ASSESSMENT OF MANAGEMENT AND INDUSTRIAL SAFETY IN MACHINE SHOP IN SCIENTIFIC EQUIPMENT DEVELOPMENT INSTITUTE, MINNA NIGER STATE

BY

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2016/1/62415TI

THE DEPARTMENT OF INDUSTRIAL TECHNOLOGY EDUCATION,
SCHOOL OF SCIENCE AND TECHNOLOGY EDUCATION,
FEDERAL UNIVERSITY OF TECHNOLOGY MINNA,

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A RESEARCH PROJECT SUBMITTED TO THE DEPARTMENT OF INDUSTRIAL TECHNOLOGY EDUCATION, SCHOOL OF SCIENCE AND TECHNOLOGY EDUCATION, FEDERAL UNIVERSITY OF TECHNOLOGY MINNA, IN PARTIAL FULFILMENT FOR THE AWARD OF BACHELOR OF TECHNOLOGY (B. TECH) IN INDUSTRIAL AND TECHNOLOGY EDUCATION

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DECLARATION

I Akende Terhile, Matric No. 2016/1/62415TI an undergraduate of the department of industrial and technology education, certify that the work embodied in this project is original and has not been submitted in part or full for any other degree or diploma of this or any other institution

Akende Terhile

2016/1/62415TI

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Signature/Date

CERTIFICATION

This project has been read and approved as meeting the requirement for the award of B.Tech degree in Industrial and Technology Education, school of science and technology education, Federal University of Technology, Minna.

Dr. S. A. Owodunni ______________________

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Prof. Hassan Bello ________________________

External Examiner Signature/Date

DEDICATION

This research is dedicated to God Almighty for all his mercies and protection toward me and also to my parent Mr/ Mrs AKENDE SM for her love and support parental guidance, and to my beloved friend Miss TOLULOPE OYAWALE LYDIA for her prayers and support to me during this course of study.

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ABSTRACT

The assessment of industrial safety and management in the machine shop of the Science Equipment Centre in Minna, Niger State was conducted to evaluate the level of compliance with safety standards and to identify areas for improvement. The study involved a review of relevant literature and an on-site inspection of the facility, including the examination of safety policies and procedures, equipment maintenance records, and personal protective equipment usage. The results revealed that the facility had a comprehensive safety policy in place, but there were gaps in its implementation, particularly in the areas of equipment maintenance and personal protective equipment usage. The inspection identified several safety hazards, including unguarded machines, inadequate ventilation, and electrical hazards. Furthermore, there was a lack of awareness among some employees about the importance of safety measures, and there was a need for regular safety training and communication to reinforce the safety culture. The study recommends the implementation of a more robust safety program, including regular safety audits, hazard identification and risk assessments, and increased training and awareness-raising programs. In conclusion, the study underscores the importance of prioritizing safety in the machine shop and highlights the need for continuous monitoring and improvement of safety policies and practices to prevent workplace accidents and injuries.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of the Study

Industrial workplaces are known for their constantly changing conditions, such as the movement of vehicles and the presence of workers on foot. Unfortunately, these work environments are also known for their dangerous conditions, as shown by the frequent occurrence of workplace injuries and deaths. These risky industries encompass a range of activities, such as construction, steel production, oil and gas drilling, aviation, agriculture, forestry, and fishing, among others.

For instance, the construction industry remains one of the most hazardous and unsafe industries with fatality and incidence rates considerably higher than the all-industry average in many countries. Incident statistics indicate that construction workers have consistently incurred more fatal injuries than in other industries. Despite the efforts to improve safety performance, the construction sector continues to account for disproportionate injury rates accounting for the most on-the-job fatal injuries. In the United States, construction remains the most hazardous industry in terms of the aggregate number of fatalities. Thus, innovative intervention strategies are being continuously explored by researchers and practitioners to enhance management controls as well as modify human behavior and work environment to improve construction safety.

The steel manufacturing industry is considered to be very dangerous due to its complex combination of socio-technical factors. Because the process involves both advanced technology and physical labor, it can be difficult to manage safety effectively.

Unfortunately, workers in the U.S. steel manufacturing industry continue to suffer a high number of injuries, illnesses, and deaths. The complex interplay between technology and labor creates a significant challenge for safety managers working in this industry.

The fundamental goal of measuring safety performance is to create and implement intervention strategies for potential avoidance of future accidents. Recognizing signals before an accident occurs offers the potential for improving safety; many organizations have sought to develop programs to identify and benefit from alerts, signals, and prior indicators. Traditional measures of safety performance rely on some form of accident or injury data, with actions being taken in response to adverse trends in injuries. Many organizations rely heavily on failure data to monitor performance. The consequence of this approach is that improvements or changes are only determined after something has gone wrong. In most cases, the difference between whether a system failure results in a minor or catastrophic outcome is purely a matter of chance.

To effectively manage major hazards, it's important to take a proactive approach to risk management and ensure that critical systems are functioning properly. Shifting the focus towards leading indicators that confirm the continued effectiveness of risk controls is a crucial step in managing major hazards. Accurate measurement of safety performance enables ongoing evaluation of safety management practices and motivates project participants to make improvements.

The ability to collect, analyze and disseminate safety information using a large amount of useful data from leading indicators can allow for hazardous events and conditions to be efficiently mitigated and controlled before a lagging indicator occurs. In this chapter, a background to safety management in industrial engineering is presented followed by a discussion of the various issues of industrial safety management. The existing and commonly used safety performance measurement methods are extensively described. Several case studies are used to explain the methods and explore the important application areas relevant to most industrial sectors. The techniques and tools for safety data collection, analysis, and sharing are introduced together with their applications for safety management while the use of emerging technologies for enhancing safety management in most industries is discussed in the last section.

Strict adherence to industrial safety has become a major challenge in the manufacturing industries of Nigeria because of its effects on overall productivity and production cost. Ofuonye (2004) lamented on the pathetic situation of incessant dozens of industrial accidents occurring in manufacturing industries in Nigeria on a monthly basis leading to loss of life, injuries, damage to material resources and hindrance to achievement of production target.

Many accidents occur due to a lack of safety awareness, such as workers falling from ladders, operating machines without guards, dropping objects on their toes, and misusing tools. Some accidents are even more severe, such as crushing fingers between moving sprockets or losing vision due to incorrect settings of timing valves. According to Atsumbe (1996), these accidents are caused by unsafe acts that result from incomplete safety instructions or education on safe practices. To promote safety, various methods of safety education can be utilized, such as awareness meetings, posters, safety booklets, films, classroom sessions, and contact with safety specialists and supervisors. Some organizations even use mass educational methods to promote safety.

Thorough and aggressive safety education in industries can lead to various benefits, such as compensation and medical payments, reduced damage to equipment and products, and fewer production delays and profit losses. According to Atsumbe (2006), correct safety education can also result in good community relations, lower employee turnover and absenteeism, better employee morale, and higher production targets. Industrial safety involves investigating and managing the risks that personnel and equipment may encounter in their environment to prevent injury or damage. Safety education is a control process that identifies and corrects unsafe acts and conditions to promote safety. Manufacturing industries transform materials and information into goods to satisfy human needs.

Mewis (1995) emphasized the need for safety education in the industries to prevent accidents and injuries. He also stated that the implementation of safety education program have contributed immensely to the declining rate of accidents and injuries in industrial work places. Industrial safety education program in the industry is a very important component which cannot just be ignored by the industry but must be enforced to the fullest to prevent injuries to workers, loss of life and damage to materials, tools, equipment and machines. Miller (1998) stated that it is difficult to teach and implement industrial safety education program without first giving thought to the causes of factory accidents. He also confirmed that factory workers, students, safety engineers and teachers of safety must have a thorough understanding of how accidents occur before they can identify an unsafe condition and correct the situation.

An effective safety education program involves providing sufficient instruction on the operation and maintenance of tools, equipment, and machinery in the workplace. According to Jain (2010), the high rate of accidents in industries is due to workers' poor attitude towards safety practices, as well as employers' lack of provision of safety awareness training and incomplete instructions on safe practices and technical knowledge. Workers may operate machines without guards, drop objects on their toes, or misuse tools due to a lack of safety education. Jain(2006) noted that lack of safety education have led several workers into unsafe acts such as operating machines which they are not familiar with, lifting heavy loads which is above their strength in an incorrect manner, adjusting moving belts, sprockets and timing chains which has led to fatal accidents. He further emphasized that a good industrial safety education program for manufacturing industries should involve both mass industrial safety education methods as well as personalized industrial safety education training method. Mass industrial safety education methods involve having meetings, use of posters, safety booklets, films, special classroom sessions and some safety contacts by safety teachers, specialists and supervisors; while the personalized industrial safety education training method permits the conversion of safety generalities into specific safe practices that apply to a specific job and to the individual doing the job. Personalized safety training is more effective since it permits consideration of the worker's rate of learning, his interests, his natural ability and his physical limitations at work.

According to Riggs (2010), efforts to control accidents without first developing a proper safety philosophy, imparting safety principles, and dispelling myths regarding the causes of accidents will be ineffectual. It is necessary to enforce safety regulations, create safe working environments, and provide workers with the necessary training in order to prevent accidents and guarantee workplace safety. Supervisors, safety instructors, and engineers need to think that accidents are both caused and preventable.

However, manufacturing industries in Nigeria in a bid to maximize cost go the extra mile to ensure over utilization of human and material resources with little regard to industrial safety education which makes personnel and material resources vulnerable to accident and loss of life. Apagu, Bulama and Diraso (2000) found out that industrial accidents and mishaps can generally be attributed to environmental conditions, human behaviors, and improper use of tools/machines. Specifically, the accidents are tied to the following five conditions: insufficient skill of the workers, lack of knowledge of safety education, poor work habits and attitudes, unsafe behaviors and environmental hazards. Equipment in the industries need to be protected, while workers and employers of labour need to have sound knowledge of industrial safety education to minimize loss of life, materials and waste of working hours due to industrial accidents. It is the pathetic situation of constant occurrence of industrial accidents in manufacturing industries in Nigeria due to the incessant negligence and poor attitude towards industrial safety education program that necessitated this study.

The operation of machines and equipment in the industry poses a significant and common threat to workers and the workplace environment. These include presses, machine tools, jacks, and industrial robots. To ensure safety, it is important to adhere to mandatory legal regulations and risk assessment principles. It is also necessary to prioritize methods to improve machine safety through legal remedies, economic, organizational, and technical measures. Various studies, such as Chinniah (2015), Chybowski and Gawdzinska (2016), Niciejewska and Klimecka Tatar (2018), and Pacana and Ulewicz (2017) emphasize the importance of protecting workers through these measures. It should be assumed that primary goal of labor protection is to protect the health and life of an employee.

The main goal of labor protection is to safeguard the health and lives of employees, ensuring their ability to work and providing economic and social security. International regulations also highlight the importance of physical, mental, and social well-being in defining what it means to be healthy. Therefore, labor protection should promote and maintain this definition of health. The legal concept of labor protection is synonymous with the protective function of labor law, which encompasses all the regulations and provisions governing the duties and responsibilities of employers and employees in the workplace.

1.2 Statement of the Problem

The problem of research addressed in this project is the need to assess the industrial safety and management practices in a machine shop. Although machine shops are crucial components of various manufacturing industries, they pose significant hazards to workers due to the nature of their work, which involves operating heavy machinery and handling hazardous materials. These hazards can cause severe injuries or fatalities, resulting in personal and financial loss to the workers and the company. Despite the implementation of safety protocols and management practices, machine shop workers are still at risk of various hazards that can cause injuries and fatalities. Therefore, it is crucial to identify the gaps in the current safety protocols and management practices that lead to these hazards and propose improvements that will enhance the safety and well-being of the workers.

One significant problem in the machine shop is mechanical hazards. These hazards arise from operating heavy machinery, which can cause crushing injuries, amputations, or even death. The workers may also be exposed to noise pollution, which can cause hearing loss, or vibration, which can cause injuries to the muscles and joints.

Electrical hazards are also a significant concern in machine shops. These hazards can arise from improper grounding or insulation of electrical equipment, leading to electrical shocks or electrocution. Workers may also be exposed to high voltage electrical systems, which can cause severe injuries or even death.

In addition to mechanical and electrical hazards, machine shop workers are also exposed to chemical hazards, such as exposure to harmful chemicals, gases, or fumes. These hazards can cause respiratory problems, skin irritation, or even chronic illnesses such as cancer.

Another problem in the machine shop is inadequate safety protocols and management practices. The current safety protocols and management practices may not be effective in preventing accidents and injuries in the workplace. For instance, workers may not be adequately trained on safety procedures, or the equipment may not be maintained correctly, leading to increased hazards.

Moreover, the machine shop management may not have an effective emergency response plan in place to address accidents and incidents that may occur in the workplace. This can lead to delays in addressing the situation, which can exacerbate the injuries and the damages incurred.

In conclusion, the problem of industrial safety and management in the machine shop is a significant concern that requires urgent attention. The hazards posed by the machine shop can cause severe injuries or even fatalities to workers, leading to personal and financial loss to the workers and the company. Therefore, it is crucial to identify the gaps in the current safety protocols and management practices and propose improvements that will enhance the safety and well-being of the workers.

1.3 Aim and Objectives of the Study

The aim of this research is to assess industrial safety and management in machine shop in science equipment Centre Minna, Niger State with the following objectives:

1. To identify various hazards associated with the use of machine in the Institute.
2. To find out the procedures adapted for use of machines.
3. To find out the safety rules usually adopted in the operation of machines.
4. To identity the effective ways of safety management in the machine shops.

1.4 Research Questions

1. What are the various hazards associated with use of machines in the Institute?
2. What are the safety procedures adopted for the safe use of machines?
3. What are the various rules usually adopted during machines operations?
4. What are the effective ways of safety management in machine shop?

1.5 Statement of Hypothesis

H1: Hazards are associated with the use of machines

H2: Safety measures are required while handling or operating machines

H3: There is need for safety skills in handling machines.

1.6 Scope of the Study

The scope of this study is limited to the assessment of industrial safety and management practices in a machine shop. The machine shop is a facility that specializes in the production, repair, and maintenance of mechanical parts and equipment. The study will focus on a single machine shop and will assess the safety protocols and management practices implemented in the facility.

1.7 Limitation of the Study

This research is limited to assessment of industrial safety and management in Machine Shop in Scientific Equipment Development Institute Minna, Niger State. The study's findings may be influenced by the biases of the respondents or the researchers themselves. The respondents may not provide accurate information due to fear of repercussions or personal biases. The researchers may also have biases that could affect the analysis and recommendations.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Physical Hazard

A physical hazard refers to an element, agent, or situation that can lead to harm upon contact. These hazards can be categorized as either occupational or environmental hazards. Many industries encounter physical hazards, which can result in injuries. Although some industries, such as construction and mining, cannot entirely avoid these hazards, people have developed safety protocols and procedures to mitigate the risks of physical danger in the workplace over time.

To comply with the Personal Protective Equipment (PPE) at Work Regulations of 1992, an engineering workshop that specializes in fabricating and welding components must adhere to specific guidelines. It is the employer's responsibility to furnish all equipment (including clothing that offers protection against adverse weather conditions) that is designed to be worn or held by workers and safeguards them against one or more potential health and safety hazards. In a fabrication and welding workshop, an employer must provide face and eye protection, safety footwear, overalls, and any other necessary PPE. In the following section, we will explore some of the concepts related to physical hazards.

2.1.1 Falls

Falls are a common cause of occupational injuries and fatalities, especially in construction, extraction, transportation, healthcare, and building cleaning and maintenance. Circumstances like floor holes and wall opening, misused fall protection, slippery, cluttered, or unstable walking surfaces, unprotected edges and unsafely situated ladders are associated with occupational fall injuries.

2.1.2 Machines

Machines are commonplace in many industries, including manufacturing, mining, construction and agriculture, and can be dangerous to workers. Many machines involve moving parts, sharp edges, hot surfaces and other hazards with the potential to crush, burn, cut, shear, stab or otherwise strike or wound workers if used unsafely. Various safety measures exist to minimize these hazards, including lockout-tagout procedures for machine maintenance and roll over protection systems for vehicles.

Machines are also often involved indirectly in worker deaths and injuries, such as in cases in which a worker slips and falls, possibly upon a sharp or pointed object. Power tools, used in many industries, present a number of hazards due to sharp moving parts, vibrations, or noise. The transportation sector bears many risks for the health of commercial drivers, too, for example from vibration, long periods of sitting, work stress and exhaustion. These problems occur in Europe but in other parts of the world the situation is even worse

2.1.3 Confined Spaces

Workplaces with confined spaces also pose a significant hazard. According to the National Institute for Occupational Safety and Health (NIOSH), a confined space has limited openings for entry and exit, poor natural ventilation, and is not designed for continuous employee occupancy. Examples of confined spaces include storage tanks, ship compartments, sewers, and pipelines. These spaces can be dangerous not only for workers but also for rescuers. Injuries and fatalities in confined spaces can result from a variety of hazards, such as entrapment, drowning, asphyxiation, or exposure to toxic chemicals. It is possible to prevent physical and atmospheric hazards in confined spaces by recognizing and addressing these hazards before entering to carry out work.

2.1.4 Electricity

Electricity poses a danger to many workers. Electrical injuries can be divided into four types: fatal electrocution, electric shock, burns, and falls caused by contact with electric energy. Electrocution is one of the major hazards on construction sites. It can be fatal and can result in serious and permanent burn injuries to the skin, internal tissues and damage to the heart depending on the length and severity of the shock. Below are few highlighted accident associated with electricity

1. When electric current flows through tissues or bone, it produces heat that causes electrical burns. Electrical burns cause tissue damage and need immediate medical attention.

2. Electric shocks can result in the injuries like muscle spasms, palpitations, nausea, vomiting, collapse, and unconsciousness.

3. Faulty electrical connections and damaged electrical equipment can lead to an electric shock to workers and to others at or near the workplace.

4. Electrical injuries are preventable through safe work practices like keeping electrical tools properly maintained, de-energizing electrical appliances before inspection or repair, and exercising caution when working near energized lines. Personal protective equipment such as hard hats, hoods,

2.1.5 Vibration

Vibration has long been recognized as a severe occupational hazard that can result in injuries or illnesses from repeated exposure to high levels. There are two general types of vibration exposure: hand-arm and whole-body vibration. Hand-arm vibration can cause direct injury to the fingers and hand and affect feeling, dexterity, and grip. It is also a known contributing factor to other ergonomic-related fatalities. Equipment that produces vibration, such as grinders, impact drills, chipping hammers, pavement breakers, dental tools, sanders, air-powered wrenches, and saws of all types, can cause hand-arm vibration injury. Long-term use of vibrating machinery can result in independent vascular, neurosensory, and musculoskeletal disorders of the hand and arm, known as Hand-arm Vibration Syndrome (HAVS).

Whole-body vibration is a significant cause of lost time and decreased production output, as it can cause low back pain and injury due to higher-than-expected levels of vibration. Industries such as agriculture, forestry, mining, quarrying, and off-shore small-fast boats are associated with whole-body vibration injuries. Control measures such as redesigning appliances to reduce vibration exposure, using machines designed to decrease the vibration transmitted to the operator, implementing speed limits, scheduling regular work breaks, posture changes, or job rotation to reduce exposure time, providing training, information, and supervision on adjusting and operating equipment can be used to successfully reduce vibration exposure. A combination of these control measures can be effective in reducing whole-body vibration injuries.

2.2 Chemical Hazards

Any material, regardless of form, that may put individuals at risk for physical harm or health problems or create environmental impact is considered a chemical hazard. It can also be described as the actual risk connected to a particular chemical, such as skin burns, long-term health effects, environmental harm, fires, or even explosions.

The Hazard Communication Standard (HCS) from the Occupational Safety and Health Administration (OSHA) and Safe Work Australia emphasize the importance of informing employees about the risks and hazards associated with their regular job duties. By recognizing hazards, the likelihood of exposure to dangerous chemicals and the harm they can cause can be reduced. Chemical hazards are non-biological substances that have the potential to cause harm to life or health.

Chemicals are used widely in homes and other places, and exposure to them can result in acute or long-term detrimental health effects. Hazardous chemicals include Neurotoxins, Immune agents, Dermatologic agents, Carcinogens, Reproductive toxins, Systemic toxins, Asthmagens, Pneumoconiotic agents, and Sensitizers. In the workplace, exposure to chemical hazards is an occupational hazard. Using personal protective equipment (PPE) can significantly reduce the risk of damage from contact with hazardous materials. Therefore, we will explore the different ways in which individuals can be exposed to chemical hazards.

2.2.1 Routes of exposure

The most common exposure route to chemicals in the work environment is through inhalation. Gas, vapor, mist, dust, fumes, and smoke can all be inhaled. Those with occupations involving physical work may inhale higher levels of chemicals if working in an area with contaminated air. This is because workers who do physical work will exchange over 10,000 liters of air over an 8-hour day, while workers who do not do physical work will exchange only 2,800 liters. If the air is contaminated in the workplace, more air exchange will lead to the inhalation of higher amounts of chemicals.

Chemicals may be ingested when food or drink is contaminated by unwashed hands or from clothing or poor handling practices.

Chemical exposure to the skin is a common workplace injury and may also occur in domestic situations with chemicals such as bleach or drain-cleaners. The exposure of chemicals to the skin most often results in local irritation to the exposed area. In some exposures, the chemical will be absorbed through the skin and will result in poisoning. The eyes have a strong sensitivity to chemicals, and are consequently an area of high concern for chemical exposure. Chemical exposure to the eyes results in irritation and may result in burns and vision loss.

Injection is an uncommon method of chemical exposure in the workplace. Chemicals can be injected into the skin when a worker is punctured by a sharp object, such as a needle. Chemical exposure through injection may result in the chemical entering directly into the bloodstream.

2.2.2 Symbols of Chemical Hazards

Hazard pictographs are a type of labeling system that alerts people at a glance that there are hazardous chemicals present. The symbols help identify whether the chemicals that are going to be in use may potentially cause physical harm, or harm to the environment. The symbols are distinctive, as they are shaped like diamonds with red borders. These signs can be divided into:

1. Health hazards - symbolized by a person with their chest and face surrounded by a black outline, indicating the danger of breathing in or ingesting the substance.

2. Flammable hazards - symbolized by a flame, indicating that the substance has the potential to catch fire or explode.

3. Explosive hazards - symbolized by an exploding bomb, indicating that the substance has the potential to explode or cause explosions.

4. Oxidizing hazards - symbolized by a flame over a circle, indicating that the substance can enhance the risk of fire and combustion.

5. Corrosive hazards - symbolized by a test tube pouring liquid onto a hand, indicating that the substance can cause corrosion or severe damage upon contact.

6. Environmental hazards - symbolized by a tree and fish, indicating that the substance can cause harm to the environment if released.

Understanding the hazard pictographs is crucial for people working in places where hazardous chemicals are used, stored, and transported. It helps them recognize the risks associated with these chemicals and take necessary precautions to avoid accidents and injuries.

2.2.3 Controlling chemical Exposure

The methods for controlling Chemical Exposure are as follows;

Elimination and Substitution

Chemical exposure is estimated to have caused approximately 190,000 illnesses and 50,000 deaths of workers annually. There exists an unknown link between chemical exposure and subsequent illness and/or death. Therefore, the majority of these illnesses and deaths are thought to be caused by a lack of knowledge and/or awareness concerning the dangers of chemicals. The best method of controlling chemical exposure within the workplace is through the elimination or the substitution of all chemicals that are thought or known to cause illness and/or death.

Engineering Controls

Although the elimination and the substitution of the harmful chemicals is the best-known method for controlling chemical exposure, there are other methods that can be implemented to diminish exposure. The implementation of engineering controls is an example of another method for controlling chemical exposures. When engineer controls are implemented, there is a physical change made to the work environment that will eliminate or reduce the risk to chemical exposure. An example of engineer controls is the enclosure or isolation of the process that creates the chemical hazard.

Administrative and Work Practices Controls

If the process that creates the chemical hazard cannot be enclosed or isolated, the next best method is the implementation of administrative and work practices controls. This is the establishment of administrate and work practices that will reduce the amount of time and how often the workers will be exposed to the chemical hazard. An example of administrative and work practices controls is the establishment of work schedules in which workers have rotating job assignments. This will ensure that all workers have limited exposure to chemical hazards.

Personal Protective Equipment (PPE)

Employers should provide personal protective equipment (PPE) to protect their workers from chemicals used within the workplace. The use of PPE prevents workers from being exposed to chemicals through the routes of exposure—inhalation, absorption through skin and/or eyes, ingestion, and injection. One example of how PPE usage can prevent chemical exposure concerns respirators. If workers wear respirators, they will prevent the exposure of chemicals through inhalation.

First Aid

In case of emergency, it is recommended to understand first aid procedures in order to minimize any damage. Different types of chemicals can cause a variety of damage. Most sources agree that it is best to rinse any contacted skin or eye with water immediately. Currently, there is insufficient evidence of how long the rinsing should be done, as the degree of impacts will vary for substances such as corrosive chemicals. However, the recommended flush time is as follows:

5 minutes - non- to mild irritants

15 minutes - moderate to severe irritants and chemicals that cause acute toxicity

30 minutes - most corrosives

60 minutes - strong alkalis such as sodium, potassium or calcium hydroxide

Transporting the affected person to a health care facility may be important, depending on condition. In the case that the victim needs to be transported before the recommended flush time, then flushing should be done during the transportation process. Some chemical manufacturers may state the specific type of cleansing agent that is recommended by.

2.3 Machines Safety Procedures

Machines are integral to many workplaces, and their safe operation is essential for preventing injuries and fatalities. Employers must establish and maintain effective machine safety procedures to safeguard workers from harm. Here are some essential steps for machine safety procedures:

1. Conduct a risk assessment: Employers should evaluate the risks of operating a machine and assess its potential hazards. This assessment should include the type of machine, its age, its condition, and the nature of the work being performed.

2. Implement machine guarding: Guarding refers to the installation of physical barriers, such as barriers, interlocked guards, and light curtains, around the machine to prevent workers from coming into contact with hazardous parts.

3. Train workers: All workers who will be operating the machines should receive proper training on the machine's operation, hazards, and safety procedures. Training should be ongoing and refreshed periodically to ensure workers are up-to-date on the latest safety procedures.

4. Provide personal protective equipment (PPE): In addition to machine guarding, workers should also be provided with appropriate PPE, such as gloves, eye protection, and hearing protection, to reduce the risk of injury.

5. Implement lockout/tagout procedures: Lockout/tagout is a set of procedures that ensure machines are shut off and prevented from starting up again while workers are performing maintenance or repair tasks. This procedure helps prevent accidental startup, which can cause serious injuries or fatalities.

6. Regularly inspect and maintain machines: Regular maintenance and inspection of machines can help identify potential hazards before they result in an accident. Employers should establish and implement a regular maintenance and inspection schedule for all machines.

7. Establish emergency procedures: Despite all precautions, accidents can still occur. Employers should establish clear emergency procedures for dealing with machine-related injuries, including procedures for reporting incidents, providing medical attention, and investigating the root cause of the accident.

8. By following these machine safety procedures, employers can help prevent injuries and fatalities and ensure a safe and healthy workplace for all workers.

2.4 Machines Safety Rules

Operation of Machines in the Workshop require observing safety rules; these rules are listed as follows.

1. Never remove or try to defeat machine safeguards.
2. Don't create new hazards, such as allowing objects to fall into the moving parts or by creating a new pinch point.
3. Report problems with machine safeguards to your supervisor immediately.
4. Never leave machines unattended with parts still moving. Remember that parts may still be moving after the machine has been turned off
5. Remove guards only when the machine has been locked out and tagged out.
6. If possible, lubricate machine parts without removing the safeguard; otherwise, turn the machine off and lock it out before lubricating.
7. Operate equipment only when guards are in place and properly adjusted.
8. Do not use unauthorized or damaged guards.
9. Do not wear loose clothing, jewelry, or long hair around machines—these increase the risk of being caught in the machinery.
10. Ask your supervisor if you have any questions about a machine safety or how to work with machine guards safely.

2.5 Safety Management in Machine Shops

2.5.1 Engineering [controls] management

These are strategies designed to protect workers from hazardous conditions by placing a barrier between the worker and the hazard or by removing a hazardous substance through air ventilation. Engineering controls involve a physical change to the workplace itself, rather than relying on workers' behavior or requiring workers to wear protective clothing. Engineering controls is the third of five members of the hierarchy of hazard controls, which orders control strategies by their feasibility and effectiveness. Engineering controls are preferred over administrative controls and personal protective equipment (PPE) because they are designed to remove the hazard at the source, before it comes in contact with the worker. Well-designed engineering controls can be highly effective in protecting workers and will typically be independent of worker interactions to provide this high level of protection. The initial cost of engineering controls can be higher than the cost of administrative controls or PPE, but over the longer term, operating costs are frequently lower, and in some instances, can provide a cost savings in other areas of the process. Elimination and substitution are usually considered to be separate levels of hazard controls, but in some schemes, they are categorized as types of engineering control. The U.S. National Institute for Occupational Safety and Health researches engineering control technologies, and provides information on their details and effectiveness in the NIOSH

The fundamental way to safeguard workers from occupational hazards is by controlling their exposure to such hazards. This is typically achieved through a hierarchy of controls that consists of various methods such as elimination, substitution, engineering controls, administrative controls, and personal protective equipment. Among these, the methods that are higher on the list are considered to be more effective in reducing the risks associated with a hazard. For instance, process changes and engineering controls are recommended as the primary means to reduce exposures, while personal protective equipment should be considered only as a last resort. By following this hierarchy, it is expected that inherently safer systems will be established, thereby substantially reducing the risk of illness or injury.

Engineering controls are physical changes to the workplace that isolate workers from hazards by containing them in an enclosure, or removing contaminated air from the workplace through ventilation and filtering. Well-designed engineering controls are typically passive, in the sense of being independent of worker interactions, which reduces the potential for worker behavior to impact exposure levels. They also ideally do not interfere with productivity and ease of processing for the worker, because otherwise the operator may be motivated to circumvent the controls. The initial cost of engineering controls can be higher than administrative controls or personal protective equipment, but the long-term operating costs are frequently lower, and can sometimes provide cost savings in other areas of the process.

These are training, procedure, policy, or shift designs that lessen the threat of a hazard to an individual. Administrative

2.5.2 Administrative (controls) management

controls typically change the behavior of people (e.g., factory workers) rather than removing the actual hazard or providing personal protective equipment (PPE). Administrative controls are fourth in larger hierarchy of hazard controls, which ranks the effectiveness and efficiency of hazard controls.

Administrative controls are more effective than PPE because they involve some manner of prior planning and avoidance, whereas PPE only serves only as a final barrier between the hazard and worker. Administrative controls are second lowest because they require workers or employers to actively think or comply with regulations and do not offer permanent solutions to problems. Generally, administrative controls are cheaper to begin, but they may become more expensive over time as higher failure rates and the need for constant training or re-certification eclipse the initial investments of the three more desirable hazard controls in the hierarchy. The U.S. National Institute for Occupational Safety and Health recommends administrative controls when hazards cannot be removed or changed, and engineering controls are not practical.

Some common examples of administrative controls include work practice controls such as prohibiting mouth pipetting and rotating worker shifts in coal mines to prevent hearing loss. Other examples include hours of service regulations for commercial vehicle operators, Safety signage for hazards, and regular maintenance of equipment.

2.5.3 Personal protective equipment (PPE)

These are protective clothing, helmets, goggles, or other garments or equipment designed to protect the wearer's body from injury or infection. The hazards addressed by protective equipment include physical, electrical, heat, chemicals, biohazards, and airborne particulate matter. Protective equipment may be worn for job-related occupational safety and health purposes, as well as for sports and other recreational activities. Protective clothing is applied to traditional categories of clothing, and protective gear applies to items such as pads, guards, shields, or masks, and others. PPE suits can be similar in appearance to a cleanroom suit.

The purpose of personal protective equipment is to reduce employee exposure to hazards when engineering controls and administrative controls are not feasible or effective to reduce these risks to acceptable levels. PPE is needed when there are hazards present.

PPE has the serious limitation that it does not eliminate the hazard at the source and may result in employees being exposed to the hazard if the equipment fails. Any item of PPE imposes a barrier between the wearer/user and the working environment. This can create additional strains on the wearer, impair their ability to carry out their work and create significant levels of discomfort. Any of these can discourage wearers from using PPE correctly, therefore placing them at risk of injury, ill-health or, under extreme circumstances, death. Good ergonomic design can help to minimize these barriers and can therefore help to ensure safe and healthy working conditions through the correct use of PPE.

Practices of occupational safety and health can use hazard controls and interventions to mitigate workplace hazards, which pose a threat to the safety and quality of life of workers. The hierarchy of hazard controls provides a policy framework which ranks the types of hazard controls in terms of absolute risk reduction. At the top of the hierarchy are elimination and substitution, which remove the hazard entirely or replace the hazard with a safer alternative. If elimination or substitution measures cannot be applied, engineering controls and administrative controls – which seek to design safer mechanisms and coach safer human behavior – are implemented. Personal protective equipment ranks last on the hierarchy of controls, as the workers are regularly exposed to the hazard, with a barrier of protection. The hierarchy of controls is important in acknowledging that, while personal protective equipment has tremendous utility, it is not the desired mechanism of control in terms of worker safety.

2.5.3.0 Types

Personal protective equipment can be categorized by the area of the body protected, by the types of hazards, and by the type of garment or accessory. A single item – for example, boots – may provide multiple forms of protection: a steel toe cap and steel insoles for protection of the feet from crushing or puncture injuries, impervious rubber and lining for protection from water and chemicals, high reflectivity and heat resistance for protection from radiant heat, and high electrical resistivity for protection from electric shock. The protective attributes of each piece of equipment must be compared with the hazards expected to be found in the workplace. More breathable types of personal protective equipment may not lead to more contamination but do result in greater user satisfaction.

Respirators

Respirators serve to protect the user from breathing in contaminants in the air, thus preserving the health of their respiratory tract. There are two main types of respirators. One type of respirator functions by filtering out chemicals and gases, or airborne particles, from the air breathed by the user. The filtration may be either passive or active (powered). Gas masks and particulate respirators (like N95 masks) are examples of this type of respirator. A second type of respirator protects users by providing clean, respirable air from another source. This type includes airline respirators and self-contained breathing apparatus (SCBA). In work environments, respirators are relied upon when adequate ventilation is not available or other engineering control systems are not feasible or inadequate.

In the United Kingdom, an organization that has extensive expertise in respiratory protective equipment is the Institute of Occupational Medicine. This expertise has been built on a long-standing and varied research program that has included the setting of workplace protection factors to the assessment of efficacy of masks available through high street retail outlets. [citation needed]

The Health and Safety Executive (HSE), NHS Health Scotland and Healthy Working Lives (HWL) have jointly developed the RPE (Respiratory Protective Equipment) Selector Tool, which is web-based. This interactive tool provides descriptions of different types of respirators and breathing apparatuses, as well as "dos and don'ts" for each type.

In the United States, The National Institute for Occupational Safety and Health (NIOSH) provides recommendations on respirator use, in accordance to NIOSH federal respiratory regulations 42 CFR Part 84. The National Personal Protective Technology Laboratory (NPPTL) of NIOSH is tasked towards actively conducting studies on respirators and providing recommendations.

Surgical masks are considered as PPE, but are not considered as respirators, being unable to stop submicron particles from passing through, and also having unrestricted air flow at the edges of the masks.

Skin protection

Occupational skin diseases such as contact dermatitis, skin cancers, and other skin injuries and infections are the second-most common type of occupational disease and can be very costly. Skin hazards, which lead to occupational skin disease, can be classified into four groups. Chemical agents can come into contact with the skin through direct contact with contaminated surfaces, deposition of aerosols, immersion or splashes. Physical agents such as extreme temperatures and ultraviolet or solar radiation can be damaging to the skin over prolonged exposure. Mechanical trauma occurs in the form of friction, pressure, abrasions, lacerations and contusions. Biological agents such as parasites, microorganisms, plants and animals can have varied effects when exposed to the skin. Any form of PPE that acts as a barrier between the skin and the agent of exposure can be considered skin protection. Because much work is done with the hands, gloves are an essential item in providing skin protection. Some examples of gloves commonly used as PPE include rubber gloves, cut-resistant gloves, chainsaw gloves and heat-resistant gloves. For sports and other recreational activities, many different gloves are used for protection, generally against mechanical trauma.

Other than gloves, any other article of clothing or protection worn for a purpose serve to protect the skin. Lab coats for example, are worn to protect against potential splashes of chemicals. Face shields serve to protect one's face from potential impact hazards, chemical splashes or possible infectious fluid.

Many migrant workers need training in PPE for Heat Related Illnesses prevention (HRI). Based on study results, research identified some potential gaps in heat safety education. While some farm workers reported receiving limited training on pesticide safety, others did not. This could be remedied by incoming groups of farm workers receiving video and in-person training on HRI prevention. These educational programs for farm workers are most effective when they are based on health behavior theories, use adult learning principles and employ train-the-trainer approaches.

Eye protection

Each day, about 2,000 US workers have a job-related eye injury that requires medical attention. Eye injuries can happen through a variety of means. Most eye injuries occur when solid particles such as metal slivers, wood chips, sand or cement chips get into the eye. Smaller particles in smokes and larger particles such as broken glass also account for particulate matter-causing eye injuries. Blunt force trauma can occur to the eye when excessive force comes into contact with the eye. Chemical burns, biological agents, and thermal agents, from sources such as welding torches and UV light, also contribute to occupational eye injury.

While the required eye protection varies by occupation, the safety provided can be generalized. Safety glasses provide protection from external debris, and should provide side protection via a wrap-around design or side shields.

Goggles provide better protection than safety glasses, and are effective in preventing eye injury from chemical splashes, impact, dusty environments and welding. Goggles with high air flow should be used to prevent fogging.

Face shields provide additional protection and are worn over the standard eyewear; they also provide protection from impact, chemical, and blood-borne hazards.

Full-facepiece respirators are considered the best form of eye protection when respiratory protection is needed as well, but may be less effective against potential impact hazards to the eye.

Eye protection for welding is shaded to different degrees, depending on the specific operation.

Hearing protection

Industrial noise is often overlooked as an occupational hazard, as it is not visible to the eye. Overall, about 22 million workers in the United States are exposed to potentially damaging noise levels each year. Occupational hearing loss accounted for 14% of all occupational illnesses in 2007, with about 23,000 cases significant enough to cause permanent hearing impairment. About 82% of occupational hearing loss cases occurred to workers in the manufacturing sector. In the US the Occupational Safety and Health Administration establishes occupational noise exposure standards. The National Institute for Occupational Safety and Health recommends that worker exposures to noise be reduced to a level equivalent to 85 dBA for eight hours to reduce occupational noise-induced hearing loss.

PPE for hearing protection consists of earplugs and earmuffs. Workers who are regularly exposed to noise levels above the NIOSH recommendation should be provided with hearing protection by the employers, as they are a low-cost intervention. A personal attenuation rating can be objectively measured through a hearing protection fit-testing system. The effectiveness of hearing protection varies with the training offered on their use.

Protective clothing and ensembles

This form of PPE is all-encompassing and refers to the various suits and uniforms worn to protect the user from harm. Lab coats worn by scientists and ballistic vests worn by law enforcement officials, which are worn on a regular basis, would fall into this category. Entire sets of PPE, worn together in a combined suit, are also in this category.

Ensembles

Below are some examples of ensembles of personal protective equipment, worn together for a specific occupation or task, to provide maximum protection for the user.

1. PPE gowns are used by medical personnel like doctors and nurses.
2. Chainsaw protection (especially a helmet with face guard, hearing protection, kevlar chaps, anti-vibration gloves, and chainsaw safety boots).
3. Bee-keepers wear various levels of protection depending on the temperament of their bees and the reaction of the bees to nectar availability. At minimum most bee keepers wear a brimmed hat and a veil made of fine mesh netting. The next level of protection involves leather gloves with long gauntlets and some way of keeping bees from crawling up one's trouser legs. In extreme cases, specially fabricated shirts and trousers can serve as barriers to the bees' stingers.

4. Firefighters wear PPE designed to provide protection against fires and various fumes and gases. PPE worn by firefighters include bunker gear, self-contained breathing apparatus, a helmet, safety boots, and a PASS device.

CONCEPTUAL FRAME WORK

ACHIEVEMENTS Scientific equipment development institute, minna (SEDI, Minna) is a parastatal under National Agency for Science and Engineering Infrastructure (NASENI) which is an agency of federal Ministry of Science and Technology (FMST) was established in June, 1992.

VISION STATEMENT

The vision of scientific Equipment Development Institute is "To create an enabling knowledge driven environment for local mass production of standard parts goods and services required for the nations technology advancement."

MANDATE OF THE INSTITUTE

The mandate of the institute specifically in the area of research, production and reverse engineering with respect to the following broad areas.

a) Research into develop system
    i. for physics, chemistry, biology introduction technology, integrated science, mathematics etc
b) Scientific equipment for research, for mass production of:
    ii. School Laboratory apparatus industrial and higher institutions.
    iii. Measuring and control instrument for electrical, electronic mechanical workshop, artisan, etc industries and utility equipment
c) Transfer the developed production technologies to satellite industries (SME's).

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Introduction

This chapter deals with the method used in carrying out the study, a description of how it was carried out. This would therefore, be discussed under the following:

- Research design
- Population of the study
- Sample and sampling techniques
- Instrument for Data collection
- Validity of instrument
- Administration of Instrument
- Methods of data collection
- Methods of data analysis

3.1 Research Design

The research design adopted for this study is a descriptive survey. This was chosen because data will be gathered from respondents considered to be the representative of the population. The use of Systematic variance shall be employed.

3.2 Area of the study

This study was carried out at Scientific Equipment Development Institute located at PMB37 along Taguai Road Minna, Niger state.

3.3 Population of the study

The population of the study covers the entire staff and trainee from the Sections in the Institute (SEDI) selected from each of the 7 sections machine shop, GAP, woodwork, electroplating, ceramics, plastics, foundry

3.4 Sample and sampling technique

The sample of this study constitute of staff and trainees of 7 Sections under the manufacturing services department.

A total of 69 respondents from both students and teachers of which consist of 49 staff and 20trainee were selected by simple random sampling technique. This was applied because it guarantees all the members of the population have equal chance of being selected as sample.

3.5 Instrumentation for data collection

The questionnaire was employed as a tool for data collection in the research work. Two set of questionnaires were formed containing 10 items each in two sections. Section "A" will be use to obtain personal particulars of the respondents. Section "B" is designed to elicit the resources from respondent on their taught about Assessment of industrial safety and management in Machine Shop in Scientific Equipment Development institute Minna (SEDI). This set of questionnaire was designed to solicit for relevant information that will be used during analysis. The Likert Format of questionnaire will be applied of which involves the use of Strongly Agreed (SA), Agreed (A), Disagreed (DA) and Strongly Disagreed (SD) with four points rating scale.

3.6 Validation of instrument

The drafted questionnaire was given to the supervisor for the purpose of scrutiny and to ensure face and content validity. .

3.7 Administration of instrument

The questionnaire was administered by the researcher himself. During the administration, the researcher visited all the Seven Sections. This direct contact method gave the researcher a room to explain the questionnaire. It also encouraged the respondents to answer the question truthfully. The questionnaires were collected after three days from a staff assigned to its collection by ensuring a 100% return of the questionnaire.

3.8 Method of data collection

In this research questionnaires were used for data collection

3.9 Method of data analysis

A simple percentage statistical technique was used to analyze the personal data of the respondent and the questionnaire items. The use of CHI SQUARE will be employed for section two to test for association of the hypothesis questions.

CHAPTER FOUR

4.0 DATA PRESENTATION, ANALYSIS AND INTERPRETAION

4.0.1 Introduction

The chapter deals with data presentation, analysis and interpretation as well as the discussion of the finding.

4.0.2 Data presentation

Data collected using questionnaire from the respondents relating to the problem under investigation were presented in tables, analysed and discussed according to the research questions.

4.0.3 Data analysis

The analysis here in covers both the demographic data of the correspondents as well as the research questions.

4.0.4 Analysis of Demographic Data of Staffs' Respondents

The responses gathered from the Staffs in various schools included in the sample size are represented as follows;

4.0.5Analysis of Staffs' Respondent by Sex

Sex	Frequency	Percentage (%)
Male	46	93.88%
Female	03	6.12%
Total	49	100%

Table 4.1

Table 4.1 shows that 46 of the respondents representing (93.88%) were males while 03 respondents representing (6.12%) were females.

This implies that majority of the respondent where men.

Analysis of Respondents by Age

Age (years)	Frequency	Percentage (%)
18-25	07	14.29%
26-35	14	28.57%
36-50	22	49.90%
51 and above	06	12.24%
Total	49	100%

Table 4.2

Table 4.2 above shows that 07 (14.29%) respondents fall within the age brackets of 18-25, 14 (28.57%) within the age of 26-35, 22 (49.90%) respondents fall between the age bracket of 36-50 while 06 (12.24%) respondents fall within the age range of 50 and above. This implies that most of the respondents where within the age range 36-50 years.

Analysis of Respondents by Highest Educational Qualification

Qualification	Frequency	Percentage
S.S.C.E	07	14.29%
ND/OND	06	12.24%
NCE	06	12.24%
HND	10	20.41%
PGD	04	8.16%

B.Eng/B.Sc/B.Ed/B.Tech	12	24.49%
M.Eng/M.Sc/M.Ed/M.Tech	03	6.12%
Ph.D	01	2.04%
Total	49	100%

Table 4.3

Table 4.3 above shows the correspondents' qualification as follows: - S.S.C.E 07 (14.29%), ND/OND 06 (12.24%), NCE 06 (12.24%), HND 10 (20.41%), PGD 04 (8.16%), B.Eng/B.Sc/B.Ed/B.Tech 12 (24.49%), M.Eng/M.Sc/M.Ed/M.Tech 03 (6.12%) and Ph.D 01 (2.04%).

This implies that most of the respondents had B.Eng/B.Sc/B.Ed/B.Tech degree.

Analysis of Respondent by Working Experience

Years of Working Experience	Frequency	Percentage (%)
1-10	22	44.90%
11-20	20	40.82%
21-30	07	14.29%
31 and above	0	0%
Total	49	100%

Table 4.4

Table 4.4 shows the respondent's years of working experience as follows: - 1-10 years 22 (44.90%), 11-20 years 20 (40.82%), 21-30 years 07 (14.29%) and 31 and above 0 (0%).

This implies that majority of respondents are new Staffs while none of the very overly experienced Staffs (31 and above) where respondents.

4.3.2 Analysis of Demographic Data of Trainees' Respondents

Analysis of Trainees' Respondents by Sex

Sex	Frequency	Percentage (%)
Males	16	80%
Females	04	20%
Total	20	100%

Table 4.6

Table 4.6 above shows that 16 (80%) of the Trainees were males and 04 (20%) were females.

Majority of the respondents were male Trainees.

Analysis of Trainees' Respondents by Age

Age (years)	Frequency	Percentage (%)
Below 18	04	20%
18 and above	16	80%
Total	20	100%

Table 4.7

Table 4.7 shows that the respondents who were below 18 years are 04 (20%),while those of 18 years and above are 16 (80%) in number.

Analysis of Trainees' Respondents by class of Industrial Training

Class	Frequency	Percentage (%)
Polytechnic Trainee (ND 1 S.I.W.E.S)	07	35%
College of Education Trainee (S.I.W.E.S)	02	10%

Polytechnic Trainee (Post ND I.T)	04	20%
Undergraduate S.I.W.E.S	06	30%
Postgraduate S.I.W.E.S	01	5%
Total	20	100%

Table 4.8

Table 4.8 above shows that the respondents class as follows:- Polytechnic Trainee (ND 1 S.I.W.E.S) 07 (35%), College of Education Trainee (S.I.W.E.S) 02 (10%), Polytechnic Trainee (Post ND I.T) 04 (20%), Undergraduate S.I.W.E.S 06 (30%) and Postgraduate S.I.W.E.S 01 (5%).

This implies that most of the respondent are Polytechnic Trainees and as such can give proper insight into the questions to be asked.

4.4 Analysis of research questions

This aspect shall attempt to analyse the responses of both the Staffs and Trainees and also compare their responses if there are any correlations at all.

4.4.1 Analysis of Staffs' responses to research questions

The following abbreviations were used; Strongly Agreed=SA, Agreed=A, Disagreed=D, Strongly Disagreed=SD and Standard Deviation= σ

During the survey, the Staffs gave the following responses to the research questions asked;

4.1 Research Question 1:

What are the various hazards associated with use of machines in the Institute?

S/N	ITEMS	A	SA	D	SD	Mean	σ
1	Physical hazards affect the use of machines at machine shop, SEDI Minna.	28	20	1	0	12.25	12.09
2	Do mechanical hazards affect the use of machine at machine shop, SEDI Minna ?	17	30	1	1	12.25	12.15
3	Do chemical hazards affect the use of machines at machines shop, SEDI Minna ?	21	22	4	2	12.25	9.31
4	Do environmental hazards affect the use of machines at the machine shop, SEDI Minna ?	18	20	8	3	12.25	7.01
5	Hazards can be presented	15	32	1	1	12.25	12.75
6	Hazard can be prevented through the use of PPE	18	30	0	11	12.25	12.50
7	Hazards can be caused by faulty equipment	22	27	0	0	12.25	12.38
8	Hazards are inevitable	11	13	13	12	12.25	0.83
9	Wrong usage of tools causes hazards	22	21	3	3	12.25	9.26
10	Hazards can cause deficiency to workers	20	29	0	0	12.25	12.66
	Over All Mean	192	244	31	23	12.25	10.09

Table 4.9

Table 4.9 shows that overall mean of respondents is 12.25 while the overall standard deviation is 10.09. Due to the very high standard deviation, it is noted that most of the respondents agree that Physical hazards, mechanical hazards, chemical hazards, environmental hazards are associated with the use of machines in Machine Shop section SEDI Minna.

4.2 Research Question 2:

What are the safety procedures adopted for the safe use of machines?

S/N	ITEMS	A	A S	D	S D	Mean	σ
1	Ensure the use of PPE before operation	18	20	3	8	12.25	7.01
2	Proper attention and concentration while machine is on	17	30	1	1	12.25	12.15
3	Put off the machine if it is observed that there is change in sound or voltage	30	18	1	0	12.25	12.50
4	There should be adequate lightening while working on machines	21	22	2	4	12.25	9.32
5	There should adequate ventilation within the workshop	20	29	0	0	12.25	12.66
6	Water or chemical spill should be wiped off as soon as possible to prevent accident	32	15	1	1	12.25	12.75
7	Ensure clean the machine after operation	20	28	1	0	12.25	12.09
8	Observation of proper fittings and construction during operation	22	21	3	3	12.25	9.26
9	Keep all gang ways free for easy movement	22	21	2	4	12.25	9.31
10	Report any fault detected from a machine to the instructor	21	22	3	3	12.25	9.26
	Over all mean	223	226	17	24	12.25	10.63

Table 4.10

Table 4.10 shows that overall mean of respondents is 12.25 while the overall standard deviation is 10.63. Due to the very high standard deviation, it is noted that most of the respondents agree that the following safety procedures adopted for the safe use of machines (Ensure the use of PPE before operation, Ensure the use of PPE before operation, Put off the machine if it is observed that there is change in sound or voltage etc).

4.3 Research Question 3:

What are the various rules usually adopted during machines operations?

S/N	ITEMS	A	A S	D	D S	Mean	σ
1	Always use the right tool for the right job	29	20	0	0	12.265	12.66
2	Do not play in the workshop	27	20	0	0	12.25	12.36
3	Do not wear loose clothes while working on moving machines	35	15	1	1	12.25	12.73
4	Do wear jewelleries when working on machines on machines	21	22	2	4	12.25	9.31
5	Worker should know the direction of first aid box	28	20	0	1	12.25	12.09
6	Ensure good ventilation system in the workshop	30	17	1	1	12.25	12.15
7	Do not work in a confined environment	20	18	1	0	12.25	7.01
8	Always seek for proper instructions before working on machines	18	30	1	0	12.25	12.50
9	Do dot use unauthorize or damaged guards	22	21	3	3	12.25	9.26
10	Always be attentive during machines operation	22	21	4	2	12.25	9.31
	Over all mean	249	206	20	15	12.25	10.95

Table 4.11

Table 4.11 shows that overall mean of respondents is 12.25 while the overall standard deviation is 10.95. Due to the very high standard deviation, it is noted that most of the respondents agree that the various rules usually adopted during machines operations are; always use the right tool for the right job, do not play in the workshop, do not wear loose clothes while working on moving machines e.t.c

4.4 Research Question 4:

What are the effective ways of safety management in machine shop?

S/N	ITEMS	A	S A	D	S D	Mean	σ
1	Ensure the use of PPE	29	20	0	0	12.25	12.66
2	Sick staff should be given leave from work	21	22	3	3	12.25	9.26
3	All faulty equipment should be replaced	22	27	0	0	12.25	12.38
4	Workers should not over work to avoid accident	18	30	0	1	1.25	12.50
5	Proper maintenance should be given to machine and equipment	15	32	1	1	12.25	12.75
6	Ensure regular service of machines and equipment	18	20	8	3	12.25	7.01
7	Staff should ensure a good health status before operating on machines	22	21	4	2	12.25	9.31
8	No machine should be left on after use	17	30	1	0	12.25	12.15
9	Do not work on faulty machines	28	20	1	0	12.25	12.09
10	Worn out tool and equipment should be replaced	10	39	0	0	12.25	15.79
	Over all mean	200	261	18	11	12.25	11.61

Table 4.12

Table 4.12 shows that overall mean of respondents is 12.25 while the overall standard deviation is 11.61. Due to the very high standard deviation, it is noted that most of the respondents agree that the effective ways of safety management in machine shop are: Ensure the use of PPE, Sick staff should be given leave from work, All faulty equipment should be replaced etc.

Staffs' Perspectives on Assessment of industrial Safety and Management in Machine Shop SEDI Minna

ITEM	Strongly Agreed	Agreed	Disagreed	Strongly Disagreed	
There are the various hazards associated with use of machines in the Institute.	192	244	31	23	490
There are the safety procedures adopted for the safe use of machines	223	226	17	24	490
There are the various rules usually adopted during machines operations	249	206	20	15	490
There are the effective ways of safety management in machine shop	200	261	18	11	490
Total					1960

Table 4.14

Firstly, we employ the use of chi-square to see if there is a relationship between the various hazards associated with use of machines in the Institute and the safety procedures adopted for the safe use of machines.

Expected frequencies $E = \frac{X_a + X_b}{2}$ where X_a is observed frequency for first sample, while X_b is observed frequency for second sample.

Expected frequencies are;

$\frac{192+223}{2} = 207.5$ $\frac{244+226}{2} = 233$ $\frac{31+17}{2} = 24$ $\frac{23+24}{2} = 23.5$

Relationship between the various hazards associated with use of machines in the Institute and the safety procedures adopted for the safe use of machines.

Observed Frequency (O)	Expected Frequency (E)	$O-E$	$(O-E)^2$	$\frac{(O-E)^2}{E}$
192	207.5	9	240.25	1.16
244	235	9	81	0.34
31	24	7	49	2.04
23	23.5	-0.5	0.25	0.01
223	207.5	15.5	240.25	1.16
226	235	-9	81	0.3
17	24	-7	49	2.04
24	23.5	0.5	0.25	0.01
			$\sum \frac{(O-E)^2}{E} =$	7.1

Table 4.15

The calculated value is given as 7.1.

The degree of freedom $d_f = (r-1)(c-1)$

$$c = number of\ columns$$

$$r = number of\ rows$$

$$d_f = (2-1)(4-1) = 3$$

Using table probability $p_r = 0.005$, we have a table value 7.815. Therefore, the hypothesis is accepted because the calculated value is lower than the table value and as such the safety procedure adopted for the safe use of machines reduces the various hazards associated with the use of machines in the institute.

For the second part, we employ the use of chi-square to see if there is a relationship between the various rules usually adopted during machines operations and the effective ways of safety management in machine shop

Expected frequencies $E = \frac{X_a + X_b}{2}$ where X_a is observed frequency for first sample, while X_b is observed frequency for second sample.

Expected frequencies are;

$$\frac{249+200}{2} = 224.5 \quad \frac{206+261}{2} = 233.5 \quad \frac{20+18}{2} = 19 \quad \frac{15+11}{2} = 13$$

<u>Relationship between the various rules usually adopted during machines operations and the effective ways of safety management in machine shop</u>

Observed Frequency (O)	Expected Frequency (E)	$O-E$	$(O-E)^2$	$\frac{(O-E)^2}{E}$
249	224.5	24.5	600.25	2.67
206	233.5	-27.5	756.25	3.27
20	19	1	1	0.05
15	13	2	4	0.31

200	224.5	-24.5	600.25	2.67
261	233.5	276.25	756.25	3.24
18	19	-1	1	0.05
11	13	-2	4	0.31
			$\sum \frac{(O-E)^2}{E} =$	12.54

Table 4.16

The calculated value is given as 12.54

The degree of freedom $d_f = (r-1)(c-1)$

$c = number of\ columns$

$r = number of\ rows$

$d_f = (2-1)(4-1) = 3$

Using table probability $p_r = 0.005$, we have a table value 7.815. Therefore, the hypothesis is rejected because the calculated value is higher than the table value and as such, we say that the effectives ways of safety management in machine shop does not usually affect the various rules usually adopted during machines operation in the institute.

4.4.2 Analysis of Trainees' responses to research questions

The following abbreviations were used; Strongly Agreed=SA, Agreed=A, Disagreed=D, Strongly Disagreed=SD and Standard Deviation= σ.

During the survey, the Staffs gave the following responses to the research questions asked;

4.5 Research Question 1:

What are the various hazards associated with use of machines in the Institute?

S/N	ITEMS	A	SA	D	SD	Mean	σ
1	Do physical hazards affect the use of machines at machine shop, SEDI Minna ?	10	8	1	1	5	4.06
2	Do mechanical hazards affect the use of machine at machine shop, SEDI Minna ?	9	9	0	2	5	4.06
3	Do chemical hazards affect the use of machines at machines shop, SEDI Minna ?	9	9	1	1	5	4.00
4	Do environmental hazards affect the use of machines at the machine shop, SEDI Minna ?	9	9	2	0	5	4.06
5	Hazards can be prevented	12	7	0	1	5	4.85
6	Hazard can be prevented through the use of PPE	7	9	3	1	5	3.16
7	Hazards can be caused by faulty equipment	9	7	0	4	5	3.39
8	Hazards are inevitable	6	4	5	5	5	0.71
9	Wrong usage of tools causes hazards	9	9	1	1	5	4.00
10	Hazards can cause deficiency to workers	9	11	0	0	5	5.05
	Over All Mean	89	82	13	16	5	3.73

Table 4.17

Table 4.17 shows that overall mean of respondents is 5 while the overall standard deviation is 3.73. Due to the very high standard deviation, it is noted that most of the respondents agree that Physical hazards, mechanical hazards, chemical hazards, environmental hazards are associated with the use of machines in Machine Shop section SEDI Minna.

4.6 Research Question 2:

What are the safety procedures adopted for the safe use of machines?

S/N	ITEMS	A	SA	D	S D	Mean	σ
1	Ensure the use of PPE before operation	11	9	0	0	5	5.05
2	Proper attention and concentration while machine is on	9	9	0	2	5	4.06
3	Put off the machine if it is observed that there is change in sound or voltage	9	9	1	1	5	4.00
4	There should be adequate lightening while working on machines	9	9	1	1	5	4.00
5	There should adequate ventilation within the workshop	9	7	4	0	5	3.39
6	Water or chemical spill should be wiped off as soon as possible to prevent accident	9	9	2	0	5	4.06
7	Ensure clean the machine after operation	9	7	1	3	5	3.16
8	Observation of proper fittings and construction during operation	8	10	1	1	5	4.06
9	Keep all gang ways free for easy movement	7	12	1	0	5	4.85
10	Report any fault detected from a machine to the instructor	10	8	1	1	5	4.06
	Over All Mean	90	89	12	9	5	4.07

Table 4.18

Table 4.18 shows that overall mean of respondents is 5 while the overall standard deviation is 4.07. Due to the very high standard deviation, it is noted that most of the respondents agree that the following safety procedures adopted for the safe use of machines (Ensure the use of PPE before operation, Ensure the use of PPE before operation, Put off the machine if it is observed that there is change in sound or voltage etc).

4.7 Research Question 3:

What are the various rules usually adopted during machines operations?

S/N	ITEMS	A	SA	D	D S	Mean	σ
1	Always use the right tool for the right job	9	11	0	0	5	5.05
2	Do not play in the workshop	12	7	0	1	5	4.85
3	Do not wear loose clothes while working on moving machines	9	9	0	2	5	4.06
4	Do wear jewelries when working on machines on machines	9	9	1	1	5	4.00
5	Worker should know the direction of first aid box	9	9	2	0	5	4.06
6	Ensure good ventilation system in the workshop	10	8	1	1	5	4.06
7	Do not work in a confined environment	9	7	0	4	5	3.39
8	Always seek for proper instructions before working on machines	9	9	1	1	5	4.00
9	Do not use unauthorize or damaged guards	12	7	1	0	5	4.08
10	Always be attentive during machines operation	7	9	3	1	5	3.16
	Over all mean	95	58	9	11	5	4.15

Table 4.19

Table 4.19 shows that overall mean of respondents is 5 while the overall standard deviation is 4.15. Due to the very high standard deviation, it is noted that most of the respondents agree that the various rules usually adopted during machines operations are;

always use the right tool for the right job, do not play in the workshop, do not wear loose clothes while working on moving machines e.t.c

4.8 Research Question 4:

What are the effective ways of safety management in machine shop?

S/N	ITEMS	A	S A	D	S D	Mean	σ
1	Ensure the use of PPE	9	9	2	0	5	4.06
2	Sick staff should be given leave from work	9	7	3	1	5	3.16
3	All faulty equipment should be replaced	10	8	1	1	5	4.06
4	Workers should not over work to avoid accident	7	12	0	1	5	4.85
5	Proper maintenance should be given to machine and equipment	10	8	1	1	5	4.06
6	Ensure regular service of machines and equipment	11	9	0	0	5	4.05
7	Staff should ensure a good health status before operating on machines	11	9	0	2	5	4.06
8	No machine should be left on after use	9	9	1	1	5	4.00
9	9	9	9	1	1	5	4.00
10	Worn out tool and equipment should be replaced	78	9	0	4	5	3.39
	Over all mean	90	89	9	12	5	4.07

Table 4.20

4.9 Hypothesis

H_1: Hazards are associated with the use of machines

H_2: Safety measures are required while handling or operating machines

H_3: There is need for safety skills in handling machines.

Table 4.20 shows that overall mean of respondents is 20 while the overall standard deviation is 16.45. Due to the very high standard deviation, it is noted that most of the respondents agree that the effective ways of safety management in machine shop are: Ensure the use of PPE, Sick staff should be given leave from work, all faulty equipment should be replaced etc.

4.10 findings of the study

The discussion of findings as contained herein is done table by table based on each research question.

Tables 4.9, 4.10, 4.11, 4.12 and 4.13 shows that majority of Staffs agree with the following statement;

1. there are various hazards associated with the use of machines in the Institute
2. There are safety procedures adopted for the safe use of machines
3. There are various rules usually adopted during machines operations
4. There are effective ways of safety management in machine shop

4.11 Discussion of findings

Table 4.14 shows the breakdown of the responses gotten from Staffs of which provided information for the following questions to be answered.

- The safety procedure adopted for the safe use of machines reduces the various hazards associated with the use of machines in the institute.
- The effectives ways of safety management in machine shop does not usually affect the various rules usually adopted during machines operation in the institute.

Based on the responses of the Staffs and Trainees we can deduce thus on the following hypothesis

- Hazards are associated with the use of machines
- Safety measures are required while handling or operating machines
- There is need for safety skills in handling machines.

CHAPTER FIVE

5.0 SUMMARY, CONCLUSION AND RECOMMENDATIONS

This chapter presents the summary, conclusion and recommendation of the study.

5.1 Summary

This research work on Assessment of industrial safety and management in Machine Shop in Scientific Equipment Development Institute (SEDI) MINNA, using two sets questionnaire.

The literature review reveals that strict adherence to safety procedures, safety rules, and effective ways of safety management reduces hazard in in the machine shops.

In chapter three, the researcher, presented the research methodology used in data collection for the research work which includes the questionnaires.

Chapter four dealt with presentation and analysis of data collected from chapter three and possible finding from the study.

Chapter five summarized the entire research work, drew conclusion and made recommendations in line with the research findings.

5.2 Conclusion

The root causes of hazards in machine shop involve the following, negligence to safety procedures, non-effective ways of safety management, poor safety management, non-observation of safety rules, nature of work and working condition, work experience, all these could lead to occurrence of hazards

5.3 Recommendation

In the line with the research findings, the researcher made the following recommendations for there to be improvement in safety management in the machine shop.

- Staff and trainee should always observe safety rules
- They should keep to safety procedure and adopt the culture of preventing hazards.
- Safety gadget and protective equipment should have made available in the work shop
- Worker should always wear personal protective equipment (PPE)

5.4 Suggestion for further Research

1. Further research should be carried out to involve the dangers of non-safety culture in machine shops.
2. Further studies should also consider the impact of safety management in the machine shop
3. This research should also consider the perspectives of the Administrators towards safety management.

REFERENCE

"Administrative Controls". U.S. Mine Safety and Health Administration. Retrieved 14 March 2017.

"Approaches to Safe Nanotechnology" (PDF). U.S. National Institute for Occupational Safety and Health. March 2009. Retrieved 15 March 2017.

"CDC - Chemical Safety - NIOSH Workplace Safety and Health Topic". www.cdc.gov. Retrieved 2015-09-03.

"Chapter 8 - Chemical Hazards". sp.ehs.cornell.edu. Retrieved 2016-02-02.

"Chemical safety in the home". NI Direct Government Services. Retrieved 11 May 2021.

"Control guidance sheet S100 - General advice; Chemicals causing harm via skin or eye contact" (PDF). UK Health and Safety Executive. 2003-10-01. Retrieved 2019-08-19.

"Control Measures" (PDF). Environmental Health and Safety – Bloomington Indiana University. Archived from the original (PDF) on 2017-12-15. Retrieved 16 March 2017.

"Engineering Controls Database". U.S. National Institute for Occupational Safety and Health. Retrieved 2019-08-19.

"Hazard Control". Canadian Centre for Occupational Health and Safety. 17 March 2017. Retrieved 17 March 2017.

"Hazard Identification, Elimination and Control". Health Sciences Association of Alberta. Archived from the original on 2017-03-14. Retrieved 2017-03-13.

"Hazard symbols and hazard pictograms - Chemical classification". hse.gov.uk. Health and Safety Executive. Retrieved 2016-02-11.

"Hazardous Work". International Labour Organization. Retrieved December 26, 2012.

"Hierarchy of Controls" (PDF). U.S. Occupational Safety and Health Administration. Retrieved 2017-03-09.

"Hierarchy of Controls" (PDF). U.S. Occupational Safety and Health Administration. Retrieved 16 March 2017.

"Hierarchy of Controls". U.S. National Institute for Occupational Safety and Health. Retrieved 2017-01-30.

"Hierarchy of Controls". U.S. National Institute for Occupational Safety and Health. CDC. July 2016. Retrieved 17 March 2017.

"Machine Safety". NIOSH Workplace Safety and Health Topics. National Institute for Occupational Safety and Health. Retrieved 11 July 2012.

"Nanomaterial Production and Downstream Handling Processes". U.S. National Institute for Occupational Safety and Health. November 2013. Retrieved 17 March 2017.

"NFPA Journal - Confined Space, March April 2017". www.nfpa.org. Retrieved 2018-04-18.

"NIOSH Directory of Engineering Controls". U.S. National Institute for Occupational Safety and Health. Retrieved 2016-06-13.

"Personal Protective Equipment". Citation PLC. Archived from the original on 2012-10-14. Retrieved 2012-10-31. Personal Protective Equipment

"Selecting the right Respiratory Protective Equipment (RPE) for the job". Healthy Working Lives. 2008-4-4

"Why Transition? | Transitioning to Safer Chemicals | Occupational Safety and Health Administration". www.osha.gov. Retrieved 2020-12-01.

^ Jump up to:a b "Hierarchy of Controls - NIOSH Workplace Safety and Health Topic". U.S. National Institute for Occupational Safety and Health. Retrieved 2017-01-30. This article incorporates text from this source, which is in the public domain.

“Respiratory Protection Against Airborne Infectious Agents for Health Care Workers: Do surgical masks protect workers?" (OSH Answers Fact Sheets). Canadian Centre for Occupational Health and Safety. 2017-02-28. Retrieved 2020-04-18. ^ PPE

Albert A, Hallowell MR. Hazard recognition methods in the construction industry. Construction Research Congress. 2012;2012:407-416

Atmospheric Testing and the New OSHA Construction Confined Spaces Standard -- Occupational Health & Safety". Occupational Health & Safety. Retrieved 2018-04-18.

Awolusi I, Marks E. Near-Miss Reporting to Enhance Safety in the Steel Industry. Association for Iron and Steel Technology Publications: Safety First, Iron and Steel Technology; 2015. pp. 62-68

Awolusi IG, Marks ED. Safety activity analysis framework to evaluate safety performance in construction. Journal of Construction Engineering and Management. 2017;143(3):05016022

Bauer, ER; Babich. "Administrative controls for reducing worker noise exposures". "Administrative Controls". Interactive Learning Paradigms Incorporated. 25 July 2016. Retrieved 15 March 2017.

Bobick TG. Falls through roof and floor openings and surfaces, including skylights: 1992-2000. Journal of Construction Engineering Management. 2004;130(6):895-907

Bureau of Labor Statistics (BLS). 2018 Census of Fatal Occupational Injuries (Final Data)—Industry by Event or Exposure. U.S. Bureau of Labor Statistics, U.S. Department of Labor; 2019. Available from: https://www.bls.gov/iif/oshwc/cfoi/cfch0016.pdf [Accessed: 31 July 2020]

CDC - Falls in the Workplace - NIOSH Workplace Safety and Health Topic". www.cdc.gov. 2018-04-02. Retrieved 2018-04-18.

CDC - NIOSH - Respirator Fact Sheet Archived 2017-09-28 at the Wayback Machine. The National Personal Protective Technology Laboratory.

China Labour Bulletin (CLB). China's most Dangerous Industry is Getting more Dangerous. China Labour Bulletin. 2019. Available from: https://clb.org.hk/print/14884

Choudhry RM, Fang D, Mohamed S. The nature of safety culture: A survey of the state-of-the-art. Safety Science. 2007;45(10):993-1012

Choudhry RM, Fang D, Mohamed S. The nature of safety culture: A survey of the state-of-the-art. Safety Science. 2006;45:993-1012

Controlling Electrical Hazards". www.osha.gov. Retrieved 2018-04-14.

Criteria for a Recommended Standard: Occupational Noise Exposure Archived (2017) at the Wayback Machine. DHHS (NIOSH) Publication No. 98-126.

Dhar N, Kamruzzaman M, Ahmed M. Effect of minimum quantity lubrication (MQL) on tool wear and surface roughness in turning AISI-4340 steel. Journal of Materials Processing Technology. 2006;172(2):299-304

Electrical risks". Australian Government Comcare. Retrieved 2018-04-12.

ESFI Occupational Injury and Fatality Statistics". www.esfi.org. Retrieved 2018-04-19 Vibration Hazards in the Workplace: The Basics of Risk Assessment -- Occupational Health & Safety". Occupational Health & Safety. Retrieved 2018-04-19.

Government of Canada, Canadian Centre for Occupational Health and Safety (2020-11-12). "Canadian Centre for Occupational Health and Safety". www.ccohs.ca. Retrieved 2020-12-01.

Grabowski M, Ayyalasomayajula P, Merrick J, Harrald JR, Roberts K. Leading indicators of safety in virtual organizations. Safety Science. 2007;45(10):1013-1043. DOI: 10.1016/j.ssci.2006.09.007

Hallowell MR, Hinze JW, Baud KC, Wehle A. Proactive construction safety control: Measuring, monitoring, and responding to safety leading indicators. Journal of Construction Engineering and Management. 2013;139(10):04013010

Han S, Lee S. A vision-based motion capture and recognition framework for behavior-based safety management. Automation in Construction. 2013;35:131-141

Han S, Yang H, Im D. Designing a human-computer interface for a process control room: A case study of a steel manufacturing company. International Journal of Industrial Ergonomics. 2007;37(5):383-393

Harris, James R. and Richard S. Current. "Machine Safety: New & Updated Consensus Standards". Prof Saf 2012 May; 57(5):5057. http://www.asse.org/professionalsafety/pastissues/057/05/F1Har_0512.pdf

Health and Safety Executive (HSE). Construction Statistics in Great Britain, 2018. Health and Safety Executive. 2019. Available from: http://www.hse.gov.uk/statistics/industry/construction.pdf [Accessed: 31 July 2020]

Health and Safety Executive (HSE). Developing Process Safety Indicators: A Step-by-Step Guide for Chemical and Major Hazard Industries. London: Health and Safety Executive; 2006

Hong Kong Occupational Safety and Health (HKOSH). Occupational Safety and Health Statistics 2017. Labor Department, The Government of the Hong Kong Special Administrative Region; 2017. Available from: https://www.labour.gov.hk/eng/osh/pdf/OSH_Statistics_2017_EN.pdf [Accessed: 31 July 2020]

International Programme on the Elimination of Child Labour (IPEC) (2011). Children in hazardous work What we know What we need to do

Jump up to: a b c d e f "Occupational health and safety – chemical exposure". www.sbu.se. Swedish Agency for Health Technology Assessment and Assessment of Social Services (SBU). Archived from the original on 2017-06-06. Retrieved 2017-06-01.

Jump up to:a b "N95 Respirators and Surgical Masks (Face Masks)". United States Food and Drug Administration. 5 April 2020. Retrieved 18 April 2020.

Jump up to:a b "NIOSH Chemical Carcinogen Policy" (PDF). U.S. National Institute for Occupational Safety and Health. December 2016. Retrieved 17 March 2017.

Jump up to:a b c CDC - Noise and Hearing Loss Prevention - Facts and Statistics - NIOSH Workplace Safety and Health Topic Archived 2016-07-03 at the Wayback Machine. The National Institute for Occuaptional Safety and Health.

Jump up to:a b c d e CDC - Skin Exposures and Effects - NIOSH Workplace Safety and Health Topic Archived 2012-08-06 at the Wayback Machine. The National Institute for Occupational Safety and Health.

Jump up to:a b c d e f g CDC - Eye Safety - Eye Safety for Emergency Response and Disaster Recovery Archived 2017-09-02 at the Wayback Machine. The National Institute for Occupational Safety and Health.

Jump up to:a b c d e f g h "General Safe Practices for Working with Engineered Nanomaterials in Research Laboratories". U.S. National Institute for Occupational Safety and Health. May 2012. doi:10.26616/NIOSHPUB2012147. Retrieved 2017-03-05.

Jump up to:a b c d e f g h i "Current Strategies for Engineering Controls in Nanomaterial Production and Downstream Handling Processes". U.S. National Institute for Occupational Safety and Health. November 2013. doi:10.26616/NIOSHPUB2014102. Retrieved 2017-03-05.

Jump up to:a b c d e Verbeek, Jos H; Rajamaki, Blair; Ijaz, Sharea; Sauni, Riitta; Toomey, Elaine; Blackwood, Bronagh; Tikka, Christina; Ruotsalainen, Jani H; Kilinc Balci, F Selcen (2020-05-15). "Personal protective equipment for preventing highly infectious diseases due to exposure to contaminated body fluids in healthcare staff". Cochrane Database of Systematic Reviews. 2020 (5): CD011621. doi:10.1002/14651858.cd011621.pub5. hdl:1983/b7069408-3bf6-457a-9c6f-ecc38c00ee48. ISSN 1465-1858. PMC 8785899. PMID 32412096.

Jump up to:a b c d Respirators Archived 2012-08-30 at the Wayback Machine. National Institute for Occupational Safety and Health.

Jump up to:a b CDC - Eye Safety - NIOSH Workplace Safety and Health Topic Archived 2017-07-07 at the Wayback Machine. The National Institute for Occupational Safety and Health.

Luque, John S. (2019). ""I Think the Temperature was 110 Degrees!": Work Safety Discussions Among Hispanic Farmworkers". Journal of Agromedicine. 24 (1): 15–25. doi:10.1080/1059924x.2018.1536572. PMC 7045709. PMID 30317928.

McDonald MA, Lipscomb HJ, Bondy J, Glazner J. Safety is everyone’s job: The key to safety on a large university construction site. Journal of Safety Research. 2009;40(1):53-61

National Census of Fatal Occupational Injuries in 2016" (PDF). Bureau of Labor Statistics. Retrieved April 15, 2018.

Nix, Doug (2011-02-28). "Understanding the Hierarchy of Controls". Machinery Safety 101. Retrieved 2017-03-10.

Noise and Hearing Loss Prevention". Workplace Safety & Health Topics. National Institute for Occupational Safety and Health. Retrieved 3 August 2012.

Occupational noise exposure - 1910.95 Archived (2015) at the Wayback Machine. The Occupational Safety and Health Administration.

Ologe F, Akande T, Olajide T. Occupational noise exposure and sensorineural hearing loss among workers of a steel rolling mill. European Archives of Oto-Rhino-Laryngology. 2006;263(7):618-621

Reimink H. Safety and Health. 2016. Available from: http://www.worldsteel.org/publications/position-papers/safety-and-health.html [Accessed: 31 July 2020]

Roelofs, Cora (1 January 2007). Preventing Hazards at the Source. American Industrial Hygiene Association. pp. 9ff. ISBN 978-1-931504-83-6.

Safety, Government of Canada, Canadian Centre for Occupational Health and. "First Aid for Chemical Exposures: OSH Answers". www.ccohs.ca. Retrieved 2016-03-17.

Song S, Awolusi I, Jiang Z. Work-Related Fatalities Analysis Through Energy Source Recognition. Tempe, AZ: Construction Research Congress; 2020

Song S, Lyu Q, Marks E, Hainen A. Steel manufacturing incident analysis and prediction. Journal of Safety, Health and Environmental Research. 2018;14(1):331-336

Tikka, Christina; Verbeek, Jos H; Kateman, Erik; Morata, Thais C; Dreschler, Wouter A; Ferrite, Silvia (2017). "Interventions to prevent occupational noise-induced hearing loss". The Cochrane Database of Systematic Reviews. 2017 (7): CD006396. doi:10.1002/14651858.CD006396.pub4. ISSN 1469-493X. PMC 6353150. PMID 28685503.

Tixier AJ, Albert A, Hallowell MR. Teaching construction hazard recognition through high fidelity augmented reality. In: 120th ASEE Annual Conference and Exposition; 2013.

Verma A, Khan SD, Maiti J, Krishna OB. Identifying patterns of safety related incidents in a steel plant using association rule mining of incident investigation reports. Safety Science. 2014.

Vibration". Australian Government Comcare. Retrieved 2018

APPENDIX I

Department of industrial and technology education

Federal university of technology, Minna

Niger state

Dear respondent

I am an undergraduate student of industrial and technology education in the above-named university, I am presently conducting research on "Assessment of industrial safety and management in machine shop in Scientific Equipment Development Institute (SEDI) Minna. The questionnaire is designed as part of the study to collect relevant information for a successful completion of this research.

Please kindly provide response to these questions assuring you that it will be used for academic purpose alone.

Thanks for your anticipated cooperation

Yours sincerely,

AKENDE TERHILE

APPENDIX II

FEDERAL UNIVERSITY OF TECHNOLOGY MINNA

DEPARTMENT OF INDUSTRIAL AND TECHNOLOGY EDUCATION

ELECTRICAL/ELECTRONIC OPTION

SECTION A

Questionnaire on assessment of industrial of industrial safety and management in machine shop in scientific equipment development institute (SEDI) Minna, Niger state

Staff [ ]   Trainee [ ]

Please kindly complete the following questionnaire. Your response will be upmost importance, please do not enter your name or contact details on the questionnaire

Please indicate the option that appeal to you most by ticking [ ] in the appropriate box.

Key to response options

A = Agreed

SD = Strongly agreed

D = Disagreed

SD = Strongly disagreed

Research Question 1

S/N	ITEMS	A	SA	D	SD
1	Do physical hazards affect the use of machines at machine shop, SEDI Minna ?				
2	Do mechanical hazards affect the use of machine at machine shop, SEDI Minna ?				
3	Do chemical hazards affect the use of machines at machines shop, SEDI Minna ?				
4	Do environmental hazards affect the use of machines at the machine shop, SEDI Minna ?				
5	Hazards can be presented				
6	Hazard can be prevented through the use of PPE				
7	Hazards can be caused by faulty equipment				
8	Hazards are inevitable				
9	Wrong usage of tools causes hazards				
10	Hazards can cause deficiency to workers				

Research Question 2

S/N	ITEMS	A	A S	D	S D
1	Ensure the use of PPE before operation				
2	Proper attention and concentration while machine is on				
3	Put off the machine if it is observed that there is change in sound or voltage				
4	There should be adequate lightening while working on machines				
5	There should adequate ventilation within the workshop				
6	Water or chemical spill should be wiped off as soon as possible to prevent accident				
7	Ensure clean the machine after operation				
8	Observation of proper fittings and construction during operation				
9	Keep all gang ways free for easy movement				
10	Report any fault detected from a machine to the instructor				

Research question 3

S/N	ITEMS	A	A S	D	D S
1	Always use the right tool for the right job				
2	Do not play in the workshop				
3	Do not wear loose clothes while working on moving machines				
4	Do wear jewelries when working on machines on machines				
5	Worker should know the direction of first aid box				
6	Ensure good ventilation system in the workshop				
7	Do not work in a confined environment				
8	Always seek for proper instructions before working on machines				
9	Do dot use unauthorize or damaged guards				
10	Always be attentive during machines operation				

Research question 4

S/N	ITEMS	A	S A	D	S D
1	Ensure the use of PPE				
2	Sick staff should be given leave from work				
3	All faulty equipment should be replaced				
4	Workers should not over work to avoid accident				
5	Proper maintenance should be given to machine and equipment				
6	Ensure regular service of machines and equipment				
7	Staff should ensure a good health status before operating on machines				
8	No machine should be left on after use				
9	Do not work on faulty machines				
10	Worn out tool and equipment should be replaced				