

UNIVERSITY OF GHANA

**TECHNOLOGY AND ITS IMPACT ON PORT OPERATIONS IN THE
PORT OF TEMA, WITH RESPECT TO SAFETY OF CARGO AND SHIP**



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**THIS DISSERTATION IS SUBMITTED TO THE UNIVERSITY OF
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DECLARATION

I, the undersigned, unreservedly declare that except for references to other people's works which are duly acknowledged in line with the ethics of academic honesty, this research is my own work. All errors and omissions found in this work are my responsibilities.

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DEDICATION

I dedicate this dissertation to almighty God who saw me through from the beginning to the end and also to my entire family, especially my Father who made me believe that everything is possible as long as you believe.



ACKNOWLEDGEMENTS

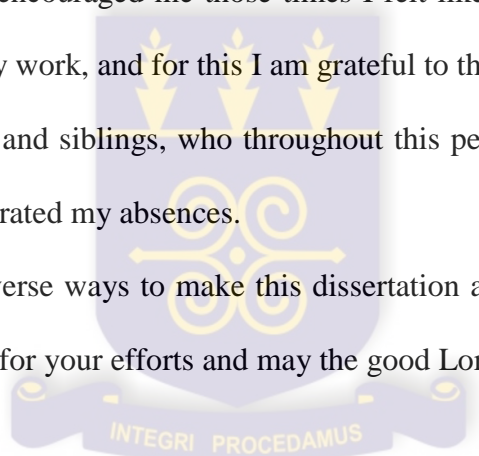
My gratitude goes to the Almighty God; the Beginning and the End, who took care of me and saw me through this programme.

My heartfelt thanks goes to my supervisors Mr. S. O. K. Yeboa and Mr. Jonas Aryee, who guided me with patience and helped in giving a clearer understanding into the impact that technology has made on port operations with regards to safety of cargo and ships. Their critical and meticulous supervision, with useful inputs, has made the work what it is.

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ABSTRACT

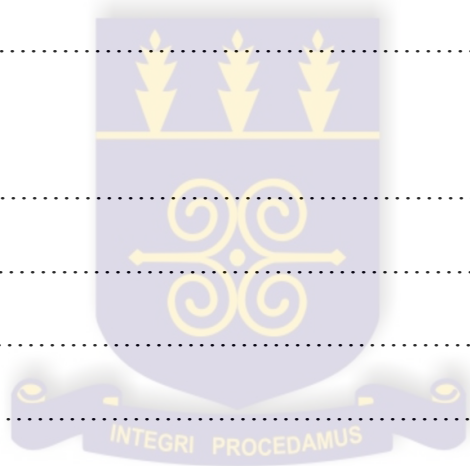
Safety is paramount in all human activities, in this regards the government of Ghana came out with strategic port development policy to transform the ports of Ghana from service ports to landlord ports. This strategy allowed the Ghana Ports and Harbours Authority to adopt a port reform programme to increase the participation of the private sector in the provision of services and facilities to ships and cargo.

Over the period of about ten years (2003 -2013), the port of Tema has employed modern technology and innovation to improve performance and contribute towards a clean and healthy environment. This study therefore, assesses the impact of technology on port operation in the port of Tema.

The study employed both the qualitative and quantitative method of study. With both methods, data was gathered from 65 respondents with the use of questionnaire and interview guide. Empirical evidence points out that since the transformation of the port to a landlord port, there has being the installation of modern technological equipment. A further finding was that the modern equipment has increased efficiency and effectiveness of work performance and this has further improved the services provided by the port. It has also increased the safety of cargos as movement of goods are monitored from the vessel till the final destination with modern equipment such as the CCTV camera. Based on the outcome of the study, it is recommended that there should be a renovation of the roads within the ports to promote easy and smooth movement of machines during work. As it was revealed that pot holes within the ports slows down work.

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CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

It cannot be denied that technology has become part of the 21st century living; at least most people have used a technology related gadget either for communication, education, health purposes, job creation, and travel or business growth. Its introduction into all aspects of human activities has been an interesting phenomenon and has attracted much research. While some argue that businesses which have embraced technology have gained a competitive advantage in the market (Porter, 1990), others are of the view that, the use of automated systems will mean that manual labor will be cut down which is a benefit to the business owner but this will leave many people who would have done this task jobless (O’Sullivan, 2009).

Technology is defined by the Oxford Dictionary as ‘the application of scientific knowledge for practical purposes, especially in industry’¹. The Cambridge Dictionary also defines it as ‘the practical, especially industrial use of scientific discoveries’². From the two definitions, it can be said that, technology has been adapted as the best way to improve industries and business, even if the human element is ignored.

The present-day meaning of the term ‘technology’ is defined by Merriam-Webster as:

“...application of knowledge to the practical aims of human life or to changing and manipulating the human environment. Technology includes the use of materials, tools, techniques, and sources of power to make life easier or more pleasant and work more productive.

¹ www.oxforddictionaries.com (checked 14/08/2014)

² Dictionary.cambridge.org (checked 14/08/2014)

One other source describes ‘technology’ as “systematic knowledge for the manufacture of a product, for the application of a process or for the rendering of a service (UNCTAD, 1985). Modern technology used in the ports today are those tools that help move cargo easily with less effort and it includes reach stackers, rubber gantry cranes, ship to shore gantry cranes and forklifts.

According to Osaretin (2006), sea port operations is defined as cargo handling (or moving) activity, performed by a designated company (gang or team), consisting of labour and machines. It is also defined as the operation of a wharf and other port facilities, operation of port passenger transport service, operation of cargo loading or unloading, haulage and warehousing services within a port area and so on.

Port operation has evolved from the use of push trucks in the carriage of goods to advanced mechanization and computerization. Today, mechanization and automation is the essence of port work. Furthermore, the introduction of the container has been at the center of the growth and development of advanced mechanization and information technology that has developed, to define the character of modern port operations.

The port of Tema, till 2000, was a service port and management began a programme to increase the participation of the private sector in the provision of services and facilities to ships and cargo in line with the government’s strategic port development policy to transform the ports of Ghana from service ports to landlord ports. By 2001, stevedoring and shore handling licenses as well as joint venture and concession agreements had been signed with private companies that had the capacity to introduce modern operational equipment and procedures into cargo handling (GPHA, 2012). Port operations at the Tema port basically include cargo handling, and handling of vessels. However, the country’s drive towards a Landlord port management

system, coupled with the government's inability to invest leaves port authorities with no option than to turn to the private sector to invest in their ports (UK essays accessed, 10/09/2014)

1.2 Problem Statement:

Vulovic, (n.d) states that over 90% of international trade is carried by sea. This indicates how sea ports are important in the transfer of goods across borders. In the operation of ports, modern technology is required to ensure goods from vessels are discharged quickly and that cargos are safe. In modern business and running of organizations, technology is highly relevant and required for operation. For instance, in Australia, approximately 1.5 million organizations and individuals have access to modern technology such as the Internet. Out of this number, approximately 250,000 are business related (Kia *et al.*, 2000). Further studies reveal that Electronic Commerce conducted with the use of modern technology over the Internet and its derivatives is expected to reach US\$300 billion a year by the early part of the next decade (Kia *et al.*, 2000). What does this imply for the port of Tema after its transformation to landlord port with the use of modern sophisticated technologies?

The problem statement for this work is that, since safety is of paramount interest in any human endeavour and with reference to data obtained from GPHA (2012) which revealed a high accident rate between the periods of 2003 to 2013, and claims made by shippers due to damaged goods, in thousands of dollars and British pounds (Appendix A and B respectively), this work seeks to find out how the introduction of technology in the port of Tema has affected the operations of the port with regards to safety of ships and cargo.

1.3 Objective of the Study

The general objective was to identify the effect that technology has had on port operations, especially with regards to safety of the ship and cargo, since Ghana's adaptation of the Landlord

port service system, and also to review existing literature on the use of technology in operations with respect to safety of cargo and ship.

Specifically, the study seeks to:

- Determine the new technology introduced into the port since the port reform in 2003.
- Identify areas in the port operations that technology has made much impact, both positive and negative as regards to the handling of vessels and cargo.
- Identify the challenges with port operations in terms of safety of cargo and ships, with keen regard to technology at the port of Tema
- To propose key steps that can be implemented to ensure that the port of Tema catches up with the rest of the developed world in terms of safety of cargo and ships when it comes to modern technology.

1.4 Research Questions

To achieve the objectives of the study, the research questions asked are:

- What new technological improvements have been made in the port of Tema for the past 10 years?
- What safety issues have arisen in the past 10 years with regards to the technology being used?
- What other factors, apart from technology compromise the safety of the ship and cargo?
- What impact has the introduction of modern technologies made in the port operations at the port of Tema?

1.5 Scope of Study

The Port is an organized institution hence it was prudent to limit the coverage to those who were employees of Ghana Ports and Harbours Authority Port operations at the port of Tema. To avoid getting a biased view on issues related to the safety of cargo and ship, some shippers and representatives of shipping lines will be included in the scope of study.

Port operation in this study is mainly restricted to sea land port operations, involving the loading and off-loading of cargo. Technology here is related to mechanical technology, including machines and equipment. The technology involved is to a large extent container orientated since this type of transport shows dynamic developments and therefore a focus of the study.

1.6 Significance of the Study

Technology, as most people know, is here to stay. The heightened competition between and among ports to be recognized as the best in the sub- Saharan African region, has led to many reforms being adopted. In the Ghanaian situation, the government's strategic port development policy to transform the ports of Ghana from service ports to landlord port resulted in the increased participation of the private sector in the provision of services and facilities to ships and cargo, hence, investment in more modern technology.

The study contributes to existing knowledge and literature, especially knowledge concerning port performance, particularly to GPHA, who may use it as a tool to support their strategic investment planning needs on the impact of technology in the Port of Tema operations. Educating the public about the Tema port will also be achieved.

The study also identifies other significant factors that determines the impact that technology has made in the past 10 years in port operations. Hopefully, knowledge gleaned from this study will help the port of Tema identify areas that really need technological improvement in the port area.

Finally, the findings of the study would provide evidence for further research work.

1.7 Organization of the study

The study is organized as follows:

Chapter one centers on introduction and background to the study. Included in this chapter are the research problem, the research objectives and related research questions, significance of the study and finally the definition of relevant technical terms. Chapter Two looks at literature review and considers the various sources of secondary data that were gathered in relation to the study. This chapter dwelt on sources like text books, magazines, company journals, reports, periodicals and internet resources.

Chapter Three is on methodology and profile of the research area. These discuss how the data collection was done and the respective data collection instruments that were used.

Chapter Four focuses on presentation of findings. In the presentation of the findings, tables, charts and graphs were used to analyse the responses of the various respondents. Percentages are also used as a common basis for assessing the responses of the respondents.

Finally, Chapter Five deals with summation of the findings. It also considers the recommendations that could be generated from the research and conclusions.

1.8 Limitations of the study

Some restraints were encountered in the course of this work. These include the fact that, some workers were not cooperative for fear of divulging company secrets and hence losing their jobs. Also, some areas in the port are restricted, and even with the proper documentation, access to them were restricted only to port workers hence data could not be collected.

Time constraints on the part of both the researcher and respondents left little room for much work to be done. Not much interaction was done between the researcher and respondents, who had much work to attend to.

Communication was also a barrier for the researcher. The workers were more adept in operating the technology available, but left much to be desired in passing on their views and opinions to the researcher.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

Maritime transport is the shipment of goods (cargo) and people by sea and other waterways. Port operations is a necessary tool for the effective and efficient turnaround of vessels. Port operations is made up of four (4) different activities; (a) vessel movement, (b) cargo operations, (c) ashore operations (storage and delivery operations) and (d) land connectivity.

A vessel is deemed to have arrived at a port once it gets to the anchorage. The safety of the vessel is at that moment partly dependent on the captain and crew and also the port of call. The most modern technology available to perform this task is the use of some systems used the world over. Long Range Identification and Tracking System (LRIT), Vessel Traffic Management Information System (VTMIS), Automatic Identification System (AIS), Very High Frequency (VHF), satellite phones, Radio Detection and Ranging (RADAR), and others. All these systems are used to ensure the safety of vessels at different times.

2.1 The Use of Modern Technology in Vessel Traffic Management

The fleet of vessels on the globe as determined by the Review of Maritime Transport (2014) is 47,601 and the number of ports available in the world amounts to 8,293 in 222 countries (Seaports 2015). This is an indication that vessels queue at ports to have access to berths in order to load or discharge cargoes. If there is no vessel management system in a port it will result in chaos and vessel collision and other accidents will abound.

To ensure safe movements of vessels every port in the world has a vessel movement management system with a basic idea of ensuring vessel and port safety but different methods depending on the resources of the port in question. While some ports, in especially the

developed world, the channels of entry are separated from the exit channels, ports in other parts of the world such as those in Africa more often than not have one channel serving as the entry and exit channel at the same time. In such instances there must be a strict vessel traffic management system in place, any mistake in the management of vessels entering and leaving such ports could result in very serious accidents.

The International Maritime Organisation (IMO) is the International body that regulates world maritime activities. It has put measures in place to ensure the safety of ships and ports. For example ports are supposed to operate lighthouses to indicate the presence of the port to ships. A port is also supposed to be a sheltered area where visiting vessels will be safe. As such there is a break water facility to ensure just that. Chapter XI-1 and XI-2 of the International Convention for the Safety of life at Sea (SOLAS) 1974 which includes the International Port and Ship Facility (ISPS) Code have a number of rules that ports and ships must comply with to ensure their safety.

Therefore in the case of the Port of Tema, it is part of its regulations that any vessel wanting to enter the port announces its arrival in the territorial waters of the port and by the use of an AIS the port is able to access every information needed that relates to the safety of the ship and the port (Ghana Maritime Authority, 2012). Other information that cannot be accessed by means of this technology such as the gross tonnage and the draught for example and are necessary for port operations will have to be provided by the ship. Sometime past such information used to be provided by filling a form on arrival at the port. In recent past the needed information was provided by means of VHF which was limited to verbal communication. The use of AIS is an improved version of the VHF which includes the use of satellite to access and disseminate information by sending and receiving information for precision (Ghana Maritime Authority, 2012). The internet and the mobile phones are currently the norm since they have become cheaper, more reliable and provide real time information.

There is a Hydrographic Department which is in charge of ensuring that the approach channel is free of any obstacles and silt is equipped with a team of divers and a purposely-built craft “Diving Pot One” in order to prevent collision or grounding by a vessel (GPHA, 2012).

The Port of Tema, like most ports in the sub-region requires that a local pilot assist the captain to pilot the vessel into port (GPHA, 2012). The reason for this decision is based on the security of the ship and the port. There is the assumption that a local pilot has the most recent information about occurrences in his port than the captain of the ship no matter how extensive his knowledge about the port may be. In spite of this policy the ultimate responsibility of the safety of the vessel remains with the captain of the ship.

The safety record of the port for vessels entering and leaving the port has a commercial implication on the port. Vessels will refuse to call at ports with bad safety records and pass the information to other vessels.

2.2 The Use of Modern Technology in Cargo Handling On Board Ships

Cargo handling on board ships is an activity performed by stevedoring companies. Vessels are said to make money while sailing and spend money while in port (Stopford, 2003). The longer a vessel stays in port the more money it spends and the shorter it stays the less money it spends. As a result ship owners and charterers do not tolerate any delays in port especially in the discharge of cargo.

In times past cargo was discharged by conventional means. That is break bulk shipping, in which goods were transported loose or packaged in boxes, bags, barrels, or other relatively small containers that varied depending on the type of goods. This was the most common way goods were discharged from ships in the early days of shipping (Levinson, 2006). Heavy reliance on manual labour was employed to see to the loading and discharge of cargo in ports and vessels had to spend far longer periods which was gradually making shipping expensive

and unattractive. Cargo was moved on and off ships with extensive manual labor, and the longshoreman's hook was the basic tool of the Stevedore (Pinder & Slack, 2004). As time went on, ships were equipped with derricks, then to cranes that could lift up to 30 to 35 tons at a time. This improved until hundreds of tons of cargo could be moved with one single lift. In this modern day thanks to the progressive development of technology the world can boast of equipments like ship-to-shore cranes which combine efficiency and speed to handle cargo.

This began when in 1956, Malcolm McLean, a former trucking company magnate, transported cargo in unitized form from ship to truck, reducing the cost of handling cargo significantly. His concept was based on the use of metal shipping containers similar to those used by the U.S Military but in size that was larger yet still capable of being transported by truck or train (Erie, 2004). On the 26th April, 1956, a ship carrying 58 containers left the Port of Newark in New Jersey, bound for Houston Texas. Arriving in Houston six days later, the 58 containers were hoisted off Ideal X, which was a ship that Malcom McLean bought and transformed to a container vessel, and delivered to their intended destinations with no intermediate handling by stevedores (Erie, 2004). The container revolution had begun and this developed to make the shipping industry one of the world's most exciting businesses (Stopford, 2003)

The nature of dockside labor changed as well. With the development of the new technology in port operations few skilled labour was required instead of the numerous unskilled labour that the conventional cargo handling of yesteryears required. More technical skills in operating heavy machinery such as the ship-to-shore gantry cranes and reach stackers were needed.

The use of containers started coming to the Port of Tema in the 1980s and the numbers have increased since then. The Port reform which was introduced in the year 2000 to allow private participation in the port saw the introduction of new technology in the cargo handling

operations (GPHA, 2012). Investments in the form of ship-to-shore gantry cranes, rubber-tyre gantry cranes, reach stackers, forklifts etc. improved tremendously.

Today cranes have devices mounted on them that allow operators to assess the actual weight of the cargo being lifted. If the cargo is heavier than the safe lifting load (SWL) the operator will be in the know immediately and set it down instead of lifting it higher, only to damage the crane or to cause a serious accident in the end that could risk the lives of personnel working around the ship. This is important since shippers quite often do not declare the accurate weight of their cargoes. This same device helps the ship to manage effectively its stability during loading which goes a long way to avoid listing at high seas that has caused many ships to sink.

The use of VHF in stevedoring is very much in vogue. Constant communication by the use of walkie-talkie (commonly known as the Motorola) among crane operators, foremen and supervisors has reduced accidents in stevedoring drastically and this is a very important step in port operations.

As human beings work on cargo and are often attracted to some items of the cargo it is important not only to protect the cargo in terms of damage but also in terms of it being stolen. In the port of Tema, CCTV cameras have been installed all around the port to enable security have complete surveillance in the port. Since the installation of these devices, pilferage and illegal breaking into containers have halted after a few miscreants were arrested (GPHA, 2012), the threat still persists though and constant efforts are being made to discover any new methods that may be adopted. However, documentary theft is still a challenge to all ports in the world. Human capital in the form of security personnel are also available to ensure safety of cargo and port facility.

Conversely, on a social level, less dock workers are needed in the cargo handling process and the number needed are required to have special skills in the handling of the variety of equipment

used in cargo handling, this affects the labour market in most ports, increasing the unemployment rate in many shipping countries.

2.3 The Use of Modern Technology in Cargo Handling Ashore

Every port aims at efficiency in its services provided. Individual ports have their own management strategies in the handling of cargo ashore.

In the Port of Tema, ashore handling is in two forms: the direct and indirect delivery of cargo. Cargo is divided into three groups; general cargo, rolling stock and containerized cargo.

Quite a high percentage of general cargo, for example bagged riced, bagged sugar, bagged cement, bagged fertilizer and steel products are delivered directly onto trucks from the ship side without going to any storage facility. The remaining percentage of general cargo that is not delivered directly is sent to warehouses and/ or open storage facilities handled by a private company called Red Sea Maritime Services (RSMS) (Owusu- Mensah, 2007).

On the other hand, all rolling stock, with the exception of heavy duty equipment, are handled at a private car terminal known as Safe Bond Car Terminal.

Containerized cargo however, are distributed among a number of Inland Container Depots (ICDs). The biggest of these terminals is the Golden Jubilee Terminal managed by the GPHA, and a few other privately ran terminals like Atlantic Coastal Services (ACS), Tema Container Terminal (TCT), Tema Bonded Terminal (TBT), etc.

One of the biggest challenge of ports and shipping lines is the delivery of cargo. In recent years the shipping industry and maritime commerce have seen a sharp increase in not only the number of fraud cases but also the variety of fraud, fraudsters are becoming more and more ingenious in their design and execution of schemes, including the use of modern technology

such as computer hacking, but sometimes tried and tested ‘old school’ methods such as document fraud work just as well (Todd, 2010).

According to the UK P& I Club (2015), the total number of bill of lading fraud cases has tripled, ports have resorted to the use of soft wares to help in the fast processing and checking of documents for authenticity at the same time in the delivery of cargo. For instance, UNCTAD developed the Automated System for Custom Dada (ASYCUDA) software for ports in developing countries in Africa, to replace the human interface in the documentation process (UNCTAD, 2013), however some of these ports have moved on to use their own developed soft wares.

In the case of the Port of Tema, the Ghana Community Network Service (GCNet) is used by the Customs and Excise Preventive Service (CEPS) to help in the fast and secured documentation process (Asuliwonno, 2011). An electronic way billing system has been integrated into the GCNet system to help in the authentication of documents at the Golden Jubilee Terminal to ensure that delivery orders reaching GPHA are authentic for the cargo to be delivered to the rightful owners instead of fraudsters (GPHA, 2012).

Cargoes leaving the Port of Tema to landlocked countries (LLCs) are tagged with transponders to ensure that such cargoes exit the country safely, since fraudsters use the transit system to defraud the state of its needed revenue (Custom duties) (GPHA, 2012).

The use of technology has helped in speeding up the delivery process in the port and also providing check systems in the documentation process, this has helped in easing congestion in the port, which was endemic in the year 2009 in the Port of Tema. This has provided room for more cargo to be received in the Port of Tema (GPHA, 2012).

As a result, more and more shipping lines are confident in calling at the Port of Tema without fear of any delays and this impacts on the freight charged on cargo destined for the Port of

Tema. The confidence of individuals who do business through shipping is boosted and are able to import or export more since freight charges are less, make more profit and as a result grow their businesses. They are then able to employ more people and this impacts of the social life in the country as a whole. The country as a whole can generate more revenue from the commercial activities through the port.

On the other hand, unreliability of the country's various communication network systems and unstable power supplies ('Dumsor') have greatly affected the results expected from the use of the softwares.

2.4 Inland Connectivity and Its Impact on the Port Of Tema

Goods cleared at the port will definitely have to be taken to their destination points. The shipping process is never complete when the customer does not receive his cargo. In most developed ports, connectivity to the hinterland is very sophisticated. The ports are linked directly to well-developed rail systems, inland waterways, and first grade road systems. Some are even connected directly to their airports as is the case of the New York and New Jersey Ports. The concept of Multimodal Transport and supply chain management systems have made managements of the different transport systems to interconnect for the sake of mutual benefits.

With the massive growth in containerisation and the great shift in thinking from a conventional unimodal to a concept of multimodal transport approach, multimodalism is currently the main method used in the international transportation process as it enables the optimization and organisation of all transport modes into an integrated continuous system in order to achieve operationally efficient and cost-effective delivery of goods in the supply chain.

In the case of the Port of Tema, the port is linked to the hinterland through several road networks and a partially developed rail system. The road system in the country in general is underdeveloped and in a poor state in most parts of the country. This is a setback for the Port

of Tema since the expected reduction in transport cost offered by maritime transport is annulated by the very expensive road costs created by the bad nature of roads in the country.

The Ghana Shipper Authority attempted to initiate the development of an inland port at Boankra near Kumasi in 2008 to help ease the congestion in the ports in Ghana and also to bring the port closer to the hinterland (Ghana Shipper's Authority, 2012). But the project turned out to be a bad investment because it was not well planned. Investments were made on the site without taking the railway connection, which was the bigger chunk of the project, into consideration. The whole project failed miserably but it is such a viable project that stakeholders need to bring themselves together to reconsider.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0. Introduction

The aim of this chapter is to explicate the research methodology and the theory upon which the chosen methodologies are based.

According to Leedy & Ormrod (2010) research can be defined as a systematic process of collecting, analyzing, and interpreting information (data) in order to increase our understanding of a phenomenon about which we are interested or concerned. This chapter presents a description of the methods that were used to collect and analyze the data. It spells out the research design, the population, sampling techniques, data collection and the data analysis procedures that were used to obtain insight into the existing modern technology in the Port of Tema and how it has impacted on port operations with regards to the safety of cargo and ships.

3.1 Study Area

The research was conducted at the port of Tema in relation to the technology that has been introduced by GPHA between 2003 and 2013, and the impact it has had on port operations with respect to safety of cargo and ship. Basically, the research was carried out with help from stevedore and the marine operations department of the Ghana Ports and Harbours Authority, Tema, some shippers and four shipping lines.

3.2 Research Design

A combination of qualitative and quantitative methods was used to conduct this research. This mixed method has a central premise that the use of both quantitative and qualitative approaches provides a better understanding of research problems than either approach alone.

Kothari (2004) defined a research design as the “arrangement of conditions for collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure.”

The study made use of primary data sourcing as well as secondary data sourcing approaches in relation to the subject matter. The primary source of data collection was through survey by distributing questionnaires while the secondary source of data collection was from books, published articles, and related studies from maritime reports, the internet and journals.

According to Leedy and Ormrod (2005), research studies are categorized into two broad categories, quantitative and qualitative research. Qualitative research focuses on phenomena that occur in natural settings and involves studying these phenomena in all their complexity, while Quantitative research involves either identifying the characteristics of observed phenomena or exploring possible correlations among two or more phenomena and involves not changing or modifying the situation under investigation.

Shao (2002) posited that both qualitative and quantitative research can be used together when carrying out a research. It depends on what the researcher wants to study or investigate but that must be clearly defined for the reader in understanding method used in carrying out the research.

Malhotra (2002) classifies research design broadly as exploratory, descriptive and causal research. An exploratory and descriptive design was adopted by the researcher in this research. The exploratory was used to help gain new insights into the problem and the descriptive was to help portray accurately the characteristics of the individuals and the situation being researched. Malhotra (2002) explains descriptive research as a type of conclusive research that has its major objective of describing an event or something.

A significant advantage of a descriptive survey is that it has the potential to provide a lot of information obtained from quite a large sample of individuals (Fraenkel and Wallen, 2000). In

using descriptive survey one must be critical about the questions in that they should be clear and not misleading. This is because descriptive survey results can vary significantly depending on the exact wording of questions. The results produced by this design can however be unreliable because the questions which are normally asked seek to delve into private matters of the respondents and respondents may not be completely truthful about the response (Fraenkel and Wallen, 2000).

3.3 Research Instruments

The methods used for the research were questionnaires and structured interviews. The researcher developed and used questionnaires to solicit the views of the respondents. This helped the researcher to survey a large number of respondents within a short period of time. The questionnaire was preferred to other instruments because it is judged the fastest mode of collecting data from the sample. The questionnaire is also believed to guarantee confidentiality and anonymity of respondents since it is generally self-reporting. Thereby, it elicited more responses and also less expensive compared to the other data collection techniques.

The questionnaire, as an instrument, however has some inherent problems. For instance, some of the items could be misinterpreted due to poor wording or differential meaning of terms, which might not elicit the responses expected by the researcher. However, the researcher reduced the impact by undertaking a pilot study to test the suitability of the research instrument to gather accurate data for the study. The pilot study ensured that all factors or variables that may influence the validity and reliability of the questionnaire are taken care of.

Interviews were conducted in cases where the respondents were unwilling to fill the questionnaires. A tape recorder, with permission from the interviewees, was used. The researcher needed to collect as much significant data from some selected people, in order to gain an in depth understanding of the key factors involved in the issue. The interviews helped the researcher to glean some valuable information from the interviewees and necessary

adjustments were easily made to the interview guide as a result of questions that arose due to the respondents' replies.

3.4 Target Population and Sampling

3.4.1 Target Population

The target population of the study consists of employees of Ghana Ports and Harbour Authority; specifically the marine operations department.

According to Kothari (2004), all the items under consideration in any field of inquiry constitute a 'population' or 'universe'. It defines those units for which the findings of the survey are meant to generalize.

3.4.2 Sample Size and Sampling Procedure

A sample size of 90 was used for the study. The sample size comprised of 65 employees of GPHA, 21 shippers and 4 employees of shipping lines. The respondents were selected through stratified random sampling and purposive sampling. The stratified random sampling was used in selecting the employees of GPHA and shippers to respond to questionnaire. Within each department (strata) where respondents were selected to respond to questionnaire the simple random sample was applied. The purposive was used to select the heads of the four departments of GPHA considered in this study, key informants from four shipping lines considered in this study, and another key informant who is a shipper. In all there were 82 respondents for the questionnaire and 8 interviewees.

Probability sampling was used for the research. The type of probability sampling used was stratified random sampling. In stratified random sampling, a population is first divided into subgroups, called strata, and a sample is selected from each stratum. This method was used since different cohorts or strata were used. However, simple random sampling was used within

each stratum. Simple random sampling is a sample formulated in such a manner that each item or person in the population has the same chance of being included.

Table 3.1: Population, Sampling Procedure and Research Instruments

Department	Position	Population	Sample Size	Sampling Technique	Research Instrument
Marine Engineering of GPHA	Personnel	44	14	Simple random	Questionnaire
	Manager/ Officer in charge	2	1	Purposive	Interview guide
Marine Operations of GPHA	Personnel	103	19	Simple random	Questionnaire
	Officer in charge	2	1	Purposive	Interview guide
Logistics (Marine operations) of GPHA	Manager/ Officer in Charge	1	1	Purposive	Interview guide
	Personnel	49	9	Simple random	Questionnaire
Stevedoring of GPHA	Personnel		20	Simple random	Questionnaire
Shippers in Tema Port			20	Simple random	Questionnaire
	Key informant		1	Purposive	Interview guide
Shipping lines in Tema Port	Heads/key informants		4	Purposive	Interview guide
TOTAL			90		

Source: Field Data, September 2014

3.5 Reliability and Validity

The validity and reliability of the measuring instruments influence the extent to which one can learn something about the phenomenon they are studying. They are an indication of the extent to which the researcher can draw a meaningful conclusion from the data collected. Both

validity and reliability reflect the degree to which there may be an error in the measurements (Leedy and Ormrod, 2005).

3.5.1 Reliability

Kothari (2004) was of the view that, a measuring instrument is reliable if it provides consistent results. The accuracy of the research data can be measured only when its consistency can also be measured. With regard to the questionnaire, Saunders et al (2000) describe reliability of a question in terms of whether the question and answer make sense. For a question to be valid and reliable, it has to go through these stages:

- The researcher must be clear about the information and then design the question.
- Thereafter the respondent decodes the question in the way the researcher intended.
- Then the respondent answers the question.

Lastly the researcher decodes the answer in the way the respondent intended

The questionnaire served its purpose because respondents were able to answer questions without any difficulties and the responses received gave views of the respondents. The major aspect of this is that the responses helped with addressing the main and sub problems of the research study.

3.5.2 Validity

Validity is concerned with the soundness and effectiveness of the measuring instrument. Leedy and Ormrod (2005) say that the validity of a measuring instrument is the extent to which the instrument measures what it is supposed to measure. There are various types of validity and the most common ones, according to Leedy (1997) are:

- Face validity which relies on the subjective judgment of the researcher. The researcher has to ensure that the questions are relative to the subject being investigated.
- Criterion validity which is determined by relating performance of one measure to the performance on another measure.
- Content validity is the accuracy with which an instrument measures the factors being investigated.
- External validity which is based on whether the conclusions reached in the study can be generalized.
- Construct validity which observes the honesty of the data collected.
- Internal validity which focuses on the conclusion of the study free of bias.

The secondary data collected are valid because they come from reviewed journals and books.

The data received from respondents are regarded valid as well because it is from people involved in the port industry and they know more about the marine or port industry.

3.6 Data Analysis

This is a process of converting the collected data into information so that it can serve as the factual base for recommendation and management decision. A computerized statistical analysis of the data was necessary to describe and interpret the data that was obtained from the questionnaires. A conversion was made through a computer package, Statistical Package for The Social Sciences (SPSS version 16) and Microsoft excel in order to do a descriptive analysis of the information. Based on the questionnaire, frequencies and percentages were used for all variables of this study.

3.7 Data Collection Problems

The most common problem was the unwillingness of respondents to assist the research. Some of the respondents blatantly refused to respond to the researcher regardless of the numerous efforts to let them know it was strictly for academic purposes. For this reason not all the questionnaires that were given out were received although a greater percentage (85%) were received.

Some respondents had grudges with the company, resulting in them spending more time in answering the questionnaires. The researcher had to follow up on several occasions before some of such respondents completed their questionnaires. This prolonged the period of the study which is likely to affect the validity of findings in terms of being time specific.

Another problem encountered during the data collection was with the busy schedules of some of the respondents. In view of that, the researcher had to spend several hours on different occasions to wait for some of the respondents in their offices.

The researcher also underestimated the financial commitment needed for the data collection. Moving from one respondent to the other was very financially demanding.

CHAPTER FOUR

PRESENTATION, ANALYSIS, AND DISCUSSION OF THE FINDINGS

4.0. Introduction

The previous Chapter discussed the methods of data collection. This chapter deals with the outcome of the study which would comprise the research findings, analyzing them and finally discussing the findings. The analysis took into consideration the views expressed by the interviewees who participated in the research.

The data was obtained from four (4) main departments considered to be relevant to the topic under investigation, shippers, and four shipping lines that operate in the port of Tema. The breakdown is as follows:

Table 4.0: Survey Population and Percentages of Departments Selected for the Research

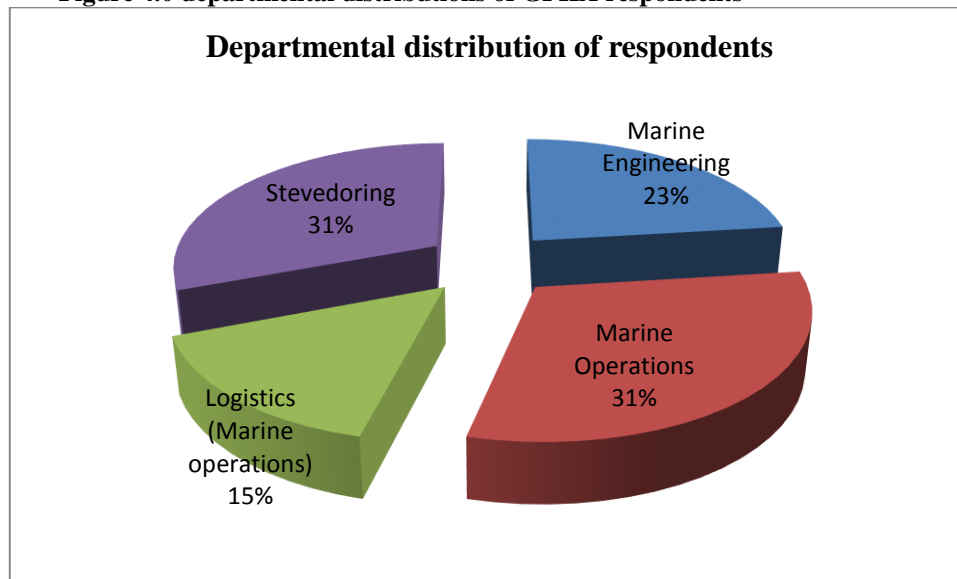
Department	Sample Size	Percentage (%)
Marine Engineering of GPHA	15	16.7
Marine Operations of GPHA	20	22.2
Logistics (Marine operations) of GPHA	10	11.11
Stevedoring of GPHA	20	22.22
Shippers in Tema Port	21	23.33
Shipping lines in Tema Port	4	4.4
TOTAL	90	100%

Source: Field Data, September 2014

With regards to the departments selected for this research, figure 4.0 indicates that out of the total of 90 respondents, majority were from shippers in the Tema port, making a percentage of 23.33 with a sample size of 21, the Marine Operations and Stevedoring departments of GPHA,

with a percentage of 22.2 and a sample size of 20 each while the shipping lines in the Tema Port recorded the least percentage of 44. Marine Engineering also comprised 16.7% of the respondents interviewed. Figure 4.0 below shows a graphical representation of the departments selected for this research.

Figure 4.0 departmental distributions of GPHA respondents



Source: Field Data, September 2014

4.1 Demographic Profile of Respondents

This section was designed to obtain information on the demographic characteristics of the respondents. As previously stated all of the respondents were from four (4) departments considered to be relevant to the study. Knowing the demographic characteristics of respondents gives the researcher an understanding of background of workers, their nature and how this impact on their response to questionnaires.

4.1.1 Gender of Respondents

On the gender of the respondents as indicated by table 4.1.1, and figure 4.1.1, 84 out of 90 respondents were males. That is, 93.33% of the respondents were males while females formed only 6.7% of the total survey sample. The males were in the majority basically as result of the

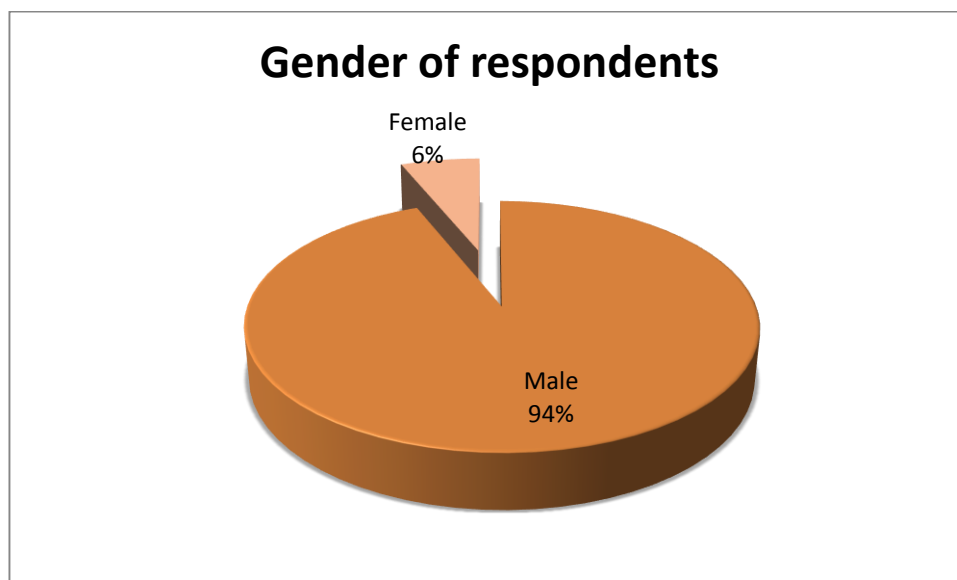
four departments considered in the study. The departments' lines of operations are tedious and require a lot of physical strength. It was therefore expected that most of the workers there would be males and data gathered confirmed it.

Table 4.1.1: Gender Distribution of Respondents

Gender	Frequency	Percent (%)
Male	84	93.33
Female	6	6.7
Total	90	100

Source: Field Data, September 2014

Figure 4.1.1: Gender Distribution of Respondents



Source: Field Data, September 2014

4.1.2 Age of Respondents

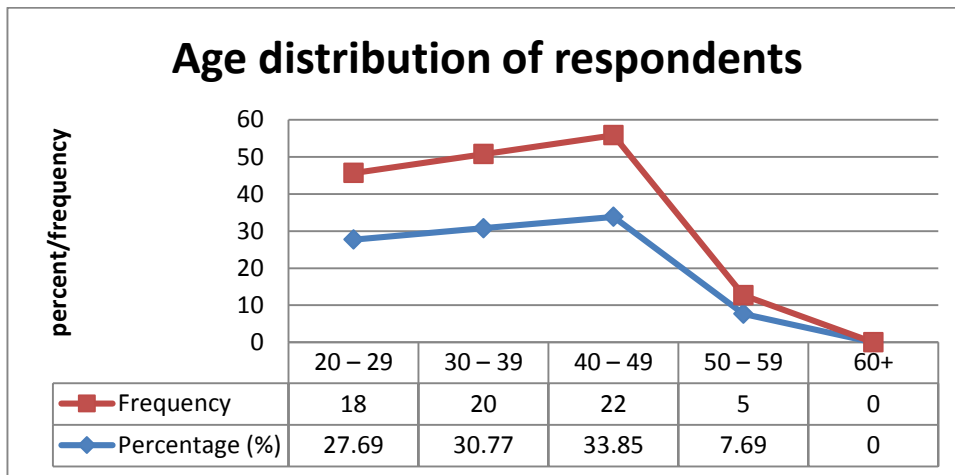
Table 4.1.2: Age Distribution of Respondents

Age Group (in years)	Frequency	Percentage (%)
20 – 29	18	27.69
30 – 39	20	30.77
40 – 49	22	33.85
50 – 59	5	7.69
60+	0	0.00
Total	65	100

Source: Field Data, September 2014

Only respondents from the GPHA were made to state their age category. The age breakdown of the respondents is illustrated in Table 4.1.2 above. The ages of the respondents ranged between 20 years and not more than 60 years. In particular 27.69% of the respondents, (18 out of the 65 respondents) were aged between 20-29 years old, followed by 30.77% (20 respondents) aged between 30-39 years old, 33.85% which represents 22 respondents were between 40-49 years old and 7.69% which represents 5 respondents were between 50-59yrs old but none of them were above 60 years. This is shown graphically below in Figure 4.1.2.

Figure 4.1.2: Age Distribution of Respondents



Source: Field Data, September 2014.

Observing from figure 4.1.2, there seems to be a positive relationship between the number of workers and age. Thus, the number of workers is seen to be increasing as the age increases. This is observed until it reached the apex age category of 40 – 49 years then the number of workers older than forty-nine years began to fall. That is at age fifty and above the number of workers in that age decreases.

4.1.3 Educational Level of Respondents

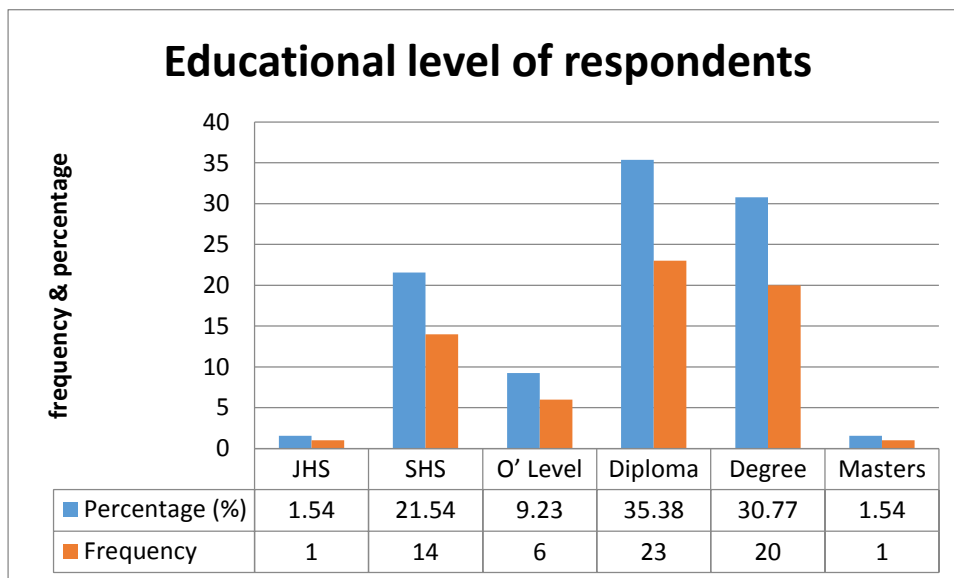
Table 4.1.3: Level of Education of Respondents

Education	Frequency	Percentage (%)
JHS	1	1.11
SHS	19	21.11
O' Level	8	8.89
Diploma	32	35.56
Degree	27	30.00
Masters	3	3.33
Total	90	100

Source: Field Data, September 2014

Table 4.3 above presents the level of education of the respondents who participated in the study. 1.11% representing 1 respondent had Junior High School education; followed by 21.11% representing 19 out of the 90 respondents had Senior High School education. 8 respondents (8.89%) had ‘O’ Level education while 32 out of the 90 respondents (35.56%) had Diploma education. 30.0% (27 respondents) degree level of education and 3 out of the 90 respondents (3.33%) had a Master’s degree. This indicates that most of the respondents are highly educated and this had a great impact on the responses. Table 4.3 is graphically represented below in figure 4.1.3.

Figure 4.1.3: Educational Level of Respondents



Source: Field Data, September 2014

The majority of the respondents hold diploma followed by first degree. Thus, with such high level of education reported by the workers, the implication here is that workers have better understanding of their work environment. They are preview to the impact of modern technology adoption in organizations and institutions such as that of the Ghana port and harbor authority. Therefore, they stand in a good position to assess the impact of modern technology on operations at the port.

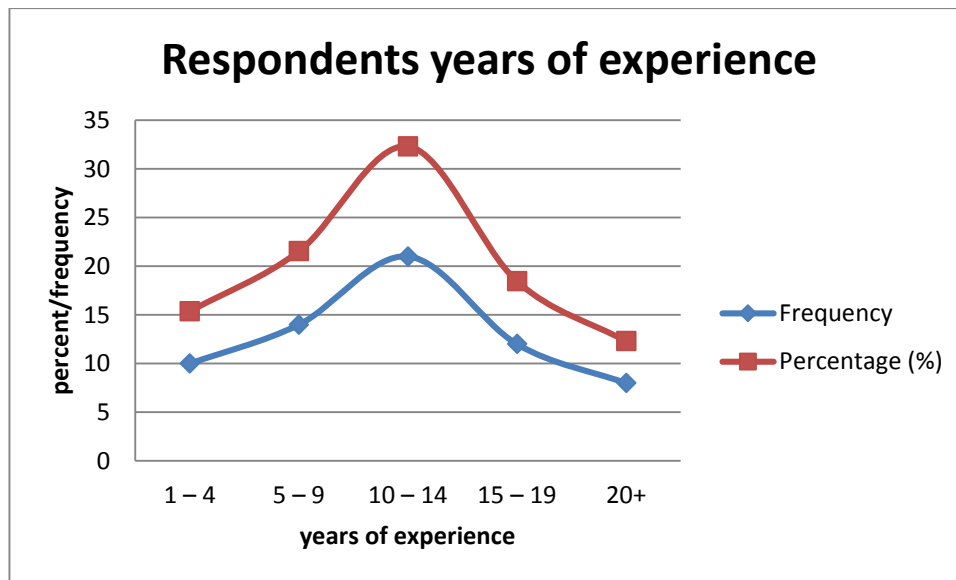
4.1.4 Years of Experience

Table 4.1.4: Number of Years of Service

Years	Frequency	Percentage (%)
1 – 4	10	15.38
5 – 9	14	21.54
10 – 14	21	32.31
15 – 19	12	18.46
20+	8	12.31
Total	65	100

Source: Field Data, September 2014

On the number of years that the respondents have worked, data was gathered on respondents who are from the various departments within GPHA. The table 4.4 indicated that 15.38% of the respondents (10 out of the 65 respondents) had worked between 1-4 years. 21.54% (14 of the respondents) had worked from between 5-9 years, followed by 32.31% (representing 21 of the respondents) who had spent between 10-14 years in service. 18.46% (representing 12 out of the 65 respondents) had spent 15-19 years in stevedoring, whilst 12.31% (also representing 8 respondents) had spent more than 20 years working in their respective departments. This is illustrated in Figure 4.1.4.

Figure 4.1.4: Number of Years of Service

Source: Field Data, September 2014

The figure 4.1.4 above indicates a normal distribution between the years of experience and the number of workers within the various categories. It is observed that as the number of workers increases, the years of experience also increases until it reaches an apex where the number of workers begins to fall as years of experience increases. Thus, years of experience for workers are highly concentrated within the middle portion from 5 to 19 years. The impact of this distribution on the study is that most of the workers have enough experience and are therefore in the position to provide adequate information regarding the adoption of modern technology in their line of duty.

4.2 New Technology Introduced into the Port since the Port Reform in 2003.

The port of Tema prior to 2003 was a service port until the government's strategic port development policy to transform the ports of Ghana from service ports to landlord ports impacted on the activities of the port of Tema. The transformation from a service port to

landlord port requires the installation of modern equipment to hasten operations at the port. As such this study sought to know modern technology that has been installed in the port to facilitate operation.

The interview conducted with the heads of the various departments revealed that most of the operations in the four departments under study have been digitalized with the installation of modern equipment such as high speed computers, CCTV camera, JCB tele truck forklift etc. Further, the heads of departments revealed that systems such as the Fiber-optic systems, vehicle tracking systems, Ghana community Network (GCNET), and multi system vessel discharge are installed within the port to facilitate operations. The various state of the art installations according to the Heads ensures a proper handling of cargo, containers discharged by vessels move through the ACS, TCT and GJT for proper scanning and checks. The head of the Marine operation department had this to say;

‘Since the port became a landlord port, there has been the installation of CCTV Cameras, fiber-optic systems, biometric identification, vehicle tracking systems, and computerized state of the art cargo handling equipment’.

The head of the marine engineering department also stated that;

‘Operations here have been digitalized and this had introduced us to electronic documentation processing and it is working very well. There are even CCTV cameras all over and this equipment (pointing to Bar code reader) ensures that goods discharged here are all captured into the system’.

The newly installed technology as mentioned by the heads of the various departments was confirmed by the workers (respondents) when asked to list new technologies installed in their departments. Thus, over 90% of the workers indicated (by listing) that there has been the

installation of computers (both hardware and software) and CCTV cameras, and over 60% listed the cargo handling equipment and the vehicle tracking system. Table 4.2 gives the distribution of new technologies installed as mentioned by the respondents.

Table 4.2.1 new technologies installed

Technology	Number of respondents	Percentage (%)
Computers	60	95.2
CCTV camera	58	92
Mobile cranes	29	46
GCNET	20	31.7
Cargo handling equipment	40	63.5
Tele truck forklift	21	33.3
Vehicle tracking system	43	68

Source: Field Data, September 2014

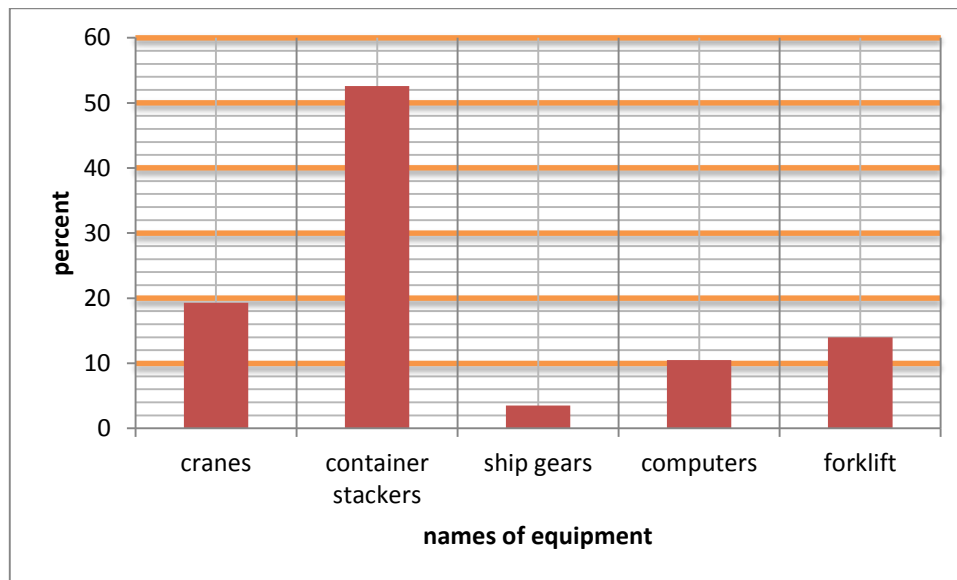
Further on the modern technological equipment, respondents were asked to indicate the technological equipment they use in the daily operations at the port. Out of the total respondents, 52.6% (table 4.2.2, figure 4.2.1) of the workers indicated that they use the container stackers. This followed by 19.3% who use the cranes in their daily activities. The forklift was used by 14% of the respondents to carry out their daily routine activities. The use of computers for daily routine activities was done by 10.5% of the respondents and only 3.5% use the ship gears in their daily activities at the port.

Table 4.2.2 Equipment workers normally use

	Frequency	percent
cranes	11	19.3
container stackers	30	52.6
ship gears	2	3.5
computers	6	10.5
forklift	8	14

Source: Field Data, September 2014

Figure 4.2.1 equipment used by workers



Source: Field Data, September 2014

From the perspective of cargo and ship interest, response from the questionnaire and interviews confirms the claims made by the GPHA staffs. Thus, from the interview with shipping lines, it came out that the selected shipping lines have operated at the port for more than a decade. Therefore, all the shipping lines attest to the fact that modern equipment has being installed and used in operations at the port. It was added that most of the equipment were installed within the past ten years after the port had been transformed to a landlord port. This is what an interviewee from the Maersk shipping line had to say:

‘The port has been improved in the past ten years. A lot of new equipment seen in other ports in the developed world is in operation here’

Another interviewee from the Delmas shipping line also mentioned that:

‘These days, unlike eight to ten years ago you really see a lot of modern equipment in operations at the port. I think either all or most of the processes at the port now have been automated and it is good for us as shipping lines’.

Further, almost all shippers who responded to the questionnaire listed more than two modern equipments that have being installed and used in operation at the port. Top on the list as mentioned by the shippers was computers. This was followed by CCTV, the vehicle tracking system, cargo handling equipment, and tele truck forklift. Table 4.2.3 below indicates the equipment and number of shippers that listed them.

Table 4.2.3 Modern equipment at the port (shippers’ views)

MODERN EQUIPMENT	FREQUENCY
Computers	20
CCTV	18
Vehicle Tracking system	17
Cargo handling equipment	15
Tele truck forklift	14

Source: Field data, 2014

4.3 Impact of Technology on Port Operations (GPHA Perspective)

This section is focused on the impact modern technology has brought to the operation of the port. The study looked at both the positive and negative impacts that technology has brought. Data for this part of analysis is both primary and secondary data. The primary data seeks to

look at the positive impacts from workers perspective and the secondary being accidents recorded since the introduction of technology obtained from GHPA, analyzing the negative impacts. The data on number of accidents recorded was complimented by workers asked to indicate their experience of accidents if any in the course of work.

4.3.1 Positive Impacts of Technology on Port Operations (GPHA perspective)

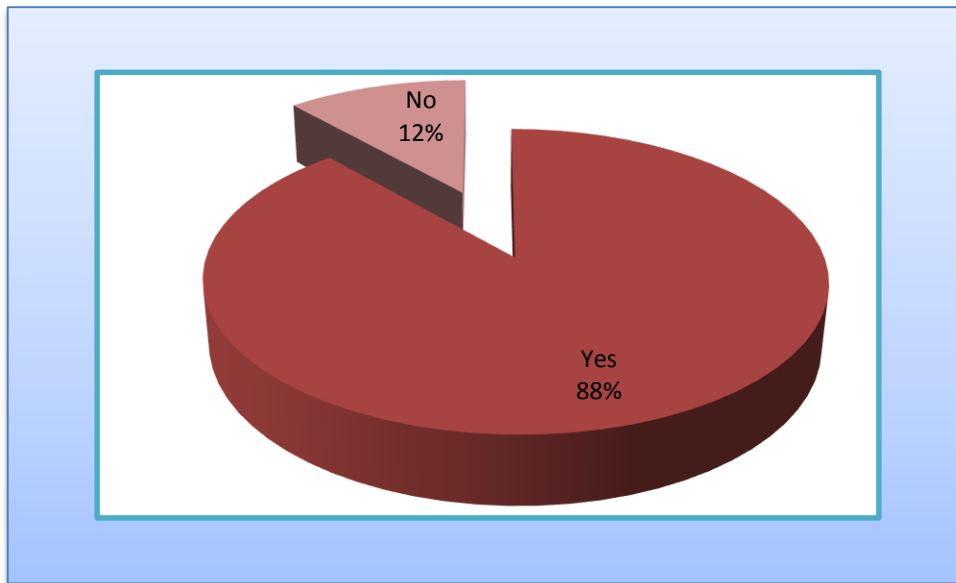
Interview with the heads (managers) of the departments indicated a positive impact in the installation of modern technology in port. They mentioned that the advantages of the new technologies have been enormous to the operation of the port. The advantages are seen in the area of record keeping, monitoring, efficiency and effectiveness of work, and safety at work. One of the heads mentioned that;

‘Technological equipment installed has made record keeping easy. The equipment makes it easy to monitor the work environment without causing any fatalities and also readily makes information about cargo available making the work a bit easier and faster’.

Another head (manager) added that;

‘electronic systems installed has helped reduced fraud that was with the old system of operation, speed up work, and also reduced the occurrence of accidents within the port’.

The advantages of the modern technology in the operation of the harbor as revealed from the interview were confirmed by the respondents (workers) of the questionnaire. Majority of the workers that is about 88% (figure 4.3.1) pointed out that, the installation of modern technology at the port has been advantageous and has impacted positively in their line of duty at the port. All the 88% of the respondents agreed that the use of the technological equipment has increased safety at the port.

Figure 4.3.1 Modern technology advantages in safety

Source: Field Data, September 2014

Further, respondents were asked to state some of the positive impacts the installation of modern technological equipment had brought to their work, their response was no different from that of the heads interviewed. Thus, they mostly stated that the technological equipment have made them work effectively and efficiently, the use of the equipment has reduced accidents and pollution in the port, has made information sharing between subordinates and superiors and shipping agents easy, and reduced pilfering and fraud within the system.

This is what one respondents from the logistic department stated;

‘the new equipment have enhanced efficiency in plant operation, reduced accidents, improved the safety of cargo, and improved the flow of information’.

Another respondent from the marine engineering department also stated;

‘The installation of the new equipment has been more advantageous because, accidents in the operation field have reduced and has sped up work’.

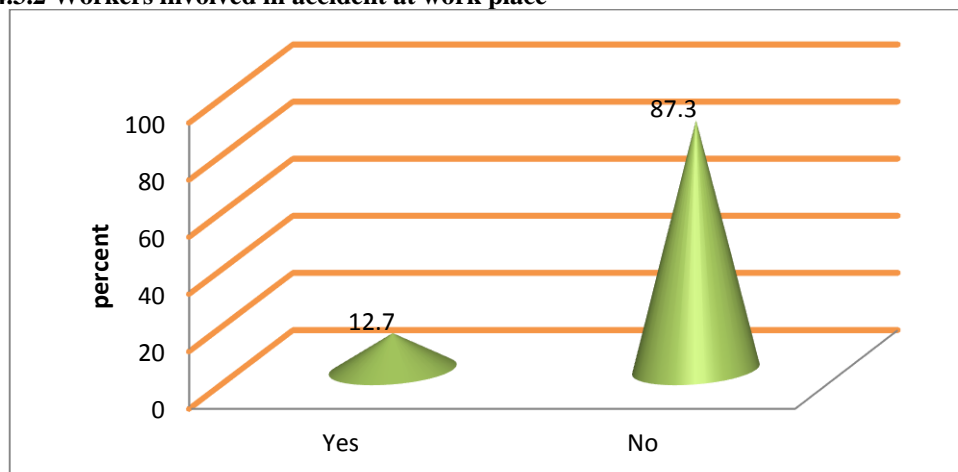
From the operation section of the logistic department, this respondent mentioned that;

‘air pollution has reduced because the new equipment have air conditioners installed in them, therefore, operators need not to open their cabin to inhale poisonous gases and dust around the working area’.

4.3.2 Negative Impact of Technology on Port Operations (GPHA Perspective)

An attempt to analyze the negative impact of modern technology from the workers perspective was made by asking workers to indicate whether they have been victims of any accident in the use of the newly installed equipment and the nature of the accident. Data gathered revealed that only a few of the workers have had accidents in the cause of operating equipment. As presented in the figure 4.3.2 below, only 12.7% of the workers have had accidents in the cause of operating the equipment. Even though a number of workers involved in accidents were few, cut was high on the list. Five out of the 8 workers involved in accidents were cuts from one of the sharp equipment, 2 was vehicles that had bust tyre, and the remaining one the worker tripped and fell as result of slippery floor.

Figure 4.3.2 Workers involved in accident at work place



Source: Field Data, September 2014

The low level of accidents as indicated by the workers in the cause of operating equipment can be attributed to the fact that workers were mostly trained and assessed after the training before fully given the chance to operate equipment. This was revealed from data gathered where about 75% (table 4.3.2) of the workers pointed out that they were given training regarding the use of the equipment and 89% (table 4.3.2) of those trained were assessed before handing of equipment to use.

Table 4.3.2 training and assessing of respondents before use of equipment

Trained on equipment	frequency	Percent (%)	Assessed after training	Frequency	Percent (%)
Yes	46	75.4	Yes	41	89.1
No	15	24.6	No	5	10.9

Source: Field Data, September 2014

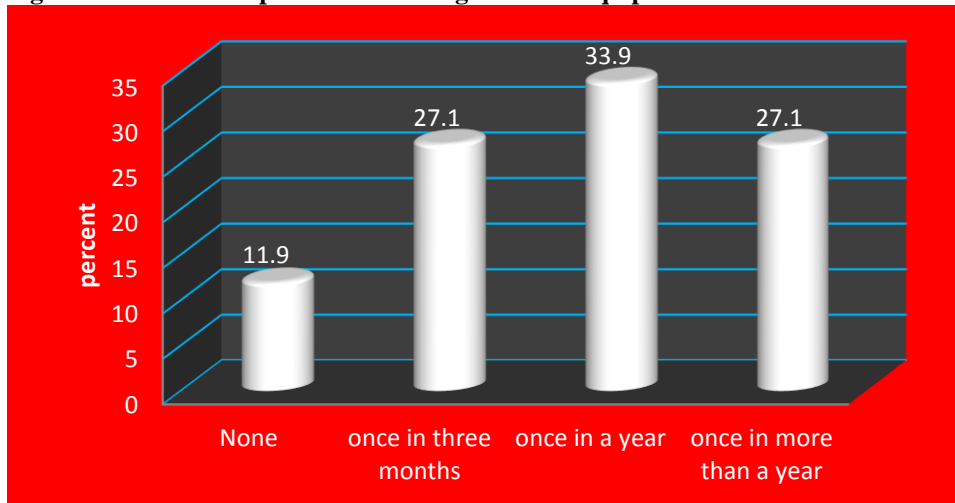
The initial training of the workers on the use of the equipment was not the only training given to the workers. About 88% of the Workers revealed that there are periodic personnel training. Only 11.9% indicated that there have been no further personnel training on the use of equipment after the initial training. Out the workers who mentioned that there periodic personnel training, about 27.1% each stated that they undertake personnel training once every three months and once in more than a year. The remaining 33.9% are taken through personnel training on equipment use once very year. This is presented in the table 4.3.3 and figure 4.3.2. Such periodic training given to workers is a contributing factor to the low rate of accidents as reported by the workers.

Table 4.3.3 Period of personnel training on use of equipment

	frequency	Percent
None	7	11.9
once in three months	16	27.1
once in a year	20	33.9
once in more than a year	16	27.1

Source: Field Data, September 2014

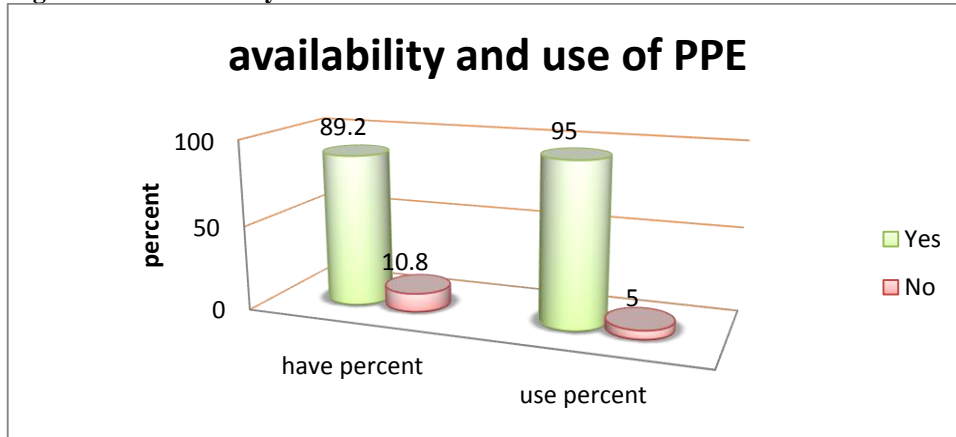
Figure 4.3.3 Period of personnel training on use of equipment



Source: Field Data, September 2014

Furthermore, the low accident rates in the use of equipment can also be attributed to the high rate of access and usage of personal protective equipment. Thus, the study observed that about 89.2% of the workers interviewed had the required personal protective equipment and 95% of them use it regularly in undertaking their duties. This presented in the figure 4.3.2 below

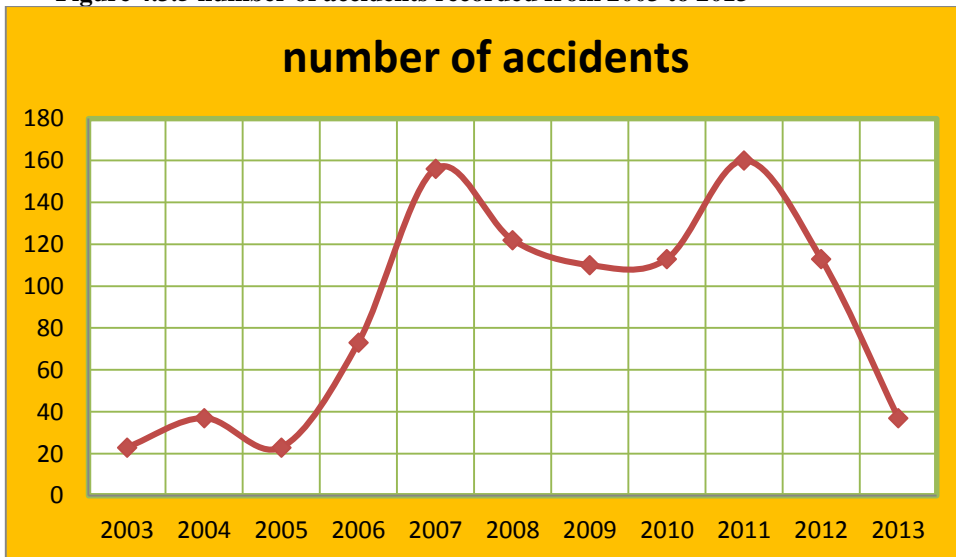
Figure 4.3.4 availability and use of PPE



Source: Field Data, September 2014

The data gathered regarding workers who have been involved in accidents in the course of operating a machine seems to be contrary to accident records that have occurred from 2003 to 2013. Records of accidents made available to the researcher show an increasing trend in the occurrence of accidents from 2003 when the port was transformed to a landlord port. Figure 4.3.4 shows the trend of accidents that has been recorded from 2003 to 2013 obtained from Ghana ports and harbors authority.

Figure 4.3.5 number of accidents recorded from 2003 to 2013



Source: GPHA, 2012 . constructed by researcher, September 2014

From the figure above, the least number of accidents were recorded in 2003 and 2005 and in both years 23 accidents occurred. The number of accidents increased from 23 in 2005 to 73 in

2006 and then to 156 in 2007. Even though the number of accidents declined from 2007, the number of accidents between 2008 and 2010 was still above one hundred. In the year 2011 the number of accidents recorded was 160 the highest for the period under consideration but thereafter, the number of accidents have decreased for the last two years.

Focusing analysis on the types of accidents that occurred for period under consideration, cuts is observed to be the most frequent accidents that occur. This observation is confirmed by data gathered as majority of the workers who have had accidents were cuts from sharp parts of equipment. Following cuts in terms of frequency of occurrence is trips and fall, and then dislocation. Sprain is the least occurred accident among the types of accidents. It occurred only once in 2012. The table 4.3.4 presents the number of accidents classified under the various types of accidents for the period 2003 to 2013.

Table 4.3.4 Number of accidents for the various types of accidents for the period 2003 to 2013

year	cuts	dislocation	fatality	fracture	laceration	puncture wounds	sprain	trips/falls	vehicle	Hits	forklift	not recorded
2003	17	9	0	9	9	4	0	4	0	0	0	0
2004	3	3	6	11	0	3	0	37	3	0	0	20
2005	39	9	9	0	0	0	0	9	0	0	0	0
2006	47	15	3	15	0	0	0	15	0	0	0	0
2007	25	8	1	8	0	0	0	0	0	0	0	0
2008	37	13	1	0	0	0	0	0	0	0	0	0
2009	0	0	1	0	0	0	0	0	0	0	0	0
2010	25	0	1	0	0	1	0	42	3	22	0	0
2011	30	1	3	1	2	3	0	53	3	26	3	0
2012	25	1	5	1	2	2	1	50	1	0	1	17
2013	17	1	4	1	0	0	0	4	1	0	1	4
total	265	60	34	46	13	13	1	214	11	48	5	41

Source: GPHA, 2012

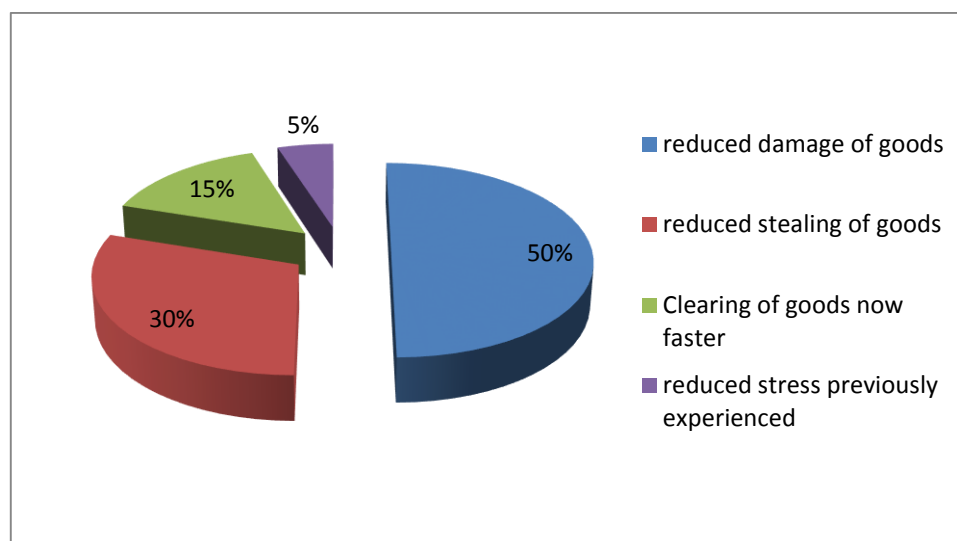
4.4 Impact of Technology on Port Operations (Cargo and Ship Interest Perspective)

The impact of technology in the operation of port of Tema was assessed from the perspective of individuals and organizations that have interest in the safety of cargo and ship. As a result, 20 shippers responded to questionnaire and 5 interviews conducted for four shipping lines and a shipper. The study looked at both the positive and negative impacts that technology has brought from the perspective of cargo and ship interest.

4.4.1 Positive Impact of Technology on Port Operation from the Perspective of Cargo and Ship Interest

The introduction of new technology in the operation at the port of Tema is observed to be beneficial to shippers and shipping lines that operate within the port. From the angle of the cargo and ship interest parties, four benefits were outlined. These included; reduced damage to goods, reduced stealing of goods, increased speed at clearing, and reduced stress that was previously experienced.

Figure 4.4.1 positive impact of technology on port operation



Source: Field Data, September 2014

From the figure 4.4.1 about half of the respondents who are made up of the interest group in cargo and ship revealed that the introduction of modern technology in operation at the port of Tema has helped reduced damage to imported goods at the point of offloading the goods. The reason was cited that, manual operations at the port have reduced and this has reduced manual loading and off-loading of goods. Another 30% made mention that the installation of modern technology, most especially, the CCTV cameras have reduced the stealing of goods drastically. Further, the increased speed in the clearing of goods was mentioned by 15% of the shippers interviewed with 5% mentioning the reduction in stress as the positive impact the new technology has brought to the port.

In an interview with one shipper who was the key respondents confirmed the response from the other shippers who responded to the questionnaire. This is what the shipper had to say;

‘The transformation of the harbor to landlord port has increased security for goods that we import as a result of the installation of modern technologies within the harbor. The newly installed technologies have also reduced clearing time for the goods’.

Further, interviews with the shipping lines outlined positive impacts of technology on the operation of the port in confirmation to that already outlined by the shippers and to some extent the workers of GPHA. Basically, the shipping lines mentioned that off-loading of cargos and containers from the ships are faster and easier than it used to happen in the past. In addition to this impact brought about by the installation of new technologies in the harbor, the shippers mentioned that the security of goods and cargos at the port has now increased. Thus, complaints about missing goods have now reduced drastically. This is what an interviewee from PIL shipping line had to say;

'We no longer receive a lot of complaints from our clients about stolen goods and damage of goods. I think the installation of CCTV cameras have helped in this direction. Formerly, people intentionally damage goods so they could take them away for free but this has really reduced'.

Another interviewee from Grimaldi ship line also mentioned that;

'Due to the automation of operation within the port, off-loading of cargo and containers have been relatively faster than when it used to be manual operation. This has really helped our business as we are able to make relatively more trips than it used to be'.

4.4.2 Negative impact of technology on port operations from the perspective of cargo and ship interest

From the perspective of cargo and ship interest, the installation of modern technology have had no significant negative impact on their operations as shippers and shipping lines. The only negative impact which was unanimously mentioned by both the shippers and the shipping in both the questionnaire and interviews was the frustration they go through when there is a system break down. This is because work comes to a standstill as operations cannot be carried out manually. Further, the cargo and ship interest respondents identified that there are quite a lot of minor accidents that are observed. Thus, GPHA staffs that operate some of the modern equipment sustain minor injuries in somewhat regular interval. Even though this has no direct impact on them, it affects their operations indirectly. Thus, the injuries leads off loading of cargos and containers, and clearing of goods delays because the equipment operators from GPHA are involved in the carriage of the cargos and containers.

4.5 Challenges with Port Operations

With the transformation of the port to a landlord port and the introduction of modern technology in operation at the port, this section of the study sought to analyze the challenges faced by workers with regards to the safety of cargos. Data gathered revealed that equipment needed for operations are easily accessible most especially when a department or a worker has requested for use or is assigned to use the equipment for operation. One of the heads had this to say;

‘Requests are put forth by the user department upon which equipment are supplied. We also ensure a number of equipment is always available for the task operation unit’.

The claim of the heads on the accessibility of equipment was confirmed by almost all the respondent workers. Thus, about 95% out of the total workers interviewed made statements similar to that of the heads. For instance one worker from the marine engineering department stated that;

‘Operation equipment is accessible if you have been allocated to work with it either during the day or the night shift’.

Another worker from the stevedoring department also said this;

‘The equipment is accessible after an operator has been given the green light to work at the operations department whenever there is a vessel’.

Other areas where challenges were possible to arise were also analyzed. With regards to safety procedures that operators were expected to go through were duly done as data from interviews revealed. Interview with heads disclosed that operators of equipment are taken through routine training on safety measures and are also encourage to regularly using their personal protective

equipment. This is revealed in the words of the heads of departments and the workers that were interviewed. The head at the marine operation stated that;

‘In the event of loading jute sacks, workers are taught to wear nose mask and protective eye goggles’.

A senior staff at the logistic department mentioned that as part of safety procedures

‘An operator does pre-operational checks of the machine before using the machine and post-operation checks after the close of work’.

One other worker stated that as part of the safety procedures ‘

‘one has to be in reflective jacket and safety shoes, do daily checks on the machine (e.g. engine oil, hydraulic, radiator tank, water level etc.), and check if the equipment is in good condition before proceeding to the allocated job side’.

Therefore, based on what is said by workers and their heads of departments, it can be concluded that there are no challenges with regards to the accessibility of equipment for daily routine work, and safety procedures expected of equipment operators.

The issue of communication is also observed not to be a challenge or of little challenge in the port. This stems from the fact that majority of the worker agreed to have marks and signals that serve as communication with safety around their area of operation. Thus the table 4.4.1 shows that about 70% of the workers have marks and signals that serve as communication language in their area of operation. Only a few of the workers that is 30% indicated there are no marks and signals at their area of operation. These few may be workers whose major tasks are based in the office environment, although this was not information sought from the interviews.

Table 4.5.1 Communication marks at area of operation

	frequency	Percent
Yes	42	70
No	18	30

Source: Field Data, September 2014

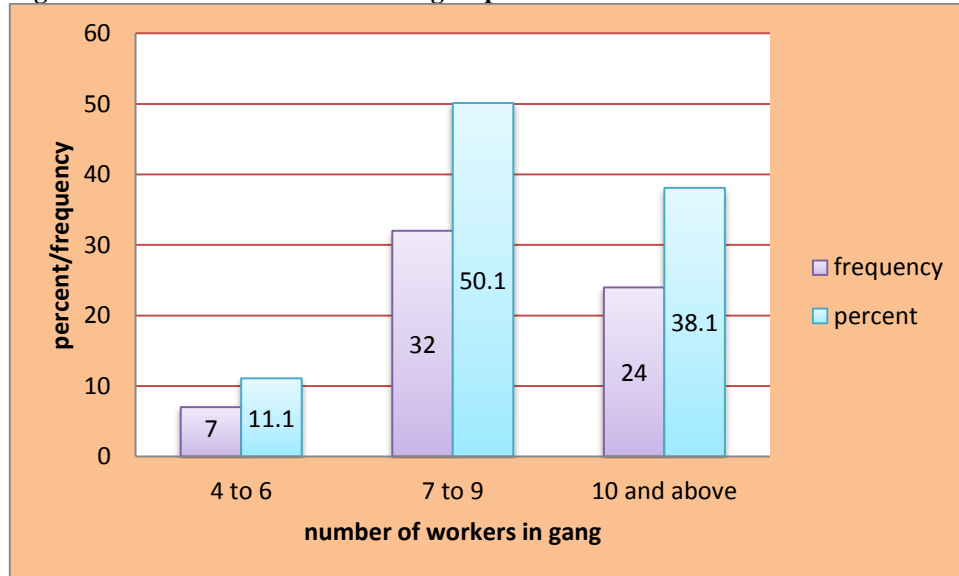
An attempt to understand the work schedule of workers was a form of challenge to them. In the quest to do this, questions were asked regarding the number of workers in a gang and the standard number of hours worker work. From Table 4.4.2, it observed that workers are made to work in groups of four and above. About half (50.1%) of the workers work in groups made of 7 to 9 members and this was followed by groups made up of 10 or more members. This work group recorded 38.1% of the respondents being in such work groups. Only about 11.1% are in work groups made up of 4 to 6 members.

Table 4.5.2 Number of workers in a group

	frequency	Percent
4 to 6	7	11.1
7 to 9	32	50.1
10 and above	24	38.1

Source: Field Data, September 2014

Figure 4.5.1 Number of workers in a group



Source: Field Data, September 2014

The respondents also revealed that their working hours to be mostly eight hours. Thus, 59.7% indicated that their standard working hours is eight hours followed 16% of the workers who work for six hours. Form the table 4.4.3 only 3.2% of workers work for more than ten hours.

Table 4.5.3 Working hours for equipment operators

	frequency	percent
4 hours	8	12.9
6 hours	10	16.1
8 hours	37	59.7
10 hours	5	8.1
more than 10 hours	2	3.2

Source: Field Data, September 2014

Based on the number of members in a gang they work with and their standard working hours, respondents were asked to indicate if their work arrangement is a challenge to their

performance of duty with modern technology, almost all the workers revealed that they face no challenge in terms of their work schedule.

The only challenge in the area of operation was on the roads and platforms provided for operations. Thus, the workers indicated that the roads are full of potholes and this makes the use of vehicles and other equipment very frustrating and tiring. Further, there were complains of platforms provided for work being old and weak. This is what one worker said;

'The roads in the port and the platform provided for operations are full of potholes and slopes, and there are too much obstacles which are very dangerous for operation'.

4.6 Challenges in Port Operations (Perspective of Cargo and Ship Interest)

The interviews with shipping lines brought out that the challenge faced by the shipping lines is the limited number of berths at the port which as a result increases the time and days to unload and load goods. Even though this seen as the challenge, shipping lines interviewee acknowledged the fact that this in recent times have reduced the time spent at and the inconveniences and attributed the reason to the automation of most processes in the port. An interviewee from the Grimaldi shipping line had this to say:

'Oh, the only challenge I will say we face as shipping lines is the limited number of berths at the port. Sometimes a ship arrives and the berths are all occupied so the ship has to wait for some to finish and leave before it can come to berth. This actually increases shipping days which cost us a lot'

Another interviewee from the PIL shipping line added that:

‘The automation of activities at the port by way of installing modern equipments has help reduced the times ship spend at berth but because the number of berths are limited, the impact of the automation is largely becoming insignificant’

Further, the shippers in their responds to the challenges they face at the port in terms of its operation, mentioned that they still face the challenge of stolen goods and damaged goods. Thus, they revealed that in every consignment that they ship, some goods will be stolen or damaged. This was unanimous as all twenty (20) shipper respondents stated this as their only challenge at the port. In spite of this being their major challenge, they confirm that it has drastically reduced.

4.7 Discussions of Findings

The analysis from the data obtained indicated that males dominated in this study. This can be attributed to the type of work been too tedious for women who are physically not as strong as men. Respondents were also found to be made up of people in the vibrant age range who can work well and efficiently in the harbour environment where a lot of physical strength is needed and also with a literate workforce which in the case of the introduction of new technologies, less funds will be spent in the training of workers to adopt to the changing trends.

New technologies in terms of modern equipment such as high speed computers, surveillance cameras, JCB tele truck forklift, Fiber-optic systems, vehicle tracking systems, biometric identification, computerized state of the art cargo handling equipment and multi system vessel discharge are technologies that have been installed at the harbour since the Strategic Port Development Policy which ensures a proper handling of cargo. These systems will also help check and safeguard properties as well as reduce occupational hazards. These technologies also makes communication during the line of duty between workers much easier unlike it was

previously when workers resorted only to the use of signals and gestures in communication as pointed out by Davis, (2003). These systems also ensure proper documentation, easy tracking of goods and a much easier retrieval of information concerning items which was likely not the case prior to the introduction of technology. The introduction of these technologies over the years has brought some advantages in the area of record keeping, monitoring, efficiency and effectiveness of work, and safety at work while also minimizing the likelihoods of fraudulent activities. This finding is similar to findings of Kia *et al.* (2000) in their study ‘the importance of information technology in port terminal operations’ which revealed that Electronic devices employed in container terminals reduced the manual effort and paper flow, facilitated timely information flow and enhanced control and quality of service and decision made. From the point of view of cargo and ship interest, the installation of the modern equipment have helped reduced the rate at which goods were stolen and damaged. In addition it has also reduced the time ships spend at berth and this has hastened the transportation of goods through the port of Tema.

Even though there was still records of accidents after the introduction of technologies in the port operation it could be noted that they were not as a result of the introduction of these new technologies but as a result of some poor safety measures during duties with which occupational hazard cannot be completely dealt with. The reduction therefore in the accidents recorded after the introduction of the technologies indicates a positive effect of the technologies. The reduction in accidents as pointed out by findings of the study can be attributed to the training given to workers and the use of protective equipment. This finding is different from that of Meletiou, (2006) who attributes the reduction in accidents (fatal) to factors such as changes in patterns of employment, with movement away from hazardous industries, economic trends, and implementation of quality management systems. His

accession that lower rate of accidents is as a result of higher unemployment cannot be confirmed by this study as data on employment rates do not form part of the focus of the study.

From the analysis, worker respondents from GPHA made mentioned that their challenge in operations at the port was the poor roads within the port and the weak platforms that they work with. Therefore, in explaining the challenge raised by the cargo interest (shippers) that is their challenge of stolen and damaged goods, reasons can be attributed to poor roads and weak platforms. Thus, because the roads are in poor conditions and full of pot holes, movement of the goods by vehicles will be in slow and shaken manner, at this point theft can occur or goods can fall off the vehicle and get damaged. Further the weak platforms can also cause damage to the goods as goods can fall off from the platforms.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSION AND RECCOMENDATION

5.1 Summary of Findings

This chapter outlines a summary of the main findings, conclusion and recommendations. In order to address the objectives stated in chapter one, a combination of stratified random sampling and purposive sampling technique was used to select 90 respondents from the Ghana Ports and Harbors Authority (65 respondents), shippers in the Tema port (21 respondents) and shipping lines in the Tema Port (4 informants). The four departments from GPHA, deemed to be relevant to this study, included the Marine Engineering, Marine Operations, Logistics and Stevedoring departments of which 15, 20, 10 and 20 respondents selected respectively making the sample size of 65 respondents.

This study therefore focused on four specific objectives. Concerning the first objective which was to determine the new technologies introduced into the port since the port reform in 2003, it was found that since the transformation from a service port to landlord port, there has been the installation of modern equipment which has helped in the operations of the Tema Ports. These technologies included computers, CCTV cameras, JBC tele truck forklift, vehicle tracking systems, mobile cranes, Cargo handling equipment and fibre optic systems which has helped in the proper handling of cargo, good record keeping, easy tracking of goods, and reduced port accidents. These technologies has improved the working conditions and aided in the safety of both goods and workers at the Tema port.

The second objective of the study which was to identify areas in the port operations that technology has made much impact, both positive and negative as regards the handling of vessels and cargo, the analysis revealed that, advantages of these technologies are seen in areas

of record keeping, monitoring, efficiency and effectiveness of work, and safety at work which makes work at the ports much easier and faster. Installation of these technologies also reduces fraudulent activities at the ports and also occupational hazards have reduced which has improved work safety. On the other hand, work safety cannot be fully guaranteed since port operation involves the use of machines. In the operation of some of the technologies that were introduced recorded accidents though this was in the minimal. This however, cannot be solely blamed on new technologies but on the safety measures employed in port operations and also in the use of these equipment. None-the-less, the disadvantages recorded since the introduction of these technologies has been very minimal as compared to the previous years prior to their introduction.

Thirdly, the study sought to identify the challenges with port operations in terms of safety of cargo and ships with keen regard to technology at the port of Tema. The data gathered and analyzed indicated a positive outcome as there is easy access to equipment needed for the Port operations, regular training and good safety procedures. With regards to challenges workers face, there was no challenge with regards to the accessibility of equipment for daily routine work, safety procedures expected of equipment operators and communication signals on duty. None-the-less, the poor nature of the roads within the port and the platforms provided for operations posed as the only challenges in the port operations. The weak platforms and bad roads pose serious risk in operations

5.2 Conclusion

Technology has become part of everyday activities and its usage has improved lives and work. It has simplified work and increased productivity in many ways. The Tema port therefore saw an introduction of technology in its operations from the year 2000, when the program to increase private sector participation in the provision of services and facilities to ships and cargo

started. Therefore the introduction of the private companies into the port operations through the Landlord port management system increased the technologies used at the ports.

Conclusion can therefore be drawn from this study that since the transformation from service port to landlord port management, private companies have increased technologies at the port and this has improved port management, record keeping and safety of workers. The introduction of technologies such as communication technologies have reduced the port related accidents among workers while others such as computers, forklifts and cameras have helped overcome previous challenges such as records keeping and easy goods tracking, safe cargo movement and fraudulent activities in the port operations.

The findings in this study were all in accordance with the objectives set in the chapter one and therefore answers the research questions earlier raised.

5.3 Recommendation

The fourth objective of this study was to propose key steps that can be implemented to ensure that the port of Tema catches up with the rest of the developed world in terms of safety of cargo and ships when it comes to modern technology. Therefore, based on the discussion of results from the analysis of data, the following recommendations are made for consideration.

Firstly, there is the need for the rehabilitation of the roads within the port's roads to promote easy and smooth movements of machines during work. Pot holes within the ports which slows down work on the ports due to drivers delaying in movement from one place to the other must be worked on and a maintenance team also set up to help maintain the roads.

Secondly, the structures within the harbor need to be changed or renovated. The study revealed that one of the challenges of port operation was weak structures and platforms. It is therefore recommended that the port authorities should engage in a routine checkup and maintenance of the platforms to avert any possible port accidents since this could be fatal.

Again, it is recommended that danger signs be placed at vantage points to prevent minor accidents which could be caused by slippery surfaces. Workers should also be trained on proper handling of tools to prevent injury from these tools and the appropriate protective cloths be provided for workers.

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APPENDIX A: Number of accidents for the various types of accidents for the period 2003 to 2013

year	cuts	dislocation	fatality	fracture	laceration	puncture wounds	sprain	trips/falls	vehicle	Hits	forklift	not recorded
2003	17	9	0	9	9	4	0	4	0	0	0	0
2004	3	3	6	11	0	3	0	37	3	0	0	20
2005	39	9	9	0	0	0	0	9	0	0	0	0
2006	47	15	3	15	0	0	0	15	0	0	0	0
2007	25	8	1	8	0	0	0	0	0	0	0	0
2008	37	13	1	0	0	0	0	0	0	0	0	0
2009	0	0	1	0	0	0	0	0	0	0	0	0
2010	25	0	1	0	0	1	0	42	3	22	0	0
2011	30	1	3	1	2	3	0	53	3	26	3	0
2012	25	1	5	1	2	2	1	50	1	0	1	17
2013	17	1	4	1	0	0	0	4	1	0	1	4
total	265	60	34	46	13	13	1	214	11	48	5	41

Source:

GPHA, 2014 (Fire and Safety Department)

APPENDIX B

APPENDIX C

RESEARCH QUESTIONNAIRE

DISSERTATION TOPIC: TECHNOLOGY AND ITS IMPACT ON PORT OPERATIONS AT THE PORT OF TEMA WITH RESPECT TO SAFETY OF CARGO AND SHIP (2003–2013)

Preamble:

I am a graduate student of the Regional Maritime University, Nungua-Accra. I am conducting a research on the above dissertation topic. This research is in partial fulfillment for the award of Master of Arts Degree in Ports and Shipping Administration. You have been selected to assist the study by providing candid answers to the following questions on the subject. Your responses will be used solely for the intended purpose and be treated with utmost confidentiality. Thank you.

Please tick as appropriate where applicable.

SECTION A

GENERAL INFORMATION

1. Age group (in yrs.): (a) 20-29 [] (b) 30 -39 [] (c) 40-49 [] (d) 50 - 59 [] (e) 60+ []
2. Level of education: a) J.H.S [] b) S.H.S [] c) Diploma [] d) Degree [] e) Any other, please specify.....
3. Name of Department/ Section
.....
4. How long have you worked with this department? (In yrs.)
(a)1-4 [] b) 5 -9 [] c) 10 – 14 [] d) 15 – 19 [] e) 20+ []

SECTION B

5. Which modern technology has been introduced into your department between 2003 and 2013?
.....
.....
.....

6. Which equipment do you normally handle in your daily work?

(a) Cranes [] (b) Container stackers [] (c) Gantry cranes [] (d) ship gears [] (e) Any other(s) specify.....

7. Were you trained in the use of such equipment?

(a) Yes [] (b) No []

8. If yes for how long?

9. Were you assessed after the training before given full charge of it?

(a) Yes (b) No

10. Have you ever been involved in any work accident or incident as a result of the use of any port equipment?

(a) Yes [] (b) No []

13. If yes, what was the nature of this accident or incident?

.....

14. How often do you have personnel training for the equipment you use?

.....

15. Do you have required personal protective equipment (PPE)?

(a) Yes [] (b) No []

16. Do you always wear your PPEs before starting the day's work?

(a) Yes (b) No

17. If No why?

.....
.....
.....

18. In your view has the introduction of the modern technology been more advantageous when it comes to safety issues? Please give reasons for your answer.

(a) Yes [] (b) No []

.....
.....
.....
.....

SECTION C

NUMBER OF PEOPLE IN A GANG AND WORK SCHEDULE

19. What is the number of people in each gang?

(a) 3 (b) 5 (c) 7 (d) 10

20. What are the standard working hours for an equipment operator?

(a) 4hours (b) 6 hours (c) 8 hours (d) 10 hours

21. How are the work floor arrangements of the operations done?

.....
.....
.....
.....

22. How accessible are the equipments needed for operations?

.....
.....
.....

23. What are the safety procedures/ orientation of work that an operator of equipment is expected to go through?

.....
.....
.....

24. Are there any marks and signals around the operational areas of work which serve as a communication language with respect to safety or the safety of operations?

(a) Yes (b) No

APPENDIX D

RESAERCH QUESTIONNAIRE

DISSERTATION TOPIC: TECHNOLOGY AND ITS IMPACT ON PORT OPERATIONS OF THE PORT OF TEMA WITH RESPECT TO SAFETY OF CARGO AND SHIP (2003 – 2013)

I am a graduate student of the regional maritime university, Nungua – Accra. I am conducting a research on the above dissertation topic. This research is in partial fulfillment for the award of Master of Arts degree in ports and shipping administration. You have been selected to assist the study by providing candid answers to the following questions on the subject. Your responses will be used solely for the intended purpose and be treated with utmost confidentiality. Thank you.

Please tick as appropriate where applicable.

FOR SHIPPERS ONLY

1. Gender [] male [] female
2. Educational level [] J.H.S [] SHS [] Diploma [] degree [] masters
3. Period of operation [] one to five years [] six to ten years [] more than ten years
4. If you have operated in the port for ten or more years, what is the difference in operation at the port in recent times compared to previous years?

.....

.....

.....

5. What new technologies or equipments do you see being used in operating in the port?

.....
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6. Do you think these new technologies have contributed positively to operations in the port, especially in your line of business? Yes No

If yes in what way(s) has the new technologies contributed to port operation in terms of cargo and ship safety?

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If no in what ways has affected you negatively

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7. Do you see any negative impact of these new technologies in line of operation? Yes No

If yes what are these negative impacts

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If no why

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8. Despite the installation of modern equipment within the port to help its operation, are there challenges you face as shipper? Yes NO

If yes what are these challenges?

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APPENDIX E

INTERVIEW GUIDE

1. How long have you worked with this department? (In yrs.)
2. Which modern technology has been introduced into your department between 2003 and 2013?
3. Are all personnel trained in the use of such equipment?
4. If yes for how long?
5. Were they assessed after the training before given full charge of it?
6. Has there ever been any form of work accident or incident as a result of the use of any port equipment?
7. If yes, what was the nature of this accident or incident?
8. How often do you have personnel training for the equipment used?
9. Do you have required personal protective equipment (PPE)?
10. Is it a policy to wear these PPEs before the start of work?
11. If No why?
12. In your view has the introduction of the modern technology been more advantageous when it comes to safety issues? Please give reasons for your answer.
13. Have there been any claims made as a result of destruction to containers and cargoes due to equipment used.