UNIVERSITY OF EDUCATION, WINNEBA

COLLEGE OF TECHNOLOGY EDUCATION, KUMASI

ASSESSING MACHINERY SAFETY PROCEDURES AND HEALTH MANAGEMENT IN WOOD WORKSHOPS' OPERATIONS IN KUMASI

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DECLARATION

Students' Declaration

I, Thomas Kuubeituo Baaune, declare that this Project report, with the exception of quotations and references contained in published works which have all been identified and duly acknowledged, is entirely my own original work and it has not been submitted either in part or whole for another degree elsewhere.

SIGNATURE……..DATE……

Supervisor's Declaration

I hereby declare that, the preparation and presentation of this work was supervised in accordance with the guidelines for supervision of Dissertation as laid down by the University of Education, Winneba

NAME…….

SIGNATURE……..DATE……

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DEDICATION

I dedicate this work to my wife Rosemary Kuubeituo, my children Francis Maalu, Joana Kuubeituo, Andrews Kuubeituo, Christiana Kuubeituo, Benedicta Kuubeituo as well as brothers and sisters of Baaune family.

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ABSTRACT

In this study, safety and health management in the operation of woodworking machines as was examined in some selected wood workshops in Kumasi, Ghana. The specific objectives of the study were as follows; investigate the machine layout procedures use in the woodwork machine shops, evaluate the operating skills those who man the machine shop use that negatively affect their health and asses the maintenance practice adopted to make the machines safe to use and improves their efficiency. Data were collected using structured questionnaire. 69 respondent comprising 60 machine operators at the Kwadaso sawmill shop and 9 machines at Kumasi Technical Institute.

Random Sampling technique was used to select nine machines at Kumasi Technical institute for the data collection while at Kwadaso sixty identify machines were also used in the study. Results of the study also indicated that KTI has a well-lay out woodwork machine shop whiles the Kwadaso woodwork machine shop has no layout plan, the machines and equipment used in KTI were bought new and installed by manufacturers and the needed operational practices that contribute to efficiency of the use of the machine and the safe and health of the users, whereas the machines in Kwadaso were 'used machines' purchased in the 1989 and 2000 without the knowledge of how long these machines were used before purchase and they were also not maintained appropriately as in the case of KTI where there is a planned scheduled maintenance, regular maintenance and parts are bought even before they are needed for replace during repairs and maintenance.

Education level influenced the woodworking machine shop layout adopted in the areas of the study. Majority of the operators had their educational level up to the technical school level or below with their assistants having junior high level. Thus is the regular need for education and training on the use of the machines and their maintenance and strict observation and adherence to safety rules and regulations

CHAPTER ONE

INTRODUCTION

1.1 Background to the study

The sawmilling industries throughout developing countries are generally subject to regulations governing the precautions and conditions necessary for ensuring the safety and well-being of the personnel involved. For the benefit of all concerned, owners, management and employees, it is necessary that these regulation are fully understood and put into practice. Failing to do so will not only result in low efficiency, but will lead to accidents and, hence affects the output of the sawmills concerned (Bureau of Labour Statistics, 1995).

WHO (1994) claims that occupational health and the well being of the working populations are crucial pre-requisites for productivity and are of utmost importance for all socioeconomic and sustainable development. Effective machine guards and protection clothing includes some few specified safety requirement which are often available but not used by most sawmill employees. The suspensors however, must accept the responsibility of ensuring that these equipments are used and maintained in good condition. The rate of industrialization in Ghana is in ascendance and this has led to larger percentage of the Ghanaian workforce being exposed to varying occupational hazards. According to the Ghana Labour Act 2003, Act 651 employers are required to ensure their employees are not exposed to conditions that would lead to work place related, injuries or illnesses. Employees on the other hand are also required to exhibit their duty with care in ensuring standard practice as per employer's practice of safety first. Safety first is a term used

when precautions are taken in an attempt to control situation in order to prevent, injury to the person concern; injury to others damage to the workshops its equipment and materials (Walton, 1981). Thus safety is largely dependent upon knowledge and common sense. Krause (1995) also opined that, common-sense reliance on safety consciousness can cover a multitude of confusions. Krause (1995) required what safety consciousness is and what is it actually supposed to achieve in the way of safety performance and concluded that, in the absence of objectives specification of working sold, workers and managers are like only fall back on objective definitions.

Woodworking machine tools are power drives cutting or shopping tools which are stationary, mounted on the bench or a stand where the job has to be taken to far cutting or shaping than is necessary for using hard tools and also primarily to increase output. According to Walton (1981), it must be noted that their operations can be dangerous especially if careless methods are used.

Bayliess (1963) holds that, accident rate among wood machine operatives have always been extremely high, resulting in the introduction of regulations for safety in the 1878 and subsequent factory Acts, Bayliess (1963) added that one of their provisions is that a copy of those regulations must be displayed workshop where power-operated woodworking machine are used.

According to Brett (2005) wood working accounted for a disproportion high number of machine accident. He veiled that in Health and safety executives (HSE) survey of 1000 woodworking machine accidents 73% of the total were attributed to four machine types,

namely; circular saws, vertical spindle moulding machine, narrow band saw and the surface planning machines. It is against that backgrounds that manufacturers over the years have devise means of reducing hazard to a minimum by invention and improvement such as self-contained direct motor drive, enclosed years, safety switches and improved cutting tool (Walton, 1981). The main Legislative documents on occupational safety and health in Ghana are the (factories, offices and shops Act of 1970, workmen's compensation Law, 1987 and Labour Act 651 of 2003 and cited by Adei & Kuufaa (2007). However, the woodworking machines regulations of 1974 as stated by Mckay (1958) and Bomery (1984) which covers safe usage of woodworking machines almost worldwide has been revoked giving way to the following legal requirements to which are part of safety are health regulations for the European community and also farming part of the UK law Brett, (2003).

- Provision and Use of Work Equipment Regulation (PUWER).
- Management of Health and Safety at work Regulations (MHSR)
- And a supporting Approved Code of Practice (ACOP) for safe use of woodworking machine.

He maintained that the guidance reflects the precautions widely accepted and used in industry and in addition mirror many of the requirements contained in the revoked woodworking machine regulations several studies have been conducted on occupational safety and health with the view of develop interventions to improve workplace safety and health (Rease, 1985; Gellery, 1996; Matooane, 1997; Boateng & Wimatto, 2000;

Amedofu & AsamoahBoateng, 2003; Ezeomu, 2004; McCann & Babin, 2007 and Adei & Kunfaa, 2007).

Adei and Kunfaa (2007) conducted a research on the operation of the wood processing industry in Kumasi, Ghana focusing on perceived hazards that workers in the wood processing industry were exposed to and the effectiveness of public put in place.

The study revealed the trend on perception of unsafe working environment increasing with decreasing size of companies, vulnerability to occupational hazards and accidents of workers as a result of inadequate engineering and administrative controls and the low use of personal protective devices. According to Feier *et al.,* (1992) accident rate of small companies is highest and that the higher the number of employers in an organization. Again Renjo and Leon (2005) revealed that workers in small-scale industries receive little training, hence safety measures may not be a priority in their daily operation. In addition to the lack of formal training and qualifications the earnings of these workers leave them in fix of trading between their health and earnings. It follows that, there is limited research on how wood workshop in particular respond to health and safety messages especially and instructional working shop in Ghana.

1.2 Statement of the problem

The ability to respond appropriately to safety challenges is crucial but often unrecognized aspect to any effective total approach to safety.

According to Krause (1995) sharpening and sustaining work group adapting safety practices requires several things, first it means that the worker understanding the hazards that are critical to safety of his/her workplace. They need to be able to identify the Hazards associated with performing their jobs. Second, they need to know exactly which practices put them at risk and which practices are critical to their continued well-being throughout their working lives. Third, they need to know which machine can be operated safely without the risk of accident and which machine also meet safety standard in terms of regulating the Kwadaso timber market comprises of woodworking machine shop and their operatives. It is perceived that most of these machines are second-hand machine something without the requisite safety guards/guides which promote safe working of the machine, as shown in plate 1.1. These guards or guide, one attached they seems, to be defective. Again, it is also perceived that a sizeable number of the machines are manufactured here in Ghana without going through and test but considered safe once it is performing the function they are required of them.

Plate 1.1 second-hand or used woodworking machines without the needed safety gadgets used in Kwadaso wood work machine shop.

To be able to operate a woodworking machine there is the need to have formal education that will allow the operator to known the safety rules apply, however, it is perceived that operators of woodworking machines around Kwadaso timber have not undergone any formal training but are able to operate the machine through apprenticeship and long services of working e

However, Hilton (1970) warns the first and the most important aspect of machine tools is the training of all persons engaged in the used of woodworking machinery to a recognition of dangers involved and to a sensible used guards and safety devices which are part of the standard equipment of all such machine.

Again, the study was also to find out the background that the researcher intends to assess the proper use and safety of woodworking machines with regulations and existing best practices as well as find out the health hazards that operators are exposed in small scale and institutional wood workshop in Kumasi as shown below.

Plate 1.2 Dust everywhere at the woodwork machine shop

1.3 Objectives of the study

The general purpose of the study is to find out the occupational safety and health practices which are being adopted in the operation of woodworking machine as compared to best practices. The specific objectives of the study were to;

- Investigate the machine layout procedures use in the woodwork machine shops.
- Evaluate the operating skills of those who man the machine shops use that negatively affect their health.
- Asses the maintenance practice adopted to make the machines safe to use to enhance their efficiency.

1.4 Research Questions

In order to achieve the stated objectives of this study, the following research questions have been developed to guide the study:

- What is the acceptable machine shop layout procedure could the woodwork machine shops in the selected areas in Kumasi adopt to improve safety and workshop management?
- What are the operating skills used by those who man the machine shops that negatively affect their health effective management of the machine shops?
- What maintenance practices are used to make the machines safe to use to enhance their efficiency?

1.5 Significance of the study

It is the hope of the researcher that, the outcome of this study would reveal practices that put operatives of woodworking machines health of risk and the extent to which it impact on socioeconomic development. Information from the study would also sensitize the managers of the facility on the need to educate and train operators on safety regulations and rules. Furthermore the findings of this study would enhance decision making in terms of which machine is safe to purchase and the need to adopt a maintenance culture to prolong the serviceable life of the place and its machines. Again the information from this study would also add to knowledge gather.

3.7 Limitation of Study

The study was limited to operatives of six types of woodworking machines in the Kwadaso Timber Market. This eliminated some operatives who work on their woodworking machines not included in the survey. Another limitation of the research was that the operatives selected in the survey were those found to be consistent in the operation of a particular machine. This step was adopted to eliminate the possibility of one person answering more than one questionnaire as a result of he/she being able to operate more than one machine or work on more than one machine.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Timber industry in Ghana

The performance of the timber industry has suffered a steep decline contributing to about 20% drop in export of timber products within the last two years (from Breakfast news gathered, 2012) The timber industry which is said to contribute an annual foreign exchange value of over 200 million euro from the export of 16 different wood products has over the last 15 years experienced a series of challenges accounting for the collapse of about 60 timber companies. An estimate figure of over 5,000 Ghanaian are said to have lost their jobs and source of livelihood as a result of these persistent challenges which culminate in job cuts, across the operational area of the industry.

Accordingly, the CEO of GTMO, in an exclusive interview with breakfast show on Adom FM station asserted that despite a number of interventions from government dating as far back as the 1970 to date a great deal of work still exist and needs to be done to address the barrage of problems the industry now faces. The current performance of the industry can be attributed to a number of causes including high cost doing timber business in the country emanating high interest and borrowing electricity tariff and cost of fuel and lubricants.

Ghana is ranked third largest producer of timber and the second largest exporter of wood and wood products in Africa. The timber firms in the country are engaged in logging,

milling and trade in timber products which offers direct employment to cover 100,000 peoples undertaking various timber industry operations.

The operations of the sector are said to contribute immeasurably to the construction of roads (about 240km a year) which in most cases also serve as feeder roads for transportation of people and agricultural crops from the rural areas as part of its logging activities, besides, the huge revenue generating to the government in the form of fees and taxes. It also contributes to development and sustainability of commercial activities in rural areas e.g. Samareboi, Dwinase and Mim in the Western and Brong Ahafo Region. Dr. Adams revealed that little or no effort has been made to improve the declining stock of high value species in the natural forest which for over 100years has been the only source of timber since moves were initiated to harvest the natural forest. He laments further that, the cutting rate will always exceed the natural replacement rate if nothing is done to intervene and hasten the natural regeneration in process. He thus call for the use of lesser natural forest stocking expansion of the resource base through a natural plantation policy that will attract private participation including Ghanaian owners, and the provision of requisite training operation and maintenance, sawmilling technology, timber harvesting technology and information application among others. Dr. Adams is of the opinion that to overcome the setback which have related operation of the sector declining supply or raw material can be addressed through the application of improved natural regeneration techniques to the natural production of forest to hasten growth as well adoption of aggressive and well-coordinated reforestation programme in degraded forest reserves and less productive farmlands to grow more timber trees for the industry.

There are different types of industry in the wood business, large, small, and medium sawmills pearly which deal in production of various pieces for the consumers.

2.2 Structure of Ghana Technical Education

The structure of pre-tertiary education in Ghana is composed of the pre-school education, 2years basic education comprising 6 years primary, and 3 years junior high school. Technical education takes 3 years, polytechnic education 3 years, university education 4 years. An intervention which sought to develop workshop and laboratories with new equipment was introduced under a VOTECH resource center project which commenced 2001. (President Committee. October, 2002). This includes twenty (20) resource centers, which were established to provide practical skill training to cluster school surrounding each centre. As a result many more technical institute trainees have access to modern equipment for practical training purposes.

In some cases classrooms have been provided at the resource centers to make classroom teaching more effective. This intervention is in far out over twenty one (21) trade's areas.

2.3 Personal safety measure in sawmills and wood workshops

Personal safety measure should underline every stage of woodworking practice being sawmill or wood workshop including layout of benches and machines. It is better to plan the workshop to eliminate hazards rather than accommodating them. Using a dust extractor on machine that creates a lot of dust is better solution than wearing a dust mask because woodworking depends on the use of cutting tools. This deem a risk that cannot

be avoided but experienced craftsman will confirm that a sharp tool is actually less dangerous than blunt one or a toll that is used incorrectly (Corbett, 2002)

According to Voicy (1987), it is better not to wear loose clothing and jewelry when working especially with machinery and power tools. A stout pair of boots should be worn in workshop. In case of accidents, a sheet of plywood will be painful if it slips and land on the toe, this can be prevented by wearing a pair of leather safety boots and canvas gloves when handling timber. Always inspect a piece of wood for splinters and protruding nails before picking it up and always have first aid kit in the workshop for minor injuries. Do not work alone in large machine in case of injury and report all injuries to the instructor in charge so that first aid can be applied and if possible can refer to hospital for necessary treatment.

Plate 2.1 lack of the observation of safety regulation at woodwork machine shop

Kreindlin (1984), state that small off cuts of wood should not be stored above moving machine but stored in a bin, even if the off cut is too small to directly cause injury if it fell, it might high a rotation part and piece might break off and cause an injury. Wood must be stored away from machinery, should be stored flat and preferably in racks.

Guards missing from machines, faulty machines and tools, strobe effects of fluorescent light that make it appear as if machines have stopped rotation and poor lighting on machines can cause accidents in the workshop, this is a prevailing situation with spindle moulder, however it is used in Kwadaso woodwork machine shop without any of its safety parts installed as seed in plate 2.2a and b below. Power outlets can be different from country to country and with the age of the equipment or building for that reason to prevent accident in the workshop. Never operate portable power grinding tools in the presence of others in the workshop. If the grinder surface breaks up the bulk of the debris flies away from the user if the guard is not attached. Foot powered tools should always be shut off before laying power unit down. Accidentally, powering the unit with and attached aggressive cutting tool could result in injury.

Plate 2a Spindle moulder operator without any of the safety gadgets in place neither on the machine or the user

Plate 2b Another Spindle moulder operator without any of the safety gadgets in place neither on the machine or the user

Brett (1994) believes it is normal practice for the machine shop to be controlled by one person who will personally do all the machines required, although on same site woodworker may be asked to carry out the machinery. In either case, it is essential that the basic common sense rules are observed at all time to prevent accident to the operator.

Before using a machine, check that the machine and the working area around it is clean and free from obstruction, off cuts and savings. Check that the cutter are in good condition and suitable for the work at hand and ensure that all the guard guides and fences are correctly set up and held securely in place. Make the push stick and or push blocks are close to hand and do not use any machine unless on have been fully instructed in the operation and is capable of operating it. Never feed timber into a machine until the cutter is moving even after switching off, many machines take considerable time to stop. Do not become distracted while operating a machine, never pass hands over cutter or even stop of the timber being machined and always isolate the machine, clean it down and cover after use.

The first thing one should do when entering a shop is to put on a work apron that covers the torso to keep splinters and sawdust off the feet also deserves consideration, sneaker are comfortable but not offer protection from objects that may drop offer protection from steel toed work shoes with a padded arch-support insert for cushioning to prevent accident in the workshop and wear safety glasses to protect the eyes when working with fast moving debris-spewing machinery and can be toxic if one is allergic to certain wood species, glue subtracts or finishing materials. Dust collection system should eliminate a good deal of the dust related toxins when dust concentration in the air becomes visible, wear a mask.

Plate 2.3 woodwork machine operators with no safety gadgets on working in a very unkept machine shop.

If the dealing with toxic fumes, a dust mask is infective, wear a rubber-shield carbon filter regularly exposed to high concentration of fumes. The best protection comes from elimination hazardous materials from the workshop. Avoid formaldehyde de-laden particle-board; stop using solvent-based finishing products in favour of those that are water based. Protect the workshop against fire and keep at least two fully charge ABC-type fire extinguishers (good for all types of fires) in separate readily accessible locations. Don't keep any extinguisher near the stove because it is likely source of a conflagration one may not be able to get them when needed them (Tolpin, 1992).

2.4 Safe working techniques in sawmills and wood workshops.

Intoxicating substances and wood working are dangerous mix, stay out of the workshop when under influence of an intoxicants and whenever changing blade or bit on a machine or power tool. Disconnect the electricity to the machine before even beginning the blade change. Do not just check to see the switch, it could get bumped or malfunction, congested working area is dangerous, in the case of accident one will find it difficult to escape. Distraction while in the middle of performing an action with machine or power

tools are also dangerous. Remember to always finish the cut to a safe conclusion before dealing with the distraction. Taking away attention from the wood working machine or power tool is a recipe for disaster (Mathiason, 2002)

According to Walton (1974), the right way to do a job and using the right tool for the job protects a worker injury. The limitations of the tool or machine and correct use of tools and machine are important when using portable machines tools care and maintenance also prolong the lifespan of machines and tools. Accidents in wood workshops do not just happen, it is very important to know the correct use of a machine before using it. Using chisels and punches with mushroomed ferules or ends may cause serious accidents in the workshop. Working with machine should be free from obstruction such as off cuts, oil rags and hipped savings. These can easily cause accidents in the workshop. It is important to develop and follow safe work practice at all times. Machines shop and workshop must be a safe environment for all who use the facility; simple rules can be applied so that workers can work safely and confidently.

Equipment, machines and materials are used in accordance with agree policy and procedures and are displayed on or near the machine and correct manual handling techniques are followed when carrying pushing or pulling heavy objects. Depending on the size and type of workshop, storage facilities can vary from the very sophisticated and expensive to very basic. The main aspect of storage should be to allow easy storage and retrieval, ease of stock control and security (Common Wealth of Learning, 2000).

Research on lumber, suggests that when cutting thick stock make sure the blade clears the back upper corner of the stock prior to cutting, and a space block between the stock and fence securely at the same time. Any unusual noise should be brought to the immediate attention of the instructor. Avoid cramped conditions where operator may get knocked by others or materials being handled and ensure proper stacking of raw materials and keep working area tidy. Isolate the machine when setting up, making adjustment that cannot be done safely either the machine running and clear machine or tool after setting up and before operating and maintaining machines regularly. Observe correct manual handling techniques and where necessary carry out an assessment of manual handling operations.

Plate 2.4 There is no observation of any of the machine shop safety regulation

Boards should be stacked flat ideally or using a pigeon hole system for a smaller number of boards and ensure good layout and construction. Keep the workers who come into contact with the hazardous substances as low as possible and keep the length of the fine they have to work with hazardous substances short as possible and monitor workers health.

2.5 Workshop and Machine Shop Layout.

Webster new collegiate dictionary defined a workshop as a small establishment where manufacturing or handicrafts are carried on. Sackey (1999) states that a workshop is a place or building where facilities such as machines, tools and work benches are provided to enable a worker or student to carry out his or her new practical activities in a satisfactory manner. The workshop must be designed to allow students to work without injuries. Machines in the workshop should be placed with enough space around it to enable students observe the instructor during demonstration.

Plate 2.5 woodwork machine shop layout at Kumasi Technical Institute (KTI)

In the view of Rumoro (1998), an unobstructed working area is fundamental to the safe operation of machines. The layout of the machine shop should be given careful attention so that the machines are positioned cycle. Machines should be positioned where the operator cannot be pushed, bumped into or easily distracted. Where possibly cutting machines should be separated from assembling or packing areas and used by forklifts,

trucks, or other transport vehicles. The production process should be arranged so that materials follow a logical path from delivering and storage, through the production process and on the dispatch area.

According to Tolpin (1992), before setting any machinery think about layout because proper placement of the major stationery tools and work surfaces is critical to the creation of a shop that works well. A good layout will maximize production, reduce operator fatigue and facilitate the smooth flow of materials throughout the shop to prevent an unwanted accident.

Baylish (1963), states that it is very difficult to get a perfect layout for the machines and benches in a workshop because of the varying nature of the work they are used for. It is a good plan, however to arrange the machine in the following groups. First the cutting of machines (cross-cut and rip saws), nest planners thicknesser and fair siders) jointing and finish machines (mortising, tenoning and moulding machines; belt from disc sanders. The joiners should be near the finishing machines so that there is no necessary waste of time when work is carried between operations. The working space is necessary to allow free time of work in the workshop and safety to work in and in the event of an accident, there will be clear emergency producers.

The layout and size of a working is determined by the woodworking needs. Make safety the number one concern when planning for workshop. Make airless wide enough for passage and leave plenty of room around each machine.

Sharp edges on machine should be either peddled or placed in a position that will not interfere with persons moving around the shop. A fire extinguisher should be place at each end of the shop preferably by the entrance or an exist point.

A good temperature extremes and humidity will make the shop in comfortable and stress, tools and machines. A skylight or two would be nice to have for natural lighting and paint the ceiling to reflect the maximum light. Ideally a shop should have two wide exists and one at each end of the shop for emergency evacuation.

Natural light is still the best lighting and window high up should be up to wall area to provide natural light and ventilation without taking up loss of space, skylight should be put in each working area. Concrete floors must be painted or made of wood to eliminate much of the dust and provide a surface that is easy to sweep or mop up. should be on a separate circuit from tools break up the shop lighting into two grids that way, if one circuit develops trouble there will be another circuit to use when fixing the problem (Books, 1994).

2.6 Use of Portable tools Appliance – Safety

There are several advantages to working with power tools rather than hand tools. One can do most woodworking operation faster with power tools. Power tools eliminate much of the physical effort in woodworking. They are also easier to work with their hand tools. However, power tools can be much more dangerous to operate. Safety appliances such a well-designed push stick, push block and jigs are essential in keeping the hands in safe

position while maintaining full control of the work piece during cutting. The use of power feed will reduced the need for the operators hands to approach the cutter and power feeds should be used whenever it is reasonably practicable (Tolpin, 1992).

According to Voicy (1987), appliances are very important when working on woodwork machine. These help to keep the hands away from the cutter and blades when working. It also helps the operator to have full control of the work piece. A push block should be used when machining timber less than 450mm in length when working on the machinery ensure that all guards' guides and fences are correctly set up and help securely in place. Push sticks and push blocks must be close to hands for safe work.

Bayliss (1967), states that a careful planned machine shop contains machines able to carry out all the shop contains machines able to carry out all the operations of sawing, planning, joint making, moulding and finishing. Timber can be fed into the cutting heads of the machines in different ways. In hand operated feed feeding the operator can push or guide the timber through the cutting heads using of course the necessary equipment for safety such as push stick and push block. Mechanically operated rollers and tracks feed the timber on many sawing, planning and moulding machines, thus giving the operator a greater degree of safety. With tenoning machines the timber is clamped on to a carriage and is either push through the cutting heads by the operator of feed into them by mechanical means. For mortising, the timber is clamped into the machine and the cutting head (chain or chisel) brought down into the timber by the operator. A small shop would

probably have mainly hand-operated machines with perhaps mechanical feed attachment to the planning machines and spindle moulders.

In the larger shops most of the machines have mechanical feeds or feed attachments. Only machines such as narrow band saws, chisel mortise machines and router would be hand-operated. Push stick should stick should be used when working on hand-operator feeding machines to protect hands while cutting sheet material or timber on the circular saw where the rip fence will not just to the required width, a straight button can temporarily be fixed along the fence to act as a fence for the sloe plate of the saw to run against and ensure that the material to be cut is properly supported and securely fixed down. As the saw cuts from bottom upwards the face side of the material should be place downwards. This ensures that any breaking out which may occur does not spoil the face of the materials. Every surface planner must be equipped with an easily adjustable bridge guard fitted centrally over the cutter block. This guard must be long enough to cover the cutter block and be at least as wide as the diameter of the cutter block.

A push block should be used when machining timber less than 600mm in length. Hands should not be used while shooting on the surface. Rebating and moulding must be carried out on planning machine unless it is effectively guarded, normally by a saw guard. The bridge guard is not considered effective for those operations.

Walton (1974) discussed that machine tools are power driven cutting or shaping tools. They are stationery power tools usually mounted on the bench or a stand thus the job has to be taken to them for cutting or shaping but portable tools are generally taken to the job.

Some machine tool (e.g. circular saws, radial arm saws, jointers and some combination machines are sometimes described as portable in the sense that being light compact units, carpenters and jointers can transport them from one job to another even in the boot or luggage compartment of a car. Woodworking machines are Labour-saving devices which enable the amateur woodworker to carry out a wide range of woodworking operations accurately, requiring less skill than is necessary for using hard tools. In industry they are primarily used to increase output by reducing hand tool processes to a minimum.

It must be remember, however that the operation of machines can be dangerous especially if careless methods are used every care and precaution must be exercised to ensure safety in their use. Push sticks and push blocks could be available on each machine to help the operator keep his or her hands away from the cutters and blades when working. Set the fence at the required distance away from the blade and raise or lower the table so the blade projects about 8mm above the surface.

2.7 Health Hazards Associated with Wood Dust

Wood is one of the most important resources, as raw material for industries, for construction and as fuel. Worldwide today, forest covers constipated 3, 952 million hectored or 30 percent of the total land area (Rowell, 2004).

Ghana's Forest cover, which stood at 8.2 million hectares in 1900, has now been reduce to about 1.2 million hectares with an estimated loss of 65,000 hectares of forest annually (Acheampong, 2010). In 2003 the worldwide annual harvest was 3.342 million $m^3$of

round log 1754 million m^3 (52%) of which was used as fuel. The industrial consumption of longs wood wide was 1.592 million m^3 (FAO, 2006). The wide of wood makes it one of the most commonly seen occupational exposures. In year 2000 approximately 13 million people were occupied in the forest sector worldwide and additionally about 3.5 million people in the furniture industry. This means that about 0.4% of the total labour force worldwide is occupied in the forest sector (Arvydas, 2004). There is a very wide selection of species of each having its own characteristics. These are botanically classified by the type of seed they produce: there are two different classes; gymnosperms and angiosperm (Raven et al: 1996).

Major wood dust are generated as a results of variety of airborne wood dusts, which are produced daily the processing and handling of both hard and softwood, chipboard, hardboard, and other composite materials (Large, 2008; Health and safety Executives, 2003) as seen in the plate 4.6 below. Softwood particles are more fibrous and usually large and as a result less capable of becoming airborne (Walker, 1988 in Alwis 1998). Thorpe and Brown (1995) as cited by Alwis (1998) also reported that hardwood give rise to giver airborne dust at a Lower rate daily sanding than soft woods and that the total almost of airborne dust produced depends only on the quantity of wood removed are not the type of wood. The health effects of occupational exposure to wood dust can be summarized under six headings for the purpose of this study.

Plate 4.6 Dust seen everywhere and the machine operators are seen close their eyes intermittently.

- Toxicity (including dermatitis and allergic respiratory effects).
- Non-allergic respiratory effects.

  Respiratory, Nasal Eye and other symptoms

  Skin Irritation and Sensitization
- Other risk and precautions of wood dust.
- Dust exposure control.

2.7.1 Toxicity of wood the irritant effects of wood

On the skin and respiratory system of man are well documented (HSE, 2005; Alwis 1998; Dennekamp et al, 1999; Yamanaka 2000; Borm et al; 2002; Rauppineu, 2006; Pesch et al; 2007, Lange, 2008).

Most woods contain chemicals which are likely to cause skin problems to many foresters and woodworker. These chemicals in some woods are mainly found in the sap, bark or

crack in the wood and are more responsible for most toxic, irritant, and sensitizing effects (NCDOL OSH programme, 2005). Over 400 different has been isolated from plants and they commonly occur in the heartwood of trees leading to the coloration of the wood (Obst, 1997 in Lange, 2008). Most of these elements are considered as by-product and end-products of the biological functions of a living tree, which are of no use to the tree, (Hausen, 1981 in Alwis, 1998).

Bark and Sapwood may contain different or the same constituents as found in heartwood, but in different amounts. Wood dermatitis is mainly cause by the heartwood constituents of tropical species, the more rare cases of contact dermatitis in wood cutters and debunkers are mainly due to compounds found in the outer sapwood and lichens growing on the bark. Although and freshly cut wood is as rule quite toxic, the wood can become even more toxic on seasoning (Senear, 1933, as cited in Alwis, 1998). Roy (1998) also added that the constituents of wood contain a virulent poisonous principle which is used for spear heads by aboriginals. The toxic effect associated with wood or wood dust include skin irritation, sanitation dermat (allergic detmatitis), allergic respiratory effects, nasal and eye irritations and splinter wounds according to HSE (1995), (2005), Safe work (2005) and Kauppinen (2006).

2.7.2 Skin irritation and skin sensitization

Skin irritation is generally caused by the physical, mechanical nature of wood dust particles. This may affect the eyes, upper and / or lower respiratory tract or the skin, symptoms sub-side once the irritant is removed, contact with the irritant compounds in

wood sap can cause dermatitis and other allergic reactions. The respiratory effects of wood dust exposure include asthma, hypersensitivity, pneumonitis, chronic bronchitis and nettle rashes or irritant dermatitis on genitals (Alwis, 1998; safe work, 2005).

2.7.3 Allergic Respiratory effects

The most commonly reported allergic respiratory effect due to wood dust is asthma (wood-worker's asthma). Studies conducted by Ahman *et al*. (1995) as cited by Skovsted *et al*. (2003) found are increasing prevalence of asthma symptoms among workers in the wood industry.

At a main exposure of around 1mg/m^3 wood dust is considered to be mucous membrane in health risk between wood species is minimal, hardwood species seem to constitute greater health risk than softwood for most health effect argued Bnarson and Chan-Yeung (1990) in Borm *et al*. (2002). Again in two report (Hernandez et al. 1999; Quirce *et al*, 2000 as cited by Skoveted *et al*. 2003 concluded that specific IqE against obeche and beech wood extract is responsible in subjects with wood dust related occupational asthma and rhinitis.

2.7.4 Non-Allergic Respiratory Effects

Employees at sawmills, working with wet or dry wood, may be co-exposed to biohazards like fungi and bacteria, which also causes Lung diseases, (Alwis, 1999 as cited by Lange 2008).

Many of the epidemiological studies of wood dust associated health hazards are focused on the furniture industry. A number of studies have demonstrated a reduction in pulmonary function due to wood dust exposure (Alzuhair *et al*; 1981, Goldsmith and Sly, 1988b as cited by Alwis, 1998). However, unlike-nasal cancer, these health effects are often non-debilitating and reversible (Yamana-ka, 2000). However the truth need be fold that exposure to wood dust has been associated with occupational asthma and nasal cancer, (Black *et al,* 2007). It is known that natural wood may contain toxics such as terpenes, tannins, tropolones, resin acids and lignin's that inhabit fungal growth and causes important in lung function (Tesch.ke, 2000). It is possible that substances intrinsic to the natural wood itself may be the causes Teschke (2000) concluded. Most terpenes affect the fluidity of membranes, while some have cytotoxic potential (Walkins *et al*; 2008).

2.7.5 Respiratory, Nasal, Eye and other Symptoms

Other common symptoms associated with wood dust exposure include skin and eye irritation, Nasal dryness and obstruction; and prolonged colds (Priha, 2004 in Lange, 2008; OSHA, 2008), Among respiratory symptoms phlegm was more frequent in smokers (36.7%) than in non-smokers (30%) according to a study by Borm *et al*, (2002). Another study by Li *et al.* (1990) in Alwis (1998) reported similarly that chronic bronchitis among smokers was 33% and non-smokers 17%. The Industrial Injuries Advisory Council (IIAC) in the UK concluded in a recent study that there is a link between wood dust exposure and nasoph-ayngeal cancer based on literature reviewed (11AC 2007 in Lee *et al*. 2010).

The European scientific committee on occupational Exposure Limits (SCOEL, 2003) as cited by Lee *et al.* (2010) also concluded that wood dust exposure greater than 0.5 mg/m^{-3} induces pulmonary effect and must be avoided.

A South Australian study according to Pisaniello *et al*, (1999) as cited by Alwis (1998) reported that the prevalence of regular blocked nose was 51%, sneezing 41%, regular runny nose and excess nasal secretion 45% and eye irritation 35% among furniture workers. Hardwood users reported more nasal symptoms than users of reconstituted wood. A South African study revealed that the prevalence of nasal symptoms was 49%, cough 43% and phlegm 15% among furniture workers (Shamssain, 1992). A Canadian study reported high prevalence of cough 38%, sputum 30%, wheeze 18%, rhinitis 32% and eye irritation 20% among woodworkers compared with the controls (Holness *et al.* 1985). Significant, correlation has also been reported between frequents needing and eye irritation with exposed job wood dust (Lange, 2008).

2.7.6 Other Risks and Precautions of Wood Dust

In addition to the health hazards associated with wood dust the following are other risks involved according to Brett (2005).

- Wood dust on the floor results in shipping and tripping risk.
- Wood dust in the air can impair those machine operators' vision.
- Concentration of five dust particles in the air form a mixture that can explode if ignited.
- Wood dust will also burn easily if ignited

- Under the control of substance Hazardous to health (COSHH) Regulations according to Brett (2005), employers are required to
- Carry out an assessment of the health risk associated with wood dust and the actions required to prevent or control the risk.
- Prevent the exposure to wood dust, or where this is not reasonably practicable take measures to adequately control it.

2.8 Wood Dust Exposure Limits

A number of countries have set occupational exposure standards or guidelines for wood dust. Some countries have classified standards according to the type of wood dust (e.g. "hardwood", and "softwood") Austria, the U.S or according to carcinogenic potential of wood dust (Alwis, 1998; Black *et al.* 2007). Dust from both hardwoods and softwoods have been assigned Maximum Exposure Limits (MELs) of 5mg/m^3 over average 8 hour period also known as Time Weighted Average (HSE, 2005; Brett, 2005).

2.8.1 Exposure Limits

The regulations are generally described as the duration per day (hours) one can be exposed to a formed level (Dba) before damage may occur. For example, regulations set by OSHA state that exposure to an NOdBA sound level for longer than half of an hour may result in damage. The EPA of Ghana on the other hand state that any noise above 90dBA may cause damage to the ear either temporally or permanently. Te HSE also contended that daily personal noise exposure of 87dBA and a peak sound pressure of 140dBA exposures Limits must not be exceeded.

In a study conducted by Ahmed et al. (2001) in Saudi Arabia, it was found that 75% (2002 subjects) from the exposed group were exposed to a daily leg above the permissible level of 85% dBA and most (61%) of these did not and had never used any form of hearing protection.

2. 9 Woodworking machine noise source

The wood working industry has experienced noise level increases as a result for modern higher speed, and more compact machines. The basic noise elements in wood working machines are cutter heads and circular saws. Equivalent sound pressure levels (Leq) in the furniture manufacturing industry can reach 106dBA (Gerge, 1992). Wood working machinery according to Gerges (1992) uses operation, such as cutting, milling, planning, shaping, etc., with 3 basic noise sources involved.

- Structure vibration and noise radiation of the work pieces or cutting tool (such as circular saw blade) and machine frame, especially at the mechanical resonance frequencies.
- Aerodynamic wise cause by turbulence, generated by tool rotation and the work piece in their air flow field.
- Fan dust and chip removal air carrying systems series of detailed studies from Japan showed that blade geometrical designs tooth height, blade thickness and clearance angle affected second pressure Levels (Tamaka *et al*; 1982; Ikegiwa, (1982). The whistling noise of an idling circular saw is itself a considerable noise source, sometimes over 70dBA. Furthermore, it has been estimated that the idling time of some saw blade is around 80% of the operation time (Hattori and

Noguchi, 1992). These types of noise origin with running machinery engines and air cylinder exhaust create a substantial noise hazards in any sawmill or planner mill (Dost and Gorvad, 1979).

Differences between idling and processing wise level (i.e., the differences in noise levels between a machine that is idling and a machine that is actively cutting or processing Lumber) are important in determining what corrective engineering or other controls that might be needed to put in place (Dost, 1974 in Roehncke, 1999).

In a review of course in the wood working industry, Smith (1971) as cited by Koehucke (1999) also alluded to the fact that no-load cutter head noises can be quite significant, especially in the case of planners or moulders, Kochncke (1999) again cited Lamb (1979) in a review of industrial noise exposure, and described planners as the loudest (108dBA) overall cut of a variety of wood working machines. Noise levels can vary widely pray machine to depending on conditions of use, however risk of severe hearing difficulty and persistent tinnitus rise with years spent in a noisy job (Palmer et al.; 2002).

2.9.1 The law

Under the factories, offices and shops Act; (1870) part 5 sections 26, the regulation specified that noise likely to affect the health of persons employed in any factory, office or shop shall be reduced as far as possible appropriate and practicable measures. However, under the noise at work regulation (HSE, 1998) as cited by Brett (2005), certain responsibilities are placed on manufactures/suppliers, employers and employees

to reduce the risk of hearing damages to the lowest reasonably practical level and explained as follows:

2.9.2 Manufacturing/Suppliers

It is a requirement to provide Low-noise machinery and to provide information to purchasers' concerning the level of noise likely to be generated and its potential hazards.

2.9.3 Employers

It is a requirement to reduce the hearing damage. Special actions are triggered at daily personal noise exposure levels of 85 and 90dBA. At 85dBA employers must

- Make a noise assessment to identify worker exposed and the actions to be taken.
- Provide suitable ear protection on request.
- Provide information to employers about the risks to hearing and the legislation.

2.9.4 At 90 dBA, the Employers Responsibilities

Reduces noise exposure as far as is reasonably practicable by means other than hearing protectors, e.g. by erecting acoustic enclosures around machines. To ensure combinations of the noisier machines are not used at the same time:

- Designate the work area as an ear protection zone, by suitable signs indicating "Ear protection must be worn;
- Provide suitable ear protectors and ensure that all who enters the area wears them.

2.9.5 Employees Responsibilities

Employees have the duty to use the noise control equipment and hearing protection that is provided and to report any defect.

2.9.6 Hearing protectors

Hearing protectors vary in the degree of protection given (HSE, 1995), select them to:

- Protect against the noise levels in the work-place.
- Be comfortable
- Be suitable for wearing with others personal protective equipment.

They should also be;

- Issued on an individual basis.
- Kept clean
- Regularly checked and maintained.
- Replaced when necessary

Avoid protectors that reduce the level at the ear to below 70dBA as this over-protection may interfere with communication and hearing working signals (HSE, 2007).

2.9.7 Reduction of Noise In wood work machinery

Noise level can be reduced through the use of some or all of the following simple and practical methods discussed below (OSHA, 1999).

- Source control
- Path control
- Hearing protection

2.9.8 Sources controls

Noise sources controls, which generally involve engineering controls, reduce noise of its source provide the most effective means of protection, since they actually reduce noise emanating from the work place. Source control begins with a thorough analysis of each pieces of noise-generating equipment. This involves taking all possible steps to identify all noise source within a given pieces of equipment, as well as surrounding road then all effort should be made to both quite the source and dampen the sound (OSHA, 1999; Cowan, 2000).

2.10 The Approach

- Maintain of motors and all moving parts in top operating conditions, maintenance involves lubricating and cleaning; replacing worn parts; maintaining people belt tensions and bolt torques; proper balancing pulleys blades and other rotating parts.
- Reducing the speed of operating of the equipment to the slowest level consistent with product quantity and quality goals.
- Ensuring that equipment frames are as rigid as possible.
- Isolating noisy equipment with rubber footings, springs or other forms of dumping suspension to reduce implication of noise through vibration.

2.10.1 Maintenance of Wood working Machines

It is important that all parts of wood working machinery are maintained or smooth, efficient and effective plant operations so that performance does not deteriorate to the extent that it puts people at risk. The extent and complexity of maintenance can vary

significantly from simple checks on basic woodworking machinery to integrated programmes for complex machinery (HSE, 1998), woodworking machinery should be checked according to university oxford policy statement 54/99 frequently to ensure that safety related features are functioning correctly. Maintenance according to the British standards of Glossary of terms (3811: 1993) is defined as the combination of all technical and administrative actions, including supervision actions, intended to retain an item in or restore it to a state in which it can perform a required function. Again maintenance refers to the act of maintaining or keeping an existence or continuation. Additionally it means to keep in appropriate condition and generally refers to a form of up keep where by someone or something is kept in functioning order through series of actions (Shewanda, 2009).

It is a fact that various parts of a machine assembly will one day break down as a result of improper usage, fatigue and wear overtime. Similarly, no amount of idleness built into the machine assembly will amount to consistent performance over an extended operation horizon unless periodic maintenance is undertaken (Desai, 2006).

This section of the paper seeks to examine:

- Maintenance techniques or concepts.
- The approach to maintaining woodworking machinery.

2.10.2 Maintenance concepts

2.10.3 Breakdown maintenance

According to Watt (2017), this concept of maintenance also known as unplanned or emergency maintenance is where when damaged section of a plant is replaced only when there is equipment breakdown. Watt (2017) further emphasized that there is no way to eliminate unplanned maintenance but it can be reduced by implementing a Preventative Maintenance Program. The goal should be a maintenance plan that is 80% planned 20% reactive. It means that people waits fill plant fails are repair it, Venkatesh (2009) argued that such a thing could be used when the equipment failure does not significantly affect the operation or production or generate any significant loss other than repair cost. However Brett (2005) is of the opinion that, this method is costly, dangerous and totally inefficient.

2.10.4 Corrective maintenance

This concept of maintenance originates in the 1957 according to Venkatesh (2009) and it improves equipment and it components so that preventive maintenance can be carried out reliably; Equipment with design deficiency must be redesigned to improve reliability or improving maintainability (Venkates 2009). Connective maintenance is essentially reactive in nature, according to Desai (2006) and that the following steps constitute connective maintenance. Once the failure is identified, of must be confirmed.

If failure is not confirmed, the plant is generally returned to service. This no –fault syndrome leads to considerable amount of time being wasted at a significant cost (Desai, 2006).

- If the failure is confirmed, the item is prepared for maintenance action and the failure report is completed.
- Quarantine of a failed part in the assembled is the natural next step in performing corrective maintenance.
- The failed part is removed for disposal or repair.
- The item may be reassembled, realigned and adjusted after repair.

According to Desai (2006) the chief demerit of this maintenance concept is the inherent amount of uncertainty associated with it, similarly, the procedure is capable of shutting down an entire, operation because of a single failure in a single machine in extreme conditions.

2.10.5 Preventive maintenance

It is a daily maintenance (clearing, inspection, oiling and retightening) according to Venkatesh (2009) designed to retain the efficient condition of plant and eliminate failure through the prevention of deterioration, periodic inspection or plant condition diagnosis, to measure deterioration. If encompassed a maintenance activity that is undertaken after a specific period of time or after a specific period of equipment use (Gits, 1992). Preventive maintenance is carried out so as to reduce the possibility of a failure (Swanson, 2001). It is worth noting that preventive maintenance schedules, and procedure derives its influence on decision from corrective maintenance Reiche, 1994) as cited by Desai (2006). According to Venkatesh (2009) preventive maintenance originates in 1951, and it's further divided into periodic maintenance and preventive maintenance.

- Periodic maintenance (Time based maintenance – TBM)
- This concept consists of periodically monitoring servicing and clearing equipment and replacing parts to avoid impromptu failure process problems.
- Predictive maintenance

This system of maintenance involves monitoring the condition of safety critical parts and carrying out maintenance wherever necessary so that hazards do not occur as a result of deterioration (PUWER, 1998). According to Venkatesh (2009) this is a method where the service life of important part is predicted based on inspection or diagnosis, in order to use the parts to the limits of their service life.

2.10.6 Maintenance prevention

In this concept as stated by Venkatesh (2009), it indicate the design of a new plant studied sufficiently weakness of currents machines, such as information leading to failure perseveration, easier maintenance and defect preventions, safe and case of manufacturing and incorporation it into a new equipment before commissioning. Maintenance prevention work to improve equipment performance through improved equipment design (Swanson, 2001).

2.10.7 Approach to maintaining wood working machinery

Several factors are critical for perfect results. There it is important to develop a maintenance schedule base on manufactures procedure in order to derive the best or efficiency from equipments or machine tools (Martensson, 1980; Brett, 2005). The

maintenance of woodworking machinery should include at least, as indicated by Martenson (1980), PUWER (1998) and Brett (2005) the following;

- Worktable (upon which a work piece rests or over which if passes). These should be smooth and kept clean without putting bottles or cups on since they will form permanent hips, Brush if off regularly and rub candle wax an it for ease of working.
- Mechanical feed system (where used) should track and run smoothly.
- Check all guards are freely adjustable over the full range and that they continue to fulfill their safety functions.
- Check operation of switches and other protection devices to ensure they are in effective working order.
- All tooling must be sharpen and undamaged. They must be accurately set and their tables correctly adjusted. According to Martenson (1980) sharp cutters give better results which saves time in sanding.
- Check that all jigs, work piece holders and push sticks or blocks are fit for safe use and are stored to minimize the risk of damage.
- Check that all tool holders and cramping systems function freely and safety.
- Clean off nipples and apply correct grade and right amount of grease using the correct gum.
- Remove all rust spots with fine wire tool.
- Wipe over the entire machine using clean rag.
- Apply a coat of high grade oil to all screws and slide.

- There should be enough space around each machine for the operator to maneuver. Maintenance friendly machines are important in terms of both productions as well as safely. Also, machines that are difficult to maintain routinely are vulnerable to receive he required standard of maintenance (Ferguson et al; 1985). For example, according to Johnson (1988), breakdown on some machines was often found to be associated with or was a direct result of lack of maintenance or abuse of equipment other than just poor engineering.

2. 11 Woodworking machinery accident history and safe use

When compared to other industries woodworking account for a disproportionately high number of machine accidents. In an HSE survey of 1000 woodworking machine according to Brett, (2005), 73% of total accidents were attributed to four machine types. Again the study further revealed that accident is high in small premises. Over 50% of those injured had only received on the job training", 24% had not received instruction on the machine they were using, and of these 5% were under supervision; finally 25% of accidents involved formally trained operators indicating a bypassed of safe working method.

2.11.1 Safe working practices for circular saw Benches

The guidance applicable to circular saw benches includes but not limited to the following points according to, Hilton (1970), Walton (1974), Emary (1984), HSE (1992), HSE (1998), and Brett (2005);

- The part of the saw below the saw table must be fully enclosed (Emary, 1984)

- To reduce the risk of contact with the moving saw blade during round own a braking device must be fitted to the machines to bring the blade to rest within 10 seconds. A riving knife must be provided for every circular sawing machine behind the saw blade with the aim of parting the timber and prevent it gaining on the blade and thrown back towards the operator (Brett, 2005).
- The upper parts of the saw blade which projects must be fitted with flanges on either slide and also be adjustable. The crown guard must be raised and lowered to suit the depth of the cut (Hilton, 1970).
- Saw benches should be fitted with local exhaust ventilation both above and below the table to effectively control wood dust.
- When an assistant is employed at the out feed end of the machine to remove the cut piece, an extension table must be fitted so that the distance between the saw blade and the table end is at least 1200mm. The assistant must not reach forward towards the saw blade.
- A suitable push stick should be provided for feeling materials over the last 500mm of the cut, remove cut pieces from between the saw blade and the fence.

These as required, are not seen on the circular saw at the Kwadaso Timber Market as seen in the plate 4.7 below.

Plate 2.7 Circular saw in use virtually without any of the afore mentioned guidance

2.11.2 Safe use of the narrow Band Saw

The guidance applicable for the safe use of the narrow band saw includes but not limited to the following points according to, Walton (1970), HSE (1998) and Brett (2005).

- All moving parts must be totally enclosed with substantial guards with exception of the cutting section from the top pulley down to the table. On new machines constructed to conform to the European standard bearing the "mark CE", these guards should be interlocked with motor to prevent it starting if any guard is not fully in place.
- An adjusted guard should be provided to cover the part of the blade between the top pulley wheel enclosure and the table.
- During operation the guard and top blade guide should be adjusted as close as reasonable to the work piece and firmly secured in position.
- The blade below the table must be guarded at all angles of the life.

- The blade will keep it condition longer if relaxed at the end of each work shift. A suitable notice e.g. black blade, re-tension between switching on" should be on the machine to remind the nest user.

None of these outlined guidance are observed at Kwadaso Timber Market as seen in plate 2.8 below

Plate 2.8 Band saw without any of the safety guidance as outlined above used at Kwadaso Timber Market

2.11.3 Safe use of the Hand-fed planning machines

The guidance applicable to hand-fed planning includes but not limited to the following point of indicated by (Brett, 2005; HSE, 1998).

- There must be no access to the planning cutter block or drive mechanism below the table.

Only cylindrical (or round form) cutter block should be used and hand –fed planning machines. Keep knife projections to a minimum-on new machines that is post 1995) the maximum cutter projection should be 1.1 mm (BSBN 847-2005).

- Every hand –fed planning machine must be fitted with a bridge guard centrally position over the cutter block.
- During operation, the bridge guard must be adjusted so that the gap between the guard fence and work piece is as small as possible where fingers can set contact the cutter block.
- A guide must be fitted to the fence to cover both the width and length of the non-working side of the fence.
- A push block should be used when working on short length timber. This is to prevent the work dipping as it leaves the lip of the in feed table and snatching on the cutters causing kick back.

2.11.4 Safe use of vertical spindle moulding machines

The guidance applicable to vertical spindle moulding machines include but not limited to following points as indicated by health and safety executives (2007) and Bratt (2005);

- In order to reduce the risk of contact to the cuter block during round own a braking device should be fitted to bring the machine to rest within 10 seconds.
- The selected rotational speed for the machine must be appropriate for the tooling being used. The design speed range should be market on the cutter block.

- The cutters, cutter block and the spindle behind the fence should be fully enclosed by a suitable guard that induces the provision for the connection of dust exhaust outlet.
- Front and back tops fixed to the false allow greater control of the jig, give stability and prevent kick back when dropping on.
- Whenever possible a demountable power feed together with pressure pad should be used.
- If a power feed cannot be used, the cutting area must be covered with vertical with vertical and horizontal pressure pads which form termers through which the work piece can be fed safely with a push stick.

2.11.5 Safe use of the wood lather machine

According to Hunt country wood workers (2007) a local chapter of the American Association of wood Turnners (AAWT) the following safety guidelines in the usage of the wood late must be adhered to.

- Safe and effective use of the wood lathe requires a study and complete understanding of tools of tools and operator's manual.
- Always wear proper eye protection, dust mask in dusty work conditions and hearing protections during extended period of operations.
- Avoid gloves, loose clothing or any dimpling objects that may come into contact with revolving part. Tie long hair at the back.
- Make sure all devices are in good working condition. Guards and covers on place fail stock and toothbrush tight.

- Make sure the lathe is turned off before making major adjustment.

In order to sum up the safe usage of the above mentioned wood working machines. Brett (2005) realizing the dangers involved, stated that wood working machines often have high speed cutters which owing to the nature of the work they do, cannot be totally enclosed. It is therefore particularly imperative to maintain clean and safe working environment that takes into account the capabilities weakness of those working in it.

- Taking shortcuts: Workers in very day life makes decisions to carry out a job in a faster and efficient manner. However, a short cut that reduces your safety on the job is not shortcut but an increased chance for injuries.
- Starting a task with incomplete instructions. Jobs come with instructions; don't be shy about asking for explanations.
- Poor housekeeping: Poor housekeeping creates hazards of all types. Never throw rubbish on the floor, if oil, or grease is spilled, wipe it up immediately or someone might slip and fall well maintained area sets a standard for others to following.
- Being over confident: It will never happen to me is an attitude that can lead to improper procedure; selection of tools or methods in the workplace.

Hinze (2002) and Vredenbargh (2002) state that workplace safety could only be improved of workers change their behavior toward causes of accident.

- Ignoring safety procedures: Purposely failing to observe safety rules that of others. Being "casual" about safety can lead to causality.

- Mental distraction from work: Dropping your "mental" guard can pull your focus away from safety work procedures, carrying a bad day at home to work is a hazardous combination.
- Failure to pre-plan the work: Being hasty in standing a task or not think king through the process can endanger one's life.

In a related development Black (2007) also identifies the following as causes of accident;

- Carelessness, through failure to think ahead or as a result of fatigue.
- Taking medicines can affect people's ability to safety, as can the same effects of alcohol takers.
- Horseplay, practical jokes or silly cricks. The workplace must not be used for these types of behavior.
- Improper dress had led to serious injury: inappropriate personal protective equipment such as term, overalls, trainees, loose cuffs, and floppy woolen jumpers is breaking the law of work.
- Unguarded or faulty machine
- Poor ventilation, bad lighting, unsafe passages, doors, floors, temperature too high or too low and dangers from falls and falling objects resulting from work place environment.
- Poor maintenance of equipment and materials.
- Lack of training instruction, supervision or inexperience which is the duty of the employer to provide.

2.12 Summary

From the review of the related literature, it could be noted that several studies have been conducted on exposure to wood dust and excessive noise indicating the dangers they poses to the health of workers in the timber industry. Again the use of woodworking machine may have greater effects on operators if engineering, administrative and protective measures are not taken.

However work related injuries can be minimize greatly if proper maintenance practices are adopted, workers educated supervised and safety systems put in place. This requires that management place occupational safety and health at the top of their scale of preference. Direct and indirect costs associated with safety related losses can be substantial for small and medium scale shop owners who are found liable due to irresponsibility and inadequate provisions for safety controls to protect their employees and the public. An integrated system to monitor measure and control OSH related activities require commitment to achieve organizational objectives and control OSH related activities require commitment to achieve organization objectives and sustain the desired results.

CHAPTER THREE

MATERIALS AND METHODS

3.0 Introduction

This section deals with the research design, the population, the sample and sampling procedure in the study. In addition, the research instrument, methods of data collection and analysis were also discussed.

3.1 Study Design

A cross-sectional survey design was used for the study operatives employed to operate six machines at Kwadaso timber market and Kumasi Technical Institute, Kumasi - Ghana. A cross-sectional survey collects data to make inferences about a population of interest at one point in time. Cross-sectional surveys have been described as snapshots of the populations about which they gather data. Cross-sectional surveys may be repeated periodically because a respondent to one administration of the survey could be randomly selected for a subsequent one. Cross-sectional surveys can thus be contrasted with panel surveys, for which the individual respondents are followed over time. Panel surveys usually are conducted to measure change in the population being studied, Lavrakas (2008). Cross-sectional surveys can be conducted using any mode of data collection, including telephone interviews, emails etc.

3.2 Population

The targeted subject was woodworking machines and their operators, technicians and assistance in the selected woodwork machine shops in Kumasi Metropolis in Ashanti

Region. Individual respondents are followed over time in the study thus, accessible population was the woodworking machine operators from KTI and Kwadaso Timber sawmill who work on the following machines: the cross-cut saw, Narrow Band saw, spindle moulding machine, the narrow bad saw, thicknesser, wood lathe turning machine.

The machines and their operatives were stratified based on their functions and roles and then a proportional stratified method used to select between 20 and 30 percent of operations and their assistants, belonging to each stratum respectively, for which the individual respondents are followed over time. The variations in the percentages were due to the fact that some machines were very common in most shed than others and also have more operatives responsible for its operation than others. To ensure equal chance of being selected to represent each stratum "Yes" and "No" were written on pieces of papers cut using the same size. The ballots were then put in a container and thoroughly shaken. Thus, when one picks yes, he represents the stratum. This was repeated for each strata, and through this sampling procedure a sample size of six machines operators were observed, interviewed and questionnaires given them.

3.3 Sample and Sampling Procedure

It was necessary for the research to concentrate on a part because the entire size of the population was large. The time available for the research was limited and the financial resources not adequate. The researcher selected types of woodworking machines and their operators from K T I while the same number at Kwadaso timber market and manual counting of the wood working machines were carried out at both woodwork shops on 14/07/14 and this is indicated in Table 3.1. This was necessitated because managers of

the facility did not have a list of the number of woodworking machines available. The cross-cut saw, the moulding machine the narrow Band saw, thicknesser and wood lathe turning machine.

Table 3.1 Distribution of Machines at Kumasi Technical Institute (KTI)

Machine types	Number of machine
Spindle moulder	2
Narrow board saw	2
Thicknesser	2
Wood turning	2
Cross-cut saw	3
Belt sander	2
Surface	2
Mortise	2
Circular saw	3
Total	**20**

Table 3.2 Distribution of machines at Kwadaso Sawmills

Machine types	Number of operatives
Circular saw	5
Spindle moulder	6
Wood turning lathe	5
Thicknesser	7
Narrow band saw	6
Surfacer	10
Total	**40**

3.4 Instrumentation for data collection

Two questionnaires were used to collect data for this study. One questionnaire on Appendix section A was given to machine operators of Kwadaso operatives and the other was given to technicians at Kumasi Technical Institute this is due to the level of education in this these two areas. The questionnaire seeks basic demographic questions about the individual operators and their working experiences. It then asked questions regarding perceived safety and health hazards in the operation of their respective machines, training, and adherence to maintenance techniques and of inspections were being canned out. The survey continued with questions about safe use of personal protective equipment and how wood dust was controlled while working.

3.5 Data Collection Procedure at Kwadaso

The administration of the instruments was done through personal visit to the operatives of the forty selected woodworking machines at the Kwadaso Timber mill. The instrument was personally delivered to the literate operatives who filled the questionnaire in the presence of the researcher. This afforded the researcher the opportunity to explain some items which were not understood by the respondents. Some respondents who indicated they were busy at the time of the visit and they could respond to the questionnaires on their own for it to be collected later were given short briefing on things that were technical in nature. In the case of the illiterates and semi-illiterates, the researcher conducted a sort of face to face interview using the questionnaire as a guide, fifty two (52) literate and ten (10) illiterate and semi-illiterate were involved with this exercise. The items on the questionnaire were translated into the languages best spoken by the

operatives. (Twi, Hausa and Kansena language) to make some of the respondents understand them without difficulty. Though the translation was quite difficult and involved much time, it made data collection very effective and promoted a high level of interpersonal relationship between the researcher and the respondents. The data collection was done in two phases. Phase 1 was carried out on the 28th to 21st July, 2015 and this covered forty selected woodworking machines. Six questionnaires were administered with a conveying letter explaining the purpose of the study, soliciting their co-operation and assuring them of confidentiality of information they would provide, was attached to the instruments. This was after permission was sort from the managers of the facility after presenting a covering letter to that effect. At Kumasi Technical institute the Head of Department (HOD) of furniture Department gave the go ahead to administer the questionnaire to both teaching and non-teaching staffs of institute.

3.6 Data Analysis Procedure

Data were analyzed by tabulating the different responses to each question and then calculating the percentages of each response using the statistical Package for Social Science (SPSS). Descriptive analysis was used on information gathered.

Based on the responses, the researcher could draw conclusion on the extent to which wood working machine tool safety was effective, practices which negatively affect health of operatives, the extent to which machines meet safety requirements and the maintenance strategies adopted for efficient running of the machines.

CHAPTER FOUR

RESULTS AND DISCUSSION

This chapter presents the analyses of the data obtained from the two study areas. It is presented into two categories of workforce in the field of work.

4.1 Demography of respondents

Presented in table 4.1 is about the results on the demographic characteristics of the respondents used for the study.

Table 4.1 Demographic Characteristics of respondents

	Frequency	Percent
Gender		
Male	62	96.9
Female	-	-
Missing	-	-
Total Response	**62**	**96.9**
Total Questionnaires	**64**	**100.0**
Age (years)		
< 18	3	4.7
19 – 22	6	9.4
23 – 25	11	17.2
26 – 30	13	20.3
31 – 40	29	45.3
No response	2	3.1
Total	**64**	**100.0**
Working experience		
< 1 year	3	4.7
1 – 5 yrs.	11	17.2
6 – 10 yrs.	28	43.8
11 and above	20	31.2
No response	2	3.1
Total	64	100.0
Level of education		
MSLC	4	6.2
SSS/SHS	12	18.8
Tech/Voc. Education	31	48.4
JHS and Below	5	7.8
No formal education	2	3.1
Others	8	12.5
No response	2	3.1
Total	**64**	**100.0**

Source: Fieldwork (2016)

Results in table 4.1, describes the demographic characteristics of the respondents. From the table, it could be observed that all the respondents surveyed were all males (100%). Results on the age distribution of the respondents revealed that nearly half of the respondents approximately 47% of the respondents were aged from 31 – 40 years of age. Again, 21% of the respondents were aged from 26 – 30 years of age.

Results on how long respondents have been in the wood business shows that nearly 45% of the respondents have been in the wood business 6 – 10 years whereas about 32% of the respondents have been in the business for 11 years and more.

On the level of education, the table shows that majority (n=31, 48.4%) of the respondents were holders of Technical and Vocational education certificates whereas 12 (18.8%) were SSS/SHS leavers. Eight (8) representing (12.5%) of the respondents had other levels of educational qualifications. Age, gender and educational levels were considered in this study because in Kwadaso sawmill, there is no age limit for those who operate the machines and female as well work at this place unlike KTI where there is a defined group of people who operate the machines, thus there was therefore the need to consider age, gender and educational level in this study.

The difference in education levels observed between Kwadaso sawmill and KTI was that, those at Kwadaso although have the practical knowledge on the use of the machines but do not have any formal education whatsoever on the effective use, the safety regulation and the appropriate maintenance practices of the machines they are using. However, it

was evidently clear that the machine operators at Kumasi Technical Institute (KTI) are equipped with the requisite technical and practical knowledge through the formal education on the appropriate or acceptable woodwork machine shop operations and practices.

4.2 Provision of sufficient working space

The respondents were requested to indicate whether their machines have sufficient space to work around. The results in table 4.2 shows that more than two-thirds (n=50, 81%) of the respondents responded 'Yes' to having sufficient space to work around their machines. However, 12 respondents representing approximately 19% reported 'No' to having sufficient space to work around as being shown in table 4.2 below

Table 4.2 Provision of Sufficient Space to Work Around

Response Scale	Frequency	Percent
Yes	50	80.6%
No	12	19.4%
Total	62	100.0

Source: Fieldwork (2016)

This implies that there is no adherence to the health and safety regulation at this wood workshop. However, the regulation states, Employees working outdoors should be protected against bad weather, noise, slippery conditions, congestion and be given enough space to manipulate the machineries and be able to move around freely etc. Guide to the Safety, Health and Welfare at Work (General Application) Regulations 2007. Thus

it is imperative and very expedient for the provision of enough working space around wood working machines.

4.3 Machine installation

The respondents were asked whether the machines are well installed. The results as being shown in table 4.3 indicates that more than two-thirds of the respondents (n=47, 73.4%) responded 'Yes' to having their machines well installed. On the contrary, 14 being 21.9% of the respondents reported 'No' reporting that they could not install their machines well. This is shown in table 4.3 presents the results on whether the machines have been well installed.

Table 4.3 Machine well installed

Response Scale	Frequency	Percent
Yes	47	73.4
No	14	21.9
No response	3	4.7
Total	**62**	**100.0**

Source: Fieldwork (2016)

4.4 Mostly used machine by operators

Table 4.4 presents the results regarding the machine which respondents frequently work off. Analysis of the results indicates that (n=23, 37.1%) reported that they frequently work off the Circular. In addition, another 23 being 37.1% of the respondents said they

work off the Surfacer frequently than any other machine. Further checks revealed that the Spindle moulder and Wood lathe turning machine were the least frequently worked off.

Table 4.4 Particular type of machine operator frequently use

Response Scale	Frequency	Percent
Circular	23	37.1
Surfacer	23	37.1
Bandsaw	4	6.5
Spindle moulder	6	9.7
Wood lathe turning machine	6	9.7
No response	2	3.13
Total	**64**	**100.0**

Source: Fieldwork (2016)

4.5 Machine purchase date

The respondent were further asked to indicate when the machines were purchased and the outcome as presented in the figure above depicts that majority of the machines were purchased in the 1990s as reported by 38 respondents. In addition, 14 respondents reported of purchasing their machines in year 2000 and beyond. Six respondents also reported that their machines were purchased in the 1980s.

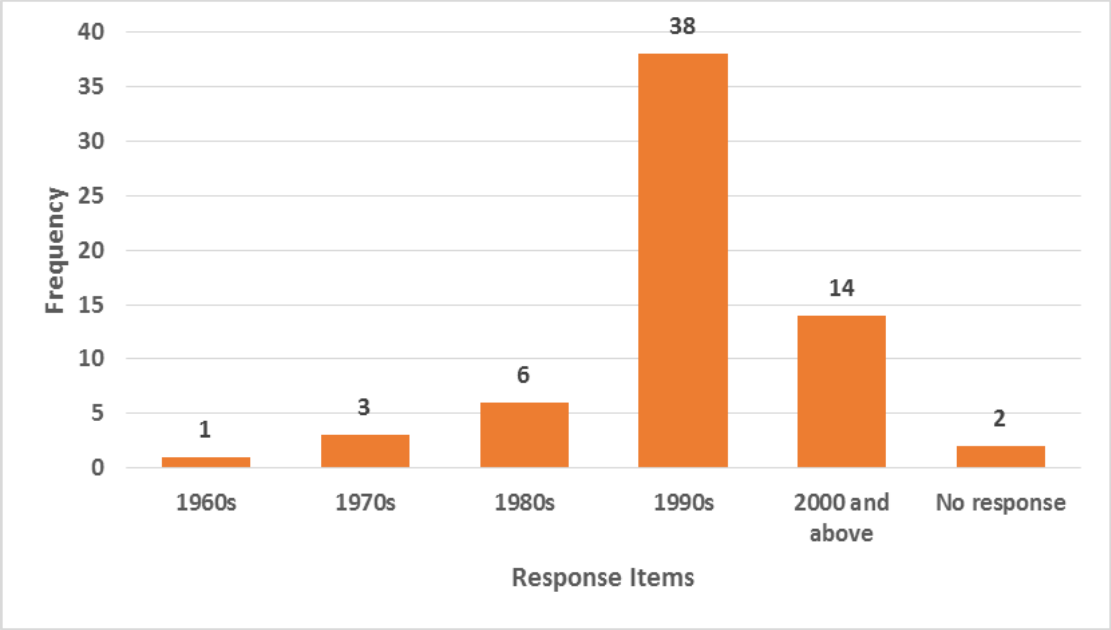


Figure 4.1 Date of the machine purchased
Source: Fieldwork (2016)

4.6 Year of machine installation

As a follow, up the respondents were requested to point out when the machines were installed. The results as being shown in table 4.5 shows that majority of the machines were installed in the 2000 and beyond with 37 representing 59.7% of the respondents reported. Again, 20 comprising 32.3% of the respondents reported their machines were installed in the 1990s.

Table 4.5 Year the machine was installed

Response Scale	Frequency	Percent
1970	4	6.5
1980	1	1.6
1990	20	32.3
200 & above	37	59.7
No Response	2	3.13
Total	**64**	**100.0**

Source: Fieldwork (2016)

4.7 Noise levels of the machines

The respondents were requested to indicate the level of the noise generated by the machine when it is being worked on. The outcome showing in table 4.6 above give credence that more than half (n=33, 53.2%) of the respondents consider the noise level of the machine to be high whereas 8 respondents being 12.9% regard the noise to be very high. However, 20 respondents being 32.3% consider the noise level to be low.

Table 4.6 Level of Noise of the machine you are working on

Response Scale	Frequency	Percent
High	33	53.2
Very high	8	12.9
Low	20	32.3
Very low	1	1.6
No Response	2	3.13
Total	**64**	**100.0**

Source: Fieldwork (2016)

4.8 Awareness about the effect of excessive noise levels

Showing in table 4.7 represents the results regarding whether respondents consider the noise level excessive enough to affect their hearing. From the responses, it could be observed that more than two-thirds (n=52, 83.9%) reported that the noise level is excessive to affect their hearing. However, 10 being 16.1% of the respondents responded 'No' to the fact that the noise level could affect their hearing.

Table 4.7 Knowing level of Noise excessive to affect your hearing

Response Scale	Frequency	Percent
Yes	52	83.9
No	10	16.1
No response	2	3.13
Total	**64**	**100.0**

Source: Fieldwork (2016)

4.9 Duration of continuous work on a machine in a day

The respondents were asked to give how long they spend continuously working on a machine at the job site. Table 4.8 shows that majority (n=34, 54.8%) of the respondents spend 60 minutes a day continuously working on a machine. In addition, 14 comprising 22.6% of the respondents spend 30 minutes a day working continuously on a machine. The results imply that on the average workers spend an hour on the machines daily.

Table 4.8 Duration of Continuous Work on a Machine in a Day

Response Scale	Frequency	Percent
30 mins	14	22.6
50 mins	1	1.6
60 mins	34	54.8
80 mins	13	21.0
Total	**64**	**100.0**

Source: Fieldwork (2016)

4.10 Availability of personal protective equipment

Figure 4.2 above presents the results on whether the acquisition of the machines was accompanied with the personal protective equipment. The figure depicts that in most cases the acquisition of the machines was accompanied by personal protective equipment. However, it was only in a case of 12% of the respondents whose purchases were not accompanied by personal protective equipment. Five percent of the respondents failed to respond to the question.

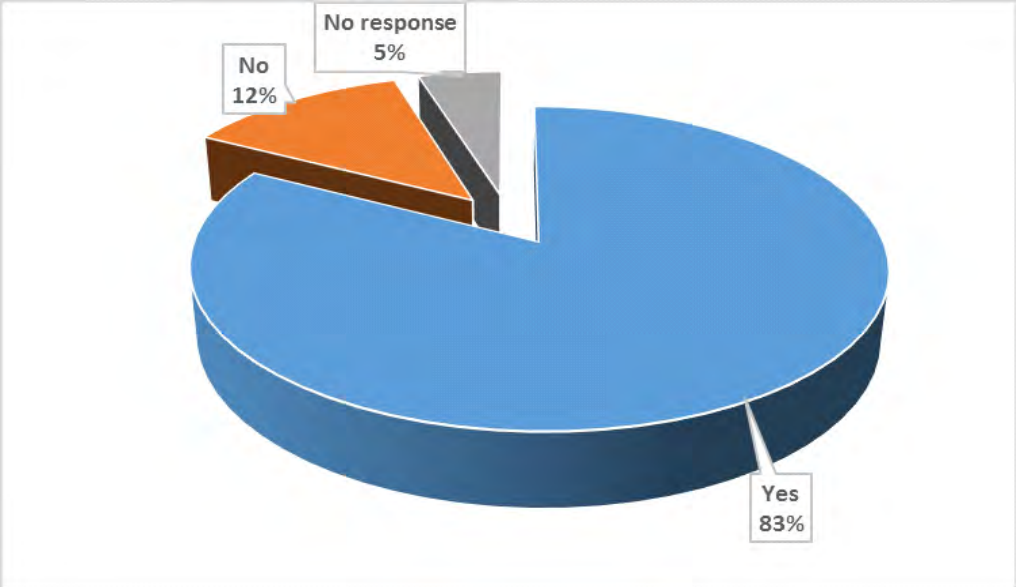


Figure 4.2 Provision of personal protective equipment with machines

Source: Fieldwork (2016)

4.11 Types of Protective equipment provided

As a matter of follow up the respondents were asked to indicate the type of device that was provided as part of the machine. From table 4.9 above, it could be deduced that respirators were the most provided protective equipment as 28 constituting 45.2% of the respondents suggested. Again, 13 consisting 21% of the respondents were given goggles upon purchasing the machines. From the results, it could be inferred that respirators are the most widely used protective device at the workshops.

Table 4.9 Types of devices were provided

Response Scale	Frequency	Percent
Respirator	28	45.2
Ear protector	3	4.8
Overcoat	8	12.9
Goggles	13	21.0
Nose musk	4	6.5
Safety boots	6	9.7
No response	2	3.13
Total	**64**	**100.0**

Source: Fieldwork (2016)

4.12 Understanding the purpose of the hearing protection

Responses in table 4.10 concerns how often the respondents use hearing protection equipment whenever they operation a machine. The result shows that 33 being 53.2% of the respondents stated that they always use the ear protective equipment whenever they operate a machine. On the contrary, 29 representing 46.8% of the respondents posited that they 'Sometimes' use the equipment to protect their ears when they are working with the machine.

Table 4.10 Understanding Use of Hearing Protection of oneself

Response Scale	Frequency	Percent
Always	33	53.2
Sometimes	29	46.8
No response	2	3.13
Total	**64**	**100.0**

Source: Fieldwork (2016)

4.13 Effects of hazardous sound on hearing

On receiving training about the effects of hazardous sound on one's hearing ability, almost two-thirds (n=46, 74.2%) of the respondents responded 'Yes' to being aware of the effects of hazardous sound on their hearing. From the table 16 consisting 25.8% of the respondents on the other hand responded 'No' to be aware of the dangers of hazardous sounds on their hearing.

Table 4.11 Knowledge of the Effects of Hazardous Sound on Hearing

Response Scale	Frequency	Percent
Yes	46	74.2
No	16	25.8
No response	2	3.13
Total	**64**	**100.0**

4.14 Benefits of the use of respirators

From the responses in table 4.12 above it could be observed that majority (n=45, 72.6%) of the respondents responded 'Yes' to the use of respirators or nose mask to control the inhalation of wood dust. On the contrary, 17 consisting 27.4% rather do not use the respirators or nose masks to control the inhalation of the wood dust. The results have also been presented according to the level of education of the respondents. From the results, it could be implied that that respondents perceive the use of respirators beneficial especially when it comes to controlling the inhalation of wood dust.

Table 4.12 The Benefits of the use of Respirators or Nose Mask on Control Wood Dust

Response Scale	Frequency	Percent
Yes	45	72.6
No	17	27.4
No response	2	3.13
Total	**64**	**100.0**

Source: Fieldwork (2016)

4.15 After effect of wood dust exposure

The results in figure 4.3 represent the responses given by the respondents on the effects of exposure to wood dust on their health. Analysis of the responses shows that 23 respondents reported Skin irritation whereas another 23 respondents also complained of Sneezing. In addition, 8 respondents reported of Asthmatic condition while 7 also reported Rashes. Only 3 respondents failed to respond to the question. The results give

the impression that upon exposure to wood dust workshop attendants are prone to the conditions of skin irritation and sneezing.

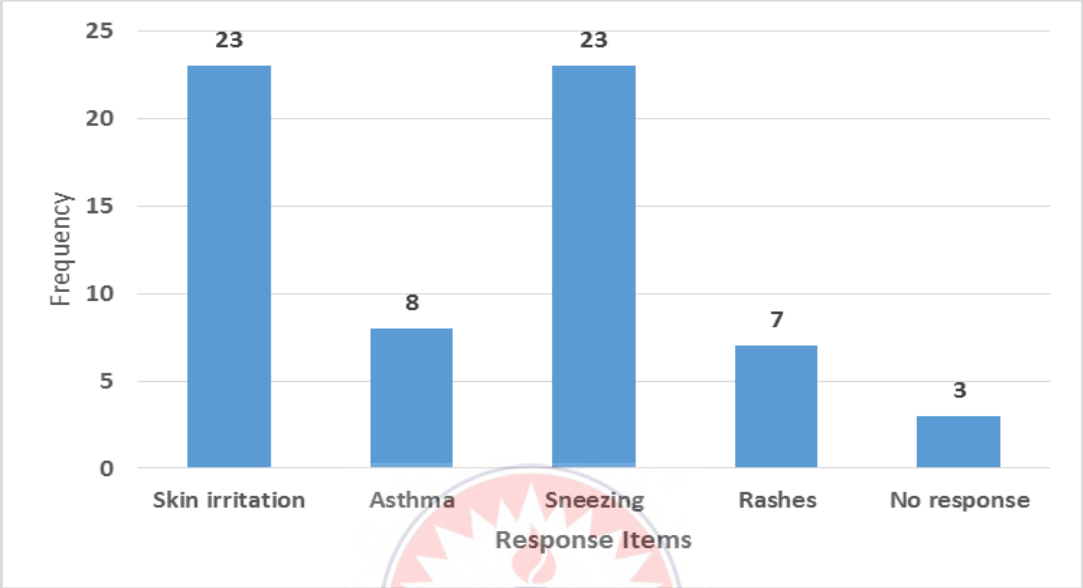


Figure 4.3 Symptoms after exposure to wood dust

Source: Fieldwork (2016)

4.16 Availability of maintenance plans

The respondents were asked whether they have any maintenance plan for their machines. From the results in table 4.13 it could be seen that nearly two-thirds (n=46, 74.2%) of the respondents responded 'Yes' implying they have a maintenance plan for their machines. On the other hand, 16 respondents being 25.8% reported of 'No' maintenance plan in place to cater for their machines. The data has further been disaggregated by the level of education of the respondents. The results imply that there is maintenance plans in place for the machine shops.

Table 4.13 Availability of Maintenance Plan for Your Machine

Response Scale	Frequency	Percent
Yes	46	74.2
No	16	25.8
No response	2	3.13
Total	**64**	**100.0**

Source: Fieldwork (2016)

4.17 Type of maintenance practiced

The respondents were asked to give account of the type of maintenance in place. The responses as being shown in table 4.14, more than half (n=22, 57.9%) of the respondents who reported of having a maintenance in place indicated that they do what is referred to as Replacement Maintenance. Meanwhile 9 constituting 23.7% of the respondents do shut down maintenance whereas the remaining 7 comprising 18% of the respondents also do corrective maintenance. From the results, it can be concluded that mostly problem machines are replaced at the workshop.

Table 4.14 Type of Maintenance Do Apply

Response Scale	Frequency	Percent
Corrective	7	18.4
Shut down	9	23.7
Replacement	22	57.9
No response	2	3.13
Total	**64**	**100.0**

Source: Fieldwork (2016)

4.18 How often machines are cleaned after use

On display in figure 4.4 concerns the rate at which respondents clean their machines after use. The results show that more than half that is 57.8% of the respondents suggested that they always clean the machines after each use. Again, only 39.1% of the respondents indicated that they sometimes clean the machines after use. Only 3.1% of the respondents failed to respond to the question. The outcome of the responses reflects the assumption that the machines are always cleaned after use.

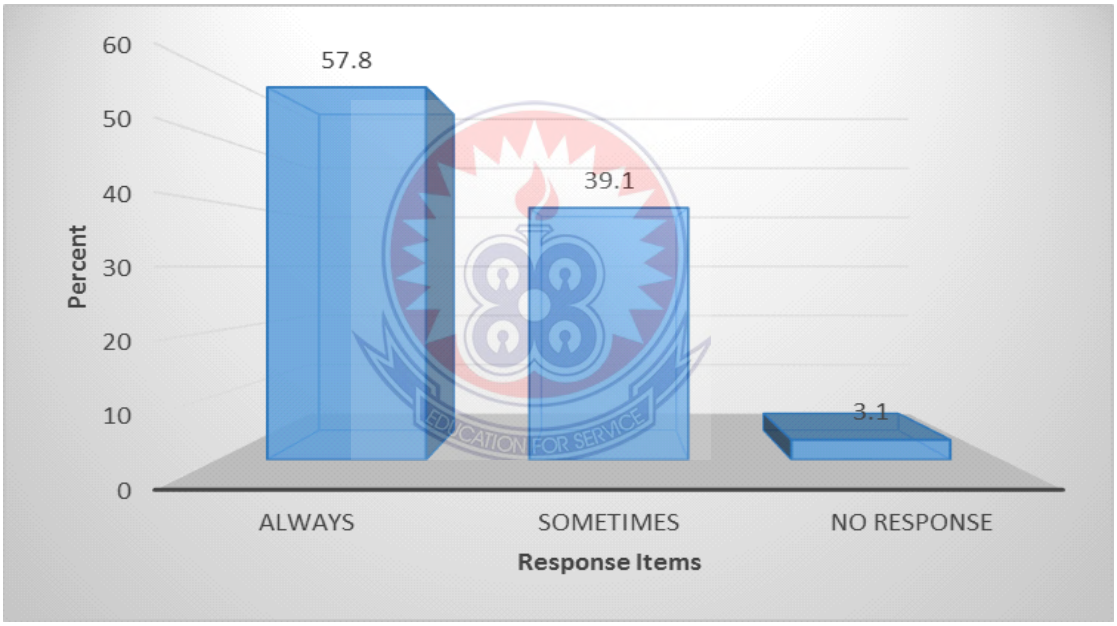


Figure 4.4 Caring of machines cleanness after use.

Source: Fieldwork (2016)

4.19 Instance of maintenance at the workshop

Table 4.15 gives the responses on whether the machines are only maintained when there is a break down. Analysis of the results shows that more than two-thirds (n=53, 86.9%) of the respondents responded 'Yes' to only maintaining the machine when there is a breakdown. However, only 8 representing 13.1% of the respondents responded 'No' to that effect. The results have been presented in relation to the level of education of the respondents. From the responses, it can be concluded that the machines are maintained whenever there is a breakdown.

Table 4.15 Maintained, when there is a Breakdown

Response Scale	Frequency	Percent
Yes	53	86.9
No	8	13.1
No response	3	4.7
Total	**64**	**100.0**

Source: Fieldwork (2016)

4.20 Periodic checks on machines for corrective measures

From table 4.15, the respondents were asked to indicate the frequency of periodic checks they carry out on the machines for corrective measures to be taken. Analysis of the responses suggest that majority (n=34, 54.8%) of the respondents always check on the machines for corrective measures to be taken whereas 26 representing 41.9% of the respondents stated they sometimes do the period checks on the machines for corrective measures. However, 2 constituting 3.2% of the respondents stated that they never do the periodic checks on the machines. The outcome of the responses implies that there is periodic check on the machines for corrective measures to be taken.

Table 4.16 Periodic check on the Machines for Corrective Measures Taken

Response Scale	Frequency	Percent
Always	34	54.8
Sometimes	26	41.9
No response	3	4.7
Total	**64**	**100.0**

Source: Fieldwork (2016)

4.21 Daily greasing of moving parts of the machine

From table 4.16, the respondents were asked to indicate whether they grease old moving parts of their machines. The responses suggest that more than two-thirds (n=50, 80.6%) of the respondents stated 'Yes' whereas 12 representing 19.4% stated 'No' to greasing

old moving parts of their machines. By implication the result has shown that moving parts of the machines are greased daily.

Table 4.17 Daily Greasing of Moving Parts of Machines

Response Scale	Frequency	Percent
Yes	50	80.6
No	12	19.4
No response	2	3.13
Total	**64**	**100.0**

Source: Fieldwork (2016)

4.22 Type of maintenance expert hired

The respondents were asked to give who repairs their machines in case it is damaged. The results as been shown in table 4.17 above suggests that nearly half (n=29, 46.8%) of the respondents surveyed resort to Mechanical technicians to repair their machines whenever it is damaged through operations. Also, 16 comprising 25.8% of the respondents hire qualified woodworkers to repair their machines whereas 13 respondents consisting of 21% of the respondents turn to electricians to repair their machines for them. From the outcome, it could be inferred that it is the mechanical technicians who work on the machines anytime there is a fault.

Table 4.18 Type of expert who works on the Machine in case of Damage

Response Scale	Frequency	Percent
Workshop technician	4	6.5
Hire qualified woodworker	16	25.8
Electrician	13	21.0
Mechanical technician	29	46.8
No response	2	3.13
Total	**64**	**100.0**

Source: Fieldwork (2016)

4.23 Implications of the results on Health and Safety

There are a large number of injuries and sometimes death in most professional wood working machine shops and sawmills every year, and this project interest was centered on Investigating the machine layout procedures used in the woodwork machine shops, evaluate the operating skills of those who man the machine shops use that negatively affect their health and asses the maintenance practice adopted to make the machines safe to use to enhance their efficiency. In most of the study centers visited the machine layout needs to be relooked and it is normally a challenge with the less educated machine shop or sawmills operators and owners. Comparatively machine shop layout at Kumasi Technical Institute (KTI) as seen in plate 4.1 is so convenient environment to work in and with the health and safety regulation in mind. also most of the machine operators in the other sawmills other than the KTI do not have much knowledge on the appropriate skills for the machine operations and maintenance. Moreover, practices adopted by these

sawmills and wood machine operators are not up to the standard, however the project reveals that KTI is on better side with respect to health and safety. It was evidently clear that physical workspace impact the employee experience and motivation to work. Many of this sawmills and woodwork machine shop do not have workplace layout and this is one of the fundamental requirement in health and safety regulation, Morgan (2015).

Workshop safety precautions and health and safety need to be observed by the operators in the timber industries as the Government takes keen interest in the enforcement of the health and safety regulations 2007.

Plate 4.1 KTI woodwork machine shop well organized and kept

Plate 4.2 Kwadaso woodwork machine shop disorganized and unkept

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

The safety, proper maintenance and management of traditional local woodwork machine shops are scattered in the various communities in the country and some are even sited out of site of the appropriate agencies in charge of their regular supervision and monitoring. This chapter summaries the key findings of the study, draws conclusions and suggests recommendations. It also gives the indication on the areas of the study that could be replicated or further research.

5.1 Summary of the Findings

The study revealed that those operators with eleven years (11) and above experience have improved or better wood workshop layout of their machine shops as compared with those of lesser number of years of machine shop working experience. Moreover, the effect of education level on the layout procedure adopted was evidently clear between that of KTI and Kwadaso machine shop. Those of the machine operators at Kumasi Technical Institute (KTI) are equipped with the requisite technical and practical knowledge through the formal education on the appropriate or acceptable woodwork machine shop operations and practices. This is evidently seen in the pictures in appendix section B, showing the picture of layout of the machine shop in Kumasi Technical Institute (KTI) and Kwadaso Woodwork Machines shop. Thus the education level influenced the woodworking machine shop layout adopted in the areas of the study. Majority of the operators had their educational level up to the technical school level or below with their assistants having junior high level. This finding confirms Madhi's (1995) findings as

cited by Rango and Leon (2005) that the informal sector workforce has majority completing only primary education level.

- Data from the study shows that the following machines are used in the selected machine shops; Circular saw, Surfacer, Bandsaw, Spindle moulder and wood lathe turner. Some of these machines installed at Kwadaso Woodwork Machines shop were purchased and installed in 1980 and others 2000 and were all 'used machines' and the number of years in used before purchased were not known to the operators. However, those machines from the Kumasi Technical Institute (KTI) were all installed new from the machine manufacturers and the acceptable operational practices and safety precautions were given to the users of the machine.
- The results from the study indicate that the biggest threat to a woodworker comes not from the bodily injury from a power tool, but from wood dust. Now to overlook or minimize the importance of hearing, eye and overall physical safety when dealing with power tools, it is the small stuff-the tiny and easily overlooked wood long-term damage and that was identified during the study to be wood dust. Some of the effect of wood dust on the operator of the machines were identified as; Long term effect, irritants, sensitizers, toxins and carcinogens, (Wood Toxicity and Allergen Chart). Due to the absence of the effective use of the safety wears and safety precautions, the operators are exposed to these mentioned effects. This situation was virtually absence in the case of the KTI woodwork machine operators. Since it is their daily practice to observe the workshop safety practices.

- In Kwadaso Sawmill since the machines there were old type maintenance work normal carry along by remolding the part that are spoil or getting a new one to replace as they work along. In the institutions proper allocated period is put in place to maintain these machines every semester or break period. The idea is to prolong the lifespan of these machines while they work without putting workers life in danger.
- The study also reveals that, the woodwork machine operators at Kwadaso Sawmill virtual don't observe any safety measures or precaution with the use of the wood milling machines. However, there are different safety measures can be used depending on what tool you are using and what procedure is being done on the wood. Since there are variety of operations that can be done, there are also a variety of protective measures they include the use of Dust mask, Manual respirator, Power respirator, Air filters, Air exhaust, Eye goggle. Pictures from appendix section three attest to this fact.
- The study also indicates that proper machine shop layout was not taken into consideration in Kwadaso Sawmill. Most of the important decisions in the layout of a shop involve the placement of basic machines such as the table saw and jointer. (Finewoodworking July 2017). Machine shop in Kwadaso handles long stocks and large sheet goods, but do not have clearance area around these machines, allowing each item to be machined and finished with ease and in a comfortable environment. The Kwadaso Sawmills have no layout procedure. Their plan was to give them enough space to saw their beams into boards and plan them .These machines are either two or more in a small space provided for their

operations. At Kumasi Technical Institute a whole building is put up for woodwork machine shop. There is a well-planned machine shop layout for the woodwork shop. This therefore ensures workers and machine operator work in a safe and healthy environment.

- The study again informed that there is no proper maintenance culture established and practiced in Kwadaso woodwork machine shop. KTI has a well-established maintenance practice; schedule maintenance according to equipment usage, ensure that the preventive maintenance task being performed are beneficial to the equipment, they buy spare parts before they are needed, the management or employers learn from equipment service personnel. It can be said that a well-maintained equipment extend it life span, improve efficiency and ensure the safety of the users and operators.

5.2 Conclusion

The conclusions were drawn from the findings of the study.

- At Kwadaso Sawmill, majority of machine operators, had not received any formal training of the safe usage of woodworking machines and also had little knowledge on the health implications of wood dust and excessive machine noise. There was low use of personal protective equipment and clothes which invariably protect operatives from injury and other health hazards. The floor surfaces of the working area as well as the lightening around the machines didn't meet safety regulation.
- The woodwork machine operators with vocational or technical education background were more aware of safety issues at the Kwadaso Sawmill their

employees should promote the regular observation of the safety rules and regulations governing the use of the woodwork machines.

5.3 Recommendations

From the findings of the study, the following recommendations are made.

- It is therefore recommended that employees of wood industry need to be educated on the use of personal protective equipment and identifiable hazards related to the jobs they are employed to do.
- They should be trained on the use of machines and authorized mechanist should be allowed to operate such machines.
- Non-functional parts of machines need to be repaired or maintained. Regular inspection of machines and their parts that need to be oiled, greased or cleaned and sharpened, adjusted and screwed to prevent unnecessary accidents in the workshops.
- Shop floors must be cleaned, free from debris, dust, protruding nails and other stripping hazards must be removed to prevent accidents.
- Again, employers must contribute all feasible engineering and work practice and controls to eliminate or reduce hazards (engineering controls involve physically changing the machine or work environment to prevent employees exposure to the potential hazards and injuries while working in these areas which can be protected).
- They should train their employees to prevent the numerous accidents in the wood workshops and sawmills and also workshops and seminars organized by skill

development centre such as Wood Industries Training Centre (WITC) and known other training institutions within Kumasi.

- Factory inspectorate Division should enforce the safe policies by asking their officers to go round to check if employers provide employees with personal protective equipment. This should be done periodically and the visit should be unnoticed.
- Finally, the Environmental Protection Agency (EPA), should also visit these sawmills and wood workshops occasionally to access if the environmental policies governing their operations are being implemented, and also to check sector for such milling industries within the unknown areas in the country and monitor their operations.

REFERENCES

Books, H. (1994). *Essentials of Health and Safety at work*. 3rd Ed. Macmillan Education Ltd. London Pp. 32

Brett, P. (1994). *Site Practice*. Stanley Thornes (Publishers) Ltd. Pp. 110 – 111, 222 –240

Burrows, D. (1998). *Basic Woodworking Techniques*. The Bath press London. Pp. 8

Carpenter, T. (2005). *Working with Wood*. North Americans Affinity Clubs Inc. Pp. 98
Construction Industry Training Board (1989). *Site management safety.*

Crump, D. (1992). *The Complete Guide to Wood Finishes.* Quarfo Publishing p/c. London. Pp. 110 – 132, 168 – 169

De Cristoforo, R. J.(1997). *The Complete Book of Wood Joinery*. Sterling Publishing Co. Inc. New York. Pp. 108

Feirer, J. L. (1987). *Wood Technology and Process*. Glencoe Publishing Co. Mission Hills, California.

Feirer, J.L. (1988). *Beginning Woodwork, 6th Ed*. Macmillan/Mc-graw-Hill Peoria. Pp 204 – 206

HSB Books (1992). LBV: dust capture at sawing machines. Sudbury, London

HSE (1995). Toxic woods. Woodworking sheet. No. 30. Sudbury, London

HSE (1998). Safe use of hand – fed planning machines. Woodworking information sheet No.17. Sudbury, London

Hunt Country wood turners, Inc (2007), Nasophary ngeal cancer due to exposure to wood dust: London

Ikegiwa, H, (1982). Improvement of the ripping fence of the circular – saw bench for the control of saw noise. Mokuzai Gakkaishi Journal of Japan Wood Research Society. Vol.28 (No.12), Pp. 774 – 777

ILO (1983). Woods in encyclopedia of occupational Health and safety. Vol. 11, Pp.2308–2316. International labour organization, Geneva.

Intention paper (2008). Open burning smoke control regulation policy intention paper for onsultation. www.env.gov.bc.ca/epd/codes/openburning/pdf/obscr-paper.pdf (Date assessed; July 16 2017)

International Topical Timber Organization (1999). *Manual for project foundation, 2nd Ed.*

Kauppinen, T, Vincent, R, Lukkonen, T. (2006). Occupational exposure to inhalable wood dust in the member state of the European Union. Annatated Occupational Hygiene. Vol. 50, Pp, 549 – 561

Kennedy, G. (1997). Construction foreman's safety hard hook: Albary, Delmai

Krause, R. T. (1995). Employee driven systems for safe behavior. USA: International Thompson Publishing Inc.

Kreindlin, L. (1984). *Woodworking*. Mir publishers, Moscow. Pp. 95 – 97

Labour Act of Ghana (2003). Am act to amend and consolidate the laws relating to labour and employers, www.ilo.org/GHA66955.pdf.3.03-11 (Date assessed; May 10 2017)

Lamb. F.M. (1981). Performance and annoyance effects of noise. forest products journal, Vol. 31 (No.1) Pp.48 – 53

Lange, J. (1982). Site safety. Hong Kong: Astros printing limited.

Lange, J.B. (2008). Effect of wood dust inflammation, Genotoxicity and Cance (Unpublished). Copenhagen

Lavrakas, P. J. (2008) Cross-Sectional Survey Design, Encyclopedia of Survey Research Methods. DOI: http://dx.doi.org/10.4135/9781412963947.n120. Assessed April 30, 2018

Leigh, J. (1998). Workers compensation an d common law: how the civil legal system discourage occupational injury prevention. West Post, C.N: Quorum book.

Ley, K. (2004*). Furniture Workshop a Woodworkers Guide*. Kyodo printing, Singapore. Pp. 10

Longo, L. M. B. and Bean, B. (2005). Qualitative method for assessing dust exposure in the informal sector. East African Journal of Public Health Vol. 2, (No.1), Pp. 32-38

Martenson, A. (1980). The worker bible (3rd edition). London; A and C Black Mcgraw –Hill 3008 w.willow throll Arive Peoria. Pp. 33 – 36

Mckay, W. B. (1958). Building craft series (joinery). Great Britain; the dairy press limited.

Motooance, B. M. (1997). The woodworking industry in Lesotho, Africa newsletter on occupation, health and safety, Vol. 7 (No.2, Pp. 46 – 47)

Nandi, S.S. and Dhatrak, S. V. (2008). Occupational noise induced hearing loss in India; India Journal of occupational and environmental medicine, Vol. 12, issue 2

National Tourist Institute (NTI)(2000) Occupational noise. The University of New Jersey, Rutgers.

NC Department of Labour (2008). A guide to occupational exposure to wood, wood dust and combustible dust hazards, U.S.A; Hillsborough St.

Obst, I. R. (1997). Special (secondary) metabolites from wood in forest products biotechnology. UK; Taylor and Francis Inc

Occupational Safety and Health Administration (OSHA), (1999), Industrial Safety Requirement United State Department of Labour. https://www.osha.gov

Pang, K.L (1995) audition of effect management tool green cross (March, 1996 edition), Pp. 23 -27

Peak, E.S. (1995). Occupational safety and health: a source book. New York; IL Human Kenetics publishers.

Petersen, D. (1996). Safety by objectives; what set measured gets done. New York; Van Nostrand Reinhold

Priha, E., Pennamen, S., Rantion, T. Uitti, J., Liesivueri, J. (2004). Exposure to and acute effects of medium density fibre board dust. Journal of occupational hygiene. Vol.1, Pp 738 – 744

Raven, P.H, Evert, R.F, Eichhon, S.E, (1996). Biology of plants (5th edition). New York: Worth publishers.

Ridley, J. and Channing, J. (1999), Risk Management, Great Britain, Reed Educational and Professional Publishing Limited

Robinowitz, P (2000). Noise – induce hearing loss. American family physician Vol.61:Pp. 2749-2760

Rowell, R.M (2004). Handbook of wood chemistry and wood composites. Boca Raton. C.R.C press.

Rowlinson , S. (2003) Hong Kong Construction site safe management and the law. Hong Kong sweet and Maxwell Asia

Safe work (2005). Health hazards of wood dust. www.gov.ml.ca/bltn238pdf (Accessed 2011)

Sampson, L. (2005). Linking maintenance to performance. International journal of production. Economics Vol. 70, Pp. 237-244

SCOEL (2003), Recommended from the scientific committee on occupational exposure limits, risk assessment for wood dust. SCOEL/sum/102 fine report.

Shamission, M.H (1992), Pulmonary function and symptoms in workers exposed to wood dust. Thorax 47, Pp.84-87

Sockey J.K.N. (1999). The Motivate Woodwork Technology. McMillan Education Ltd. London. Pp.1 – 3

Teschke, K.(2000). Lecture notes from wood dust exposure conference in Yamanaka, W.M.(2002. An investigation of wood dust exposure in Alberta Sawmill (unpublished), University of Alberta, Canada.

The Commonwealth of Learning (2000). *Workshop Organization and Management module 7, unit 7.1*. Pp. 31 – 41

Voisey, Sin (1987). *Wood Machining Complete, Guide to Effective and Safety Woodworking Practices*. London Educational Ltd, London. Pp. 1 – 3, 82 – 105

Vredenburgh, A. G. (2002). Organization safety: which management practices are most effective in reducing employee injury rate? Journal of safety research, Vol.33, issue 2, Pp. 259.

Walton A. J (1981), woodworking theory and practice, London; Australia publishing company limited

Walton J.A. (1974). *Woodwork in Theory and Practice*. New century press pty Ltd. 3-5 Cumberland SL. Sydney. Pp. 412 – 413

Watlin R. Turley, D. Chaudhry, Q. (2008). Secondary (special) metabolites from trees.

http://treechemical.csi.gov.uk/review/metabolities.cfm (Date assessed; June 1 2017)

Watt, D. (2017). The impact of unplanned or reactive maintenance, Realize production potential. Zedi, www.zedisolutions.com (Assessed March 3 2017)

Woodworking Manufacturing Technologies Department (WMTD), Cerritos College Norwalk, CA, August, 2008

www.osh.dol.govt.nz/oder/research/shtml (Date assessed; June 1 2017)

The wood database wood allergies and toxicity, www.wood-database.com (Date assessed; July 16 2017)

www.osh.dol.govt.nz/order/catalogue/index (Date assessed; June 1 2017)

www.osh.dol.govt.nz/order/lumberprocess (Date assessed; July 16 2017)

www.stilemachinery.com (Date assessed July 16, 2017)

APPENDIX

SECTION A

Questionnaire given to machine operators at Kwadaso wood workshop machine operators and wood workshop technicians at Kumasi Technical Institute.

UNIVERSITY OF EDUCATION, WINNEBA

COLLEGE OF TECHNOLOGY EDUCATION, KUMASI

SCHOOL OF GRADUATE STUDIES

QUESTIONNAIRE ASSESSING MACHINERY SAFETY PROCEDURE AND HEALTH MANAGEMENT IN WOOD WORKSHOPS IN KUMASI, (A CASE STUDY IN KWADASO/KUMASI TECHNICAL INSTITUTE.

Preamble:

The researcher is a Postgraduate student from the above mentioned Institution and would be very grateful if you could kindly give your views by responding to the following questions as it may be applicable to you in order to help gather factual information on the numerous contributions that Ghana as an industrializing country can benefit from ensuring effective safety measures at wood workshop.

Please be reassured that, your responses will be treated with utmost confidentiality

Thanks for your responses

INSTRUCTIONS FOR COMPLETING THE QUESTIONNAIRE

Please do not write your name, business address or phone number(s) on the forms.

Please tick (√) in the appropriate Box below

SECTION A: DEMOGRAPHIC PROFILE OF THE RESPONDENT

1. Gender
   - A. Male [ ]
   - B. Female [ ]

2. Age
   - A. 18 [ ]
   - B. 19-22 [ ]
   - C. 23 -25 [ ]
   - D. 26-30 [ ]
   - E. 31 - 40 [ ]

3. Educational level
   - A. MSLC [ ]
   - B. SSS/SHS [ ]
   - C. Tech/Voc. Education [ ]
   - D. J.H.S and below [ ]
   - E. No formal education [ ]
   - F. Others Please, specify

4. How long have you been in the wood business?
   A. Less than a year [ ]
   B. 1-5 years [ ]
   C. 6-10 years [ ]
   D. 11 years and above [ ]

5. What type of employment are you engaged in?
   Apprenticeship [ ]
   Temporary [ ]
   Permanent [ ]

SECTION B: WOOD MACHINES

6. What machine do you frequently work on?
   A. Circular Saw machine [ ]
   B. Surfacer planner [ ]
   C. Bandsaw saw machine [ ]
   D. Spindle moulder [ ]
   E. Wood lathe turning machine [ ]
   F. Others, please, specify....

SECTION C: MACHINES, YEAR OF PURCHASE AND INSTALLMENT

7. When was these machines purchased?
   A. 1960s [ ]
   B. 1970s [ ]
   C. 1980s [ ]
   D. 1990s [ ]
   E. 2000 and above [ ]

8. When was it installed?
   A. 1960s [ ]
   B. 1970s [ ]
   C. 1980s [ ]
   D. 1990s [ ]
   E. 2000 and above [ ]

9. Who installed these machines?
   A. Qualify contractor [ ]
   B. Chief technician [ ]
   C. Team of technicians [ ]
   D. A mason [ ]
   E. Mason and Technician [ ]

SECTION D: MACHINE OPERATION

10. Have you been trained to operate a woodworking machine?
    A. Yes [ ]
    B. No [ ]

11. Is your machine sufficiently guarded to promote safe working condition?
    A. Yes [ ]
    B. No [ ]

12. Is the saw cutting blade fully enclosed to prevent contact made with moving parts of the operator?
    A. Yes [ ]
    B. No [ ]

13. Are you aware of the risk in woodworking machines?
    A. Yes [ ]
    B. No [ ]

14. Were you provided with devices to protect your ear?
    A. Yes [ ]
    B. No [ ]

SECTION E: MACHINES LAYOUT ARRANGEMENT

15. Does your machine have sufficient space for operation?
    A. Yes [ ]
    B. No [ ]
16. Are you aware of any safe working practices of woodworking machines?
    A. Yes [ ]
    B. No [ ]

17. Does the machine you work on have sufficient space to work around?
    A. Yes [ ]
    B. No [ ]

18. Is the machine well installed?
    A. Yes [ ]
    B. No [ ]

SECTION F: HEALTH HAZARDS THAT MACHINE OPERATORS ENCOUNTER

19. What is the noise level of the machine you are working on?
    A. High [ ]
    B. Very high [ ]
    C. Low [ ]
    D. Very low [ ]

20. Is the noise excessive to affect your hearing?
    A. A. Yes [ ]
    B. B. No [ ]

21. How long do you continuously work on a machine in a day?
    A. 30mins [ ]
    B. 50mins [ ]
    C. 60mins [ ]
    D. 80mins [ ]

22. Were you provided with personal protective equipment?
    A. Yes [ ]
    B. No [ ]

23. Which type of device was provided?
    A. Respirator
    B. Ear Protector [ ]
    C. Overcoat [ ]
    D. Goggles [ ]
    E. Gloves [ ]
    F. Nose Musk [ ]
    G. Safety Boots [ ]

24. How often do you use hearing protection whenever you operate a machine?
    A. Always [ ]
    B. Sometimes [ ]

25. Did you experience ringing or other noise in your ears?
    A. Always [ ]
    B. Sometimes [ ]
    C. Never [ ]

26. Have you been taught about the effects of hazardous sound on hearing?
    A. Yes [ ]
    B. No [ ]

27. Do you use respirators or nose mask to control wood dust?
    A. Yes [ ]
    B. No [ ]

28. Which of the following sickness do you experience after exposure to wood dust?
    A. Skin Irritation [ ]
    B. Asthma [ ]
    C. Sneezing [ ]
    D. Rashes [ ]

SECTION G: MAINTENANCE PRACTICES IN WORKSHOP

29. Do you have any maintenance plan for your machine?
    A. Yes [ ]
    B. No [ ]

30. If "Yes" what type of maintenance do you use?
    A. Corrective maintenance [ ]
    B. Shut down maintenance [ ]
    C. Replacement maintenance [ ]

31. How often do you clean the machine after use?
    A. Always [ ]
    B. Sometimes [ ]
    C. Never [ ]

32. Is the machine only maintained when there is break down?

A. Yes [ ]

B. No [ ]

33. Is there a periodical check on the machines for corrective measures to be taken?

A. Always [ ]

B. Sometimes [ ]

C. Never [ ]

34. Do you grease or oil moving parts of the machines often?

A. Yes [ ]

B. No [ ]

35. Do you periodically check on all machines essential if efficient and trouble free performance to be maintained?

A. Yes [ ]

B. No [ ]

36. What type of lubricant did you used?

A. Machine oil [ ]

B. Neat oil [ ]

C. Dirty oil [ ]

37. How many times do you sharpen your cutters?

A. Daily [ ]

B. Weekly [ ]

C. Monthly [ ]

D. Quarterly [ ]

38. Who normally repair your machine in case of damage?

A. Workshop technician [ ]

B. Hire qualify woodworker [ ]

C. Electrician [ ]

D. Mechanical technician [

Kumasi technical institute (KTI) carpentry/joinery workshop

A well-organized KTI wood workshop

A well-organized KTI wood workshop

A well layout workshop at Kumasi technical institute

Badly exposed circular saw machine – Kwadaso layout

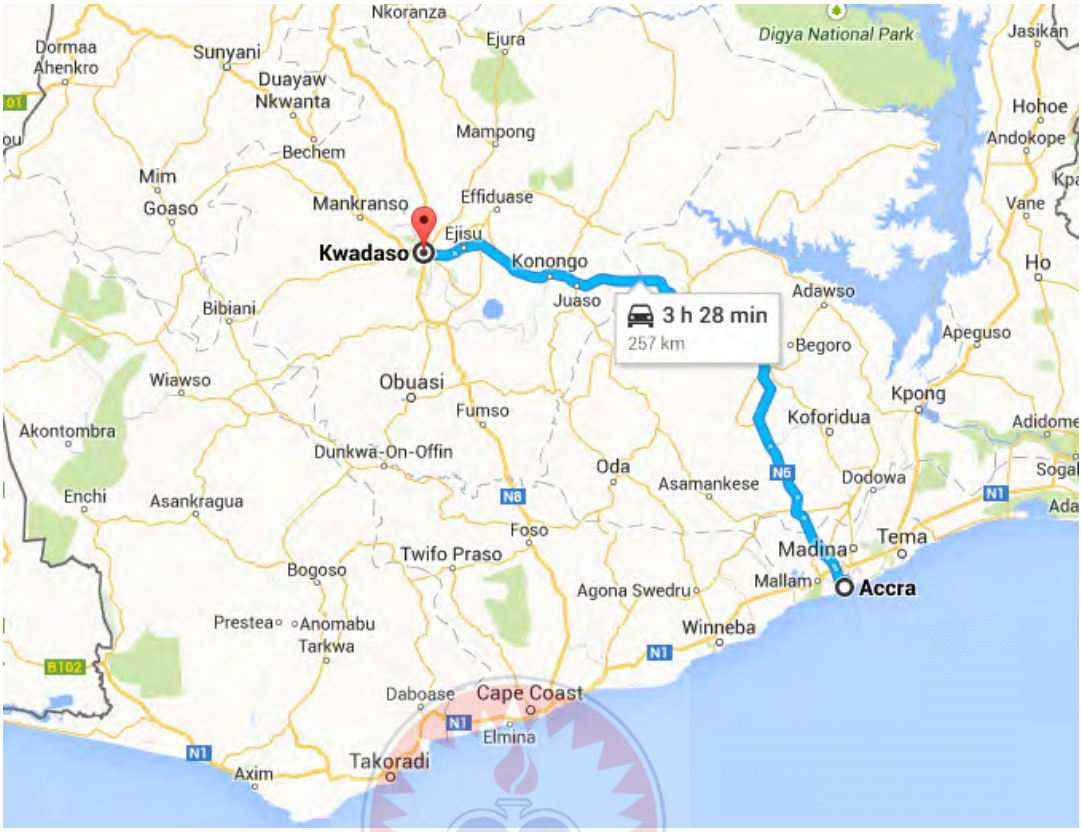
A heap sawn dust around push bench saw – Kwadaso

Pile of processed lumber surround the machine shop making the place unsafe to work

A heap sawdust and processed boards around circular saw machine– Kwadaso

A heap sawn boards around circular saw machine– Kwadaso

Badly machines shop layout – Kwadaso



Map direction to Kwadaso timber market