety hazards in comparison to ordinary building construction sites, and its mitigation measures; occupational health and safety policies and systems; rights and responsibilities of both employees and employers in confined building construction sites; workers' participation in health and safety policy formulation; and awareness of occupational health and safety issues on confined building construction sites. All respondents had different years of experience in the construction industry.

3.1.1. Questionnaire Design

In this study, the questionnaires were prepared in accordance with objectives of the research. The questionnaire was divided into three parts which covered for both building contractors and construction workers; first part requested on general information about respondent, second and third part were split into two, for building contractors and building construction workers, focusing on common hazards on confined building construction sites; efficiency of health and safety trainings provided to building construction workers; vulnerability of confined building construction sites, to health and safety hazards in comparison to ordinary building construction sites, and its mitigation measures; occupational health and safety policies and systems; workers' participation in health and safety policy formulation; and awareness of occupational health and safety issues on confined building construction sites. Through a quantitative approach, data used were acquired with a questionnaire survey, in which the closed ended questionnaire was compiled based on the refined list above, after a pilot study. Closed-ended questions were used as they are very convenient for collecting factual data and are simpler to analyze because the range of potential answers is limited,[3]. However, open ended questions were also incorporated to get further opinions from respondents. The pilot study was carried out to mark better the quality of the questionnaire and improve reliability of the questions.

Through using a 5-point likert scale, and by using Kothari,(2004),[40], writings in scaling; the respondent was asked to respond to each of the statements in terms of several degrees, normally five degrees. The ratings used were depending on the data needed, whereby most of the questions used, Strongly Disagree(SD)=1; Disagree (D)=2; Neutral(N)=3; Agree(A)=4; Strongly Agree(SA)=5; with only views on the common hazards on confined building construction sites using Not Frequent(NF)=1; Less Frequent (LF)=2, Neutral (N)=3; Frequent(F)=4; Highly Frequent (HF)=5 and extensive mitigation measures on the vulnerability of health and safety on confined building construction sites, using Highly Insignificant(HI)=1; Insignificant(I)=2; Neither(N)=3; Significant(S)=4; and Highly Significant(HS)=5. This type of scale has been found to be acceptable in other construction management research. Furthermore, respondents were asked to provide their views on vulnerability to health and safety hazard of confined building construction sites in comparison to other ordinary construction sites; the efficiency of health and safety training provided by the employer on confined building construction sites; awareness and availability of the policies on health and safety.

3.1.2. The Case Study Area and Its Selection.

This study focused on selected on-going building construction projects in Dar-Es-Salaam, with the specific study area being Kariakoo and Posta due to having confined areas. Isaac,(2007),[37], reports that; Kariakoo is composed of a high number of developed high density plots, in which the built houses are mainly for business and residential purposes and very few other lands uses. The area is characterized by an increasing number of newly built multi-storey buildings,[37]. On the other hand, Posta area is the administrative district part of the city, where almost all

government offices and ministries are housed. Furthermore, commercial and the residential areas are mainly for middle to high-income, and has the highest concentration of Asian communities. These areas are also famous for hosting most colonial houses and mansions built in Indian, Arabic and European styles.

To unearth the on-site vulnerabilities, various existing confined building construction sites were used as a case study. One key criteria used in the pre-selection of the case studies was the inclusion of the definition for a confined building construction site. Purposive (judgmental) sampling technique was employed for the case study selection process as the most informative, suitable and beneficial case study.



Plate 3.01; The aerial view of Kariakoo, showing the spatial structure and buildings

Source: Moshi,(2015).

This was done because not all construction works operate in confined building construction environment. Each case study was selected due to its complexities, difficulties and overall lack of space, evident on each of the sites assessed. Case studies that fulfilled the criteria were a low rise structures, mid-rise structures and a high rise structures. In each case, the majority of the site were occupied by the building footprint, leaving very little room around the building's perimeter for the accommodation of the various facilities and amenities necessary to project completion.

3.4. The Study Sample

The study required the use of stratified probability sampling for the contractors since the population of contractors in Tanzania is heterogeneous and it is categorized into strata such as class I – VII. The study employed purposive or judgemental sampling technique in selecting the sample. Judgmental or Purposive Sampling which as per Kombo & Tromp,(2006),[39], it is a sampling technique where a researcher purposely selects and target a group of people believed to be reliable for the study such that they can provide the necessary information, assistance and response for the successful accomplishment of the particular study was used. Singh,(2006),[55], defines population as the entire mass of observations, which is the parent group from which a sample is to be formed. Additionally, Kothari,(2004),[40], affirms that; this is a group of individuals, objects or items from which the sample is taken for measurement, and it refers to an entire group of person or elements which have one

thing in common. In this study, the sample population includes all building Contractors from class I – V, in which most visible and easy to reach building contractors were visited for the interview. The interviewees were selected during confined building construction site reconnaissance in the Kariakoo and Posta areas in Dar-Es-Salaam.

According to CRB,(2017), the number of ongoing building projects specifically Kariakoo and Posta, during the study conduction was 39 as seen in Table #1.02. The sample size is proposed to determine what is termed by Kothari,(2004)[40], as precision and confidence rate. Where time and resources allow researcher should take a big sample as possible, the size of sample should be optimum, neither large nor small

Table 1.02; List of Building Contractors within Posta Area and Kariakoo in Dar-Es-Salaam, Under Survey

SN.	Building Contractor	Category	Number
01.	Class I	Local	09
02.	Class I	Foreign	02
03.	Class II	Local	08
04.	Class III	Local	05
05.	Class IV	Local	14
06.	Class V	Local	01
TOTAL			39

Source: CRB,(2017).

3.4.1. Statistical Method

$$\text{Sample size } (n) = \frac{(Z_{1-\alpha/2})^2 p(1-p)}{d^2}$$

Where; $Z_{1-\alpha/2}$ = Standard normal variation (at 5% type 1 error ($P < 0.05$), it is 1.96. As in majority of studies P values are considered significant below 0.05. Hence 1.96 is used in formula

P = Expected proportion in population based on previous study or pilot studies. As for this case, $p = 2.5\%$ of the population = $2.5\% \times 39 = 0.9/100$ approximately 0.00975.

d = Absolute error or precision. Take $d = 0.05$

$$\text{Sample size } (n) = \frac{(1.96)^2 \times 0.00975 (1 - 0.00975)}{(0.05)^2} = 14.8$$

So for this study, the population sample of at least **15** case studies was taken.

Table 1.03; List of Building Construction Firms (Contractors) Surveyed in Dar-Es-Salaam.

SN.	Building Contractor	Category	Number
01.	Class I	Local	03
02.	Class II	Local	03
03.	Class III	Local	01
04.	Class IV	Local	07
05.	Class V	Local	01
TOTAL			15

Source: Author,(2017).

3.4.2. Profile of the Study Respondents

Structured interviews were self-administered for the study whereby interviewees were asked the same questions with the same wording and in the same sequence. The interview consisted of closed ended, fixed choice questions and few

open ended questions which focused on the subject matter and aimed to cover the specific objectives of the research.

The structured interviews were carried out to both employers and employees. A total number of 15 case studies in Kariakoo and Posta in Dar-Es-Salaam were surveyed, and interviews were held with building construction site supervisors (i.e. project managers, site engineers, site quantity surveyors, clerk of works, health and safety officers, site technician and site foremen) and labourers/workers, both skilled and unskilled, making a total of 41 interviews held. About 20% of the building construction contractors contacted belong to Class I; 20% belong to Class II; 7% belong to Class III; 47% belong to Class IV; and 7% belong to Class V of the building construction classification. Furthermore, the percentage of the site supervisors and labourers contacted under this survey, has been illustrated in the form of a Pie chart in figure #3.01 below.

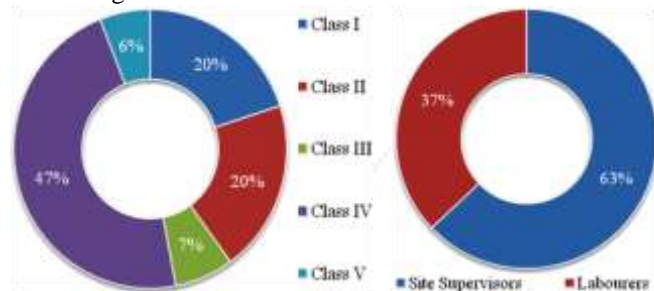


Figure 3.02: (Left) the percentage distribution of various building construction classes contacted during the survey, (Right) the percentage distribution of building construction site supervisors and labourers contacted during the survey, Source: Author,(2017)

4. Results, Analysis and Discussion

Main parameters used for investigation in study included; identifying the common vulnerable health and safety hazards on confined building construction sites; exploring the adequacy of workplace Occupational Health and Safety(OH&S) policies and procedures on confined building construction sites; evaluating the adequacy of workers' awareness of workplace OH&S rights and responsibilities on confined building construction sites; and examining workers' empowerment to participate in health and safety workplace policy formulation on confined building construction sites; which paved the way for suggesting probable possible vulnerability mitigation measures to improve occupational health and safety on confined building construction sites. Data collected, coded, analyzed and presented using Statistical Package for Social Scientists, version 19 (SPSS), Microsoft Word and Excel (Tables, Bar charts and Pie charts) in order to get more accurate computation that mapped out a pattern or relationship between measured or comparable variables.

The study adopted descriptive statistical method where analysis was done based on the frequency of occurrence to analyze the data based on the research questions depending on how the respondents responded to the questionnaires. Analysis on the main parameters was done by Descriptive Statistical Method, to obtain their cumulative means score

and ranking them accordingly . Some of the findings for this study were relatively small data hence the data was analyzed by calculating frequencies and Mean score. The value of cumulative mean score was calculated using the following formula:—

$$\text{Mean Score} = \frac{\text{Ranking} \times \text{Number who chose the ranking}}{\text{Total number of respondents}}$$

Analysis of the data based on the following guide;

Table 4.01: Ranking scale guide for comparison of mean scores

SN.	Intervals of Mean Scores	Responses		
		Level of Agreement	Level of Frequency	Level of Significance
01.	1.00 – 1.5	Strongly Disagree	Not Frequent	Highly Insignificant
02.	1.51 – 2.5	Disagree	Less Frequent	Insignificant
03.	2.51 – 3.5	Neutral	Neutral	Neither
04.	3.51 – 4.5	Agree	Frequent	Significant
05.	4.51 – 5.0	Strongly Agree	Highly Frequent	Highly Significant

Source: Author,(2017).

4.1. Common Vulnerable Health and Safety Hazards on Confined Building Construction Sites

Through observation, the study revealed that; workers on confined building construction sites, work in awkward work posture, due to presence of untidy materials placed within the restricted site environment in areas of wide circulation of workers. This is due to lack of adequate storage space for materials as it appears in plate #3.01.



Plate 4.01: (Left) worker working on a site with untidy hazardous materials; and (Right) hazardous steel material stored untidy within the site, Source: Author,(2017).

Moreover, the study revealed that; workers on confined building construction site, interact with hazardous/dangerous substances such as unincorporated iron sheets, timbers with exposed nails (sinking out nails), cut steel wastes which are placed in the place where people work and thus, it becomes even difficulty for personnel within the site to move around safely and ensure safe getting to and from their area of work as it appears in plate #3.02.



Plate 4.02: (Left) hazardous wooden materials stored untidy within the site; and (Right) hazardous waste materials stored untidy within the site, **Source:** Author,(2017).

Again, the study revealed that; workers on confined building construction sites, interact with heavy plant and machinery such as tower cranes, heavy concrete mixer which occupy the limited space on confined construction sites. Thus, workers work in close proximity to these plant and machinery.



Plate 4.03: (Left) tower crane within confined site; and (Right) large concrete mixer within confined site **Source:** Author,(2017).



Plate 4.04: (Left) falling hazard at height which has been barricaded; and (Right) hazard working at 2 meters or more above the ground, **Source:** Author,(2017).

Furthermore, through observation, the study revealed that; workers on confined building construction sites, work at a height 2 meters or more above the ground for which it may be easier for them to fall from height if they are not provided with proper safety gears. Besides, it was also revealed that; workers on confined building construction sites, work at a height nearby electric posts and transmission lines for which they are vulnerable to electric shocks.



Plate 4.05: (Left) electric transmission lines near the site; and (Right) electric shock hazards due to electrical post near the site, **Source:** Author,(2017).

The study also revealed that, workers on confined building construction sites, work without complete protective clothing/safety gears with regard to the working environment.



Plate 4.06: (Left) lack of protective clothing hazard; and (Right) a worker with protective clothing, **Source:** Author,(2017)

The plate #4.07(right) shows an example of a new confined building construction site, which is surrounded by existing structures in the three sides, and at the front there is a road passing nearby while on the left side, the plate shows "a very busy outdoor environment" outside the confined building construction premises. These kinds of site environments bring about difficulty in the management of on-site traffic.



Plate 4.07: (right) confined construction sites restricted by other existing structures; and (left) outside environment of a confined building construction site, **Source:** Author,(2017).

From the plate #3.07, it was revealed through observation that; confined building construction sites are situated with many hazards which endanger the personnel working within such sites.

4.2. Workplace Occupational Health and Safety(OH&S) Policies and Procedures on Confined Building Construction Sites

Through observation, the study revealed that; building contractors Class III to V, do not have/place written health and safety policies in the main areas, such as main entrances, inside the site areas of untidy materials and objects which actually endanger the personnel within such sites.



Plate 4.08: (Left) entrance gate of a confined building construction site without health and safety policies in the main entrance; and (Right) inside of a confined site without health and safety policies within the site, **Source:** Author,(2017).

Likewise, the study revealed that; high class building contractors like ESTIM Construction Company LTD, have and place written health and safety policies in the main areas such as main entrances inside and outside, health and safety instructions for site visitors, safety statistics boards and safety rules. These policies are written in both Swahili and English for everyone to understand as depicted in plate #4.09.



Plate 4.09: (Left) safety policies outside site compound; and (Right) safety rules within the confined site, **Source:** Author,(2017).

It was therefore revealed that; site with workplace health and safety policies have proper systems of keeping health and safety records, while those without written policies, have no culture of obtaining records about health and safety in the workplace. In the observations all contractors Classes III-V had no written workplace health and safety policies.



Plate 4.10: (Left) safety instructions for visitors; and (Right) safety statistic board within the confined site, **Source:** Author,(2017).

4.3. Common Vulnerable Occupational Health and Safety(OH&S) Hazards on Confined Building Construction Site.

Site Supervisors' Perception;— Through questionnaires, the site supervisors were asked to indicate the level of agreement to hazards that are common on confined building construction sites. The Table #3.01, shows the analysis of the data collected. Where by **TNR** – Total Number of Respondents, and **SD** – Standard Deviation.

Table 4.02; Site supervisors' perception on the descriptive statistic of the common hazards on confined building construction sites in Dar-Es-Salaam.

SN.	Site Supervisors' Perception of Common Hazards on Confined Building Construction Sites	TNR	Mean	SD	Rank
01.	Work at height 2 metres or more above the ground	15	4.73	0.59	01
02.	Do repetitive movement with your hands or wrists for at least 3 hours during the day	15	4.20	1.01	05
03.	Excavating deep trenches	15	3.67	1.05	10
04.	Contaminated land and materials	15	3.27	0.96	14
05.	Protective clothing	15	4.53	0.92	02
06.	Perform work tasks or use work methods that you are not familiar with	15	3.60	1.24	13
07.	Plants and machinery, tools usage	15	4.07	0.46	07
08.	Workers fall from height	15	3.60	0.99	12
09.	Work in noise levels that you have to raise your voice when talking to people	15	4.33	1.11	04
10.	Fire and emergency	15	3.60	0.83	11
11.	Interact with hazardous substance such as chemicals, flammable liquids and gases	15	3.80	1.08	09
12.	Manually lift, carry or push items heavier than 20kg at least 10 times during the day	15	4.13	1.187	06
13.	Electric shock	15	3.87	1.13	08
14.	Work in bent, twisted or awkward work posture	15	4.40	0.91	03

Source: Author,(2017).

The study revealed that; site supervisors agree with all the hazards making up the list in the table above, being common on confined building construction sites (with mean score above 3.51) with an exclusion of contaminated land and

material whose mean score is 3.27 of which most of the site supervisors remained neutral.

Workers' Perception;— Through questionnaires, the workers were asked to indicate the level of frequency to hazards that are common on confined building construction sites. The Table #4.03, shows the analysis of the data collected. Where by **TNR** – Total Number of Respondents, and **SD** – Standard Deviation.

Table 4.03; Workers' perception on the descriptive statistic on common hazards on confined building construction sites in Dar-Es-Salaam.

SN.	Workers' Perception of Common Hazards on Confined Building Construction Sites	TNR	Mean	SD	Rank
01.	Work at height 2 meters or more above the ground	26	4.85	0.61	01
02.	Do repetitive movement with your hands or wrists for at least 3 hours during the day	26	4.65	0.69	04
03.	Excavating deep trenches	26	3.50	1.07	10
04.	Contaminated land and materials	26	3.27	1.15	11
05.	Protective clothing	26	3.92	1.06	08
06.	Perform work tasks or use work methods that you are not familiar with	26	3.65	1.02	09
07.	Plants and machinery, tools usage	26	3.96	0.66	07
08.	Workers fall from height	26	2.54	1.24	12
09.	Work in noise levels that you have to raise your voice when talking to people	26	4.58	0.70	05
10.	Fire and emergency	26	2.00	1.06	14
11.	Interact with hazardous substance such as chemicals, flammable liquids and gases	26	4.15	0.78	06
12.	Manually lift, carry or push items heavier than 20kg at least 10 times during the day	26	4.77	0.43	02
13.	Electric shock	26	2.23	1.18	13
14.	Work in bent, twisted or awkward work posture	26	4.73	0.45	03

Source: Author,(2017).

Again, the study revealed that; workers find most of these hazards frequently in their workplace on confined building construction sites (with mean score above 3.51) with an exclusion of workers falling from height, excavating in deep trenches and contaminated land, and material whose mean score is 2.54, 3.50 and 3.27 respectively of which most of the workers remained neutral. While disagreeing with electric shocks, fire and emergency. Hence, Table #4.02 and #4.03 show clearly that; both groups (workers and site supervisors) agrees with confined building construction sites being subjected to many health and safety hazards, which endanger all personnel working within these sites.

4.4. Are Confined Building Construction Sites More Vulnerable to Health and Safety than Unconfined Construction Sites?

With reference made to figure #4.01, the respondents (site supervisors) revealed that; confined building construction sites are more vulnerable to health and safety with 93% 'Yes'

response; 5% 'No' response; while 2% said they were 'Not Sure'. Hence, confined building construction sites should be considered differently as long as health and safety issues are concerned.

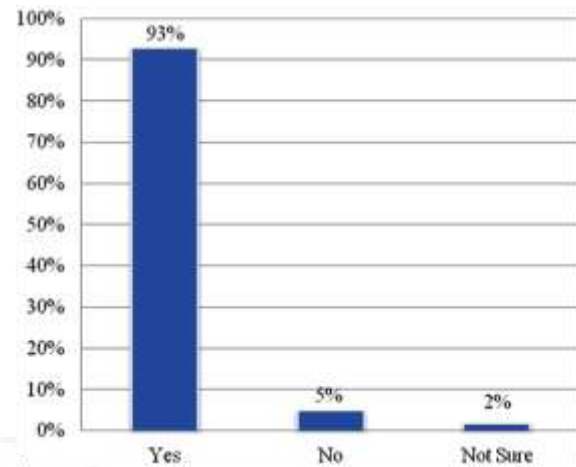


Figure 4.01: The percentage distribution of site supervisor's if confined building construction site are more vulnerable to health and safety than unconfined construction sites, Source: Author, (2017).

4.5 Features/Situations on Confined Building Construction Sites

Through questionnaires, the respondents were asked to indicate Level of agreement to features/situations that are common on confined building construction sites. The Table #4.04, shows the analysis of the data collected. Where by **TNR** – Total Number of Respondents, and **SD** – Standard Deviation. The most common features having the highest mean were identified.

Table 4.04; Descriptive statistic on features/situations on confined building construction sites in Dar.

SN.	Workers' Perception of Common Hazards on Confined Building Construction Sites	TNR	Mean	SD	Rank
01.	Difficulty in ensuring site is tidy and all plants are stored safely	15	4.58	1.08	07
02.	Increased health and safety risk due to various tasks being executed in close proximity to each other	15	3.93	0.96	11
03.	Lack of adequate room for effective handling of material	15	4.53	1.06	06
04.	Difficulty in ensuring proper arrangement and collection of waste materials on site	15	4.53	0.83	05
05.	Lack of adequate space	15	4.67	0.82	03
06.	Close proximity of individuals to operation of large plants and machinery	15	4.00	1.13	10
07.	Difficulty in the management of on-site traffic	15	4.80	0.56	01
08.	Difficulty in ensuring personnel getting to and from their area of work safely	15	4.07	0.96	08
09.	Difficulty to move material around site healthy and safely	15	4.80	0.41	02
10.	Difficulty in positioning	15	4.60	0.83	04

	temporary facilities to avoid accidents from falling heights				
11.	Workplace become overcrowded	15	4.08	0.97	09

Source: Author,(2017).

The study revealed that; site supervisors agrees with all the features/situations making up the list in the table above being common on confined building construction sites, with the evidence seen in the mean scores above 3.51.

4.6. Efficiency of Health and Safety Trainings, Provided to Workers on Confined Building Construction Sites

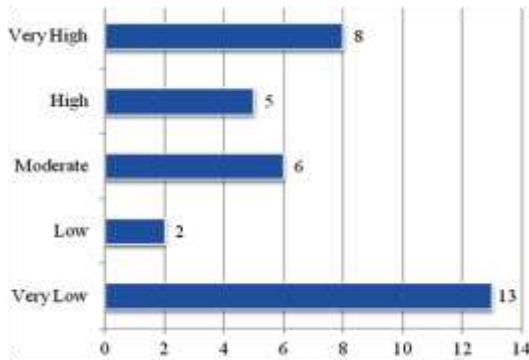


Figure 4.02: The Efficiency of health and safety trainings on building construction sites in Dar-Es-Salaam, Source: Author,(2017).

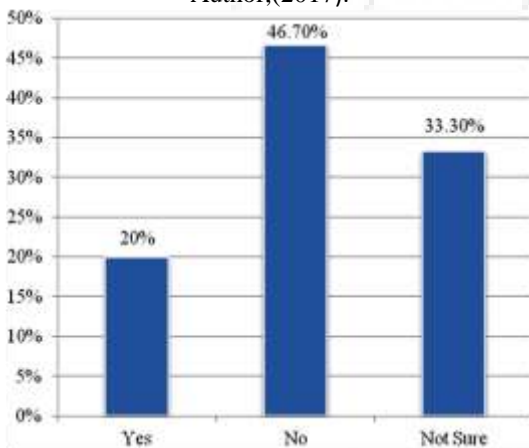


Figure 4.03: The workers' response to health and safety training provided on building construction sites in Dar-Es-Salaam, Source: Author,(2017).

The respondents revealed that; the efficiency of trainings provided to workers on confined building construction sites was very low as seen in figure #4.03. The site supervisors affirmed that; in most cases, trainings are being affected by personal behaviors, lack of understanding and change of casual workers on daily basis.

4.7. Is the Workers Response to Health and Safety Trainings Adequate?

46.7% of the respondents (site supervisors) said "No"; 33.30% said they were "Not Sure", while 20% said "Yes", as indicated in figure #4.04 which indicates the percentage distribution of workers' response to health and safety trainings. This reveals that; the efficiency of health and safety trainings is still poor.

4.8. Adequacy of Workplace Occupational Health and Safety(OH&S) Policies and Procedures on Confined Building Construction Sites.

The awareness of workers to health and safety, its implementation and adequacy on confined building construction sites, was identified as follows.

Awareness of Workers to Occupational Health and Safety Policies on Confined Building Construction Sites;— 38% of respondents said "Yes" and 58% responded "No" while 4% were "Not Sure" as illustrated in figure #4.04(left). This shows that; most of the workers, are not aware of the workplace health and safety policies.

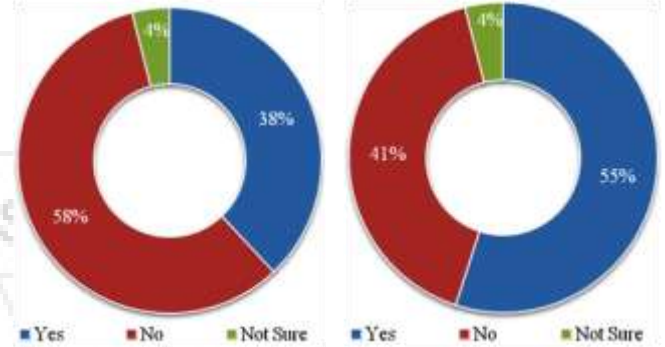


Figure 4.04: (Left) the awareness of workers on health and safety policies in building construction sites in Dar-Es-Salaam, (Right) implementation of health and safety policies in building construction sites in Dar-Es-Salaam, Source: Author,(2017).

Implementation of Occupational Health and Safety Policies on Confined Building Construction Sites;— 55% of respondents responded "Yes", 41% responded "No" while 4% were "Not Sure" as illustrated in figure #4.04(right). This indicates that some of workers see the health and safety policies being implemented but others also do not.

Adequacy of Occupational Health and Safety Policies on Confined Building Construction Sites;— 81% of respondents responded "No", 8% responded "Yes" while 11% were not sure as illustrated figure #4.05. This indicates that; workers are not satisfied with the health and safety policies, being implemented on confined building sites.

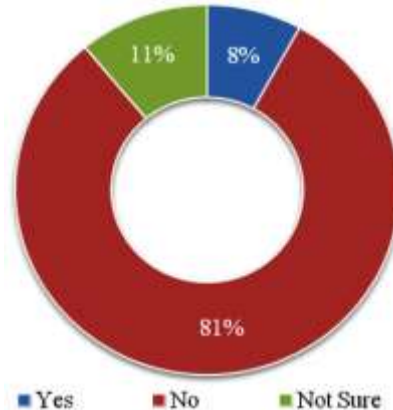


Figure 4.05: The adequacy of health and safety training policies in building construction sites in Dar-Es-Salaam, Source: Author, (2017).

4.9. Adequacy of Workers’ Awareness of Workplace Occupational Health and Safety(OH&S), Rights and Responsibilities on Confined Building Construction Sites.

On establishing the level of awareness of Occupational Health and Safety(OH&S) rights and responsibilities of building construction workers on confined building construction sites, the study revealed as per what is seen in figure #4.06 that; 14 workers strongly disagree, 8 disagree and 3 agree that they are clear about their employers’ rights and responsibilities; 9 workers strongly disagree, 11 disagree and 3 agree that health and safety measures provided by the organisations are adequate; 14 workers strongly disagree, 5 disagree and 6 agree that they are clear about their rights and responsibilities to workplace health and safety; and 23 workers agree that they know the necessary precautions that they should take while doing their job.

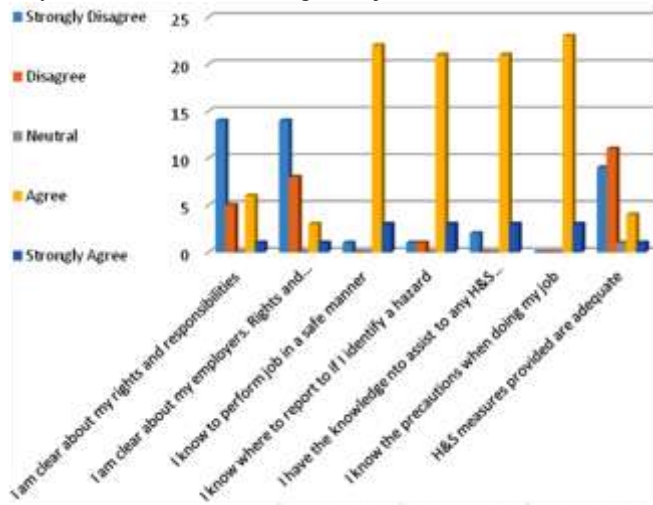


Figure 4.06: The OH&S awareness of rights and responsibilities on confined building construction sites in Dar-Es-Salaam, **Source:** Author,(2017).

Moreover, 22 workers agree that they know to perform their job in a safe manner, 21 workers agree and 2 disagree that they have the knowledge to assist in responding to any health and safety concerns at their workplace and 21 workers agree, 1 strongly agree and 1 disagree know where to report if they identify a health or safety hazard at their workplace. The findings indicate that workers are not clear about their employer’s rights and responsibilities in relation to workplace health and safety, the health and safety measures provided by the organisations are not adequate, they are not clear about their rights and responsibilities to workplace health and safety.

4.10. Examination of Workers’ Empowerment to Participate in Occupational Health and Safety(OH&S) Workplace Policy Formulation

The establishment of the level of workers’ participation in Occupational Health and Safety(OH&S) policies formulation in confined building construction sites, the study revealed as per what is seen in figure #4.07 that; 17 workers strongly disagree, 5 disagree and 3 agree that they feel free to make suggestions about workplace health and safety, 19 workers strongly disagree, 7 disagree that they are often asked for their inputs in health and safety issues, 12 workers strongly

disagree, 9 disagree and 5 agree that there is genuine cooperation over health and safety-a joint effort between all in the organization and 18 workers agree that they warn fellow workers about health and safety dangers. Basically, it was observed that; their participation should not be underestimated, as their involvement plays a greater role in strengthening the management of Occupational Health and Safety(OH&S).

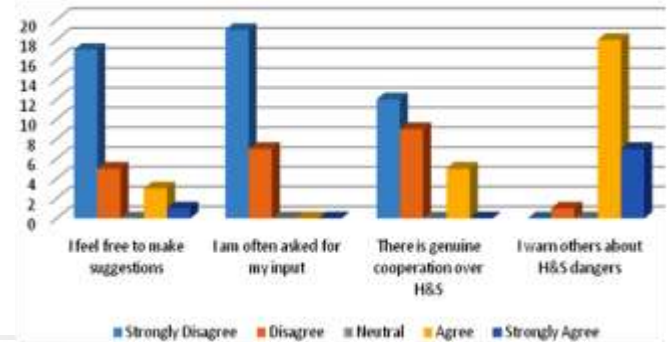


Figure 4.7: The participation of workers in Occupational Health and Safety(OH&S) policy formulation, **Source:** Author,(2017)

The findings indicate that; workers are not often asked for their inputs in health and safety issues, not free to make suggestions about workplace health and safety. Meanwhile there is no genuine cooperation over health and safety-a joint effort between all in the organization.

4.11. Measures for Mitigating the Vulnerability of Health and Safety on Confined Building Construction Sites Site Supervisors’ Perception

Through questionnaires, the site supervisors were asked to rank the mitigation measures to overcome the vulnerability of health and safety on confined sites in the Tanzanian construction industry. The ranked eleven(11) mitigation measures were identified using observation and secondary data. The Table #4.05, shows the analysis of the data collected. Where by **TNR** – Total Number of Respondents, and **SD** – Standard Deviation.

Table 4.05; Descriptive statistic on vulnerability measures perception of site supervisors in confined building construction sites in Dar-Es-Salaam

SN.	Site Supervisors' Perception on Vulnerability Measures of OH&S on Confined Building Construction Sites	TNR	Mean	SD	Rank
01.	Perform pre-employment health and safety training	15	4.67	0.62	10
02.	Regular meetings on site health and safety	15	4.87	0.52	05
03.	Undertake an audit on health and safety hazards	15	4.80	0.56	09
04.	Adequate provision of protective equipment	15	4.93	0.26	2.5
05.	Willingness of stakeholders to invest in health and safety resources will mitigate the vulnerability of health and safety on confined construction sites	15	4.93	0.26	2.5
06.	Increasing awareness of OH&S rights and responsibilities will be useful to mitigate the vulnerability of H&S on	15	4.93	0.26	2.5

	confined construction sites				
07.	Creating adequate OH&S policies will be useful to mitigate vulnerability associated with construction activities on confined construction sites	15	5.00	0.00	01
08.	Assess and evaluate risk	15	4.60	0.51	11.5
09.	Recording findings and updating in relation to the work condition	15	4.60	0.51	11.5
10.	Employees should be motivated to adopt good health and safety attitude on confined construction sites	15	4.20	0.68	13
11.	Ensure that a very new employee on project confined construction site is given an appropriate orientation regarding safety and health inspection	15	4.87	0.35	6.5
12.	Appropriate training to construction workers by the management will mitigate the vulnerability of health and safety on confined construction sites	15	4.87	0.35	6.5
13.	Involving workers in OH&S policy formulation will mitigate the vulnerability of health and safety associated with construction activities on confined construction sites	15	4.87	0.35	6.5

Source: Author,(2017).

The results in the Table #4.05 indicates site supervisors perception on the vulnerability measures provided and it indicates that; all are significant in mitigating vulnerability of health and safety and promoting the health and safety wellbeing of construction workers on confined building construction sites since the mean scores were above 3.51.

Workers Perception;— Through questionnaires, the workers were asked to rank the mitigation measures to overcome the vulnerability of health and safety on confined sites in the Tanzanian construction industry. The ranked thirteen(13) mitigation measures were identified using observation and secondary data. The Table #4.05, shows the analysis of the data collected. Where by **TNR** – Total Number of Respondents, and **SD** – Standard Deviation

Table 4.06: Descriptive statistic on vulnerability measures perception of Workers in confined building construction sites in Dar-Es-Salaam.

SN.	Workers' Perception on the Vulnerability Measures of OH&S on Confined Building Construction Sites	TNR	Mean	SD	Rank
01.	Perform pre-employment health and safety training	26	4.81	0.40	09
02.	Regular meetings on site health and safety	26	4.92	0.27	07
03.	Undertake an audit on health and safety hazards	26	4.42	0.51	11
04.	Adequate provision of protective equipment	26	5.00	0.00	1.5
05.	Willingness of stakeholders to invest in health and safety resources will mitigate the vulnerability of health and safety on confined construction sites	26	5.00	0.00	1.5
06.	Increasing workers' awareness of OH&S rights and responsibilities will be useful to mitigate the	26	5.00	0.00	1.5

	vulnerability of health and safety on confined construction sites				
07.	Creating adequate OH&S policies will be useful to mitigate the vulnerability associated with construction activities on confined construction sites	26	5.00	0.00	1.5
08.	Assess and evaluate risk	25	4.24	0.44	13
09.	Recording findings and updating in relation to the work condition	26	4.46	0.51	10
10.	Employees should be motivated to adopt good health and safety attitude on confined construction sites	26	4.35	0.56	12
11.	Ensure that every new employee on confined building construction site is given an appropriate orientation regarding safety and health inspection	26	4.88	0.33	08
12.	Appropriate training of construction workers by the management will mitigate the vulnerability of health and safety on confined building construction sites	26	5.00	0.00	1.5
13.	Involving workers in OH&S policy formulation will mitigate the vulnerability of health and safety associated with construction activities on confined construction sites	26	5.00	0.00	1.5

Source: Author,(2017).

The results in the Table #4.06 indicate workers perception on the vulnerability measures provided and it indicates that; all are significant for mitigating vulnerability of health and safety, and promoting the health and safety wellbeing of construction workers on confined building construction sites since the mean scores were above 3.51.

4.12. Findings Discussion

The operations on confined building construction sites are often associated with high levels of occupational hazards. Due high levels of occupational hazards on confined building construction sites, the risks also increase. Risk consequences depend on the degree of vulnerability to such hazards. The study sets out to identify vulnerability measures of health and safety on confined building construction sites in the various construction firms under survey.

Common Vulnerable Occupational Health and Safety(OH&S) Hazards on Confined Building Construction Site;— it was revealed through both observation and questionnaire methods that; confined building construction sites, are situated with so many occupational hazards which may result into greater risk consequences making them more vulnerable to health and safety, as highlighted in the previous section

Adequacy of Workplace Occupational Health and Safety(OH&S) Policies and Procedures on Confined Building Construction Sites;— it was revealed through both observation and questionnaire methods that; workplace health and safety is not considered to be at least as important

as production and quality, also systems are not in place to identify, prevent and deal with hazards at workplace also, there is no active and effective health and safety committee and/or worker health and safety representative, not everyone receives the necessary workplace health and safety trainings when starting a job, changing job or using a new technique, there is no regular communication between employees and management about health and safety issues. Thus, workplace OH&S policies and procedures on confined construction sites are not adequate.

Adequacy of Workers' Awareness of Workplace Occupational Health and Safety(OH&S) Rights and Responsibilities on Confined Building Construction Sites;— it was revealed that, workers on confined construction sites are not clear about their employer's rights and responsibilities in relation to workplace health and safety, the health and safety measures provided by the organisations are not adequate, they are not clear about their rights and responsibilities to workplace health and safety. However, the main sources of legislative regulations on occupational health and safety includes construction industry policy, Contractors Registration Board Act of 1997, Occupational Safety and Health Authority Act of 2013, are there and they are silent about construction in confined sites. Thus, workers' awareness of workplace OH&S rights and responsibilities on confined construction sites is not adequate.

Examination of workers' empowerment to participate in Occupational Health and Safety(OH&S) workplace policy formulation;— it was revealed that; workers are not often asked for their inputs in health and safety issues, not free to make suggestions about workplace health and safety. Meanwhile there is no genuine cooperation over health and safety-a joint effort between all in the organization. Thus, workers are not empowered to participate in health and safety workplace policy formulation on confined construction sites.

Mitigation Measures on the Vulnerability of Health and Safety on Confined Building Construction Sites;— the study sort to identify vulnerable measures needed to achieve a healthy and safety working environment for workers on confined construction sites. These measures will also prevent hazards and reduce various health and safety menaces. Using descriptive statistics method, the critical measures needed to encourage the incorporation of occupational health and safety on confined sites were identified. It was revealed that; the major factors for the study correlate closely and proved to be essential for this study. This has been presented below.

- Create adequate OH&S policies associated with construction activities on confined construction sites,
- Increase workers' awareness of OH&S rights and responsibilities associated with construction activities on confined construction sites,
- Involve workers in health and safety workplace policy formulation,
- Appropriate training of construction workers by the management,
- Willingness of stakeholders to invest in health and safety resources,

- Adequate provision of protective equipments

5. Conclusion

This study identified vulnerability measures of health and safety on confined building construction sites in Dar-Es-Salaam, Tanzania. Basing on the study primary objectives which were to identify the common vulnerable health and safety hazards on confined building construction sites; to explore the adequacy of workplace OH&S policies and procedures on confined building construction sites; to evaluate the adequacy of workers' awareness of workplace OH&S rights and responsibilities on confined building construction sites; to examine workers' empowerment to participate in health and safety workplace policy formulation on confined building construction sites; and lastly to suggest vulnerability measures to improve occupational health and safety on confined building construction sites; the study concludes the following:-

The study revealed that; occupational high levels of health hazards are perceived to be available on confined construction sites. This is due to situations/features available with confined construction sites. Construction firms do not have a written health and safety policy for their enterprises setting out safety and health standards. Furthermore, it was revealed that, most construction firms have no workplace Occupational Health and Safety(OH&S) policies such as system to identify, prevent and deal with hazards at work and workplace health and safety is not considered as important as production and quality. Also, most construction firms have no culture to train workers when starting a job, changing job or using a new technique. Construction safety policy therefore is something that must be developed by each operating company prior to starting any construction job. Once developed, the development safety plan should be placed into a training program that's needed to be participated in by every site worker prior to partaking in any job. This helps to understand Occupational Health and Safety(OH&S) risks and take into account both the potential for and protection from exposures occurring within the workplace.[42].

Moreover, it was also revealed that workers on confined construction sites are not aware about their rights and responsibilities, are not aware about their employers' rights and responsibilities in relation to workplace health and safety. As Downey at el.,(1995),[18], identified that; employees' basic rights under the joint responsibility model include the rights to know about workplace safety hazards, the right to participate in the occupational health and safety process, the right to refuse unsafe work if they have "reasonable cause" to believe that the work is dangerous. "Reasonable cause" usually means that a complaint about a workplace hazard has not been satisfactorily resolved, or a safety problem places employees in immediate danger. If performance of a task would adversely affect health and safety, a worker cannot be disciplined for refusing to do the job. However, the main sources of legislative regulations on occupational health and safety includes construction industry policy, Contractors Registration Board Act of 1997,

Occupational Safety and Health Authority Act of 2013 are there and they are not specific about construction health and safety matters on confined sites.

Additionally, there is need to improve the knowledge of construction workers on occupational health and safety specifically in confined site construction through empowering them to participate in workplace policy formulation. It was revealed that, workers are not free to make suggestions about workplace health and safety. Also, workers are not asked for their inputs in health and safety issues. Lastly but not least there is no genuine cooperation over health and safety—a joint effort between all in the organization. This helps to impart individual's capacity to protect from hazards and exposure to hazards. The study also identified the following practices as effective for promoting occupational health and safety on confined construction sites; create adequate OH&S policies associated with construction activities on confined construction sites, increase workers' awareness of Occupational Health and Safety(OH&S) rights and responsibilities associated with construction activities on confined construction sites and involve workers in health and safety workplace policy formulation. It can be concluded that vulnerability of health and safety on confined building construction sites in Tanzania construction industry is due to inadequate Occupational Health and Safety(OH&S) policies in the workplace, unawareness of workers of their rights and responsibilities and workers not being involved in workplace policy formulation.

6. Recommendations

Numerous recommendations have been made by researchers in promoting Occupational Health and Safety(OH&S) on confined building construction sites in the Tanzanian Construction Industry. However, these have not been implemented. The Tanzanian construction industry particularly in confined building construction site is still having difficult in performing on issues relating to occupational health and safety. The following are some of the recommendations made at the end of the study to mitigate the vulnerability of health and safety on confined construction sites. For easy identification, the recommendations have been put together under various groups such are; Government, enterprises/construction firms and workers.

6.1. Recommendations for the Government

- Amendment in Existing National Construction Industry Policy of 2003;— by either reformulating the construction industry policy or by to producing the entirely new OH&S law to add particular section on confined building construction site.
- Amendments in Existing Occupational Safety and Health Authority Act of 2013;— which does have policies on how to hold employers accountable to exposing their employees to hazards. There is need to either reformulate, or add new policies specifically for occupational health and safety on confined building construction sites.
- Establishment of HSE Department;— Construction firms should be bound to establish the HSE Department within

their organization. HSE Department plays significant role in reducing site accidents. Companies that have HSE Department have less number of reported accidents than companies who have not got the HSE Department.

6.2. Recommendations for the Enterprises/Construction Firms

- Workplace Occupational Health and Safety(OH&S) policies;— since occupational accidents occur at workplaces, cautionary and control moves within the organization should be planned and enforced all together by the stakeholders and workers related. These precautionary steps should be based upon well-defined practical and precise workplace policies. The policies should be in written form and should specify the organizational understanding to guarantee the occupational health and safety particularly in confined building construction sites.
- Establishment of HSE Department;— each construction firm must have this department to supervise, and deal with occupational health and safety on building construction sites. Healthy workers increase job efficiency and productivity.
- Sufficient Budget Allocation;— employers must allocate sufficient budget for the HSE Department so that they can equip the construction site with all necessary protective equipment and systems.

6.3. Recommendations for Workers

Ensuring Cooperation;— workers must oblige fully with the employer in any step that employer takes or proposes in order to ensure safety. This can be done by reporting hazards and incidents, using correct PPE during work, doing work in a safe way, obeying the health and safety instructions and standard operating procedures and attending the safety sessions/ trainings. They must understand the nature of confined building construction sites, vulnerable hazards and risks involved.

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