

MAINTENANCE MANAGEMENT OF PRISON FACILITIES IN SOUTH-WEST, NIGERIA

By

AJAYI, Oluranti Olupolola (039052010)

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Nigeria.

AUGUST, 2016

**SCHOOL OF POSTGRADUATE STUDIES
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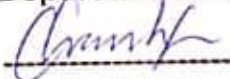
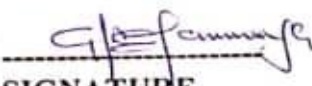
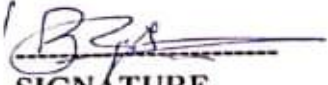
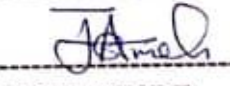
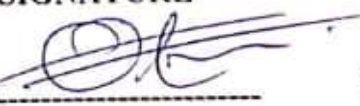
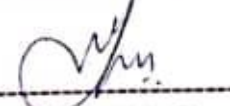
**MAINTENANCE MANAGEMENT OF PRISON FACILITIES IN SOUTH-
WEST, NIGERIA**

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University of Lagos

For the award of the degree of
DOCTOR OF PHILOSOPHY (Ph.D.)
is a record of original research carried out
By:

AJAYI, OLURANTI OLUPOLOLA

In the Department of Building

<u>AJAYI Oluranti O.</u>	<u></u>	<u>05/08/2016</u>
AUTHOR'S NAME	SIGNATURE	DATE
<u>DR AGENUGA OLUMIDE A.</u>	<u></u>	<u>05-08-2016</u>
1 ST SUPERVISOR'S NAME	SIGNATURE	DATE
_____	_____	_____
2 ND SUPERVISOR'S NAME	SIGNATURE	DATE
<u>Dr. O. E. Ogunfesan</u>	<u></u>	<u>05-08-2016</u>
3 RD SUPERVISOR'S NAME	SIGNATURE	DATE
<u>Dr. O. J. AMEH</u>	<u></u>	<u>05-08-2016</u>
1 ST INTERNAL EXAMINER	SIGNATURE	DATE
<u>DR. OLATUNJI J. OLADIRAN</u>	<u></u>	<u>05-08-2016</u>
2 ND INTERNAL EXAMINER	SIGNATURE	DATE
<u>PROF. EMMANUEL ACHUENU</u>	<u></u>	<u>05-08-2016</u>
EXTERNAL EXAMINER	SIGNATURE	DATE
<u>Prof. Olamiji OKEKE</u>	<u></u>	<u>5th August 2016</u>
SPGS REPRESENTATIVE	SIGNATURE	DATE

DECLARATION

MAINTENANCE MANAGEMENT OF PRISON FACILITIES IN SOUTH-WEST, NIGERIA

I declare that this thesis represents my original work in the Department of Building, University of Lagos. It has not been accepted for any previous application for a higher degree or previously published by any other person.

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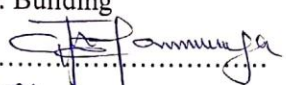
Ajayi, Oluranti Olupolola

August, 2016

SUPERVISOR'S ATTESTATION

We hereby certify that the work in this thesis titled: **"Maintenance Management of Prison Facilities in South-West, Nigeria"** was carried out under our supervision and that it is the original work of the researcher, Ajayi Oluranti Olupolola.

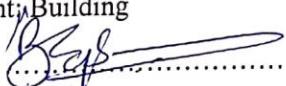
1st Supervisor

- i. Name: O. A. Adenuga
- ii. Designation: Associate Professor
- iii. Department: Building
- iv. Signature: 
- v. Date: 9th SEPTEMBER, 2016

2nd Supervisor

- i. Name: R. O. A. Iyagba
- ii. Designation: Professor
- iii. Department: Building
- iv. Signature:
- v. Date:

3rd Supervisor

- i. Name: O.E. Ogunsanmi
- ii. Designation: Associate Professor
- iii. Department: Building
- iv. Signature: 
- v. Date: 9/09/2016

DEDICATION

This thesis is dedicated to the Most High, the infinitely great God whose majesty reaches above the high heavens. For thy mercy is great unto the heavens, and thy truth unto the clouds. Psalm 57 vs. 10 (KJV).

To my late father Pa Babajide Akinwunmi Farinde Farinloye, daddy this is your dream come true for me. Also, to my late daughter Oluwapelumi Glory.

To my sweet mother Deaconess Ayodele Janet Farinde Farinloye. To my darling husband Dr Abiodun Akintoye Ajayi and my Jewels Temiloluwa Deborah and Oluwasemilore Daniel.

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LIST OF ABBREVIATIONS

A&S	Administration and Supply
CPF	Condition of Prison Facilities
CV	Coefficient of Variation
F&A	Finance and Account
H&SW	Health and Social Welfare
ITP	Inmates' Training and Productivity
W&L	Works and Logistics
MPIs	Maintenance Performance Indicators
OHCHR	Office of the High Commissioner for Human Right
PERFMTCE	Performance of Maintenance unit
PPF	Performance of Prison Facilities
MTCEBUDGET	Prison Maintenance Budget per Inmate
PMS	Prison Maintenance Staff
PNMS	Prison Non-Maintenance Staff
PRAWA	Prison Rehabilitation and Welfare Action
PSO	Prison Service Technical Order
Ops	Prison Staff of Operations
QPMS	Questionnaire for Prison Maintenance Staff
QPNMS	Questionnaire for Prison Non-Maintenance staff
SERVQUAL	Service Quality
UNODC	United Nations Office on Drugs and Crime

Abstract

Maintenance management optimises the use of available maintenance resources to improve and sustain the functions of facilities. This ensures that prison facilities provide a safe environment for its users and also create an environment that supports Nigerian prisons goals. As such, prison facilities are expected to meet certain minimum standards as prescribed by the United Nations in order to serve their purposes. However, Nigerian prison facilities are grossly inadequate to accommodate inmates, their condition being deplorable and dehumanising. Consequently, there is an urgent need to transform Nigerian prison facilities through maintenance management. The research thus investigates maintenance management of prison facilities in South-West Nigeria with a view to developing a framework that can assist prison maintenance staff to effectively realise maintenance objectives. The study assesses the conditions and factors that affect the maintenance management of the prison facilities. Further, it examines the maintenance management practices adopted for the maintenance of facilities as well as evaluating the performance of the prison facilities. The study is survey research and it adopts a cross-sectional survey design. Data were collected using two sets of self-administered questionnaires on a census sample of 42 prison maintenance staff and a quota sample of 1094 prison non-maintenance staff across South-West, Nigeria. In addition, secondary data were also obtained from the Budget Office of the Federation of Nigeria and the Nigerian Prison Service. The survey had a response rate of 60% and 35% for prison maintenance and non-maintenance staff respectively. Both descriptive and inferential statistical tools were employed. Results of the analysis indicated that there was no significant difference between the perception of prison maintenance and non-maintenance staff on the physical conditions of prison facilities. Results revealed critical factors affecting maintenance management of prison facilities as deterioration due to age of the facility, overcrowding, and inadequate training and development of staff among other factors. The study indicated inconsistency in the implementation of maintenance policies, maintenance planning and discrepancies in the frequency of use among the maintenance strategies. It was also found that the maintenance budget per inmate and performance of maintenance unit are not significantly correlated. Study indicated partial satisfaction for performance of prison facilities with significant agreement among prison non-maintenance staff. Also, study showed that the difference between expectations and perceived quality of maintenance services was statistically significant. In addition, the study developed a model predicting performance of prison facilities from the condition of prison facilities. A framework having basic components to guide prison maintenance staff was developed and this was validated using focus group discussions with maintenance management experts. The study confirmed the criticality of poor conditions in Nigerian prison facilities. The study suggests that, to improve the state of prison facilities, the Federal Government, the Nigerian Prison Service, Prison Works and Logistics Department, prison facilities users' and Academia are to be an advocate for safe and decent prison facilities. Indeed, a proactive maintenance approach with emphasis on the logical phases of the developed maintenance management framework should be adopted in the maintenance of prison facilities.

Keywords: Prison facilities, Maintenance management, Prison maintenance staff, Prison non-maintenance staff.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Investigations have revealed that the Nigerian prison system, especially the physical facilities are overly punitive, degrading and dehumanizing (Prison Rehabilitation and Welfare Action [PRAWA], 2000). The prison system is also grossly inadequate (Library of Congress Country Studies; CIA World Factbook, 2005) and incapable of being reformatory and rehabilitative. The situation could have been averted with good maintenance management action of performing routine maintenance activities (including minor repairs or replacements) to keep the prison facilities operational and ensure proper performance of the prison facilities (Bruce, Courtney, Nancy, George, David & David, 2006).

Maintenance management optimises the use of available maintenance resources. It involves the utilisation of manpower to attain the desired objectives of keeping facilities in a safe condition and avoid the need for potential expenses and disruptive repairs which may damage the facilities (Pun, Chin, Chow & Lau, 2002; Sodangi, Khamdi, Idrus, Hammad & Umar, 2014). Zawawi, Kamaruzzaman, Ithnin and Zulkarnain (2011) described maintenance management as planning, directing, organizing and controlling of maintenance activities and services to obtain maximum returns on investment. The main purpose of maintenance management is to improve and sustain facilities in functional state including services and surrounding areas using a systematic approach that is based on standard regulations, accepted and implemented by a competent operative (Abd Rani, Basharun, Akbar & Nawawi, 2015).

The function of prison facilities includes providing a safe and decent environment for prison staff and prisoners to work and live in, as well as for all others who interact with the prison facilities (Prison Service Technical Order [PSO] 5900 & 5901). To sustain these functions it becomes imperative for the prison service to put in place a structured maintenance management system. That is capable of providing the right tools, equipment, maintenance materials, technologies, manpower (Pun, Chin, Chow & Lau, 2002) and methodologies of carrying out maintenance activities on prison facilities as well as measures for evaluating the performance of the facilities.

Beyond these functions, prison facilities are to create an environment that supports the prison service objectives. That is, reformation, correction and rehabilitation of prisoners. However, the deplorable state of the Nigerian prison facilities could have prevented them from providing a decent environment and supporting reformatory and corrective activities. Despite the terrible and dehumanising conditions of these prisons (Nyakaisiki, 2008), there is severe pressure on them to accommodate more inmates (Ayuk, Emeka & Omono, 2013). With these circumstances, the Nigerian prison facilities will most likely not meet the basic standards for prison facilities as specified by the United Nations provisions (Office of the High Commissioner for Human Right [OHCHR], 2008; United Nations Office on Drugs and Crime [UNODC], 2014).

Despite the increasing awareness of maintenance management in this 21st Century, it is worrisome, that the Nigerian prisons, especially the physical facilities, have been described as uncivilized (Obioha, 2011). Like any other establishment, the Nigerian prisons service should perceive maintenance management as an essential function classified as non-core activities that

support its core (rehabilitation and reformation) business (Siu, 2000). Institutional facilities should be managed and maintained properly to ensure the functioning of the facilities and to reduce maintenance cost by carrying out an appropriate maintenance programme that extends the life cycle of facilities while providing safe environment for the users (Abdullah Sani, Mohammed, Misnan & Awang, 2012; Hamzah & Kobayashi, 2013).

The core business or cardinal objectives of the Nigerian Prison Service is to manage prisoners from crime and other anti-social activities and offer them guidance that will enable them to live a normal life again (“Prison of Horror,” 2000). Agomoh and Oghozor (2006) confirmed that the functions of the Nigerian Prison Service include ensuring safe custody of persons legally interred and identifying the causes of inmates’ inherent anti-social behaviour. Other functions include treating and reforming inmates to become law-abiding citizens of a free society. Training inmates towards rehabilitation on discharge as well as generating revenue for the government through prison farms and industries. However, these functions could be achieved with adequate and well structured maintenance and repairs that presume safe access to prison facilities (Mendes Silva & Falca, 2009).

The defectiveness of criminal justice administration in Nigeria has led to overcrowding of prisons and abuse of prisoners /citizens’ right (PRAWA, 2000). A major problem was confirmed to be associated with the state of prison facilities based on the survey carried out on countries like Kenya, Nigeria, Tanzania and Uganda (Nyakaisiki, 2008). More disturbing than the mere head count of inmates is the rate of growth relative to prisons’ installed capacities that have

resulted in the congestion of prisons. By late 1980, the Nigerian Prison Service was housing 58,000 inmates in facilities designed for 28,000 inmates (Library of Congress Country Studies; CIA World Factbook, 2005). Subsequently, there was a decrease in the prison population by 2010, with 47,628 inmates out of which only 1,300 were convicted while the other 34,328 were awaiting trial (Nwezeh, 2010). This showcase the defectiveness of the judicial system handling matters relating to prisons service. Despite efforts by the Federal Government for reforms, in 2014 the population of Nigerian inmates rose to 53,100 (Ohia, 2014). Congestion of prisons takes its toll on inmates, the prison system, prison facilities and the society at large, causing premature obsolescence of the few facilities that are grossly inadequate for prison service (“Prison of Horror,” 2000).

The Nigerian Prison Service’s total annual capital expenditures between 1985 and 1988 ranged from N3 million to N11.6 million (Library of Congress Country Studies; CIA World Factbook, 2005). In 2012, the total expenditure was N56.7billion. Capital expenditure was N3billion while construction of fixed assets and repairs of fixed assets was N1.5 billion and N716 million respectively (www.budgetoffice.gov.ng). This shows a rise in capital expenditure and government concern for the maintenance budget.

Agomoh and Oghozor’s (2006) assessment of the Nigerian prison system reveal that the system has failed in security, reformation, rehabilitation, re-integration and revenue generation. It appears these failures could be associated with the state and availability of the prison facilities to perform the functions for which it is designed, used or required to be used. In the year 2008, the

Minister of Internal Affairs, during the inauguration of Suleja Prisons, disclosed the Federal Government's intention to undertake a massive reform of the nation's prison system in a bid to address the observed decadence and improve prison facilities across the Country. Such decadency in prison facilities affect the inmates whereby they are expose to developing sick building syndrome (itchy skin, headaches, stuffy nose etc.) due to low level of inmates control over ventilation, poor standard of cleanliness and lack of repairs in the cell blocks (Health and Safety Executive [HSE], 2000).

Another major problem with the prison facilities is the condition of the sanitary and sewage facilities that impede the health of the inmates (PRAWA, 2000). Poor prison facilities, structural failure of facilities, and inadequate security features is most likely or could most time result in prison break as evident in the Nigerian prisons. Several cases of prison breaks have been reported between 2009 and 2014. This has resulted in the escape of over 2000 prisoners across the Nigeria prisons (Wikipedia, 2016). Basically, maintenance of prison facilities arises as a result of extensive use of facilities which inevitably deteriorate with time (Oladapo, 2005). It is thus imperative that any system's downtime resulting from failure should be kept to an absolute minimum (Quan, Greenwood, Liu & Hu, 2007). Therefore, the need for maintenance management of prison facilities becomes paramount.

European Standard EN 13306:2001 (as cited in Crespo Marquez & Gupta, 2006) defines maintenance management as follows:

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 management method in order to achieve maintenance objectives), and responsibilities and implement them by means such as maintenance planning, maintenance control and supervision, and several improving methods including economical aspects in the organization.

European Standard 13306 also defines maintenance as:

The combination of all technical, administrative and managerial action during the life cycle of an item intended to retain it in, or restore it to, a state in which it can perform the required function (function or combination of functions of an item which are considered necessary to provide a given service).

Maintenance of facilities in the Nigerian Prison Service, as in most Third World countries, is inadequate (Osisoma, 2010). Prison facilities maintenance is not being carried out according to actual maintenance needs due to poor funding on the part of relevant authority. This is also due to poor maintenance culture that is evident in our society. This inadequacy of the Government to provide fund for maintenance of facilities in prisons has serious implications for economic and social development (Yahaya, 2012). Zubairu (1999) affirms that maintenance problems have been worsened by the uncaring attitude of users of public facilities having an impression that the maintenance of public facilities is the sole responsibility of government. Indeed, this uncaring

attitude of users coupled with poor maintenance culture has a negative impact on the building elements and environment which could lead to unnecessary investment in prison facilities. Facilities that are not maintained deteriorate faster, have a shorter life span, waste scarce investment funds and preclude effective cost recovery (United Nations Centre for Human Settlement [UNCHS], 2003).

Previous researches on maintenance management practice in Nigeria such as those of Ikpo (1990), Adebayo (1991), Zubairu (1999), Oladapo (2005) and Adenuga (2008) focus on public office buildings, housing estates and hospital buildings. Ikpo (1990) studies the causes of housing deterioration and determined renewal cycles for building elements and components. Oladapo (2005) derives measures for minimising maintenance costs, maintenance prioritization procedures and performance appraisal of housing maintenance systems. Adenuga (2008) investigates the state of public hospitals, methods of executing maintenance work, factors affecting effective health delivery, managerial quality of maintenance personnel and performance of hospital buildings.

These researches address the problems of public buildings and public facilities. Though, breakthrough in one problem area can be considered as solutions to similar problems in the other area. Solutions that are provided by those researches could be of much relevance to the maintenance of prison facilities. However, the peculiarity of the Nigerian prison system, characteristics of the users especially the inmates, and the intensity of usage of the prison facilities calls for an in-depth maintenance management research.

There have been other studies relating to prisons, such as Ifeanyichukwu (2009) that investigates on managerial and structural problems hampering the reformative and rehabilitative objective of the Nigerian prison system. Kadiri and Haliso (2011) dwell on the effect of information on reformation of prisoners. Ayuk et al. (2013), in a related prison study, investigates the reasons why the objectives of correcting, reforming and rehabilitating of convicts are hardly realisable. These studies dealt more on prison reform and did not consider the physical facilities that support the reformation.

A close study of colonial and post colonial laws in Nigeria indicates that there is more to the custodial and correctional functions of modern prisons (Usiwoma, 2001). To achieve these functions, the building fabrics of prisons and services require maintenance input during their pre-design, design, construction and after-completion phase. Maintenance input in all the phases are important as continuous use of prison facilities for 24 hours per day over decades is likely to amount to deterioration and decay of facilities. It is not enough to clamour for new facilities but to improve the standard of the existing ones (Durango-Cohen & Madanat, 2008).

For Nigerian prison facilities to meet current and changing standards and for them to create an environment that supports their custodial, reformatory and rehabilitative functions as well as generate revenue, there is a need for proper maintenance so that those negative factors militating against prison facilities can be reduced or possibly eliminated (Yusof, Abdullah, Zubedy & Mohd Najib, 2012). In addition, there is a need for maintenance unit of the Nigerian Prison

Service to continually review its maintenance policy. Consequently, this study focuses on maintenance management of prison facilities in South-West, Nigeria.

1.2 Statement of Problem

Prisons are a microcosm of the society in a confined population that requires many of the facilities and social amenities available for contemporary society to perform effectively (William, 1994; Consoli, 2005). Such facilities include minimum floor space, visiting facilities, facilities for children in custody, kitchen facilities, library and educational facilities, sanitary, bathing and shower installations among others. These facilities are to be functional, fit for purpose and meet up with the stipulated minimum standard specified for prison estate (UNODC, 2014). It is imperative to have a structured maintenance programme to maintain prison facilities to a required standard, ensuring their availability and enhancing performance of prison facilities (Her Majesty prison service, 2005).

Unfortunately, facilities available in Nigeria Prisons are in a state of dilapidation and are not suitable for human habitation (PRAWA, 2000). According to “Prison of Horror” (2000) Nigeria prisons face numerous challenges related to maintenance of facilities. These include: lack of potable water, inadequate and unwholesome sewage facilities, insufficiency of bed spaces, appalling state of sanitation, and inadequate plant and equipment for maintenance operations. Besides these, there is also a paucity of facilities compared to the population of inmates (Ayuk et al., 2013). Additionally, predominant problems that pose a threat on maintenance of prison facilities are administrative bottle neck (“Prison of Horror,” 2000), bureaucracy, paramilitary

nature of the prisons service, and inadequate government subvention. Such that maintenance of facilities is confined to the budget rather than budget being derived from maintenance needs for public buildings (Adenuga, 2014).

These challenges have consequences on the Nigerian Prisons Service as they put a lot of strain on budgeted maintenance costs, stretch the workforce, and affect occupants' needs/priorities in terms of health, safety, security, functional performance and satisfaction. These challenges invariably result in lower availability of facilities and high maintenance costs in the long run.

Despite several reports in print and social media on the deplorable state of Nigerian prison facilities, not much attention has been paid to them by the relevant authority. These challenges are aggravated by strong demand for facilities to accommodate convicts, marginal increase in the incarceration rate (Nyakaisiki, 2008), and a constrained government budget for maintaining facilities fit (IBIS World, 2014).

Other challenges arise from the absence of a prompt trial of inmates awaiting trials ('Prison of Horror', 2000), overcrowding, conditions required for bail, deferred maintenance (Minnesota Office of the Legislative Auditor, n.d.) and high intensity of usage. Olubodun (2001) explains that users' (inmate and prison staff) characteristics (personalities, lifestyle and attributes) exert a significant influence on maintenance needs. The study further claims that users' maintenance needs vary according to building type and its use. This suggests the magnitude of maintenance

needs for prison facilities that are in use for 24hours in a day and 7days in a week by persons with alleged criminal attitude.

Studies on maintenance management in Nigeria in the past were on hospital buildings (Adenuga, 2008), housing estates (Oladapo, 2005; Ikpo, 1990) and public office buildings (Zubairu, 1999; Adebayo, 1991). Faremi and Adenuga (2012) evaluated maintenance management practice in the banking industry. Farinloye, Ogunsanmi and Adenuga (2011) assessed maintenance practices on correctional institutions. However there is a paucity of maintenance management research on prison facilities in Nigeria.

This study, therefore researches into the physical condition of prison facilities as well as factors affecting prison maintenance management with focus on maintenance planning, policy and strategy to performance appraisal of prison facilities.

1.3 Aim and Objectives of the Study

The aim of the study is to investigate maintenance management of prison facilities in South-West, Nigeria with a view to developing a framework to assist the maintenance staff in performing maintenance objectives effectively.

The specific objectives are to:

1. Assess the perception of prison maintenance staff and prison non-maintenance staff on the physical conditions of prison facilities.

2. Examine factors affecting maintenance management of prison facilities.
3. Examine the existing maintenance management practices in use (maintenance strategies, maintenance policies, maintenance planning and maintenance budgeting) for maintenance of prison facilities in South-West, Nigeria.
4. Assess the perception of prison non-maintenance staff on the performance of prison facilities.
5. Develop a framework to guide the prison maintenance staff in performing effectively the maintenance of prison facilities in South-West, Nigeria.

1.4 Research Questions and Hypotheses

1.4.1 Research Questions

The study addressed the following questions on maintenance management of prison facilities.

1. What are the perception of prison staff on the physical conditions of prison facilities?
2. What are the factors affecting maintenance management of prison facilities?
3. What are the maintenance management practices used in the maintenance of prison facilities?
4. What is the perception of prison non-maintenance staff on the performance of prison facilities in South-West, Nigeria?
5. What framework can be developed to guide prison maintenance staff in performing effectively the maintenance of prisons facilities?

1.4.2 Research Hypotheses

The hypotheses postulated are as follows:

1. There is no significant difference between the perception of prison maintenance staff and prison non-maintenance staff on the physical condition of prison facilities.
2. There is no significant correlation among the factors affecting maintenance management of prison facilities.
- 3 (a). There is no significant difference in the frequency of maintenance strategies used for prison facilities.

(b). There is no significant relationship between maintenance budget and performance of maintenance unit.
- 4 (a). There is no significant agreement among prison non-maintenance staff in their rating of performance of prison facilities

(b). There is no significant difference between prison non-maintenance staff expectations and perceived quality of maintenance services.

(c). Condition of prison facilities does not predict performance of prison facilities.

1.5 Significance of the Study

The study reveals the criticality of the state of Nigerian prison facilities. This will enable the government to know whether the subvention on prison facilities is producing returns on the resources expended. It provides a clear picture of whether investment in the maintenance of prison facilities is commensurate with the physical condition of the facilities.

This study also shows the critical underlying factors affecting the maintenance management of prison facilities. Likewise, the government, and other stakeholders concerned with prison policies and reformations can take advantage of this study by considering identified factors that are responsible for the dilapidation of prison facilities when making maintenance-related decisions. The study suggests an appropriate and cost-effective maintenance strategy for each item or group of items.

Furthermore, the study reveals the impact of maintenance activities on prison facilities and establishes the difference between expectations and perceived quality of maintenance services provided by the maintenance unit (SERVQUAL). These measures of the system also detect if planned and unplanned maintenance works are carried out within stipulated time and also assist in tracking maintenance resources consumed. The study provides prison maintenance staff with a structured framework that extends the life span of prison facilities and that sustains the utility and facilities' value, thus preserving investment on prison facilities.

1.6. Scope and Delimitation of the Study

The research studied the twenty (20) prisons located across South-West, Nigeria. These prisons are owned and controlled by government. They constitute 12.9% of the total number of Nigerian prisons (PRAWA, 1999; Nigeria Prisons Service, 2014). The study covered the maintenance of physical prison facilities within the prisons and the existing maintenance practices of the Nigerian Prison Service.

1.7 Limitation of the Study

The use of electronic devices was not permitted and access to administer copies of questionnaires on inmates was not granted. For security reasons, records of maintenance operation logs/ registrar were not made available to the researcher for sighting by the prison authorities. Also, the number of prison maintenance staff in maintenance units was found to be exceptionally low.

1.8 Definition of Terms

1.8.1 Maintenance: Work undertaken in order to keep or restore every facility, i.e. fabrics, services and contents to an acceptable standard and to sustain the utility and value of the facilities.

1.8.2 Maintenance management: This comprises tools, technologies and methodologies used in carrying out repairs, maintenance activities on facilities and evaluating the performance of such facilities.

1.8.3 Prison maintenance staff: These are the maintenance managers and technical officers working in the maintenance unit of the prison service at both tactical and functional levels.

1.8.4 Prison non-maintenance staff: These are prison staff of operations (Ops), administration and supply (A&S), health and social welfare (H&SW), finance and account (F&A), inmates' training and productivity (ITP), and logistics (L) departments.

1.8.5 Prisons: These are corrective institutions structured to identify the peculiar problems of each inmate and also to devise a means of guiding the individual out of the problem.

1.8.6 Prison facilities: These are classified as building fabrics, services, aesthetics and its environment.

1.8.7 Maintenance Performance Indicators (MPIs): These are measures of efficiency, effectiveness, quality, timeliness, safety and productivity. MPIs are utilized to evaluate the satisfaction derived from the use of prison facilities and the effectiveness of maintenance carried out on prison facilities.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents the body of knowledge relating to maintenance management of prison facilities to identify gaps in knowledge that needs to be filled. It reviews the Nigerian prison service and the functions of prison facilities. The chapter examines the impact of maintenance management activities on prison facilities that support the reformatory and corrective programme. It also examines factors that affect the maintenance management of prison facilities.

2.2 Nigerian Prisons Service

2.2.1 Nigerian Prisons Service Operations

The Nigerian prison service operates under CAP 366 Law of the Federation of Nigeria 1990 to keep in custody those certified to be kept by courts of competent jurisdiction, to identify the causes of their anti-social dispositions and provide treatment and training to allow for integration of such into society after release (Nigerian Prison Services, 2014). The Nigerian Prison Service has at its apex the Controller-General with six sub directorates having different and distinct mandate (www.prisons.gov.ng/organogram/work.php). These six sub divisions are operations (Ops), administration and supply (A&S), health and social welfare (H&SW), finance and account (F&A), inmates' training and productivity (ITP), and works and logistics (W&L). Works and logistics directorate, being the infrastructural mainframe directorate, is divided into works section and logistics section. The works section is further divided into a Project unit that deals with construction and supervision of new prison cells/walls, barracks, office blocks and hospital

blocks and a Maintenance unit that deals with the maintenance of prison infrastructures (www.prisons.gov.ng/organogram/work.php).

Nigerian prisons are located across the states of the federation. There are twenty Nigerian prisons located across South-West, Nigeria. Five in Lagos State, five in Ogun State, two in Oyo State, two in Osun State, five in Ondo State and one prison in Ekiti State. Prisons are designed to be centres for reformation, rehabilitation and correction. The prison system is a creation of the need for a structured environment where those who commit offences inimical to the society are put away in order to get reformed before being allowed to return to their various communities (PRAWA, 1999). Although prison policy called for the provision of legal, religious, educational, vocational and social welfare services, Nigeria, like most third-world countries, has been grossly inadequate in making these provisions. One of the major problems confronting the Nigerian Prisons Service is the rate of overcrowding relative to the capacity of the prison facilities, which, according to prison statistic, stand at over 60% of the total inmate population.

In the year 1999, the fortune of the Nigerian Prison Service changed with the leadership of the country. The presidential committee on prison decongestion recommended over 8000 prisoners for release. It was also suggested that prisons in Nigeria should be assessed and evaluated as a step towards achieving modernization of prison buildings and that renovation work should be carried out in prisons, particularly those built during the colonial era (The Presidential Commission, 2006). It is appalling that most of Nigerian prisons have no modern toilets, as pail/bucket system is mostly used in overcrowded cells. This unsanitary condition causes

ailments such as malaria and cholera, thus devastating the health of the prisoners. Most of the prisons environment also features stagnant water, mountains of refuse and overgrown grass. These constitute the physical features of most Nigerian prisons. Most of the prisons in Nigeria cannot boast of having portable water for human consumption (PRAWA 2000), with toilet facilities, water provision and medical facilities equally being severely limited. Food is inadequate while disease and malnutrition is rampant (The Library of Congress Studies; CIA World Factbook, 2005).

According to the Annual Abstract on statistics, in 1990, no fewer than 482 of the 13,036 offenders were found to have been convicted six times or more, 758 were found to have been convicted five times and 1,017 were also found to have been four times. Six hundred and forty six (646) offenders convicted (641 men and five women) three times; 1,252 (1,237 men and 15 women) twice; 2,598 (2,572 men and 26 women) once, while 10,417 were fresh offenders. The illicit attitude of these convicts could have been as a result of the hostile environment, especially the prison facilities that do not support their reformation. Presently, Nigeria has 155 conventional convict prisons and about 83 satellite prisons, 12 major prison farms, nine subsidiary farms, nine cottage industries for the training of inmates, 124 market gardens, three borstals, one open prison camp, one prison Staff College, one prison academy and five training institutions (Nigeria prison service, 2014). The 155 convict prisons containing both the convicted and awaiting trials inmates are of two types; the maximum and medium security prisons. Maximum security prisons take into custody condemned convicts and long term prisoners while medium security prisons take into custody remand inmates and short term convicts.

According to “Prison of Horror” (2000) the actual prison facilities capacity of the Nigerian prisons was convenient for 33,348 inmates but the prisons held 47,000 inmates. Statistics of the Nigerian Prison Service (November 2000) revealed that out 47,000 inmate population, 24,953 (59%) of this figure were awaiting trials. This shows that congestion is evident in most Nigerian prisons. This situation of over use of prison facilities amounts to speedy deterioration of the facilities. The most overcrowded is the Awka prison in Anambra State, where 452 prisoners occupied prison facilities with capacity for 98 inmates. This represents 361 per cent more than its capacity. Kirikiri Maximum Security Prison has 1,782 inmates for a capacity of 1,056; the Medium Security Kirikiri Prison, with a capacity for 704, has 2,200 inmates; the Ikoyi Prison has 1,460 inmates as against its capacity for 800 inmates. Male prisons exceed their prison facilities capacity with 5,442 (98.33 per cent) inmates, while the female prison facilities are overshoot by a paltry 92 (1.66 per cent) inmates. It has been reported by the special rapporteur on extrajudicial, summary and arbitrary execution that the Nigerian prison population remains 44,000 as at 2006 (Penal Reform International, 2007). In a more recent statistics as at April 2014, the total installed prison facilities capacity was 49,505 as against the population of 55,935 prisoners, with 38,297(68%) non convicted prisoners (Nigerian prisons service, 2014).

2.2.2 Facilities in Prisons

Prison facilities are delivered traditionally as government-owned and government-operated facilities as it applies to Nigeria or alternatively as government using the private sector as a mechanism for procuring prison facilities as in developed countries like Australia, USA, and UK, etc (Love, Wood, Picken & Confoy, 2000). Prison facilities are unique in design and construction, usually surrounded by fencing, walls or other barriers, secured and defensible main gates, armed guard towers, security lighting, motion sensor, dogs and roving patrol depending on the level of security. There are remotely controlled doors, CCTV monitor, alarms, cages, restraints, nonlethal and lethal weapons, riot control gears and physical segregation of units to monitor and control movement and activity of prisoners within the facility (Prison Wikipedia, 2014). Indeed, prison facilities must be secured, effective and fit for purpose. They should be safe from attack and compliant with current legalization while meeting the standard requirements regarding health, ventilation, floor space, heat and lighting (UNODC, 2014).

Prison facilities comprise of accommodation that allows access to the person with a disability and should have flexible accommodation layout that allows for fluctuations in the numbers of prisoners as well as their classification and status. There must also be facilities for visitors and children in custody, library and educational facilities, mail rooms, telephone rooms, prison store, furniture, supply of potable water, secured physical perimeter space, contraband facilities, and security post, as well as kitchen layout design that allows for observation of staff activity (Consoli, 2005).

According to (OHCHR, 2014) rules for general application by United Nations provision relative to facilities in prison, it is expected that each prisoner occupy a cell or a room; only when there is a temporary overcrowding can an exception be made to this rule and where dormitory facilities are used, they should be occupied by prisoners carefully selected as being suitable to associate with one another. Sleeping accommodation shall meet all requirement of health, due regard to climatic conditions, air changes, minimum floor space, lighting, heating and ventilation. Sanitary, bathing and shower installations must be adequate to enable the prisoner to comply with the needs of nature when necessary in a clean and decent manner. Windows are to be large enough to allow for natural light to read and work and to be constructed allowing the entrance of fresh air, as well as provision of sufficient artificial light for reading and working in the building.

The conditions and type of prison facilities within prison vary widely around the world and also depend on many intersecting factors including funding, legal requirement, and cultural belief (PrisonWikipedia, 2014). This is evident in the Nigerian prison facilities as in most Third World counties with poor funding for prison facilities and a poor maintenance culture.

2.2.3 Organisational Structure of Prison Maintenance Management

For effective and efficient administration and management, the Nigerian Prison Service organization structure has at its apex the Controller-General with six sub divided directorates having different and distinct mandate. These six sub division are operations (OPs), administration and supply (A&S), health and social welfare (H&SW), finance and account (F&A), inmates' training and productivity (ITP), and works and logistics (W&L). Works and

logistics directorate is the infrastructural mainframe directorate and is divided into two broad sections: Works section and Logistics section. The work section is responsible for collating, planning, implementing, supervising, monitoring, and maintaining of building projects. The logistics section is charged with the responsibility of maintaining the fleet of prison vehicles and plant. Works section is further divided into Project unit and Maintenance unit. Project unit deals with construction and supervision of new prison cells/walls, barracks, office blocks, and hospital blocks while the Maintenance unit deals with the maintenance of prison facilities (www.prisons.gov.ng/organogram/work.php). See figure 2.1

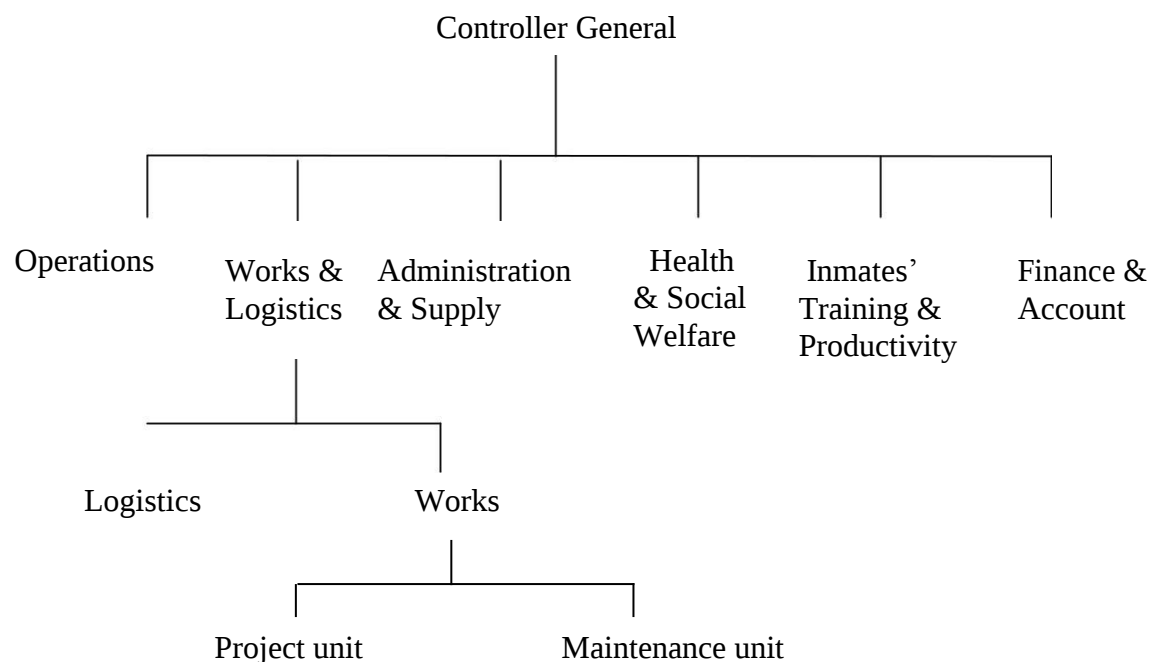


Figure 2.1: Organization Structure of Nigerian Prison Service

Source: Developed by Author

The organizational structure of maintenance management is usually structured into three levels: top, middle and low level (Murthy, Atrons & Eccleston, 2002). These levels are also applicable to the maintenance structure of Nigerian Prison Service. Top level managers must possess a good knowledge of all activities in the maintenance unit together with adequate strategic thinking capability to integrate maintenance into the overall reformatory, corrective and rehabilitative objectives of the Nigerian Prison Service.

The top management level deals with issues relative to the overall business view point. This involves:

- ☐ Deciding either to outsource maintenance operations or using of in-house maintenance to carry out maintenance activities.
- ☐ Providing the resources (human, maintenance plant and equipment, workshop, etc) needed at any of the prisons.
- ☐ Creating a culture that foster closer relationship among different units, that is, a cordial relationship between the maintenance unit and all other departments/ unit in the Nigerian Prison Service.

The middle level managers must be able to design planning of optimal maintenance strategies. This implies that they understand the numerous causes of defect in prison facilities and can do proper data analysis using appropriate models/framework to predict the performance of prison facilities and optimising available maintenance resources. They also possess management skills to interface between top and low level management. Middle level maintenance management deals with planning of strategies. This involves:

- Analysis of all data captured, including maintenance request from prison non-maintenance staff, inmates and possibly from all other persons interacting with the prison facilities.
- Deciding on maintenance strategies to be adopted for each prison facilities and every components/services identified for maintenance activities.
- Monitoring the implementation of in-house maintenance activities carried out by low level management.
- Monitoring outsourced maintenance activities carried out by external service agents.

The low management level must have basic concepts and techniques to cater for specific maintenance needs such as implementing maintenance policies of the prison facilities. Unlike what is expected of their qualifications, Nigerian prison maintenance staff possesses much lower qualification. The low level management deals with:

- The implementation of in-house maintenance actions
- Collecting of relevant data and information on maintenance activities to be executed.

The hierarchy of maintenance structure is of three levels, sometimes four levels depending on the organizational structure. The first level corresponds to the corporate or strategic level, the second level corresponds to the tactical or managerial level and the third level corresponds to the functional/operational level. The maintenance objectives of the functional level are to be integrated and linked to tactical or middle level to help the management (Nigerian Prisons

Service) for analysis and decision making at the strategic or tactical level (Parida & Chattopadhyay, 2007).

Subjectivity exists at the strategic level, as it is linked to the vision and long term goals. This subjectivity reduces down the various levels, with high objectivity at the functional level. The strategic goals are spelt out into maintenance objectives target for the operating/functional maintenance level while the outcome of the maintenance objectives are linked from the operational level to the strategic level.

In the Nigerian Prison Service, it is essential that the maintenance objectives/activities of the maintenance unit align with the overall prison functions (reformation, correction and rehabilitation).

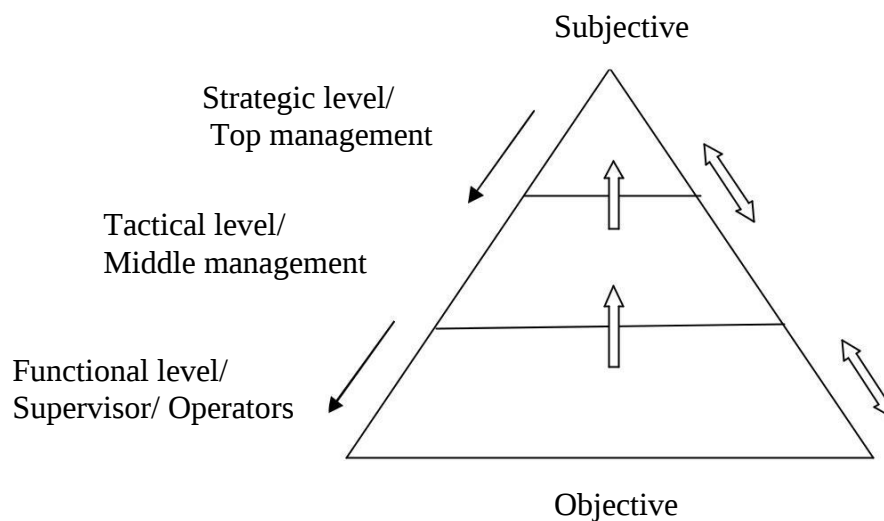


Figure 2.2: Organisation Hierarchy Level

Source: Parida and Chattopadhyay (2007), page 248

Consequently, the prison service goals should also be adequately communicated down through the levels, in a language simply understandable by all the employees of the maintenance unit. Information on maintenance activities for prison facilities is to flow in both top-down and bottom-up directions. There should also be adequate communication within and outside the Prison Service on issues relating to maintenance information and on decision making (Parida and Kumar, 2006). The management and administration of prison maintenance activities and decisions could likely be presided over at the prison state headquarter. Prison maintenance staff at the functional level would be deployed to carry out maintenance activities at other prison locations. Likewise, maintenance staff at this level is expected to give a feedback to the maintenance manager. Keeping records of all maintenance works executed.

2.3 Maintenance Management

Maintenance management is the control, execution and quality of those activities that ensure optimum level of availability of facilities and overall performance of plant/buildings/facilities (Davies & Greenough, 2001). Maintenance management plays a major role in the performance of constructed facilities, comprises of clear maintenance policies and techniques that are adopted to keep facilities fit and to minimise the problem of breakdown (Shohet, Lavy-Leibovich & Bar-On 2003; Nahdatul et al., 2015).

Maintenance management is an orderly and systematic approach to planning, organizing, monitoring and evaluating maintenance activities and their cost (Technical Information Document, 2000). The scope of maintenance management covers every stage in the life cycle of

a technical system (plant, equipment and facilities), acquisition, planning, operation, performance evaluation, replacement and disposal (Murray et al. 1996, cited in Tsang, Jardine & Kolodny, 1999). This implies that maintenance management for prison facilities start with acquiring of the facilities by the Nigerian Prison Service, followed by planning and executing maintenance operations and evaluating the performance of the prison facilities. It also involves replacement of prison facilities due to wear and tear and disposal of obsolete prison facilities.

Maintenance management for facilities or infrastructure is developed based on the organizational/ corporate business goals, that is, reformation and correction as in the case of Nigerian Prisons Service, as well as clear understanding of the role of maintenance in the prison service (Abd Rani et al., 2015). This involves understanding of the management situation of the functions of the facilities as well as inspection of facilities to measure the physical characteristic and maintenance history of the prison facilities (Hamzah & Kobayashii, 2013). A good maintenance management system run by knowledgeable and competent prison maintenance staff prevents health and safety problems and environmental damage. It extends the life span of asset/ prison facilities with fewer breakdowns, thus leading to lower operating costs and higher quality of prison facilities (Technical Information Document, 2000). In essence, prison facilities can enhance the safety and health of their occupants once there is a structure that allows for effective maintenance management and competent maintenance staff.

Maintenance is the action of performing routine activities to keep the system/facilities operational. This includes minor repairs or replacements to ensure continuous performance of the

system while management is a collective term that describes the necessary steps in conducting operational services, maintenance, monitoring and compensation (Bruce et al., 2006). Management is also a process or form of work that involves the guidance or direction of a group of people toward organizational goals or objectives. Most times, the organizational structure of firms is structured into three levels: strategic, tactical and functional. Maintenance management activities are carried out in both strategic and operational context (Murthy et al. cited in Aditya & Uday, 2006) and are monitored and controlled at the top managerial level.

The British Standards Institution and HMSO Committee define maintenance as work undertaken in order to keep, restore or improve every facility, its services and surroundings to a currently acceptable standard and to sustain the utility and value of the facility (BSI, 1984; HMSO, 1972). This definition of maintenance is widely adopted by Horner, Buys and Nkado (2006), Chew, Tan and Kang (2004) and El-Haramand Munns (1997) while maintenance management has been defined as the organization of maintenance with an agreed strategy. An effective maintenance programme and management system is characterized as the product of prudence, of the sentiment that ‘a stitch in time saves nine’ (Rapp & George, 1998; Buys & Nkado 2006).

Any form of business (reformatory) institution/organization needs to have an integrated maintenance management system that is comprised of key (technical/operational, commercial and tools) elements for effective performance (Murthy et al., 2002). The interactions between these elements ensure continuous improvement via the understanding of equipment/components/items to be maintained, as well as planning and implementing of optimal maintenance actions.

The technical/operational issues involves link between science, engineering and technology (reliability theory) for assessing the physical condition of components/items/facilities and predicting the deterioration rate under different scenario for maintenance and operating load (intensity of usage); other operational decisions include preventive and corrective maintenance.

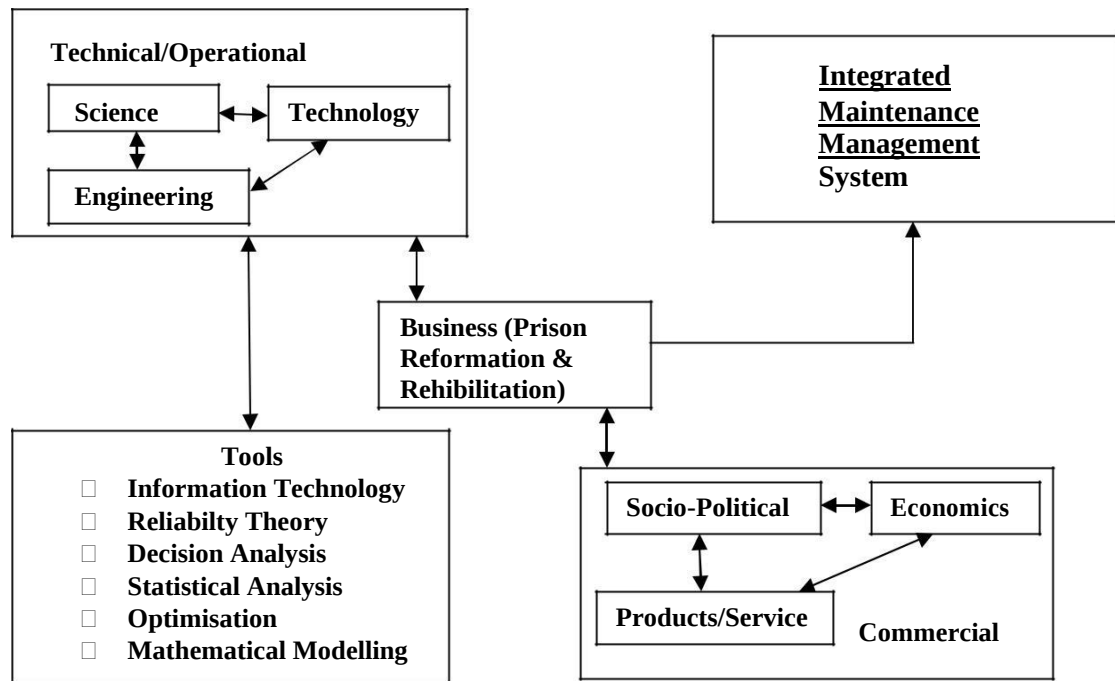


Figure 2.3: Maintenance Management System

Source: Murthy, Atrens and Eccleston (2002), page 294

The commercial aspect deals with economics, cultural factors and issues like socio-political, service and products which are liken to prison functions. The variety of tools include information technology for collecting and storing data, statistical techniques for data analysis, computational

tool for modeling, optimization and optimal decision making that are relevance for effective maintenance management of the facilities.

2.4 Maintenance Management Strategies

2.4.1 Preventive Maintenance or Time Based Maintenance

Preventive maintenance simply means doing everything possible to prevent the breakdown (Priel, 1992). This is sometimes referred to as time-based maintenance and its tasks are performed in accordance with a predetermined planning at regular fixed interval (Horner, El-haram & Muns, 1997). The aim of preventive maintenance is to catch small problems before they become big problems. Preventive maintenance keeps building and facilities auxiliary operating at peak efficiency through regular inspection and repairs (Arditi & Nawakorawit, 1999). It is believed that regular maintenance attention will keep an otherwise troublesome failure mode at bay (www.main2k/what-is-tpm.html). Preventive maintenance is widely recognised as being important to prevent premature breakdown and to ensure that building systems or facilities operate efficiently. Its activities include regular inspection of electrical, mechanical systems as well as building elements/facilities and building exteriors so that problems are corrected before they cause more serious problem such as a mechanical breakdown, a major roof leak or structural damage (Minnesota office of the legislative auditor, 2000). Time based maintenance predefines the cycle in which the building parts/prison facilities are maintained. The frequency of action depends on the life span of the building elements/facilities. Its advantage is in adaptability of maintenance action, lower total costs, the overall condition of a building/facilities and a higher degree of safety, together with inevitable disadvantages such as

manipulative costs, higher resource engagement and hidden defects (Dusan & Alaksander, 1999).

2.4.2 Corrective Maintenance or Failure Based Maintenance

In corrective maintenance, a failure occurs before a remedy is offered as quickly as possible. This is also referred to failure-based maintenance where element in building or facilities used totally breaks down. It covers all maintenance activities including replacement or repair of an element that has failed to a point at which it cannot perform its required function. It tasks often take place in an ad hoc manner in response to a breakdown or user request (Horner, El-haram & Muns, 1997). It consists of repairs to the buildings/facilities and equipment due to natural wear and tear or faulty preventive maintenance (Arditi & Nawakorawit, 1999).

2.4.3 Predictive or Condition Based Maintenance

Predictive or condition based maintenance is a procedure carried out when the condition of the building/equipment/facilities warrant. Over the year, this has proven effective and detecting problems when they are still minor so that corrective actions are taken as needed (Spintelligent Labs, 2006). This is maintenance carried out in response to significant deterioration in a unit/building elements/facilities as indicated by a change in monitoring parameter of the unit condition or performance. In this strategy, maintenance tasks are determined and planned by efficiently monitoring the building elements such as wall, floors, roof and service equipment such as boilers, pumps, and heating systems to identify which elements or piece of equipment

have evidence of change that require maintenance before a major failure occurs (Horner, El-haram & Muns, 1997).

2.4.4 Routine Maintenance

Routine maintenance includes general maintenance necessary to keep the building/facility in good condition (Arditi & Nawakorawit, 1999). Simply put, this is service done in a regular way or as much as the organisation can afford (Priel, 1992). It involves ongoing maintenance activity such as cleaning, grading roads, mowing lawns and disposal of refuse that is required because of continuing use of facilities (Technical Information Document, 2000).

2.4.5 Detective Maintenance

Detective maintenance applies to the types of devices that only need to work when required and do not indicate when they are in failed state, e.g. fire alarm or smoke detector. This requires periodic functional checks to ascertain their working condition (www.main2k/what-is-tpm.html).

2.4.6 Deferred Maintenance

Deferred maintenance occurs where the necessary maintenance is postponed until a later date. This delay could arise as a result of budget limitation, owner preference, availability of parts and inclement weather (Arditi & Nawakorawit, 1999). Such maintenance works may be postponed owing to safety, operational and economic concerns. The work should be done, but cannot be scheduled because of higher priority work, funds shortage, work site access, or condition outside the control of the maintenance department (NASA, 2008). Minnesota office of the legislative

auditor (1998) defines deferred maintenance to include physical defects that occurred because of physical deterioration and cost of upgrading buildings/facilities to meet standards. This includes ventilation within facility space, air conditioning standards, energy standards, fire and life safety standards and accessibility standards.

2.4.7 Emergency Maintenance

Emergency maintenance occurs when and where there is an unexpected breakdown of assets/facilities or equipment. This is an unpredictable or reactive type of maintenance that is more difficult to schedule (Technical Information Document, 2000). See figure 2.4 for types of maintenance.

Furthermore, Rani et al. (2015) depicts the type of strategies according to category. These categories are unplanned maintenance and planned maintenance. See figure 2.5

2.4.8 Unplanned Maintenance Strategy

This is referred to reactive maintenance or emergency maintenance. It is a maintenance that happened in unexpected cases.

2.4.9 Planned Maintenance Strategy

This is used in maintenance management. It is involved in management planning and monitoring of maintenance works. Further, planned maintenance strategies are classified as pro-active, preventive, corrective and predictive.

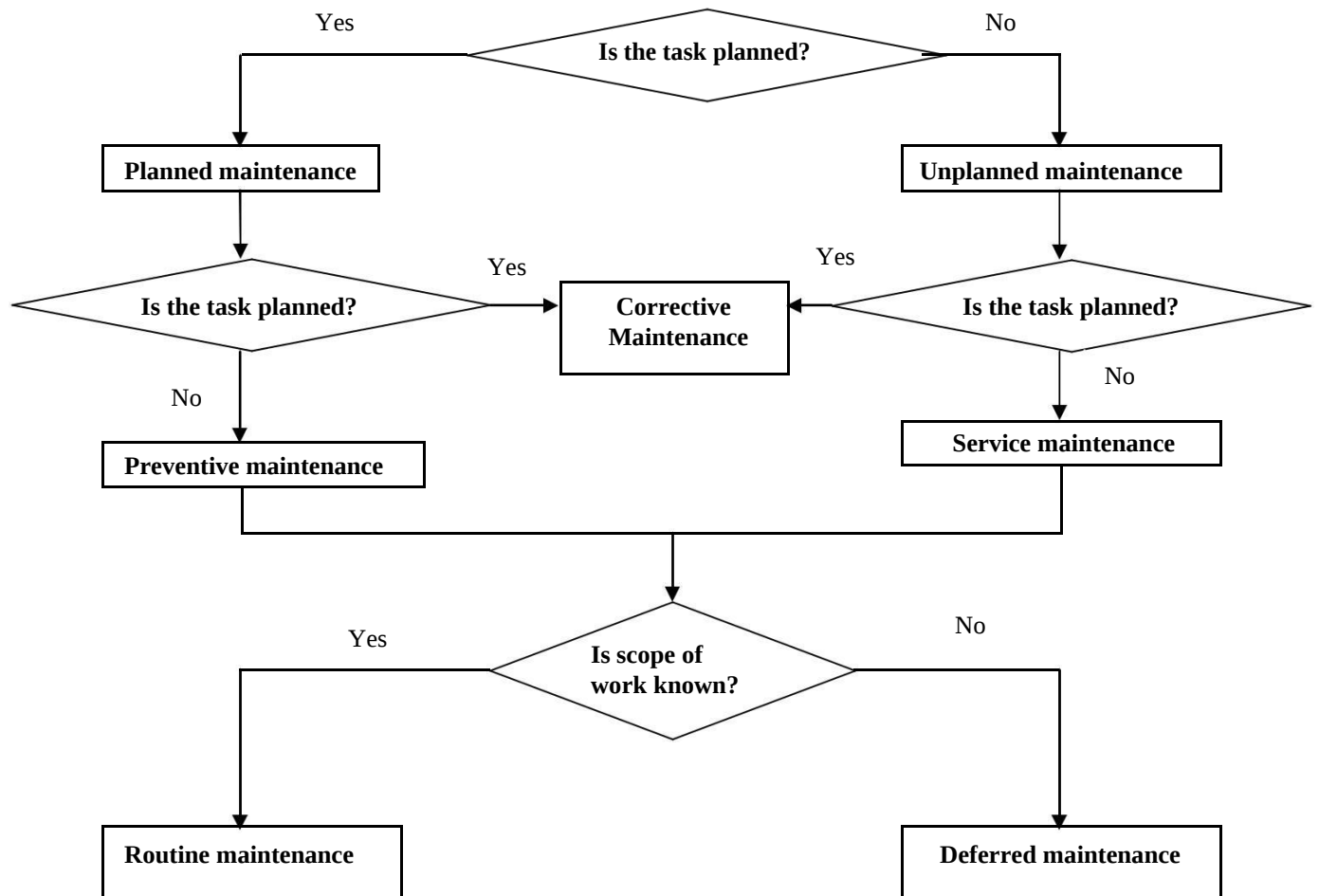


Figure 2.4: Types of Maintenance Strategy

Source: Arditi and Nawalorawit (1999), page 11

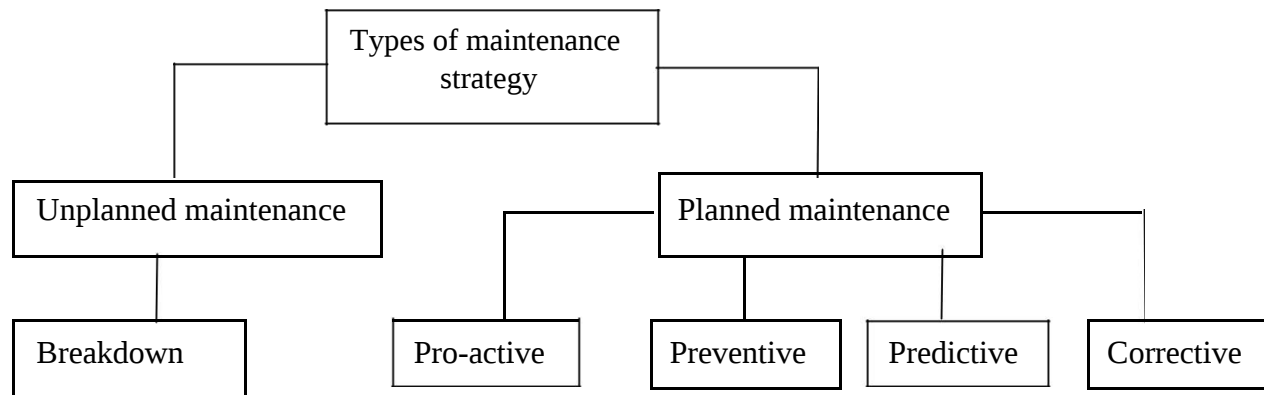


Figure 2.5: Category of Types of Maintenance Strategy

Source: Rani, Baharum, Akbar and Nawawi (2015), page 275

2.4.10 Selection of Maintenance Strategy

To choose the best maintenance strategy, maintenance leaders must recognise different patterns. The patterns include accepting the weakness and strength of the current plant, crew, management team, attitude of maintenance staff and users, equipment/building age, purchase policies and business conditions. Each of the maintenance strategies is best when given the right situation and equipment. The choice of strategy depends largely on the level of logistical support (people, systems, tools, good advice and training resources) that the maintenance departments can expect from the organization (Joel, 1998). Horner et al. (1997) opined that selection of maintenance strategy of any items of building would be based on the significance or non-significance of items/ elements.

Significant items are items whose failures affect health, safety, satisfaction of users, environments and cost of maintenance. Depending on the nature of failure, from minor to catastrophic, the cost of rectification of such items/components can be high as well as the cost of any consequential damage posted on the facilities (Murthy et al., 2002). Non-significant items are those whose failure has no significant effect. The process of choosing the right strategy involves at least the steps that decide among the important and unimportant building parts through the criteria of initial costs, controllability and feasibility (Dasan & Alaksander, 1990). In general, failure based-maintenance is suitable for relatively expensive building components which are difficult to supervise while condition-based support “on – line” surveillance with cost feasible decisions. This is explained in figure 2.6.

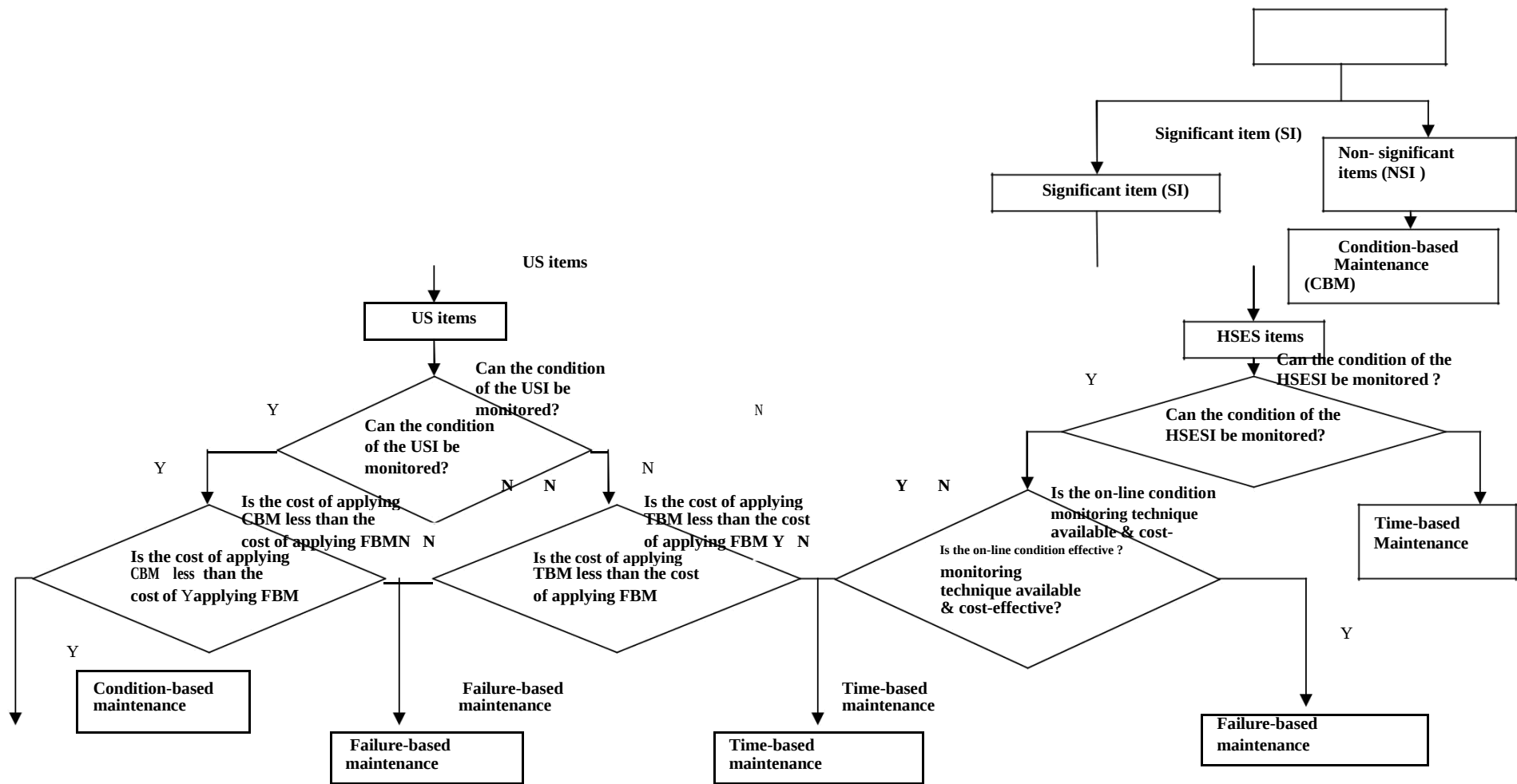


Figure 2.6: Building Maintenance Strategies Selection Diagram
 Source: Horner, El-Haram and Munns (1997), page 273

Key
 HSES = Health, Safety and Environment Significant
 US = Utility significant

2.4.11 Maintenance Management Optimal Strategies

Other maintenance approaches that are sometimes referred to as optimal strategies are either semi-quantitative or quantitative in nature. They are discussed below.

2.4.11.1 Reliability Centered Maintenance (RCM)

This is a semi-quantitative approach whereby maintenance activities are carried out on components and elements level, the maintenance effort for such component being a function of the reliability of the components and consequence of its failure under normal operation (Murthy, Atrens and Eccleston, 2002). RCM involves a procedure for discovering the actual maintenance task that is required by a component or an asset in its operating context, in particular what must be done to ensure that such components continue to provide their intended function for the owner/or users (Sherwin, 2000). It also helps in identifying the root cause of component failure and categorizing their consequence. It suggests the correct type of maintenance task for each failure mode (Pun, Chin, Chow & Lau, 2002).

2.4.11.2 Total Productive Maintenance (TPM)

In the context of service-oriented organisation, maintenance is viewed in terms of its impact on the facilities through its effect on components/items/equipment availability, production rate (amount of maintenance work carried out) and output quality (Sherwin, 2000; Tajiri and Gotoh, 1992, as cited in Murthy, Atrens and Eccleston, 2002). TPM is a life cycle and employee approach to maintenance management that uses team concept, maximise both overall equipment and facility effectiveness and efficiency, develops and uses motivational management to promote preventive maintenance programme for the life cycle of facilities (Riis, Luxhoj & Thorsteinsson, 1997).

Both RCM and TPM deal with short to medium operational issues that are focusing on equipment, plant, components and facilities as opposed to medium to long term strategic issues (focusing on the business as a whole) (Murthy et.al, 2002). In a situation where more suspects are sent to prison cells by the Nigerian police force or where the Ministry of Justice fails to carry out prompt trials on inmates awaiting trials, this in the short run will lead to overcrowding and high intensity of usage. In essence, intensity of use of prison facilities and their appropriate maintenance strategies are optimised jointly. Since continuous use of prison facilities cause deterioration of facilities and maintenance actions control the deplorable condition of prison facilities.

2.4.11.3 Effectiveness Centered Maintenance (ECM)

Effectiveness centered maintenance (ECM) shifts emphasis from ‘doing the right things’ to ‘doing things right’. It encompasses the core concept of quality management, total productive maintenance and reliability maintenance. ECM helps in optimising of decision for co-planning of operations in maintenance, overhauling/renewal of equipment/plants/components, improvement of service quality and performance (Pun, Chin, Chow & Lau, 2002).

2.4.11.4 Strategic Maintenance Management (SMM)

In the SMM approach, maintenance is viewed as a multi-disciplinary activity involving:

- ☐ The scientific understanding of degradation mechanism of equipment/facilities
- ☐ Building a quantitative model that can predict the impact of maintenance actions and operation (intensity of usage) on equipment/facilities degradation and
- ☐ Managing maintenance from a strategic perspective

SMM views maintenance in a long-term strategic context, which involves integrating the operational context of equipment, components and facilities (component failure and their consequence) and different technical and commercial issues in an effective manner. It also pictures maintenance management to be a vital core activity that is based on quantitative business model for business survival and success (Murthy et al., 2002).

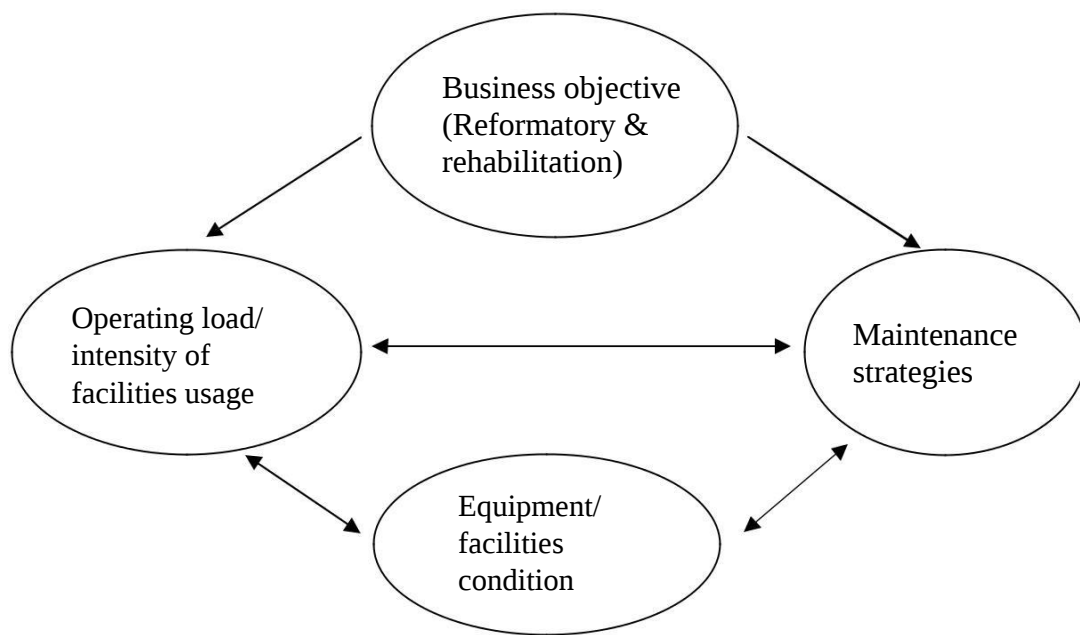


Figure 2.7: keys Elements for Strategic Maintenance Management

Source: Murthy, Atrens and Eccleston (2002), page 291

2.5 Maintenance Management Policies

According to Mushumbusi (1999) an organization or institution needs a policy statement on how they intend to deal with the maintenance activities. Standards to be achieved are to be unambiguously stated depending on their expectations for their buildings requirements. This includes the financing aspects together with the subsequent major maintenance programmes intended to be carried out in a given span of time.

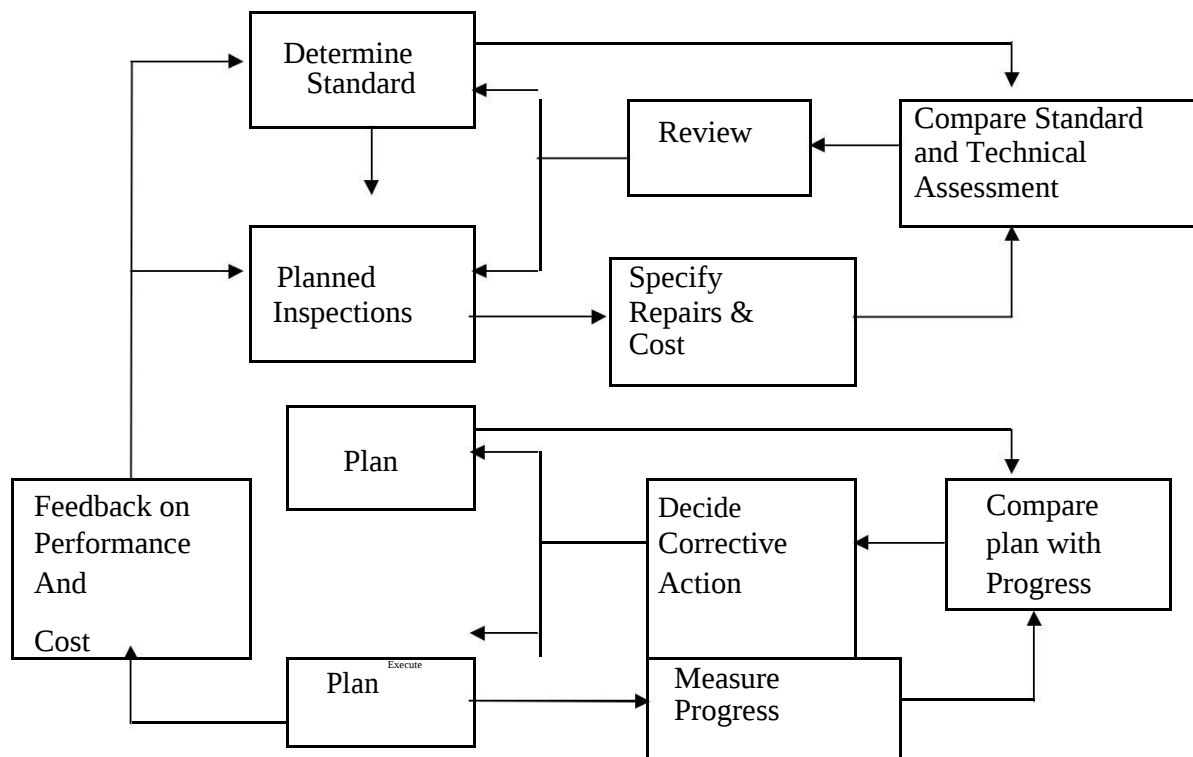


Figure 2.8: Maintenance Management (Functions) Policy.

Source: Mushumbusi (1999), page 3

Lee (1992) advances maintenance management policies that are technical in nature; these entail planning and controlling of maintenance resources. In order to ensure maximum

efficiency in the maintenance of facilities in which the prison facilities are not to be excluded. These include:

- ☐ Determining maintenance standards
- ☐ Planning physical (prison facilities) inspections
- ☐ Identifying and specifying the necessary maintenance work
- ☐ Estimating the cost of the maintenance work and
- ☐ Organizing the execution of the maintenance work

A major key role of maintenance policy is to provide a framework for deciding priorities for action (Then, 1995). The policy on maintenance will enable the formulation of long-term maintenance strategy and facilitate the preparation of budgetary forecast on which the priorities are set. The maintenance resources available sometimes necessitate the need to drawing up of a priority list in terms of what is viewed as a state of alarm for immediate attention, work to be phased out for future dates which in most cases are dictated by physical characteristics (i.e. degree of deterioration), economic considerations (the value attached to the building) and the statutory requirements to be observed. The policy ensures a satisfactory state of repair within a lower and steadier level of expenditure through correct diagnosis of facilities at the right time and by taking the right decisions. This leading to a planned maintenance works.

According to Al- Zubaidi (1997), Horner, EL- Haram & Munn (1997) and Kindred (2004) some of the main purposes of maintenance policy include:

- ☐ that the condition of buildings/ facilities meets all statutory requirements

- ☐ that necessary maintenance works are carried out to meet the value of physical assets of the building stock or facilities and that the quality of the buildings and facilities are maintained
- ☐ that the level of demand for maintenance are established
- ☐ that the appropriate maintenance actions/works are planned
- ☐ that maintenance budget is control and value for money is readily obtained

The common basis for the above requirements is having accurate information, relating to the size and nature of the building/asset/facilities, their current condition and knowledge of any backlog or deferred maintenance, feedback information from existing maintenance planning, control and audit procedure for maintenance works, executing of maintenance jobs and monitoring performance of the facilities (Then, 1995). Realising the inevitability of the maintenance needs make the organization or the institution to consider the creation of effective maintenance policy with a well-equipped and staffed to cater for the maintenance requirements in which the Prison Service is not exempted.

2.6. Maintenance Management Planning

Basically, one of the ways to reduce cost of operating maintenance and providing maintenance actions is to optimise utilisation of maintenance resources (Duffua and Al-sultan, 1997). Maintenance planning involves the utilization of resources (manpower, equipment, plant, tools and spare parts and finances) for maintenance jobs. The planning and scheduling functions controls the utilisation of maintenance resources.

The planning functions include:

- ☐ identifying the maintenance work

- determining the complexity and composition of maintenance work
- estimating the number of manpower to be required
- identifying the spare parts, materials, and special tools to be required and
- executing the maintenance works

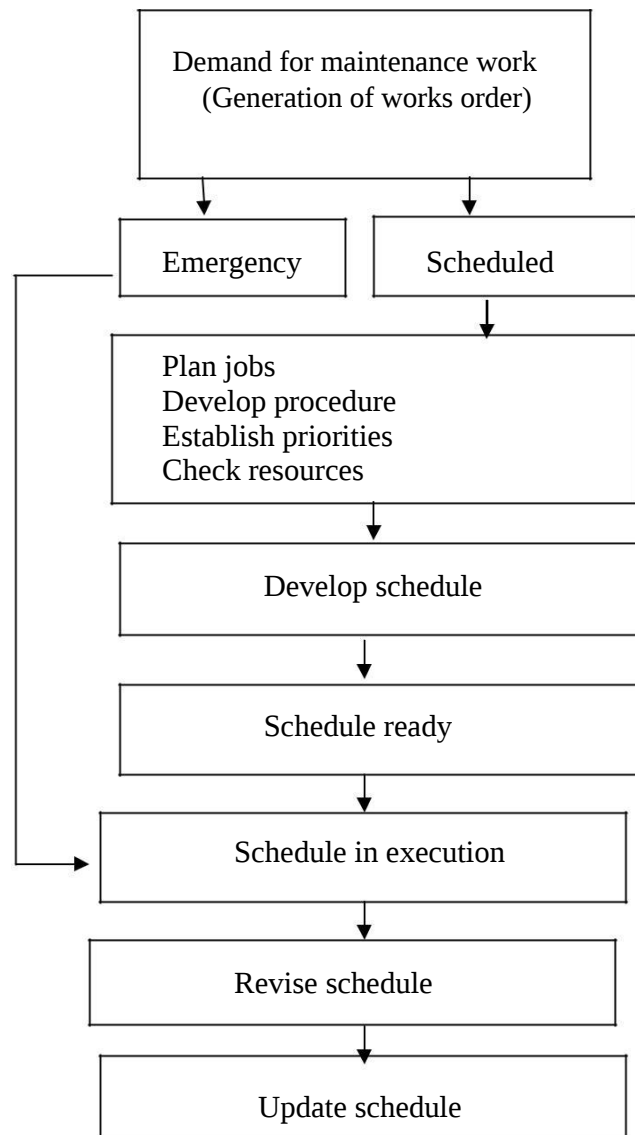


Figure 2.9: Maintenance Schedule

Source: Duffua and Al-sultan (1997), page 164

The scheduling functions involve developing a schedule for all planned jobs. It is of important that scheduling functions consider maintenance works that are deterministic and stochastic in nature. See figure 2.9.

The key steps in preparing a typical maintenance planning are:

1. Prepare an asset inventory: identify the physical features of the buildings/facilities that require maintenance works.
2. Identify maintenance activities and tasks: define the type of maintenance task (activity) to be performed on each component or element and what work should be done under each activity. For example, activity to be carried out is cleaning while the work to be done is cleaning the chalk board.
3. Identify the frequency of the tasks: determine how often the activities should be performed, frequency of service in emergency or reactive type of repairs are unpredictable
4. Estimate the time required to complete the task
5. Develop an annual work schedule: planning what time the maintenance work of each component/ elements of the building should take place for the entire year.
6. Prepare and issue a work order: identify what, when, where and by whom maintenance work is to be done
7. Determine a budget: determining the cost for all maintenance activities by calculating labour hours, materials, equipment and contracting costs.

However, formats and steps for preparing a maintenance plan differs depending on the type of maintenance system (Technical Information Document, 2000), use of facilities and the characteristics of users. See figure 2.10.

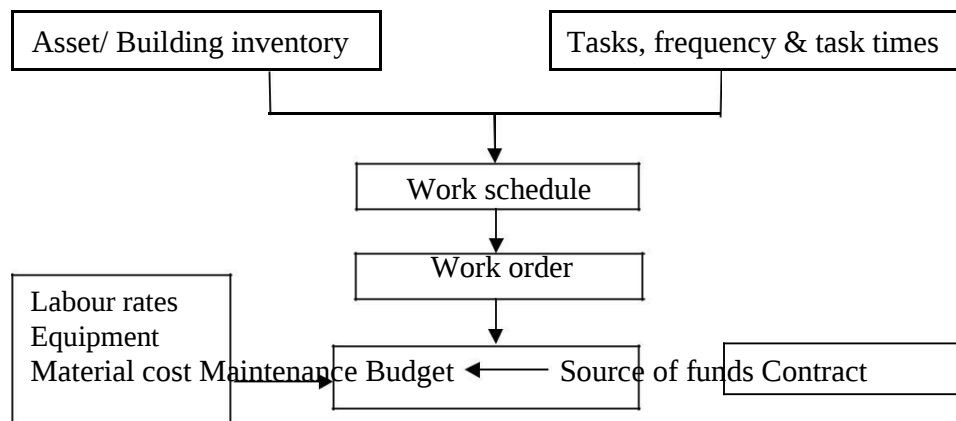


Figure: 2.10: Maintenance Management System Process.

Source: Technical information document (2000), Page 6

According to NASA (2008), maintenance planning is augmented with customer work requests, processing of the request by identifying equipment breakdowns and documenting of all requests for maintenance, repairs, and service works. Work request is received, processed, and if approved it is converted into a work order. Work disapproved for any number of reasons is returned to the users of the facilities with an explanation or request clarification. Work that is valid but cannot be accomplished within the immediate resource is the deferred. Works that have been converted into work order are then executed. See figure 2.11.

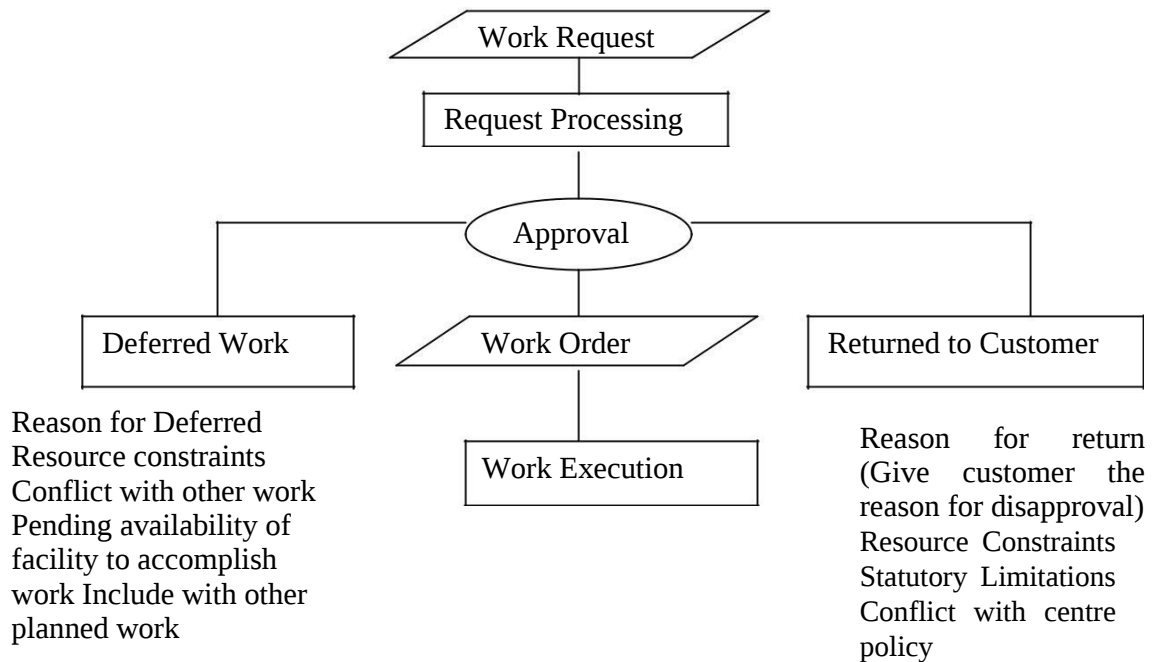


Figure 2.11: Maintenance Planning Process.

Source: NASA (2008), page 59

2.7 Maintenance of Prison Facilities

The effective use of any facilities, its components and their services largely depends on continuous and planned periodical maintenance. This poses a challenge to the Federal Government, Prison Controller, Works and Logistic department, and Maintenance Managers to institute precise planning based on a well-structured maintenance programme. It is important that prison facilities provide a safe environment for prison staff to work in, as well as being suitable place for holding prisoners. Development in the prison facilities should be part of the strategic plan and there should be a planned preventative maintenance scheme in place (PRAWA 2000). This development could be in terms of capital investments and

maintenance operations for prison facilities as a crucial aspect of the strategic plan for a planned preventative maintenance strategy in place for the prison facilities

The Federal Government has in the past made strong statements on the issue of maintenance of public buildings. In 1984, the nation was forced to adopt some level of maintenance consciousness due to the stark reality of the economic situation. The Military Government appointed a study group on maintenance of public institutions called the 'Usman study group' to examine, among many things, the causes of ineffective maintenance of public utilities, assess adequacy of existing resources for effective maintenance and propose remedial measures. The study group recommended that there should be sustainable and effective maintenance of all public buildings, including prison facilities, but unfortunately this has not been adequately implemented (Zubairu, 1999) as little or nothing has changed in the situation.

Several authors have defined maintenance in a similar way as preserving buildings and facilities in their initial effective state, as far as practicable, so that they serve its purpose efficiently (Al-Zubaidi, 1997). Management Review Guide (1998) considers Building maintenance to be work undertaken to keep, restore or improve every part of a building, its service and surrounds. Arditi and Nawakorawit (1999) also define maintenance as the preservation of a building so that it can serve its purpose and as a combination of any actions carried out to retain an item in, or restore it to, an acceptable condition. According to UNCH (2003), maintenance is defined as a set of activities or procedures conducted to return or keep an infrastructure system in a fully functioning or operational condition.

Also, as an important support function that creates additional value (Parida and Kumar, 2006) and that which plays a role in backing up emerging operational strategies in an organization (Pun, Chin, Chow & Lau, 2002). Basically, the main purposes of maintaining public buildings, which are also applicable to prison facilities, are as follows:

Retaining value of prison facilities.

Maintaining the prison facilities in a condition in which it continues to fulfill its functions (reformation, correction and rehabilitation).

Ensuring the safety of inmates, visitors and general public within the prison facilities and its surroundings.

Maintaining an acceptable prison facilities standard.

Keeping the prison facilities wind tight and water tight.

Maintaining services, lighting and fire safety in prison buildings.

Maintaining decorative surfaces and carrying out adequate cleaning of the prison surroundings.

Preventing significantly the deterioration of the prison facilities.

Hajshimohammadi and Wedley (2004) describe semi-centralised maintenance management system as a system in which the management and administration of all maintenance functions are central while tradesmen and operatives are assigned to other locations. It appears that the management and administration of maintenance functions of the Nigerian prisons service are carried out in prison state headquarters. The services of maintenance operative are deployed to either the facilities in the prison headquarter or to facilities within other prison locations on

request. In view of this, the type of maintenance management system practiced in Nigerian prisons service is semi-centralised system.

Maintenance has become a principal phase in the life cycle of built assets (prisons facilities inclusive) and is most beneficial when it is done right, with planned preventative schemes to reduce or remove the need for repairs and thus prevent loss of original fabric/facilities. The amount of maintenance depends on the type and quality of building material used during construction, construction techniques adopted, quality of workmanship, users of the facilities, use of facilities (Olubodun, 2001) and also on the maintenance policy of the Nigerian Prisons Service.

All building structures, materials, finishes and services deteriorate over time through the effect of climate, usage, as well as wear and tear. The inevitable process of decay can be minimised with the right execution of maintenance and repair works. This in turn would extend the physical life of the buildings or facilities and guarantees safe access to the (prison) facilities (Mendes Silva & Faloca, 2009). Maintenance activities in any organization including Prison Service would be considered to be of high quality if they are initiated on time and capable of returning facilities to their initial state or currently acceptable standard at required time within the budgeted cost (Pun et al., 2002).

Maintenance management involves introducing of leading-edge information systems that enable the introduction of customised maintenance programmes. Such as deciding whether to repair or replace an item, initiating necessary maintenance activities, as well as developing strategies for efficient maintenance logistics. Repair is restoring an asset by replacing a part

which is broken or damaged, or reconditioning the part to its original or acceptable working condition. The need for repairs can result from normal wear, vandalism, misuse or improper maintenance (Technical Information Document, 2000).

Building operation and maintenance is the ongoing process of sustaining the performance of a building system/facility according to design intent, the owners' or occupants' changing needs and optimum efficiency level. This broadly describes operations as activities such as scheduling, optimising and control strategies so that equipment/building components/facilities operate to the degree needed in fulfilling their functions while maintenance activities involve physical inspections and caring for equipment/ building components/ prison facilities.

Recent studies have shown that maintenance activities are moving from a reactive based (break down, failure-finding and corrective) maintenance to a proactive based and high-service level maintenance approach. Unlike the traditional maintenance, new maintenance approach such as total productive maintenance (TPM) and effectiveness-centered maintenance (ECM) focus on both functions of facilities and the services provided for customers with practical features that enhances the effectiveness of maintenance practices (Pun et al., 2002). It is essential that maintenance priorities, strategies, planning and tactics align with corporate priorities (reformation and rehabilitation activities) of the Nigerian Prison Service (Tsang, Jardine, Campbell and Picknell, 2000). The maintenance unit supports the goal of the Prison Service by performing maintenance activities that retain the prison facilities in an acceptable condition or return the facilities to an acceptable condition (Mobley, as cited in Pun et al., 2002).

2.8. Best Practice Maintenance Management

Best practice represents benchmarking standards for whatever area they are applied to, nothing is better or exceeds a 'best practice' because it is the highest point toward which we measure from the lowest point (Smith, 2003). Best practices are necessary for successful and effective maintenance management system. Various authors have identified elements of a best practice approach to maintenance management. Buys & Nkado (2006), Howard (2006), Smith (2003) and Maintain our Heritage (2003) identified the following best practice criteria among others for an effective maintenance management system.

2.8.1 Maintenance Inspection

A proper maintenance strategy should include the establishment of regular inspection cycles of facilities. Regular inspections of the prison buildings and all its facilities are necessary to ensure that maintenance works are carried out before expensive corrective maintenance need to be carried out. Regular inspections are fundamental part of a preventive maintenance programme. Clarity about the purpose and uses of a condition survey is essential. This provides an assessment of the condition of facilities; also identifies the optimum moment for intervention and aids the prioritization of actions and planning for the future. Before inspecting prison facilities, building/ facility managers need to plan for the inspection programme.

Building/ facility managers should determine in advance the scope of the programme and know what information to record, including maintenance deficiencies; managers also need to decide whether in-house employees can conduct the inspection or whether certain building systems require specialized knowledge that extends beyond in-house expertise. A methodical

approach to building audits would improve data consistency from buildings/facilities under inspection. Furthermore, building/facility managers should design inspection forms to help inspectors observe building components/facilities logically and record data uniformly. This type of systematic maintenance inspection approach is needed for the prison facilities to embark on preventive maintenance programme has against corrective maintenance.

2.8.2 Setting Priorities

General best practice guidance suggests that the prioritization of maintenance activity should take account of the condition of the building components/ facilities. The sequence of doing maintenance work should depend on predetermined priorities, e.g. emergency, urgent, routine or deferred maintenance work. A maintenance plan that is based on a balanced assessment of priorities and up-to-date knowledge of the condition of the buildings/ facilities help in ensuring that difficult long-term decisions are not outweighed by short-term considerations.

A good maintenance planning requires a process for ranking maintenance activities because sometimes maintenance needs outpace available maintenance resources; a ranking process recognises that not all maintenance activities share equal importance. For instance, some projects left undone would pose a great risk to building occupants' safety or could result in premature and expensive equipment failure. To set priorities, building/facility managers should use objective criteria to sort out the relative importance of each facility. The criteria are to indicate the urgency of each maintenance works. For instance, conditions that pose no immediate threat but may endanger the future integrity of other building components/ facilities could receive somewhat lower priority than those that threaten the occupants' safety.

2.8.3 Life Cycle Costing (LCC)

A LCC approach should be used to get ‘value for money’ avoiding the ‘cheap-to-build-expensive-to-maintain’ phenomenon. Design team members, top management and maintenance managers must realise that the decisions they take during design stage takes into account the long-term financial consequences. Building/facility managers should use life cycle costing to make cost-effective decisions on whether to replace or maintain building systems, facilities and equipment. Estimating life-cycle costs involves determining the total cost of a building system or facility - not only its initial purchase price, but also the annual maintenance, repairs, and energy costs over its expected life span, and salvage value. With estimates of life cycle costs, building managers can compare a range of alternatives and decide whether it is economical to continue repairing a component/facility, deferring facility maintenance or replacing.

2.8.4 Computerized Maintenance Management System (CMMS) and Information System

An effective CMMS is critical to an organised, efficient transition to a proactive maintenance approach. CMMS is used to assist in managing maintenance. CMMS provides access to historical information, provides information on completed, current and outstanding maintenance work, provides information on all work orders, provides comprehensive building information, generates cost estimates, prepares long and short-term maintenance plans while prioritising maintenance tasks and linking these information with other institutions/organisation information systems.

A good information system and accessible records is vital for effective maintenance management of buildings/facilities because effective records detailing the historical development of the building/facility are an integral part of the cultural history of the building/facility as they explain how and why the building/facility is significant. The purpose of a management information system is to make sure that building/facility managers have sufficient information to properly oversee maintenance work and efficiently identifies building/facility maintenance problems before major failures occur. An information system allows facility managers to compare budgeted cost to actual cost, determines components/ equipment/facility expected life spans and evaluate performance of the facilities.

2.8.5 Maintenance Budget

The maintenance of buildings/facilities should be based on financial requirements as set out in the maintenance plan. Long-term financial planning and ring-fenced budgets for maintenance works are essential for comprehensive maintenance management systems to be implemented successfully. The annual work plan should have a direct link with the yearly maintenance budgets. Maintenance works to be carried out on prison facilities stated in the work plan comes into reality only when they are included in operating or capital budgets. The annual budget shows what money is needed for executing each maintenance works in the annual work plan.

Maintenance budget development requires preparing a cost estimate for annual maintenance operations, such as maintenance personnel, maintenance resource supplies costs, as well as capital cost for executing maintenance repairs. The amount of spending needed for facility maintenance works depend on the cost of maintenance needs of the facility, the extent of

deferred maintenance and the planned period over which the organization/institution hopes to reduce building/facility deficiencies.

2.8.6 Maintenance Policy and Decision Making

Maintenance management policies should provide an explicit framework for making decisions and practice. This should include clear statement of maintenance objectives and method to be employed to meet those objectives- a framework that ensures sufficient funds for maintenance work. That ensures regular execution of maintenance work to eliminate a major breakdown in equipment or failure of materials. All information on maintenance activities and cost of maintenance resources and maintenance approach alternatives are to be readily available for all stakeholders for decision making. As such, all strategic maintenance plans should have a clear indication of how maintenance of prison facilities is to be managed. Operatives responsible for carrying out maintenance activities and where this maintenance functions reside in the organisational structure of the Nigerian Prisons Service.

2.8.7 Work Order System

Work order is a document directing facilities maintenance work execution once requested work has been approved. The work order includes an estimate of the resource required to perform the maintenance tasks (work hour by craft, materials, equipment, tools, and specialised supports) and procedures required in performing the tasks (NASA, 2008). It is a standard way of processing maintenance work, whether the job originates as a problem communicated by building users or as part of planned maintenance works. It controls the large numbers of job request and provides uniformity in planning maintenance jobs. Using work orders for upcoming preventive maintenance tasks help ensure that work does not get

abandoned amidst multiple maintenance job requests. By analyzing completed work orders, building/facility managers are able to track recurring maintenance problems in a piece of equipment/components/facilities. Work order also provides a written record of actual maintenance work for each day, number of man hours to complete tasks, spare parts needed for the maintenance job and feedback on the completed maintenance work.

2.8.8 Training

Regardless of the size of the maintenance workforce, ongoing training and development for the workforce should be available to improve employees' technical skills and meet their individual training needs. Building/facility managers or those employees with specific responsibilities for managing or overseeing maintenance activities need to be exposed to additional maintenance training. Those in leadership roles need managerial skills in addition to their hand-on maintenance skills. The type of training needed is determined among the maintenance department and the concerned organisation.

Performing a maintenance task analysis will help define the skill levels required by the department. Job training analysis (JTA) should be followed by assessment of employee knowledge and skill levels. The gap between required maintenance skills and available maintenance skills is determined to know the amount and level of training necessary to close the gap. Well-trained prison maintenance staff is more likely to work safely and make fewer mistakes. Furthermore, training assists in maintenance resources allocation when scheduling maintenance tasks helps in quicker maintenance delivery and ensures safe on-site practice (CITB, 2008).

2.8.9 Maintenance Report

Maintenance managers should be able to obtain reports of completed, current and future maintenance work when required. They are to make important decisions regarding maintenance work to be carried out on the facilities. Whether maintenance work must be carried out immediately or deferred. Whether to redirect or re-allocate the resources for maintenance work. Better still, to determine whether an item or facility should be repaired or replaced. Basically, in making these decisions maintenance manager ought to have relevant information on available cost implications for various maintenance alternatives and minimum acceptable standards for prison facilities.

2.9 Best Practice Maintenance Management for Prison Facilities

According to Her Majesty's Inspectorate of prison (2005) prison facilities that are to be used for the activities of prison services must be physically safe. The maintenance of prison facilities comprises of repairs of building elements, components, utilities, testing of plant and equipment like boilers, pumps, fire alarms, air condition for continuous functioning and ensuring health and safety of prison staff, inmates and all other people interacting with the facilities. The Prison Service Technical Order (PSO) is designed to reflect prison service policy – a strategic, planned preventive and reactive policy that is operationally focused. It also introduces 'best practice' on how prison managers and maintenance unit should maintain prison facilities. According to Prison Service Technical Order (PSO) 5900 and PSO 5901, all buildings, structures, and utilities forming the prison estate are to be maintained to a standard that provides a safe and decent environment for prison staff and prisoners to work and live in, and for all others who interact with the prison facilities.

The best practice maintenance for prison establishments is constituted by the following; service delivery agreement, management information, general maintenance, repairs and testing of equipment, health and safety, fire safety, security, and energy management.

2.9.1 Service Delivery Agreement

This acts as the maintenance elements of the prison business plan and it does include the followings:

- ☐ Identifying the responsibilities of the individual stakeholders in the Prison Service
- ☐ Identifying works to be carried out by prison maintenance staff at different level
- ☐ Specifying standards to be achieved when executing maintenance work and delivering of maintenance works/services within the stipulated budget.
- ☐ Defining the resources that will be required for delivering maintenance works and services in terms of funding, managerial support and manpower.
- ☐ Recording all works undertaken to include dates on which maintenance works was done and cost of works done
- ☐ Supporting prison organisation for performance testing or performance improvement planning.
- ☐ Specifying the ‘informed client’ monitoring process
- ☐ Publishing of detailed programmes and cost estimates for implementing work programme.
- ☐ Gathering of data to enable planning for future development of prison estate/ facilities.
- ☐ Auditing of security of the prison service on agreed timescale.

2.9.2 Facility Management Information

The need to provide, support and sustain a system (computer aided facility management system) to accommodate data required in meeting the need of the service delivery agreement.

- ☐ Identifying resources needed for updating of the system in case of alteration and/or addition to buildings, services, plants and equipment are made.
- ☐ Updating of the maintenance plan, providing technical and professional support, and disseminating of information.
- ☐ Preparing and maintaining maintenance management system for prison facilities that are operationally reviewed.
- ☐ Adding to the system details of all buildings/prison facilities constructed or refurbished. This includes the full maintenance requirement of buildings/facilities.
- ☐ Providing technical advice and guidance on health and safety, maintenance and information on related issues.

2.9.3 General Maintenance of Prison Facilities, Repairs and Testing of Equipment

This involves the maintenance of all the physical prison facilities/structures of the prison service:

- ☐ Putting in place a full and effective planned maintenance (PM) system that meets up the service delivery agreement.
- ☐ Identifying the general maintenance requirement of prison facilities.
- ☐ Extending or altering response times for completing general maintenance activities depending on the statutory requirement and on operational impact of the procedure.

- ☐ Putting in place a system for emergency repairs and identifying response times for reactive urgent or emergency repairs.
- ☐ Recording all maintenance works that are executed on the prison facilities/system with date of repairs execution.
- ☐ Keeping records for prison facilities inspection.
- ☐ Initiating a program necessary for testing tools, plant and equipment that is consistent with manufacturer's instructions.
- ☐ Testing program updated within an agreed timescale, recording test dates together with results of the testing.
- ☐ Programming for actions all remedial works detected during tool testing into the repair procedures.

2.9.4 Health and Safety and Security

It is of high importance that prison facilities and their environment are maintained to a standard that ensures health and safety as well as secured environments for its users. This involves:

- ☐ Maintaining a standard that ensures health and safety, decency, hygiene and an acceptable environment.
- ☐ Carrying out building works and maintenance operations safely, so that prison staff, prisoners and any other persons interacting with the facilities are not exposed to risks.
- ☐ Ensuring that a physical security 'self audit' is carried out appropriate to the security level of the prison. This audit should include fabric of the buildings, plant and

equipment, physical surroundings that support the security tasks. This could be done either once in two years or every year.

- ☐ Compiling of an action plan based on the findings of the audit as well as the needed improvement in the prisons security system.

2.9.5 Fire Safety

PSO 0200 HM Prison service standard ensures that the risks of fire are reduced to the minimal and that in events of fire outbreak measures are in place to protect the health and safety of prison staff, inmates and any other persons interacting with the prison facilities.

This entails:

- ☐ Having a policy statement on fire, that is, a written policy document on fire which is often reviewed, and notifying the prison maintenance/fire staff in case of any changes.
- ☐ Receiving competent fire safety advice and compliance so far as is reasonably practicable with the requirements of the regulations.
- ☐ Assessing related fire risk, implementing control measures on identified risks and having in place a contingency plan for dealing with fire.
- ☐ Providing and maintaining firefighting equipment, water supplies, fire detection equipment and fire signage
- ☐ Delivering fire safety training to all prison maintenance/fire staff and other relevant persons.
- ☐ Investigating and reporting all fire outbreak
- ☐ Liaising with local fire service authority.

2.10 Factors Affecting Prison Maintenance Management

Critical issues that affect maintenance management are enormous and these impact on the overall performance of maintenance activities of prison facilities just as in other facilities or system. The major factor influencing maintenance management is financial (Zakaria, Arifin, Ahmad and Aiyub, 2012), although other factors cannot be overlooked.

2.10.1 Funding

Zakaria et al. (2012) opine that maintenance costs are necessary expense that are part of the operating budget while Murthy et al. (2002) see cost of maintenance (preventive, corrective and predictive) as a fraction of total operating budget. It is important that effects of such factors are assessed for optimum maintenance management (Oladapo, 2005).

2.10.2 Deterioration due to Age of Buildings or Facilities

Another influential factor includes the rate at which prison facilities/systems deteriorate; facilities, plant/equipment and tools degenerate with age and usage. Deterioration of facilities worsens the condition of facilities and ultimately increases cost of operation of facilities or render facilities non operational (Durango & Madanat, 2002). The rate of deterioration of facilities could be attributable to decisions made during design and manufacturing of the facilities, design characteristics, environmental condition, intensity of facilities usage and technical skills of operator and the maintenance officers (Durango & Madanat, 2002; Murthy et al., 2002).

2.10.3 Plant, Equipment, Materials and Spare Parts for Maintenance operations

There are factors influencing the choice of plant and equipment for maintenance operations as regard to when and where to purchase based upon data from previous machines and competing suppliers (Sherwin, 2000). The extent and efficiency of maintenance also depends on volumetric planning, design solutions, quality of materials, structure and engineering service and capacity to satisfy user of facilities (Zavadskas, Kakluaskas & Bejder, 1998). In essence the use of poor quality materials and spare parts affect the quality of maintenance, repairs and efficiency of maintenance.

Pun et al. (2002) acknowledge that effective maintenance management is attributable to proper deployment of maintenance resources such as spare parts, maintenance materials, tools, equipment and manpower. In the same vein, Arditi and Nawakorawit (1999) affirm that the functional design of facilities and quality of materials and equipment used are of major importance to maintenance activities. For maintenance planning, identification of spare parts, special tools and material requirement and their availability is a critical function. Availability of spare parts, delivery times of spare parts, availability and reliability of equipment and tools are essential factors for modeling maintenance scheduling in emergency or breakdown maintenance (Duffuaa & Al-sultan, 1997).

2.10.4 Reckless Use of Facilities

Zubairu (1999) asserts that maintenance problems increase by the uncaring attitude of users of public facilities that tends to have the notion that the maintenance of public facilities is the sole responsibility of government. The need for repairs and maintenance often thus results

from vandalism, misuse and improper handling by users' of facilities (Technical Information Document, 2000)

2.10.5 Third-party Vandalism

Third-party vandalism is the crime of destroying or damaging of equipment, facilities deliberately. It is a nuisance attitude involving broken glass, graffiti, destruction of materials and damage to equipment (Farinloye, Odusami & Adewunmi, 2013). Vandalism also acknowledged as a significant factor determining the maintenance requirement of housing (Olubodu 1996; Olubodun, 2001).

2.10.6 Delay in Reporting Failures and Executing Repairs

Delay in reporting defect by the users of facilities and executing repairs is likely to cause permanent damage. Duffuaa & Al-sultan (1997) maintain that with a well developed schedule for maintenance jobs, delay in executing maintenance activities are likely to be minimised.

2.10.7 Workmanship

There is frequently a shortage of qualified and trained technical skill and manpower requirement (Duffuaa & Al-sultan, 1997) to undertake maintenance activities. This shortage of skill has great impact on the workmanship outcome of technical skill workers in the maintenance of infrastructure and facilities (Forster & Kayan, 2009). Poor workmanship is reducible by quality control and training. Provision of technical training via traditional skills education and professional training has been recognised to relieve the shortage of skills and inadequacy of professional skill for specialised maintenance activities (Forster & Kayan, 2009).

2.10.8 Training and Development of Maintenance Personnel

Maintenance works are essentially performed by craftsmen most of whom acquire skill by ‘watch and learn’ and by apprenticeship training for skill development. Lack of technical skill training leads to poor quality of maintenance particularly where a technical skill is required (Sherwin, 2000). Training and development of employee involves acquisition of knowledge and specialized skills required to perform their duties properly. Technical skills training increase optimum performance of tasks and productivity of maintenance (Abdullah Sani et al., 2012). Training assists in maintenance resource allocation when scheduling maintenance tasks, helps in quicker maintenance delivery and ensures safe on-site practice (CITB, 2008).

2.10.9 Lack of Discernable Maintenance Culture

Developing countries are well known for their poor maintenance culture (Mushumbusi 1999). Lack of discernable maintenance culture in public buildings leads to environment that are not conducive for occupants, such as hospital, prison, etc. People working and interacting in public facilities are often exposed to allergic like dizziness, nausea, irritation of mucus membrane and sensitivity to odour for waste, poor toilet facilities and unkempt environment (Adenuga & Ibiyemi, 2012). A study of Faremi and Adenuga (2012) confirms lack of a discernable maintenance culture as factor responsible for poor maintenance management of public facilities. Maintenance culture has been recognised to increase quality of maintenance work which invariably extend the life cycle of facilities as well as health and safety of occupants (Abdullah Sani et al., 2012).

2.10.10 Maintenance Work not based on Priorities

Policy statements are crucial to an organisation. They describe how the organisation deals with maintenance activities, with the standards to be achieved being well stated when carrying out maintenance works. This has to cover the financing and major maintenance programmes to be carried out within a given span of time. The limited resources available necessitate the drawing up of a priority list in terms of what is viewed as emergency work or what is to be phased out for future dates. This is usually prioritised based on the physical characteristics (degree of deterioration), economic value of the facilities and statutory requirements to be observed (Mushumbusi, 1999).

Duffuaa and Al-Sultan (1997) outline the following assumptions in formulating maintenance schedule: available manpower, spare parts, and the delivery times of spare parts, available and reliable equipment and job standard. Based on these assumptions with a set of maintenance job at hand and the probability of a set of emergency job occurring, the priority of maintenance jobs is determined. In essence, a schedule for maintenance jobs at hand and anticipated jobs is developed and prioritised, while delay in executing maintenance activities is minimised and utilisation of resources maximised.

2.10.11 Lack of Motivation for Maintenance Staff

Government attitude towards maintenance of its public facilities can often be disturbing. Most times owners of facilities take short-term approach to maintenance, failing to get the benefits of regular minor interventions (Forster & Kayan, 2009). To correct this, it is important to have staff motivated for a maintenance regimen. Motivation is the act of encouraging a person in achieving a certain goals. This can make a work environment filled

with passion and every maintenance staff becomes more dedicated to maintenance tasks they are assigned to do. Motivation can be created for maintenance staff through recognition, a reward system and support from management commitment toward the welfare of individual (Abdullah Sani et al., 2012).

2.10.12 Construction of Facilities

The design and construction of facilities must be strictly monitored and should involve the technical competency of the maintenance profession. Faulty design and construction of facilities is attributable to degradation of facilities (Murthy et al., 2002).

2.10.13 Overcrowding in Prisons

Overcrowding concerns rate of growth of inmate relative to prisons' installed capacities that have resulted in the congestion of prisons (PRAWA, 2000). Congestion of prisons takes its toll on inmates, the prison system and maintenance of prison facilities, causing premature obsolescence of the few facilities that are grossly inadequate for prison service ('Prison of Horror', 2000). This has also been identified as a significant factor that affects maintenance of prison infrastructure (Farinloye, Adenuga & Iyagba, 2010).

2.10.14 Inspection of Facilities

Lee (1992) identifies planning of facilities inspection as a critical function in the maintenance of facilities. The inspection of facilities is important as this give a clear picture of the magnitude of maintenance works to be carried out and relatively the maintenance resources to be utilized.

2.11 Performance of Prison Maintenance Management

2.11.1 Maintenance Efficiency

Efficiency is defined as a function of value and productivity. Karlof (as cited in Then, 1995) describes efficiency as “value created in relation to productivity. Value is the relationship between utility and price while productivity is the relationship between number of unit produced and cost. This implies that value is the relationship between customer (prison staff or inmates) satisfaction and price while productivity is the relationship between amount of maintenance work carried out on prison facilities and cost of maintenance.

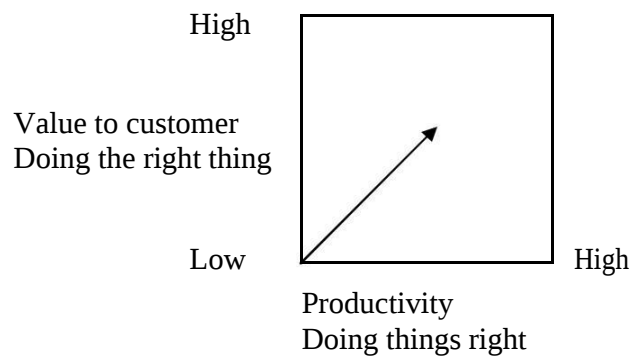


Figure 2.12: Efficiency Matrix

Source: Then (1995), Page 69

Indeed, it can be said that productivity is the relationship between output and labor force (Pun et al., 2002). The two axes of the efficiency graph and their derivatives are in fact the parameters that can be manipulated to attain short-term and long-term improvements. It is recently realised that measures aimed at the soft issues related to people in the works department/ maintenance unit can make measurable impact on improving performance of the prison facilities along value axis. Indeed, a well-motivated prison maintenance staff makes a

greater effort to serve all other person like inmates and prison staff that needs their maintenance services.

According to UNCH (2003), efficiency means the amount of input resource, usually in monetary terms (maintenance resources such as manpower, equipment/plant/tools/spare parts and finances) per unit of maintenance services delivered. This might as well be described as all maintenance resources per unit of quality of maintenance services provided by the maintenance unit of the Nigerian Prison Service. Efficiency can be very useful for monitoring trends in a service area, for comparing different service approaches and establishing targets and standards for maintenance works and quality of service delivery.

To measure the efficiency and effectiveness of the maintenance functions, performance measurement should reflect factors that affect performance (Niebel, 1994). Shohet et al. (2003) offer a preliminary development of maintenance index for examining the efficiency of maintenance department. These four indices developed are:

- Building Performance Index (BPI) – express the physical-functional condition of the building;
- Manpower Source Diagram (MSD) – represents labor composition;
- Maintenance Efficiency Index (MEI) – evaluates maintenance efficiency
- Managerial Span of Control (MSC) – reflects the organisational effectiveness of maintenance department.

An efficient maintenance programme depends on and is responsive to the condition of the building/facility. The maintenance manager must decide which of the various components or elements of the building/facilities such as walls, floors, roof, doors and firefighting

equipment need detailed inspection for assessing their condition. In making decisions concerning what prison facilities to inspect, how often, and response to an observed condition, it is essential that the cost implications of various maintenance alternatives along with the minimum acceptable condition of the element must be known.

Maintenance is not simply mixture of running repairs and replacing like with like when individual facility/components wear out, but also involves necessary investment in refurbishment or improvement in order to maintain facilities to a standard appropriate for its intended use or to bring it into line with current standard and thereby maximise its asset value (Al-zubaidi, 1997).

2.11.2 Maintenance Performance Measurement

Performance measurement is the process of quantifying action and can be defined as measuring the efficiency and effectiveness of action (Neely, Gregory and Platts, 1995). Any choice of action concerning performance measurement generally and within maintenance should be viewed in relation to the institution types and should also satisfy the requirements of the decision-maker (Bourne, Mills, Wilcox, Neely & Platts, 2000). Performance measurement is a tool for managing the implementation of maintenance plans, for providing information for management control and decision making and for the indices used for monitoring progress. The essence of performance management is to improve organizational effectiveness and to enhance employee motivation (Tsang et al., 1999).

Maintenance performance focuses on condition of facilities to customer service; it allows for duly recognising the impact of maintenance on the performance of a system (prison facilities) and business (prison functions) (Murthy et al, 2002). The condition of buildings/facilities is a

measurement maker and a typical way to measure performance of facilities (Wahida, Milton, Norazela, Nik Mohd & Abdul Hakim, 2012). The scope of maintenance management in the life cycle of a technical system (plant, equipment, or facilities) should embrace acquisition, specification, planning, operation, and replacement as well as disposal and performance evaluation, among others (Tsang et al., 1999). This means that for maintenance management process to be completed in any system (facilities) the performance of such system (prison facilities) must be evaluated. The essence of evaluating performance of the prison facilities is to assess the impact of maintenance activities on the future value of the associated facilities (Al-Najjar, 1996). Information used in monitoring performance includes relevance, accuracy, timeliness, completeness, cost effectiveness and presentation among others.

Several performance indices regarding reliability, availability and productivity are widely used in production plants as well as service industries in which the Nigerian Prison Service is not an exemption. The Overall Equipment Effectiveness (OEE) or Overall Plant Effectiveness (OPE) is a widely used index that indicates the performance of production line, equipment or plant. It gives an objective appraisal of the actual performance of the facility or the equipment based on individual indices of availability, performance efficiency, and quality of plant and equipment (Pun et al., 2002).

Productivity equal to unit produced per cost of production. Alternatively, productivity equal output (maintenance service provided) per labour (work) force. Overall system effectiveness measures whole organisation while individual system effectiveness measures items/components. The outcome of evaluating performance of whole organisation or any items/components/ facilities reveals whether there are substantial achievements in individual

system or success of continuous improvement. If any individual system/facility degrades rapidly, overall system effectiveness deviates accordingly. Consequently, organisation needs to identify deviation and implement correction (Pun et al., 2002).

Survey carried out on performance measurement such as those of KPMG survey of 150 Times, 1990; postal survey on performance measurement of 12,800 organization (both private and public sector), 1991 in UK; and survey on performance measurement APQC covering 200 organisations in 1996, reveals the characteristics of the performance measurement. The performance measurement of those studies failed to measure all the factors that create value, giving little account of asset creation and growth, and are mostly dominated by financial or other backward- looking indicators as well as concentrating on immediate short-term goals rather than long-term goals. Other survey conducted on small and medium sized enterprises in Australia (Dejong, 1997) and study on practice of maintenance operations in six large- scale steel, public utility, transportation, and process industries in Hong Kong and Canada also shared the following characteristics that organisation/management are sometimes not aware of the fact that measurement system can achieve vertical alignment of goals and horizontal integration of activities, that performance measures are primarily used for operational control purpose, the most often used measures for performance are financial indicators such as operation cost, maintenance cost, equipment availability, process-oriented, labour productivity, and number of incident caused by in-service failures (Tsang et al., 1999) and that the outcome indicators for evaluating performance actually reflect short-term result. Performance measurement should offer the satisfactory characteristic of measuring the efficiency and effectiveness of the relevant organisation. In the same vein, the performance of the Nigerian prison facilities is to be evaluated in determining their effectiveness.

Performance measures are to be positioned in a strategic context, as they influence what people do since 'what get measured gets done'. The performance of maintenance is dependent on decisions made at different organizational levels (Parida and Chattopadhyay, 2007). At strategic level, decision are taken on whether to have a centralized and decentralized maintenance system, in-house or adopting policy for out sourcing, design options for maintenance activities, or plant and machinery to be acquired. Tactical maintenance decisions relates to formulation of maintenance policies, effective distribution of maintenance resources, maintenance budget for plant/machineries, skills, inventories and decisions on preventive and condition-based maintenance while operational decisions are made to achieve and implement a high level of effective maintenance activities carried out on facilities, maintenance inspections of facilities, as well as repairs, and replacement of facilities.

2.11.3 Maintenance Performance Indicators

Maintenance Performance Indicators (MPIs) are set of measures used for measurement of maintenance impact on the process (prison) of performance. These measures are equipped with baselines and realistic target to facilitate prognostic and /or diagnostic processes and justify associated decisions and subsequent actions at appropriate levels in the organisation to create value in the business process (Liyanage & Kumar, 2002).

MPIs helps organization to understand what maintenance is doing, that is, the effect of maintenance on business (reformatory) performance and reliability of buildings/equipment /facilities within the organization (Wardhaugh, 2004). The essence of MPIs is to measures and identifies performance gaps between current and desired performance which invariably

provide improvement to close up the identified gaps. Performance indicators used in maintenance are adapted to the organization goals/strategies, they consist of several indicators and are usually users' friendly (Visser & Kotze, 2010).

Ellingsen, Kumar, Hamre, Waldeland, Nilsen, Dragesaet and Liyanage (2002) suggest performance measurement framework for the Norwegian oil and gas industry that is based on a balanced scorecard model. This includes:

- i. Financial
- ii. Customer perspective
- iii. Infrastructure
- iv. Innovation.

Martorell et al. study (as cited in Hagerby & Johansson, 2002) discloses basic indicators collated from historical cost and downtime data of maintenance management system to include the followings:

- i. Overall equipment efficiency (OEE)
- ii. Effectiveness/cost efficiency of preventive maintenance (PM)
- iii. Cost of production
- iv. Relation between cost for PM and CM
- v. Hours of maintenance training/total maintenance hours
- vi. Contractors maintenance costs as percentage of total maintenance costs
- vii. Maintenance overhead costs
- viii. Spare part inventory turnover
- ix. Cost of poor quality, distribution on relevant causes

- x. Number of incidents resulting in employee absence
- xi. Cost of emissions
- xii. Required availability level of safety equipment
- xiii. Preventive maintenance cost and/or hours as percentage of total maintenance cost and/or hours
- xiv. Maintenance cost
- xv. Total operating hour/number of breakdown
- xvi. Breakdown maintenance hour/number of breakdown

Wardhaugh (2004) affirms the useful indicators for maintenance to include the followings:

- i. Reliability of equipment
- ii. Quality and speed of execution/responses
- iii. Maintenance costs
- iv. Prediction of failure

Parida and Chattopadhyay (2007) assert the performance measurement study to include maintenance and employee satisfaction to come up with a list of maintenance performance indicators:

- i. Equipment related indicators
- ii. Maintenance task related indicators
- iii. Cost related indicators
- iv. Impact on customer satisfaction
- v. Learning and growth
- vi. Health, safety, security and the environment (HSSE) and

- vii. Employee satisfaction

Visser and Kotze (2010); Kotze and Visser (2012) report the following categories of maintenance performance indicators in the South African Mining Industry. This includes:

- i. Equipment and process
- ii. Safety, health and environment
- iii. Maintenance workflow
- iv. Continuous improvements
- v. Organization culture
- vi. Cost/finance
- vii. Customer satisfaction

According to Simoes, Gomes and Yasin (2011) a more balanced approach on maintenance performance measurement emphasises on the followings:

- i. Equipment related performance
- ii. Task related performance
- iii. Cost related performance
- iv. Immediate customer impact related performance
- v. Learning and growth related performance

2.12 Quality of Maintenance Services

Service quality perception results from the comparison between a customer's pre-consumption expectations and post-consumption experience, and it is perceived along reliability, responsiveness, tangibles, assurance and empathy dimensions (Parasuraman, Berry

& Zeithaml, 1985). Other generic service quality models are Gronroos' (1982) model that divides service quality into two dimensions: functional quality and technical quality. Sureschandar, Rajendran and Anantharaman (2002) suggest more dimensions as physical quality, corporate quality and interaction quality. Service quality (customer satisfaction index) has a long-time effect on companies' (Nigerian Prison Service) profitability and an indirect positive effect on performance (Rasila & Gersberg, 2007). It is characterised by delivering right type of maintenance services to customers (prison non maintenance staff and inmates). From customer perspective, quality of service and timeliness of service delivery are invariably of utmost importance. According to Aditya and Uday (2006), customer satisfaction is characterised as service quality (of repairs/modification and promptness of response), timeliness of delivery and safety, delivery of right product/or services to customers on demand at the right time.

Customer satisfaction can be viewed on two different perspectives. From the consumer's view, it is the customer perception as to whether the organisation has met the customer's requirements (International Organisation for Standardisation (ISO), 2000); from provider's view, it is making sure that products or services rendered meet up customer's expectation (Bleul, 2004). Empirical studies have confirmed that facility maintenance services are to be assessed on specific dimensions relative to the features that affect the end-user of facilities.

As such Gersberg and Siekkinen (2006), as well as Rasila and Gersberg (2007) apply the Gronroos' (1982) service quality model to facility maintenance services in a likely manner that functional quality refers to the service recovery quality and that technical quality refers to observed maintenance quality

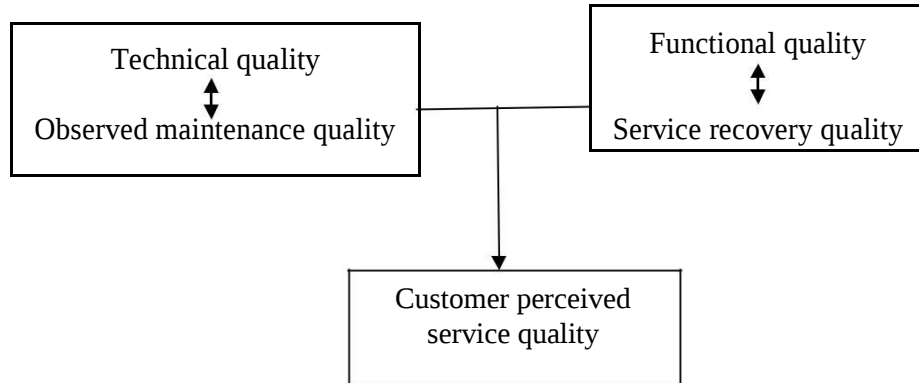


Figure 2.13: Service Quality Dimension Model

Source: Rasila and Gersberg (2007), page 41

Service recovery quality involves initiating a recovery process of facility where service failure has occurred. Observed maintenance service quality entails services that are tangibles and directed to the facility where most times the technical quality and service process are not easily assessed by the end users because of the skill and knowledge required. The Customer or end user of facility concerns are mostly on the availability of service or products and not actual defect rectification time that is time taken to entertain customers' or users' request on improving the functionality of the faulty system or piece of equipment (Kit-fai et al, 2002).

2.13 Evaluating Maintenance Activities

Many of the day-to-day activities or systems used in planning and operating of maintenance programmes could also be used in generating the types of information that would be needed to evaluate the effectiveness of any maintenance programme (School Facilities Maintenance Task Force, 2003). This includes the followings:

Physical Inspection of Facilities

Records of physical inspections are good evaluative material. To care for building elements/ components, maintenance staff must observe and assess the condition of building elements/ facilities on a regular basis. Inspection should be both visual (i.e. how things look) and operational (i.e. how things work).

Work Order System

An effective work order system is a good tool for identifying, monitoring, and projecting future maintenance needs. Maintenance work recorded on work order would provide valuable quantitative information for evaluations.

User Feedback and Customer Satisfaction Survey

There are many ways to gather information from users/customer (i.e., the people that benefit from the maintenance activities), including collecting satisfaction surveys and convening advisory committees of stakeholders. The value of user perceptions should not be overlooked as an evaluation tool.

2.14 Constraints to Performance of Maintenance Management

Mushumbusi (1999) pinpoints some performance constraints. These constraints to performance of maintenance are discussed below:

Resources Constraints

The problem of balancing the scarce resources available with the uncompromising demands in maintaining prison facilities is a big challenge. These maintenance resources have to be allocated judiciously so that optimum results are obtained. Therefore, comparative costs as well as elements of cost benefits and effectiveness of repairs have to be considered before a

course of action is sought. These are materials, tools and equipment as well as level of maintenance staff (expertise) resources. Staffing is found to be critical because without the right maintenance staff all the information to be collected and processed will be of no use. Thus, these resource constraints impose on management of the Prison Service the need to plan for available resources before maintenance action is undertaken. Furthermore, there is need to evaluate different staffing alternatives: either to recruit more staff or not, to identify what level of trainings is needed for the maintenance staff, and to know when to outsource maintenance works.

Lack of Clear Policy

A good policy defines the scope of the maintenance problems, the standards to be achieved, and the intended methods to carry out the maintenance works. It is built on a mechanism whereby predetermined inspections leads to continuous monitoring of the defect build-up and enables systematic data collection concerning the structural condition and the state of repair of buildings/ facilities. It is not enough to have a clear understanding of the scope of the problems and standards to be achieved; it is also important to have efficient property/ facilities information system capable of detailed descriptions and analysis of the stock of buildings/facilities that is capable of defining the amount of maintenance backlog and its estimated cost. This infers the need to realistically budget for and program maintenance work. Where there is faulty policy it becomes impossible to forecast, in quantifiable terms, what work is likely to be required in the short-term and the long-term, what maintenance resources will be required to execute the work in the short-term and long-term and the means or method of maintenance work execution.

Funding Constraints

Inadequate funding from government for development and maintenance of existing facilities is a major constraint. Also, when the available funds are not properly managed due to lack of clear short-term and long-term maintenance requirements forecast. Constraints in funds result from unrealistic budgets for maintenance activities; worse still, funds released are usually less than what is requested.

Shortage of Man power

There is often lack of adequate professional manpower for collection and processing the maintenance information required for planning, implementation and monitoring purpose. This could have contributed to the poor facility records of the Nigerian Prison Service in terms of detailed structural surveys of facilities, inspection of maintenance cycles of facilities, formation of planned maintenance programmes and feedback from maintenance work carried out. Nigerian Prisons lack craftsmen trained specially for conservation of historic buildings/ facilities. This inadequacy also affects the level of supervision of the works in progress and inspection of the completed works.

Alternative Resources

Maintenance staff need not reinvent the wheel when it comes to evaluations. Maintenance and operation manuals, vendor expertise, warranties, and other resource (e.g. websites) can be a source of benchmarking data or evaluation standards.

Regulatory Activities

Trained maintenance staff is assigned to determine whether applicable public safety and environmental regulations are followed. There is need for documenting of inspection activities and reports, notifying organisation of deficiencies, developing strategies for

remedying deficiencies, and verifying compliance with applicable laws and regulations. Hence, documentation of these activities can be used in programme evaluation.

2.15. Theoretical Framework

The logical process of integrating existing ideas from previous conceptual framework enables the ongoing study to benefit from previous scientific contributions (Amaratunga and Baldry, 2003). One of the aims of research in building maintenance management is to provide tools that would assist in making maintenance decision on facilities (Printelon & Gelder, as cited in Adenuga, 2008). Theoretical statement and concept of previous studies are examined and modified to form basis of the framework.

2.15.1 Post-Occupancy Evaluation Criteria

Zubairu (1999) study focused on level of maintenance of government office buildings. The study stated the criteria to be used for post-occupancy evaluation as:

1. Quality of space: This is assessed by considering cleaning, lighting, ventilation, and furnishing of office spaces
2. Level of maintenance services: This is assessed based on complaints/ responses time for repairs, general condition of the building and its components
3. Efficiency: Efficiency deals with cost of maintaining the building offices
4. Internal image: This has to do with the ability to satisfy the users of the building, as the building cannot be assessed independently from the organization inhabiting it. The

model examined criteria for evaluating office buildings but excludes the relationship between the condition of buildings and performance of buildings. This current study considered the conditions of prison facilities and also adopted the post-occupancy evaluation

criteria model as part of the variables for measuring the satisfaction level derived from the performance of the prison facilities.

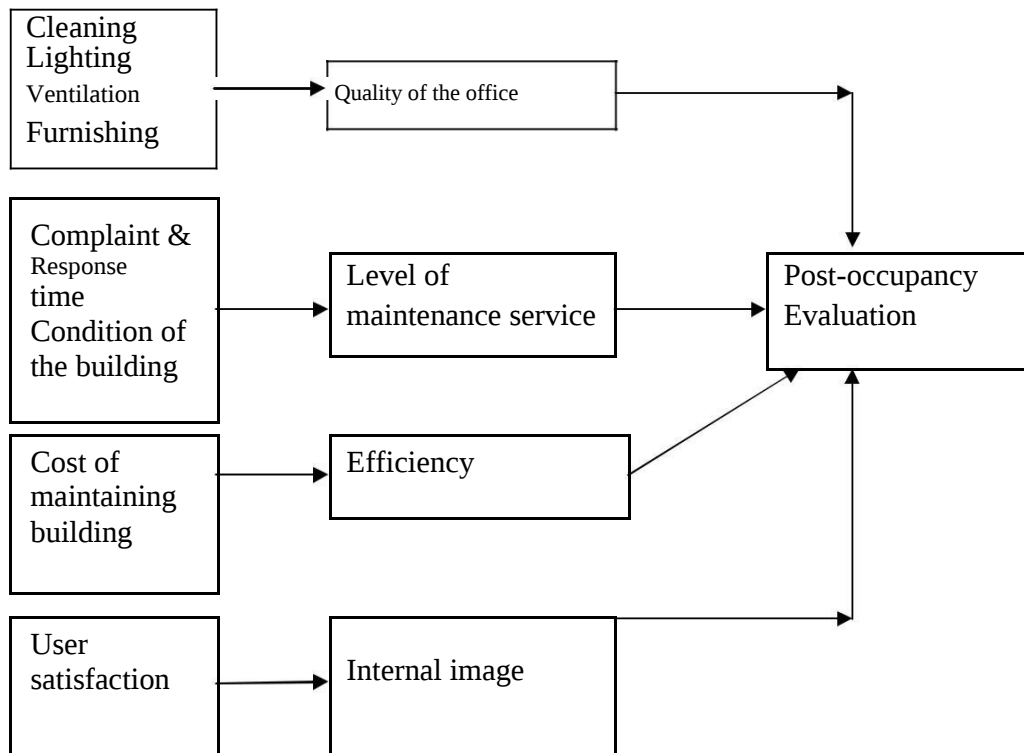


Figure 2.14: Post-occupancy Evaluation Criteria

Source: Zubairu (1999)

Quality of space was adopted as a criterion that was further simplified into measures like level of cleanliness in the prison environment, waste removal, vehicular access, etc. The model explains efficiency as cost of maintaining building offices. This current study further assessed maintenance efficiency in respect to maintenance task and cost related measures. In view of this, the users' (prison non-maintenance staff) satisfaction survey was assessed on the criteria of quality of space, response to complaints/repairs, maintenance task and maintenance cost related indicators.

2.15.2 Optimal Building Maintenance Management Model

Katavic, Ceric and Zavrski (1999) pointed out that buildings need to be preserved for historical, cultural, and architectural value and also for safety and quality usage. The steps involved are identifying both structural and non structural elements and defining the maintenance activities necessary to maintain them while investigating the possible technical solutions. It involves defining maintenance priorities, by first determining maintenance priority for individual building elements, taking into consideration their influence on safety, functionality, quality of living, external appearance, historical and aesthetic value. Secondly, it determines hierarchy of priority of maintenance or reconstruction of the building elements. The steps further calculate the cost of maintenance, repair or replacement of elements and formulate a model to predict the cost of maintaining buildings. It then correlates the funds invested in maintenance, repair and reconstruction with the increase in usefulness, life span and value of the building elements (cost-benefit analysis).

The model is limited to ascertaining the performance of the building elements or actual performance of the facilities. This current study adopted part of the model, basically the physical prison facilities and the identification of facilities/ components/ services that required maintenance activities via their physical condition.

2.15.3 Parameters for Measuring the Physical-Functional Condition of Building

Shohet, Leibovich and Dany (2002) developed a management tool to examine the performance of hospital buildings. Each building's systems were given a weighted score, on a scale from 0 to 100, which expresses its physical and functional (performance) states. The score for each building's system was (denoted P_n) assumed to be the sum of points for three

basic measures; the system's physical state, typical failures or defects and the policy governing its maintenance.

Building elements	Very good	(81-100)
	Good	(61-80)
	Satisfactory	(41-60)
	Run-down	(21-40)
	Dangerous	(0-20)

Failure or defects	12 times a year or more	1
	6-11 times a year	2
	2-5 times a year	3
	Once a year	4
	Less than once a year	5

Maintenance policy	Break-down	1
	Preventive	2
	Combined	3

The combination of these three measures represents the performance level of the entire building system (P_n).

$$P_n = C_n * W(C)_n + F_n * W(F)_n + MP_n * W(MP)_n$$

Where P_n ; Combination of the three measures representing the entire building system performance level

C_n ; Actual condition of the system

$W(C)_n$; Weight of component condition of system n

F_n ; State component failure

$W(F)_n$; Weight of failure in system n

MP_n ; Maintenance policy for each system

$W(MP)_n$ Weight of maintenance policy for system n

For every system n , the sum $W(C)_n + W(F)_n + W(MP)_n = 1$

Weighting of each building system (W_n) is accomplished by weighting the contributions of the system's component to the total cost of erection, maintenance, and replacement (life cycle cost).

The BPI is obtained as follows:

$$BPI = \sum_{n=1}^{10} P_n * W_n$$

- ☐ $BPI > 80$ indicates that the state of the building and its resultant performance, are good or better.
- ☐ $70 < BPI \leq 80$ indicates that the state of the building is such that some of the system are in marginal condition, i.e. some preventive measures must be taken.
- ☐ $60 < BPI \leq 70$ reflects deterioration of the building, i.e. preventive and break-down maintenance activities must be carried out.
- ☐ $BPI \leq 60$ means that the building is run-down.

This model (index) monitored the physical-functional state and fitness for use of the facilities, frequency of typical failure of the different components/ utilities within it and most likely the

adopted maintenance policy. The model is limited to only two methods of executing maintenance activities (preventive and corrective maintenance). In a slightly different manner, the parameters considered for maintenance policy are considered for maintenance strategy in this current study. Further, this current study interprets performance of prison facilities based on a graduated scale 1– 5; $1.00 \leq MS < 1.49$ means high dissatisfaction, $1.50 \leq MS < 2.49$ means dissatisfaction, $2.50 \leq MS < 3.49$ means partial satisfaction, $3.50 \leq MS < 4.49$ means satisfaction and $4.50 \leq MS \leq 5.0$ means high satisfaction. This allows performance level of various facilities components/utilities within the prison to be ascertained. This index was relevant as it enabled this current study to ascertain the condition and performance level of different facilities and also suggested the best maintenance strategy needed at any point for the prison facilities.

2.15.4 Benchmarking Model for Evaluating Maintenance Management Performance

Buys and Nkado (2006) developed a model that enabled tertiary institutions to readily assess their maintenance approaches in relation to a well-argued best practice that enabled re-position of their maintenance approaches to best practice standards. The study discovered that ratings for best practice criteria were dependent of demographic variables, namely institution type, age of buildings and numbers of users / occupants, and these variables are incorporated in the model. The model did not assess the condition of the learning facilities and this was not related to their performance.

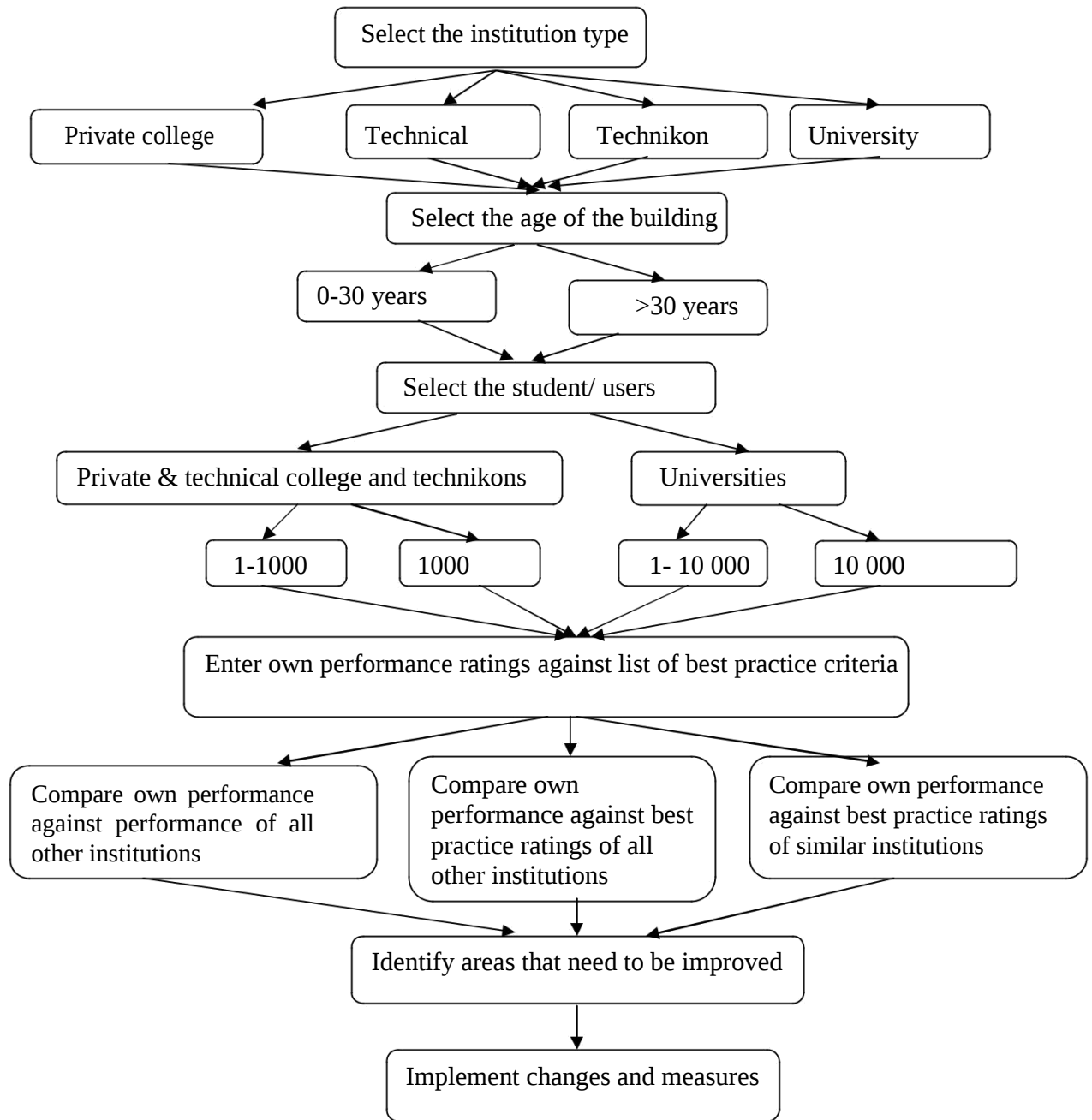


Figure 2.15: Benchmarking Model for Evaluating Maintenance Management Performance

Source: Buys and Nkado (2006)

This model was applicable to the present study in the sense that respondents of the study that is the prison staff were classified into prison maintenance staff and prison non maintenance staff while the maintenance management of prison facilities were evaluated by perceiving the physical condition of facilities, effects of factors on maintenance management, and performance of the prison facilities. This pattern enhanced comparison of prison facilities among Nigerian prisons within the study area and comparison between the perception Nigerian prison staff on the prison facilities. However, the current study compared own performance (a state) of prison facilities against performance of all other (states) prison facilities.

2.15.5 An Evaluation of the Maintenance Management of the Staff Housing Estates of Universities in Southwestern, Nigeria

Oladapo (2005) study involved objective assessment of three critical success factors:

- ☐ identification and assessment of factors affecting housing maintenance needs
- ☐ determination and prioritization of maintenance needs and
- ☐ housing maintenance performance evaluation.

The model basically considered the impact of decay factors on the maintenance of housing estate. The model described some concept in housing maintenance performance viz: customer satisfaction measures, service quality measures, employee measures, and operational measures.

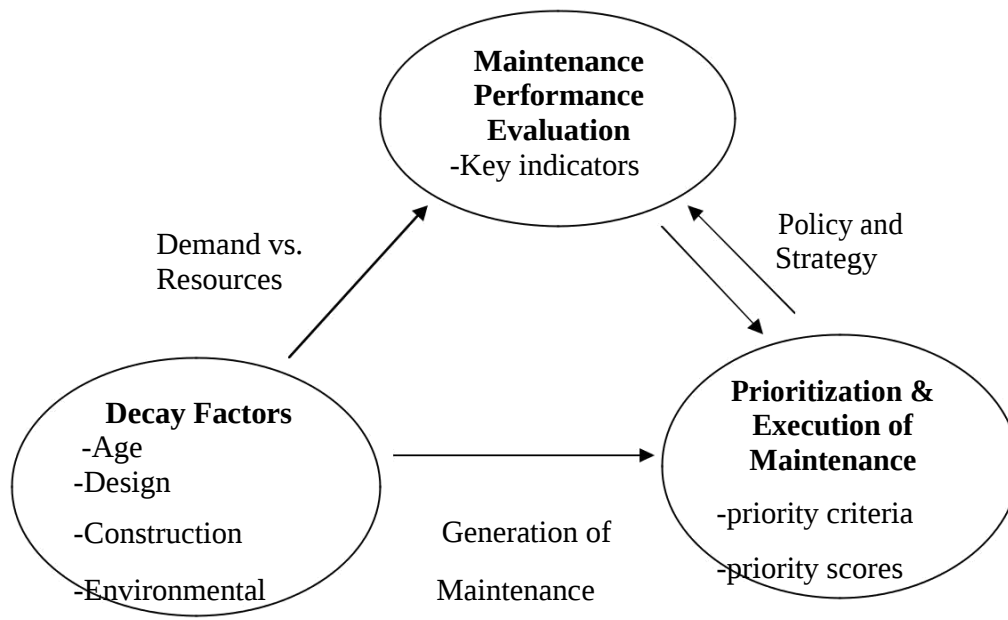


Figure 2.16: Maintenance Management of Staff Housing Estate of Universities

Source: Oladapo (2005)

Customer satisfaction measures emphasize the importance of organizational ability in achieving its goals and how it is viewed by the customers. Service quality measures include reliability of building services, number of tenant complaints and responsiveness of the maintenance department to tenant's needs. Employee measures indicate how well the maintenance workforce has been utilized. This indicator could be measured by manpower utilization index (MUI) that assesses the productivity, well-being and motivation of the maintenance workforce. Operational measures explain the ratio of number of supervisor to number of workmen directly supervised by a supervisor.

These concepts are relevant and thus adopted in this present study, which elaborates more on this concept by relating it to the situation of the maintenance unit of Nigerian Prison Services. Performance indicators were set of measures that indicated the extent or level in which

management was able to attain its goals. The current study utilized the maintenance performance indicators to evaluate the effectiveness of maintenance work carried out and reviewed strategies/policies taken for remedial actions where necessary.

Towards evaluating the performance of prison facilities, the current study adopted some ideas of the previous study, such as level of customer (prison non-maintenance staff) satisfaction and service quality measures extending to up-to-date equipment, neat appearance of maintenance staff, interest in solving maintenance problems, and performing repairs right at first attempt for evaluating performance of the prison facilities.

2.15.6 Maintenance Management Cycles of Public Hospital Buildings

Adenuga (2008) assessed the maintenance management performance of hospital buildings using maintenance cycles of 5M's in terms of maintenance strategy, maintenance performance indicators, maintenance manager attributes, maintenance budget and maintenance management efficiency. The model examined the influence of maintenance strategy (exclusive of routine and detective maintenance), maintenance manager attributes, maintenance performance indicators, maintenance budget on maintenance management efficiency of hospital buildings.

The study measured maintenance management efficiency by the functional state of the hospital buildings and the utility derived by the users of the hospital buildings. In a slightly different manner, the current study assessed the performance of the prison facilities based on the condition of the prison facilities.

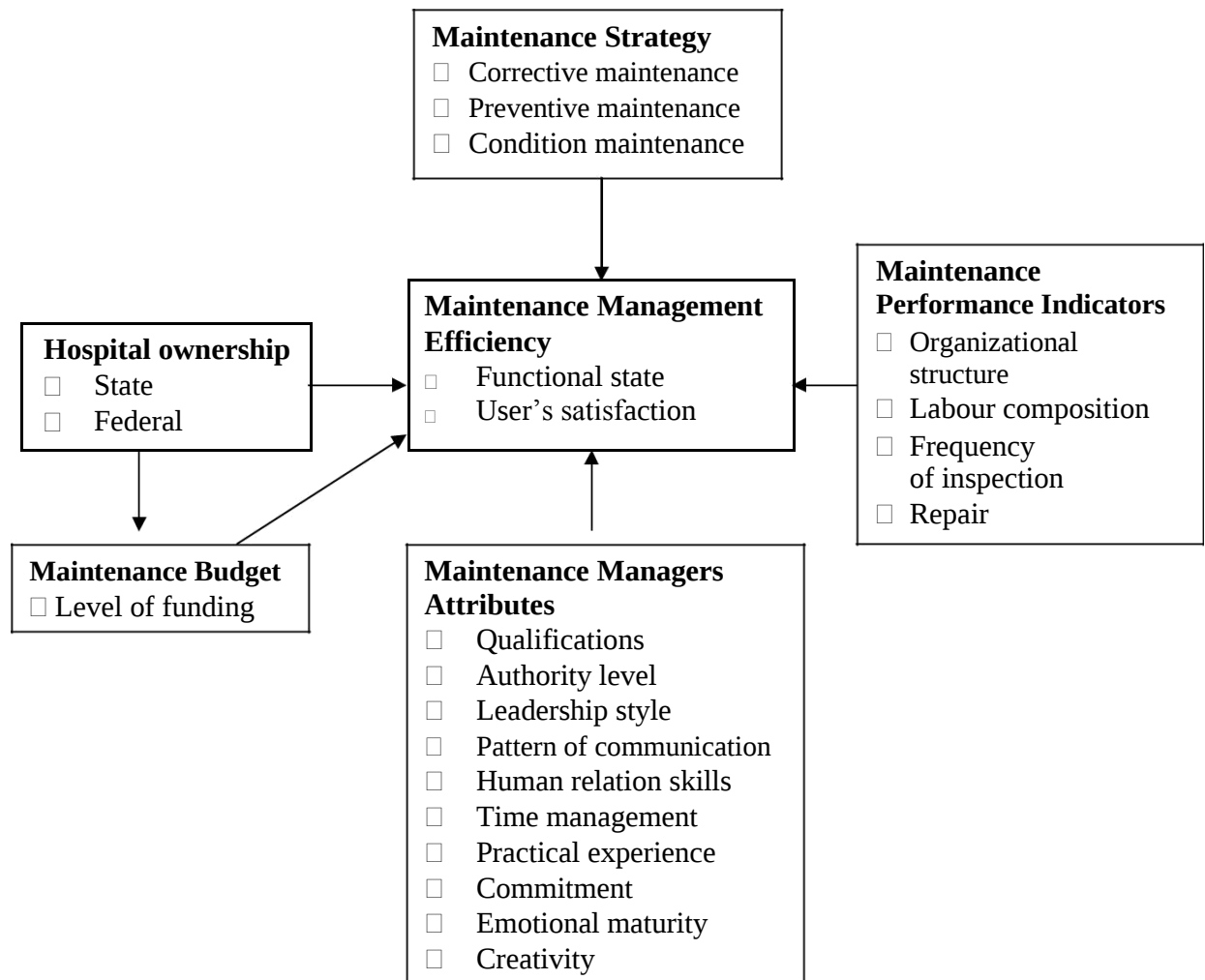


Figure 2.17: Maintenance Management Cycle of Hospital Buildings

Source: Adenuga (2008)

Among the 4M's considered to influence the maintenance management efficiency, this current study adopted two of it that is maintenance strategy and maintenance budget. On the other hand, this current study examined the maintenance policies and planning, types of maintenance strategy adopted for maintaining prison facilities, maintenance budget expended

on the prison facilities and performance of facilities. This current study further evaluates those factors that affect the maintenance of prison facilities.

2.15.7 Situational Maintenance Model

Riis, Luxhoj and Thorsteinsson (1997) situational maintenance model identified and integrated the elements of maintenance system of a manufacturing enterprise. These elements are the situation of the enterprise/firm/organization concerned, declared goals, object system of maintenance, maintenance tasks profile, maintenance system and actual performance. The essence of this theory was that the exact situation of the concerned enterprise, together with its environment, determined the appropriate maintenance solution.

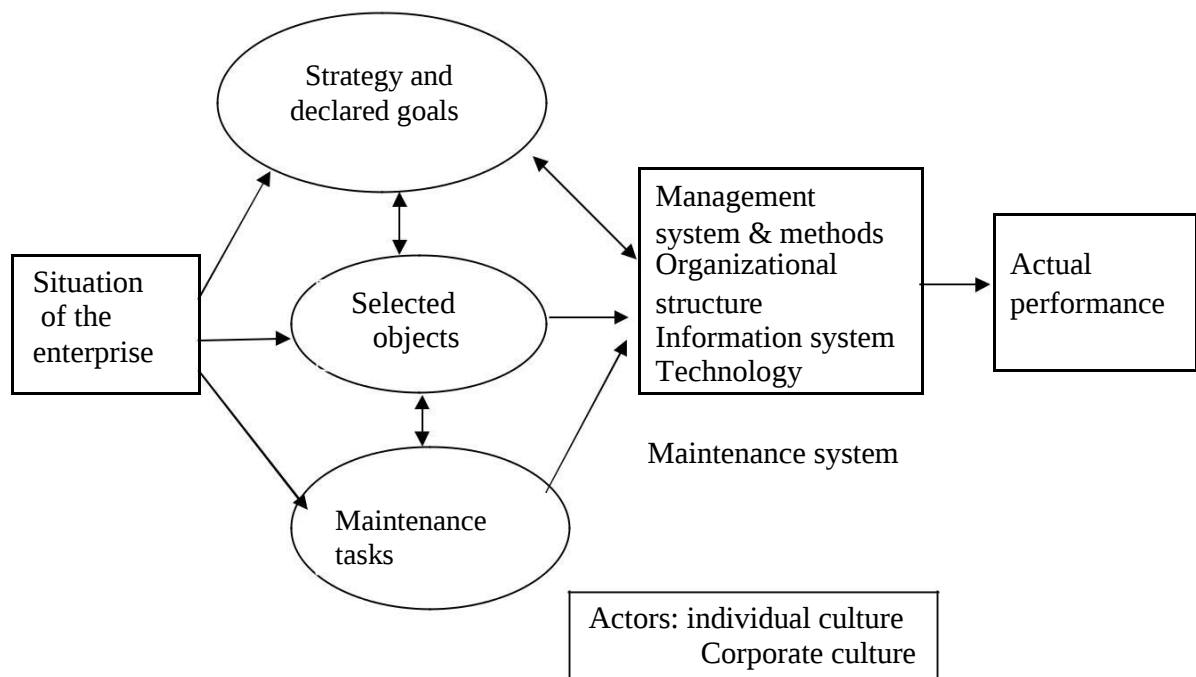


Figure 2.18: A situational Maintenance Model

Source: Riis, Luxhoj and Thorsteinsson (1997)

The model recognized peculiar factors that were relative to the manufacturing industry as situational factors; these factors to be considered include delivery times, quality demand, production process required, equipment required, safety needs, and skill of workforce etc. According to the model, following a contingency theory to a large extent, these situation factors determined the declared goals, the object of maintenance and how the maintenance system is to be designed. The current study does not feature the characteristics of the Nigerian prisons service.

Declared goals evolved around the concept of Total Productive Maintenance (TPM) relating and linking the maintenance system goals of the manufacturing enterprise to their corporate strategy. This involves establishing maintenance strategies and policies that are consistent with the organization goals. Defining the maintenance tasks and methods, accumulating knowledge, planning and controlling maintenance activities, and defining target value for maintenance performance. This current study does not feature declared goals but it is assumed to be evidenced since the study is based on maintenance of prison facilities.

The object system of maintenance is the physical components such as machinery, material handling equipment, transportation, buildings, communication system, supply systems, utilities etc. The current study features the object system as the physical prison facilities.

Typical maintenance tasks include isolating faults in machines/ equipment, detecting faults, diagnosing machine faults, inventory control of spare parts, determination of inspection, schedules and methods, specification of quality of maintenance jobs, specification of working

methods, and relationship between groups of skills, responsibility and authority, etc. Maintenance system involves formal and informal design variables; the formal variables include the management systems, organization structure, information systems and technology while informal design variables include individual actor, that is, the maintenance technicians, operators, manager and the influence of corporate culture.

Management system stipulates the right time for carrying out maintenance activities, procedures involved in the maintenance activities, the person to carry out the maintenance activities, skills and the knowledge required. Information system includes manual data collection and reporting. Maintenance technology includes equipment like diagnostic devices, vibration analysis, temperature monitoring, hydraulic and pneumatic testing etc. Lastly, organization structure deals with distinct division of responsibility for maintenance task among the operators. Basically, the current study adopted the maintenance task and maintenance system but these two constructs feature in the maintenance management practices construct.

Actual performance of the system is basically compared with the anticipated performance of the organization in order to establish the gap. This in turn provides a basis for improvement. Though, the model dwells lightly on actual performance, the current study used more generally accepted indicators to ascertain the extent to which the Nigerian Prison Service (maintenance unit) was able to attain their goals. Furthermore, it utilised maintenance performance indicators to assess the satisfaction derived from the use of the prison facilities. The model excludes factors affecting the maintenance management. This formed one of the main construct of this present study.

2.16 Conceptual Framework

2.16.1 Conceptual Framework of Maintenance Management of Prison Facilities.

This conceptual framework is designed from previous models of authors that have researched in the relevant field of maintenance management. The framework is drawn from Riis, Luxhoj and Thorsteinsson (1997), Katavic, Ceric & Zavrski (1999), Zubairu (1999), Shohet, Keibovich & Danny (2002), Oladapo (2005), Buys & Nkado (2006) and Adenuga (2008).

The conceptual framework is typically built on the concept of situational maintenance model theory which states that the specific situation of an enterprise or organization (Prisons service) and its environment describes which maintenance management is most appropriate (Riis et al, 1997). Although the current study does not feature situational characteristics of the Nigeria prisons service as one of its main construct, better still, it is the Nigerian Prisons service that determined the (maintenance unit) goals, objects (prison facilities) of maintenance, and how the maintenance system was designed. This current study does not feature declared goals as a main construct. However, these goals are evidenced in the study. Since the essence of the study is based on maintenance of prison facilities.

The conceptual framework established the interrelationship among the various constructs. Its highlight factors that affect the maintenance management, the maintenance management practices influence the conditions of the prison facilities which invariably predict the performance of the facilities

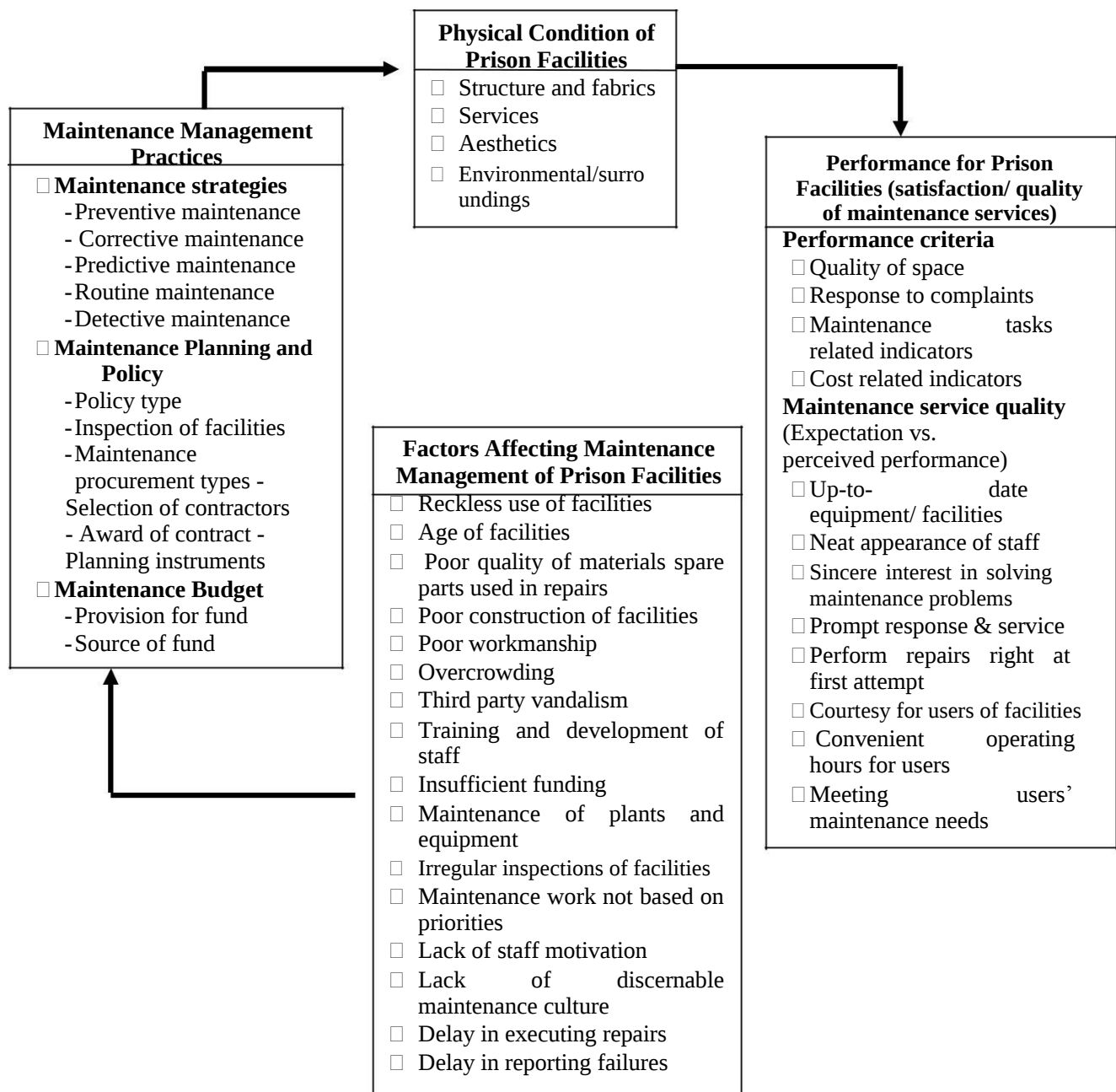


Figure 2.19: Conceptual Framework for Maintenance Management of Prison Facilities

The different factors highlighted in this study are assumed to have some measures of significant effect on the maintenance management practices been adopted by the Nigerian prisons service. Maintenance management practices constitute of maintenance policies of the maintenance unit as regard to the maintenance of prison facilities. Allocation and estimation of maintenance resources, strategy used in executing maintenance task and maintenance budget. Basically, the extent and the impact of maintenance activities on prison facilities would depict the condition of such facilities. The condition of the facilities would eventually predict the level of satisfaction to be derived from the use of the facilities.

2.16.2 Operationalisation of Variables in the Conceptual Framework

In view of the conceptual theory of the framework stated earlier, the study established the relationship between variables. The framework can be used to examine factors affecting the maintenance management, maintenance management practice of Nigerian prison service as well as the conditions of prison facilities and its performance appraisal. Hence, the framework can establish the relationship between the independent variable and dependent variable. This makes it possible in developing a mathematical model of the relationship between two variables.

Factors affecting the maintenance management, the variables consist of reckless use of facilities, age of facilities, poor quality of materials and spare parts used in repairs, poor construction of facilities, poor workmanship, overcrowding, third-party vandalism, training and development of staff, insufficient funding, maintenance of plant and equipment, irregular inspections of facilities, sequence of maintenance work, lack of staff motivation, lack of discernible maintenance culture, delay in executing repairs and delay in reporting failures.

Maintenance management practices are comprised of maintenance strategy, maintenance planning, maintenance policies and maintenance budget. Variables for maintenance strategy adopted for prison facilities are preventive maintenance, corrective maintenance, predictive maintenance, routine maintenance and detective maintenance. Maintenance planning and policy variables are inspection of facilities, procurement methods used for maintenance works, selection of contractors, award of contract and planning instruments. Maintenance budget variables were provision for budget and source of funding. Furthermore, quantitative data for maintenance budget allocations were assessed.

The physical conditions of the prison facilities were examined based in terms of fabric and structure, services, aesthetics and environments. Similarly, performance of prison facilities, the dependent variables consist of performance criteria – quality of space, response to complaints, maintenance and cost related tasks. It also consists of variables of expectations and perceived quality of maintenance services. These variables include up-to date equipment, appearance of prison maintenance staff, sincerity in solving maintenance problems, prompt response to maintenance request, performing repairs right at first attempt, courtesy for users' of facilities, convenient operating hours for users, and meeting users' maintenance needs.

Thus, these are the variables used in this current study as the basis for maintenance management of prison facilities in the South-West. Accordingly, the relationship between these variables affords the regression equation for the condition of prison facilities and performance of prison facilities.

Assume model $Y = \beta_0 + \beta_1 X + \epsilon$

β_0 and β_1 Where are two unknown constants that represent the intercept and slope, also known as coefficient or parameters, and ϵ is the error term.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter reports the method employed in data collection, the component of the variables to adopt for testing the hypothesis and the statistical tool used in processing of the data. It discusses the method of collecting data and the procedures addressing the research topic. It explains the instruments and analytical tools for processing data and describes the population for investigation as well as sample frame and size.

According to Fellows and Liu (2003), it is paramount that methodology is carefully considered so that most suitable approaches and research methods are adopted at the outset of a research. This chapter therefore provides an in-depth description of steps followed and methods by which the research was carried out in realising the objectives of the study (Ogolo, 1996). The chapter also explains how research was conceived, designed and executed.

3.2 Research Design

The research design refers to the overall strategy chosen to integrate different components of a study in a coherent and logical way to effectively address the research problem (De Vaus, 2001; Gorard, 2013; Vogt, Dianna & Lynne, 2012). The research design specified the procedures adopted for realising the research goals/objectives. Ex post facto research and cross sectional survey were explored. Ex post facto design involves examining the effect of a naturalistically occurring treatment after it has occurred (Bruce & Brian, 2012).

The events on prison facilities had occurred before the study took off, that is, the investigation starts after the fact has occurred without interference (Silva, 2010). The events measured had occurred already, thus giving no room for manipulation by researcher. A cross-sectional study was used for data collection from the Nigerian prison population at one specific point in time. This design allowed the study to decide on what to find out, to identify the study population, to select a sample population and to contact the respondents for their responses. A structured questionnaire was designed and employed for collection of useful data and information that was required for the research work.

3.3 Research Approach

Research in the built environment comprises cognitive and behavioural components as well as use of qualitative and quantitative methodologies (Amaratunga et al., as cited in Oladapo, 2005). For this study, a quantitative approach is considered appropriate to be adopted as it affords:

- ☐ an objective measurement of subject under analysis and facilitates replication by others
- ☐ ensures the independence of observer from subject being observed
- ☐ emphasises the need to formulate hypothesis for subsequent verification

A large scale cross-study of prison facilities was impracticable due to constraint of time and financial resource; therefore, the study examined all the 20 prisons located in South-West, geographical zone of Nigeria.

The research methodology follows the under listed approaches of Walker (1997) as cited in (Oladapo, 2005). These approaches are:

1. an appropriate data gathering and analysis procedure was decided upon after the review of literature
2. a pilot study was conducted and used to test the validity of the data required for testing the hypotheses
3. a pilot study was conducted using copies of self administered questionnaires sent to the prison non-maintenance staff and prison maintenance staff to get more information on issues to be addressed by the study
4. the responses from the pilot study were reviewed to develop the final structured research questionnaires
5. final set of data were collected using data collection instruments – questionnaires
6. the collected data was analysed using percentages, frequency, mean score, relative importance index, Mann-Whitney U test, paired sample t-test, Friedman test, Spearman's rho correlation, Kendall's coefficient of concordance and linear regression analysis.

3.4 Research Study Area

The research was conducted in South-West, Nigeria. Prisons in this location were chosen because they were located in same geopolitical zone. The study area of South-West geopolitical zone consist of Lagos State having five (5) prisons, Ogun State having five (5) prisons, Oyo State having two (2) prisons, Osun State having two (2) prisons, Ondo State having five (5) prisons, and Ekiti State having one (1) prison till date (PRAWA, 1999; www.prisons.gov.ng). The names of prisons in each of the states are listed below;



Figure 3.1: Map showing the South-West Zone of Nigeria

Source: http://article.sapub/10.5923.j.re.20120202.06_001.gif

Table 3.1: Locations and Number of Prisons in South-West, Nigeria

S/no	Prison locations	Number of prisons
A Lagos prisons		
1	Badagry prison	1
2	Ikoyi prison	1
3	Female prison, Kirikiri	1
4	Medium prison, Kirikiri	1
5	Maximum prison, Kirikiri	1
B Ogun prisons		
1	Abeokuta new prison	1
2	Abeokuta old prison	1

Table 3.1: Locations and Number of Prisons in South-West, Nigeria

S/no	Prison locations	Number of prisons
3	Ijebu Ode prison	1
4	Ilaro prison	1
5	Shagamu prison	1
C	Oyo prisons	
1	Ibadan Agbodi male prison	1
2	Oyo Isehin male prison	1
D	Osun prisons	
1	Ile Ife prison	1
2	Ilesha prison	1
E	Ondo prisons	
1	Akure prison	1
2	Ondo male prison	1
3	Ondo female prison	1
4	Okitipupa prison	1
5	Owo prison	1
E	Ekiti prison	
1	Ado-Ekiti	1
	Total number of prisons	20

3.5 Population of the Study

Population refers to the entire group of people, events, and things that are to be investigated (Diono-Adetayo, as cited in Adewunmi, 2014). Aggregate of things that is having similar characteristics (Asika, 2004). The study population was made up of 42 prison maintenance staff and 2,187 prison non-maintenance staff of all the 20 prisons located across South-West, Nigeria (www.gov.ng/prison).

Initially, the targeted population also includes the inmates' populace, that is, both convicted and awaiting trial inmates. During the pilot study in Lagos State prisons accessibility to prison inmates were somehow denied. Some of the Prison state controller out-rightly denied accessibility to prison inmates while those that gave the researcher access allowed it under strict supervision. This circumstance had influence on the inmates' responses; the information gathered was biased because it was provided under close monitoring. Therefore, the study had to leave out the inmates from its list of respondents.

Structured questionnaires were administered to prison maintenance staff (technical officers and maintenance managers) and prison non-maintenance staff across the South-West, Nigerian Prison Service. Prison maintenance staff (technical officers) are officers that have acquired both semi-skilled and skilled training in repairs and maintenance operations while prison maintenance staff (maintenance managers) are professionals that are involved in decision making relating to maintenance management of prison facilities. Prison non-maintenance staff includes staff of other departments.

3.6 Sampling Techniques

3.6.1 Prison maintenance staff

The entire number of the prison maintenance staff in the unit which was relatively low prompted the study to take responses from all members of the population. The technique used for prison maintenance staff was census, where every member of the population was sampled (Research Observatory, 2007; The Institute of Food and Agricultural Sciences [IFAS], 2013; Statistic Canada, 2013). This technique allows population of all prison maintenance staff in the maintenance unit, to be used as the sample frame and as the sample size (IFAS, 2013).

3.6.2 Prison non-maintenance staff

The other technique used was stratified sampling technique in order to have a sample that is proportionately representative of the whole population of all prison non-maintenance staff of other departments. The population N, that is, the population of all prison non-maintenance staff in South-West, Nigeria was first divided into a homogenous subset (subpopulation) called strata, that is, the population of all prison non-maintenance staff in each state; from each of these stratum a sample size was then drawn (Columbia Centre for New Media and Teaching [CNMTL], 2012) whereby the inference drawn from such sample were generalised to the total sampling population.

The adequacy of any sample suggests how well a sample is able to represent the whole population of the participants from which the sample was drawn. The degree of accuracy of a sample is expressed as a percentage of sampling error, a statistical measure that indicates how closely the sample results reflect the true values of a parameter (Frankfort-Nachmias &

Nachmias, 2000). Formulas, tables and power function charts are well-known approaches to determine sample size. Steps for using sample size determination table are

1. postulate the effect of size of interest α and β
2. check sample size table
 - ☐ select table corresponding to the selected α ,
 - ☐ locate arrow and column corresponding to desired power and estimated effect size
 - ☐ the intersection of the column and row is the minimum sample size required

3.7 Sample Frame and Sample Size

3.7.1 Sample Frame

This is an objective up-to-date list of the population from which the researcher makes his/her selection. According to Ogolo (1996), where the population is finite at least 10% of it should be researched. The number of prisons across Nigeria is 155 while the number in South-West, Nigeria is 20; this makes up 12.9% of the total number of Nigerian prisons (Wikipedia, 2016). This implies that the study on all prisons in South-West is a good representation of the whole prisons across Nigeria. The population of prison staff in each of the prisons in South-West Nigeria was investigated to determine the researchable sample. Prison staff population in each of the 20 prisons located in the South-West of Nigeria was selected to represent the whole and this was found to be the sample frame for the study.

Two categories of respondents made up the population in this research. The first category is the prison maintenance staff, an extremely small population; the second category is the prison non-maintenance staff in other departments, with a large population. Therefore, two different sample sizes become adequate for the study.

3.7.2 Sample size

The two sample sizes were determined using census and a simplified formula for proportion representation respectively. The sample size for prison maintenance staff was the entire population of the maintenance unit. The census sample is an approach suitable for small population, as it eliminates error and provides data on all the individuals in the population. The adoption of census sampling helps to include all prison maintenance staff in the maintenance unit identified from the prison staff list made available by the Nigerian Prison Service. All the prison maintenance staff in the maintenance unit was carefully sampled because of their involvement in the maintenance activities of the prison facilities.

Table 3.2: Sample Size for Prison Maintenance and Non-Maintenance Staff in South-West, Nigeria

Prison (strata)	Prison maintenance staff		Prison non-maintenance staff	
	Population size “N”	Sample size “S”	Population size “N”	Sample size “S”
Lagos prisons	8	8	624	244
Ogun prisons	8	8	331	181
Oyo prisons	6	8	338	183
Osun prisons	5	5	307	174
Ondo prisons	8	8	453	212
Ekiti Prison	7	7	134	100
Total	42	42	2187	1094

Source: Nigerian Prison service (www.gov.ng/prison-info) *N = population size, n = sample size.

The first sample size by census consists of all the 42 prison maintenance staff in prisons located across South-West. This comprises of eight (8) prison maintenance staff in Lagos prisons, eight (8) prison maintenance staff in Ogun prisons, six (6) prison maintenance staff in Oyo prisons, five (5) prison maintenance staff in Osun prisons, eight (8) prison maintenance staff in Ondo prisons, and seven (7) prison maintenance staff in Ekiti prison (IFAS, 2013).

The second sample size was determined using a simplified formula for proportions Yamane (1967: 886) at 95% confidence level and 0.05 precision levels.

$$\text{Sample size (n)} = \frac{N}{1 + N(e)^2}$$

The possibility of not being able to collect data from everyone in the group being researched, allowed the study to get evidence from a portion of the whole with the expectation that what was found in that portion applies equally to the rest of the population. The appropriate sample size is the proportional representation of the population size of Lagos prison non-maintenance staff (624), Ogun prison non-maintenance staff (331), Oyo prison non-maintenance staff (338), Osun prison non-maintenance staff (307), Ondo prison non-maintenance staff (453) and Ekiti prison non-maintenance staff (134). The minimum sample size needed for the study, with a degree of accuracy of $\pm 5\%$ was 244, 181, 183, 174, 212 and 100 respectively. The more accurate the samples desired the larger the sample should be (Creative Research Systems, 2012) see Table 3.1.

For this study, an accuracy of $\pm 5\%$ was desired; hence the sample size of forty two (42) and one thousand and ninety four (1094) was generated for prison maintenance staff and prison

non-maintenance staff respectively from the twenty (20) prisons study. The samples were randomly chosen using random number generators.

3.8 Sources of Data

For the purpose of this study, primary and secondary data were collected. Primary data collected include responses of respondent via copies of structured questionnaires distributed to prison maintenance staff and prison non maintenance staff. Other primary data were review of literature from related books, journals, articles, conference proceedings and papers, while secondary data were collected from the archives of the Nigeria Prisons Service and budget office of the federation.

3.9 Data Collection Instrument

3.9.1 Research Instruments

The research tool proposed for this study includes:

1. Structured questionnaires
2. Oral interview and discussion
3. Building survey

The peculiarity of the Nigerian Prison Service, such as its paramilitary nature and tight security limited the study to use structured questionnaires only

Two sets of questionnaires were designed and used for the study. They were:

- i. Questionnaire for prison maintenance staff (technical officer and maintenance manager) (QPMS)
- ii. Questionnaire for prison non-maintenance staff (QPNMS)

3.9.2 Questionnaire Administration Survey

The Nigerian Prison Service is a paramilitary institution where protocol and order are strictly observed. This made the researcher to adjust to their principle and procedure in administering of copies of structured questionnaires. Initially the study proposed the use of structured questionnaires, pictorial instrument and interview but for security reasons only structured questionnaire was accepted.

Furthermore, all copies of questionnaires were dropped at the prison desk for screening before they were administered on the respondents. The use of electronic devices like cameras to take picture of the physical prison facilities was not permitted. For security reasons, records of maintenance operation logs/registrar were not made available by the prison officials for this research. The main survey instrument was structured questionnaire distributed among prison maintenance staff and prison non-maintenance staff in the 20 prisons across South-West, Nigeria.

Two sets of questionnaire were used to collect data to test the research hypotheses. The first set of structured questionnaires was administered on prison maintenance staff (maintenance managers and technical officers) while the second set was administered on prison non-maintenance staff. The questionnaire for prison maintenance staff, that is, the maintenance managers consists of twenty-nine main questions with ninety-one variables while the technical officer questionnaire consists of eight questions with fifty-two variables. The structured questionnaire for prison non-maintenance staff consists of eight main questions with eighty two variables.

3.9.3 Questionnaire Design

The structured questionnaires were prepared for two sets of respondents: the prison maintenance staff and prison non-maintenance staff. The copies of structured questionnaires administered on prison staff (maintenance managers and technical officers) of maintenance unit were basically closed ended questions and a few open ended questions. The copies of structured questionnaires administered on prison non-maintenance staff of other departments were also closed ended questions and few open ended questions. Fellow and Liu (1997) claimed that the questionnaire is a widely used approach survey to find out facts, opinions and views of respondents.

The under listed guidelines was used in the design of the questionnaires to have a meaningful response rate from the targeted respondents (Fife-Schaw, 2001, as cited in Oladapo, 2005):

- The structured questionnaires were piloted (Dawson, 2002; Kothari, 2004; Greener, 2008). This allows the questions to be readjusted and modified for data collection
- The questions were framed in such a way that the respondents (prison maintenance staff and prison non maintenance staff) easily understood what he or she was being asked and the answers to be given to each questions (Dawson, 2002; Brace, 2004; Greener, 2008).
- An appropriate mix of closed-ended questions and open-ended questions was used (Dawson, 2002; Kothari, 2004; Greener, 2008).
- The questions were arranged in an order that would interest the respondents to go on to the next question (Dawson, 2002; Fife-Schaw, 2001, as cited in Oladapo, 2005).

3.9.4 Questionnaire Instruments

The structured questionnaires were in two sets. Each of the structured questionnaires had an introductory part that explained the aim of the study and sought for the cooperation of the respondent. It also assured the respondent that responses will be treated in confidence and anonymously.

The first set of copies structured questionnaire administered on prison maintenance staff of maintenance unit was further split into two; type A was administered on maintenance manager of the maintenance unit. This consists of five sections; Section A sought to know the demographical information of the respondent. In section B, the respondent was asked to rate the identified factors as they critically affect maintenance management of prison facilities. Section C sought to know the type of maintenance strategies that was most appropriate and being adopted for each of the prison facilities.

Section D sought to find out the existing maintenance policy, that is, the type of policy in place, how often their policy is reviewed, type of maintenance procurement adopted for executing maintenance/repairs works, selection of contractors for maintenance works and the basis of awarding maintenance contract to contractors. The respondent was also asked to rate maintenance attributes that prompt executing of maintenance works and the performance of the maintenance unit based on staff strength, experience and competency. In section E, the respondent was asked if their maintenance unit made use of maintenance manual guides, log books, work schedule and if they prepared an asset inventory for their facilities. The respondent was also asked to rate reasons why some maintenance work requests were not totally converted into work order. Section F addressed the budgetary allocation of the

maintenance unit; the respondent was asked if there was a specific budget for maintenance of prison facilities, how budget was being arrived at and also asked to rate the level of funding for maintenance works executed.

The type B was administered on the technical officer of the maintenance unit, and it had three sections. Section A sought to know the demographical information of the respondent. Section B asked respondent to rate the physical condition of their prison facilities in terms of structure and fabric, services, aesthetics, and environment/surroundings. Finally, in section C the respondent was asked to rate the identified factors as they critically affect maintenance management of prison facilities.

The second set of copies structured questionnaire administered on the prison non-maintenance staff of other departments consists of five sections. Section A sought to know the demographical information of the respondent. Section B requested the respondent to rate the physical condition of their prison facilities in terms of structure and fabric, services, aesthetics, and environment/surroundings. In section C, the respondent was requested to indicate their level of satisfaction in relation to the performance of the prison facilities using identified maintenance performance indicators. Finally, section D sought to know the view of the respondent on the expectations and perceived quality of the maintenance services provided by the maintenance unit.

3.10 Research Variables and Measurement

Maintenance management of prison facilities variables includes measuring the physical conditions of the prison facilities and the influential factors affecting maintenance management of the prison facilities such as rate at which facilities deteriorate, degree of usage, and peculiarity of the environment (Murthy et.al, 2002). It examines the existing maintenance management practice of Nigerian Prison Service used in the maintenance of the prison facilities. In addition, it considers the level of satisfaction of prison non-maintenance staff in terms of quality of space, responses to complaints, maintenance and cost-related tasks. Furthermore, the quality of maintenance services provided by the maintenance unit was assessed. The variables of the study and its measurement are as follows:

3.10.1 Demographic Characteristics of the Respondents

This sought to know the particular name of the prison and its location, the gender of inmates imprisoned in a particular prison, number of years of experience, designation, number of employees, number of prison buildings maintained and educational qualification of respondents. The variables are labeled V1-V7 respectively. These variables were analysed using frequency, percentage, pie chart and bar chart.

3.10.2 Physical Condition of Prison Facilities

The variables for physical condition of prison facilities consist of building fabric and structures, services, aesthetics, and surroundings and were measured in a Likert scale type. These variables include;

V8	Roof coverings	V23	Electricity supply (lighting)
V9	Roof structures	V24	Electrical appliances
V10	Roof finishes	V25	Firefighting equipment
V11	Beams and columns	V26	Telephone lines
V12	Walls	V27	Internet facilities
V13	Floor slab	V28	Air condition or fan
V14	Floor finishes	V29	Alarm and detector
V15	Doors	V30	Internal painting
V16	Windows	V31	External painting
V17	Netting	V32	Furniture
V18	Stair case	V33	Refuse disposal
V19	Water supply	V34	Level of cleanliness
V20	Sanitary fittings	V35	Air circulation (ventilation)
V21	Solid waste removal	V36	Noise protection
V22	Waste water removal	V37	Security of environment

These variables were analysed using mean scores and Mann-Whitney U test. This data were analysed to establish whether there are significant differences between the perception of prison staff (maintenance and non- maintenance staff) on the physical condition of prison facilities. A Likert scale can be analysed using non-parametric tests (Norman, 2010).

3.10.3 Factors affecting Maintenance Management of Prison Facilities

Critical factors affecting maintenance management were derived from literature search and these variables include the followings:

- V38 Reckless use of prison facilities
- V39 Age of prison buildings or facilities
- V40 Construction of prison facilities
- V41 Third-party vandalism
- V42 Poor quality of materials and spare parts used in maintenance repairs
- V43 Delay in reporting failures
- V44 Delay executing maintenance repairs
- V45 Poor workmanship
- V46 Overcrowding
- V47 Inadequate training and development of maintenance staff
- V48 Funding
- V49 Plant and equipment for maintenance operations
- V50 Lack of discernable maintenance culture
- V51 Irregular inspections of facilities
- V52 Maintenance work not based on priorities
- V53 Lack of motivation for maintenance staff

These variables' order of significance was measured in Likert scale type. The variables were analysed using mean score and Kendal coefficient of concordance test to reveal the underlying critical factors that affect maintenance management of prison facilities. Also,

Pearson correlation was used to determine the relationship between one factor and the other factors.

3.10.4 Maintenance Management Practices

3.10.4.1 Maintenance Strategy

Type of maintenance strategies - preventive, corrective, predictive, routine and detective maintenance were derived from literature and list of prison facilities and the component of prison facilities include;

V54	Roof structures	V68	Refuse disposal
V55	Roof coverings	V69	Electricity supply and appliances
V56	Roof finishes	V70	Firefighting equipment
V57	Floor slab	V71	Level of cleanliness
V58	Walls	V72	Safety and security of the environment
V59	Beam and columns	V73	Floor finishes
V60	Foundation	V74	Wall finishes
V61	Doors	V75	Internal painting
V62	Windows	V76	External finishes
V63	Netting	V77	Floor and wall tiles
V64	Water supply	V78	Telecommunications
V65	Sanitary fittings	V79	Air condition and fans
V66	Waste water disposal	V80	Furnishing
V67	Solid waste disposal		

The type of maintenance strategy adopted in maintaining each of these facilities or services was identified. The variables were analysed using percentages and Friedman test to establish whether there are significant differences among the frequency of use of the maintenance strategies.

3.10.4.2 Maintenance Policies

Maintenance policy variables include type of policy, frequency of reviewing maintenance policies, facility inspection and type of maintenance procurement adopted for executing maintenance works. It also includes the method of selecting contractors for maintenance works and the basis for awarding maintenance contract to contractors. Other variables was on maintenance attributes that prompt executing of maintenance works; end of useful life of facility, point of failure of facility, at users request, significant deterioration, predetermined regular interval and condition survey. The maintenance attributes that prompt executing of maintenance works were measured on nominal scale. The variables are labeled V81-V92. These variables were analysed using frequency, percentage, mean score and relative importance index.

3.10.4.3 Maintenance Planning

Use of maintenance manual guides, asset inventory for prison facilities, log books and work schedules was measured on nominal scale. The reasons why some maintenance work requests were not totally converted into work order were also measured on nominal scale. This variable includes finance constraints, personnel constraints, inadequate tools and equipment. Also include inadequate material and spare parts, conflict with other works, statutory

limitations and conflict with policy. These variables are labeled V93-V103. These variables were analysed using percentage and relative importance index.

3.10.4.4 Maintenance Budget

Variables for budgetary allocation include budget for maintenance operations, methods of arriving at maintenance budget; fixed % of construction cost, fixed % of current value of facility, previous year's budget, actual maintenance needs, cost of maintenance activities. Other variable are grant from other sources and level of funding for maintenance works executed. Variables label is from V104-V111. These variables were measured on nominal scale. Budget figures for maintenance between 2007 and 2012 were utilized. The variables were also analysed using mean score and Spearman's rho correlation to test relationship between performance of maintenance unit and the maintenance budget.

3.10.5 Performance of maintenance workforce

The performance of the maintenance unit was measured based on staff strength, experience and competency. These are variables are labeled V112-114.

3.10.6 Performance of Prison Facilities

3.10.6.1 Customer Satisfaction Survey

Performance of prison facilities variables used was adapted from review of literature. The level of satisfaction of prison non-maintenance staff (customer satisfaction survey) on these variables were measured in terms of quality of space, responses to complaints/repairs, maintenance tasks and cost related indicators. These variables include;

Quality of space	V132 Adequacy of car park
V115 Level of cleanliness	Response to repairs
V116 Waste removal	V133 Reporting defects
V117 Adequacy of lighting	V134 Time of response
V118 Control of ventilation	V135 Behavior of maintenance staff
V119 Odour of environment	V136 Level of maintenance backlog
V120 Comfort level	V137 Level of nuisance
V121 Space for meetings	Maintenance tasks related indicators
V122 Sound insulation	V138 Asset inventory
V123 Furniture arrangement	V139 Prioritizing of maintenance
V124 Quality of exterior	V140 Speed of work
V125 Quality of interior	V141 Quality of work done
V126 Quality of water	V142 Ability to react to emergency
V127 Fire safety	V143 performing routine maintenance
V128 Security gadget	Cost related indicators
V129 Ease of communication	V144 Money spent on reporting faults
V130 Exit route in case of emergency	V145 Cost of transporting maintenance staff
V131 Vehicular access	V146 Purchase of minor spare parts

These variables were measured using a Likert scale. Variables were analysed using mean score and Kendall's coefficient of concordance test to establish whether there is a significant agreement among prison non-maintenance staff in their satisfaction rating for performance

prison facilities. Linear regression analysis was used to predict performance of prison facilities based on condition of prison facilities

3.10.6.2 Quality of Maintenance Services

Also derived from literature are variables on quality of maintenance services perceived along assurance, reliability, responsiveness, tangibles, and empathy dimensions. These variables are as follows:

- V147 Up-to- date equipment
- V148 Neat appearance of maintenance personnel(s)
- V149 Interest in solving maintenance problems
- V150 Promptness of service
- V151 Performing repairs right at first attempt
- V152 Courteousness
- V153 Operating within user's conveniences
- V154 Meeting individual maintenance needs

The expectations and perception of respondent on quality of maintenance services were measured using a Likert scale to ascertain their extent of agreement on these variables. To quantify the extent of agreement on expectations and perceived quality of maintenance service, a graduated scale of 1 – 5 was used. The variables are labeled V147-V154. The variables was analysed using the mean score and paired sample t- test to establish whether there is a significant difference between prison non-maintenance staff expectations and perceived quality of maintenance services for prison facilities.

3.11 Scales of Measurement

A variable is any characteristics, number or quantity that can be measured, controlled or counted (Australian Bureau of Statistics, 2013). Independent variables are variables that are manipulated, changed or controlled in order to show or test the effects on the dependent variable, whereas dependent variable are variable that are measured, tested or registered (Helmenstine, 2015).

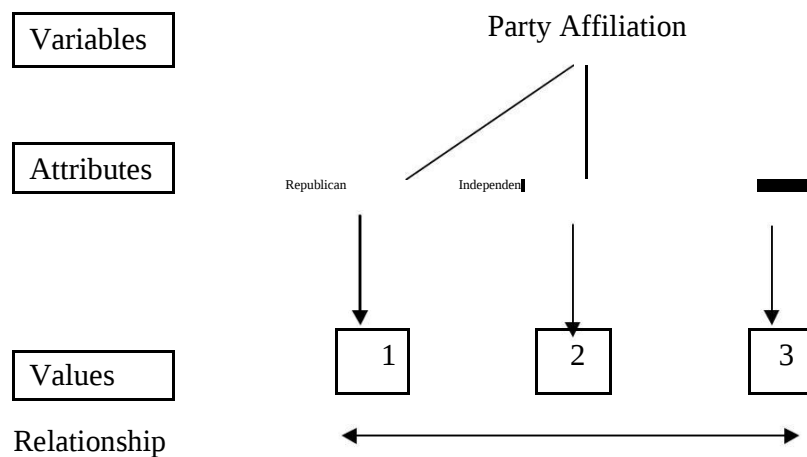


Figure 3.2: Levels of measurement

Source: William (2006)

Data can be classified into numerical and non-numerical. Numerical data include age, family size and time in months, etc.; non-numerical data include such measurement as the degree of one's opinion (i.e., mild, moderate or harsh) on some issues. Measurement is the assigning of numbers to objects, events and observation with respect to certain rules (Fife-Schaw, 2001). It describes the relationship among values, simply using the numbers as shorter placeholders for lengthier text terms. This helps in deciding on how to interpret the data from the variable and what statistical analysis is appropriate on the assigned values (William, 2006).

3.11.1 Nominal scales

Nominal measurement consists of assigning items to group or categories; the numerical values just “name” the attribute uniquely (Brace, 2004). No quantitative information is conveyed and no ordering of the case is implied. Examples include religious preference, race and sex (Hyperstat online contents, n.d). The statistics used with nominal scales are non-parametric statistic like frequency distribution and mode.

The nominal scale was used to measure some of the data required in general. For example, the demographic section and parts of section D such as ‘what kind of maintenance policy does your department operate?’ The responses ranged from unplanned, planned, or combination of both. Another example is that of section E, such as ‘is there maintenance manual to guide the operatives?’ The response ranged from “yes” to “No”. In section F, there is such a question as ‘does your maintenance unit receive grant from other sources apart from government to meet maintenance needs?’ Responses ranged from “yes” to “No” in the copies of structured questionnaire administered on policy, planning and budget allocation respectively.

3.11.2 Ordinal scales

Ordinal measurement describes order, but not relative to size or degree of difference between the items measured. The numbers assigned to objects or events represent the rank order (1st, 2nd, 3rd, etc) of the entities assessed. In ordinal measurement, the attributes can be rank-ordered but distances between attributes do not have meaning. A scale may use names with an order such as “bad”, “medium”, and “good” or “very satisfied”, “satisfied”, “neutral”, “unsatisfied”, and “very unsatisfied”. The statistic used for ordinal variables are median and

percentile. Measurements with ordinal scales are ordered in the sense that higher numbers represent higher values. However, the interval between numbers is not necessarily equal (Hyperstat online contents, n.d). This measurement scale was used to measure responses of prison maintenance staff (maintenance manager) on factors affecting the maintenance management of prison facilities ranging from ‘insignificant’ to ‘highly significant’ in section B of the administered questionnaire.

3.11.3 Interval scales

The interval scale of measurement has the qualities of the nominal and ordinal scales, plus the requirement that equal distance or interval between numbers represent equal distance in the variable being measured (Fife-Schaw, 2001). In this level of measurement, the distance does have meaning, the interval between values is interpretable and an average of an interval variable can be computed. Quantitative attributes are all measurable on interval scale; one unit on the scale represents the same magnitude on the trait or characteristic being measured across the whole range of the scale. It is measured along a scale in which each position is equidistant from one another; it also measures attributes along an arbitrary scale between two extremes e.g. level of happiness, rated from 1 to 10 or level of significance, rated 1 to 5 (Changing minds, 2014).

Interval scales do not have a “true” zero point; however, it is not possible to make a statement about how many times higher one score is than another. Mean score, correlation, regression, analysis of variance, mode, median, arithmetic mean, range and standard deviation are type of analysis used for interval scales. This measurement scale was used to measure responses of prison maintenance staff (technical officers) on physical conditions of prison facilities

ranging from ‘very bad’ to ‘very good’ in section B of the administered structured questionnaire. The same measurement scale was used to measure responses of prison non-maintenance staff on level of satisfaction ranging from ‘highly unsatisfied’ to highly satisfied in section C of the administered structured questionnaire. The likert scale type is a popular and practical application of interval scale.

3.11.4 Ratio scale

Ratio scales are like interval except they have true zero points that is meaningful; a meaningful fraction (or ratio) can be constructed with a ratio variable. Most measurement in the physical science is done on ratio scales, e.g. mass, length, time, plane angle and energy etc. All statistical measures can be used for a variable measured at the ratio scale, such as mode, median, arithmetic mean, geometric or harmonic mean, range, standard deviation and coefficient of variation.

It should be stated that there is a hierarchy implied in the level of measurement idea. At lower level of measurement, an assumption is less restrictive and data analyses are less sensitive. The ratio scale was used to measure number of years of experience, number of prison buildings/ facilities maintained, maintenance budget provided by Government and inspection of prison facilities by the maintenance unit.

3.12 Methods of Data Analysis

The nature of a study determines the appropriate methods of analysis. The data collected for this study was processed using SPSS (Statistical Package for Social Sciences) version 20. According to Amaratunga, Baldry, Sarshar and Newton (2002), as cited Oladapo (2004)

studies that are quantitative in nature are undertaken to yield statistical evidence of relationships and their strengths (like this study), as statistics are very important in determining directions of relationships when combined with theory and literature. Thus in this study, variables were mostly subjected to mean score, independent t-test, factor analysis, frequency, percentage, relative importance index, Spearman's rho correlation, Kendall's coefficient of concordance test, paired sample t-test and linear regression analysis. This tests whether there are differences or relationships or agreement among the groups studied. It also, determines whether those differences, relationships or agreement are significant or not.

3.12.1 Mean score

Is the total sum of multiplication of frequency and matching score all over the total sum of frequency.

$$\text{Mean } \bar{X} = \frac{\sum fx}{\sum f}$$

Where F = frequency, rate at which something occurs in a given sample

X = matching score

3.12.2 Frequency

This is one of the most ways of describing a single variable. It is usually depicted either as a table or as a graph (Williams, 2006).

3.12.3 Percentage

Distribution is a summary of the frequency of individual values or ranges of values for a variable. These Frequency distributions are sometimes displayed using percentage (Williams, 2006).

3.12.4 Relative Importance index

According to Lam, Wong and Wong (2007), as cited in Adewunmi (2014) relative Importance Index (RII) method was adopted to derive the relative importance of variables studied. The formula for calculating the RII is shown as follows:

$$\text{Relative importance index (RII)} = \frac{\sum_{i=1}^n (i \times \text{Frequency}_i)}{\text{Total number of samples} \times \text{Maximum rating}}$$

Where the **i** and **n** represent the smallest and the largest points in the Likert scale respectively. When 5-points Likert scale is used, the points are from 1 to 5. “Frequency” is the number of respondents who rated 1, 2, 3, 4 and 5, respectively. The “maximum rating” is the highest point that can be given by the questionnaire respondents, i.e. 5.

3.12.5. Mann-Whitney U test

This test does not assume that the difference between the samples is normally distributed or that the variance of the two populations is equal. It is used to test whether two independent samples of observations are drawn from the same or identical distributions. The advantage with this test is that the two samples under consideration may not necessarily have the same number of observations (Brightstat, 2016).

For null hypothesis, it is expected that 'X<Y' occurs as frequently as

'Y<X' U measures how often a Y-value is smaller than X-value.

If Y<X, Z= 1

If X<Y, Z= 0

$$U = \sum Z$$

$$U = n_1 * n_2 + \frac{n_1 * (n_1 - 1) - R_1}{2}$$

R₁= Sum of ranks for sample

$$U' = n_1 * n_2 - U = \sum (X < Y)$$

3.12.6 Friedman test

This is used to detect difference in treatments across multiple test attempts. The procedure involves ranking each of the rows together and considering the values of ranks by columns (Pennstate, 2016). The test assumes that there are k experimental treatments ($k \geq 2$).

$$X^2 = \frac{12b}{\sum^k (R_i - b(k+1)/2)^2} \cdot b k (K + 1)$$

3.12.7 Pearson product moment correlation

Correlation between sets of data is a measure of how well they are related. This test shows the linear relationship between two set of data (Statistic How To, 2016).

$$r = \frac{n (\sum xy) - (\sum x) (\sum y)}{\sqrt{[n \sum x^2 - (\sum x)^2]} \sqrt{[n \sum y^2 - (\sum y)^2]}}$$

3.12.8 Paired T-test

A paired sample t-test typically consists of matched pairs of similar units or one group of units that has been tested. This type of test is used to compare groups that are related in some way. One way is that participant in the first group (expectations) are the same as participant in the second group (perceptions). This analysis is appropriate to compare the means of two groups (William, 2006). It finds out if means are significantly different from each other (Field, 2007).

3.12.9 Spearman's rho correlation

Spearman's Rank correlation coefficient is used to test the strength of a relationship between two sets of data. It is frequently used as a statistical method to aid with either proving or disproving a hypothesis (Royal Geographical Society, n.d.).

$$r = \frac{6\sum d^2}{n(n^2 - 1)}$$

3.12.10 Kendall's coefficient of concordance test

Kendell's coefficient of concordance (W) is a measure of the agreement among several (p) judges (variables or characters) that are assessing a given set of n objects (Wikipedia, n.d.; Legendre, 2005).

$$W = \frac{12S}{P^2(n^3 - n) - pT}$$

n = Number of objects

p = Number of judges

T = Correction for tied

3.12.11 Linear regression analysis.

This is a simple approach to supervised learning. It assumes that the dependence of Y on $X_1, X_2, \dots, X_p$ is linear.

Assume model $Y = \beta_0 + \beta_1 X + \epsilon$

Where β_0 and β_1 are two unknown constants that represent the intercept and slope, also known as coefficient or parameters, and ϵ is the error term.

According to Nau (2014) the correlation between Y and X, denoted by r_{xy} , is equal to the average product of their standardized value, that is, the average of { the number of standard deviation by which Y deviates from its mean} times {the number of standard deviation by which X deviates from its mean}, using the population standard deviation in calculation. This statistic measure the strength of the linear relation between Y and X on a relative scale of -1 to +1.

The slope coefficient in a simple regression of Y and X is the correlation between Y and X multiplies by the ratio of their standard deviations.

$$b_1 = r_{xy} \times (\text{STDEV.S (Y)} / \text{STDEV.S (X)})$$

The percentage of variance “explained” by the model, which is called R-Squared, is the square of the correlation between Y and X.

$R\text{-Squared} = r_{xy}^2$, this means that the sample standard deviation of errors equal to { the square root of 1 minus R-Squared} times the sample standard deviation of Y. $\text{STDEV.S (errors)} = (\text{SQRT (1 minus R-Squared)}) \times \text{STDEV.S (Y)}$

Adjusted R-Squared, which is obtained by adjusting R-Squared for the degree of freedom for error in exactly the same way, is an unbiased estimate of the amount of variance explained (Nau, 2014). $\text{Adjusted R-Squared} = 1 - ((n-1) / (n-2)) \times (1 - \text{R-Squared})$

3.13 Pilot Study

The pilot study was carried out to pre-test the reliability of the research instruments of the study. For the pilot study, one of the prisons in Lagos state was used named Kirikiri Medium Prison. Findings from literature review were utilised in designing the two sets of questionnaires for prison maintenance staff and prison non maintenance staff. These questions were validated by four academic researchers two of whom specialise in maintenance management and were piloted. The researcher was able to retrieved 17 copies of the structured questionnaires from prison maintenance staff and 37 copies of the structured questionnaires from prison non-maintenance staff for the analysis.

Experience from the pilot suggested that respondents should be limited to prison staff only excluding inmates. The structured questionnaire designed for prison maintenance staff was split into two: one for maintenance managers and the other for technical officers. For maintenance managers questions relating to strategic and tactical level were posted while questions relating to operations/ functional level were posted to technical officers. The contents of each of the questionnaire were precisely reviewed to enable the respondents to easily understand and not to lose interest in responding to the questions. The findings for the pilot study are found in Farinloye, Ogunsanmi and Adenuga (2011).

3.14 Validity and Reliability

The validity and reliability for research are important since no research is totally free from error. This concept involves:

- i. Whether we are measuring what we intend to measure
- ii. Whether the same measurement process yields the same results (Kothari, 2004)

3.14.1 Validity

Validity describes whether an instrument or measurement measures what they are supposed to measure. This refers to the extent which any research findings can be generalised beyond the immediate research sample or setting, that is, the extent to which findings drawn from studying one group are applicable to other groups or setting (Oladapo, 2005). To assess the validity of a set of measurements, a valid measure should satisfy the following criteria:

- ☐ **Face validity:** whether a measure appears to measure the concept it is intended to measure
- ☐ **Content validity:** concerns the extent to which a measure adequately represents all facet of a concept.
- ☐ **Criterion-related validity:** where an instrument can be used as an indicator of specific traits or behavior e.g. driving test as a social measurement that is a good predictive validity, i.e., an individual's performance on a driving test correlates well with his driving ability.
- ☐ **Construct validity:** the extent to which a measure is related to other measures as specified by theory or previous research.

For this study, the above stated criteria were considered for the measurements. The questionnaires were validated by four academic experts teaching postgraduate courses, with two of them being experts in maintenance management field and also maintenance staff of the Prisons Service.

3.14.2 Reliability

Reliability is the extent to which a test or procedure is capable of producing similar results under constant conditions at all time. This refers to repeatability and consistency or stability. A measurement is said to be reliable if it is able to come up with the same circumstance time after time, even when employed by different groups. The goal of reliability is to minimise the errors and biases in a study. This is to ensure that if another researcher followed exactly the same pattern or procedure, the same findings and conclusion would emerge.

All things been equal, the higher the sample size, the higher the reliability estimate (Hammon, 2001; Statistic Finland, 2002 cited in Oladapo, 2005) and as explained by William (2006). Reliability could be assessed based on the following criteria:

- **Test-retest reliability:** this is when a researcher administers the same measurement tool multiple times – asks same questions, follows same research procedures and does obtain consistent result, i.e., get back same results all times.
- **Inter-item reliability:** cases where multiple items are used to measure a single concept. In such cases, answer to a set of questions designed to measure some single concept should be associated with each other.
- **Inter observer:** concerns the extent to which different interviewer or observer using the same measure get equivalent results whereby same instrument are used for scoring same thing.

Reliability test for this study was done using internal consistency method using coefficient alpha which is said to be preferable for summated ratings and scales (Asika, 2004).

Table 3.3: Reliability Test Results of Prison maintenance staff (Maintenance Manager)

Instrument

Instrument	No of items	No of samples	Mean	SD	CV	Cronbach's Alpha
Maintenance Strategies	27	5	73.20	10.569	0.14	0.720
Maintenance policy	18	5	24.80	14.096	0.57	0.996
Maintenance planning	9	5	31.00	9.899	0.32	0.930
Budgetary allocation	4	5	6.33	1.155	0.18	0.706
Factors affecting maintenance management	16	5	45.00	3.916	0.09	0.786

Source: field survey *SD = standard deviation * CV = coefficient of variation

The test of reliability for the responses of prison maintenance staff (maintenance manager), using standardised Cronbach's Alpha, is obtained as 0.720, 0.996, 0.930, 0.706, and 0.786 greater than 0.70 threshold value. These results are supported by the coefficient of variation (CV) values 0.14, 0.57, 0.32, 0.18, and 0.09 which are respectively less than 0.50 threshold value, indicating homogeneity on how the respondents rated the items. Hence, there is an internal consistency of response from the respondents and therefore the data do not violate the assumption of reliability.

Table 3.4: Reliability Test Results of Prison maintenance staff (Technical Officers) Instrument

Instrument	No of items	No of sample	Mean	SD	CV	Cronbach's Alpha
Maintenance awareness	5	20	7.20	1.704	0.24	0.727
Factor affecting maintenance management	16	20	40.33	7.228	0.18	0.721
Condition of prison facilities	30	20	107.40	14.501	0.14	0.889

Source: field survey *SD = standard deviation * CV = coefficient of variation

The test of reliability for the responses of prison maintenance staff (technical officers), using standardised Cronbach's Alpha, is obtained as 0.727, 0.721, and 0.889 greater than 0.70 threshold value. This result suggests that the instrument of evaluation is highly reliable. These results are also supported by the coefficient of variation (CV) values 0.24, 0.18, and 0.14 which are respectively less than 0.50 threshold value, indicating homogeneity on how the respondents rated the items. Hence, there is an internal consistency of response from the respondents and therefore the data do not violate the assumption of reliability.

Table 3.5: Reliability Test Results of Prison Non-Maintenance Staff Instrument

Instrument	No of items	No of samples	Mean	SD	CV	Cronbach's Alpha
Maintenance awareness	6	380	9.40	1.751	0.19	0.726
Condition of prison facilities	30	380	97.47	20.995	0.22	0.955
Customer satisfaction survey	32	380	103.49	25.241	0.24	0.968
Quality of maintenance services	16	380	59.93	11.430	0.19	0.911

Source: field survey *SD = standard deviation * CV = coefficient of variation

The test of reliability for the responses of prison non-maintenance staff using standardised Cronbach's Alpha, is obtained as 0.726, 0.955, 0.968 and 0.911 greater than 0.70 threshold value. This result suggests that the instrument of evaluation is highly reliable. These results are also supported by the coefficient of variation (CV) values of 0.19, 0.22, 0.24 and 0.19 which are respectively less than 0.50 threshold value. This indicates the homogeneity on how the respondents rated the items. Hence, there is an internal consistency of response from the respondents and therefore the data do not violate the assumption of reliability. The reliability of scale for the instruments of the study using Cronbach's Alpha ranged from 0.720 to 0.996 (99.6%) and 0.721 to 0.889 (88.9%) for questions administered on prison maintenance manager and technical officer of the maintenance unit. The Cronbach's Alpha values for the questions administered on prison non maintenance staff ranged from 0.726 to 0.968 (96.8%). These results suggest that the instrument of evaluation (questionnaires) was highly reliable judging from the fact that 99.6%, 88.9%, and 96.8% are greater than 70% threshold value. Furthermore, the results implied that there was an internal consistency of the items in the instrument used for data collection (Santos, 1999).

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND DISCUSSION OF RESULTS

4.1 Introduction

The purpose of this chapter is to presents the results and analysis of the data obtained through copies of the structured questionnaires distributed and refutes the research hypotheses. Descriptive and inferential statistics were used to analyse the data and to find differences, relationships and agreements in sample data.

4.2 Survey Returns

In the maintenance unit survey, five out of the six copies (83%) of structured questionnaires administered on the prison maintenance staff (maintenance managers) were completed and returned while 20 out of 36 copies (56%) of the structured questionnaires administered on prison maintenance staff (technical officers) were completed and returned.

Table 4.1: Survey Returns of Questionnaires

Prisons	Prison maintenance staff						Prison non-maintenance staff		
	Maintenance managers			Technical officers					
	Sample size	Number returned	Response rate %	Sample size	Number returned	Response rate %	Sample size	Number returned	Response rate %
Lagos	1	1	100	7	3	42.85	244	93	38.11
Ogun	1	1	100	7	4	57.14	181	86	47.51
Oyo	1	1	100	5	4	80	183	46	25.41
Osun	1	-	-	5	-	-	174	38	21.83
Ondo	1	1	100	7	7	100	212	87	41.03
Ekiti	1	1	100	5	2	40	100	30	30
Total	6	5	83.33	36	20	55.55	1094	380	34.73

Three hundred and eighty (35%) copies of structured questionnaires out of the one thousand and ninety four (1,094) administered on prison non-maintenance staff were completed and returned. The response rates indicate the adequacy of responses from the respondents.

4.3 Demographic Characteristics of Respondents

4.3.1. Demographic Characteristics of Prison Maintenance Staff

4.3.1.1. Maintenance Manager Characteristics

The characteristics of the maintenance manager includes ratio of maintenance staff, prison locations, prison type based on gender, length of service, number of buildings maintained, and educational background of the respondent.

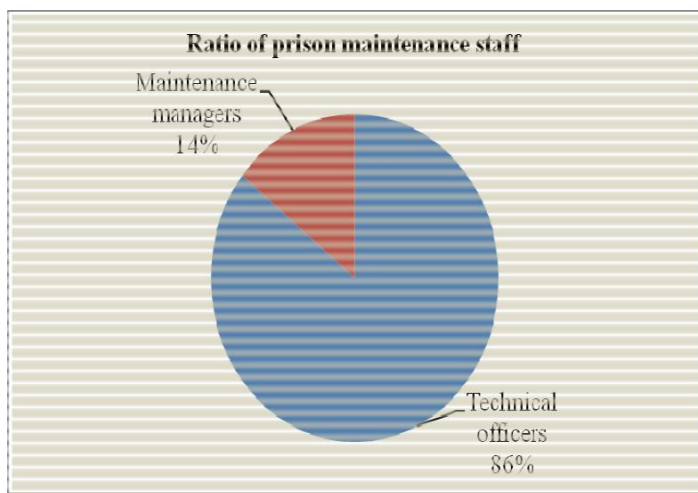


Figure 4.1: Relative Proportion of Prison Maintenance Staff

Figure 4.1 shows the ratio of maintenance manager (14%) to technical officers (86%) in the maintenance unit. This revealed that on the average there is one manager to six or seven subordinates. This implies flow of communication regarding maintenance is likely to be adequate.

Table 4.2: Prisons Type According to Inmate Gender

Prisons type	Prison maintenance staff		Total	Percentage
	Maintenance manager	Technical staff		
Male and female prisons	3	9	12	48
Male prisons	2	11	13	52
Female prisons	-	-	-	-
Total	5	20	25	100

Table 4.2 shows the three types of prisons. It indicates that twelve (48%) prison maintenance staff works in the male and female prison while 13 (52%) prison maintenance staff works in the male prison. It also reveals that no maintenance staff works in the female prison type. This means that for any maintenance work to take place in a female prison, prison maintenance staff from other prisons would have to be engaged. This would invariably result to delay in maintenance works execution.

Table 4.3: Length of Service of Maintenance Managers

Length of service	Frequency	Percentage %
Less than 10 years	2	40
10-19 years	1	20
30 years and above	2	40
Total	5	100

Table 4.3 shows that two of the managers (40%) had less than 10 years work experience, one of the managers (20%) had between 10 and 19 years work experience while the other two managers (40%) had above 30 years work experience. This shows that three (60%) of

managers had at least 10 years of experience. This implies that the managers can be relied upon to give adequate information with regard to the survey.

Table 4.4: Number of Buildings Maintained by Maintenance Unit

Number of buildings	Frequency	Percentage %
10 – 19 buildings	3	60
30 buildings and more	2	40
Total	5	100

Table 4.4 shows the range of number of buildings being maintained by the maintenance unit. Three of the maintenance managers (60%) indicated that between 10 and 19 buildings are been maintained while the other two managers (40%) indicated that over 30 buildings were maintained. This suggests that the number of buildings that are most likely maintained is low. This could result to deterioration of the few available buildings that are meant to supports reformatory delivery.

Table 4.5 shows the educational background of the prison maintenance staff. The maintenance staff indicated their highest educational qualification. The result indicated that more than 60% of the prison maintenance staff are graduates. This means that they possess the basic knowledge for handling maintenance tasks. It also implies that they possess the relevant competency to respond to issues outlined in the questionnaire.

Table 4.5: Educational Background of Prison Maintenance Staff

Qualifications	Managers	Percentage %	Technical	Percentage %
OND	-	-	5	25
HND	-	-	9	45
B.Sc/B.Tech	3	60	2	10
M.Sc	-	-	1	5
Others	2	40	3	15
Total	5	100	20	100

4.3.1.2 Technical Officer Characteristics

The characteristics of the technical officer include the length of service, designation of office and number of employees.



Figure 4.2: Length of Service

Figure 4.2 shows that eight of the technical officers had less than 10 years work experience, another eight technical officers had between 10 and 19 years work experience while the other

four technical officers had between 20 and 29 years work experience. This implies that twelve technical officers had at least ten years of work experience and that they were moderately experienced. It suggests that those technical officers can be relied upon to give adequate information with regard to the survey.

Table 4.6: Designation of Technical Officer Sampled

Designation	Frequency	Percentage %
Carpentry workshop officer	3	15
Inspector of prison works	5	25
Personal assistant	1	5
Industrial officer	3	15
Senior maintenance officer	1	5
Maintenance officer	3	15
Head of department	1	5
Principal inspector	1	5
Technical instructor	1	5
Instructor	1	5
Total	20	100

Table 4.6 shows various designation ascribed by technical officers. In the questionnaire posted to the technical officers they were asked to state their present designation in the maintenance unit. The above details were the information provided. This information revealed that designation of staff is not formalised in the maintenance unit, as each official adopts a designation that suits their feelings. This implies that organization structure is not

defined and this could result to not knowing precisely who is responsible for specific tasks or duties.

Table 4.7 Employees in Maintenance Unit

Number of employees	Frequency	Percentage %
Less than 10 employees	12	50
10 – 19 employees	10	42
20-29 employees	2	8
Total	24	100

Table 4.7 shows that maintenance units have maintenance staff ranging between 1 and 29. Result indicates that twelve (50%) technical officers showed that they have less than 10 employees and ten (42%) officers also revealed that they have between 10 and 19 employees. This indicates the staff strength of the maintenance unit. This could determine the rate at which maintenance works are executed.

4.3.2. Demographic Characteristics of Prison Non-Maintenance Staff

The characteristics of prison non-maintenance staff include number of administered questionnaires, type of prison according to gender, length of service and educational background.

Table 4.8 Prison Non-Maintenance Staff

Prisons	Number of questionnaire administered	Number questionnaire returned	Response rate
Lagos	244	93	38
Ogun	181	86	48
Oyo	183	46	26
Osun	174	38	22
Ondo	212	87	41
Ekiti	100	30	30
Total	1,094	380	35

Table 4.8 shows the number of copies of structured questionnaire administered, number of copies of structured questionnaires returned and the response rate of prison non-maintenance staff in each of the prison locations. The response rate achieved with the structured questionnaire administered was 35% across all the prisons.

Table 4.9 Types of Prisons

Prisons type	Prison non-maintenance staff	Percentage
Male and female prison	161	42
Male prison	174	46
Female prison	29	8
Missing	16	4
Total	380	100

Table 4.9 shows that one hundred and sixty one (42%) prison non-maintenance staff works in male and female prison. One hundred and seventy four (46%) prison non-maintenance staff works in male prison while 29 (8%) prison non-maintenance staff works in female prison. This indicates the placement of the staff according to Nigerian prisons service posting.

Table 4.10 Length of Service of Prison Non-Maintenance Staff

Length of service	Frequency	Percentage %
Less than 10 years	208	55
10 – 19 years	104	27
20 – 29 years	52	14
30 years and above	8	2
Missing	8	2
Total	380	100

Table 4.10 shows that two hundred and eight (55%) prison non-maintenance staff had less than ten years work experience. One hundred and fifty six (41%) prison non-maintenance staff had between ten (10) years and twenty nine (29) years work experience, while eight (2%) prison non-maintenance staff had a work experience between thirty (30) years and above. This implies that there are reasonable numbers of respondent from whom data can be retrieved with regard to the survey.

Table 4.11 Educational Background of Prison Non-Maintenance Staff

Qualifications	Prison non maintenance staff	Percentage (%)
OND	96	25
HND	72	19
B.Sc/ B.Tech	101	27
M.Sc	28	7
PhD	1	1
Others	74	19
Missing	8	2
Total	380	100

Table 4.11 reveals the educational background of the prison non-maintenance staff. The non-maintenance staff indicated their highest educational qualification. Results revealed that ninety six (25%) prison non-maintenance staff had ordinary national diploma certificate. Seventy two (19%) non-maintenance staff had higher national diploma certificate. One hundred and one (27%) non-maintenance staff had first degree certificate. Also, twenty eight (7%) and one (less than 1%) non-maintenance staff had master degree and PhD qualification respectively. The figures suggest that the data from the copies of the structured questionnaire are useful and reliable to some extent.

4.4 Physical Conditions of Prison Facilities in South-West, Nigeria.

4.4.1 Perception on Physical Conditions of Prison Facilities

The physical condition of the facilities was assessed by prison maintenance staff and prison non-maintenance staff in terms of fabrics and structures, services, aesthetics and environment/surroundings as derived from the literature (Adenuga, 2008).

Table 4.12 Perception on Physical Conditions of Prison Facilities

Prison facilities	Prison maintenance staff		Prison non-maintenance Staff	
	Mean score	Rank	Mean Score	Rank
Security of environment (E)	4.10	9	4.08	1
Level of cleanliness (E)	3.80	12	3.82	2
Air circulation (E)	3.95	11	3.72	3
Doors (F)	4.42	2	3.63	4
Roof structures (F)	4.42	2	3.62	5
Walling (F)	4.44	1	3.61	6
Roofing finishes (F)	4.11	7	3.60	7
Beams and columns (F)	4.18	6	3.59	8
Floor slab (F)	4.06	10	3.55	9
Roof coverings (F)	4.25	5	3.52	10
Windows (F)	4.42	2	3.50	11
Floor finishes (F)	4.11	7	3.48	12
Water supply (S)	3.80	12	3.47	13
Noise protection (E)	2.83	27	3.44	14

*F=fabric, S=services, A= aesthetic, E= environment

Table 4.12 Physical Conditions of Prison Facilities (contd.)

Prison facilities	Prison maintenance staff		Prison non-maintenance Staff	
	Mean score	Rank	Mean Score	Rank
Stairs case (F)	3.20	19	3.44	14
Sanitary fittings (S)	3.47	16	3.30	16
Waste water disposal (S)	2.95	21	3.22	17
External painting (A)	3.30	17	3.20	18
Electricity supply(lightning) (S)	3.58	14	3.17	19
Refuse disposal (E)	2.95	21	3.16	20
Internal painting (A)	3.20	19	3.11	21
Solid waste disposal (S)	3.26	18	3.09	22
Electrical appliances (S)	3.50	15	3.08	23
Furniture (A)	2.84	25	2.95	24
Netting (F)	2.79	29	2.89	25
Air conditioner or fan (S)	2.84	25	2.62	26
Firefighting equipment (S)	2.95	21	2.60	27
Alarms and detector (S)	2.88	24	2.52	28
Telephone lines (S)	2.45	30	2.47	29
Internet facilities (S)	2.80	28	2.42	30

**F=fabric, S=services, A= aesthetic, E= environment*

Table 4.12 shows the responses of the prison staff. To quantify the physical condition of facilities, a graduated scale of 1- 5 was used and the mean score were calculated. The mean values were interpreted using the following scale $1.00 \leq MS < 1.49$ means very bad, $1.50 \leq$

MS < 2.49 means bad, $2.50 \leq \text{MS} < 3.49$ means average, $3.50 \leq \text{MS} < 4.49$ means good and $4.50 \leq \text{MS} \leq 5.00$ means very good physical condition.

Result from Table 4.12 reveals that prison maintenance staff confirmed that walling (4.44) ranked first, roof structures, doors and windows with mean score (4.42) all ranked second, roof coverings (4.25) ranked fifth, beam and column (4.18), roof finishes (4.11), floor finishes (4.11), security of environment (4.10), floor slabs (4.06), air circulation (3.95), level of cleanliness (3.80), water supply (3.80), lighting supply (3.54) ranked fourteenth and electrical appliances (3.58) ranked fifteenth were in good physical condition.

Sanitary fittings (3.47) ranked sixteenth, external painting (3.30) ranked seventeenth, solid waste disposal (3.26), internal painting (3.20), staircase (3.20), waste water disposal (2.95), refuse disposal (2.95), firefighting equipment (2.95), alarms and detectors (2.88), air conditioners or fan (2.84), furniture (2.84), noise protection (2.83), internet facilities (2.80) ranked twenty eighth, and netting (2.79) ranked twenty ninth were rated average while telephone lines (2.45) ranked thirtieth were in bad condition.

Prison non-maintenance staff also indicated that security of environment (4.08) ranked first, level of cleanliness (3.81) ranked second, air circulation (3.72) ranked third, doors (3.63), roof structures (3.62), walling (3.61), roof finishes (3.60), beams and column (3.59), floor slab (3.55), roof coverings (3.52) ranked tenth and windows (3.50) ranked eleventh were in good physical condition.

Facilities like floor finishes (3.48) ranked twelfth, water supply (3.47) ranked thirteenth, noise protection (3.44), staircase (3.44), sanitary fittings (3.30), waste water disposal (3.22), external painting (3.20), lighting supply (3.17), refuse disposal (3.16), internal painting (3.11), solid waste disposal (3.09), electrical appliances (3.08), furniture (2.95), netting (2.89), air condition or fan (2.62), firefighting equipment (2.60) ranked twenty seventh, and alarms and detectors (2.52) ranked twenty eighth were rated average while telephone lines (2.47) ranked twenty ninth and internet facilities (2.42) ranked thirtieth were in bad condition.

The results revealed that both categories of respondents confirmed that only few numbers of facilities were in good condition. It was observed that the condition of facilities (especially services) were rated average while telephone lines were in a bad condition. This implies that most of the services are not functioning at their best; consequently, it is paramount to ensure upgrading of these facilities for a holistic overhaul of the prisons. Surprisingly, none of the prison facilities was found to be in a very good condition ($4.50 \leq MS \leq 5.00$) based on the author mean value interpretation. This suggests that the conditions of prison facilities in South-west, Nigeria are perceived not to meet the minimum standards stipulated for prison facilities.

4.4.2 Perception on the Physical Condition of Prison Facilities across Prison Locations in South-West, Nigeria.

The physical condition of the facilities was further assessed across prison locations based on the perception of prison non maintenance staff in terms of fabrics and structures, services, aesthetics and environment/surroundings as derived from literature (Adenuga, 2008).

Table 4.13 shows the responses of prison non-maintenance staff in each of the prison locations. Respondents in all the six prison locations ranked security of environment as first and indicated that security of the prison environment was in good condition. This suggests that the Nigerian Prison Service is conscious of the security of lives and property within prison environments.

In Lagos prisons the respondents indicated that level of cleanliness, walling, air circulation and roof structures were in good physical condition. Facilities such as doors, roofing sheet, floor finishes, beams and columns, floor slabs, staircases, water supply, windows, noise protection, external painting, waste water disposal, lighting supply and refuse disposal were rated average.

Also, rated on average condition are sanitary fittings, internal painting, solid waste disposal, netting, furniture, telephone lines, air conditioning or fan, and firefighting equipment. Internet facilities, alarms and detectors were indicated to be in bad physical condition.

Ogun prisons respondents indicated that level of cleanliness, air circulation, water supply, floor finishes, noise protection, doors, walling, floor slab, and roofing sheets were in good physical condition. Facilities such as roof structures, beams and columns, sanitary fittings, stair cases, windows, roof coverings, lighting supply, waste water disposal, external paintings, internal paintings and refuse disposal were rated average. Solid waste disposal, electrical appliance, furniture, netting and air conditioners or fans were also rated average. Facilities such as internet, firefighting equipment, telephone lines, alarms and detectors were indicated to be in bad physical condition.

Table 4.13 Physical Condition of Prison Facilities across Prison Locations by Prison Non-Maintenance Staff in South-West, Nigeria

Prison facilities	Lagos prisons		Ogun prisons		Oyo prisons		Osun prisons		Ondo prisons		Ekiti prison	
	MS	R	MS	R	MS	R	MS	R	MS	R	MS	R
Security of environment (E)	3.96	1	4.24	1	3.89	1	4.18	1	4.15	1	3.93	1
Level of cleanliness (E)	3.71	2	3.98	2	3.67	5	3.82	3	3.93	2	3.47	8
Walling (F)	3.70	3	3.57	8	3.52	10	3.59	8	3.64	14	3.50	5
Air circulation (E)	3.54	4	3.91	3	3.48	11	4.08	2	3.88	4	3.20	12
Roof structures (F)	3.52	5	3.49	11	3.83	3	3.51	12	3.84	7	3.50	5
Doors (F)	3.49	6	3.58	7	3.65	7	3.62	7	3.79	8	3.67	2
Roofing sheets (F)	3.45	7	3.52	10	3.66	6	3.57	10	3.91	3	3.33	10
Floor finishes (F)	3.41	8	3.61	5	3.29	17	3.64	6	3.68	12	2.86	20
Beams and columns (F)	3.40	9	3.47	12	3.65	7	3.58	9	3.88	4	3.53	3
Roof coverings (F)	3.39	10	3.35	16	3.83	3	3.43	14	3.72	11	3.47	8
Floor slab (F)	3.39	11	3.55	9	3.41	13	3.69	5	3.85	6	3.23	11
Stairs case (F)	3.38	12	3.41	14	3.39	14	3.38	16	3.68	12	3.15	13
Water supply (S)	3.36	13	3.66	4	3.85	2	3.47	13	3.41	20	2.90	19
Windows (F)	3.25	14	3.40	15	3.61	9	3.54	11	3.79	8	3.50	5
Noise protection (E)	3.21	15	3.59	6	3.13	19	3.71	4	3.74	10	3.00	17
External painting (A)	3.14	16	3.15	19	2.91	23	3.29	19	3.60	15	2.72	26
Electrical appliances (S)	3.13	17	2.98	23	3.07	20	3.16	23	3.14	24	3.03	16
Waste water disposal (S)	3.11	18	3.19	18	3.37	15	3.37	17	3.32	21	2.93	18
Lighting (S)	3.09	19	3.24	17	2.70	25	3.26	20	3.26	23	3.53	3
Refuse disposal (E)	3.01	20	3.01	21	3.15	18	3.18	22	3.46	18	3.13	14
Sanitary fittings (S)	2.99	21	3.46	13	3.43	12	3.41	15	3.45	17	3.07	15

*F=fabric, S=services, A=aesthetic, E=environment, R=rank, MS=mean rank

Table 4.13 Physical Condition of Prison Facilities across Prison Locations by Prison Non-Maintenance Staff in South-West, Nigeria

(contd.)

Prison facilities	Lagos prisons		Ogun prisons		Oyo prisons		Osun prisons		Ondo prisons		Ekiti prisons	
	MS	R	MS	R	MS	R	MS	R	MS	R	MS	R
Internal painting (A)	2.92	22	3.12	20	2.98	21	3.21	21	3.48	16	2.76	25
Solid waste disposal (S)	2.89	23	2.99	22	3.33	16	3.32	18	3.29	22	2.83	23
Netting (F)	2.81	24	2.65	25	2.82	24	3.16	23	3.13	25	2.86	20
Furniture (A)	2.71	25	2.83	24	2.70	25	3.03	25	3.46	19	2.86	20
Telephone lines (S)	2.64	26	2.33	29	2.35	29	2.78	30	2.33	29	2.57	28
A/C or fan (S)	2.60	27	2.51	26	2.49	28	2.97	27	2.78	26	2.37	29
Firefighting equipment (S)	2.59	28	2.40	28	2.58	27	2.92	28	2.64	28	2.67	27
Internet facilities (S)	2.46	29	2.48	27	2.98	21	2.92	28	2.28	30	2.10	30
Alarms / detector (S)	2.45	30	2.31	30	2.10	30	3.03	25	2.74	27	2.82	24

**F=fabric, S=services, A=aesthetic, E=environment, R=rank, MS=mean score*

Respondents in Oyo prisons indicated that water supply, roof coverings, roof structures, level of cleanliness, roofing sheets, beams and columns, doors, windows, and walling were in good physical condition. Facilities such as air circulation, sanitary fittings, floor slab, stair case, waste water disposal, solid waste disposal, floor finishes, refuse disposal, noise protection and electrical appliance were rated average. Internal paintings, internet facilities, external paintings, netting, furniture, lighting supply and firefighting equipment were also rated average. Air conditioners or fans, telephone lines, alarms and detectors were indicated to be in bad physical condition.

In Osun prisons the respondents indicated that prisons facilities were either in good condition or average. Respondents indicated that air circulation, level of cleanliness, noise protection, floor slabs, floor finishes, doors, walling, beams and columns, roofing sheets, windows and roof structures were in good physical condition. Other prison facilities were rated average such as water supply, roof coverings, sanitary fittings, stair case, waste water disposal, solid waste disposal, external paintings, internal paintings, refuse disposal, nettings, electrical appliances, furniture, alarms and detectors, air conditioners or fans, firefighting equipment, internet facilities and telephone lines.

Respondents in Ondo prisons indicated that level of cleanliness, roofing sheets, beams and columns, air circulation, floor slabs, roof structures, doors, windows, noise protection, roof coverings, stair cases, floor finishes, walling, and external paintings were in good condition. Internal paintings, sanitary fittings, refuse disposal, furniture water supply, wastewater disposal and solid waste disposal were rated average. Also

rated, average were lighting supply, electrical appliances, netting, air conditioners or fans, alarms and detectors and firefighting equipment. Telephone lines and internet facilities were in bad condition.

In the Ekiti prison respondents indicated that a few facilities such as doors, beams and columns, lighting supply, windows and roof structures were in good condition. Level of cleanliness, roof coverings, roof sheets, floor slabs, air circulation, stair cases, refuse disposal, sanitary fittings, electrical appliances and noise protection were rated average. Also rated average were wastewater disposal, water supply, netting, floor finishes, solid waste disposal, alarms and detectors, external and internal paintings, firefighting and telephone lines. Air conditioners or fans and internet facilities were indicated to be in bad condition.

Generally, none of the facilities of the Nigerian Prison Service were in very good physical condition. Invariably, this implies that at present no prisons in South-west, Nigeria meet the standards of Prison Service Technical Order PSO 5900 and PSO 5901. These guidelines stipulated that prison estates must provide safe and decent environments for prison staff and prisoners to live and work in, and for all others who interact with the prison facilities. This suggests that more investment ought to be made in the maintenance of prison facilities, as well as investing on maintenance personnel via training. The study also found that prison facilities, most especially (services) such as alarms, detectors, firefighting equipment, air conditioners, fans, telephone lines, and internet facilities were in critically poor condition. The poor state of facilities like telephone lines and internet connection might be linked to the delay in reporting facility defects and the delay in response to complaints.

4.4.3 Hypothesis One

Null Hypothesis (H₀): There is no significant difference between the perception of prison maintenance and non-maintenance staff on the physical conditions of prison facilities

Alternative Hypothesis (H₁): There is significant difference between the perception of prison maintenance and non-maintenance staff on the physical conditions of prison facilities

The hypothesis for significant difference between the perception of prison maintenance and non-maintenance staff on the physical conditions of prison facilities was tested using Mann Whitney U test. Prison facilities are divided into four subheadings: fabrics, services, aesthetics and environment.

Table 4.14: Mann-Whitney U test Results for Comparing Perception of Prison Maintenance and Non-Maintenance Staff on the Physical Conditions of Prison Facilities

Facilities	Maintenance Staff		Non-Maintenance Prison Staff		U	p-value	Decision
	N	Mean rank	N	Mean rank			
Fabrics	13	199.27	272	140.31	1036.500	0.012	Reject H ₀
Services	12	184.83	295	152.75	1400.000	0.219	Accept H ₀
Aesthetics	19	185.21	350	184.99	3321.000	0.993	Accept H ₀
Environment	17	177.00	358	188.52	2856.000	0.667	Accept H ₀
Overall	9	147.50	215	111.03	652.500	0.98	Accept H ₀

Table 4.14 shows that the difference between the perception of prison maintenance staff (Mean rank= 199.27) and prison non-maintenance staff (Mean rank= 140.31) on fabrics was significant with a p-value of 0.012. The difference between the perception of prison maintenance staff (Mean rank= 184.83) and prison non-maintenance staff (Mean rank= 152.75) on services was not significant at a p-value of 0.219. The

difference between perception of prison maintenance staff (Mean rank= 185.21) and prison non-maintenance staff (Mean rank= 184.99) on aesthetics was not significant with a p-value of 0.993. The difference between the perception of prison maintenance staff (Mean rank= 177.00) and prison non-maintenance staff (mean rank= 188.52) on environment was not significant with a p-value of 0.667. Overall, the difference between the perception of prison maintenance staff (mean rank= 147.50) and prison non-maintenance staff (mean rank= 111.03) on condition of prison facilities was not significant with a p-value of 0.98.

This implies that both categories of respondent perceived the condition of prison facilities similarly. It suggests that there could be obstacles preventing maintenance units from discharging their duties effectively towards enhancing the performance of prison facilities. This result differs from Adenuga (2008) study where a significant difference was found between maintenance staff and users on the rating of the operational state of building elements and services of public hospital buildings in South-west, Nigeria.

4.5 Factors affecting Maintenance Management of Prison Facilities

4.5.1 Factors affecting Maintenance Management of Prison Facilities in South-West Nigeria.

Table 4.15 shows the responses of prison maintenance staff on factors affecting maintenance management of prison facilities in prisons across states in South-west, Nigeria. To quantify the effect of factors affecting the maintenance management of prison facilities, a graduated scale of 1- 5 was used and mean score were calculated. The mean values were interpreted using the following scale $1.00 \leq MS < 1.49$ means

insignificant, $1.50 \leq MS < 2.49$ means barely insignificant, $2.50 \leq MS < 3.49$ means partially significant, $3.50 \leq MS < 4.49$ means significant and $4.50 \leq MS \leq 5.00$ means highly significant.

Prison maintenance staff in Lagos prisons indicated that effects of overcrowding and insufficient funding (4.33) ranked first, delay in executing repairs, natural deterioration due to age of facilities and lack of staff motivation (4.00) ranked third, inadequate training and development for maintenance staff, and inadequate plant and equipment for maintenance operations (3.67) ranked sixth, and lack of discernible maintenance culture (3.50) ranked eighth were significant. It was also indicated that the effect of reckless use of facilities (3.33) ranked ninth, poor workmanship (3.00) ranked tenth, maintenance works not based on priorities (3.00), delay in reporting failures (3.00), third-party vandalism (2.67), irregular inspections (2.67) and poor construction of facilities (2.67) ranked sixteenth were partially significant while the effect of poor quality of materials and spare parts used for maintenance repairs (1.50) was barely insignificant.

In Ogun prisons, Prison maintenance staff indicated that effect of overcrowding and insufficient funding (3.75) ranked first, poor construction of facilities, natural deterioration of facilities and poor construction of facilities (3.50) ranked third were significant. Effect of poor quality of materials and spare parts used for maintenance repairs (3.33) ranked fifth, inadequate training and development for maintenance staff, inadequate plant and equipment for maintenance operation, irregular inspections, poor workmanship and lack of discernible maintenance culture (3.00) ranked sixth, lack of motivation for maintenance staff, third-party vandalism and

delay in reporting failures (2.50) ranked eleventh were partially significant while the effect of reckless use of facilities (1.25) ranked sixteenth was insignificant.

Prison maintenance staff in Oyo prisons considered the effects of natural deterioration of facilities due to age (4.00) ranked first and third-party vandalism (3.80) ranked second to be significant. The effect of lack of motivation for maintenance staff (2.80) ranked third, inadequate plant and equipment for maintenance operations (2.75) ranked fourth and lack of discernible maintenance culture (2.50) ranked fifth were partially significant. The effect of poor construction of facilities and reckless use of facilities (2.40) ranked sixth; overcrowding (2.33), inadequate training and development for staff (2.25) and delay in executing maintenance repairs (2.00) ranked tenth were barely insignificant. Also barely insignificant were maintenance works not based on priorities and delay in reporting failures (2.00) ranked tenth, insufficient funding and poor quality of materials and spare parts used for maintenance repairs and irregular inspections (1.80) ranked thirteenth and poor workmanship (1.75) ranked sixteenth.

In Ondo prisons the effect of deterioration due to age of facilities (4.57) ranked first and was highly significant. The effects of overcrowding (4.25) ranked second and lack of a discernible maintenance culture (3.50) ranked third were significant. The effect of insufficient funding (3.38) ranked fourth, inadequate training and development for staff (3.00), inadequate plant and equipment for maintenance operations (2.63) and lack of motivation for maintenance staff (2.63) ranked sixth were partially significant.

Table 4.15: Factors affecting Maintenance Management of Prison Facilities in South-West.

Factors	N	Lagos Prisons		Ogun Prisons		Oyo Prisons		Ondo Prisons		Ekiti Prison		Pooled Mean Score	Overall ranking
		MS	R	MS	R	MS	R	MS	R	MS	R		
Natural deterioration due to age of facilities.	20	4.00	3	3.50	3	4.00	1	4.57	1	3.67	4	4.05	1
Overcrowding	21	4.33	1	3.75	1	2.33	8	4.25	2	4.00	2	3.86	2
Inadequate training & development for maintenance staff	22	3.67	6	3.00	6	2.25	9	3.00	5	4.33	1	3.14	3
Insufficient funding	23	4.33	1	3.75	1	1.80	13	3.38	4	1.67	14	3.00	4
Lack of discernible maintenance culture	21	3.50	8	2.75	10	2.50	5	3.50	3	2.33	10	3.00	4
Inadequate plant & equipment for maintenance operations	22	3.67	6	3.00	6	2.75	4	2.63	6	3.67	4	2.91	6

**MS=mean score, R=ranking*

Coding: HS = highly significant, 5; S = significant, 4; PS = partially significant, 3; BIS = barely insignificant, 2; IS = insignificant, 1.

Interpreting scale: $1.00 \leq MS < 1.49$ means insignificant effect, $1.50 \leq MS < 2.49$ barely insignificant effect, $2.50 \leq MS < 3.49$ means partially significant effect, $3.50 \leq MS < 4.49$ means significant effect and $4.50 \leq MS \leq 5.0$ means highly significant effect.

Table 4.15: Factors affecting Maintenance Management of Prison Facilities in South-West (Contd.)

Factors	N	Lagos Prisons		Ogun Prisons		Oyo Prisons		Ondo Prisons		Ekiti Prison		Pooled Mean Score	Overall ranking
		MS	R	MS	R	MS	R	MS	R	MS	R		
Lack of motivation for maintenance staff	23	4.00	3	2.50	11	2.80	3	2.63	6	3.00	6	2.87	7
Third-party vandalism	23	2.67	13	2.50	11	3.80	2	1.87	9	1.33	15	2.43	8
Irregular inspections	23	2.67	13	3.00	6	1.80	13	1.63	10	4.00	2	2.35	9
Delay in executing repairs	22	4.00	3	2.50	11	2.00	10	1.38	12	3.00	6	2.27	10
Poor construction of facilities	23	2.67	13	3.50	3	2.40	6	1.13	15	2.67	9	2.22	11
Maintenance work not based on priorities	22	3.00	10	2.50	11	2.00	10	2.25	8	1.33	15	2.22	11
Poor workmanship	22	3.00	10	3.00	6	1.75	16	1.50	11	2.33	10	2.14	13

**MS=mean score, R=ranking*

Coding: HS = highly significant, 5; S = significant, 4; PS = partially significant, 3; BIS = barely insignificant, 2; IS = insignificant, 1.

Interpreting scale: $1.00 \leq MS < 1.49$ means insignificant effect, $1.50 \leq MS < 2.49$ barely insignificant effect, $2.50 \leq MS < 3.49$ means partially significant effect, $3.50 \leq MS < 4.49$ means significant effect and $4.50 \leq MS \leq 5.0$ means highly significant effect.

Table 4.15: Factors affecting Maintenance Management of Prison Facilities in South-West (Contd.)

Factors	N	Lagos Prisons		Ogun Prisons		Oyo Prisons		Ondo Prisons		Ekiti Prison		Pooled Mean Score	Overall ranking
		MS	R	MS	R	MS	R	MS	R	MS	R		
Poor quality of materials & spare parts used for repairs	21	1.50	16	3.33	5	1.80	13	1.38	12	2.33	10	1.90	14
Reckless use of facilities.	23	3.33	9	1.25	16	2.40	6	1.13	15	2.33	10	1.87	15
Delay in reporting failures	23	3.00	10	2.50	11	2.00	10	1.38	12	3.00	6	1.83	16
Grand		3.37		2.86		2.38		2.31		2.69		2.61	

*MS=mean score, R=ranking

Coding: HS = highly significant, 5; S = significant, 4; PS = partially significant, 3; BIS = barely insignificant, 2; IS = insignificant, 1.
 Interpreting scale: $1.00 \leq MS < 1.49$ means insignificant effect, $1.50 \leq MS < 2.49$ barely insignificant effect, $2.50 \leq MS < 3.49$ means partially significant effect, $3.50 \leq MS < 4.49$ means significant effect and $4.50 \leq MS \leq 5.0$ means highly significant effect.

Prison maintenance staff also indicated that effects of maintenance works not based on priorities (2.25) ranked eighth, third-party vandalism (1.87), irregular inspections (1.63) and poor workmanship (1.50) ranked eleventh were barely insignificant. Effect of delay in executing repairs, poor quality of materials and spare parts used for repairs and delay in reporting failures (1.38) ranked twelfth, poor construction of facilities and reckless use of facilities (1.13) ranked fifth were insignificant.

In the Ekiti prison, maintenance staff indicated that the effects of inadequate training and development for maintenance staff (4.33) ranked first, overcrowding and irregular inspection (4.00) ranked second, natural deterioration due to age of facilities and inadequate plant and equipment for maintenance operations (3.67) ranked fourth were significant. Respondents indicated that the effects of delay in reporting defects, lack of motivation for maintenance staff, delay in executing repairs (3.00) ranked sixth and poor construction of facilities (2.67) ninth were partially significant.

Furthermore, prison maintenance staff in Ekiti prison indicated that the effects of lack of a discernible maintenance culture, poor workmanship, poor quality of materials and spare parts used for repairs and reckless use of facilities (2.33) ranked tenth and insufficient funding (1.67) ranked fourteenth were barely insignificant while the effects of maintenance works not based on priorities and third-party vandalism (1.33) ranked fifteenth were insignificant.

Overall, prison maintenance staff indicated that the effects of natural deterioration due to age of facilities (4.05) and overcrowding (3.86) were significant. The effect of inadequate training and development for maintenance staff (3.14), insufficient funding (3.00), lack of a

discernable maintenance culture (3.00), inadequate plant and equipment for maintenance operations (2.91) and lack of motivation for maintenance staff (2.87) were partially significant. Third-party vandalism (2.43), irregular inspections (2.35), delay in executing repairs (2.27), poor construction of facilities (2.22), maintenance works not based on priorities (2.22), poor workmanship (2.14), poor quality of materials and spare parts used in repairs (1.90), reckless use of facilities (1.87), and delay in reporting failures (1.83) were barely insignificant.

The study revealed the effects of diverse the factors affecting the maintenance management of prison facilities. The study exposed various factors as they affect the prison facilities in each of the prison locations across South-west, Nigeria. This implies that the effects of factors like natural deterioration due to age of facilities, overcrowding, inadequate training and development of maintenance staff, insufficient funding, lack of a discernible maintenance culture and inadequate plant and equipment for maintenance operations among other factors affecting maintenance management of prison facilities were critical.

Table 4.16: Kendall's coefficient of concordance test of agreement on ranking of factors affecting maintenance management of prison facilities

No of cases	Kendall's W	Chi-square	Df	P-value
16	0.271	78.126	18	0.001

Kendall's coefficient of concordance test was further used to test for agreement among the respondents in their ranking of the sixteen factors. Table 4.16 indicates a significant agreement among the respondents at $p < 0.05$.

This is consistent with Oladapo (2005), where age of buildings and overcrowding are identified as important determinant factors in housing maintenance. The study is also in line to Farinloye et al. (2010) study on the significance of factors affecting maintenance of which deterioration of facilities due to age and staff training was rated significant. These findings suggest that the Nigerian Prisons Service should consider these underlying critical factors when making relevant decisions on maintenance works.

4.5.2 Hypothesis Two

Null Hypothesis: There is no significant correlation among the factors affecting maintenance management of prison facilities in South-west.

Alternative Hypothesis: There is significant correlation among the factors affecting maintenance management of prison facilities in South-west.

The correlation analysis of the data revealed the significant correlations among factors affecting maintenance management of prison facilities. The correlation results would enable the maintenance unit to identify group of factors that are to be controlled together. Result shows that the effect of deterioration due to age of facilities is strongly related poor quality of materials and spare parts used in repairs $r = -.836$, $p < 0.01$, poor workmanship $r = -.604$, $p < 0.01$ and overcrowding $r = .644$, $p < 0.01$. Likewise effect of overcrowding is strongly related to third-party vandalism $r = .589$, $p < 0.01$. This implies that there is a significant correlation between the effect of deterioration due to age of facilities and poor quality of materials and spare parts used in repairs, poor workmanship as well as overcrowding. The result implies that the effect of deterioration due to age of facilities could be minimised with quality materials, good workmanship as well as making sure that inmates population does not exceeding facilities capacity.

Table 4.17: Correlation of Factors affecting Maintenance Management of Prison Facilities in South-West, Nigeria.

		F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11
F1	Pearson correlation	1	-.401	.300	.260	.280	.548**	.593**	.436*	-.161	.065	-.127
	Sig (2-tailed)		.080	.165	.232	.218	.007	.004	.042	.484	.773	.563
F2	Pearson correlation	-.401	1	-.470*	-.429	-.836**	-.364	-.454	-.604**	.644**	.381	.479*
	Sig (2-tailed)	.080		.037	.059	.000	.115	.051	.005	.003	.098	.032
F3	Pearson correlation	.300	-.470*	1	.343	.557**	.562**	.544**	.531*	-.179	.057	-.059
	Sig (2-tailed)	.165	.037		.109	.009	.005	.009	.011	.437	.802	.789
F4	Pearson correlation	.260	-.429	.343	1	.057	.386	.169	.420	-.589**	-.513*	-.410
	Sig (2-tailed)	.232	.059	.109		.805	.069	.452	.052	.005	.015	.052
F5	Pearson correlation	.280	-.836*	.557**	.057	1	.205	.368	.746	-.337	-.146	-.186
	Sig (2-tailed)	.218	.000	.009	.805		.373	.110	.000	.158	.540	.420
F6	Pearson correlation	.548**	-.364	.562**	.386	.205	1	.503*	.488*	-.291	-.259	.107
	Sig (2-tailed)	.007	.115	.005	.069	.373		.017	.021	.200	.244	.628
F7	Pearson correlation	.593**	-.454	.544**	.169	.368	.503*	1	.473*	-.124	.068	.019
	Sig (2-tailed)	.004	.051	.009	.452	.110	.017		.030	.594	.771	.932
F8	Pearson correlation	.436*	-.604**	.531*	.420	.746**	.488*	.473	1	.195	.026	-.040
	Sig (2-tailed)	.042	.005	.011	.052	.000	.021	.030		.397	.908	.858
F9	Pearson correlation	-.169	.644**	-.179	.589**	-.377	-.291	-.124	-.195	1	.595**	.695**
	Sig (2-tailed)	.484	.003	.437	.005	.158	.200	.594	.397		.004	.000
F10	Pearson correlation	.065	.381	.057	-.513*	-.146	-.259	.068	.026	.595**	1	.277
	Sig (2-tailed)	.773	.098	.802	.015	.540	.244	.771	.908	.004		.211

**Correlation is significant at the 0.01 level (2-tailed).

*Correlation is significant at the 0.05 level (2-tailed).

Table 4.17: Correlation of Factors affecting Maintenance Management of Prison Facilities in South-West, Nigeria (contd.)

		F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11
F11	Pearson correlation	-.127	.479*	-.059	-.410	-.186	.107	.019	-.040	.695**	.277	1
	Sig (2-tailed)	.563	.032	.789	.052	.420	.628	.932	.858	.000	.211	
F12	Pearson correlation	-.204	.581**	-.412	-.619**	-.517*	.000	-.419	-.431	.511*	.257	.742**
	Sig (2-tailed)	.375	.009	.063	.003	.023	1.000	.066	.051	.021	.261	.000
F13	Pearson correlation	.036	.403	.113	-.184	-.442	.199	-.114	-.082	.260	.485*	.413
	Sig (2-tailed)	.874	.078	.617	.412	.051	.376	.621	.718	.254	.022	.056
F14	Pearson correlation	.297	-.347	.520*	-.421*	.535*	.191	.412	.325	.240	.325	.111
	Sig (2-tailed)	.168	.134	.011	.045	.012	.383	.057	.140	.294	.140	.615
F15	Pearson correlation	.031	.053	-.004	-.308	-.032	.192	.412	.325	.240	.325	.493*
	Sig (2-tailed)	.889	.826	.986	.152	.891	.380	.057	.140	.294	.140	.017
F16	Pearson correlation	.389	.085	.078	.142	-.067	.277	.281	.313	-.050	.508	.100
	Sig (2-tailed)	.067	.720	.722	.519	.773	.200	.205	.156	.828	.016	.649

**Correlation is significant at the 0.01 level (2-tailed).

*Correlation is significant at the 0.05 level (2-tailed).

F1- Reckless use of facilities

F4- Third party vandalism

F7-Delay in executing repairs

F2-Age of facilities

F5-Poor quality of materials and spare parts

F8-Poor workmanship

F3-Poor construction of facilities

F6-Delay in reporting failures

F9-Overcrowding

Table 4.17: Correlation of Factors affecting Maintenance Management of Prison Facilities in South-West, Nigeria (contd.)

		F12	F13	F14	F15	F16
F1	Pearson correlation	-.204	.036	.297	.031	.389
	Sig (2-tailed)	.375	.874	.168	.889	.067
F2	Pearson correlation	.581**	.403	-.347	.053	.085
	Sig (2-tailed)	.009	.078	.134	.826	.720
F3	Pearson correlation	-.412	.113	.520*	-.004	.078
	Sig (2-tailed)	.063	.617	.011	.986	.722
F4	Pearson correlation	-.619**	-.184	-.421*	-.308	.142
	Sig (2-tailed)	.003	.412	.045	.152	.519
F5	Pearson correlation	-.517	-.442	.535*	-.032	-.067
	Sig (2-tailed)	.023	.051	.012	.891	.773
F6	Pearson correlation	.000	.199	.191	.192	.277
	Sig (2-tailed)	1.000	.376	.383	.380	.200
F7	Pearson correlation	-.419	.114	.412	-.014	.281
	Sig (2-tailed)	.066	.621	.057	.950	.205
F8	Pearson correlation	-.431	.082	.325	-.076	.313
	Sig (2-tailed)	.051	.718	.140	.738	.156
F9	Pearson correlation	.511*	.260	.240	.273	-.050
	Sig (2-tailed)	.021	.254	.294	.231	.828
F10	Pearson correlation	.257	.485*	.325	-.256	.508*
	Sig (2-tailed)	.261	.022	.140	.251	.016

**Correlation is significant at the 0.01 level (2-tailed).

*Correlation is significant at the 0.05 level (2-tailed).

Table 4.17: Correlation of Factors affecting Maintenance Management of Prison Facilities in South-West, Nigeria (contd.)

		F12	F13	F14	F15	F16
F11	Pearson correlation	.742**	.413	.110	.493*	.100
	Sig (2-tailed)	.000	.056	.615	.017	.649
F12	Pearson correlation	1	.573**	-.093	.546*	.181
	Sig (2-tailed)		.007	.689	.010	.434
F13	Pearson correlation	.573**	1	-.057	.070	.507*
	Sig (2-tailed)	.007		.816	.757	.016
F14	Pearson correlation	-.093	-.057	1	.338	-.131
	Sig (2-tailed)	.689	.816		.114	.550
F15	Pearson correlation	.546*	.070	.338	1	-.265
	Sig (2-tailed)	.010	.757	.114		.222
F16	Pearson correlation	.181	.507*	-.131	-.265	1
	Sig (2-tailed)	.434	.016	.550	.222	

**Correlation is significant at the 0.01 level (2-tailed).

*Correlation is significant at the 0.05 level (2-tailed).

F10-Inadequate training and development for maintenance staff

F11-insufficient fund

F12-Lack of discernable maintenance culture

F13-Inadequate plant and equipment for maintenance operations

F14-Irregular inspections

F15-Maintenance work not based on priorities

F16-Lack of motivation for maintenance staff

4.6 Maintenance Management Practices in use for Maintenance of Prison Facilities

4.6.1 Maintenance strategies used for prison facilities in South –West, Nigeria

Table 4.18 shows the type of maintenance strategy and the frequency of usage for different building elements/components, utilities and services in prisons. The results indicated that routine maintenance strategy was most frequently used for the maintenance of fans, air conditions and telecommunications in Ondo, Ekiti and Lagos prisons. It was most frequently used for level of cleanliness in Oyo, Ondo and Ekiti prisons.

Routine maintenance strategy was more frequently used for maintenance of external and internal paintings in Ekiti and Lagos prisons, used for maintenance of water supply in Ondo and Ekiti prisons and for maintenance of furniture in Ondo and Lagos prisons.

Routine maintenance strategy was frequently used for maintenance of floor slab, roof structures, roof coverings, ceilings, doors, windows, nettings, electricity supply and appliances, sanitary fittings, wastewater disposal, solid waste disposal and refuse disposal in Ondo prisons.

Preventive maintenance strategy was more frequently used for maintenance of roof structures, doors, windows and safety and security of environments in Ogun and Lagos Prisons. It was more frequently used for maintenance of floor finishes, floor tiles and wall tiles in Ondo and Ekiti prisons, used for maintenance of water supply, waste water disposal, solid waste disposal in Ogun and Oyo prisons and for maintenance of firefighting equipment in Ogun and Ondo prisons. Preventive maintenance strategy was frequently used for maintenance of floor slabs, ceilings, sanitary fittings, refuse disposal and level of cleanliness in Ogun prisons. Preventive maintenance strategy was used for maintenance of roof coverings and walling in Lagos prisons and used for maintenance of wall finishes, beam and

columns, foundations as well as external and internal paintings in Ondo prisons. It was also frequently used for maintenance of nettings in Oyo prisons and for maintenance of electricity supply and appliances in Ekiti prison.

Corrective maintenance strategy most frequently used for nettings in Ogun, Ekiti and Lagos prisons. Corrective maintenance strategy was more frequently used for maintenance of roof coverings, wall finishes in Ogun and Ekiti prisons. It was used for maintenance of ceilings, refuse disposal, waste water disposal, solid waste disposal in Ekiti and Lagos prisons.

Corrective maintenance strategy was frequently used for maintenance of roof structures, beams and columns, foundation, walling, doors, windows, sanitary fittings and furniture in Ekiti prison. It was used for maintenance of floor finishes, floor tiles and wall tiles as well as internal and external paintings in Ogun prisons, used for maintenance of floor slabs in Lagos prisons and maintenance of electricity supply and appliances in Oyo prisons.

Predictive maintenance strategy was most frequently used for foundations in Lagos prisons, Ogun prisons and Oyo prisons. Predictive maintenance was more frequently used for maintenance of sanitary fittings, beams and columns in Oyo and Lagos prisons.

In Oyo prisons, predictive maintenance was frequently used for maintenance of floor slabs, roof structures, roof coverings, ceilings, walling, wall finishes, doors, windows, refuse disposal, furniture and for internal and external paintings. It was frequently used for the maintenance of water supply, level of cleanliness, electricity supply and appliances in Lagos prisons and used for safety and security of environment in Ogun prisons.

Table 4.18: Types of Maintenance Strategy used for Prison Facilities in South-West, Nigeria.

Maintenance strategy	Components/elements/facilities	Category of components	Percentage	Prisons	Remark
Routine maintenance	Walling	Fabric	40	Ogun/Ondo	More frequently used
	Floor finishes	Fabric	40	Oyo/Lagos	More frequently used
	Floor and wall tiles	Fabric	40	Oyo/Lagos	More frequently used
	Floor slab	Fabric	20	Ondo	Frequently used
	Roof structures	Fabric	20	Ondo	Frequently used
	Roof coverings	Fabric	20	Ondo	Frequently used
	Ceiling	Fabric	20	Ondo	Frequently used
	Beam and column	Fabric	20	Ogun	Frequently used
	Wall finishes	Fabric	20	Lagos	Frequently used
	Doors	Fabric	20	Ondo	Frequently used
	Window	Fabric	20	Ondo	Frequently used
	Netting	Fabric	20	Ondo	Frequently used
	Internal painting	Aesthetics	40	Ekiti/Lagos	More frequently used
	External painting	Aesthetics	40	Ekiti/Lagos	More frequently used
	Furniture	Aesthetics	40	Ondo/Lagos	More frequently used
	Fans and air conditions	Services	60	Ondo/Ekiti/Lagos	Most frequently used
	Telecommunication system	Services	60	Ondo/Ekiti/Lagos	Most frequently used
	Water supply	Services	40	Ondo/Ekiti	More frequently used
	Electricity supply and appliance	Services	20	Ondo	Frequently used
	Firefighting equipment	Services	20	Oyo	Frequently used
	Sanitary fittings	Services	20	Ondo	Frequently used
	Wastewater disposal	Services	20	Ondo	Frequently used
	Solid waste disposal	Services	20	Ondo	Frequently used
	Refuse disposal	Services	20	Ondo	Frequently used
	Level of cleanliness	Environment	60	Oyo/Ondo/Ekiti	Most frequently used
	Safety and security of environment	Environment	40	Ondo/Ekiti	More frequently used

Table 4.18: Types of Maintenance Strategy used for Prison Facilities in South-West, Nigeria (contd.)

Maintenance strategy	Components/elements/facilities	Category of components	Percentage	Prisons	Remark
Preventive	Roof structures	Fabric	40	Ogun/Lagos	More frequently used
	Door	Fabric	40	Ogun/Lagos	More frequently used
	Window	Fabric	40	Ogun/Lagos	More frequently used
	Floor finishes	Fabric	40	Ondo/Ekiti	More frequently used
	Floor and wall tiles	Fabric	40	Ondo/Ekiti	More frequently used
	Floor slab	Fabric	20	Ogun	Frequently used
	Roof covering	Fabric	20	Lagos	Frequently used
	Ceiling	Fabric	20	Ogun	Frequently used
	Walling	Fabric	20	Lagos	Frequently used
	Wall finishes	Fabric	20	Ondo	Frequently used
	Beam and column	Fabric	20	Ondo	Frequently used
	Foundation	Fabric	20	Ondo	Frequently used
	Netting	Fabric	20	Oyo	Frequently used
	Water supply	Services	40	Ogun/Oyo	More frequently used
	Wastewater disposal	Services	40	Ogun/Oyo	More frequently used
	Solid waste disposal	Services	40	Ogun/Oyo	More frequently used
	Firefighting	Services	40	Ogun/Ondo	More frequently used
	Electricity supply and appliance	Services	20	Ekiti	Frequently used
	Sanitary fittings	Services	20	Ogun	Frequently used
	Refuse disposal	Services	20	Ogun	Frequently used
	Safety and security of environment	Environment	40	Ogun/Lagos	More frequently used
	Level of cleanliness	Environment	20	Ogun	Frequently used
	Internal painting	Aesthetics	20	Ondo	Frequently used
	External painting	Aesthetics	20	Ondo	Frequently used

Table 4.18: Types of Maintenance Strategy used for Prison Facilities in South-West, Nigeria (contd.)

Maintenance strategy	Components/elements/facilities	Category components	Percentage	Prisons	Remark
Corrective	Netting	Fabric	60	Ogun/Ekiti/Lagos	Most frequently used
	Roof coverings	Fabric	40	Ogun/Ekiti	More frequently used
	Ceiling	Fabric	40	Ekiti/Lagos	More frequently used
	Wall finishes	Fabric	40	Ogun/Ekiti	More frequently used
	Floor slab	Fabric	20	Lagos	Frequently used
	Floor finishes	Fabric	20	Ogun	Frequently used
	Roof structures	Fabric	20	Ekiti	Frequently used
	Beam and column	Fabric	20	Ekiti	Frequently used
	Foundation	Fabric	20	Ekiti	Frequently used
	Walling	Fabric	20	Ekiti	Frequently used
	Floor and wall tiles	Fabric	20	Ogun	Frequently used
	Doors	Fabric	20	Ekiti	Frequently used
	Window	Fabric	20	Ekiti	Frequently used
	Refuse disposal	Services	40	Ekiti/Lagos	More frequently used
	Wastewater disposal	Services	40	Ekiti/Lagos	More frequently used
	Sewage/Solid waste disposal	Services	40	Ekiti/Lagos	More frequently used
	Electricity supply and appliance	Services	20	Oyo	Frequently used
	Sanitary fittings	Services	20	Ekiti	Frequently used
	Internal painting	Aesthetics	20	Ogun	Frequently used
	External painting	Aesthetics	20	Ogun	Frequently used
	Furniture	Aesthetics	20	Ekiti	Frequently used
Predictive	Foundation	Fabric	60	Ogun/Oyo/Lagos	Most frequently used
	Beam and column	Fabric	40	Oyo/Lagos	More frequently used
	Floor slab	Fabric	20	Oyo	Frequently used
	Roof structures	Fabric	20	Oyo	Frequently used
	Roof coverings	Fabric	20	Oyo	Frequently used
	Ceiling	Fabric	20	Oyo	Frequently used

Table 4.18: Types of Maintenance Strategy used for Prison Facilities in South-West, Nigeria (contd.)

Maintenance strategy	Components/elements/facilities	Category of components	Percentage	Prisons	Remark
Predictive	Ceiling	Fabric	20	Oyo	Frequently used
	Walling	Fabric	20	Oyo	Frequently used
	Wall finishes	Fabric	20	Oyo	Frequently used
	Doors	Fabric	20	Oyo	Frequently used
	Window	Fabric	20	Oyo	Frequently used
	Sanitary fittings	Services	40	Oyo/Lagos	More frequently used
	Water supply	Services	20	Lagos	Frequently used
	Refuse disposal	Services	20	Oyo	Frequently used
	Electricity supply and appliance	Services	20	Lagos	Frequently used
	Level of cleanliness	Environment	20	Lagos	Frequently used
	Safety and security of environment	Environment	20	Ogun	Frequently used
	Internal painting	Aesthetics	20	Oyo	Frequently used
	External painting	Aesthetics	20	Oyo	Frequently used
	Furniture	Aesthetics	20	Oyo	Frequently used
Detective	Floor slab	Fabric	20	Ekiti	Frequently used
	Firefighting	Services	40	Ekiti/Lagos	More frequently used
	Telecommunication system	Services	40	Ogun/Oyo	More frequently used
	Fans and air conditions	Services	40	Ogun/Oyo	More frequently used
	Electricity supply and appliance	Services	20	Ogun	Frequently used
	Furniture	Aesthetics	20	Ogun	Frequently used

Predictive maintenance strategy was most frequently used for foundations in Lagos prisons, Ogun prisons and Oyo prisons. Predictive maintenance was more frequently used for maintenance of sanitary fittings, beams and columns in Oyo and Lagos prisons.

In Oyo prisons, predictive maintenance was frequently used for maintenance of floor slabs, roof structures, roof coverings, ceilings, walling, wall finishes, doors, windows, refuse disposal, furniture and for internal and external paintings. It was frequently used for the maintenance of water supply, level of cleanliness, electricity supply and appliances in Lagos prisons and used for safety and security of environment in Ogun prisons.

Detective maintenance was more frequently used for maintenance of firefighting equipment in Lagos prisons and the Ekiti prison. It was more frequently used for maintenance of telecommunication systems, fans and air conditioners in Ogun prisons and Oyo prisons.

It was also used for maintenance of floor slabs in the Ekiti prison and for maintenance of furniture, electricity supply and appliances in Ogun prisons.

Selection of the maintenance strategy used for most of the prison facilities was discrepantly chosen. This suggests that choice of maintenance strategy for maintenance of facilities was made without considering the logistical supports available for the maintenance unit. This invariably resulted in low performance of facilities, as their conditions were inevitably poor.

4.6.2 Hypothesis Three A

Null Hypothesis: There is no significant difference in the frequency of maintenance strategies used for prison facilities.

Alternative Hypothesis: There is significant difference in the frequency of maintenance strategies used for prison facilities.

Table 4.19: Ranks of Maintenance Strategies used for Prison Facilities

Strategies used for maintenance of prison facilities	Mean rank
Routine maintenance	2.5
Preventive maintenance	2.5
Corrective maintenance	2.64
Predictive maintenance	2.36

Table 4.20: Friedman Test for Comparing the Frequency of Maintenance Strategies used for Prison Facilities

	Chi-square	df	Asymp Sig	Decision
Comparison of strategies used for maintenance of prison facilities	0.667	3	0.881	Accept Ho

Table 4.20 shows Friedman test for comparing the frequency of maintenance strategies used for prison facilities. Test revealed that there was no significant difference between the maintenance strategies used for maintenance of prison facilities ($X^2(3) = 0.667$, $p > 0.05$) with a mean rank of 2.50 for routine maintenance, 2.50 for preventive maintenance, 2.64 for corrective maintenance and 2.36 for predictive maintenance as shown in table 4.19. This suggests that there are discrepancies in the use of maintenance strategies for prison facilities.

4.6.3 Maintenance Policies used for Prison Facilities in South –West, Nigeria.

Table 4.21: Maintenance Policies Practiced for Prison Facilities According to Maintenance Managers

Responses on maintenance policy	Frequency	Percentage (%)
<u>Policy type</u>	5	100
Written policy		
<u>Frequency of policy revision</u>		
Annually	2	40
Others	2	40
<u>Facilities inspection</u>		
Every 6 months	2	40
Every year	3	60
<u>Maintenance procurement type</u>		
Contract only	2	40
Direct labour only	1	20
Contract and direct labour	2	40
<u>Selection of contractors</u>		
Open competitive	4	80
<u>Award of contracts</u>		
Based on bill of quantities	3	60

Table 4.21 shows the responses on maintenance policies for prison facilities. Maintenance managers indicated that they have a written policy for maintenance of facilities. Maintenance managers (40%) indicated that written policies were actually reviewed annually while the

other (40%) acknowledged that the review of policy was situational. This suggests that there is no consistency in maintenance policy implementation as regard to type of maintenance structure identified to be practiced in the maintenance unit of the Nigerian Prison Service. This implies the need for training of prison maintenance staff, essentially in the administrative and managerial action of maintenance.

For inspection of facilities 40% of the maintenance managers indicated that inspection of prison facilities was carried out every 6 months while the other 60% indicated that facilities inspection was carried out on a yearly basis. This suggests that inspection of facilities is influenced by facilities characteristics such as relative degree of deterioration or economic value. Further, 40%, 20% and another 40% of the managers indicated that the maintenance procurement types were contract only, direct labour only, and a combination of contract and direct labour. Maintenance managers revealed that selection of contractor for maintenance works is usually based on an open competition and awarded based on bill of quantities.

Table 4.22 shows the attributes that stipulate the choice of maintenance strategy for executing maintenance works on prison facilities. The results indicated that maintenance works were mostly carried out at users' request ranked 1st with RII = 0.90; significant deterioration is evidenced and based on a condition survey report on facilities ranked 2nd with RII = 0.80 Other attribute deciding choice of maintenance strategy for executing maintenance works for prison facilities are at the end of facility's useful life as recommended by manufacturer (RII = 0.70), at failure point at which facilities cannot perform (RII = 0.70), and at predetermined regular plan intervals for facilities (RII = 0.70) which was ranked fourth.

Table 4.22: Execution of Maintenance Works for Prisons Facilities in South-West

Executing maintenance works attributes	Relative importance index	Ranking
At users request/ complaints	0.90	1
When there is a significant deterioration in facilities	0.80	2
Based on condition survey report on facilities	0.80	2
At the end of facility useful life as recommended by manufacturer	0.70	4
At failure point at which facilities cannot perform	0.70	4
Works executed at predetermined regular plan interval	0.70	4

This suggests that maintenance units mostly decide on maintenance strategy to be used to carry out maintenance activities when users' put up a request. This implies that most facilities reported for maintenance could have failed before being restored. It also implies that maintenance works were carried out on facilities based on condition survey reports or, better still, on facilities when deterioration was evidenced.

4.6.4 Maintenance Planning used for Prison Facilities

Table 4.23: Information maintenance guide for prison Facilities

Information Maintenance Guide	Respondents			
	No		Yes	
	N	%	N	%
Maintenance manual guide	2	40	2	40
Maintenance asset inventory	1	20	3	60
Maintenance logbook	3	60	2	40
Maintenance work schedule	2	40	3	60

Table 4.23 reveals that 40% of the respondents indicated that there was maintenance manual for guiding maintenance operatives while another 40% indicated otherwise. Study shows that 60% of the respondents indicated that the maintenance unit prepared an asset inventory while 20% indicated otherwise. Further, 40% of the respondents indicated that the maintenance unit used a maintenance logbook while 60% stated otherwise. Sixty percent (60%) of the respondents indicated that the maintenance unit developed a work schedule while 40% stated otherwise. This indicates absence of substantial planning before execution of maintenance activities. It implies that the ideal procedures that ought to be followed and adhered to by maintenance operatives executing maintenance works could be altered. It also implies that maintenance activities are somewhat decided upon in error.

Table 4.24: Reasons for Non-Conversion of Work Requests

Reasons for non-conversion of work request	Relative Importance Index	Ranking
Financial constraints	0.90	1
Personnel constraints	0.75	2
Inadequate tools/equipment	0.63	3
Inadequate materials/spare parts	0.63	3
Statutory limitations	0.63	3
Conflict with other works	0.50	6
Conflict with policy	0.50	6

Table 4.24 shows the reasons for non-conversion of a work request to work order. Maintenance managers ranked financial constraint first (RII = 0.9) and personnel constraints second (RII = 0.75). Financial constraint and personnel constraints were among the cogent reasons for not converting work requests. This implies insufficient funds and manpower to execute maintenance works. Hence, some work requests could be deferred or returned to users with explanations. This suggests that maintenance work requests posted by users' of prison facilities might not be planned according to their maintenance needs but based on the available maintenance resources. For example, maintenance of facilities is not actually carried out based on users' needs but according to the financial situation of the organisation (Abd Rani et al., 2015).

4.6.5 Maintenance Budget used for Prison Facilities

The study also sought responses on method of arriving at budget, sources of grant, level of funding available for maintenance unit and performance of maintenance unit in terms of staff strength, experiences and competency.

Table 4.25: Maintenance budget for Prison facilities

Maintenance budget	Frequency	(%)
<u>Method of arriving at budget</u>		
A fixed % of original construction cost adjusted for inflation	1	25
A fixed % of the current value of facilities	1	25
Budget based on the actual maintenance need of facilities via condition survey	2	50
Budget based on cost of maintenance activities by adding labour hour, materials, equipment and contracting cost	2	50
<u>Grant from other sources</u>		
Yes	-	-
No	4	80
<u>Level of funding</u>		
Average	3	60
Adequate	2	40

Table 4.25 shows the frequency of methods used in arriving at maintenance budget. It reveals that no grants from any other source made up the maintenance budget and that the level of funding for the Prison Service was fairly adequate for maintenance operations. This implies that maintenance budget was absolutely funded by government. The study equally accessed quantitative data on maintenance budget allocations and inmates' population from the Budget

Office of the Federation as well as the Statistics Unit of the National Headquarters, Nigerian Prison Service.

4.6.6 Maintenance budget per Inmate

To quantify the maintenance budget per inmate, a graduated scale of 1-5 was used, with the following ratings: less than N1000 = extremely low (1); N1000 to less than N3000 = quite low (2); N3000 to less than N5000 = slightly low (3); N5000 to less than N7000 = slightly high (4) and N7000 and above = high (5). See table 4.29

4.6.7 Performance of Maintenance Unit

Table 4.26: Performance Rating of Maintenance Unit

Ratings of performance	N	Percentage (%)
Average	2	40
Good	2	40
Very good	1	20

Performance of the maintenance unit based on staff strength, experiences and competency was rated on a 1-5 scale: very good (5), good (4), average (3), bad (2), very bad (1). Two of the managers (40%) rated their performance average. Another two of the managers (40%) rated their performance to be good while one manager rated performance to be very good. The variation in opinion shows that the real position of efficiency is not depicted.

Table 4.27: Maintenance Budget Allocation (in Naira) for Prison Facilities

Maintenance service general	2007	2008	2009	2010	2011	2012
Maintenance of motor vehicles	45,989,800	48,289,290	48,289,290	53,118,219	64,968,368	52,469,566
Maintenance of office furniture	11,877,032	12,470,883.6	12,470,884	13,717,972	22,291,892	18,003,314
Maintenance of office building/ residential quarters					81,900,000	66,143,842
Maintenance of computer & IT	44,764,000	47,002,200	47,002,200	51,702,420	50,096,543	40,458,826
Maintenance of plants/ generator	17,600,000	18,480,000	18,480,000	20,328,000	19,696,612	15,907,321
Other maintenance services	10,586,400	161,115,720	151,115,720	100,227,292	759,150,513	563,102,950
Total	130,817,232	287,358,093.6	277,358,094	239,093,903	998,103,928	756,085,819

Source: Budget Office of the Federation, Federal Republic of Nigeria

Table 4.27 presents prison maintenance budget figures as presented by the Budget Office of the Federation from 2007 to 2012.

Table 4.28: Nigerian Prison Inmate Population

Terms of imprisonment	2007	2008	2009	2010	2011	2012
Awaiting trial	86,525	82,125	80,664	88,696	66,920	98,929
Short term	38,817	20,992	40,105	36,703	22,564	17,760
Long term	2,900	25,826	32,169	44,887	35,123	16,648
Condemned	16	92	31	56	72	117
Detainees	276	314	1,754	471	2,181	1,107
Others	4,784	1,435	1,628	1,068	4,672	3,282
Total	133,318	130,784	156,351	171,881	131,532	137,843

Source: Statistics Unit, National Headquarters Nigerian Prison Service.

Table 4.28 presents Nigerian inmates' population as presented by Nigerian Prisons Service respectively from 2007 to 2012.

Table 4.29: Prison Maintenance Budget per Inmate per annum

Prison budget/population (Naira)	2007	2008	2009	2010	2011	2012
Maintenance budget	130,817,232	287,358,093.6	277,358,094	239,093,903	998,103,928	756,085,819
Inmates population	133,318	130,784	156,351	171,881	131,532	137,843
Maintenance budget per inmate	981.24	2,197.20	1,773.95	1,391.04	7,588.30	5,485.12

Table 4.29 shows the prison maintenance budget per inmate. This shows whether maintenance budget was on the increase or decrease putting into cognizance the inmate population. The table reveals no steady increase of maintenance budget except for 2011.

4.6.8 Hypothesis Three B

Null Hypothesis: There is no significant relationship between maintenance budget per inmate and performance of maintenance unit.

Alternative Hypothesis: There is significant relationship between maintenance budget per inmate and performance of maintenance unit.

Test for the relationship between maintenance budget per inmate and performance of maintenance unit was carried out using the information on table 4.29 and 4.26 respectively.

Table 4.30: Spearman's Rho Correlation Coefficient between Prison Maintenance Budget per Inmate and Performance of Maintenance Unit

		MTCEBUDGET	PERFMTCE
MTCEBUDGET	Correlation coefficient	1.000	.825
	Sig. (2-tailed)		.086
	N	6	5
PERFMTCE	Correlation coefficient	.825	1.000
	Sig. (2-tailed)	.086	
	N	5	5

** MTCEBUDGET = Prison maintenance budget per inmate, PERFMTCE = Performance of maintenance unit*

Table 4.30 indicates that maintenance budget per inmate and performance of the maintenance unit are not significantly correlated at $r = 0.825$, $p > 0.05$. Therefore, the null hypothesis was accepted. The finding aligns with Adenuga's (2014) study on the relationship between level of funding of hospital buildings and performance of the maintenance department. This implies that fund

provided for maintenance unit does not guarantee an efficient maintenance unit. This suggests that other maintenance management measures such as maintenance policy, planning, choice of strategy, logistical support (people, systems, tools, good advice and training resources) and financial factors (labour hour rate, cost of materials, plant and equipment) could also be essential to enhance the performance of the prison maintenance unit in South-West, Nigeria.

4.7 Performance of Prison Facilities in South-West, Nigeria.

4.7.1 Satisfaction of Prison Non-Maintenance Staff with Prison Facilities

This is to assess the satisfaction ratings of prison non maintenance staff on the performance of prison facilities using identified performance criteria (Adewunmi, Omirin, Famuyiwa & Farinloye, 2010) on a Likert scale and interpreted on a graduated scale 1– 5: $1.00 \leq MS < 1.49$ means high dissatisfaction, $1.50 \leq MS < 2.49$ means dissatisfaction, $2.50 \leq MS < 3.49$ means partial satisfaction, $3.50 \leq MS < 4.49$ means satisfaction and $4.50 \leq MS \leq 5.00$ means high satisfaction.

Table 4.31 shows the satisfaction ratings of prison non-maintenance staff in various prisons across states in South-West, Nigeria. Prison non-maintenance staff of Lagos prisons, Ogun prisons, Oyo prisons, Osun prisons and Ondo prisons showed satisfaction with the level of cleanliness in the prison at mean scores of 3.75, 3.92, 4.03, 3.73 and 3.91 respectively while prison non-maintenance staff of Ekiti prison showed partial satisfaction at a mean score 3.33.

Prison non-maintenance staff of Ogun prisons, Osun prisons, and Ondo prisons showed satisfaction with control of ventilation by means of windows at the mean score of 3.62, 3.74 and

3.69 respectively. Prison non-maintenance staff in Lagos prisons, Oyo prisons and Ekiti prison also showed partial satisfaction with control of ventilation by means of windows.

The results also showed that there was partial satisfaction with use of modern security gadgets (CCTV, alarm system, voice speakers, digital video recorder) by prison non-maintenance staff of Lagos, Ogun, Osun, Ondo and Ekiti prisons at mean scores of 2.64, 2.51, 2.79, 2.87 and 2.76 respectively as well as dissatisfaction by prison non maintenance staff of Oyo prisons at a mean score of 2.40. There was also partial satisfaction with ease of communication (telephone lines, internet facilities, voice speakers, etc.) by the non-maintenance staff of Lagos, Ogun, Oyo, Osun, Ondo and Ekiti prisons at mean scores of 2.77, 2.61, 2.51, 2.59, 2.88 and 2.67 respectively. This implies that the Prison Service should shift to use of modern security gadgets, as there use allowed for total area coverage of prisons at a glance. This acts as a proactive mechanism in sighting attacks like prison breaks (e.g. Boko Haram) from afar and allowing for readiness to combat such.

Basically, in Lagos prisons non-maintenance staff showed satisfaction with only level of cleanliness but showed partial satisfaction with performance of all other prison facilities. In Ogun prisons, non-maintenance staff showed satisfaction with facilities such as level of cleanliness of environment, control of ventilation by means of windows and quality of water while they showed partial satisfaction with all other prison facilities.

Table 4.31: Performance of Prison Facilities as Perceived by Non-Maintenance Staff in South-West, Nigeria

Performance criteria	Lagos prisons		Ogun prisons		Oyo Prisons		Osun prisons		Ondo prisons		Ekiti Prison		Pooled Mean score	Over all Rank
	Ms	R	Ms	R	Ms	R	Ms	R	Ms	R	Ms	R		
Quality of space														
Level of cleanliness in the prison environment	3.75	1	3.92	1	3.73	2	4.03	1	3.91	1	3.33	3	3.82	1
Waste removal	3.23	9	3.34	8	3.62	3	3.54	12	3.48	11	3.00	10	3.37	7
Adequacy of artificial and natural lighting	3.27	7	3.39	7	3.18	19	3.37	18	3.55	7	3.37	1	3.37	7
Control of ventilation by means of windows	3.45	2	3.62	2	3.33	9	3.74	3	3.69	3	3.37	1	3.55	3
Odour of environment	3.12	14	3.48	5	2.96	25	3.63	9	3.34	23	2.60	30	3.24	15
Comfort level in building	3.13	13	3.10	21	3.16	20	3.63	9	3.50	10	3.03	9	3.26	14
Space for meeting with visitors	3.38	3	3.21	15	3.33	9	3.71	5	3.52	9	3.20	6	3.39	6
Sound insulation	3.01	23	2.87	26	2.98	24	3.12	29	3.30	26	2.63	29	3.02	25
Furniture arrangement	3.05	18	2.76	28	2.88	28	3.16	27	3.35	22	2.80	21	3.02	25
Quality of exterior of building	3.36	5	3.18	17	3.11	23	3.67	7	3.59	6	2.90	15	3.34	9
Quality of interior of building	3.31	6	3.24	13	3.14	22	3.42	14	3.62	5	2.96	12	3.33	10
Quality of water	3.37	4	3.54	3	3.77	1	3.83	2	3.70	2	3.21	5	3.57	2

Table 4.31: Performance of Prison Facilities as Perceived by non Maintenance Staff in South-West, Nigeria (Contd.)

Performance criteria	Lagos prisons		Ogun prisons		Oyo prisons		Osun prisons		Ondo prisons		Ekiti prison		Pooled Mean score	Over all Rank
	Ms	R	Ms	R	Ms	R	Ms	R	Ms	R	Ms	R		
Fire safety	2.84	28	2.70	30	2.91	27	3.35	19	3.30	26	2.83	19	2.97	30
Security (CCTV, alarm system, voice speakers, digital video recorder e.t.c.)	2.64	32	2.51	32	2.40	32	2.79	31	2.87	32	2.76	25	2.66	32
Ease of communication (telephone, internet facilities, voice speakers' e.t.c.)	2.77	31	2.61	31	2.51	31	2.59	32	2.88	31	2.67	28	2.70	31
Exit route in case of emergency	2.92	26	2.75	29	2.80	30	3.23	25	3.32	25	2.80	21	2.98	28
Vehicular access	3.20	11	3.24	13	3.43	5	3.61	11	3.47	12	2.90	15	3.31	11
Adequacy of car park	3.22	10	3.49	4	3.22	15	3.67	7	3.54	8	3.23	4	3.44	4
Response to complaints/repairs														
Procedure for reporting defects and getting work done	2.98	25	3.26	10	3.27	13	3.38	17	3.41	17	2.83	19	3.20	19
Time taken by maintenance unit to responds to complaints	2.90	27	2.87	26	2.95	26	3.28	23	3.14	30	3.00	10	3.00	27

Table 4.31: Performance of Prison Facilities as Perceived by Prison non Maintenance Staff in South-West, Nigeria (Contd.)

Performance criteria	Lagos prisons		Ogun prisons		Oyo prisons		Osun prisons		Ondo prisons		Ekiti Prison		Pooled Mean score	Over all Rank
	Ms	R	Ms	R	Ms	R	Ms	R	Ms	R	Ms	R		
Behaviour of maintenance unit staff	3.03	20	3.20	16	3.37	8	3.69	6	3.44	15	2.93	13	3.26	13
Level of maintenance backlog (i.e. defect you have reported but yet to be done)	2.80	29	2.96	23	2.88	28	3.14	28	3.24	29	2.70	27	2.98	28
Level of nuisance (i.e disturbance and interference with your privacy by maintenance staff)	3.06	16	3.00	22	3.32	11	3.29	21	3.40	18	2.87	18	3.16	21
Maintenance task related indicators														
Asset inventory (i.e the way maintenance staff identify physical features that require maintenance	3.02	22	3.14	18	3.30	12	3.24	24	3.40	18	2.93	13	3.18	20
Ability of maintenance department to prioritize maintenance needs with available resources	3.02	22	3.26	10	3.19	18	3.39	16	3.44	15	2.79	24	3.21	17

Table 4.31: Performance of Prison Facilities as Perceived by Prison non Maintenance Staff in South-West, Nigeria (Contd.)

Performance criteria	Lagos prisons		Ogun prisons		Oyo prisons		Osun prisons		Ondo prisons		Ekiti Prison		Pooled Mean score	Over all Rank
	Ms	R	Ms	R	Ms	R	Ms	R	Ms	R	Ms	R		
Speed of work (i.e repairs time)	3.01	24	3.12	19	3.20	16	3.03	30	3.40	18	3.10	7	3.16	22
Quality of work done by maintenance staff	3.19	12	3.42	6	3.52	4	3.72	4	3.66	4	3.07	8	3.43	5
Ability to react to emergency maintenance	3.06	16	3.08	21	3.16	20	3.29	21	3.34	23	2.80	21	3.14	23
Ability to perform routine maintenance	3.24	8	3.12	19	3.40	7	3.42	14	3.45	14	2.90	15	3.27	12
Cost related indicators														
Money spent reporting faults	3.05	18	3.30	9	3.20	16	3.43	13	3.46	13	2.73	26	3.24	16
Cost of transporting maintenance staff	3.10	15	3.26	10	3.41	6	3.32	20	3.39	21	2.41	32	3.21	18
Money spent on purchasing minor parts	2.79	30	3.01	24	3.25	14	3.19	26	3.27	28	2.50	31	3.03	24
Grand mean	3.09		3.15		3.18		3.40		3.41		2.91		3.21	

*MS=mean score, R=ranking

Interpretation scale: $1.00 \leq MS < 1.49$ means high dissatisfaction, $1.50 \leq MS < 2.49$ means dissatisfaction, $2.50 \leq MS < 3.49$ means partial satisfaction, $3.50 \leq MS < 4.49$ means satisfaction and $4.50 \leq MS \leq 5.0$ means high satisfaction.

Prison non-maintenance staff in Oyo prisons showed satisfaction with quality of water, level of cleanliness of prison environment, waste removal and speed of completing repair works. They also showed partial satisfaction with all other facilities except security gadgets for which they showed dissatisfaction.

In Osun prisons, prison non-maintenance staff showed satisfaction for level of cleanliness of environment, quality of water, control of ventilation by means of windows, quality of work done by maintenance staff, space for meeting visitors and behavior of maintenance staff. They showed satisfaction for adequacy of car park, quality of exterior of buildings, odour of environment, comfort level of buildings, vehicular access, waste removal and showed partial satisfaction with all other facilities.

Prison non-maintenance staff in Ondo prisons showed satisfaction with facilities such as level of cleanliness of prison environment, quality of water, control of ventilation by means of windows, quality of work done by maintenance staff and quality of interior of buildings. They showed satisfaction with quality of exterior of buildings, adequacy of artificial and natural lighting, adequacy of car park, comfort level in buildings and space for meeting visitors while they showed partial satisfaction with all the other facilities. In Ekiti prison, non-maintenance staff showed partial satisfaction with all other prison facilities but showed dissatisfaction with cost of transporting maintenance staff. In general, prison non-maintenance staff were just satisfied with the performance of a small number of prison facilities, such as level of cleanliness of prison environment, quality of water and control of ventilation by means of windows.

Basically, they were partially satisfied with a good number of prison facilities. This suggests low performance of prison facilities and could be a cogent reason why Nigerian prison facilities are perceived as places of punishment. This implies that extensive renovation, refurbishment, repairs and upgrading of prison facilities are inevitable.

4.7.2 Hypothesis Four A

Null Hypothesis: There is no agreement among prison non-maintenance staff in their satisfaction rating of prison facilities in South-West, Nigeria.

Alternative Hypothesis: There is agreement among prison non-maintenance staff in their satisfaction rating of prison facilities in South-West, Nigeria.

Table 4.32: Kendall's Coefficient of Concordance Test of Agreement on Satisfaction Rating of Performance of Prison Facilities

No of cases	Kendall's W	Chi-square	Df	P-value.
255	0.75	596.115	31	0.001

A non-parametric Kendall's coefficient of concordance test for satisfaction ratings of prison facilities based on identified performance criteria was conducted. The result indicated that there was an agreement in the satisfaction ratings of performance of prison facilities at $P < 0.05$ levels; hence, the null hypothesis was rejected. This result is in agreement with findings on the measurement of performance of hostel facilities (Adewunmi et al. 2010), the slight difference being only the type of facility studied.

4.7.3 Expectations and Perceived Quality of Maintenance Services for Prison Facilities

To measure the relationship between expectations and the perceived quality of maintenance service for prison facilities, prison non-maintenance staffs were asked to assess eight variables of quality of maintenance service (Sui, Bridge & Skitmore, 2001; Arditi & Lee, 2002).

To quantify the extent of agreement on expectations and perceived quality maintenance service, a graduated scale of 1 – 5 was used for interpretation; $1.00 \leq MS < 1.49$ means strongly disagree, $1.50 \leq MS < 2.49$ means disagree, $2.50 \leq MS < 3.49$ means partially agree, $3.50 \leq MS < 4.49$ means agree, and $4.50 \leq MS \leq 5.00$ means strongly agree.

Table 4.33: Difference between Expectations and Perceived Quality of Maintenance Service

Quality of maintenance service attributes	Prison non maintenance staff		Difference between expectations and perceived
	Expectations mean score	Perceived mean score	
Up-to-date equipment/ facilities	3.65	3.17	0.48
Neat appearance of staff	3.67	3.44	0.23
Sincere interest in solving maintenance problems	3.95	3.63	0.32
Prompt responses and services	3.79	3.39	0.40
Perform repairs right at first attempt	3.53	3.31	0.22
Courtesy for users of facilities	3.65	3.54	0.11
Convenient operating hours for users	3.47	3.36	0.11
Meeting users' maintenance needs	3.57	3.43	0.14
Pooled mean	3.66	3.40	0.26

Table 4.33 shows that prison non-maintenance staff expectations were higher than their perceived quality of maintenance services. The result showed that for quality of maintenance services (courtesy for users of facilities, convenient operating hours for users and up-to-date equipment/ facilities) the difference between expectations and the perceived quality of maintenance services were 0.11, 0.11 and 0.48 respectively.

This also suggests that the Prison Service (Maintenance Unit) ought to provide adequate and right equipment/plant as well as good working facilities for prison maintenance staff to enhance productivity. There is also need to put in place a structure for prompt responses to maintenance requests and for getting the job done correctly at every first attempt.

4.7.4 Hypothesis Four B

Null Hypothesis: There is no significant difference between prison non-maintenance staff expectations and perceived quality of maintenance services.

Alternative Hypothesis: There is significant difference between prison non-maintenance staff expectations and perceived quality of maintenance services.

In Table 4.34, a t- test was carried out to establish the mean difference of the responses of prison non maintenance staff on their expectations and the perceived quality of maintenance services.

The t-test for up-to-date equipment/facilities showed a significant difference (0.477) for the mean score between expectation (3.65) and perceived performance (3.17); $t(366) = 6.646$, $p < 0.05$. Therefore, the null hypothesis was rejected. Since the significance is less than 0.05 ($p < 0.05$). The t-test for neat appearance of maintenance staff showed a significant difference (0.232)

for the mean score between expectation (3.67) and perceived performance (3.44); $t_{(366)} = 4.135$, $p < 0.05$ Therefore, the null hypothesis was rejected.

For sincerity of solving maintenance problems, the t-test showed a significant difference (0.316) for the mean score between expectation (3.95) and perceived performance (3.63); $t_{(366)} = 5.258$, $p < 0.05$ Therefore, the null hypothesis was rejected. For prompt responses to users' request, the t-test showed a significant difference (0.401) for the mean score between expectation (3.79) and perceived performance (3.39); $t_{(366)} = 5.757$, $p < 0.05$ Therefore, the null hypothesis was rejected. The t-test for performing repairs right at first attempt showed a significant difference (0.217) for the mean score between expectation (3.53) and perceived performance (3.31); $t_{(354)} = 3.538$, $p < 0.05$. Therefore, the null hypothesis was rejected.

The t-test for courtesy for users' of facilities showed a significant difference (0.116) for the mean score between expectation (3.65) and perceived performance (3.54); $t_{(362)} = 2.115$, $p < 0.05$. Therefore, the null hypothesis was rejected. The t-test for meeting maintenance need of users' showed a significant difference (0.142) for the mean score between expectation (3.57) and perceived performance (3.43); $t_{(366)} = 2.369$, $p < 0.05$. Therefore, the null hypothesis was rejected. However, the t-test for conveniences in operating hours for users showed no significant difference (0.104) for the mean score between expectation (3.47) and perceived performance (3.36); $t_{(363)} = 1.763$ with a p-value of 0.079 at 95% confidence level. Therefore, the null hypothesis was accepted.

Table 4.34: Paired t-test for Expectations and Perceived Quality of Maintenance Services

Quality of Maintenance Services Attributes	Paired difference			T	Df	Sig.	decision
	Mean	Std. deviation	Std Error mean				
Up-to-date equipment/ facilities	0.477	1.375	0.072	6.646	366	.001	Reject H _O
Neat appearance of maintenance staff	0.232	1.073	0.056	4.135	366	.001	Reject H _O
Sincere interest in solving maintenance problems	0.316	1.152	0.060	5.258	366	.001	Reject H _O
Prompt responses and services to users' request	0.401	1.333	0.070	5.757	366	.001	Reject H _O
Perform repairs right at first attempt	0.217	1.155	0.061	3.538	354	.001	Reject H _O
Courtesy for users of facilities	0.116	1.042	0.055	2.115	362	.035	Reject H _O
Convenient operating hours for users	0.104	1.131	0.059	1.762	363	.079	Accept H _O
Meeting users' maintenance needs	0.142	1.146	0.060	2.369	366	.018	Reject H _O
Overall quality of maintenance services	0.240	0.792	0.429	5.606	339	.001	Reject H _O

Overall, the t-test showed a significant difference (0.240) for the mean score between expectations (3.66) and perceived performance (3.40); $t_{(339)} = 5.606$, $p < 0.05$. Therefore, the null hypothesis was rejected. It suggests that there is a significant difference between expectations and perceived quality of maintenance services in prisons in South-West, Nigeria. This implies that satisfaction is not achieved with regard to the quality of maintenance services provided by the maintenance unit.

4.7.5 Hypothesis Four C

Null Hypothesis: Condition of prison facilities does not predict performance of prison facilities.

Alternative Hypothesis: Condition of prison facilities does predict performance of prison facilities.

Table 4.35: Regression Analysis of impact of Condition of Prison Facilities on Performance of Prison Facilities

Variable	Unstandardized coefficient		T	Sig.	R2/ Adjusted
	Unstdz Beta	Std Error			R square
Performance of prison facilities (PPF)					
Constant	.795	.200	3.969	0.000	.492/.489
Condition of prison facilities (CPF)	.750	.060	12.517	0.00	F = 156.677 P = 0.001

The condition of facilities is a typical way of measuring the performance of facilities (Wahida et al., 2012). The condition of the prison facilities was used for predicting the performance of the facilities. A linear regression was calculated to predict the performance of prison facilities based on the condition of prison facilities. According to Field (2009), R^2 value of 0.01 is of a small effect, 0.09 is of a medium effect and of 0.25 is of a high effect. The R^2 value of this study is of high effect.

Table 4.35 shows the value of the constant β_0 and the regression coefficient of the independent variable. The equation of the model is obtained from the regression formula.

$$Y = \beta_0 + \beta_1 X + \epsilon$$

$$\text{That is, PPF} = \beta_0 + \beta_1 \text{ CPF} + \epsilon$$

Where PPF = Performance of prison facilities; CPF = Condition of prison facilities

β_0 = Constant; β_1 = Coefficient determinant of independent variable and ϵ = error

The regression equation of the relationship between PPF and CPF is hereby stated as:

$$\text{PPF} = .795 + .750\text{CPF}$$

Thus, there was a positive relationship between condition of prison facilities and their performance. This suggests that prison staff and prisoners are likely to perform better if they are in facilities that are in the best of condition.

4.7.6 Model Validation

Cross validating of model is the process through which one ensures that the model actually measures what it is required to measure. The model was validated using coefficient of determination (R^2) and adjusted R^2 . The aim of validating the model was to ascertain the accuracy and extent at which condition of prison facilities and performance of facilities relates. The adjusted R^2 indicates the extent to which the model can be generalized to the population and should be close to the R^2 . The difference between adjusted R^2 and R^2 must be within 5% (Field, 2009). The difference is 0.6%, this indicates a good cross validation of model.

4.8 Framework for Maintenance of Prison Facilities

4.8.1 Proposed framework for maintenance of prison facilities

The framework proposes to assist prison maintenance staff to achieve their prison maintenance objectives. It sets out to outline the various maintenance activities/maintenance jobs to be employed to keep prison facilities in a condition to provide a safe and decent environment for prison staff, inmates and all other people interacting with the prison facilities.

Further, it ensures that prison facilities are well maintained to create an environment capable of supporting the goals of the Nigerian Prison Service (reformation, correction and rehabilitation).

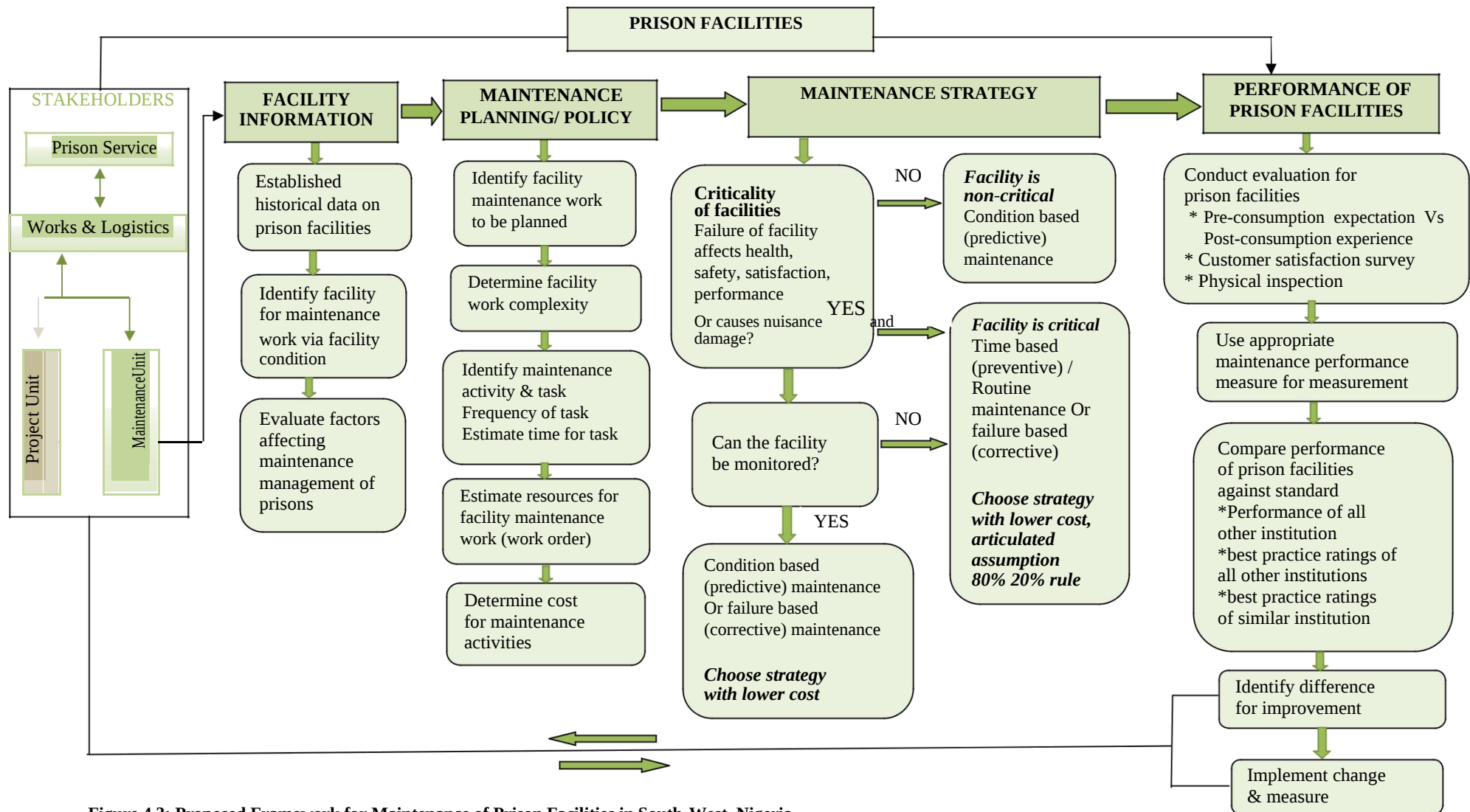


Figure 4.3: Proposed Framework for Maintenance of Prison Facilities in South-West, Nigeria

The phases of the framework include facility information, maintenance planning and policy, as well as maintenance strategy and maintenance performance. Each of the phases further explains the various activities that need to be carried out in achieving the maintenance objectives of the Prison Service in relation to the facilities.

In the facility formation phase, the framework sought the prison facility data and evaluated those factors acting as a barrier to the maintenance of prison facilities. The maintenance policy and planning phases entailed the planning of maintenance works, complexity of the work, allocations of maintenance resources and cost of maintenance. The maintenance strategy phase focused on the types of maintenance strategy practiced as well as factors that are considered before selecting a particular maintenance strategy.

Performance of prison facilities phase evaluated the prison facilities via customer satisfaction and quality of maintenance services. The phase identified difference for improvement of prison facilities. This is a proposed framework for maintenance of prison facilities that is subject to review and improvement.

4.8.2 Developed Framework for Maintenance of Prison Facilities

Figure 4.4 breaks the four key phases of the maintenance management framework (box with dark shading) into sub-steps (box with lighter shading) and shows the main processes that are directly linked. The phases include prison facility, which is to the ascertain condition of facilities. It includes factors affecting maintenance management, maintenance management practiced and maintenance performance.

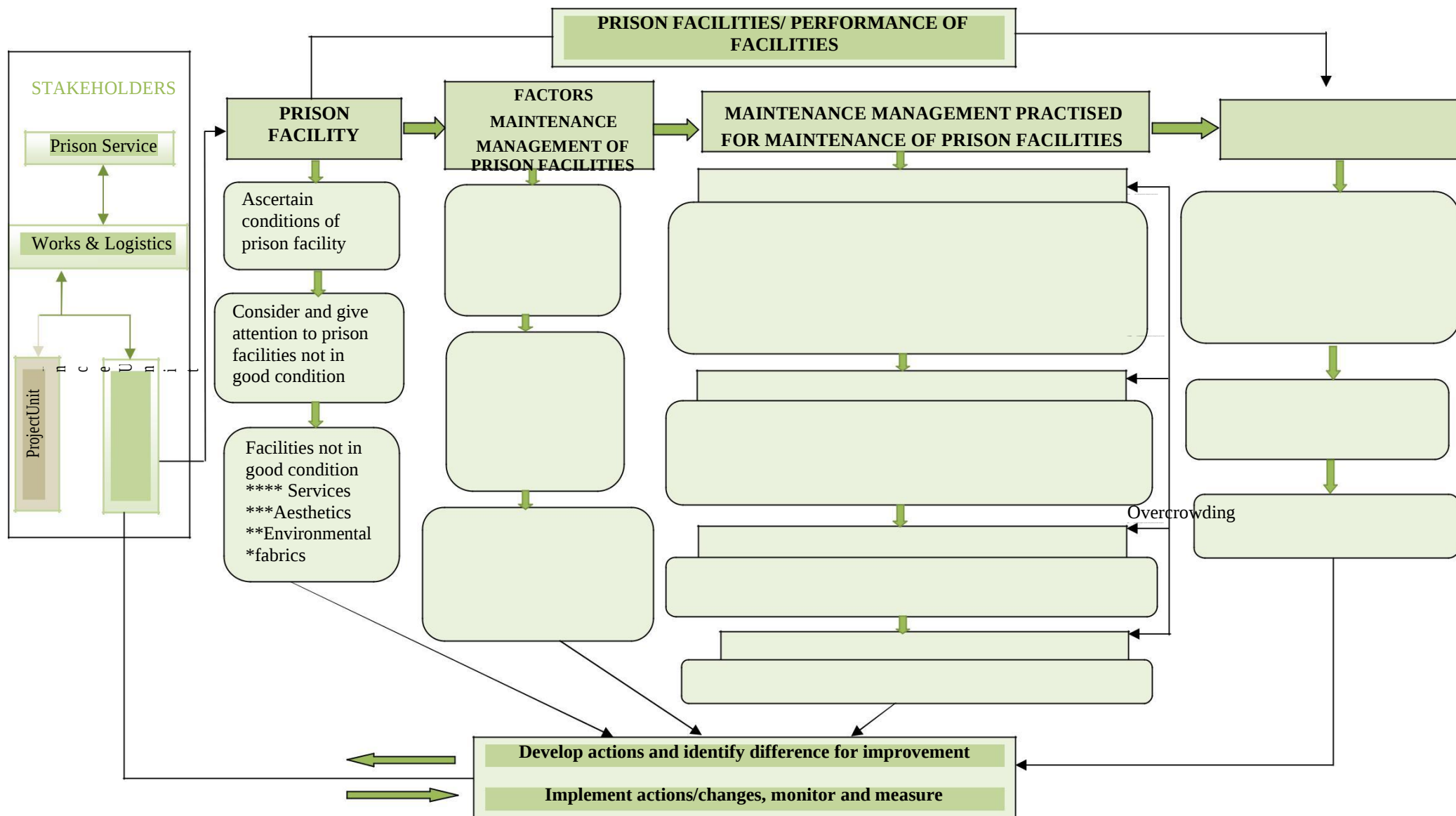


Figure 4.4: Developed Framework for Maintenance Management of Prison Facilities in South-West, Nigeria.

Figure 4.4 shows the four phases of the framework with the various activities to be undertaken under each phase. The bottom arrow links develop actions/differences for improvement and implementing actions/changes to the Maintenance Unit (facility). This indicates that the framework process is cyclical as findings and measures to retaining or restoring facilities for better performance need to be fed into the maintenance objectives of the maintenance unit.

The framework that is developed in this study takes its clue from Riis et al. (1997) that designed a situational maintenance model for an industrial enterprise where the process of maintenance was discussed. Also from Mojela (2013) that highlighted the maintenance roles of various stakeholders in the multi-stakeholder framework for the maintenance of public schools.

The framework assesses the physical condition of facilities and examines the predominant barriers to maintenance of facilities. It elaborates on the maintenance tasks for facilities and considers the resources at the disposal of the maintenance unit. It proposes specific maintenance strategies for facilities and essentially evaluates their performance. The framework explains the relationship among prison organisational structures in prisons and the roles of stakeholders while detailing the need for communication throughout the procedures. Although Riis et al.'s model was developed in the industrial sector and Mojela's model was developed in the educational sector, this framework adapts the model to another field, that is, the Prisons Service in South-West, Nigeria. The focus of the model is on the facilities, as showed in the figure makes this framework easily accessible to prison maintenance staff in the maintenance unit.

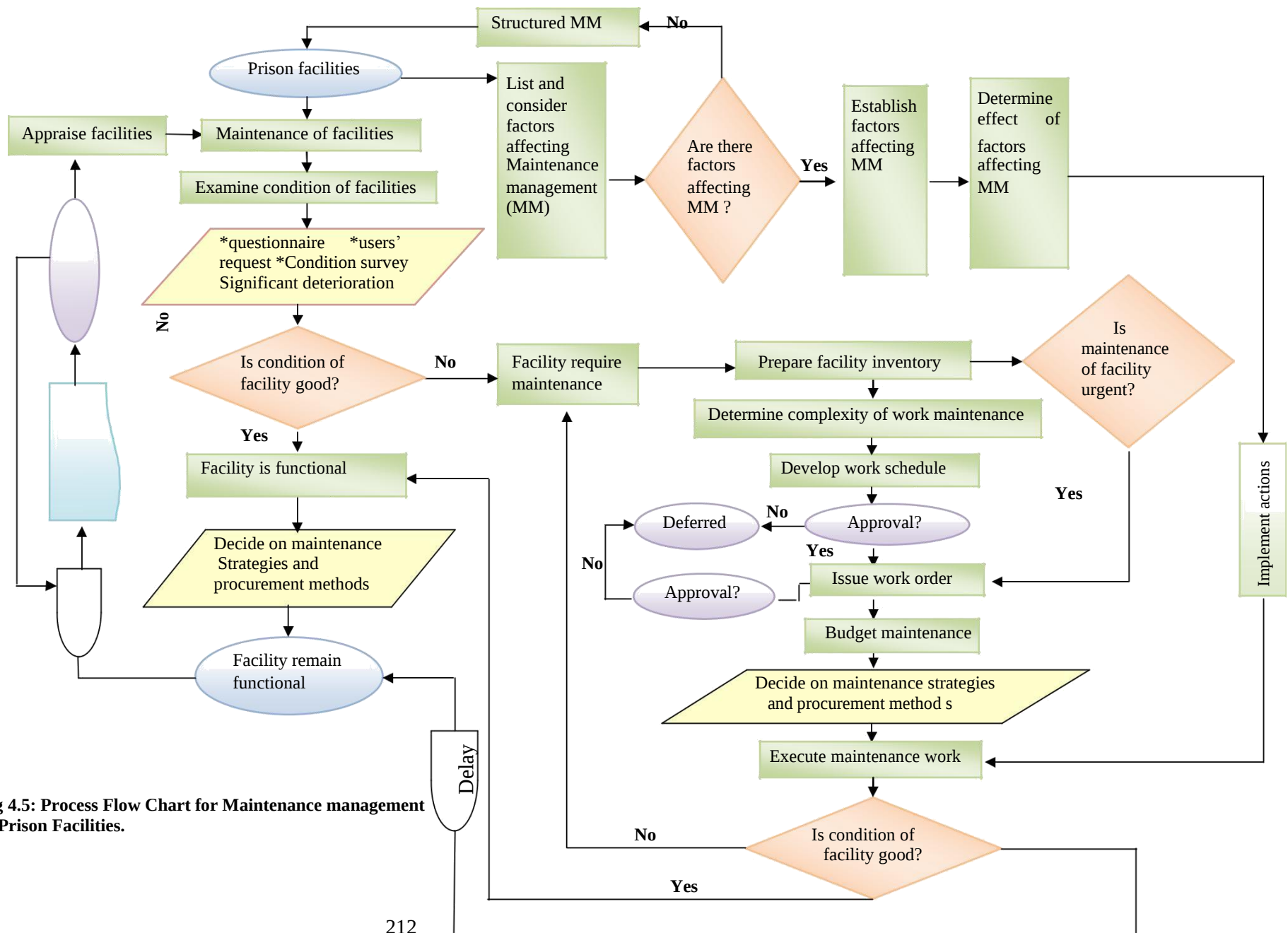


Fig 4.5: Process Flow Chart for Maintenance management of Prison Facilities.

The process flow chart for maintenance management of prison facilities was also developed for easy understanding of the framework by the staff. This is a process chart indicating the sequence of the flow of the process by recording all the events with the help of process chart symbols as depicted in figure 4.5.

The process starts with ascertaining the condition of prison facilities. From the study carried out perception on prison facilities were used to ascertaining the condition of prison facilities. There are other means of ascertaining the condition as suggested. These are condition survey, users' maintenance request of facilities, and significant deterioration of facilities. Either the condition of the facility is good or bad there is need for maintenance. Facility that is in good condition must remain in good state and must be duly maintained. When deciding on the maintenance strategy, it is necessary to know whether the facility is critical or non-critical. For critical facilities preventive and routine maintenance might be adequate.

Factors affecting maintenance management of prison facilities are to be examined to establish the dominant factors and also the significant relationship among factors. Findings from this study have indicated significant relationship among deterioration due age of facility, delay in reporting failure and executing maintenance works. Information on these factors examined will give an insight on the specific factors that are expected to be considered and controlled. Especially, during planning and implementation of maintenance activities by Maintenance unit, Works and Logistic department, and the Nigerian prisons service.

Prison facilities that have been identified to be in a bad condition require maintenance. Facility inventory for facility requiring maintenance provides information on the physical features and the status of such facility. Like in this study, it was found out that most of the

facilities classified as services are either rated average or bad. Keeping an inventory of items such as firefighting equipment, alarms and detectors and performing routine checks will ensure that they are functional when needed. Maintenance works identified to be urgent, especially where the facility is critical should be executed immediately.

The complexity of maintenance is determined and the work schedule is developed. Approval for maintenance works from the relevant authority might be required. The next action is the work order. This identifies what and where maintenance tasks are to be carried out and the maintenance staff to carry out the tasks. Estimate cost of maintenance activities such as labour hour, materials and spare parts etc. Finally, decide on methods of executing and execute maintenance works.

Essentially, maintenance management covers different stages in the lifecycle of a facility, acquiring, planning, operation, performance evaluation, replacement and disposal. The performance of the facilities is evaluated by utilising performance indicators to assess the satisfaction derived from the use of the prison facilities.

4.8.3 Application of Developed Maintenance Management Framework

4.8.3.1 Prison Facility

Ascertain condition of prison facilities

This involves categorising prison facilities into basic components/elements. That is, into fabrics, services, aesthetics and environment as categorised in this study. The current physical condition of each of the prison facilities can also be ascertained via the perception of users, user maintenance request or through condition survey.

Consider state of prison facilities

This involves identifying the current condition of prison facilities with maintenance objectives being linked to those of the Prison Service. Here the maintenance manager should identify facilities that are not in good physical condition. Such bad facilities should be given adequate maintenance. This could be achieved by paying attention to the condition of facilities, users' maintenance requests, visible deterioration of facilities, and manufacturer's useful life for auxiliary facilities etc.

4.8.3.2 Factors affecting maintenance management of prison facilities

This step involves evaluating the factors affecting maintenance of facilities. It is important for the maintenance manager and maintenance unit to determine the effect of these factors on maintenance of prison facilities. Some of the critical factors found in this study were deterioration due to age of facilities, overcrowding, inadequate training and development for maintenance staff, insufficient funding and inadequate plant and equipment for maintenance operations. The effect of factors on maintenance management is likely to vary in terms of prison locations.

4.8.3.3 Maintenance Management Practice

4.8.3.3.1 Maintenance Policies

Adherence to clear maintenance policy

The maintenance manager is expected to define the scope of the maintenance problem, the standards of repairs to be achieved, lower and steadier levels of expenditure (estimating the cost of maintenance works) and the intended methods to carry out the maintenance works/jobs.

Facility inspections

The maintenance unit of the Prisons Service should ensure correct diagnosis of facilities at the right time (planning inspection of maintenance work) and making the right decisions on executing maintenance works.

Prioritising urgency of maintenance works

The maintenance manager should decide on priorities for maintenance action. That is, the state of alarm for immediate attention. Identifying and specifying the necessary and emergency maintenance works. This could be dictated by physical characteristics of the facility (i. e. degree of deterioration), economic considerations (value attached to the facility) and the statutory requirements to be met. It is also necessary to identify the maintenance works to be phased out for future dates.

Prioritising maintenance attributes

The maintenance manager should prioritise maintenance works attributes for deciding the methods (maintenance strategy) for executing maintenance works. Basically, these attributes include user maintenance request, significant deterioration of facilities, and condition survey as identified by this study.

Maintenance procurement

It is essential that the Prisons Service specifies suitable maintenance procurement type for executing maintenance contracts. This provides information on whether the maintenance work would be carried out by the maintenance unit (direct labour) or be contracted out.

4.8.3.3.2 Maintenance planning

Utilisation of maintenance resources

This stage involves planning and estimating for facility maintenance work. Depending on the goals of maintenance units and the resources (work hour, materials, equipment, tools and logistic supports) at their disposal, the maintenance manager could consider all facilities within the prison or streamline them to a few facilities for the work order. Technical officers assigned must function formally.

Facility inventory

This is to identify the physical features of the facilities that require maintenance and plan for the maintenance work identified. This step involves defining the maintenance task(s) to be performed on each prison facility.

Maintenance work schedule

This involves planning what time the maintenance works for each component/elements of the prison facilities should take place for the entire year. Identifying the complexity of maintenance works, entails ascertaining the volume of the maintenance works and technical know-how required as well as the amount of facilities involved etc. It also involves determining how often maintenance works are to be performed on prison facilities and estimating man hour required to complete each tasks.

Cost of maintenance works

This step involves determining the cost of labour hour, cost of materials, as well as cost of acquiring plant and equipment and contracting fee. The level and sources of funding must be ascertained.

Adherence to maintenance manuals

Adherence to use of maintenance manuals for auxiliary facilities and procedures to guide maintenance operatives should be encouraged and enforced by the maintenance unit. This enhances suitable workmanship and avoidance of waste of maintenance resources during execution of maintenance works. Maintenance activities should be recorded for future references.

4.8.3.3 Maintenance budget

The maintenance unit is advised to judiciously manage the budgetary allocations from Federal the Federal Government. Although the study has found out that there are no steady increases in maintenance budget in recent years. Also, this had been the only source of funding usually available for the maintenance of facilities.

4.8.3.4 Maintenance strategy

Selection of maintenance strategy

Appropriate maintenance strategies must be identified. This can be achieved by outlining and identifying the various maintenance strategies disposable and practiced in the Nigerian Prison Service.

Criticality of facilities

This is to check if failure of facility has effect on the health of users' of facilities, safety of occupants, satisfaction of users, or whether it causes nuisance to the environment, or damage to another facilities, etc. These parameters help to decide whether items/facilities are critical.

Critical and non-critical prison facilities

Critical prison facilities must be given urgent attention whenever a need for maintenance of such facilities arises. Preventive maintenance strategy is recommended to be adopted for critical facilities and its tasks are to be performed in accordance with a predetermined plan at regular fixed intervals, or better still, routine maintenance for general maintenance of facilities for continuous upkeep of facilities in good condition. Corrective maintenance is also recommended to be carried out in response to the breakdown of facilities or user request for maintenance. Predictive maintenance could be carried out in response to significant deterioration in elements or facilities as indicated by a change in monitoring parameters of the facility condition or performance.

4.8.3.4 Performance of Prison Facilities

Evaluating prison facilities

This step involves determining the period for evaluating and identifying the team members. Here the maintenance manager should ensure that the team members are complementary.

Performance measures to collect data

The use of appropriate performance measures to collect data can be through questionnaires as carried out in this study. Other measures could include facility historical data, as well as visual and operational inspections. The maintenance manager could adopt from this study the relevant maintenance service attributes and maintenance performance indicators. The maintenance manager should develop the analytical skills to effectively perform this function. The data used for the exercise should be trusted and correct data so that the best results can be achieved.

Identify difference and actions for improvement

The identified factors responsible for the differences in performance of prison facilities discovered in this study through the expectations and perceived performance of quality of maintenance services and users' satisfaction survey analysis can be used by the maintenance manager. The manager can then determine the processes needed to be put in place and how to go about the transferability of difference ascertained to the prisons service via maintenance unit. Other actions for improvement suggested that is out of the scope of this study are comparing the performance of prison facilities against the performance of other institutions' facilities, comparing the performance of prison facilities against the best practice ratings of other institution's facilities as well as comparing prison facilities against the best practice ratings of similar prison facilities, e.g. similar prison facilities like those of private prisons or developed country.

Develop action plan and implement

Findings in this study can be utilized together with findings from the appraisal of facilities which would be conducted by the maintenance manager. These findings should be communicated and are expected to gain acceptance from the organization (Prisons Service). The benefit of the findings to prison facilities, inmates and Prison Service at large to gain management commitment should be outlined. There is need to capture quantitative and qualitative benefits. The major benefits believed to be realised from assessing the performance of facilities include enhancing facilities value, resource efficiency, as well as quality and operational improvements.

Maintenance managers should also be able to demonstrate improvements made on both tangible and intangible attributes in order to obtain top management support for

implementing changes. Every plan should be flexible to accommodate changes if the need arises in the Prisons Service. The maintenance manager should ensure that processes are in place so that if there is a change in the processes are specified. Such that whoever comes in perform his or her role effectively.

Duties are to be delegated to different technical staff for execution with estimated time set for each task. It is essential that maintenance unit has a formalised designation. As this study has revealed that maintenance staff possesses designation status based on personal opinion. Where necessary the task officer should be trained on the necessary steps to be taken in order to close the performance gap of the facilities managed and there should also be feedback.

4.8.3.5 Stakeholders in the Prison Service

Stakeholders of the Prison Service on strategic level

The framework emphasises the strategic level to comprise the Prisons Service, Works & Logistic directorate, Works Department and maintenance staff functioning at the managerial level in the Maintenance Unit. This level of stakeholders is to ensure that policies, legislations, standard and plans are put in place. They are to specify the technical skills required and make funding available for effective maintenance of prison facilities

Stakeholders of prison service on tactical level

The role of stakeholders at the tactical level involves maintaining the facilities of the prison. They are obliged to manage the prison facilities on how to achieve set goals, adhere to maintenance policies and legislations backing maintenance activities. They are to monitor the maintenance activities/works carried out by the low-level operatives.

Stakeholders of prison service on operational level

These are operatives such as electricians, carpenters, welders, etc. This set of stakeholders carry out the actual maintenance works, implementing the maintenance actions, guidelines, plans and ensuring that all resources allocated are fully utilised.

4.8.4 Validation of the Framework for Maintenance Management of Prison Facilities

The framework was validated on the criteria of acceptability, adoption, possibility, practicability, usefulness, suitability, feasibility and appropriateness, as recommended by Adeyeye, Bouchlaghem and Pasquire, (2010) and Nilsen, (2015) for evaluation of a framework. The framework describes the procedures involved in each phase. Participants considered the logical arrangements of the framework to be adequate. They suggested that for the framework to be effective there is a need to ascertain the suitability of the prison facilities aside the physical condition and to include prisoners in the customer (users') satisfaction survey. They suggested that roles and duties of prison maintenance staff should be highlighted. They also noted the possibility of varying effect of factors that could affect the maintenance management of facilities due to peculiarity of prison locations.

Members of the group that validated the framework agreed that the framework can be reviewed and could be useful in other zones of the country considering its flexible and adaptable nature. It is feasible since it is easy to use. It has also taken cognizance of the important aspects of maintenance management. However, with limitation to investigate quantitative maintenance data of the prison participants believe that when the framework is put to use it would assist prison maintenance staff in realising maintenance objectives effectively.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter discusses the findings and the implication of the study. Also, draws conclusions and make recommendations as well as directions for further research.

5.2 Summary of Findings

The major findings of this study can be summarised as follows:

Prison staff confirmed that quite a number of prisons facilities classified as fabrics and environment were in good physical condition while those classified as services were either rated average or in bad physical condition. Prison maintenance staff perceived the condition of prison facilities to be good while prison non-maintenance staff perceived the condition as average. There is every possibility that the condition of inmates' facilities such as cell blocks and toilet could be in bad condition. Since the condition of facilities used by non-maintenance staff is rated average. The findings showed that prison facilities in South-West, Nigeria are yet to meet the stipulated global standard for prison estates, since none of the facilities was rated as being in very good physical condition. Mann-Whitney test result showed that the difference between the perception of prison maintenance staff and prison non maintenance staff on the physical condition of prison facilities was not significant.

Predominant factors that affecting maintenance management of prison facilities in South-West, Nigeria were established. The critical underlying factors are deterioration due to age of facilities, overcrowding, inadequate plant and equipment for maintenance operations as well as inadequate training and development for prison maintenance staff.

Study further evaluated the factors affecting maintenance management of prison facilities in each of the prison locations. Factors affecting maintenance management of prison facilities in Lagos and Ogun prisons are natural deterioration due to age of facilities, overcrowding and insufficient funding. Factors affecting maintenance management of prison facilities in Oyo prisons are lack of motivation for prison maintenance staff, third-party vandalism and natural deterioration due to age of facilities.

In Ondo prisons, critical factors affecting maintenance management of prison facilities are lack of discernible maintenance culture, overcrowding and natural deterioration due to age of facilities. The critical factors affecting maintenance management of prison facilities in the Ekiti prison were overcrowding, irregular inspections of facilities, as well as inadequate training and development for prison maintenance staff.

The study showed the prevalence of the maintenance strategy used for prison facilities. The study revealed that routine and preventive maintenance were the most prevalent type of strategy adopted for maintenance of prison facilities while predictive and detective maintenance strategies were rarely adopted. The study found that there was no significant difference among the frequency of use of maintenance strategies. That selection of maintenance strategy was discrepantly done without considering the logistic supports available for the maintenance unit.

The study indicated that the written policy was either reviewed annually or sometimes reviewed when necessary. Inspection of prison facilities was either carried out every six (6) months or on a yearly basis. This implies a disparity in the inspection of prison facilities where inspection is done at a different time.

Also, indicated that the maintenance procurement type used for maintenance works were contract only, direct labour only, and a times contract and direct labour combined. Further, contractors' selection for maintenance works was arrived at by open competition and awarded based on a bill of quantities. The study affirmed that the maintenance unit more often carried out maintenance works at the users' request, when there is a significant deterioration in facilities and also based on a condition survey report on prison facilities. However, these work requests are sometimes not converted to work order due to financial constraints and maintenance personnel constraints.

The study showed the relative use of maintenance planning instruments such as maintenance manual guides, maintenance assets inventories, maintenance logbooks and work schedules adopted for prison facilities. The study revealed that 40% of the respondents indicated use of maintenance manuals for guiding maintenance operatives while another 40% indicated otherwise. The study showed that 60% of the respondents indicated that the maintenance unit prepares maintenance assets inventories while 20% indicated otherwise. Further, 40% of the respondents indicated that the maintenance unit use maintenance logbook while 60% stated otherwise. Sixty percent (60%) of the respondents indicated that the maintenance unit develops a work schedule while 40% stated otherwise. It seems to be no reference to use of specific maintenance tools. This indicated poor maintenance structure and could eventually affect the maintenance activities.

Preferences for maintenance manual guides, assets inventories, log books and work schedules are not uniformly distributed. The study also revealed the reasons why some work requests were not converted to work order. These cogent reasons were financial and personnel

constraints: other reasons were inadequate tools/equipment, materials and statutory limitations.

Frequency of methods used in arriving at maintenance budgets was identified. Study revealed that the only source for maintenance budgets is the Federal Government allocation. Respondents indicated that maintenance budget allocations for maintenance works of prison facilities and performance of the maintenance unit were slightly insufficient and good respectively. Besides these, the study deduced from the quantitative data on the maintenance budget allocation and inmates' population that there was no steady increase of maintenance budget. The study deduced that the maintenance budget per inmate and the performance of the maintenance unit are not significantly correlated. Though, this is an unexpected circumstance that calls for immediate attention on how budget is managed.

Satisfaction ratings of prison non-maintenance staff on the quality of space, response to complaints/repairs, as well as maintenance task related and cost related indicators. The result indicated that there was partial satisfaction among prison non-maintenance staff since most of the respondents were not highly dissatisfied with the performance of prison facilities. Prison non-maintenance staff were satisfied with the performance of level of cleanliness in the prison environment, quality of water and control of ventilation by means of windows while they are partially satisfied with the performance of every other prison facilities. The study indicated partial satisfaction with performance of prison facilities and agreement among prison non-maintenance staff on this satisfaction rating was found to be significant.

Also, study revealed a difference between Non-maintenance staff expectations and perceived quality of maintenance services. The result indicated that prison non maintenance staff

expectations were higher than the perceived quality of maintenance services. The study showed a significant difference between prison non maintenance staff expectations and perceived quality of maintenance services. Non-maintenance staff were not satisfied with the quality of maintenance services.

The condition of prison facilities was used to predict the performance of the prison facilities. The maintenance performance model developed by the study is:

$$\text{Performance of Prison Facilities (PPF)} = 0.795 + 0.750 \text{ Condition of Prison Facilities (CPF)}$$

There is a positive relationship between the condition of facilities and the performance of such facilities. This is a pointer to the fact of having performing prison facilities, performing prison staff and performing inmates when the condition of prison facilities is good.

The developed evaluating framework comprises four phases. The first phase ascertains the condition of prison facilities. The second phase identifies the critical factors that affect the maintenance management of prison facilities. The third phase examines the maintenance management practice used for the maintenance of the prison facilities while the fourth phase predicts the performance of prison facilities. Process flow chart developed presents the sequence of flow of the process among the phases. The improvement from each phase is identified and this is to be communicated via the Maintenance Unit to the Works and Logistics Department and office of the Controller-General of the Prison Service. Actions and changes are to be implemented, monitored and measured by the maintenance team to ascertain prison facilities enhancement.

5.3 Conclusion

The study confirmed the criticality of poor conditions in prison facilities in South-West Nigeria. The study revealed that a few prison facilities such as doors, roof structures, walling, windows, security of the environment, level of cleanliness, and air circulation were in good operational state. It was also confirmed that the conditions of facilities such as telephones, internet, and firefighting equipment were bad. This implies a low performance of these prison facilities.

The study acknowledged the barriers to implementation of satisfactory maintenance management. Some of the predominant factors that affect maintenance management of prison facilities include age of building, overcrowding and inadequate staff training and development. This gives an insight to issues militating against maintenance of prison facilities; these issues require immediate attention of the relevant stakeholders.

The study found distinct maintenance management practices as adopted in various prison locations. It also found that there was poor implementation of structured maintenance management policies, leading to the poor condition of prison facilities. The study discovered evidence of inappropriateness in the implementation of the policy type practised, while investigating when and how inspection of facilities was conducted and the maintenance procurement methods adopted. The use of various maintenance planning instruments, such as maintenance manual guides, assets inventories, logbooks and work schedules, was not duly implemented. Some of the prison maintenance unit have neither written nor unwritten schedules for components/elements/facilities. Selection of maintenance strategies for prison facilities was made arbitrarily. Study concluded there was no significant difference among the frequency of use of maintenance strategies. Also, that the relationship between

maintenance budget and the performance of maintenance unit was not significantly correlated.

The study indicated partial satisfaction with performance of prison facilities among prison non-maintenance staff. It also, indicated that prison non-maintenance staff expectations were higher than their perceived quality of maintenance services. This implies that satisfaction is not achieved.

The developed framework emphasises the logical phases of the maintenance management of prison facilities. This pertinent developed framework guides the maintenance unit in achieving its maintenance objectives in prisons in South –West, Nigeria. It equally increases the quantum of data needed to make the right decisions when it comes to maintenance of prison facilities.

5.4 Recommendations

The following recommendations are made towards improving practices of maintenance management of prison facilities in South-West, Nigeria.

The Nigerian Prisons Service should deploy more prison maintenance staff at the tactical level, with well defined job designations for each prison maintenance staff so that there are no uncertainties regarding their specific tasks.

The Nigerian Prison Service should ensure that the barriers to implementation of satisfactory maintenance management are timely addressed. Prison maintenance staff should have access to maintenance training and development to enhance their performance in maintenance

services delivery. Continuous training provides them with the appropriate skills, attitude and degree of sensitivity required for dealing with the maintenance management of prison facilities. It is essential for prison staff, prison inmates and those interacting with prison facilities to perceive them as a national asset and tax payers' property. In essence, prison facilities are to be rightly used and preserved.

Government interest in the Prisons Service should encompass both the social welfare of prisons and the technical efforts aimed at redressing the deplorable state of prison facilities. The government should provide all the necessary maintenance and capital resources. Such as sufficient maintenance budgets, plant and equipment for maintenance operations and enabling policies that would ensure functionality of prison facilities. Congestion of prison facilities should be reduced or, if possible eliminated by ensuring that the judicial arm of government addresses all awaiting trial cases on time. The government can also grant amnesty on compassionate grounds in order to decongest the prisons. All existing prison facilities should be promptly and adequately maintained. New prison buildings should be constructed with adequate facilities provided to ease congestion

The maintenance unit should adopt maintenance strategies that have been tested and proven to be adequate for building components/elements/services. Horner et al. (1997) opined that all facilities that are not critical component/elements, such as wall, floor finishes, painting and furniture should be maintained by adopting predictive/condition based maintenance. Significant/ critical facilities/ items are to be maintained using either preventive/time-based maintenance or corrective/failure-based maintenance, even as cost implications are borne in mind in the selection of any strategy. However, it is not being suggested that any particular

strategy is the best, since facilities and their maintenance requirement vary and only professionals are in the best position to determine what is most appropriate.

Adherence to a structured maintenance policy with good planning for prison facilities should be paramount to ensure maintenance efficiency and effectiveness. The maintenance unit should develop a formal maintenance programme. Like a written maintenance manual guides for maintenance officers in executing maintenance operations. The maintenance unit should also utilise maintenance asset inventories and written schedules that should be strictly adhered to. In addition to documentation of the actual maintenance works performed via maintenance logbooks.

There should be a well defined maintenance schedule for prison facilities categorised as services, such as firefighting equipment, CCTV cameras, alarm systems, telephones, internet facilities, and air conditioners with low performance. This is because their maintenance schedules are complex. They require frequent checking, although schedules for other facilities are equally important. For example, it is crucial to have regular roof inspections to correct minor problems before they shorten the life span of the roof element.

There should be continuous evaluation of prison facilities to ascertain the physical condition and performance of facilities. It is therefore the joint responsibility of the Nigerian Prison Service, Prison Works and Logistics Department, Maintenance Unit, Government, prison facilities users' and academia to be an advocate of safe and decent prison facilities. Indeed, a proactive rather than reactive maintenance approach should be adopted in the maintenance of prison facilities. Further, there is need to aspire to meet the minimum standards for treatment of prisoners and the stipulated prison facilities.

5.5 Contributions to Knowledge

1. The study developed a framework for maintenance management of prison facilities.
2. Dominant factors affecting the maintenance management of prison facilities were established in the study.
3. The study developed a model predicting the performance of prison facilities from the condition of prison facilities.

5.6 Directions for Further Research

The findings of this study provide possible directions for future research as follows:

- 1 This study specifically investigated maintenance management of prison facilities in South-West, Nigeria. Studies in other regions can be carried out to discover the prevailing situations in those regions. Comparative studies can also be done between geographical zones in Nigeria.
- 2 Further research works can be carried out on how the government can use the private sector as a mechanism for procuring and maintaining prison facilities. An alternative method that is used for delivery of prison facilities in developed countries.
- 3 There could be research that uses mainly quantitative data rather than perception of prison staff for the evaluation of maintenance management of prison facilities.
- 4 Research might also focus on a computerised based maintenance system for prison facilities – customised schedules for facilities, generating daily work order and for recording the maintenance works performed.
- 5 Research is also suggested that assesses the performance of prison facilities based on the perspective of primary users (inmates) of prison facilities. Such work will consider the performance of prison facilities in relation to performance of prison staff and prison inmates in selected prison locations.

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Appendix 1: Questionnaires

Department of Building
University of Lagos
Lagos

Dear Sir,

QUESTIONNAIRE FOR MAINTENANCE MANAGERS OF PRISON FACILITIES

This study is purely an academic exercise for a degree in construction management being conducted by a student of Building department. It aims at **investigating maintenance management of prison facilities in South - West, Nigeria.**

Maintenance management is referred to as the management, control, execution and quality of those activities which ensure optimum level of availability and overall performance of plants, constructed facilities and/or buildings.

This questionnaire is designed for maintenance management personnel (Managers, Maintenance Expertise, and Engineers), who have experience in the use and maintenance of such facilities. You are kindly requested to answer the questions in this questionnaire. The questionnaire is divided into sections and would take approximate 5 minutes to complete. Your contribution toward this study is greatly appreciated.

Please you are requested to fill the questionnaire promptly.

Note: you can fill your comments in any underlined spaces as you want. However, for some noted options, you can only make **one** choice, while multiple choices are possible for the others. **All information will be kept securely and will remain confidential.**

Yours Faithfully

Ajayi Oluranti Olupolola

E-mail: ofarinloye@unilag.edu.ng, olu_ranti2002@yahoo.co.uk

Phone: +2348033912148

Maintenance Management of Prison Facilities in South–West, Nigeria (maintenance manager)

This study is purposely for an academic exercise for research in Construction Management. You are kindly required to respond to this questionnaire. Confidentiality of your responses assured and your anonymity is guaranteed.

SECTION A: Demographic Characteristics

Instruction: Please tick as appropriate.

- Q1. Prison name and location
- Q2. What is your type of prison? Male and female inmates []¹ Male inmate only []²
Female inmate only []³ Juvenile inmate []⁴
- Q3. Please state your present position/ designation in the maintenance unit?.....
- Q4. How long have you been in this maintenance department of prison service? Less than 10 years []¹ 10 – 19 years []² 20 – 29 years []³ 30 years and above []⁴
- Q5. Number of employees in your maintenance unit? Less than 10 employees []¹ 10 - 19 employees []² 20 - 29 employees []³ 30 employees and above []⁴
- Q6. How many buildings (cell building inclusive) do your unit maintain? Less than 10 buildings []¹ 10 – 19 buildings []² 20 – 29 buildings []³ 30 buildings and more []⁴
- Q7. What is your highest educational qualification? OND []¹ HND []² B.Sc / B.Tech. []³ M.Sc []⁴ Ph.D []⁵ Others specify []

SECTION B: FACTORS AFFECTING MAINTENANCE MANAGEMENT OF PRISON FACILITIES

Q8. Kindly rate the following factors as they critically affect the maintenance of prison buildings in order of their significance.

S/n	Factors	Insignificant	Barely insignificant	Partially significant	Significant	Highly significant
		(1)	(2)	(3)	(4)	(5)
1	Reckless use of facilities					
2	Natural deterioration due to age of buildings					
3	Poor construction of buildings					
4	Third party vandalism					
5	Poor quality of materials and spare parts used in repairs					
6	Delay in reporting failures					
7	Delay in executing repairs					
8	Poor workmanship					
9	Overcrowding					
10	Inadequate training and development of personnel					
11	Insufficient funding					
12	Lack of discernable maintenance culture					
13	Inadequate maintenance of plants and					

	equipment for maintenance operations					
14	Irregular inspections					
15	Sequence of maintenance work not based on priorities					
16	Lack of motivation for maintenance staff					

SECTION C: Maintenance strategies

Instruction: Please tick the appropriate response.

Q9. Kindly identify the type(s) of maintenance strategy adopted in maintaining these following building elements and services by your department as: Preventive maintenance, Corrective maintenance, Predictive maintenance, Routine maintenance, Detective maintenance.

Preventive maintenance: Prevent premature breakdown to ensure building systems operate efficiently

Corrective maintenance: Wait

Predictive maintenance: Maintenance procedure carried out when the condition of building/equipment warrants

Routine maintenance: This includes general maintenance necessary to keep the building in good condition

Detective maintenance: Applicable to devices that only work when required e.g. fire fighting devices, alarms.

S/n o	Prison elements/Services	Preventive Maintenance	Corrective Maintenance	Predictive Maintenance	Routine Maintenance	Detective Maintenance
	A. Significant items					
1	Roof structures					
2	Roof coverings					
3	Roof finishes					
4	Floor slab					
5	Walling					
6	Beams & columns					
7	Foundation					
8	Doors					
9	Windows					
10	Netting					
11	Water supply					
12	Sanitary fittings					
13	Waste water disposal					
14	Solid waste disposal					
15	Refuse disposal					
16	Electricity supply & electrical appliances					
17	Firefighting equipment					
18	Level of cleanliness					
19	Safety & security of the environment					

	B. Non - Significant items	Preventive Maintenance	Corrective Maintenance	Predictive Maintenance	Routine Maintenance	Detective Maintenance
20	Floor finishes					
21	Wall finishes					
22	Internal painting					
23	External painting					
24	Floor & wall tiles					
25	Telecommunications					
26	A/C and fans					
27	Furnishing					

SECTION D: Maintenance policy

Instruction: Please tick the appropriate response.

Q10. Does your department have a written maintenance policy? Yes []¹ No []²

Q11. How often do you review your maintenance policy? Every two years []¹

Annually []² Biannual []³ Not at all []⁴ Others

(specify).....[]⁵

Q12. How often are your buildings inspected for maintenance purposes?

Every 6 months []¹ Every year []² Every 2 years []³ Every 5 years []⁴ No

inspection []⁵ Others (specify).....[]⁶

Q13. What type of procurement method(s) do you use for your maintenance/ repair works?

Contract only []¹ Direct labour only []² Contract and direct labour []³

If your option is 1 or 3 go to question 18 & 19 If your option is 2 go to question 20

Q14. How are the contractors selected?

Open competitive tendering []¹ Selective tendering []² Negotiation tendering []³

Others (specify).....[]⁴

Q15. On what basis are the contracts awarded? Based on BOQ []¹ Cost reimbursement

[]² Schedule of rate []³ Others (specify).....[]⁴

Q16. When do you execute maintenance work on building components? Please tick as many as appropriate.

At the end of its useful life time recommended by the manufacturer []¹

When it has failed to a point at which it cannot perform its required functions []²

At users request/ complaints []³

When there is a significant deterioration in a unit []⁴

Work executed in accordance with predetermined regular plan interval []⁵

When there is a condition survey report due to regular inspection of those elements []⁶

SECTION E: Maintenance planning

Instruction: Please tick the appropriate response.

Q17. Is there maintenance manual to guide the operatives? Yes []¹ No []²

Q18. Does your maintenance unit prepare an asset inventory for the facilities? Yes []¹ No []²

Q19. Does your department make use of maintenance logbook? Yes []¹ No []²

Q20. Do your maintenance department develop a work schedule that show the time in which maintenance work of defected components will take place? Yes []¹ No []²

Q21. Kindly tick the reason(s) why work requests are not been converted into work order?

Finance constraints []¹

Personnel constraints []²

Inadequate tools/equipment to accomplish work []³

Materials/spare parts []⁴

Conflict with other work []⁵

Statutory limitations []⁶

Conflict with policy []⁷

SECTION F: Budgetary allocation Instruction:

Please tick the appropriate response.

Q22. Does your maintenance department have a specific budget for maintenance operations?

Yes []¹ No []²

If yes go to question 23

If no skip question 32

Q23. How does your department arrive at your maintenance budget?

A fixed percentage of original construction cost adjusted for inflation []

¹ A fixed percentage of current value of buildings []²

Previous year's budget adjusted for inflation []³

Based on the actual maintenance need of buildings via condition survey []⁴

Based on cost of maintenance activities by adding labour hour, materials, equipment & contracting cost []⁵

Q24. Do your maintenance unit receive grant from other sources like (voluntary organisations, formal sectors, individuals) apart from government to meet

maintenance needs? Yes []¹ No []²

Q25. What is the level of funding of maintenance work executed by your department?

Very inadequate []¹ Inadequate []² Average []³ Adequate []⁴ Very

adequate []⁵

SECTION G: Performance of maintenance workforce

Q26. Rate your workforce performance in terms of staff strength (numbers), skill/ experiences and competency

Building/ Civil unit

S/no	Attributes	Very bad	Bad	Average	Good	Very good
	Staff strength					
	Experiences					
	Expertise/ competency					

Electrical unit

S/no	Attributes	Very bad	Bad	Average	Good	Very good
	Staff strength					
	Experiences					
	Expertise/ competency					

Plumbing/mechanical unit

S/no	Attributes	Very bad	Bad	Average	Good	Very good
	Staff strength					
	Experiences					
	Expertise/ competency					

Q27. How would you rate the overall performance of your maintenance department within the limit of your responses? Very bad []¹ Bad []² Average[]³ Good []⁴ Very good []⁵

Thanking you for completing this survey.
O. O. Ajayi (Mrs)

Department of Building
University of Lagos
Lagos

Dear Sir,

QUESTIONNAIRE FOR MAINTENANCE (TECHNICAL) OF PRISON FACILITIES

This study is purely an academic exercise for a degree in construction management being conducted by a student of Building department. It aims at **investigating maintenance management of prison facilities in South - West, Nigeria.**

Maintenance management is referred to as the management, control, execution and quality of those activities which ensure optimum level of availability and overall performance of plants, constructed facilities and/or buildings.

This questionnaire is designed for maintenance technical officers who have experience in the use and maintenance of such facilities. You are kindly requested to answer the questions in this questionnaire. The questionnaire is divided into sections and would take approximate 5 minutes to complete. Your contribution toward this study is greatly appreciated.

Please you are requested to fill the questionnaire promptly.

Note: you can fill your comments in any underlined spaces as you want. However, for some noted options, you can only make **one** choice, while multiple choices are possible for the others. **All information will be kept securely and will remain confidential.**

Yours Faithfully

Ajayi Oluranti Olupolola

E-mail: ofarinloye@unilag.edu.ng, olu_ranti2002@yahoo.co.uk

Phone: +2348033912148

Maintenance Management of Prison Facilities in South–West, Nigeria (Technical officers)

This study is purposely for an academic exercise for research in Construction Management. You are kindly required to responds to this questionnaire. Confidentiality of your responses assured and your anonymity is guaranteed.

SECTION A: Demographic Characteristics

Instruction: Please tick as appropriate.

- Q1. Prison name and location
- Q2. What is your type of prison? Male and female inmates []¹ Male inmate only []²
Female inmate only []³ Juvenile inmate []⁴
- Q3. Please state your present position/ designation in the maintenance department?.....
- Q4. How long have you been in this maintenance department of prison service?
Less than 10 years []¹ 11 – 20 years []² 21 – 30 years []³ Above 30 years []⁴
- Q5. Number of employees in maintenance unit? Less than 10 employees []¹
11 -20 employees []² 21 - 30 employees []³ More than 30 employees []⁴
- Q6. What is your highest educational qualification?
OND []¹ HND []² B.Sc / B.Tech. []³ M.Sc []⁴ Ph.D []⁵ Others specify.....[]⁶

SECTION B: PHYSICAL CONDITION OF PRISON FACILITIES

Q7. Rate the state of your facilities in terms of building structures, building services, surroundings, and aesthetics

S/no	Prison elements/ services	Very bad	Bad	Average	Good	Very good
A	Structure and fabric	(1)	(2)	(3)	(4)	(5)
1	Roof coverings					
2	Roof structures					
3	Roof finishes					
4	Beams & columns					
5	Walling					
6	Floor slab					
7	Floor finishes					
8	Doors					
9	Windows					
10	Netting					
11	Stairs case					
B	Services	Very bad	Bad	Average	Good	Very good
12	Water supply					
13	Sanitary fittings					
14	Solid waste disposal					
15	Waste water disposal					
16	Electricity supply (lighting)					
17	Electrical appliances					
18	Fire fighting equipment					
19	Telephone lines					
20	Internet facilities					

21	A/C or fan					
22	Alarms & detector					
C	Aesthetics	Very bad	Bad	Average	Good	Very good
23	Internal painting					
24	External painting					
25	Furniture					
D	Environment/surroundings	Very bad	Bad	Average	Good	Very good
26	Refuse disposal					
27	Level of cleanliness					
28	Air circulation (ventilation)					
29	Noise protection					
30	Security of environment					

SECTION C: FACTORS AFFECTING MAINTENANCE MANAGEMENT OF PRISON FACILITIES

Q8. Kindly rate the following factors as they critically affect the maintenance of prison facilities in order of their significance.

S/n	Factors	Insignifi cant (1)	Barely insignifica nt (2)	Partially significant (3)	Signifi cant (4)	Highly significant (5)
1	Reckless use of facilities					
2	Natural deterioration due to age of buildings					
3	Poor construction of buildings					
4	Third party vandalism					
5	Poor quality of materials and spare parts used in repairs					
6	Delay in reporting failures					
7	Delay in executing repairs					
8	Poor workmanship					
9	Overcrowding					
10	Inadequate training and development of personnel					
11	Insufficient funding					
12	Lack of discernable maintenance culture					
13	Inadequate maintenance of plants and equipment for maintenance operations					
14	Irregular inspections					
15	Maintenance work not based on priorities					
16	Lack of motivation for maintenance staff					

Thanking you for completing this survey.
O. O. Ajayi (Mrs)

Department of Building
University of Lagos
Lagos

Dear Sir,

QUESTIONNAIRE FOR NON-MAINTENANCE STAFF OF PRISON FACILITIES

This study is purely an academic exercise for a degree in construction management being conducted by a student of Building department. It aims at **investigating maintenance management of prison facilities in South - West, Nigeria.**

Maintenance management is referred to as the management, control, execution and quality of those activities which ensure optimum level of availability and overall performance of plants, constructed facilities and/or buildings.

This questionnaire is designed for users' of building facilities. You are kindly requested to answer the questions in this questionnaire. The questionnaire is divided into sections and would take approximate 5 minutes to complete. Your contribution toward this study is greatly appreciated.

Please you are requested to fill the questionnaire promptly.

Note: you can fill your comments in any underlined spaces as you want. However, for some noted options, you can only make **one** choice, while multiple choices are possible for the others. **All information will be kept securely and will remain confidential.**

Yours Faithfully

Ajayi Oluranti Olupolola

E-mail: ofarinloye@unilag.edu.ng, olu_ranti2002@yahoo.co.uk

Phone: +2348033912148

Maintenance Management of Prison Facilities in South – West, Nigeria. (Non-maintenance staff)

This study is purposely for an academic exercise for research in Construction Management. You are kindly required to responds to this questionnaire. Confidentiality of your responses assured and your anonymity is guaranteed.

SECTION A: Demographic Characteristics

Instruction: Please tick the appropriate response

Q1. Prison name and location

Q2. What is your type of prison? Male and female inmates []¹ Male inmate only []² Female inmate only []³ Juvenile inmate []⁴

Q3. How long have you been in the prison service?

Less than 10 years []¹ 11 – 20 years []² 21 – 30 years []³ Above 30 years []⁴

Q4. What is your highest educational qualification?

OND []¹ HND []² B.Sc / B.Tech. []³ M.Sc []⁴ Ph.D []⁵ Others specify..... []⁶

SECTION B: PHYSICAL CONDITION OF PRISON FACILITIES

Q5. Rate the state of maintenance of your building in terms of building structures, building services, surroundings, and aesthetics

S/no	State of building components	Very bad (1)	Bad (2)	Average (3)	Good (4)	Very good (5)
A	Structure and fabric					
1	Roof coverings					
2	Roof structures					
3	Roof finishes					
4	Beams & columns					
5	Walls					
6	Floor slab					
7	Floor finishes					
8	Doors					
9	Windows					
10	Netting					
11	Stairs case					
B	Services	Very bad (1)	Bad (2)	Average (3)	Good (4)	Very good (5)
12	Water supply					
13	Sanitary fittings					
14	Solid waste disposal					
15	Waste water disposal					
16	Electricity supply (lighting)					
17	Electrical appliances					
18	Firefighting equipment					
19	Telephone lines					
20	Internet facilities					
21	A/C or fan					
22	Alarms & detector					

C	Aesthetics	Very bad (1)	Bad (2)	Average (3)	Good (4)	Very good (5)
23	Internal painting					
24	External painting					
25	Furnitures					
D	Environment/surroundings	Very bad (1)	Bad (2)	Average (3)	Good (4)	Very good (5)
26	Refuse disposal					
27	Level of cleanliness					
28	Air circulation (ventilation)					
29	Noise protection					
30	Security of environment					

SECTION C: PERFORMANCE OF PRISON FACILITIES

Q6. Kindly determine your satisfaction rating using these identified maintenance indicators.

S/no	Criteria	Highly unsatisfied	Unsatisfi ed	Partially satisfied	Satisfied	Highly satisfied
A	Quality of space					
1	Level of cleanliness in the prison environment					
2	Waste removal					
3	Adequacy of artificial and natural lighting					
4	Control of ventilation by means of windows					
5	Odour of environment					
6	Comfort level in building					
7	Space for meeting with visitors					
8	Sound insulation					
9	Furniture arrangement					
10	Quality of exterior of building					
11	Quality of interior of building					
12	Quality of water					
13	Fire safety					
14	Security gadget (CCTV, alarm system, voice speakers, digital video recorder e.t.c.)					
15	Ease of communication (telephone, internet facilities, voice speakers e.t.c.)					
16	Exit route in case of emergency					
17	Vehicular access					
18	Adequacy of car park					
B	Response to complaints/repairs					
1	Procedure for reporting defects and getting work done					
2	Time taken by maintenance department to responds to complaints					
3	Behaviour of maintenance department					

	staff					
4	Level of maintenance backlog (i.e defect you have reported but yet to be done)					
5	Level of nuisance (i.e disturbance and interference with your privacy by maintenance staff)					
C	Maintenance task related indicators					
1	Asset inventory (i.e the way maintenance staff identify physical features that require maintenance)					
2	Ability of maintenance department to prioritise maintenance needs with available resources					
3	Speed of work (i.e time taken by maintenance staff to do repairs)					
4	Quality of work done by maintenance staff					
5	Ability to react to emergency (unplanned) maintenance					
6	Ability to perform routine (planned) maintenance					
D	Cost related indicators					
1	Money spent reporting faults					
2	Cost of transporting maintenance staff					
3	Money spent on purchasing minor parts not available in store					

Q7. What is your overall rating of the performance of the maintenance department in maintaining your buildings?

Very poor []¹ Poor []² Average []³ Good []⁴ Very good[]⁵

SECTION D: Quality of maintenance services

Q8.The under listed statement are expectations of service quality, please tick the extent to which you expect the maintenance department to possess these attributes.

S/no	Expectations	Strongly Disagree	Disagree	neutral	Agree	Strongly agree
1	Maintenance department will have up-to- date equipment/ facilities to work with					
2	Maintenance officers will be neat in appearance					
3	Maintenance department will demonstrate sincere interest in solving maintenance problem					
4	Maintenance officers will provide prompt service/responds to users request					

5	Officers will perform repairs right at first attempt					
6	Maintenance officers will be consistently courteous with users' of building					
7	Maintenance department will have operating hours convenient to users					
8	Maintenance officers will give individualised attention to users to meet their specific maintenance need					

Q9. The following set of statement describes perceptions about the quality of service of maintenance department. Tick the extent to which you agree that maintenance department possess these attributes.

S/no	Perceived service quality	Strongly Disagree	Disagree	neutral	Agree	Strongly agree
1	Maintenance department has up-to-date equipment/ facilities to work with					
2	Maintenance officers are neat in appearance					
3	Maintenance department demonstrate sincere interest in solving maintenance problem					
4	Maintenance officers provide prompt service/responds to users request					
5	Officers perform repairs right at first attempt					
6	Maintenance officers are consistently courteous with users' of building					
7	Maintenance department operating hours are convenient to users					
8	Maintenance officers give individualised attention to users to meet their specific maintenance need					

Thanking you for completing this survey

Thanking you for completing this survey
O. O. Ajayi (Mrs)

Appendix: 2

Questionnaire for Validating the Developed Maintenance Framework

Framework for Maintenance Management of Prison Facilities in South – West, Nigeria.

This study is purposely for an academic exercise for research in Construction Management. You are kindly required to respond to this questionnaire. Confidentiality of your responses assured and your anonymity is guaranteed.

Here is an outline of the proposed framework which serves as a guide to prison maintenance staff in performing effectively in the maintenance of prison facilities.

- I. In this proposed framework there are four phases consisting of twenty steps. Kindly read through thoroughly to give your comments.
- II. Also specify other aspects of the steps that you will like to add to the already listed steps in the maintenance framework detailed below.
- III. Lastly what are your recommendations to maintenance unit and other stakeholders of the prison service in respect of maintenance of prison facilities?

What is the name of your organisation?

.....

A. Determining the current condition of the prison facilities

This could be ascertained via users' perception, what are other ways or means to know the condition of the facilities?

Please specify if any.....

.....

B. Identify facility for maintenance work

This involves knowing the facility that needs maintenance work through users' request, visible deterioration. Aside this please specifies other means for identifying facility due for maintenance.....

.....

.....

C. Influencing factors affecting maintenance of prison facilities

Some of the factors having significant effect on maintenance of prison facilities include; Deterioration of facilities, overcrowding, staff training, insufficient fund among others Please specify any other aggravating factor(s) you are aware of.....

.....

.....

D. Identify complexity of maintenance work (maintenance planning)

1. Volume of work
2. Technical know how
3. Skill of personnel

Please specify other criteria to determine complexity of work.....
.....
.....

E. Allocating resources for facility maintenance work (maintenance planning)

This depends on the goal of the maintenance unit and resources at their disposal e.g. man work hour, tools and equipment, logistic supports. What are other attribute that determine the allocation of maintenance resources?.....
.....

How does your unit go about allocating resources for facility maintenance work?
.....

F. Cost for maintenance work (maintenance policy)

This could be cost of labour, cost of material, cost of tools & equipment, contracting cost etc. How your unit do arrived or determined cost of maintenance of facility?
.....
.....

G. Maintenance strategy

What are the types of maintenance strategy practiced in your unit?
.....

How do you determine the type of strategy to be used for an item/ components/ services?
.....

H. Failure of facility/ consequences of failed facility

Failure of facility can cause a negative hamper the health of facility occupant, safe custody of inmates, safety of other user of prison facilities etc. Aside, those outlined in the framework. What are the other negative consequences?
.....
.....

I. Maintenance team formation

1. Identify maintenance team leader
2. Identify maintenance team members
3. Engage maintenance contractor (outsourcing) if there is need

What other steps will you take in setting up a team?
.....
.....

J. Data collection method

Determine data collection methods and collect data through questionnaires, inspection etc.

1. Sort information collected and validate the information collected
2. Ensure that information collected is in line with identified MPIs and maintenance service quality attributes.

Are there other methods of collecting and verifying data collected during evaluation of facilities?

Please specify.....
.....

K. Comparing performance of prison facility with other facility

Compare current performance of prison facilities. Then identify causes of gap and the process to determine transferability to the prison organisation. Are these adequate activities under this step? Please give your comments.....
.....

L. Findings and gaining acceptance for findings

Communicate findings and gain acceptance. The acceptance can be gained from the management of prison service, prison staff and inmates. Are these adequate activities under this step? Please make your comments.....
.....

M. Implementation of findings

Findings derived from the results of the assessment of facilities performance should be planned and implemented and necessary duties should be delegated to different maintenance staff in execution of maintenance works with target time set for each tasks. Where necessary task officer should be trained on necessary activities to be taken to close the performance gap of the facilities managed.

Are these adequate activities under this step? What are your recommendations?

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

Kindly made known your observations not captured in this open ended questionnaire.

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