

ADAMA SCIENCE AND TECHNOLOGY UNIVERSITY
SCHOOL OF CIVIL ENGINEERING AND ARCHITECTIS DEPARTMENT OF
CONSTRUCTION TECHNOLOGY AND MANAGEMENT

**Assessment of Public University Building Maintenance Management in
Ethiopia (in case of Adama Science and Technology University (ASTU)
and Addis Ababa University (AAU)).**

**Graduate Project submitted in partial fulfillment of the requirement for
Master of Engineering in Construction Technology and Management**

By
Mosisa Takele

April, 2017
Adama

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Student: Mosisa Takele

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Adama

April 2017

DECLARATION

I hereby declare that this project study is the result of my own original paper towards the MSc and that to the best of my knowledge no part of it has been published by another person or presented for another degree in this university or elsewhere except where due acknowledgement has been made in the text.

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Sign :Date:.....

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Assessment of Public University Building Maintenance Management in Ethiopia (in case of Adama Science and Technology University (ASTU) and Addis Ababa University (AAU).

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ACKNOWLEDGEMENTS

I owe my special thanks to the almighty GOD for Empowering and giving me internal courage and strength to accomplish my educational career one step further. I would like to take this opportunity to express my sincere appreciation to my advisor, Mr. Yashasvi Raj, for his supervision, guidance, expert and valuable advice, usual assistance during the period I was carrying out this Project work.

I thank the Department of Civil Engineering and Architects, of Adama Science and Technology University

I am grateful to all those who participated in the questionnaire survey. At Adama Science and Technology University and Addis Ababa University to respond objectively all questionnaires.

I would like to express my sincere appreciation to my brothers Dr Birhanu Takele (candidate) for his valuable time to comment and advices for my project paper.

I do appreciate my Wife Wro. Ebise Melaku and my son Numan Mosisa for their encouragement and providing conducive atmosphere during my long hour work

Last, but not least the support of my friends and parent is invaluable in shaping me to the best of their capacity in a disciplined manner to develop self-confidence, believe in my own ability and not to give up under difficult situations and thus this work is dedicated to my daughter Kena Mosisa.

ABSTRACT

A building exists to serve the user's space requirement. The essence of maintenance is, therefore, to maximize the service life of a building, by delaying deterioration, decay and failure. Building maintenance management is a complex and multi-faceted thought process that involves planning, directing, controlling and organizing resources for the sustenance of the building's functional performance. The purpose of this project study is to assess the building maintenance strategy of existing management of ASTU and AAU on different item of existing building. Through extensive literatures review of other different country maintenance management system and the qualitative data collecting approaches, through structured and unstructured questionnaires and interview, also this project study aimed that to emerge the need of building maintenance management system that reflects on the efficient and effective use of maintenance resources and Building conditions. A structured maintenance management system and sustainable approach is the right direction. Along the line, the key factors affecting sustainable maintenance management system are economical considerations, and the obvious benefits relates to social matters.

And The project concludes by enumerating a number of recommendations aimed at providing the necessary framework for proper and effective maintenance of buildings. These are the need for public Universities to embrace preventive maintenance practice as a high priority rather than unplanned maintenance.

Managers are to oversee periodic inspections of buildings' conditions and create an inventory of buildings' components and equipment. Public institutions should ensure that their maintenance department is adequately staffed. There is also the need for a national policy on maintenance to be formulated to protect buildings, institution of a maintenance awards scheme for public institutions and establishing a maintenance fund to be managed for maintenance of public buildings in the country.

Key Terms: Maintenance, Maintenance strategy, Maintenance Policy, Maintenance Management, Maintenance Management system, Maintenance and Implementation.

ABBREVIATIONS AND ACCRONYMS

ASTU	Adama Science and Technology University
CPO	Construction Project Office (in ASTU &AAU)
BS	British Standard
UK	United Kingdom
AAU	Addis Ababa University
CMMS	Computerized Maintenance Management System
MMS	Maintenance Management System
MIS	Maintenance Information System
BM	Building Maintenance.
BPCDA	Beautification, Parks and Cemetery Development Agency (Ethiopia)

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CHAPTER ONE

1.1. INTRODUCTION AND BACK GROUND TO THE PROBLEM

Adama Science and Technology University and Addis Ababa University are the known higher institution in Ethiopia and which are playing a great role in the country development in producing educated manpower and different Technology innovations and researches held on.

The College of Veterinary Medicine and Agriculture is one of the colleges under Addis Ababa University. It was established in 1979 with the objective of producing animal health assistants (Diploma program). It is the pioneer veterinary college for the nation. Currently it is upgraded to college level with diversified disciplines. Seven departments are organized under this college. Veterinary education is offered in Bishoftu, a beautiful town surrounded by 7 crater lakes and located at a distance of 47 km south east of the capital, Addis Ababa, while the agricultural program is delivered in Fiche campus (144 km away from Addis Ababa in the North of the City). Adama Science and Technology University (ASTU) was first established in 1993 as Nazareth Technical College (NTC), offering degree and diploma level education in technology fields. With a few buildings using for Dormitories and class rooms . Later, the institution was renamed as Nazareth College of Technical Teacher Education (NCTTE), additionally. In 2003, a new addition came about—introduction of business education. Nonetheless, the new entries were solely meant for similar purposes: these graduates were also expected to help overcome the existing shortage of educators in vocational institutions.

Following its renaming by the Council of Ministers as Adama Science and Technology University in May 2011, the university has started working towards the attainment of becoming a center of excellence in science and technology, thereby. The university is also venturing out to the wider community and is currently engaged in various joint undertakings

It is known that the Ethiopian government boost the thirteen new universities and expansion of the existing universities in the country in the University capacity Building program by GIZ IS in this program ASTU and AAU is one of the university many buildings built in this campus, however, now days both Universities “Construction Project office” (CPO) engaged in construction of New buildings and Maintenance. because of this and the two universities location are nearby each other relative to other universities the project study take ASTU and AAU particularly collage of Veterinary and Agriculture for case study. And Building maintenance is one of the important current issues, which has attracted much researchers

attention, in building construction (Amani et al. 2012; Christian & Pandeya 1997; Fu, Kaya & Aouad 2007; Kishk et al. 2003; Lai, AW & Pang 2010; Olanrewaju, Khamidi & Idrus 2011), and the state of art in maintaining the building facilities sustainably is another topic which have been studied in many countries. The entire life cycle of the building include manufacturing of building materials, construction, operation, maintenance, demolition and removal, and the normal expected life span public building is 30 years, 50 years to 100 years' time frame upon the completion and occupation (Ding & Itoh 2002; Rojahn et al. 2011). In order to maintain the usability and efficiency of the building premises, there is a need to be regularly maintained and refurbished. Chanter and Swallow (2008) state that BS 3811 has defined maintenance as “a combination of any actions carried out to retain an item in, or restore it to an acceptable condition”. It is challenge that maintenance is the work undertaken in order to keep, restore or improve every facility, its services and surrounds to a currently acceptable standard and to sustain the utility and value of the facility. This may include refurbishment to raise the original standards where appropriate. In fact, the ability to upgrade an existing public building not only extends its useful life, but is also clearly a more sustainable option than the process of demolition and rebuilt (Bullen :2007). Maintenance works is an important function in organizations with significant investment in physical assets and plays an important role in achieving organizational goals (Tsang, 2002). The most important reason for implementing a maintenance management system is to measure the value created by the maintenance process. The effectiveness or failure of the maintenance management system may be judged by the maintenance condition of the facilities. It is therefore imperative that the management system adopted meets the predetermined standards from the outset. Therefore, the key focus for this project paper is to review and study the maintenance management of ASTU and AAU effectiveness and the challenge hindered to implement the managing system.

1.2. Statement Of The Problem

When maintenance is not well managed, it often leads to buildings that will be very expensive to own or operate in the long run (Spare, 2001; Christian et al, 2002).

Maintenance management is crucial especially in developing countries like Ethiopia in construction industry is highly increasing while the idea of maintenance management and technology were not implemented where maintenance budgets and managing system are constrained. All buildings should be well maintained to achieve an expected facility; and

protecting buildings from physical deterioration, hence effective Maintenance management is required.

Maintenance management is an area that has been given very little attention in public buildings and the higher institutions of the country. The deterioration of University buildings due to lack of maintenance management can lead to future financial burdens, pose legal and other issues that will affect the delivery of teaching and research. (David Gidudi Choka: 2012) By engaging in strategic approach to maintenance universities Buildings are bound to benefit from the increase and enhance effective use of Universities' physical assets. This state of affairs has been a common feature in other countries: (Mwebia, 1988). In as much as maintenance services department do a core function, their contribution to the universities of teaching and research should not be underestimated.

1.3. PROJECT OBJECTIVES

1.3.1. General Objective

The main objective of this study is to assess the extent to which maintenance management is developed and applied in public University and preparing as a check list manual document for the university maintenance management system effectiveness.

1.3.2. Specific Objectives

This study Intends to meet the following objectives

- i. To examine the maintenance management system used in the ASTU and AAU and highlight the shortcomings and inadequacies in their implementation
- ii. To identify the impact of the shortcomings in the maintenance management system on the maintenance condition of built facilities at these Universities.
- iii. To evaluate the maintenance management implementation in the two universities and the challenges hinder the implementation
- iv. To recommend the measures to improve the maintenance management systems in AAU and ASTU and put a corner stone for other researchers on maintenance management of other institution and public buildings in Ethiopia.

1.4. Project Questions

The study seeks to answer the following questions;

- i. Does the effectiveness of maintenance management system influence the maintenance condition of built facilities?
- ii. What measures can be adopted to improve effectiveness of maintenance management systems of AAU and ASTU?
- iii. What factors in the maintenance management process contribute to current maintenance condition of built facilities in public universities?
- iv. Do ASTU and AAU have a maintenance management system and what are the inadequacies of the systems?
- v. What are the factors influencing the implementation of maintenance management system in the two public Universities?

1.5. Justification For The Study

The two Universities were serving as a benchmark for best practice on many Technological innovative it's true that on maintenance management system in ASTU, AAU to be an exemplar to other Ethiopian public universities. A number of studies on maintenance of institutional buildings in many countries especially in public universities have concluded that most built facilities are in poor state of repair due to many factors. Few studies have critically studied the maintenance management system in place in these institutions and how much these systems have contributed to the condition of the built facilities. The universities have a relatively developed maintenance departments even if not fully isolated from the project office, the two universities engaged in wide maintenance work.

1.6. Scope Of Study

The study was focused on maintenance of built facilities that contribute directly to the core functions of universities building like: class rooms, Dormitories, dining Hall, lecture hall Library, and Administration and research office because of limited time ,resources and considering relative physical condition of the Building It was only focused mainly on Dining halls, libraries and Administrative buildings of the selected facilities at University of Adama Science and Technology and Addis Ababa University (Collage of Veterinary Medicine and Agriculture at Bishoftu)

1.7. Limitations Of The Study

A major limitation in the study was the respondents' thoughts towards the study. This had been a major barrier to accuracy of information in that, the respondents' were suspicious about the objectives of the study result implementation, negligence to respond the whole questions accordingly and short period of time for the study. To deal with this challenge, the action taken was convincing the respondents who were hesitant and made several follow ups to ensure most of the questionnaires were filled.

CHAPTER TWO:

2. LITERATURE REVIEW & THEORETICAL FRAMEWORK

2.1. Introduction

The literature review identified the variables of critical concern to the study. The project paper surveyed and examined existing literature related to the area of research. The primary sources of literature were past research projects, theses, and referred journals, published and unpublished articles on maintenance, maintenance management and maintenance condition assessment. The Literature Review also identified and defined the variables of main interest to the study. (David Gidudi Choka 2012)

2.2. Maintenance Management Process

2.2.1. Definition of Maintenance Management

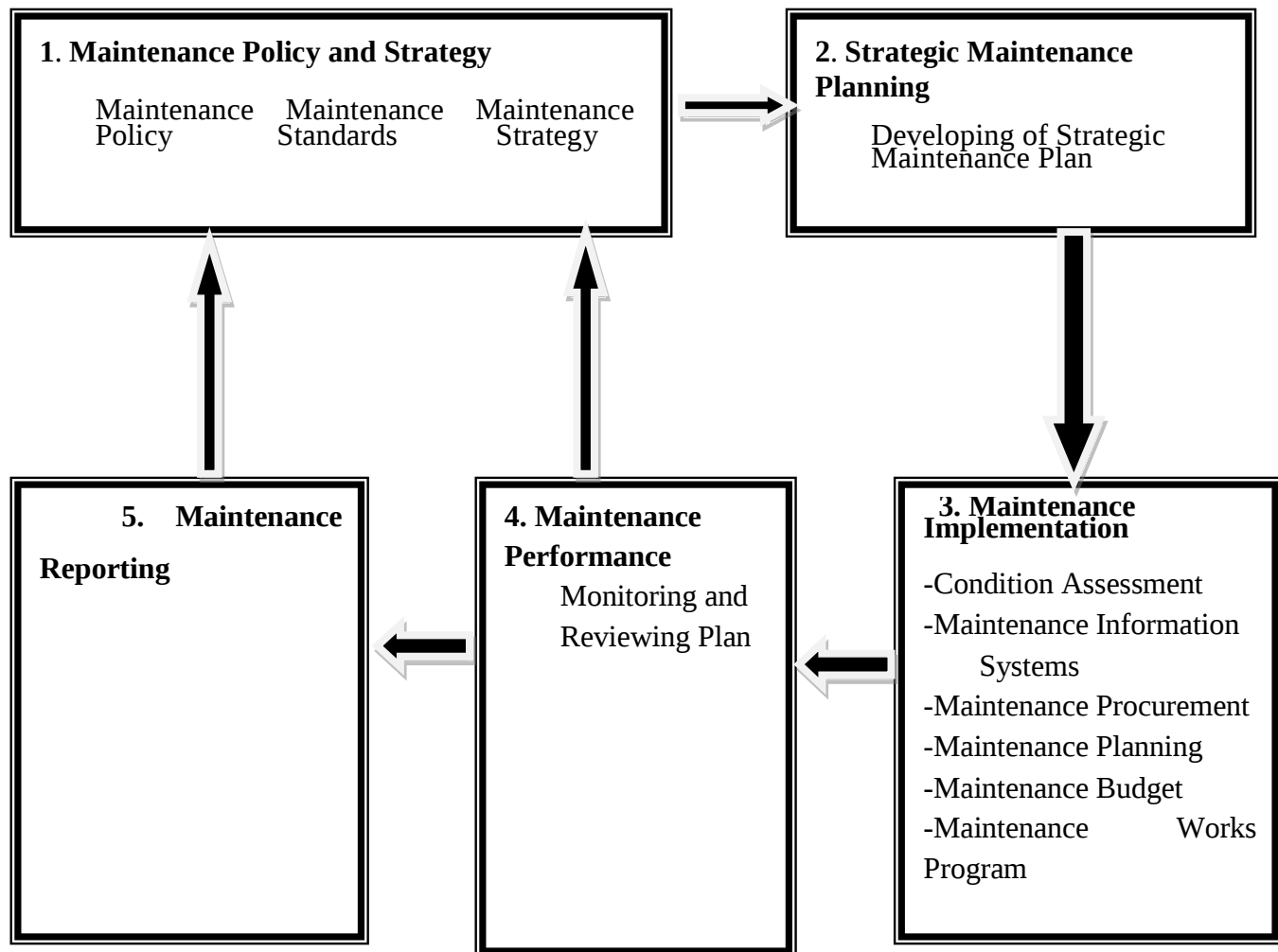
Maintenance is defined as the combination of all technical and administrative actions including supervisory actions, intended to retain an item in or restore it to a state, a state where it can perform a required function: (Seeley, 1972). Maintenance management is an orderly and systematic approach to planning, organizing, monitoring and evaluating maintenance activities and their costs. (David Gidudi Choka (2012) Maintenance management has also been defined as the organization of maintenance with an agreed strategy (Vanier and Lacasse, 1999). A good maintenance management system coupled with knowledgeable and capable maintenance staff can prevent health and safety problems and environmental damage; yield longer asset life with fewer breakdowns and result in lower operating costs and a higher quality of life. Maintenance management provides a framework for developing maintenance plans, tracking work accomplishment and preparing reports that compare planned and actual performance.

2.2.2. Maintenance Management Process

A Maintenance management process assists organizations in establishing a framework for maintenance works. Its objective is to achieve consistency in planning, implementing and reporting of building maintenance. It must be emphasized that the establishment of condition standards is fundamental to the maintenance management process. (David Gidudi Choka 2012) The development of condition standards provides a statement of the desired condition

standard to which assets should be maintained to enable an organization service delivery to be achieved effectively. Figure 2.1 illustrates the maintenance management process, which acts as a guideline for organizations in maintenance management.

Figure 2:1 Graphical Representation of Maintenance Management Process



Outputs from the maintenance management process include; Maintenance management plan, maintenance plan and the maintenance management system.

2.2.3. Maintenance Policy

Maintenance policy refers to a formalized set of rules and guidelines to achieve good maintenance practices. Maintenance policy has also been described as a written document that provides a management framework to ensure building assets are maintained appropriately to support the organization's strategic objectives. It is realized that maintenance activities

may not achieve the desired outcomes without a defined maintenance policy (Hackman & Scott) Lee (1976) defines maintenance policy as the ground rules for allocation of resources between the alternative types of maintenance actions that are available to management. According to Seeley, 1987 the benefits of a maintenance policy is the ability to formulate a long term maintenance strategy and prepare budgetary forecasts

In Ethiopia Despite the recommendation for the formulation of a comprehensive national maintenance policy there has no maintenance policy is formulated while the maintenance policy is considered as adding value to the existing building still there is thinking of aesthetic value as a regulation.

2.2.3.1. Buildings Maintenance Regulation in Ethiopia

A new regulation is being prepared by Addis Ababa Beautification, Parks and Cemetery Development Agency (BPCDA), which will compel building owners to renovate their properties regularly. The regulation, which is expected to be presented for the city cabinet in few months, will punish building owners if they do not comply with the regulation. According to construction experts, moist and/or unclean and rough surface of walls on which the paint is applied, mainly caused by poor workmanship, is by large the most common cause of paint failures causing hiccups such as blistering, peeling and staining. As a result, several buildings turn scruffy thereby impacting on the city's beauty. The Public Relation Head of BPCDA, told Capital that the regulation will help to make the city more attractive. "Some buildings are cracked, their paint faded, and some have tarnished looks. We weren't able to tell the owners to paint or maintain them because there was no law that support us." Also under consideration is punishing individuals who pluck plants on streets and squares. (By Staff | Capital Ethiopia April 30, 2016.)

2.2.4. Organization of Maintenance Management

Different authors have viewed good maintenance management differently. According to (Shake, (1995) the main factors that determine types of maintenance management structure to be set up are the principal function of the parent body. Maintenance departments operate within established organization structure and for this reason tend to be organized on the same way as the parent organization.

In setting up any organization structure for maintenance management top management should look into the following factors;

Firstly, the volume of maintenance work load to determine the staff, time required for inspections, estimating requirements, preparation of drawings and technical documents programming and control functions. Secondly the nature and complexity of maintenance work load and whether predominantly building or engineering will determine the desirable qualifications of the maintenance supervisory staff. Thirdly, the geographical over which work load is spread. The location and dispersal of maintenance work will influence the traveling time and hence the number of supervisors required for maintaining effective control. Fourthly, the timing of the work and in particular the need for certain works to be habitually undertaken outside normal working hours may demand some duplication of supervisory staff to ensure continuous control. Fifthly, the method of executing the work by direct labor or by contract

2.2.5. Organizational Structure for Maintenance

In the larger organizations, especially the public sector maintenance management structure tends to require elaborate administration. In addition to the top management in the strategic apex and the people who do the basic maintenance works in the operating core. As it grows larger, the organization may also find that it needs two kinds of staff.

First are the analysts who design the system concerned with the formal planning and control of work they form the techno-structure.

Secondly the support staff providing indirect services to the rest of the organization. Most maintenance departments in the public sector find they have to justify their action to outsiders because external control encourages bureaucratization and centralization

2.2.6. Maintenance Management Systems

A Maintenance Management System (MMS) is a reporting system designed to track daily maintenance activities. Maintenance management systems are used to plan, organize, schedule, control and evaluate maintenance activities using standardized procedures. The system tracks labor, material, equipment and contract costs". (Technical information Document, October 2000). The basic components of maintenance management systems developed include:

- The development of performance standards
- The determination of workload
- Scheduling of activities within the budgeted program to utilize resources in the most efficient manner

- The establishment of management information system which provides the basic knowledge required by managers for decision making

As the study by: (David Gidudi Choka 2012). Depending on the application and design, Maintenance Management Systems may have various formats and procedures but the basic principles are;

2.2.6.1. Asset inventory; Is a list of physical features of capital assets that require maintenance? The types of data to be kept vary with maintenance activity and the task required. A maintenance plan begins with the inventory of facilities and information on their conditions. Inventory and condition data provides maintenance managers needed to plan maintenance work.

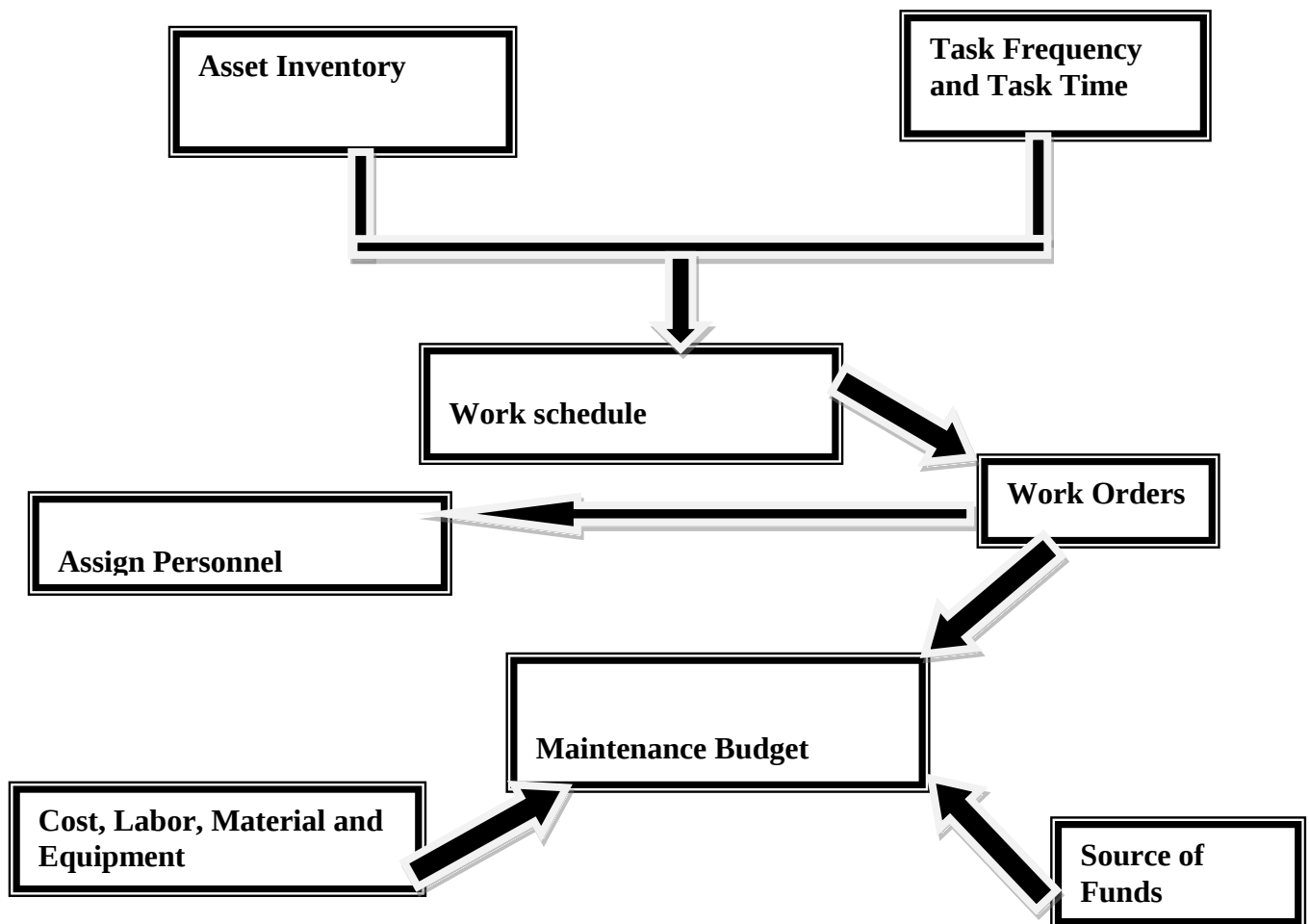
2.2.6.2. Task statement; is a detailed list of generic maintenance tasks performed for particular type of asset in conducting preventive or routine maintenance. Frequency Refers to how often the maintenance tasks performed. Task times indicate how long it will take to do such an amount of work. Each task statement relates to a specific appropriate for an asset. To prepare a set of tasks applicable to a particular assets one should review the physical features of an asset and maintenance manual to determine the maintenance tasks, task times and frequencies required.

2.2.6.3 Work Schedule; is a list of maintenance tasks done for the whole year for each asset. It can used to identify workloads. It serves as a basis of preparing and issuing scheduled work order for preparing the maintenance budget.

2.2.2.4 Work Orders provide information on what, where and how long and who carry out maintenance work. A Work order system is a standard way of processing maintenance work and provides uniformity in planning maintenance work. Work Orders are prepared from inventory data and task statements.

2.2.6.5. Maintenance Budget ;is a cost projection based on the costs of labor, equipment, material and other items required to do all the work identified in the work schedule. After the costs have been are calculated for the work order, the process is repeated for the remaining work orders to get the total cost required to maintain the identified work

Figure 2.2: Components of a Maintenance Management System



(Source: Maintenance Management Systems [http://www. Publications.gc.ca/collections/collections/p25-5-5-2-2000E.pdf](http://www.Publications.gc.ca/collections/collections/p25-5-5-2-2000E.pdf))

2.3. Objectives of a Maintenance Management System

The primary objectives of a Maintenance Management System include the following;

- Optimize the use of available funds, personnel, facilities and equipment through effective maintenance management methods.
- Provide accurate data for maintenance decision making
- Systematically identify maintenance needs or deficiencies
- Determine backlog maintenance
- Prioritize maintenance works
- Preparation of maintenance budget reports using systematic standardized procedures
- Monitor and document corrective actions expenditure and accomplishments
- Conduct comprehensive condition assessments

2.3.1. Best Practice Criteria for Effective Maintenance Management Systems

As the Study by (David Gidudi Choka 2012) having an effective maintenance management system in place is critical to ensure that maintenance expenditure is kept to a minimum. The development of an efficient maintenance management system is not an easy task and maintenance managers often faced with the task of determining what best practice, in their search for an effective maintenance management system. (Nkado et al 2006) Recent research has identified recognition by business managers that the standards of property and facilities management affect the organization as a whole in terms in terms of cost efficiency, service delivery and performance as well as protecting this substantial property asset. (Housley, 1996)

A study by (Nkado, R. 2006) on maintenance management systems in South African educational institutions an effective maintenance management system consists of the following main elements;

- Clearly formulated maintenance budget based on the maintenance plan
- Open and effective communication at all levels of the organization
- Computerization of maintenance management system
- Maintenance staff with the right qualification and experience at both top management and operational level
- Training of staff on maintenance technology
- Maintenance plan and a sound maintenance policy
- Setting maintenance standards
- Maintenance information Management- recording maintenance works and maintenance reports
- Flexible organization structure
- Regular Maintenance Inspections
- Life cycle costing at the design stage

A Maintenance Management System (MMS) is necessary for the optimal use of maintenance resources such as funds, personnel, facilities and equipment using standardized procedures.

To ensure that a Maintenance management system functions properly, several other subsystems are necessary. These subsystems include maintenance planning and scheduling, budgeting, inventory control system, work order system and maintenance information system. These components are not exhaustive but considered more critical in the proper functioning of a maintenance management system.

2.4. Maintenance Planning And Strategy

Maintenance strategy is a long-term plan covering all aspects of maintenance management, which sets direction for maintenance. Maintenance strategy describes the systems and procedures to use to plan and manage maintenance work. It also specifies the types of maintenance carried out.

Strategic maintenance planning is a structured process undertaken to ascertain the immediate, medium and long-term maintenance requirements of an organizations built asset portfolio. Strategic maintenance planning involves a review and analysis of the organization's building portfolio, corporate and service delivery objectives and the building maintenance environment.

Therefore, maintenance objective must be one of the organizational sub-business objectives. Planning of maintenance objectives have impacts on the facility management operation in terms of using different maintenance strategies, which influenced by the cost, quality and process directly and indirectly. Lai (2010) has studied the problems with budget allocation of building operation and maintenance for commercial buildings in Hong Kong. The importance of satisfying facilities management needs is usually recognized but the motivations of practitioners toward preparation of proper budgets are inadequate. (Ali et al. (2010))

2.5. Maintenance Project Concept

The technology of maintenance is concerned with all the factors that influence and cause the need for maintenance work. The occurrence of defects in the fabric of a building can result from many unrelated design decisions- unsuitable material, incorrect assessment of loads, inadequate appreciation of conditions of use and inadequate assessment of exposure. Exposure had been influenced by rainfall, direction of prevailing winds, microclimate, atmospheric pollution and aspect and height of building. The durability of the building material also influenced by frost action, crystallization of salts, sunlight, biological agents, abrasions and impact, chemical action and corrosion and incompatibility of modern building material. Cracks in building normally result from failure or defective Design, construction and are customarily understanding and unacceptable to occupants. If severe, they may result in loss of stability. In addition, cracks frequently give rise to air infiltration, heat loss and reduced sound insulation all of which cause reduced efficiency in buildings. Cracking generally caused by tensile stresses in excess of the tensile strength of the material, produced by externally applied loads or internal movements arising from temperature or moisture changes.

Other important concept of the maintenance can illustrate by reference to roof construction. A good roof, which well maintained last the life of a building and it, is false economy to save money on roof during construction, because if it ever requires replacement, it will cause serious dislocation of production, occupancy or other activities within the building. A leaking roof apart from causing considerable inconvenience to users can lead to accelerated deterioration of other parts of the building such as ceiling, floors and walls and can cause serious damage to decorations and electrical installation. Traffic over a roof should be kept to a minimum and where it is essential, appropriate walkways and access ladders must be provided. To ensure that roofs are adequately maintained, they should ideally be inspected every three (3) years or alternatively one-third each year.

2.6. Maintenance And Types Of Maintenance

2.6.1 Definition of maintenance

Maintenance is defined as the combination of all technical and administrative actions including supervisory actions, intended to retain an item in or restore it to a state, a state where it can perform a required function (Seeley, 1972). Maintenance is also defined as the restoring of an item to its original condition to working order. This can be achieved by repair, replacement of parts or total replacement of the item. Maintenance is also defined as work undertaken in order to keep or restore every facility i.e. every part of a site, building and contents to an acceptable standard. (BS 3811 (1964) (Syagga (1985) in his thesis defines maintenance in its simplest sense to entail the repair or replacement of worn out or damaged parts in order to keep the building in a standard corresponding to its original characteristics and functions. In this case maintenance does not include work necessitated by higher demands or for a change in the pattern of use that could not have been foreseen at the time of initial design.

2.6.2 Classification of Maintenance

Maintenance is classified generally into; planned and unplanned maintenance, the former being further divided into preventive and corrective maintenance. (Seeley,1976)

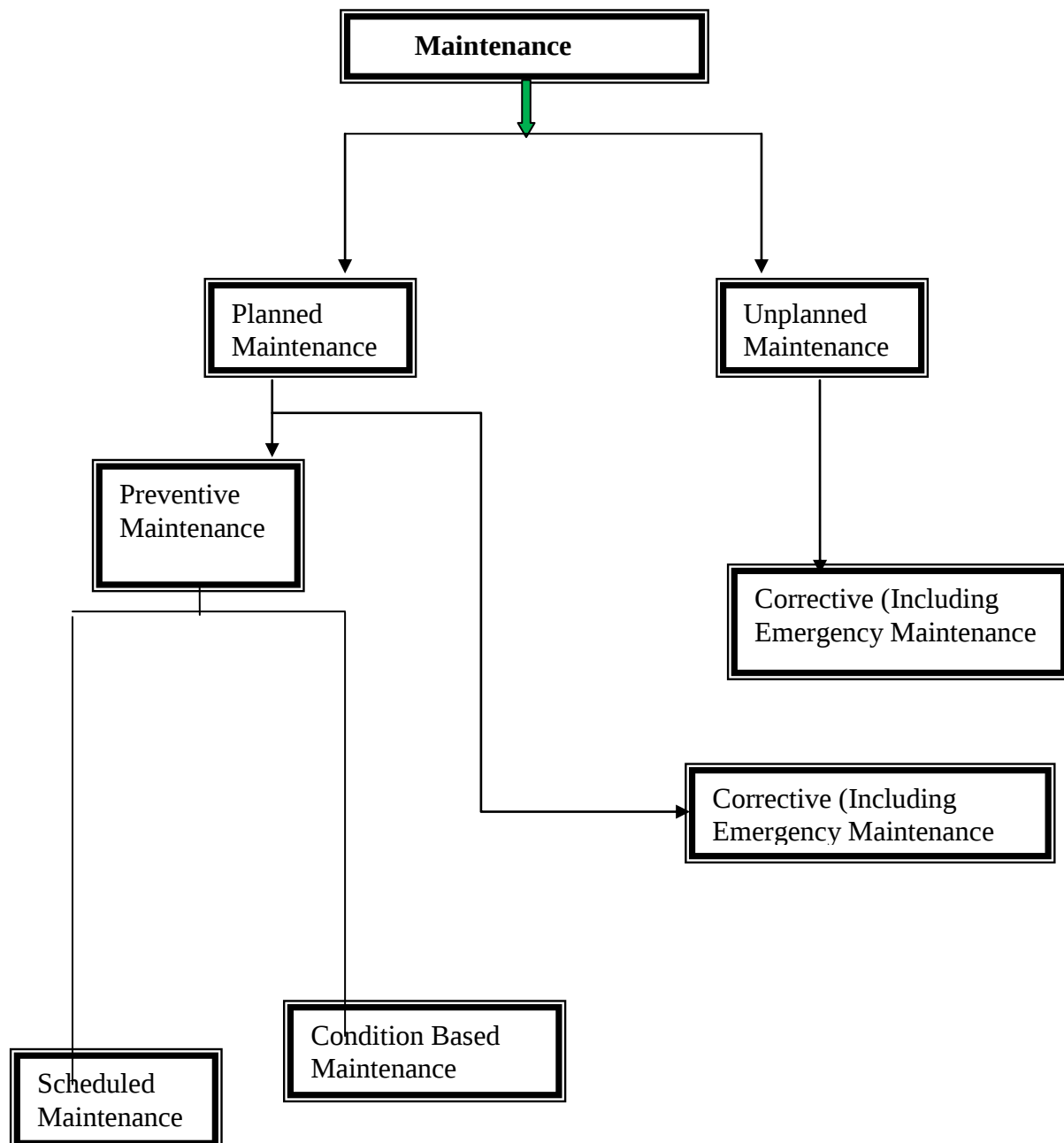


Figure 2.3 Types of maintenance (source: BS 3811: 1984)

2.6.2.1 Planned Preventive Maintenance; is work directed towards the prevention of a failure of a facility, carried out within the expected life of the facility to ensure its continued operation. Planned preventive maintenance is work organized and carried out with forethought, control and use of records to a predetermined plan. It can be divided into:-

- Scheduled maintenance- preventive maintenance carried out a predetermined interval.
- Condition based maintenance – preventive maintenance initiated as result of knowledge of the condition of an item.
- Preventive running maintenance – maintenance carried out while the facility is in service.
- Planned Corrective Maintenance; is work performed to restore a facility to operation or to an acceptable standard. It is carried out after failure has occurred and is intended to restore an item or facility to a state in which it can perform its intended function
- Unplanned Maintenance; is work resulting from unseen breakdown or damage due to external causes. It is based on the policy of waiting until the user lodges a complaint before maintenance action is taken. According to (Seeley, 1976) Maintenance work can also been categorized as predictable and avoidable;

Predictable maintenance ;is regular periodic work that may be necessary to retain the performance characteristic of a product as well as that that may be required to replace or repair the product after it has achieved a useful lifespan.

Avoidable maintenance; is the work required to rectify failures caused by incorrect design, incorrect installation or the use of faulty materials

2.6.3. Significance of Maintenance

Maintenance provides a critical support for heavy and capital intensive industry by keeping facilities in a safe operating condition. Today it is accepted that maintenance is a key function in sustaining long term profitability for an organization (Al-Sultan and Duffua, 1995). Maintenance works as an important support function in business or organizations with significant investment in physical assets and plays an important role in achieving organizational goals (Tsang 2002) Prior to the early 1900's maintenance was considered as wickedness. There was no alternative for avoiding failure and the general attitude was "It costs what it costs". After Second World War and with technological advances, maintenance was considered a support function. During (1950—1980) with the advent of techniques like preventive maintenance and condition monitoring, the perception was that maintenance can

be controlled and planned. Today maintenance is considered an integral part of business process and it's perceived as creating additional value (Liyanange and Kumar,2003) Poor maintenance has an adverse effect on the nation's economy; a badly maintained factor will not encourage productivity; commerce will not flourish in a poor environment; a badly maintained hospital will have an adverse effect on patients on trained staff and on the nation's health. The benefits of maintenance can be categorized generally into the social and economic benefits. On the economic front, it is of great significance not only because of the scale of expenditure involved but also its important to ensure that the nation's stock of building as a factor of production is used effectively as possible. The preservation of the value and utility of the stock of buildings is therefore essential to the economic well being of a country.

Socially it is widely accepted that the built environment expresses in physical form the complex social and economic factors which give structure and life to a community. The condition and quality of buildings reflect the public pride and confidence. There's little doubt that a dilapidated and unhealthy building in a decaying environment depress the quality of life and contribute to antisocial behaviors.

Generally the purpose of maintenance is to return or keep buildings or infrastructure in a functioning or operational condition. It protects the capital asset from decay thus from being a liability as a factor of production from being a source of discomfort to users. A properly maintained building retains both its capital and physical structure values for a longer period than a neglected property. Regular maintenance at a reasonable cost per annum avoids major ad costly repairs which would occur after failure has occurred.

2.6.4. Maintenance Process

The maintenance process starts with the maintenance objectives and strategy which are derived from corporate vision goal and objectives based on stakeholders expectations. Based on the maintenance objectives, maintenance policy, organization, resources and capabilities a maintenance program needs to be developed. The program is broken down into maintenance tasks. The execution of maintenance tasks is undertaken at specified times and locations as per the maintenance plan. Management must understand the importance of maintenance and match the plan to the vision, goals and objectives of the organization. The function of managing the maintenance process is maintenance management which forms the crux of this study and is discussed in the next section. Rapp and George, (1998) maintain that good maintenance

management systems are essential for economically viable and operationally safe buildings. A lot of work is required to set up a successful maintenance management system. The maintenance manager must also monitor the progress of the work periodically depending on the nature of the situation and the potential impacts of breakdowns. The maintenance manager must continuously review the maintenance budget and not wait until the end of the year. Any variance in costs for a particular asset should be identified and its cause determined and alternative solutions should be developed or actions taken to reduce time and costs. These steps will help improve the efficiency and effectiveness of the maintenance system

2.7. Maintenance Condition Standards

2.7.1. Introduction

Building performance can be measured in many ways, the most common being condition. A building's condition gives a measure of the effectiveness of current maintenance programmes because it determines the remaining useful life of components or systems and compares it with the full economic life expected, given good maintenance (Abbot et al, 2007). Condition however changes over time as the physical and operational environments impact on the building and regular, accurate and consistent assessment are therefore required to update current information provide for maintenance works done subsequent to the previous condition assessments and capture any significant changes in condition before they can impact on the performance of the building.

The condition of building asset relates to the physical state of repair and influences the physical and functional performance of the asset. The required standard of maintenance should depend on how much the failure to achieve the standard will affect the objectives of the parent organization or the users of the building or facility and how sensitive the users are to failure (Chepkorir, 2002) Maintenance can only be effectively managed if the maintenance demand is properly quantified and this demand is governed by the need to define the gap between current condition and the desired condition (Then, 1995). The desired condition or condition standard should be clearly defined. (Abbot, 2007) Lee (1987) outlines three ways in which Maintenance standards can be expressed;

Firstly in physical terms; whereby an element could be left to deteriorate up to a predetermined point before remedial action is taken. Presumably deterioration beyond this point would be detrimental to the users. Some buildings have been designed to specific

performances. These specifications can be used to express standards. These are called condition controlled maintenance.

Secondly; where studies have been carried out to determine their useful life of elements a frequency based maintenance system could be used so that times when to repair or replace are fixed in advance.

Thirdly; financial criteria which may take the form of a variable sum related to the cost of some primary functions or replacement value or fixed sum based on historical costs or analysis of anticipated benefits.

2.7.2. Developing Condition Standards

The establishment of condition standards for building assets is fundamental to the maintenance management process. Condition Standards provide a clear statement of the level to which assets must be maintained. Specifically condition standards;

- Are the starting point of departmental maintenance strategies and plans
- Are benchmarks against which building condition assessments results are evaluated
- Thus identifying the extent of any gap between desired and actual building condition
- Facilitate the analysis of actual condition over time
- Are important factors in the development of maintenance budgets and annual works programs
- Ensure that during condition assessments, maintenance activities bring s the assets to the specified condition.

Prior to developing building condition standards there's need for an organization to determine the service requirements of built facilities to meet service delivery requirements. Through this process, organizations will be able to determine the relative importance and required performance of each building asset to meet service delivery and organization's objectives.

The benefits in establishing building condition standards include;

- Ensuring that building assets are not under or over maintained
- Ensuring maintenance funding is used effectively
- Providing direction to maintenance service provider regarding expectations and the level of Maintenance required for each building asset
- Enabling comparison of the actual condition of building asset against a desired condition

- Standard and the identification of maintenance works required to bridge the gap.
- The factors to be considered in the development of desired building condition standards include;
- The aesthetics of the building including the general appearance, color, surface, integrity.
- The physical integrity of the building including water-tightness and structural stability that is required.
- Compliance with statutory requirements. The functional performance and reliability of the services required including the operational performance of systems, design compliance and acceptability of defects. The standards developed for the condition of the building asset must adequately reflect the asset performance required to meet service delivery demands.

The steps involved are summarized as follows;

- Determine service delivery requirements
- Classify building assets in terms of:-
 - a. Criticality of their function to meeting core services of the organization
 - b. Functionality-how well the facility fits within the operation of the business and the design of the space of current use. Establish condition standards and assign ratings.

Prior to developing building condition standards there is need to determine the relative importance and required performance of each building asset to meet service delivery and organizations objectives. The actual facility condition will be compared against the desired maintenance standard. This is done through condition assessment. Any variance from the standard will form the basis for maintenance planning. Each facility will be allocated a maintenance grading to identify the maintenance standard that is required for the particular asset. Maintenance standards, conditioning, auditing and frequency of servicing/maintenance will vary depending on the importance of the facility in achieving core organizational needs and strategic priorities.

2.7.3. Assigning Condition Ratings

After identifying the requirements for each building asset, an organization or maintenance department must decide how they will assign condition standard ratings. The approach to

determine these ratings must be outlined in the maintenance policy. Once determined, condition ratings form the basis regarding the level to which buildings must be maintained. Any proposals for disposals, refurbishment and any future changes to service delivery will impact on the settings of standards and should be considered when assigning standards. In particular, the life cycle of the asset needs due consideration. Where assets are meeting the end of their economic life, the condition standards are not set too high and causing assets to be over maintained.

Standards can be assigned to buildings as:

- Overall assets; Amenity Blocks, Halls of Residence: Lecture dormitories
- Element/Element Grouping; Substructures, superstructure; Finishes; Services
- Sub-Elements: Floor Finishes, Wall Finishes, Sanitary Fittings and Electrical installations

The criticality of asset portfolio, the relative importance of the building and the criticality of the elements and sub-elements will dictate how building conditions should be assigned. In the case of the less complex and critical built assets, building condition standards may generally be assigned for the overall asset or element grouping.

As the more complex, critical and strategically important assets will generally have specific performance requirements that will need to be specified in detail. Where an organization has a mixture of asset classifications different methods of assigning standards may also be required for the various asset classifications.

Ratings should be used in the condition assessment to identify gaps between the desired and actual condition of buildings. On the basis of the assessment maintenance works required to return the buildings to desired standards can be determined. Appropriate detailed and well documented standard ratings provide a clear statement of an organization's expectation regarding the maintenance of their portfolio.

Where condition standards are specified at overall building level, detailed descriptions of what is meant by the ratings should be articulated in terms of condition standards of key elements most critical to delivery of services. This is because more complex and critical building elements will generally have specific performance requirements and these elements may need to be maintained above the required standards required of the overall building.

2.7.4. Review Of Condition Ratings

It's important that assigned building condition standards are reviewed regularly to ensure buildings do not become over or under rated due to changes in service delivery requirements over time that the standards reflect the true needs of the asset and that resources are used efficiently. The review should be undertaken prior to the establishment of the annual condition assessment program so that any changes may be taken into consideration and incorporated in service delivery arrangements.

2.7.5. Risks Involved In Condition Ratings

The application of building condition standards has the following inherent risks:

- Establishing standards that are too detailed and impractical or costly to practice
- Deterioration and loss of value of the asset to the point where the organization's service delivery is ineffective and inefficient if the standard is set too low and
- An increase in maintenance cost if the standard set is too high internationally there seems to be a tendency to favor a five point rating scale for condition standards. A five point rating system has been developed and refined through experience and sustained research and development (Abbot, 2007) The Department of Public Works, Queensland Government, Australia (1999); also proposes a five point rating scale in its Maintenance Management Framework Guidelines for Condition Standard Rating as shown in the following table below.

Table 1.0 : Condition Standard Ratings

Rating	Condition Standard	Performance Standard
5	BEST Asset to be in best possible condition. Only minimal deterioration will be tolerated	Highly sensitive functions with critical results (e.g hospital operating theater) or high profile public building
4	GOOD Asset to be in good operational and aesthetical condition, benchmark against industry for that class of asset.	Operations requiring good public presentation and high quality working environments e.g health facilities, modern multistory CBD building
3	REASONABLE Asset to be in reasonable condition fully meeting operational requirements	Functionally focused asset at utility level

Rating	Condition Standard	Performance Standard
2	MINIMUM Condition needs to meet minimum operational requirements only	Functions are ancillary only with no critical operational role or asset has limited life
1	HOLD IN Condition can be allowed to deteriorate marginally maintained at minimum cost comply with statutory requirements	Functions have ceased; the asset is dormant on hold pending disposal, demolition

2.8. Condition Assessment System

The current condition of the fabric, elements or building and the maintenance work required, to restore the fabric, elements or building to the desired condition, primarily determine the cost and timing of maintenance works (Then,1995) . Without this information cost effective planning and management of building maintenance are impossible.

Buildings are complicated three-dimensional configuration of a diverse range of fabrics and materials, which deteriorate at different rates depending on use applications and environmental conditions. Because the deterioration of fabric and materials is varying and ongoing process information on the conditions of these fabrics and materials tend to age rapidly and regular accurate and consistent assessment are therefore essential to effective building maintenance management. The type and extent of maintenance work required to restore the fabric, element or building to the desired condition (standard) should form an integral part of the condition assessment exercise. “Effective building maintenance requires the correct diagnosis of defects and implementation of the correct remedial measures, all based on sound technical knowledge, otherwise there can be additional waste of materials, labour and money since the work will in all probability have to be done again. Observing and rectifying a defect at an early stage is likely to reduce repair costs” (Seeley, 1987)

Table 2.0 sets out the commonly used condition ratings for describing the current/existing condition of a building or built facility. The condition rating is also referred to as condition index

Table 2. 2: Condition Assessment Ratings/Condition Index

RAT	CONDITION	DESCRIPTION
5	AS NEW/ VERY GOOD	The fabric, element or building is either new or has recently been maintained: does not exhibit any signs of deterioration

RAT	CONDITION	DESCRIPTION
4	MINOR REPAIRS/GOOD	The fabric element or building exhibits superficial wear and tear, minor defects, minor signs of deterioration to surface finishes and require maintenance/servicing. It can be reinstated with routine scheduled or unscheduled maintenance
3	SERIOUS REPAIR FAIR	Significant sections or elements require repair usually by a specialist. The fabric element or building has been subjected to abnormal use or abuse and its poor state of repair is beginning to affect surrounding elements. Backlog maintenance work exists
2	CRITICAL REPAIR BAD	Substantial sections or elements have deteriorated badly, suffered structural damage and require critical repairs, upgrading or replacement. There is a serious risk of imminent failure. The state of repair has a substantial impact on surrounding elements or creates a potential
1	CONDEMN /REPLACE/VERY BAD	The fabric element or building has failed, is not operational or deteriorated to the extent that it does not justify repairs but should rather be condemned or replaced. The condition of the element actively contributes to the degradation of surrounding elements or creates a safety, health or life risk.

Condition assessment generally comprises;

- Physical inspection of a building to assess the actual condition of the building and its individual elements or services in comparison to the specified condition standard.
- Identification of maintenance works required to bring the condition of the building and its services up to, maintain at the specified condition standard.
- Ranking of maintenance works in order of priority
- Determination of actions by assessor to mitigate any immediate risk until remedial works or other actions are taken to address problems

2.8.1. Frequency of Condition Assessments

The frequency of condition assessment is usually determined by the maintenance department or organization depending on the nature of the building and its elements or services. The more critical and complex an asset is, the more likely it is that condition assessment will be required more often.

The following should also be taken into account when determining assessment intervals;

- Intensity and extent of use of the facility by occupants and other members of public
- Exposure to harsh environmental conditions
- Age of the building and its components
- Costs, risks and benefits of assessment interval adopted
- Likelihood of possibility of health and safety or other environmental issues occurring

Development of condition standards for facilities is the benchmark for the maintenance management process. Establish of condition standard is vital in the design of a maintenance management system as it provides a point of reference during condition assessment process to determine the maintenance needs of the facilities. If a condition standard is not set for particular building or facility there's a likelihood of over or under maintaining the building/facility. It is prudent for maintenance managers to set such standards, which will form a yardstick of evaluating effectiveness of their maintenance strategies. A comparison between the desired condition and actual condition of a building would provide a basis for making decisions on the maintenance of the building Condition Assessment forms a crucial facet of a maintenance management system. The overall result of a systematic and objective condition assessment is that adequate and reliable information is made available for effective maintenance planning scheduling and implementation. The condition of a building could be a pointer of an ineffective maintenance management system especially where there are no condition standards set for the facilities from the onset.

CHAPTER THREE:

3. PROJECT STUDY METHODOLOGY

3.1. Introduction

This chapter outlines the how the Project study seeks to find answers to the study questions emanating from the project problem. In this paper the variables of the study. The proposed instruments used in the collection of data are also outlined in this chapter. Techniques that are used in the analysis of the data collected by the writer are also outlined in this chapter.

3.2. Research Design

A research design is the plan and structure of investigation to obtain answers to project questions. The strategy used in the study to answer the questions is exploratory case study. The case study strategy has considerable ability to generate answers to Why?’ as well as What and How questions. Case study method is an in-depth study of one or a few of events or cases in order to understand the phenomenon being studied. The case study approach places more emphasis on full analysis of a limited number of events or conditions and their interrelationships. It is also preferable in examining contemporary events but where the relevant behaviors cannot be manipulated. The case study approach allows to retain the holistic and meaningful characteristics of real life events such as individual life cycles, organizational and managerial processes.

It’s important to note that a case study is selected for analytic generalization and not for statistical generalization. A case study is not a sampling unit. (Yin,1984). Analytic generalization can be used whether the case study involves one or several cases. A case study like an experiment does not represent a sample and is generalize to theoretical propositions and not to populations or universe. The Project study objective is to confirm, challenge or to extend existing theory.

In reference to this study the project studies the selected public universities in Ethiopia particularly ASTU and AAU extensively in order to have an in-depth understanding of their maintenance management system and how it impacts on the maintenance condition of built facilities

3.3. Sample frame/ unit of analysis

The sample frame for this study includes all buildings in the institutions. Sampling in the study was especially for selecting facilities for condition assessment. The population consists of buildings at ASTU University, and AAU University. The targeted buildings are Dining halls, libraries and Administration office the Buildings are selected because of that less in number than types of Building. Purposeful sampling was employed in narrowing the sample frame to only educational facilities and random sampling to select the actual buildings to be analyzed. The sampling technique selected for this study is purposive sampling. This sampling technique allows the project to use cases that have required information with respect to the project objectives.

3.4. Data Collection Method

Data's collected from the population using the following instruments: interview schedules, structured questionnaires and physical observation of buildings sampled for the study.

3.4.1. Primary Data Collection

3.4.1.1. Structured and unstructured interviews

Structured interviews targeted maintenance managers. The study targeted that the senior managers at maintenance departments. The purpose was to evaluate the organizations maintenance management system. Unstructured interviews will identify preliminary issues which will assist the project formulate a good idea of what variables need further in-depth investigation. These interviews could result in identification of several critical factors relating to the problem. Structured interviews will further pursue issues touching on the study problem raised by the unstructured interviews.

3.4.1.2. Observational Surveys

The observational surveys were mainly focused on the condition assessment of the sampled buildings. The project had predetermined aspects of maintenance condition which was form the basis of the observation schedule used. The purpose of observation schedule is to record the status of the buildings as they are in their natural setting. By simply observing and recording the phenomena of concern to the study.

3.4.1.3. Questionnaires

The proposed use of questionnaires which will be self- administered to respondents which was considerably reduce the time and cost involved. The questionnaire will be constructed in a manner that covers the areas relating to the main study objectives so that the information obtained conforms to these objectives and assists in a better understanding the project study problem.

3.4.2. Secondary data

Secondary data was collected from analysis of related and relevant literature and internet sources on the World Wide Web.

CHAPTER FOUR

4. DATA PRESENTATION AND ANALYSIS

4.1. Introduction

This chapter presents the results, analysis and findings on the data collected. Analysis of the results was done according to the research objectives. The data examined the maintenance management system in the two public universities; University of Adama science and Technology and Addis Ababa University. The systems were compared against best practice for effective maintenance management systems. A survey of the maintenance condition was also carried out on selected buildings at the universities. This is to establish whether these practices have a bearing on the maintenance condition built facilities in the university

4.2. Maintenance Policy And Strategic Planning

All the maintenance managers interviewed have qualifications with at least undergraduate degree training or backgrounds relevant to Engineering disciplines:

None of the universities maintenance departments had a well-defined and documented maintenance policy.

None of the maintenance departments had a departmental strategic plan for managing maintenance works. They operated within the institutions strategic plan, which broadly touched on maintenance works. The maintenance strategy for all the universities was corrective maintenance with little planned preventive maintenance.

None of the universities set minimum condition standards at which their buildings should be maintained. The challenge in setting standards was due to age of buildings, complexity of the exercise, lack of knowhow and personnel to effectively carry out the exercise.

All the maintenance managers prepare an annual maintenance works program as is a requirement of performance contracting that has been introduced in the two Universities. Rated their implementation as Good while rated the implementation as average due to different challenges in the actual implementation. Addis Ababa University has maintenance manual with little information. While Adama Science and Technology University indicated that, they have no manual, which outlines all information regarding maintenance.

4.2.1. Maintenance Information system

In both universities asset registers containing information on all buildings are recorded manually and kept the data in facility department or directorate

None of the University has a computerized database of all maintenance works executed recorded by a data entry clerk. Addis Ababa University had initiated processes towards computerizing its maintenance works.

None of the universities had put in place a computerized maintenance management system and relied on manual filing of maintenance information. The main challenge raised of instituting a CMMS was the high cost of acquiring the software based programme. And Qualified and Experienced staff members due to the department organization structure and less salary payments in relative to payment outside the Universities for Technical person.

4.2.2. Organization of Maintenance

Addis Ababa University organization structure for maintenance is decentralized with autonomous maintenance units for routine and preventive maintenance while Adama science and Technology University is Construction and Maintenance department headed by manager. Further the maintenance officer is directly the technical head of the building maintenance function and advises the manager on the technical issues relating to maintenance.

The two Universities have shortage of Budget of Maintenance and managed centrally with other annual budgets which are planned as a lump sum for maintenance work and the information from the respondents' show that as a maintenance budget is limited and sometimes it is a force measure work and forced to use other budgets due to its urgencies. Managers at the universities concurred that the number of staff at the operatives' level is insufficient to deal with the demand of maintenance requests. At both universities there's heavy turnover of skilled labor due to less payments.

At both universities there is no training policy for staff formulated by the human resource division

4.2.3. Implementation of Maintenance

The two Universities reported that 95% of their maintenance works are executed by direct labor and outsources about 5% of its major maintenance works.

Both Universities are responding as they are respond for the maintenance request with in one to three months.

4.3. Present Maintenance Condition Of Buildings

This section examines the current maintenance condition of buildings at the Universities of ASTU and AAU. A building constitutes of various elements each performing specific functions. The effective functioning of these elements determines the condition of the building. All the elements have well defined and distinct functions irrespective of the design of the building, its specifications and constructions. The condition rating allocated per building survey was on the scale below:

Table 4.1 The condition rating scale of the building survey

Rating	Condition	Description
5	AS NEW/ VERY GOOD	The fabric, element or building is either new or has recently been maintained: does not exhibit any signs of deterioration
4	MINOR REPAIRS/GO	The fabric element or building exhibits superficial wear and tear, minor Defects, minor signs of deterioration to surface finishes and Requires maintenance/servicing. It can be reinstated with routine scheduled or unscheduled maintenance
3	SERIOUS REPAIRS/FA	Significant sections or elements require repair usually by a specialist, The fabric element or building has been subjected to abnormal use or abuse and its poor state of repair is beginning to Affect surrounding elements. Backlog maintenance work exists
2	CRITICAL REPAIRS/BA	Substantial sections or elements have deteriorated badly, suffered Structural damage and require critical repairs, upgrading or replacement There is a serious risk of imminent failure. The state of repair has a substantial impact on surrounding elements or creates a potential health safety risk
1	CONDEMN /REPLACE/ VERY BAD	The fabric element or building has failed, is not operational or deteriorated to the extent that it does not justify repairs but should rather be condemned or replaced. The condition of the element actively contributes to the degradation of surrounding elements or creates a safety, health or life risk.

The maintenance condition of buildings for this study will be done by assessing the following elements:

- a. External finishes
- b. Internal finishes
- c. Suspended floor
- d. Doors
- e. Windows
- f. Electrical Installation
- g. Mechanical fittings
- h. Roofing
- i. Sanitary Installation

This part evaluates the current general maintenance situation of the Dining hall, Library, and Administration or office buildings (three buildings) on average value of field survey of the two public Universities in the AAU and ASTU in relation to the building elements. A building is made of several elements with each performing specific functions. The effective functioning of these elements determines the condition of a building. All the elements have well defined and distinct functions irrespective of the design of the building, its specifications and construction. The maintenance condition of the buildings will be done by assessing the following elements from the field survey of the respondents and the result of the data is calculated in two forms for the two Universities for three Blocks and summarized in another table and the comment had been written based on the calculation of the percentage for the two obtained by number of respondent for each rating scale divided by total respondents for each University and compared on summery form then ,By taking the average value of the two and comparing with the rating scale the comment had been written in the right end column of the Table

Table 4.4 Evaluation of Building elements

4.4.1. External Finishes

External finishes enhances the beauty of buildings and the built environment in general and protects the buildings against vagaries of weather. The predominant external finish for most the two universities buildings is paint. Paint as a finishing material adds aesthetic value of the physical buildings as per the architectural designs.

The three Buildings average maintenance condition observed for the two Universities analyzed as follows for the selected Building Elements.

University/ Rating	ASTU		AAU		Composite Score	
	N ^o Respondents	%=N ^o R/T	N ^o Responder	%	N ^o Respondents	%
5-Very Good	2	9.09	1	5.56	3	7.50
4-Good	8	36.36	6	33.33	14	35.00
3-Fair	11	50.00	9	50.00	20	50.00
2-Bad	1	4.55	2	11.11	3	7.50
1-Very Bad	0	-	0	-	0	-
Total	22	100.00	18	100	40	100

Summary

University	N ^o Respondents	%	Total Condition Rating Score	Average Condition Rating	Comments on maintenance condition
ASTU	22	55.00	77	3.50	Fair
AAU	18	45.00	60	3.33	Fair
Composite	40	100	137	3.42	Fair

Source: Field Survey

From these evaluation table we conclude that the composite value shows that the maintenance condition is fair that mean Significant sections or elements require repair usually by a specialist, The fabric element or building has been subjected to abnormal use or abuse and its poor state of repair is beginning to affect surrounding elements. Backlog maintenance work exists.

4.4.2. Internal Finishes

4.3.2.1 Floor Finishes

University/ Rating	ASTU		AAU		Composite Score	
	№ Respondents	%	№ Respondents	%	№ Responde	%
5-Very Good	4	18.18	1	5.56	5	12.50
4-Good	5	22.73	7	38.89	12	30.00
3-Fair	12	54.55	9	50.00	21	52.50
2-Bad	1	4.55	1	5.56	2	5.00
1-Very Bad	0	-	0	-	0	-
Total	22	100.00	18	100	40	100

Summary

University	№ Respondents	%	Total Condition Rating Score	Average Condition Rating	Comments on maintena condition
ASTU	22	55.00	78	3.55	Fair -Good
AAU	18	45.00	62	3.44	Fair
Composite	40	100	140	3.49	Fair

4.4.2.2 Internal Wall Finishing work

University/ Rating	ASTU		AAU		Composite Score	
	N ^o Respondents	%	N ^o Respondents	%	N ^o Respondents	%
5-Very Good	5	22.73	4	22.22	9	22.50
4-Good	8	36.36	7	38.89	15	37.50
3-Fair	9	40.91	7	38.89	16	40.00
2-Bad		-		-	0	-
1-Very Bad	0	-	0	-	0	-
Total	22	100.00	18	100	40	100

Summary

University	N ^o Respondents	%	Total Condition Rating Score	Average Condition Rating	Comments maintenance condition
ASTU	22	55.00	84	3.82	Fair-Good
AAU	18	45.00	69	3.83	Fair-Good
Composite	40	100	153	3.83	Fair-Good

4.4.2.3 Ceiling Finishes

University/ Rating	ASTU		AAU		Composite Score	
	№ Respondents	%	№ Respondent	%	№ Responde	%
5-Very Good	2	9.09	1	5.56	3	7.50
4-Good	5	22.73	6	33.33	11	27.50
3-Fair	13	59.09	10	55.56	23	57.50
2-Bad	2	9.09	1	5.56	3	7.50
1-Very Bad	0	-	0	-	0	-
Total	22	100.00	18	100	40	100

Summary

University	№ Respondents	%	Total Condition Rating Score	Average Condition Rating	Comments on maintenance condition
ASTU	22	55.00	64	2.91	Fair
AAU	18	45.00	61	3.39	Fair
Composite	40	100	125	3.15	Fair

4.4.2.4 Suspended Finishes

University/ Rating	ASTU		AAU		Composite Score	
	No Respondents	%	No Respondents	%	No Respondents	%
5-Very Good	1	4.55	3	16.67	4	10.00
4-Good	10	45.45	7	38.89	17	42.50
3-Fair	9	40.91	7	38.89	16	40.00
2-Bad	2	9.09	1	5.56	3	7.50
1-Very Bad	0	-	0	-	0	-
Total	22	100.00	18	100	40	100

Summary

University	No Respondents	%	Total Condition Rating Score	Average Condition Rating	Comments on maintenance condition
ASTU	22	55.00	76	3.45	Fair
AAU	18	45.00	66	3.67	Fair-Good
Composite	40	100	142	3.56	Fair-Good

4.4.3 Door

University/ Rating	ASTU		AAU		Composite Score	
	№ Respondents	%	№ Respondents	%	№ Respondents	%
5-Very Good	6	27.27	3	16.67	9	22.50
4-Good	10	45.45	12	66.67	22	55.00
3-Fair	6	27.27	3	16.67	9	22.50
2-Bad	0	-	0	-	0	-
1-Very Bad	0	-	0	-	0	-
Total	22	100.00	18	100	40	100

Summary

University	№ Respondents	%	Total Condition Rating Score	Average Condition Ra	Comments maintenance condition
ASTU	22	55.00	88	4.00	Good
AAU	18	45.00	72	4.00	Good
Composite	40	100	160	4.00	Good

4.4.3 Windows

University/ Rating	ASTU		AAU		Composite Score	
	№ Respondents	%	№ Responder	%	№ Respondents	%
5-Very Good	3	13.64	2	11.11	5	12.50
4-Good	8	36.36	9	50.00	17	42.50
3-Fair	10	45.45	7	38.89	17	42.50
2-Bad	1	4.55	-	-	1	2.50
1-Very Bad	0	-	0	-	0	-
Total	22	100.00	18	100	40	100

Summary

University	№ Respondents	%	Total Condition Rating Score	Average Condition Rating	Comments maintenance condition
ASTU	22	55.00	79	3.59	Fair-Good
AAU	18	45.00	67	3.72	Fair-Good
Composite	40	100	146	3.66	Fair-Good

4.4.4 Electric Installation

University/ Rating	ASTU		AAU		Composite Score	
	№ Respondents	%	№ Respondents	%	№ Respondents	%
5-Very Good	2	9.09	1	5.56	3	7.50
4-Good	8	36.36	6	33.33	14	35.00
3-Fair	10	45.45	9	50.00	19	47.50
2-Bad	2	9.09	2	11.11	4	10.00
1-Very Bad	0	-	0	-	0	-
Total	22	100.00	18	100	40	100

Summary

University	№ Respondents	%	Total Condition Rating Score	Average Condition Rating	Comments on maintenance condition
ASTU	22	55.00	76	3.45	Fair
AAU	18	45.00	60	3.33	Fair
Composite	40	100	136	3.39	Fair

4.4.5 Sanitary Installation

University/ Rating	ASTU		AAU		Composite Score	
	N ^o Respondents	%	N ^o Respondents	%	N ^o Respondents	%
5-Very Good	1	4.55	2	11.11	3	7.50
4-Good	2	9.09	1	5.56	3	7.50
3-Fair	8	36.36	6	33.33	14	35.00
2-Bad	11	50.00	9	50.00	20	50.00
1-Very Bad	0	-	0	-	0	-
Total	22	100.00	18	100	40	100

Summary

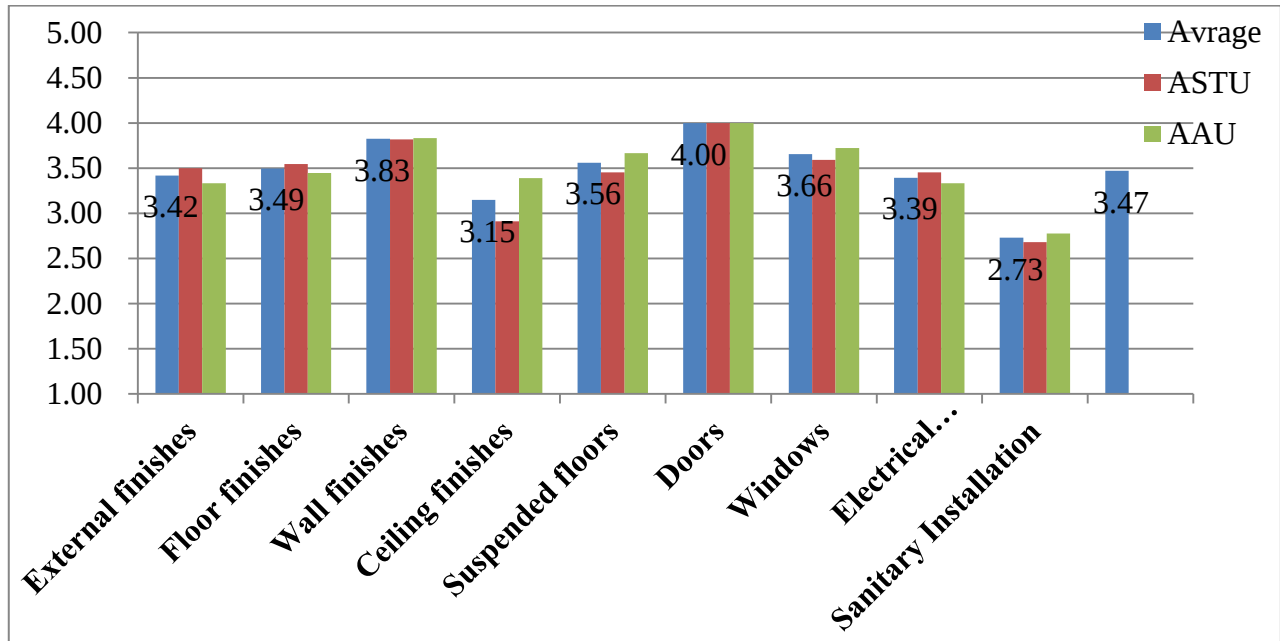
University	N ^o Respondents	%	Total Condition Rating Score	Average Condition Rating	Comments on maintenance condition
ASTU	22	55.00	59	2.68	Bad –Fair
AAU	18	45.00	50	2.78	Bad- Fair
Composite	40	100	109	2.73	Bad-Fair

Source: Field Survey.

Table 4.2.6 Overall condition rating of buildings of the two Universities

Element	AASTU Average Rating Score	Univer Condi	AAU Average Rating Score	Univer Condi	Composite Average Rating Score	Comments
External finishes	3.50		3.33		3.42	Serious Repairs
Floor finishes	3.55		3.44		3.49	Serious Repairs
Wall finishes	3.82		3.83		3.83	Minor repairs
Ceiling finishes	2.91		3.39		3.15	Serious Repairs
Suspended floors	3.45		3.67		3.56	Minor Repairs
Doors	4.00		4.00		4.00	Minor repairs
Windows	3.59		3.72		3.66	Minor repairs
Electrical installati	3.45		3.33		3.39	Serious Repairs
Sanitary Installati	2.68		2.78		2.73	Critical repairs
Total	3.44		3.50		3.47	Serious Repairs

The average score for the two Universities obtained from the evaluation table of the each element of the building summery.



Graphical representation of the overall condition of the building elements

From these Graphical representation we conclude that the composite value shows that the maintenance condition is fair that mean Significant sections or elements require repair usually by a specialist, The fabric element or building has been subjected to abnormal use or abuse and its poor state of repair is beginning to affect surrounding elements. Backlog maintenance work exists. In other way the two public universities yet not well developing organized and maintenance works system and maintenance management systems.

CHAPTER FIVE:

5. CONCLUSIONS AND RECOMMENDATIONS

5.1. Introduction

This chapter outlines and discusses the key objective of the project findings of the study

5.2. Conclusions On Key Project Findings

A survey of maintenance condition of the buildings in the two public universities revealed that their condition is need but in need of repair especially the older building stock. In both Universities even if, most of the buildings are relatively new majorities of the buildings have been subjected to a lot of disrepair.

The following were the key project findings of this study:

- ❖ In the two case studies there was no clear and well defined and documented departmental maintenance policy. There was some indication on plan of action on building maintenance but it was apparent that the plan of action is not documented and well defined in form of a policy document.
- ❖ The predominant maintenance strategy for both case studies was corrective maintenance with very limited planned preventive maintenance, where there was a maintenance plan, this was hardly adhered to in the course of the year for which its intended. This has resulted in a backlog of maintenance works.
- ❖ No condition standards are set for the universities buildings therefore no clear performance indicators are set from the outset to gauging effectiveness of the building maintenance strategies. Some building conditions are therefore left to deteriorate to very low standards as there are no guidelines or benchmarks for maintenance activities.
- ❖ Annual maintenance works program have recently been adopted in both universities but its implementation was reported to be average due a lot of intervening factors. It also became apparent that this was introduced as part of performance contracting concept that has been introduced in both public universities.
- ❖ It was also evident that at both there was also no maintenance management manual where all information regarding maintenance of building and other facilities is recorded. From perusal of records it was not possible to collect historical information of all maintenance activities relating to specific building.

- ❖ The maintenance management system in both universities was not IT based. The system is not a computerized and it was established that there were no near future plans to introduce computerized maintenance management systems (CMMS). This has result a lot of inefficiencies in performance of certain paper based tasks and limited data analysis that would aid decision making.
- ❖ There was no established condition assessment system in the maintenance departments that would accurately establish maintenance needs of buildings for universities.

An in-depth analysis of maintenance management system at both universities revealed various shortcomings as compared to best practice criteria leading to an overall conclusion that an effective maintenance management system influences positively on the maintenance condition

of buildings as maintenance activities are focused and efficiently implemented. Regardless of the myriad of challenges faced by public universities such as low funding for maintenance work, the available scarce resources also managed effectively to ensure maintenance objectives met at the least cost.

5.3. Recommendation

The two public universities should embrace proactively preventive maintenance tasks into their work order systems. The condition based approach or maintenance on crisis should be avoided and they need to incorporate planned preventive maintenance program in the annual maintenance works program.

As an integral part of their maintenance management system, the managers need formulate and document their maintenance policy, strategic maintenance plan for effective and efficient management of building maintenance works.

Need for Introduction of maintenance performance evaluation, maintenance departments should develop a condition assessment system for all their built facilities that set minimum condition standards at which various building should be maintained. Likewise they need to introduce or intensify their periodic condition assessment/surveys from which their maintenance workload and prioritization of maintenance work is determined.

Both public universities need to embrace the application of modern information technology in maintenance management by computerization of their maintenance records and also embracing computerized maintenance management systems to improve the efficiency of

managing their maintenance tasks. In the modern times university managers must invest in software that would improve efficiency of their maintenance management systems.

Managers must weigh the benefits the pros and cons of “outsourcing of maintenance works and executing the works “in-house” with a view of determining the mix of the two that serves the university well in terms of effectively and efficiently managing building maintenance. Such a mix should be also being cost effective. Public universities should view building maintenance as an integral part of their operations that contributes to their success in meeting their strategic objectives. A deliberate and proactive effort must be taken to facilitate the work of maintenance departments by enhancing budget for maintenance work and also staffing the latter with requisite manpower with appropriate skills, qualifications and experience to manage and execute maintenance works.

This paper may put corner stone for further study on Building Maintenance managements in our country and also help as a reference guide line to develop a maintenance policy , MMS and as a check list to develop maintenance condition standard assessment of Buildings.

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7. APPENDIX “B-C”

Structured Questionnaire from Top Management to Bottom Level Workers of AASTU and AAU

The series of questions in this questionnaire are designed to obtain organizational responses on maintenance of the University 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 purposes only and will be treated with the strictest confidentiality.

Thank You

I .Maintenance Strategies And Planning

Q1 Kindly specify your academic background/ field of training.....

Q2 What are your level of qualifications: [please tick as appropriate]

Postgraduate degree ☐

Professional qualifications ☐

Undergraduate degree ☐

Higher Diploma/Diploma ☐

Other (Please specify) -----

Q3 Does the department have a well defined and documented policy on the maintenance of university buildings?

Yes ☐ NO ☐

If Yes, how would you evaluate its implementation

Very Good	5	
Good	4	
Average/Fair	3	
Poor	2	
Very Poor	1	

Q4. Have you formulated a strategic plan for maintenance of the university buildings?

Yes ☐ NO ☐

Q5 Does the department have a maintenance strategy?

Yes ☐ NO ☐

Q6 If Yes, What is the maintenance strategy:

1. ☐ Planned preventive maintenance
2. ☐ Corrective maintenance
3. ☐ maintenance by crisis/ adhoc
4. ☐ unplanned maintenance
5. ☐ condition based maintenance
6. other (Please specify) -----

Q7 Does the department set minimum condition standards at which various buildings should be maintained

Yes ☐ NO ☐

If NO what challenges hinders this-----

Q8 If YES how regularly do you review and evaluate the above condition standards

Monthly ☐

Quarterly ☐

Annually ☐

Other (Please specify)

Q9 Does the department prepare an annual maintenance works program ?

Yes ☐ NO ☐

If Yes, how would you rate its implementation

Very Good 5 ☐

Good 4 ☐

Average/Fair 3 ☐

Poor 2 ☐

Very Poor 1 ☐

Q10 Does the department have in place a maintenance management manual which outlines all information regarding maintenance of buildings and other facilities?

Yes ☐ NO ☐

SECTION

II:

MAINTENANCE

CE INFORMATION

Q11 Does the department maintain an asset register of all buildings maintained?

Yes ☐ NO ☐

Q12 If Yes, which of the following information does it contain

☐ Building name

☐ Location and Age

☐ Construction details

☐ Functions of buildings

☐ Maintenance history-maintenance work done on it

☐ Replacement cost of building

☐ Previous and current condition assessment reports

Q12 Is the asset register updated regularly?

Yes ☐ NO ☐

Q13 Do you have a computerized data base of maintenance records?

Yes ☐ NO ☐

Q14 Do you have in place a computerized maintenance management system (CMMS?)

Yes ☐ NO ☐

Q15 Briefly enumerate the challenges faced in developing a maintenance information system _____ for _____ the department.....
.....

SECTION III: ORGANISATION OF MAINTENANCE

Q17 How would you describe the organization structure for the department
Centralized [☐]
Decentralized [☐]
Other (Please specify).....

Q18 Please indicate by what proportion (%) maintenance is executed
By Direct Labour.....
By Contract (Outsourcing).....
Other (Please specify).....

Q19 Does the department have a policy on the training of staff at all cadres.
Yes [☐] NO [☐]

Q20 Please indicate number of staff in the department at the various levels

Senior Managers []

Middle level managers []

Technical staff []

Supervisors []

Foremen []

Operatives, painters, masons, plumbers, carpenters, welders, electricians []

Q21 What is your evaluation of the sufficiency of the number of staff at the various cadres given the needs of the department in relation to human capital? [Please tick as appropriate]

	Very Adequate (5)	Adequate (4)	Fairly Adequate (3)	Barely Adequate (2)	Insufficient (1)
Senior Managers					
Middle level					
Technical					
Foremen					
Artisans					

Q22 Briefly enumerate the challenges faced in organization of maintenance works

.....

.....

.....

SECTION IV: MAINTENANCE IMPLEMENTATION

Q23 How long does the department respond to maintenance requests [Please specify]

Less than one month []

1-3 months []

6-12 months []

More than 1 year []

Q24 Does the department conduct condition assessment or physical inspections of buildings (assessment of the current physical condition of building, component, fabric or element

Yes ☐ NO ☐

Q25 If Yes, How frequently do you conduct condition assessments?

Annually ☐

Every two years ☐

Every five years ☐

Every ten years ☐

Other (Please specify)

Q26 In your evaluation how would you rate the sufficiency of funding received for maintenance works against the maintenance needs of university buildings

5 Very Adequate ☐

4 Adequate ☐

3 Fairly Adequate ☐

2 Barely Adequate ☐

1 Insufficient ☐

Q27 In your evaluation how would you rate the university's system for procurement for materials and services for maintenance works?

5[] Exceeds Expectations

4[] Meets Expectations

3[] Barely Meets Expectations

2[] Below Expectations

1[] doesn't meet expectations

Maintenance Condition of the Buildings check List with Building Elements

S.No	Building Type or Block			
	Element	Noted Defects	Condition Rating	Comment Recommendations
1	External finishes			
2	Internal finishes			
3	Suspended floor			
4	Roofing			
5	Doors			
6	Windows			
7	Electrical Installation			
8	Sanitary Installation			

Condition Rating

5-Very Good 4-Good 3-Fair 2-Bad 1-Very Bad

APPENDIX -C: Interview Schedule For Maintenance Supervisors and Managements

1. What is your professional back ground /trades are you trained in?
2. What is your level of training?
3. In your opinion are the departmental maintenance processes and procedures effective in addressing maintenance needs of the university buildings?
4. Would you say that at you are sufficiently facilitated in your work? If no what is your greatest deficiency
5. Would you say that you have sufficient training and skills to execute your work/ if no what way can this be improved?
6. Do you keep a record of all your daily activities? Are these records filed or stored also as computer records?
7. Are you computer literate? Do you have knowledge of computerized maintenance systems?
8. How are requests for maintenance handled by your department? Would you rate the department's response as being effective and timely?
9. How would you rate the current maintenance state of the institution's buildings?
10. What in your opinion would you rate as the greatest challenge in maintaining the university buildings?
11. In your view is university or departmental management committed to building maintenance?
12. Any suggestions on how maintenance management can be improved given challenges faced at implementation stage