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Occupational Health and Safety Monitoring at Construction Site

[1]Shyambabu Dangi

[1]Student of ME (M. Tech. - Industrial Safety Engineering)
Department of Fire Technology & Safety Engineering, Shiv Kumar Singh Institute of Technology & Science, Indore, M.P. Pincode- 452001, India.

Abstract : Safety in the construction industry has always been a major issue. Occupational health and safety practices have become a problem in construction sites since some of the employers undermine the safety of their workers on sites which result to a lot be injured during the construction process. This research is to find out how some occupational health and safety practices involving high rise building sites are obey. Safety practices in the construction industries contribute a good way to accidents prevention and reduction.

Wherever reliable records are available, construction is found to be one of the most dangerous on safety and health criteria, particularly in developing countries. Though much improvement in construction safety has been achieved, the industry still continues to lag behind most other industries with regard to safety. In developing countries, safety rules do not usually exist; if any exist, the regulatory authority is usually very weak in implementing such rules effectively. Further, work hazards at the construction workplace are either not perceived at all, or perceived to be less dangerous than what they actually are. India is a developing country that is currently enjoying a relatively strong growth in construction activities. Unfortunately, India's construction industry suffers from poor safety and health conditions.

Research on this thesis is based on a general overview of health and safety in the construction industry, highlighting on a strategic approach to dealing with three major issues with regards to health and safety in the construction industry. First, the thesis tries to deal with the problem of how to improve organisational health and safety (OHS) through the monitoring of the process of procurement in construction projects.

Therefore, this research was done in view of identification and examines some occupational health, safety and environment related practices in our construction industries. The framework of the existing occupational and health conditions is fragmented and inadequately enforced, making construction sites more hazardous. It may even be argued that relevant regulations are outdated and irrelevant in day-to-day construction operations.

The demonstrated results show the feasibility to implement the proposed system in real construction project which the supervising personnel can easily inspect and control the specified safety measures, safety signs, and personal protective equipment.

Keywords- Health, Safety and Environment Monitoring, organization, construction, industry, management, accidents, projects, risk, construction site; occupational hazard, occupational safety, risk, health and safety solutions, occupational accident, Workers.

1. INTRODUCTION

1.1 INTRODUCTION OF CONSTRUCTION INDUSTRY-

Construction has its own characteristics that are different from the manufacturing. Tasks and activities are always performed in an open area and exhibit variation in the physical environment. Many tasks and activities are performed high from the ground conditions. There is a potential for serious accidents in construction sites due to the following causations: many people are close

together, many activities are unpredictable, and the tolerance of risk is traditionally quite high, making the frequency and impact of unplanned activities very high. According to the cause codes of accidents in the construction industry by OSHA, there are five basic cause codes, consisting of falls, being struck by an object, caught in/between equipment or material, electric shock, and others. The statistics on occupational injuries and fatalities then show that falls and being struck by a moving or flying/falling object are the top three accident causations in the construction industry. In order to avoid accidents caused by falls or falling objects, preventive strategies such as identifying the potential hazards, proper selection and use of safety protection system, training in the workplace, and provision of adequate preventive equipment are necessary. In order to prevent accidents and improve the level of safety in construction, various safety management systems are implemented during project-execution phases. According to a study of, safety management is the set of actions or procedures associated with health and safety in the workplace. Three main tasks of safety management consist of hazard identification, safety measure planning, and control. Not only these tasks, but safety education and training are also other essential tasks for achieving a zero accident target. However, in order to support construction personnel and to enhance the efficiency of safety management, potential tools such as information technology are required. Therefore, many previous studies have made an effort to suggest the implementation of information technology in safety management processes.

The global volume of construction output is forecast to grow by 85% to $15.5 trillion by 2030, according to PricewaterhouseCoopers, with the largest construction markets -- the US, India, and China -- accounting for 57% of global growth. Other key markets include Japan, Germany, Spain, France, and Italy. Emerging markets such as India is growing quickly as a result of increased urbanization, rising populations, and the expanding middle class. Construction growth in China is expected to slow in some sectors such as housing and shift to health care, education, social infrastructure, and retail. Construction in some mature economies has been constrained by government deficits and austerity measures. The US construction industry includes about 660,000 establishments (single-location companies and units of multi-location companies) with combined annual revenue of about $1.5 trillion (First Research Industry Profiles; Fort Mill, South Carolina).

Over the last two decades, the construction industry has grown tremendously hence becoming one of the main engines of growth and development in many economies as shown by statistics above. It has provided infrastructure that other sectors of the economy rely on to produce goods and services as well as housing which is a basic human need. Other opportunities that come with it are: employment opportunities and communication networks. However, despite its importance, it's littered with a lot of hazards and presents itself as one of the riskiest sectors to work with especially where rules and regulations are not fully implemented. Potential hazards for employees in the construction sector include: scaffold collapse, trips, slips, failure to use proper personal protective equipment, falls from height, collapse of trenches, noise, repetitive motion injuries caused by vibrating tools, falls, electric shocks and arc flash blasts and everyday and this makes them have the potential for becoming sick, ill or disabled for life. The above scenario can be managed by ensuring rules and regulations are fully implemented, there is adequate supervision, training of workers and other hierarchy of control measures. However, there is no single best approach to the management of hazards in the construction sector but it should involve all stakeholders. In that way, all their interests will be considered.

And evidence shows that a well-considered policy contributes to business efficiency and continual improvement throughout the organization. It helps to minimize financial losses arising from avoidable accidents and demonstrates to the workforce that accidents are not necessarily the fault of any individual member of the workforce. A good health and safety policy helps to ensure that there is a systematic approach to risk assessment and sufficient resources, in terms of people and money, have been allocated to protect health and safety and welfare of the workforce. This elucidates the fact that having a quality policy in place can help in addressing the challenges arising in the construction.

In India construction industry is fastest growing industry day by day, different type of construction is in progress with heavy engineering and technologies, as we all know that maximum no. of workers is employed by the construction work, around 16 per cent of the nation's working population depends on construction for its livelihood. The Indian construction industry employs over 30 million people and creates assets worth over 200 billion. It contributes more than 5 per cent to the nation's GDP and 78 per cent to the gross capital formation. India GDP from Construction GDP from Construction in India increased to 2812.62 INR Billion in the second quarter of 2019 from 2586.14 INR Billion in the first quarter of 2019.

The construction industry is recognized as a major economic force in India. The construction industry also plays an important and strategic role in supporting the development and the growth of industry in a nation. India, as a developing country, has concentrated in improving the development of the country by having an increasing number of mega projects, some categorized as national projects.

Construction industry, often termed as 'high-risk', has a significant impact on the health and safety of the workers. Though it is common to see a construction worker work at heights with equipment and building materials, these scenarios are plagued by potentially dangerous situations and poor working conditions. They are exposed to hazards that are difficult to quantify. Different job sites have different procedures and conditions – identifying the source(s) that poses challenges to OHS of the workforce remains critical.

Despite the fact that construction industries are in line with the intensity of the development, many aspects within the construction itself are neglected. Just as important is the safety of the workers during the working time, concerning the occupational safety aspects within construction industry, it is apparent that the implementation of safety best practices is still far from good. Construction accidents are due to neglecting certain safety regulation despite the presence of government regulation regarding safety. These cases have been going on since the early development of the construction industry. Generally speaking, every case of construction accident involving casualty of an individual or to a number of workers is investigated thoroughly and ironically the matters are finally resolved with conclusion of careless conduct.

It is very difficult to fulfill occupational safety requirements in construction sector due to the fact that different teams come together for a specific project and separate from each other at the end of the project. Relationships are project based, staff turnover is very high and risks related to work are constantly changing because of the constant change of organizational structure. In order to ensure occupational safety in construction works, types of occupational accidents and the factors that cause these accidents should be determined first. Prevention of accidents and safety assurance can then be achieved by taking these into consideration.

Assessment of occupational hazards as well as assurance of occupational safety at a construction site is an extremely important question to be analyzed. It has-been estimated that every third occupational fatality or injury occurs at a construction site.

2017 ILO statistics quote that in India, 48,000 people died due to occupational accidents and the construction sector contributed to 24.20% of the fatalities. Apart from fatalities, there are workers who suffer from work-related health hazard and suffer non-fatal injuries. The scale and severity should be enough for the stakeholders to ensure the safety and health of their workforce.

The Construction industry in India consists of the **Real estate** as well as the Urban development segment. The Real estate segment covers residential, office, retail, hotels and leisure parks, among others. While Urban development segment broadly consists of sub-segments such as Water supply, Sanitation, Urban transport, Schools, and Healthcare.

In respect to the workers' health in construction site, workers are exposed by various type of hazards i.e. physical, biological, chemical, electrical, agronomical, psychological, and environmental etc. and this all are affect the health of workers, employees, other staff as well all other people who has present of live near the construction area. As workers face many problems due the unsafe work at construction site as well unsafe environment at construction site like dust is the major hazard at construction site, and all workers are exposed due to this at site, and may result into the respiratory dieses and many other dieses to the workers.

Construction industry, world over, has borne **extreme losses due to onslaught of COVID pandemic**, so much so, that the pain and scars inflicted upon the industry, due to damages and losses, will haunt its stakeholders for a long time to come. Even today, the pandemic is far from being over, and the damages & losses are continuing unabated. The green shoots are, however, visible as the industry operations have started under the shadow of pandemic. To heal and revive the construction industry, what we need are collaborative and joint actions by constituents. These, irrespective of the presence of pandemic, will hasten the industry recovery process bringing our industry back to its pre-COVID status as quickly as possible.

1.2 Safety Monitoring-

The level of safety monitoring can be improved by implementing the information technology, for example, automated monitoring and control algorithms for detection of the guardrails in accordance with safety planning. The fall hazards from the activities and areas in which these activities are performed were focused on. The algorithms of the model were developed in a computer program written in VISUALBASIC (VB), AUTOCAD, and MS PROJECT. The outputs of this study showed that the model can

identify potential fall hazards and dangerous areas in real time and compare them with the planning. Moreover, it can warn the site personnel regarding the existing safety measures that have been missed or removed. presented a real-time safety monitoring system which focused on the reduction of fatal accidents caused by falls. This system consisted of a mobile sensing device, transmitter sets and repeaters for sending the detected information to a receiver, and software for interpreting the received information. In the experiment, when the workers entered defined dangerous area, the system automatically received the data and transmitted the information to the main computer to inform the safety managers regarding hazardous situations. From the eleven construction sites observation in Thailand, superintendents normally inspected working conditions and identified hazards based on their knowledge and experience. Shop drawings and safety checklists sometimes were applied. If the worker wore personnel protective equipment, the superintendents did not mention inspecting or providing other safety measures. Most of the construction projects used their own checklist forms, such as those for personnel protection equipment and safety system evaluation. However, these forms contained rough details and were ineffective for monitoring safety at the construction site. Normally, the site personnel used safety checklists to inspect their construction sites only once a week. Nevertheless, this technique was not effective. It did not provide enough information for safety execution and communication among project participants. Moreover, the majority of the information is presented in a two-dimensional graphical or text-based paper format. Construction personnel have to mentally interpret and understand the obtained project information. One of the advance visualization technologies is Augmented Reality (AR) which is properly applied for information-intensive tasks which deal with information access and communication. This technology was deployed in many previous studies due to its potential. Therefore, this paper which proposes the innovative and visualized system to assist the supervising personnel in the safety monitoring process for preventing fall accidents at construction site, use the potential technology, called Augmented Reality.

1.3 Motivation behind the work-

Even when the industry has improved, not only in number but also in their scale and which sometimes involves foreign companies where international safety regulations should be applied. As a result, accidents in the construction industry especially on high rise building sites, in spite of everything, are increasing. Construction industry in the nation has always suffered from poor image, for instance, high cost, poor quality and hazardous working condition. Improving safety practice on Ghanaian high rise building construction sites will not be achieved without the concern and involvement of the government. This is because the government has the influence and the highest authority in the making and enforcing of rules and regulations on health and safety. Hence the need for research into the field to come out with the necessary recommendation.

1.4 Health and safety at the workplace

Health and safety management is a problem that relates to and is vital for all companies, belonging to various industries, ranging from traditional to commercial and information technology (IT) industries, the National Health Services (NHS), care homes, schools, higher educational institutions, travel and leisure, etc. Health and safety is specifically significant and crucial for the construction industry. The organization and its functions are influenced by health and safety issues and practices at the workplace For a company that is considered to be at 'low hazard', the health and safety issues can be managed by a single proficient manager. However, in a 'high hazard' organization, such as a manufacturing plant or construction project, different specialists (engineers, medical doctors, lawyers, trainers, supervisors, work planners, etc.) may be assigned the responsibility of helping the manager responsible for health and safety in the organization in making certain that the health and safety regulations in the firm are up to the mark. In the United Kingdom, the construction industry is the largest of all industries. It accounts for about 8% of gross domestic product, employs about 10% of the national workforce and generates an annual turnover of up to £250 billion. The UK construction industry is well known all over the world for its quality operations; however, it continues to be one of the riskiest industries in the country. For instance, back in 2004/2005 the rate of injury per 100,000 workers was 3.4 with and industrial average of 0.8 and in 2006/2007 there was a 28% increase in fatalities accounting for about 32% of all recognizable fatal injuries. The Health and Safety Executive (HSE) found that till August, 2010, there was an 5% decrease in output in 2009, as compared to 5% drop for the whole economy. The UK Government initiated the 'Revitalizing Health and Safety' campaign in collaboration with the Health and Safety Commission in June 2000. This led to the establishment of targets by the construction industry for bringing a decline in the number of major and critical injury to the workers. For example, a client managing a construction project is perceived to be a significant stakeholder seeking to enhance the levels of health and safety standards This kind of client should

be firm on obtaining sufficient evidence for good health and safety performance and record at the preliminary tendering stage, and should make certain that health and safety standards are fulfilled at the construction site. The client should require that all individuals working on the construction site have adequate training with regards to their specific jobs on the site. There are various challenges and responsibilities involved in terms of dealing with OHS in the construction industry, and such challenges and responsibilities are based on the stakeholders in the industry. For example, the HSE is obliged to make certain that there are adequate risk controls with respect to health and safety of the workers (Health and Safety at Work Act 1974). According to the HSE, the effective management of OHS is important to the well-being of employees, and contributes towards the improvement of organizational reputation, which may lead to the achievement of high-performance teams and financial benefits for the organization. In terms of corporate responsibility as far as OHS is concerned, the HSE encourages Organizations to demonstrate, at board level, the significance of OHS; enhance OHS systems within the organization in order to reduce ill-health and injuries; and report publicly on OHS – alongside performance measured against goals. As stakeholders in the construction industry, organizations also have various challenges and responsibilities in terms of dealing with OHS. Some of the challenges faced by organizations include organizational complexity, the pressure of performance target and production and budget and financial constraints. However, there are certain powerful incentives available for organizations to strive towards improving OHS standards, such as economic, legal and moral considerations, which are normally covered under the aspect of corporate responsibility or corporate social responsibility. Corporate responsibility can be defined as approach by organizations in managing the core aspects of their business (economic) alongside social and environmental considerations in order to promote sustainable and positive effects on both the business as well as the society. The aspect of corporate responsibility in the workplace has been extensively used in the 21st century, especially in the last few decades mainly due to corporate malpractices that affected the entire operations of organizations and even led to the collapses of many well-known businesses. Corporate responsibility covers a broad area of issues such as the impact of an organization's operations on human rights, Third World countries and the environment in general. Therefore, OHS plays a crucial role in corporate responsibility. It has been asserted earlier that a few significant motivations exist that motivate organizations to enhance OHS, one of which is that of moral considerations. A justification for this is the rate of workplace accidents as also mentioned above. Workplace accidents can sometimes lead to serious injuries, and can even be fatal. Accidents can be major, such as a fracture of a person's limb that may lead to a long-stay in the hospital. Also, work related disease or ill-health can lead to absence and even death. Such occurrences may result in costs to the organization (such as sick pay or compensation payments), the industry (industry-based industrial scheme, and even the entire economy (for instance, back in 2009/2010 there were about 1.3 million people in the UK who were suffering from Work-related ill-health, which led to a loss of about 23 million working days (Hughes and Ferrett,2012). The legal incentive for the improvement of OHS by organizations includes organizations' civil and criminal law duty. There are legal consequences in place in the UK for organizations' breach of health and safety law, such as fines and compensation awards. Economic incentive for improving OHS includes the avoidance or reduction of the costs of accidents and ill-health in the workplace. For example, the organization is going to incur direct as well as indirect costs in case of any organization accident or ill-health. In addition, it will also incur insured and uninsured costs. Hence it is crucial to consider all these costs in the calculation of the full costs of accidents and ill-health in the organization. Therefore, organizations do have a strong moral, legal and economic case to do more in order to reduce levels of accidents and ill-health in the workplace, thereby improving OHS.

In addition to the economic case for OHS mentioned above, there is a business case for OHS as well. Such a business case, according to Burke, Clarke and Cooper (2011) is based on the potential costs asa result of ineffective standards of OHS. And as mentioned previously, there are both direct as well as indirect costs incurred by organizations due to poor standards of OHS. Direct costs are those costs incurred as a direct effect of an accident or ill-health. Some costs may be insured or uninsured. Insured direct costs may include damage to plants, equipment, vehicles, and buildings; claims leveled against the organization and the public liability insurance; and any costs that can be directly attributed to the accident that has occurred or any ill-health to an employee. Uninsured indirect costs that may be incurred as a result of poor standards of OHS include sick pay; fines as a result of prosecution by government authorities; an increase in insurance premium due to an accident; damage to plants, equipment, vehicles, products, property as a result of an accident; compensation not covered by an insurance policy; and legal fees following court actions and claims for compensation. Unlike direct costs, indirect costs may not be attributed directly to an accident or ill-

health; however such costs may result from accidents and ill-health over a period of time. Such indirect costs may also be insured as well as uninsured. Insured direct costs include liability claim for products and processes, cumulative business loss and cost of recruiting a replacement for the loss of an employee due to an accident or ill-health. Uninsured indirect costs include additional overtime payments, poor corporate image and loss of organizational goodwill, delays in processes and production, cost of providing first-aid treatments, lower employee morale which may affect the level of workplace productivity, and additional administration time. In terms of the legal framework regulating OHS in the UK, there are two applicable parts of the law: civil and criminal law. Civil law deals with disputes arising between individuals or those disputes between companies and individuals. In such a case an individual who normally brings a complaint to court is referred to as the plaintiff or claimant (in the case of Scotland, is known as the pursuer), and the person or company sued is referred to as the defendant (defender in Scotland). In civil law, the court is normally concerned with the liability and the extent of such liability - it is not concerned with guilt or non-guilt. Therefore, a 'balance of probability' serves as the degree of proof required, which is at quite lower degree of certainty in comparison to what is required in the event of a criminal court where 'beyond reasonable doubt' is needed. Criminal law is different from the civil law discussed earlier in the sense that it consists of rules of behavior that the government has imposed, and these rules of behavior are usually adopted by the Parliament through 'Acts of Parliament'. The Acts are applicable on the public for their own safety and are subsequently implemented by various government bodies. In case a person defies criminal law, that person is believed to have carried out a crime or offence, and incase the person is indicted, the court will have to determine whether the accused person is guilty or not guilty 'beyond reasonable doubt'. If a person is found guilty under a Criminal Court, he or she could be sentenced to a fine or imprisonment. Examples of criminal laws are the Health and Safety at Work(HSW) Act and the Road Traffic Act. The HSW Act was adopted following the results of the Roben's Report (1972) (Sato, 2009). Back in 1970, Lord Roben was asked to conduct a review on workplace health and safety. His report, which produced certain conclusions and recommendations, was then the basis of the HSW Act 1974. The principal recommendations of the Act were: a single Act to cover all employees and such Act should entail general duties that should influence the attitudes of people; the Act should emphasize health and safety management and development of workplace safe systems; enforcement of the Act should be focusing on 'self-regulation' by the employers rather than enforcement by the court; and the Act should include all those aspects that are influenced by the activities of unemployed, like contractors, visitors and public. Hence, such recommendations resulted in the introduction of the HSW Act in 1974. The HSW Act is enforced by either the Local Authority Environmental Health Officers (EHOs) or the HSE. However, the processes consisting of criminal cases are generally different from those consisting of health and safety matters. In a criminal case, as mentioned above, any prosecution must be proven beyond reasonable doubt. This kind of responsibility is not completely eliminated in health and safety cases; however, section 40 of the HSW Act 1974asserts that in any duty to carry out a particular act or perform something 'so far as is practicable' or 'so far as is reasonably practicable' or 'use the best practicable means', the accused has the burden of proof to show that he/she could not perform his/her duty in any better way. However, when the burden of proof rests on the accused, only the court needs to be convinced on a balance of probabilities that the proof they are trying to give has actually been done.

1.5 Definition of key terms

1.5.1 Health

Health is the process of protecting the minds and bodies of people against illness as a result of the mishandling of materials, procedures and processes involved in the workplace.

1.5.2 Safety

Safety involves the process of protecting people against physical injury. Health and safety are normally used together to show worry for the mental and physical health of the individuals at work.

1.5.3 Accident

The HSE asserts that an accident refers to any unforeseen event that injures people or damages their health. It also refers to any damage or loss to property, materials, business prospect or the environment (HSE, 2014)

1.5.4 Risk

Risk can be generally defined as the likelihood of losing something valuable. Such valuable things may include social status, wealth, or physical wellbeing and health. Such values can be gained or lost depending on the type of risk taken by a person. Risk can also be referred to as the intentional approach to dealing with uncertainty.

1.5.5 Hazard

A Hazard refers to the likelihood of an activity, substance, process or person causing harm to another person, or anything of value. It is also critical to distinguish between a risk and a hazard. Although these two terms are often used interchangeably, however as far as the aspect of construction is concerned, they are frequently being confused - for instance the reference to construction work being high-risk rather than high hazard activities. And most times in construction there is a tendency for the reduction of risks as controls are implemented or improved, despite the continued presence of high hazard. When various controls have been implemented; the level of risk that remains is normally referred to as residual risk. Residual risk is normally high when there are inadequate control measures in place or poor management of health and safety.

1.5.6 Near Miss

The term 'near miss' refers to any incident or occurrence that could have led to an accident.

1.5.7 Dangerous Occurrence

A dangerous occurrence is a grave form of near miss that could have resulted in a serious injury or death. For instance, it may involve the downfall of a crane or scaffold or the breakdown of passenger carrying equipment.

1.6 Aim & Objectives-

1.6.1 Research aim

The principle aim of this research is to give a general overview of the current state of health and safety in the construction industry, and to discuss the procurement, monitoring, cost effectiveness and strategy. It will explore methods used by stakeholders in the construction industry in terms of improving OHS; it will look into various aspects of these strategies, to include those to improve OHS through procurement, the economic priority of these strategies and the various responsibilities and duties of the stakeholders involved in the industry in terms of designing and implementing strategies that improve OHS.

1.6.2 Research objectives

In order to achieve the above mentioned aim, the following objectives were set:

- Assessing health and safety in the construction industry, a description of general occurrences which have taken place, events and incidents that have allowed accidents to take place and any lessons to be learned,
- An overview of health and safety in the construction industry,
- Monitoring of procurement,
- Vetting bidders for contracts,
- Strategic decisions in construction projects,
- Financial and legal implications with construction accidents,
- Cost effectiveness.

The above objectives, coupled with the following three areas, within a general overview of the current state of health and safety in the construction industry, will be analyzed. The first objective in this study is to explore the strategic process of improving OHS through the proper control and management of procurement in construction projects. This includes, finding out the impact that the organizational culture of the parties involved in construction contracts has on a particular project involved; and how this impact will affect the improvement or hindrance of OHS. The study also finds out the steps taken by organizations in selecting bidders for a particular project given that such bidders may influence how OHS is dealt with in the organization. Second, the project explores the process of organizations in the construction industry attempting to balance or trade-off cost and OHS; which is, finding out the key economic considerations in terms of improving OHS, and why OHS should be an economic priority for organizations in construction. It finds out the significance of economic factors in influencing contractors towards improving OHS strategies. This includes looking into how contractors acknowledge the underlying idea that making money should be the bottom line, in that they should also pay attention to the improvement of human values in an attempt to improve OHS. For many contractors this is not an easy approach. Therefore the research attempts to find out the extent to which they can deal with such a

'dilemma'. Third, the research explores the process of strategic decision-making in terms of OHS. It attempts to find out the various strategies that organizations consider in terms of dealing with OHS and how these strategies may affect the duties and responsibilities of stakeholders such as the contractor, the client and workers. In such, the thesis attempts to identify who these various stakeholders are and what are their responsibilities. For instance, in the case of a contractor, the study attempts to find out the nature of a contractor, what is to be expected from the contractor in terms of dealing with OHS, etc. Interns of the client, the research explore the level of the client's safety expertise, the reasons and the benefits of the client's involvement in OHS. In meeting the above areas and objectives, an extensive literature review, questionnaires and interviews were carried out and critically analyzed.

1.6.3 Scope of the study

As mentioned previously, the problems of health and safety in the construction industry can be addressed simultaneously, with regards to the objectives set out. The scope of this research, based on information retrieval throughout the period of the study, will introduce a foundation in which further exploration can be carried out, with a view to increased awareness of client-contractor relationships in any supply chain/procurement procedure, within a carefully managed health and safety environment.

This can be seen as follows;

- To improve general health and safety standards in the UK construction industry,
- To improve better relationships between client, contractor and stakeholder,
- To understand and increase better knowledge of construction procurement,
- To understand and increase better knowledge of strategic decision making in construction projects,
- To understand and increase better knowledge of financial and legal implications with construction accidents,
- To understand and increase better knowledge of cost effectiveness.

1.6.4 Significance of the study

The importance of this research stems primarily from an underlying theme regarding health and safety, to develop an understanding of its structure within a construction environment, and to establish cause and effect regarding procurement.

1.7 Company Profile and Study Area -

1.7.1 Company Profile:

Shapoorji Pallonji And Company Private Limited (SPCPL) is a global, diversified organization of 18 major companies. They deliver end-to-end solutions in 6 business segments, namely Engineering & Construction, Infrastructure, Real Estate, Water, Energy and Financial Services. Developing mega structures and iconic landmarks, our dedicated workforce of over 70,000 people in over 70 countries is focused on sustainable development.

2. Overview of Health and Safety

2.1 Introduction.

Health and safety issues have been the subject of study since the development of a construction site and other related work settings. The adverse effects of an unhealthy workplace on the workers were discussed by Hippocrates (460-377 BC). It was known that Caesar (100-40 BC) employed an official for taking care of the safety of his troops (Pease, 1985, Weaver, 1980). The field of health and safety is quite extensive and varied; hence, it is not possible to carry out a detailed discussion of these aspects in this thesis, or in any thesis for that matter, as has been stressed by Geller (1996); Guarnieri (1992);Heinrich (1959); Heinrich, Petersen, & Roos (1980); Margolis & Kroes (1975); Weindling, and others. A conceptual methodology is going to be adopted by the OHS them. The concepts are abstract and so, it is possible for health and safety experts to create a framework for the concepts. For this purpose, Figure 2 has been developed to explain the impact and flow of health and safety within an organization.

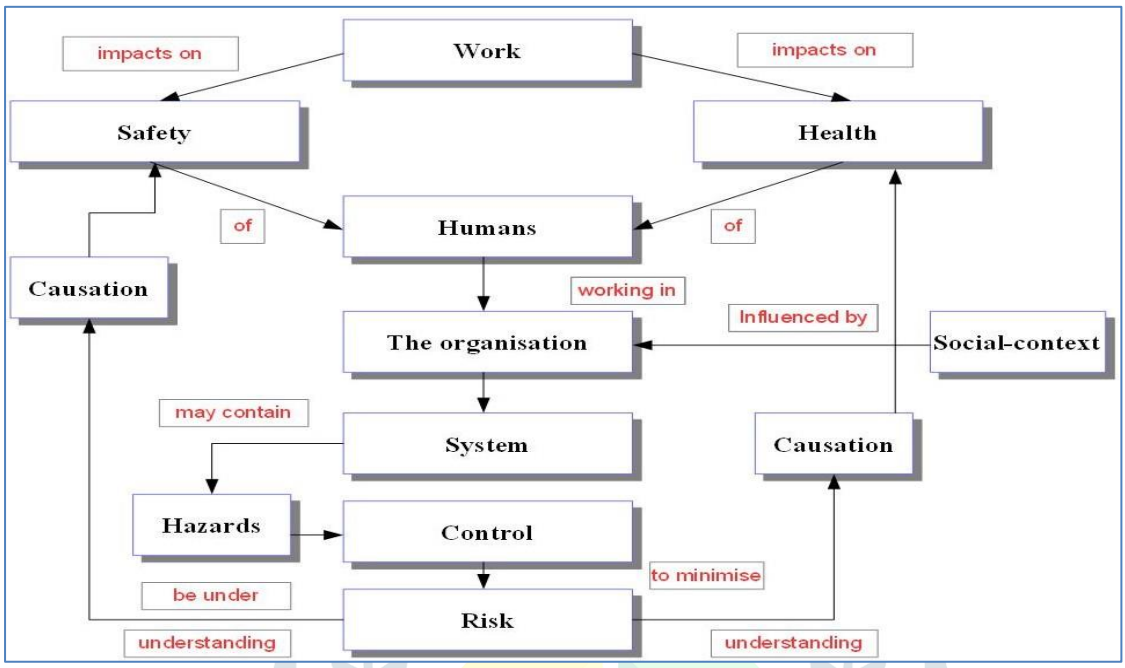


Figure 1.- Overview of a health and safety framework.

This chapter presents a generic and observational overview of health and safety, within the construction industry, giving an account of its history, history of accidents, management, health and safety management, risks, motivation, overview of accidents, causation and its effects, legal fundamentals and summary. It will build up a discussion to give an insight of developing a conceptual framework identified as an essential base of a practitioner within OHS. This overview would be seen as a background and basis to develop and use this information to implement, in later chapters, the identification of the three main areas to be discussed within this thesis, thus being the problem of how to improve organizational health and safety within the monitoring of procurement in construction, it's cost effectiveness and the responsibility of the contractor. In light of this, health and safety legislation deals with accidents, and ways to prevent such matters. To lead on, this chapter will identify and highlight accidents, by examining existing literature on health and safety with a view to defining what an accident is, its major causes and associated costs. It also will discuss health and safety systems and how it can help in reducing the rates and fatalities of accidents and ill health in organizations. Also, this chapter identifies the phrases 'health and safety management system(HSMS)', 'safety management system (SMS)' and occupational health and safety (OHS)' which are used interchangeably. An emphasis will be placed on the identification of the essential elements of health and safety, with a view to identify and deduce safety standards in organizations within the construction industry. To minimize the confusion between structured and non-structured efforts to minimize accidents, it is important to distinguish between those activities which are seen to have been undertaken by an organization and the actual existence of health and safety within construction. First, a system defines a "set of things considered as a connected whole; a plan of action; a method of procedure; method of organization" (Brookes et al. , 2003). Thus, a system as used in health and safety literature refers to the composition of humans, machines and the environment which interact in order to achieve a defined goal (Sanders and McCormick, 1993). Systems can also be purposive and hierarchical (that is, considered as being or forming parts of larger systems) or a nesting of systems within a set system boundary (Sanders and McCormick, 1993). The inference from these is that a system operates in an environment which ensures the interaction of its various parts.

Subsequently, the primary aim of occupational health and safety (OHS) is not only to ensure the maintenance of the working ability of the labor force, but also to ensure that hazards within the working environment are identified, assessed and prevented (Ahasan, 2002). It also ensures that workers carry out their jobs in safe environments, by establishing mechanisms that help to correct unsafe actions and eradicate unsafe conditions. The argument by Scipioni et al. (2001) that accidents at work and occupational injuries are unintended consequences of production that are inextricably linked to the relationship of the worker to the plant, machinery, materials and substances present in the workplace, suggests that there is a relationship between work and work environment/facility. Subsequently, it becomes essential that activities which not only ensure safe conditions for work but also in stil safe attitude to work are identified, developed and implemented. This argument suggests that health and safety interventions should be concerned not only with making the environment and equipment safe for use, but also with changing the perception and attitude of workers for whom these facilities have been provided for. Thus, workplace safety involves technical interventions as well as the adoption of management, organizational, and training instruments that can influence risk behavior (Scipioni et al., 2001), through targeted intervention aimed at changing how things are done (Robson et al., 2001).This intervention may be in the form of a new program, practice, or initiative intended to improve safety (e.g., engineering intervention, training program, administrative procedure). Interventions to improve organizational health and safety management or performance could be focused on activities aimed at improving the technical sub-system or the human sub-system as shown in

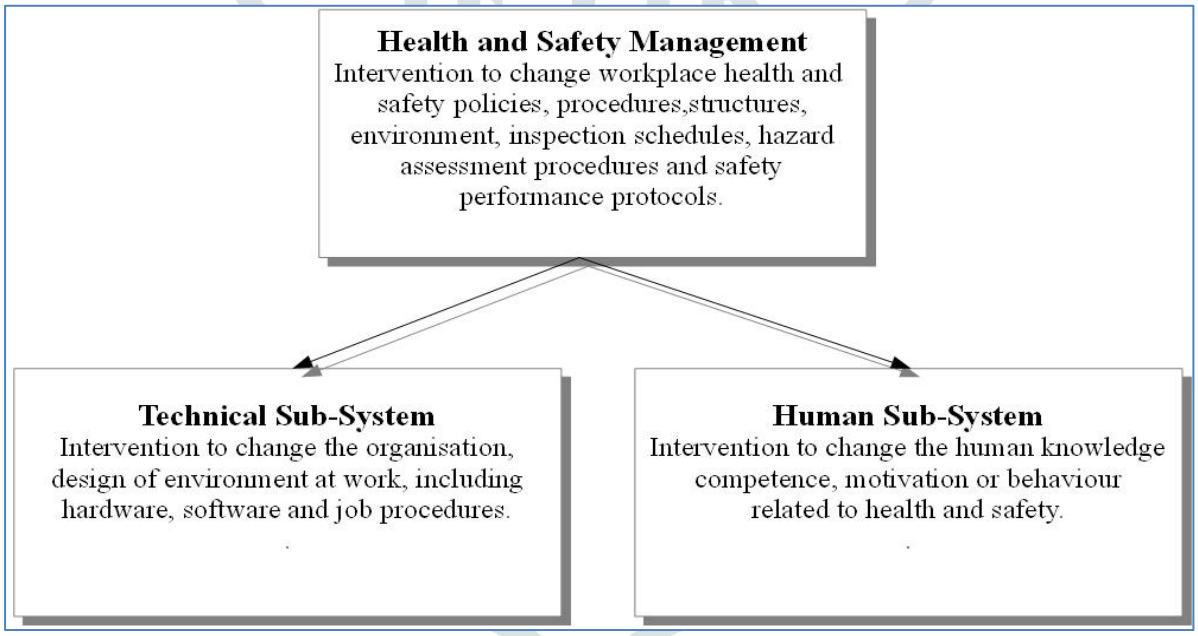


Figure 2- Different aspects of a workplace health and safety environment.

2.2 Importance of health and safety.

It is perceived that there is a requirement for the reaffirmation of the fact that an effective health and safety administration would contribute to enhancing the stature of a firm, demonstrated by a decreased incidence of accidents and damage to property in the company (Confederation of British Industry, 1990).After an extensive review and summarization of existing and available literature in this regard, the researcher is of the conclusion that most companies seem to consider health and safety measures as contributing to the cost of doing business, and do not necessarily view the same as enhancing the competitiveness of the business. It is perceived that there is a requirement for the reaffirmation of the fact that an effective health and safety administration would contribute to enhancing the stature of a firm,

demonstrated by a decreased incidence of accidents and damage to property in the company (Confederation of British Industry, 1990).After an extensive review and summarization of existing and available literature in this regard, the researcher is of the conclusion that most companies seem to consider health and safety measures as contributing to the cost of doing business, and do not necessarily view the same as enhancing the competitiveness of the business. In any event, the majority of firms and businesses

do seem to follow and implement health and safety standards, even while it is clear that organizations need to be encouraged to adopt the same through

their own free will so that they accrue greater associated financial benefits, and are therefore able to transfer part of the benefits to the general public too (European Agency for Health and Safety at Work, 2002). Elgstrand (1985) is of the perspective that increased standards and levels of safety and health standards implemented would ensure more productivity and increased profits for the firm in the long run.

Correspondingly, the European Agency for Health and Safety at Work (1999) has seemingly highlighted and identified some of the possible benefits in this regard, while White and Benjamin (2003) have emphasized how implementing the standards would contribute towards greater prosperity within the organization and increase worker productivity since there would be lower rate of absences due to injuries and illness. This would enhance the stature of the organization and contribute to greater profit and turnover. Because of lower expenses connected with work environment accidents, a superior relationship with builders and contractors has an additional minimized probability of prosecution and ensuing penalties. Despite the advantages resulting from the usage of an effective health and safety administration framework in any case, there are still questions about the utilization of economic advantages as an avocation for setting out on health and safety improvement activities. In such cases, organizations have ceaselessly re-composed to reduce costs, due to mishap and ill health. Moreover, health and safety management being a key component of successful manufacturing associations and organizations (Basu and Wright, 1997), has been recognized as having the capacity to enhance the aggressiveness and competition of an organization. Regardless of the advantages logically from the execution of a viable health and safety administration framework in any case, there are still questions about the utilization of financial advantages as a defense for embarking on health and safety change activities. However, organizations have consistently re-sorted out so as to cut costs due to mishap and ill health. Beach (1980), states that an accident is an unexpected event that interferes with the consistent advancement of an action, and could occur without an injury occurring. Whilst this definition appears to have considered each part of an accident, it is still insufficient as it neglects to consider both the circumstances and end results of such accidents. This insufficiency is further highlighted by the perception that injuries at work and work related diseases, as results of the generation cycle, are inseparably connected to the relationship of the specialist, i.e, the operator of plant, machinery, materials and substances show in the working environment (Scipioni et al., 2001). As a result of these perspectives, a superior portrayal of an accident or injury, maybe, is that given in Bamber (2003) which characterizes an accident as a sudden, impromptu, occasion in a succession of events, that happens through a variety of reasons; results in a physical damage (harm or malady) to an individual, harm to property, a close miss, a misfortune, or any blend of these impacts.

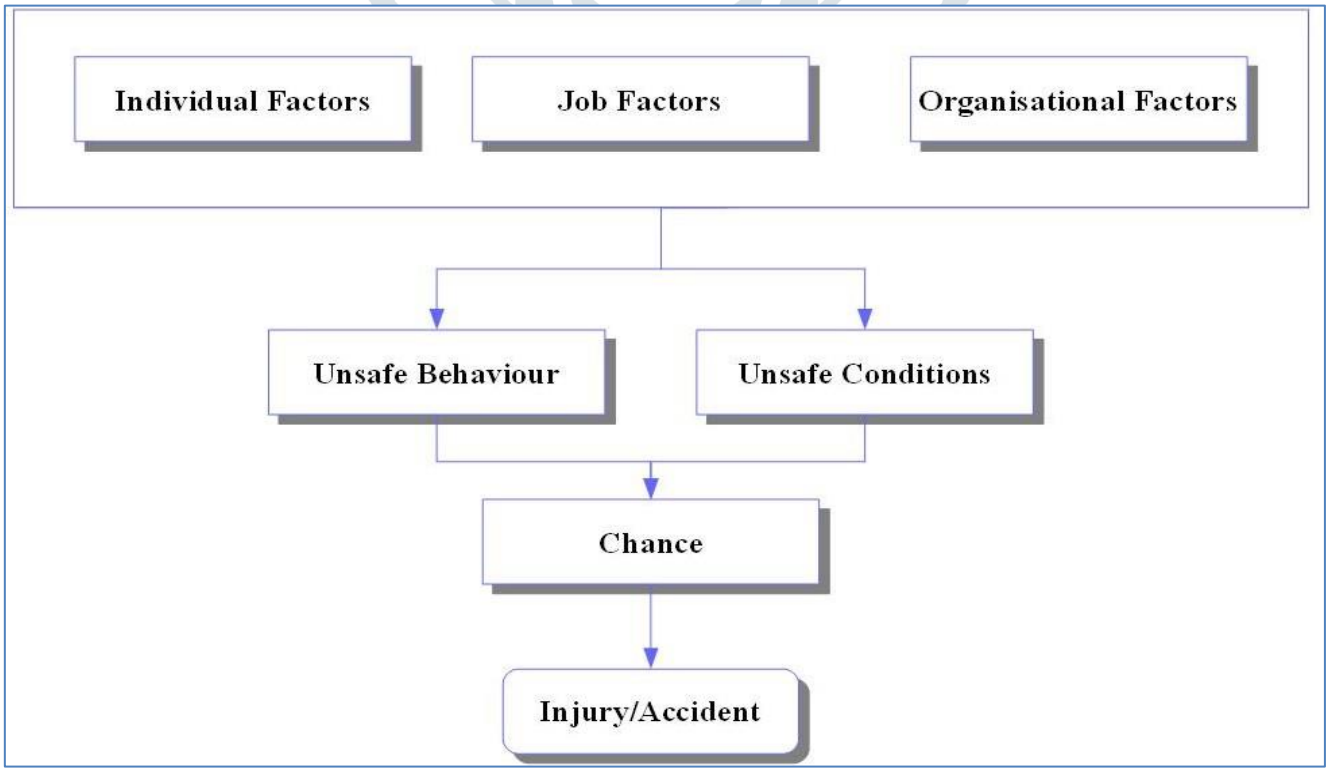


Figure. 3- Accident contributory factors. [Adaptation from Burnett, 2005]

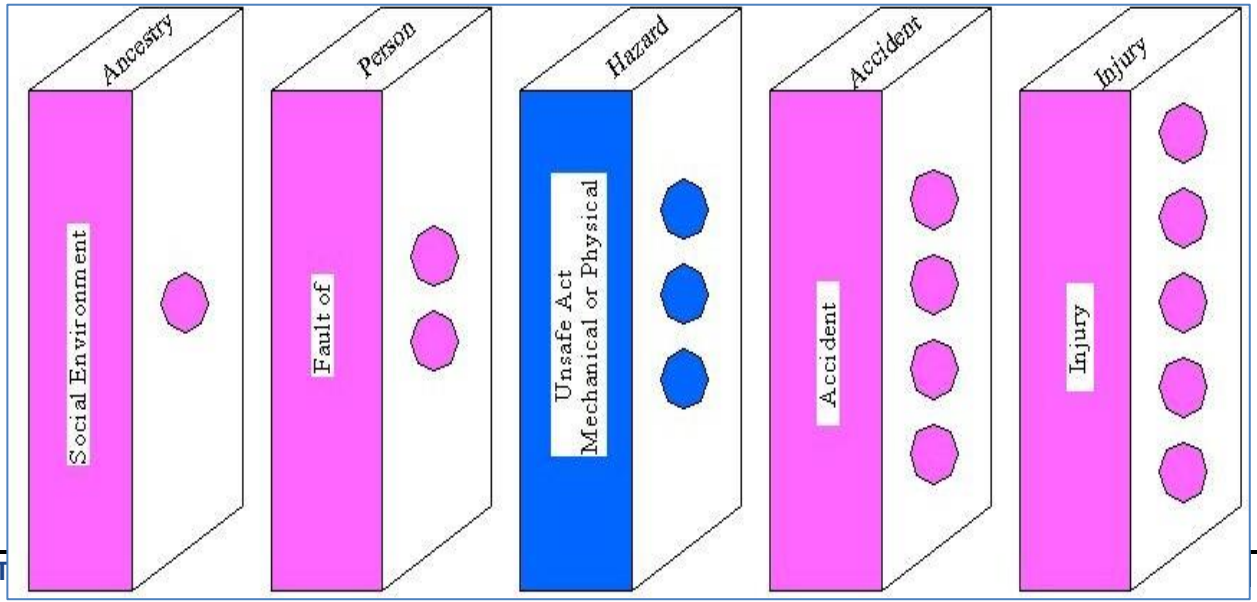
These views suggest that within a working environment, health and safety does include specialized, technical interventions as well as obligations for the appropriation of management, authoritative and training which could impact "risk behavior" (Scipioni et al., 2001). This perspective gives an impression that injuries result from chance elements that are unavoidable; a feeling that appears to be misinformed, as it has been noted that in about every example of an injury, there are measures that could have been taken to deflect the injury (Beach, 1980). Factors that can bring about an accident are extensively arranged into unsafe conditions and unsafe actions as demonstrated in Figure 2.2. (Adjusted from Burnett, 2005). While Stranks (2000) accepts that accidents are results of specialized and human errors, Mill (1992) contends that accidents and sickness are, by and large, results of carelessness that if not legitimately distinguished and tended to through a health and danger evaluation process. It is observed that a range of health and safety inputs in this regard seemingly relate to how there could be further improvements within existing policies and processes already implemented. Thus, a concerted effort is made towards ensuring that existing policies are formulated with a focus on enhancing administrative and management processes so as to incorporate and accommodate health and safety aspects, instead of implementing organization wide processes (Health and Safety Executive, 1997). If accidents somehow managed to be stayed away from, or indeed avoided, it is basic that supervisors, group leaders, administrators, and workers must co-work and join in the arranging, association, execution, and control of operational exercises. These administration controls or protections that have been put in place and set up with an intention to diminishing the re-occurrence or effect of accidents ought to be in view of prevailing hypotheses, if they have a desired impact. This is on account of they help in an efficient identification, detachment and possible removal of those components that can bring about accident(s).

2.3 What causes accidents?

Two mainstream accident hypotheses about such causes are the Domino theory and the systems theory. While accident examination models that are in view of the "framework" or "theory" have a tendency to inspect all potential contributory elements to any accident, those that are in light of the "customary" theory focus their investigation and examination on the people concerned, and on the most immediate

Causes for an accident. Thompsons Solicitors (2001), indicated that the conventional approach is supported by associations and organisations which recommend that numerous such bodies do not operate a framework that would empower them to separate adequately the underlying or basic reasons for accidents amid the investigation of accidents. Despite the complexity quality of any theories or

Hypotheses behind accident causation, these must be comprehended if there are to be any imperative updates in incident avoidance techniques. Notwithstanding the way that these theories can be seen as speculative in nature, and perhaps of obliged use in the repulsiveness and control of accidents, it ought to be seen that no single theory or hypothesis could be seen as right or legitimate, with a far reaching attestation. In like way, these hypotheses and speculations, yet essential, are not adequate for adding to a packaging of reference for discernment of accident events (Raouf, 1998). Notwithstanding the way that the Domino (or standard setback approach) speculation (Figure 2.3) considers incidents as aftereffects of threat bearing goes about furthermore dangerous conditions, these perilous and risky conditions, don't however contribute in equivalent measures to accidents. For example, it has been fought that around 88% of all incidents are made by dangerous human acts, 10% by hazardous



activities and the remaining 2% by "shows of God" (Heinrich, 1959). In this manner, the obliteration of these surprising human acts which prescribes well over more than 80% of all accidents identifies with an essential step towards the suspicion of setbacks (Sznaider, 2000).

Figure.4- Causes of an accident - the Domino sequence. [Adaptation from Heinrich, 1959]

Critics of this model contend that by embracing an intolerant perspective of accidents, this model neglects to perceive that accidents result from various reasons. In this way, the chance of distinguishing and explaining the underlying causes of accidents get to be extraordinarily decreased (Petersen, 1971). This is however by all account not the only criticism of this model. For example, (Wright et al), noticed that in the domino theory of accident causation, there is not just a wrong concentration on what happened and how it happened as opposed to on why it happened, there is likewise a limitation of an incident investigation to just a restricted arrangement of reasons. Also, Wright and his associates, proceed with this theory to be inciting a supposition that the aversion of future events could just be accomplished through disciplinary or procedural methods and a culture of distributing and finding fault to those most immediately included. Additionally, intercessions taking into account of this model are often short term and incapable, on the grounds that they are not able to address the remote conditions brought on by an accident. The framework theory or the various causation hypotheses is a branch of the domino theory. It however varies from it by perceiving and enhancing the way that accidents are frequently results of a few contributory elements happening in the meantime, and in this manner expects to dispose of these contributory variables. The system based approach is to deal with accident examination, and perceives that people have inherent vulnerabilities and tries to comprehend the full scope of elements that add to an incident. Because of this, organizations that are agreeable to this framework are receptive about the reasons for hazardous conduct and behavior. This attitude, and indeed state of mind is induced by the perspective that people frequently work in accident actuating circumstances. This approach addresses the fundamental reasons i.e. hierarchical and organizational strategies, of these conditions by first distinguishing the prompt reasons for an incident e.g. inability to hold down methods and procedure. Leverage of this approach is deduced by distinguishing the immediate and remote reasons for an incident; it is proactively handling the conditions that could prompt future occurrences. Another model of accident causation theory is the loss causation model (Bird, 1974), which is shown in Figure 2.4 (Source: Bird and Germain, 1990).

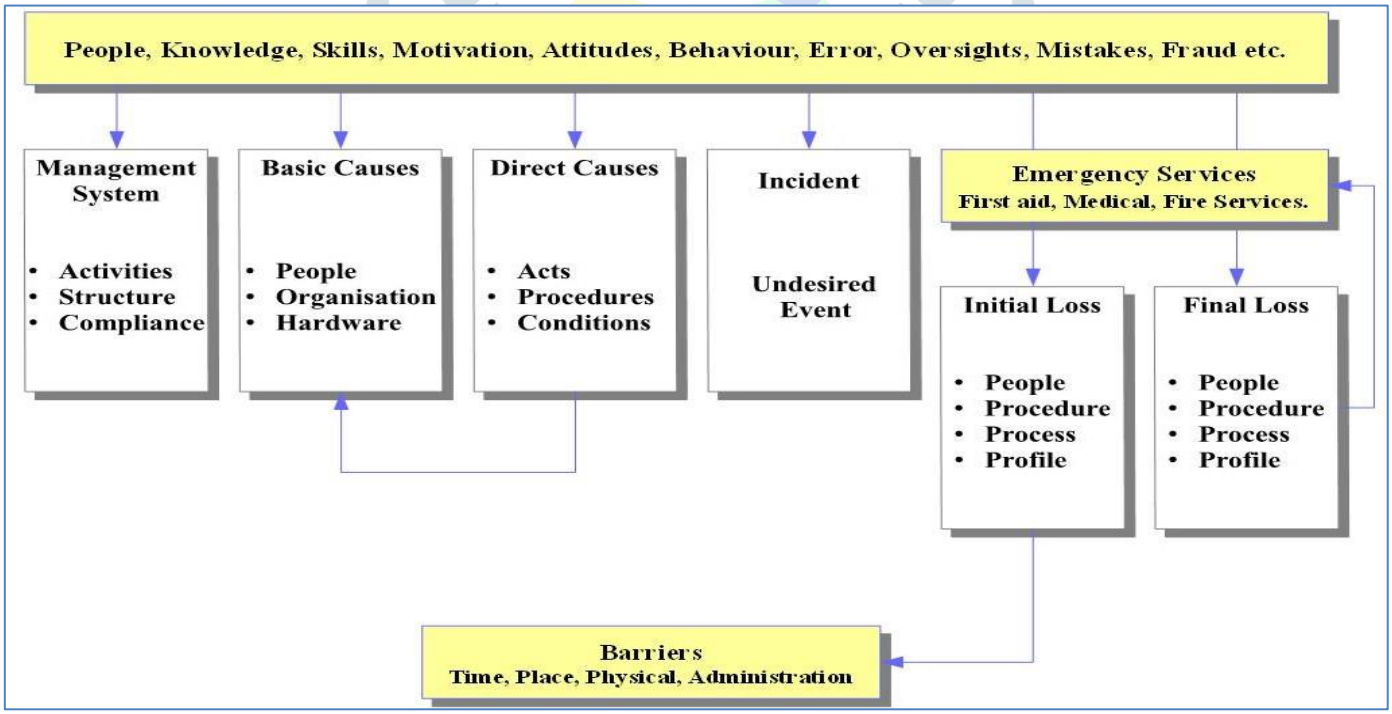


Figure 5- Loss causation model.

The loss causation model is a practical and effective comprehended accident investigation framework which shows what could be utilized by all levels of an organization, from first line administrators upwards. It is a basic, however exhaustive model which dependably looks for, and gets information about accident causation. It also represents the planning, management and control of such accidents. A significant supposition in this model is that absence of legitimate control is frequently the underlying driver of real accidents endured by the organization. A loss for the reasons of this work is characterized as a production issue, natural contamination, property damage, individual damage, deterioration of Workers health and so forth.

2.4 The evolution of models of accident causes.

Herbert. W. Heinrich was the first individual to understand and assemble models of mishaps. His work, depicted in his book "Industrial Accident Prevention", conveyed in 1931, was a basic generation as to understand incidents. The benchmarks in which he outlined, regarding the utilization of science to accidents, portrays, (1) "through the creation and upkeep of a dynamic excitement for security; (2),be assurance finding; and (3) lead to medicinal movement in perspective of the facts", (Heinrich, 1931). Heinrich's book, now in its fifth edition, goes on and highlights the consecutive variables inciting an incident and declared what can be termed a period of fundamental progressive sequential modeling.

2.5 Cost of work related accidents, injuries and ill health.

Accidents at work, in addition to having prominent impacts on a workforce health and organization performance, likewise represent a considerable economic weight. These expenses are either visible or invisible (Mossink and De Greef, 2002), self-evident (direct cost) or hidden (indirect costs) (Confederation of British Industry, 1990). Cases of these incorporate property harms, protection and additionally lawful/legal expenses, restorative costs, wages and profitability misfortunes and losses. These expenses are not generally transparent and organizations are not regularly mindful of the amount they spend as an after effect of work based accidents and ill health. For instance, it was noted in Curran (2003) that the expense connected with health and safety incidents are up 300% to 400% higher than those recorded in organization records. Figure 2.5 (Source-Estimating the Cost of Accidents and ill Health at Work, EU-OSHA, 2014) condenses and generalizes an applied system of work related accidents and sick health outcomes/ monetary expense of accidents at work.

Figure 6- Estimating the cost of accidents and ill health at work a review of methodologies.

[European agency for health & safety at work - EU - OSHA]

A comparable perspective to the above had been expressed by Heinrich (1959) and also Bird and German (1966). Without doubt, organisations will unavoidably be influenced by the results of these health and accidents if there are no satisfactory organizational controls put up to prevent accidents from happening. There is a view that the expense of cost related injuries and sick health to the general public and society is totally underestimated (Loewenson, 1998; Pantry, 1999). This outcome from the propensity avoids the expense brought about as a consequence of brand value harm and damage, loss of consumer certainty and identity, and preoccupation of management time, disturbance in the production network activity, loss of worker assurance and morale, and loss of human lives (Baldwin and Anderson, 2002), during the calculation of damages. The basic legal framework establishing health and safety standards within the United Kingdom is the Health and Safety at Work Act (HSW Act), enacted in 1974.

3. LITERATURE REVIEW

3.1 General Introduction.

In the paper a brief overview of occupational health and hygiene of construction workers, Occupational Health and safety issues have been the subject of study since the development of a construction site and other related work settings. occupational accidents at construction site, occupational health hazards among construction site, occupational health and safety practices at construction site, and occupational health and safety monitoring at construction site, and occupational health and safety solution at construction site. Different methods to monitor the workers' health and safety and process to check the workers' health at construction site,

workers heath is very important to get better productivity in the construction site and it will help to complete the project within the time frame if health and safety conditions are maintaining properly at site and monitored day by day with continual improvement as per the requirement.

3.2 Paper for Occupational Accidents in Construction Works.

Şahin Tolga Güvel, Emel Laptalı Oral, did the study on occupational Accidents in construction industry and explain about the Causes and Suggestions for Preventions of the accidents at construction site. Construction is one of the leading sectors in occupational accidents. In these study occupational accidents in construction sector, their causes and suggestions for prevention are discussed. Five different occupational groups working in construction area including labour-skilled labour, technical staff, occupational safety staff, building inspection staff and senior executives were investigated for their opinions on occupational health and safety applications in Turkey. In the survey study, the causes of occupational accidents and the suggestions for prevention were evaluated using the data obtained by a questionnaire survey applied to a total number of four hundred and eighty workers from all of the above-mentioned groups.

3.2.1 Introduction

It is very difficult to fulfil occupational safety requirements in construction sector due to the fact that different teams come together for a specific project and separate from each other at the end of the project. Relationships are project based, staff turnover is very high and risks related to work are constantly changing because of the constant change of organizational structure. In order to ensure occupational safety in construction works, types of occupational accidents and the factors that cause these accidents should be determined first. Prevention of accidents and safety assurance can then be achieved by taking these into considerations.

3.3 Paper on Occupational Health Hazards among Construction Workers.

Joseph Emuron, did the study on occupational health hazards among the construction workers at site and evaluate the risk, The purpose of this study was to identify and highlight the hazards that are most commonly found at construction sites in Botswana. Respondents from Estate Construction Company located in Gaborone were selected for this study. Questionnaire survey was conducted on the construction site to establish the health and safety hazards prevailing and control measures therein. A physical observation was also conducted on the construction sites in order to relate questionnaire responses to what actually obtains on the construction site.

In Botswana, the construction industry is booming as economic development takes its course. However, much as construction has come with its benefits, records of the factories inspectorate of the department of labour reveal that between 2000 and 2003, five fatalities were recorded in Botswana's construction industry. Even though the number of these accidents is not alarming, the benefits paid to the accidents victims are high. These accidents represent a considerable economic and social burden to employers, employees and to the society as a whole. This therefore calls for urgency in mitigating this problem. This study will help come up with comprehensive measures to rectify this problem such; identifying the hazard, assessing the risk and controlling the risk to ensure a safe and conducive working condition for the workers. Implementation of control measures requires different approaches due to changing working environment at the construction sites.

3.3.1 Introduction

The global volume of construction output is forecast to grow by 85% to $15.5 trillion by 2030, according to PricewaterhouseCoopers, with the largest construction markets the US, India, and China accounting for 57% of global growth. Other key markets include Japan, Germany, Spain, France, and Italy. Emerging markets such as India is growing quickly as a result of increased urbanization, rising populations, and the expanding middle class. Construction growth in China is expected to slow in some sectors such as housing and shift to health care, education, social infrastructure, and retail. Construction in some mature economies has been constrained by government deficits and austerity measures. The US construction industry includes about 660,000 establishments (single-location companies and units of multi-location companies) with combined annual revenue of about $1.5 trillion (First Research Industry Profiles; Fort Mill, South Carolina).

Over the last two decades, the construction industry has grown tremendously hence becoming one of the main engines of growth and development in many economies as shown by statistics above. It has provided infrastructure that other sectors of the economy rely on to produce goods and services as well as housing which is a basic human need. Other opportunities that come with it are: employment opportunities and communication networks. However, despite its importance, it's littered with a lot of hazards and

presents itself as one of the riskiest sectors to work with especially where rules and regulations are not fully implemented. Potential hazards for employees in the construction sector include: scaffold collapse, trips, slips, failure to use proper personal protective equipment, falls from height, collapse of trenches, noise, repetitive motion injuries caused by vibrating tools, falls, electric shocks and arc flash blasts and every day and this makes them have the potential for becoming sick, ill or disabled for life. The above scenario can be managed by ensuring rules and regulations are fully implemented, there is adequate supervision, training of workers and other hierarchy of control measures. However, there is no single best approach to the management of hazards in the construction sector but it should involve all stakeholders. In that way, all their interests will be considered.

And evidence shows that a well-considered policy contributes to business efficiency and continual improvement throughout the organization. It helps to minimize financial losses arising from avoidable accidents and demonstrates to the workforce that accidents are not necessarily the fault of any individual member of the workforce. A good health and safety policy helps to ensure that there is a systematic approach to risk assessment and sufficient resources, in terms of people and money, have been allocated to protect health and safety and welfare of the workforce (Phil Hughes 1995-2001). This elucidates the fact that having a quality policy in place can help in addressing the challenges arising in the construction.

3.4 Paper on Safety Monitoring to Prevent Fall Accidents at Construction Site Using Augmented Reality.

Petcharat Limsupreeyarat1, Tanit Tongthong1, Nobuyoshi Yabuki2, did the critical analysis for the safety monitoring to prevent fall accidents at construction site using augmented reality; Safety monitoring is normally separated from the main construction processes and relies on the site personnel's knowledge and experiences. Most of project information is presented based on a 2D paper format and is difficult to understand. The site personnel have to convert the paper-based information and generate 3D mental pictures. They use the converted information to track the safety measures, safety signs and workers in the actual construction environment. This task is tedious and burdensome. Therefore, this paper proposed the integrated and visualized system to assist the site personnel in safety monitoring by using Augmented Reality (AR) technology. This technology can provide the specified virtual information and superimpose into the real world scene. The safety protection for preventing fall accidents is focused on. The prototype system was developed and tested in both laboratory and real environment. The demonstrated results show the feasibility to implement the proposed system in real construction project which the supervising personnel can easily inspect and control the specified safety measures, safety signs, and personal protective equipment.

3.4.1 Introduction

Construction has its own characteristics that are different from the manufacturing. Tasks and activities are always performed in an open area and exhibit variation in the physical environment. Many tasks and activities are performed high from the ground conditions. There is a potential for serious accidents in construction sites due to the following causations: many people are close together, many activities are unpredictable, and the tolerance of risk is traditionally quite high, making the frequency and impact of unplanned activities very high [1]. According to the cause codes of accidents in the construction industry by OSHA, there are five basic cause codes, consisting of falls, being struck by an object, caught in/between equipment or material, electric shock, and others [2]. The statistics on occupational injuries and fatalities then show that falls and being struck by a moving or flying/falling object are the top three accident causations in the construction industry [3]–[4].In order to avoid accidents caused by falls or falling objects, preventive strategies such as identifying the potential hazards, proper selection and use of safety protection system, training in the workplace, and provision of adequate preventive equipment are necessary [5].In order to prevent accidents and improve the level of safety in construction, various safety management systems are implemented during project-execution phases. According to a study of [6], safety management is the set of actions or procedures associated with health and safety in the workplace. Three main tasks of safety management consist of hazard identification, safety measure planning, and control. Not only these tasks, but safety education and training are also other essential tasks for achieving a zero accident target. However, in order to support construction personnel and to enhance the efficiency of safety management, potential tools such as information technology are required. Therefore, many previous studies have made an effort to suggest the implementation of information technology in safety management processes.

3.5 Paper on Investigating the Occupational Health and Safety Practices in High-Rise Building Construction Sites.

Agu Ransford Tetteh1, Ye Liang2, did critical evaluation on the investigation of the occupational health and safety practices in high rise building construction sites, Occupational health and safety practices have become a problem in construction sites since

some of the employers undermine the safety of their workers on sites which result to a lot be injured during the construction process. This research is to find out how some occupational health and safety practices involving high rise building sites are obeying. A safety practice in the construction industries contributes a good way to accidents prevention and reduction. Therefore, these researches were done in view of identification and examine some occupational health and safety practices in our construction industries. This study based in the Accra metropolis, Ghana. Data gathering was obtaining by questionnaire and data analysis was carried out using ranking method. The findings showed that almost all factors including occupational health and safety practices, unsafe occupational health and safety practices, adherence to occupational health and safety measures, sanctions for non-adherence, health and safety document on hazardous practices, training workshops on health and safety practices, how often training workshops come off, provision of health and safety equipment for workers. Therefore, to promote Health and safety practices in the constructions fields and reduce construction accidents on high rise building site, all these factors have to be considered.

3.5.1 Introduction

Apparently, the construction industry is currently being recognized as a major economic force in Ghana. The construction industry also plays an important and strategic role in supporting the development and the growth of industry in a nation. Ghana, as a developing country, has concentrated in improving the development of the country by having an increasing number of mega projects, some categorized as national projects. These do not include the increasing number of local projects in most cities in the country, since every region has control of the development within its own area. Despite the fact that construction industries are in line with the intensity of the development, many aspects within the construction itself are neglected. Just as important is the safety of the workers during the working time, concerning the occupational safety aspects within construction industry, it is apparent that the implementation of safety best practices is still far from good. Construction accidents, which often occur, are due to neglecting certain safety regulation despite the presence of government regulation regarding safety. These cases have been going on since the early development of the construction industry. Generally speaking, every case of construction accident involving casualty of an individual or to a number of workers is investigated thoroughly and ironically the matters are finally resolved with conclusion of careless conduct.

4. DATA COLLECTION AND PROBLEM STATEMENT

4.1 Data Collection

4.1.1 Occupational health services for building workers at Construction Project site.

1. A special medical service or an occupational health service is always available at site along with the following services-

- We do provide first-aid and emergency treatment.
- We do conduct special medical examination for occupational hazards to our building workers before their employment and thereafter at such intervals as specified by the Chief Inspector / state BOCW act & rules from time to time.
- We conduct training of first-aid personnel of all such medical services.
- Promote health education, including family welfare among such building workers.
- Co-operate with the Inspector having jurisdiction in the detection, measurement, and evaluation of chemical, physical or biological factors suspected of being harmful to such building workers.
- Undertake immunization for all such building workers against tetanus, typhoid, cholera, and other infectious diseases.
- The special medical service referred to in clause (a) collaborates with the Labour department or any other concerned department or service of the State Government in matters of treatment, job placement, accident prevention and welfare of such building workers.
- The special medical service referred to in clause (a) is headed by a construction medical officer and is provided with adequate staff, laboratory, and other equipment's.
- The premises of the special medical service referred to in clause (a) are conveniently accessible, comprise at least a waiting room a consulting room a treatment room, a laboratory and suitable accommodation for nurses and other staff of such service.
- The special medical service referred to in clause a) maintains records pertaining to its activities referred to in sub-clause (i) to (vii) of clause(a) and sends to the Chief Inspector once in every three months, information in writing on-

- The state of health of such building workers.
- The nature and causes of occupational injuries or disease suffered by any of such building workers, treatment provided to such worker and measures taken to prevent recurrence of such injuries or disease.

4.2 Steps to Improving Workplace Health and Safety

4.2.1 Create a Plan

As an employer, we have identified hazards in our workplace and take steps to eliminate or minimize them. Safety plan has been developed & discussed with our employees what we must do to ensure their safety and what you expect from us. We have also ensured that our employees have access to a first aid kit at many work locations/ offices. Hazards can include: a cleaner working with heavy duty cleaning products, a mechanic working with large machinery or a warehouse manager stacking heavy boxes.

4.2.2 Inspect Our Workplace

All equipment and tools have been regularly checked to ensure that they are well maintained and safe to use. Also, has been checked storage areas and review safe work procedures. Boxes are in our storage area stacked in a safe manner. Our employees are instructed how to lift heavy goods without injuring themselves. Employees have been also aware that where the fire exit and where they should gather if there is a fire.

4.2.3 Train Our Employees:

Proper training is necessary for all employees, especially if there is a risk for potential injury associated with a job. Provide written instructions and safe work procedures so they can check for themselves if they are unsure of a task or have forgotten part of their training. Supervise our employees to ensure that they are using their training to perform their job properly and safely. By not providing the correct training for our employees you are not only endangering the safety of our employees, but you will be held liable for the incident which could have serious consequences.

4.2.4 Keep an Open Dialogue

Meet regularly with our staff and discuss health and safety issues. Encourage them to share their ideas and thoughts on how to improve safety in the workplace. You might even consider providing first aid training for staff, so they are prepared to deal with emergency situations.

4.2.5 Investigate Accidents

If an incident does not cause a serious injury, an incident is investigated to help determine why an incident occurred so that we can take steps to ensure that it will not recur.

4.2.6 Maintain Records

Records of all first aid treatments, inspections, incident investigations and training activities are kept. This information helps us identify unsafe conditions or trends in work processes.

4.2.7 Make Improving Health and Safety a Key Part of Business

After security is not thought; it is as important to a successful business as customer service, inventory control and financial planning. A commitment to health and safety makes good business sense as it is a way to protect our largest resource.

4.3 Occupational Health Management Plan:

Our occupational health management plan focuses on the physical and mental wellbeing of workers in the workplace. Initiatives mentioned in the plan ensure that all workers on site are in good health and fit for the Job.

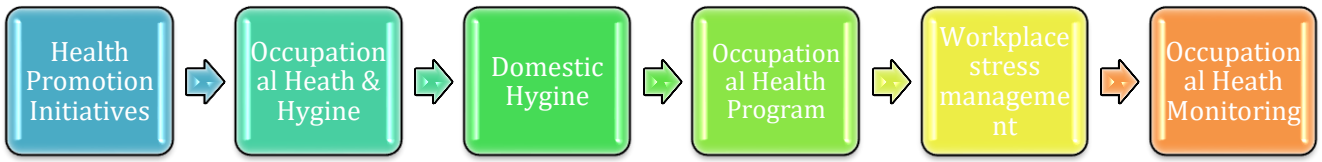


Figure 6- Occupational Health Management Plan

At Construction Project site, we are using different procedures and techniques to identify hazards, hazards are identified in different stages of the project to make a step ahead plant to deal with any kind of hazard.

4.4 Problem Statement

Every year huge no. of workers got injured due to acute and chronic diseases at construction site and there are many fatal accidents and other Incident happened due to non-compliances and other safety related less awareness among the workmen and management of any organizations, so by doing proper health and safety monitoring of workers at any construction site we can reduce/ eliminate any kind or incidents/ accidents at construction site.

5. MATHODOLGY

We have identify the types hazards of hazards present at construction site, and how many workers are exposed by this hazards and then calculate the risk score by the help of risk calculation based on the below risk matrix and categorized the level of risk then collect the data from the survey from different locations by medical check-up and mock interview of the workers as well collect the data from occupational health center, and first aid center, as well medical history of all workers and employees at construction site, done analysis of this all records on the basis of injuries, age, gender, trade, weight, height, eye vision, skilled or unskilled etc. different parameters, and then categorized the level of risk and there consequences and severity.

At Construction Project site; we have followed system to provide medical examination for all workers and staff to ensure that all are in good health and fit for the job, are working at site, according to BOCW act & rules and ensure all workers health is good and perfectly fit for the job.

Following steps are taken at Construction Project Site-

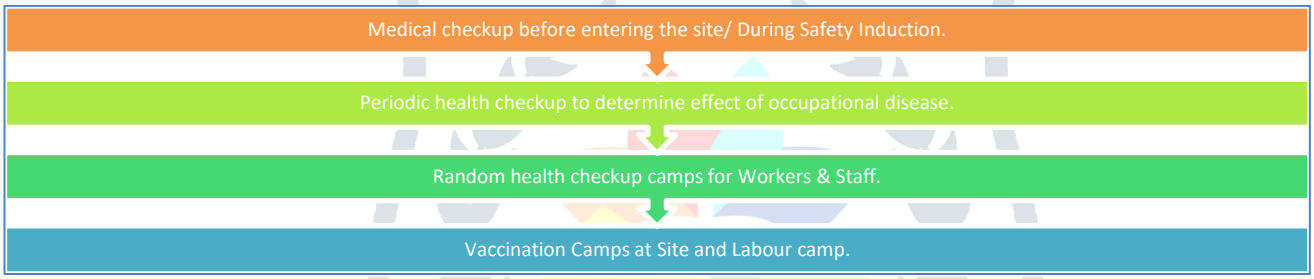


Figure 8- Occupational Health Management at construction site.

We have well equipped health care center and ambulance with construction medical officer/ doctor and GNM qualified male nurse, certified & experienced first aiders. We also have tie-up with local hospital to perform occupational health checkup which we cannot do at our OHC and for any emergency, which can't be dealt at site OHC.

5.1 Identification of Hazards at different stages of the project-

Figure 9- Stages of Hazard Identification at Construction Project

5.4.1 Process of HAZARD identification.

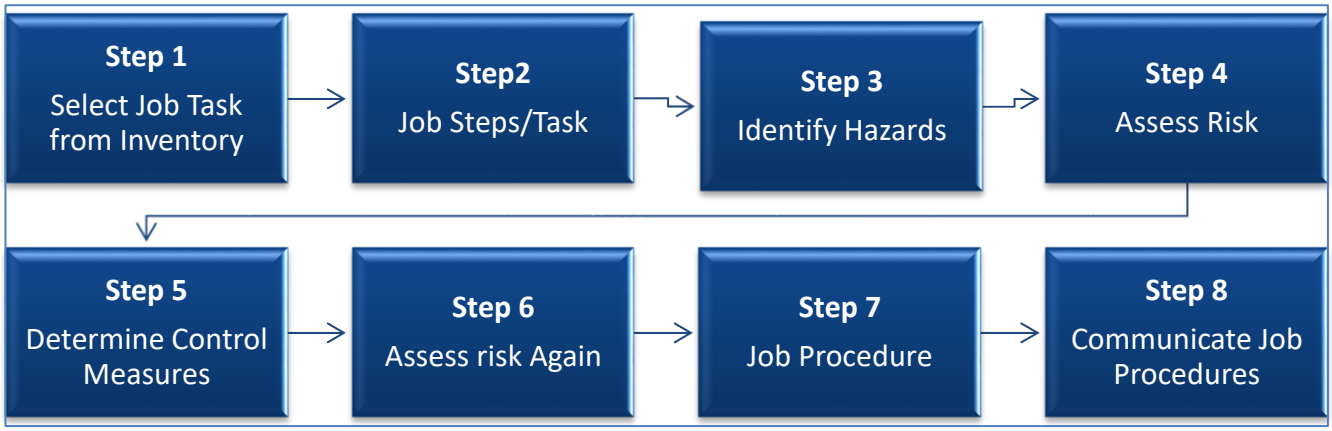


Figure 10- Process of Hazard Identifications

5.4.2 Techniques which have been applied in specific areas/ operations are given below-

Sr. No	Techniques to identify hazards	Area of operation covered
1	Scheduled Workplace Safety Inspection (i.e. - daily, weekly, monthly etc.)	Applied to all Activities at Site
2	Daily Site Visit	Applied to all Activities at Site
3	Daily Observations	Applied to all Activities at Site
4	Safety Sampling.	Applied to all Activities at Site
5	HSE alert campaign.	Applied to all Activities at Site
6	Weekly HSE Walk down	Applied to all Activities at Site
7	Surprise Visit	Applied to all Activities at Site
8	Inspection by Checklist	Applied to Plant & Machineries, and Critical Operations needed permit to work and activities which could be hazardous
9	Higher management visit	Applied to all Activities at Site
10	Regional co-ordinator/corporate HSE head Visit	Applied to all Activities at Site
11	Inter region Visit	Applied to all Activities at Site
12	Internal Audits	Applied to all Activities at Site on sample basis
13	External Audits	Applied to all Activities at Site on sample basis
14	IOHSR (HIRA)	Applied to all Activities to be performed at site
15	JSA (Job Safety Analysis)	Applied to all Activities to be performed at site
16	SOP	Applied to Plant & Machineries, and Critical Operations needed permit to work and activities which could be hazardous
17	Tool Box Talk(TBT)	Applied to all Activities at Site
18	ESWER (Either Safe Work Else Refusal) Campgain.	Applied to all Activities at Site
19	ROMESH (Respect Own Manage HSE)	Applied to all Activities at Site
20	Safety Round, Safety Survey	Applied to all Activities at Site on sample basis
21	Safety Sampling	Applied to all Activities at Site on sample basis

Table 1- Hazard Identification Techniques

In the establishment Hazard identification & Risk assessment & control is for the construction activites. In the first kick off meeting held at the site Regional HSE co-ordiantor, Regional Head, project Co-ordinaotor , project manager, engineers & PMV co-oridnator dicussed the HSE plan with site team. List of activites are identified as per the contract document.

5.4.3 Following inputs are taken to conduct the exercise of Hazard identification & risk assessment & its control.

Based on the above parameters, the hazards identification & risk assessment (HIRA) is done at site. Before starting the activity , the site team prepard work procedure, JSA, HIRA for each part of the job with detailed description of task to be performed & the HSE measures used to mitigate the hazards associated with task& submitted to client.

Based on the approval , the site team submits work-permits to client & start up the job.

Establishment has prepared job safety analysis for the construction activites. Counter measures were mentioned in the HIRA & authorised by the concerened authorities. The filled formats of HIRA is attached.

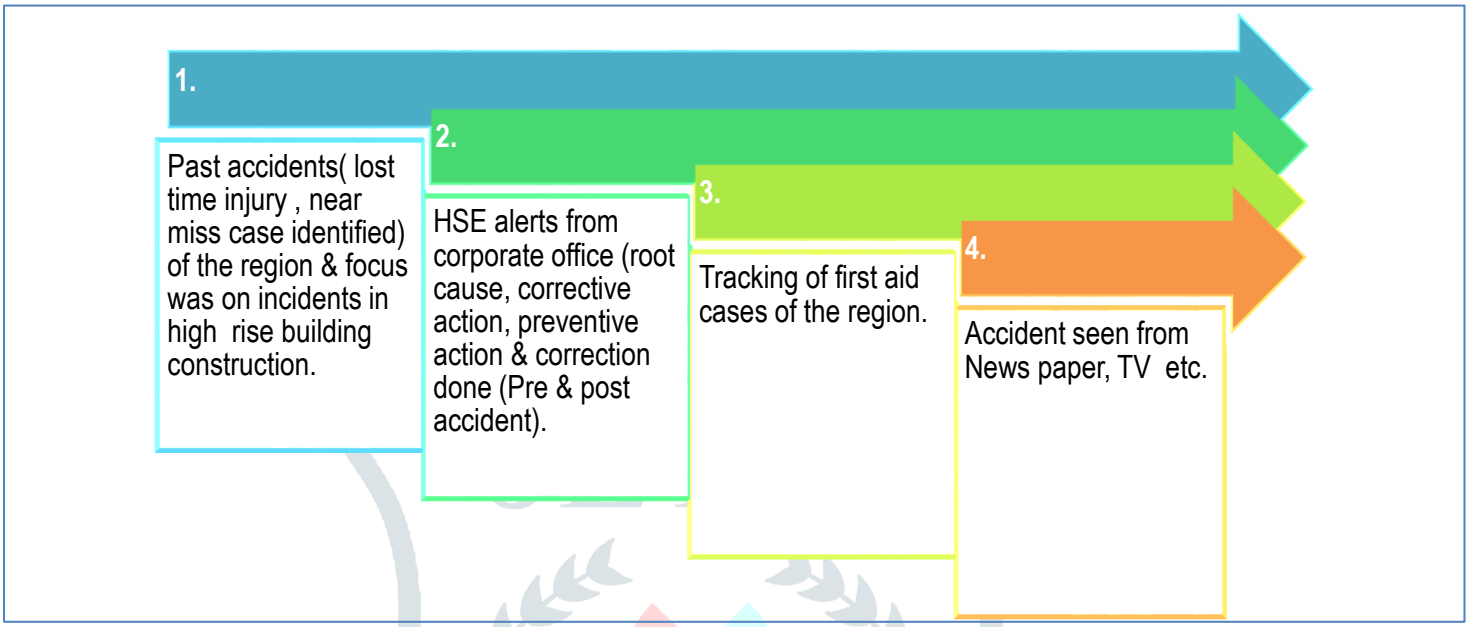


Figure 11- Strategies to mitigate the hazards

Before doing any job, Job safety Analysis is prepared for each activity and then submitted to client for approval. After approval of JSA, SPCL is allowed to do the job as per OSHAS 18001 standards (Hazard Identification & Risk Assessment- HIRA). HIRA is done as per applicable IS:15656.Initial occupational health and safety review (IOHSR) is one of the best technics to identify the hazard:All insignificant &Significant Hazards are identified in IOHSR register Hazard identification and risk assessment (HIRA) The significant hazards assessed through the IOHSR risk assessment scale & the legal requirements are integral input to calculate the significance of the hazard/risk. The risk level scores are given as per the defined process, any risk having ≥ 9 is not acceptable and risk is categorized as per the below table under 5 categories.

5.4.4 Risk Opportunity Identified Key Risk:

This is an "inherent" risk register addressing the risk independent of controls already in place. The validation of controls that mitigate these risks will be performed at a later stage. The risk will be a living document.

In the below mentioned, we are we are illustrating the key risk identified for the department. These key risks are the risk directly related to the department's activities accompanied with the rating of each risk differentiated into:

7. DATA ANALYSIS, RESULT, OBSERVATION AND RECOMMENDATION

7.1 Data Analysis

Training is essential part of any work done, It is key factor to get preferred output from worker / staff. It can help improve performance and reduce incidents on sites. There are several types of trainings can be utilized on site. It can be necessary or need based, we at ITPO Project try to impart 100 man hour per person per year training and we have achieved it for the assessment year of 2019. Different types of training which are given at our site people at different levels are listed below.

Induction training	Daily Tool Box Training
Job specific training	First Aid Training/CPR Training
Electrical Safety Training	Work at Height Training
Confined Space Training	Road Safety Training
Hot work Safety Training	Use of PPE's Training

Chemical Safety Training	Spillage/ Leakage Control Training
Emergency Response Training	Ergonomically Safety Training
Fire Fighting Training	Technical training
On job training	Defensive driving Training
Defensive driving Training	HSE Skills Improvement training
Motivational Training	3ST (Site Supervisor Safety) Training
Workplace Safety Training	Authorization training
HSE Awareness training	HSE Management System Life cycle in Construction Project
Legal Aspects in Construction Projects	Behavior Based Safety Training
Bar bending/cutting training	Lifting training
Stress management training	Excavation Training
Material Safety Training Environment awareness training	Hygiene training HIV AIDS Awareness Training

Table 2- List of Trainings provided

And to give above listed different trainings we have certified trainers within the organization, and outside agencies are also invited as well, Profiles of Internal Certified Trainers are given below-

Induction training program

Management and Supervisory Personnel				
Category of persons	No. of persons trained	% of trained Personnel over the total Management and supervisory personnel	**Duration in Man-hours**	**% of Training Man-hours over total Man-hours worked by the Management and Supervisory personnel**
1	2	3	4	5
Managerial Staff	82	100% (Ongoing Process)	2 Hrs.	0.054
Engineers	121			
Supervisors/ Forman	197			
Total	400		s.	

Table 3- Category wise training man hours calculation.

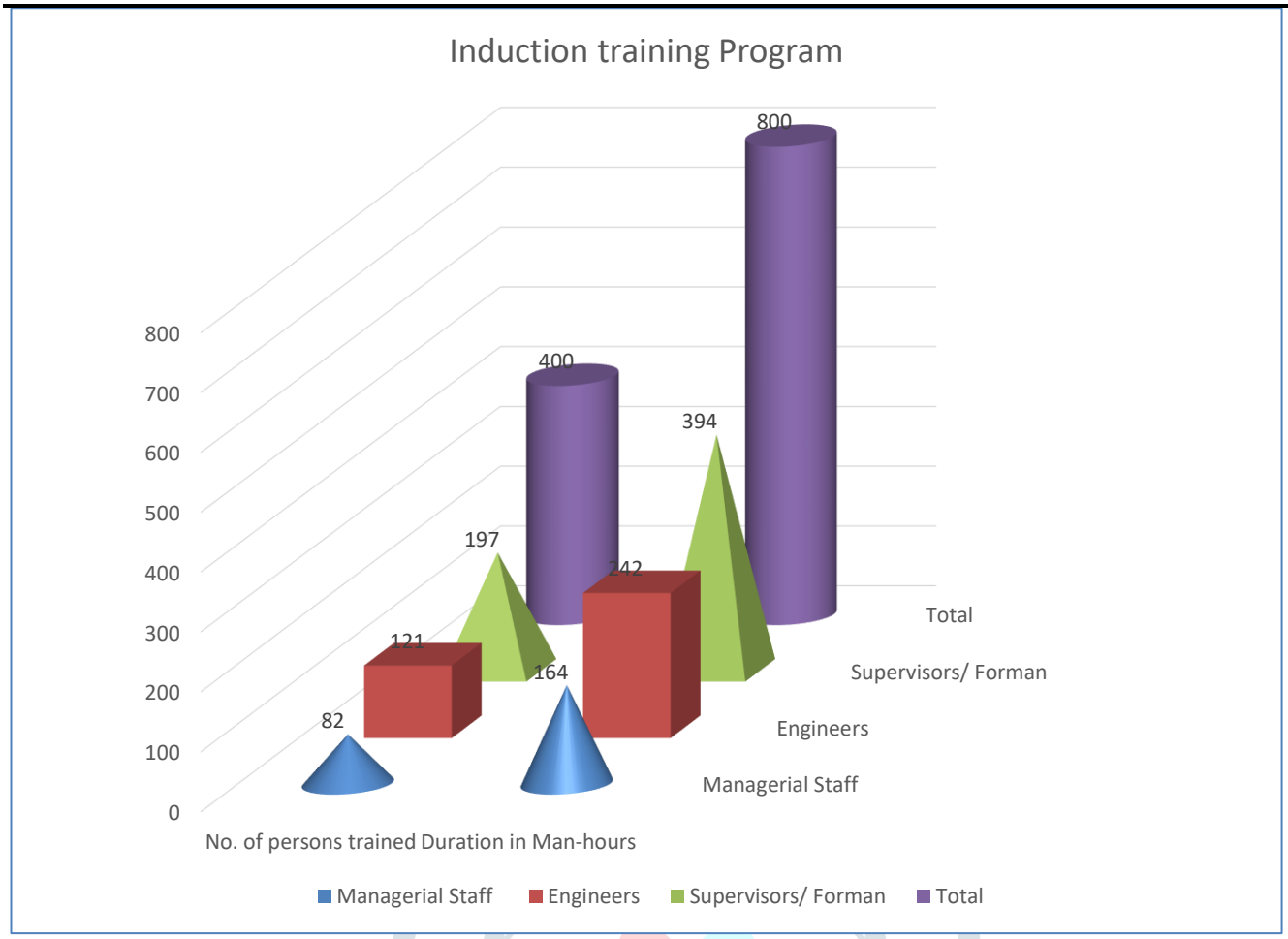


Figure 12- Graphical analysis category wise training provided.

b). Job Specific HSE training conducted by internal faculty /external from

For giving job specific training on different topics we have many internal certified trainers as well as we take help of some external faculties, details are given below-

Title of course	Agency Name	Management & Supervisory personnel				
		Category of Persons	No. of person trained	% of trained personnel over the total Management and Supervisory Personnel	Duration in man hours @2Hrs.	% of Training Man-hours over total Man-hours worked by the Management and Supervisory Personnel
1	2	3	4	5	6	7
HSE Management System	SPCL	Managers, Engineers & supervisors	332	100%	664	0.045
Emergency Preparedness	SPCL	Managers, Engineers & Supervisors	315	94%	630	0.043
Legal Compliances	SPCL	Managers, Engineers & Supervisors	276	83%	552	0.037
Hazardous Materials Management	SPCL	Managers, Engineers & Supervisors	219	70%	438	0.030
Oil Spill Prevention and Response Plan	SPCL	Managers, Engineers & Supervisors	154	46%	308	0.021
Scaffold erection and dismantling.	SPCL	Managers, Engineers & Supervisors	178	53%	356	0.024
Good Housekeeping	SPCL	Engineers & Supervisors	282	85%	564	0.038

Hazard Identification and Risk Assessment (HIRA)	SPCL	Managers, Engineers & Supervisors	332	100%	664	0.045
Fire Safety	SPCL	Managers, Engineers & Supervisors	332	100%	664	0.045
Safety in Working at Height	SPCL	Engineers & Supervisors	262	79%	524	0.036
Power Operated Hand Tools	SPCL	Engineers & Supervisors	185	56%	370	0.025
Hot Work	SPCL	Engineers & Supervisors	215	65%	430	0.029
Electrical Safety	SPCL	Engineers & Supervisors	332	100%	664	0.045
Behavioral base safety	SPCL	Engineers & Supervisors	332	100%	664	0.045
First-Aid Training	SPCL	Engineers & Supervisors	332	100%	664	0.045
Use of PPE's	SPCL	Engineers & Supervisors	262	79%	524	0.036
Road Safety	SPCL	Engineers & Supervisors	332	100%	664	0.045
Manual Material Handling	SPCL	Engineers & Supervisors	262	79%	524	0.036
Equipment and Machine Guarding	SPCL	Engineers & Supervisors	192	58%	384	0.026
Bar bending & Cutting	SPCL	Engineers & Supervisors	165	50%	330	0.022
Lifting	SPCL	Engineers & Supervisors	156	47%	312	0.021
Safety in Excavation	SPCL	Engineers & Supervisors	210	63%	420	0.028
Standard Operating Procedure of SPCL-IMS	SPCL	Managers, Engineers, supervisors	332	100%	664	0.045
Environmental Protection & Global warming	SPCL	Managers, Engineers, supervisors	332	100%	664	0.045

Table 4- Topic wise training man hours calculation.

Average Manpower – 332;
Total Man-hours – 1474652

7.2 RESULT

Before starting any activity at site, TBT is conducted, and the topic is very much specific about that job, details are given below-

Title of the course	Workers including contract workers			Duration in Man-hours @15 Min (15/60=0.25 Hrs.)	% of Training Man-hours over total Man-hours worked by the Workers
	Category of persons	No. of persons trained	% of trained personnel over the total Workers		
1	2	3	4	5	6
Fire Safety	All Workers	3057	100%	(3057*26*12*0.25)= 238446 Hrs.	1.42
Electrical Safety	Electricians	24	37%		
	Welders & Helpers	250		(1139*26*12*0.25)=88842 Hrs.	0.52
	Elevator/ escalator Installers	28			
	Roofers	45			
	Tower Crane Operators	32			
	Plumbers	24			
	Tile Cutters/Setters	62			
	Brabender & Cutters	342			
	Carpenter & Helper	332			
Slip Trips & falls	All Workers	3057	100%	(3057*26*12*0.25)= 238446 Hrs.	1.42
Housekeeping	All Workers	3057	100%	(3057*26*12*0.25)= 238446 Hrs.	1.42
PPE safety	All Workers	3057	100%	(3057*26*12*0.25)= 238446 Hrs.	1.42
Material Handling	Construction Labours/ Helpers	1231	47%	(1456*26*12*0.25)=113568 Hrs.	0.67
	Riggers & Helpers	225			
Working at	All Workers	3057	100%	(3057*26*12*0.25)= 238446	1.42

height				Hrs.	
Hot Work	Welders & Helper	250	13%	(406*26*12*0.25)=31668 Hrs.	0.18
	Gas Cutters & Helpers	156			
Scaffolding Safety	All Scaffolders & Helpers	386	12%	(386*26*12*0.25)=30108 Hrs.	0.18
Concreting	Construction labours/Helpers	1231	40%	(1231*26*12*0.25)= 96018 Hrs.	0.57
Hand tools & Power tools	Barbender & Cutters	352	24%	(746*26*12*0.25)=58188 Hrs.	0.35
	Carpenters & Helpers	332			
	Tile Setters & Cutters	62			
Structural Erection	Crane Operator & Helper	24	21%	(655*26*12*0.25)=51090 Hrs.	0.30
	Gas Cutter & Helper	156			
	Welder & Helper	250			
	Riggers & Helpers	225			
Machine Safeguarding	Crane Operators	24	25%	(770*26*12*0.25)=60060 Hrs.	0.36
	Barbender & Bar cutters	352			
	Carpenters & Helpers	332			
	Tile cutters & Setters	62			
Uses of PPE	All Workers	3057	100%	(3057*26*12*0.25)= 238446 Hrs.	1.42
Safety Signs	All Workers	3057	100%	(3057*26*12*0.25)= 238446 Hrs.	1.42
Woodwork	Carpenters & Helpers	332	10%	332*26*12*0.25)= 25896 Hrs.	0.15
Road Safety	All Workers	3057	100%	3057*26*12*0.25)= 238446 Hrs.	1.42
Excavation	JCB Operators	10	40%	1251*26*12*0.25)= 97578 Hrs.	0.58
	Construction Labours	1231			
	Pump Operators	10			
Behavioral Safety	All workers	3057	100%	(3057*26*12*0.25)= 238446 Hrs.	1.42

Table 5- Topic wise training man hours calculation.

Average Manpower of Worker – 3822;
Considered 80% of the Average Manpower of Worker i.e. 3057
Total Man-hours Worked by Workers – 16781567

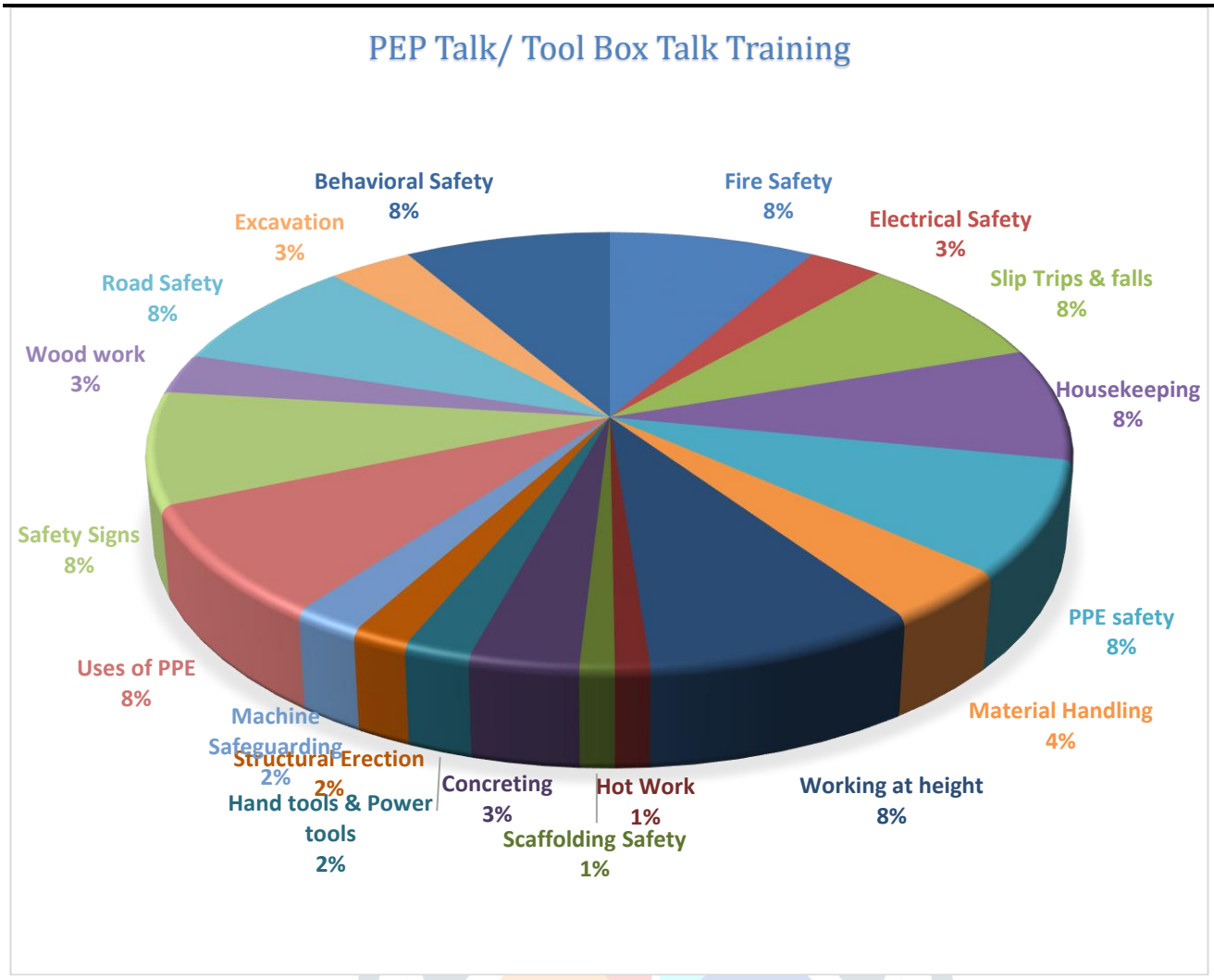


Figure 13- Graphical analysis topic wise training provided.

7.3 OBSERVATION AND RECOMMENDATION

Sr.No.	Observations/ Work Activity	Recommendations
1	Unloading of spun pile, piling machine parts &equipment's.	1. Unload material / parts / spun piles in safe manner. 2. Inform workers during Safety Briefing of unloading activities. 3. Secure unloading area from trespassers.
2	Install piling machinery parts and equipment's.	1. Ensure safe installation procedures for machinery parts. 2. Work in pairs.
3	Survey work & pegging	1. Beware of movement of piling machine. 2. Ensure personal safety around machine
4	Lifting of spun pile into piling machine	1. Ensure piling machine, lifting gear, wire rope sling in good condition. 2. Check for fatigue, damaged, bird cage & brokenwires.
5	Welding of extension piles	1. Welders to wear gas mask. 2. Provide fire extinguisher at welding area. 3. Ensure welders possess welding certificate.
6	Trip & fall into pile hole	1. To cover-up exposed pile hole.
7	Operating piling machine	1. Operators to possess Sijil Operator Krin from JKKP 2. To operate in safe manner.
8	Excessive black smoke	1. To ensure periodic maintenance of piling machine. 2. To ensure compliance to environmental regulations.
9	Oil leakage from machines.	1. To maintain machinery in good condition. 2. Provide drip tray for leaking oil.

10	Noise pollution from piling works.	1. Wear ear protection at high noise level areas. 2. Ensure noise level kept to minimum.
11	Work site preparations apply WPS.	Safety officer receiver/foreman shall conduct JSI to list and correct all additional precaution prior to work.
12	Use of Tower crane.	1. Conduct pre-use inspection to all elevation to ensure they are in good operating, defect noticed on the equipment shall be written and reported and the particular equipment shall not be used and removed from the jobsite. 2.Pre-use inspection/visual inspection of all below the hook's equipment shall be done every day. 3. Ensure that all lifting, activities are carried at by a certificate crane operator and a certificate rigger.
13	Tower crane operational during unloading and loading equipment.	1. Operators/riggers should have NC II Certificate. Tagline must be use. Rigger must supervise all critical lift. 2. Wear appropriate PPE. Personnel not directly involved shall be kept clear the lifting area. 3. No person allowed under load. 4. Work area must be limitedtoessential personnel only.
14	Improve housekeeping during and after work completion	1. Warning signs to be positioned adjacent tosite. 2. Housekeeping is to be conducted before/after work on daily basis. 3. Remove all tools, equipment and other materials. 4. Ensure that the work site is returned to its original condition provided with safe and good.
15	Running compressor	1.Check the fuel level in compressor 2. Set compressor to appropriate pressure for use. 3. Be aware of anything that may get hot or burn around compressor 4. Have proper size and type of fire extinguisher within 15 feet of work area with trained fire watchman. 5. Remove any flammable items from work area.
16	Fuelling compressor	1. Allow compressor time to cool down before fuelling, at least 5 minutes. 2. When stopping, some compressors may need to go through cooling cycle. 3. Read instructions on side of compressor to determine if it requires cooling cycle, release any stored air in compressor when done for the day and before disconnecting hoses, keep valve closed when connecting/disconnecting.
17	Pneumatic Testing	1. PTW/TBT/all relevant attachment (drawing, connection joint, Marked up P&ID) 2. Use the proper PPE's. Follow the pneumatic test site 3. Project method of statement and risk assessment. 4. Only trained and experienced personnel must be carried out the pneumatic test. 5. Pneumatic test activity must be supervised closely by competent foreman. 6. Ensure that the gauges and PSV calibrations are valid and the devices are working accurately. 7. Ensure the pressure relieving device is set at maximum allowable pressure for weakest portion of the 8. Segment to be pressure-tested Ensure that the pressure manifold 9. Complies with project specification. The air compressor must be inspected with valid quarterly colour coding. 10. Before pressurizing, all fittings /flanges of the system to receive pressure test

		shall be walked through and visually inspected for to check if the entire line is ready to receive pressure. 11. Verify test blinds are in position & secured as indicated on P& ID's. 12. Piping, equipment or system under test must be properly identified, area isolated with warning tape (red- white) attached onto appropriate size rope. 13. Once the system is under the required test pressure, tightening of bolts or any adjustment shall not be
18.	Excavation Area	1. Area should be Barricaded. 2. Unauthorized person should not allow to enter the excavation area. 3. Operator and worker should wear appropriate PPE. 4. Wear ear protection at high noise level area.

Table 6 - Activity wise observations & Findings.

8. CONCLUSION AND FUTURE RESEARCH

8.1 Conclusions

The work, research, and collection of all results, with the literature review to define the research areas has shown that very little work has been undertaken as concerns health and safety in the construction industry, in review of any procurement monitoring, vetting of bidders and overall strategy, within the India. Henceforth, it can be seen that the importance of questionnaires and interviews, using both quantitative and qualitative research methodologies, is crucial to the investigation of a new area of research, or new topic of concern, however limited it can be. Although the research carried out is only a very small detail to a whole situation and construction environment, it could be seen as footprint for further research within the specific topic area, and serve as a foundation to be built upon. A health and safety contingent within the construction industry is a very important one, as it protects the client, employee, contractor, sub-contractor and customer from any harmful or indeed any legal eventuality. It affects the way bidding for work is set, how it influences contracts, and the way it is seen to be as important as making profit. There is not one without the other. Hence there are powerful incentives, for the aforementioned, for companies and organizations to encourage high level of health and safety standards which are moral, legal and economic. As long ago in the 1960's, the construction industry has had tremendous development and growth, it is now increasingly important that employers and employees are indeed aware of all the necessary legislation that is particular to them. The specific piece of legislation, to enable the correct vetting protocol of contractors, for credit, references, observance of fair play and to protect themselves and the contractor. Proper implementation of health and safety legislation gives increased cost effectiveness, hence giving way for higher profitability, and to develop a strategy to be implemented as part of the company's infrastructure of economics. This creates a sense of loyalty towards the organisation. What was also seen in the surveys was the general sizes of the companies. A substantial number of companies were to be of a smaller size - larger contractors tend to perform better compared to smaller companies general y because they have greater resources to do so. Large firms are associated with larger projects containing more risks and so is typical y required to implement better health and safety procedures. Small contractors and subcontractors on the other hand, generally perform poorly for similar reasons, although many of the surveyed companies had a good grasp of health and safety, with a good understanding of contractual and vetting procedures. It was also seen that a management commitment played a major role in health and safety performance, as it was discovered that the majority of training of health and safety legislation was done by the managing director. However, small companies seem to lack both the financial resources and management commitment to improve their own health and safety performance. Increasingly, the performance of these firms reflects on the manager of the facility, which may lead to liability. Future research may be needed to investigate how to improve health and safety within small enterprises in particular, and sample at least 5 respondents in each company, to the same aims and objectives as set out in this current research.

8.2 Future research

From the research undertaken, there is every reason why to encourage further health and safety investigations in the India, with the same approach but to achieve improvements. As with this survey, there should be a well planned approach to this, using the same format and collective as before, this being al involved parties, namely governments, local government, companies, contractors and clients.

The following could be observed;

- Develop the questionnaire to cover more construction companies, especial y larger companies, with at least 5 respondents to each one, with the same questions;
- Have interviews with health and safety officers or responsible people who are experts at the same;
- An investigation with the same agenda but to a European country, to see if any comparisons/contrasts can be drawn.

8.3 Contribution to knowledge

The writer suggests that a very small contribution to knowledge has been achieved with this research, however the size, it is one single step to increase the awareness of health and safety in the construction industry, specifically to the 5 areas looked at in a brief manner. The main focus point in looking at and to find out about the topic was the exhaustive literature review which was taken, giving a general overview of the health and safety issue in companies based in the India, to moving onto more specific and detailed synopsis of literature, to identify what is currently happening and how, if any, knowledge gaps can be closed. The vast majority of published work researched for the literature review was in the form of academic papers, journal articles, magazine articles and government directives/policies. The writer believes this research would be of great importance to anyone who would wish to take this very small contribution and increase this knowledge to everyone's interest.

ACKNOWLEDGMENT

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