Maintenance Strategies and Condition of Public Secondary School Buildings in Ado-Odo/Ota Local Government Area Ogun State, Nigeria

A Ph.D Thesis

By

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SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF DEGREE OF DOCTOR OF PHILOSOPHY (PH.D) IN ARCHITECTURE, COVENANT UNIVERSITY, OGUN STATE, NIGERIA

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DECLARATION

I, Izobo-Martins Oladunni Oluwatoyin, declare that the work referred to in this thesis was carried out entirely by me under the supervision of Prof. E.A Adeyemi (Main Supervisor) of the Department of Architecture, Covenant University, Canaan-Land, Ota, Ogun State and Prof. Abiodun Olotuah (Co-Supervisor) of the Department of Architecture, Federal University of Technology, Akure, Ondo State. I certify that no portion of the thesis has been submitted in support of any application for another degree or qualification in this or any other university or institutions of learning. All sources of scholarly information referred to in this thesis were properly acknowledged.

Izobo-Martins Oladunni

CERTIFICATION

This thesis titled a Study, **Maintenance Strategies and Condition of Public Secondary School Buildings in Ado-Odo/Ota L.G.A; Ogun State, Nigeria** carried out by Oladunni Izobo-Martins under my supervision meets the regulations governing the award of the degree of Doctor of Philosophy (Ph.D.) in the Department of Architecture, Covenant University, Ota, Ogun State, Nigeria. I certify that it has not been submitted in part or full for the award of the degree of Ph.D. or any other degree in this or any other University, and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This work is dedicated to the Alpha and Omega, the only God who has given me strength to finally complete the programme, I do not deserve this but yet I am blessed.

Secondly, to my hubby: Leonard Izobo- Martins and our kids.

Lastly, to my parents, Mr.& Mrs. E.O Aiyelabola who have been there to provide support from day one. Thanks, Mum and Dad, for always being there.

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ABSTRACT

There is a growing awareness that appropriate maintenance strategies can help to improve the present conditions of buildings in public secondary schools in Nigeria. However, there are few studies on the most appropriate maintenance strategies to be engaged in by maintenance managers to improve the conditions of the existing academic buildings in public secondary schools in this country. Therefore, the aim of this research was to investigate the present conditions of academic buildings and the maintenance strategies in the public secondary schools in Ado-Odo/Ota Local Government Area of Ogun State, Southwest Nigeria. The study examined the availability and conditions of academic buildings in Public Secondary Schools. A survey research strategy and stratified random sampling technique were used in selecting thirty-six public secondary schools out of forty-seven in the study area. Structured questionnaire was used to extract primary data from the users of the academic buildings, while direct observations were employed in deriving data on the state of disrepair of the buildings. The quantitative data was analysed using univariate and multivariate analyses; while the qualitative data was analysed using content analysis. The result shows that most academic buildings, especially classrooms in public secondary schools investigated were in the state of disrepair, and that there was a need for urgent steps to be taken in addressing the situation. Also eleven of the nineteen deterioration factors investigated were the most significant, five were less significant and two were found not to be significant in explaining the conditions of academic buildings in the schools. In terms of their contribution to deterioration of academic buildings in the public secondary schools sampled, the lack of maintenance body and policy was rated higher than location of the schools. In addition, result of the multiple regression analyses involving seventy-four independent variables and four dependent variables was significant at ($p < 0.005$) and the 95% confidence level; and the adjusted R^2 for the four models were 30%, 25%, 25% and 60%, respectively. Validation of the models confirmed that in the order of importance, maintenance planning; maintenance strategy; physical condition of buildings; and the length of stay of maintenance managers in the schools were the key predictors of the present conditions of academic buildings in public secondary schools in the study area. Findings of this study imply that if adequate attention is given to the development and adoption of appropriate maintenance strategies; maintenance planning, building components and length of stay of maintenance managers in public secondary schools, there will be a significant improvement in the conditions of academic buildings in public secondary schools in the study area in particular, and Nigeria in general.

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CHAPTER ONE

INTRODUCTION

1.1 Background to the Research

Buildings require adequate maintenance as they get older over time. Building maintenance is required to ensure the safety of building occupants and properties. Lack of maintenance can result in unsafe, unhealthy and hazardous environment. Maintenance is not restricted to a certain type of building or to any location, rather maintenance is an important operation for the provisions of infrastructural development. It plays an important role among other activities in the building operations (Zulkarnain, 2011). Maintenance is controlling the conditions, state and situations of buildings to an acceptable standard. According to Adenuga and Iyagba (2005), it is impossible to produce buildings which are maintenance free, but maintenance work can be minimized through good designs and appropriate workmanship carried out by experts or competent craftsmen.

However, much can be done at the design stage to reduce the rate of subsequent maintenance works. According to Faremi and Adenuga (2012), all elements of a building deteriorate at a greater or lesser rate depending on materials, methods of construction, age and environmental conditions. Neglect of maintenance, in most buildings, results to rapidly increasing deterioration of the fabric and finishes of a building accompanied by harmful effects on the contents and occupants. Some building owners most often try to keep maintenance expenditure to a minimum, ignoring the adverse long-term effects of such a practice.

Maintenance has become a principal issue in the life of public buildings. The importance attached to Public Secondary Schools, in the society, requires that maintenance issues be considered at all times. Maintenance plays a major role in the performance of Public Secondary Schools. Public buildings are assets developed by government and used by the people. Spedding (1994) noted that continuous neglect of the assets of educational institutions is not only storing potential enormous bill for the future, but is also seriously affecting the quality of work and achievement of many learners. The primary objective of building maintenance is to preserve buildings in their initial functional, structural and aesthetic state (Adejimi, 2005). This is to ensure that such a facility continues to remain in such state and retain its investment value over a long period of time. Buildings are generally required to provide safe and conducive environment for the performance of various human activities. Odediran *et. al.* (2012) observed that the ability of a building, to provide the required environment for a particular activity, is a measure of its functionality. Therefore, as the components of a building begin to deteriorate, it becomes necessary to take some measures to ensure that the desired characteristics of that facility, which provide safety and convenience, are retained through adequate maintenance.

Maintenance enhances the quality of a building structure to meet modern requirements in order to prolong the life span of the building. It is required to ensure the safety of building occupants. Shohet, Puterman and Gilboa (2002) made it clear that there are increasing demands on maintenance programme to provide tools that will support maintenance planning. This is also confirmed by Olagunju (2012) who also noted that that the absence of appropriate tools for predictive maintenance of existing buildings can have a detrimental effect on the future of such buildings. It is necessary to carry out maintenance works for the safety of users and properties in the buildings, to also

preserve the physical condition of the buildings and keep the buildings in good operational state at all times. Appropriate building maintenance can be achieved by providing maintenance tools for all public buildings, especially in Public Secondary Schools.

Maintenance issues play a major role in the performance of Public Secondary Schools. Abiodun (1996) observed that lucrative building maintenance contracts were awarded without due process which also contributed to poor maintenance of buildings. Adejimi (2005) attributed the array of abandoned and epileptically functioning facilities in Nigeria to poor or lack of maintenance culture. This underscores the need for a study on the maintenance strategy used by the school managers and various factors affecting secondary school building maintenance. This is with a view to proffering appropriate maintenance strategies and tools.

1.2 Statement of the Research Problem

Much has been written on maintenance of public secondary school buildings in Ogun State Nigeria. However, very little is known and documented on the objectives and outcome of maintenance strategies as a way out of deterioration. Precisely, much is not known on the reality of maintenance strategies on the existing public secondary school buildings in the past and present. As a result, it has become increasingly difficult to identify a precisely the existing maintenance strategy and options providing solutions in addressing maintenance problems. In addition, there is a paucity of empirical data on the public secondary school buildings and infrastructure.

The challenges facing public schools are multifaceted and include the following: teachers dissatisfaction; non-commitment of educators; chronic absenteeism by educators; low morale; poor work ethics by educators; late coming of both educators

and learners; overcrowding in classes, lack of technical resources and many more others (Bosah, 2005). A cursory investigation of the public secondary school buildings in Ado-Odo/Ota L.G.A shows that they are in deplorable conditions of structural, aesthetical and decorative disrepair. Many buildings have obsolete mechanical and electrical systems as well as problems with roofing, asbestos, disability accessibility, safety, fire code compliance, and high operational costs (Ayers, 1999). Series of investigation have been carried out on factors responsible for the poor maintenance of public secondary school buildings in Nigeria. It is against this background and the need for proper understanding of the outcome of various maintenance strategies in public secondary school buildings that an in-depth evaluation was carried out in this study.

The gap between this study and other existing studies on public secondary school buildings reviewed particularly in Nigeria were identified to be;

1. Previous studies showed that most maintenance managers did not investigate building user-perceptions of the prevailing deterioration condition of buildings in their study.
2. Majority of the studies assessed the current level of poor-maintenance of public building using POE and key performance measurement. This study applied all of the above and the Facility Condition Index (FCI), to evaluate the building condition and the condition of the premises.
3. Several studies on maintenance are limited to maintenance types. This study concentrated on maintenance strategies.

In view of the problem statement, it has become necessary to study the maintenance strategy engaged in by the school managers and identify the factors affecting

secondary school building maintenance activities. To address the goal of this study, the following research questions were formulated:

1. What are users' perceptions of the present condition of public secondary school buildings in the study area?
2. What are the current state/ level of maintenance of public secondary school buildings in Ado-Odo/Ota L.G.A?
3. What are the factors responsible for the present state of the maintenance of public school buildings in the study area?
4. What are the maintenance policies and strategies that are put in place for the public secondary school buildings as well as the maintenance experience of school managers in the study area?
5. Which maintenance models can be developed to preserve the existing buildings as well as improve their condition?

1.3 The Aim and Objectives of the Research

The aim of the study was to evaluate the building conditions and maintenance strategies adopted in Public Secondary School buildings in Ado-Odo/Ota Local Government Area of Ogun State with a view to developing maintenance models that can assist in proper maintenance.

The specific Objectives of the study were to:

1. investigate users'-perceptions of the prevailing deterioration level of public secondary school buildings in Ado-Odo/Ota L.G.A;

2. assess the present state/ level of maintenance of public secondary school buildings in Ado-Odo/Ota L.G.A;

3. identify the factors responsible for the state of maintenance of public school buildings in the study area;

4. investigate the maintenance policies and strategies, being adopted for the public secondary school buildings and assess the maintenance experience of school managers in the study area; and

5. develop models that can be used to preserve the existing buildings and improve their condition.

1.5 Significance of the Study

This study sought to contribute to a good maintenance practice of public secondary school buildings in Nigeria. This study attempted to provide solutions to the present condition of poor maintenance of public school buildings, based on the opinion of the users and maintenance managers. The choice of Ado-Odo/Ota L.G.A, Ogun State can be justified in terms of its importance within the State. The L.G.A has the highest number of secondary schools within the twenty Local Government Areas in Ogun State.

Another reason for this research was to add to the existing body of knowledge in the area of maintenance of school buildings. This study also provides valuable maintenance solutions that can be adopted by administrators, policymakers, school managers, Ministries of Education, government and school planners and designers in Nigeria. The study likewise documents the information that can be used in the planning of school renovations and future replacement projects, as well as in the general maintenance decision-making process to be utilized in school maintenance and repairs.

The study is beneficial to the management, staff and students of Public Secondary Schools, government, educational planners, researchers as well as the general public.

The study has both empirical and theoretical significance. Empirically, it provides the different recipients with essential information on maintenance issues in Nigeria. Such information is necessary for effective decision making on matters of school maintenance.

1.5 Scope and Limitations of the Study

The study is focused mainly on the maintenance issues in public secondary school buildings in Ado-Odo/ Ota L.G.A, Ogun State, Nigeria. It was an intentional action to investigate public school buildings because they have common ownership. The study covered thirty-six out of the existing forty-seven Public Secondary Schools in the study area. Maintenance evaluation of public secondary school buildings in this study area was carried out using three sources of data on maintenance, namely; the public secondary school buildings users' opinion (academic and non-academic staff); the secondary school buildings' maintenance managers (Principals or Vice-Principals) and observation survey of the public secondary school buildings by walkthrough the school buildings using a scale to rate the building condition and components.

This study investigated the diverse ways maintenance practices are carried out by the school Principals or Vice- Principals who also double as maintenance managers of the respective Public Secondary Schools in the study area. The users' opinion (academic and non- academic staff) was obtained with respect to the effects of adequate and inadequate maintenance has on school buildings. The investigation was focused on the following basic school facilities: (i) Classrooms (ii) Laboratories (iii) School hall (iv) Library (v) Art Studio (vi) Computer rooms (vii) Toilet facilities (viii) schools compounds.

Building observation survey was also carried out to assess the physical condition of Public Secondary Schools buildings using building condition rating scales.

Sufficient effort has been put to exhaust the scope aforementioned but time and cost constraint relative to the magnitude of maintenance problems are the major forms of limitations for the total achievement of the set objective.

1.6 The Study Area

The study area is Ado-Odo/Ota Local Government Area which is one of the 20 Local Government Areas of Ogun State, Nigeria. The L.G.A came into existence on May 19, 1989 following the merging of Ota, part of the defunct Ifo/Ota Local Government with Ado-Odo/Igbesa Areas of the Yewa South Local Government. Ado-Odo/Ota shares boundary with metropolitan Lagos State in the East and South, Yewa South and Ifo Local Governments in the North and Ipokia Local Government in the West. The Local Government Area is the second largest in Ogun State (Ogun State Ministry of Information and Sports, 1999).

The headquarters of Ado-Odo/Ota Local Government is in Ota, located 6°41′00″N 3°41′00″E to the North. It has a land area of 878 km² and a population of 526,565 as at the 2006 census. The creation of Ado-Odo/Ota Local Government united the Awori people of Ogun State within a local government area. Also found in the local government area are Egba settlers at Atan, Ijoko and Sango Ota, while the Yewas and the Eguns are in Ado-Odo area.

The administrative structure of Ado-Odo/Ota L.G.A has been changing in line with the trend in Ogun State's political history. Presently, the State has 20 Local Government

Areas (LGAs) (Figure 1.1). Each LGA is headed by a Chairman and assisted by a Vice Chairman. It also has an elected Councilor as enshrined in the 1999 Constitution of the Federal Republic of Nigeria.

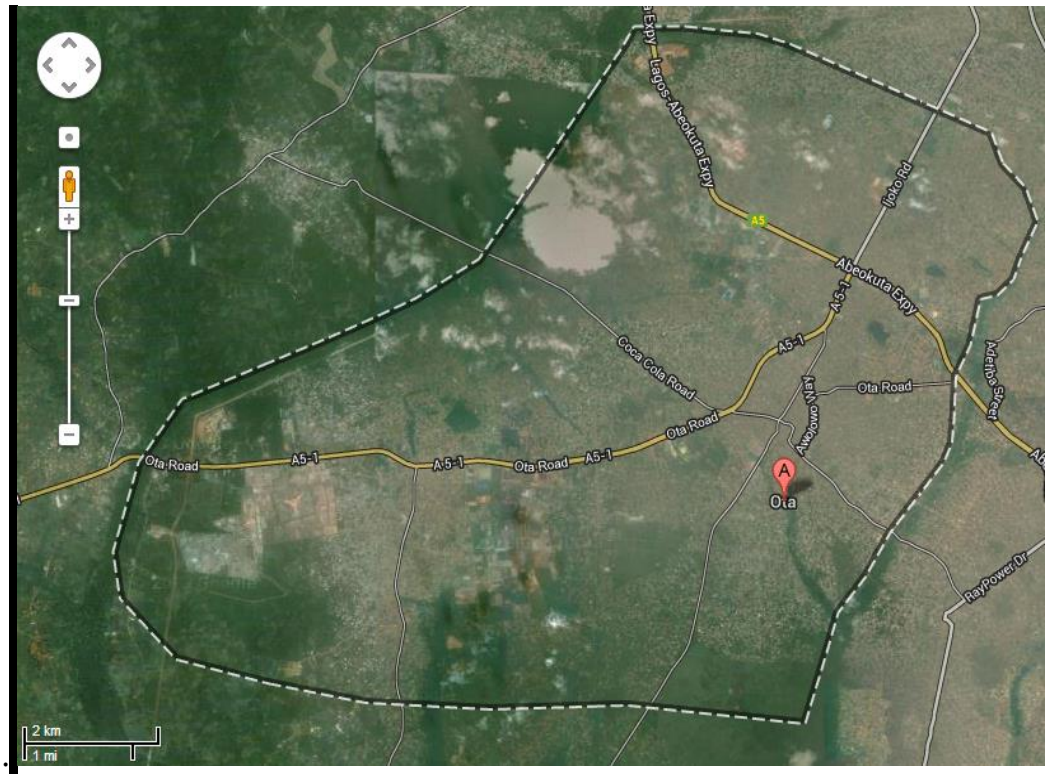


Figure1.: Layout of Ado-Odo/Ota L.G.A

Presently, the State has 20 Local Government Areas (LGAs) (Figure 1.2). Ado-Odo/Ota L.G.A covers the following areas: Ota 1, Ota 2, Ota 3, Ilogbo, Atan, Alapoti,

Ado-Odo (I), Ado-Odo/Ota(II), Ere, Igbesa, Ketu, Adie Owe, Agbara 1, Agbara 2, Iju,

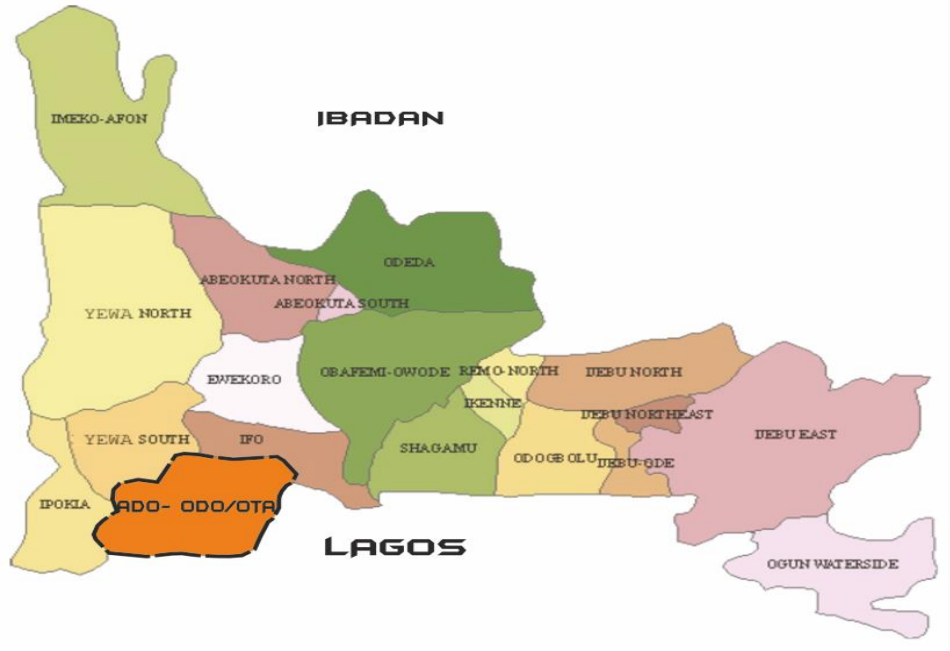


Figure 1.2: The Map of Ogun State Showing Ado-Odo/Ota Local Government Areas
Source: Ogun State Regional Plan (2012)

1.6.1 Public Secondary School Education in Ado-Odo/Ota, L.G.A

Secondary school education is the intermediary between the primary and tertiary (Ayers, 1999). The importance of secondary education made the Federal Government of Nigeria to declare the broad aim of secondary education as preparation for useful living within the society and for higher education. This implies that secondary schools should be able to provide quality secondary education to all those who can benefit from it.

Secondary education started in Nigeria with the establishment of CMS Grammar School in 1859 but made a noticeable impact shortly after independence with the establishment of the Federal Ministry of Education (Obemeata, 1995).The Introduction of Free Universal Primary Education in the old Western Region started in Ogun State between 1954 and 1955 under the leadership of the late sage, Chief Obafemi Awolowo (Ekundayo and Alonge, 2012). Since then, more schools are coming up on a daily

basis in the state. Therefore there are four hundred and seventy four Public Secondary Schools in Ogun State. Table 1.1 shows the distribution of the schools across the State.

1.6.2 Population of the Public Secondary Schools in Ogun State:

Enrolment of students into its Public Secondary Schools in Ogun State had risen from 292,324 in 2010/2011 session to 387,915 in the 2011/ 2012 academic session. According to Obemeata (1995), since the takeover of secondary schools in 1975 by government, secondary education had deteriorated in practically all the secondary schools in the country, Ogun State inclusive, as both human and material resources deteriorated and schools were not satisfactorily managed. While the population of secondary students rose sharply, there were no appreciable increases in classrooms.

Table 1.1: List of all Public Secondary Schools in Ogun State (2011- 2012 Academic Session)

S/N	Local Government Area	JSS	SSS	Combined Schools	No of Public Sec. Schools
1	Abeokuta North	9	9	8	26
2	Abeokuta South	19	19	1	39
3	Ado-Odo, Ota	18	18	11	47
4	Ewekoro	3	3	5	11
5	Ifo	9	9	9	27
6	Ijebu East	5	4	9	18
7	Ijebu North	16	16	3	35
8	Ijebu North East	4	4	5	13
9	Ijebu Ode	11	11	3	25
10	Ikenne	7	7	4	18
11	Imeko Afon	5	5	7	17
12	Ipokia	9	9	4	22
13	Obafemi Owode	8	7	7	22
14	Odeda	6	6	5	17
15	Odogbolu	8	8	9	25
16	Ogun Waterside	6	6	7	19
17	Remo North	1	1	6	8
18	Sagamu	9	9	9	27
19	Yewa North	10	10	11	31
20	Yewa South	11	11	5	27
	Total	174	172	128	474

Source: *Statistic Department, Ogun State, Ministry of Science and Technology (2012)*

1.6.3 Population of schools and students in Ado-Odo/Ota L.G.A

At the inception, Ado-Odo/Ota L.G.A only had a few schools owned and operated by various Christian organizations. The Muslim community also established school, operated by the Ansar-Ud-Deen Society. State schools came on board in the late 1970s, and there are now several private schools in the area. It is on record that Iganmode Grammar School founded in 1960 is the oldest. Ado-Odo/Ota has the highest number of schools in Ogun State presently. (see Table 1.1)

As at the time of carrying out this study, there were forty-seven schools, eighteen senior secondary schools and eighteen junior secondary schools. Table 1.2 shows the details of the schools. Some of the schools share common names with different status, Principals and vice-Principals. Thirty-six schools were found in that category, while eleven were the combined schools. All these schools were investigated in this study.

Table 1.2: Population of the students in Ogun State secondary school

S/N	Local Government Area	Jss1 Total	Jss2 Total	Jss3 Total	Ss1 Total	Ss2 Total	Ss3 Total	Total	% Per L.G.A.
1	Abeokuta North	4,819	3,861	3,569	4,108	3,252	2,473	22,082	6.37
2	Abeokuta South	8,157	7,335	6,130	7,269	6,237	4,317	39,445	11.38
3	Ado-Odo, Ota	12,488	10,882	9,513	10,027	9,145	6,549	58,604	16.91
4	Ewekoro	1,463	1,179	981	1,379	1,221	1,132	7,355	2.12
5	Ifo	6,502	4,946	5,005	5,647	5,012	3,438	30,550	8.82
6	Ijebu East	1,618	1,275	1,168	1,018	954	905	6,938	2.00
7	Ijebu North	3,264	3,048	2,645	2,524	2,490	2,084	16,055	4.63
8	Ijebu North East	666	742	648	680	691	681	4,108	1.19
9	Ijebu Ode	4,558	4,043	3,881	4,636	3,422	2,097	22,637	6.53
10	Ikenne	2,483	1,917	1,892	2,464	1,713	1,505	11,974	3.46
11	Imeko Afon	1,675	1,224	1,107	1,050	961	1,011	7,028	2.03
12	Ipokia	3,546	2,424	2,295	2,684	2,675	2,820	16,444	4.75
13	Obafemi Owode	2,976	2,446	2,275	2,418	2,067	1,796	13,978	4.03
14	Odeda	2,475	1,806	1,701	1,670	1,740	1,497	10,889	3.14
15	Odogbolu	1,949	1,788	1,593	1,286	1,509	1,384	9,509	2.74
16	Ogun Waterside	1,038	1,020	1,133	980	1,111	1,070	6,352	1.83
17	Remo North	616	579	509	508	478	452	3,142	0.91
18	Sagamu	5,431	4,375	5,236	4,043	3,596	2,616	25,297	7.30
19	Yewa North	3,059	2,825	2,594	2,286	2,104	1,940	14,808	4.27
20	Yewa South	4,293	3,437	3,037	3,133	2,804	2,577	19,281	5.56
		73,076	61,152	56,912	59,810	53,182	42,344	346,476	100.00

Source: ***Statistic Department, Ogun State, Ministry of Science and Technology*** **(2012)**

Table 1.3: Showing the List of all Public Secondary Schools in Ado-Odo/Ota L.G.A

S/N	NAME OF THE SCHOOL	JSS	SSS	Combined
1.	A U D Comprehensive College,Ota	1	1	
2.	A U D Comprehensive High School,Lafenwa-Ota	1	1	
3.	Ado Odo High School, Ado Odo	1	1	
4.	Agbara Community High School, Edu-Agbara.	1	1	
5.	Ajogbo Grammar School, Ajibode-Ota.	1	1	
6.	Alamuwa Grammar School, Ado-Odo.	1	1	
7.	Anglican Grammar School, Ota	1	1	
8.	Community High School, Alapoti	1	1	
9.	Community High School, Iroko-Aparadija.	1	1	
10.	Iganmode Grammar School. Ota	1	1	
11.	Igbesa High School, Igbesa	1	1	
12.	Iju-Ebiye High School, Iju-Ota	1	1	
13.	Local Government Secondary Commercial School, Atan-Ota	1	1	
14.	Male Comprehensive High School,Igbesa.	1	1	
15.	Sango-Ota High School, Sango-Ota.	1	1	
16.	St Stephen's Comprehensivel High School, Ado-Odo.	1	1	
17.	Unity High School, Ijoko-Ota	1	1	
18.	Unity High School, Kajola-Ibooro	1	1	
19.	Araromi Community High School, Araromi-Orita, Ota			1
20.	Community High School, Ejila Awori			1
21.	Ilogbo-Asowo Community High School, Ilogbo-Asowo			1
22.	Adie-Owe Community High School, Adie-Owe			1
23.	St. Michael's High School, Ota			1
24.	Iyesi-Ota High School, Iyesi-Ota			1
25.	Agbara Grammar School, Agbara			1
26.	A. U. D. Comprehensive High School, Itele-Ota			1
27.	Toyon High School, Ere, Ado-Odo			1
28.	Community High School, Igbala-Ota			1
29.	Ewupe Community High School, Ewupe, Sango			1

Source: Ogun State Teaching Service Commission (2013)

1.7 Definition of Terms

British Standard BS 3811:1993 "Glossary of Terms in Terotechnology" defined 'Maintenance' as – "the combination of all technical and administrative actions, including supervision actions, intended to retain an item in, or restore it to, a state in which it can perform a required function". It envisages two processes: 'retaining', (work carried out in anticipation of failure, referred to as 'preventive maintenance') and 'restoring', (work carried out after failure, referred to as 'corrective maintenance').

School Building Maintenance: Akasah, Zainal Abidin and Shamsuddin , Sharifah Hamimah and Abd Rahman , Ismail and Alias, Maizam (2009) defined school building maintenance as a continuous operation to keep the school buildings, furniture and equipment in the best form for normal use. The maintenance of the school building is a daily activity of the institution and its personnel.

Maintenance Strategy: A maintenance strategy refers to the rules for the sequence of planned maintenance work. It consists of general scheduling information, maintenance tasks and maintenance plans as required (Akasah, 2009). Further, Mintzberg *et al*.(1999) present the criteria for effective strategies to include clear decisive objectives; maintaining the initiative; concentration; flexibility; coordinated and committed leadership; surprise and security.

Maintenance Policy: BS 3811(1984) defines maintenance policy as a strategy within which decisions on maintenance are taken. Alternatively, it may be defined as the ground rules for the allocation of resources (men, materials and money) between the alternative types of maintenance actions that are available to management.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The literature review provides a theoretical background for the study. This section reviewed literature on the prevailing deterioration of buildings, level of poor maintenance of public buildings, factors responsible for the poor maintenance of public buildings, maintenance policies, strategies, practices and mode in relation to public school buildings with emphasis on the Nigerian situation. Maintenance of buildings has been studied using various methods, conceptual frameworks and methodologies. Several authors had worked on maintenance of buildings but using different approaches or systems.

Diverse methods of maintenance strategies used by past authors that are relevant to this study were reviewed. Each of the concepts and methods was explained in relation to this study. It is essential to be guided by an existing conceptual framework in order to provide integration in a study, this normally exposes one to previous scientific contributions (Adenuga, 2009). However, different researchers in the past, made attempts at providing solutions to the problem of building maintenance. Some of them established concepts and theories, for predicting the extent of the deterioration after which they proposed models and methodologies for maintenance.

Literature related to the study were sourced and reviewed under present deterioration present deterioration condition of building, building inspection as a way out of deterioration and disrepair, factors responsible for poor maintenance of buildings, assessment of the current state and level of poor maintenance of public secondary school buildings, factors influencing decision to undertake maintenance, previous

building maintenance methodologies for public buildings, previous models for building maintenance and building performance indicators.

2.2 Descriptions of Maintenance

Building maintenance is the most economical way of keeping the building and equipment in their best form for normal use, to preserve the building design and to retain the construction and all building components without minding the maintenance type. Maintenance of buildings and equipment is an effective plan or disaster mitigation measure in terms of cost and building usage. However, different authors gave different definitions of building maintenance and some of the definitions are presented in Table 2:1.

Table 2.1 Building Maintenance Concept by different Authors

Authors	Concept	Maintenance Elements
Afranie and Osei-Tutu (1999)	necessary work done to preserve a building with its finishes and fittings, so that it continues to provide the same or almost the same facilities, amenities and serves as it did when it was newly built	Societal Expectations
Zubairu (1999)	day to day cleaning, inspecting, repairing, fixing of various systems and components of a building as well as, work undertaken in order to keep, restore or improve every facility.	Societal Expectations
Oladipo (2005)	Controlling the conditions, state, and situations of buildings to an acceptable standard.	Acceptable standard.
Adenuga (2008)	work that is done to ensure that all buildings are safe and also in healthy condition in accordance with specific acceptable standards.	Acceptable standard.

The concept of an ‘acceptable standard’ by Oladipo (2005) and Adenuga (2008) may be construed as acceptability to the owner of the building, to the users of the building or to some outside body with the responsibility for enforcing minimum standards. Additionally, it can also be construed more widely as acceptability to the public at large or to specific sections of the public. However there are no absolute standards which would be equally acceptable to everybody or which would remain acceptable to the same group of people over a period of time. The standards acceptable at the time of undertaking the construction work may be higher or lower than the initial design standards, especially if the construction is not commenced immediately after the building design. In many instances the standards deemed acceptable would be higher than that originally provided and the building would include an element of improvement. Buildings, with the passage of time, are modified to accommodate new uses and it becomes increasingly unrealistic to think in terms of keeping or restoring the initial standards. Clearly, the standards would be related to safety and efficiency, and this has to be determined by the amount of money allocated or available rather than as a result of assessing the benefits obtained from maintaining the building to a particular state.

Whereas from the two definitions given by Afranie and Osei-Tutu (1999) and Zubairu (1999), it is obvious that acceptable standard indicates that maintenance work is not tailored to suit individual needs, conditions and abilities but societal expectations. The definitions envisage a range of acceptability with upper and lower limits between which the conditions of the building must be maintained. This study agrees with the definitions but feels that acceptable standard may be a difficult thing to define since a cost is always attached to maintenance work.

From the earlier definitions, building maintenance can be said to be applying a plan, a policy or strategy to retain the quality of a building fabric to avoid deterioration or defects with a view to funding to ensure a good appearance at all times. This study emphasizes that building maintenance enhances the quality of facility/structure to meet modern requirements, in order to prolong the life span of buildings and to ensure the safety of building occupants and components. This definition is to gives a clear picture of which direction this study viewed maintenance for proper guidance.

2.2.1 Type, Nature and Scope of Building Maintenance

King *et al.* (1984) listed six types of maintenance. These are:

(i) Service maintenance which is the emergency attention to issues in building or occupants' request for repairs.

(ii) Routine maintenance is the general maintenance that is carried out at the owners' discretion to keep the building in good condition.

(iii) Preventive maintenance comes up through regular inspection.

(iv) Corrective maintenance consists of repairs to the building and equipment due to natural wear and tear or faulty items.

(v) Deferred maintenance occurs when a necessary maintenance is put off until a later date, as a result of budget limits, owners' preference, unavailability of parts or inclement weather.

(vi) Extra- ordinary maintenance involves major retaliation, replacement or refurbishments of units, buildings or grounds.

Recently, studies had however classified maintenance into two broad categories: Planned and Unplanned Maintenance" (Yates and Ge, 2010). These groups were classified into several types, as presented in Figure 2.1.

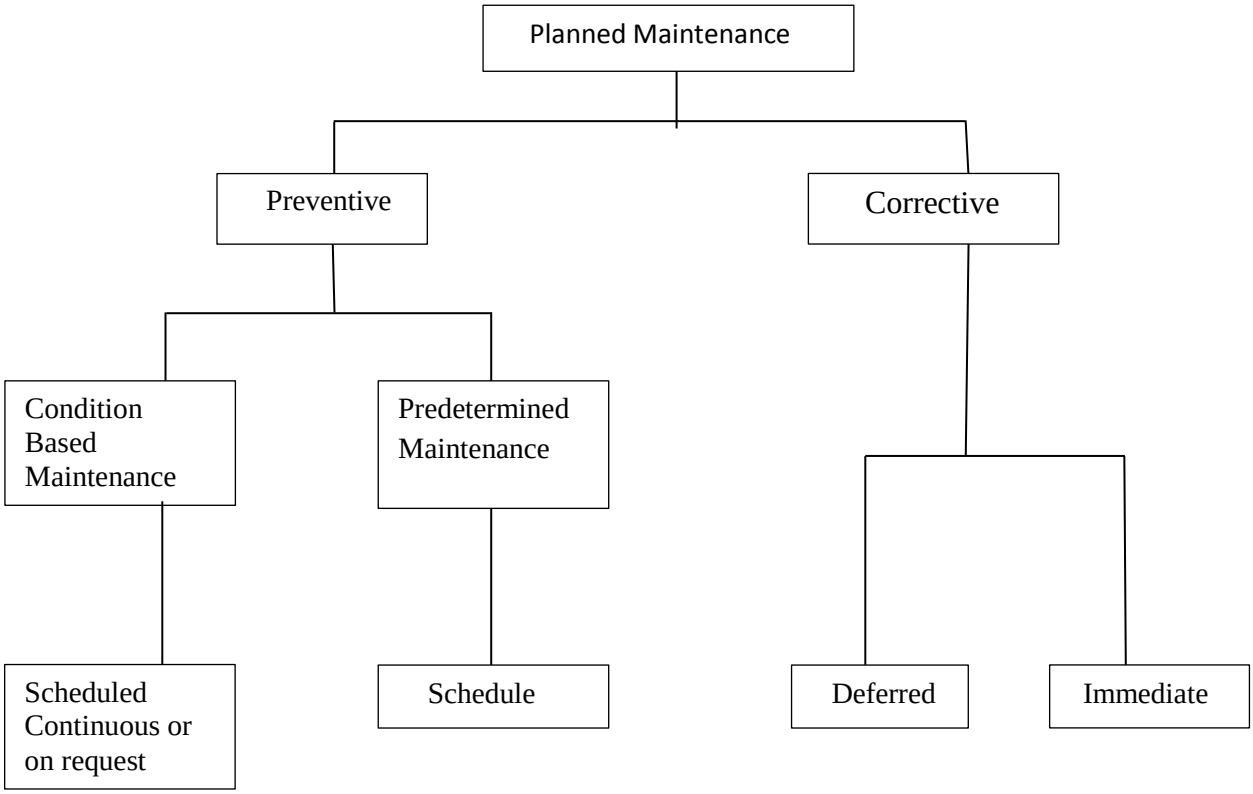


Figure 2.1: Grouping of different types of maintenance

Source: Yates and Ge (2010)

Planned maintenance is a major repair, structured and carried out with the use of records to a pre-determined plan and is different from the day-to-day repair service because it keeps buildings modern, safe and comfortable over a long term. It can also categorised into "Preventive and Corrective Maintenance" as in Figure 2.1.

In line with the definition by Yates and Ge (2010), the study defines planned maintenance as work to prevent failure, which recurs predictably within the life of a building. It involves planning of the periods in which preventive maintenance is to be performed. It also determines the size of the maintenance crew, when and how many materials should be purchased and the scheduling of the different maintenance jobs.

Un-planned or emergency maintenance deals with work that must be initiated immediately for health, safety and security reasons; or that may result in the rapid deterioration of the structure or fabric if not undertaken (e.g. roof repairs after storm damage, repairing broken glasses). Zubairu (1998) affirms that buildings are too valuable to be neglected in anyway and that maintenance is an essential thing to retain the building investment values, in order to fulfill their function and present a good appearance.

There are numerous maintenance techniques or practices that are in vogue amongst various maintenance departments in different industries and buildings. Among these are (i) breakdown (ii) reactive (iii) preventive (iii) Running (iv) Routine Maintenance, (v) Scheduled Maintenance (vi) Shutdown (vii) Predictive (viii) Condition-based (ix) Reliability-centred (x) Proactive (xi) Design-out (xii) Productive (xiii)Prevention (xiv) Autonomous (xv)On-line (xvi) Off-line (xvii) Area Maintenance (xviii) Deferred (xix) Fixed Time (xx) Mechanical (xxi) Electrical (xxii)Instrument (xxiii) Opportunity (xxiv) Consequence Driven (xxv)Total Productive maintenance.

Shen *et al.* (1998) were of the view that there are ever-increasing needs for maintenance planning which is not met in public buildings. On the other hand, Gits (1994) argued that it is uneconomic to have large maintenance staffs for emergencies that can be avoided through planning and systematized inspection. Buys (2004) made it clear that there can be no proper maintenance without a plan. Gits (1994) contended that the process of compiling and appraising the budget should be based on preventive maintenance plan of the organization. The study further explained that lack of proper maintenance plan in tertiary institutions do lead to poor condition of buildings. The place of planning in maintenance shows that many things such as adequate

maintenance planning can bring about reduction in maintenance cost. If maintenance is not planned, unexpected repairs would be interrupting the life cycle of the building.

Shohet *et al.* (2002) noted that regular inspection is a fundamental part of preventive maintenance. That study suggested a condition survey for effective maintenance work to carry out an assessment of the present condition, identification of the intervention moment and maintenance priority for maintenance planning. The study stated clearly that preventive maintenance must have inspection cycle until when failure becomes impossible to avoid. As a follow up to the study, Iyagba (2005) noted that more emphasis should be on preventive maintenance because it is the most important of all types of maintenance practice. The study recommended that regular inspection should be carried out for good maintenance; this must be done with sound knowledge of causes of decay and understanding of building construction. It was further explained that all building properties should be inspected at stipulated intervals to identify existing deterioration and recommend required maintenance planning work. That study concluded that deterioration should be measured within a stipulated time and that, the state and period of interval between one condition survey and the other should be stated.

Gits (1994) was however of the view that adequate maintenance planning is preferable because it includes preventive and corrective maintenance. Planned maintenance ensures that needed spare parts and materials are on hand. Preventive maintenance or correction of defective conditions not only decreases the cost of repairs but also maintains the quality and capacity of machinery, building or anything that requires maintenance. Buys (2004) concurs with Gitts's (1994) proposition that it is vital that top management should be aware of the importance of maintenance planning and the

consequences of neglecting maintenance. The building owner should know that it is important to have maintenance plans for his buildings. It will be difficult to direct a building owner or an organization to adopt a single type of maintenance.

2.3 Deterioration of Buildings

All elements of buildings deteriorate at a greater or lesser rate depending on materials, method of construction, age, environmental conditions, usage of building, and method of design and maintenance management. Before maintenance would be required in buildings, much can be done at the design stage to reduce the amount of subsequent maintenance work (Faremi and Adenuga, 2012). The deterioration of a building hampers its ability to perform adequately and thus is important to ensure proper maintenance for building continuity (Amusan and Bamisile, 2012). The continued efficient and effective performance of any building depends partly on the nature or condition of the buildings and partly on other factors. Adenuga (2008) established that a to large extent, a building deteriorate at a greater or lesser rate depend on materials, methods of construction, age and environmental conditions, usage of the building, method of design and maintenance management of buildings. There was no clarification on the type of building or ownership.

Zubairu (1999) emphaised that all buildings start to deteriorate from the moment they are completed, whether occupied or not. Therefore, understanding how existing buildings affect occupants, designers can minimize problems and have successful design features. Further study by Zubairu and Olagunju, (2012) on post occupancy evaluation of some selected Secondary Schools in Minna, Nigeria, noted that there are deterioration factors. The maintenance of a building, the building usage, exposure to natural forces, correction and identification of defects would increase the life span of

the buildings and the safety of users. The major problem in many schools is overcrowded classrooms. That study investigated fourteen secondary schools, the top five well performing schools were all private secondary schools with one Federal Government secondary school taking the sixth position, while the remaining were State Government owned schools. That study concluded that public schools are far less well maintained than private ones.

High deterioration can lead to failures, hence, Arayela and Adam (2001) recommended that "urgent actions needed to be taken by government to enact the National Building Code, to regulate the construction of buildings. The authors did not state how the code shall be enforced, but admitted that the National Building Code was essential because it would assist in the development of minimum maintenance standards and also reduce the rate of building failures. There was no investigation or provision for maintenance policies, strategies and practices in the recommended National building code.

In the same manner, Olotuah (2006) carried out an appraisal of the state of repairs of buildings in Akure, Ondo State, Nigeria. The study revealed that most buildings were in poor state and required major repairs. The variables investigated were floor finish, building age, household size, number of bedrooms, amenities, mode of construction, wall materials and type of tenure. These variables significantly showed the state of disrepair and the need for rehabilitation.

Ikpo (1990) studied the deterioration phenomena of selected housing estates in South–west, Nigeria. The variables used were building age, building types, construction methods/detail, user's income, average maintenance cost annually and estate total

floor area. The author used descriptive and analytical survey in the study. The study showed that environmental factor, the user's attitudes, building designs and building construction affect the annual maintenance cost of buildings. The study established some problems that may lead to high rate of maintenance needs. The problems includes; untested design and construction methods, old age of many components which require replacement that depend on funds, response from maintenance bodies and users' satisfaction, lack of or little funds that are allocated for maintenance, and inadequate number of maintenance staffs is cited as the main cause for delays in carrying out maintenance work.

Authors such as Shen and Lo (1999); Buys (2004) and Igal *et al.* (2004) agreed with Ikpo (1990) that density causes deterioration and ageing in public buildings but some of these authors only identified few factors that are responsible for deterioration in buildings. Investigating few deterioration factors would not be enough for a detailed study of this kind.

Amole (1997) carried out a study on twenty selected halls of residence in selected Universities in South-West, Nigeria. The data were collected from occupants of the halls; physical and socio-physical characteristics of the halls of residence with information about the students' demographic characteristics. However the users' claimed to be satisfied with the design and location of the halls. Nevertheless, they were dissatisfied in the population, congestion and lack of maintenance. It however recommended post occupancy evaluation of all the halls. The study was very explicit and focused on conditional assessment of those hostels as they affect the students in higher institutions. It is also imperative to examine educational buildings using larger building users as sample size to enable robust deductions to be made.

Shen *et al.* (1999) investigated the reason for high building deterioration. The authors identified problems that led to high rate of maintenance needs or deterioration. The findings of the study revealed that high density and lack or little funds allocated to maintenance causes deterioration in public building.

Buys (2004) cited Shen *et al.* (1999) in a study on causes of delays in carrying out maintenance work in South Africa. The study noted that sometimes maintenance is delayed and deprived. According to the author, occasionally insufficient number of maintenance staff was cited as the main cause for delays in carrying out maintenance work. These studies established that funding and age are factors of building deterioration. These studies did not establish how long a component can last and the significance of each component in the building. There is need to apprehend that building wear out at different rates depending on the life span of its component, material quality, type, standards, and method of construction of buildings. However, Buys (2004) observed that, lack of funds, poor response from maintenance bodies, long waiting time for materials from suppliers also contribute to building deteriorations. All the identified factors were considered in this study.

The manner of usage of a building can result in disrepair and exposure to natural forces. Human activities responsible for the deterioration and decay of building includes failure to clean and carry out routine maintenance, ignorance of the causes of deterioration and decay, failure to promote awareness of maintenance needs by all who use the building and adopting a negative attitude of waiting until emergency measures are required. Others are presence of chemical, fire, faulty design, construction, materials and systems as well as vandalism, (Adenuga, 2010). However, Olagunju

(2003) explained that deterioration can however be avoided or rectified through maintenance of the building. Maintenance (planned and unplanned) can make the necessary impact only if the financial regulator of the building through correct diagnosis of defects ensures that funds are made available for such a purpose. Failure to undertake regular maintenance of a building will ultimately in reduce the life span of the building and finally its demolition.

From all the literatures reviewed, it is obvious that maintenance of the building will however ensure that the building is restored thereby increasing its life span. However, it would be difficult to find one best solution to promote safety and reliability of maintenance activities or to determine and describe deterioration factors in general. The opinion of the users will definitely assist the maintenance manager in the maintenance delivery.

2.3.1. Building Inspection as a Way out of Deterioration and Disrepair

Regular inspection is fundamental to good maintenance, together with knowledge of the design, construction of building and the causes of decay with a sound understanding of the deterioration factors (Iyagba, 2005). According to the author, all properties should be inspected at regular intervals to identify any deterioration and disrepair, in order to document the required maintenance jobs. The author was that the frequency of inspections would be influenced by rates of decay and deterioration. Another study carried out by Shohet and Straub (2013) described regular inspection as a fundamental part of a preventive maintenance. The study suggests that a building condition survey be carried out so as to identify the optimum moment for intervention, with the aid of prioritization of actions and planning for the future. The study recommended the use of non-technical staff, building users and regular/ periodical

visitors to provide the maintenance function with vital information regarding condition which would otherwise wait until a subsequent inspection cycle or until failure becomes impossible to ignore. Adenuga (1999) recommended that the occupier of any building should bring to the attention of the building owner or his representative all failures which affect his tenure. Such a failure is by simple wearing out, failure, accidental or deliberate damage so that the owner or his representative will decide on the methods of dealing with the maintenance by inspection; based on the type of property and age.

2.4 Poor Maintenance of Public Secondary School Buildings

The physical causes of maintenance problems include all natural/physical factors that negatively affect the durability of the building. The durability of a built facility is a measure, in an inverse sense, of the rate of deterioration of materials or components, (Afranie *et al.* 1999). British Standard Institution (BSI) Code of Practice sees 'durability' as the quality of maintaining a satisfactory appearance and performance of required functions. The code measures this parameter in terms of the minimum number of years of satisfactory life. British Standard Institution (BSI) Code of Practice looks at durability, as the quality of maintaining a satisfactory appearance and performance of required functions.

From previous literature, a number of factors were considered to influence deterioration of buildings. These range from building age, lack of funds, poor response from maintenance bodies, long waiting for materials to building location among others. There are different causes of deterioration and hence maintenance problems. The major ones are; age or period of construction, environmental factor, location, poor construction, design, life of buildings, life cycle of building component, (Adenuga,

2010). Dwindling resources, especially finance, are the major challenge facing building maintenance and maintenance managers in meeting up with expected building performance as explained by Adenuga (2008), Wordsworth (2001), Zubairu (2000), Randy and George (1998) and Westerkamp (1997). The location of a building has a direct effect on the maintenance problem as explained by Odulami and Iyagba (2001).

Waziri (2013) evaluated the factors affecting building maintenance in Nigeria from users' perspective. Fifty structured questionnaires focusing on the demographic profile and maintenance factors were administered. Maintenance culture was a major factor according to the study findings. The author described this as an attitude which is lacking in Nigeria in both the private and public sectors. Poor maintenance culture has been widely recognized as a problem in Nigeria by Mbamali (2003); Adejimi, (2005) and Usman *(*2012). Lack of maintenance culture was also attributed to lack of maintenance policy in Nigeria as also pointed out. Waziri and Vanduhe (2013), Odulami and Iyagba (2001) seemed to have a different opinion because they argued that corruption within the construction industry has contributed to building deterioration while location was influenced by the terrain of the environment, soil, nature of social and seismic movement, salt laden winds and salty water effects as well as high temperatures and drastic temperature changes.

Similarly Zubairu (1998) carried out a study on maintenance of Government office buildings using post-occupancy evaluation approach. The study used analytical and descriptive survey methods. The study investigated deterioration of building components such as doors, ceiling boards, doors and windows. Emphasis was on inadequate maintenance budget as part of the problems The author stated that poor

architectural and mechanical design, poor materials, building age, poor environment, bad electrical and structural design were the causes of maintenance problems in government buildings. The author developed a maintenance priority listing computer programme and a maintenance management performance evaluator (MMPE) for the evaluation of maintenance activities. The study did not emphasize the need to have a maintenance strategy and policy.

Odulami and Iyagba (2001) explained that during construction, few contractors sometimes refuse to redo and replace defective work and materials. Some professionals seems to be so sure of their work and have some supports from managements. Some deterioration factors like inadequate supervision during construction will expose buildings to quick deterioration. Some of the contractors are unskilled and they lack understanding of Architectural drawings and specifications. ‘‘Poor construction or workmanship by the contractor apart from causing future maintenance problems, can also lead to building collapse’’ as Zunguzane (2013) noted.

In discussing the issue of building construction, Olusola (2002) buttressed that poor construction sometimes leads to building collapse. Therefore a distinction must be made between buildings, which fail during construction or within the service life and to those that fail after the service life, which is usually 25 years. Generally, a building has economic and structural life. The economic life is the period when the building can cope with the requirements of the users if not poorly constructed while structural life or physical life is the period when the cost of maintaining the building is no longer economically viable. Buildings Energy Data Book (2008) stated that the lifespan of an institutional building has a median of 73 years.

The age of the facility has an impact on the rating of the physical condition of the facility, (Stevenson, 2001). Older buildings in general are more costly to maintain due to aging, including out-dated systems of electricity, heating, air conditioning, and water, and often suffer because of a lack of parts and labour to repair them (Lair, 2003**).** Although older building may be costly to maintain, yet not all components would deteriorate at the same time. It should also be noted that older buildings may not have the capacity for the infrastructure needed or used in the buildings, if such are installed forcefully this may lead to disrepair. The position of these authors is significant to this study but the life span of a building could be much beyond forty years if adequate attention is given to maintenance. The gap here is that the condition of the each building components was not investigated. Building age is a general thing but each component has a life span.

2.5 Assessment of the Current State and Level of Maintenance of Public Secondary School Buildings

Jegede and Owolabin (2003) observed that in Nigeria, emphasis is increasingly placed on academic qualifications; hence, schooling is beginning to be part of people's life style. For people to be encouraged, a befitting academic environment must be established. According to Wong *et.al.* (2006), in Singapore, schools are handled with care to the extent of having guidelines on standards and criteria for the planning of both primary and secondary schools. In South Africa, great attention is also given to schools, as explained by Idris (1998). There is increased liability in school buildings, considering the importance of schools. The owners, public or private, need informed decision in setting out the priorities that could drive maintenance of their properties, Silva (2009).

2.5.1 Natural Lighting as a Physical Condition Rating in School Building

Learning and teaching are adversely affected by poor lighting, which may be as a result of poor design, bad constructing or deteriorating condition of the school buildings. In an attempt to get the required level of day light needed, provision of more windows and allowing more natural light to enter the room is an option (Ayers, 1999). Windows provide air, light, a view and feeling of the outside environment. For this reason, school window design should strive to create equilibrium between the psychology and physical comfort of its users. There should be more attention on natural daylight in school design since it is a major source of Vitamin D. Schneider (2002) noted that recently there has been renewed interest in increasing natural daylight in school buildings. None of the two studies established if providing or not providing lighting would affect the students' performance. However, this study would attempt to establish the condition of buildings by discussing lack of adequate day light.

2.5.2 Flooring Materials as a Condition in Rating School Building

Carpet and other acoustical materials in the classroom are said to have positive influence in controlling noise caused by footsteps and conversation (Bowers and Burkett, 1987). The authors recommended the use of carpet as floor materials not minding the maintenance of the carpet in a classroom. Lyons (2001) indicated that hard flooring materials should, as much as possible, be avoided because it has poor acoustical properties. The study suggested that there should be less noise in the classroom, hence sound and outside noise should be reduced to the minimum. Noise in classrooms often makes children struggle to hear and sometimes loose focus. It is worthy of note that floor materials chosen may sometimes be a function of cost or its maintenance rather than that of noise control.

2.5.3 Roofing as a Condition for Rating School Building

The roof of any building is one of the most critical structural devices putting a barrier between people inside and outside of the building. All buildings have roofs, windows, doors and mechanical systems that need replacement at the end of their useful lives (Lyons, 2001). Many buildings have problems with roofing, among other subsystems (Ayers, 1999). Earthman (1996) stressed the importance of proper maintenance of the roof and other subsystems for keeping a building in good condition, noting that poor roof condition can cause rapid deterioration of other building systems. Left unrepaired, roof leaks can lead to significant structural damage and can also cause significant cosmetic damage through stained ceilings, peeling paint, and damaged floors (Lanham, 1999).

2.5.4 School Building Quality as Condition for Rating School Building

School buildings should be one of the most important public buildings in the society. It is amazing that such an important structure has been allowed to fall into disrepair in the society. School building quality can be measured by the level of resources, infrastructure and facilities available in a school. It is the responsibility of government to play a substantial role in providing good education for their citizens. A variety of reasons usually motivate government and this can be either economy or politics. School quality may be measured by the amount of investment from the government not minding the society. Ekundayo (2010) found that most Nigerian school buildings were of poor quality. However the poor quality was linked with numerous problems bedeviling the system, such as inadequate funding, inadequate facilities, low morale of staff, poor supervision of schools and frequent changes in policies.

2.5.5 Maintenance Budgets/Funding as a Condition for Rating Public School Buildings

Budgeting is an essential part of maintenance of any type. Chanter and Swallow (2008) emphasized that there cannot be maintenance without finance and management. Any maintenance plan without a financial budget will be absurd. Ibitoye (1985) described maintenance budget as a quantitative statement of plan for future period, usually twelve calendar months and that it gave expression to the objectives of the business for the period and policy for achieving those objectives. Dunn (1990) was of the opinion that if funding maintenance does not become a regular item, organization will soon find themselves mired in the same situation despite current fix-up campaigns. Adebayo (1991) declared that financial aspect of building maintenance was the responsibility of the building maintenance manager who should be concerned with controlling and planning of financial resources of building maintenance works. According to the study the financial plan must be of interest to both the manager and the building owner.

Seeley (1993) opined that the process of compiling and appraising maintenance budget should be based on preventive maintenance plan of the organisation. Shen *et. al. (*1998) confirmed the statement and remarked that maintenance budget was low when compared with the maintenance needs of buildings, therefore, maintenance budget can be done in line with maintenance planning. Dekker, (2002) buttressed that most maintenance agencies normally justify their budget to the government but most time allocation is lacking and this is very much needed by the agency. There was a comparison between maintenance cost and building quality. The authors developed a Markov Decision Model for rationalizing building maintenance at a strategic level. Idris (1998) confirmed the findings of Widen and Dekker (1998) declaration that

maintenance cost in between 1980 and 1985 plan period for schools in South Africa was 16.6% of the total project cost while in 1985 and 1990; it was reduced to 10%. It is important for people to know that the accuracy of maintenance budget depends on information with respect to labour charges, materials, execution methods, nature of work and condition.

Shohet and Perelstein (2004) remarked that resource scarcity gives limitation to building maintenance because people do not have maintenance budget in their agenda. In many developing countries, maintenance of buildings and infrastructures had not been well planned, as remarked in the studies of Zubairu (2001); Adebayo (1991); Almeida (2011). Building maintenance is useful for cost savings and better functioning of facilities and buildings. Lee (1995) worked on building maintenance; the study gave a prediction on maintenance cost but did not do a balancing between cost and quality.

2.5.6 Secondary School Leaders and Maintenance Managers

The effectiveness of schools building maintenance is highly dependent upon the nature of leadership in each school. Most school Principals are characterized by a combination of formal and informal leadership. The school principal is involved in maintenance management, and administrative issues. By implication, the principal of a school is a leader, director, controller, coordinator, organiser, adviser and a maintenance manager (Maduabum, 2000). The principal is the person on whose shoulders rest the entire administration, success or failure of the school. The principal implements the set goal and objectives of the school, which of course, must be in line with the national objectives; he/she tasks and allocates responsibilities to the staff according to specialization and expertise (Uyanga, 2007).

The school leader and maintenance managers need to solve the problems facing the secondary school, in line with their maintenance responsibilities.

(i) Management of school finance: the managers control the government allocation to the schools. They solicit and get money from the Parents Teachers Association, Alumni Association, Non-Governmental Organizations and individuals.

(ii) Provision and maintenance of physical facilities: Principals must be fully concerned with the physical environment and other facilities around the school. Dilapidated buildings, leaking roofs, abandoned projects, over-grown trees and lawns, dingy and dark buildings, have demoralizing effects on people, especially the adolescents (Obidoa, 2006). As a result, the Principals have the responsibilities of ensuring that these facilities are in good shape. Even with the little resources at their disposal, they are obliged to provide teachers and other instructional staff with necessary resources for effective teaching (Babayemi, 2006).

Whatever the case, it is the responsibility of the principal as the leader to initiate the process for the maintenance of the school buildings.

2.6 Factors Influencing Decision to Undertake Maintenance

Whatever the condition of a building is, it is the responsibility of the owners to take a decision on when to carry out maintenance of the buildings. However, Miles and Syagga (1987) identified the following factors as influencing the decision to carry out maintenance on a building:

(i) Finance: Inadequate finance is a major constraint on effective maintenance, because maintenance budgets are the easiest to cut when money is scarce. Maintenance

expenditure can be absorbed more easily in commercial and industrial organizations where it may account for as little as 0.5% of turnover, but even in these cases maintenance is taken for granted except when it threatens production, profitability of life in buildings. However, the situation is more serious in the public sector (buildings) where damaging effects of poor maintenance are less immediately obvious. Also in the case of building development, it is common for organizations, governments, even individuals to emphasize the need for provision of new buildings, with a refusal to spend some funds on maintaining their existing stock. Some building owners neglect their day-to-day repairs, but efforts at improvements and rehabilitation are considered of lower priority to new construction. A poorly maintained building would lead to rapid deterioration of existing building stock resulting or increasing the demand for new buildings.

(ii) Building design and construction: It is not uncommon to find that buildings are inherently expensive to maintain because of inappropriate priorities applied during the design phase. Poor detailing and specification of unsuitable components and materials are common complaints. In addition, construction errors arising from inadequate drawings and specifications, coupled with poor workmanship because of contract awards to incompetent contractors result in rapid physical deterioration in buildings. Good design should make provisions for adequate working space for service and routine maintenance such as cleaning, and minor repairs to pipes, ducts and cables. Seeley (1976) affirmed that some maintenance problems are due to design faults. Zubairu (1999) found that consciousness of maintenance at the design stage can reduce maintenance liabilities without necessarily increasing the cost of construction. The study further explained that maintenance should be seen as a building entity and

the ease of maintainability of each component of a building is a factor that has to be considered by the designer.

(iii) Management: This refers to the idleness and waste among maintenance personnel. Some of the people involved in maintenance work were either not trained or lack the required qualifications, while some have carefree attitude towards their responsibilities. Afranie and Osei-Tutu (1999) pointed out that the decision to carry out maintenance is affected by many factors, among which are:

(a) Maintenance cost- Maintenance managers would want to have the most economic method for carrying out maintenance work, whether corrective or preventive, thus they compare the actual cost of maintaining the building with the cost of maintaining similar buildings. Consideration of money spent to achieve acceptable standard at present and in the future, the economy of replacing facilities as well as amount of work available should lead to maintenance priority.

(b) Availability of physical resources: The availability or non-availability of physical resources affects decisions in that, when suitable materials for maintenance are not available, it becomes difficult to undertake maintenance. Again even if suitable materials are available but not in adequate quantities and the alternative materials are not available, it will deprive people from undertaking maintenance activities. The level of craftsmanship, in terms of both skills and efficient numbers can also affect decisions to carry out maintenance;

(c) Urgency of work- This also affects decisions on maintenance in that investors consider whether delayed work in the short run will require more expensive work at a later stage. This usually takes into account safety of building users and possible damage to structure and finishes used in the building.

(d) External Influence- Some organizations would find it difficult or impossible to stop their operations in order for maintenance to be carried out.

Seeley (1993) summarized the principal criteria which could influence the decision to carry out maintenance briefly as, cost, age and condition of property, availability of adequate resources, urgency, future use, policy and sociological considerations.

2.6.1 Maintenance Policy

BS 3811(1984),defines maintenance policy as a strategy within which decisions on maintenance are taken. Alternatively, it may be defined as the ground rules for the allocation of resources (men, materials and money) between the alternative types of maintenance actions that are available to management. In order to make a rational allocation of resources the benefits of those actions to the organization as a whole must be identified and related to the costs involved. Issues under consideration in a policy include; objectives, benefits and policies.

A maintenance policy should be a clear and comprehensive written document(s), stating the condition of the building(s) and the standard of maintenance for every building component. RICS (1990) states that a maintenance policy should be clear, written documents that takes into consideration the followings; (i) Life cycle of the building, their fittings and services. (ii) The standards to which the building and its services are to be maintained. (iii) The length of time for which the buildings are required to be in their present use/ state and at which point will they require maintenance. (iv) The reaction time between when a defect occurred and when a repair is being carried out. Sherwin (2000), also emphasized the need for a written maintenance policy for buildings and suggested some factors to be considered in the formulation of policy. The factors include; the function and requirements of the parent

organization, the required standard for each building, compliance with statutory requirements, cost / method of financing and method of execution, to describe if it is direct labour or contracts

2.6.2 Maintenance Strategy

Maintenance strategy has been variously defined in literature. Some authors define it as the choice between preventive, corrective and condition based maintenance. Others, like Gallimore and Penlesky (1988) stated that maintenance strategy is formulated through the combination of (1) reactive maintenance, (2) scheduled preventative maintenance, (3) inspection, (4) backup equipment, and (5) equipment upgrades. The mix of these elements is specific to each facility, the nature of the facility or equipment to be maintained depends on the goals of the maintenance, and the work environment. According to Kelly (2006), a maintenance strategy involves the identification, resourcing, execution of repair, replacement and inspections. It is concerned with:

• Stating the maximum best life plan for each unit.

• Formulating a maintenance schedule for the plant/ building.

• Establishing the organization to enable the scheduled and unscheduled maintenance work to be resourced.

Pinjala (2006) observed a set of strategic decision elements that have to be dealt with when designing maintenance strategy. The study highlights two decision elements which are:

(i) Structural decision element: This consists of maintenance capacity, maintenance facilities, maintenance technology and vertical integration.

(ii) Infrastructure decision element: This consists of maintenance organization, maintenance policy and concepts, maintenance planning and control

systems, human resources, maintenance modifications and maintenance performance measurements and reward systems.

2.6.3 The Importance Maintenance Manager

The maintenance department in an organization is managed by a maintenance manager. The maintenance manager is responsible for the planning and control of maintenance operations. In a small firm, the functions may be undertaken by a member of staff in addition to his other duties, while in a larger firm there should be a separate group of people solely responsible for maintenance. According to Geneen (1997) cited in Krass (2000), management is not a collection of boxes with names and title on the organizational chart, management is a living force. For this study, it is the force that gets things to acceptable standards. Ubeku (1975) described a manager as a person that organises other people to obtain a desire result. Geneen (1997) as reported by Krass (2000) described a good manager as someone who has the courage to gamble, delegate and be tough. Adenuga (2010) mentioned that management must have purpose and dedication which must be an emotional commitment. It must be developed as a vital part of anyone who truly is a manager. He or she is the one who understands that management must be managed. For the purposes of this study, a maintenance manager is someone who arranges, organizes and leads a group of people to achieve a set task.

Blisset (2004) designated maintenance manager as somebody that can carry others along, Furthermore, some attitude of a good manager as courage decisiveness; dependability, judgment, sensibility, loyalty, enthusiasm, endurance and initiative. among others. Eade (1996) described a good manager as somebody that is able to plan, teach, delegate not dump; encourage independent thinking, build a team; listen, set

example and accept responsibility. Another author, Adenuga (2010) noted that a maintenance manager makes major decisions relating to execution of maintenance work, by planning, estimating, identifying the important work and determining standards of work. He also plans, inspects and controls cost and monitors the performance of building quality.

Adejimi (2011) emphasized that a maintenance manager should know in details what he is managing. He needs basic knowledge to decide his maintenance policy or prepare the estimate of expenditure which usually forms the budget. To the author, a maintenance manager should know his task in order to develop a maintenance strategy and policy. He needs to have a comprehensive list of maintenance needs at all times for him to develop maintenance budget. Oyefeko (1999) in his own view, stated that a maintenance manager should be able to identify the defects in a building that necessitate maintenance action for an efficient/effective maintenance work to be done. A maintenance manager should have a programme that will be reflecting the plans when renewal work is to be carried out on a structure. The place of maintenance management shows that many things have to be put into consideration to bring about a reduction in maintenance costs.

Adebayo (1991) carried out a study on maintenance management of forty (40) public buildings in Nigeria. The work included hospitals, sports stadium, markets, hotels, banks, airports, libraries and educational institutions. The data were sourced with the use of questionnaire physical observation and interviews. First the author observed that performances of maintenance managers of public buildings were usually influenced by age, year of experience and educational qualifications. Second, it was also found out that there were no maintenance manuals and planned maintenance

programme for the maintenance of public buildings after design. Third, the study revealed that the maintenance fund allocated to public buildings was too small. Fourth, that lack of adequate maintenance tools was identifying as being responsible for poor maintenance.

Oladapo (2004) carried out a study on comparative evaluation of building maintenance management of tertiary educational institutions in Osun State, Nigeria. The author examined maintenance management of the institutions, using maintenance policy and strategy, maintenance budget and finance, the building state and organisation of the maintenance departments. The findings of the study showed were that each of the institution had a central maintenance department headed by a director. It also showed that none of the institutions had a maintenance policy. Maintenance budgets of all the Institutions were determined by their maintenance needs. In conclusion, lack of maintenance policies and strategies are the cause of poor maintenance performance.

Adenuga (2008) carried out a study of the maintenance of public hospitals in South-West Nigeria. The study found that some members of staff of the maintenance departments did not have the required experience on maintenance of public buildings. Also there was inadequacy of fund for maintenance management programme in public hospitals in South-West Nigeria. The developed a conceptual model for maintenance management of public hospital buildings. However, the study ignored the effect of building age and physical condition in that study.

2.6.4 Building Condition Survey

Regular inspection is fundamental to good maintenance, together with knowledge of the causes of decay and a sound understanding of the construction and a development of the building (Iyagba, 2005). In the author's opinion, all properties should be inspected at regular intervals to identify any deterioration. He stated that the frequency of inspections should be influenced by rates of decay and deterioration. Shohet *et al*. (2004) viewed regular inspection as a fundamental part of a preventive maintenance programme. They suggested a condition survey as a means of providing an assessment of condition, identify the optimum moment for intervention, and aid the prioritization of actions and planning for the future. They recommended the use of the presence of non-technical staff, other users and visitors on a regular basis to provide the maintenance staff with vital information instead of waiting until a subsequent inspection cycle, or until failure becomes impossible to ignore.

2.7 Previous Building Maintenance Methodologies for Public Buildings

Planning for maintenance in the design process is an important way to improve the performance of the existing building facility. Buildings require efficient maintenance programmes to enable them to be serviced properly and to meet up with their life spans. All buildings deserve to be maintained, regardless of the cost of their construction since they all have maintenance consequences. Searls and Thomasen (1991) employed laboratory test methods approach to investigate maintenance needs. The authors recommended the approach for singular investigation in buildings. It requires working in isolation and intensive condition. However the study focused on life expectancy of buildings.

Opinions of researchers on maintenance situation differ in several cases. Many scholars used point accumulation system which is another concept in building maintenance work. The system was adopted by Shen and Lo (1999) to classify some buildings according to the assessed priority of their renovation. They used the concept with the aid of indicators, their indicators with scores attached to each factor. The authors emphasized that the physical appearance of the building should have the highest score and the final score should be summed up. However, this study shall not adopt this method because this study is beyond maintenance priority.

Arditi and Nawakorawit (1999) in a survey conducted on the largest 230 property management firms in the United States investigated their current maintenance practices. The study disagreed in the property manager perspectives of Shen and Lo (1999) at the University of West of England, which is simple in practice and flexible from a management point of view. According to that study building maintenance should not be on the physical appearance of buildings alone but also the totality of the building components, environment and the furniture. Furthermore, the study attested to this by investigating the existing maintenance practices in their locality, but adopted double method concept through questionnaire and a test of significance. It was found that firms generally specialize in managing only one type of building or one component at a time.

Zubairu (2001) developed a model process for maintenance planning and operations in Nigeria. The study focused on the establishment of property database, using information like date of construction, building drawings (architectural, structural, mechanical and electrical) subsoil conditions, topography, floor areas, services, furniture and maintenance manual. The researcher adopted post occupancy evaluation to evaluate the performance of government office buildings in Nigeria.

Silva *et al.* (2009) carried out a study on the causes of poor maintenance of buildings Colombo metropolitan. The approach of investigation of the risk factors was based on exploring the causes of existing defects and problems, which tend to lower the maintainability. They attributed the problems to design limitation, over work and lack of maintenance schedule through questionnaire based survey to proffer solutions. Oedewald and Reima (2002) used observation, case study, inspection and interviews, survey and work groups to enhance the application of Markov Chains concept. Lounis *et al.* (1998) also adopted Markov Chains concept to carry out a study. There is a common finding in all these works. This is that maintenance should be done by evaluating the total building and probably using at least two methods.

2.8 Existing Models for Building Maintenance

Olotuah (2006) investigated state of repairs of buildings in Akure, Nigeria. The study investigated the characteristics of the materials used in 600 residential buildings considering the quality of the materials. He used descriptive and regression analysis methods with the assistance of Statistical Package for Social Sciences to analyze the data. Some variables used include; floor finishes, building age, construction method, wall materials, households size, tenure type, bedroom numbers, and amenities. That study found that many buildings were in very poor state and require major maintenance. The study developed a linear model for residential buildings instead of several models.

A study was carried out by Adejimi (2011) on poor building maintenance works in Nigeria asking if architects were free from blame. The study focused on design components as a factor of high maintenance needs. The study found lack of maintenance culture among Nigerians as a major factor. The paper advised Architects

to put in maintenance consciousness into design since people build only for them not to maintain. It also recommended a model of maintenance management in buildings designed by Architects. Shen *et al.* (1998) used analytic hierarchy process in a study on maintenance prioritization in facility as a tool to obtaining value for money in maintenance works. The study sets a prioritization policy for facility managers that put the managers' decisions, issues and factors into considerations. The finding was that the managers play a major role in building maintenance but without a guide. The study therefore developed a mathematical model that can guide maintenance managers in the work using post occupancy evaluation.

2.9 Building Performance Indicators

Holmes *et. al.* (1990) states that performance indicators are measures by which buildings can be assessed in terms of maintenance demands. The study showed that to have an effective maintenance work, standards and levels of maintenance must be equal across the housing stock.

Shohet *et al.* (2003) used building performance indicators in a study of maintenance monitoring of hospital buildings system in Israel with a performance rating – scale from 0 to 100. It was carried out through building observation method. The building performance indicator (BPI) value reflects the performance level of the building in question: According to the study when BPI>80, the state and resultant performance of the building are good or better, 70<BPI ≤ 80 indicates that the state of the building is such that some of the systems are in marginal condition, 60<BPI≤ 70 reflects deterioration of the building while BPI≤ 60 means that the building is run down. Three criteria were used to obtain the (BPI), this includes: (i) The physical conditions, (ii) Failures frequency in building (iii) Preventive maintenance on the building. Equally O'shea *et. al*. (2000) also adopted a Key Performance Indicator, to measure in a study.

However, the study recommended the application of the tool in large buildings and in cases where attention would be given to the building occupants because buildings have different interests, values, characteristics and organizational structure. They also differ in size, financial and resource capabilities, status and strategy. The observed that the inherent comparative advantage of the tools over and above one another would ensure synergy for effective collaboration in achieving maintenance set goals.

2.9.1 Criteria for Building Condition Evaluation

There is a widely accepted condition rating by maintenance managers used in England, Wales, Scotland, and Northern Ireland called house condition survey. It is a scale that can be used to calculate the Facility Condition Index (FCI), to evaluate the building condition and the condition of the premises. Australasian Association of Higher Education Facility Officers (2000) used Strategic Asset Management to undertake Facility Audit. Some countries described it as Guidelines for Strategic Asset Management and applied it to residential buildings. The tool brings about equal standards without any preference on determining physical performances of buildings. It was used to calculate Facility Condition Index (FCI) to evaluate the overall asset condition of buildings by AAPPA. The scale was also used in 2003 by the Department of Labour (DOL) in United States in the evaluation of buildings. This current study engaged in maintenance planning by measuring all building components which encompass all other types of maintenance that can be used when the need arises. This is with an intention to develop maintenance programme and policy for the study.

2.10 Identification of Gaps in Literatures

Previous research in this area also indicated the importance of several of these factors in terms of school buildings. Cash (1993), Hines (1996) and Lowe (1990) all noted the

importance of the condition of school facilities to student performance. O'Neill and Oates (2000), found a relationship between the condition of exterior paint and landscaping and student performance. Cash (1993), Hines (1996), Earthman, Cash and Van Berkum (1995), and Lanham (1999) all noted the importance of HVAC in terms of student achievement. Hines (1996) established a connection between the environment and student performance. In this study, evidence is also presented supports previous authors like Hines, Adenuga, Waziri and other authors, but also highlights the importance of the adequacy of these facilities in terms of functionality and size. The literature review focused on present deterioration condition of buildings, building deterioration and disrepair, factors responsible for poor maintenance of buildings, assessment of the current state and level of poor-maintenance of public secondary, school buildings, previous building maintenance methodologies for public buildings, as well as previous models for building maintenance. Some gaps identified in literature were as follows:

1. Most of the previous studies focused on the use of preventive maintenance which is an aspect of maintenance planning.
2. The bulk of the literature reviewed identified few factors with maximum of four factors that are responsible for the deterioration of buildings. This study applied nineteen factors to measure deterioration levels in public secondary school buildings.
3. Most of the studies focused on maintenance managers and did not investigate building user-perceptions.
4. Majority of the studies assessed the current level of poor-maintenance of public building using POE and performance measurement. This study applied added

the Facility Condition Index (FCI), to evaluate the building condition and the condition of the premises.

5. Several studies on maintenance are limited to maintenance types. This study concentrated on maintenance strategies.

2.11 Summary

The Chapter reviewed earlier works related to the study. It also identified the existing gaps in literature. It also outlined a set of broad ideas and concepts relevant to the study from previous studies. The Chapter also discussed in addition some important generic issues regarding the significance of public building maintenance. Maintenance strategies were described as an important contributor to improving the condition of public secondary school buildings.

This Chapter traced the history of western education especially as it affects Public Secondary Schools, from the beginning of western education era to date. The review showed that even though Public Secondary Schools have grown in number, they have not actually developed to the extent that people's expectations are met. This was attributed to the problem of lack of maintenance planning, strategy, policy, maintenance managers and under-funding. The review also indicated that funds are indispensable in the school building maintenance. It went on to identify that the condition of public secondary school buildings can be improved with provision of maintenance models. Previous investigations showed that studies have been conducted on maintenance of public buildings in Nigeria. The studies commonly held that governments do not have established maintenance strategies and models. Nevertheless, there is no existing study on the evaluation of maintenance strategies and condition of public secondary school buildings in Nigeria. The investigation was

justified by the fact that after the entire review of literature, no work was seen to have been done on the topic of research especially on empirical basis. A vacuum in literature (gap in knowledge) thus appeared to exist. It was the attempt to provide the apparent missing link that informed the conception of the study.

CHAPTER THREE
THEORETICAL AND CONCEPTUAL FRAMEWORK

3.1 Introduction

This Chapter explains a set of broad ideas and concepts relevant to the study. The framework illustrates how such concepts are connected as a way of providing proper understanding of the study and communicating it appropriately. The Chapter ends with a summary of the basic features and a pictorial/ graphic illustration of the different components of the framework as well as relationships between and among them.

3.2 Concepts for Measuring Building Maintenance Planning

Shen and Lo (1999) used three functional steps (Physical parameters, functional parameters and facility infrastructures) to establish a methodology for setting maintenance priority analytical approach. The concept is applicable where there is an established maintenance history.

3.2.1 Neutral Networks Models

Fwa and Chan (1993) adopted Neutral Networks for priority assessment, maintenance needs and rehabilitation of infrastructures. Neural networks are developed to mimic the decision-making process of human beings and do not require users to predefine a mathematical equation relating pavement conditions to priority ratings. There are three different priority-setting schemes involved. These include:

1. General-purpose microcomputer-based neural network software.
2. Linear function relating priority ratings to pavement conditions

3. Nonlinear functional and subjective priority assessments obtained from a pavement engineer.

For the first two schemes, noise was also introduced to examine how it would affect the performance of the neural network. Test results were positive and indicative of the potential of neutral networks as a useful tool that highway agencies can use for priority rating. The model has various functions for setting priority of maintenance activities.

3.2.2 Multi-Attribute System

In the University of the West of England, Spendding (1995) developed a method called the Multi-Attribute System. The method is based on a comprehensive study of several different methods for the determination of maintenance priorities. There are six criteria involved which and these are the indispensability of the building or dispensability, the physical condition of building, the importance of the buildings in use, the resultant effect on the users, the resultant effect on the structure, the failure or component and the effect on service provision and condition.

Maintenance is ranked in the work using Multi-Attribute System. The relative weight of each criterion, $C_{i,}$ is $W_{i,}$ and each work, j, is given score

($S_{j1,}$ S_{j2}....., S_{jn}) in relation to criteria $C_{1,}$ $C_{2,}$....., $C_{n.}$ The priority index (or overall score) S_j for work can be calculated using equation 1;

$S_j = S_{j*}W_1+Sj*W_2 +.....+S_{jn}*W_n$ ——————————————— (1)

However, Shohet (2003) modified the Multi-Attribute System and used the theory in a study on the maintenance monitoring of hospital buildings. The study measured some building systems including structure, interior finishing, exterior envelop, fire

protection, water and waste water, elevators, electrical system, communications HVAC, medical gases. The study reported that each of the building systems was determined based on the economic value, preventive maintenance value and the repair system. The partial weights were determined on the basis of an evaluation of labours and materials in relation to the type/ method of maintenance compared with the cost of failures.

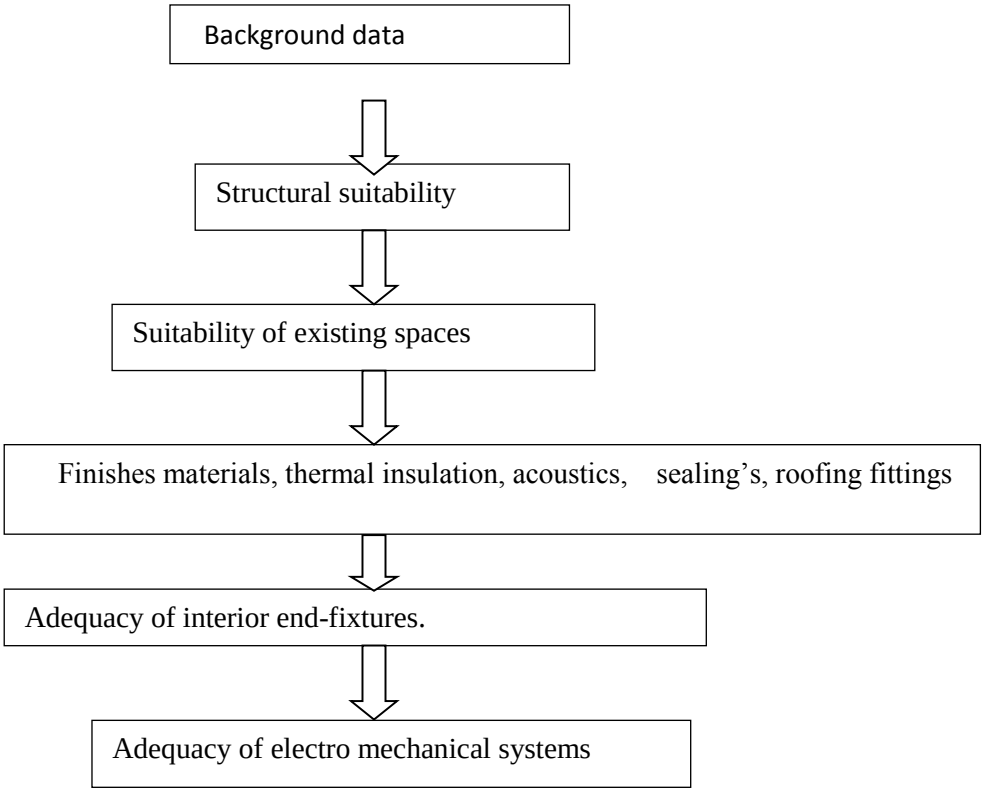


Fig 3.1: The Maintenance Evaluation Methodology Flow Chart

Source: Shohet (2003)

The maintenance evaluation methodology flow chart presented in Figure 3.1 adopted theory with the aid of a building performance indicator. The evaluation of the entire building was conducted by summing up the performance scores obtained with the building performance indicator. Three criteria were used to obtain the (BPI). These

include: (i) The physical conditions (ii) Failures frequency in building (iii) Preventive maintenance on the building.

Actual score between 0 and 100 where

For every system n, the sum $w(c)_n + w(f)_n + w(pm)_n$---------- (1)

$P_n = c_n \times w(c)_n + f_n \times w(f)_n + (pm)_n \times w(p_m)_n$---------- (2)

$w(c)_n$ = weight of component condition of system n

$w(f)_n$ = weight of failures in system n

$w(pm)_n$ = weight of preventive maintenance for system n

The weight of each building system in the BPI was considered for evaluation, this includes cost of construction, cost of maintenance and life cycle (LCC) index as expressed in the following mathematical relationship.

$$W_n = \frac{\sum_{j=i}^{m}(R_{nj} + M_{nj} + C_{nj})}{\sum_{n=1}^{10}\left(\sum_{j=1}^{n}(R_{nj} + M_{nj} + C_{nj})\right)}$$ ---------- (3)

n is the index of building system

w_n = weight of the building system (e.g structure, exterior, envelope etc.)

J= index of component in system (columns, beams and slab in building)

M= number of components in building system n

R_{nj} = replacement cost of component j in system n

M_{nj} = annual maintenance cost of component j in system n

C_{nj} = reinstatement value of component j in the nth building system

The BPI= $\sum_{n}^{10} = Pn\ X\ wn$------ (4)

It is a standard maintenance model that is recommended for establishments where all maintenance details are available.

3.3 Parameter for Determining Deterioration Patterns of Building Components

Shohet, Puterman and Gilboa (2000) carried out a study on deterioration pattern, using conceptual model, where there is a combination of the factorial method with the systematic ranking of performance levels of cladding components. This combination takes advantage of the benefits of factorial methods (it is a practical and timesaving tool) and the systematic rating of performance levels (uniform performance criterion). The study attempted to reduce the increasing demands that are made on maintenance programmes by providing tools that will support maintenance planning. In contrast to other methods reviewed in literature, the proposed method is sustained by the evaluation of the actual performance level of the component, rather than using an identical predicted paradigm of deterioration. The method requires a systematic evaluation of the performance level integrated with deterioration patterns of identified failures.

Due to the scope of the subject, the methodology was implemented on three types of exterior cladding: (i) Stucco (iii) Ceramic claddings (iii) Stone claddings. Among the most important parameters affecting the efficiency of maintenance management are the precision and the reliability of the predicted service life (PSL) of building components. The methodology consists of four steps namely, identification of failure patterns, determination of the component performance (CP), determination of the life expectancy of deterioration path (LEDP), evaluation of the predicted service life (PSL).

According to that study, the methodology can be used for planning of maintenance activities, for evaluation of economic implications of intensive decay and for maintenance management. Nevertheless, the method treats the components supplied

performance rather than the supplied attributes. The study identified six deterioration factors in exterior of cladding to be faulty design, poor quality of application, poor quality materials, adverse climatic, poor maintenance and intensive use (e.g. in school or military building, above standard occupancy) the methodology combines the factorial method with systematic ranking of performance levels of cladding component. This is illustrated mathematically in the following equations:

$$Y = Y_S \times A \times B \times C \times D \times E \times F \quad \text{----------(1)}$$

$$PSL = SLE \times LELC_i \quad \text{----------(2)}$$

$$LELC = 1 - \frac{SLE - LEDP}{SLE \times IC} \quad \text{----------(3)}$$

LELC= is the life expectancy limiting coefficient for the deterioration mechanism

LEDP= is the life expectancy of the deterioration path for the specific mechanism

IC= is the influence coefficient for the specific deterioration factor

LELC decreases as IC and LEDP increase and vice versa. The influence coefficients were determined with the data gathered in the review of failures in the field survey. The LELC is highly sensitive to the influence coefficient. The typical deterioration pattern is therefore presented in figure 3.2 below.

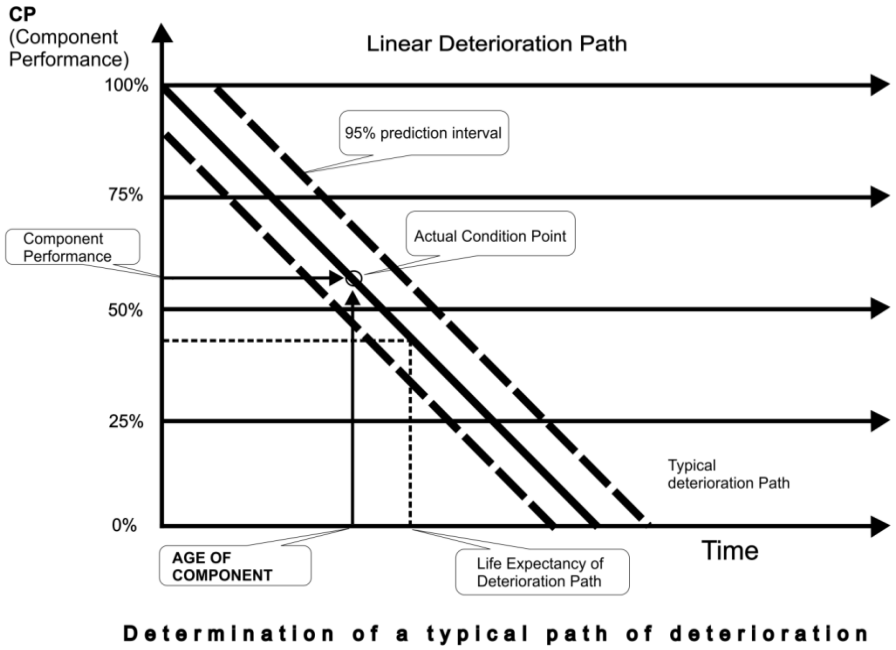


Fig 3.2 Typical Deterioration Determinant
Source: Shohet, Puterman and Gilboa (2000)

The model as stated is applicable where there is a maintenance documentation stating the dates, predictive information of the component and the actual condition. The component of buildings as at delivery to the owners is 100% but as the years roll by, it deteriorates gradually and may not meet up with the life expectancy. However, lack of detailed and documented information on maintenance works preclude the adaptation of the theory.

3.3.1 Building Performance Indicator Tool as an Approach to Building Maintenance

Shohet *et.al.* (2003) in their study used a systematic field survey, and an in-depth statistical analysis to monitor some buildings. Four-stage scheme was used to establish a Key Performance Indicator tool as an assessment model in the study. These include:

1. The building performance indicator (BPI) which was used to indicate the functional condition of buildings.

2. The manpower sources diagram (MSD) reflects the efficiency labour provision for maintenance, using in-house labour versus. the outsourcing of labour.
3. The maintenance efficiency indicator (MEI) is maintenance efficiency is based on the annual costs of maintenance, the building age coefficient and the building occupancy coefficient. This indicator reflects the efficiency of usage of the resources (labour, outsourcing, materials and spare parts) in maintenance.
4. The effectiveness of organisational structure which is an indicator that deals with the organizational structure of the maintenance division.

However, the research method which included critical literature survey, field survey, the use of a structural questionnaire and systematic monitoring of hospital building performance, statistical analysis of data obtained in the field, development of quantitative criteria for maintenance were adopted in that study.

O'shea (2000); Pullen *et.al* (2000) and Hinks (2002) developed and used four indicators in researches on Building Performance Indicator (BPI). Their separate studies focused on the physical state and fitness of buildings. The systems in each building were weighted on a scale from 0 to 100. Ten principal building systems were measured. They were the skeleton, exterior, envelope, interior finishes, electricity, sanitary systems, HVAC, fire protection, elevators, communications and other systems (e.g. medical gases). The following relation was used

$$BPI = \sum_{n=1}^{10} Pn * Wn \text{----------equ (1)}$$

Three basic things were measured in the system, namely: physical state, typical defects and the policy of governing on the maintenance. The combination of these three elements represents the performance level of the entire system which is denoted by (P_n).

P_n= physical state, typical defects and the policy of governing on the maintenance

(Wn) = Weighting of each building system

BPI = Obtained for each system by multiplying its weight by its score

Similarly in a study on Facility Management Performance and accountability, Hinks and McNay (1999) also adopted this method by using the following four indicators namely building performance indicator (BPI) was used to study the physical condition and state of the buildings. Manpower sources diagram (MSD) was used to study the composition of labours. Maintenance efficiency indicator (MEI) was used to evaluate the efficiency of maintenance. Managerial span of control (MSC) was used to reflect the organizational effectiveness of maintenance.

The main contribution of the work is the development of a model of key performance indicators, based on the order of their maintenance priorities. The study can only be used by a professional maintenance manager.

3.4 Model for Maintenance Planning and Operation

Zubairu (1999) produced a model for maintenance planning and operations. That study was on evaluating maintenance management of government secretariat building using a Post- Occupancy evaluation method (Fig 3.3). The study proposed maintenance management performance evaluator (MMPE) using government office buildings in Nigeria to describe the task that must be performed and their frequency with resources needed to implement each task.

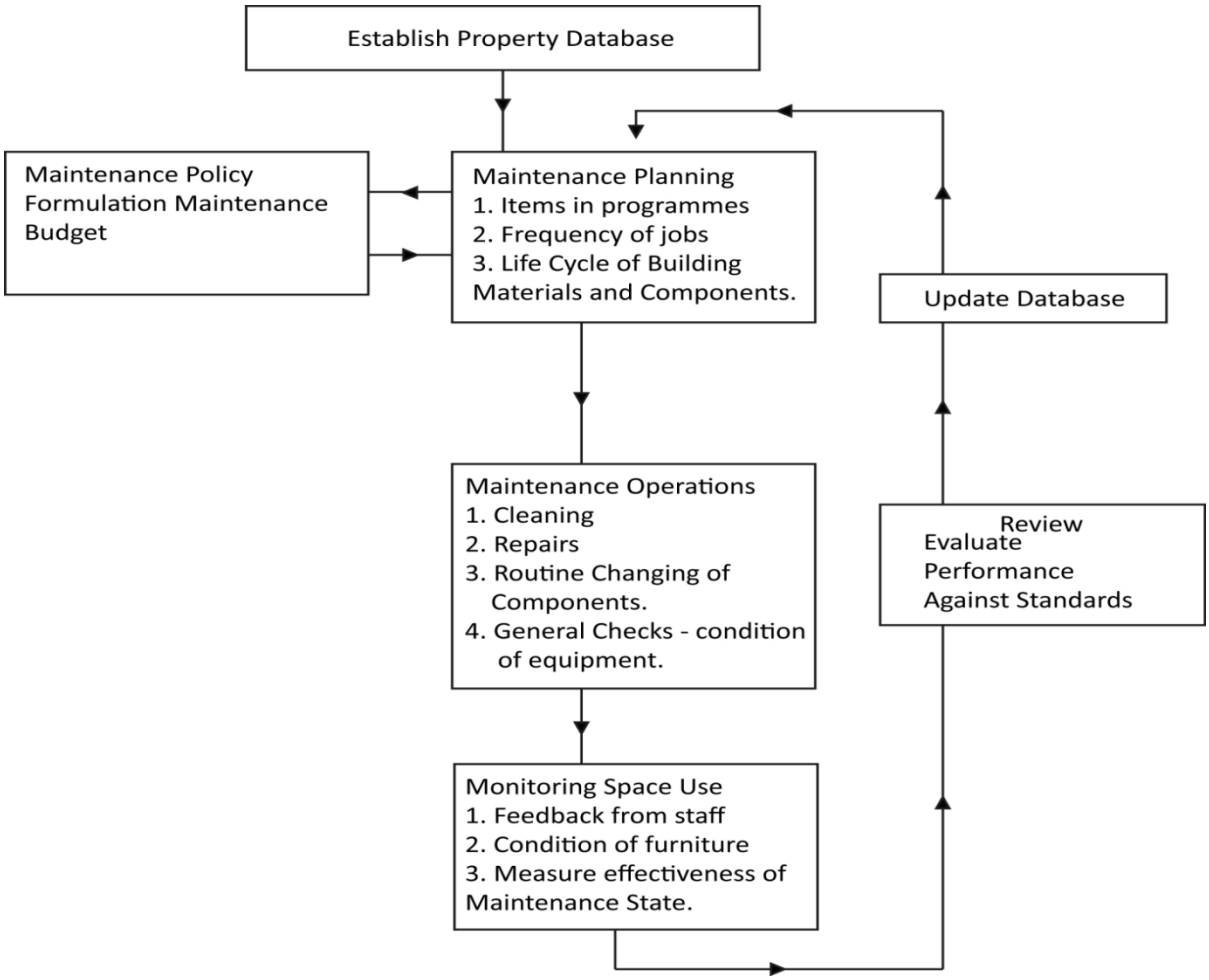


Fig. 3.3: Model for Maintenance Planning and Operation (Zubairu, 1999)

3.5 Model for Maintenance Management

Wales (2001) developed a model based on maintenance timing, reasons for executing maintenance, types of maintenance and various forms of activities under its implementation (see Fig. 3.4. for detail components of the model). Although the study lacked maintenance performance measurement as a majority of the performance indicators were not indicated in the model, the present study adopted the model especially on maintenance strategies and policies. This is mainly because these are part of the variables proposed for measuring the maintenance efficiency in a school environment.

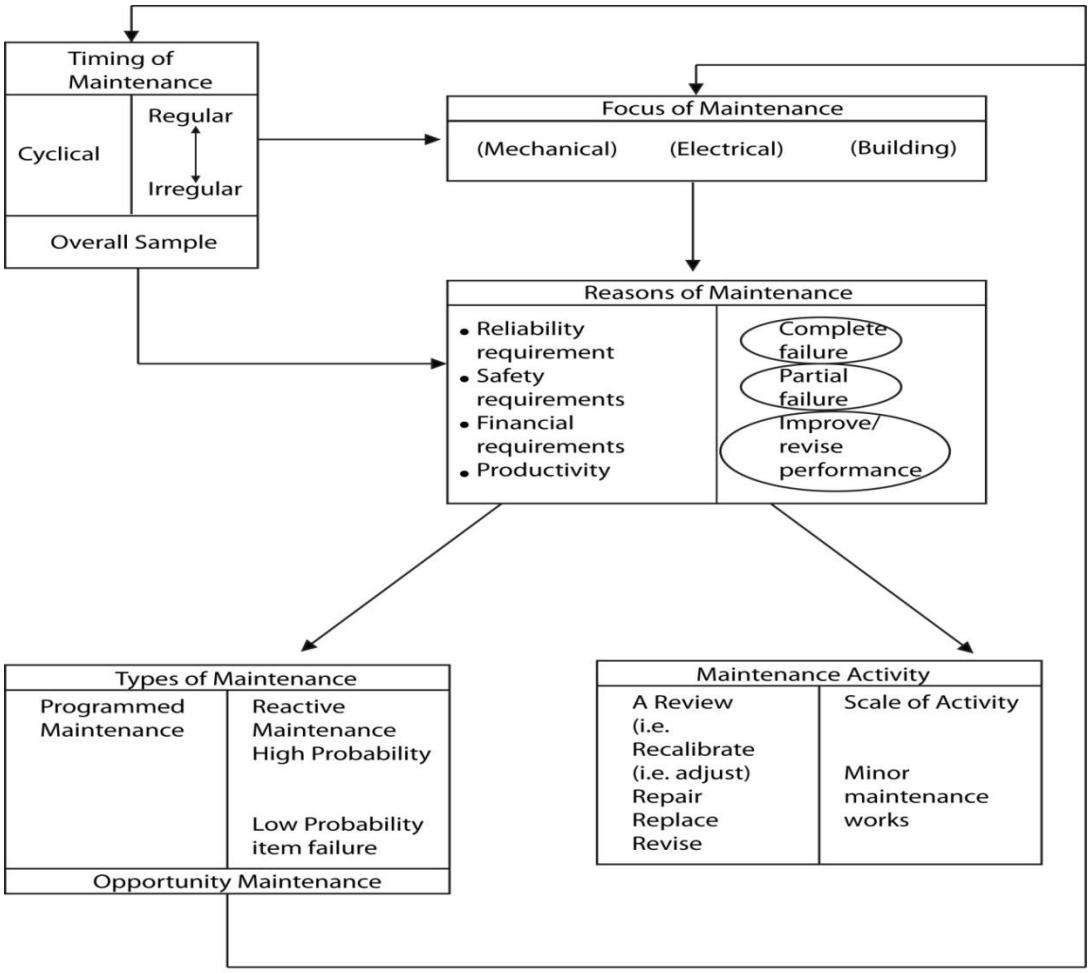


Fig. 3.4: Maintenance Management Model **(**Wales, 2001)

3.6 Model for Maintenance Management of Staff Housing Estates

Oladapo (2005) improved on the existing models by indicating some of the key performance indicators especially for prioritization of maintenance needs in housing stock (Fig 3.5). The study investigated the maintenance performance level through the effect of the decay factors and maintenance work-load they generated vis-à-vis the strategies adopted. The performance is measured by users' satisfaction and housing stock condition. This model is relevant to the present study in measuring the efficiency of maintenance management. The process is incomplete without mechanism for monitoring and assessing the efficiency and effectiveness of the maintenance management system.

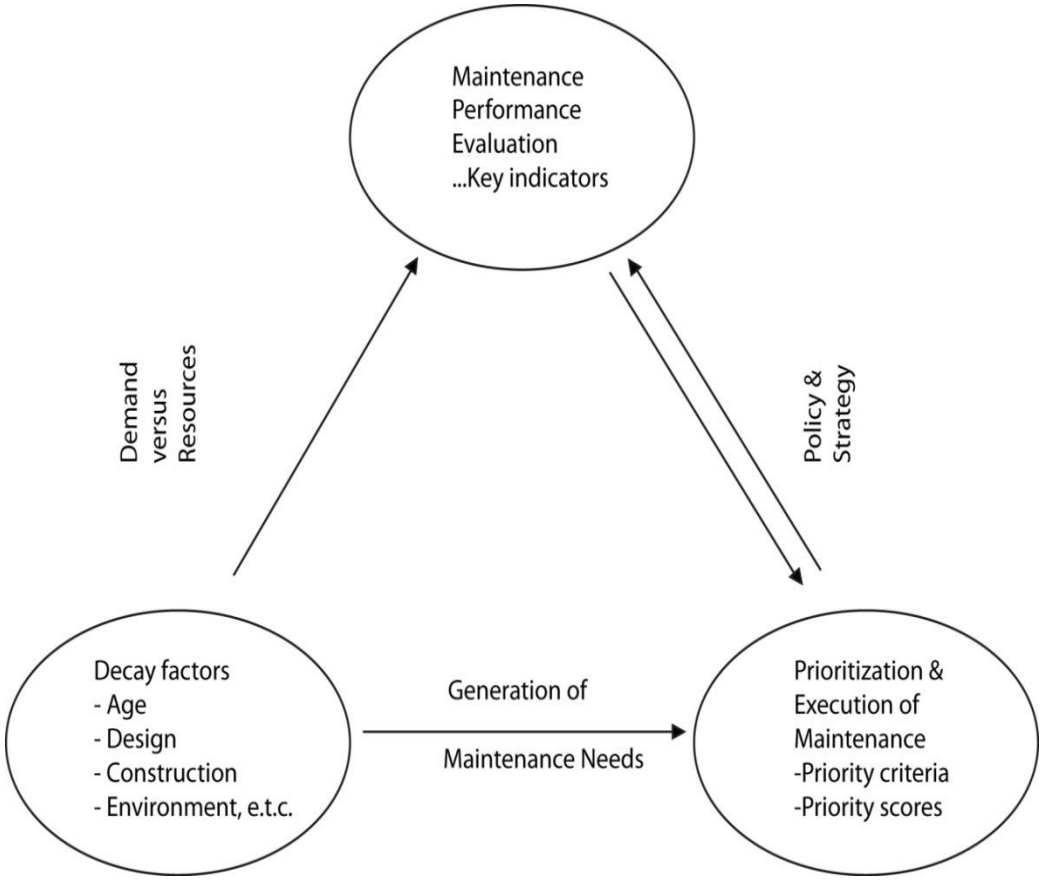


Fig. 3.5: Model for Maintenance Management of Staff Housing Estates in First Generation University in South West Nigeria (Oladapo, 2005).

3.7 Model for Maintenance Management of Public Hospital Buildings

Adenuga (2010) identified some of the maintenance performance indicators especially for efficiency maintenance (Fig 3.6). The study examined the maintenance performance level through the use of the indicators. The performance was measured by maintenance managers attributes. The evaluation of the maintenance management performance (efficiency) used in the study were functional state i.e. the building stock condition and users' satisfaction. This model is relevant to the present study, however, there is no provision for schedule of dilapidation in measuring the efficiency of building maintenance. The ownership of a building and maintenance

budget can influence the efficiency of maintenance management. The maintenance manager attributes in this concept also influenced maintenance management.

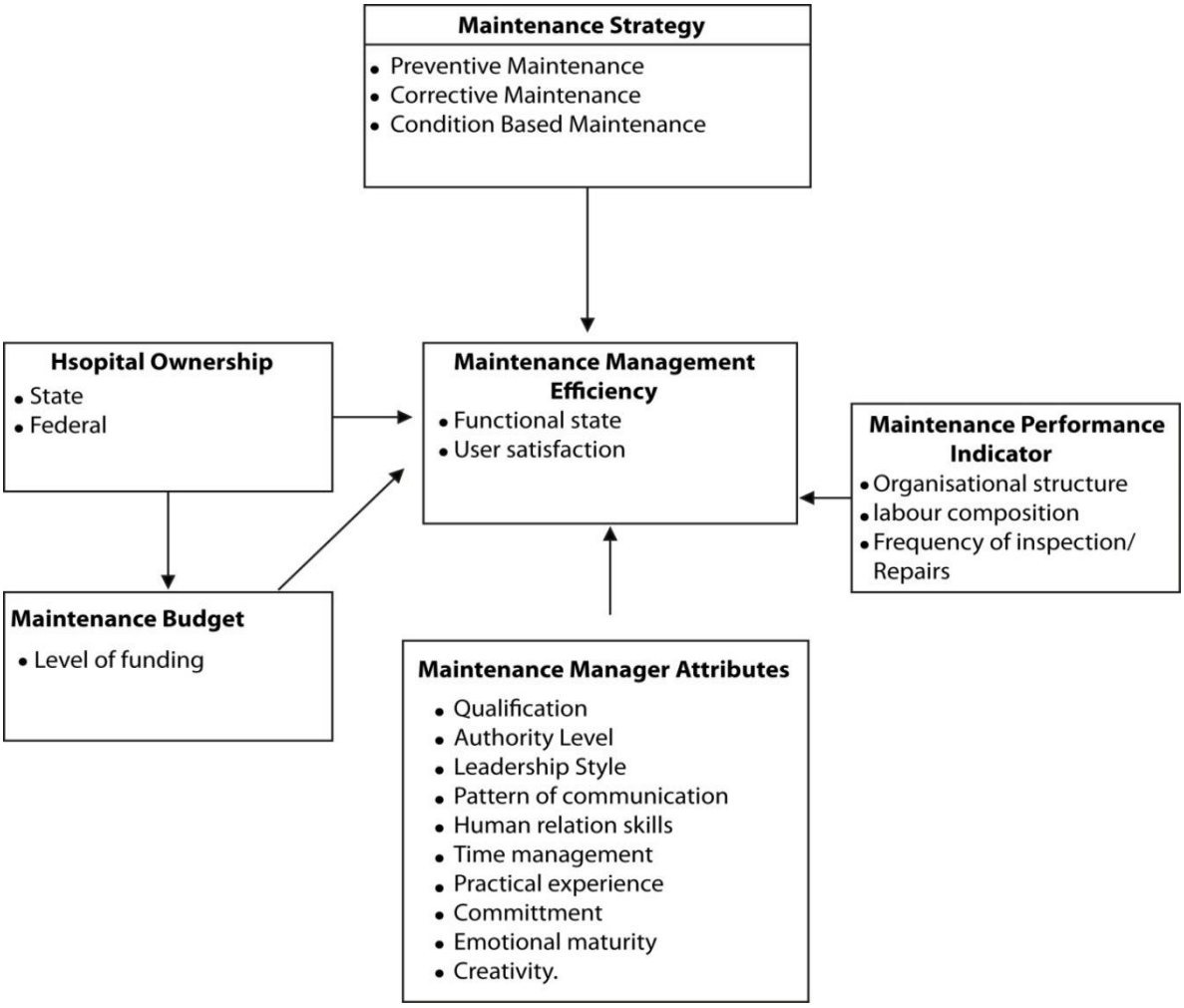


Fig. 3.6: Model for Maintenance Management of Public Hospital Buildings

Source: Adenuga, (2010).

3.8 Conceptual Framework Measurement Tools

This study was conceptualised on the proposed model in Fig. 3.7. This choice was based on a number of reasons. It was found useful for almost any building type, collecting activity information or setting of building relationships data such as performance of the building and need for maintenance. Many people can use the concept giving individual opinion on its usefulness thus permitting a high tendency of transparency. The use of scales and the urgency of the maintenance work can easily be

determined based on the factor that has the highest scales. Maintenance will be better if appraisal of the existing building stock is carried out and documented in a dilapidation schedule. This will help in establishing maintenance data base as suggested by Zubairu (1999). There is need to have and enforce the use of building standards, materials specifications, codes and regulation. The findings of Shohet (2003) were adopted in evaluating the changes in the school buildings and their construction needs in the future with the required maintenance. This study also employed Waziri and Vanduhe, (2013) identified factors of deterioration.

The conceptual framework (Fig. 3.7) employed in this research integrates the concept of building deterioration, maintenance and continuous monitoring. It was also appropriate and useful in the evaluation of the maintenance funding, qualification of maintenance staff with emphasis on the application of maintenance indicator which was used as a guide. The composition of the framework is an improved reason of the conceptual models of Adenuga, (2010).

These conceptual foundations suggest that any type of maintenance can be used for buildings but there should be provision for schedule of dilapidations. The schedule would be used to investigate the present condition of buildings as at the time of taking maintenance decision. The deterioration factor and maintenance model were therefore used to decide the maintenance funding and budgets. However, the recommendation of professionals, maintenance manager or officer may influence the funding.

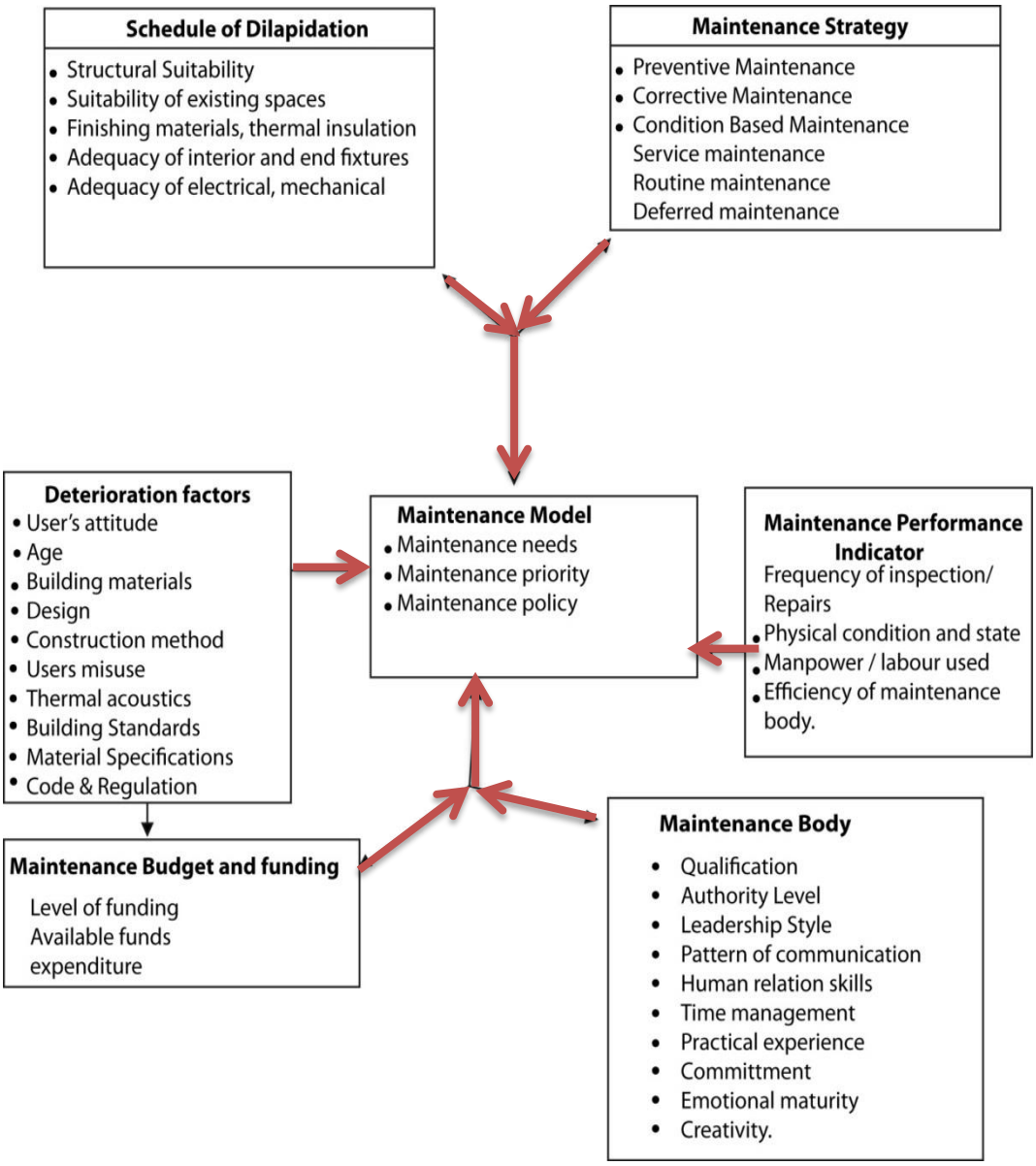


Fig 3.7: Conceptual Model for Maintenance Strategies of Public Secondary School Buildings

3.8.1 The Relevancy of the Concept to the Current Study

The maintenance model is located in the centre showing that it has impact on the others. Schedule of dilapidation would explain the condition of the buildings at all times. Maintenance strategy would suggest which maintenance strategy is applicable to the model. Deterioration factors on the left side would indicate the contributively variables that affect the condition and such can be focused upon. However,

maintenance budget and funding would suggest to the model based on the available fund and the performance of a maintenance body would enhance the model. Maintenance performance indicator would suggest to the model the solution to proffer to the buildings.

3.9 Summary

The Chapter reinforced the need for a broad based framework that transcends boundaries of any one discipline and theory in the evaluation of public secondary school as an educational intervention programme. The framework, indicates direct and indirect relationships among the different components, and presents the basis for the research design, literature review, data collection and analysis as well as interpretation of results. Subsequently, an evaluation of some of the key competency frameworks adopted recently for the building maintenance in particular were undertaken to help establish their potential usefulness in this respect.

CHAPTER FOUR

RESEARCH METHODOLOGY

4.1 Introduction

This chapter presents and discusses the methods used in carrying out the research in order to obtain the desired results, taking into cognizance the research problem, aim and objectives. It further describes the methodological approach and procedures, including the required data, data collection and presentation techniques, data instruments, presentation, processing and analysis The procedures (methods) adopted for the study are presented under the following subheadings: research design, population of the study, sample and sampling technique, instrument for data collection, validation of the instrument, reliability of the instrument, method of data collection and method of data analysis

4.2 Research Design

Having reviewed relevant literature in this study, taking into consideration the research strategies used in previous studies, the current study adopted both quantitative and qualitative research methods. Specifically, this study adopted the survey research design. Stratified random sampling was used to select the samples of Public Secondary Schools for questionnaire survey. Two principal survey techniques used were the administration of questionnaires and non-participant observation. These techniques enabled the researcher to collect of both qualitative and quantitative data from the public secondary school users and managers of the buildings and facilities in the schools.

4.3 Data Collection

This section explains the sources of data and methods of data collection.

4.3.1 Sources of data collection

The study obtained both primary and secondary data. Quantitative data were collected from the public secondary school building users through structured questionnaire. Quantitative data were obtained from the Principals or vice-Principals who are responsible for maintenance decision-making by means of a questionnaire. Qualitative data was also obtained by the survey of the existing academic buildings in the Public Secondary Schools. The secondary data was derived from multiple sources such as published and unpublished materials in books, journals, encyclopedias, magazines, research works, conference or seminar and working papers, including, school records, maps and layout drawings of the housing estates and relevant publications.

4.3.2 Methods of Data Collection

This study used two major data gathering instruments: questionnaire and observation schedule. Both were used in the collection of primary data for this study. Two sets of questionnaires were prepared based on findings from review of the existing literature. Two set of questionnaires was prepared, one for the school maintenance managers and the second one for the staff of the secondary school buildings who are the users of these buildings in the selected schools. All the questions were closed ended.

(i) Administration of structured questionnaire technique

Quantitative data were collected by means of the structured questionnaire method, which was used in eliciting information from 307 building users' who were selected using the stratified sampling techniques and 36 purposely selected managers in the

schools. There were two separate questionnaires, one for each group (see Appendices 1 and 2 respectively). The questionnaires were designed to give an assessment of the maintenance strategies from the maintenance managers and the building condition. Questionnaire 1 consisted of three sections with school user's information in Section-A, maintenance opinion in Section-B and conditions of building components in Section-C. However, questionnaire 2, consisted of three sections namely: maintenance managers information in Section-A; maintenance strategies in Section-B and factors of deteriorations in Section- C. The respondents were asked to indicate the level of satisfaction or dissatisfaction with some selected quality performance criteria based on 5 Likert-type scale.

(ii) Direct observations

Direct observation of the selected public secondary school academic buildings by the researcher was used to derive data on the physical characteristics of the school buildings. The observation schedule was prepared basically to record observations made by the researcher with the aid of a building condition rating scale (see Appendix 3). The observations sought to collect data on the physical condition of academic buildings under study. Specifically, data was collected on the types of buildings and materials used, as well as the physical conditions of the buildings.

4.4 The Study Population

Population of the study consisted of 47 public secondary school Principals and 1000 secondary school staff in Ado Odo/Ota L.G.A. The study population includes, Ministry of Education officers, Local Government education officer, all Public Secondary Schools in Ogun State, all Principals or vice-Principals in Public Secondary Schools Ogun State, all teachers in Public Secondary Schools, all PTA in Public

Secondary Schools and all maintenance committee in Public Secondary Schools in the study area

4.5 Sampling Frame

The sampling frame for the study constituted of all the Principals or Vice- Principals in the study area, all 1000 staff in the study area, all parent teachers association in Public Secondary Schools, all maintenance committee in the study area, State and Local Government Officers.

4.6 Sample Size

Levy and Lemeshow (2013) argued that if the population is relatively small, the sample size should comprise a reasonably large % of the population. Based on this, the sample size for this study is thirty-six (36) Principals or Vice Principals from the existing 47 Public Secondary Schools. However, four hundred (400) out of the 1000 staff members identified in the schools were randomly selected. This is in line with the recommendation by Nwana (1981) cited in Bassi and Camble (2011) who advocated 40% sample size for any study. Stratified sampling method was used in the selection of nine representatives of Parents-Teachers' Associations (PTAs) and 7 members of the maintenance committee of the Public Secondary Schools in the study area.

4.7 Sampling Technique

Sampling is the procedure for choosing the sample units from a population. It is a common method of collecting data in a survey research. Although there are a number of sampling techniques available for selecting sampling units, sampling techniques can be categorized into probability and non-probability techniques (Abosede, 2000). The sampling technique most suited for the study was random sampling technique.

Following from this, thirty-six were selected from the existing forty- seven schools in the study area. The investigative method of building performance indicator was employed in gathering the primary data for the current study. Only academic and non-academic staff members who have spent minimum of one year in each of the selected schools were selected. This category of staff members were identified through the help of the Principals.

In this study, the stratified random sampling technique was used to select 36 Public Secondary Schools Maintenance Managers for the questionnaire administration. One selection was made out of two representatives in each school. The Principals and Vice –Principals were involved in the maintenance planning and execution in the Public Secondary Schools.

A total of four 400 questionnaires were distributed; while 312 were retrieved. However, 307 questionnaires representing around 77% of the distributed questionnaires were found to be valid; and were subsequently used in the analyses.

4.8 Research Factors

Three parameters were considered in this study. The parameters covered the research aim and objectives. The key parameters considered deal with the structural condition of the school buildings; the availability of infrastructural facilities in the school buildings; and the defects in the buildings.

4.9 Data Collection and Treatment

In this section, data collection and analyses are presented in relation to the stated objectives of the study. The instrument used in the collection of data and its subsequent analysis are clearly identified including the characteristics and nature of data collected and treatment of the data for each of the research objectives.

Objective 1: To investigate the users' perception of the present condition of public secondary school buildings.

***Nature of Data*:** The data for this objective are quantitative in nature and describe the general characteristics of the schools in terms of location, age, staff qualifications, etc. (see Appendix 1). A questionnaire (see Appendix 2) was purposely designed for the school users.

Data Analysis: The quantitative data obtained was subjected to both descriptive and inferential statistical analyses. The qualitative data was subjected to content analysis**.** The quantitative data were analyzed with the help of Statistical Packages for Social Science (SPSS) Version 21.0**.** Descriptive statistics were used to analyze the data obtained. This involved the calculation of frequencies and %s and the presentation of the result using tables and charts.

Objective 2: To assess the current state/ level of maintenance of public secondary school buildings in Ado-Odo/Ota L.G.A through observation.

***Nature of Data*:** The physical characteristics of the buildings were assessed in order to achieve this objective. The data for this objective are qualitative in nature.The condition of building components, building services, finishes, building maintenance and external conditions were all assessed using Likert type scale rating. The data for this objective was sourced from the users of the school buildings. In addition, the researcher also carried out observations on the buildings with the permission of the Principal in each of the schools sampled. The building condition rating scale provided the framework for observations.

Data Analysis: The quantitative data were analyzed using pie chart and kurtosis, while the qualitative data were analyzed using content analysis was used for data analysis.

Objective 3: To identify the underlying factors responsible for current state of maintenance of Public Secondary Schools.

***Nature of Data*:** The data for this objective are basically quantitative in nature. The data collected for this objective included, length of stay of the maintenance managers in the schools, the type of maintenance and factors that can lead to poor maintenance (Appendix 2). The data were derived through the questionnaire instrument administered to the Principal/ Vice-Principal (managers) of the Public Secondary Schools.

Data Analysis: Data were analyzed using descriptive statistical tools , and the results presentation in pie charts and tables.

Objective 4: To investigate the maintenance strategy and policy practiced/ used by the maintenance managers of Public Secondary Schools in the study area.

***Nature of Data*:** The data for this objective were basically quantitative in nature. Data for this objective was mainly on maintenance funding, policy, strategy, type, (Appendix 2). Data were derived from the same questionnaire administered to the Public Secondary Schools Principals or vice-Principals. The questionnaire was administered to the respondents by the researcher on one-on-one basis.

Data Analysis: Data were analyzed using descriptive statistical tools.

Objective 5: To develop maintenance models for maintenance strategies and maintenance managers of Public Secondary Schools in the study area.

***Nature of Data*:** The data for this objective was basically collected from Objective 1-4.

Data Analysis: Data were analyzed using multiple regression analysis.

4.10 Research Variables Investigated in the Study and Coding Process

Two factors of research were measured and presented in this study. These are qualitative data (applicable to nominal and ordinal variables) and quantitative data (interval variables). The quantitative data were considered as dependent and independent variables as explained in the next paragraphs.

4.10.1 Dependent Variable

A dependent variable is a variable that has impact on another variable. It is the variable that is selected, controlled or manipulated by a study to determine the relationship to the observed outcome of the study. There are four `dependent variables in this study. Each one of the variables is derived from for each of the objective as shown in Table 4.1

Table 4.1: Coding of Dependent Variables Adopted by Study

S/n	Description	Variable Code	Objective	Scale of Measurement
1.	Length of Stay	LENST	1	Interval
2.	Physical Condition of buildings	PHYCONB	3	Interval
3.	Opinion on present condition of building component	COBL	2	Nominal
4.	Maintenance Strategy	MTSRA	4	Nominal

4.10.2 Independent Variables

The independent variables are the variables that affect dependent variables. AS shown in Table 4.2, there are seventy –eight independent variables investigated in this study.

Table 4.2: Operational Definition of Variables

V/N	CODE	DESCRIPTION	Scale of measurement	Range of Values
V1	SCHNA	secondary school location	String	
V2	SSTA	status in the school	Nominal	Academic Staff Non- Academic Staff
V3	LENST	Length of Stay	Interval	1-4yrs, 5-8yrs, 9-12yrs, 13- 16yrs and 17 andAbove
V4	ACADQU	academic qualification	Ordinal	SSCE, OND, NCE, BSC/ HND, MSC, Ph.D. and]Professional Certificate
V5	SSEX	Sex	Nominal	Male and Female
V6	SCHAGE	school age	Interval	Below 20 years, 21-30, 31-40, 41-50 and Above 51
V7	EFTEL	Effect on teaching and learning	Nominal	Yes and No
V8	MTOFF	maintenance officer	Nominal	Yes and No
V9	OLDEST	Most deteriorated building	Nominal	Classroom, Library , Computer room and Laboratory
V10	EFBLUS	Current states of building on users	Nominal	Yes and No
V11	STUMT	Students input to daily maintenance	Nominal	Sweeping, weeding and cleaning, Technical Involvement, Not Involved, and paying maintenance fee
V12	STAFF	Input of academic staff to school maintenance	Nominal	Supervising, consciousness, Nothing and punishing offenders
V13	NACMT	Input of Non-academic staff to school cleaning	Nominal	Supervising, Sweeping and Cleaning, Weeding and Technical work
V14	MTACBL	Opinion on maintenance of academic building	Nominal	Yes and No
V15	COBL	Opinion on present condition of building component	Nominal	Good and Bad
V16	DTFACT	Factors responsible for deterioration	Nominal	Age, Lack of maintenance culture, Users Attitudes, Over population and funding.
V17	FOUNDCO	Condition of foundation	Nominal	Existing cracks, exposed foundation, weak and good condition.
V18	ROOFCO	Condition of roof	Nominal	Leaking, rusty, partly ripped off/ sagging, completely ripped off and good condition.
V19	PAINTCO	Condition of Paint	Nominal	Not painted, faded paint, dirty paint and well painted.

V20	FLORCO	Floor screed Condition	Nominal	Cracks, peeled-off, defect and no defect.
V21	WALLCO	Wall Condition	Nominal	Partly broken down, develop cracks, peel – off ,tilted and Good condition
V22	WINDCO	Condition of Windows	Nominal	No existing, partly broken down, completely broken down and Good condition.
V23	DOORCO	Condition of Doors	Nominal	No doors, partly broken down, completely broken down and Good condition.
V24	ELECO	Electrical installations?	Nominal	not existing, not functioning, faulty and Good condition.
V25	PLUMBCO	Condition of pipes for Plumbing/ water	Nominal	There is water but no pipes, leaking taps, broken down and no water.
V26	TOILET	Type of toilet facility	Nominal	Water closet, Pit Latrine and Bush.
V27	WC	Condition of WC	Nominal	Water closet, Pit Latrine and Bush
V28	PIPES	Source of water supply	Nominal	There is water but no pipes, leaking taps, broken down and no water.
V29	DRAG	Drains/Gutters	Nominal	Open gutter, Covered with concrete slabs and Not existing
V30	SCLEAN	School Cleanliness	Nominal	Strongly disagree, Disagree, Average, Agree and Strongly Agree
V31	POST	The position of the maintenance managers	Nominal	Principal and Vice-Principal
V32	MTCREW	Maintenance crew	Nominal	Yes and No
V33	MTPOL	Maintenance Policy	Nominal	Yes and No
V34	MTSTR	Maintenance strategy	Nominal	Yes and No
V35	MTPLAN	Maintenance Planning	Nominal	Yes and No
V36	MTTYPE	Maintenance type	Nominal	Periodic maintenance, Routine maintenance , Condition based maintenance, Preventive maintenance and Corrective maintenance
V37	ALLOSM	Allocation of space to be maintained	Nominal	PTA, Principal, Maintenance Officer and Government Body
V38	MTINVE	Maintenance yearly inventory	Nominal	Yes and No
V39	RIIMT	Regular Inspection at intervals for maintenance	Nominal	Yes and No
V40	UPSTAG	School upgrade or stagnant	Nominal	Yes and No
V41	MTWIRE	Maintenance work without request	Nominal	Yes and No
V42	MTTIME	Frequency of maintenance	Ordinal	Biannual, annually and No specific time
V43	PERIMT	Period to maintain	Interval	1-2month, 3-4 months, 5-6 months, 7-8 months and 9 month and above.
V44	PROMT	Proper buildings maintenance	Ordinal	Strongly disagree, Disagree, Average, Agree and Strongly Agree

V45	MOMTBD	Most maintained buildings	Nominal	1-5 Classroom, Library, Laboratory, Art Studio and Computer Room
V46	PTAIM	Role of PTA in maintenance	Nominal	Financial Contribution, Man Power, Nothing and Building Materials.
V47	RESID	Users report disrepair in buildings	Ordinal	Never, Rarely, Often, Sometimes and Always
V48	MISUSE	Maintenance Negligence by student	Nominal	[ ] Physical punishment [ ] Suspension [ ] Student repair [ ] Student refund [ ] Nothing
V49	MTSUP	Maintenance support by stakeholders	Interval	Between 1-20% of maintenance fund Between 21-40 % of maintenance fund Between 41-60 % of maintenance fund Between 61-80 % of maintenance fund Between 81-100 % of maintenance fund.
V50	MTTIM	Maintenance time	Interval	Upon inspection, upon request or break down, upon resumption of new session, upon new Government, Based on the maintenance plan and Upon Deterioration and failure
V51	MTTRAN	Maintenance training	Nominal	Yes and No
V52	GMTPLAN	Middle range maintenance plan	Nominal	Yes and No
V53	MTMAN	Maintenance manual	Nominal	Yes and No
V54	MTLOG	Maintenance logbook or computer	Nominal	Yes and No
V55	PHYCONB	Physical Condition of buildings	Ordinal	Strongly disagree, Disagree, Average, Agree and Strongly Agree.
V56	MTMONT	Maintenance monitoring officer	Nominal	Yes and No
V57	IMSTPE	Students performance in maintenance	Ordinal	Strongly disagree, Disagree, Average, Agree and Strongly Agree.
V58	IMSFPE	Staff performance in maintenance	Ordinal	Strongly disagree, Disagree, Average, Agree and Strongly Agree.
V59	SCHD	Deterioration of buildings on account of design	Ordinal	Strongly disagree, Disagree, Average, Agree and Strongly Agree.
V60	SCHC	Deterioration on account of Construction	Ordinal	Strongly disagree, Disagree, Average, Agree and Strongly Agree.
V61	SCHAG	Deterioration of buildings because of Age	Ordinal	Strongly disagree, Disagree, Average, Agree and Strongly Agree.
V62	MATCUL	Lack of Maintenance Culture	Ordinal	Strongly disagree, Disagree, Average, Agree and Strongly Agree.
V63	UATITUD	Users attitudes	Ordinal	Strongly disagree, Disagree,

				Average, Agree and Strongly Agree.
V64	POPULA	Over Population of the students in the classrooms	Ordinal	Strongly disagree, Disagree, Average, Agree and Strongly Agree.
V65	SCHLOC	School Location	Ordinal	Strongly disagree, Disagree, Average, Agree and Strongly Agree.
V66	SCHENV	Poor Environmental Condition	Ordinal	Strongly disagree, Disagree, Average, Agree and Strongly Agree.
V67	SCHFUND	Government funding	Ordinal	Strongly disagree, Disagree, Average, Agree and Strongly Agree.
V68	BULDMAT	Building materials	Ordinal	Strongly disagree, Disagree, Average, Agree and Strongly Agree.
V69	MATPERS	Maintenance persons in construction	Ordinal	Strongly disagree, Disagree, Average, Agree and Strongly Agree.
V70	METPLAN	Maintenance plan for the school	Ordinal	Strongly disagree, Disagree, Average, Agree and Strongly Agree.
V71	METBODY	Maintenance Body and policy	Ordinal	Strongly disagree, Disagree, Average, Agree and Strongly Agree.
V72	SCHCOMP	Pressure on School Building due to misuse	Ordinal	Strongly disagree, Disagree, Average, Agree and Strongly Agree.
V73	NORESP	Maintenance Request	Ordinal	Strongly disagree, Disagree, Average, Agree and Strongly Agree.
V74	NOREPL	Replacement of building materials	Ordinal	Strongly disagree, Disagree, Average, Agree and Strongly Agree.
V75	INPRIC	Inflation of Maintenance materials	Ordinal	Strongly disagree, Disagree, Average, Agree and Strongly Agree.
V77	LACKEP	Experts in Maintenance Work	Ordinal	Strongly disagree, Disagree, Average, Agree and Strongly Agree.
V78	LACKTRA	Training of the maintenance personnel	Ordinal	Strongly disagree, Disagree, Average, Agree and Strongly Agree.

4.10.3 Scale of Measurement

Every research is expected to have some form of measurement. In the current study, the following scales of measurement were used.

- **Nominal**: This study used Nominal scales as naming scales, to represent categories where there is no basis for ordering.

- **Ordinal**: Ordinal scales in the study are adopted for variables that can be ordered along a pre-established dimension which are descending or ascending other.
- **Interval**: Interval scales were applied for variables that are very similar to standard numbering scales except that they do not have a true zero, which means that the distance between successive numbers is equal, but that the number zero does NOT mean that there is none of the property being measured. Many measures that involve psychological scales, especially those that use a form of normal standardization (e.g. time) are assumed to be interval scales of measurement in this study.

4.11 Data Analysis Design

Analysis of the data was done using both qualitative and quantitative analytical techniques. In the case of quantitative technique, data gathered were analyzed using frequencies, tables, charts, %s and textual write-ups. Qualitative analysis was done using content analysis, descriptions and photographs. In addition, cross case analysis was done. These methods were employed to refine and distill the data so that readers can glean interesting information without the need to sort through all the data on their own. The choice of the appropriate statistical techniques for analyzing the collected data has much influence on this study. One basic determinant of choice of a technique to adopt in a study is to determine whether the statistical problem is univariate, bivariate or multivariate. The scale of measurement, as categorized in Table 4.2 is pertinent to determine whether they are nominal (categorical), ordinal (ranked) or interval. The analytical techniques used in this study were chosen to ensure simplicity and clarity in the communication of the results. Therefore, the following techniques

presented in the next section were considered to be appropriate for the nature of data collected for this study.

4.11.1 Univariate Analysis /Frequency Distribution

The univariate analysis was carried out using frequency distribution, tables, bar charts, mean, median and mode to measure central tendency, range and standard deviation to measure dispersion, skewness and kurtosis to measure asymmetry. These were helpful in the analysis of each in sequestration order, showing descriptive summary measures of all the variables.

4.11.2 Non-parametric Statistical Techniques

The non-parametric statistical techniques utilized in this study are:

(a) Pearson Chi-Square: This was used to investigate associations between frequency distribution of nominal or ordinal variables.

(b) Contingency coefficient, a symmetric measure of association: This is complementary to chi-square test. The possible values vary between 0 and 1. While `0` represents no relationship and `1`, a perfect relationship.

4.11.3 Bivariate and Multivariate Statistical Techniques

These were used to explore the basic relationships between variables. They represent analyses carried out on two variables at a time, and sought to check the differences between categories of variables; relationship between variables; associations between frequency distributions and significant.

In this study, some relationships were discovered between two variables some of which were either insignificant or significant. A variable that shows insignificant indicate that relationship does not truly exist while the one that show significant

indicates that the relationship is not due to chance or random error. Therefore, the following analysis were adopted;

(a). Analysis of Variance (ANOVA)

This involved comparing the means of the test variable, for categories of the grouping (independent) variables, to ascertain whether there is any significant difference between the categories. In this study, one-way and two-way ANOVA were used.

(***b) Coefficient of Determination***

This represents the proportion of the variance of the dependent variable that is accounted for by the independent variable. It is useful way of determining the importance of a situation of correlation. It was computed as r-squared, where r is the measure of correlation, linear association or linearity between the variables.

(c) Multiple Regression Analysis

This was employed in examining patterns of relationship between a dependent variable and a group of independent variables. Together with correlation analysis, they were used to generate collection of statistics describing and estimating significance of relationships among a group of variables in this study. The multiple R-squared correlation coefficients representing the extent to which a group of independent variable is correlated with a single quantitative outcome variable, is interpreted similarly to the simple R^2, the coefficient of determination. The unique contribution of each of the in variables to reducing prediction errors in the outcome variable is estimated through calculating partial regression weight (b weights).

Sequel to the research aim, objectives, tools and scale of measurement applied data were collected for this research and the following analytical tools were found relevant to this study.

Regression Coefficient helps in writing equation of best fit, aid the model prediction and is used to describe the relationship of the variables.

Table 4.4: Statistical Tools adopted

S/No	Types of Analysis	Applied Statistical tools
1.	Building Physical condition evaluation rating scale.	Building Condition evaluation rating scale (Adapted from AAPPA) –Australasian Association of Higher Education Facilities Officers, 2000
2.	Descriptive	Frequencies, Mean, Median, Kurtosis, Skewness, Pie -chart and Bar chart.
3.	Prediction	Linear and multiple regressions.

Source: As Adopted by Researcher in the current study

Table 4.5: Condition Rating: Scale of Asset Condition and Definition

Building Component Condition	General Description	Condition Rating (C)	Building Condition Index
Very poor	Building has failed Not operational Not viable Unfit for occupancy Environmental/ contamination pollution issues exist	1	0.00 to 0.19
Poor	Badly deteriorated Potential structural problems (e.g. structural cracks) Inferior appearance Major defects Components fail frequently	2	0.20 to 0.49
Fair	Average condition Significant defects are evident (e.g. non – structural cracks) Worn finishes require maintenance Need services but its functional Deferred maintenance work exists	3	0.50 to 0.74
Good	Minor defects (e.g. hairline cracks) Superficial wear and tear Some deterioration to finishes Major maintenance not required	4	0.75 to 0.94
Excellent	Asset has no defects As in new building condition and appearance	5	0.95 to 1.00

Source: Adapted from AAPPA –Australasian Association of Higher Education Facilities Officers, 2000

NOTE:

Facility/ Building Condition Index

The Building Condition Index (BCI) indicates the current condition of the asset measured relative to its 'as-new' condition.

$$BCI = \frac{\text{Asset Current Condition}}{\text{As-new Condition}}$$

4.12 VALIDITY OF RESEARCH INSTRUMENT

To test the validity of the research instrument, a pilot test was carried out to ensure that the instrument measured exactly what it was designed to measure. The questionnaire was validated through consultations with two trouper researchers in building maintenance, two secondary school Principals and ten building users. They were given draft copies of the questionnaire with the aim of the study and the research questions. They were requested to critically examine the instrument, with respect to relevancy and appropriateness of items as well as the aptness of language, instructions and arrangement. The validators made useful corrections and contributions. All the inputs of the validators were effected in this study with due permission from the supervisors of this study.

Before drafting the final questionnaire, two major things were ensured; first, was that item distribution across strands was measured according to the relationship to identify standards. Second, test items were reviewed and removed for bias and differential item functioning, for example, language that might be offensive to members of a particular group, or present obstacles to a group due to factors unrelated to content and processes specified in the standards.

4.13 RELIABILITY OF RESEARCH INSTRUMENT

Reliability is often at risk when assessments are taken over time, performed by different people or are highly subjective. Reliability is concerned with the consistency in the results given by the same instrument and this is tested using any of test-re-test technique, multiple (alternate) forms, split-half technique and Cronbach`s alpha test (Asika 2005). The reliability of the study instrument was tested using Cronbach alpha test. The instrument was administered twice on the same respondents within an interval of four weeks. Results obtained in first and second tests for all the variables were subjected to Spearman`s Rank Correlation to determine the reliability of the instrument. The coefficient of correlation obtained from the two questionnaires was 0.76, which was higher than the empirically acceptable coefficient of 0.70 for reliabilities in basic research (Cournoyer and Klein, 2000). Finally, for reliability test, Cronbach alpha test was conducted. The result showed the Cronbach alpha coefficient of reliability of the mathematics portion of the test for all maintenance managers was 0.94, with a standard error of measurement of 3.42. The building users' test has a reliability coefficient of 0.95 with a standard error of measurement of 3.27.

4.14. Summary

In this chapter, the research methods used in carrying out this study was presented. The chapter also explained that both qualitative and quantitative research methods were adopted for the study. Sample size for the school buildings survey was 36 Public Secondary Schools out of the existing 47 schools. A combination of questionnaire and observation schedule assisted the researcher to collect primary data for this research. Descriptive statistics was used in evaluating the values of the dependent and independent variables in the data set. The qualitative data for the study in respect of

Objective 1, which related to the identification and analysis of the opinion of the building users, were analysed by means of content analysis. The data related to the assessment of the physical condition of the building component (Objective 2), was rated by the users and later involved an expert rating of the buildings. The factors responsible for deterioration measured by the respondents (Objective 3) and were analysed with the aid of descriptive statistics. Inferential statistical techniques were used in examining the relationships of variables in Objectives 4 and 5 of the research.

CHAPTER FIVE

DATA PRESENTATION AND ANALYSIS OF THE RESULTS

5.1 Introduction

This Chapter is on data presentation and analysis of information gathered through the two types of questionnaires distributed to the building users on one part and maintenance managers on the other part. In addition, researcher's observations on the present state of buildings in the selected Public Secondary Schools were discussed.

5.2 Analysis of the Responses from the Respondents

The two questionnaires on school buildings' maintenance in this study were analysed using two major methods namely: Univariate and Multivariate methods of analysis.

5.2.1 The Characteristics of the Respondents (Building Users)

A total of 400 members of staff representing 30.7% of the staff strength in the thirty-six Public Secondary Schools in Ado-Odo/Ota L.GA were involved in the questionnaire survey. As contained in Table 5.1, 62.2 % and 37.7% of the respondents were females and males respectively.

Table 5.1: Sex of Respondents

Sex of respondent	Frequency	Valid Percent %
Male	116	37.8
Female	191	62.2
Total	307	100.0

This result was not unexpected since there was a prevailing dominance of female teachers in both public and private secondary schools across States in Nigeria. This is similar to the results of Ekundayo *et.al*. (2012).

5.2.1.1 Status of Respondents in the Selected Public Secondary Schools (SSTA)

The teaching profession is made up of two groups' namely academic and non-academic staff. Both groups are very important because while the academic staff may have a better insight into the school's relationship with Ministry of Education, the non-academic staff have a better insight into the history of the school because they are rarely transferred. Table 5.2 presents the status of the respondents as 90.6% of respondents were academic staff.

Table 5.2: The Status of the Respondents

Status in the School	Frequency	Valid Percent
Academic staff	278	90.6
Non-academic staff	29	9.4
Total	307	100

Approximately, 10% of the respondents were non-academic from whom additional information concerning the physical characteristics of the Public Secondary Schools' buildings was sourced.

5.2.1.2 Respondents' Academic Qualifications (ACADQU)

The academic qualifications of respondents in the study area were as presented in Table 5.3. By the Nigerian educational standard, the lowest qualification for a teacher

in a secondary school is National Certificate of Education. A closer look at Table 5.3 shows that 86.7% of respondents had a minimum of National Certificate of Education. This is a clear indication that majority of teachers in Public Secondary Schools in Ogun State were qualified to teach at this level of educational syatem .

Table 5.3: Respondents' Academic Qualifications

Highest Academic Qualification	Frequency	%age
SSC	10	3.3
OND	28	9.1
NCE	77	25.1
B.Sc./HND	170	55.4
M.Sc.	18	5.9
Ph.D	1	0.3
Others	3	1.0
Total	307	100

From Table 5.3 it is evident that around 6.2% of the respondents hold either M.Sc. or a PhD degree. That this caliber of teachers were also found teaching in secondary schools showed that the State Government has been doing everything possible to encourage their teachers to advance in knowledge so as to be competitive even among civil servants in the State.

5.2.1.3 Length of Stay in a Public Secondary School (LENST)

The present condition of a building is the sum total of the efforts by users or owners to maintain it over the years. Staff perception on maintenance of a school building can only be tenable after working for a reasonable period of time. It is for this reason that the length of stay of respondents was investigated in this study. Result of the analysis of the data on this is presented in Table 5.4.

Table 5.4: Length of Stay in Public Secondary School

Length of Stay	Frequency	Valid Percent
1-4yrs	223	72.6
5-8yrs	60	19.5
9-12yrs	14	4.6
13-16yrs	2	0.7
16yrs and above	8	2.6
Total	307	100.0

It is evident from the result (Table 5.4) that a majority (73%) of respondents have worked in their current schools for a period of about 4 years. This is so because of a recent massive transfer of teachers across schools within the Local government area as a way of injecting new ideas in school management. However, evidence across schools in the State was likely to be similar since maintenance functions were mostly implemented by the Local government council. Also, the result indicates that around 20% of respondents had worked in the schools for a period of between 5and 8 years with approximately 8% having worked uninterrupted in the schools for a period above

9 years. Opinions of such people on the maintenance efforts on the school buildings cannot be faulted.

5.2.1.4 Ages of the Public Secondary School Buildings (SCHAGE)

Buildings wear out with age no matter the attention given to them since building elements, e.g. roofing sheets, wooden doors and window frames; have varying life spans. Others such as windows, doors and plumbing fittings become worn out due mainly to the quality of materials and intensity of usage. It was difficult for the respondents to know the age of each building in the schools because, in most cases, there was no document in the school showing the age of each of the buildings. However, none of the staff had stayed long enough to know or even guess the actual ages of the buildings.

Table 5.5: Age of Public Secondary Schools

School Age	Frequency	Valid Percent
Up to 20	104	33.9
21-30	67	21.8
31-40	107	34.9
41-50	9	2.9
51 and above	20	6.5
Total	307	100.0

Data in Table 5.6 shows that less than 10% of the schools were more than 40 years old, while approximately one-third (34.9%) were between 31 and 40 years old. It was evident that 55.7% of the schools were below 30 years old as well as 56.7% of the schools

being between 21years and 40 years of age. This result was not unexpected in view of the developmental status of Ogun State in Nigeria especially in the field of education.

5.2.2 Responses to Maintenance Managers' Questionnaire

Result of analysis of the second questionnaire administered to the maintenance managers is as shown in Table 5.6.

Table 5.6: Responses to Questionnaire Distribution

Respondents	Questionnaires Administered	Questionnaires Retrieved	%
School Maintenance Managers	36	36	100

A 100% response rate was achieved for the Principal category because they were only thirty-six. Principals or Vice Principals were randomly selected based on their availability to attend to the questionnaire. However, all the questionnaires in this category were instantly filled and returned.

5.2.2.1 Length of Stay of the Respondents in a Public Secondary School

The response of the secondary school maintenance managers was required and the result is indicated in Table 5.7. The result showed 72.2% (Table 5.7) had worked in their present schools for between 1 and 4years while 27.8% had only worked between 5years and 8 years. This result can be due to the fact that government of Ogun State transferred some of the old Principals while some were retired from service when the present State government assumed office.

Table 5.7: Length of Stay in a School within the Study Area

Length of Stay	Frequency	Valid Percent
1-4yrs	26	72.2
5-8yrs	10	27.8
Total	36	100.0

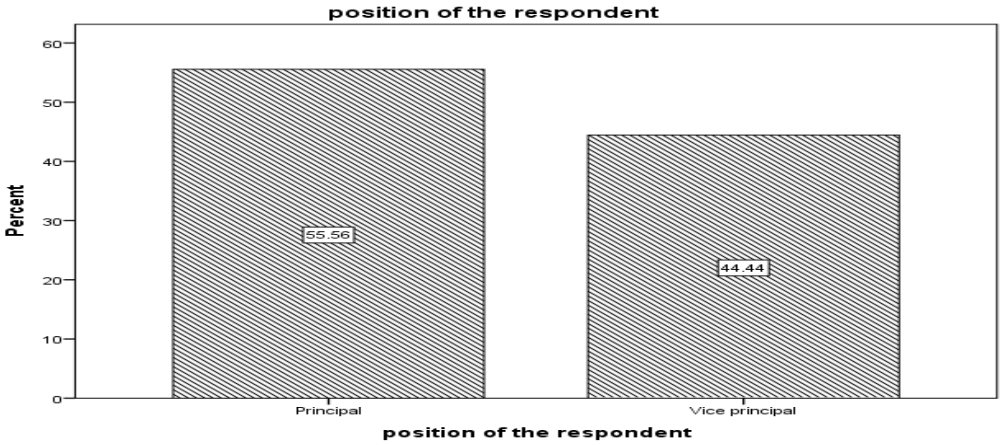
5.2.2.2 The Position of the Maintenance Managers in a Public Secondary School

The result in Table 5.8 indicates that the maintenance managers who responded to the management issues were mainly senior staff. It was gathered that the professional background of the maintenance managers is irrelevant to the task. The responsibility comes along with the appointment into office of the principal or vice-Principals.

Table 5.8: Status of Respondents

Status of Respondent	Frequency	Valid Percent
Principal	20	55.6
Vice principal	16	44.4
Total	36	100.0

Staff members who were involved in school maintenance questionnaire were either Principals or Vice- Principals in the Public Secondary Schools. About fifty-six percent (56%) of the respondents were Principals, while around 44 % were Vice-Principals.



5.3 Analysis of the Users' Perception of the Present Condition in Public Secondary Schools

In this section, attempt was made at addressing the first objective of the study, which was to investigate the users' perspectives on the prevailing conditions of the public secondary school buildings in Ado-Odo/Ota, Ogun State.

5.3.1 Negative Effects of Present Condition of Buildings on Teaching and Learning (EFTEL)

The performance of the users of building can sometimes be influenced by the condition of the buildings. The condition of working or learning environment may affect the productivity of staff as well as the academic performance of students. It was important to investigate this in the study.

Table 5.9: Negative Effects of Present Condition of Buildings on Teaching and Learning

Negative Effect	Frequency	Valid Percent
Yes	253	82.4
No	54	17.6
Total	307	100.0

Table 5.9 shows that around 82.4% of the respondents from the school users perceived that the condition of the buildings affected their teaching and learning while 17.3% were of opinion that the condition of buildings did not affect their work or the students learning process. It can therefore be inferred from this result that the building users desired better conditions of buildings which can be attained if maintenance of school buildings is improved upon. There is an indication that the staff and students would work and learn better if the buildings are in better conditions.

5.3.2. Most Deteriorated Academic Building in the Public Secondary Schools (OLDEST)

Deterioration level in the buildings will always be different; this may be as a result of the usage of the buildings. Some school buildings are usually put into use more than the others. The study investigated the academic buildings that were mostly deteriorated in the schools so as to advise that maintenance priority should be given to such a building. The analysis is presented in Table 5.10.

Table 5.10: The mostly deteriorated academic building

Most Deteriorated Academic Building	Frequency	Valid Percent
Classroom	239	77.9
Library	23	7.5
computer room	18	5.9
Laboratories	27	8.8
Total	307	100.0

From Table 5.10 it is evident that there is a disparity in the deterioration level of academic buildings. The result showed a breakdown of the most deteriorated buildings on the schools sampled. It can be seen from the result that around 78% of the respondents revealed that classroom blocks were the most deteriorated buildings in most secondary schools in Ado-Odo/Ota L.G.A, around 9 % of the respondents indicated that it was the laboratory and 8 % were of the view that the library was the most deteriorated in their own school. Lastly, 6% of the respondent rated computer rooms as the most deteriorated buildings. Based on the result present here, it can be inferred that classroom blocks were the most deteriorated buildings because it was indicated by the highest number of respondents. However, most of the schools did not have enough and befitting classrooms. Some of the classrooms in the schools were also observed to be over populated as attested to by the respondents. In fact, some students were seen sitting on the window sill during classes, during the fieldwork.

5.3.3 Availability of Maintenance Officers in Public Secondary Schools (MTOFF)

Findings show that there was no provision for a maintenance body for the Public Secondary Schools by the State or local government. For effective maintenance, each school should have a maintenance officer who is a professional in the building industry. The result of the investigation is shown in Table 5.11

Table 5.11: Availability of Maintenance Officer in Public Secondary Schools

Provision of Maintenance Officer	Frequency	Valid Percent
Yes	86	28.0
No	221	72.0
Total	307	100.0

The data in Table 5.11 reveals that about 72% of the respondents indicated that there was no maintenance committee in the school, while 28% claimed that they have maintenance committees in their own schools. This result is an indication that there was no maintenance officer in most of the Public Secondary Schools studied and particulars the secondary school buildings' maintenance works were carried out by the Principal and Vice-Principals in these schools.

5.3.4. Deterioration Factors from Users Perception (DTFACT)

The extent of defects and deterioration in public secondary school buildings would be easy to measure by the users, since they are the regular occupants of those buildings. The information on the factors influencing the defects can be measured. These factors

that were responsible for the deterioration of the school buildings are presented in Table 5.12.

Table 5.12: Deterioration Factors from Users' Perception

Deterioration Factors	Frequency	Valid Percent
Natural deterioration due to age	51	16.6
Insufficient fund for maintenance	145	47.2
Attitude of users and misuse of facilities	22	7.2
Over population and insufficient funding	89	29.0
Total	307	100.0

Among the respondents, 47.2% opined that the buildings were highly deteriorating as a result of insufficient funds for maintenance; 29% of the respondents attributed the deterioration factors of the school buildings, as to insufficient fund for maintenance by the government and over population respectively. The response gathered from the building users indicated that some factors were causing the high deterioration. A closer interaction with some of the Principals during the observation survey revealed that the school maintenance managers were given one hundred Naira, per student, per term.

5.3.5 Maintenance of the Academic Buildings in Public Secondary Schools (MTACBL)

Building defects are usually the outcome of failure or lack of maintenance. An accurate cause of a building defect and the form of its appearance must be understood

before accurate remedies can be applied. The level of maintenance of the school buildings were investigated and result presented in Table 5.13.

Table 5.13: Maintenance of Public Secondary School Buildings

Good Maintenance	Frequency	Valid Percent
Yes	127	41.4
No	180	58.6
Total	307	100.0

From the result, it can be seen that around 41.4% of the respondents indicated that the buildings were properly maintained, while 58.6% of the respondents claimed the buildings were not adequately maintained. Further, the result revealed that the highest proportion of those who claimed that the buildings were adequately maintained were those who had maintenance committee. From the results, there is also an indication that schools in locations nearer urban areas were better maintained than those in less urbanized areas.

5.4 Present Conditions of Building Components

Univariate analysis of variables was used to achieve Objective Two, which is to assess the present condition, state/ level of maintenance of academic buildings in public secondary school buildings in Ado-Odo/Ota L.G.A. As part of measures to assess the overall physical attributes of the academic buildings, respondents were asked to indicate their perception of the present condition of some of the major components as of the existing academic buildings.

5.4.1: Analysis of Wall Construction of the Public School Buildings (WALLCON)

The respondents were requested to describe the types of building materials used in wall construction. The result is presented in Table 5.14.

Table 5.14: Wall Construction of the School Buildings

Wall Construction	Frequency	Valid Percent
Sandcrete Block	270	88
Mud	37	12
Total	307	100.0

The results (Table 5.14) shows that 88% of the academic buildings sampled were constructed with sandcrete blocks, while 12% were constructed with mud. Those with sandcrete blocks were the purpose built school buildings. Out of the 88% buildings only about 50% of the block walls were plastered, while the remaining were not plastered. However, 12% of the buildings were constructed with mud were plastered, thus translating to about 60% of buildings that had plastered walls. The defects observed in the walls of the buildings ranged from structural and non-structural cracks, tilted walls, peeled paints to worn-out finishes.

5.4.2: Analysis of Floor Condition of the Public School Buildings (FLORCO)

The condition of the floors was also investigated using condition rating scale. The building users were requested to evaluate the flooring conditions. The main flooring material was cement-sand screed. The result as shown in Table 5.15 reveals the rate at which there were deteriorations of the floors.

Table 5.15: Floor Condition of the Public School Buildings

Condition of floor	Frequency	Valid Percent
Cracks	96	31.4
Peeled/ ripped off	154	50.3
Structural defects	38	12.4
No defect	20	5.9
Total	307	100

The result revealed that 31.4% of the respondents rated the floors as cracked, floors in this condition were in fair category, while 50.3% of the users rated the academic buildings' interior floor as peeled or ripped off with soil showing. Another 12.4% rated the majority of their floors as having material failing defects. Only 5.9% of the respondents were of the opinion that the floors in the academic area were in good or very good condition. It was observed during the survey that floor peeling was very pronounced in some academic buildings. The photographs of the floor condition taken during observation survey are presented in Plates 5.1 to 5.3.

Plate 5.1: Showing a Typical Floor of a Classroom in a Public School

Plate 5.2: Showing the Condition of a Typical Floor in a School Building

Plate 5.3: Showing the Condition of a Typical Floor to a Classroom

5.4.3 Condition of Roofs in Public Secondary Schools (ROOFCO)

Roof is a major covering in building that needs to be in good condition. The building users were requested to state the condition of the roofs as a means of investigating the condition. The roof condition of the school buildings as rated by the users are presented in Table 5.16.

Table 5.16: Condition of Roofs and Ceilings in Academic Buildings

Condition of roofs	Frequency	Valid Percent	Condition of ceiling	Frequency	Valid Percent
Leaking	152	49.5	No ceiling	131	42.7
Rusty not leaking	65	21.2	Sagging	132	43.0
Partly ripped off/sagging	52	16.9	Broken	25	8.1
Completely ripped off	27	8.8	Good	19	6.2
Good	11	3.6			
Total	307	100.0			

The results (Table 5.16) reveals that 49.5% of the users described the roof as leaking, 21.2% described their roof as rusty but not leaking, 16.9% described the roof as partly ripped off or sagging, 8.8 % described the roof as completely ripped off and only 3.6% of the respondents claimed that the roofs were in good condition. Majority of the

academic buildings that had sagging roofs and completely ripped off were the classrooms. The common roofing material was corrugated galvanized iron roofing sheets and 75% of schools in the study area had one roof problem or the other. About 66.4% of school buildings needed either minor or major repairs, while 8.8% of them were completely old and dilapidated. Only 24.8% exhibited evidence of physical soundness (see Tables 5.14). A pictorial condition of the analysed roof condition is also presented in Plate 5.4 and Plate 5.5.

Plate 5.4: Deteriorated ROOFCO

Plate 5.5: Rusted Roofing Sheets in ROOFCO

The condition of ceilings was also rated by the users of the buildings. Majority of them (43%) indicated that the ceilings were sagging in most of the school buildings. Another 42.7% of the respondents indicated that the buildings had no ceiling. The ceilings may have fallen off in such cases. For proper description of the ceiling conditions, the photographs of some ceilings were taken. Plate 5.6 shows a classroom without any ceiling board, while Plate 5.7 shows a school library room with ceilings in a relatively condition.

Plate 5.6: Showing a Classroom without Ceiling Boards

Plate 5.7: Showing a Decent Classroom Environment

5.4.4 Condition of Walls in Public Secondary School Buildings (WALLCO)

Walls of buildings are a fundamental part of the superstructures that enclose spaces in a building. Building walls support roofs, ceiling and floors. There was a need to investigate the condition of walls in the secondary school buildings to ascertain if they

were providing shelter and security. Building users were also asked to indicate the condition of walls of the academic buildings. The results are presented in Table 5.17.

Table 5.17: Condition of Walls

Condition of Walls	Frequency	Valid Percent
Structural (Tilted)	8	2.6
Partly broken down	69	22.4
Non-structural cracks	146	47.7
Good	84	27.3
Total	306	100.0

It is evident from Table 5.17 that around 47.7 % of the respondents claimed that the walls were cracked while 22.4% claimed that most of the walls in their schools were partly broken as a result of structural defects. However, only 2.6% of the respondents described the walls as either tilled or completely broken down, 27.3% of the respondents were satisfied with the condition of the walls of the academic buildings. The pictorial representation of the WALLCO is presented in Plate 5.8.

Plate 5.8: A Fairly Rated WALLCO

5.4.5 Conditions of Windows in the Academic Buildings (WINDCO)

The respondents were also requested to rate the condition of windows. Table 5.18 contained data on the condition of windows.

Table 5.18: Conditions of Windows in the School Buildings

Window Conditions of the Buildings	Frequency	Valid Percent
No Louvre blades just frame	119	38.8
Some glasses fall off	122	39.7
Completely broken down	58	18.9
In good shape	8	2.6
Total	307	100.0

It is evident from Table 5.18 that around 98% of the windows in the selected secondary school buildings were in various stages of poor condition. About 38.8% of the windows had no louvre blades, while 39.7% still had a few louvre blades. Also 18.9% of the windows of the selected school buildings had no window frames and window panes. In all only, 2.6% of windows in secondary school buildings could be considered to be in good condition.

A general survey of school buildings as presented in Plate 5.9 indicate that there was no academic building with contemporary windows such as aluminum sliding or steel casement as many remodeled buildings still have wooden and louvre windows in them.

Plate 5.9: A Typical Window of a School Library

5.4.6 Conditions of Doors in the Public Secondary School Buildings (DOORCO)

For security reasons, solid doors are required for any building especially for secondary schools that will be empty after school hours. Where doors are not provided, such school classrooms serve as bedrooms for miscreants. Table 5.19 shows the condition of doors in the buildings sampled.

Table 5.19: Conditions of Doors in the Academic Buildings

Condition of Windows	Frequency	Valid Percent
No door	141	45.9
Partly broken down	95	30.9
Completely broken down	64	20.8
Good	7	2.3
Total	307	100.0

As shown in Table 5.19, around 45.9% of the school buildings had no doors, 30.9% had doors that were partly broken, while 20.8% had doors that were completely broken and only 2.3% had very good doors. The most common door type identified was

wooden (90%). Other door types found in buildings were metal doors. There were no sliding or steel casement doors in some of the schools investigated.

5.4.7 Types of Sanitary Services in Public Secondary Schools (TOILET)

There is the need for students and staff to regularly empty their bowels as at when due. To this end, toilets and sanitary facilities should be provided for use while the school is in session. To ascertain if this provision exists, staff of the secondary schools were asked to assess what they have in terms of toilet facilities.

Table 5.20: Types of Sanitary Services in Secondary Schools

Type of Sanitary Services	Frequency	Valid Percent
Water closet	128	42.0
Pit latrine	136	44.6
Bush	43	13.4
Total	307	100.0

It is clearly from the data presented in Table 5.20 that pit latrine was predominant in the Public Secondary Schools investigated as 44.6% of the respondents in the schools affirmed this see type of toilet (see Table 5.20 for a typical example of pit toilet in the schools investigated). The result reveals that around 42% of the respondents said used they used water closet, while 13.4% indicated that there was no provision for toilet facilities in the school compounds. This result suggests that around 13.4% of public secondary students do not have a place to defecate with the school premises; implying that defecating in the open suffices in these schools.

5.4.8 Condition of Public Secondary Schools with Modern Sanitary Appliances

Water supply, in some instances, in the study area cannot be guaranteed. For this

reason, the conditions of public secondary school buildings with Water Closets were further examined. The result is as presented in Table 5.21.

Table 5.21: Condition of Water Closets in Public Secondary Schools

Condition of WC	Frequency	Valid Percent
Minor defects e.g. water leakages	21	16.4
Broken down	28	21.9
Poor appearance	28	21.9
Very good	51	39.8
Total	128	100.0

In Public Secondary Schools where water was not a challenge, the study (Table 5.21) found out that only 39.5% of the population were in very good condition. This result is disturbing as further enquires showed that around 43.8% of the toilet facilities were due to poor handling by the users, while 16.4% was traceable to poor workmanship as water leakages were observed. A situation where defects and adequate maintenance of toilets cannot be guaranteed, it is not advisable for the system bearing in mind the health challenges poor sanitary conditions poses to students and staff in these schools.

5.4.9 Source of Water Supply in the Public Secondary Schools (PIPES)

It is the duty of government to provide pipe borne water for her citizens but due to rapid expansion of villages, towns and cities coupled with dwindling financial resources, the provision of expected beneficial goods to the common man is largely lacking across the country. To this end, the result of the condition of water supply was presented in Table 5.22.

Table 5:22: Water Supply to Public Secondary Schools

Source of Water	Frequency	Valid Percent
Well/Borehole	242	78.9
Stream	27	8.8
No water supply	38	12.4
Total	307	100.0

Data analysis showed that 78.9% of Public Secondary Schools' used pipe borne water while source water from wells. Only a few (8.8%) obtained water from streams. Surprisingly, 12.4% of Public Secondary Schools had no water in their school compounds.

5.4.10. Condition of Plumbing Works (PLUMBCO) in Public Secondary Schools

Having examined the condition of water closets and sources of water supply in the study area, it became pertinent for this study to assess the condition of pipes that convey waste and foul water within the buildings. The assessment was carried out by direct observation of the layout of the pipes in the school premises. It was observed that a majority of the pipe works in the school buildings were done on the surface of the walls. The result of the analysis is presented in Table 5.23.

Table 5.23: Condition of Water Pipes in the Public Secondary Schools

Condition of water pipes	Frequency	Valid Percent
Minor defects in pipes	93	30.2
Leaking taps	79	25.7
Broken down	117	38.1
Good	18	6.0
Total	307	100.0

The result revealed that only 6% of the pipes were in good condition, while 55.9% had one challenge or another. The study also showed that 38.1% of the plumbing pipes

were no longer functional; and the pipes used for plumbing works were low quality was very low. There was obvious poor workmanship in the entire plumbing work.

5.4.11. Condition of Electrical Wiring and Installations (ELECO) in Public Secondary Schools

Respondents were asked to indicate the condition of electrical wiring and installations. The main source of electricity supply to the area was through the Power Holding Company of Nigeria (PHCN). About 20% of Public Secondary Schools investigated had a generating plant each as back up to grid supply. Most of the generating plants owned by the Public Secondary Schools were of lower capacity since they were meant to service only the administrative blocks. It was quite remarkable that all the Public Secondary Schools had electricity supply except for the erratic nature of power supply, which of course is a national problem in Nigeria. The responses on the condition of ELECO are shown in Table 5.24.

Table 5.24: Condition of Electrical Wiring and Installations in Public Secondary Schools

Condition of Electrical Wiring and Installations	Frequency	Valid Percent
Poor Electrical Wiring	143	46.7
Loose electrical cables	91	29.7
Damaged electrical plugs/sockets	41	13.1
Functional	32	10.5
Total	307	100.0

A closer look at Table 5.24 will show that only 10.5% of Public Secondary Schools can be said to be enjoying constant electricity supply. A majority of respondents (89.5%) would not be able to put on their appliances for fear of being electrocuted as a result of poor electrical wiring (46.7%), loose electrical cables (29.7%) or damaged electrical plugs/sockets (13.1%). Further investigations revealed that many of the

Public Secondary Schools are unable to teach in the laboratory or put the computer room to use for weeks or months due to lack of power supply.

5.4.12. Condition of Drainage (DRAG) in Public Secondary Schools

When it rains, some water naturally seeps into the ground the rest makes its way through drainage systems. Large amount of water can build up quickly during heavy rains, and without adequate drainage this flows towards low-lying land, causing flooding and risks to life and property. The drainage system is essential in a city or urban area as it eliminates flooding by providing appropriate channels to discharge storm water from buildings and roads. The users were asked to state the condition of drainage around the buildings. The result is as presented in Table 5.25.

Table 5.25: Condition of Drainage Channels in Public Secondary Schools

Condition of Drainage	Frequency	Valid Percent
Open Gutter	95	30.9
Covered gutter	44	14.3
Not existing	168	54.8
Total	307	100.0

The result in Table 5.25 reveals that most of Public Secondary Schools had no drainage channels for the discharge of storm and foul water. Consequently, waste / foul water was found on the surfaces of roads in some of the school premises resulting in odour and filthy environment with the attendant health and environmental consequences. Erosion and lack of roof drains were also observed in many schools. Many schools lacked drainage to the extent that some school compounds were already eroded with rain water; even some of the existing drainages were not properly channeled, while some were left uncovered. However, 30.9% had open drainage channels and 14.3% had proper drainage put in place around the buildings.

Plate 5.10: A Typical eroded entrance to a Public Secondary School Building

5.5 Factors Responsible for Poor Maintenance of Public Secondary School Buildings

The study examined the factors that affected and the deterioration of secondary school buildings. It became very important to determine the weight of the variables in this study, in order to measure the effectiveness of these factors on the public secondary school buildings. This study considered 19 variables (V59-78) as deterioration factors within the secondary school buildings. This was done to address Objective 3 of the study.

Table 5.26: Deterioration based on Factors in Public Secondary Schools

S/N		Yes (%)	No(%)
1.	Sub-standard workmanship	47.2	52.8
2.	Poor Quality of Building Materials	80.6	19.4
3.	No Maintenance Plan	16.7	83.3
4.	Over Population	63.9	76.1
5.	No maintenance Culture	19.5	80.5
6.	Insufficient funding	13.9	86.1

5.5.1 Deterioration Based on Sub Standard works by Contractors in Public Secondary Schools

The construction processes and quality of the products were major focus in the assessment of building construction process. It is known that good work will reduce deterioration in any building and the attention in construction management is naturally focused on the determinants of quality construction work factor. The construction of the school buildings was investigated through the maintenance managers who were requested to evaluate the construction methods. Table 5.26 showed that 47.2 % of the respondents indicated that the school buildings were deteriorating because they were not properly constructed while 58.8% indicated that the quality of construction was not a contributing factor to the present conditions of the buildings.

5.5.2. Deterioration Based on Poor Quality of Building Materials in Public Secondary Schools

The quality of building materials is often evaluated based on manufacturers' specifications, users' perspective and value of the materials. In taking maintenance decision and problem solving the quality of materials are contributing factors. There is a tendency of a building not depreciating quickly, when good quality materials are used. The study investigated the quality of the building materials that were used to erect the school buildings. The result is presented in Table 5.26. It is evident from Table 5.26 that the response from the maintenance managers shows that around 80.6% of them did not agree that poor materials were used in the construction of the school buildings, while 19.4% indicated that building materials used were of poor quality.

5.5.3 Deterioration Based on Lack of Maintenance Plans for Public Secondary Schools

Maintenance plans create a workflow of the tasks required to make sure that a building is in proper condition. School buildings maintenance managers were also asked to indicate whether or not they have deterioration on the account of lack of maintenance planning. The result as presented in Table 5.26 shows that around 83.3% of the respondents agreed that the rate of deterioration in the buildings were as result of a lack of maintenance planning, only 16.7% disagreed with the assumption that lack of maintenance plan was a major influence on the present condition of school buildings in study area. This result goes to suggest that the lack of maintenance planning is not the main reason for the rate of deterioration observed in the buildings sampled.

5.5.4 Deterioration Based on Population Pressure on School Compounds in Public Secondary Schools

In several situations, it was observed that two Public Secondary Schools (junior and senior) were sharing a school compound. Despite the separation of the schools, there was no provision for new school compounds by the government. Based on the assumption that there was mostly going to be differences and approaches to maintenance standards among the school heads due to population pressure; this study investigated deterioration as a result of pressure on the school compounds considering the situation of two secondary schools (junior and senior) in the same compound in some schools. The result revealed (Table 5.26) that 63.9 % of the respondents were of the view that there was no pressure on the school buildings and facilities, while 36.1% indicated that there was pressure on their school compound due to number of schools in the compound.

5.5.5 Deterioration Based on Lack of Maintenance Culture (MATCUL) in Public Secondary Schools

A virile maintenance culture is imperative for any building owners and users that intends to retain the buildings. The ever decaying and poor condition of school buildings in Nigeria can be linked to poor maintenance culture. The current study investigated the maintenance culture in the schools. The respondents were asked to indicate if lack of maintenance culture was a contributory factor to the current rate of deterioration in the buildings. The result (Table 5.26) shows that maintenance culture was a deterioration factor in the school buildings sampled. This is because 80.5% of the respondents agreed that MATCUL was a deterioration factor, while only 19.5 % of the respondents said this was not a deterioration factor.

Table 5.27: Deterioration Based on some Deterioration Factors

S/N	Deterioration Factors	Agree (%)	Disagree (%)
1	Poor Response to Maintenance Requests (NORESP)	13.9	86.1
2	Lack of Replacement of Worn out Building Components (NOREPL)	22	88
3	Users' Attitude (UATITUD)	41.6	58.4
4	Inflation on Price of Materials (INPRIC)	77.8	12.2
5	School Location (SCHLOC)	88.9	11.1
6	Poor Environmental Condition (SCHENV)	83.3	16.7
7	Building Design (SCHD)	61.1	38.9
8	School Buildings Age (SCHAGE)	-	100
9	Over Population of Students in the Classroom (POPULA)	16.7	83.3
10	Due to lack of Maintenance Experts	22.2	77.8
11	Absence of Maintenance Body and Policy	11.1	88.9
12	Lack of Maintenance Training (LACKTRA)	63.9	36.1
13	Based on Un-skilled maintenance person in construction	22.8	72.2

5.5.6 Deterioration Based on Inadequate Responses to Maintenance Requests (NORESP) from Government

It is the responsibility of a building owner to ensure that the building is maintained, however. In this case of public schools, this obligation rests on the Maintenance Managers. Therefore, the building maintenance managers were requested to rate the level of response they got after maintenance requests were sent to the appropriate government quarters. The NORESP as rated by the respondents is presented in Table 5.27. It is evident from Table 5.27 that poor response to maintenance was high with 86.1% and 13.9% of the respondents saying that they got poor response and quick response to their reported maintenance issues, respectively.

5.5.7 Deterioration Based on Lack of Replacement of Worn out Building Components (NOREPL)

Building components begin to wear out from the moment they are placed in buildings. Repairs often mean simple replacement of worn out or used components. A building wears out or get break down or may even become obsolete if there is no provision for replacement of parts/components. The Maintenance Managers were also requested to rate if the buildings were in their present condition because the worn out building materials were not replaced. The result (Table 5.27) shows that 88% of the Maintenance Managers indicated that there was no provision for replacement of deteriorated building elements in school buildings, while 22% of them noted that there were provisions for this type of maintenance activity in their respective schools.

5.5.8 Deterioration Based on Users' Attitude (UATITUD)

Users' attitude towards their environment is always a factor to consider in the performance of constructed facilities such as buildings. This is because users' behaviour can easily contribute to deteriorating condition of buildings. Therefore, it

was important to investigate the features and functionality of the school buildings in relation to the attitudes of the users. In the current study, attitude of users' was investigated as a deterioration factor. The result is as presented in Table 5.27 shows that around 58.4% of the respondents were of the opinion that poor user attitudes were contributory factor to the deterioration level of the school building, while 41.6% of the respondents had a contrary view on this.

5.5.9 Deterioration of Public Secondary School Buildings Based on High Repair Bills (INPRIC)

The study investigated the effect of changes in the price of building materials on the optimal maintenance of public secondary school buildings. Analysis of the responses in the survey presented in Table 5.27 show that 77.8% of the respondents were of the view that changes in the cost of building materials affected the maintenance and rate of deterioration of the buildings; meaning that INPRIC is a deterioration factor. However, only 22.2% of the respondents indicated that the INPRIC variable was not a deterioration factor in the present condition of Public Secondary Schools.

5.5.10 Deterioration Based on the Public Secondary School Location (SCHLOC)

One of the assumptions in this study was that deterioration of academic buildings in public secondary school may be affected by the location of such schools. This study therefore, investigated the effect of location on the deterioration of public secondary school buildings. The respondents were also requested to rate if the school location was a deterioration factor. The result as presented in Table 5.27 indicates that around 89% of the respondents disagreed with the assumption that the location of the school location was affecting the deterioration of school buildings.

5.5.11 Deterioration of Public Secondary School Buildings Due to Existing Environmental Condition (SCHENV)

Environmental health expert are interested in health risks from exposure to biological agents (bacteria, parasites etc.), chemical agents (pollution, pesticides etc.) and disease vectors (mosquitoes, snails). Environmental improvement are often more effective than curative efforts as prevention is better than cure. Examining the environmental condition of the schools was another issue of interest in this study. The result as presented in Table 5.27 reveals that around 88.3% of the respondents were of the view that poor environmental condition had no influence on the present condition of school buildings. Therefore, it can be inferred from this result that environmental condition had little influence on the deterioration school buildings.

5.5.12 Deterioration as a result of the level of Funding from Government (SCHFUND)

Maintenance fund is a periodic non-repayable grant to Public Secondary Schools. It is expected to be used for the maintenance of furniture, equipment and public secondary school buildings. The level of the funding is a determinant to the maintenance of the public secondary school buildings. Data on this is presented in Table 5.26. The level of funding from government as a deterioration factor was investigated and the responses showed that 86.1% of those encountered in the survey were of the view that the maintenance funding available in the schools was a contributive factor to the deterioration level of the school buildings.

5.5.13 Deterioration Based of Building Design (SCHD) Of Public Secondary Schools

Building designs can contribute to the rate of deterioration of buildings in use. Building design as a deterioration factor was investigated in the current study. The

result in Table 5.27 confirmed that building design was not a deterioration factor as reported by 61.1% of the respondents.

5.5.14 Deterioration Based on the Age of Public Secondary School Buildings (SCHAGE)

The age of school buildings, conditions, state of repairs, renovation and replacement of the building components were also investigated. The age of each school was investigated as a means of identifying the age of academic buildings in them. The result of the analysis as presented in Table 5.27 shows that 100% of the respondents claimed that the school buildings were deteriorating because of age. This result was not expected as the age of buildings is one of the key factors that influence its rate of deterioration.

5.5.15 Deterioration Based on Over-Population of Students in the Classroom (POPULA)

The inadequacy of public secondary school buildings due to the excessive pressure of the student population was another factor explored in the study. The study examined the influence of population of students in the Classroom on the school buildings. The result is presented in Table 5.27. Form Table 5.27, it is evident that over population of students in the school buildings especially classrooms were rated very high by around 83.3% of the respondents as a contributive factor to the deterioration condition of school buildings. There is an indication that over population of students in the classroom is a one of the factors that contributes to the deterioration.

5.5.16 Deterioration of Public Secondary School Buildings Due to lack of Maintenance Experts

The most qualified experts in this area are those with good knowledge of design construction and management practices, such as architects, builder, engineers and

general contractors. Non-utilization of these professionals in maintenance works may lead to rapid building deterioration. To ascertain the involvements of maintenance experts in maintenance activities in the schools, the respondents were requested to evaluate the impact of non-involvement of experts in maintenance works in public secondary school buildings. The result as presented in Table 5.27 shows that there were more positive (77.8%) than negative (22.2%) responses on this. This is an indication that the variable is one of the factors that is contributing to the deterioration condition of public secondary school in the study area.

5.5.17 Deterioration Based on Lack of Maintenance Body and Policy

Public Secondary Schools are owned by government; and as such has a duty to maintain them. To achieve this, there is a need to have a policy in place to ensure adequate and regular maintenance of the schools. To ascertain whether or not the lack of maintenance body and policy was a contributory factor to the level of deterioration of buildings in the schools, the data in Table 5.26 show that around 89% of the respondents indicated that the lack of maintenance body and policy was a contributory factor to the level of deterioration of buildings in the schools, while the 11.1% disagreed with this notion.

5.5.18 Deterioration Based on Lack of Maintenance Training (LACKTRA)

The opinion of the maintenance managers was examined it relates to the effect of lack of maintenance managers training in school maintenance. From Table 5.27 it is evident that 63.9% of the respondents agreed that the lack of training for maintenance managers was a factor contributing to the deterioration of school buildings. This implies that maintenance training has influence on the present condition of buildings.

5.5.19 Deterioration as a Result of the Use of Un-Skilled Maintenance Personnel

This is another factor that seems to be affecting school buildings. The respondents were asked to indicate their opinion about this variable. The result is presented in Table 5.27 shows 'yes' indicated that 72.2% of the respondents indicated that the use of unskilled persons as maintenance managers contributed to the deteriorating condition of school buildings .

5.6 The Maintenance Manager Survey

In Objective Four of this study, the researcher investigated the maintenance strategy and policy engaged in by the maintenance managers in the Public Secondary Schools in the study area. To obtain data on the maintenance strategies of public secondary school buildings. A separate questionnaire (2) was used to gather information on maintenance strategy, policy, funding, planning, factors of deterioration as well as maintenance stagnancy. Personal data were obtained from the maintenance managers who doubled as the Principals of the schools.

5.6.1 Analysis of Maintenance Fund from Other Stakeholders (MTFUND)

Maintenance support fund from other sources was also investigated from the schools Principals, giving them **e**xplicitly mutually-exclusive options (Table 5.28).

Table 5.28: Maintenance fund from other stakeholders

MTFUND	Frequency	Valid Percent
Never	5	13.9
Rarely	11	30.6
Often/ Sometimes	20	55.5
Total	36	100.0

Source: Authors field Survey, 2013.

In examining the financial contributions from other stakeholders like PTA and Alumni of the schools, the result in Table 5.28 becomes useful. From the result on this Table

6.28 it can be seen that 13.9% of the respondents claimed that they never get financial support from any source, 30.6 % rarely get financial support from other stakeholders, 11.1% often get maintenance fund, while 44.4 % sometimes get financial support from other stakeholders and no respondent indicate the receipt of support from external sources always. This is an indication of that the maintenance manager cannot budget on this type of maintenance fund because such funds may not be there when the need arises. This result also implies that Ogun state government is the sole sponsor of maintenance activities and programmmes in the schools. Therefore, it would not be out of place for school maintenance managers/ institutions to seek maintenance support from stakeholders like PTA, alumni and corporate organizations within the neighborhood when government cannot give adequate funding for maintenance activities.

5.7.2 The Maintenance Policy Used by the Maintenance Managers of the Public Secondary Schools in the Study Area

For proper maintenance to be carried out on a building, a policy should be put in place. Table 5.29 shows the distribution of the respondents according to their availability of a maintenance policy in the study area.

Table 5.29: Analysis of existence of maintenance policy

MTPOL	Frequency	Valid Percent
Yes	8	22.2
No	28	77.8
Total	36	100.0

Source: Field Survey, 2013.

Table 5.29 shows that majority (77.8%) of the respondents have no maintenance policy used for the maintenance of the Public Secondary Schools in Ado-Odo/ Ota, Ogun State and (22.2%) claimed that they have maintenance policy for the schools. From all indications, there is no maintenance policy for the schools in the study area.

5.6.3 Regular Inspection by School Head for Maintenance Needs (RIIMT)

The questionnaire was used to investigate from the respondents if they carry out regular inspections on the academic buildings in the secondary schools. The result, presented in Table 5.30 shows that the maintenance managers always inspect the school buildings.

Table 5.30: Analysis of Regular inspection by school head for maintenance needs

RIIMT	Frequency	Valid Percent
Never	7	19.4
Rarely	5	13.9
Sometimes	8	22.2
Always	16	44.4
Total	36	100.0

Source: field Survey, 2013.

The result presented in Table 5.30, indicates that out of 16 school maintenance managers (representing 44.4%) who always carry out regular inspections of building condition to determine the maintenance needs, 8 respondents (representing 22.2%) sometimes inspect the building, 7 respondents (representing 19.4%) never inspected the building conditions to determine the maintenance needs while only 5 (representing 13.9%) rarely inspect the buildings to determine the maintenance needs. This is an indication that because the managers were not trained building professions they may not know the importance of regular building inspection. The result also indicates that 44.4% of the respondents had poor level of building inspection.

5.6.4 Improvement or Stagnancy of the School Buildings (UPSTAG)

The study further investigated whether or not there was any major maintenance in the last five years (UPSTAG). Some buildings in the schools have fairly good visual and maintenance trait while some appeared abandoned. The result is presented in Fig 5.11.

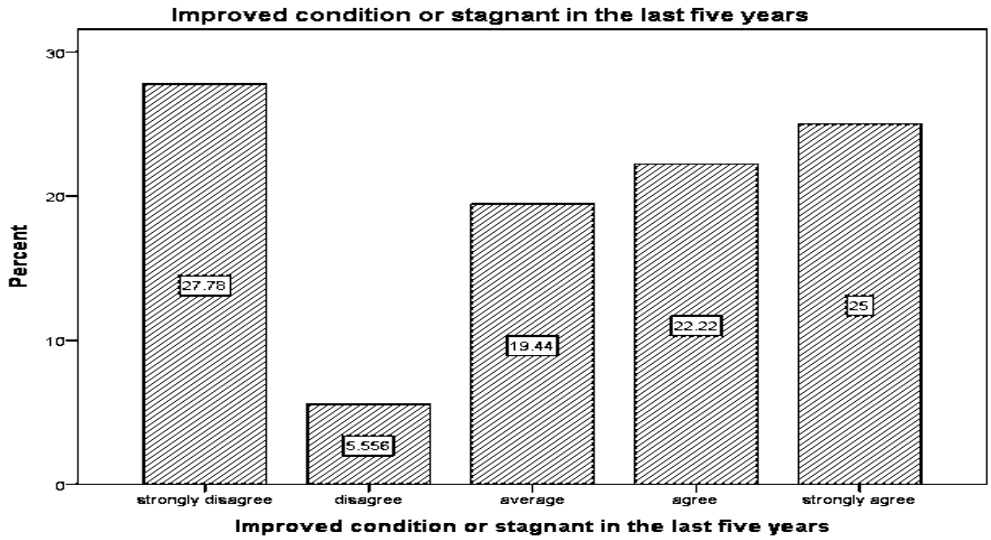


Fig. 5.11: Analysis of position of the maintenance managers

Fig.5.11 shows the scores of the respondents on UPSTAG which is the building condition improvement or stagnant in the last five years. According to the data, 27.7% of the respondents strongly disagree, 25% strongly agree, 22.2% agree, 19.4% average, and disagree 5.5%. This result indicates that the schools maintenance manager carry out maintenance work on the academic building in the schools. It was also observed that there were some transformations in a number of the school buildings but they are poorly maintained but not stagnated.

5.6.5 Identification of Spaces to be Maintained (ALLOSM)

The respondents were asked to indicate the people who are responsible for the allocation of spaces to be maintained. Table 5.31 presents the responses from the school maintenance managers.

Table 5.31: Identification of spaces to be maintained

ALLOSM	Frequency	Valid Percent
PTA	7	19.4
Principal	20	55.6
Maintenance committee	9	25.0
Total	36	100.0

The findings shows that 55.6 % of all respondent claimed that the Principals were responsible for the allocation of spaces to work upon, followed by 25% who claimed

to have maintenance committee in place, and they were responsible for the allocation of spaces to be maintained, while 19.4% indicated that Parent Teacher Association (P.T.A) allocated the spaces for be maintained .

5.6.6 Maintenance work without request (MTWIRE)

This study investigated the responsibility level of the maintenance manager and availability of fund by asking if maintenance work was usually carried out without the users complaining or an accident occurrence.

Table 5.32: Maintenance work without request

MTWIRE	Frequency	Valid %
Yes	33	91.7
No	3	8.3
Total	36	100.0

Source: Field Survey, 2013.

The result of analysis of maintenance work without users request or complaints in the Public Secondary Schools as presented in Table 5.32 shows that 91.7% of the respondents carried out maintenance, repairs without users reporting or complaining to the office, while small fraction (8.3%) claimed that they did not carry out a maintenance work until when the users lodged a complaint. This result implies that around 92% of the respondents are exhibiting one of the qualities of a maintenance manager by carrying out repairs without waiting for the users. The physical environments or some of the buildings in some schools were of tolerable quality which is an indication than the schools were not abandoned but poor maintenance.

5.6.7 Maintenance Planning of Public Secondary School Buildings

As part of the measures to assess the maintenance strategies used in the Public Secondary Schools, maintenance managers in the schools were asked to indicate the type of maintenance plan used. Table 5.33 shows the result of the analysis.

Table 5.33: The type of maintenance planning in the schools

MTPLAN	Frequency	Valid Percent
Periodic	7	19.4
Routine	2	5.6
Corrective	27	75.0
Total	6	100.0

Source: Field Survey, 2013

The result in Table 5.33 shows that 75% of the respondents indicated that they were engaged in corrective maintenance, 19.4% periodic and 5.6 % engaged in routine maintenance. Other types of maintenance were not considered in this study. This is an indication that until when cases go bad, maintenance will not take place and therefore justify the reason for high deterioration level in the schools. Result in Table 5.33 appears to be in agreement with what was obtained from the building users. Most of the respondents perceived that some of the building components were falling apart, poor and very poor than those that said it was fair and good. This result also suggests why the respondents did not need to rely on users complaints before carrying out corrective maintenance. It was observed that in most schools surveyed, the deterioration was usually on a high side and obvious to all before the maintenance managers would implement the claimed corrective maintenance measures.

5.6.8 The Availability or Existence of Maintenance Strategy for the School

The School Principals or Vice-Principals were asked if there is availability or existence of maintenance strategy for their schools. The result presented in Table 5.34 indicated that a greater number of the respondents (representing 83.3%) claimed do

not have any maintenance strategy, while 16.7% of the respondents disclosed that they have a strategy that guides them.

Table 5.34: Analysis of availability of maintenance strategy in the schools

AMTSTR (V33)	Frequency	Valid Percent
Yes	6	16.7
No	30	83.3
Total	36	100.0

Source: Field Survey, 2013

This is an indication that maintenance strategy is not a strange thing to the maintenance managers though the strategy was not documented but was in use. The result is an indication that most secondary schools were maintained through the discretion of the Principals/ Vice-Principals.

5.6.9 Frequency of maintenance works in school building

The service life and periodic maintenance do reinstate and slow the degradation of a building. Therefore the school maintenance managers were required to indicate the response time to reported repair needs from building users. The result is presented in Figure 5.3

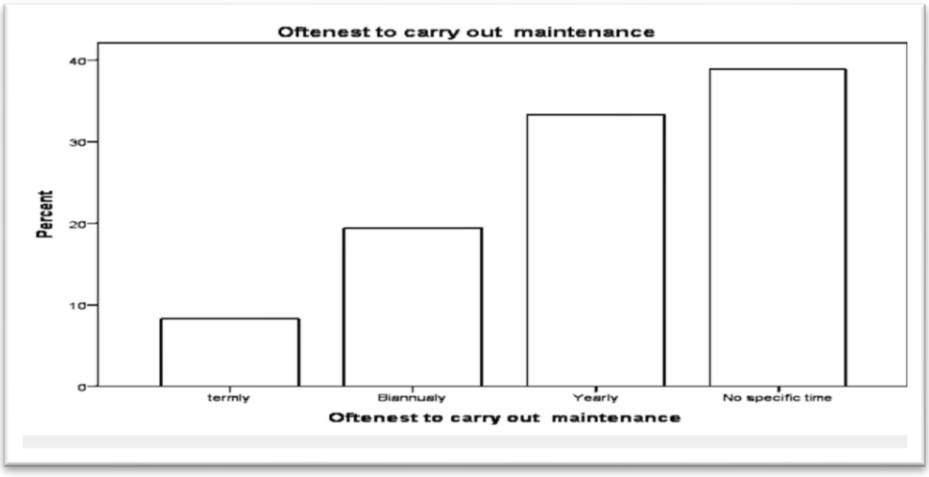


Fig. 5.16: Analysis of the frequency of maintenance work

Figure 5.3 showed the distribution of the frequency of maintenance work disrepair. This result was to be expected because maintenance works can only be carried out when funds are made available to the maintenance managers.

5.6.10 Response to Reported Disrepair in Secondary Schools

It was also enquired from the maintenance managers how long it usually takes for government to respond to request for repairs in the public secondary school buildings, Fig.5.4 contains the analysis. The results in Figure 5.4 showed that (52.78%) of respondents were of the opinion that it takes more than 8 months for the government to respond to request concerning repair complaints.

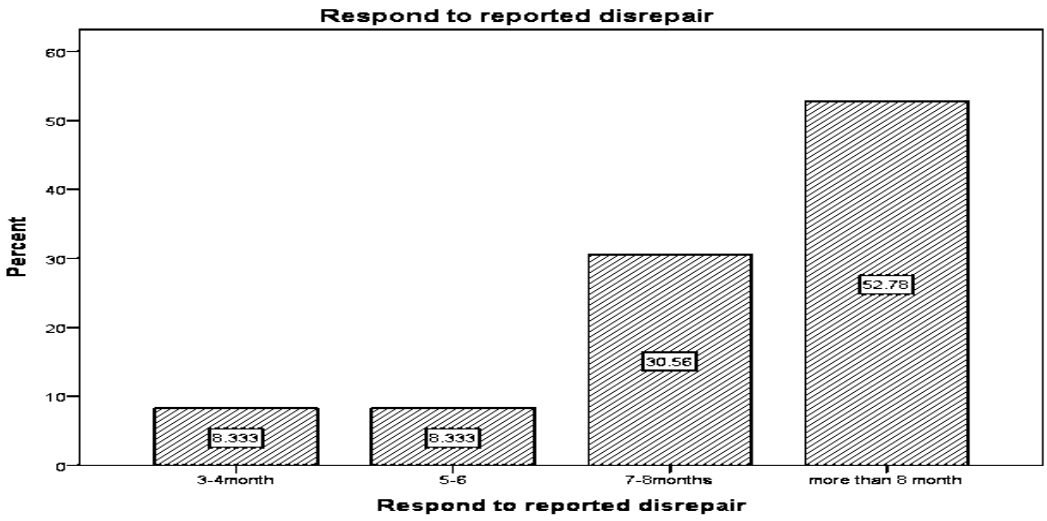


Fig. 5.17: Analysis of the oftenest to carry out a maintenance work

5.7 **Summary**

From this Chapter, it is obvious that majority of the building components were in a deteriorating condition. The users were not satisfied with the public secondary building condition and environment, while small proportion indicated that they were

satisfied and some were neither satisfied nor dissatisfied with the school buildings condition and the adopted maintenance strategies.

The results of the responses in the questionnaires were in most cases in conformity with the results of the physical investigation of the public secondary school buildings. The study observed that in a majority of the public secondary schools, there was pile up waste in the school compound space, inadequacy of public secondary buildings in the school compound, the ease of movement in and out of the buildings area, and the ease of movement through the lobby of the buildings. Daily cleaning and maintenance of the public secondary school compounds was observed mostly on the light cleaning of the buildings. The deep cleaning was seemed to be abandoned and unattractiveness in the schools. There was an indication that the office of a school Principal or Vice-Principal may be too engaged to combine with the monitoring of building deterioration. Moreover, any of them can be transferred to another school at anytime; therefore a maintenance officer will be more effective in the Public Secondary Schools maintenance

CHAPTER SIX

MULTIPLE REGRESSION ANALYSIS TOWARDS MODEL DEVELOPMENTS IN THE STUDY

6.1 Introduction

Following the analysis presented in Chapter Five, this Chapter addressed the development of the multivariate analysis using multiple regression analysis to develop maintenance models in order to address the fifth objective. The essence of multiple regression analysis in this study was to assess the relationship between some dependent variables and several independent variables. The end result of multiple regressions was the development of a regression equation. Standard multiple regressions (forced entry) were applied to ascertain the size of the overall relationship between the dependent variable and the independent variables as well as determine how much each independent (predictor) variable uniquely contributes to that relationship.

In a standard multiple regression, all predictor variables are entered into the regression equation at once which is described as forced entry. After which the significant level would are displayed on the co-efficient table. In the stepwise regression method, not all independent (predictor) variables in the forced entry method ended up

in the equation. The independent variable with maximum of 0.05 significant levels would be selected and used for stepwise entry method.

In this study, stepwise multiple regressions were used to answer a different question. The focus of stepwise regression was to investigate the best combination of independent (predictor) variables in predicting the dependent (predicted) variable. In a stepwise regression, predictor variables are entered into the regression equation based on the significance level following the Beta value in the model. Some stepwise multiple regressions methods were applied in this study with a view to investigating individual influences of independent variables on the dependent variables. Stepwise method were carried out based on the ability to explain variation in the dependent variable, the ability is indicated in their beta value column of the coefficient tables. At each step in the analysis the predictor variable that contributes the most to the prediction equation. Four different regression analyses were carried out using the following as dependent variable:

(1) Maintenance Strategy

(2) Physical condition of building

(3) Length of Stay of the maintenance Managers

(4) Maintenance Planning

6.2 Regression Model (1) Development (Forced Entry) Condition of Building Component

Generally speaking, multiple regression offers the opportunity to establish the evidence that one or more explanatory variables (independent variables, X1,X2….X) cause another dependent variable Y to change (Blaikie, 2003). Thus, the analysis establishes the relative magnitude of the contribution of each predictor variable.

Furthermore, it offers the opportunity to examine what proportion of the variance in the outcome variable is explained by each predictor variable and/or their combined effect (Brace *et al*., 2003).

Table 6.1 presents ten independent variables that were entered using the force entry. The independent variables are: (i) Maintenance fund (ii) Most maintained buildings (iii) Maintenance work without request (iv) Maintenance policy (v) Period to maintain, (vi) Respond to reported disrepair (vii) Improved condition or stagnant in the last five years (ix) Regularity of carrying out maintenance; and (x) type of maintenance planning

Table 6.1: Variables Entered/Removed on Model 1 Development (forced entry)

Model	Variables Entered	Variables Removed	Method
1	Type of maintenance planning, Building maintenance, Maintenance fund, Most maintained buildings, Maintenance work without request, Maintenance policy, Period to maintain, Respond to reported disrepair, Improved condition or stagnant in the last five years, Regularity of carrying out maintenance	None of the independent variables was removed.	Forced Entry

a. Dependent Variable: maintenance strategy

b. All requested variables entered.

However, among the ten predictors, only two predictors are significant in explaining the dependent variable (maintenance strategy). The two independent variables are: period to maintain; and maintenance work without request. The details are as presented in Table 6.2.

Table 6. 2: Coefficients on Model 1 Development (forced entry)

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Correlations		
		B	Std. Error	Beta			Zero-order	Partial	Part
1	(Constant)	2.032	.599		3.392	.002			
	Maintenance fund	.059	.053	.180	1.121	.273	.077	.219	.148
	Maintenance policy	.310	.132	.346	2.345	.027	.299	.425	.309
	Period to maintain	-.212	.049	-.783	-4.307	.000	-.442	-.653	-.567
	Regularity of carrying out maintenance	-.136	.096	-.349	-1.412	.170	.091	-.272	-.186
	Maintenance work without request	-.428	.194	-.318	-2.209	.037	-.135	-.404	-.291
	Improved condition or stagnant in the last five years	.044	.047	.181	.939	.357	.129	.185	.124
	Most maintained buildings	.113	.057	.311	1.984	.058	.134	.369	.261
	Respond to reported disrepair	-.025	.062	-.063	-.407	.687	-.107	-.081	-.054
	Building maintenance	.019	.072	.040	.259	.798	.202	.052	.034
	Type of maintenance planning	.034	.050	.110	.671	.508	.112	.133	.088

a. Dependent Variable: Maintenance Strategy

Furthermore, from the forced entry, a model summary was generated showing the residual R =.752 and R^2=56.6 %. The yielded model is presented in Table 6.3 while Table 6.4 presents the ANOVA .

Table 6.3: Model 1 Summary Development (forced entry)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.752[a]	.566	.393	.29455	.566	3.263	10	25	.008

a. Predictors: (Constant), Type of maintenance planning, Buildings properly maintained , Maintenance fund, Most maintained buildings, Maintenance work without request, Maintenance policy, Period to maintain, Respond to reported disrepair, Improved condition or stagnant in the last five years, Regularity of carrying out maintenance.

Table 6.4: ANOVA Summary of Forced Entry Model 1

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	2.831	10	.283	3.263	.008[b]
	Residual	2.169	25	.087		
	Total	5.000	35			

a. Dependent Variable: Maintenance Strategy

b. Predictors: (Constant), Type of maintenance planning, Buildings properly maintained , Maintenance fund, Most maintained buildings, Maintenance work without request, Maintenance policy, Period to maintain, Respond to reported disrepair, Improved condition or stagnant in the last five years, Regularity of carrying out maintenance

6.2.1 Model (1) Development using Stepwise Method

Having arrived at a model that shows that there is a relationship between the dependent variable and some independent variables in the forced entry, a further test was carried out using stepwise regression method. The stepwise selection ensures that the regression ends up with the smallest possible set of predictor variables in the final model. Thus, a key advantage of using stepwise is that it results in the most

parsimonious model (Walliman, 2001; Brace *et. al.*, 2003). Regression Model (1) was developed, using stepwise regression method for maintenance strategy.

Table 6. 5: Variables Entered/Removed on Model 1 Development (Stepwise Entry)

Model	Variables Entered	Variables Removed	Method
1	Period to maintain	None of the two independent variables	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	Maintenance policy	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: Maintenance Strategy(MTSTR)

Stepwise multiple regression analysis was conducted to predict the maintenance strategy. The Period to Maintain and Maintenance Policy entered into the regression model and they were both significantly related to maintenance strategy with F change =4.919, p = 0.034. R is .547. The co-efficient was moderately high and also showed the relationship between dependent variable and all the independent variables that were tested. R Square shows the co-efficient of determination to be 30%. How much of the variability is explained by the independent variable with significant F change = 0.05. The model in Table 6.6 shows that all independent variables collectively have impact upon the dependent variable (i.e. maintenance strategy).

Table 6.6: Model 1 Summary Development (Stepwise Entry)Model

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.442[a]	.195	.172	.34401	.195	8.251	1	34	.007
2	.547[b]	.300	.257	.32575	.104	4.919	1	33	.034

a. Predictors: (Constant), Period to maintain

b. Predictors: (Constant), Period to maintain, Maintenance policy

ANOVA of the dependent variable is presented in Table 6.7. This shows that regression variability as explained by the dependent variable is 0.003. Independent variable PERMIT and MTPOL collectively affected the dependent variable MTSTRA significantly.

Table 6.7: ANOVA Summary of Maintenance Strategy Model 1(Stepwise Entry)

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	.976	1	.976	8.251	.007[b]
	Residual	4.024	34	.118		
	Total	5.000	35			
2	Regression	1.498	2	.749	7.060	.003[c]
	Residual	3.502	33	.106		
	Total	5.000	35			

a. Dependent Variable: Availability of maintenance strategy

b. Predictors: (Constant), Period to maintain

c. Predictors: (Constant), Period to maintain, Maintenance policy

Table 6. 8: Coefficients on Model 1 Development (stepwise entry)

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Correlations		
		B	Std. Error	Beta			Zero-order	Partial	Part
1	(Constant)	2.029	.089		22.773	.000			
	Period to maintain	-.120	.042	-.442	-2.872	.007	-.442	-.442	-.442
2	(Constant)	1.521	.244		6.234	.000			
	Period to maintain	-.124	.039	-.459	-3.149	.003	-.442	-.481	-.459
	Maintenance policy	2.290	.131	.324	2.218	.034	.299	.360	.323

a. Dependent Variable: Availability of maintenance strategy

Derivation of Maintenance Strategy Model (1)

It was important to establish that Table 6.8 is showing the Regression coefficient from which the model equation was derived. The equation of best fit is

Y= Maintenance Strategy

$Y= \beta_{0+} \beta_1 X_1 + \beta_2 X_2$ ---------- (1)

$Y= 2.029 - 0.124 X_1 + .290 X_2$

6.3 Regression Model (2) Development (Forced Entry) Physical Condition of School Buildings

Another multiple linear regression analysis was carried out to establish the relationships between dependent variable Physical Condition of school buildings and seventeen predictor variables using forced entry regression method. The forced entry method was used in order to explore the relationship between the dependent variable and the predictors, no variable was removed. Table 6.9 present the independent variables.

Table 6.9: Variables Entered/Removed on Model 2 Development (forced entry)

Model	Variables Entered	Variables Removed	Method
1	Condition of gutters/ Pipes, Condition of WC, Most deteriorated building, Maintenance crew, Effect of current states of building on behaviour of users, Condition of roof, Source of water supply, school cleanliness, Condition of windows, Condition of foundation, Condition of Floor screed, Condition of water pipes, Condition of walls, Condition of Electrical installations, Condition of Painting, Condition of Toilet facility, Condition of doors	None of the independent variables was removed.	Forced Entry

a. Dependent Variable: Physical condition of school buildings
b. All requested variables entered.

From the forced entry method, Table 6.10 was generated showing the ANOVA. Additionally, a model was also derived from the model and it is presented in Table 6.11 from which regression variability was explained by the dependent variable with significant value of 0.000. This indicates that all the independent variables collectively affected the dependent variable significantly.

Table 6.10: ANOVA Summary of Model 2 Physical condition (Forced Entry)

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	16.697	17	.982	5.028	.000[b]
	Residual	52.936	271	.195		
	Total	69.633	288			

a. Dependent Variable: Physical Condition of School Buildings

b. Predictors: (Constant), Condition of gutters/ Pipes, Condition of WC, Most deteriorated building, maintenance crew, Effect of current states of building on behaviour of users, Condition of roof, Source of water supply, school cleanliness, Condition of windows, Condition of foundation, Condition of Floor screed, Condition of water pipes, Condition of walls, Condition of Electrical installations, Condition of Painting, Type of toilet facility, Conditions of doors.

Table 6.11: Model 2 Summary Development (Forced Entry)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.490[a]	.240	.192	.44197	.240	5.028	17	271	.000

a. Predictors: (Constant), Condition of gutters/ Pipes, what is the condition of WC, Most deteriorated, maintenance crew, Effect of current states of building on behaviour of users, Condition of roof, Source of water supply, school cleanliness, Condition of windows, Condition of foundation, Condition of Floor screed, Condition of water pipes, Condition of walls, Condition of Electrical installations, Condition of Painting, Type of toilet facility, Conditions of doors

The dependent variable- Physical Condition of School Buildings has high correlation coefficient with some independent variables from the forced entry method. The result as presented in Table 6.12 reveals the coefficient values. Out of the selected seventeen independent variables, six were significantly related to the dependent variable; and were further used in stepwise entry method**.**

Table 6.12: Coefficients on Model 2 Development (Forced Entry Method)

Model				Df	Sig. F Change			
	B	Std. Error	Beta			Zero-order	Partial	Part
(Constant)	1.440	.227		6.355	.000			
maintenance crew	.303	.062	.277	4.903	.000	.325	.285	.260
Most deteriorated building	.013	.029	.024	.445	.657	.103	.027	.024
Effect of current states of building on behaviour of users	-.020	.038	-.029	-.528	.598	-.086	-.032	-.028
school cleanliness	.023	.026	.052	.880	.380	.027	.053	.047
Condition of foundation	-.002	.028	-.004	-.076	.939	-.096	-.005	-.004
Condition of roof	.008	.025	.020	.338	.736	-.086	.021	.018
Condition of Painting	-.088	.038	-.145	-2.328	.021	-.247	-.140	-.123
1 Condition of Floor screed	.081	.038	.132	2.146	.033	-.037	.129	.114
Condition of walls	-.081	.027	-.183	-3.020	.003	-.253	-.180	-.160
Condition of windows	.019	.042	.031	.441	.659	-.126	.027	.023
Conditions of doors	-.101	.043	-.175	-2.365	.019	-.190	-.142	-.125
Condition of Electrical installations	-.018	.030	-.037	-.605	.546	-.110	-.037	-.032
Condition of water pipes	.007	.023	.018	.299	.765	-.066	.018	.016
Type of toilet facility	.064	.045	.089	1.412	.159	.060	.085	.075
Condition of WC	-.006	.019	-.021	-.328	.743	.048	-.020	-.017
Source of water supply	-.096	.030	-.179	-3.158	.002	-.178	-.188	-.167
Condition of gutters/ Pipes	.012	.032	.022	.380	.704	-.030	.023	.020

Furthermore, multiple regression analysis was again applied with stepwise method to establish the relationship between the dependent variable and six other variables that were related in the forced entry. The essence of this was to investigate the strongest among the six variables and to generate equation of best value. The result in Table

6.13 shows that four independent variables were retained from the six that were entered. They are WALLCO, DOORCO, SCHCLEAN and MTCREW.

Table 6.13: Variables Entered/Removed on Model 2 Development (Stepwise)

Model	Variables Entered	Variables Removed	Method
1	school cleanliness	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	Maintenance crew		Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
3	Conditions of doors	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
4	Condition of walls	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: Physical Condition of School Buildings

Table 6.14 shows the summary of the second model. The multiple correlation coefficient 'r' is about 50%. This indicates that there is a strong and positive relationship between the physical condition of school buildings and some independent variables (maintenance crew, conditions of doors, condition of walls and school cleanliness). The coefficient '$r^{2'}$ is about 25%. This means that the predictor variables can give 25% explanation for residual variation in the physical condition of school buildings (dependent variable). However other changes may be as a result of chance which may not be determined or measured.

Table 6.14: Model 2 Summary Development (Stepwise)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.397[a]	.157	.155	.45286	.157	56.197	1	301	.000
2	.441[b]	.195	.189	.44341	.037	13.968	1	300	.000
3	.479[c]	.229	.222	.43451	.035	13.417	1	299	.000
4	.499[d]	.249	.239	.42952	.020	7.980	1	298	.005

a. Predictors: (Constant), condition
b. Predictors: (Constant), school cleanliness , maintenance crew
c. Predictors: (Constant), school cleanliness , maintenance crew, Conditions of doors

d. Predictors: (Constant), school cleanliness, maintenance crew, Conditions of doors, Condition of walls

Table 6.15: ANOVA Summary of Model 2 Physical condition (Stepwise)

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	11.525	1	11.525	56.197	.000[b]
	Residual	61.729	301	.205		
	Total	73.254	302			
2	Regression	14.271	2	7.136	36.293	.000[c]
	Residual	58.983	300	.197		
	Total	73.254	302			
3	Regression	16.804	3	5.601	29.669	.000[d]
	Residual	56.450	299	.189		
	Total	73.254	302			
4	Regression	18.276	4	4.569	24.766	.000[e]
	Residual	54.978	298	.184		
	Total	73.254	302			

Dependent Variable: Physical Condition of School Buildings

a. Predictors: (Constant), school cleanliness

b. Predictors: (Constant), school cleanliness, maintenance crew

c. Predictors: (Constant), school cleanliness, maintenance crew, conditions of doors

d. Predictors: (Constant), school cleanliness, maintenance crew, conditions of doors, condition of walls

Table 6.16: Coefficients on Model 2 Development (Stepwise Method)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.928	.092		10.080	.000
	school cleanliness	.384	.051	.397	7.496	.000
2	(Constant)	.661	.115		5.742	.000
	school cleanliness	.311	.054	.321	5.780	.000
	maintenance crew	.228	.061	.208	3.737	.000
3	(Constant)	.865	.126		6.876	.000
	school cleanliness	.304	.053	.314	5.760	.000
	maintenance crew	.229	.060	.209	3.828	.000
	Conditions of doors	-.108	.029	-.186	-3.663	.000
4	(Constant)	1.090	.148		7.380	.000
	school cleanliness	.275	.053	.284	5.168	.000
	maintenance crew	.205	.060	.187	3.434	.001
	Conditions of doors	-.100	.029	-.173	-3.426	.001
	Condition of walls	-.065	.023	-.149	-2.825	.005

a. Dependent Variable: Dependent Variable: Physical Condition of School Buildings

Derivation of Physical Condition of School Buildings Equation (2)

It was important to establish that Table 6.16 is showing the Regression coefficient from which the model equation was derived. The equation of best fit is

Y= Physical Condition of School Buildings

$Y= \beta_{0+} \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4$ ---------- (2)

$Y= 1.090 + 0.275 X_1 + .205 X_2 - 0.100 X_3 - .065 X_4$

6.4 Regression Model (3) Development (Forced Entry) Length of Stay

A standard multiple regression analysis was conducted to evaluate the predicted length of stay of the maintenance managers. The variables in the model include response to reported disrepair, maintenance work without request, maintenance fund, regular inspection by school head for maintenance needs, buildings properly maintained and age of school. The linear combination of the predictors was significantly related to the length of stay of the school maintenance managers, F (6) = 4.183 p < .001. The coefficient of determination R^2 is indicating that approximately 46% of the variance of the length of stay of the maintenance manager can be accounted for by the linear combination of the predictors.

Table 6.17: Forced Entry for length of stay Variables Entered/Removed

Model	Variables Entered	Variables Removed	Method
1	Respond to reported disrepair, Maintenance work without request, Maintenance fund, Regular inspection by school head for maintenance needs, Buildings properly maintained , Age of school	.	Enter

a. Dependent Variable: Length of Stay
b. All requested variables entered.

Table 6.18: Model (3) Summary of length of Stay Forced Entry Method

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.681[a]	.464	.353	.58169	.464	4.183	6	29	.004

a. Predictors: (Constant), Respond to reported disrepair, Maintenance work without request, Maintenance fund, Regular inspection by school head for maintenance needs, Buildings properly maintained , Age of school

Table 6.19: Regression Coefficients Model (3) Forced Entry Method

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.348	.834		1.617	.117
	Age of school	.225	.091	.458	2.473	.019
	Maintenance fund	-.007	.105	-.012	-.070	.945
	Maintenance work without request	.651	.381	.252	1.707	.099
	Regular inspection by school head for maintenance needs	.250	.064	.563	3.923	.000
	Buildings properly maintained	.023	.132	.026	.175	.862
	Respond to reported disrepair	-.286	.125	-.373	-2.287	.030

a. Dependent Variable: Length of Stay

6.4.1 Regression Model (3) using stepwise regression method for Length of Stay

Stepwise multiple regressions were conducted to evaluate whether respond to reported disrepair, regular inspection by school head for maintenance needs and age of school has an effect on the length of stay. Respond to Reported Disrepair and Age of School did not enter into the equation at step 1 and 2 respectively. At step 3 of the stepwise method, regular inspection by school head for maintenance needs entered into the regression equation and was significantly related to length of stay $F(1) = 11.064$, $p < .005$. The coefficients of determination R^2 was .245, indicating approximately 25% regular inspection by school head for maintenance needs accounted for the length of stay of the maintenance managers.

Table 6.20 Model (3) Summary of length of Stay (Stepwise Method)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.495[a]	.245	.322	.63735	.642	11.064	1	34	.002

a. Predictors: (Constant), Regular inspection by school head for maintenance needs

Table 6.21: Regression Coefficient Model (3) Stepwise Method

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.572	.260		6.051	.000
	Regular inspection by school head for maintenance needs	.220	.066	.495	3.326	.002

a. Dependent Variable: Length of Stay

The regression equation for predicting length of stay:

$Y= \beta_{0+} \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3$ ----------(3)

Length of stay = 1.348 -0.225 x age of school + 0.250 x regular inspection -0.286x respond to reported disrepair----------(3)

Therefore the above model (3) equation is

$Y= \beta_{0+} \beta_1 X_1$ ---------- (3)

$\hat{Y}= 1.572 -0.220x X_1$ ---------- (3)

$\hat{Y}$= 1.572-0.220x (Regular inspection by school head for maintenance needs) ------(3)

$\hat{Y}$= 1.572- 0.220x3.5294 ----------(3)

$\hat{Y}$= 1.572-0.220x3.5294

$\hat{Y}$= 1.572-0.776468

$\hat{Y}$= 0.795232

Model (3) estimate, $\hat{Y}$=0.795232 while actual observed Y= 1.2941

- This means that the error term is 0.24886928, which explains the deviation of Y from the regression model ($\hat{Y}$)
- Model (3) shows that length of the maintenance managers in all the Public Secondary Schools in Ado-Odo/Ota is in good condition prolonging their length of stay will reduce regular inspection by school head for maintenance needs.

6.5 Development of Forced Entry model (4) Variable: Maintenance Planning of Public Secondary School Buildings

Another multiple linear regression analysis was carried out to establish relationships between dependent variable maintenance planning of public secondary school buildings and another seven predictor variables using forced entry regression method. The forced entry method was used in other to detect the strongest variables among the predictors. The result is as follows;

- The three predictor variables are significant.
- The multiple correlation coefficient 'r' is 0. 813. This indicates that there is a strong and positive relationship between maintenance planning (dependent variable) and the predictor variables.
- The coefficient of determination 'r^{2}' is 0.661. This means that the predictor variables can give 66.1% explanation for residual variation in factors responsible for the present condition of maintenance planning (dependent variable). However other changes may be as a result of chance which may not be determined or measured.
- Therefore, the Table 6.22 shows the emerging model (4) from the regression coefficient estimate.

Table 6.22: Variables Entered/Removed Model (4) Development (Forced Entry) for maintenance planning

Model	Variables Entered	Variables Removed	Method
1	Period to maintain, Maintenance policy, Age of school, Maintenance manual, Lack of Maintenance Culture, Lack/ insufficient funding from Government, maintenance frequency	.	Enter

a. Dependent Variable: maintenance planning

6.4.1 Development of Stepwise Method for Model (4)

Again, multiple regressions were applied with stepwise method to establish the relationship between the significant dependent variable and those who were related in the force entry. The essence of this was to investigate the strongest among them and to generate equation of best value. The result is as follows:

- The regression coefficient table revealed that the only three predictor variables are significant.
- The multiple correlation coefficient 'r' is 0. 712. This indicates that there is strong and positive relationship between physical condition of buildings (dependent variable) and the predictor variables.
- The coefficient '$r^{2'}$ is 0.507. This means that the predictor variables can give 50.7% explanation for residual variation in factors responsible for deterioration (dependent variable). However other changes may be as a result of chance which may not be determined or measured.
- The degree of freedom F ratio is 1=5.211
- Therefore, from the Table 6.19 below the emerging model (4) is derived. Using the regression coefficient estimate and mean values in the Appendix.

Table 6.23: Variables Entered / Removed Model (3) Development (stepwise method) for Maintenance Planning

Model	Variables Entered	Variables Removed	Method
1	Maintenance frequency	.	Stepwise (Criteria: Probability-of-F-to-enter <= .490, Probability-of-F-to-remove >= .500).
2	Maintenance policy	.	Stepwise (Criteria: Probability-of-F-to-enter <= .490, Probability-of-F-to-remove >= .500).
3	Age of school	.	Stepwise (Criteria: Probability-of-F-to-enter <= .490, Probability-of-F-to-remove >= .500).

a. Dependent Variable: Physical condition of school buildings

Table 6.24: Model (3) Summary (stepwise method) for Physical condition of school buildings

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.555[a]	.308	.288	.61030	.308	15.147	1	34	.000
2	.653[b]	.427	.392	.56378	.119	6.843	1	33	.013
3	.712[c]	.507	.461	.53092	.080	5.211	1	32	.029

a. Predictors: (Constant), Regularity of carrying out maintenance
b. Predictors: (Constant), Regularity of carrying out maintenance, Maintenance policy
c. Predictors: (Constant), Regularity of carrying out maintenance, Maintenance policy, Age of school

Table 6.25: Regression Coefficient Model (3) Development (stepwise) for Physical Condition of School Buildings

Model		CODE	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
			B	Std. Error	Beta		
1	(Constant)		.695	.440		1.580	.123
	Regularity of carrying out maintenance		.414	.106	.555	3.892	.000
2	(Constant)		2.068	.664		3.115	.004
	Regularity of carrying out maintenance		.343	.102	.461	3.374	.002
	Maintenance policy		-.613	.234	-.357	-2.616	.013
3	(Constant)	β_0	1.775	.638		2.782	.009
	Regularity of carrying out maintenance	X_1	.331	.096	.445	3.452	.002
	Maintenance policy	X_2	-.633	.221	-.369	-2.865	.007
	Age of school	X_3	.140	.061	.284	2.283	.029

a. Dependent Variable: Physical condition of building

Therefore the above model (3) equation is

$Y = \beta_{0+} \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \text{ł}$---------- (3)

$\hat{Y} = 1.775 + 0.331x\ X_1 - .633x\ X_2 + 0.140x X_3$ ---------- (3)

$\hat{Y}$= 1.775 + 0.331x Frequency of maintenance-.633x Maintenance policy + 0.140x Age of school ---------- (3)

$\hat{Y} = 1.775 + 0.331x\ 4.000 - .633x\ 1.7647 + 0.140x\ 2.6471$---------- (3)

$\hat{Y} = 1.775 + 1.324 - 1.1171 + 0.3701$----------(3)

$\hat{Y} = 2.72209$

Model (3) estimate, $\hat{Y} = 2.72209$ while actual observed Y= 2.3611

- The model (3) shows that Physical condition of school buildings of most Public Secondary Schools in Ado-Odo/Ota are in poor condition.

6.5 Maintenance Planning model (4) Development Using Forced Entry

A multiple regression analysis was conducted to evaluate the relationship between the predicted maintenance planning and maintenance support by stakeholders, inadequate training of the personnel , age of school, maintenance policy, period to maintain, maintenance time, lack/ insufficient funding from government, maintenance fund, frequency of maintenance using forced entry. The force entry method was applied in other to detect the relationship between the dependent and independent variables. The result shows that maintenance strategy was significantly related to five out of the investigated eleven independent variables. They are: maintenance fund; Regularity of carrying out maintenance; Maintenance policy; Period to maintain, Lack/ insufficient funding from government; and Inadequate training of the personnel $F(9) = 3.724$ $p < .001$. The coefficient determination r^2 was .563, indicating that approximately 56.3% of the variance of the maintenance strategy can be explained by the predictor variables.

Table 6.26: Variables Entered/Removed Model (4) Development (Forced Entry) for Maintenance Planning

Model	Variables Entered	Variables Removed	Method
1	Maintenance support by stakeholders, Inadequate training of the personnel , Age of school, Maintenance policy, Period to maintain, Maintenance time, Lack/ insufficient funding from Government, Maintenance fund, Frequency of maintenance	.	Enter

a. Dependent Variable: Maintenance Planning
b. All requested variables entered.

Table 6.27: Regression Coefficient Model (4) Development (Forced Entry)

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.603	.647		4.024	.000
	Age of school	-.070	.043	-.273	-1.637	.114
	Maintenance fund	.132	.059	.401	2.249	.033
	Maintenance policy	.302	.149	.336	2.018	.054
	Regularity of carrying out maintenance	-.246	.092	-.631	-2.681	.013
	Period to maintain	-.195	.049	-.721	-3.970	.001
	Lack/ insufficient funding from Government	-.187	.083	-.360	-2.243	.034
	Inadequate training of the personnel	.153	.055	.494	2.789	.010
	Maintenance time	-.001	.038	-.002	-.016	.988
	Maintenance support by stakeholders	.067	.053	.189	1.268	.216

a. Dependent Variable: Maintenance Planning
b. Predictors: (Constant), Inadequate training of the personnel , Maintenance fund, Users attitudes and misuse, Maintenance manual, Maintenance monitoring team or committee, Period to maintain, Maintenance training, Role of PTA in maintenance, Users report disrepair in buildings, Maintenance policy, Age of school, Lack/ insufficient funding from Government, frequency of maintenance.

6.5.1 Development of model (4) for Maintenance Strategy Stepwise

A stepwise regression model was further applied to evaluate the relationship between the predicted variable and available maintenance strategy. It became important to detect the relationship between the dependent and independent variables. The result shows that available maintenance strategy was significantly related to maintenance period among five variables that were investigated. $F(1) = 8.251$ $p < .001$. The coefficient determination r^2 was .595, indicating that approximately 60% of the variance of the maintenance strategy can be explained by the predictor variables. Five

predictors were put into the stepwise method of entry to measure the Dependent Variable availability of maintenance strategy. Period to maintain is the closet among all; from step one to four, none of the variables gave any equation.

Table 6.28: Model Summary of Maintenance Strategy Model (4) Development (Stepwise method)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.442[a]	.595	.172	.34401	.595	8.251	1	34	.007

a. Predictors: (Constant), Period to maintain

Table 6.29 Regression Coefficient Model (4) Development (Stepwise method)

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.029	.089		22.773	.000
	Period to maintain	-.120	.042	-.442	-2.872	.007

a. Dépendent Variable: Maintenance planning

Therefore the above model (4) equation is

$Y = \beta_{0+} \beta_1 X_1$ ---------- (4)

$\hat{Y} = 2.029 - 0.120x X_1$ ---------- (4)

$\hat{Y} = 2.029 - 0.120x$ (period to maintain) -------- (4)

$\hat{Y} = 2.029 - 0.120x1.6765$ ----------(4)

$\hat{Y} = 2.029 - 0.20118$

$\hat{Y} = 1.82782$

Model (4) estimate, $\hat{Y}$= 1-82782 while actual observed Y= 1.8235

- This means that there is 0.0000186624 error, which explains the deviation of Y from the regression model ($\hat{Y}$).
- The model (4) shows that in maintenance strategy in all the Public Secondary Schools in Ado-Odo/Ota, there is specific period to maintain in the school buildings, which will bring about changes to the buildings and assist the maintenance managers.
- The implication of the models is that the independent variables identified have a positive relation with all the dependent variables.
- Thus, the adjusted R^2 is useful because its gives an indication of how much of the variance in the performance outcome is accounted for in the population from which the sample was chosen.

6.7 Summary

This study has developed four regression models with their coefficients. The findings suggest that the developed models are statistically valid and have the potential for subsequent development for use by maintenance practitioners. To this effect, a discussion of the convergence of the findings against the background of the theoretical framework adopted is provided to help demonstrate the validity of the conclusions drawn. Subsequently, the chapter ends with an in-depth discussion of the significance of the individual variables identified (in the model) including issues relating to their potential application towards enhancing public secondary school building maintenance.

In developing the regression models, the aim was to try and maximise the measurement of the adjusted R^2 which is a measure of good-fitness. As already pointed out in the previous section, the adjusted R^2 for the four models are 30%,

24.9%, 24.5% and 59.5%, (model 1-4) is appreciably high and this suggests that the models are relatively good models. The regression coefficient model Tables also indicated that the regression equation (i.e. equation 1-5) is significant (i.e. at $p < 0.0005$). These equation parameters are additional indications that the models are of the goodness of fit.

CHAPTER SEVEN

DISCUSSION OF RESULTS AND FINDINGS

7.1 Introduction

In the previous Chapter an attempt was made to develop four models for the maintenance of public secondary school buildings. However, it was discovered that there are a number of dependent variables that could be improved upon by maintenance managers in the prediction of school building conditions. To this end the variables earlier listed were all discussed in relation to the study objectives. The mathematical models developed from this research were also interpreted in line with the application and effect of the predictor variables. Furthermore, policy implication of the predictor variables in each model was used to establish the research findings as well.

7.2 The Present Condition of Public Secondary School Buildings

From a similar study by Olagunju (2012), eight factors were identified to be significant to physical condition of residential buildings in Niger State, Nigeria. The variables are: (i) structural components condition (ii) roof components (iii) toilet facilities (iv) discharge of waste water component (v) exterior wall condition (vi) condition of walkway within the building premises (vii) electrical wire and switches conditions; and (viii) interior walls surface condition.

Findings in this study appear to be consistent in the previous study in identifying all listed variables except for walkway which was not investigated. However, among all the building components of the public secondary school buildings surveyed, painting, walls condition, windows condition, door conditions, roof conditions, foundation conditions and the floor condition had the most maintenance problems. Around 38 % of the floors were and 1% good, this may also be attributed to poor construction and materials and as a result of students dragging furniture on the floors. The condition of the roof was rated 27% poor and only 3.6 % good.

The condition of the secondary school building indicated that majority of the users are stressed when it rains because of the high roof leakage. However, 42.7 % indicated no ceiling with only 19% good. Some walls were as described very poor (8%), poor 22.4%, while only 27.4 in good condition. 18.9% specified of poor windows and 45.9% had no doors. The most prevalent maintenance problems in the buildings were cracks in walls, faded painting, partly broken windows and doors, exposed foundation and leaking roofs affecting, non-existence of toilet and dirty school compounds.

i. Roof Condition of Public Secondary Schools

Leaking roof was most pronounced in the classroom buildings sampled in the study. However 18.6 percent and 18.4 percent of the roofs of public secondary school libraries and laboratories had the same problem. Leaking roofs have resulted in damage of some building elements especially walls. It is a prime source of microbial contamination that affects quality of indoor air, posing emotional trauma and health risks. Lanham (1999) stressed the importance of maintaining the roof to prevent

further damage to building facilities, thus it was unfortunate to see this essential building components in poor condition in the study area.

Flat roof without good storm water drainage channels were identified in the roofs of some public secondary school buildings. This resulted to “ponding”, which not only causes stubborn stains on the walls, but also contributed to the breeding of mosquitoes with the attendant and health issues. Pitched roof without proper connections between the roofing sheets can result in the penetration of rainwater into the roof structures. Frequent cleaning can only be done for those existing buildings to prevent the clogging of water outlets on surfaces. Proper sealants must be used to seal the surrounding frame of the access door to the roof top to avoid penetration of rainwater into interior spaces. Refurbishment can be done on the existing flat roof in order to prolong the life span and eliminate the defects.

Roofs are essential element of buildings, sagging and completely ripped off roof conditions should be replaced in public secondary school buildings. When such roofs are left, they deface the buildings, put stress on the building components and sometimes cause accident within the buildings during heavy rainfall or wind. From the data collected, the roof materials and finishes indicated that the conditions of the roof of the academic buildings in the study area were yet to catch up with the required condition of the modern school buildings. Earthman (1996) reported that poor roof condition could cause rapid deterioration of other systems in buildings. The level of maintenance of the roof still remains crude and shows little or no care, attention should be given to majority of roofs in the public secondary school buildings in the study area for the safety of the users. The consequence of this is that the buildings users may experience some of the ceiling falling off or roof leakage.

ii. Windows and Doors of Public Secondary Schools

The major problems with the wooden members of the public secondary school buildings surveyed are either partly or completely broken down as a result of the rottening due to penetration of water resulting from lack of coating and poorly treated wood. The problem of wooden members was most prevalent in the classrooms in public secondary school buildings.

Furthermore, a major of the windows have their louvers blades removed or broken. Properly designed windows play an important role in achieving energy efficiency, environmental friendliness, users comforts, health and satisfaction; thus and enhancing productivity of the users of the buildings. However, a window should be installed in a building strictly for light and ventilation but in some of the public secondary school buildings, students were seen sitting on the window seals. From the result on window condition, it is evident that the users (students) were not handling the louver blades properly and the maintenance managers were not up to the task in repairing damaged windows.

The conditions of the majority of the doors in the study area were rated fair. Doors of public buildings are always expected to open outwards. Doors should be easy and readily identifiable and this was common in most of the buildings studied. The doors in the schools were expected to be shutting out noise, to shutting out the atmosphere outside and prevent the spread of fire. However, this was not the case in most of the academic buildings sampled. Some were just opening without any barrier; suggesting that some of the doors are really in a deteriorated state.

iii. Gutters/ Drains of the Public Secondary Schools

Most of the public secondary school compounds were without any floor drains. In cases where there were drains, the gradients were not properly done, which makes it difficult to be cleaned or repaired. However, the respondents have tried to fix some parts of the drains and some have been by abandoned which may contribute to breeding of mosquitoes. In most cases the abandonment of drain leads to breakage of connecting pipes and erosion in the public secondary school compound. Therefore, protection of drains in the school compounds is required. In addition, frequent cleaning of water drains should be conducted to ensure a healthy environment.

iv. External Block Wall of the Academic Buildings

A majority of the walls of the public secondary school buildings tend to have cracks due to the splashing of rainwater and some students sitting on the walls. Cracking is the major problem affecting walls with 62% of classroom buildings of public schools having developed cracks. Peel offs and partly broken down walls were the other problems affecting 26.4% and 24.8% of all buildings surveyed. The classrooms had the most of the wall condition issues with 58.5% of buildings developing cracks.

Stain and cracks spoil the appearance of the buildings. The stain defects on the walls can be reduced only through the use of more durable exterior screed and paint instead of normal emulsion paint. Besides, the specifications for the exterior wall must be taken into consideration by using the more durable and long-lasting paint. Painting protects walls as well as serving aesthetic purpose, but as high as 89.8% of all buildings surveyed had problem with painting. The problem of painting is more pronounced in all type of buildings. Where 92.3% of all the buildings surveyed were being dirty, faded, and had no painting.

As observed during the survey, the paints were peeling off and a majority of the walls required repainting. If normal emulsion paint is selected to be used, then probably repainting is needed in every two years intervals. Extending the eaves overhang of the roof can provide more shading to the facade from sunlight and rainwater. Another alternative is to extend the eaves overhang of the roof to provide more shading to the facade from sunlight and rainwater as suggested by Ali *et.al*.(2013).

v. Ventilation and Lighting System in Public Secondary School Buildings

Ventilation and lighting requirements in some of the enclosed spaces sometimes forced the public secondary school buildings users to stay more in the school compounds, during the school hours or not to concentrate during classes. However, more classrooms can be created to reduce the population in the existing classrooms in the Public Secondary Schools.

vi. Ironmongery

It was observed during the field work that a majority of the cabinets in the public secondary school laboratories has a problem of rusting and collapse due to the inappropriate design of spaces and utilization. The wrong selection of the materials and maintenance has contributed to this problem too. The only way to eliminate the frequent deterioration is to have suitable space in the laboratories and library. Besides, the public secondary school maintenance managers should be able to reduce the problem by instructing the students to be more gentle with the cabinets.

vii. Facilities and Services

Sanitation generally refers to the provision of facilities and services for the safe disposal of human urine and fecal matters. It is essential to make provision for good

sanitary services because poor or lack of them, would affect the users health. Table 5.18 presented earlier on revealed that the sanitary services in the schools needed urgent attention. A large proportion of the buildings examined had substandard, inadequate or inconveniently located toilet facilities. Inadequate provision of water and sanitation is one of the three things that increase the transmission of airborne infections and increases the risk of accidents within a building as explained by Ekop (2012).

The existing situation of water supply in the study area does not really guarantee adequate and quality water supply to the Public Secondary Schools in Ado-Odo/Ota. Therefore, the people are at greater risk of getting acute water borne diseases. The findings of the current study reconfirm the works of Olanrewaju and Akinbamijo (2002) in which they reported that environment has great and obvious effects on the health of the inhabitants. If findings of the current study are anything to go by, the condition of the schools may have adverse effect on the teaching and learning of the staff and students in public secondary schools in the study area.

7.6 The Current Level of Maintenance and Condition of buildings in Public secondary school Buildings

The study has established that most of the Public Secondary Schools surveyed have some basic buildings necessary to run a school in terms of classrooms, library, laboratories, offices staff rooms school hall, sick bay/first aid, toilet facilities, snack shop among other key facilities. However, a majority of public secondary school buildings surveyed were old (75.1%), with only 15.6% and 9.4% being classified as recent and middle aged buildings, respectively. In the case of library, 85.7% were old and small when compared with the school population and 14.3% of the buildings were

big, younger and middle-aged. A school in Ota was identified as having the best library in the study area. In most schools there were more classrooms than other buildings. In fact, around 83.4% of the total buildings surveyed were classrooms, showing that majority of the buildings in the Public Secondary Schools are used as classrooms.

Generally, condition of infrastructural facilities (toilets, water, pluming, drainage and electricity) in public buildings was poor. However, some of the infrastructural facilities are below acceptable standards and in few cases not existent. The study found that 14% of Public Secondary Schools lacked sanitary facilities; and hence open defecation in nearby bush appeared to be the only alternative for students in the schools. It was also discovered that 58.3% of the schools do not provide water closets for the students' but provided pit latrines and other unconventional options. Although storm water drains are crucial for environmental control and protection, most of the institutions (55.6%) lack this important infrastructure, exposing such premises to the devastating effects of erosion and flooding. Although a majority of the schools (55.6%) have portable water supply, this figure should be improved to cover all the schools the study area in line with best practices. The study also revealed that around 59% of the respondents agreed that the existing infrastructure have not been properly maintained. A majority (34.9%) of the schools are between the age of 31-40years, while 33.9% of the Public Secondary Schools are less than 20 years old but the conditions of the infrastructure in a deplorable state. It was however observed that some of the older schools have better maintained and functional infrastructure. Notable state of the electrical installations was rather fair in 24.35% of the schools sampled in the study.

The first predictor/independent variable in the model which is the condition of wall was found to be highly correlated with the dependent variable condition of building component (appendix V). The variable WALLCO (Condition of walls) correlated with the dependent variable condition of building components. The estimated regression coefficient also shows that PAINTCO was an important variable affecting the opinion of the users. The coefficient indicates that opinion of the users will increase by 57% when WALLCO is improved upon and 72% when PAINTCO is improved upon given that the effect of other variables remains.

Building walls are important building component that can be used to improve the aesthetic and the opinion of the building users about the maintenance condition of the school buildings. Furthermore, another model was also developed to investigate the relationship between the physical condition and some predictors. Three predictors were found to be significant to the dependent variable; they are: frequency of maintenance, maintenance policy, age of school buildings. The first predictor variable in the model is regularity of maintenance. This shows a strong association between the two variables. The regression coefficient indicated 100% increase in regularity of carrying out maintenance will induce 30.8% in physical condition of the buildings. It also indicates that 100% increase in regularity of maintenance and maintenance policy will induce 42.7% improvement in the physical condition of the buildings. Lastly, 50.7% improvement would be attained if 100% improvement is put into regularity of carrying out maintenance, maintenance policy and school building age given that the effect of other variables remain constant. The lack of the documentation of Public Secondary Schools building age is a major deficiency that should be addressed. If the building age is documented, it will be reflected on the physical condition of school buildings because each component has its own life span.

7.7 The Factors Responsible for the Present State of the Maintenance of Public School Buildings

From the analysis, the maintenance managers and public secondary school buildings users are in agreement that insufficient fund for public secondary school building maintenance is a dominant factor among others responsible for poor maintenance management of secondary school buildings. The maintenance managers rated the attitude of users and misuse of facilities as the most significant factor responsible for poor maintenance management of public secondary buildings. The problem of poor maintenance culture has been widely recognized in Nigeria (Mbamali, 2003; Adejimi, 2005; Usman *et al*., 2012). The lack of maintenance culture was also attributed to lack of maintenance policy in Nigeria by Waziri and Vanduhe (2013). The lack of maintenance culture reduces the life of buildings before the obsolescence state.

On the contrary, the users, rated inflation of cost of maintenance and the use of poor quality materials by the maintenance managers as the most significant factor responsible for poor maintenance management of Public Secondary Schools. In all, nineteen deterioration factors were considered in this work, eleven were found to be the most significant factors, while five significant and two less significant. The most ranked factors has a mean value 4.5833 which indicates that most significant while the variable with the least rating is school location and it is having 1.1111 as the mean value.

From the study, the deterioration conditions of Public Secondary Schools in Ado-Odo/Ota, Ogun State is affected by the listed factors. In the order of their contributions, the factors are as follows:

(i) Absence of Maintenance Body and policy (METBODY): There was no maintenance body and policy in place in the Public Secondary Schools sampled. This can be linked to the absence of effective national maintenance policy, laws and regulations to compel both maintenance managers of public schools and users to undertake maintenance activities or be sanctioned for failure to do so. This view is consistent with Zubairu (1998) who stated that the country does not have a maintenance policy which has resulted in the persistent problems of building maintenance.

(ii) Over Population of the students in the classrooms (POPULA): It is obvious from the study that the population of the students in the classroom was more than the carry capacity of the classrooms. For instance, it was observed that a classroom designed for sixty students was occupied by one hundred and twenty students. This obviously has adverse implication for the loads on the buildings and rate of deterioration of the elements.

(iii) Lack/ insufficient funding from Government (SCHFUND): Another impediment to maintenance of public secondary school buildings was funding. The lack of fund, inadequate funds and delays in the release of funds contributed significantly to the present condition of public secondary school buildings in the study area.

(iv) Non response to maintenance request (NORESP): Some disrepair works could be avoided if there is quick response to deterioration by the maintenance managers. In most cases, some components were abandoned and allowed to deteriorate for a while before they gain maintenance attention.

(v) No provision for the replacement of building materials (NOREPL): This has been worsened by the high cost of building materials, new constructions often receives

more attention than the existing buildings that calls for maintenance. After building completion, there is no provision put in place for maintenance in the future.

(vi) Non-involvement of experts in maintenance work (LACKEP): Most renovation work was found to be carried out by inexperienced persons who are not professionals. Sometimes their charges were found to be cheaper than the professionals'. Consequently, jobs of higher amounts are given out in form of maintenance contracts to mostly unqualified maintenance contractors as explained by Kunya (2007).

(vii) The lack of maintenance plan for the school (METPLAN): There was also high deterioration on school building because of a lack of maintenance schedule and plan. Even for those that claimed to be having it was observed that they do not apply them properly.

(viii) The lack of skilled maintenance persons in construction (MATPERS): The maintenance condition seems to be worst in the schools because unskilled person were used instead of skilled labour in carrying out maintenance activities. Sometimes, the students were instructed to carry out some construction and renovation work with the school premises.

(ix) The lack of maintenance culture (MATCUL): There is generally a lack of maintenance culture on the part of both the government and maintenance managers, thus resulting in deferred maintenance of school buildings. The result is in line with Kunya's *et. al.* (2007) observation that there is apparent lack of maintenance culture in Nigeria. However, emphasis is placed on the construction of new buildings for public sector and neglecting the aspect of maintenance which commences immediately the builder leaves the site. This situation is also evident in the lack of preventive

maintenance plan for public secondary school buildings. However, the users' also exhibited apathy towards the maintenance of public school buildings.

(x) Users attitudes and misuse (UATITUD): Buildings deteriorate because of the users' attitude. Some drag furniture, break louvers, and throw stones at the ceilings. Eventually such students are sometimes not compelled to replace those components. For this reason, the students continue to act in such manner.

(xi) Inadequate training of the personnel (LACKTRA): Buildings and infrastructural decay can stems from poor workmanship and poor supervision (Amobi 2003). School buildings are deteriorating because the maintenance managers do not have any training in building design, construction and management. They seem not to know which maintenance tool to apply to the school buildings. Maintenance decisions and building management are taken at the management level of the individual Principal.

(xii) Pressure on School compound due to number of User (SCHCOMP): The schools premises have not receive the greatest attention from the maintenance managers. The reason for this is the high population, lack of through controlled of students activities..

(xiii) Low quality of building materials (BULDMAT): Some of the school buildings were constructed with the use of inferior materials.

(xiv) The buildings are deteriorating because of Age (SCHAG): The building age sometimes do have influence on academic achievement of students. The modern buildings were preferred over older buildings by the students because poor maintenance of older buildings in the schools.

(xv) The buildings were not properly designed (SCHD): The findings in this study did not agree with Adejimi (2005) view that most maintenance problems can be attributed

to poor design. The influence of building design was found not to have much influence on the deterioration condition of buildings in the school investigated.

(xvi) The buildings were not properly supervised during Construction (SCHC): Buildings require properly planning, designing and constructed. The factors to be observed in building construction include durability, adequate stability to prevent its failure or discomfort to the users, resistance to weather, fire outbreak and other forms of accidents. Some of the Public Secondary Schools are in their present condition and cannot be relied upon to fulfill its principal functions because they lacked adequate supervision during the construction.

(xvii) Inflation on materials by the maintenance staff (INPRIC): Some of the public secondary school buildings are aged due to wear and tear, weathering and climatic factors over the years thus resulting in dilapidated nature. In the cause of repairing some of the aforementioned, the maintenance managers or contractors inflate the prices of the required materials.

(xviii) Poor Environmental Condition (SCHENV): The lack of maintenance of these school buildings negatively affects the users' in their teaching and learning. The working environment are sometimes not conducive for the teachers, the capacity of the classrooms are stretched in some cases doubled. This may result in ill-health, psychological trauma and poor performance.

(xix) School Location (SCHLOC): The public secondary school investigated were scattered around in different settlement. Some of the Public Secondary Schools are neighborhood schools serving nearby residential areas. Students traveling through areas with sidewalks on main roads were also more likely to walk, this made theme to have many foot paths in the schools.

However, the models development identified two different factors that are significant predictors of the dependent variable of deterioration from the entire list investigated in this study. The variable secondary school location correlated with the factors that are responsible for the present state of public secondary school buildings. This is an affirmation that Public Secondary Schools that are in the remote areas, eroded environment, unfriendly environment, noisy areas were deteriorating not because they are poorly maintained but because such factors are not put into consideration when maintenance fund is allocated. The estimated regression coefficient also shows that the contribution of Non-academic staff to maintenance is poor, despite that some of them were employed to carry out daily maintenance. The coefficient indicates that an extension of good maintenance to schools in the rural areas and additional funds for other environmental issues will bring about 23% reductions in factors that cause deterioration in Public Secondary Schools. Also if there is 100% improvement in the maintenance performance or contribution of Non-academic staff there will be 47% reduction in factors that cause deterioration, if assuming given the effect of other variables remains constant.

7.8 The Maintenance Policies, Strategies and Practices that are in Place for the Public Secondary School Buildings.

The first most important factor is lack of preventive maintenance with RII of 0.84. Faulty workmanship was ranked second with RII of 0.80 which also indicates a most significant rating. Faulty workmanship is also considered a significant factor by Assaf (1996) and Adejimi (2005) who noted that defects due to construction inspection, defects due to inaccurate measurements among others leads to poor workmanship.

Adejimi (2005) earlier confirmed that many buildings suffer serious maintenance problems due to the incompetence of those who maintain such buildings. He further

recommended that engaging qualified and skilled personnel will go a long way in reducing maintenance problems. Design resolution is a very important factor that affects building maintenance. From the study it was ranked third with RII of 0.79. Adejimi (2005) considered this as a maintenance strength factor in his study. That author also asserted that a poorly resolved building design eventually results in severe maintenance problems. This study found that the design of public secondary school buildings functional spaces to be mostly of rectangular shape with the sizes too small and insufficient for the students in most schools. A poorly resolved building design does not suit the owner and transformation may be taking place. It was observed that some of the spaces have been remodeled. This corroborated by the findings by Usman *et al*. (2012) showing that the design resolution factor was the third most important factor out of the 22 factors investigated. The use of sub-standard materials and building components was ranked fourth with an RII of 0.76 this is also considered an important factor affecting building maintenance by Usman *et al*. (2012). The use of substandard materials and components no doubts affects maintenance to a large extent because such materials have lower life span and durability than standard materials and components. Frequent maintenance is required in situations where substandard building materials were used in construction in other to preserve the building over its life span.

Lastly, among the two positions that were involved in public secondary school building maintenance in this study and none of them has any background of building maintenance. The great majority of respondents in this group were school Principals. It can therefore be assumed that the respondents have no understanding of building maintenance because they are not professional in the construction industry. The public secondary school maintenance managers were not building professionals. The

situation affirms Adejimi's (2005) claim that many buildings suffer serious maintenance problems due to the incompetence of those who maintain such buildings.

7.6 Development of models to preserve the existing buildings as well as improve their conditions

The ANOVA tables explain the regression variability as implies by the dependent variables 0.00. All independent variables collectively affect the dependent variables significantly. R shows the relationship between dependent and all independent variables. R^2 is the coefficient of determination that explains the percentage of changes that can be attain by the independent variables. How much of variability is explained by the independent variable.

According to Blaikie (2003), an index is a set of items that measures a concept indirectly by assuming that what is being measured is related to that concept. To this effect, an index is useful for structuring multiple regression analysis. Thus, the four dependent variables used in this study have different indexes. It is also possible to calculate the mean scores for each respondent for each index. This is done by computing a summation of each model. Above all, in multivariate analysis, the various indexes identified can be combined to form an overall single index, which is particularly useful if dependent variables are involved (Meyers *et al.*, 2005).

This study used the ratings provided by the participants for the dependent variables to establish the mean scores. The multiple regression analysis was selected for developing the predictive model. Multiple regression analysis is by far the most widely used multivariate technique to analyse the relationship (including the prediction) between several independent variables and a single dependent variable (Hair *et.al*

1998). Thus, multiple regression offers the opportunity to establish the evidence that one or more explanatory variables (independent variables, X1,X2….Xk) cause another dependent variable Y to change (Blaikie, 2003). In so doing, the analysis establishes the relative magnitude of the contribution of each predictor variable. Furthermore, it offers the opportunity to examine what proportion of the variance in the outcome variable is explained by each predictor variable and/or their combined effect (Brace *et al*., 2003).

linear regression model, the relation between the predicted outcome Y, and the predictor variables, x1, x2…..xk is defined as:

$Y = \alpha + \beta 1x1 + \beta 2x2 + \ldots \beta KxK + c$ …….

Where α = a constant on the y –axis; $\beta 1$ to βK are coefficients so chosen as to minimise the sum of squared discrepancies between the predicted and obtained values of yp; c = error term of random variable with mean 0 and variance $\sigma 2$ and K= number of independent variables or parameters. In this case, the independent variables were represented by the operational measures identified for both contextual and task performance behaviours while the dependent variable (Y) as noted earlier is defined as a measure of given the large number of independent variables identified for this study, it was decided to use the stepwise selection technique in this analysis (see also Chan and Kumaraswamy, 1999).

Stepwise selection is the most sophisticated technique of the multiple regression analysis when large independent variables are involved (Brace *et al.*, 2003). In this study, each variable is entered in sequence and its value assessed. If adding a variable contributes significantly to the predictive qualities of the model, then it is retained, but all other variables in the model are then retested to see if they are still contributing to

the success of the model. If they no longer contribute significantly, they are removed. Thus, stepwise selection ensures that the regression ends up with the smallest possible set of predictor variables in the final model. Thus, a key advantage of using stepwise is that it results in the most parsimonious model (Walliman, 2001; Brace *et al.*, 2003).

At that point the objective was to discover the relationships between the performance of a dependent variable and independent variables. Before developing the models, it was important to have a fair idea of how closely a change in one variable is tied to a change in another variable and vice versa and also whether multicollinearity existed among the predictors. In particular, predictors that correlate highly with each other (i.e. $r > 0.9$, where r is Pearson's correlation coefficient) should be a source of concern (Blaikie, 2003; Brace *et al.*, 2003; Field, 2005).

In stepwise regression each variable is entered in sequence (i.e hierarchical) and its value assessed until all variables significantly contributing the criterion variable are identified. Because of the sequential assessment different models are developed at each stage until the most rigorous model is identified for each dependent variable. Subsequently here the analysis indicates that four models were developed.

The model numbers usually give the minimum number of variables extracted whilst R represents a measure of the correlation between the observed value and the predicted value of the criterion variable (i.e. the performance outcome). R square (R^2) is a measure of this correlation and indicates the proportion of the variance in the criterion variable which is accounted for by the model. Thus, R^2 is a measure of how good a prediction of the overall performance outcome can be made by knowing the predictor variables (Field, 2000; 2005). However, R^2 tends to somewhat over-estimate the success of the model when applied to the real world, so an adjusted R^2 value is

calculated which takes into account the number of variables in the models and the number of observations (i.e. participants) the model is based on (Brace *et al*., 2003). Thus, the adjusted R^2 is useful because its gives a signal of how much of the variance in the performance outcome is accounted for in the population from which the sample was chosen. Subsequently, using the adjusted R^2 and the analysis of variance (ANOVA), given that the p value is less than 0.0005. The p-value (reported in the ANOVA Table) also assesses the overall significance of the model. As $p < 0.0005$, it confirms that model is significant. The beta value (i.e. estimated regression co-efficient) is a measure of how strongly each predictor variable influences the criterion variable. However, prior investigation revealed that the t and p-values associated with the co-efficients for the respective variables proved significant (at $p < 0.0005$).

7.9 Summary

The ANOVA table decomposes the variance of the data into two components: a between-group component and a within-group component. Since the P-value of the F-test is less than 0.05, there is a statistically significant difference between the means of the 19 variables at the 95.0% confidence level. The regression models were developed to determine which means are significantly different from one another. The standardized skewness and/or kurtosis are attached to appendix 8 which shows outside the range of -2 to +2 for the deterioration factors. This indicates some significant normality in the data, which violates the assumption that the data come from normal distributions.

CHAPTER EIGHT

SUMMARY, CONCLUSION AND RECOMMENDATIONS

8.1 Introduction

This Chapter discusses the key findings, summary, conclusion and recommendations from the study. The different issues analysed in the foregoing chapters have provided better insights into the issues, nature, causes and effects of the maintenance problems of public secondary school buildings. These findings have informed the recommendations of the study as to how the maintenance challenges could be effectively addressed by the stakeholders.

8.2 Overview of the Study

A look at the Nigerian environment would reveal erratic building maintenance pattern in most of the public buildings because they are left unattended to, while the major preoccupation seems to be, construction of big edifice without considering subsequent maintenance of such a property (Amusan and Bamisile, 2012). The physical condition of some secondary school buildings do not leave up to the societal expectations, (Kruse and Louis, 1993). Decaying and deteriorating environmental conditions such as peeling paint, cracked walls, crumbling plaster, nonfunctioning toilets, poor lighting and inadequate ventilation, can affect the learning, health, and morale of students and staff in school buildings (Broome, 2003). The lack of maintenance in some school buildings have resulted in student truancy, lateness to school, lack of seriousness of

students and all sorts of negative attitudes (Kruse and Louis, 1993). According to Ajayi (2002) and Omoregie (2005), secondary school education in Nigeria is riddled with crises of various dimensions and magnitude, all of which combine to suggest that the system is in a state of fix. The dilapidated nature of the school buildings has also left the students and teachers usually exposed to harsh weather conditions as many schools hold classes in the open air. Omoregie (2005) reported that some vital documents in some schools have been messed up by rainfall as a result of non-maintenance of roofs.

Facility, issues arise at all educational levels, from pre-kindergarten through post-secondary, and at all sites, from classrooms to administrative offices. Challenges arise in new and old facilities alike, though the types of concerns may differ (National Centre on Education Statistics, 2003). In the words of Bosah (2005) "*the level of dilapidation in secondary schools is monumental"*. The environments of the educational institutions are anything but conducive for learning. Lecture rooms/halls which are in short supply are usually in bad conditions, either suffering from leaking roofs or collapsing walls. Some of the halls are riddled with broken glasses and chairs. Students hardly find chairs to seat on during lectures. The situation is most pronounced in state owned institutions.

It is against this background and the need for proper understanding of the outcome of various maintenance strategies in public secondary school buildings that an in-depth evaluation of was carried out in this study. The research activities and findings are reported in this thesis.

In an attempt to achieve this goal, Chapter One of this thesis outlined the following objectives of this study to include:

1. To investigate user-perceptions of the prevailing deterioration level of public secondary school buildings in the study area;

2. To assess the current state/ level of maintenance of public secondary school buildings in Ado-Odo/Ota L.G.A;

3. To identify the factors responsible for the state of maintenance of public school buildings in the study area;

4. To investigate the maintenance strategies that are in or for the public secondary school buildings and assess the maintenance experience of school managers in the study area; and

5. To develop models that can be used to preserve the existing buildings as well as improve their condition.

Based on the research questions and objectives of the study, the related existing body of knowledge was reviewed on building maintenance, deterioration, school building quality, deterioration factors, and maintenance managers, in Chapter Two. In fact, Chapter Two specifically established a link between the literature and various conceptual approaches used. The concepts and theories applicable to this research were discussed in Chapter three. In Chapter Four, the study methodology and the variables for data collection were spelt out, it can be seen that both survey research methods were used in this study. This Chapter also identified the questionnaire as the key survey technique and observation schedule as the two qualitative techniques used in the study. From Chapter Five data collection, presentation, processing, analysis and interpretations of results were reported. In the same chapter, the results, interpretation of the results and findings were presented. In chapters Six, models were developed for this study while Chapter seven, focused on the discussion of data and the findings of

the study were unveiled. Chapter Eight was used to present a summary of key findings, synthesis of key issues arising from the study and their implications, areas of further research and final conclusions respectively.

8.3 Summary of Key Findings of the Study

The study sets out to investigate user-perceptions of the prevailing deterioration level of public secondary school buildings in Ado-Odo/Ota L.G.A. The study also assessed the present state/ level of maintenance of public secondary school buildings. Identification of the factors responsible for the state of maintenance of public school buildings in the study area was also carried out. The study also investigated the maintenance policies, strategies and practices that are being adopted for the public secondary school buildings and assess the maintenance experience of school managers in the study area.

The study found out the followings:

(1) In an attempt to investigate user-perceptions of the prevailing deterioration level of public secondary school buildings in the study area, the following were observed.

(i) Among all the building elements in the public secondary school buildings surveyed, painting, walls, windows and doors, the ceilings and the floor had the most whilst the roof had the least of the maintenance problems.

(ii) The most prominent maintenance problems were cracks in walls, faded painting, partly broken windows and doors, no ceiling and leaking roofs affecting the public secondary school buildings.

(iii) Building maintenance problems were more pronounced in classrooms more than other buildings in public secondary school buildings.

(2) To assess the current state/ level of maintenance of public secondary school buildings in Ado-Odo/Ota L.G.A , the following were the findings;

(i) The majority of the classrooms in public secondary school buildings that were surveyed were old buildings with few that were new.

(ii) Generally, the conditions of services (toilet, water and drains) in the public secondary school buildings were in poor condition while electricity supply was in fairly state.

(iii) Building age were unknown by the users, it became difficult to ascertain if a component has exhausted its life span.

(**3) The major factors responsible for the state of maintenance of public school buildings in the study area were identified to include the following**

(i) The lack of maintenance culture on the part of both the governments, maintenance managers and the building users, thus resulting in deferred maintenance of the academic buildings in Public Secondary Schools.

(ii) A lack of maintenance plan with an evidence of lack of preventive maintenance plan by public secondary school buildings maintenance managers.

(iii) According to the maintenance managers, a majority of the public secondary school building users were also indifferent towards maintaining their buildings because they destroy the facilities the more, on a daily basis.

(iv) There is also the problem of individual maintenance manager decisions taking by the school Principals.

(v) Inflation on building materials often affects the maintenance cost resulting from works done by maintenance managers to undertake such tasks.

(vi) From the population data, there is also pressure on public secondary school buildings by number of users. There is inverse relationship between population density and the quality of school buildings conditions. Public Secondary Schools with fewer people had better conditions as against those with large number of occupants.

(4) To investigate the maintenance policies, strategies and practices, that are in or for the public secondary school buildings and assess the maintenance experience of school managers in the study area, there were some major findings;

(i) There is a lack of effective national maintenance policy, laws and regulations to compel both state government and maintenance managers to carry out maintenance.

(ii) There is majorly no maintenance documentation such as with maintenance manual or computers in the public secondary school buildings.

(iii) Public secondary school maintenance is handled like maintenance of individual buildings since the maintenance manager are using their discretion.

(iv) Another hurdle to maintenance strategies in public secondary school buildings is funding. Inadequate funds and delays in the release of funds by government were found to have contributed significantly to the present state of public secondary school buildings.

(5). Maintenance models that can be used to preserve the existing buildings as well as improve their conditions were developed with the following findings;

(i) The models developed in this study indicated that none of the models is less than 25% and given that the p value (as shown above) is less than 0.0005, the report indicates that such variables correlate with the dependent variable in the models.

8.4 Implications of Study Findings

There is no doubt that findings of this study have vast policy and practice implications that will be of interest to all public secondary school stakeholders. This section attempts to highlight possible implications of findings of this study for maintenance problems of Public Secondary Schools.

On the whole, 84 percent of all buildings of Public Secondary Schools surveyed have one maintenance issue or the other. Maintenance problem is more prominent in classrooms 61.2 percent and 23.8 percent of other buildings in a bad condition. This study supports previous research, it is clear that when the condition of a building is taken into consideration, along with the deterioration factors a considerable amount of the variance related to users' performance can be explained. Making improvements in certain areas of the public secondary school building condition can have a positive impact on users' attitude and performance which is the most important area related to school buildings. Adequate maintenance funding and provision of maintenance officer was the second most important factor in terms of public secondary school buildings deterioration.

As noted earlier on, seventy nine variables were investigated in this study. As a result of inclusion, factors relating to deterioration were noted as having an influence on public secondary school building condition. These factors should be adopted in the future, more detailed research as to the level of significance that each factor has on school buildings can be investigated.

This study however found out that the research has developed proficiency-based models representing a workable solution for predicting the public secondary school building maintenance. The models could be used by maintenance managers and government to recruit maintenance officers for the Public Secondary Schools. They could also develop their own maintenance solutions based on the adopted variables in this study and also adopt the developed models for their use. It is proposed that the developed models has the potential for improving the condition of public secondary school buildings.

8.4 Contribution to Knowledge

This study has demonstrated that appropriate maintenance would improve the condition of public secondary school buildings in Ado-Odo/Ota L.G.A Ogun State. This study adds to the body of knowledge by suggesting factors that relate to the deterioration conditions of secondary school buildings and development of four maintenance models. As in previous research, building age accounted for the deterioration of some public buildings. The research work has made an attempt at providing four maintenance models. To this end, a predictive maintenance strategy model is developed with an emphasis on period to maintain and maintenance planning.

8.5 Recommendations for Public Secondary Schools

Very little is known and documented about public secondary school buildings in Nigeria. This study was thus an attempt to understand and describe the characteristics condition of the school buildings. It is believed that for the proper maintenance of the school buildings, government needs to have maintenance strategies for the schools.

There is however a situation where the school Principals and Vice-Principals with no related professional background are the maintenance managers.

However, the following should be on the paramount list of school owners:

(1) There is a need for Public Secondary Schools to embrace preventive maintenance planning as a high priority rather than ad-hoc maintenance. To gain optimum benefits from preventive maintenance, building maintenance managers should incorporate preventive maintenance tasks into a work-order system and keep systematic maintenance records, either by computer or manually. Managers should evaluate the preventive maintenance programme to improve it over time.

(2) There should be a provision for maintenance officer in each school and a maintenance body for each state of the federation. The department should be adequately staffed with the requisite manpower and appropriate training to competently and safely undertake maintenance tasks.

(3). Building professionals like Architects, Builders, Engineer and other allied professionals should be invited to take periodic inspections of public secondary school buildings' conditions and create an inventory of buildings' components. They should plan building inspection, maintenance strategy, fund, policy and strategy. Maintenance planning and inspection is a sure way to reduce cost of maintenance because doing so can provide insight into future maintenance needs and avoid unnecessary costs.

(4). There should be a state legislation to regulate the maintenance of public secondary school buildings by developing state building and maintenance code. It should also deal with the issue of accessibility, electricity supply, fire protection, plumbing, water supply and other infrastructures.

(5) The model developed in this study, needs to be applied in the maintenance of public secondary school buildings. They can be used for quick assessment of school buildings by the professionals.

(6) Ogun State government needs to develop and formulate policy and strategy for maintenance planning and development of minimum maintenance standards for public secondary school buildings in the state. This may be through renovation permit for minor repair works, major repair works and total redevelopment, decoration and improvement notice. In addition, planning standards for school building developments must also be well spelt out, such as planning standards, architectural standards, structural engineering standards, electrical engineering standards and mechanical engineering standards. Doing all these would enhance and give effective improvement to buildings and their surrounding environment.

(7) Government needs to educate school building users on the need for school buildings and buildings' premises maintenance and the implications for failure to maintain buildings and their premises through radio and television programme and discussions. In addition, strategic placement of posters and effective distribution of hand bills can also be employed for the enlightenment campaign.

8.5.1 Areas for Future Research

Based on the findings of this research, the following areas are suggested for future research on the subject matter.

(1) Implication of building performance on students' performance: A study examining the relationship between building condition/ performance and student

achievement and behaviour should be conducted by introducing more variables of maintenance.

(2) Information design for further study: As in other change projects, further replication of this study is needed in other States to provide a larger knowledge base on information representing different governance structures, funding mechanisms, assessment instruments, geographic locations, and socio-economic contexts.

(3) A study examining the relationship between the conditions of public secondary school buildings and the users' attitudes should be conducted. The models presented in this study indicate that public secondary schools have a direct relation to building users.

(4) The relationship between maintenance body and policy, funding and population in relation to the physical condition in secondary school needs to be further examined.

8.6 Conclusion

The main objective of this research was to suggest a work-process for the formulation of maintenance strategies for public secondary school buildings. To achieve this, a literature review was carried to set the theoretical framework for the performed research. Furthermore, observation survey was conducted to further investigate the condition of buildings in Public Secondary Schools and the existing maintenance methods, and how they may work with a structured process for formulating new maintenance strategies. The literature review showed the current academic view on maintenance strategy, policy and management. The most important conclusion was

that the terms maintenance strategy and planning lack a unanimous definition among researchers. Another conclusion from the literature review was that there are few proposed processes for the formulation of maintenance strategies. Also, in the cases where formulation processes are suggested, they are quite complex and resource demanding, indicating that the processes are mainly developed for maintenance body.

The study can make an inference that deterioration, dilapidation and other maintenance problems are more pronounced in classrooms in the study areas. School buildings surveyed have maintenance problems. Maintenance problem is more prominent in the classrooms. The most widespread maintenance problems as found in the study were cracks in walls, faded and unpainted walls, partly broken windows and doors, exposed foundation and leaking roofs affecting high percent of surveyed.

It was observed that in the public secondary schools sampled that maintenance problems the study have been influenced by (i) lack or absence of a national (ii) maintenance policy (iii) inadequate funds and high cost of maintenance (iv) low capacity of maintenance staff (iv) pressure on buildings due to the number of users and poor users' attitudes. The study concludes by enumerating a number of recommendations aimed at addressing the problem of poor maintenance of public secondary school buildings in the country. It is hoped that these recommendations if implemented will contribute in no small way in reducing the maintenance problems plaguing the public secondary school buildings in the study area at the moment.

Finally, this study suggests that to improve the maintenance strategies of public secondary school buildings the developed models should be put to use because they will significantly contribute to the criterion variable that were identified in this study. A maintenance strategy should be formulated. The maintenance strategy should be

well-aligned with the overall condition of the existing school buildings as well as with the strategic goals of the State Government. Strategic performance indicators should be used in controlling the strategic development of maintenance. The maintenance strategy should periodically be revised in order to remain dynamic. Maintenance managers should create time to walk through the buildings, not only during renovation or when deterioration has been reported but also to monitor the age of building component.

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APPENDIX

APPENDIX 1

QUESTIONNAIRE FOR PUBLIC SECONDARY SCHOOL BUILDINGS USERS

Dear Sir/ Madam,

This questionnaire is structured to obtain responses from the public secondary school users in Ado/ Odo Ota L.G.A. The series of questions in this questionnaire are designed to elicit information on maintenance of public secondary school buildings. Please, answer the questions that follow by ticking the appropriate option (if provided) or writing unrestrictedly for open-ended questions. Please answer all questions freely but objectively. The information is for academic purpose only and will be treated with the strictest confidentiality.

NOTE: **"Structural defect"** means any defect in a structural element of a building that is attributable to defective design, defective or faulty workmanship or defective materials (or any combination of these).

Thank You for your anticipated co-operation.

Yours Faithfully

Oladunni IZOBO-MARTINS

Section A (Please tick [√] Maintenance of Building)

1. Name of Secondary School and its location…….....
2. What is your status in the School? Academic Staff [1] Non- Academic Staff [2]
3. How long have you being in the School? 1-4yrs [1] 5-8yrs [2] 9-12yrs [3] 12- 16yrs[4] 17 andAbove [5]
4. What is your academic qualification? SSCE [1] OND [2] NCE [3] BSC/ HND [4] MSC [5] Ph.D [6]Professional Certificate [7]
5. What is your Sex? Male [1] Female [2]
6. How old is your school? Below 20 years[1] 21-30[2] 31-40 [3] 41-50 [4] Above 51 [5]

Section B: please opinioned maintenance issues as its affect the school buildings

7. Does the current state of the building affect the teaching and learning of the users in the school? Yes [1] No [2]

8. Do you have maintenance crew in the school? Yes [1] No [2]

9. Which Academic building is the most deteriorated in the school? Classroom [1] Library [2] Computer room [3] Laboratory [4]

10. Does the current state of the building affect the behavior of the users in the school? Yes [1] No [2]

11. What is the contribution of Students in the Maintenance of the school buildings? Sweeping, weeding and cleaning [1] Technical Involvement [2] Not Involved [3] paying maintenance fee [4]

12. What is the contribution of Academic Staff in the Maintenance of the school buildings? Supervising [1] consciousness [2] Nothing [3] punishing offenders [4]

13. What is the contribution of Non- Academic Staff in the Maintenance of the school buildings? Supervising [1] Sweeping and Cleaning [2] Weeding [3] Technical work [4]

14. In your opinion are the academic buildings properly maintained? [1]Yes [2] No.

15. What is your opinion about the present condition of the components of the buildings? Good [1] Bad [2]

16. What are the factors responsible for the deterioration of the school buildings? Age[1] Lack of maintenance culture[2] Users Attitudes [3] Over population [4] funding [5]

Section B: You are to tick the appropriate condition of the building components

17. What is the Condition of the foundation? Existing cracks [1] exposed [2] weak [3] good condition [4]

18. What is the Condition of Roof? Leaking [1]rusty [2] partly ripped off/ sagging [3] completely ripped off [4] good condition [5]

19. What is the condition Painting? Not painted [1] faded paint [2] dirty paint [3] well painted [4]

20. What is the condition of floor? Cracks [1] peeled-off [2] defect [3] no defect [4]

21. What is the condition of walls? Partly broken down [1] develop cracks [2] peel – off [3] tilted [4] Good condition[5]

22. What is the condition of windows? No existing [1] partly broken down [2] completely broken down [3] Good condition [4]

23. What is the condition of doors? No doors [1] partly broken down[2] completely broken down [3] Good condition [4]

24. What is the condition of Electrical installations? not existing[1] not functioning [2] faulty [3] Good condition [4]

25. What is the condition of water pipes? [1] There is water but no pipes [2] leaking taps [3] broken down [4] no water

26. What type of toilet facility do you use? Water closet [1] Pit Latrine [2] Bush[3]

27. What is the condition of WC? Leaking [1] broken down [2] not functioning [3]

28. Source of water supply? Well [1]Bore hole [2] Spring [3]No supply [4]

29. Condition of Drains/gutter? Open gutter [1] Covered with concrete slabs [2] Not existing[3]

30. The schools compound is very clean. [ ] Strongly disagree [ ] Disagree [ ] Average [ ] Agree [ ] Strongly Agree [ ]

APPENDIX 2:

MAINTENANCESCHEDULE FOR PUBLIC SCHOOL BUILDINGS

[PRINCIPAL OR VICE-PRINCIPAL]

Dear Sir/ Madam,

This questionnaire is structured to obtain responses from the public secondary school users in Ado/ Odo Ota L.G.A. The series of questions in this questionnaire are designed to elicit information on maintenance of public secondary school buildings. Please, answer the questions that follow by ticking the appropriate option (if provided) Please answer all questions freely but objectively. The information is for academic purpose only and will be treated with the strictest confidentiality.

NOTE: **"Structural defect"** means any defect in a structural element of a building that is attributable to defective design, defective or faulty workmanship or defective materials (or any combination of these).

Thank You for your anticipated co-operation.

Thank You for your anticipated co-operation.

Oladunni Izobo-Martins

SECTION A

GENERAL INFORMATION

Name of the school **……..**

1. What is your position? Principal [1] Vice- Principal [2]

2. How long have you being in the School?1-4yrs[1] 5-8yrs [2] 9-12 yrs.[3]

12 -15yrs [4] Above 15 yrs. [5]

3. How old is your school? [ ] Less than 20[1] 21-30yrs [2]31-40yrs [3] 41-50yrs [4]

Above 51yrs [5]

SECTION B

1. Does your school get financial resources for maintenance from other stakeholders apart from the government? Yes [1] or No [2]

2. Does your School have a maintenance policy? Yes [1] or No [2]

3. Does your school have maintenance strategies in place? Yes [1] or No [2]

4. Does your school have maintenance planning? Yes [1] or No [2]

5. What type of maintenance planning do you have in place? [ ] Periodic maintenance [1] Routine maintenance [2] Condition based maintenance [3] Preventive maintenance [4] Corrective maintenance [5]

6. Who determine the spaces to be maintained? PTA [ ] Principal [ ] Maintenance Officer [ ] Government Body [ ]

7. Do you take inventory of the building condition and maintenance needs in the school yearly? [ ] Yes [ ] No

8. Does your buildings undertake regular inspection of the school buildings for maintenance at intervals? [ ] Yes [ ] No

9. Have building conditions in this school improved or stagnant in last five years? [ ] Yes [ ] No

10. Do you carry out maintenance work on the building without request? [ ] Yes [ ] No

11. How often do you maintain the school buildings? [ ] Quarterly [ ] biannual [ ] annually [ ] No specific time

12. How long does it take before you responded to reported disrepair? [ ] 1-2months [ ] 3-4 months [ ] 5-6 months [ ] 7-8 months [ ] 9months and above.

13. The school buildings are properly maintained? [ ] Strongly disagree [ ] Disagree [ ] Average [ ] Agree [ ] Strongly Agree [ ]

14. Which academic building is the most maintained building in the school?

Classroom [1] Library [2] Laboratory [3]Art Studio[4] Computer Room [5]

15. What is the role of PTA in the maintenance of your school buildings? [ ] Financial Contribution [ ] Man Power [ ] Nothing [ ] Building Materials

16. Building users report disrepair to your office? [ ] Never [ ] Rarely [ ] Often [ ] Sometimes [ ] Always

17. How does the school treat any incidence of misuse and negligence that lead to disrepair by the students? [ ] Physical punishment [ ] Suspension [ ] Student repair [ ] Student refund [ ] Nothing

18. Based on the maintenance done, what % of support do you get from stakeholders? [ ] Between 1-20% of maintenance fund [ ] Between 21-40 % of maintenance fund [ ] Between 41-60 % of maintenance fund [ ] Between 61-80 % of maintenance fund [ ] Between 81-100 % of maintenance fund

19. What necessitates the carrying out of maintenance on the school buildings?

[ ] Upon inspection [ ] upon request or break down [ ] upon resumption of new session [ ] upon new Government [ ] Based on the maintenance plan [ ] Upon Deterioration and failure

20. Do you as the maintenance managers receive training to conduct assessments of the buildings? Yes [1] No [2]

21. Does the school buildings have a written middle-range plan for building maintenance and repairs that extends to a minimum of three to five years? [ ] Yes [ ] No

22. Does the school have a maintenance manual? Yes [1] No [2]

23. Does the school have a maintenance log book or computerize maintenance issues? [ ] Yes [ ] No

24. The physical condition of buildings is in acceptable state? [ ] Strongly disagree [ ] Disagree [ ] Average [ ] Agree [ ] Strongly Agree

25. Do you have maintenance monitoring officer in the school? [ ] Yes [ ] No

26. Improvement in physical condition of school buildings will improve students' performance?

[ ] Strongly disagree [ ] Disagree [ ] Average [ ] Agree [ ] Strongly Agree [ ]

27. Improvement in building condition will improve staffs working performance?

[ ] Strongly disagree [ ] Disagree [ ] Average [ ] Agree [ ] Strongly Agree [ ]

SECTION C

Please indicate in your opinion the reasons/factors responsible for the present condition of the school buildings. Grade them on the scale 1-5 with [1] Very insignificant [2] Insignificant [3] Normal [4] Significant [5] Very Significant

S/no	Factors	1	2	3	4	5
28	The buildings were not properly design					
29	The buildings were not properly supervised during Construction					
30	The buildings are deteriorating because of Age					
31	Lack of Maintenance Culture					
32	Users attitudes					
33	Over Population of the students in the classrooms					
34	School Location					
35	Poor Environmental Condition					
36	Lack/ insufficient Maintenance funding from Government					
37	Low quality of building materials					
38	Lack of skilled maintenance persons in construction					
39	Lack of maintenance plan for the school					
40	Absence of Maintenance Body and policy					
41	Pressure on School Compound due to misuse					
42	Non response to maintenance request					
43	No provision for the replacement of building materials					
44	Inflation on materials by the maintenance staff					
45	Non-involvement of experts in maintenance work					
46	Inadequate training of the personnel					

APPENDIX 3: The measure of beta value for model writing of deterioration factors

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		β	Std. Error	Beta		
1	(Constant)	2.826	2.283		1.238	.234
2	The buildings were not properly design (SCHD)	-.109	.639	-.142	-.170	.867
3	The buildings were not properly supervised during Construction (SCHC)	.895	.494	.887	1.811	.089
4	Age of school (SCHAG)	.158	.134	.322	1.184	.254
5	Lack of Maintenance (MATCUL)	-.273	.181	-.445	-1.510	.151
6	Users attitudes and misuse (UATITUD)	.168	.223	.196	.755	.461
7	Over Population of the students in the classrooms (POPULA)	.253	.421	.268	.601	.556
8	School Location (SCHLOC)	-1.075	.718	-.474	-1.496	.154
9	Poor Environmental Condition (SCHENV)	.641	.493	.335	1.301	.212
10	Lack/insufficient funding from Government (SCHFUND)	.149	.128	.238	1.170	.259
11	Low quality of building materials (BULMAT)	-.313	.572	-.552	-.548	.591
12	Lack of skilled maintenance persons in construction (MATPERS)	-.059	.211	-.093	-.281	.782
13	Lack of maintenance plan for the school (METPLAN)	.394	1.045	.380	.378	.711
14	Absence of Maintenance Body and policy (METBODY)	.016	.848	.015	.019	.985
15	Pressure on School compound due to number of User (SCHCOMP)	.192	.539	.401	.355	.727
16	Non response to maintenance request (NORESP)	-1.074	.844	-1.082	-1.273	.221
17	No provision for the replacement of building materials (NOREPL)	.339	.347	.475	.976	.344
18	Inflation on materials by the maintenance staff (INPRIC)	-.188	.276	-.176	-.680	.506
19	Non-involvement of experts in maintenance work (LACKEP)	-.286	.432	-.322	-.662	.517
20	Inadequate training of the personnel (LACTRA)	.179	.252	.301	.708	.489
a. Dependent Variable: Physical Condition of buildings						

APPENDIX 4:

Showing Standard deviation and Kutosis of the school building deterioration factors

S/n	The Variables	Std. Deviation	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis
1	Absence of Maintenance Body and policy	.69179	-1.413	.393	.679	.768
2	Over Population of the students in the classrooms	.76636	-.813	.393	-.783	.768
3	Lack/ insufficient funding from Government	1.15022	-.310	.393	-1.474	.768
4	Non response to maintenance request	.72812	-.765	.393	-.677	.768
5	No provision for the replacement of building materials	1.01419	-1.257	.393	.230	.768
6	Non-involvement of experts in maintenance work	.81455	-.567	.393	-1.250	.768
7	Lack of maintenance plan for the school	.69693	-.238	.393	-.843	.768
8	Lack of skilled maintenance persons in construction	1.13389	-1.024	.393	.533	.768
9	Lack of Maintenance Culture	1.18019	-.542	.393	-.512	.768
10	Users attitudes and misuse	.84468	-.393	.393	-.410	.768
11	Inadequate training of the personnel	1.21890	.212	.393	-1.554	.768
12	Age of school	1.47007	.508	.393	-1.056	.768
13	Pressure on School compound due to number of User	1.51186	.187	.393	-1.492	.768
14	Low quality of building materials	1.27335	.285	.393	-1.026	.768
15	The buildings were not properly design	.94952	.232	.393	-1.916	.768
16	The buildings were not properly supervised during Construction	.71714	.602	.393	-.796	.768
17	Inflation on materials by the maintenance staff	.67612	1.827	.393	1.918	.768
18	Poor Environmental Condition	.37796	1.868	.393	1.572	.768
19	School Location	.31873	2.584	.393	4.948	.768

APPENDIX 5: Standard Deviation of all Variables

Variables	Mean	Std. Error of Mean	Median	Mode	Std. Deviation	Variance	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Range
position of the respondent	1.4444	.08399	1.0000	1.00	.50395	.254	.233	.393	-2.064	.768	1.00
Lenght of stay in school	1.2778	.07571	1.0000	1.00	.45426	.206	1.036	.393	-.985	.768	1.00
Age of school	2.6944	.24501	2.0000	2.00	1.47007	2.161	.508	.393	-1.056	.768	4.00
Maintenance fund	2.8611	.19170	3.0000	4.00	1.15022	1.323	-.310	.393	-1.474	.768	3.00
Maintenance policy	1.7778	.07027	2.0000	2.00	.42164	.178	-1.395	.393	-.060	.768	1.00
Availability of maintenance strategy	1.8333	.06299	2.0000	2.00	.37796	.143	-1.868	.393	1.572	.768	1.00
Type of maintenance planning	3.3056	.20633	4.0000	4.00	1.23796	1.533	-1.295	.393	-.244	.768	3.00
Allocation of spaces to be maintained	2.0556	.11230	2.0000	2.00	.67377	.454	-.065	.393	-.667	.768	2.00
Regular inspection by school head for maintenance needs	3.5833	.27131	4.0000	5.00	1.62788	2.650	-.662	.393	-1.305	.768	4.00

Improved condition or stagnant in the last five years	3.1111	.26058	3.0000	1.00	1.56347	2.444	-.242	.393	-1.452	.768	4.00
Maintenance work without request	1.0833	.04672	1.0000	1.00	.28031	.079	3.148	.393	8.371	.768	1.00
Regularity of carrying out maintenance	4.0278	.16177	4.0000	5.00	.97060	.942	-.653	.393	-.560	.768	3.00
Period to maintain	1.6389	.23283	1.0000	1.00	1.39699	1.952	2.027	.393	2.449	.768	4.00
Respond to reported disrepair	4.2778	.15742	5.0000	5.00	.94449	.892	-1.249	.393	.731	.768	3.00
Buildings properly maintained	2.0278	.13503	2.0000	2.00	.81015	.656	-.052	.393	-1.465	.768	2.00
Most maintained buildings	2.3056	.17284	2.0000	2.00	1.03701	1.075	1.939	.393	3.184	.768	4.00
Role of PTA in maintenance	2.3056	.16339	2.5000	3.00	.98036	.961	-.092	.393	-1.170	.768	3.00
Users report disrepair in	3.3056	.20633	4.0000	4.00	1.23796	1.533	-.625	.393	-.466	.768	4.00
Buildings MTINSP	1.6765	.08144	2.0000	2.00	.47486	.225	-.790	.403	-1.466	.788	1.00
Maintenance Negligence by students	2.4167	.21593	3.0000	1.00	1.29560	1.679	.152	.393	-1.440	.768	4.00
Maintenance support by stakeholders	1.8889	.17718	2.0000	1.00	1.06309	1.130	.988	.393	-.235	.768	3.00
Maintenance training	1.9167	.04672	2.0000	2.00	.28031	.079	-3.148	.393	8.371	.768	1.00
Maintenance time	4.6389	.24929	5.0000	5.00[a]	1.49576	2.237	-.854	.393	-.804	.768	4.00
Middle range maintenance plan	2.1389	.09044	2.0000	2.00	.54263	.294	.115	.393	.424	.768	2.00
Maintenance logbook or	1.9722	.02778	2.0000	2.00	.16667	.028	-6.000	.393	36.000	.768	1.00

computer											
Maintenance manual	1.8889	.05312	2.0000	2.00	.31873	.102	-2.584	.393	4.948	.768	1.00
Physical Condition of buildings	2.3611	.12053	2.5000	3.00	.72320	.523	-.682	.393	-.748	.768	2.00
Maintenance officer	1.6944	.07786	2.0000	2.00	.46718	.218	-.881	.393	-1.299	.768	1.00
Improvement on student performance	1.3889	.08240	1.0000	1.00	.49441	.244	.476	.393	-1.881	.768	1.00
Improvement on staff performance	1.4722	.08438	1.0000	1.00	.50631	.256	.116	.393	-2.107	.768	1.00
The buildings were not properly design	1.8889	.15825	1.5000	1.00	.94952	.902	.232	.393	-1.916	.768	2.00
The buildings were not properly supervised during Construction	1.6667	.11952	2.0000	1.00	.71714	.514	.602	.393	-.796	.768	2.00
The buildings are deteriorating because of Age	1.0000	.00000	1.0000	1.00	.00000	.000		.393		.768	.00
Lack of Maintenance Culture	3.5833	.19670	4.0000	4.00	1.18019	1.393	-.542	.393	-.512	.768	4.00
Users attitudes and misuse	3.5278	.14078	4.0000	4.00	.84468	.713	-.393	.393	-.410	.768	3.00
Over Population of the students in the classrooms	4.3889	.12773	5.0000	5.00	.76636	.587	-.813	.393	-.783	.768	2.00
School Location	1.1111	.05312	1.0000	1.00	.31873	.102	2.584	.393	4.948	.768	1.00
Poor Environmental Condition	1.1667	.06299	1.0000	1.00	.37796	.143	1.868	.393	1.572	.768	1.00
Lack/ insufficient funding from Government	4.3889	.12135	5.0000	5.00	.72812	.530	-.765	.393	-.677	.768	2.00
Low quality of building materials	2.4167	.21223	3.0000	1.00	1.27335	1.621	.285	.393	-1.026	.768	4.00

Lack of skilled maintenance persons in	3.8333	.18898	4.0000	4.00	1.13389	1.286	-1.024	.393	.533	.768	4.00
Inflation on materials by the	1.3333	.11269	1.0000	1.00	.67612	.457	1.827	.393	1.918	.768	2.00
Non-involvement of experts in maintenance work	4.2778	.13576	4.5000	5.00	.81455	.663	-.567	.393	-1.250	.768	2.00
Inadequate training of the personnel	3.3333	.20315	3.0000	2.00	1.21890	1.486	.212	.393	-1.554	.768	3.00
Construction lack of maintenance plan for the school	4.1667	.11616	4.0000	4.00	.69693	.486	-.238	.393	-.843	.768	2.00
Absence of Maintenance Body and policy	4.5833	.11530	5.0000	5.00	.69179	.479	-1.413	.393	.679	.768	2.00
Pressure on School compound due to number of User	2.6667	.25198	3.0000	1.00	1.51186	2.286	.187	.393	-1.492	.768	4.00
Non response to maintenance request	4.3889	.12135	5.0000	5.00	.72812	.530	-.765	.393	-.677	.768	2.00
No provision for the replacement of building materials	4.3333	.16903	5.0000	5.00	1.01419	1.029	-1.257	.393	.230	.768	3.00

Analysis of Variance of Maintenance Strategy

Statistics	*AMSTRAD*	MTFUND	*MTPolicy*	*MTPlan*	*MTTIME*	*MTLOG*	*MTMAN*
Count	36	36	36	36	36	36	36
Average	1.83333	2.86111	1.77778	3.30556	4.02778	1.97222	1.88889
Median	2.0	3.0	2.0	4.0	4.0	2.0	2.0
Mode	2.0	4.0	2.0	4.0	5.0	2.0	2.0
Geometric mean	1.7818	2.58569	1.71449	2.93947	3.89375	1.96186	1.85175
5%Trimmed mean	1.87037	2.90123	1.80864	3.39506	4.08642	2.0	1.9321
5%Winsorized mean	1.83333	2.86111	1.77778	3.30556	4.02778	2.0	1.88889
Variance	0.142857	1.32302	0.177778	1.53254	0.942063	0.0277778	0.101587
Standard deviation	0.377964	1.15022	0.421637	1.23796	0.9706	0.166667	0.318728
Coeff. of variation%	20.6162%	40.202	23.7171%	37.4508	24.0976	8.4507%	16.8738
Standard error	0.0629941	0.191704	0.0702728	0.206326	0.161767	0.0277778	0.0531213
5% Winsorized sigma	0.389249	1.18457	0.434226	1.27492	0.999579	0.0	0.328244
MAD	0.0	1.0	0.0	0.0	1.0	0.0	0.0
Sbi		1.19311			0.974272		
Minimum	1.0	1.0	1.0	1.0	2.0	1.0	1.0
Maximum	2.0	4.0	2.0	4.0	5.0	2.0	2.0
Range	1.0	3.0	1.0	3.0	3.0	1.0	1.0
Lower quartile	2.0	2.0	2.0	3.0	3.0	2.0	2.0
Upper quartile	2.0	4.0	2.0	4.0	5.0	2.0	2.0
Interquartile range	0.0	2.0	0.0	1.0	2.0	0.0	0.0
1/6 sextile	1.5	2.0	1.0	1.0	3.0	2.0	2.0
5/6 sextile	2.0	4.0	2.0	4.0	5.0	2.0	2.0
Intersextile range	0.5	2.0	1.0	3.0	2.0	0.0	0.0
Skewness	-1.86759	-0.310312	-1.39512	-1.29471	-0.653384	-6.0	-2.5838
Stnd. skewness	-4.57464	-0.760107	-3.41734	-3.17138	-1.60046	-14.6969	-6.329
Kurtosis	1.57219	-1.4741	-0.0601604	-0.244395	-0.560239	36.0	4.9482
Stnd. kurtosis	1.92553	-1.80539	-0.0736812	-0.299321	-0.68615	44.0908	6.06028
Sum	66.0	103.0	64.0	119.0	145.0	71.0	68.0
Sum of squares	126.0	341.0	120.0	447.0	617.0	141.0	132.0

Correlations Analysis of Variance of Maintenance Strategy

	AMSTRAD	Maint Fun	Policy	MTPlan	MTTIME	MTLOG	MTMAN
AMSTRAD		0.0767	0.2988	0.1119	0.0909	-0.0756	-0.1581
		(36)	(36)	(36)	(36)	(36)	(36)
		0.6567	0.0767	0.5157	0.5982	0.6613	0.3570
Maint Fun	0.0767		-0.1244	0.1310	0.2339	0.1283	0.0346
	(36)		(36)	(36)	(36)	(36)	(36)
	0.6567		0.4699	0.4464	0.1698	0.4557	0.8410
Policy	0.2988	-0.1244		0.2980	-0.2637	-0.0904	-0.1890
	(36)	(36)		(36)	(36)	(36)	(36)
	0.0767	0.4699		0.0775	0.1201	0.6002	0.2697
MTPlan	0.1119	0.1310	0.2980		-0.4353	-0.0962	0.0161
	(36)	(36)	(36)		(36)	(36)	(36)
	0.5157	0.4464	0.0775		0.0080	0.5769	0.9258
MTTIME	0.0909	0.2339	-0.2637	-0.4353		0.3581	0.0103
	(36)	(36)	(36)	(36)		(36)	(36)
	0.5982	0.1698	0.1201	0.0080		0.0320	0.9526
MTLOG	-0.0756	0.1283	-0.0904	-0.0962	0.3581		-0.0598
	(36)	(36)	(36)	(36)	(36)		(36)
	0.6613	0.4557	0.6002	0.5769	0.0320		0.7292
MTMAN	-0.1581	0.0346	-0.1890	0.0161	0.0103	-0.0598	
	(36)	(36)	(36)	(36)	(36)	(36)	
	0.3570	0.8410	0.2697	0.9258	0.9526	0.7292	

APPENDIX 6: LIST OF SCHOOL USED IN THE RESEARCH

S/No	School Names
1.	Agbara Senior Grammar School, Agbara
2.	Ansarudeen Comprehensive senior College, Ota
3.	Ansarudeen Comprehensive High School,Lafenwa-Ota
4.	Ado Odo Senior High School, Ado Odo
5.	Ado Odo junior High School, Ado Odo
6.	Ajogbo Grammar School, Ajibode-Ota.
7.	Alamuwa Senior Grammar School, Ado-Odo.
8.	Anglican Senior Grammar School, Ota
9.	Anglican junior Grammar School, Ota
10.	Adie-Owe Community High School, Adie-Owe
11.	Toyon High School, Ere, Ado-Odo
12.	Community High School, Ejila Awori
13.	Ilogbo-Asowo Community High School, Ilogbo-Asowo
14.	Iyesi-Ota High School, Iyesi-Ota
15.	Ewupe Community High School, Ewupe, Sango
16.	Alamuwa Senior Grammar School, Ado-Odo.
17.	Alamuwa junior Grammar School, Ado-Odo.
18.	Anglican Senior Grammar School, Ota
19.	Anglican junior Grammar School, Ota.
20.	Community High School, Alapoti
21.	Community Senior High School, Iroko-Aparadija
22.	Iganmode Senior Grammar School, Ota
23.	Iganmode junior Grammar School, Ota
24.	Igbesa Senior High School, Igbesa
25.	Igbesa junior High School, Igbesa
26.	Iju-Ebiye High School, Iju-Ota
27.	Local Government Senior Secondary Commercial School, Atan-Ota
28.	Male Comprehensive High School, Igbesa.
29.	Sango-Ota Senior High School, Sango-Ota
30	Sango-Ota junior High School, Sango-Ota
31.	St Stephen's Senior Comprehensive High School, Ado-Odo.
32.	St Stephen's junior Comprehensive High School, Ado-Odo.
33.	St. Michael's High School, Ota
34.	Unity High School, Ijoko-Ota
35.	Community junior High School, Iroko-Aparadija
36.	Alamuwa junior Grammar School, Ado-Odo.

APPENDIX 7:
SITE INSPECTION CHECKLIST

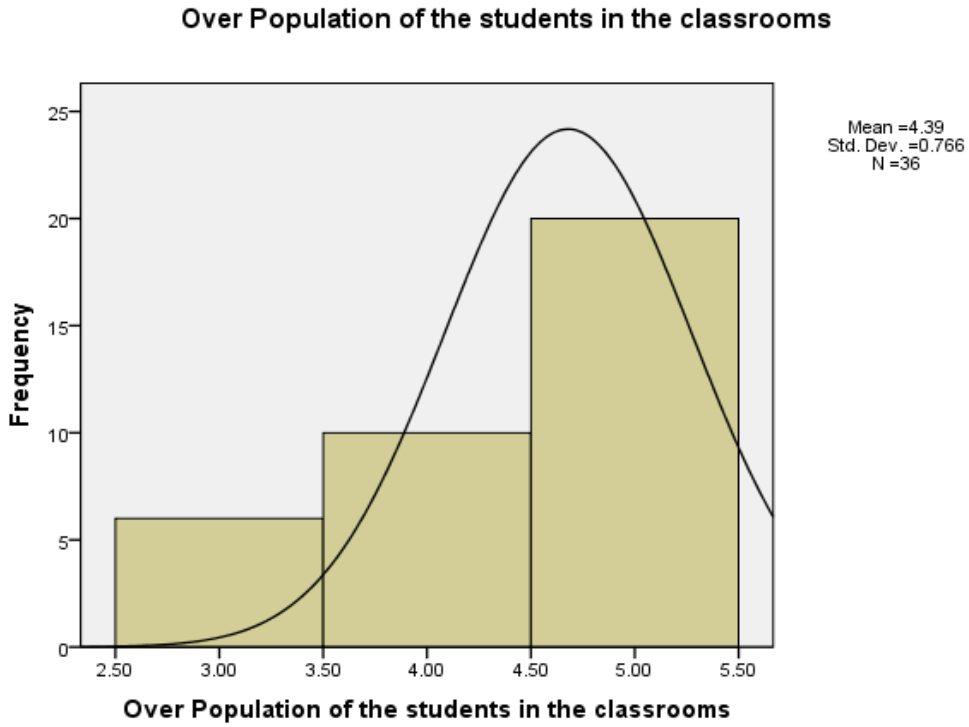
1. Drainage

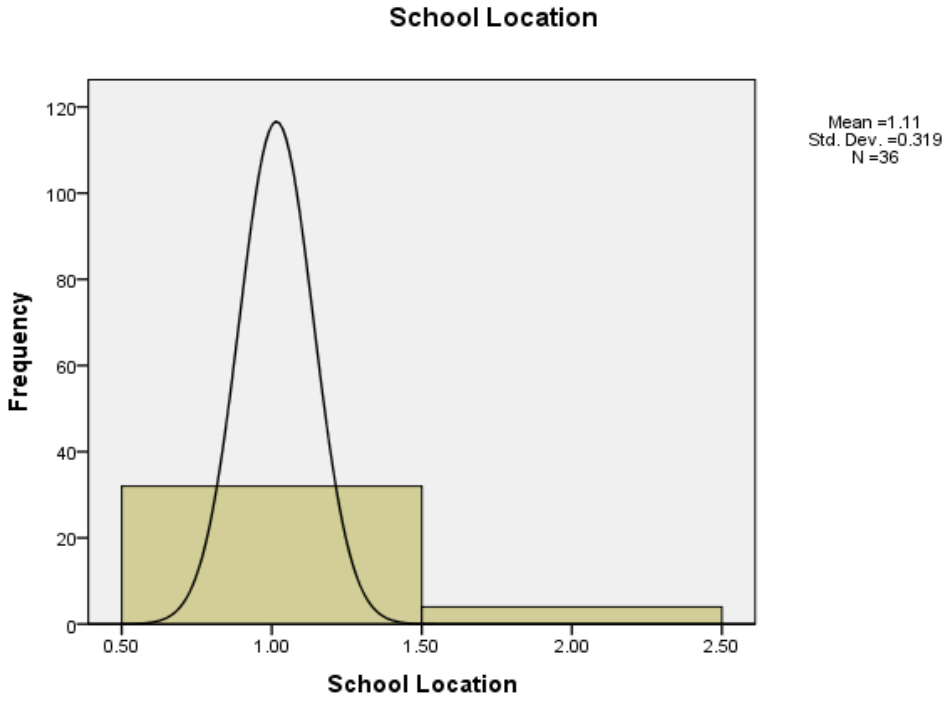
2. In-Situ reinforced concrete

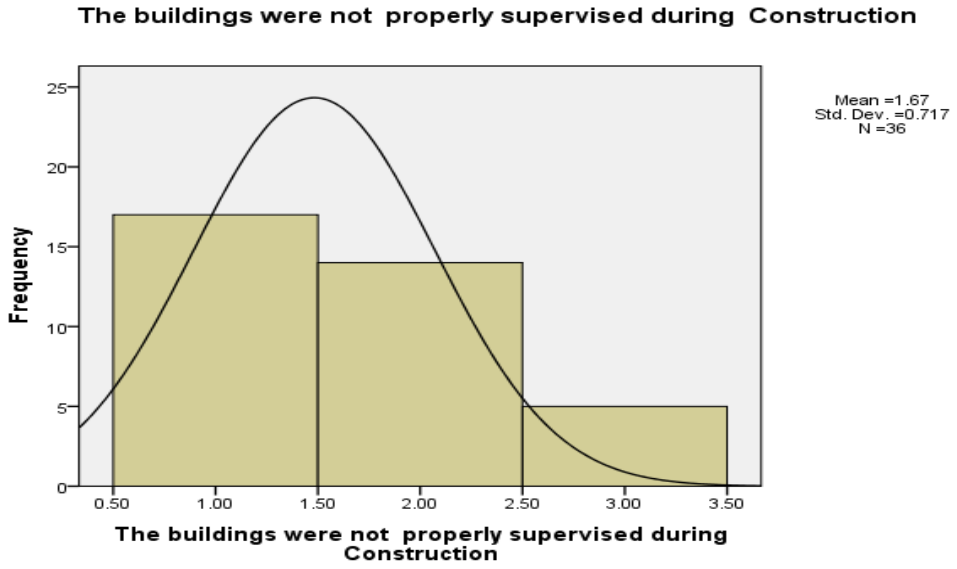
3. Precast reinforced concrete

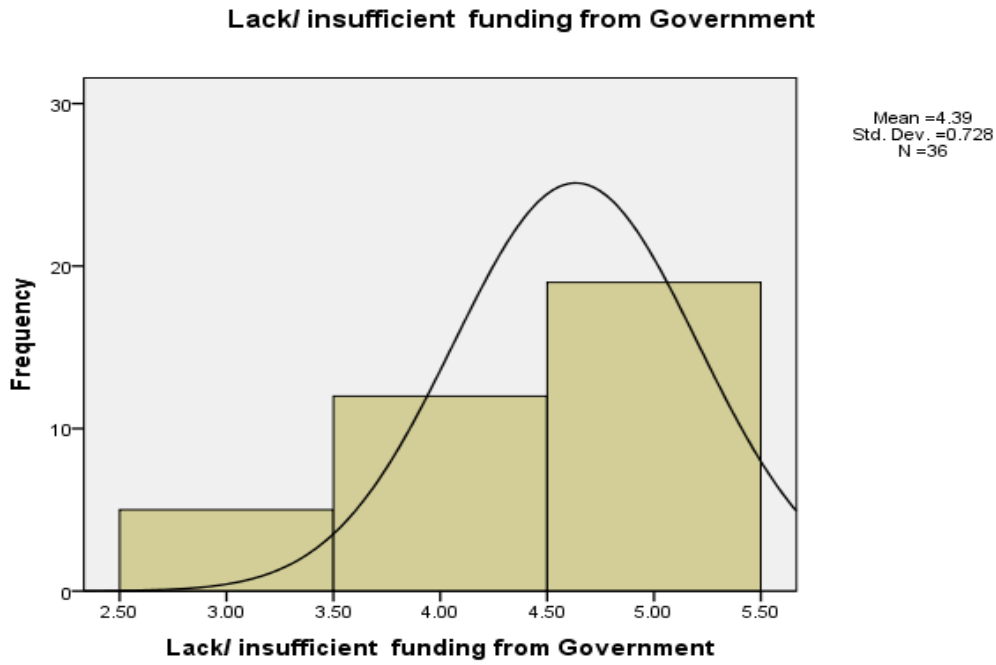
4. Block walling
5. Carpentry and joinery
- Timber free from defects.
6. Wall and roof cladding
7. Metal work
8. Roofing
9. Discharge pipework and sanitary fittings
10. Water Supply
11. Ventilation: Indoor Quality Air andlighting
12. Electrical installation
13. Floor finishes
14. Plastering and wall tiling
15. Suspended ceilings
16. Proprietary partitions
17. Glazing
18. Painting and decorating.
19. Ironmongery
- locks,
- Doors, windows, open easily, not in need of adjustment.
20. Cleaning down
- Floors scrubbed, free from point splashes.
- Painted surfaces clean, free from faults.
- Glass cleaned, undamaged.
- Sanitary fittings clean, undamaged.
- Lighting fittings clean, undamaged.
- Switch plates, ironmongery, door/window furniture clean.
- Rooms, areas generally immaculate.

APPENDIX 8: DETERIORATION FACTORS






The buildings were not properly supervised during Construction
Mean =1.67
Std. Dev. =0.717
N =36
Frequency
25
20
15
10
5
0
0.50
1.00
1.50
2.00
2.50
3.00
3.50
The buildings were not properly supervised during Construction


Lack/ insufficient funding from Government
Mean =4.39
Std. Dev. =0.728
N =36
Frequency
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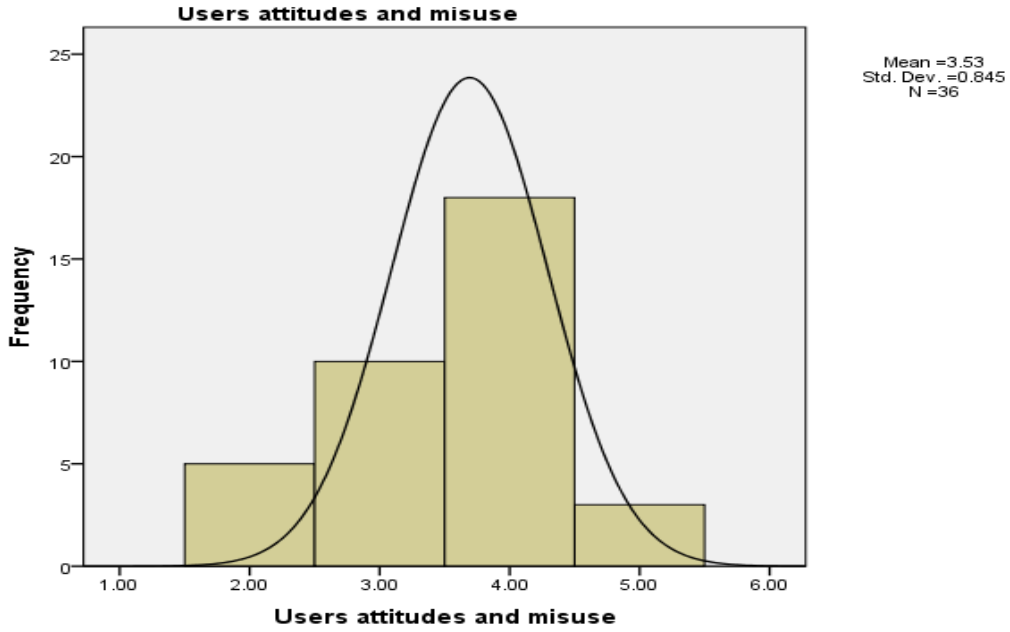
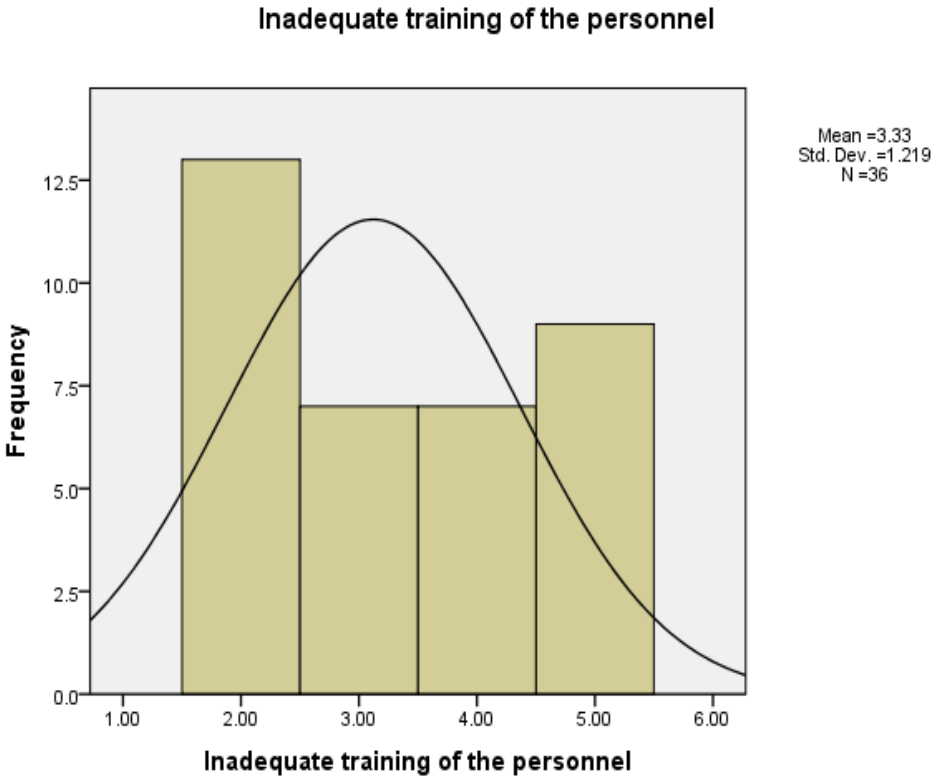
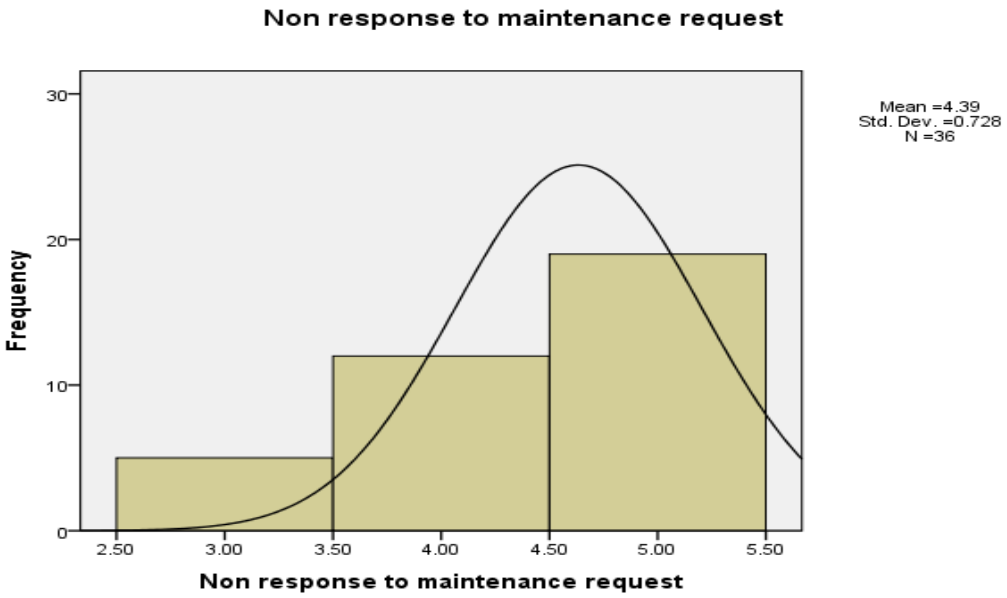
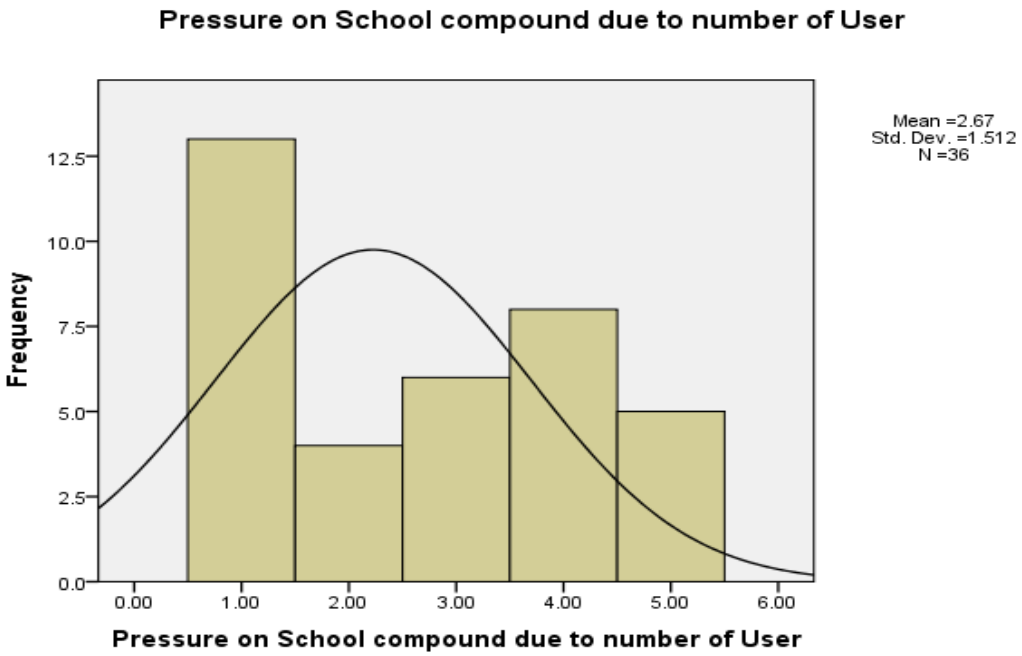
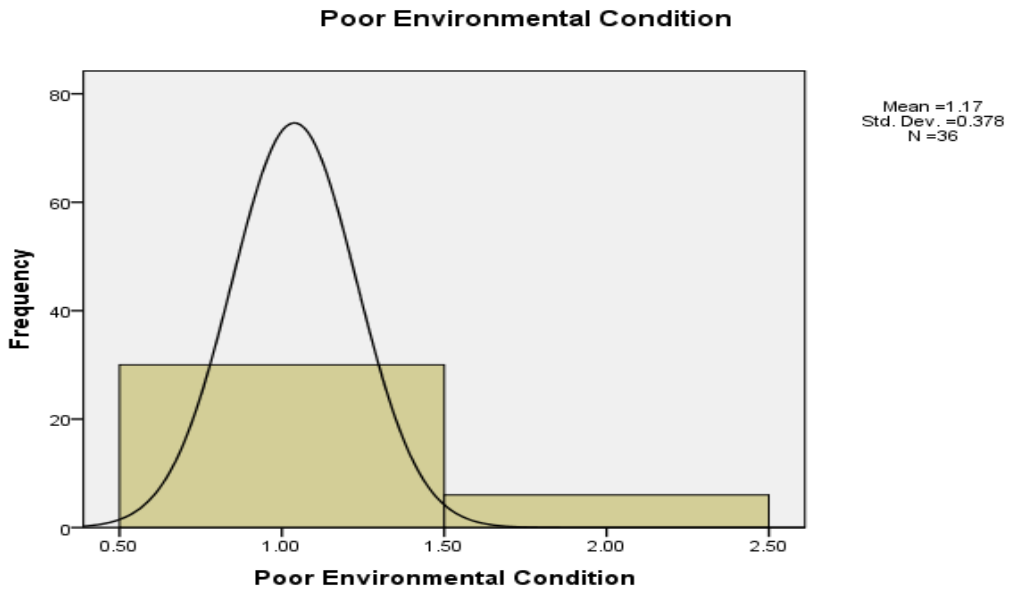
20
10
0
2.50
3.00
3.50
4.00
4.50
5.00
5.50
Lack/ insufficient funding from Government

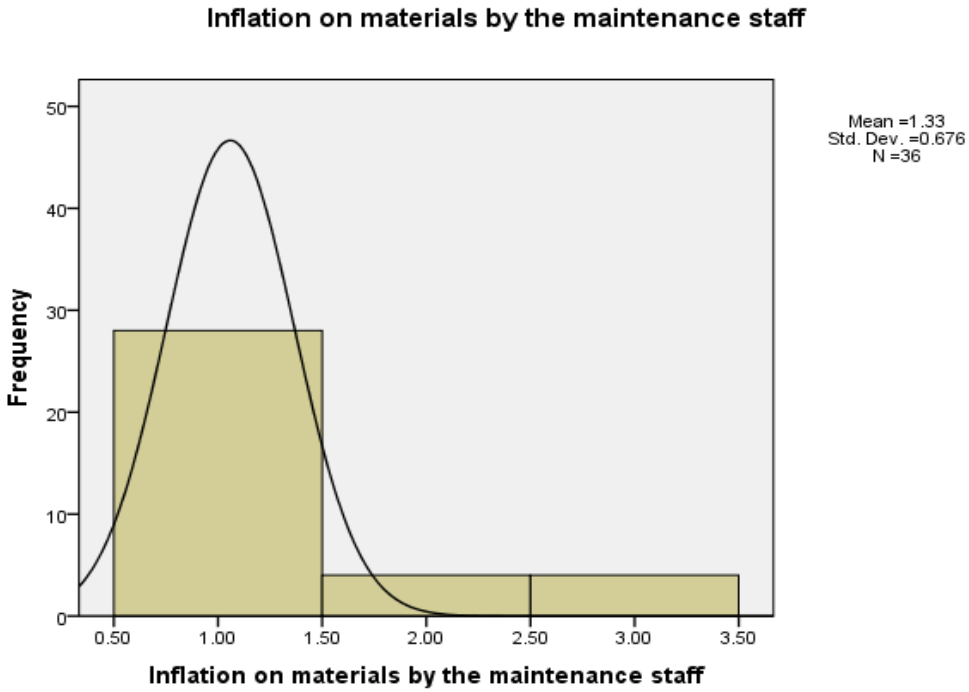

Users attitudes and misuse
Mean =3.53
Std. Dev. =0.845
N =36
Frequency
25
20
15
10
5
0
1.00
2.00
3.00
4.00
5.00
6.00
Users attitudes and misuse

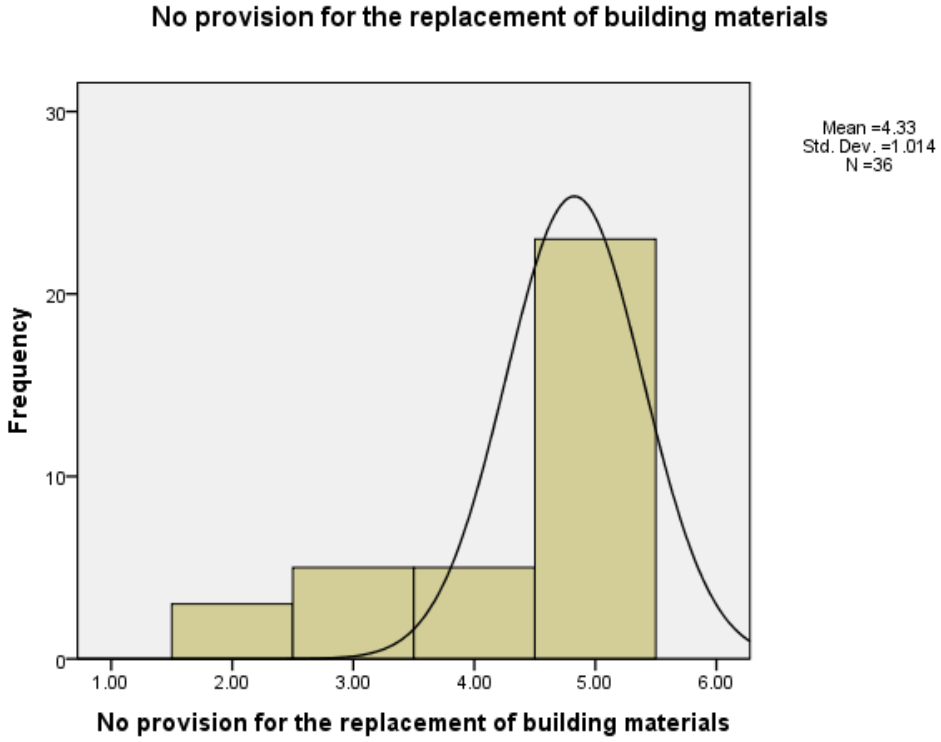

Inadequate training of the personnel
Mean =3.33
Std. Dev. =1.219
N =36
Frequency
12.5
10.0
7.5
5.0
2.5
0.0
1.00
2.00
3.00
4.00
5.00
6.00
Inadequate training of the personnel

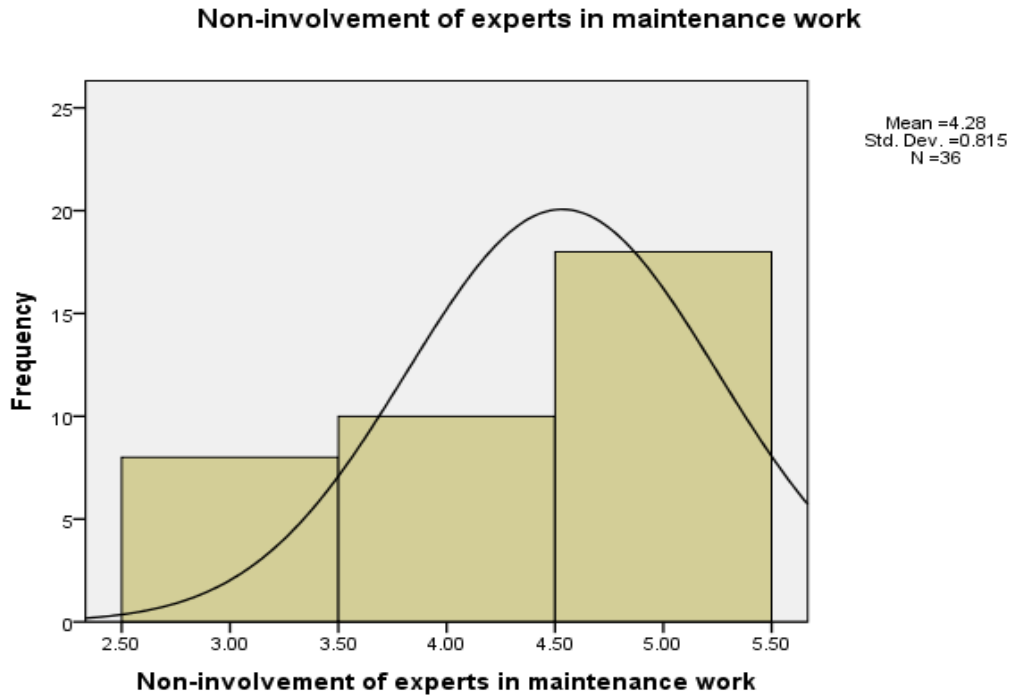

Non response to maintenance request
Mean =4.39
Std. Dev. =0.728
N =36
Frequency
30
20
10
0
2.50
3.00
3.50
4.00
4.50
5.00
5.50
Non response to maintenance request

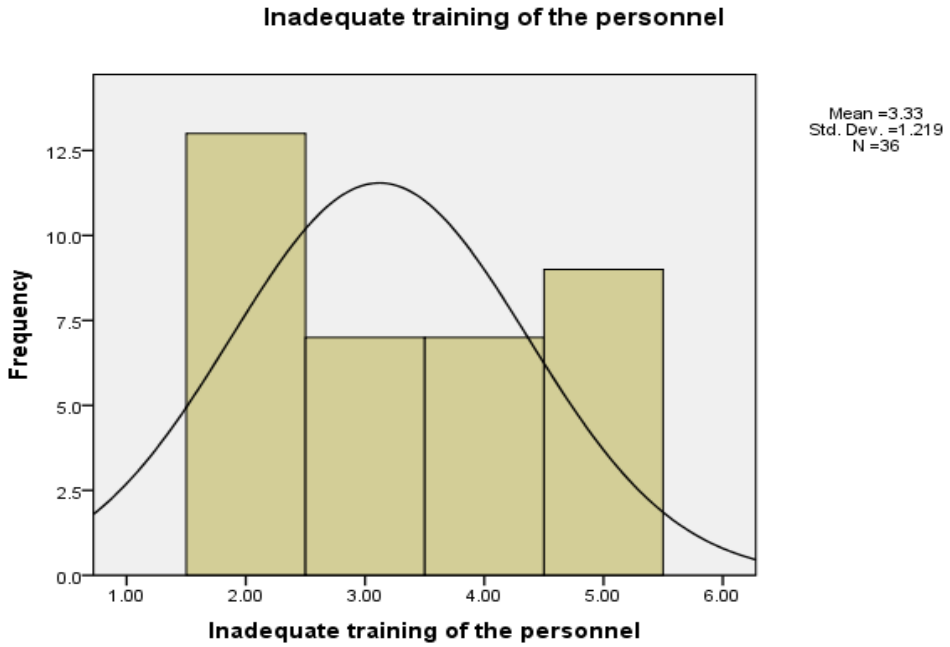

Pressure on School compound due to number of User
Mean =2.67
Std. Dev. =1.512
N =36
Frequency
12.5
10.0
7.5
5.0
2.5
0.0
0.00
1.00
2.00
3.00
4.00
5.00
6.00
Pressure on School compound due to number of User

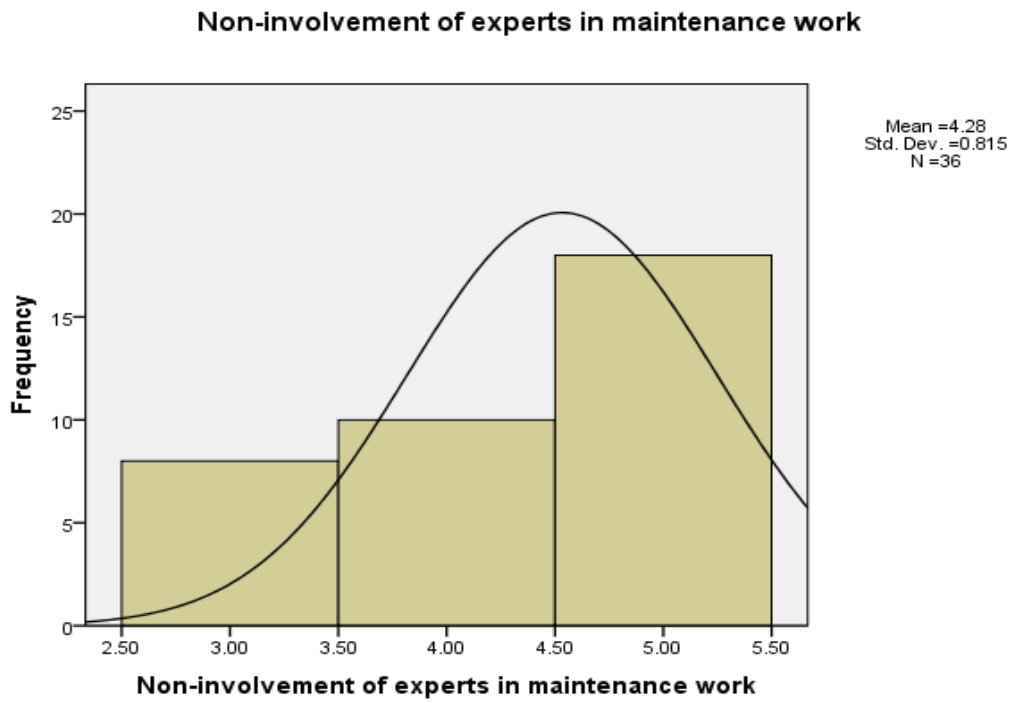

Poor Environmental Condition
Mean =1.17
Std. Dev. =0.378
N =36
Frequency
80
60
40
20
0
0.50
1.00
1.50
2.00
2.50
Poor Environmental Condition

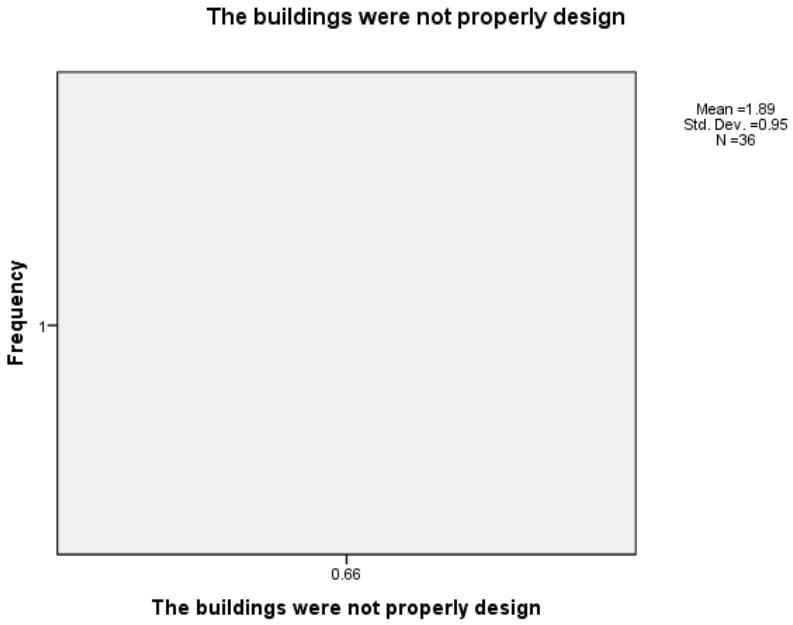

Inflation on materials by the maintenance staff
Mean =1.33
Std. Dev. =0.676
N =36
Frequency
50
40
30
20
10
0
0.50
1.00
1.50
2.00
2.50
3.00
3.50
Inflation on materials by the maintenance staff

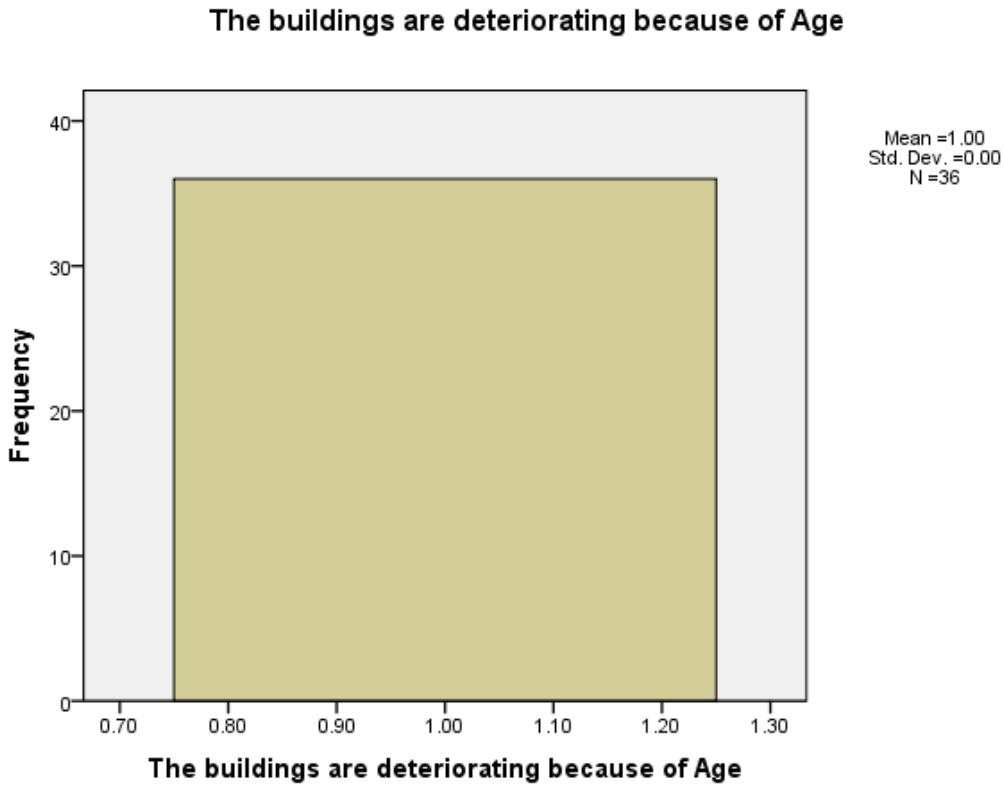

No provision for the replacement of building materials
Mean =4.33
Std. Dev. =1.014
N =36
Frequency
30
20
10
0
1.00
2.00
3.00
4.00
5.00
6.00
No provision for the replacement of building materials

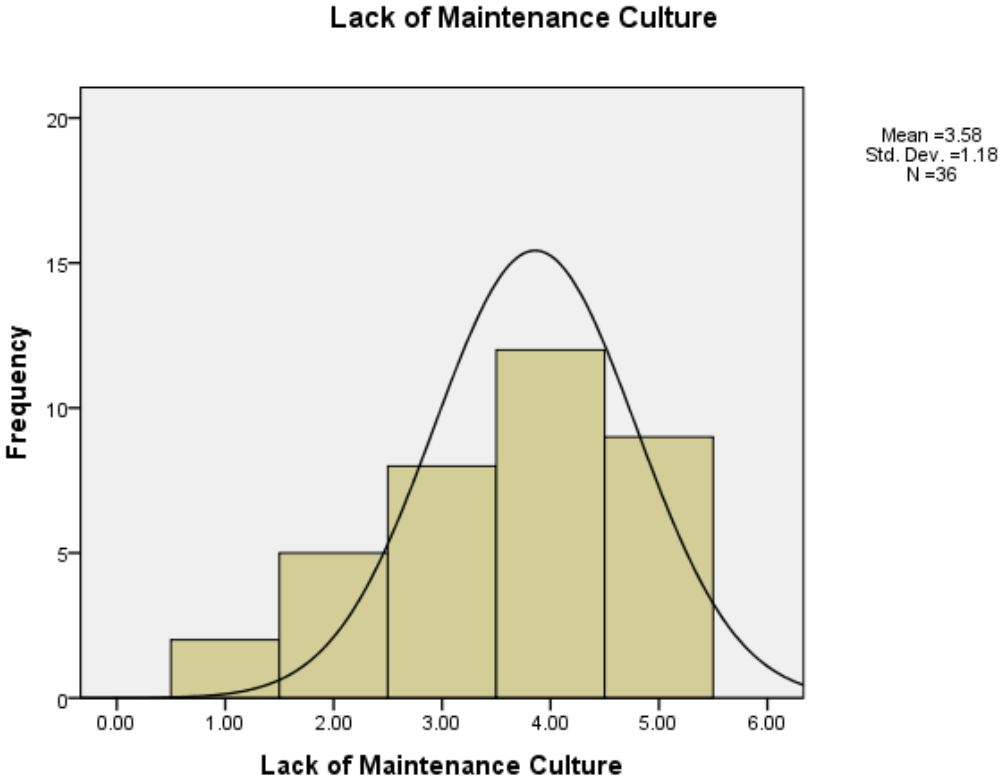

Non-involvement of experts in maintenance work
Mean =4.28
Std. Dev. =0.815
N =36
Frequency
25
20
15
10
5
0
2.50
3.00
3.50
4.00
4.50
5.00
5.50
Non-involvement of experts in maintenance work

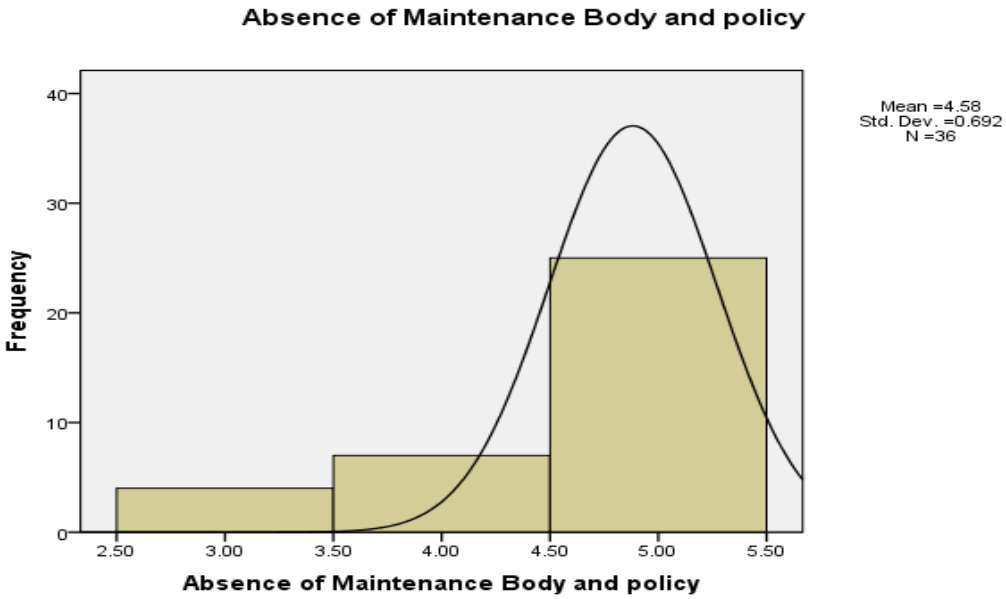

Inadequate training of the personnel
Mean =3.33
Std. Dev. =1.219
N =36
Frequency
12.5
10.0
7.5
5.0
2.5
0.0
1.00
2.00
3.00
4.00
5.00
6.00
Inadequate training of the personnel


Non-involvement of experts in maintenance work
Mean =4.28
Std. Dev. =0.815
N =36
Frequency
25
20
15
10
5
0
2.50
3.00
3.50
4.00
4.50
5.00
5.50
Non-involvement of experts in maintenance work


The buildings were not properly design
Mean =1.89
Std. Dev. =0.95
N =36
Frequency
1
0.66
The buildings were not properly design


The buildings are deteriorating because of Age
Mean =1.00
Std. Dev. =0.00
N =36
Frequency
40
30
20
10
0
0.70
0.80
0.90
1.00
1.10
1.20
1.30
The buildings are deteriorating because of Age


Lack of Maintenance Culture
Mean =3.58
Std. Dev. =1.18
N =36
Frequency
20
15
10
5
0
0.00
1.00
2.00
3.00
4.00
5.00
6.00
Lack of Maintenance Culture


Absence of Maintenance Body and policy
Mean =4.58
Std. Dev. =0.692
N =36
Frequency
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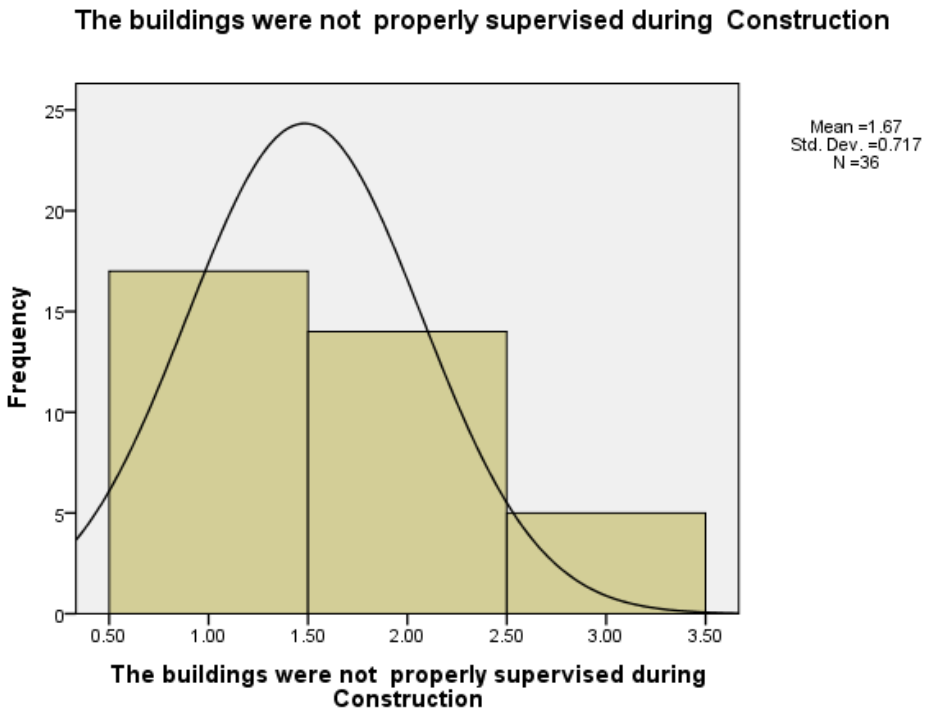
30
20
10
0
2.50
3.00
3.50
4.00
4.50
5.00
5.50
Absence of Maintenance Body and policy


The buildings were not properly supervised during Construction
Mean =1.67
Std. Dev. =0.717
N =36
Frequency
25
20
15
10
5
0
0.50
1.00
1.50
2.00
2.50
3.00
3.50
The buildings were not properly supervised during Construction