# Høgskulen på Vestlandet

## MMO5017 Master thesis

MMO5017-MOPPG-1-2022-VÅR-FLOWassign

### Predefinert informasjon

| | | | |
|---|---|---|---|
| **Startdato:** | 22-04-2022 14:11 | **Termin:** | 2022 VÅR |
| **Sluttdato:** | 03-06-2022 14:00 | **Vurderingsform:** | Norsk 6-trinns skala (A-F) |
| **Eksamensform:** | Master thesis | | |
| **Flowkode:** | 203 MMO5017 1 MOPPG-1 2022 VÅR | | |
| **Intern sensor:** | (Anonymisert) | | |

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# AN EVALUATION OF EFFECTIVE MAINTENANCE PRACTICES ONBOARD SHIP ON NIGERIA WATER

**BY**

**RAJI MUDASIRU**

**A THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENT OF WESTERN NORWAY UNIVERSITY OF APPLIED SCIENCE FOR MASTERS PROGRAM**

**THE RESEARCHER DECLARES THAT THE RESEARCH STUDY IS RESULT OF HIS INDEPENDENCE STUDIES, EXCEPT WHERE STATED**

## ABSTRACT

Machinery or mechanical equipment needs to be maintained in order to function properly. Whether it's a massive machine or small machine, appropriate maintenance can aid it last longer and create better outcomes. Maintenance on a ship keeps the machinery up to date and working smoothly. This study focuses on effective maintenance practices on-board Nigeria ships and develops a framework to avoid lapses in effective maintenance practice on-board ships in Nigerian water. After thorough research, the study has revealed that effective maintenance is not well practiced on board ships on Nigerian water and improved maintenance has significant effect on prolonged life of ships.

Based on the findings of this study, the following recommendations were made by the researcher:

i. Schedule routine preventative maintenance should be practiced to enhance effective maintenance practices on-board ships in Nigerian water
ii. Improving inspection process should be practiced to enhance effective maintenance practices on-board ships in Nigerian water
iii. Optimizing inventory management system should be practiced to enhance effective maintenance practices on-board ships in Nigerian water
iv. Tracking operations data through electronic reports should be ensured to enhance effective maintenance practices on-board ships in Nigerian water
v. Insurance companies should be compelled to insure vessels, in order to enhance effective maintenance practices on-board ships in Nigerian water
vi. Flag state (NIMASA) to ensure that standard maintenance policies are followed on ship sailing in Nigeria water
vii. NIMASA monitoring teams should avoid compromising with the master of ship or shipping operators.

## ACKNOWLEDGEMENT

All thanks, adoration, and glory to the Almighty for his guidance, protection, and for his perfect health and wisdom that made it possible for me to complete this research study. Furthermore, I wish to express my ultimate appreciation to Prof Ove Tobias for his guideline and advice throughout the study.

I also like to express my deepest gratitude to my parents Mr and Mrs Raji whose continuous inspiration and prayer in day-to-day events of my life. Likewise, I wish to express my gratitude to those that constantly helped me in one way and the other during the course of my study such as Big brother Ganiyu Raji, brothers Yinkabest and Sirojudeen and my best friend (Ohadike Lovelyn).

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# CHAPTER ONE

# 1.0 INTRODUCTION

## 1.1 Background of the Study

Any machinery or mechanical equipment needs to be maintained in order to function properly. Whether it's a massive machine or small machine, appropriate maintenance can aid it last longer and create better outcomes. Maintenance on a ship keeps the machinery up to date and working smoothly. Engineers and crew perform maintenance in the engine room of a ship, where the major machinery is situated, to ensure safe and efficient operation. Maintenance is required for each machine on board a ship, and it must be done at regular intervals. Repairs are required from time to time. The number of crew members and engineers on a ship used to be far larger; therefore maintenance was done quickly and easily. However, thanks to autonomous control, the number of crew members and engineers on a ship has decreased dramatically. Many ships now have only three to four engineers on board, and even ship maintenance time has been cut in half. Because the number of crew members is smaller and the amount of machinery is larger, maintenance needs labor and time that may not be accessible at all times (Mohit, 2016).

Sea transportation has been a vital, essential and most focused area all over the globe. The term “port" originated from the word “PORTUS” in Latin, which means an entry point or gateway, which joins both land and maritime or sea together (Badejo, 2002). Furthermore, the significant contribution of shipping to the development of each nation cannot be over-emphasized since about 90% of world global trade is transported through the sea (Lam and Dai, 2012). However, the most important drivers for shipping services demand recently are the ship’s reliability, efficiency, speed, safety, security and environmental protection, which dominate both international and national ports (Whitehead, 2000). Thus, effective

maintenance management serves as major backbone for the shipping industry and their services.

Ship Maintenance can be simply defined as the combinational of the administrative, technical, managerial arrangements throughout the life span of the vessel to retain it to a state where the vessel can execute the required duty without any interruption. From this definition, it can be denoted that effective maintenance practices cannot be carried out when the organization do not implement ways to address maintenance issues in the company. However, feeble co-ordination has compromised the efficiency of maintenance management in most of the shipping companies in Nigeria. Furthermore, the efficient and effective maintenance management of vessels is vital and essential to seafarers and customers, who require ship services to transport their passengers and goods from one port to another or make use of the ship for offshore work.

## 1.2 Problem statement

Effective maintenance and repairs on-board ships have been identified as one of the major factors in preserving shipping activities. However, this practice has been compromised by some of the ship operators in Nigerian territorial water. Thus, this act has caused major challenges to seafarers in the country and continues to affect the growth in Nigerian shipping industry. Therefore, the cause associated with poor effective maintenance on-board ships in Nigerian water needs to be properly investigated.

## 1.3 Justification

Ship effective maintenance has been compromised in most of the Nigerian shipping companies; in spite of the fact that Nigeria has an official body known as the Nigerian maritime administration and safety agency (NIMASA), responsible to implement an international safety management system on-board each ship in Nigerian water. Therefore, it is very significant to properly carry out a study on how an effective maintenance management

culture has been compromised by Nigerian shipping companies. This study will reveal a framework to enhance the deficiency in maintenance practice. Further, this would enhance the shipping industry and suggest improvements in areas where ship operators need to meet international standards with respect to maintenance and repair practices.

## 1.4 Goal and Objectives

The goal of the research is to investigate effective maintenance practices on-board ships and develop a framework to avoid lapses in effective maintenance practice on-board ships in Nigerian water.

In order to achieve this goal, the research objectives are as follows:

- To examine the maintenance practice on-board ships in Nigerian water.
- To identify the impact of lacks in effective maintenance practice in Nigerian shipping
- To investigate the challenges associated with the development and the implementation of effective maintenance practice on-board ships in Nigerian water.
- To suggest a proper practice to enhance effective maintenance practice on-board ship in Nigerian water.

## 1.5 Research questions

- Is effective maintenance practiced on-board ships in Nigerian water?
- What are causes of poor maintenance practice on-board Nigerian ships?
- What are the ways to enhance effective maintenance practice on-board ships in Nigerian water?

## 1.6 Research Hypothesis

The hypothesis formulated for the study is stated as follows

$H_0$: Improved Maintenance Practices On-board Ships in Nigerian Water has little significant effect on prolonged life of Ships

$H_1$: Improved Maintenance Practices On-board Ships in Nigerian Water has significant effect on prolonged life of Ships.

## 1.7 Scope of the Study

In fulfilment of the research study, attention shall be focused on ships sailing on Nigerian waters. In order to conduct an empirical investigation into effective maintenance practices, the study will focus on ships in the ports of Lagos, Port-Harcourt and Warri. This study will be carried out with limited financial resources and within a relatively short time framework.

# CHAPTER TWO

## 2.0 LITERATURE REVIEW

### 2.1 Maintenance Management

In the late 1970s, the production industry developed and formalized the concept of "maintenance". However, the European committee for standardization in 2017 identifies generic terms and definitions for the administrative, technical, and managerial areas of maintenance:

- Maintenance: is the combination of administrative, technical, and managerial measure during the life span of an item intended to keep or restore the item to a state in which it can carry out the required purpose
- Maintenance management is defined as: all management activities that regulate the strategies, maintenance objectives, and responsibilities, and implementation of them by such means as planning, control, and the improvement of maintenance activities and economic
- Maintainability: Is the ability of an object under certain conditions of use, to be preserved in, or restored to a state in which it can perform a required function, when maintenance is performed under given conditions and utilizing resources and procedures
- Failure: is the inability of an item to carry out a required purpose
- Down-time: is the time interval during an object is in a down state.

Maintenance has always been thought of as a step in the production process. The primary goal of maintenance is to maximize equipment availability at the lowest possible cost. When the notion of "sustainable development" was brought up, maintenance was included in the product's life cycle, along with economic, environmental, and social concerns (Malgorzata, 2013). According to Lee, 2003 defined maintenance management "All the activities of the

management that determine the maintenance objectives or priorities (defined as targets assigned and accepted by the management and maintenance department), strategies (defined as a management method in order to achieve the maintenance objectives), and responsibilities and implement them by means such as maintenance planning, maintenance control and supervision, and several improving methods including economic aspects in the organization."

According to other definitions, maintenance management is the management of a company's entire asset possessed with the goal of increasing the asset's return on investment (Ramus and Neroda, 2003). Saint-Voirin et al. (2005) provide another approach, in which a maintenance system is viewed as a basic input-output system. Manpower, management, tools, equipment, and so on are the inputs, and the output is well-configured and reliable equipment that allows the factory to operate as planned. Maintenance planning (philosophy, maintenance workload prediction, capacity, and scheduling), maintenance organization (work design, standards, work measurement, and project administration), and maintenance control are shown to be needed tasks for this system to be functional (of works, costs, materials, inventories, and quality-oriented management).

### 2.1.1 Efficiency and Effectiveness of Maintenance Management

The process of maintenance management can respectively be categorized into two:

- The definition of the strategy,
- And the strategy's implementation.

The definition of the maintenance strategy deals with the definition of the maintenance objectives as an input, which will be directly derived from the plan. This incipient part of the maintenance management process describes the requirements for the success of maintenance in a vessel, and find out the efficacy of the succeeding execution of the maintenance plans, schedules, improvements and controls. Nevertheless, this very crucial point is sometimes forgotten. The proficiency to deal with this difficulty of getting to an efficient maintenance

strategy indicates the ability to foresee the right maintenance requirements over time and the ability to foreseen these requirements to accord with the production requirements. This will allow the arrival at a position where maintenance indirect costs will be minimized (Hoque, 2000), those costs associated with production losses, and ultimately, with customer dissatisfaction.

Obviously, effectiveness stresses on how well a company division part reaches its goals or company needs, and this is frequently talked about in terms of the quality of the service delivered, observed from the crew and passenger customer's perspective. In the case of maintenance practice, effectiveness can represent the total company satisfaction with the condition and capacity of its assets (Wireman, 1998), or the decrease of the total company cost achieved when the production capacity is available when needed (Palmer, 1999). Effectiveness focuses then on the accuracy of the practice and whether the practice produces the required outcome.

The implementation of the selected strategy which is the second part of the process has a distinctive significance level. The proficiency of dealing with the maintenance management implementation problem (for instance, the ability to ensure suitable tools and schedule fulfillment, proper work preparation, proper skill levels), will enable minimal maintenance direct cost (labor and other maintenance required resources). In this part of the procedure, the effectiveness of management will be dealt with, which should be less significant. Efficiency is obtained with minimum expense, waste, or needless effort. Efficiency collates the quantity of service provided to the resource disbursed; it also measures to what degree the task is carried out and not whether the task itself is correct. Efficiency is then understood as providing the same or better maintenance for the same cost.

### 2.1.2 Types of Maintenance

Maintenance has evolved across four generations, beginning in 1950, from being regarded as a "necessary evil," then as a "means of enhancing profit," and finally as a "integral element of the organization" (Arunraj et al., 2007). Maintenance is traditionally divided into two categories: scheduled and unscheduled. Maintenance can be preventive or remedial, according to the European committee for standardization (2017). Preventive maintenance is divided into two forms according to the standard: planned maintenance with a time-based execution interval and conditional maintenance with a different execution dynamic (Ang et al., 2017). Conditional maintenance is referred to as predictive maintenance by other authors. Figure 2.1 depicts a brief definition and distinctions between maintenance kinds.

United States Department of Energy grouped maintenance into preventive, reactive, reliability-centered and predictive (USDOE, 2010). However, Khazraei and Deuse (2011) proposed two key types of maintenance and the various procedures linked with them.

- Reactive (prospective, corrective)
- Preventive (proactive, predetermined, predictive).

The nomenclature used to identify and classify maintenance types continues to cause difficulties in maintenance management. Even if the nomenclature varies, it is critical to grasp the concepts described above. As a result, Trojan and Marcal's (2017) concept for classifying maintenance types considers factors such as associated hazards, modalities of intervention, action planning, prices, and resources available for each form of maintenance. The research divides maintenance into four categories: reactive, proactive, predictive, and advanced maintenance (figure 2.2).

Finally, an efficient maintenance program will follow the ideas and methodologies provided above for the various forms of maintenance

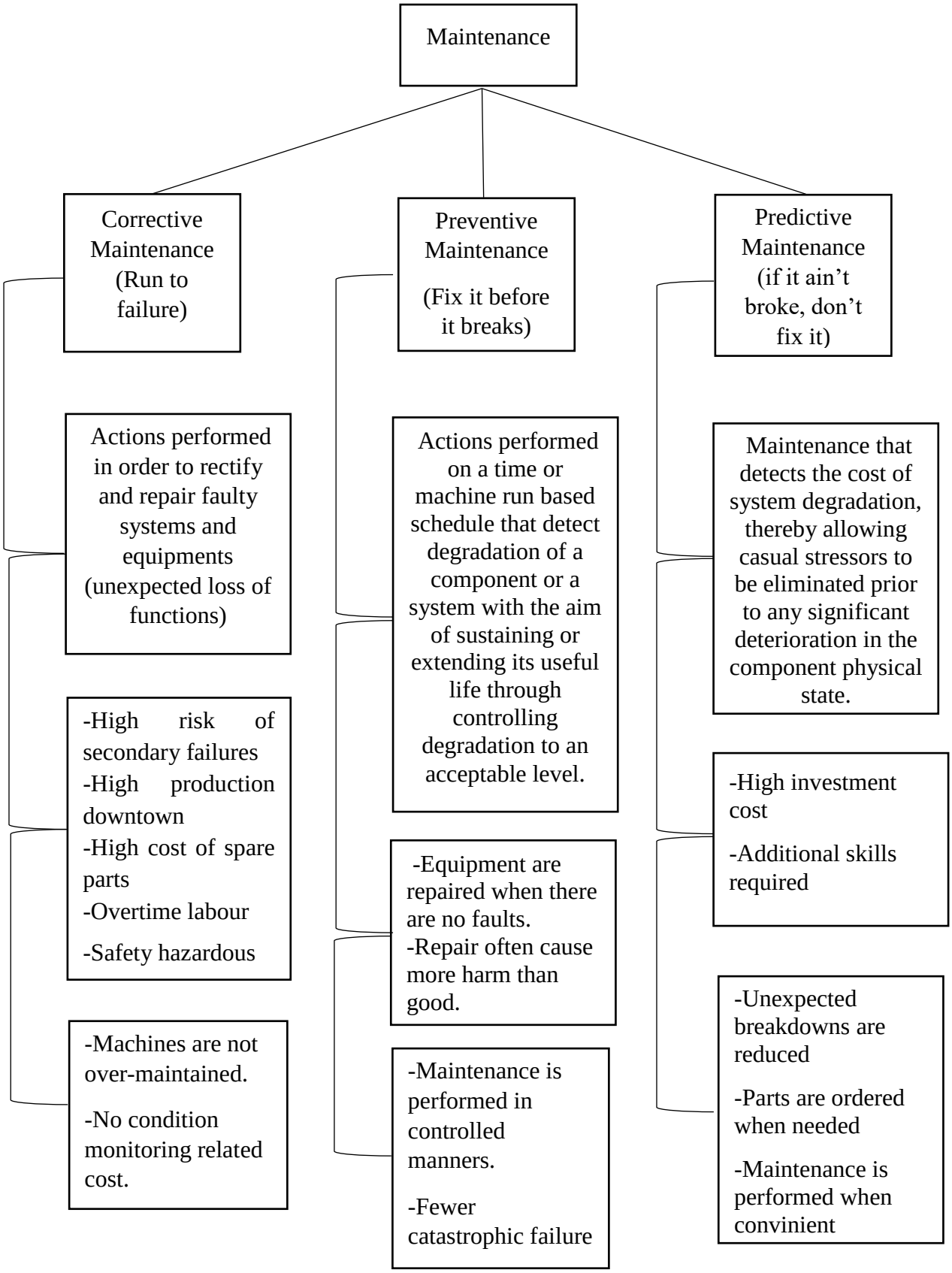


Figure 2.1. Definition and differences of maintenance types

Source: Bengtsson *et al.* (2004)

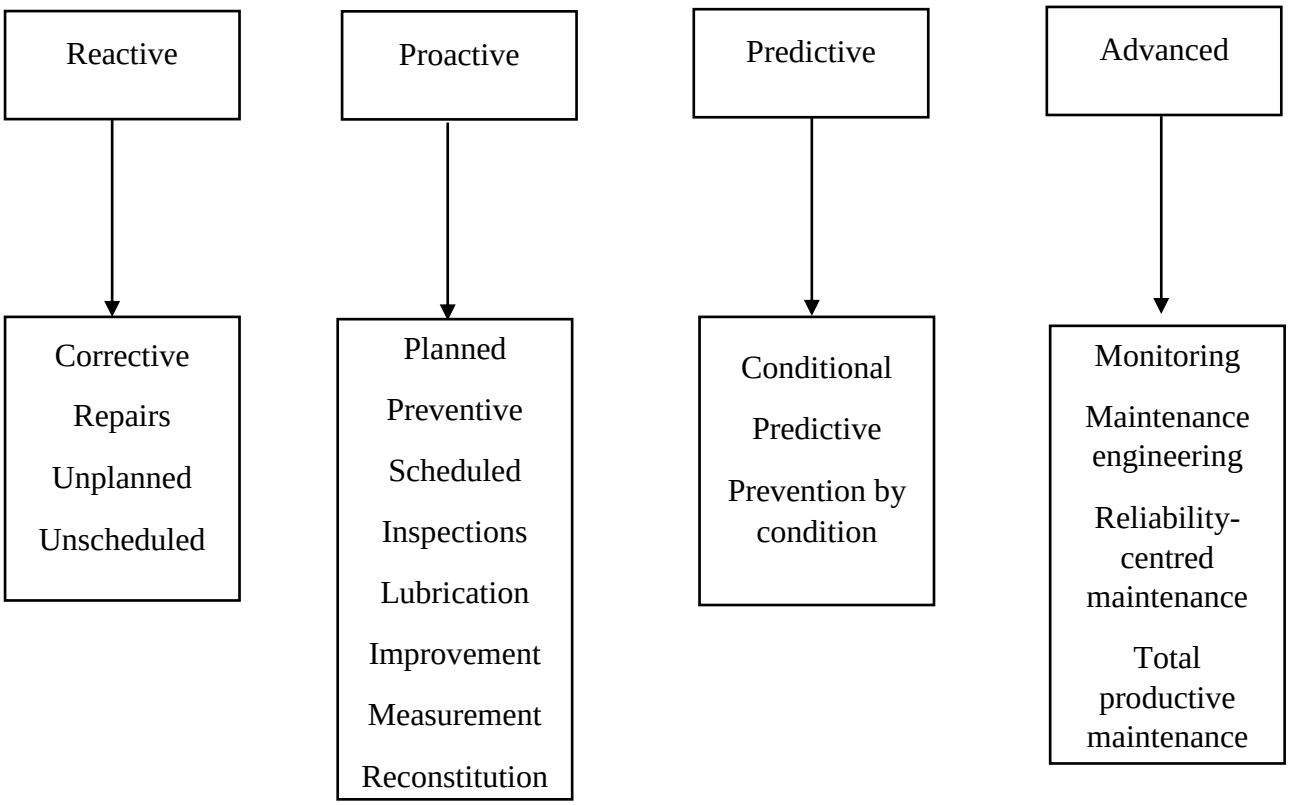


Figure 2.2. Types of maintenance

Source: Trojan and Marcal (2017)

## 2.2 Ship maintenance

### 2.2.1 Legislative framework

Ships are categorized by special organizations known as classification societies in order to verify that they meet the International Maritime Organization's (IMO) minimal structural and operational standards. A classification society develops the rules, certifies the model (ship design), and specifies the safety requirements that the ship and its equipment must meet. The actions of a classification society must adhere to the IMO's requirements.

The International Safety Management (ISM) Code was created by the IMO in 1993, and it establishes the foundation for a preventative maintenance system. It lays out the procedures, requirements, and obligations that businesses must follow in order to comply with international standards. From a technological standpoint, the primary goal of equipment maintenance was to minimize damage and, if damage did occur, to reduce operational time.

Shipping has responded to international guidelines and standards established by the International Maritime Organization (IMO) and other advisory groups in the area in recent years. The following objectives should be addressed while designing a ship's maintenance management system (Lazakis et al., 2010):

- e very well structured;
- to have a certain flexibility;
- to allow the operator to obtain feedback;
- be designed by experts in the field;
- allow for periodic evaluation and changes accordingly;
- allow the storage of information on the history of the maintenance works.

Military ships are not obligatory to follow the IMO Convention's norms and regulations; instead, they must follow the requirements of national legislation. Military ships were not

classed the same way as commerce ships in this circumstance. However, in the last two decades, classification organizations such as the Lloyd's Register (LR) and American Bureau of Shipping (ABS) in partnership with partner state defence authorities, have built the groundwork for a set of particular design and capability requirements for military boats. France was the first country to use the classification system for the building of "Mistral" class ships. The implementation of these sets of regulations will contribute significantly to boosting the interoperability capabilities of military equipment and lowering the design and construction costs of new military ship projects in the future (Narula and Agarvala, 2015).

### 2.2.2 The evolution of the maintenance concept in shipping

The IMO's regulations and the unique norms of classification societies have influenced ship and onboard system maintenance. Until now, all maintenance procedures have attempted to compensate for the disparities between the theoretical solutions supplied by maintenance strategies and their practical application onboard ships. On multiple levels, difficulties were faced due to the complexity of the onboard equipment and systems: data collection and enormous volumes of maintenance information, monitoring of operating parameters and maintenance, correct maintenance procedures implementation and so on.

Corrective maintenance was initially used onboard ships as a maintenance method. According to the IACS (International Association of Classification Societies) recommendation (2019), several stages must be followed in order to execute corrective maintenance:

- fault recognition;
- determining the causes of failure;
- troubleshooting possibilities;
- Corrective measures implementation.

Furthermore, preventive maintenance involves making planned repairs or replacing worn parts in accordance with a predetermined protocol in order to avoid equipment failure. When it was possible to analyse the condition of the equipment and apply maintenance methods to avert breakdown, the preventive maintenance plan was followed by predictive maintenance. Predictive maintenance also had the following advantages:

- optimization of intervals for the execution of maintenance works;
- extending the period of use of the parts (by evaluating the wear);
- only replacement of spare parts and reduction of cost with spare parts.

The reliability-cantered maintenance (RCM), risk-based inspection (RBI), and condition monitoring categories are shown in Figure 2.3. (CM). By utilizing IT technologies for controlling the maintenance process predictive and preventive maintenance methods have evolved.

### 2.2.3 Computerized maintenance management system

Ship-owners must make sure to implement preventive procedure and maintenance measures for on-board systems and equipment in accordance with the International Safety Management (ISM) Code. Ship Maintenance can be performed by implementing maintenance management software, by utilizing written techniques or by combining the two approaches (ISM, 2002).

A planned maintenance system (PMS) allows operating personnel and ship-owners to plan, carry out, and document the maintenance procedures for ship system at time intervals in accordance with the class requirements and manufacturer's procedures. The first PMS programs were often implemented on manual, card-based systems. Many things have improved with the introduction and improvement of computers and information technology (Chang *et al.*, 2011).

The first planned maintenance software precisely considered for shipping industry was designed in 1984, called the Asset Management Operating System (AMOS), utilizing the MS-DOS operating program, was implemented on merchant vessels. The PMS has evolved permanently and finally became the computerized maintenance management system (CMMS), which is a software solution through which the maintenance program of the on-board technology is implemented. Currently, the programs contain not only the maintenance management module but also other modules developed in order to manage information and increase the operational safety of the ship.

In a military vessel, the maintenance planning system was not a compulsory condition to categorise the vessel, as is the case with merchant vessel. CMMS solutions implemented onboard merchant vessels are offered both by recognized IT companies (e.g., AVECS Corporation – TITAN, BASS - BASS net, Spec Tec Company- AMOS) but also by large shipping companies, which have created their own system for ships in the fleet (Gasper *et al.*, 2018). US Navy has conducted several studies since 1972 on the possibility of using automatic data processing systems onboard military ships. The researchers led to the development by Navy Management System Support Office (NAVMASSO) of a software called Shipboard Non-tactical Automated Data Processing Program (SNAP II), with six key modules (supply, administration, pay/disbursing, personnel and medical and maintenance) and it was used onboard ships since 1981 (McMican and Richards, 1985).

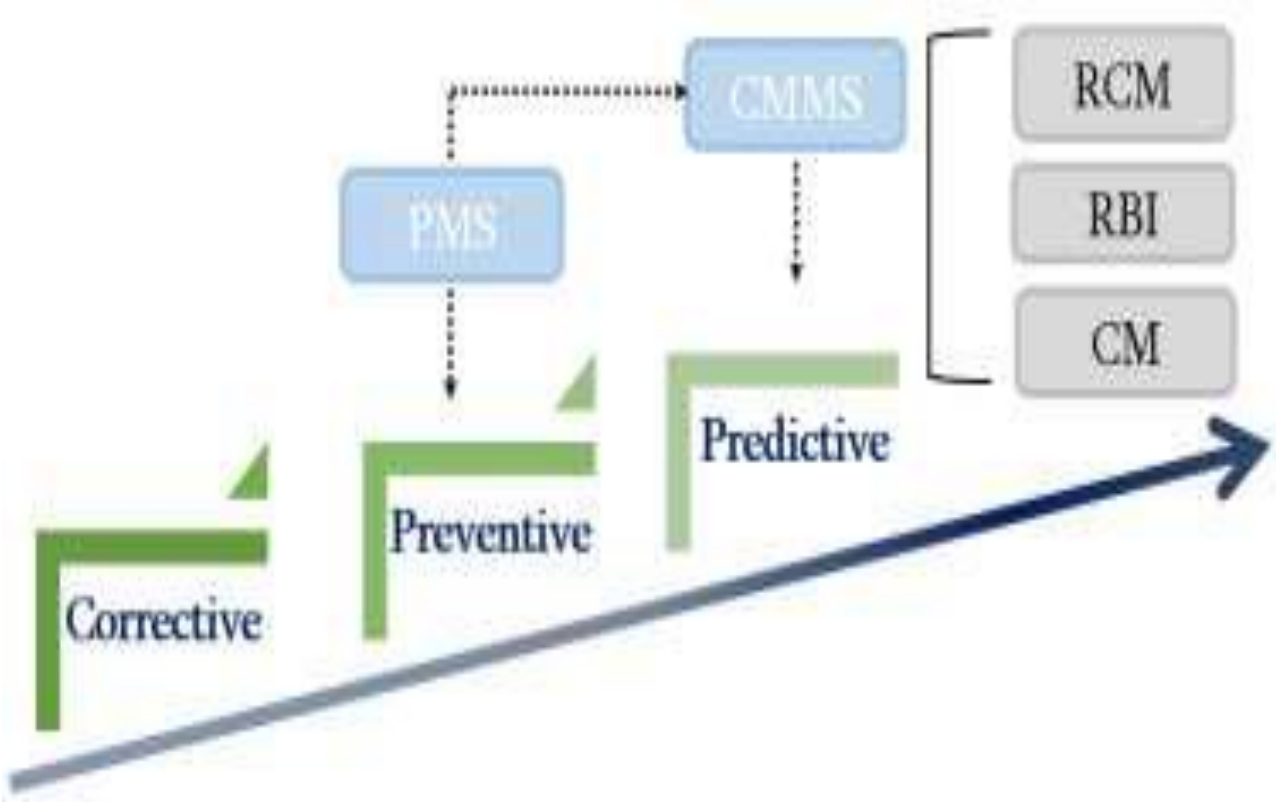


Figure 2.3: The evolution of the maintenance process in the ship-building industry

Source: Lazakis *et al.* (2010)

### 2.2.4 Improving maintenance management on a specific ship using a CMMS program

The process of developing a maintenance management program for a military ship is also described, with equipment data from the training ship Mircea, which has been in service for 80 years. Figure 2.4 depicts the logical flow of a CMMS implementation. The ship's primary systems and equipment were improved and overhauled multiple times throughout the years, with the most recent significant repair taking place between 1994 and 2002. Maintenance information (e.g., work orders, fault histories, operating and maintenance procedures, and operating hours) is primarily kept on paper in the form of operating books, registers, and operating logs. IT systems were only utilized to track equipment's operation hours and to send periodic requests and reports to the logistics department**.**

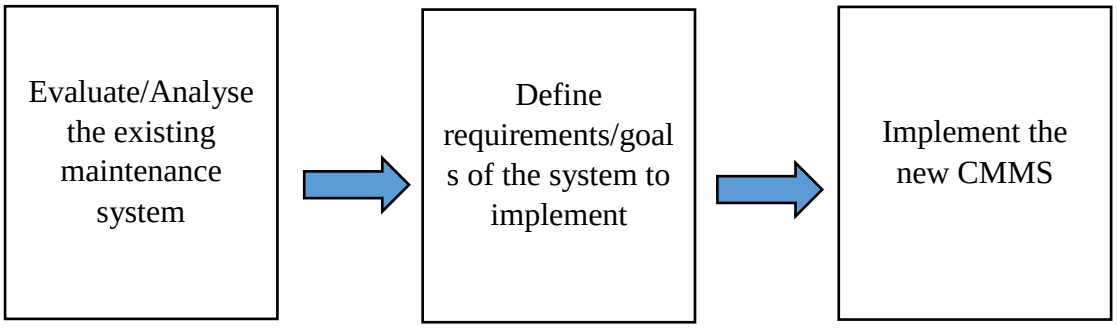


Figure 2.4: Logical sequence to implement a CMMS in an organization,

Source: Cornicius and Verissimo (2017)

Preventative and corrective maintenance procedures are used in the maintenance schedule for on-board equipment. To maintain it operational and prevent accidental falls, each piece of equipment on board follows a preventive maintenance routine (at intervals or throughout operation). When a failure occurs, the onboard maintenance crew takes action to remedy the problem. The ship is typically dry-docked every three years for the following tasks: routine hull and freeboard repairs, substantial body, accommodations, and deck repairs (replacement of corroded steel), and propeller, shaft, and rudder inspections. The ship has undergone a ten-year upgrade program that included the replacement of the following items:

The ship has undergone a ten-year upgrade program that included the replacement of the following items: navigation and communications equipment, modernization of the power plant, main engine and propulsion system overhaul, improvements/retrofitting of the steering gear system. The goals of implementing such a system aboard military ships are to improve maintenance operations in order to boost equipment availability, prevent machinery breakdowns, better execute repairs in the event of failure, and lower maintenance expenses.

In order to attain the objectives, it is essential that the CMMS solution allows:

- Generating a thorough list of equipment, equipment and accessories on board;
- Recording the relevant data from the maintenance activity (e.g. measured parameters, technical data, maintenance history);
- Generating a maintenance strategy for all equipment;
- Management of spare parts stock;
- Use the maintenance history to optimize maintenance plans;
- Managing maintenance resources for better asset utilisation;
- Employee positioning and workload allocation;
- Use of standardized work orders;
- Performance assessment.

It is required to plan and perform some operations in order to prepare and use the software and all of its features for the practical execution of a CMMS program. All of these processes must be completed by maintenance personnel, and a clear understanding of how this process can increase overall efficiency, as well as an accurate cost estimate (for software, training, data gathering, and continuing maintenance costs), will lead to a successful CMMS deployment.

## 2.3 Challenges in Nigeria's Shipping Sector

According to UNCTAD, developing economies accounted for the highest proportion of global seaborne trade in 2019, both in terms of imports and exports. According to the UNCTAD, they discharge 65 per cent of the world's cargo and loaded 58 per cent. Thus, Oceanic and Asian developing economies account for the majority of that amount, with 4.3 billion tons loaded and 6.1 billion tons unloaded. While emerging economies continue to be the most important marine trade hubs, the structure of their trade has changed. Their share of global exports has been declining since 2014, according to UNCTAD.

According to UNCTAD, developing economies' decreasing contributions of seaborne trade exports and increasing contributions of seaborne commerce imports are reflected in a continuing decline in their trade balance. "Their balance shifted from a surplus of 433 megatons in 2009 to a deficit of 49 megatons in 2014, which worsened to 776 megatons in 2019," it said. However, UNCTAD claims that this trend is primarily due to a rising gap among Asian developing economies. The surplus of transition economies increased from 412 to 614 megatons over the last decade. In developed economies, a drop of 820 megatons in 2009 has been replaced by a gain of 155 million tons in 2019. But that's not all. For example, products carried at ports around the world were predicted to be 7.42 gig-tonnes in 2006, up from 5.98 gigatonnes in 2000. The overall value of the global exports climbed by 64% from $6.454 trillion in 2002 to $40.393 trillion in 2005. Despite the important impact of shipping to global trade, Nigerians citizens and their government play a little role to it. It is documented that no fewer than 90% of Nigerian-owned shipping companies have either entirely shut down or are barely surviving. Some of the shipping company owns by Nigeria are: Equatorial Energy, Peacegate, Morlap Shipping, Joseph Sammy, Al-Dawood Shipping, Pokat Nigeria Limited, Oceanic Energy, Potram Nigeria Limited, Multi-trade Group, and Genesis Worldwide Shipping are all based in Lagos, while Starzs Investment Group in Port-

Harcourt, Rivers State, Niger-Delta Shipping is based in Abuja, and Niger-Delta Shipping in Warri, Delta State. Only two of the enterprises listed above are running sustainable businesses, while the rest are either dead or in a coma.

Capt. Niyi Labinjo, former General Secretary of the Indigenous Ship-owners Association of Nigeria (ISAN) said that most of the Lagos shipping companies are either dead or struggling to striving, whilst those in Warri and Port Harcourt are thriving. They are thriving in terms of coastal trade with multinational oil firms. The enterprises have generally shrunk and are functioning with less than 20% of the personnel they had two to four years ago.

According to the findings of the publication THISDAY (Lagos based newspaper), all of the companies are significantly in debt to banks and are unable to service the loans they took out to buy ships. According to a significant investor in the business, most ship owners have sold their properties to service their bank loans, while others have lost their main properties to the banks. According to accounts, the corporations owe their crews pay ranging from six to fourteen months, and some have sold their vessels (International Shipping News, 2021).

### 2.3.1 Self-inflicted problem

The ship-owners have always mentioned lack of insecurity and financial capacity as the bane of the shipping companies in Nigeria. However, there is evidence that revealed that many Nigerian ship owners are essentially lousy managers with no prior expertise in the industry. As a result, Nigerian-owned vessels are primarily old "rust buckets" that are abandoned as wrecks on the waterways, destined for dismantling because they can no longer operate.

Greg Ogbeifun, Chairman of Starzs Investment Company and Starzs Marine and Engineering Company, and ship owners took turns lamenting the many issues they face in Nigerian ports at his 70th birthday celebrations. According to Margret Orakwusi (a leading marine lawyer and Chairman of the Nigerian Ship Owners) revealed that no Nigerian ship was named

among the 500 ships that visited Nigerian ports in the first quarter of 2015. On the international route, no Nigerian-flagged ships were sailing international till present. This means that the massive annual tonnage created by freight earnings receives no value addition, resulting in billions of dollars in lost revenue for Nigeria. Furthermore, even the offshore trade set aside for indigenous operators. They are dominated by foreign operators, and the main reason for this is that local operators lack the capacity to provide seaworthy ships.

According to Aminu Umar, the former President of Nigerian Ship-owners Association (NISA), identified the following point as the challenge faced by Nigeria local operators;

- Inadequate of finance as one of the key setback facing Nigerian ship-owners.
- Insecurity on the waterways as well as deploying poorly trained seafarers as crew also pose challenges for indigenous operators.

But, a master mariner who did not want his name published disputed with ship-owners' allegations. He claimed that most Nigerian ship-owners had no prior experience prior to investing in ship purchases, and that they typically keep all of the proceeds. Most Nigerian ship owners, from what he observed, have the idea that if they receive N100 as a result of engaging the ship, they will take N90 for personal use rather than investing it back into the business. When you visit some of these ships, the status of the ship makes you wonder why they don't reinvest earnings back into the business, and they start making excuses (International Shipping News, 2021).

### 2.3.2 Vessel maintenance in Nigeria

A master mariner revealed that a state of vessels in Nigeria is not being properly looked upon, there is inability of the ship owners or operators to properly retain the ship to its original state, and maintenance of a vessel determines the life of it. The Nigeria ship owners were not actually familiar with the shipping business. In some cases the person that advised Nigeria ship owner to buy vessel were not even a marine person, the staff he employs to

oversee the company affairs are not mariners. Master mariner further stated there is a case they currently have at hand, the company has a vessel, but the staffs managing the affairs of the vessel at the office has no maritime related knowledge, so exactly do you imagine of such ship, he stressed that ship will be in a bad condition, and many things will be going to wrong direction because they cannot protect or realise the significance of implementing certain things on such ship. The point is typical of Nigerian mentality; most have the mentality "take" and "don't give back" mind-set (International Shipping News, 2021).

### 2.3.3 Foreigners are cheating Nigerians

Because Nigerians have a minor or non-existent part in the shipping, foreign shipping companies have taken over shipping and are taking advantage of Nigerian shippers. Despite the determinations of the Nigerian Shippers Council (NSC), foreign establishments have effused their stance on imposing various fees. Lately, freight forwarders and clearing agents have accused foreign establishments of extorting Nigerian importers by imposing arbitrary yearly costs on them. Some importers have joined the bandwagon and transported their products to neighboring countries, according to customs agent Izuchukwu Obasi, because shipping lines slam excessive transportation charges on Nigerian bound shipments.

Obasi revealed that the shipping companies initially introduced a new levy known as port duties and government taxes. They were levying the fees on importers, and many of them had no option but to pay, despite the fact that some of their customers objected. The government appeared to be unaware of the additional charges until a petition to the President was filed by several Customs brokers. Everyone began to talk about it, and journalists began to report on it. That's when the administration was obliged to come out and say it doesn't agree with such accusations. Although the Nigerian Shippers Council and the Nigerian Ports Authority (NPA) have condemned it, the shipping line has continued to collect the money. In fact, it is still being collected to this moment, and everyone is going about their business as usual. Kayode

Farinto, Vice President of the Association of Nigerian Licensed Customs Agents (ANLCA), stated that all charges are still being collected. "Importers are still paying the charge, and nobody appears to be talking about it anymore," he says. We simply hope that the administration takes action." (International Shipping News, 2021).

## 2.4 Factors affecting ship repairs and maintenance in Nigeria.

According to Mohammed Bello-Koko, the Managing Director of Nigerian Ports Authority (NPA) revealed that Nigeria lacks trained ship radio technicians and other experts needed for effective ship maintenance and repair services onboard ship. Further revealed that when he accompanied the Minister of Transportation, on a visit to Greece, the Greek Ships owner & Ports as saying the country's lack of certified ship maintenance and repair technicians came to fore.

Managing Director of Nigerian Ports Authority (NPA) said Greek ship-owners stated that they were not maintaining and servicing their vessels in Nigeria because of non-availability of experts certified and technicians. Further said, the Greece also outstretched that there were services in Nigeria in those days that were no more. For example, cleaning of ships; there are no certified providers. Repair of Radio communication; there are no certified providers of such services.

The Greek lines further said there are none Nigerian radio officers have class, and those services were no longer accessible. Although, there are people that can do radio repairs in Nigeria but they need certification to be in class. The director further added that the Greek lines said they are willing to maintain and repair their vessels in Nigeria once the nation improves on certified professionals and ship yards that can guarantee their ships remain in class (Douglas, 2021).

## 2.5 Common Deficiencies in Ships

### 2.5.1 Mechanical Ventilator

Mechanical ventilators must be checked externally and internally to ensure that they are in good working order. The following are some checkpoints:

**(i) Wastage of the Casing of Ventilator or Corrosion**

How to inspect: Visual inspection, Hammering and further visually inspect the part

What to inspect: Wastage of the casing of ventilator or corrosion

Take the following steps: The ventilator's corroded or wasted casing must be replaced

**(ii) Wastage or Holes of Fire Damper**

How to inspect: Fire damper operation test (Open up inspection)

What to inspect: Structurally sound damper flaps (Holes of fire damper or No wastage)

Take the following steps: Replace the old fire damper with a new one.

**(iii) Operation of Fire Damper and Marking of "Close-Open"**

How to inspect: Visual inspection (Operation test of fire damper)

What to inspect: Is "Close-Open" clearly marked? (Is the internal damper is in good working order?)

Take the following steps: Ensure the "Close-Open" is clearly marked.

Figure 2.5: Holes in the casing of a ventilator


Figure 2.6: Wastage of the casing of ventilator


Figure 2.7: Temporary repair by tape

Figure 2.8: Wastage/holes in a fire damper

Figure 2.9: After Repair

Figure 2.10: No marking of “Close-Open”

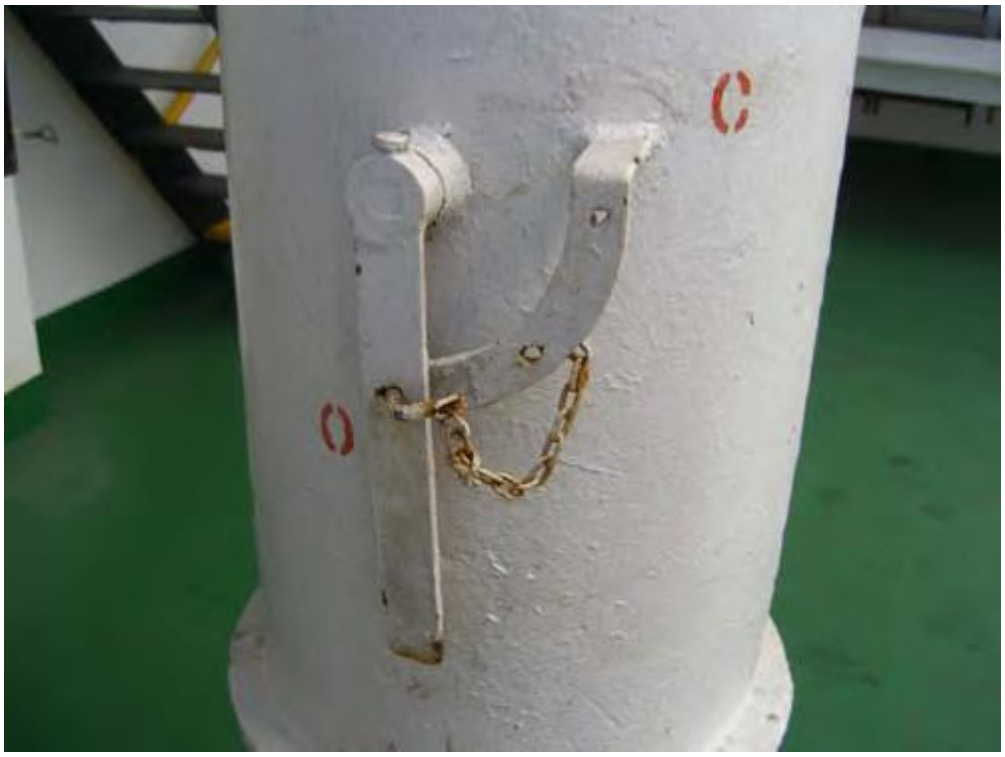


Figure 2.11: Clear marking of “Close-Open”

### 2.5.2 Air Pipe and Natural Ventilator

Natural ventilators and Air pipes must be kept in good working order and monitored both externally and internally. Check points are as follows;

**(i) Corrosion or Wastage of Air Pipe**

How to inspect: Visual inspection and hammering (Open up inspection)

Item to inspect: No corrosion or wastage of air pipes and their head?

Take the following measure: Corroded or wasted air pipe is to be renewed

**(ii) Damage or Stuck Disc Float**

How to inspect: Open up inspection

Item to inspect: No damage or stuck of disc float?

Take the following measure: Damaged disk float is to be replaced with new one.

**(iii) Corrosion or Wastage of Natural Ventilator**

How to inspect: Visual inspection and hammering

Inspect item: No corrosion or wastage of ventilator?

Take the following measure: Wasted ventilator or corroded is to be renewed.

**(iv) Missing nut or bolt**

How to inspect: Visual inspection

Item to inspect: No missing bolt or Nut?

Take the following measure: Missing nut or bolt is to be provided or replaced.


Figure 2.12: Wastage and holes of air pipe head

Figure 2.13: Wastage of the inside of air pipe head


Figure 2.14: Temporary repaired by patty

Figure 2.15: Wasted gooseneck ventilator

Figure 2.16: Missing butterfly nut of gooseneck ventilator


Figure 2.17: Missing bolt of air pipe head

### 2.5.3 Fuel System

**(i) Stuck Fuel Rack**: One of the utmost prevalent difficulties with oil-fired 2 stroke marine engines is a stuck fuel rack. A fuel rack which is a collection of mechanical links is used by the governor controls to manage fuel pump delivery. When the fuel rack becomes jammed, there is a lack of gasoline delivery in the affected unit, which causes the engine RPM to fluctuate or the engine to not start from a standstill

Solution: Before starting the main engine, make sure all of the fuel rack's mechanical links are thoroughly lubricated and greased.

**(ii) Starting Air Valve Outflow**: Any leakage from the beginning air valve will result in hot gasses returning to the engine air-line, which could contain a thin oil layer. This mixture of oil and film has the potential to cause an air-line explosion. Due to safety mechanisms incorporated in the air line (Wartsila engines/ relief valves in SULZER and bursting disk in MAN engines), this type of explosion is not very prevalent these days. Nevertheless, the potential of such devices malfunctioning and causing an explosion cannot be overlooked.

**Solution**: Normally, the temperature of the air-line providing air to the starting air valve is not monitored remotely. The best way to detect such a problem is to manually check the temperature of the airplane while maneuvering. When the engine is started frequently rather than operating continuously, this problem is more likely to occur.

**(iii) Fuel Leakage/ Fuel Valve Malfunction**: Fuel system problems are frequently encountered in the primary engine. When one unit's temperature deviates, the fuel system, particularly the fuel valve, must be examined. The fuel valve must be overhauled and pressure tested according to the PMS. There is a risk of leakage from the pump seals if the engine is running on diesel oil. In addition, incorrect fuel treatment and failure to maintain fuel temperature can result in cracks and leaks in high-pressure fuel pipes.

Solution: The "high pressure leak off tank" level and alarm can be used to assess if there is a leak in the main engine fuel oil system.

**(iv) Sparks in the Main Engine Exhaust at Funnel**: Normally, marine engineers receive a call from a bridge officer reporting sparks coming from the funnel, which is the main engine exhaust. Slow steaming and frequent maneuvering's because unburned soot deposits on the EGB boiler route, resulting in sparks from the funnel.

Solution: The ship's crew should clean the exhaust gas boiler on a monthly basis to avoid this problem.

**(v) Starting Air Outflow**: This is also one of the most underappreciated yet common marine engine issues. The main engine's control air supplies air to many sections and systems. When the engine is running, it is always in the open position. Small leaks are common and may usually be fixed by simply tightening or replacing the pipes or joints.

Solution: It is difficult to hear any air leakage sound while the engine room machinery is in good functioning order. The best technique to check for air leakage is to trace all of the lines and feel all of the connections/joints by hand. When an intentional blackout is performed for any job, it is the quickest technique to identify air leaks. All machinery will be in "stop" mode at this time, and the leaking sound (a hissing noise) will be loud and clear. Make a note of the leaky location so you can fix it later.

**(vi) Stuck Air Distributor**: The air distributor is in charge of maintaining the air supply that opens the engine cylinders' starting air valve. Because it is a mechanical component, it is prone to failure, particularly when it becomes stuck. If the air distributor fails to produce enough air to open the starting air valves, the main engine will not start since there will be no air in the cylinder to begin fuel combustion.

Solution: In order to avoid this problem, many engines such as the MAN B&W, have an air distributor at the end with an inspection cover that can be opened when the engine is not running for lubrication and maintenance

**(vii) Malfunctioning of Installed Gauges**: Having local parameter gauges on various systems of the primary engine is critical. It is always preferable to take local readings rather than remote readings when recording readings in the log book. Engineers frequently discover that one or two of the main engine's gauges (pyrometers, pressure gauges, manometers, and so on) are broken or malfunctioning. The cause of this issue could include loose parts and connections, as well as vibrations.

Solution: As soon as possible, change the malfunctioning parameter gauges with new ones.

**(viii) Faulty Sensors and Alarms**: The main engine is equipped with a number of sensors that communicate and measure data to the alarm panel. These sensors can malfunction due to causes such as vibration, excessive temperature, humidity, dust, and so on, resulting in false warnings.

Solution: All engine room sensors and alarms should be checked on a regular basis. Different primary engine safety alarms and trips should be tested on a regular basis, and any flaws should be addressed right away.

# CHAPTER THREE

## 3.0 NIGERIAN PORTS

### 3.1 Lagos Port

The Lagos Port Complex, commonly known as Premiere Port (Apapa Quays), was Nigeria's first and largest port. It is located in Apapa, Lagos State, Nigeria's commercial Centre. The port was founded in 1913, and the first four deep water berths were completed in 1921. Apapa Port is well-equipped with contemporary cargo handling equipment and human support facilities, allowing it to be both cost-effective and customer-friendly. It has rail, water, and road multimodal connections. It features four wheel gates for enormous commodities that are around 8 meters long, giving it an advantage over other ports in the handling of oversized cargoes.

The Federal Government implemented the landlord Port model to increase operational activity and efficiency, which concluded in the concession of the terminals to private operators in 2006. The Lagos Port Complex currently has five (5) private terminals with experienced management and personnel with both local and international port experience. ENL Consortium Ltd. (ENL), AP Moller Terminal Ltd. (APMT), Greenview Development Nigeria Ltd. (GNDL), Apapa Bulk Terminal Ltd. (ABTL), and Lilypond Inland Container Terminal are the terminal operators.

The Port also includes eight (8) jetties and two (2) logistics hubs, Eko Support Services Ltd. and Lagos Deep Offshore Logistics (LADOL). Sugar, salt, and flour are manufactured in factories owned by port operators. The International Maritime Organization has designated the Lagos Port Complex as an ISPS accredited port facility (IMO). The port is open 24 hours a day, and the turnaround speed for vessels is impressive. For effective manning, all operational areas are guarded by both armed and unarmed security guards, as well as Closed Circuit Television (CCTV). The concession has resulted in massive increases in port

infrastructure that are in accordance with international best practices, resulting in increased efficiency and production (NPA, 2022a).


Figure 3.1: Depicts the Lagos port and map that depict all Nigeria ports.

## 3.2 TinCan Port

Tin Can Island Port is located to the north-west of the Lagos Port Complex, with a Latitude $62^{o}$N Longitude $30^{o}$ 23E. Its pre-concession period began in 1975, when the country's economic activity grew in tandem with the oil boom and post-civil war rehabilitation. As a result of the huge amount of imports and exports, considerable port congestion developed. As a result, the government was forced to take action to decongest the Port, which it did by building a new port on Tin Can Island.

The building of the new port began in 1976, and it was christened Tin Can Island Port on October 14, 1977. It has the capacity to handle 10-16 boats at a time, with the main port complex occupying a total area of 73 hectares.


**Figure 3.2: Depicts the Tin-Can port**

### 3.2.1 Post Concessioning

The Tin Can Island Port Complex is the result of the merger of the Roro and Tin Can Island Ports. In May 2006, when the Nigerian Port Authority approved the Land Lord model as the preferred choice by the Federal Government, the terminals were concessioned to five (5) Terminal Operators under various concessioning agreements. However, in September of 2006, the several departments and their people were consolidated.

### 3.2.2 Operations

On the 10th of May, 2006, Terminals A, C, and D were given over to private terminal operators while Terminal B was handed over on the 1st of June, 2006. The BOT Port and Terminal Multiservice Limited (PTML) began operations in September 2006. In terms of berth occupancy turnaround time, and operations, have both improved considerably. The average berth occupancy rate has increased from 75% in December 2006 to 83 percent presently.

### 3.2.3 Development Plan and Quay Wall

The Terminal Operators have been planning and redeveloping their terminals since the Lease Agreement began in 2006 in order to increase capacity and remain competitive. Due to the following features and characteristics, Tin Can Island Port has turn out to be a sanctuary for investors:

a. Tin Can Island Port deals with a wide range of cargoes, with each terminal operator concentrating on a certain type of cargo (Box-Containerized cargoes, Dry and Wet bulk cargoes and RORO services).
b. The port can handle vessels ranging in length from 100 to 260 meters.
c. Pilotage is available 24 hours a day, 7 days a week.
d. Vessel turnaround time is short. Clear cargoes with

e. Tin Can Island Port is provided with well-equipped and up-to-date modern equipment to clear cargoes, as each terminal is distinct in its operations, with quick and prompt procedures and cargo delivery.

f. Fresh water wells sunk to a depth of 250 meters give fresh water to vessels berthed at the port. While recognized oil corporations handle the bunkering of ships.

g. Kiri kiri Lighter Terminal (KLT) 1&11, Kiri kiri Lighter Terminal (KLT) 1&11.CCTV (Closed Circuit Television). Each quay has a length of 780 meters and a maximum water depth of four meters.

h. With the able aid of the Marine Police and the Nigerian Navy, regular maritime patrols of all anchorages, jetties, and fairway buoys are conducted (NPA, 2022b)

### 3.3 Rivers Port

This Port also well-known as Rivers Port Complex is positioned in the Gulf of Guinea and has grown from a single berth for coal export to four berths to handle a cargo mix of import/export commodities. With a quay length of 1,259 meters, the Port can currently accommodate eight contemporary seagoing boats loading and unloading at the same time. The Port also has 16 bulk oil storage tanks with a capacity of 3,048 tons. There is a conveyor belt and a pier keeping the structure in place, as well as seven stacking spaces totaling 27,407.15 square meters and four (4) Arcon shelters totaling 12,486.15 square meters of storage space.

Rivers Port is a multi-purpose port that functions as the 'Mother-Port' to multiple jetties that serve as ‘satellites' by providing towage services and pilotage services to the various markets in the Liquid, Dry, and General cargo trades. It's worth noting that the Port is tactically located in one of the world's major crude oil production locations, and as a result of this benefit, the tanker market that can be seen at the Federal Ocean Terminal via the Bonny Fairway Buoy was born.


**Figure 3.3: Depicts the River port**

### 3.3.1 Port Reform

The Nigerian Ports were reorganized in 2006 in accordance with worldwide trends, allowing for Private Sector Participation (PSP) in port operations. The Port of Rivers was not forgotten. Private operators in the port consist of BUA Ports, Messrs Port, and Terminals Nigeria Limited and Terminal Operators Limited (PTOL) with the Nigerian Ports Authority as the Landlord. Rivers Port also regulates, supervises, and the port operator make sure the terms and conditions of the Lease Agreement are followed. The Port also manages all of the jetties within its jurisdiction and provides marine services. A joint venture company, Bonny Channel Corporation (BCC) performs capital and maintenance dredging to keep the channel open, navigable, and safe for maritime operations. Other activities include port infrastructure design and construction, bathymetric surveys, and the maintenance and enforcement of health, safety, and environmental regulations (HSE).

The Nigerian Ports Authority make security well available in accordance with the "International Ship and Port Facility Security" (ISPS Code), which is a security guideline issued by the International Maritime Organization (IMO) for universal compliance, to protect port facilities and ships against terrorist attack, and was implemented in Nigerian ports on July 1, 2004, by the "Presidential Implementation Committee on Maritime Safety and Security" (PICOMSS). Security and the combined efforts of the Navy, Port Police, Joint Task

Force (JTF), Marine Police, and NPA Security officials were also instrumental in achieving this feat.

### 3.3.2 Prospects

There is hope for higher cargo throughput records in volume terms with the continuing reactivation of rail networks across the country, including those of Port Harcourt Port. The end result will cause in a higher level of revenue generation. Importers will save a lot of money on transportation because rail is far less expensive than road. For local consumers, this means a decrease in the price of imported goods. Improving ICT through a shared network with Nigeria Customs and other Port users will add to the value of faster paperwork, resulting in increased port efficiency. Against the backdrop of international best practices, this will increase the requirement for human capacity development. Messrs. Nigerian Ports Authority was also hired by the Nigerian Ports Authority. On a Build, Operate, and Transfer (BOT) arrangement, African Circle Pollution Management Limited (ACPML) will construct and operate trash reception facilities for ship-generated rubbish in the Port. Recently, the Nigerian National Petroleum Corporation (NNPC) hired Messrs. PPP Fluids to transport crude oil from its platform to the Port Harcourt Refinery in Okrika for refining into various products, avoiding pipeline vandalism and the resulting massive loss to the Federal Government. Rivers Port's revenue base has grown with the addition of this operation.

## 3.4 Onne Port

Onne Port Complex, located along Ogu Creek on the Bonny River Estuary, was the first port in Nigeria to use the Landlord Port Model, which was created to stimulate private sector engagement in the port industry. The Port is strategically placed as one of the world’s major Oil and Gas Free Zones, facilitating Nigerian exploration and production. The Free Zone serves as a logistics and oil service center for Nigeria's onshore and offshore oil and gas

industries. It also gives you simple access to all of West Africa's and Sub-Saharan Africa's oil fields.

Over 65 percent of the export cargo through the Nigerian Sea Port passes through the Port. In addition to oil and gas operations, the Port conducts a variety of other operations. General Cargoes, Bulk Cargoes (Dry & Wet), Oil Well Equipment, Containerized Cargoes, and other Logistics Services are examples of different operations given to clients and tenants. As a result, the Port serves as a multi-purpose Cargo Port. The Port is heavily industrialized, with cutting-edge facilities and technology that will last. All clients and prospective investors who wish to cooperate with the Port in the Maritime Business will find ample land accessible for development. The Port is spread out on 2,538,115 hectares.

One of the Terminal Operators in the Onne Port owns one of the largest harbor mobile cranes in Africa (Liebherr 600) with a lifting capacity of 208 metric tons and 220 Gmk5220 grove twin cranes with a lifting capability of one heavy cargo of 300 tons. The Free Zone / Port Area also have safe and convenient hotel facilities for Oil & Gas clients. The Port is operating at security level one (1), ensuring a safe, secure, and customer-friendly environment for everyone who conducts business here (NPA, 2022d).


Figure 3.4: Depicts the Onne port

### 3.5 Calabar Port

Calabar port is situated in cross-river state Nigeria. For the Eastern States, the port has served as an important center of trade with the outside world, as well as a natural harbor for

the Northern States of Nigeria. Until December 1969, when the Federal Government took over the insufficient Calabar Port facilities from the previous operators and transferred them to the Nigerian Ports Authority, the Old Port was privately managed and operated. The Calabar port was developed, modernized, and expanded under the 3rd National Construction Plan, which ran from 1975 to 1980, in order to fulfill the ever-increasing demand of our economy.

The Calabar Port Complex includes the Old Port, New Port, and Dockyard, as well as Crude Oil Terminals in Antan, Odudu, Yoho, and QuaIboe, as well as other jetties in NIWA, McIver, NNPC, ALSCON, Dozzy, and Northwest. Calabar Port's three terminals are operated by three world-class terminal operators: ECM Terminal Ltd, INTELS Nigeria Ltd, and Shoreline Logistics Nigeria Limited.

Calabar port's prominence in the oil and gas industry is fast growing, as our mission is to help you realize your import and export goals by providing a reliable port service system that ensures quick vessel turnaround and cargo clearance (NPA, 2022e).


**Figure 3.5: Depicts the Calabar port**

# CHAPTER FOUR

# 4.0 METHODOLOGY

## 4.1 Study Area

The study was carried out in Lagos port (such as at Apapa and Tin Can), River port, Onne port and Calabar port. They were chosen for case study because they are the major viable ports, terminals and Jetties in Nigeria that are equipped with modern cargo handling equipment and personnel support facilities.

## 4.2 Research Design

The study adopted a quantitative survey approach, non-experimental and cross sectional in nature. The target of the analysis were the seafarers, ship operators, port captains, port engineers and ex mariners who sails onboard ships in Nigerian water. A Quantitative analysis was adopted because it describes the study phenomenon in terms of numbers and non-experimental design which allows analysis using statistical methods to generate descriptive statistics. The design was considered appropriate for the study due to the need to collect data from a larger sample to establish if effective maintenance is been practiced on-board ships in Nigerian water.

## 4.3 Study Population

A population in statistics is the detailed parameter about which data is desired and it may include a set of people, services, events, elements, household, or group of things that is being studied. The study population were all the seafarers, port captains, port engineers and ex mariners who specifically work onboard ships in Nigerian water.

## 4.4 Sampling Frame

The researcher selects amongst those who work onboard ships in Nigerian water using simple a random sampling method. The sample was selected because they are assumed to be

knowledgeable about the ship maintenance and the fact that the purpose of the study was to establish if effective maintenance is been practiced on-board ships in Nigerian water.

## 4.5 Sampling method and sampling size

### 4.5.1 Sampling Method

The sample of the study was selected using convenience sampling together with a simple random sampling method which means all respondents have an opportunity of being chosen. Furthermore, random sampling is a part of the sampling method in which each model has the same probability of being selected. 30 respondents were chosen randomly per day for 5 days to ensure unbiased representation of the total population.

### 4.5.2 Sample Size

From the target population of 150 research respondents, total samples of 144 questionnaires respondent were carefully chosen for the study using Krejcie and Morgan (1970) sampling table. The study targets were those found within the port vicinity and ex mariners work on Nigeria water

## 4.6 Sources of Data

The researcher used both secondary and primary sources of data. Researcher obtains the Primary data through a self-administered questionnaire to ex-mariners and seafarers. The Questionnaires was issued to randomly samples respondents found within the ports' vicinity and ex mariners work on Nigeria water.

## 4.7 Method of Data Collection

### 4.7.1 Description of Research Instrument

Primary data was collected quantitatively. This goal is to gather data in the marine field with the questionnaires. The research questionnaire was considered following the research objectives. This method was chosen because it maximizes bias and enables the researcher to cover a larger sample in a limited time frame. Based on the objectives of the

study, the questionnaire was divided into 4 sections and the tool was designed on Likert scale range, i.e., 1(strongly disagree), 2(disagree), 3(non-committal), 4(agree) and 5(strongly agree).

### 4.7.2 Method of Validating Research Instrument

For validity of the instruments, the researcher makes sure that research questionnaires are in conformity with the study objectives. Validity denotes the degree to which the data collection instrument collects data that has the attribute or characteristic the researcher wants to measure. Validity of an instrument is the capability of the instrument to gather truthful and justifiable data; i.e. determining what it is established to measure. The supervisor and other consulted experts evaluated the relevance. In addition, the Cronbach's alpha reliability coefficient test was used, to find the instrument generated coefficient alpha above the acceptance average of 0.5 as stipulated by Creswell (2003). Concerns was taken to ensure that the instrument yield consistent results. Furthermore, the content validity index (CVI) of the questionnaire was computed using the formula;

$$CVI = \frac{no\ of\ questions\ declared\ valid}{Total\ number\ of\ questions} \qquad (4.1)$$

However, the questions which are not clear were later rephrased. The degree to which a group of variables is consistent with what they are planned to assess is referred to as reliability. Cronbach's alpha is used to quantify interval consistency when the items on an instrument are not scored right versus wrong, which is common with attitude questionnaires that use Likert scale. According to Mugenda and Mugenda (2003), a value of 0.7 or more indicates a high degree of data reliability, which is what the researcher adopted in the study.

## 4.8 Method of Data Analysis

The study quantitative data was analysed with SPSS version 20 to generate descriptive statistics such as mean, percentage frequency tables, and standard deviation. When behaviour is essentials to be evaluated on a continuum, a Likert scale is more useful.

Information was captured from respondents at minimal costs and in the shortest time possible, given the facts that the respondents have many commitments and were occupied with clients.

## 4.9 Analysis of Variance (ANOVA)

Analysis of variance (ANOVA) is a collection of statistical models and associated estimate processes (such as "variation" among and between groups) that are used to analyse and compare means. Ronald Fisher, a statistician, invented ANOVA. ANOVA is based on the law of total variance, which divides observed variance in a variable into components attributed to various causes of variation. ANOVA, in its most basic form, is a statistical test that determines if two or more population means are equal, and so extends the t-test beyond two means. To put it another way, the ANOVA is used to compare two or more means.

The formula for ANOVA is:

$$F = \frac{variance\ between\ samples}{variance\ within\ samples}$$

$$= \frac{mean\ square\ (between)\ [MS_{BET}]}{mean\ square\ (within)\ [MS_{WIT}]}$$

$$MS_{BET} = \frac{Sum\ of\ squares\ (between)\ [SS_{BET}]}{Degree\ of\ freedom\ (Between)}$$

$$MS_{WIT} = \frac{Sum\ of\ squares\ (within)\ [SS_{WIT}]}{Degree\ of\ freedom\ (within)}$$

Where $SS_{BET} = \sum \frac{(\sum x_i)^2}{n_i} - \frac{(\sum x_{total})^2}{N}$

$$SS_{WIT} = \sum {x_1}^2 - \frac{(\sum x_1)^2}{n_1} + \sum {x_2}^2 - \frac{(\sum x_2)^2}{n_2} + \sum {x_3}^2 - \frac{(\sum x_3)^2}{n_3} + - - - + \sum {x_k}^2 - \frac{(\sum x_k)^2}{n_k}$$

$$DOF_{BET} = k - 1$$

$$DOF_{within} = N - K$$

$$SS_{total} = SS_{BET} + SS_{within}$$

# CHAPTER FIVE

# 5.0 RESULTS AND DISCUSSION

## 5.1 Data Presentation and Analysis

### 5.1.1 Response Rate

The study used a sample of 150 respondents found within the ports vicinity. The researcher was able to access all the respondents and received back 144 filled in questionnaires. Therefore the response rate was 96 percent which was sufficient to provide reliable data and is above the significant statistics recommendable confidence interval of 95 percent.

### 5.1.2 Analysis of Respondents' Demographic information

#### (i) Analysis of Respondents by Gender

This shows the gender of participants for the study in terms of male and female.

**Table 5.1: Gender of Respondents**

| Gender | Frequency | Percent |
|---|---|---|
| Male | 113 | 78.5 |
| Female | 31 | 21.5 |
| Total | 144 | 100.0 |

**Source: Field Survey (2022)**

Table 5.1 revealed that 78.5% were male while 21.5% were female. Respondents found within the ports vicinity is dominated by male and deemed to be the majority in the working population in shipping business. Nonetheless, both gender participated in the study which guaranteed reliability and validity of the data.

#### (ii) Analysis of Respondents by Age

This was aimed at establishing the age brackets of the respondents sampled for the study within the port vicinity.

**Table 5.2: Age bracket of Respondents**

| Age (Years) | Frequency | Percent |
|---|---|---|
| 20 – 30 | 17 | 11.8 |
| 31 – 40 | 85 | 59.0 |
| 41 – 50 | 24 | 16.6 |
| 51 – 60 | 13 | 9.0 |
| Above 60 | 5 | 3.6 |
| Total | 144 | 100 |

**Source: Field Survey (2022)**

Table 5.2 reveals that 11.8% of respondents were in age bracket between 20 years to 30 years, 59.0% were between 31 years to 40 years, 16.6% were between 41 years and 50 years, 9.0% were between 51 years to 60 years and 3.6% were above 60 years old. Majority of the respondents were adults between 31 years to 40 years of age. These constitute the working class population and dominate those found within the port vicinity.

**(iii) Analysis of Respondents by marital status**

This was aimed at establishing the marital status of the respondents sample for the study within the ports vicinity

**Table 5.3: Marital status of Respondents**

| Marital Status | Frequency | Percent |
|---|---|---|
| Single | 83 | 57.6 |
| Married | 61 | 42.4 |
| Total | 144 | 100.0 |

**Source: Field Survey (2022)**

Table 5.3 revealed that 57.6 percent of the respondents were single while 42.4 percent were married. Majority of the respondents were single which implies that, they dominate the working population or probably absence of family/ married responsibilities enables them to spare time and participate in the study than married people with family responsibilities. Still, there was slight evenly contribution of both marital status with different level of satisfaction which guaranteed validity and reliability of data.

**(iv) Analysis of Respondents by level of education**

This was aimed at establishing the level of education of the respondents sampled for the study within the ports vicinity.

**Table 5.4: Level of education of Respondents**

| Level of education | Frequency | Percent |
|---|---|---|
| Diploma | 66 | 45.8 |
| Degree | 35 | 24.3 |
| Master's degree | 4 | 2.8 |
| Others | 39 | 27.1 |
| Total | 144 | 100.0 |

**Source: Field Survey (2022)**

Table 5.4 revealed that majority of the respondents at 45.8 percent had diploma, followed by those with unclassified level of education at 27.1 percent, 24.3 percent had degree and 2.8 percent had master's degree. Majority of the respondents had diploma and above which implies that respondents had justifiable knowledge to contribute to the study. This assured the validity and reliability of the data.

**(v) Analysis of Respondents by job description**

This was aimed at establishing the job description of the respondents sampled for the study within the ports vicinity.

**Table 5.5: Job description of respondents**

| Job Description | Frequency | Percent |
|---|---|---|
| Sea farer | 119 | 82.6 |
| Port captain | 9 | 6.3 |
| Ex-Mariner | 16 | 11.1 |
| Total | 144 | 100.0 |

**Source: Field Survey (2022)**

Table 5.5 revealed that the majority of the respondents at 82.6 percent are sea farer, followed by ex-mariners at 11.1 percent and 6.3 percent are port captain.

**(vi) Analysis of Respondents by years in duty**

This was aimed at establishing the duration in duty of the respondents sampled for the study within the ports vicinity.

**Table 5.6: Years in duty of Respondents**

| Years in duty | Frequency | Percent |
|---|---|---|
| Below a year | 12 | 8.3 |
| 1 – 5 | 55 | 38.2 |
| Above 5 | 77 | 53.5 |
| Total | 144 | 100.0 |

**Source: Field Survey (2022)**

Table 5.6 revealed that majority of respondents at 91.7% have been in duty for a period exceeding a years. This implies that participants have experience to participate in the study, which guarantee reliability of the data.

**(vii) Analysis of Respondents involvement in maintenance**

This was aimed at establishing the involvement in maintenance of the respondents sampled for the study within the ports vicinity.

**Table 5.7: Involvement in maintenance**

| Response | Frequency | Percent |
|---|---|---|
| Yes | 144 | 100 |
| No | 0 | 0 |
| Total | 144 | 100 |

**Source: Field Survey (2022)**

Table 5.7 revealed that all sampled respondents at 100 percent have been involved in maintenance practice onboard ship in Nigerian water. This implies that participants have adequate exposure about maintenance practice onboard ships in Nigerian water. Thus, guaranteed reliability and validity of the data.

**(viii) Analysis on how often maintenance is practiced**

This was aimed at establishing how often maintenance is practiced onboard ships in Nigerian water.

**Table 5.8: How often maintenance is practiced**

| Response | Frequency | Percent |
|---|---|---|
| Daily | 13 | 9.0 |
| Weekly | 61 | 42.4 |
| Monthly | 70 | 48.6 |
| Total | 144 | 100.0 |

**Source: Field Survey (2022)**

Table 5.8 revealed that maintenance is often practiced monthly.

**(ix) Analysis on the rating of maintenance practice**

This was aimed at establishing the rating of maintenance practices onboard ships in Nigerian water.

**Table 5.9: Rating of maintenance practice**

| Response | Frequency | Percent |
|---|---|---|
| Very satisfactory | 12 | 8.3 |
| Satisfactory | 43 | 29.9 |
| Not satisfactory | 89 | 61.8 |
| Total | 144 | 100.0 |

**Source: Field Survey (2022)**

Table 5.9 revealed that 61.8 percent of the respondents are not satisfied with how maintenance is practiced onboard ships in Nigerian water.

### 5.1.3 Analysis of Responses on objectives of the study

**Table 5.10: Is effective maintenance practiced on-board ships in Nigerian water?**

| Maintenance practices | N | Min | Max | Mean | Std. dev. |
|---|---|---|---|---|---|
| Effective maintenance is practiced on navigation equipment/ safety equipment | 144 | 1.00 | 5.00 | 3.965 | 0.964 |
| Effective maintenance is practiced on lifesaving appliances | 144 | 1.00 | 5.00 | 3.875 | 1.276 |
| Effective maintenance is practiced on fire fighting appliances | 144 | 1.00 | 5.00 | 3.813 | 1.611 |
| Effective maintenance is practiced on radio systems | 144 | 1.00 | 5.00 | 3.417 | 1.688 |
| Effective maintenance is practiced on load lines | 144 | 1.00 | 5.00 | 3.153 | 1.310 |
| Effective maintenance is practiced on hull construction and piping on deck | 144 | 1.00 | 5.00 | 3.431 | 0.967 |
| Effective maintenance is practiced on machineries in engine room | 144 | 1.00 | 5.00 | 3.986 | 1.180 |

| | | | | | |
|---|---|---|---|---|---|
| Effective maintenance is practiced on electrical equipment | 144 | 1.00 | 5.00 | 3.750 | 0.938 |
| Effective maintenance is practiced on cargo handling gear | 144 | 1.00 | 5.00 | 3.597 | 1.405 |
| Effective maintenance is practiced on accommodation | 144 | 1.00 | 5.00 | 3.146 | 1.833 |
| Effective maintenance is practiced on ballast systems | 144 | 1.00 | 5.00 | 3.222 | 1.395 |

**Table 5.11: What are causes of poor maintenance practice on-board Nigerian ships?**

| Scenarios | N | Min | Max | Mean | Std. de0.231v. |
|---|---|---|---|---|---|
| Poor leadership causes poor maintenance practices | 144 | 1.00 | 5.00 | 4.361 | 0.231 |
| Lack of maintenance policy causes poor maintenance practice | 144 | 1.00 | 5.00 | 4.167 | 0.722 |
| Attitudinal problem and corruption causes poor maintenance practice | 144 | 1.00 | 5.00 | 4.292 | 0.859 |
| New materials and construction techniques causes poor maintenance practice | 144 | 1.00 | 5.00 | 2.236 | 0.944 |
| Poor workmanship causes poor maintenance practice | 144 | 1.00 | 5.00 | 3.694 | 1.504 |
| Poor placement of materials causes poor maintenance practice | 144 | 1.00 | 5.00 | 4.007 | 0.549 |
| Lack of quality control and monitoring causes poor maintenance practice | 144 | 1.00 | 5.00 | 4.431 | 0.412 |

| | | | | | |
|---|---|---|---|---|---|
| Inadequate funding causes poor maintenance practice | 144 | 1.00 | 5.00 | 4.000 | 0.958 |
| Lack of human resources (skills) causes poor maintenance practice | 144 | 1.00 | 5.00 | 3.368 | 1.913 |
| Lack of training causes poor maintenance practice | 144 | 1.00 | 5.00 | 4.188 | 0.7736 |

**Table 5.12: Ways to enhance effective maintenance practice**

| Scenarios | N | Min | Max | Mean | Std. dev. |
|---|---|---|---|---|---|
| Schedule routine preventative maintenance will enhance effective maintenance practices on-board ships in Nigerian water | 144 | 1.00 | 5.00 | 4.368 | 1.233 |
| Improving inspection process will enhance effective maintenance practices on-board ships in Nigerian water | 144 | 1.00 | 5.00 | 4.479 | 0.475 |
| Optimizing inventory management system will enhance effective maintenance practices on-board ships in Nigerian water | 144 | 1.00 | 5.00 | 4.472 | 0.416 |
| Tracking operations data through electronic reports will enhance effective maintenance practices on-board ships in Nigerian water | 144 | 1.00 | 5.00 | 4.139 | 0.606 |
| Refusal of insurance companies to insure vessels will enhance effective maintenance practices on-board ships in Nigerian water | 144 | 1.00 | 5.00 | 3.021 | 1.451 |

## 5.2 Testing of Hypothesis

$H_0$: Improved Maintenance Practices On-board Ships in Nigerian Water has little significant effect on prolonged life of Ships

$H_1$: Improved Maintenance Practices On-board Ships in Nigerian Water has significant effect on prolonged life of Ships.

LEVEL OF RESEARCH SIGNIFICANCE ($\propto = 0.05$)

DECISION RULE: discard the null hypothesis ($H_0$) if the p-value is less than the level of significance, if not accept the null hypothesis.

**Table 5.13: Effects of Improved maintenance practices on prolonged life of ships**

| Model | Unstandardized coefficients | | Standardized coefficient | T | Sig. | 95% confidence interval for B | |
|---|---|---|---|---|---|---|---|
| | B | Std. Error | Beta | | | Lower Bound | Upper Bound |
| (Constant) | 3.560 | 0.156 | | 21.713 | 0.000 | 3.042 | 3.412 |
| Improved maintenance | 0.156 | 0.066 | 0.216 | 2.368 | 0.012 | 0.026 | 0.285 |

Dependent Variable: Prolonged life of ship

| R | R square | Adjusted R square | Std. error of the estimate | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | R square change | F change | df 1 | df 2 | Sig. F change |
| 0.206[a] | 0.042 | 0.037 | 0.51141 | 0.045 | 5.656 | 1 | 143 | 0.012 |

Predictors: (Constant), Improved maintenance

Source: SPSS Output

Table 5.13 reveals that the respondents are of opinion that improved maintenance has a positive statistic significant effect on prolonged life of ships at 5% level ($\beta$ =0.156, P value = 0.012). The coefficient of improved maintenance (0.156) indicates that for a unit increase in improved maintenance predicts 15.6 percent increase in prolonged life of ships. Improved maintenance explains 3.7% variation on prolonged life of ships.

DEDUCTION: Ever since the p-value is less than 0.05 which is the level of significance, we reject the null hypothesis and conclude that the respondents are of opinion that improved maintenance has significant effect on prolonged life of ships.

## 5.3 Discussion of Findings

### 5.3.1 Is effective maintenance practiced on-board ships in Nigerian water?

On whether effective maintenance is practiced on navigation equipment/ safety equipment indicate a mean of 3.965 and standard deviation of 0.964. Majority of the respondents agreed to this maintenance strategy being practiced

On whether effective maintenance is practiced on lifesaving appliances indicate a mean of 3.875 and standard deviation of 1.276. Majority of the respondents agreed to this maintenance strategy being practiced.

On whether effective maintenance is practiced on fire fighting appliances indicates a mean of 3.813 and standard deviation of 1.611. Majority of the respondents agreed to this maintenance strategy being practiced.

On whether effective maintenance is practiced on radio systems indicates a mean of 3.417 and standard deviation of 1.688. Majority of the respondents agreed to this maintenance strategy being practiced.

On whether effective maintenance is practiced on load lines indicates a mean of 3.153 and standard deviation of 1.310. Majority of the respondents are not sure of this maintenance strategy being practiced.

On whether effective maintenance is practiced on hull construction and piping on deck indicates a mean of 3.431 and standard deviation of 0.967. Majority of the respondents agreed to this maintenance strategy being practiced.

On whether effective maintenance is practiced on machineries in engine room indicates a mean of 3.986 and standard deviation of 1.180. Majority of the respondents agreed to this maintenance strategy being practiced.

On whether effective maintenance is practiced on electrical equipment indicates a mean of 3.750 and standard deviation of 0.938. Majority of the respondents agreed to this maintenance strategy being practiced.

On whether effective maintenance is practiced on cargo handling gear indicates a mean of 3.597 and standard deviation of 1.405. Majority of the respondents agreed to this maintenance strategy being practiced.

On whether effective maintenance is practiced on accommodation indicates a mean of 3.146 and standard deviation of 1.833. Majority of the respondents agreed to this maintenance strategy being practiced.

On whether effective maintenance is practiced on ballast systems indicates a mean of 3.222 and standard deviation of 1.395. Majority of the respondents agreed to this maintenance strategy being practiced.

### 5.3.2 What are causes of poor maintenance practice on-board Nigerian ships?

On whether poor leadership causes poor maintenance practices indicates a mean of 4.361 and standard deviation of 0.231. Majority of the research respondents established that poor leadership causes poor maintenance practice on board Nigerian ships.

On whether lack of maintenance policy causes poor maintenance practice indicates a mean of 4.167 and standard deviation of 0.722. Majority of the respondents agreed that this factor causes poor maintenance practice on board Nigerian ships.

On whether attitudinal problem and corruption causes poor maintenance practice indicates a mean of 4.292 and standard deviation of 0.859. Majority of the respondents agreed that this factor causes poor maintenance practice on board Nigerian ships.

On whether new materials and construction techniques causes poor maintenance practice indicates a mean of 2.236 and standard deviation of 0.944. Majority of the respondents disagreed that this factor causes poor maintenance practice on board Nigerian ships.

On whether poor workmanship causes poor maintenance practice indicates a mean of 3.694 and standard deviation of 1.504. Majority of the respondents agreed that this factor causes poor maintenance practice on board Nigerian ships.

On whether poor placement of materials causes poor maintenance practice indicates a mean of 4.007 and standard deviation of 0.549. Majority of the respondents agreed that this factor causes poor maintenance practice on board Nigerian ships.

On whether lack of quality control and monitoring causes poor maintenance practice indicates a mean of 4.431 and standard deviation of 0.412. Majority of the respondents agreed that this factor causes poor maintenance practice on board Nigerian ships.

On whether inadequate funding causes poor maintenance practice indicates a mean of 4.000 and standard deviation of 0.958. Majority of the respondents agreed that this factor causes poor maintenance practice on board Nigerian ships.

On whether lack of human resources (skills) causes poor maintenance practice indicates a mean of 3.368 and standard deviation of 1.913. Majority of the respondents agreed that this factor causes poor maintenance practice on board Nigerian ships.

On whether lack of training causes poor maintenance practice indicates a mean of 4.188 and standard deviation of 0.736. Majority of the respondents agreed that this factor causes poor maintenance practice on board Nigerian ships.

### 5.3.3 Ways to enhance effective maintenance practice

On whether schedule routine preventative maintenance will enhance effective maintenance practices on-board ships in Nigerian water indicates a mean of 4.368 and standard deviation of 1.233. Majority of the respondents agreed that this factor enhances effective maintenance practice.

On whether improving inspection process will enhance effective maintenance practices on-board ships in Nigerian water indicates a mean of 4.479 and standard deviation of 0.475. Majority of the respondents agreed that this factor enhances effective maintenance practice.

On whether optimizing inventory management system will enhance effective maintenance practices on-board ships in Nigerian water indicates a mean of 4.472 and standard deviation of 0.416. Majority of the respondents agreed that this factor enhances effective maintenance practice.

On whether tracking operations data through electronic reports will enhance effective maintenance practices on-board ships in Nigerian water indicates a mean of 4.139 and standard deviation of 0.606. Majority of the respondents agreed that this factor enhances effective maintenance practice.

On whether refusal of insurance companies to insure vessels will enhance effective maintenance practices on-board ships in Nigerian water indicates a mean of 3.021 and standard deviation of 1.451. Majority of the respondents are not sure if this factor enhances effective maintenance practice.

# CHAPTER SIX

## 6.0 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

### 6.1 Summary

The general objective of the study (the research question formulated for the study) was to investigate effective maintenance practices on board ships and develop a framework to avoid lapses in effective maintenance practice on board ships in Nigerian water. Other specific objectives were to examine the maintenance practice on board ships in Nigerian water, identify the impact of lacks in effective maintenance practice in Nigerian shipping, investigate the challenges associated with the development and the implementation of effective maintenance practice on board ships in Nigeria water and to suggest a proper practice to enhance effective maintenance practice on board ships in Nigerian water.

The study adopted a quantitative design, non-experimental and cross sectional in nature. The study population includes seafarers, ship operators, port captains, port engineers and ex-Mariners. A random sampling system was used in the research study with a sample size of 144 questionnaires. The research Primary data was obtained through a self-administered questionnaires and the quantitative data method was used for the analysis, using SPSS version 20 to produce descriptive statistics.

Findings showed that effective maintenance is not practiced on board ships on Nigerian water; although improved maintenance has significant effect on prolonged life of ships. Poor leadership, lack of maintenance policy, attitudinal problem, poor workmanship, poor placement of materials, lack of quality control and monitoring, inadequate funding, lack of human resources (skills) and lack of training are causes of poor maintenance practice on-board Nigerian ships. Schedule routine preventative maintenance, improved inspection, optimizing inventory and management system, tracking operations data through electronic reports are ways to enhance effective maintenance practice on-board ships in Nigerian water.

## 6.2 Conclusions

Ship Maintenance is the combination of the administrative, technical, and managerial arrangements throughout the life span of the vessel to preserve the ship to its original state where the vessel can execute the required duty without any interruption. Thus, effective maintenance management serves as a major backbone for the shipping industry and their services. Effective maintenance practice is required on-board any ship to enable the crews to maintain the vessel to perform her required function without any delay during the operation.

Based on the findings of the study, the study concludes that effective maintenance is not practiced on board ships in Nigerian water and improved maintenance has significant effect on prolonged life of ships. From the responses obtained from the respondents concerning whether effective maintenance is practiced on-board ships in Nigerian water, the study was able to conclude that maintenance is practiced on board ships on Nigerian water but the maintenance is not effective.

## 6.3 Recommendations

Based on the findings of this study, the following recommendations are made:

viii. Schedule routine preventative maintenance should be practiced to enhance effective maintenance practices on-board ships in Nigerian water

ix. Improving inspection process should be practiced to enhance effective maintenance practices on-board ships in Nigerian water

x. Optimizing inventory management system should be practiced to enhance effective maintenance practices on-board ships in Nigerian water

xi. Tracking operations data through electronic reports should be ensured to enhance effective maintenance practices on-board ships in Nigerian water

xii. Insurance should be compelled to insure vessels, in order to enhance effective maintenance practices on-board ships in Nigerian water

xiii. Flag state (NIMASA) to ensure that standard maintenance policies are followed on ship sailing in Nigeria water.

xiv. NIMASA monitoring teams should avoid compromising with the master of ship or shipping operators.

**How effective practice can be attain by NIMASA (Flag state)**

The findings revealed that effective maintenance is been compromised on Nigeria vessels. Therefore, the study suggests that the Nigeria government should empower and provide funds to NIMASA (Maritime administration and safety agency), to ensure NIMASA implements proper repair and maintenance practice onboard Nigeria ships both at local level and at international level. Effective maintenance is practice required for growth in the maritime industry in Nigeria to improve the shipping business in Nigeria to meet up to the standard international practice. Furthermore, NIMASA must ensure that the NIMASA patrol teams and Class Society such as ABS, DNV and Lloyds are carrying out their routines checks onboard Nigeria vessels without using any “short forms”.

By following the above practice by NIMASA, effective maintenance will be significantly improving onboard Nigeria vessels.

## REFERENCES


Ang J. H., Goh C., Flores Saldivar A.A., Li Y. (2017). Energy-Efficient Through-Life Smart Design, Manufacturing and Operation of Ships in an Industry 4.0 Environment. Journal of Energies 2017,10,610

Arunraj, N., S., Maiti, J., Risk-based maintenance - techniques and applications, Journal of Hazardous Materials, 142, 653-661, 2007

Badejo, B.A. (2002). The role and implication of government policies, charting the course of the maritime industry. In paper presentation on the occasion of the National Seminar on erandication of corruption and sharp practice in our ports. Anchorage Press and Publishers. Lagos.

Bengtsson M., Olsson E., Funk P. and Jackson M., Technical design of condition based maintenance system - a case study using sound analysis and cased-based reasoning, Proceedings of the 8th Conference of Maintenance and Reliability, Knoxville, 2004

Chang, V.T., Dung V.A., Thien D.M., Bich V.N., Implementation of the Computerized Maintenance Management Systems (CMMS) for the Maritime Industry, Proceedings of the International Multi Conference of Engineers and Computer Scientist Vol. II, Hong Kong, 2011

Corniciuc, C., Veríssimo, A., Case study: implementing a CMMS for maintenance management in a university campus, (2017). Atlantis press.

Creswell, J.W. (2003). Research design: Qualitative, quantitative and mixed methods approaches (2nd edition). Thousand Oaks, CA:Sage.

Douglas, O. (2021). Factors hindering ship repairs and maintenance in Nigeria- NPA boss. Available at https://businesstraffic.com.ng/factors-hindering-ship-repairs-and-maintenance-in-nigeria-npa-boss/ {Assessed on 20 January, 2022}.

Gašpar, G., Poljak, I., Orović, J., Computerized Planned Maintenance System software models, Scientific Journal of Maritime Research 32 (2018) 141-145 © Faculty of Maritime Studies Rijeka, 2018

Hoque F, (2000) E-Enterprise: Business models, architecture, and components. Series: Breakthroughs in Application Development (No. 2) Cambridge: Cambridge University Press.

International Shipping news (2021). Nigeria: challenges in Nigeria's shipping sector. Available at https://www.hellenicshippingnews.com/nigeria-challenges-in-nigerias-shipping-sector/ {Accessed on 23 January, 2022}.

Khazraei K., Deuse J., A strategic standpoint on maintenance taxonomy, Journal of Facilities Management, Vol. 9, No. 2, pp. 96-113, 2011.

Krejcie, R.V. and Morgan, D.W. (1970). Determining sample size for research activities. Educational and psychological measurement, 30, 607-610.

Lam, J.S.L and Dai, J. (2012). A decision support system for port selection. Transportation planning and technology, 35(4), pp. 509-524.

Lazakis, I., Turan, O., Aksu, S., Increasing ship operational reliability through the implementation of a holistic maintenance management strategy, Ships and Offshore Structures Vol. 5, No. 4, 2010, 337–357, 2010

Lee J, (2003) E-manufacturing: fundamental, tools, and transformation. Robotics and Computer-Integrated Manufacturing, 19(6): 501-507.

Malgorzata, J.K., The role of ergonomics in implementation of the social aspect of sustainability, illustrated with the example of maintenance, Occupational Safety and Hygiene. CRC Press, Taylor & Francis: London, ISBN 9781138000476, pp. 47-52, 2013.

McMican, W. J., Richards, J.J., Shipboard non-tactical computer systems of the U.S. Navy, Naval Postgraduate School, Monterey, California, 1985.

Mohit (2016). How maintenance work is done onboard ship. Available at https://www.marineinsight.com/guidelines/how-maintenance-work-is-done-onboard-a-ship/ {Accessed 20 January, 2022}.

Mugenda, O.M and Mugenda, A.G. (2003). Research methods, Quantitative and Qualitative Approaches. Nairobi. African centre for Technology (ACT) studies press.

Narula K., Agarvala N., Classification Rules for Naval Warships: Heralding a Change, 2015

Nigerian Ports Authority (NPA). (2022a). The lagos port. https://nigerianports.gov.ng/lagos-port/

Nigerian Ports Authority (NPA). (2022b). The TinCan port. https://nigerianports.gov.ng/tincan

Nigerian Ports Authority (NPA). (2022c). The Rivers port. https://nigerianports.gov.ng/rivers/

Nigerian Ports Authority (NPA). (2022d). The Onne port. https://nigerianports.gov.ng/onne/

Nigerian Ports Authority (NPA). (2022d). The Calabar port. https://nigerianports.gov.ng/calabar/

Palmer RD, (1999) Maintenance Planning and Scheduling. New York: McGraw-Hill.

Palmer RD, (1999) Maintenance Planning and Scheduling. New York: McGraw-Hill.

Ramus, W and Neroda, J. (2003). E-Diagnostics: The value proposition story. Semiconductor International, 7/1/2003.

Saint-Voirin, D., Lang, C., Zerhouni, N. and Guyennet, H. (2005) Cooperative systems modelling, example of a cooperative e-maintenance system. In: Proceedings of CIRA 2005, Computational Intelligence in Robotics and Automation, 439-444. Espoo, Finland.

The International Safety Management Code (ISM). The International Maritime Organisation (IMO), 2002

Trojan, F., Marçal R. F. M., Proposal of maintenance types. Classification to clarify maintenance concepts in production and operations management, Journal of Business Economics, 2017

US DOE, Operation and maintennce best practice guide, release 3.0, US Department of Energy, Washington, 2010

Whitehead, P. (2000). Environmental management framework for ports and related industries. Terra et Aqua, pp 22-30.

Wireman T, (1998) Developing performance indicators for managing maintenance. New York: Industrial Press.

## APPENDIX 1: SELF ADMINISTERED QUESTIONNAIRE

Dear Respondent,

I am Raji Mudasiru, a student pursuing a Masters of Maritime Operations in maritime study at Western Norway University of Applied Sciences. I am conducting a research to assess an evaluation of effective maintenance practices onboard ships in Nigerian water.

I therefore kindly request you to take a few minutes of your time to respond to the questions and all information given will be purely for academic reasons and will be treated with utmost confidentiality. Your cooperation is valuable to the success of this study.

Kindly fill in the blank spaces, tick where appropriate or give some short explanation where necessary.

**SECTION A: DEMOGRAPHIC INFORMATION**

1. What is your Gender?

Male ☐ Female ☐

2. Age bracket (years)?

20 years - 30 years ☐ 31 years – 40 years ☐ 41 years – 50 years ☐

51 years – 60 years ☐ Above 60 years ☐

3. Marital status

Single ☐ Married ☐ Divorced ☐

4. Educational qualification

Diploma ☐ Degree ☐ Master's degree ☐ others ☐

5. Job Description

Seafarer ☐ Ship Operator ☐ Port Captain ☐

Port Engineer ☐ Ex-Mariner ☐

6. No of years in duty

Less than a year ☐ 1 – 5 years ☐ Above 5 years ☐

7. Have you ever been involved in maintenance practices onboard ships

Yes ☐ NO ☐

8. If yes, how often is maintenance practices carried out

Daily ☐ Weekly ☐ Monthly ☐

9. How do you rate maintenance practices onboard ships in Nigerian water

Very satisfactory ☐ Satisfactory ☐ Not satisfactory ☐

**SECTION B: Is effective maintenance practiced on-board ships in Nigerian water?**

The following questions aim at assessing if effective maintenance is practiced on-board ships in Nigerian water. Please use the following scale in order to give your response: 1(strongly disagree), 2(disagree), 3(non-committal), 4(Agree) and 5(strongly agree).

| S/N | Scenarios | Strongly disagree | Disagree | Not sure | Agree | Strongly agree |
|---|---|---|---|---|---|---|
| 1 | Effective maintenance is practiced on navigation equipment/ safety equipment | | | | | |
| 2 | Effective maintenance is practiced on lifesaving appliances | | | | | |
| 3 | Effective maintenance is practiced on firefighting appliances | | | | | |
| 4 | Effective maintenance is practiced on radio systems | | | | | |
| 5 | Effective maintenance is practiced on load lines | | | | | |
| 6 | Effective maintenance is practiced | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | on hull construction and piping on deck | | | | | |
| 7 | Effective maintenance is practiced on machineries in engine room | | | | | |
| 8 | Effective maintenance is practiced on electrical equipment | | | | | |
| 9 | Effective maintenance is practiced on cargo handling gear | | | | | |
| 10 | Effective maintenance is practiced on accommodation | | | | | |
| 11 | Effective maintenance is practiced on ballast systems | | | | | |

**SECTION C: What are causes of poor maintenance practice on-board Nigerian ships?**

The following questions aim at assessing the causes of poor maintenance practices on-board ships in Nigerian water. Please use the following scale in order to give your response: 1(strongly disagree), 2(disagree), 3(non-committal), 4(Agree) and 5(strongly agree).

| S/N | Scenarios | Strongly disagree | Disagree | Not sure | Agree | Strongly agree |
|---|---|---|---|---|---|---|
| 1 | Poor leadership causes poor maintenance practices | | | | | |
| 2 | Lack of maintenance policy causes poor maintenance practice | | | | | |
| 3 | Attitudinal problem and corruption causes poor maintenance practice | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 4 | New materials and construction techniques causes poor maintenance practice | | | | | |
| 5 | Poor workmanship causes poor maintenance practice | | | | | |
| 6 | Poor placement of materials causes poor maintenance practice | | | | | |
| 7 | Lack of quality control and monitoring causes poor maintenance practice | | | | | |
| 8 | Inadequate funding causes poor maintenance practice | | | | | |
| 9 | Lack of human resources (skills) causes poor maintenance practice | | | | | |
| 10 | Lack of training causes poor maintenance practice | | | | | |

**SECTION D: Ways to enhance effective maintenance practice on-board ships in Nigerian water**

The following questions aim at assessing the ways to enhance effective maintenance practices on-board ships in Nigerian water. Please use the following scale in order to give your response: 1(strongly disagree), 2(disagree), 3(non-committal), 4(Agree) and 5(strongly agree).

| S/N | Scenarios | Strongly disagree | Disagree | Not sure | Agree | Strongly agree |
|---|---|---|---|---|---|---|
| 1 | Schedule routine preventative maintenance will enhance effective maintenance practices on-board ships in Nigerian water | | | | | |
| 2 | Improving inspection process will enhance effective maintenance practices on-board ships in Nigerian water | | | | | |
| 3 | Optimizing inventory management system will enhance effective maintenance practices on-board ships in Nigerian water | | | | | |
| 4 | Tracking operations data through electronic reports will enhance effective maintenance practices on-board ships in Nigerian water | | | | | |
| 5 | Refusal of insurance companies to insure vessels will enhance effective maintenance practices on-board ships in Nigerian water | | | | | |

In your opinion, what do you think should be done to enhance effective maintenance practices on-board ships in Nigerian water?

## APPENDIX 2: PROGRAM USED FOR STATISTICAL ANALYSIS OF DATA

### 1 Is effective maintenance practiced on-board ships in Nigerian water

| Scenarios | Strongly disagree | Disagree | Not sure | Agree | Strongly agree | Mean | Std. Dev. |
|---|---|---|---|---|---|---|---|
| Effective maintenance is practiced on navigation equipment/ safety equipment | 9 | 6 | 0 | 95 | 34 | 3.965 | 0.964 |
| Effective maintenance is practiced on lifesaving appliances | 6 | 20 | 6 | 66 | 46 | 3.875 | 1.276 |
| Effective maintenance is practiced on firefighting appliances | 12 | 20 | 0 | 63 | 49 | 3.813 | 1.611 |
| Effective maintenance is practiced on radio systems | 9 | 37 | 23 | 35 | 40 | 3.417 | 1.688 |
| Effective maintenance is practiced on load lines | 12 | 29 | 48 | 35 | 20 | 3.153 | 1.310 |
| Effective maintenance is practiced on hull construction and piping on deck | 0 | 37 | 23 | 69 | 15 | 3.431 | 0.967 |
| Effective maintenance is practiced on machineries in engine room | 0 | 23 | 17 | 43 | 61 | 3.986 | 1.180 |
| Effective maintenance is practiced on electrical equipment | 0 | 26 | 12 | 78 | 28 | 3.750 | 0.938 |
| Effective maintenance is | 0 | 43 | 9 | 55 | 37 | 3.597 | 1.405 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| practiced on cargo handling gear | | | | | | | |
| Effective maintenance is practiced on accommodation | 20 | 40 | 6 | 55 | 23 | 3.146 | 1.833 |
| Effective maintenance is practiced on ballast systems | 14 | 29 | 29 | 55 | 17 | 3.222 | 1.395 |

**2 What are causes of poor maintenance practice on-board Nigerian ships**

| Scenarios | Strongly disagree | Disagree | Not sure | Agree | Strongly agree | Mean | Std. dev. |
|---|---|---|---|---|---|---|---|
| Poor leadership causes poor maintenance practices | 0 | 0 | 0 | 92 | 52 | 4.361 | 0.231 |
| Lack of maintenance policy causes poor maintenance practice | 0 | 12 | 6 | 72 | 54 | 4.167 | 0.722 |
| Attitudinal problem and corruption causes poor maintenance practice | 0 | 9 | 20 | 35 | 80 | 4.292 | 0.859 |
| New materials and construction techniques causes poor maintenance practice | 35 | 58 | 35 | 14 | 2 | 2.236 | 0.944 |
| Poor workmanship causes poor maintenance practice | 9 | 23 | 14 | 55 | 43 | 3.694 | 1.504 |
| Poor placement of materials causes poor maintenance practice | 0 | 12 | 3 | 101 | 28 | 4.007 | 0.549 |
| Lack of quality control and monitoring causes poor maintenance practice | 0 | 0 | 12 | 58 | 74 | 4.431 | 0.412 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Inadequate funding causes poor maintenance practice | 0 | 23 | 0 | 75 | 46 | 4.000 | 0.958 |
| Lack of human resources (skills) causes poor maintenance practice | 17 | 32 | 14 | 43 | 38 | 3.368 | 1.913 |
| Lack of training causes poor maintenance practice | 0 | 12 | 6 | 69 | 57 | 4.188 | 0.746 |

**3 Ways to enhance effective maintenance practice on-board ships in Nigerian water**

| Scenarios | Strongly disagree | Disagree | Not sure | Agree | Strongly agree | Mean | Std. Dev. |
|---|---|---|---|---|---|---|---|
| Schedule routine preventative maintenance will enhance effective maintenance practices on-board ships in Nigerian water | 12 | 0 | 0 | 43 | 89 | 4.368 | 1.233 |
| Improving inspection process will enhance effective maintenance practices on-board ships in Nigerian water | 0 | 0 | 16 | 43 | 85 | 4.479 | 0.475 |
| Optimizing inventory management system will enhance effective maintenance practices on-board ships in Nigerian water | 0 | 0 | 12 | 52 | 80 | 4.472 | 0.416 |
| Tracking operations data through electronic reports will enhance | 0 | 6 | 17 | 72 | 49 | 4.139 | 0.606 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| effective maintenance practices on-board ships in Nigerian water | | | | | | | |
| Refusal of insurance companies to insure vessels will enhance effective maintenance practices on-board ships in Nigerian water | 14 | 37 | 49 | 20 | 24 | 3.021 | 1.451 |