

MAINTENANCE PRACTICES OF THE MANUFACTURING INDUSTRY.

By

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DECLARATION

I hereby declare that this submission is my work and that, to the best of my knowledge and belief, it contains no material previously published or written to a substantial extent has been accepted for the award of any other degree or diploma at Kwame Nkrumah University of Science and Technology, Kumasi or any other educational institution, except where due acknowledgment is made in the thesis.

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ABSTRACT

In order to ensure that a manufacturing company is able to achieve the optimum productivity and equipment reliability, an effective maintenance system must be implemented. This research formulated the maintenance strategy which leads to the deployment strategy for the development of maintenance personnel in manufacturing companies. It is necessary to understand the current maintenance practice in manufacturing industries and to establish the extent to which companies invest in developing its maintenance teams through employee development. An effective maintenance requires an understanding of the link between the maintenance and the effective maintenance practices and the challenges practitioners face. As such, there is a need for empirical research on the maintenance practices strategy for the development of maintenance personnel incorporated within the company's maintenance strategy. The commitment of top management plays a very important role in the implementation of maintenance strategy; most of the problems encountered in maintaining the machines and equipment are closely related to the human aspects, that is, maintenance personnel; higher the utilization of proactive and aggressive maintenance, better the improvement of equipment availability that could be expected; by conducting an appropriate and good training implementation, a better improvement of equipment availability could be achieved, there is higher improvement of equipment availability in the company which uses in-house maintenance. This work explores the maintenance practices in selected companies from Kumasi, Accra, Tema and Takoradi registered with the Association of Ghana Industries. A questionnaire was designed and administered. It involved carrying out a postal-survey questionnaire which examined and analyzed the maintenance implementation and the nature of problems and difficulties faced by the maintenance personnel in performing their tasks and activities. Data collected was analyzed using the MS Excel and SPSS software packages. A comparative study has also been carried out, as well as the correlation between variables measured which relate to the performance of the company.

Keywords: Maintenance, practices, manufacturing industry

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DEDICATION

This thesis is my dedicated to my beloved wife and, my children, my brothers, and all my family. My very sincere thanks and gratitude to my beloved spouse Diana Kotey Fletcher and my children Prince Kofi Nhyira Fletcher, Dag Heward Kweku Fletcher and Christolite Abena Fletcher for their continuous support and encouragement, who have always provided the balance between work and play.

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CHAPTER ONE

INTRODUCTION

1.0 Introduction

The primary goal of this section is to present a research subject and clarify the objectives of the job, which is based on a study of the management methods of stakeholders in infrastructure maintenance projects in plastics production sectors. A comprehensive introduction to the context of the studies discussed in this study is accompanied by an overview of research issues and research objectives. To this end, this section discusses the research strategy used in this study and the relationship between history and theory. A description of the importance and contribution of this study is then presented, followed by an overview of the structure of the thesis.

1.1 Background to the Research

Manufacturing sector is regarded by most countries to be important for the development and spread of riches and for enhancing labor productivity. As international competition has risen considerably, the capacity to compete in all aspects of product manufacturing is essential for modern manufacturing. As demand from the market increased, the demand for greater quality products, quicker distribution and competitive prices resulted to the growth of a manufacturing scheme that improved the maintenance of infrastructure to remain in company. However, an effective maintenance system must be put in place to ensure that the company is able to achieve optimum productivity and reliability of the equipment. However, the maintenance function plays an important role in the ability of a company to compete on the basis of cost, performance and reliability. It is very essential to understand that maintenance

adds importance to final products, that it contributes to a reliable manufacturing capability and that it should be used to accomplish company objectives. Maintenance must function in a proactive manner in order to make the factory more profitable (Amoako-Gyampah et al.,2001).

1.2 Problem Statement

Some studies have been done on maintenance practices in the manufacturing industry in Ghana. General data is readily available on the place, goods and operations of manufacturing firms. This however, does not provided enough data on the maintenance operations conducted within the sector (Amoako-Gyampah et al.,2001). Adejuyigbe, (2006) states that certain level of maintenance operations is taking place within the sector but do not provide enough information; for instance, the sort of servicing approach employed, the machinery and technique used, the role of maintenance manager, instruction and paperwork, among other. This generally leaves many maintenance persons with difficulties.

The manufacturing industry in Ghana lacks infrastructure maintenance, so the manufacturer is not guided by recommendations or service strategies. This cost companies' huge sums of moneys yearly or in fiscal terms and has hindered their growth and development. This is associated with the low nature of infrastructure maintenance work, absence of morals in maintenance viability, obliviousness to comprehend upkeep work, unpracticed and untalented laborers and labor, absence of supervision from pioneers, delays in fixing and supplanting resource, disappointment of the administration to give clear approaches and gauges to direct the maintenance staffs, deficient data of support, and absence of pledge to upkeep plan (Adejuyigbe, 2006).

The component of support culture is typically disregarded by a large portion of the association in plastics and consumable goods business. This is on the grounds that; they don't know about the necessities of support culture to be executed inside the upkeep exercises. There is no methodology to do maintenance tasks that make it conceivable to set up security and well-being measures at work and ecological assurance (Pérez, 2018). Quality experts don't control support work. There is no computer-assisted maintenance support framework, absence of assets, poor specialized state of the machinery. Poor preparing and expert preparing framework as they don't contain explicit activities relying upon the necessities of the administration and execution of upkeep (Pérez, 2018).

Along these lines, to explain the issues emerges, the infrastructure maintenance should be executed by the assembling association to expand the nature of upkeep work. Infrastructure Maintenance is interesting for every organization, consequently the organization should be advanced to meet the changing in the market requests and patterns. The infrastructure support ought to be actualized in the association to change the mentalities and frames of mind of upkeep group. The support arrangement has a general concentration and does not mirror its central goal in every one of the procedures. The general cost control framework considers the support inside other cost focuses and does not investigate the monetary status of the upkeep territories. There are no gauges that control, methodologically, crafted by upkeep the executives. Poor culture at work with the methodology and norms accessible (Pérez, 2018).

This work sought to ascertain the effective maintenance practices adopted in the Ghanaian manufacturing industry and the difficulties their encounter on daily basis.

1.3 Research Questions

- I. What are the present maintenance practices and safety procedures in the manufacturing industry?
- II. To what extent does best maintenance practices impact the efficiency of the manufacturing industry?
- III. What are the maintenance problems and obstacles faced by the maintenance department in carrying out their function?

1.4 Aim of the Study

The aim or purpose of this research is to investigate the current maintenance practice in manufacturing industries and to establish the extent to which manufacturing companies invest in developing its maintenance teams through employee development.

1.5 Objectives of Research

- I. To find out the effective maintenance practices in manufacturing industry.
- II. To examine the issues of maintenance personnel on performing their tasks and dues.
- III. To ascertain the challenges facing the manufacturing industry in terms of maintenance.

1.6 Justification of the Study

This study will add to information and hypothesis of infrastructure maintenance of machines, equipment's and the industrial facility. This study will likewise help specialists of plastic product and consumable goods business in Ghana to know the present condition of their machines and risks or consequences of awful routine with regards to maintenance strategies.

This study also reflects the importance of maintaining health and safety in terms of good maintenance practices for machinery and equipment.

1.7 Scope of Research

Research on the introduction of maintenance practice at the plastic product and consumable goods in the manufacturing industries, suggests a relationship between the Ghana plastic product and consumable goods industry in order to improve maintenance practices and explore new ways, building a culture of increased care aimed at improving health, safety and quality of work.

1.8 Significant of the Study

The significance of this research can be summarized as follows:

- I. It is thought that at the completion of the study, the findings will be of benefit to the manufacturing industries of Ghana.
- II. It will assist to understand the advantage of performing best maintenance practices and the importance maintenance management.
- III. The study will also be of excellent advantage to scientists who intend to embark on studies on comparable subjects as it will serve as a guide.
- IV. The maintenance strategy proposed in this study will show how a manufacturing industry can rely on its staff to repair rather than rely on external maintenance companies.

1.9 Research Methodology

The investigation includes the assurance of the degree of the connection between three factors to be specific, infrastructure maintenance, company productivity and health and safety practices.

The main sources of the secondary data include; course books, journal, published articles and the primary data is gotten from the field survey. Data gathering was basically collected using closed ended questionnaire. This research however employed quantity research concept.

1.10 Structure of the report

The subtleties of how the different chapters will follow. Chapter 2 reviews the literature maintenance, the types available, normal and current practices. Chapter 3 looks at the poll configuration received in attempted the exploration work. Chapter 4 provides details regarding the result of the outcomes.

Chapter 5 discusses the outcomes acquired. The work shows its suggestions and last ends in chapter 6.

1.11 SUMMARY OF CHAPTER

This chapter basically introduces and gives a brief idea of what this entire thesis is all about. After going through this chapter, one should at least be abreast with what the author wants to achieve. It started with the background of the study which took us to the literature around this topic. Then the problem or the gap in literature which needed to be filled was stated. The aim and objectives followed, and to achieve it the methodology and scope of the work was defined. Since every research would have some assumptions, the limitations of the research were also

clearly set out. Lastly, the importance of the research and how it would be structured was explicitly stated in this chapter.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

In effect, maintenance, engineering or designing is fundamental to the achievement of any manufacturing business. The best difficulties confronting frameworks or infrastructure improvement in plastics and consumable goods manufacturing business nowadays isn't the foundation configuration, fund or the accessibility of innovation, anyway upkeep of the foundation when conveyance (Adejuyigbe, 2006).

Most foundations in manufacturing item creating are in condition of dilapidation because of absence of framework upkeep. One of the huge to an organization's prosperity is a quality maintenance division that can be relied on to find methodical blemishes and suggest strong, down to earth arrangements (Adejuyigbe, 2006).

Duffuaa et al. (1999) Characterize maintenance as the blend of exercises by which plant or an infrastructure is kept in, or reestablished to, a state wherein it can play out its assigned capacities. It is a significant factor in items of quality and can be utilized as procedure for the fruitful challenge. Thus, in creating abnormal state quality, generation plant or equipment must work inside that are achievable by auspicious support exercises. The importance of relevant maintenance has changed fundamentally in late time, because of huge increment inside the assortment and type of plant and equipment that in a manner or the inverse must keep up all through the period.

Maintenance approach and stylish view at upkeep association has developed. The progression of significant worth muddled and mechanical equipment, and apparatus that intersection rectifier to the need to achieve higher item quality, longer machine life, higher machine

adequacy and operational wellbeing, has driven the issue to upgrade foundation upkeep thoughts (Al-Najjar et al. 2001).

Infrastructure maintenance is in this manner significant help works in business, essentially as the increasingly more enormous speculation is being required in physical resources (Tsang et al., 2000). Maintenance or upkeep in enterprises in as indicated by (Komonen,2002) has two fundamental destinations, that's high accessibility of creation gear and Low support costs. These expressed objectives and the circuitous effect of support on the financial exhibition of associations have been unmistakably settled (Mobley,2004). When foundation upkeep in an association is disregarded it winds up in ever visit breakdowns that end in expensive fixes and speedier disintegration of profitable and oftentimes first-class, costly and has so much arriving at unsafe outcomes on creation. This makes a high condition of upkeep strength not exclusively interesting anyway conjointly horrendously compulsory for mechanical prosperity at all stages, and also at nationwide (Gopalakrishnan and Banerji, 2004).

2.1 Definition of Terms

Infrastructure Maintenance

Engineers usually restrict the word "infrastructure" to define fixed assets in the form of a big network; in other words, difficult infrastructure. Efforts to devise more generic definitions of infrastructure have typically referred to the network elements of most constructions and the accumulated value of network investments as assets. Infrastructure is the network of resources, where the system as a whole is designed to be maintained permanently at a defined service level by continuous replacement and renovation of its parts. In this research, the

infrastructure operates consist of injection molding machines, equipment's and factory building.

Currently, maintenance is critical to organizations today. Infrastructure maintenance is essential not exclusively to keep up of machinery, production line building, consequently to limit upkeep costs and to guarantee a protected situation to building occupant and machine administrators or operators.

The advancement of manufacturing product or item in our nation is in quick development and supplanting metal, wood and pottery items because its brilliant properties and the low costs associated with the change. The lazy demeanor of maintenance culture has adversely influenced the plastic and consumable goods assembling improvement businesses in Ghana.

Infrastructure Maintenance is a frame of mind which is unfortunately ailing in the plastic and consumable manufacturing production line, likewise poor infrastructure maintenance has turned into a broadly perceived issue in Ghana.

Infrastructure Maintenance is the propensity for normally and reliably keeping the processing plants, machines, in great and working condition.

Infrastructure of maintenance is the qualities, perspective, conduct, discernment and the hidden suppositions of any individual or gathering or society that considers support as an issue that is significant and rehearses it in their life.

The plastics products and consumable goods manufacturing industries, must develop, it is the basic that a well maintenance standard of its current facilities and machinery, should have priority.

Maintenance

English Standards Institute considered maintenance as the blend of specialized and regulatory moves made to save or secure a structure, machinery to work appropriate (Abiodun et al., 2016). Propelled Learner's Dictionary (2009) characterizes maintenance as the activity or procedure of saving an item, movement and so forth (Abiodun et al., 2016). To prevent a device or component from falling or to maintain proper functionality, perform an action that affects the device depending on the capabilities of the device.

Poor maintenance of equipment can eliminate more common equipment damage, use of production schedules and delays. Incorrectly functioning or incomplete equipment can increase the speed of rejection. Inadequately kept up gear may on the other hand led to increasingly visit disappointment of the hardware, usage rate and postponing of generation plan. Equipment that is breaking down or misaligned may cause a higher piece rate.

Maintenance Culture

Maintenance culture is the qualities, perspective, conduct, discernment and the fundamental suspicions of any individual or gathering or society that considers maintenance as an issue that is significant (need) and practices it in their life. At the point when an individual or gathering has maintenance culture, they would have the frame of mind to keep up, safeguard and secure the general equipment's and machinery (Olalekan and Adejuyigbe, 2012). It is normally determined or learns through an individual making upkeep a characteristic every day practice that can be pursued and copied by other. This infers maintenance culture brings to expose the appropriation of the frame of mind of guaranteeing standard overhauling, fixes and support of working resources or built up framework to ensure their ceaseless value. In Ghana, the idea appears to be extremely new. Manufacturing firms in Ghana like Century industries

organization, Top industries, Decor plastic, and Inter plastic etc. have put such a great amount in equipment's and machines yet have not given enough thoughtfulness regarding its maintenance culture thus exceptionally low outcomes are acknowledged in the utilization of benefits. The circumstance in these firms can be credited to ineffectively prepared support divisions, deficient subsidizing for activity and maintenance, absence of extra parts, exchange of plants without enough labor necessities on ground, inadequate observing and absence of preventive and remedial support procedures. In perspective on the above mentioned, this examination tries to look at the degree to which maintenance impact execution of manufacturing product firms in Ghana.

2.2 Requirements for Upkeep Service

Favorable circumstances might exist within an efficient maintenance structure typify reduction of timeframe, improvement in all out handiness of the framework and the expanded accommodating lifetime of equipment or instrumentation, wellbeing of staff and lessening costs.

2.2.1 Minimization of timeframe

Appropriately composed maintenance timetable stops, disappointments, and thus limits timeframe.

Improvement in absolute handiness of the framework expanded handiness commonly winds up in an ascent in yield and conjointly improvement inside the nature of the item. Amplified handiness and high duty of well-kept up machines conjointly improves the spirit of labor inside the whole deal (Cook, 2003; Mishra and Pathak, 2006).

2.2.2 Expanded Supportive Lifetime Out of the Machinery

The accommodating life of machinery likewise is keen to understand the complexities of upkeep. Esteem's convincing and perfect assistance drags the instrumentation's lifetime (Mishra and Pathak, 2006; Franklin, 2008).

2.2.3 Well-being of the workforce

The irregular disappointment of operating system will result in extra faculties of harm. The right upkeep of contraption will and can thwart wounds. This guarantees the organizations, including money-related assets such as emergency clinic bills and remuneration (Franklin, 2008).

2.2.4 Lessening costs

Great servicing methods result in the improved obligation of machines among the plant. Improvement in duty conjointly winds up in the decrease in support costs. As breakdowns become less, support defrayal inside the space of materials, work, temporary workers and extra parts among others conjointly diminishing bringing about by and the large decreased estimation of upkeep (Franklin, 2008)

2.2.5 Maintenance thoughts,

Maintenance is a demonstration of putting a framework like vehicle, machine, building, hardware, plant, furniture, or a piece of these foundations in a decent condition. Upkeep is a demonstration of consistently keeping a machine, building or bit of hardware in a great working condition reliably (Tijani, 2012).

There are contrasting sorts of maintenance approach looking on the condition and application. Portrays maintenance thought because the general structure that administers the classes support activities (restorative or corrective, preventive, condition based and so forth) to be

performed. For instance, maintenance tasks are basically separated in two fundamental gatherings; restorative or corrective maintenance and Preventative upkeep (which incorporates condition-based and planned upkeep).

2.3 The Type Effective Maintenance Program

Many writers have defined distinct kinds of maintenance programs. J. Bateman, 1995, outlined three basic types of maintenance programs, including reactive (or corrective), proactive maintenance (preventive and predictive) and aggressive maintenance. Preventive and predictive maintenance are proactive strategies that allow businesses to prevent machinery breakdowns.

Some further elaborated that there are many ways to perform maintenance, and some of the formal maintenance strategies currently in vogue include the following: preventive, routine, periodic, corrective, breakdown, opportunistic, operator attention, emergency, a project (or upgrade), predictive, Reliability Maintenance Centered and Total Productive Maintenance. There are three fundamental maintenance methods: reactive, proactive and aggressive maintenance. The short descriptions of these methods:

2.3.1. Restorative or Corrective Maintenance

Is the sort of maintenance done after a disappointment has happened, and it is proposed to reestablish a thing to a state where it can play out its required capacity (EN 13306: 2001)? As per Chiang et al (2001), restorative maintenance may comprise of upkeep action which incorporates a fix, rebuilding or substitution of a segment that has experienced disappointment or that has completely separated. The test as clarified by Mobley (2002) is to watch issues that are getting down to create, before they cause absolute disappointment and to address the

shortcomings of record-breaking low potential worth. One among the advantages of embracing restorative support is that the machines aren't over kept up and machine condition isn't observed. Be that as it may, its disservices exist in the expansion of creation on time, additional time work, high estimation of extra parts in like manner as a danger of optional disappointments.

2.3.2 Preventative Maintenance or Support

The European Standard (EN 13306: 2001) characterized preventative maintenance or support as the maintenance performed at foreordained interims or as the recommended criteria and planned to diminish the likelihood of disappointment or debasement of the working of a thing. As per Wireman (1990), preventative support is any arranged upkeep action intended to improve hardware or equipment life and keep away from any spontaneous or unscheduled upkeep exercises. It is a precise way to deal with an ordinary examination completed at a pre-decided interim or in understanding to endorsed basis, proposed to lessen or ideally take out the difference in disappointment or execution of debasement of a part or equipment. The point of preventative support is proportional back the amount of disappointments and their capital use by performing expressions upkeep at a preset motivation behind occasions while not thinking about the part or hardware condition. Preventative maintenance or upkeep includes checking, testing, fixing and substitution of mechanical assembly before disappointment occurs, and is as a rule connected to muddled framework to keep away from operational disappointment especially once the disappointments' results are basic, with respect to setting, economy or security (Alsyouf, 2004; Isermann, 1997).

2.3.3 Condition-Based Maintenance or Support

As indicated by BS 3811:1993 is the sort of upkeep that is done by the need which is being demonstrated by condition monitoring. Condition – based support technique is one which depends on deterministic and probabilistic models. It makes prescient support one stride further by playing out the review in a "continuous" mode. The disappointment conduct of the framework is realistic through reasonable condition checking parameters which gives data concerning the genuine condition of the frameworks. Vibration checking, stun beat estimation, oil and flotsam and jetsam observing, and electrical flow are not many of a few existing conditions observing methods that likely could be utilized in an easy to use approach to choose the most financially savvy upkeep arrangement (Alsyouf, 2004; Wireman, 1990).

2.3.4 Unintended Maintenance or Support

Unintended maintenance alludes to the fix, substitution or rebuilding exercises performed on a machine or plant when the commonness of a disappointment to carry it to, at any rate, its base worthy condition. The errands that are within the system are most chiefly occasion determined (Mobley,2004). The significant backing machinery beneath impromptu repairs errands are predicament and interruptions (hurried to-disappointment).

2.3.5. Intended or Urgent Maintenance

This is support done as brisk or fast as conceivable or potential to carry an ineffective machine or office to a protected and operationally efficient condition. Ordinarily, disappointments that have happened and need consideration are astounding or surprising (Gopalakrishnan and Banerji, 2004).

2.3.6. Breakdown Maintenance

Additionally, expressed as fix support (Gopalakrishnan and Banerji, 2004), the method upkeep is just encompassed once the machinery or framework has fruitless (Mobley, 2004). During this arrangement of upkeep less concern is given to in activity states of basic plant apparatus, the primary center is anyway rapidly the machine might come administration. This procedure, nonetheless, is each ineffectual and furthermore the costliest. The worth worried on using this maintenance framework is at least thrice that of the arranged or planned maintenance frameworks (Mobley, 2008a).

Other upkeep sorts underneath the impromptu support framework are revamps, fixes and therapeutic.

2.3.7. Arranged or Planned Maintenance

Likewise alluded to as preventive upkeep, this procedure enhances the normal support framework and necessities the upkeep work to be arranged before. It's completed with thinking ahead, the board and records to a preset set up. Accentuation placed on equipment's needs and furthermore the normal requirements of the system. The outline is centered around suggestions made by the hardware creators. Directions for support during this framework are extra expounded and careful (Gopalakrishnan and Banerji, 2004). For the most part, all set arranged support frameworks typify exercises that arrangement, record and the board all work done to keep a plant at adequate upkeep levels. This incorporates long fluctuate thinking of and normal support stir concocting. Its utilization prompts making powerful time and value gauges and brings concerning sparing in time and cost by up the administration component (Gopalakrishnan and Banerji, 2004).

Arranged upkeep might be broken into three noteworthy support frameworks: prescient, improvement and restorative support frameworks.

2.3.8 Prescient or Predicative Maintenance

Prescient upkeep could be a support procedure that applies a standard investigation of genuine in activity states of machine, fabricating frameworks and plant the executives' capacities to upgrade absolute plant activity (Mobley, 2008d). The goal of this strategy is to pick up the adaptability to anticipate partner within reach disappointment well in time along these lines staying away from disappointments that may cause punishment costs and even produce wellbeing and security risks (Gopalakrishnan and Banerji, 2004). To accomplish this target obligation centered upkeep could be a need (Tse, 2002). This is frequently because of its usage on the applying of two procedures of observing; measurable based checking and condition-based checking.

Measurable or factual based checking could be a device in unwavering quality focused support that utilizations connected science ways to deal with see the upkeep set up (Adjaye, 1994), while condition observing could be a method of extricating information from machinery that permits the upkeep designer to point at the circumstance numerically.

Once it is viably connected, this upkeep framework will decide most of the features are geared towards the viability in addition to the strength of plant. Outcome of a prescient upkeep modified is data that should be adequately followed up on to determine its favorable circumstances (Zhou et al., 2006; Mobley, 2008d).

Other points of interest exemplify decrease in workers bringing about decrease parturient costs, work of and experienced experience which winds up in viable support done and reserve funds in consumption on associated apparatuses, offices and representatives are some of the

upsides of actualizing contracted out support (Telang and Telang, 2010). There might be a few drawbacks to executing this upkeep framework. To start with, there might be worth increment which may end in money related reserve issues. Once more, now and then, the contractual worker might be found to be bumbling and even languid when the agreement has been granted. Further, nature of the upkeep action will ordinarily be unnoticed since the temporary worker has nothing to lose when having marked the agreement. At long last, contract staff may take organization innovation and appreciates taking.

2.3.9 Contract or Agreement Maintenance

At present, there's a pattern towards re-appropriating for support administration. This is regularly because of the need for greater specialization in specialized angles, or because of the organization system of that have practical experience in key business territories (Santiago, 2010; Telang and Telang, 2010).

Identifying with this sort of methodology, associations take the resulting into the idea once agreements or contract remains composed to ensure that satisfactory nature of administrations is rendered (Santiago, 2010):

- 1 Detailed administration or requirements.
- 2 Capabilities of the providers and their quality levels.
- 3 Contracts kind and, the norms for superintendence or supervisory criteria.
- 4 Endorsement and acknowledgment of the administration rendered.

Things that create the need for temporary workers encapsulate the accompanying:

1. Where it's not monetarily reasonable to discover an upkeep division with its specialist foundation and workers.

2. Where unique approval or licenses are required before support might be finished. For instance, in instances of flames, utilization of explosives and high voltage electrical fittings.
3. Where the corporate doesn't approach save parts, even on the open market the advantages of re-appropriating upkeep exercises epitomize higher and snappier work done, presentation to outside experts and greater adaptability to receive new advances.

Factors affecting the performance of maintenance personnel in performing maintenance activities

2.4 Maintenance Ideologies

These are the mix of strategies that ensure an equipment or machine works as expected when needed. The maintenance frameworks depicted higher than are the normal ones used in most plastics item manufacturing ventures (Telang and Telang, 2010). The distinctive normal ones typify routine support, conceded upkeep, window and chance support, and so forth. Coetzee (1999) emphasizes that despite the supply of arranged upkeep practices outlined higher than there are various ways that are embraced by shifted delivering firms to change them to expand their framework support efficiencies. These exemplify Total Productive Maintenance (TPM), Reliability-Centered Maintenance (RCM) and Computerized Maintenance Management Systems (CMMS) amongst numerous others.

2.5 Total Productive Maintenance (TPM)

There are a few meanings of all out assembling support. The basic read control by a few writers is that it is an all-inclusive way to deal with the plant or equipment care, that includes the dynamic interest over the upkeep division, performing on keeping up and generally speaking instrumentation viability (Bamber et al, 1999: Mobley, 2008).

The significant target for the usage of total productive maintenance is to ceaselessly improve the supply and hinder the corruption of device and thus succeed most adequacy (Mobley, 2008j). it's a support methodology that couples the standards of upkeep, designing and all out-quality administration (TQM). The preferences picked up by actualizing this mixture upkeep methodology have made it a primary procedure to be embraced for the improvement of support nature on item and procedures (Pramod et al., 2006).It is considered by a few authors as a system that's imperative to delivering firms inside their endeavors at accomplishing a chief delivering status; a standing which can encourage them increase the upper hand in the regularly expanding global focused condition (McKone et al., 2001; Ahuja and Khamber, 2007). Once more, it encourages esteem decrease and improves quality and conveyance of upkeep (McKone et al., 2001).

2.6 Modernized Maintenance Executives Frameworks (MMEF)

Also known as Computerized Maintenance Management Systems is a mechanized administration programming whose principle point is to record an organization's upkeep history. Essentially, most computerized maintenance management systems play out the central job of expanding occupation request to cover fixes and upkeep of structures, offices and hardware just as giving an arranging office to booked preventive employment for viable

resources. They can likewise be custom fitted to get costing data for work and business-related items.

According to Nyman and Levitt (2009) it conjointly supports and encourages the accompanying:

1. Efficiency of support assets (both hourly and salaried), in this manner bringing down expense
2. Improvement of responsiveness and fix to inside partners.
3. Improvement of value duty, ability affirmation, and instrumentation up time
4. Better conveyance execution and items quality to outer partners.
5. Lower unit costs and amplified gain.

These frameworks are as of now a fundamental a piece of overseeing and prevailing resources, plant and gear support in popular delivering, offices and fix businesses (Burton, 2001). CMMS has the upside of being a framework which may work a stage for the prosperous usage of Complete Gainful Upkeep, Dependability Focused Support and furthermore the distinctive real upkeep frameworks for successful upkeep and achievement of structure objectives (Olszewski, 2008; Crain, 2003).

2.7 Reliability Centered maintenance (RCM)

This support framework could be a strategy that is reliably used to decide every one of the capacities and handy disappointments of advantages. The strategy conjointly recognizes every without a doubt cause for these disappointments then takings decide the results of those surely disappointment modes and to spot in what way those impacts sway the plant. The data gathered is then broke down to see the preeminent material support undertaking to utilize (Wikoff, 2008; Mobley, 2008).

2.8 Maintenance Staff or Staffing Training

Notwithstanding maintenance facilities, work force remains an essential asset for upkeep exercises and the board as support, regardless of development in innovation, remains an extremely staff concentrated business perform. (Pintelon and Van Puyvelde, 2006) The support workers regularly comprise of the machine administrators, maintenance specialists, mold changes, a maintenance controller, and a records representative. Every one of these workers report back to the maintenance administrator, who possibly a perceived individual from the board or any place that position isn't perceived, report back to the executives. Support staff are ordinarily had practical experience in one among the ensuing specialized fields: mechanics, electricals, gadgets, instrumentation or mechanization. Because of rapid advancement of the mechanical assembly used for assembling, it's fundamental that at whatever point new instrumentation is acquired the upkeep and in activity work force be prepared to thoroughly furnish them with the reasonable support ability.

2.8.1. Maintenance Leader

In the upkeep play out, the focal figure is regularly the support administrator. The maintenance leader is thought by a few titles regardless of the way that the perform is that the equivalent. Some of the titles exemplify building director, maintenance supervisor, senior designer, plant administrator, upkeep administrator, works engineer, plant specialist, and others. Support exercises and the board have developed so has the obligation of the upkeep chiefs. Upkeep administrators as of now have extra business and bookkeeping obligations than they need at any point had.

They're conjointly responsible for the operational, game plan and key parts of the company's support the board. Further, they're conjointly counseled on vital decisions that exemplify buys

of most recent establishments, structure approaches, and so forth (Pintelon and Van Puuyelde, 2006).

2.8.2 Machine Administrators

Machine Administrators have proceeded onward from jobs that need to operate the machines and apparatus. They mostly made to completely susceptible to the hardware's and machines that are handled in addition help inside the improvement of upkeep errands like purging, examination and oil among others. They conjointly take part inside the meaning of adjustment and plan of hardware moreover, they encourage the definition of support plans. (Santiago, 2010)

2.8.3. Maintenance Professionals or Executives

They are responsible for the resulting upkeep errands: support of hardware's and establishments in their division, take care of crises which will happen and analyze issues moreover as offering help to administrators. They're in fact poly-utilitarian and have a method for having a place with the activities" group; they approach the vibe of the procedure (Santiago, 2010).

2.9. Workshop

It is fundamental that every organization that completes upkeep puts aside an area, unremarkably alluded to as a workshop. This could be any place machines and hardware's are fixed. The workshop's important clients epitomize the upkeep director, the central architect, who is stresses with the assembling for capital and undertaking work and in the end clients from outside the organization. Inward demands, requiring the utilization of the workshop are

normally directed towards administrative upkeep or the central designer, regarding one responsible.

Ensuing the motives for an imperative to the support division is termed workshop (Mishra and Pathak, 2006).

1. A zone that any placed machinery and creation of segments for crisis upkeep fixes can happen and the necessary fragments are not accessible within the store stocks. This encourages the decrease of down time all through crisis fixes.
2. It is conjointly the spot for the machining and manufacture of parts for arranged support any place gear's ought to have stripped down for distinguishing proof, rectification, change and potential substitution of flawed components.
3. It is conjointly where, for a couple of enormous firms, capital development works that epitomize the assembling of authority generation machines are planned by the organization. This development ought to be done in-house to successfully watch mechanical mystery.

2.10 Health Safety and Environment Executive

Safety executive is the assessment and execution of activities planned for controlling peril events. Wellbeing the board energizes two huge thoughts: secure spot and sound individual ideas. The protected spot thought tries to charge the supervisor to ensure that the material parts of the activity are secure and without risk of damage thinking about worthy wellbeing measures.

The safe individual thought elevates usage to receive ways to deal with shield individuals from over the top hazard presentation by offering private defensive gadgets (Melomey and

Tetteh, 2011). Surprising occasions can happen all over the place and a post-existent security framework prompts unavoidable, undesirable and pointless wounds.

There is a conviction that raised paces of computerization have brought about a comparing ascend in wounds. The individuals who hold the view clarify that mechanization has improved the proficiency of machines which has prompted some thoughtlessness of the machine administrator and upkeep workers. A few forewarnings are available before a mishap happens. Whenever noticed and thought about, these forewarnings can help maintain a strategic distance from avoidable mishaps. To unveil events for exhaustive request to maintain a strategic distance from these mishaps can be profoundly exorbitant (Gopalakrishnan and Banerji, 2004).

Mishaps include people or equipment and frequently bring about damage, misfortune or mischief. The psychological and enthusiastic encountering the individual in question feels can't be measured in money related terms on account of the people included, aside from the misfortune, inability or agony. The harm, restorative, legitimate and remuneration expenses can be huge for the business. Different costs that the business may bring about incorporate expenses of a fix or potentially substitution and expenses of enlisting and preparing, particularly in situations where the harmed laborer must be substituted (Gopalakrishnan and Banerji, 2004).

A few examinations demonstrate that in a business there is a cozy connection between the unwavering quality of benefits and the wellbeing of representatives. In this way, security the executives have turned out to be one of the huge factors in modern administration today. Even though the present system makes wellbeing a mutual obligation of all staff, the support division has quick responsibility for the execution of the program (Dabbs, 2008).

Breakdown of machinery spots staff in awkward positions and especially when the company's upkeep approach is responsive in nature; support staff regularly prefer to take alternate routes trying to get the gear working. This intercession reveals them and improves the likelihood of damage (Franklin, 2008). While support workers are likewise presented to a wide scope of dangers that can be physical, organic, and even psychosocial.

They might be in peril of:

1. Creating, musculoskeletal sicknesses by working in awkward stances and some of the time in horrible conditions, for example, extraordinary warmth or cold.
2. Asbestos presentation while saving antiquated houses or modern facilities.
3. Electric shock in restricted zones.

Unforeseen events, for example, slipping or being struck by equipment or the hardware being coincidentally turned on (osha.europa.eu)

In this manner, wellbeing the executives is a noteworthy factor in manufacturing the board for the two employers and staff. It is management's obligation to ensure that a security arrangement exists and is clung to. To ensure that the business benefits totally from security tasks, it is respected for top administration to build up a wellbeing society and furthermore set up an inside security agent to help the culture's activities. It is noticed that the security culture is most productive when it starts from the top order and works its approach to every last one inside the association (Gopalakrishnan and Banerji, 2004).

Ventures have turned out to be basic to make wellbeing the executive's frameworks and train security specialists to maintain a strategic distance from and control mishaps, wounds, infections, and other similarly harming events in organizations (Melomey and Tetteh, 2011).

Another approach to guarantee wellbeing is to normally prepare staff in security techniques. This apparatus is generally utilized for fundamental preparing and reskilling. Test systems have the advantage of having the option to reenact unmistakable sorts of emergencies that a representative may experience while dealing with a commonplace or confused bit of hardware, totally takes out the edge of smugness and hones the worker's faculties, permitting him aware of the dangers he would experience in the field (Gopalakrishnan and Banerji, 2004).

Ensuring phenomenal security, the executives' practices, influences, both the business and the laborer. A portion of the points of interest that the business gets incorporate decreasing medicinal services, costs and protection liabilities, avoiding of expensive devices as well as machine parts, and improving the company's working condition among others.

On the opposite side, promise to great wellbeing methods upgrades staff quality and empowers him/her to make the most of his activity and furthermore anticipates him/her from any damage that could demolish his salary potential and further keeps him from losing his winning capacity for the future (Gopalakrishnan and Banerji, 2004).

A few examinations demonstrate that there's an inside and out relationship between quality duty and wellbeing of staff in an organization. Wellbeing, the executives along these lines has turned out to be one among the imperative factors in connected science nowadays. Albeit the current worldview makes security a mutual obligation of all specialists, the upkeep division incorporates an immediate duty regarding the execution of the modified (Dabbs, 2008).

Breakdown of gear place laborers in cumbersome positions and especially once the support methodology embraced by the organization is receptive in the nature, upkeep faculty for the most part wish to take easy routes on a shot to instigate the hardware running.

This activity opens them to and will build the opportunity of damage (Franklin, 2008). Though attempt upkeep staff additionally are presented a huge assortment of perils which may be physical, organic, and even psychosocial. they'll be at the possibility of:

1. Creating framework issue through working in ungainly stances and regularly in horrible conditions like extraordinary warmth.
2. Presentation to amphibole though keeping up past structures or mechanical establishments.
3. Presentation to the hurtful impacts of synthetic operators like oils, solvents and acids.
4. Mishaps like falling or being hit by hardware or the apparatus being exchanged on unintentionally (osha.europa.eu).

2.10.1. Safety Associated Laws

Because of the significance of wellbeing there are universal laws founded by global bodies to control, direct and sporadically survey and update wellbeing and security laws over the world. The Global Work Association, Worldwide Work Association is one the universal bodies that advance the usage of wellbeing and security at working environments. Global Work Association show a hundred and fifty-five, section ii, article four expresses that "each part will, inside the light of national conditions and pursue and in conference with the premier agent associations of businesses and staff plan, actualize and sporadically survey a reasonable national arrangement on action wellbeing, action wellbeing and furthermore the working environment" (Adonteng, 2011).

2.10.2. Industrial Wellbeing and Safety in Ghana

There are at least nine legislative organizations upheld by differed acts, built up and ordered among the nation to ensure that working environments are sheltered. Prominent among them for elements of this exchange are the consequent (Annan, 2011).

2.10.3. Ghana labor Commission

This body gets its forces from the Work Demonstration 2003, Act 651 to oversee mechanical relations and laborer prosperity at working environments.

2.10.4. Department of factory Inspectorate

This is a legislative office sceptered by Act 328, 1970 and accused of ensuring that shops, workplaces and manufacturing plants in Ghana adjust to wellbeing and security models in Ghana.

2.10.5. Ghana Standards Board

Enabled by the guidelines Pronouncement, 1973, the Ghana Principles Board is charged to line standard and inspect stock for adjustment to the set models inside the nation.

2.10.6. Ghana National Fire Service

Controlled or Fueled by the Ghana National Fire Service Demonstration of 1997, Act 537, this office is accused of the obstruction and the executives of undesirable flames.

Security the executive's practice has not completely created in Ghana and has been confined to process and installment of remuneration to staff who are harmed through unexpected occasion (Melomey and Tetteh, 2011).

Annan (2011) reports that even though Ghana could be an individual from the 183-part nations of the Global Work Association it's not been prepared to sign the Worldwide Work Association show a hundred and fifty-five, 1981 so the state has no settled expert committed

to action wellbeing and security at national level as demonstrated inside the R164 Word related Wellbeing and Security Suggestion, 1981. extra altogether, despite expanding modern venture, it doesn't have a far-reaching national wellbeing and security arrangement. Once more, it's not got any regulative body entrusted to create, screen and manage wellbeing and security norms and pointers crosswise over businesses. Or maybe, the action wellbeing and security lawful necessities are divided beneath totally various purviews.

Another report is absence of information of those regulative offices and furthermore the related legitimate structure by laborers. Subsequently, their powerlessness to demand for suitable working conditions at their changed working environments or get activity if the solicitations are denied. These difficulties, in addition to absence of financing for watching exercises, qualified laborers, relevant gear's and standard methods of inclusion mishaps have debilitated the adaptability of the state and its organized organizations, all in all, to successfully and quickly institutionalize, screen and control wellbeing and security exercises in businesses in like manner on adjust to universal wellbeing models.

2.11. Maintenance Efficiency Measure

The accomplishment of an organization relies upon the viable use of its workforce and assets. One among the preeminent destinations of an organization is to be prepared to utilize the capability of each laborer for the upside of an individual in like manner as that of the association. The principal basic idea during this respect is to recognize the parameters that may live upkeep execution. These parameters are used in producing an upkeep examination file. Information picked up from the translation of the record is viable and builds up a

connection between upkeep execution and cost. This information is indispensable for the board choosing (Mishra and Pathak, 2006).

The principle points of interest of the assessment are improved support execution and lessen in labor costs. Furthermore, adequate assessment of maintenance operations promotes the detection of the causes of unnecessary performance defects that are duly decreased.

Komonen (2002) highlights the need for maintenance efficiency measurement to demonstrate the effect of maintenance as a feature on the general objectives of the company. Execution proportion of machine or instrumentation execution would adjust high administration to check support perform sway on company's matter of fact (Sherwin 2000).

Execution of machine or equipment is estimated with respect to clearly laid out company's goal. The broadly grouped support marker estimates gear execution, per it accessibility, duty and in general hardware adequacy (Eti et al 2006, referred to in Campbell 1995). In general gear Adequacy could be a benchmark used in first support projects, and measures instrumentation execution which chips away at the far side basically handiness or machine period (Morbly 2002).

2.12 Executives Support

When all is said in done, the objective of any organization is to broaden gain by giving quality item, brief or complete administration in like manner as quick conveyance. In today's focused business, been prosperous for the most part involve anyway well an organization is in a situation to shape revision and adjust to those progressions fleetly. This might be viewed as a strategy of tending to out-deliberate or superannuated social control approach and various styles of social control rehearses.

As indicated by (Wireman 1990) Upkeep as a help perform along the edge of value the executives might be an impetus during this respect in two noteworthy ways that, for example by diminishing the benefit of running plant and machine though conjointly expanding capacity. Consequently, with the extension of motorization and computerization, that imply that component may come up short at some random time bringing about intruded on tasks, handiness and duty turns into a watchword.

Al-Najjar (2007) communicated that organization should be prepared to use its important and uncommon assets speedily and successfully to understand the long high addition, disregarding that planned, outside-in (for example outer components, such as ascending of firms, organization and market structure) and wrong-side-out (for example inward factors, similar to company's assets, capacity and separation) that's received or implemented by the company's administration. furthermore, the carelessness of upkeep and its job underway procedures licenses quick corruption of machine and its resultant item quality.

2.13 Maintenance of Organization

Support association in venture with Kelly (1984) might take partner boundless assortment of structures, the best for a chose situation being controlled by orderly idea of things as upkeep outstanding task at hand and its example, estimation of detachment, area of plant, amount of crisis works, generation association and upkeep assets. Kelly (1984) extra unequivocal that in a few cases the issue is one among accomplishing the ideal harmony between plant handiness and support asset use. The overwhelming considers the arranging of an upkeep association is detachment esteem. Upkeep association might be contemplated as being made of three basic and interconnected components for example:

1. Assets - work force, spare parts and devices, of a chosen size, structure, area and development.
2. Organization - a chain of importance of power and obligation regarding choosing what, when, and the way work should be apportioned.
3. Stir concocting and framework - a component for thinking of and programming the work and sustaining back information that is required if the upkeep exertion is to be appropriately coordinated towards its laid-out goal.

2.14 Objectives of Maintenance Organization

Assistance or generation structure in venture with Kelly (1984) could be an unremittingly developing creature inside which the upkeep association can might want ceaseless alteration because of regularly evolving interest. Wireman (1990) extra expresses that appropriately vital the kind of support association is affected by the objectives and targets of the upkeep association. The most assignment of a support association is to coordinate support assets to the upkeep work with the mission to achieve and continue ideal handiness. the ordinary objective and targets for a support association incorporates;

Most extreme creation of the offices at unsurpassed low worth, most astounding quality, wellbeing measures (by keeping up existing instrumentation and office) and furthermore the audit, matching of device and offices in like manner as establishment and adjustment of contraption.

Distinguishing proof and usage of significant worth decrease inside the sort of discovering ways that to diminish costs identified with upkeep and activity. for instance, looking at support rehearses, bound change might be made in apparatuses, preparing, fix method and stir thinking

of, will downsize the amount of work or material which will be expected to play out a specific employment. Gathering essential support esteem information. for instance, esteem that are identified with work, material, device, contractual worker in like manner as different worth. Enhancement of support assets, for example making the chief with the current assets, that is essential in support because of exclusively couple of upkeep associations has a few work force, material, or instrument available to them. moreover, limiting stock reachable is furthermore essential since upkeep save parts represent four-hundredth of the entire support spending plan.

2.15 Viability of Maintenance Organization

For a support division to meet its job speedily, it's essential to have an enterprise that is adjusted, defended and beneficial to oversee and the board in pointlessness of exercises (Gopalakrishnan and Banerji, 2004) to achieve this target, bound elements would must be expected idea. (Gopalakrishnan and Banerji, 2004):

2.16 Team Spirit

The association or company comprises of people and it's knowing bring them along to figure as a group. This might be through with age and sustenance of association. Any place association exists work is finished just with next to no disarray.

2.17 The Plant Engineers

It is reasonable authority that may bring people along and ingrain in like manner as support the required association that may urge the group to figure. The stress of propping the

association up lays on the shoulders of the plant/upkeep engineer. Fundamentally, the person should be in fact equipped, educated and cost intensely mindful to be and productive pioneer of the group; and may even be prepared to plug all escape clauses that reason misuse of your time, ability and vitality.

2.18 Mindset

All support offices ought to have a way of thinking and approaches to deal with its exercises. These ought to be reflected genuinely and truly by the deeds and activities of everyone among the division.

2.19 Strategy

When a way of thinking has been received to be utilized, the arrangements of the association should be archived to be utilized. These arrangements should be obviously comprehended by its clients as pointers for client joined countries office falls among its structure. Strategies is additionally formal or casual and got the chance to be frequently evaluated, surveyed and refreshed to duplicate the regularly changing exercises of the division. Strategies may cowl issues like support of plant, hardware pay and long periods of work among others.

2.20 Length of the board

To maintain a strategic distance from squandered specialist exertion and absence of viable viewing there should be a moderate numerical extent between the chief and furthermore the managed. {this is this is regularly this will be} because of there's a breaking point to the amount of people a private can oversee adequately.

Given the character of work and levels of the people being administered it's fundamental that the quantitative connection is appropriately resolved to streamline the superintendence time, specialist ability.

2.21 Improvement of Subordinates

Man is that the most fundamental gear-tooth inside the wheel of the apparatus of generation and ought to be taken care of with most extreme affectability and care. representatives ought to be prepared and regularly refreshed on current support practices to oversee and keep up the confounded machines used in vogue delivering (Gopalakrishnan and Banerji, 2004). Today, a legitimate support expert ought to at present be prepared in: computerization, instrumentation, physical science, power, hydrodynamics, pneumatics, mechanics, modern security, quality, figuring, and language abilities, other than the exact information of the technique, that is critical to get a handle on the activity of regardless of he ought to look after (Santiago, 2010). For the most part, the less taught and capable the representative is that the extra superintendence he would wish. when extra edified subordinates are left without anyone else they tend to improve in their development and advancement (Gopalakrishnan and Banerji, 2004).

2.22. Maintenance Assets

Upkeep assets incorporates work force (labor), save segments, specialized information/information, investigate hardware/devices, financing and so on that are offered or accommodated the point of support activities.

➤ **Labor or Manpower**

This may apparently characterize in venture with the specialized space inside which it's used (mechanical, electrical, instrumentation, and so forth.), it will however be extra separated in venture with specialty (welder, prepared laborer, and so on.). Since support work chiefly will in general need more than one specialty, the higher than classification is finished on the reason of the most art substance to each activity.

1. Spare parts

Accomplishing ideal harmony between the benefit of requesting and holding (devaluation, intrigue charges, rental and so on.) and cost of stock out (loss of offers because detachment, transitory lease charges and so forth.) is that the goals save segments association should address. the most issue in venture with Kelly (2006) emerges from the inconstancy and nature of thousands of different things (of wide fluctuated worth, lead times and use rate) required continuing an ordinary activity.

Testing hardware/apparatuses - although it's equivalent to the objective of extra parts association, anyway the matter of the executive's contrasts because of devices aren't inside a similar sense nonessential. the most undertaking yet with returnable devices is that the advancement of a framework for watching their credit and keeping up or replacement them if essential once came.

Specialized information/information - this typify all report, inventories, manuals or drawing that may encourage upkeep work or activity. this might be ordered into training, reference, guidance, programming and the board.

2. Productive maintenance

As indicated by Al-Najjar (1997) is that the live of what amount of the made of upkeep arrangement is monetarily useful inside the whole deal whereby two things (previously and when support improvement) is contrasted and the usage of a measurement less quantitative connection. By and large, the improvement of a support approach execution plan to downsize cost though expanding increase and battle of the corporate through upgrading technique handiness, execution power and quality rate (Al-Najjar 2007).

3. Upkeep in Developing Nations

Upkeep work relies upon the adaptability to disentangle drawback, the center piece of support abilities in this manner is information of the instrumentation and its method of disappointment (Gasskov 1992). In most creating nations, accept African nation for instance, breakdown support has proceeding to triumph in for all intents and purposes every endeavor each non-open and open. also, vitality to present or execute preventive upkeep has been ruined by the negative idea of the worth concerned. According to Eti et al. (2004), the confused feeling concerning support in African nation is that generally, the board of firms views upkeep as partner cost that may basically be diminished in importance by and large business esteem. it's nevertheless accepted that machine ought not be checked or investigates for future breakdown why it's yet working, rather remain dormant till crisis happens. Theoretically, preventive support has the master of limiting timeframe or in a perfect world wiping out undesirable stoppages because machine/breakdown in like manner as upgrading machine handiness and obligation. In any case, accomplishing these points of interest involve an abnormal state of abilities duty although some global firms have a legitimate support approach and do give professional training program on upkeep at their own chosen focuses, that is regularly

excessively choked, in this manner not tending to the chief imperative components of (upkeep association and extra segments the board). moreover, because of the choking of the previously mentioned professional instruction, there's slighter effect on the whole deal, since upkeep has progressed toward becoming piece of the economy development in many countries.

2.23 problems and challenge facing the manufacturing in terms of maintenance

People

As we all know, the pool of available skilled maintenance technicians is very shallow and the existing maintenance workforce is aging and nearing retirement. This reality, coupled with the fact that most apprentice programs have been shuttled and training programs curtailed, has created a shortage of maintenance technicians that is nearing critical proportions. Finding, training and retaining skilled maintenance people is one of the top challenges facing maintenance organizations today (Dhillon, 2002).

Maintenance leadership

Effective maintenance organizations must have leadership that is able to plan, both strategically and tactically. This leadership must Production Equipment MAINTENANCE by Steve Welch, Vice President Advanced Technology Services (ATS) Have you considered outsourcing? be able to create an environment of change not commonly found in most maintenance teams. Maintenance leadership must be able to convince the team that they need to think and work differently than they have in the past. Maintenance needs leadership that is driven by results, not activity. Where is this leadership going to come from? (Dhillon, 2002).

Procurement and management of maintenance supplies

Most manufacturing companies view spare parts as very expensive, difficult to manage, and usually way out of control. Maintenance parts and supplies constitute up to 60% of maintenance spending yet most plants do not have effective plans to reduce the cost and number of parts that are consumed (Dhillon, 2002).

Tools and technology

Effective maintenance has changed significantly in recent years. Maintenance today is far more a technology based activity than it is a repair activity with need for a far greater emphasis on predicting and forecasting maintenance needs. I am convinced that no plant can perform effective maintenance without a Computerized Maintenance Management System (CMMS). If you do not measure maintenance, you will not be able to improve maintenance. It is that simple. With the remote monitoring capabilities of today's controls, catastrophic failure can be a thing of the past (Dhillon, 2002).

Processes

If it's true that 85% of all problems are process related and 15% are people related, then why do we focus 85% of our efforts on people improvement and 15% of our efforts on process improvement? Maintenance people, despite traditional stereotypes, are hardworking employees who really care about doing a great job for their company. Maintenance organizations fail, not because of people, but because those people lack the systems, process, methodologies and disciplines to be successful. Maintenance activity, without effective processes, will not work (Dhillon, 2002).

Cost

How does a maintenance organization effectively address all of the challenges of maintenance and do it in a cost-effective way? Maintenance must be able to demonstrate a measurable return on investment and must be able to justify its existence by showing how effective maintenance reduces machine downtime, reduces overtime needed to hit production schedules, improves on time delivery and improves the quality of the product. However, maintenance usually does not know how to rationalize their participation in the savings (Dhillon, 2002).

Others challenges are:

Inadequate availability of spares and ageing equipment.

Managing technical competence gap

Unplanned downtimes of equipment

Occurrence of catastrophic failure

Unjustified use of staff resources

Possibility of secondary damages to plant and equipment due to catastrophic failure.

Labor intensive

Chances of catastrophic failure cannot be ruled out

Sometimes superfluous maintenance is performed.

High frequency of maintenance

2.24 Chapter Summary

This chapter insightfully considered maintenance practices of the manufacturing industry. It brought out and firmly established the effective maintenance programmes. On that note, it set out clearly the challenges maintenance persons face in the industry when executing their mandate were discussed.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0. Introduction

The fundamental research exertion and literature review help with deciding the area that should be tended to in structuring of the execution system or framework. Following this, the most significant period of the research work comes straightaway, the choice of research methodology for gathering data that will light up the point. In this manner, it is basic to increase a decent comprehension of the issues encompassing the research technique before going into the field. The reason for this part is to give a review of research strategies and support for the choice of suitable methodologies utilized in this study to address the goals of the research. The section shows the procedure of the study. The principle themes included here, are; research design, study population, sampling procedures, sample size, sources of data, methods of primary data collection, pre-testing of questionnaire, field observation, interviews and finally, method of data analysis. This part displays the research methodology chosen that is questionnaire survey research, in explaining the research instrument and procedure, just as the measurable investigative tools and tests utilized in this study.

3.1. Research design

There are several interpretations of the study setup provided by multiple analysts or writers (Kerlinger, 1986), characterized research design as an agreement and analysis framework so conceivable as to provide responses to study issues. The scheme is an overall plan or program of studies. It includes a design of what the researcher will do by composing the speculation and its operational consequences for the most recent information or data inquiry. The framework is the program or the specification of the relationship between the variables involved in the inquiry. The study design conveys both the structure of the study problem and

the evaluation structure used to obtain experimental evidence on the relationship of the problem.

As indicated by Blumberg (2005), the basic of research design gives a rule of the sort of answer, the examination is searching for, strategies to be connected to discover them, procedures to be utilized to accumulate information, sort of testing to be utilized and by what method will time and cost imperatives be managed. As per Baker, (2001), there are three essential strategies utilized in research: observation, experimentation and research survey.

3.2. Study Population

The targeted population includes all manufacturing Industries/firms for the study such as; Century industry, Deco – plastics, Mini Plast, Kanem Plastic, Duraplast, Quality Plast, Shifa, KGM plastics, Top industry, Poly Sack Ghana limited, Plot Enterprise Ghana, Cocoa Processing Company Limited, ADM Company Limited, Cargill, Kumankoma Company Limited, Ceres Demeter and Interplast Ghana. The population is shown in the table below.

Table 3.1: population of the respondents

S/No	Location	Selected industry	Population of Employees
1	Greater Accra	Century industry,	650
2	Greater Accra	Deco – plastics	600
3	Greater Accra	Mini Plast	500
4	Greater Accra	Kanem Plastic,	750
5	Greater Accra	Duraplast,	550
6	Greater Accra	Quality Plast,	500
7	Greater Accra	Shifa,	450
8	Accra - Spintex	KGM plastics,	750
9	Greater Accra	Top industry,	650
10	Accra - Spintex	Poly Sack Gh. Ltd	600
11	Kumasi	Plot Enterprise Ghana,	350
12	Tema	Cocoa Processing Company Limited,	850
13	Takoradi	ADM Company Limited,	450
14	Tema	Cargill,	600
15	Kumasi	Kumankoma Company Limited,	450
16	Kumasi	Ceres Demeter limited	400
17	Accra - Spintex	Interplast Gh.Ltd.	580
		Total	

Source: (Ghana's industries, 2018).

3.2.1. Sample Size

A table for deciding the random size of the populations was utilized to decide the sample size for this study or investigation. The sample size was 75, a number of respondents are chosen from each company totaling 75, This shown in table 3.2 below. The sampling of respondents was done using targeting the following: the maintenance manager, machine operators, maintenance technicians, safety officer and factory manager. But some manufacturing industries do not have all the five targeted, resulting in less five respondents responding to questionnaires. this shown in table 3.2 below.

Table 3.2 Sample Size

S/No	Location	Selected industry	Population of Employees	Sample Size
1	Greater Accra	Century industry,	650	4
2	Greater Accra	Deco – plastics	600	5
3	Greater Accra	Mini Plast	500	4
4	Greater Accra	Kanem Plastic,	750	5
5	Greater Accra	Duraplast,	550	5
6	Greater Accra	Quality Plast,	500	5
7	Greater Accra	Shifa,	450	4
8	Accra – Spintex	KGM plastics,	750	4
9	Greater Accra	Top industry,	650	5
10	Accra – Spintex	Poly Sack Gh. Ltd	600	5
11	Kumasi	Plot Enterprise Ghana,	350	4
12	Tema	Cocoa Processing Company Limited,	850	5
13	Takoradi	ADM Company Limited,	450	3
14	Tema	Cargill,	600	4
15	Kumasi	Kumankoma Company Limited,	450	5
16	Kumasi	Ceres Demeter limited	400	3
17	Accra – Spintex	Interplast Gh.Ltd.	580	5
		Total		75

Source: (Ghana’s industries, 2018)

3.3. Questionnaire advancement and organization

A questionnaire was created and used to gather data from the chosen manufacturing organizations. Closed ended questions were utilized in the questionnaire. The closed- ended questions gave potential answers from which they respondents were to select or pick.

The questionnaire or survey comprised of four (4) areas. This comprises

- Section (A) General information.
- Section (B) Effective of maintenance organization.
- Section (C) Maintenance performance measurement.
- Section (D) Challenges.

3.4. Types, Sources and Methods of Data Collection

This area introduces the sorts and sources of information or data utilized for the study. It therefore employs the different strategies for gathering data.

3.4.3. Information gathering techniques

The selection of information gathering technique, for example, email questionnaire, phone meeting and personal meeting, is noteworthy because it influences the quality and cost of information gathered. The real strategies related to subjective information gathering are meetings, perception and journal techniques, while the key strategies related to quantitative information accumulation are postal poll and, on the web, (website page based) survey studies. Every technique has a scope of choices, essentially connected to the destinations of the examination, and every ha its qualities and shortcomings. Moser and Kalton (1971) depicted five strategies for information accumulation as pursues: narrative sources, perception study,

postal questionnaire survey, interviewing, mix of the above mentioned. As per Moser and Kalton, (1971) and Fowler (1984) the decision of accumulation strategies relies upon the research topic, the example outline, attributes of the example and assets. It is obviously one of the most significant choices in this study as it has suggestions for the pace of reaction, the study instrument and the study cost.

3.4.4. Objectives of survey

A survey is an efficient strategy used to gather information from more than one source to respond to at least questions commonly masterminded on a form of questionnaire. The objectives of the survey are: to accumulate data on the organizational qualities, the support practice, the issues experienced in upkeep, preparing arranging and execution, support representative advancement.

3.4.5 Analysis of Data

The Statistical Package for Social Sciences (SPSS) software, version 23.0 and Excel spread sheets were the main instrument used to code and analyze the quantitative data derived from questionnaires. To ensure consistency. Statistical tools such as the relative importance index (RII), a pie charts, and tabulations were connotations used to depict the written interpretations of the raw data obtained. To ensure consistency, responses in the questionnaires were edited and coded. The results were presented using charts and percentages.

3.5 Data Collection

The method adopted in this survey was that of deductive approach as it is, through this method through which it is possible to reach the set of specific objectives. Scientific research in the field of education wants data to support a topic. Therefore, the data serve as the basis for any investigation (Singh, 2006). Data collection was exclusively done using a closed ended questionnaire. A structured questionnaire was administered to a sample size of 75 respondents and collected in person after the questionnaires have been filled within a specified time frame.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0. Introduction

This part shows the consequences of the overview did and their discourses in two primary areas: review results and discussions. In the principal area (section 4.1), it introduces the outcomes and investigation of the information from the overview discoveries on the present maintenance practices and preparing usage, in assembling organizations. It comprises or consists of presentation of the descriptive statistics, frequency distributions, cross-tabulations, analysis as well as the comparison study of manufacturing in Ghana. In the subsequent (section 4.2), dialogs occur that will further intricate and assess the data from the discoveries of the outcomes and examination or analysis. Section 4.3 discuss the ramifications or implication of findings of the study with respect to the objective of the study which was to establish how best maintenance practices in manufacturing industries

4.1. Results and Data investigation of Survey Findings

The all-out number of surveys conveyed was 75, of which 52 were returned finished, representing 69.33 %.

Calculation: Let R= Response Rate

$$\begin{aligned} > R/100 * 75 = 52 & & > R0.75 = 52 & & > R = 52 / 0.75 & & \mathbf{R = 69.33} \\ \% \end{aligned}$$

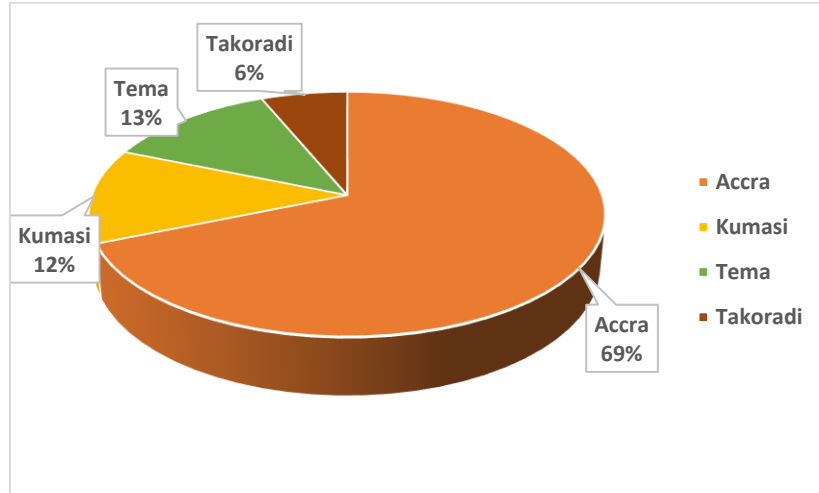


Figure 4.1 Geographical Location of Respondents

Source: (field survey, 2019)

From figure 4.1 above, out of the total respondents, 69 % were situated in the Accra, 12% were situated in the Kumasi, 13% were situated in Tema and 6% situated in Takoradi.

The research covered companies within the formal sector (organizations enlisted with the Registrar General's Department) in Kumasi, Accra, Tema and Takoradi. This decision was made on the grounds that these urban areas have the most noteworthy grouping of assembling organizations in Ghana (Frimpong Abu, 2007). Most of the respondents were from the Accra. Minimal number of respondents originated from Takoradi. Moreover, Figure 4.1 clarifies that of the respondents.

4.2 Industrial Sector of Respondents

The real sub-divisions of manufacturing caught in the review incorporate plastic packaging and production of consumable goods, shown in figure 4.2 below.

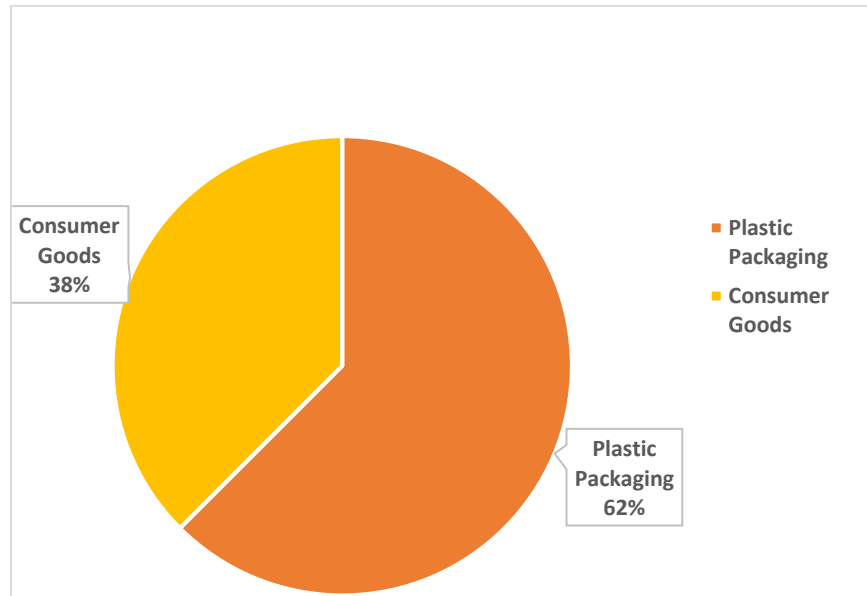


Figure 4.2 Industrial sectors of respondents in term of percentages

Source: (field survey, 2019)

Greater part (69%) of the respondents indicated classes outside the significant segments gave. These included assembling of plastic packaging and consumable products. The outcomes likewise appear (Figure 4.2)

4.1.3 Form of Ownership of Respondents

Of the companies which responded 6% are state-owned, 75% are of private-ownership, and 19% are Ghanaian joint venture.

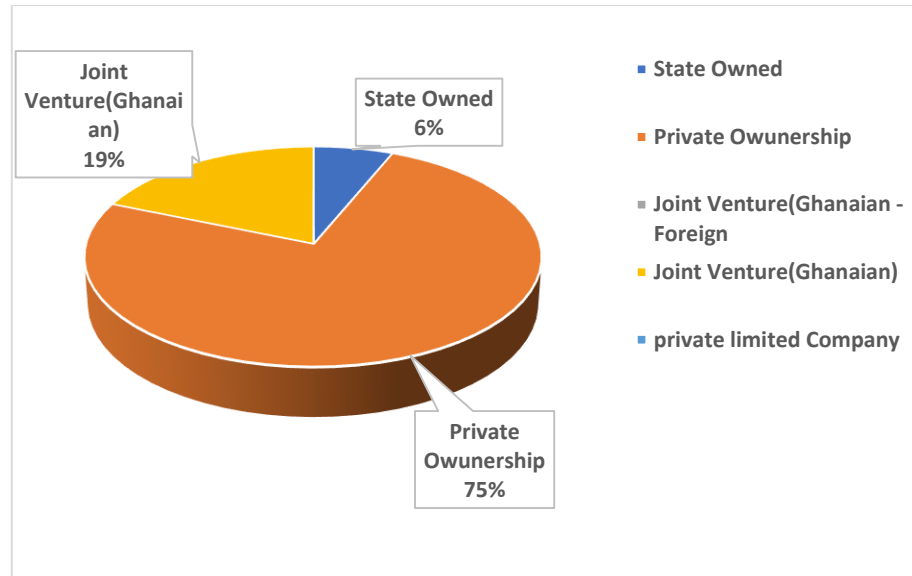


Figure 4.3 Ownership Patterns of Respondents

Source: (field survey, 2019)

Greater part of the respondent organizations is private-owned and association with assigned contact people inside these organizations. Further, the outcomes demonstrated that state-possessed organization and Ghanaian joint endeavors caught within.

4.2 Effectives of Maintenance Programme

4.2.1. Maintenance Department

The results show that 70.6% of those who answered “yes” to the question “do you have a maintenance department” and 29.4% answered “No” to the question.

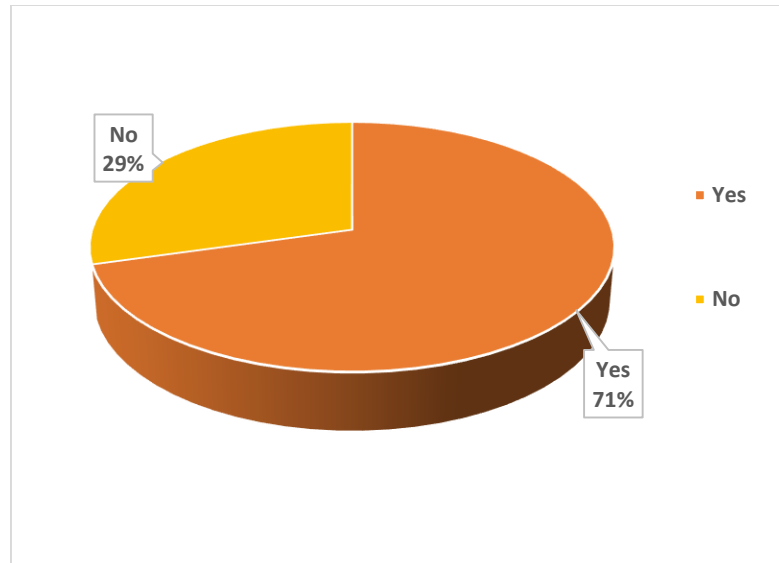


Figure 4.4 Company that Retain Maintenance Department in terms of percentage and maintenance department rate of occurrence.

Source: (field survey, 2019)

Heisler,R, (2008) recommends a decent organization is unified with successful individuals working productively together towards a shared objective. In his view, one cardinal point is for these associations to have a harmony among arrangement and practice. The outcomes acquired and connections with upkeep staff bear witness to the way that dominant part of respondents have accomplished a level of this equalization. This is claiming the administrations of respondent organizations consider support as a center capacity of their exercises and have appropriately sorted out it. As proof of this the outcomes got demonstrate that dominant part of the respondent's work is quality packages support divisions and have structures and staff inside the premises to encourage the recognition of orderly blemishes and prescribe arrangements as recommended by Damewood (2008).

Although data was not promptly made accessible it could be induced from cooperation with respondents inside the organizations that that these huge scale endeavors work this support association in light of the fact that their upkeep activities for the most part happen inside their

premises. Once more, just huge scale undertakings utilize the decentralized upkeep associations as per perceptions made by Corder (1976).

As indicated by him, this implies these endeavors have support staff nearby and furthermore at all areas of activity and the upkeep the board at all areas are autonomous of one another. For the in part decentralized support association, both medium and huge scale ventures shared equivalent rates. This implies these ventures have principle support staff inside their premises and convey groups to deal with upkeep exercises in different branches relying upon the idea of the upkeep aptitude required. Communication with the respondents uncovered that greater part clung to upkeep associations depicted. Likewise, dominant part of respondents are counseled in their upkeep offices before hardware is procured. Further connections uncovered that most respondents arrange their upkeep with the end goal that support staff could rapidly react to and give quality help to crisis and preventive support, just as occasional modifies and upgrades which as indicated by Heisler,R, (2008) is a base prerequisite for successful support associations. These pointers demonstrate that upkeep association in assembling firms in Ghana is successful.

4.2.2. Maintenance Practices

Out of the 100%,35.3% answered not very well,29.4% answered very well and 35.3% answered extremely well.

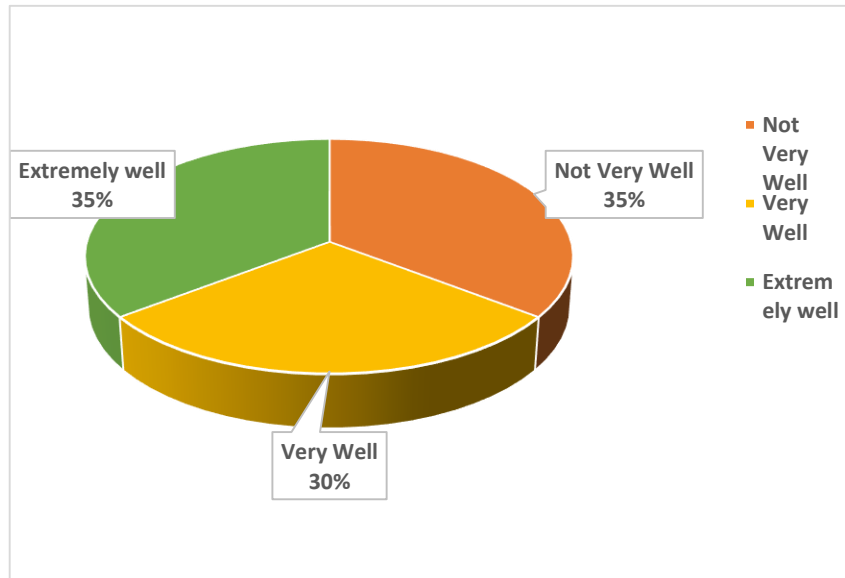


Figure 4.5 Percentages of Maintenance Practice Level and Distribution or respondent according to maintenance practice.

Source: (field survey, 2019)

4.2.3. Maintenance Store

94% of the respondent have a maintenance store and actively function.

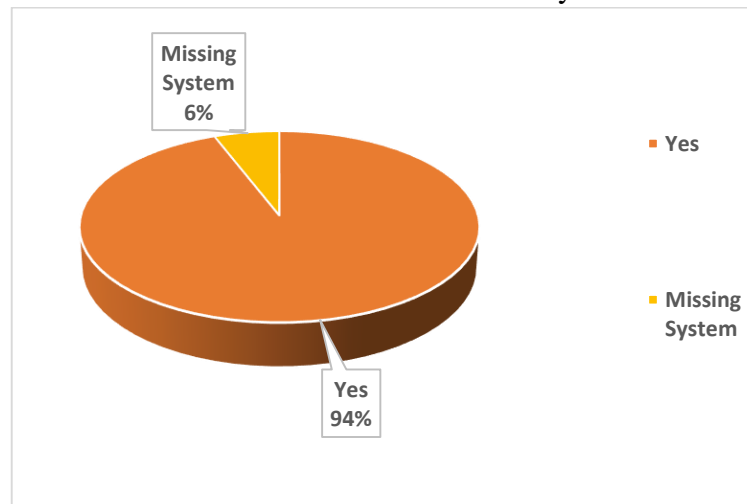


Figure 4.6 Distribution level of maintenance store

Source: (field survey, 2019)

4.2.4 Number of years of employees in maintenance department.

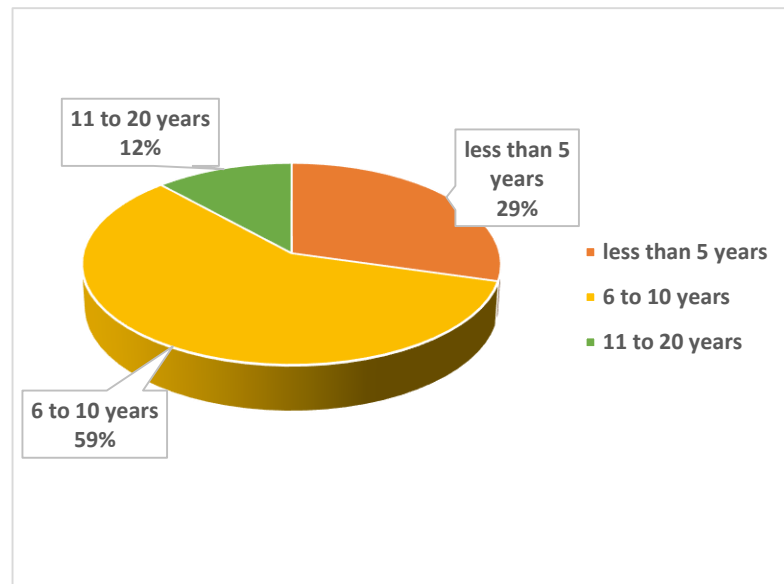


Figure 4.7 Number of maintenance employees in a department and distribution level of year of working of maintenance employees.

Source: (field survey, 2019)

4.2.5 Types of effective maintenance used in your plant

Below demonstrate the kinds of upkeep utilized and to what degree every one of them have been utilized. The outcomes demonstrate that assembling businesses in Ghana, preventive support has the most noteworthy methods esteems and most every now and again evaluated as "utilized broadly or widely", trailed by prescient upkeep.

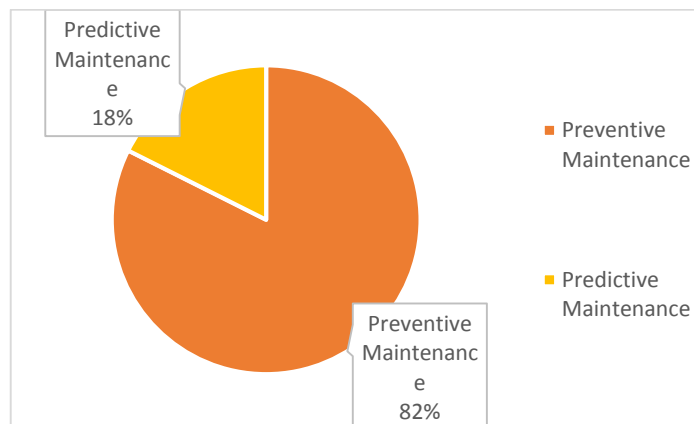


Figure 4.9 Shows the distribution of maintenance type

Source: (field survey, 2019)

4.3 Discussions

Dominant part of assembling organizations utilizes the preventive shut down maintenance framework. They likewise utilize preventive (everyday practice), prescient (condition-based) and contract upkeep conspires in diminishing request individually. The least executed support conspire, from the outcomes, is all out profitable upkeep system.

Predictive Maintenance

It is seen from Figure 4.21 that equivalent quantities of medium and enormous scale ventures utilize measurable based prescient support while huge scale undertakings structure most of the individuals who utilize the condition-based upkeep exercises. The fundamental factor which has impacted their decision is cost decrease. The respondents guarantee that utilization of the upkeep plans permits them plan better and timetable advantageously to such an extent that support activities are performed just when justified. As they would like to think, better arranging and booking create benefits which incorporate decrease of their extra parts stock, expanded plant wellbeing and machine life. These advantages just as expanded generation levels increment their benefits.

Preventive Maintenance

It is seen that respondents utilize both running and routine preventive upkeep plans. Respondent firms utilize both happenstance and shut down preventive support plans and enormous scale endeavors structure greater part of respondents who execute them. Communication with contact people from respondent firms uncovered that they utilize running, daily practice and opportunity upkeep plans since they are most appropriate to the gear which work nonstop.

Total Productive Maintenance

The Total Productive Maintenance (TPM) is the least executed support procedure. Further uncovers that the little level of respondents executing is comprised of equivalent quantities of medium and enormous scale undertakings. Reasons referred to by respondents who don't utilize it incorporate expense of execution and the idea of documentation required. TPM is considered as a significant device in endeavors expected to achieve world-class fabricating status; a status which empowers organizations to increase upper hand (McKone et al., 2001; Ahuja and Khambher, 2007) and encourages cost decrease while improving quality and conveyance of support (McKone et al., 2001). Lion's share of assembling organizations in Ghana are not in this manner encountering the advantages that could be gotten from complete profitable upkeep.

The practice of total Productivity maintenance (TPM) program and reliability centered maintenance (RCM)

The outcomes likewise demonstrate that 59% are intending to execute Total Productive Maintenance (TPM) and (RCM), simply 18% are rehearsing and 23% have no clue about (TPM) and (RCM).

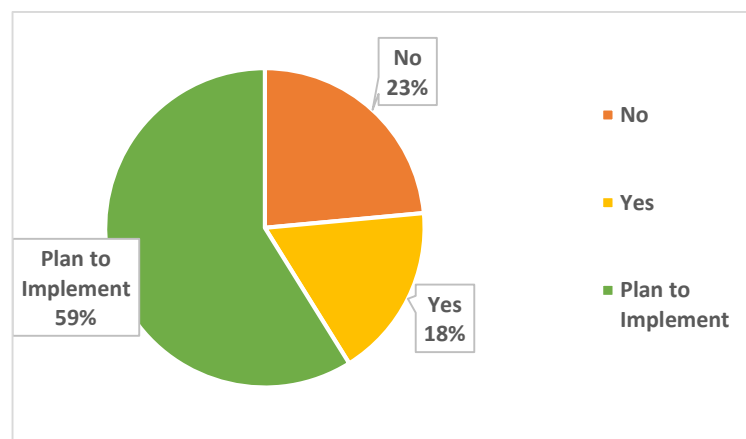


Figure 4.10 Distribution of TPM and RCM

Source; field survey (2019)

Total Productive Maintenance (TPM) and Reliability Centered Maintenance (RCM)

The outcomes likewise demonstrate that there is still absence of routine with regards to TPM and RCM among the respondents. As far as correlation, more respondents are wanting to execute TPM contrasted with RCM. The absence of routine with regards to TPM and RCM could likewise be deciphered as an absence of an "aggregate and far reaching" upkeep approach. There is a requirement for further investigation on the motivation behind why numerous organizations have not yet stepped in to use the TPM and RCM programs which have officially demonstrated to upgrade the upkeep adequacy.

4.2.7. company practice reliability centered maintenance (RCM)

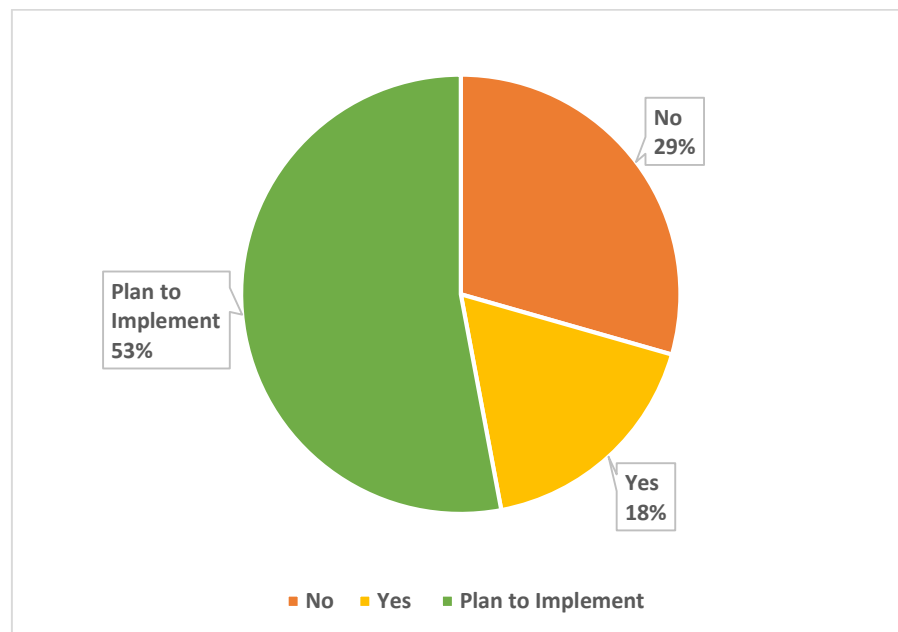


Figure 4.11 practice of reliability centered maintenance (RCM)

Source: field survey (2019)

From the above figure (4.11), it can be seen that majority of the companies plan to implement reliability centered maintenance, this forms about a whopping 59% of the subjects contacted.

followed by those other companies do not practice reliability centered maintenance constitute 29% and lastly, any few companies practice reliability centered maintenance.

4.3 The use of computerized maintenance management system (CMM)

The connection investigation demonstrates that 41% are wanting to actualize computerized Maintenance Management System (CMMS), simply 24% are rehearsing and 35% have no clue (CMMS).

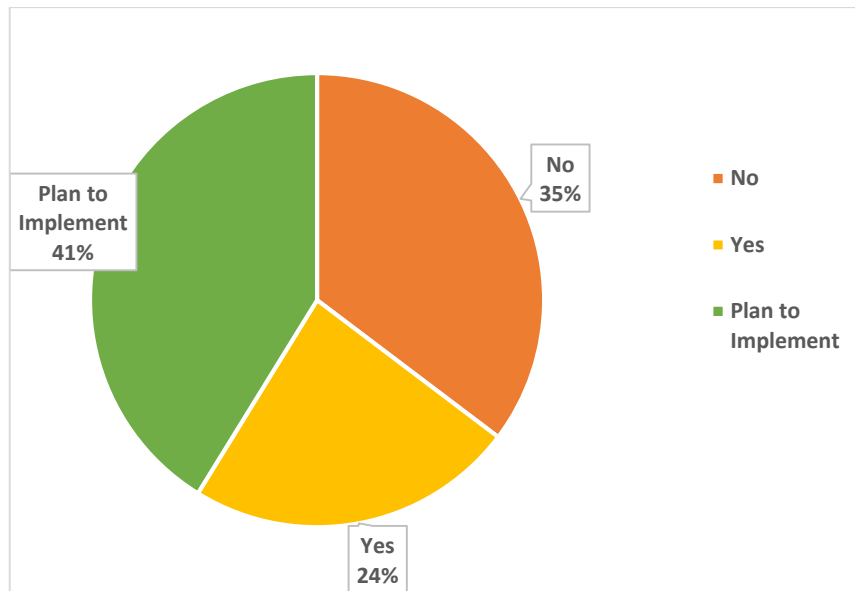


Figure 4.12 computerized management maintenance system (CMMS)

4.4. The Task of Carrying Out the Maintenance in A Company

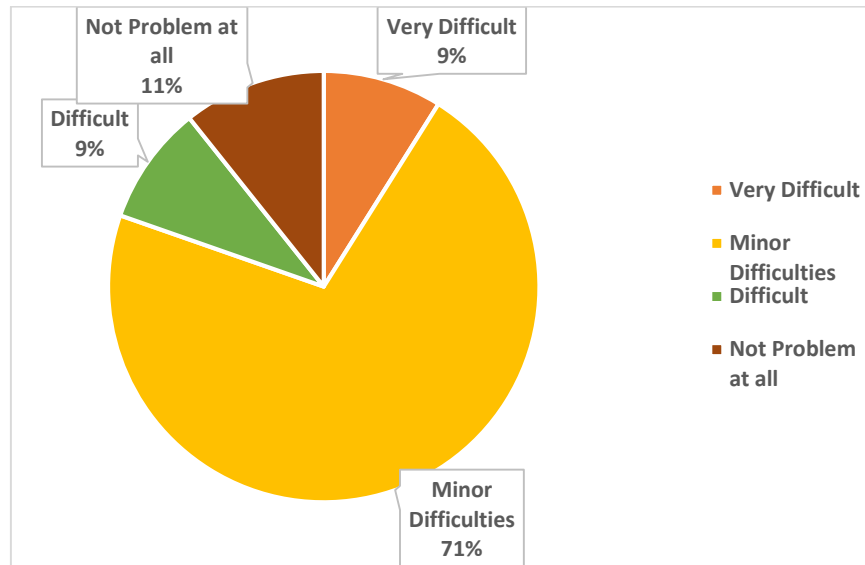


Figure 4.13 Maintenance task carrying out

Source: (field survey, 2019)

When respondents were asked to indicate the level of difficulties they encounter during maintenance activities, 71% of the respondents clearly indicated they encounter minor difficulties. 11% stated that they do not encounter any difficulties while 9% suggested that difficulties and very difficult situations respectively.

4.5 Major breakdown/problems occurred according to which area.

Tables below demonstrate the significant breakdown and issues happened by the zone and innovation utilized. As appeared, the greater part of the territories and the innovation recorded are every now and again evaluated as "normal" as far as level of breakdown and issues. The outcomes additionally demonstrate that, there are three territories which are mechanical, electrical and electronic parts have the most noteworthy methods esteems, which show the most incessant zones or parts that the issues as often as possible happened is mechanical parts.

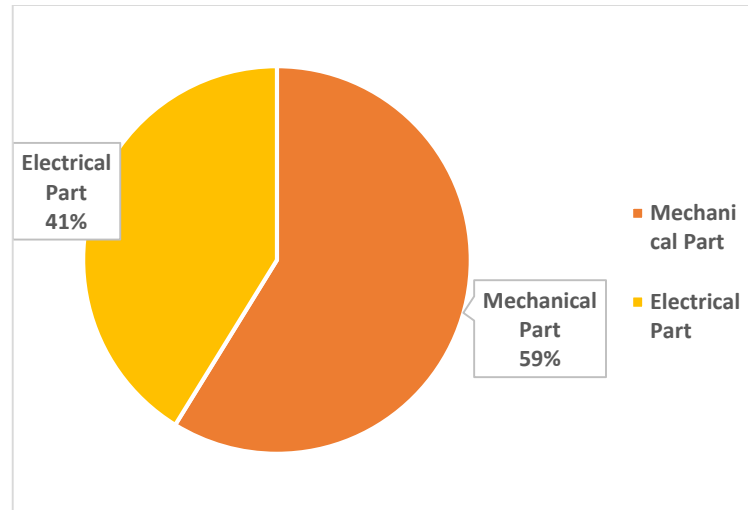


Figure 4.14 Major breakdown problem

Source: (field survey, 2019)

4.6 The Number of Times Maintenance Performance is Evaluated or Measured.

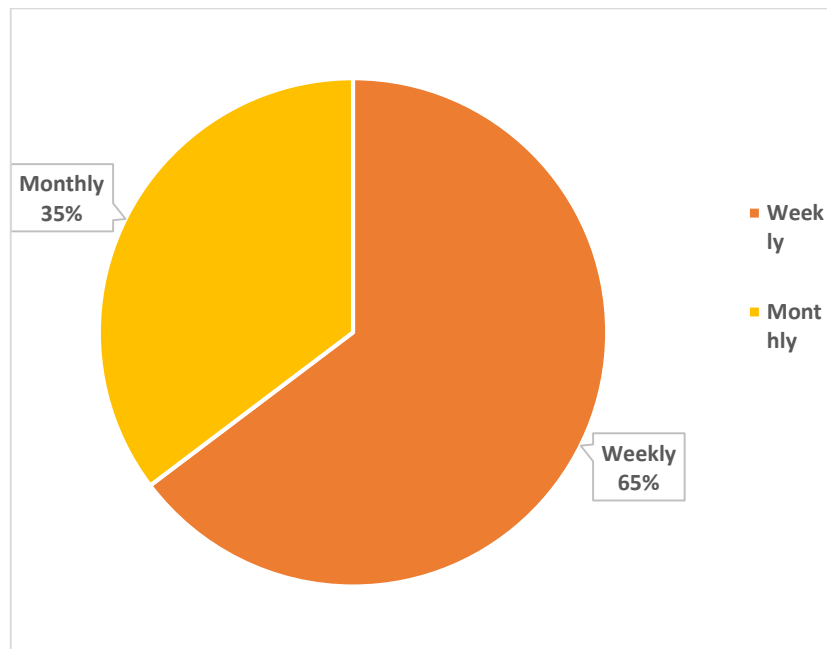


Figure 4.15 Evaluation Maintenance Performance

Source: field survey (2019)

65% of respondents indicated that maintenance performance is evaluated on weekly basis. And the remaining 35% stated that, they carry out maintenance activities on monthly basis.

4.7. The results of measurement of maintenance performance

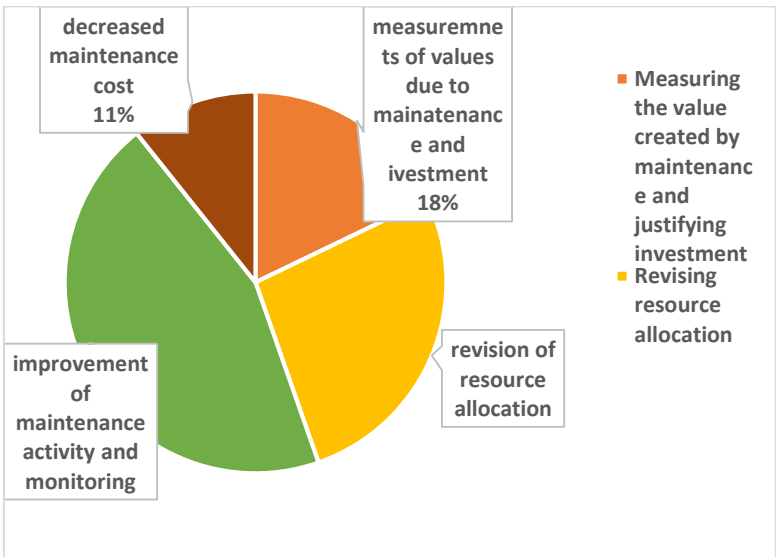


Figure 4.16 Outcome of maintenance performance measurement

Source: (field survey, 2019)

4.8 The Practice to Use Parts from Old or Unused Machines

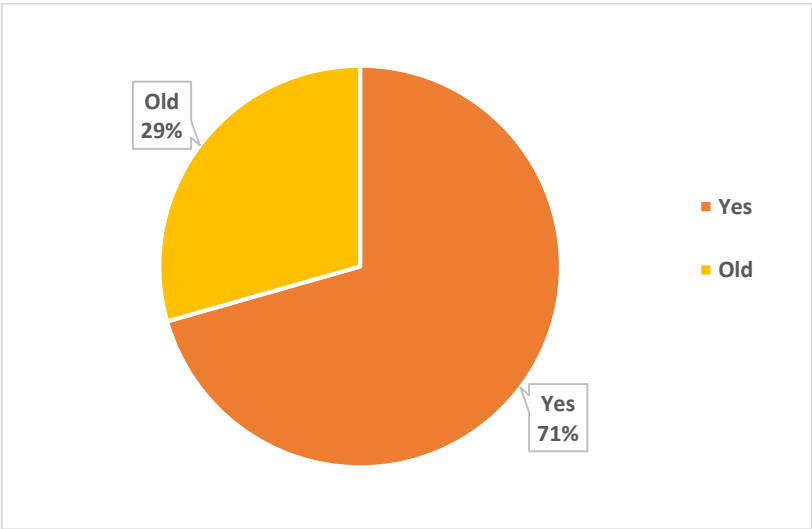


Figure 4.17 Types of parts used for maintenance distribution

Source: (field survey, 2019)

Form figure 4.16, respondents suggest that, they mostly used new parts to replace faulty part during maintenance of machines in the industry. They clearly indicated that, 71% of the respondents use new parts while only 29% still use old parts.

4.9 Training of maintenance staff

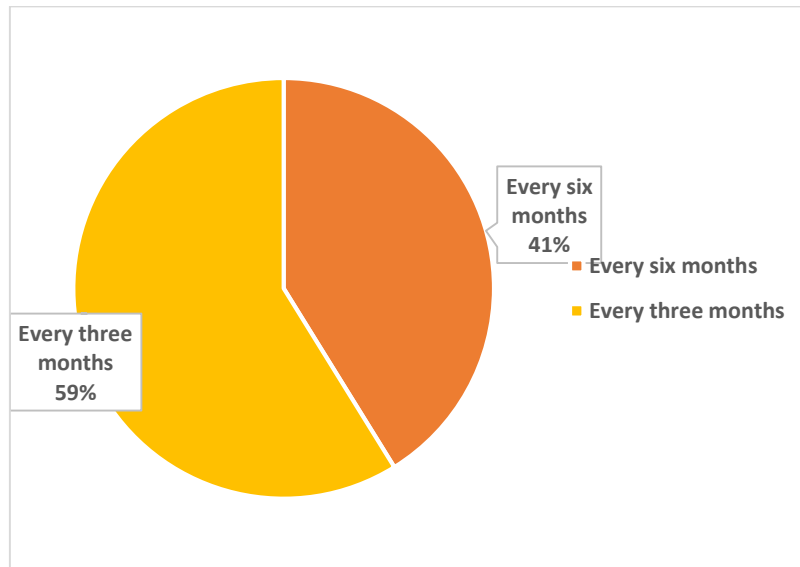


Figure 4.18 Maintenance staff training

Source: field survey (2019)

From figure 4.17, it has shown that majority of maintenance staff usually receive training average every six months constituting 59% of the total contacted respondents while the minority constituting 41% receive training every three months which is 41% of the respondents.

The overview results additionally show that most of the respondents pick "in-house training" as their first choice in directing the support preparing.

4.10 Challenges Facing the Manufacturing Industry in Terms of Maintenance

This research has one of its objectives of finding out the challenges that these manufacturing industries face in terms of maintenance. Respondents' views on this topic are laid bear on table **4.6 below**. The Highest Rank challenges they face is the cost incurred during maintenance with the RII of 0.898 and mean value of 4.489 and standard deviation of .661 and standard mean error of 0.099 and kurtosis, -0.181. lack of management attention was ranked the second (2nd) highest challenge with RII of 0.84 and mean of 4.200 and standard deviation of 0.661 and standard mean error of 0.098 and kurtosis of -.668. Responses from respondents also agree to the fact that Labor intensive or not availability of the required labour and was ranked third (3rd) with RII Of 0.836 mean of 4.178 and standard deviation of 47 0.535 And standard mean error of 0.0800 and kurtosis of 0.237. Inadequate availability of spares and ageing equipment was ranked 4th with RII value of 0.827 and a mean of 4.133 and it has standard mean error of .098. Unplanned downtimes of equipment, Possibility of secondary damages to plant and equipment due to catastrophic failure, Unavailability of tools and technology, High frequency of maintenance were ranked 5th, 6th, 7th and 8th, respectively with each having RII greater than 0.782 and mean greater than 3.911. No standard ways of measuring solid waste ranked the 9th with RII of -0.187 and a mean of 0.782 and standard deviation of 3.911 and standard mean error of .109 and kurtosis of -0.187. Unavailability of solid waste data was ranked 10th with RII value of 0.756 and a mean of 3.778 as well as standard deviation error of 0.105 and a kurtosis value of 1.239. This shows that there is a high significance level for our variable, and that they are all outstanding attributes of these organizations or companies the difficulties face during maintenance in the manufacturing industry.

Table 4.1 shows the challenges manufacturing industries face in terms of maintenance

Challenges	N	Sum	RII	Ranking	Mean		Std. Deviation	Kurtosis	
	Statistic	Statistic			Statistic	Std. Error	Statistic	Statistic	Std. Error
Maintenance Cost	52	202.00	0.898	1 st	4.489	.099	.661	-.181	.695
lack of management attention	52	189.00	0.84	2 nd	4.200	.098	.661	-.668	.695
Labor intensive (not available)	52	188.00	0.836	3 rd	4.178	.080	.535	.237	.695
Inadequate availability of spares and ageing equipment	52	186.00	0.827	4 th	4.133	.098	.661	-.632	.695
Unplanned downtimes of equipment	52	185.00	0.822	5 th	4.111	.065	.438	2.034	.695
Possibility of secondary damages to plant and equipment due to catastrophic failure	52	183.00	0.813	6 th	4.067	.092	.618	-.241	.695
Unavailability of tools and technology	52	182.00	0.809	7 th	4.044	.100	.6720	-.687	.695
High frequency of maintenance	52	182.00	0.809	8 th	4.044	.100	.673	.975	.695
lack of processes	52	176.00	0.782	9 th	3.911	.109	.733	-.187	.695
Unjustified use of staff resources	52	170.00	0.756	10 th	3.778	.105	.704	1.239	.695
Chances of catastrophic failure	52	170.00	0.735	11 th	3.766	1.12	.734	1.307	.695

Difficulties in obtaining time and cost estimates for maintenance works	52	168.00	0.721	12 th	3.657	1.15	.755	1.314	.695
Managing technical competence gap	52	167.00	0.721	13 th	3.574	1.15	.707	1.323	.695
Integration of CMMS into Maintenance Management System	52	159.00	0.719	14 th	3.563	1.19	.764	1.356	.695
Chances of catastrophic failure	52	159.00	0.714	15 th	3.561	1.20	.778	1.365	.695

Source (field survey, 2019).

From the table above, cost of maintenance was ranked the highest challenge faced, this is in line with, the procurement of the required capital resources to undertake the measurement of solid waste is a major challenge. Maintenance must be able to demonstrate a measurable return on investment and must be able to justify its existence by showing how effective maintenance reduces machine downtime, reduces overtime needed to hit production schedules, improves on time delivery and improves the quality of the product. However, maintenance usually does not know how to rationalize their participation in the savings.

Besides, lack of management attention was second, the maintenance supervisor or manager must also monitor the work progress daily, weekly or monthly depending on the nature of the situation and the potential impact of a service breakdown to the community. He or she must not wait until the year end to review the budget, as it would be too late to take any corrective action if it were necessary. Any significant variance in labour hours, work order costs or total maintenance cost for a particular asset should be identified through exception reporting. The

supervisor should determine the cause of the variance and, where possible, develop alternative solutions or actions to reduce time and costs. Taking these steps will help improve the efficiency and effectiveness of the maintenance program (Julius, 2000). As discussed above it has a mean of 0.836 and RII of 4.178.

Another challenge, the industry face in terms of maintenance is the right labour with the technical know-how. The pool of available skilled maintenance technicians is very shallow and the existing maintenance workforce is aging and nearing retirement. This reality, coupled with the fact that most apprentice programs have been shuttled and training programs curtailed, has created a shortage of maintenance technicians that is nearing critical proportions. Finding, training and retaining skilled maintenance people is one of the top challenges facing maintenance organizations today (Welch, 2009).

Inadequate availability of spares and ageing equipment was the fourth challenge, accomplishing ideal harmony between the benefit of requesting and holding (devaluation, intrigue charges, rental and so on.) and cost of stock out (loss of offers because detachment, transitory lease charges and so forth.) is that the goals save segments association should address. the most issue in venture with Kelly (2006) emerges from the inconstancy and nature of thousands of different things (of wide fluctuated worth, lead times and use rate) required continuing an ordinary activity.

Testing hardware/apparatuses - although it's equivalent to the objective of extra parts association, anyway the matter of the executive's contrasts because of devices aren't inside a similar sense nonessential. the most undertaking yet with returnable devices is that the advancement of a framework for watching their credit and keeping up or replacement them if essential once came.

Specialized information/information - this typify all report, inventories, manuals or drawing that may encourage upkeep work or activity. this might be ordered into training, reference, guidance, programming and the board.

One of the main contributing factors to the cost of a calibration is the downtime of the machine tool, which is often perceived to be a barrier to implementing predictive calibration. Both economic and performance aspects need to be considered in order to make a decision in support of machine checking and particular positional error handling policies. Financial reductions can be achieved when using preventative and predictive calibration in collaboration with TPM. Such techniques are intended to leading to a better maintenance activity performance that can provide benefits to different volumes and value of manufacturing productivity (Shagluf et al., 2013)

Generally, the rest of the variables, these variables are still some of the challenges these manufacturing industries are faced with, they come in various forms as shown in the table above. These challenges are being agreed upon by respondents as factors that hinders measurement of solid waste. They are indeed very serious challenges as each of them has a mean greater than 3.5.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.0. Introduction

In this chapter, in line with the aim of this research stated in chapter one, to find out how the effective maintenance management in manufacturing companies, which dependent on the hypothetical comprehension in the literature and the experimental information discoveries in this study or investigation. The author accepts that the improvement of the upkeep work force is central to the support system, which will expand the equipment unwavering quality and execution because of the high skillful and independent upkeep faculty.

5.1 Summary of findings

According to objective one, this study is set to ascertain the effective maintenance practices in manufacturing industry. Analysis of the results showed that, these are excessively effective maintenance practices area: Preventive Maintenance, Predictive Maintenance, Corrective Maintenance and Breakdown or emergency Maintenance are the most effective in order of relevance.

The Sampled Population however approved that these other maintenance programmes still remain relevant: scheduled maintenance, reactive maintenance, Opportunistic maintenance, total productive maintenance and e-maintenance or computerised maintenance. This was done to holistically assess and compare these maintenance systems using relevant decision techniques based on experts' (vibrating screens users and manufacturers) opinions in order to determine the best or effective maintenance mix that could be used for manufacturing industries.

Organizations embrace normal maintenance and most have received a mix of upkeep techniques to suit the distinctive plant and apparatus utilized for manufacturing. Be that as it may, on an individual premise, the most widely recognized support framework being used by respondents is preventive closed down. This is intently trailed by preventive everyday practice and predictive support frameworks separately.

Objective two was to determine the factors influencing the performance of maintenance personnel in carrying out maintenance activities. The following were the leading factors: Computerized Maintenance Management Systems, staff training, maintenance Leader, examination and handling of machine, technical know-how (maintenance professional), allocation of workshop for maintenance activities, and finally the health and safety of maintenance workers were ranked major factors affecting the performance of maintenance personnel.

Objective three sought to identify the problems and challenge facing the manufacturing in terms of maintenance. From the research data it was identified that, the most ranked challenge or problem maintenance staff face in their respective companies is cost of maintenance Cost, further more respondents ranked lack of management attention as second. These problems are very important in the sense that all the respondents have higher educational background with the least holding HND but responded to them as the first and second most difficulty challenges their encounter. The third ranked is Labour intensive (not available) and the least ranked was Chances of catastrophic failure

5.2 Recommendations

In view of the outcomes got from this work the researcher might want to make the accompanying recommendations or proposals:

From the study, the researcher recommends that, maintenance practices such as computerised maintenance management system, total productive maintenance, reliability centered maintenance and agreement or contract maintenance which are equally effective and should be implemented within the manufacturing industry other than just pay whole-heartedly to only corrective, predictive and emergency maintain.

In addressing the second objective which is the factors influencing the performance of maintenance personnel, the research recommends that training of maintenance workers on regular basis, incentives for maintenance workers, allocation of workshop for maintenance activities, ensuring the health and safety of maintenance workers and finally the use of computerized maintenance management system, these were identified to lacking in most maintenance industries.

The researcher again recommends that various manufacturing companies need to identify permanent source of income to undertakes maintenance activities, the involvement of the various stakeholders must to encourage especially management of the industry, government subsidizing imported spare parts for the manufacturing companies all these would go a long way to addressing the third objective, which is the challenges manufacturing industries face in terms of maintenance.

The researcher recommends the full introduction of maintenance education within manufacturing industry and the creation of training modules and staff routine to upgrade their viability.

Hence it is suggested that manufacturing sectors create basic and new maintenance formative assessments and train employees on a regular basis to improve their efficiency.

It is suggested that manufacturing businesses in Ghana improve their attempts to ensure consistency with safety laws and regulations to avoid unnecessary injuries and fatalities.

It is prescribed or suggested that continuing study should be taken out to supervise developments in maintenance patterns and, at the same moment, to create a database on the connection between business maintenance procedures and business efficiency.

Further examination can be completed on the prescribed methodology for maintenance practice in manufacturing industry, which will incorporate the intrigue and the requirements of value professionals.

5.3 LIMITATION OF RESEARCH

Every research has its own limitations. For this study, the limitations were seen in the form of the collection of data and determination of the population. In the collection of data aspect, it was difficult retrieving data from respondents. Since some of the respondents were top managers who most often didn't have time to even look at questionnaires much less answer them. But the few who made time out of their busy schedules did a good job. Nevertheless, this limitation didn't affect the validity of the work done.

5.4 AREAS FOR FURTHER STUDY

This research recommends a handful of areas which were identified and need further investigations into. These further researches could provide prolific results. The following are the recommended areas.

- 1 Develop a framework or guidelines or a standard measurement of industrial maintenance.
- 2 Developing specific technological tool that would aid to fast track maintenance

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APPENDICE

RESEARCH INTO THE MAINTENANCE PACTICES IN MANAUFACTRUING INDUSTRY.

SURVEY QUESTIONNAIRE

I am undertaking a research study in Kwame Nkrumah University of Science and Technology as part of my partial fulfillment of the award MSc. Project Management.

This research questionnaire has been designed to solicit your view and information regarding the topic: maintenance practices in the manufacturing industry. It is hoped that the research would unearth maintenance-related challenges facing manufacturing industries so that remedies could be sought.

ALL THE INFORMATIONS WILL BE TREATED STRICTLY CONFIDENTIAL

Name:
Region:
Location:
Mobile Number:
Email Address:
Company Name:
Company Address:

Section A:

GENERAL INFORMATION

1.What is your gender?

1. Male
2. Female

2.How many employees does your company have?

1. 100 - 200
2. 200 - 400
3. 400 - 600
4. 600 - 800
5. 800 -1000

3.How many machines does your company have?

1. 10 – 15
2. 15-25
3. 25-30

4. 30-35

5. 35-40

6. 40-45

3.How many years has your company been in business?

1. 6 - 9 years

2. 9 - 15 years

3. 15 -20 years

4. 25 - 30 years

5. 35-40 years

6. 45-50 years

4.How many years have you been with the company?

1. 3 -5years

2. 5-7years

3. 7-10 years

4. 10-15 years

5. 15 – 20 years

5. Form of ownership of company: select one of the below as appropriate

1. State Owned

2. Private Ownership

3. Joint Venture (Ghanaian -Foreign)

4. Joint Venture (Ghanaian)

5. Public Limited Company

Section B.

EFFECTIVENESS OF MAINTENANCE ORGANIZATION PRACTICES

Please tick (✓) where relevant

1. Do you have a maintenance department?

1. Yes
2. No

2. Is the maintenance department normally involved in selection of new or replacement equipment?

1. Yes
2. No

3. How well do you understand infrastructure maintenance.

1. Not at all
2. Not very well
3. Very Well
4. Extremely Well

4. Does your company have a store for maintenance.

1. Yes
2. No

5. Number of employees in maintenance department.

1. Less than 5
2. 6 to 10
3. 11 to 20

6. Apart from running their own machine, machine operators in your company are also responsible for:

1. Machine set-ups
2. Material handling
3. Gathering Data / charts
4. Job scheduling
5. Doing maintenance

7. What types of maintenance used in your plant?

1. Breakdown Maintenance
2. Corrective Maintenance
3. Preventive Maintenance
4. Predictive Maintenance
5. None of the above

8. Does your company practice Total Productive Maintenance (TPM) program?

1. Not Applicable
2. Plan to implement

9. Does your company practice Reliability Centered Maintenance (RCM)

program? (circle one)

1. Not Applicable
2. Plan to implement

10. Does your company use any Computerized Maintenance Management System?

(CMMS):

1. Not at all
2. Plan to implement

11. How would you describe, in general, the task of carrying out the maintenance?
in your company.

1. Very difficult
2. Minor difficulties
3. Difficult
4. No problem at all
5. Average

12. Major breakdown / problems occurred according to which area.

1. Mechanical Part
2. Electrical Part
3. Electronic Part
4. Pneumatic / Hydraulic Part

Section C

MAINTENANCE PERFORMANCE MEASUREMENT

1. How often is maintenance performance evaluated or measured?

1. Weekly
2. Monthly
3. Annually
4. Other (specify)

2. Which of the following has been the outcome of maintenance performance measurement?

Please tick (√) where applicable.

- 1 Measuring the value created by maintenance and justifying investment
- 2 Revising resource allocations
- 3 Adapting to new trends in operation and maintenance strategy
- 4 Effective monitoring of and improvement in maintenance activities
- 5 Reduction in maintenance cost
- 6 Changes in health and safety and environmental policy
- 7 Other (specify)

SECTION D.

Challenges and problems faced by industries in terms of maintenance.

1. Very Severe 2. Severe 3. less severe 4. Not severe

Challenges and problems	1	2	3	4
Inadequate availability of spares and ageing equipment				
Managing technical competence gap				
Unplanned downtimes of equipment				
Occurrence of catastrophic failure				
Unjustified use of staff resources				
Possibility of secondary damages to plant and equipment due to catastrophic failure				
Unavailability of tools and technology				
Labor intensive (not available)				
Chances of catastrophic failure				

High frequency of maintenance				
Superfluous maintenance				
Cost				
lack of processes				
Maintenance leadership inability to plan				
Lack of management attention to maintenance				
Little participation by accounting in analyzing and reporting costs				
Difficulties in obtaining time and cost estimates for maintenance works				
Difficulties in measuring performance				
Others				