THE UNIVERSITY OF NAIROBI

DEPARTMENT OF REAL ESTATE AND
CONSTRUCTION MANAGEMENT

A STUDY OF THE EFFECT OF SUSTAINABLE BUILDING OPERATIONS AND MAINTENANCE ON BUILDING MAINTENANCE PRACTICES IN PRIVATE UNIVERSITIES.

(A Case Study of Strathmore University)

BY

NDUNG’U CONSOLATA WANGARI

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MAY, 2013
DECLARATION

Researcher’s Declaration

I, NDUNGU CONSOLATA WANGARI, do hereby declare that this is my original work and has not been presented in any other University for the award of degree.

Signed é é é é é é é é é é é é é .

Date é é é é é é é é é .

NDUNGU C. WANGARI

Supervisor’s Declaration

This research has been submitted for examination with my approval as a university supervisor.

Signed é é é é é é é é é é é é é é é é é é
date é é é é é é é é é é é é é é é é é é

MR. NICKY NZIOKI
ACKNOWLEDGEMENTS

“Ad Dei Gloriam”

I would like to give thanks to the Almighty God for bringing me thus far through my four years.

I would like to express my greatest gratitude and grateful appreciations to my dedicated supervisor, Mr. Nicky Nzioki, whose invaluable and consistent counsel, advice and criticisms have made me able to see this project through successfully.

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Last but not least, I would like to also thank my parents, siblings and close friends for their constant love, support and encouragement. I remain eternally indebted to you all.
DEDICATION

I would like to dedicate this project to God the Almighty, without Him this project wouldn't have been possible. To my parents, Josephine and Lawrence, to my siblings and to my close friends for their unending love and support.
ABSTRACT

The world population exceeded the seven billion mark on March 12\textsuperscript{th} 2012 and continues to grow at an alarming rate according to the United Nations Population Fund (UNFPA, 2011). This increase in the world population leads to an increase in the demand for housing establishments, work areas and recreational facilities. This demand is drawn from the sense of comfort and safety that human beings feel within the buildings.

It has thus been estimated that the amount of time that people spend in the built environment ranges from about 80\% to 90\% (Chanter & Swallow 2006). This means that people spend more time indoors than outdoors. It therefore implies that there is need to take care of the space within, much more than the subsequent space without.

The focus of this study was to demonstrate the importance of taking care of the space and how best to carry this out in a sustainable way more so for private institutions in order to both reduce building running costs in the long run and increase the efficiency of use of the space. The study had as its null hypothesis that maintaining buildings sustainably has no effect on the building maintenance practices in the institution in question.

The objectives of the study were to identify the building operations and maintenance practices as well as sustainable building operations and maintenance practices within Strathmore University, to evaluate the effect of sustainable building operations and maintenance practices on building maintenance practices in the university as well as to identify the probable challenges that will be faced when implementing these sustainable building operations and maintenance practices.

One conclusion drawn from the study is that to maintain a building sustainably, the building operations and maintenance practices already in place have to be up to a high standard. The researcher recommends that for there to be success in maintaining a building sustainably, the institution has to adopt a building maintenance policy that will act as a plan that will help them to do this. As in the words of Benjamin Franklin, 

\textit{failing to plan is planning to fail}.\footnote{v}
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CHAPTER ONE: INTRODUCTION

1.1 General Introduction

Due to comfort and a sense of security, human beings spend most of their time within the built environment, be it for residential, work or educational purposes. This shows that buildings are very important components in our lives just like food and clothing. It is therefore important that we maintain our buildings to the highest possible standards because they are inseparable commodities in our lives. This can be done through sustainable building maintenance management (LEED, 2009).

The concept of sustainability emerged in 1713 in Germany and was internationalized in the 1970s and is currently being associated with the energy crisis and environmental pollution concerns. This idea of creation of sustainable buildings has been there since the start of the new millennium and architects, building planners, contractors, engineers, and vendors of building systems have all clamored for new ways to provide systems for energy-saving, sustainable buildings (Hurbisson et al 2011).

Over the last several decades, professionals in this area have learned that sustainability isn't just about new construction but also about the buildings that have been around for some time (Lateef et al, 2010). Green building ratings are now being carried for all existing buildings. These include Leadership in Energy and Environmental Design (LEED), Operations & Maintenance of 2009- which constitutes a set of performance standards for certifying the operations and maintenance of existing commercial or institutional buildings and high-rise residential buildings of all sizes, both public and private. The intention is to promote high performance, healthful, durable, affordable, and environmentally sound practices in existing buildings.

According to the Draft National Building Maintenance Policy (2011), buildings are considered to be very important to mankind. They also represent a high level of investment in terms of capital, material, labor and time. Therefore an organization that does not take into consideration any of these aspects of maintenance is not performing according to the laid standards on maintenance works.
1.2 Problem Statement

Buildings, as mentioned in the previous section, are important resources both in the economic sense as well as in the social sense. They are extremely complex, valuable and diverse and they usually tend towards obsolescence, they therefore need to be maintained in order for an organization to concentrate on their core business, (Makau, 2010).

Within the private university structures, maintenance is carried out but not in a sustainable way that considers both the space users as well as the environment within which they operate. This lack of proper maintenance could be instrumental in reducing the lifespan of the buildings thus defeating the main purpose for which these buildings were put up, that is to ensure that buildings are used as effectively as possible. University buildings around the globe are constructed to serve more than one generation, taking an international example of Harvard University that celebrated its 375th anniversary in the year 2011 (Walsh, 2012) and a local example of The University of Nairobi that was started in 1956.

For this to become a reality, they have to be effectively and sustainably maintained to increase their life span, reduce the amount of impact that they have on the environment as well as to improve the healthful living of those who study and work within the university buildings. Building operations and maintenance practices use energy and water to generate waste and other pollutants as a result of cleaning and maintenance. This brings in the need to apply sustainable building operations and maintenance within the buildings more so buildings found in institutions of higher learning.

The concept of sustainability places a certain emphasis on efficient balance between nature and the environment, while taking into account the impact that man’s activities have on the environment that surrounds him. These activities are undertaken in order to meet the needs of the present generation with an aim not to hinder future generation from meeting their own needs (Christensen, 2005).

From the global perspective, the idea of ensuring sustainability in buildings has been emphasized. This is evidenced from researches done in Irish universities and schools.
in Dublin, where departments are currently conducting demonstrations to evaluate the suitable application and performance of biomass systems with school heating requirements in terms of heating demands characteristics, controls, reliability, fuels storage as well as sustainable maintenance and operations (Department of Education and Science, 2009).

In the local aspect of it, the idea of sustainability is emphasized through the various legislations in place such as the Kenya Vision 2030 as well as the Draft National Maintenance Policy of 2011. Within these, awareness and education on sustainable development is encouraged. It is seen that even though Kenya has made progress in embracing the agenda 21 objectives and principles of Education for Sustainable Development, it was clear that Kenya had not yet adequately addressed threats to the environment- as demonstrated by the State of Environment report of 2005. According to Otieno (2005) this can be attributed to little efforts being placed on participatory approaches. Therefore within the Kenyan context there is need for awareness and action in the area of sustainable development.

In the context of institutions of higher learning we see that universities are factors of production. They are procured to create sustainable, conducive and adequate environment that support, stimulate and encourage learning, teaching, innovation and research (Lateef et al, 2010). Universities contain unique, complex and sophisticated buildings used in performing various types of activities and functions. Hence, where there is an inadequacy with the building facilities, more so with the maintenance of these buildings facilities, then the prime objective of the university would be difficult to accomplish. Maintenance is thus essentially required to delay defects to ensure that buildings perform optimally. But in as much as maintenance does this, does the environment have a say in it? Do the space users have a say?

There is a misconception held that for an institution to participate in sustainable building operations and maintenance, the building should be a ‘Green Building’. But this is not the case as it has been demonstrated by the building rating system LEED (2009), which is of the notion that, sustainable operations and maintenance of an existing building is just as important as a new building with incorporated green technology. Sustainable building operations and maintenance can be carried out
irrespective the kind of building regardless of shape, age and size, whether already green or just an ordinary building. The applicability of the sustainability concept is what the researcher would want to investigate. Through maintaining a building sustainably, the health risks resulting from the use of hazardous materials is drastically reduced from the building. The standing policy is to create the best possible conditions for people residing and working in the interior areas of the building (Draft Maintenance Policy, 2011).

This is more so especially for buildings that are used for educational purposes such as institutions of higher learning, as these are in constant use by various persons from the lecturers, supporting staff, administrators and students as noted by Magomere (1993). The need to sustainably maintain these buildings is further necessitated by the fact that, most of the university buildings in Kenya are in a sad status of maintenance. It's common, he says, to find leaking roofs, unpainted walls, efflorescence walls, stained ceilings, broken window panes and burst drainage pipes.

1.3 Research questions

What are the key building operations and maintenance practices?

What constitutes sustainable building operations and maintenance?

What effect will the sustainable building maintenance aspects have on the building operations and maintenance practices in the university?

How sustainable are the current building operations and maintenance practices in Strathmore University?

What challenges are faced when applying sustainable building operations and maintenance concepts in the university in question?

1.4 Hypothesis

The hypothesis of the study was:

H0: Incorporation of sustainable building operations and maintenance does not have an effect on building maintenance practices in private universities.
H0: Incorporation of sustainable building operations and maintenance does not have an effect on building operations and maintenance practices in private universities.

1.5 Objectives of the study

1. To establish the building operations and maintenance systems.

2. To establish the sustainable building operations and maintenance systems.

3. To evaluate the effect sustainable building operations and maintenance aspects have on building maintenance practices.

4. To determine the challenges faced when applying sustainable building operations and maintenance concepts to the university in question.

1.6 Justification of the study

A private university was selected for this project due to the fact that, from previous researches done with regards to public universities and maintenance aspects, one thing rung true, public universities are generally not well maintained due to a host of various factors ranging from financial constraints to corrupt practices and cultures (Magomere, 1993). As for private universities, the reverse is true; they are well maintained and have financial backing (Kanana, 2011). For this study to be effective, the building maintenance practices have to be of a high standard for sustainable building operations and maintenance practices to prove implementable.

The particular case study selected, as mentioned earlier, is Strathmore University. This university was chosen as it is a private university, found within the Nairobi area. Also, it has been one of the highest ranked universities in Kenya, according to the July 2009 webometrics that ranks universities across the globe.

Within its mission and vision, Strathmore strives to provide quality in teaching and learning, quality in research and provision of an enabling environment to do all the above. This shows that they take provision of an education that is of a high excellence as well as a good environment where this is to be done very seriously. For sustainable building operations and maintenance practices to be effective, there is an absolute
need for institutional support, which, from their mission, Strathmore is ready to provide.

It is also seen from the research that Strathmore has both new and old buildings hence making it a good study for sustainable building operations and maintenance practices to be examined. Some of the newer buildings have also incorporated some aspects of green technology while others have not further making the study evidentiary of the fact that sustainable building operations can be implemented to all kinds of existing buildings.

This study area selected will therefore help in demystifying the objectives of the study through finding out the maintenance practices that the university has in place, the effect sustainable maintenance on these maintenance practices as well the probable challenges that may be faced when doing this.

1.7 Scope

The study will be confined to building maintenance as well as sustainable building operations and maintenance of a private university in Nairobi. The target institution will be Strathmore University. The focus will be mainly on the operations and maintenance systems currently found within the said university and this will compared to sustainable operations and maintenance aspects.

1.8 Research Methodology

1.8.1 Introduction

This section of the study will identify the methodology used and discusses the research design, sampling techniques and data collection instruments and procedures. A more comprehensive explanation of the approach used in conducting the research methodology will be discussed in the third chapter of this research.

The variables that the study will consider include:

1. The building operations and maintenance systems found in the university.
2. The sustainable building operations and maintenance practices within the same university.
3. Effect of sustainable building operations and practices on building maintenance practices in Strathmore University.

4. The challenges of implementing these sustainable methods.

The critical study of these variables will help the study hypothesis.

1.8.2 Research Design

The research design answers the question “What data would the researcher like to find?” A case study design will be chosen for the study. In this case, according to Mugenda and Mugenda (1999, P.117), the researcher will be interested in analyzing the information in a systematic way in order to come to some useful conclusions and recommendations.

Another researcher, Kothari (1990) describes a case study as an in depth rather than breadth placing more emphasis on the full analysis of a limited number of events and or conditions and their interrelations. This research design was chosen to allow for an in depth study of the particular area. The particular case study chosen for this study will be Strathmore University.

1.8.3 Sampling techniques and sample size

Sampling according to Mugenda and Mugenda (1999, P10), is the process of selecting a number of individuals for a study in such a way that the individuals selected represent the large group from which they were selected. The individuals selected form the sample and the large group from which they were selected forms the population. The population chosen for the study is the space users who constituted the students and the staff. Owing to the nature of the study, all buildings will be selected from the university under study.

1.8.4 Data collection instruments and procedures

Through the carrying out of interviews with the building managers and administering of questionnaires to the space users, primary data will be collected. The above data collection instrument will be used together with secondary data that will be collected by the researcher. The data collected from text books, journals, previous researches, newspaper articles, will serve as a benchmark for the research to be undertaken.
1.9 Organization of the study

The study will be organized into five chapters.

The first chapter is the introductory section that lays the ground work for the study. The study area is explained and broken down in a logical sequence so as to identify the problem being researched on. The problem statement, purpose of the study objectives of the study, the scope and the study’s hypothesis are given in this section.

The second chapter deals with a theoretical framework for the study by reviewing relevant literature on the field of study. This involves reading books, previous projects, journals and newspaper articles.

Chapter three is the methodology section. This section addressed the identification of the sample population from the accessible population and the collection of data. The data for this research was collected by administering of questionnaires to identified respondents in order to get the relevant information. A series of open ended questions each touching on important aspects of sustainable building operations and maintenance will be used.

Chapter four will contain the presentation and data analysis of the data collected.

Chapter five will contain the conclusions to be made from the information found in the field and making of any relevant recommendations.
1.10 Working Definitions

Private Universities: these are institutions of higher learning that are not operated by the government, though depending on their location they may be subject to government regulation. They could be universities that are non-profit, like the case study or for profit.

Operations and Maintenance: these are activities that are related to the performance of routine, preventive, predictive, scheduled and unscheduled actions that are aimed at preventing building and equipment failure.

Policy: These are the principles, or rules that assist in achieving desired or set outcomes. It can be compared to a statement of intent and is implemented as a procedure.

Regulatory Standards: These are the enforcement of rules on certain set benchmarks to be followed by persons to whom it is applicable.

Good Building Operations and Maintenance practices: these are the desired habitual actions in building operations and maintenance practices that are aimed at preventing building and equipment failure.

Good Sustainable Building Operations and Maintenance practices: These are also the desired habitual actions in building and operations and maintenance practices that are aimed at not only preventing building failure but preventing environmental degradation as well as ensuring occupant comfort.
CHAPTER TWO: LITERATURE REVIEW

2.1 Building Operations and Maintenance Practices

2.1.1 Introduction

This chapter aims at showing the various aspects of building operations and maintenance, its importance and identifies types of maintenance. Having created a platform of this aspect of operations and maintenance, a new paradigm will be introduced, that is sustainable building operations and maintenance and its various aspects.

The maintenance of property and estates has long been portrayed as unattractive according to Wood (2003, p.1). This train of thought is further solidified by Seeley (1976) as something that would be regarded by most as, a Cinderella activity, this is due to its lack of glamour and hence unlikely to attract very much attention and it is frequently regarded as unproductive.

This point of building maintenance’s lack of productivity was nullified by (Swoden, 1990) that declared that the building maintenance and refurbishment market within the U.K. could easily be worth almost three times more the new-build market, making it more profitable to maintain a building sustainably as compared to constructing a whole new build.

In many countries, according to Syagga (1979) there is very little attention that is given to this subject of building maintenance, so that instead of being modernized, buildings are usually pulled down and rebuilt. This as seen earlier, is more expensive than doing actual maintenance work.

2.1.2 Building Operations and Maintenance Defined

A building, according to Wikipedia the encyclopedia, is an edifice erected by art, and fixed upon or over the soil, composed of stone, brick, wood or other substances connected together, and designed for use in which it is so fixed.

After an understanding of a building we then move to defining what building operations and maintenance is in the context of university buildings. Definitions,
according to Wood (2003, p.25), are not static, they evolve and change over time in the light of experience and re-evaluation.

Maintenance, according to British Standards (BS 3811; 1984), is a combination of actions carried out to retain an item in, or restore it to an acceptable condition. From this definition two key components can be defined, that is not only actions that relate to the physical execution of maintenance work, but also those concerned with its initiation, financing and organization.

The first component is that, the notion of an acceptable condition, which implies an understanding of the requirements for the effective usage of the building and its parts which in turn compels broader consideration of building performance, (Chanter & Swallow, 1996, p.19).

The second component, according to the same authors will present some problems when attempting to determine the standard to represent an acceptable condition, as opinions will vary from person to person and over time according to the type of building under construction, its usage and changing circumstances.

BS 8210: 1986 defines building maintenance as work, other than daily and routine cleaning, necessary to maintain the performance of the building fabric and its services.

In building maintenance, the aspect of improvement of the building is brought out clearly with this definition from the Chattered Institute of Building (1990), work undertaken in order to keep, restore, or improve every facility i.e. every part of a building, its services and surrounds, to an agreed standard, determined by the balance between need and available resources. This, in the opinion of Woodworth (2001, p.9), introduces the notion of an agreed standard which, from the definition, is assumed to be higher than the initial standard set.

A further definition of maintenance can be found in the Encyclopedia of real estate terms (Abbot, 1972), that is

*the acts of keeping something in a proper or particular state of condition, especially keeping a property in good order, and in a state of efficiency by repair. It is*
a continuous process which may involve repair, but requires a greater degree of attention to general upkeep than repair.

In general maintenance can be viewed as a set of activities or procedures which are undertaken to keep restore or improve any facility that is, every part of the building, its services and surrounding, and infrastructure to currently accepted standards, and to

According to the Draft Maintenance Policy of 2011 (GOK) maintenance is defined as work undertaken in order to keep or restore every part of the building and associated infrastructure to a currently acceptable standard and to sustain its value. Maintenance works include inspection, testing, planning, organising, servicing classification to servicesbility, repair, refurbishment, re-building, rehabilitation, reclamation, renewal adoption and setting standards.

Building Operations and Maintenance in a building, on the other hand, according to Guha (1995, P.1) are the post constructional activities that are required to run and upkeep the plant effectively. There is a clear distinction between the two terns operations and maintenance. Operation is the activity required for running a building, while maintenance, as seen earlier on, is the activity that furthers the life of the building. Operations and Maintenance (O&M) includes the maintenance and repair of real property, operation of utilities, and provision of other services such as refuse collection and disposal, entomology, snow removal, and ice alleviation.

The scope of O&M includes the activities required to keep the entire built environment as contained in the organization's Real Property Inventory of facilities and their supporting infrastructure, including utility systems, parking lots, roads, drainage structures and grounds in a condition to be used to meet their intended function during their life cycle. These activities include preventive and predictive (planned) maintenance and corrective (unplanned) maintenance.

Preventive maintenance consists of a series of time-based maintenance requirements that provide a basis for planning, scheduling, and executing scheduled (planned versus corrective) maintenance. It includes adjusting, lubricating, cleaning, and replacing components.
Corrective maintenance is a repair necessary to return the equipment to properly functioning condition or service and may be both planned and un-planned. Some equipment, at the end of its service life, may warrant overhaul. Further definitions of the same will be given later on.

2.1.3 Importance of Building Maintenance

Through the various definitions of what building maintenance takes into account, drawing out its benefits is made clearer. Maintenance is seen as all the necessary work done to preserve a building with its furnishes and fittings, so that it continues to provide the same or almost the same facilities, amenities and serves as it did when it was first built, (Cobbinah, 2010)

As a result of building maintenance, there is employment creation. Building maintenance is a skill that can be undertaken by both local and overseas skills and if effectively planned, building and infrastructure maintenance could be a basis of further contracting local skills hence generating more employment opportunities.

Through maintenance there is an increase in the mobilization of financial resources. Most of the maintenance works carried out within the country calls for ways to mobilize resources. This thus leads to the expansion of the banking sector as a result of all the money borrowed to carry out the maintenance works.

Prolonging the life of a building can be seen as the major reason for carrying out maintenance works in all buildings forms (Were, 1990. P.7) including institutional buildings. This good maintenance of buildings can aid the building "live" longer than the designed life.

Another reason to carry out building maintenance in learning institutions is to delay obsolescence, that is, a state of being which occurs when an object is no longer wanted even though it may still be in good working order, does not arise.

It is important to maintain buildings in learning institutions so as to increase user satisfaction which will eventually lead to an increase in the efficiency of the space users as their needs are being met.
Through the maintenance of the building, there is the ability of the building to retain its investment value that is the economic value. Maintaining or retaining the building in a condition in which it continues to fulfill its function effectively and this can be described as the functional value of maintenance. Maintenance also helps prevent deterioration and defect in buildings.

2.1.4 Types of Maintenance

After detailing the importance of building maintenance in the various sectors, that is to the country as a whole and specifically to institutions of higher learning, this section then goes on to show the various types of maintenance, the core being the planned and unplanned types of maintenance usually undertaken.

Figure Types of maintenance (source: BS 3811: 1984)
BS 3811 categorizes building maintenance by means of the following terms and definitions.

i. Planned maintenance: ‘The maintenance organized and carried out with forethought, control and the use of records to a predetermined plan.’

ii. Unplanned maintenance: ‘The plan carried out to no predetermined plan. It refers to work necessitated by unforeseen breakdown or damages. For example, the ripping-off of a building, through the action of a storm, and its remedial action constitute unforeseen damages. It can also be termed unexpected and unavoidable maintenance.’

iii. Preventive maintenance: ‘The maintenance carried out at predetermined intervals or corresponding to prescribed criteria and intended to reduce the probability of failure or the performance degradation of an item.’

iv. Corrective maintenance: ‘The maintenance carried out after a failure has occurred and intended to restore an item to a state in which it can perform its required function.’

2.1.5 Maintenance Policies

BS 3811 define maintenance policy as a strategy within which decisions on maintenance are taken. It may also be defined as the ground rules for the allocation of resources (men, materials and money) between the alternative types of maintenance actions to the organization as a whole must be identified and related to the costs involved.

According to Lee (1987), this question of policy falls under the following headings,

a) Objectives:
This begs to ask the question what does maintenance have to achieve? This is usually viewed in reference to the overall building needs.

b) Benefits
This answers the question, what is to be gained? The benefit may be either short-term or long-term and maybe classified as financial, technical, or human.
c) Policies

The question ‘how shall we proceed?’ is taken care of with the use of policies. Policies involve the laying down of operational and cost objectives for the maintenance department starting with the identification of maintenance tasks, the standards to be achieved and the limits of cost. The policies determine the structure of maintenance organization and the roles and duties of the supervisory staff.

2.1.5.1 The Draft National Building Maintenance Policy of 2011

From the ideas above of what a maintenance policy ought to include in it, a more tangible form is in the making in Kenya. The formulation of this Draft policy is anchored to the provisions made in the constitution of Kenya 2010 on the need for a clean environment and adequate housing as a right to citizens and maintenance, conservation and setting standards as a means through which to achieve progressive realisation of these rights.

According to the policy, the poor building maintenance practices within the country has led to the backlog of maintenance works that are expensive and difficult to sort out as well as rundown investment that are uneconomical and unsustainable to owners. The cause of this is attributed to lack of buildings maintenance policy and culture, existing of multiple outdated and conflicting legislations and regulations. Together with these, there is also inadequate resources such as national building stock, human, financial and tools to carry out, monitor and evaluate maintenance works.

To therefore address these problems, the government together with various stakeholders formulated a National Building Maintenance Policy. Below are the objectives of the building maintenance policy:-

a) This policy will be a road map to be followed in addressing effective restoration, preservation, refurbishment, setting standards, training and deployment of manpower, financing, enacting legislation, capacity building to both owners and users and to create awareness and capacity building of all citizens of Kenya on the great importance of proper maintenance of buildings and related infrastructures.

b) To guide on the establishment of efficient, effective and economic use of scarce maintenance resources.
c) Guide in establishment of integrated management of the built environment

d) Ensuring health and safety.

The draft maintenance policy is not law but a vision that set out long term goals and principles on how best to achieve adequate building maintenance for the national population.

2.1.6 Legislative and regulatory standards of maintenance in Kenya

Together with the draft policy, there are many laws that govern repair and maintenance of property in Kenya. As a result of the new Constitution of Kenya some have been and will be amended. These laws include:

2.1.6.1 The Constitution of Kenya 2010

Under Article 42 provides that every person has the right to a clean and healthy environment. Further; Article 43 (1b) provides that every person has a right to accessible and adequate housing, and to reasonable standards of sanitation, while Article 69 provides that the State shall ensure sustainable management and conservation of the environment. The constitution further obliges the state to legislate and create measures that will ensure that the built environment is managed, maintained and conserved in a sustainable manner.

2.1.6.2 Land Act of 2012

The land Act so formed in 2012 was created after the amalgamation of the former Registered Land Act Cap 300 (RLA) and the Government Land Act Cap 280 (GLA). Within this act various aspects of proper maintenance of land and its fixtures have been emphasized. These are:

Section 11 The Commission shall take appropriate action to maintain public land that has endangered or endemic species of flora and fauna, critical habitats or protected areas.

Section 65: (2) In every lease, there shall be implied covenants by the lessor with the lessee, binding the lessor (a) either personally or by agents, enter, the leased land or buildings at any reasonable time for the purpose of inspecting the condition and repair
of the premises, or for carrying out repairs and making good any defects that it is the lessor’s obligation to do so.

Section 66: There shall be implied in every lease, covenants by the lessee with the lessor binding the lessee to keep all boundary marks in repair; and to keep all buildings comprised in the lease in a reasonable state of repair.

Section 88: (1) There shall be implied in every charge covenants by the chargor with the chargee binding the chargor to repair and keep in repair all buildings and other improvements upon the charged land or to permit the chargee or chargee’s agent to enter the land and examine the state and condition of such buildings and improvements at after a seven day notice to the chargor until the charge is discharged.

2.1.6.3 The Kenya Vision 2030

In this document, the idea of maintenance of all kinds of public buildings is emphasized. That is through a Public facilities improvement program the target will be the improvement of the visual appeal and functionality of all public facilities and buildings.

In this regard, maintenance and management of public facilities will be enhanced through comprehensive facility management approaches. Citizens will be encouraged to value and respect public facilities through a series of public education and awareness programs aimed at engendering a sense of civic responsibility and foster nation-building attitudes among all citizens.

Further the document provides for improvement of the visual appeal and functionality of the built environment. Maintenance and management of the built environment will be enhanced through comprehensive strategic asset management plans, promotion of a National Building Maintenance culture and Building Management Information Systems.

2.1.6.4 The National Housing Policy of 2004

National Housing Policy 2004 noted that lack of proper management and maintenance reduces quality of housing stock and adversely affects the built environment including
infrastructural facilities and other services. The Policy proposes formulation of National guidelines and standards on real estate management and maintenance.

2.1.6.5 The Sectional Properties Act of 1987

Section 27 empowers an established cooperation or company within any communally owned premises to enter the premises for the purpose of maintenance, repair, replacement of pipes, electrical wires and installation of ducts and maintaining, repair or replacing some coming property. Owners of the units are also obliged to maintain them in a good state of repair.

Section 29 lays down the duties of the cooperation and one of the key duties is keeping in good repair and proper maintenance of personal and common property.

Section 31 empowers the board formed under this act to establish and maintain funds to be used for repairs and replacement of the property owned by the cooperation and to use the same funds in repairs and maintenance.

2.1.6.6 Sessional Paper No 3 of 2009 Land Policy

Section 134 states as one of the Governments obligations to ensure the protection of ecosystems and their sustainable management through maintaining beaches at high and low water marks and put in place measures to control beach erosion.

Section 145 states that the one of the principal functions of land administration is the development and maintenance of an efficient and accurate land.

Under this same policy, the government is also charged with the responsibility of keeping in a good state of maintenance the refugee camps that are found in the country.
2.2 **Good Building Operations and Maintenance practice**

Good building operations and maintenance practice assists building managers and maintenance personnel have a guideline as to how best to carry out building operations and maintenance to the buildings in the institution in question, in this case the institution being Strathmore University.

From what the literature review has informed this project, the researcher found that a good building operations and maintenance system would need to consist of three major components. These include mainly the type of maintenance that the organisation undertakes, that is, it could be either a planned kind of maintenance or it could be unplanned. The planned maintenance could be either for corrective purposes or for preventive purposes. The unplanned kind of maintenance, as seen earlier in the diagrams, could also be for corrective purposes.

Another paradigm presented by the literature review is that a good building operations and maintenance system should take into account maintenance policies. These, as seen earlier, are a strategy within which decisions on maintenance are taken. Within Kenya, currently there is a Draft Maintenance Policy that helps to give building managers and caretakers grounds for the adequate allocation of resources. This Draft Maintenance Policy is not the standing policy of maintenance in the country, but it provides a roadmap for the carrying out of maintenance works in the best way.

Together with the policy, there are various laws that have been put in place in order to regulate the carrying of maintenance works both by the space users as well as the owners of the real property. These too can be seen to assist on drafting up of a good building operations and maintenance practice. The project therefore adopted the diagram below to evaluate the practice used in the case study.
2.3 **Sustainable Building Operations and Maintenance**

This section will focus on environmentally responsible building operations and maintenance that includes measures such as keeping solar and other systems working, maintain the efficiency systems, maintaining a healthful indoor air quality and using environmental friendly cleaning products.

University buildings require sustainable building operations and maintenance in order to create conducive environment that supports and stimulates learning, teaching, innovation, and research. The prime objective of maintenance is to ensure, as far as practicable, the continued peak performance of the building throughout its design life (Lateef et al, 2010, P.76).

Through sustainable building operations and maintenance practices there can be a substantial reduction in negative environmental impacts of the building as well as reduction in the buildings operating costs, enhancing the buildings marketability hence leading to subsequent increase in level of enrolment within the institutions of higher education.

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**Fig: Good Building Operations and Maintenance Practice, Source (Author, 2013)**

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<thead>
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<th>Types of Maintenance</th>
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<th>Regulations on Building Maintenance</th>
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<tr>
<td>Unplanned Maintenance</td>
<td>The National Housing Policy of 2004</td>
<td>The National Housing Policy of 2004</td>
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</tbody>
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learning, worker and student productivity. As a result of sustainable building operations and maintenance there is a reduction in problems caused by indoor air quality.

2.3.1 Concept of sustainability

The concept of sustainability can be explained using the Chinese proverb “One generation plants a tree; the next generation gets the shade” (Gutierrez, 2009). The overall process of development is dependent upon the environment. The relationship and linkages that exist between people, natural resources and the economy are all part of the environment. In the beginning, environment was perceived as a constraint or obstruction to economic development. However, this is slowly changing, with increased awareness and the realization that natural resources are vital to the security and quality of life for the present and future generations.

The current focus is on integrating the pillars of sustainability into development as the modifications of the environment have important socio economic consequences that affect the quality of human life.

Sustainable development (SD) is development that meets the needs of the present without limiting the potential to meet the needs of future generations. This concept of sustainable development occurs through integration of biophysical, economic and social objectives, where possible and through trade-offs where full integration is not possible (Rousse et al, 2011). Thus the aim of SD is to improve the economic aspect without undermining the social and ecological aspect.

The concept of sustainability relates to the maintenance and enhancement of environmental, social and economic resources in order to meet the needs of current and future generations.

a) Environmental sustainability: This requires that natural capital remains intact. This means that the extraction of non-renewable sources should not exceed the rate at which they are renewed and the extraction of non-renewable resources should be minimised and that this should not exceed agreed minimum strategic levels.
b) **Social sustainability**: This requires that the cohesion of society and its ability to work towards common goals are maintained. That is individual needs for example health, nutrition, education and cultural expression are met.

c) **Economic sustainability**: Occurs when development that moves towards social and environmental sustainability, is financially feasible.

![Diagram of Sustainable Development Dimensions](image)

Figure 1. Basic Sustainable Development Dimensions. Source: Gutierrez, 2009

### 2.3.2 Concept of sustainable buildings

#### 2.3.2.1 What are sustainable buildings

A sustainable building maximises operational efficiency while minimizing environmental impact. According to Wood (2003), the features of a sustainable building includes the following:

a) Low Operational Energy  
b) Low carbon emission  
c) Use of renewable resources  
d) Little or preferably no waste  
e) Low maintenance  
f) High durability  
g) Use of appropriate technology

#### 2.3.2.2 Why make your building sustainable

The environmental impact of the building design, construction and operations industry is enormous. Buildings annually consume more than 30% of the total energy and more than 60% of the electricity used within the building (LEED, 2009).
Sustainable building practices can substantially reduce or eliminate negative environmental impacts through high performance, market-leading design, construction and operations practices as an added benefit, sustainable operations and management reduce operating costs, enhance building marketability, increase workers’ productivity, and reduce potential liability resulting from indoor air quality problems (LEED, 2009).

2.3.3 Building rating systems in place

Green building rating and certification systems are intended to foster more sustainable building design, construction and operations by promoting and making possible a better integration of environmental concerns with cost and other traditional decision criteria.

Different building assessment systems approach this task from somewhat different perspectives, but they have certain elements in common. Most, if not all, deal in one way or another with:

i) site selection criteria, ii) the efficient use of energy and water resources during building operations, iii) waste management during construction and operations, iv) indoor environmental quality, v) demands for transportation services, and the vi) selection of environmentally preferable materials.

There are several benefits to employing a building rating scheme on a given project. For instance, clients may request their use as they provide verification of meeting an accepted market standard for a green building, as well as acting as an auditing body for the design team.

Another benefit of a green building rating a system is that designers and owners alike can translate a successful certification into increased bottom line returns, raising the value of the structure while creating a market niche for the construction team, (Fenner and Ryce, 2008).
2.3.3.1 The Building rating systems

The building rating systems that are in use include the following:

I) BREEAM (Building Research Establishment’s Environmental Assessment Method)

BREEAM has a long track record in the United Kingdom, but it is not extensively used in the U.S. and it is difficult to obtain current information about the system. Based on the information available, it would not be applicable to all project types, specifically tenant build-out for leases. BREEAM is updated annually; however, the current version is not publicly available for purchase.

II) CASBEE (Comprehensive Assessment System for Building Environmental Efficiency)

CASBEE is a relatively new system developed for the Japanese market that is available in English, but has not been tested in the U.S. Major modifications are expected to be made to the system every year; however the process for those revisions is unknown.

III) GBTool (Green Building tool)

GBTool is an international system that has been used to evaluate U.S. buildings for the Green Building Challenge. With respect to applicability to project types, GBTool would be applicable for all but tenant build out and operations and maintenance applications; however, an operations and maintenance version is under development. Due to the flexibility inherent in the application of GBTool, it tends to require greater technical expertise to implement than other rating systems, which has limited its exposure in the U.S. market.

IV) Green Globes U.S.

Green Globes US was adapted from Green Globes Canada in 2004 and is the newest system considered in this review.
V) LEED (Leadership in Energy and Environmental Design)

Came about as a result of members of the United States Green building Council forming a committee that will research on a green building metric system.

As LEED has evolved and matured, the program has undertaken new initiatives. In addition to the rating system specifically devoted to building operations and maintenance (LEED for Existing Buildings: Operations & Maintenance), LEED addresses the different project development and delivery processes of the US building design and construction market through rating systems for specific building typologies, sectors and project scopes. These include, LEED for Core & Shell, LEED for new Construction, LEED for Schools, LEED for Neighbourhood Development, LEED for retail, LEED for Healthcare, LEED for Homes, LEED for Commercial Interiors.

2.3.4 Aspects of Sustainable Building Operations and Maintenance

Sustainable building operations maintenance in university institutions can be best achieved using the same principles that are used in the rating system, LEED for Existing Buildings: Operations and Maintenance of 2009.

This rating system can be viewed as a tool for the on-going operations and maintenance of existing commercial and institutional buildings (in the case of our study, university buildings). This is a certification system that rewards current best practices and provides an outline for buildings to use less energy, water and natural resources; improve the indoor environment and uncover operating inefficiencies.

The benefits using these principles in university buildings is that it will assist building managers to solve problems, to improve the buildings performance, reduce environmental impacts, create healthier and more productive employee workspaces and provides public recognition for leadership in sustainability. The majority of requirements for this certification system are operations and maintenance best practices. The rating system is put in place to encourage owners and operators of existing buildings to implement sustainable practices and reduce environmental impacts of their building over their functional life cycles (LEED, 2009).
This rating system is targeted at single buildings, whether owner occupied, multi-tenanted or multiple building campus projects.

2.3.4.1 Considerations for Sustainable Building Operations and Maintenance

These considerations include:

a) **Sustainable sites**

The aim of having sustainable sites is to transform the land design and development for new builds and the management practices of these sites for the already existing builds.

Aspects it includes are of building exterior management, integrated pest management, erosion control, and land scape management reduced site disturbance, alternative commuting transportation, storm water quality control and light pollution control. An expounded explanation of these aspects can be found below:

**Building Exterior and Hardscape Management**

This aspect assists in reducing exposure of people to toxic chemicals while maintaining a clean and presentable building exterior and site hardscape. It is a campus wide approach that is intended to encourage environmentally sensitive building maintenance practices while supporting high performance building operations. All staff who deals with the maintenance and operations of the building should receive orientation training on the chemical hazards they may encounter while on the job. Staff should be required to attend training workshops on the procedures for maintaining, disposing, recycling of cleaning and service chemicals (LEED, 2009). The maintenance equipment that is used in building exterior and hardscape management can be purchased to reduce the consumption of fossil fuels, generation of emissions and noise.

Cleaning products which are environmentally friendly should be selected based on a sustainable criteria for example products that are biodegradable, minimal exposure concentrates, no ozone depleting substances, recyclable packaging and reduced flammability.
Integrated pest management, erosion control and landscape management.

This aspect comprises three best practices; integrated pest management helps reduce the exposure of people that is the students, lecturers and the staff members, to toxic chemicals while maintaining a pest free environment. Erosion control involves outlining the best practices relating to storm water management strategies for the university. The landscape management aspect reduces potable water use by including drought and native plant species that require little or no irrigation. In order to reduce waste and chemical use there needs to be use of composting waste and mulching (USGBC, Implementation workbook, 2009). Training also in this aspect needs to be undertaken.

**Alternative Commuting Transportation**

This involves the reduced use of the conventionally powered automobiles hence significantly reducing air pollution and CO$_2$ emissions. Alternative commuting strategies may encourage or incentivize carpooling, use of public transportation, walking, bicycling, telecommuting, operating fuel efficient vehicles.

**Light pollution control**

Lighting maintenance practices vary widely, depending on the type of equipment, building type, and the tasks performed by its occupants, as well as building location, size, use pattern, and purpose. As with almost any energy-consuming equipment, the easiest way to save energy is to switch it off when not needed. Lights that can be shut off during unoccupied hours should be shut off promptly at the end of the workday, and over weekends and holidays. Additional savings can be achieved in commercial and institutional buildings through close coordination with janitorial hours, (USGBC, Implementation workbook, 2009).

Using sensors located throughout a building can help in maximizing the potential of a zoned system at minimal cost. Some sensors allow for both temperature and occupancy detection, and can be the basis of an automated setback system for both lights and HVAC. In general, simple occupancy sensors are the most common lighting control used in buildings today. For outdoor lighting, the simple photocell helps to turn lights on at dusk and off at dawn, which can help to reduce energy use further.
b) **Water Efficiency**

Water is a staple in our daily requirements, and concern for water and its safety has existed in society for millennia. With water shortages becoming more common, numerous regulations and campaigns have been run to conserve water. The efforts have centred primarily on water efficiency; ways to meet our needs using the least amount of water. One popular approach is the installation of high efficiency fixtures to replace the conventional water intensive ones. Water saving fixtures has been around for many years, but many of the first low flow products were not well designed and performed poorly (Dickson, 2009).

As an aspect sustainable building operations and maintenance it includes indoor plumbing fixtures, water performance measurement, water efficient landscaping, installing hardware that reduces water requirements or by reusing water in the building.

However an awareness of responsible water usage will have an effect on the water requirements of a building. An effective way to reduce personal water consumption is to install water efficient fixtures. Aerators in faucets and ultralow volume toilets can reduce water consumption.

Modifications can be made to the main intake and output water pipes hence reducing the volume of required water loads and generated waste. Water intake can be supplemented by the collection of rain water from roofs in cisterns. Water discharge can be reduced by installation or redirection of gray-water pipes that carry used water, that doesn’t contain sewage, from sinks and showers in institutional buildings (Omondi, 2012).

c) **Energy and Atmosphere**

Measures taken when considering energy efficiency are its best management practices, minimum energy efficiency performance and ozone protection. Energy efficiency assists in reducing the energy consumption of buildings. The energy that is used to operate buildings constitutes the highest bills in operations and maintenance period of the buildings life cycle (Omondi, 2012). To reduce operating energy use; high energy-
efficiency windows and insulation in walls, ceiling and floors increase efficiency of the building envelop.

Energy and efficiency is an important aspect of sustainable building operations and maintenance. These practices are known to lower utility costs and support a healthy, safe, secure and comfortable indoor environment. It involves the implementation of energy saving measures. It includes such aspects as Optimisation of energy efficiency performance. Energy performance refers to how much energy the facility actually uses and how this is measured.

d) **Materials and resources**

This involves sustainable procuring of on-going consumables and durable goods. The materials procured are renewable rather than non-renewable. These materials reduce maintenance and replacement costs over the life of the building; energy conservation; improved occupant health and productivity. Aspects touched on in this area include:

**Sustainable purchasing policy**

Sustainable purchasing can have a positive impact in a wide variety of environmental issues, including slowing the depletion of natural non-renewable resources and promoting the use of safer products. Materials purchased regionally help the local economy as reduced the energy required. The immediate benefit to schools may include the use of safer products and supplies, which improves the health and wellbeing of students, lecturers and staff (LEED, 2009).

**Solid waste management**

This includes recycling that can have immediate benefit of reduced costs to the university. Recycling of existing materials reduces that need for new materials, thereby reducing any need for raw materials, energy needed for extraction that lead to green-house emissions. In waste management, the conventional methods of dealing with waste entail shipping garbage to seemingly limitless out of sight landfill. Composting and recycling strategies need to be implemented in buildings. This involves using various forms of dustbins one for placing materials that can decompose
and the other plastics and other recyclable materials. The decomposable material can be used as manure for the out-door gardens.

e) **Indoor Environmental Quality**

The purpose of a building is not to only provide shelter for its occupants, but also provide and environment conducive to high performance of all intended occupant activities. Buildings with overall environmental quality can reduce the rate of respiratory diseases, allergy, asthma, sick building symptoms and also enhance user performance.

Factors discussed within this environmental consideration include;

**Indoor Air Quality**

Indoor air quality is a top priority for universities. By improving the indoor air quality there is enhanced well-being of the staff, lecturers and students and an increase in the attendance rates, performance and productivity. It involves the development of a plan that will effectively reduce or eliminate exposure to toxic and hazardous chemicals hence keeping the building occupants safe (Lateef et al, 2010).

Certain aspects are included under this, that is, volatile organic content of building materials, minimizing of opportunity for microbial growth, adequate fresh air supply, chemical content and volatility of maintenance and cleaning materials, minimization of business-machine and occupant pollution sources, adequate acoustic control and access to daylight and public amenities.

It includes other factors such choice of paint to be used, the building materials used in maintenance and repair of worn out parts, protecting of all occupied areas, quality assurance and control.

**Green Cleaning**

Green cleaning is a holistic approach to janitorial services. It takes into account the health, safety and the environmental risks of products and processes associated with cleaning, and balances this with the needs of the facility. Green cleaning involves the use of alternative products, application of the products in different ways, and
evaluation and/or behaviour shifts associated with how buildings are used to reduce risks, while maintaining a satisfactory level of cleanliness and disinfection.

Green cleaning practices can reduce health risks to custodial staff and building occupants, reduce costs, and increase occupant satisfaction. The term “green cleaning” is synonymous with environmentally sensitive cleaning. These terms are often used interchangeably to describe cleaning and maintenance products that protect human health and the environment without sacrificing product effectiveness, (LEED, 2009).

Within green cleaning other factors are also included, that is training of staff on how to go about green cleaning and the use of green products. The cleaning crew will be required to undertake training on the maintenance procedures, disposing and recycling of cleaning and service chemicals, have an overview of a typical green cleaning policy as well as a high performance cleaning program.

The benefits of green cleaning include reduced health effects to building occupants and janitorial staff, such as skin, eye, and respiratory irritation or burns; allergies; multiple chemical sensitivity; headaches; nausea or other gastrointestinal ailments; poisoning; cancer; reproductive hazards; and damage to liver, kidneys, and other internal organs.

Reduced cost to building management, tenants, and/or the janitorial company associated with sick leave, health care, productivity loss, and litigation. Yet another benefit of green cleaning is increased safety and increased occupant and worker satisfaction, including improved morale, productivity and efficiency, quality of life, and sense of well-being.

Occupant comfort

Comfortable, healthy school environments can increase staff, lecturer, and student productivity and also reduce absenteeism. An occupants perspective can help identify issues affecting employee health and productivity, indoor air quality and energy use.
HVAC Maintenance

This refers to Heating, Ventilation and Air conditioning systems. The main purposes are to help maintain good indoor air quality through adequate ventilation with filtration and provide thermal comfort. The HVAC systems are usually among the highest consumers in buildings. The choice and design of the HVAC system can also affect the many other high performance goals, including water consumption and acoustics (Roodman and Lessen, 1995)

HVAC maintenance practices can have a significant effect on a building's energy use and the comfort of its occupants. Mechanical systems - heating, ventilation, air conditioning, and the associated component such as fans, pumps, etc. for space conditioning - are the second largest user of energy in most buildings, exceeded in most cases only by lighting energy consumption.

Key HVAC maintenance considerations include focus on keeping people comfortable instead of keeping buildings in "comfort zones." Where possible, provide temperature for spaces according to their function to reduce HVAC loads (e.g., hallways can be cooler in the winter and warmer in the summer than office areas). And stay current on routine maintenance practices.

Daylight and views

Day lighting and views help to improve indoor quality of a school facility by allowing students, lecturers, and staff exposure to natural lighting and a visual connection to the surrounding outdoor environment. Studies have shown that access to daylight views can increase occupant productivity and performance.

2.4 Good Sustainable Building Operations and Maintenance practice

In the previous section, building operations and maintenance, it is seen that the main precepts include the maintenance types, the main maintenance type being planned maintenance more so, planned preventative maintenance and planned corrective maintenance. Together with planned maintenance the other type of maintenance is unplanned maintenance. These types of maintenance take the buildings age into
considerations and are therefore used to reduce deterioration in buildings and hence prolong the buildings life.

From the review of the literature it is seen that although these maintenance methods prolong the life of buildings, they do not however take the environment into consideration as well as the healthful living and working of the space users found in Strathmore universities' buildings.

This therefore brings in the need to bring in sustainable building operations and maintenance aspects within existing buildings. These aspects are seen to prolong the life of the buildings, increase user comfort within the building structures as well as improve energy efficiency within the buildings. These aspects are seen to both take into consideration the building fabric as well the operations that assist in the running of the building. All these aspects tie in to the overall aim of sustainable building operations and maintenance that is to not only improve the building's interior operations as well reducing a building's impact on the environment. These key aspects of sustainable building operations and maintenance are drawn from a green rating system used for already existing buildings. This rating system is the Leadership in Energy and Environmental Design (LEED) of 2009.

These aspects, as already seen earlier on, include; creation of sustainable sites, water efficiency, energy and atmosphere, procurement of sustainable materials and resources and indoor environmental quality within buildings. These aspects can be seen to be the sustainable building operations and maintenance standards applicable in any institution. An investigation as to the effect that these sustainable building operations and maintenance aspects have on building maintenance practices was undertaken by the researcher with the theory in mind that these aspects will have a positive effect on building operations and maintenance within private universities, case study being Strathmore University. The figure below depicts a working framework which was used when evaluating the case study.
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<td>CASBEE (Comprehensive Assessment System for Building Environmental Efficiency)</td>
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</tr>
<tr>
<td></td>
<td>LEED (Leadership in Energy and Environmental Design)</td>
<td>Indoor Environmental Quality</td>
</tr>
</tbody>
</table>

Fig: **Good Sustainable Building Operations and Maintenance Practice, Source (Author, 2013)**

From the literature already reviewed, it is clear that the first step to sustainably maintain a building, as well as its operations, is to have a well maintained building through following good building maintenance and operations guidelines outlined in the previous section. This creates a good foundation upon which the aspects of sustainable building operations and maintenance can be laid. When doing the evaluation of case study, the building operations and maintenance practices will first be put to scrutiny, then the sustainability of these practices will be looked at and what challenges will be faced when incorporating these sustainable building operations and maintenance practices.
CHAPTER THREE: BACKGROUND OF THE CASE STUDY AND RESEARCH METHODOLOGY

3.1 Background of the study

This chapter will attempt to give a background of the case study as well as the research methodology that was useable by the researcher, the case study being a private university, that is, Strathmore University. This university was chosen due the fact it ranks among one of the leading private universities both in Kenya as well as in East Africa. In this, there is a direct correlation between its excellent academic performance and student enrolment and staff employment. This shows that it has quite a number of space users within the confines of its structure.

3.1.1 Historical Background

Strathmore College was started in 1961 as an Advanced-level Sixth Form College offering Science and Arts subjects by a group of professionals, who formed a charitable Educational Trust (now the Strathmore Educational Trust).

In March 1966, the first intake of Accountancy students, twenty-five in number, joined the Sixth Form students, and began preparing for the examinations of the UK-based Association of Chartered Certified Accountants (ACCA). These first Accountancy students were sponsored by Shell East Africa, BAT (East Africa) and the East African Breweries. At this time Strathmore College was unique as a fully integrated post-Form 4 institution offering both academic and professional courses.

In October 1982, owing to the increased demand from companies for the professional training of their employees, the College began evening courses in Accountancy after normal working hours, with 60 students sponsored by various companies. Through donor help, the college grew with the construction of the Madaraka Campus project.

Construction of the new campus commenced in September 1989. Meanwhile, in January 1991, the Information Technology Centre was started in the Lavington Campus to run computer courses leading to the Institute for the Management of Information Systems (formerly Institute of Data Processing Management) Diploma
and Higher Diploma. In January 1992 a Distance Learning Centre was opened to offer correspondence courses in Accountancy to students who are unable to attend lectures.

In January 1993 Strathmore College merged with Kianda College and moved to Ole Sangale Road, Madaraka Estate.

**Enrolment**

In 2011, Strathmore University enrolled, 333 postgraduate students, 2436 undergraduate students and 1968 students undertaking professional diplomas. This brings to the total enrolment of students to 4737. Within the same year, the University recorded having 130 academic staff, 245 administration & support staff and 118 part-time staff.

### 3.1.2 Location

Strathmore University is located within the city of Nairobi, along Ole Sangale road, Madaraka Estate.

### 3.2 Research Methodology

Kothari (2003) defines research as the pursuit of truth with help of study, observation, comparison and experiment that is a systematic method of finding solutions to a research problem identified. Kothari (2003) further argues that the process of research is a systematic method that includes the following in logical sequence:

a) Enunciating or defining the research problem. b) Formulating the hypothesis/research questions from the research problem. c) Designing the appropriate research process. d) Collecting facts or data to help answer the research questions e) Analysing the data f) Reaching certain conclusions from the analysed data hence answering research questions.

### 3.2.1 Research Design

The formidable problem that follows the task of defining the research problem is the preparation of the design of the research project, popularly known as the research design. Decisions regarding what, where, when, how much, by what means
concerning an inquiry or a research study constitute a research design (Kothari, 2004). As mentioned earlier, a case study approach was chosen for the study.

Case study research method can be defined as the in-depth study of one or a few events or cases in order to understand the phenomenon being investigated. Rather than study a large sample and study a limited number of variables, we are limited to one or two cases and an in depth study longitudinally is done (Flyvbjerg, 2006). According to Kumekpor (2002), a case study method can be conceived as a method of investigation which aims at studying the facts of a particular case from all aspects and from all angles.

It is thus a critical and systematic examination into the circumstances and factors that resulted in a particular condition or situation. The purpose of a case study is to probe deeply and to analyse intensively the complex phenomena that constitute the life of the unit with a view to establishing generalizations about the wider population to that unit belongs (Cobbinah, 2010). The case study chosen for this research was Strathmore University.

### 3.2.2 Population, sample and sampling techniques

**Population**

Population according to Mugenda and Mugenda (1999) refers to an entire group of individuals, events or objects having common observable characteristics. In other words, population is the aggregates of all that conforms to a given specification. A population can also be seen as a well-defined group or a set that has certain properties. The population was made up of the space users found in Strathmore University, in Nairobi Kenya.

**Sample frame and Sample technique**

A sample frame is a list that includes every member of the population from which a sample is to be taken. The best method that the researcher identified for the accessible population was purposive sampling. Purposive sampling is considered desirable when the universe happens to be small and a known characteristic of it is to be studied intensively (Kothari, 2004). This research focused on private universities and one
university in particular was selected to represent the population that is Strathmore University. The sample size therefore included both students and staff of the university.

3.2.3 Data collection instruments

The researcher used primary and secondary data.

Primary data was obtained from conducting interviews and administering questionnaires to building managers and operations as well as the space users mostly constituted the students studying in this particular institution. 80 questionnaires were administered to these space users, and those selected to take part in the research were selected at random. Secondary data was obtained from published text books, unpublished scholarly works and papers from real estate journals, the internet and previous newspaper articles. These serve as a benchmark for the research to be undertaken.

Together with the above, this study employed quantitative methods for data collection as opposed to use of qualitative methods.

Quantitative data are real numbers, such as those representing rainfall figures, ph-values, subject body weights, and so on. Computation of means and variances is permissible for quantitative data. The quantitative data that was collected within Strathmore was with regards to the data which was measured using real numbers. Qualitative data are values which represent such attributes like sex, status, occupation, color (hue) and so on (Kingâ‘ria, 2010, P67).

3.2.4 Data collection procedures

There are two types of data that were collected these were the primary and secondary data. Primary data are those which are collected afresh for the first time, and thus happen to be original in character. Secondary data on the other hand, are those that have already been collected by someone else and which have already been passes through the statistical process (Kothari, 2004). The methods used to collect primary and secondary data differ significantly.
Primary data collection methods

i) Questionnaires

These consist a number of questions printed or typed in a definite order on a form or set of forms. In order to collect observations related to the concepts that are under study, a questionnaire was used. 80 questionnaires were administered to the space users, who included both the students and staff of the private institution in question.

ii) Interview method

Interview method of data collection involves presentation of oral-verbal stimuli and reply in terms of oral-verbal responses. This method can be used through personal interviews and if possible through telephone interviews. An oral interview was conducted between the researcher and the person in charge of building operations and maintenance within Strathmore University.

Secondary data collection methods

Secondary data means the data is already available that is data that was collected by somebody else. Researcher can look at both published and unpublished works. Published data are available in various publications from the government both local and foreign government in this case the researcher relied heavily on information from the United States Green Building Council (USGBC). Secondary sources include information from books, magazines reports, reports prepared by research scholars, universities, economists in different fields. The sources of unpublished data are many and include letters, unpublished biographies, unpublished research projects and scholarly articles.

3.2.5 Processing and Analysis of Data

The data that was obtained from the questionnaires and interviews was analysed and presented using photographs, charts and simple tables. This is due to the fact that the study was quantitative in nature.
CHAPTER FOUR: DATA ANALYSIS AND PRESENTATION

4.1 INTRODUCTION

This chapter interprets and analyses data and other information that was obtained from the field study. The data and information collected was aimed at evaluating the effect of sustainable building operations and maintenance on building maintenance practices in private universities. This will be with regards to the building maintenance practices found within the chosen private university that is Strathmore University, the sustainable building operations and maintenance practices already implemented within the said university and the challenges that would be faced when further implementing these sustainable aspects of building operations and maintenance.

The research was carried out in the period of February to May 2013. Main case study, as mentioned earlier, is Strathmore University. This research was done by means of administering questionnaires to the space users and holding interviews with the building manager. The case study is found on Ole Sengai road, Madaraka area, Nairobi County. The university has a total of 9 buildings all built within a span of 20 years.

The following table shows the buildings found within the university, their respective ages as well as the facilities found within each building.
<table>
<thead>
<tr>
<th>Building Name</th>
<th>Year Built</th>
<th>Age</th>
<th>Facilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase one</td>
<td>1993</td>
<td>20 years</td>
<td>Lecture rooms, offices, Chapel, Computer Laboratories, Washrooms</td>
</tr>
<tr>
<td>Library &amp; Auditorium</td>
<td>2004</td>
<td>9 years</td>
<td>Reading spaces, Halls, Washrooms</td>
</tr>
<tr>
<td>Women residence</td>
<td>2004</td>
<td>9 years</td>
<td>Reading spaces, lounge areas, dormitories, kitchen, Chapel, laundry area</td>
</tr>
<tr>
<td>Strathmore Law School (Former housed Strathmore Business School)</td>
<td>2008</td>
<td>5 years</td>
<td>Lecture rooms, offices, washrooms</td>
</tr>
<tr>
<td>Strathmore Business School</td>
<td>2011</td>
<td>2 years</td>
<td>Lecture rooms, offices, washrooms, meeting areas</td>
</tr>
<tr>
<td>Students Centre</td>
<td>2011</td>
<td>2 years</td>
<td>Reading spaces, restaurants, eating areas, meeting areas, wash rooms,</td>
</tr>
<tr>
<td>Management Science Building</td>
<td>2011</td>
<td>2 years</td>
<td>Lecture rooms, Offices, reading areas, washrooms</td>
</tr>
<tr>
<td>Strathmore Clinic</td>
<td>2011</td>
<td>2 years</td>
<td>Reception, waiting area, examination rooms, dispensary, washrooms</td>
</tr>
</tbody>
</table>

Table 1 Source: Strathmore University Administration Department (February, 2013)
4.1.1 Rate of response

The table below shows the response rate to the questionnaires administered.

<table>
<thead>
<tr>
<th>Respondents</th>
<th>Questionnaires distributed</th>
<th>Questionnaires collected back</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students</td>
<td>50</td>
<td>46</td>
<td>92%</td>
</tr>
<tr>
<td>Staff</td>
<td>20</td>
<td>18</td>
<td>90%</td>
</tr>
<tr>
<td>Staff and Student</td>
<td>10</td>
<td>8</td>
<td>80%</td>
</tr>
<tr>
<td>Total</td>
<td>80</td>
<td>72</td>
<td>88%</td>
</tr>
</tbody>
</table>

Table 2 Source: Own Field Survey (2013)

In the study 72 out of 80 questionnaires that were administered were returned giving a response rate of 88%. According to Gay (1983), a response rate of 70% or more gives a strong basis for data analysis, drawing conclusions and generalizations.

<table>
<thead>
<tr>
<th>Respondents</th>
<th>Questionnaires collected back</th>
<th>Percentage of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students</td>
<td>46</td>
<td>64%</td>
</tr>
<tr>
<td>Staff</td>
<td>18</td>
<td>25%</td>
</tr>
<tr>
<td>Staff and Student</td>
<td>8</td>
<td>11%</td>
</tr>
<tr>
<td>Total</td>
<td>72</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 3 Source: Own Field Survey (2013)

From the table above we can see that most (64%) of the respondents were students. The rest consisted of staff (25%) and those who were both students of the university as well as working within the university as staff (11%).

4.1.2 Duration of stay within Strathmore University

The table below shows the length of stay of the respondents within Strathmore University. These respondents as earlier indicated included students and staff.

<table>
<thead>
<tr>
<th>Years</th>
<th>Frequency</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0-2.0</td>
<td>26</td>
<td>36%</td>
</tr>
<tr>
<td>3.0-4.0</td>
<td>26</td>
<td>36%</td>
</tr>
<tr>
<td>&gt; 4</td>
<td>20</td>
<td>28%</td>
</tr>
<tr>
<td>Total</td>
<td>72</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 4 Source: Own Field Survey (2013)

From the table it is clear that most of the respondents have been in the university for less than one year to 4 years. This can be explained by the fact that most of the respondents, as seen earlier, were students and the longest duration for most of the
courses are four years within the said university. This period, the researcher believed, is enough time to give adequate information for the study.

4.2 Building operations and maintenance practices in the case study

The following section gives an insight as to the building operations and maintenance practices carried out within Strathmore University. This, as mentioned earlier on, was done through the means of using questionnaires from the space users and interviews with the building manager. The information gathered will be in order to full fill the objectives set in the first chapter.

4.2.1 Strathmore University’s Organizational Structure

The following diagram shows the current organizational structure of Strathmore University.

![Organizational Structure Diagram]

Source: Field Survey Research (2013)
From the flow diagram it can be seen that it is through the university council that Strathmore University is run and therefore from it stems the various directors as well as the deans of schools and research. This flow diagram is important as it helps in the determination as to whether or not the university has a maintenance department.

Having carried out the field survey, the researcher established that a maintenance department does indeed exist and this department is found under the highlighted portion that spells ‘University Services’. This department can be equated to what is conventionally referred to the Facilities Management Department as it encompasses all facilities found within the university.

To better understand this statement, the definition of what facilities management entails is needed. According to the International Facilities Management association (IFMA) it’s a profession that encompasses multiple disciplines to ensure functionality of the built environment by integrating people, place, processes and technology. According to the European Committee for standardization and ratified by BSI British Standards Institution, it is the integration of processes within an organization to maintain and develop the agreed services which support and improve the effectiveness of its primary activities.

Activities involved in facilities management include:

**Management and Leadership:** This is the role where we have strategic planning for the organization, reporting, communications, customer service, procurement, space management, human resource, energy management, environmental management, contract management, and quality assurance. Other roles can be included depending on the complexity and size of the organization.

**Operations and Maintenance:** In this role, the facility manager is expected to be in charge of janitorial, general building maintenance, grounds maintenance, security, emergency response, Service Requests and others depending on the size and complexity of the organization.

**Real Estate:** This is inclusive of leasing, lease administration, disposition
Projects; This is inclusive of new construction, office renovations and capital renewal.

Planning; This is with regards to capital and space found within a certain organization. It involves setting what needs to be done, how it should be done and doing it.

Therefore from the above, we can see that it falls within the facilities manager’s docket to address any issues with regard to operations and maintenance of the buildings found within the university.

As to whether or not Strathmore had a Facilities Manager or more specifically a building manager, 86% of the respondents gave an affirmative response, 3% did not think Strathmore had a Building manager, while the rest of the respondents were not sure.

![Chart 1 Own Field Survey 2013: Existence of a Building Manager.](image)

After carrying out the field work survey, the researcher established that indeed Strathmore University had a building manager or better put, a facilities manager.

From the above explanation it is clear what the roles and duties of a facilities manager are. Confusion then may arise as to what the role of the building manager is. When paused with this question, most (34%) of the respondents said the building manager was in charge of implementation of a maintenance policy, while a small percentage thought that the building manager should be the one to budget for maintenance works.
On the other hand, with regard to the same, according to the building manager carrying out of inspections was often done by the building management team in comparison to implementation of a maintenance policy.

### 4.2.2 Building Maintenance Budget

Building maintenance as an enterprise consists of various activities that require financing and other resources and hence bringing in the need for budgeting. A maintenance budget should therefore incorporate the cost of works that are to be undertaken, the source of the funds to undertake those works and the control mechanism.

According to the Draft Building Maintenance Policy of 2011, the budget set for maintenance of the building should be 5% of the value of the building. After doing interviews with the building manager, it came to light that Strathmore University's budget for maintenance works was less than 10% of the total university budget. This is due to the fact that maintenance is not considered huge priority in comparison to other priorities. The maintenance budget is usually allocated according to the need and not as a percentage, according to the maintenance manager, using a percentage would be misleading.
4.2.3 Types of Building Maintenance

The types of building maintenance carried out within the university are both the planned and the unplanned maintenance. Planned maintenance as seen earlier on, is the work that is carried with forethought while unplanned maintenance is the work that comes about due to unforeseen break down or damages. There are two kinds of planned maintenance that is preventive maintenance and corrective maintenance.

4.2.3.1 Preventive maintenance

This refers to work carried out before failure or breakdown occurs. It is done with the aim of preserving the structures and amenities within the building at their present level.

Successful preventive maintenance programs should achieve goals such as help buildings function as they were intended and operate at peak efficiency, including minimizing energy consumption, prevent failures of building systems that would interrupt occupants’ activities and the delivery of public services, sustain a safe and healthful environment by keeping buildings and their components in good repair and structurally sound and provide maintenance in ways that are cost-effective.

In preventative maintenance, work is carried out on a regular basis, be it daily, weekly, monthly or annually. From the field work research most of the respondents established that major maintenance tasks were carried out either on a daily basis or on a weekly basis. This is depicted in the graph in the section to come.

4.2.3.2 Corrective maintenance

This is maintenance work that is organised and carried out after failure has occurred. It is intended to restore an item to a state in which it can perform its required function (Seeley, 1987). It basically involves carrying out inspections to detect failures so that a programme for making them good can be formulated. This may include reroofing, re-plastering, keying or simply replacing a door so that the building continues to operate as intended (Makau, 2010).

Corrective maintenance could also be described as work necessary to bring a building back from a deteriorated state to an acceptable standard (eg treating rising damp,
repairing or replacing a gutter). This is a reactive process to remedy faults which have developed, usually as a result of lack of preventative maintenance (Cobbinah, 2010).

Carrying out of maintenance tasks

From the graph it is clear that according to all the respondents the cleaning of rooms and cleaning of sanitary facilities was done on a daily basis. While according to 86% of the respondents, garbage collection was done on a daily basis as well. On the other hand according to most (66%) of the respondents, the carrying out of repairs was done weekly.

When the building manager was asked to rank various factors that would necessitate the carrying of the maintenance tasks above, the factor that got the highest ranking was carrying of maintenance upon inspection of the buildings as in the graph below.
Upon inspection
Upon request
Statutory regulations in place

Chart 4 Own Field Survey Research 2013: Factors necessitating the carrying out of building maintenance tasks.

Some of the maintenance tasks are also carried out upon request from the space user though very rarely. With regard to statutory regulations in place that touch on building maintenance, the building manager agreed that Strathmore follows regulation that concerns building maintenance, but this would not be the driving force necessitating the carrying of building maintenance tasks.

According to the building manager, these inspections are usually undertaken on a monthly basis, though there is no scheduled inspection plan put in place for all the buildings within the institution.

4.2.3.3 Execution of maintenance tasks

To the question as to whether any of the above maintenance tasks were undertaken by the space users, 22% of the space users replied in the affirmative while majority 72% replied in the negative, 6% were not sure. The following chart shows a reflection of the same.
Chart 5 Own Field Survey Research 2013: Execution of maintenance works.

While on the other hand most of the respondents felt that if they detected a defect within the building they would report it to the building maintenance manager, while a smaller percentage said that would prefer to ignore the problem as the problem doesn’t concern them, or so they believe.

According to the building manager, these maintenance tasks were executed by both an inhouse management team as well as an outsourced team. The inhouse team would be a preferred approach to carrying out of most routine and cyclic work and also were the level of skill and experience required is low. On the other hand an out house team or outsourced team would be preferred where the labour required is for planned and major works.

Outsourcing labour is more often recommended due to the major fact that the organisation is able to focus on its core business, in which case in a university, that would be provision of high quality education, while the support services are taken care of by an outsourced company. Together with this reason, outsourced building maintenance firms have well trained staff who are very familiar with conducting condition assessments of the building.

Although Strathmore has both inhouse and outsourced management of the building, their support staff are not well trained with matters regarding condition assessment of
buildings. This is a worrying factor, as without trained staff, proper building maintenance may prove difficult.

**Time taken for maintenance tasks to be responded to:**

As seen from the literature review, the main aims of maintaining a building is to increase the building’s life as well as to preserve the building as well as its contents. For these aims to be made into a reality, the maintenance tasks made reference to in the previous section, must be undertaken in due time. In some instances, space users would be the ones to make the building maintenance team aware of a certain building’s defect. How long the maintenance team would take to actually to fix the particular problem identified was investigated. As can be seen from the chart below, almost 80% of the space users said that the response time to the maintenance defect was in less than a month, while the other respondents felt that either the maintenance team responded within a period of 6 months to one year or they did not do anything about the defect.

![Chart 6 Own Field Survey Research 2013: Maintenance tasks response time.](image)

**4.2.3.4 Satisfaction with the level of building operations and maintenance**

For building operations and maintenance practices in an institution to be considered as succesfull, the observations of the researcher with regard to the building fabric as well as the take of the users is considered to a great extent. This section shows the users
satisfaction with the level of building operations and maintenance practices within the university. From the chart below, it is clear that more than 50% of the respondents were satisfied with the level of building operations and maintenance within the buildings.

On the other hand less than 10% of the respondents expressed neutrality with the subject matter with some expressing specific dissatisfaction with the expertise of the maintenance personnel, while others felt that the lecture rooms, especially in the older buildings, could be better maintained.

![Bar Chart](chart.png)

**Chart 7 Own Field Survey Research 2013: Satisfaction with level of building operations and maintenance.**

### 4.2.3.5 Building maintenance policy

As mentioned earlier, a building maintenance policy has been defined by the Government of Kenya as a document that incorporates planning, inspection, budgetary and management of maintenance programmes. It is a policy tool from which maintenance framework is anchored to provide the necessary legal and institutional structures for maintenance managers to execute maintenance programmes (Lee, 1987). It also assists an organisation in the allocation of resources as well as monitor the utilization of those resources.

Strathmore University, according to the buildings' manager, does not as yet have a written long-range plan for building maintenance and repairs that is meant to extend out to a minimum of three to five years.
4.3 Sustainable Building Operations and Maintenance Practices in the case study

Sustainable building operations and maintenance has to have as its aim to take care of the requirements of the present as well as the future users. This should be done in tandem with ensuring that a building performs to its highest. For this new paradigm in building maintenance to be duly appreciated, the building manager as well as the space users have to have a sound understanding of sustainable development.

4.3.1 Sustainable Development

From the field work conducted by the researcher, it was established that both the building manager and the space users had a working knowledge as to what sustainable development involved. The bar chart shows the response of those interviewed with regards to the same;

![Knowledge of Sustainable Development](chart8.png)

It is clear from the bar chart that almost 70% of the respondents had a working knowledge as to what sustainable development entailed, while the other 30% either did not know what the term was about, or were not sure what exactly sustainable development entailed. Most respondents roughly or loosely translated sustainable development to mean development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Another definition of sustainable development that some of the respondents gave is
development that takes into consideration the economy, the environment as well as the society. As the understanding of sustainable development was important for the study and for the survey to continue, to those who did not have a working knowledge as to what this new term meant, a brief explanation was given to them by the researcher.

4.3.2 Importance of Sustainable Building Operations and Maintenance

From the researcher’s observations, the respondents who already had an understanding as to what sustainable development was, could then go a step further and answer questions paused to them about sustainable building operations and maintenance. For those who understood the brief explanation given by the researcher, sustainable building operations and maintenance was a roughly familiar term.

Therefore as to whether or not this new paradigm in research was of any importance in the university in question, almost all respondents felt it was important to sustainably manage a building as well as its operations.

According to the building manager, maintaining a building with the environment in mind is important. Maintaining a building sustainably, she added, involves not only the materials used when doing repairs of the deteriorated areas of the build, but also the use of natural resources when doing repairs, incalculating a lot of natural lighting to save on electrical billing costs and using more environmentally friendly material when creating partitioning walls. Basically making buildings within the institution more future ready.

As earlier seen from the literature review, certain important aspects give sustainability in building operations and maintenance its name. These aspects are listed below and a brief explanation of a few of them is given. They include:

a) Efficiency in water use: This is reducing water wastage by measuring amount of water needed for a particular purpose and the amount used or delivered (Vikers, 2002).
b) Energy efficiency: This is the goal of efforts to reduce the amount of energy needed to provide products and services. Includes insulating a home, installing fluorescent lights, using natural sky lights (Diesendorf, 2007)

c) Indoor Environmental Quality, that includes within it indoor air quality, this is a term that refers to the air quality within and around the building and structures with special regard to the health of the occupants. It also includes green cleaning, as the name suggests, this is the use of cleaning methods and products that are environmentally friendly that are meant to preserve human health and environmental quality.

d) Procuring environmentally friendly goods. This involves purchase of goods that are rated as environmentally friendly as well as healthy to the users.

e) Sustainability in waste management. It includes recycling of waste material that are recyclable and use decomposable materials as manure.

f) Effectively trained staff. This includes recruiting staff and training them on the sustainable building maintenance and operations practices

Respondents were then asked to rank the above sustainable building maintenance aspects according to importance. A graph depicting their response was created in the preceding section. From the graph it is clear that most (90%) of the respondents felt that efficiently using water in any building is important as it reduces water wastage as well as reducing water bills. Energy efficiency is the next best factor that the respondents felt was important to extending any building’s life.

The least popular factor from the graph, is the aspect of green cleaning. From the researcher’s observations, it can be deduced that this factor received the least number of “votes” due to the fact that most respondents were not quite familiar with the term or for those who were familiar with the term did not see it as an important or an urgent factor that could receive implementation.
Chart 9 Own Field Survey Research 2013 Importance of Sustainable Building Operations and Maintenance aspects.
4.3.3 Aspects that could be introduced to make the buildings in the institution more sustainable

The following table shows how the respondents ranked aspects that could be introduced in the buildings within the institution inorder to make them more sustainable.

<table>
<thead>
<tr>
<th>STATEMENT</th>
<th>RESPONSE RATE (%)</th>
<th>Mean Score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1- Least Preferred, 3- Neutral, 5-Most preferred</td>
<td></td>
</tr>
<tr>
<td>Water Efficiency</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2%</td>
<td>0%</td>
</tr>
<tr>
<td>Energy Efficiency</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>3%</td>
<td>0%</td>
</tr>
<tr>
<td>Sustainable waste management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>3%</td>
<td>1%</td>
</tr>
<tr>
<td>Purchasing environmentally friendly products</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1%</td>
<td>3%</td>
</tr>
<tr>
<td>improved indoor air quality</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1%</td>
<td>0%</td>
</tr>
<tr>
<td>Green cleaning programs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1%</td>
<td>0%</td>
</tr>
</tbody>
</table>

Table 5 Source:Own Field Survey (2013)

From the table above, 70% of the respondents felt that improving energy efficiency in buildings is the most preferred aspect in the quest to making buildings more efficient. It can also be argued that energy efficiency was also considered the least preferred method owing to its 3% popularity rating, but this point is refuted by the mean score attained by the same aspect, at 60.4. This mean score is derived from calculation of the average of the total score in the table.

Sustainable waste management is seen as the next best aspect in terms of the most preferred sustainability factor, though it got an overall mean score of 58, while on the other hand, improved indoor air quality, though receiving positive responses from 60% of the respondents, 9% less than sustainable waste management, it got a mean score of 60.4, same as energy efficiency. Therefore it can be safely stated that
improved indoor air quality is the second most preferred aspect that can be introduced in the making of a building more sustainably managed.

Judging from the mean score, it can be deduced that the least preferred aspect is the purchasing of environmentally friendly products at a mean score of 54.8, followed closely by green cleaning, at a mean score of 55.6.

4.3.4 Sustainable Building Operation and Maintenance aspects the institution has already incorporated

According to the building manager, not all the aspects of sustainable building operations and maintenance have been incorporated into the university buildings. The ones which are in existence have been incorporated into the newer buildings. These aspects mostly touch on improving energy efficiency within the rooms more so the lecture rooms and the offices. The main aim of energy efficiency is to reduce the costs that go into the use of energy to run the building. The energy efficiency aspects incorporated include use of fluorescent bulbs in all the rooms, these assist in reducing the amount of electricity used to light up rooms.

![Flourescent Bulb](image)

Figure 1 Own Field Survey 2013: Flourescent Bulb

Yet another energy efficiency aspect that has been incorporated into Strathmore is increased amount of natural lighting through the use of glass walling on one side of the building in place of natural concrete stone walling. This seen particularly in the Student Centre building, the Management Science building and Strathmore Business School.
Other than the glass walling, yet another innovative way of increasing energy efficiency in buildings is through the use of natural sky lights, that bring in natural lighting hence reducing the need for artificial lighting, and this has been incorporated in the Strathmore Business School building.

Figure 2 Own Field Survey 2013: Glass Walling

Figure 3 Own Field Survey (2013): Natural Skylights within Strathmore Business School.
Together with the above two aspects, Strathmore University has also embarked on purchasing of environmentally friendly materials and resources. This is done with the aim if contributing towards environmental awareness when procuring materials that would be used in the maintenance of the buildings.

4.3.4.1 Factors that would encourage incorporation of sustainable building operations and maintenance

The university has as one of its goals to incorporate these sustainable building operations and maintenance aspects indue time due to certain factors. The factors are listed below in order of priority given by the building manager:

Cost Control

This can be described as the practice of reducing an institution's expenses. With regards to building maintenance, costs can easily be controlled through introduction of less conventional ways of maintaining a building, for example using environmentally friendly products to clean, replacing conventional electric bulbs with energy saving bulbs, increasing the amount of natural lighting in rooms, recycling of both water as well as recycling of waste material.

With regards to cost control, there is a misconception that the costs of sustainable maintenance methods are the greatest barrier to maintaining a building sustainably, but it has been proven through numerous studies that use of sustainable technology to maintain a building reduces billing costs, increases the property value as well as increases employee productivity (Cassidy, 2003).

Environmental Preservation

As mentioned earlier on in the study, more than one third of energy is consumed in building worldwide, this thus accounts for about 15% of global greenhouse gas emissions. In cities, buildings can account for up to 80% of carbon emissions (Wafula et al 2009). This thus calls for improving of energy efficiency in building in order to both reduce greenhouse gas emissions as well as any energy costs.
**Improve occupant comfort**

University buildings are viewed as factors of production. These, as mentioned previously are procured with an aim to create an environment that is conducive enough and has adequate environment that will stimulate and encourage teaching, learning as well as innovation in any research. This therefore brings in the necessity to sustainably maintain these particular buildings, so as not to hinder their main objectives mentioned above.

**Improved productivity**

Healthy indoor environments can increase employee productivity according to an increasing number of case studies done in the U.S. Since workers are by far the largest expense for most companies (for offices, salaries are 72 times higher than energy costs, and they account for 92% of the life-cycle cost of a building), this has a tremendous effect on over-all costs (Garzone, 2006). Employees in buildings with healthy interiors have less absenteeism and tend to stay in their jobs.

**To increase the buildings lives**

Sustainable building operations and maintenance practices are considered to be good practices in increasing the building life. This goes hand in hand with preserving the building value as well as its outward appearance and maintain occupants.

**To conform to international standards**

Environmental conservation has now become an internationally acceptable phenomena with different countries trading in their carbon emissions to third world countries with the promise that these less developed countries will plant more trees to cater for the carbon emission. It is therefore safe to state that countries and more specifically educational institutions are seen to be conforming to international standards when they decide to incorporate more sustainable building maintenance aspects into their operations and maintenance practices.

**Personal satisfaction**

Occupants of sustainably maintained buildings tend to find these buildings very pleasant and this is reflected in reduction in absenteeism and greater productivity. In
addition, building owners, architects, and contractors who have incorporated green design report a feeling of personal satisfaction in doing the right thing.

4.3.5 Challenges likely to be faced when implementing sustainable building operations and maintenance practices

In any sector of the society, implementation of new concepts is always met with hostility hence making adoption of the new paradigm challenging. Below is a list of probable challenges that may be faced when trying to implement sustainability concepts as they relate to the maintenance of existing buildings:

**Lack of Finance**

In conventional building maintenance practices financial problems arise due to lack of sufficient funds to purchase materials as well as components and pay for labour. With regards to the implementation of sustainable building operations and maintenance practices, this is also seen as a constraint due to the fact in as much as it is cheaper to be more environmentally conscious in the long run, it costs a lot in the short term.

**Maintenance management constraints.**

This could be brought about due to lack of proper record keeping leading to a lack of proper organisation that assists in making planning for the future impossible. This then leads to a maintenance practice that is more of crisis maintenance than anything else.

**Lack of institutional support**

This is brought about where within the institutional framework, there may have been noted a weak integration of the maintenance functions. Therefore if sustainable building operations and maintenance practices were to be introduced, due to lack of institutional support, its integration will be weak and therefore may not pick as it should hence making its effectiveness bland.

**Lack of skilled and trained personnel**

This can be seen as also an area where maintenance management is wanting. It is common practice that most maintenance units are understaffed or are staffed with inexperienced and unskilled manpower. From the field work undertaken by the researcher, it was established that the maintenance staff is not well trained, this thus
creates a problem for the implementation of sustainable building operations and maintenance practices.

**Lack of proper equipment**

Maintenance operations are dependent on tools, equipment and vehicles. Therefore inadequate supply of tools and equipment equates to frequent breakdown of the already existing equipment in place. This therefore leads to limiting the performance of most maintenance units, hence making the implementation of sustainable building operations and maintenance more challenging as the foundation on which it is to be laid on is already unstable.

The above factors were presented to the respondents to give feedback as to their thoughts on the subject matter. The factors ranked were then calculated into percentage form in accordance with the number of respondents. The table therefore shows how each factor ranked.

**4.3.5.1 Most challenging factor**

<table>
<thead>
<tr>
<th>STATEMENT</th>
<th>RESPONSE (%)</th>
<th>Mean Score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1-Least Challenging, 3- Neutral, 5- Most Challenging</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Lack of Finance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maintenance Management Constraints</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of Institutional Support</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of skilled and trained personnel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of proper equipment</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 6 Source: Own Field Survey (2013)

From the above table it is deductible that the most challenging factor in implementing sustainable building operations and maintenance would be lack of finance at 55% and at a mean score of 50.8. With regard to sustainable development, one of the main constraints is that it is expensive to implement the sustainability aspects of building
operations and maintenance. The second most challenging factor from the table is lack of institutional support at 37% and at a mean score of 42.8.

Although both lack of institutional support and lack of skilled and trained personnel have the same mean score, the deciding factor between these two aspects is the percentage response garnered for the Most challenging aspect which gives lack of trained and skilled personnel a score of 28%. This we can conclude to be due to the number of respondents who either were neutral about the aspects or felt the aspects in question were more challenging as opposed to ranking the aspects as Most Challenging.

4.3.5.2 Least Challenging factor

The following table ranks the same aspects above in accordance to the factor that the respondents felt was the least challenging when it came to its probable implementation within the institution.

<table>
<thead>
<tr>
<th>STATEMENT</th>
<th>RESPONSE (%)</th>
<th>1- Most challenging</th>
<th>3- Neutral</th>
<th>5- Least</th>
<th>MEAN</th>
<th>SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of Finance</td>
<td>34%</td>
<td>13%</td>
<td>24%</td>
<td>13%</td>
<td>16%</td>
<td>35.6</td>
</tr>
<tr>
<td>Maintenance Constraints</td>
<td>35%</td>
<td>18%</td>
<td>29%</td>
<td>14%</td>
<td>4%</td>
<td>45.2</td>
</tr>
<tr>
<td>Lack of Institutional Support</td>
<td>41%</td>
<td>26%</td>
<td>11%</td>
<td>15%</td>
<td>7%</td>
<td>43.6</td>
</tr>
<tr>
<td>Lack of skilled and trained personnel</td>
<td>37%</td>
<td>22%</td>
<td>19%</td>
<td>17%</td>
<td>6%</td>
<td>43.6</td>
</tr>
<tr>
<td>Lack of proper equipment</td>
<td>45%</td>
<td>11%</td>
<td>24%</td>
<td>14%</td>
<td>5%</td>
<td>44.4</td>
</tr>
</tbody>
</table>

Table 7 Source: Own Field Work (2013)

By looking at the table, it can be easily deduced that the less challenging factor to be implemented within the institution is the lack of proper equipment, indicating that Strathmore has all the necessary equipment to maintain a building sustainably. On the other hand management constraints get a score of 35%, it has a mean score of 45.2 making it the least challenging factor in accordance with the response from most respondents.
4.3.6 Green Building Rating Systems in place in the case study

Concern over environmental impacts of buildings to the environment has led to the development of various strategies to encourage the inclusion of environmentally friendly materials and technologies in the development of built infrastructure. The notion of sustainability requires consideration of environmental impact, resource depletion and waste emissions for the entire life cycle of a building; traditionally, engineers and architects have focused primarily on initial construction and commissioning costs (Fenner et al 2007).

Sustainable buildings may be considered as structures that incorporate environmentally sensitive features and technologies from the initial design phase; they seek to meet or exceed resource and energy consumption targets that are set well above local requirements while taking into account the whole life cycle impact of the structure.

A large number of tools have been developed to facilitate the efficient and consistent evaluation of a building’s environmental impact. Known as building rating systems, they are intended to foster sustainable building design, construction and operation by promoting and facilitating better integration of environmental solutions with cost and other traditional design criteria. In addition, by promoting a holistic design approach, building rating systems attempt to capture the complicated ‘web-like’ relationship between a building’s construction, operation and impact on human health and the environment (Ryce et al 2007). There are a few critics about these building rating systems. The most prominent of these are as follows:

a) They are not universally applicable. Currently, assessment is only being encouraged in the narrow sector of stand-alone building construction. Assessment methods will need to be implemented in a much wider array of categories to foster true environmental protection.

b) They require constant updating. A rigorous revision schedule is necessary to maintain accuracy of the assessment, as well as maintain the potency and attraction of the certification.
c) **Effective application requires an integrated approach.** An integrated design strategy greatly benefits the application of a rating scheme; current schemes do little to foster this type of approach.

d) **Buildings can have many lives with different uses.** As the operational life of a building is typically far greater than that of its occupants, a building will have several *service lives* during its *design life*. Current rating schemes usually examine only the building as it is first commissioned. Breeam (Building Research Establishment Environmental Assessment Method) has a number of management and operation versions of its scheme for this reason. They are not, however, widely used, so a Breeam *In Use* option is currently under development (Fenner and Ryce, 2007).

Within Strathmore University, a few of the structures have made attempts at attaining the green status. Among them is the Strathmore law school (formerly the Strathmore Business school) as well as the new Strathmore Business School. According to the University’s website, SBS was awarded the *best green building development in Africa* by the African Real Estate and Housing Finance (AREHF)...

![Figure 4 Own Field Survey 2013: Strathmore Business School](image)

According to the building manager, the buildings adhere to the Leadership in Energy and Environmental Design (LEED) Green Building Rating System, a suite of
standards for environmentally sustainable construction. This rating system is used mostly for buildings that are built as green and not for already existing buildings.

4.4 Testing of the Hypothesis

The study had its null hypothesis as the incorporation of sustainable building operations and maintenance has no effect on building maintenance practices in private universities, while as its alternative hypothesis was incorporation of sustainable building operations and maintenance does have an effect on building operations and maintenance practices in private universities. The effect it has is a positive one at that.

From the survey conducted over 90% of the respondents felt that incorporation of sustainable building operations and maintenance practices has an effect on the building operations and maintenance practices, hence making the alternative hypothesis true and the null hypothesis false. It can therefore be deduced that the advantages derived from maintaining a building sustainably outweigh the challenges faced when attempting to implement the sustainable building operations and maintenance aspects.
CHAPTER FIVE: FINDINGS, RECOMMENDATIONS AND CONCLUSIONS

5.1 Introduction

This chapter aims to expound on the findings, recommendations and conclusions of this study with the purpose of providing a framework for Sustainable Building Operations and Maintenance practices in Strathmore University. This is done in line with the study\textsuperscript{o} objectives, which are:

i. To establish the building operations and maintenance practices in Strathmore University.

ii. To establish the sustainable building operations and maintenance practices in Strathmore University.

iii. To evaluate the effect of sustainable building operations and maintenance aspects have on building maintenance practices in the university in question.

iv. To determine the challenges faced when applying sustainable building operations and maintenance practices in Strathmore.

Conclusions that will be drawn from the research will assist in making the recommendations in aiding the implementation of sustainable building operations and maintenance practices in within the institution of higher learning.

5.2 Summary of Findings

This section will give insight as to the findings of the research. These findings will be categorised in accordance to the study\textsuperscript{o} objectives as well the conceptual frameworks laid out.

5.2.1 Building Operations and Maintenance Practices

The first objective of the research was to find out the building operations and maintenance practices found within the university in question. From the outcome of this research, it is evident that, in accordance to the conceptual framework laid out in chapter two, Strathmore practices both Planned and Unplanned kind of maintenance.
This is evidenced from the number of times they carry out daily routine tasks as well inspections. From the survey carried out, it was clear that the space users were very satisfied with how well the buildings within the university were maintained.

The second outcome of this part of the research revealed that Strathmore did not have a long range plan that would help them in maintaining their structures. This long range plan is a building maintenance policy. An organisation without a clear maintenance policy has no or few goals to achieve in carrying out its maintenance works (Draft national Policy, 2011). According to the building manager although Strathmore does not have a long range plan with regard to maintenance, there are attempts to put one in place soon enough.

The third outcome of the research was that, although Strathmore respects the rule of law, the regulatory frameworks that have been put in place to guide in proper maintenance of buildings in Kenya have not quite been adhered to. This is evidenced from the fact that even though Strathmore has a maintenance department, the department is headed by the same person that heads the University Services, who is not trained in the field of property management.

According to the Draft National Building Maintenance Policy of 2011, establishing an education and training framework for maintenance personnel at all levels is put as one of its main objectives in improving maintenance in the country. This can therefore be seen as a testimony as to the importance of having trained maintenance personnel. From the research carried out, not only did Strathmore not have a manager trained in the field of property management, but even the support staff were not trained in building maintenance practices.

Together with the above, it was also discovered that although Strathmore’s budget put emphasis on other departments in terms of budgetary allocation, the maintenance department did not have a fixed budgetary allocation.
5.2.2 Sustainable Building and Operations and Maintenance Practices

The second objective of the research was to find out what effect maintaining a building and its operations sustainably would have on the building maintenance practices already in place. As in the section above, the conceptual framework of what constitutes good sustainable building maintenance practices will be referred to.

The first outcome was that 70% of the respondents had a working knowledge as to what sustainable development involved. This according to the researcher is a good number to continue the research with. This factor is of great importance as without a working knowledge as to what sustainable development entailed, bringing in the aspect of sustainable building operations and maintenance would have proven difficult as the research mainly depended on the feedback of the building users.

The second outcome was that out of the nine buildings that Strathmore University has, three of them have been rated as green. That is the Students Center, Strathmore Law school and Strathmore Business school. According to the manager, the rating system that was used was LEED (Leadership in Energy and Environmental Design) a suite of standards for environmentally sustainable construction. As mentioned in the previous section, building rating systems are not universally applicable. This rating system was designed for the United States of America, this means a rating system for Africa needs to be introduced and therefore implemented, which is yet to happen.

The third outcome of the research was with regards to the sustainable building operations and maintenance aspects that have already been implemented within the university and those that are yet to be implemented. From the research, it was discovered that some the aspects of sustainable building operations and maintenance had been implemented in the newer buildings (aged 2 to 5 years), and none was implemented in the older buildings (aged 6 to 20 years). These aspects that were already implemented included energy efficiency, purchasing of environmentally friendly materials and resources as well as improving of occupant comfort. According to the building manager, increasing water efficiency and improving the indoor air quality, were in working progress. No attempts however have been made to sustainably manage their waste or to implement green cleaning programs.
From the field survey research carried out, sustainable building operations and building maintenance practices would have a positive effect on the building operation and maintenance practices.

5.2.3 Challenges faced when applying sustainable building operations and maintenance practices

From the data analysed in the previous section, the most challenging factor according to both the building manager as well as the space users is the financial constraint. In order for sustainable building operations and maintenance aspects to be implemented within the university, there has to be quite a bit of capital input, which is usually unavailable. This hence forces the university to rely on traditional building maintenance methods, which in as much as they assist in increasing the building’s life, do not take the environment into consideration, and also do not take occupant comfort into account. The least challenging factor was maintenance management constraint.

5.3 Recommendations

Based on the above findings, it is hereby deemed necessary to make recommendations that would help in the implementation of sustainable building operations and maintenance in Strathmore University.

In as much as the majority were satisfied with the level of maintenance in the buildings, there were still a few space users who had concerns as to the response time when it came to carrying out of repairs. If these rather salient issues are not addressed, there is a likelihood that more and more users will not be satisfied hence nullifying Strathmore’s efforts to increase occupant comfort within buildings.

Failing to plan, is planning to fail. Benjamin Franklin once said, a founding father of the United States more than 300 years ago, and these words still ring true today. By not having a maintenance policy in place, Strathmore University is in essence planning to fail. A maintenance policy is essentially a road map towards provision of a clean environment, setting of high standards and building conservation.

According to the Draft National Maintenance policy, institutions that do not have a maintenance policy run the risk of getting sick buildings which are unhealthy, unsafe
and dilapidated. Without a written out action plan, improving a building becomes difficult. This research therefore recommends Strathmore to make getting a maintenance policy, that is unique to them, a priority.

Having a maintenance budget. From the research carried out, Strathmore’s building maintenance budget is roughly 9% of the total institutions budget. This shows that maintenance of the university buildings is not accorded as much importance as other activities. The researcher’s recommendation is that, the maintenance budget ought to be 5% of the total value of all the buildings found within the University, despite what the yearly budget is set at. This could be done through establishing a sinking fund for priority maintenance (Draft National Maintenance Policy, 2011). This is done so as to achieve financial stability of building maintenance, and it is through this financial stability that implementation of sustainable building operations and maintenance can be made possible.

Training of the maintenance personnel. As a result of giving maintenance practice low priority, there has been ineffective education and training. Effective education and training for the building manager in the field of property management is of essence. This is due to the fact that training for maintenance management embraces knowledge in technology and experience necessary to identify maintenance needs, specify the right remedies, an understanding of modern business management techniques and knowledge of property and contract law.

Further awareness about sustainable development. From the research it was discovered that though 60% of the respondents had a working knowledge about sustainable development, this left 40% of respondents not being too familiar with the term. Although this number is not a majority of the space users, it is still a significant number. The researcher therefore recommends that these institutions of higher learning should create more awareness to the students as well as the staff as to what sustainable development is and what are its benefits as well as its costs.

Green building rating system in Africa. There is a great need for a green building rating system in Africa to avoid the use of building rating systems of other regions. This is due to the fact that the regions have vast differences that may lead to
applicability of the rating system in one region and inapplicability of the same rating system in another.

Importance of sustainable waste management and green cleaning. From the research survey carried out, it was evident that sustainable waste management and green cleaning were considered least important to the building manager and the space user respectively. Sustainably managing waste, as mentioned in the literature review can be essential in reducing any need for raw materials and decreasing the need for energy to extract these materials. As for green cleaning, the benefits are bountiful and some include reducing health effects of the building on the occupants as well as increased occupant comfort. The researcher therefore recommends that further awareness on these two prevalent, easy and costless to implement aspects be made with an aim increase their appreciation by the space users.

5.4 Conclusions

Institutions of higher learning are important social institutions in any country, this is due to the fact that they are where leaders are born and raised, ground breaking researches are done that could change the world as we know it as well as many social interactions take place within the walls of these institutions. It is therefore important that these walls are well maintained with an aim to extend the lives of the various buildings and to go a step further and preserve the environment as well as the health of the occupant. This can be achieved through sustainable building operations and maintenance practices. With that in mind, several conclusions can be drawn from the research conducted.

All buildings whether old or new can be sustainably maintained. This can be done using various guidelines outlined in the LEED (Leadership in Energy and Environmental Design) for existing buildings: Operations and Maintenance of 2009. The guidelines give a rough idea as to how best to implement sustainable building operations and maintenance in institutions of higher learning.

For a building to be maintained sustainably, the standards of maintenance already in place within the said building have to be relatively high. It would be harder to sustainably maintain a sick building in comparison to maintaining a building that
already has good maintenance standards in place. This good maintenance standards set a platform upon which sustainable building operations and maintenance aspects can be laid.

The lack of adequate finance set aside for maintenance purposes is brought about by the subsequent lack of a maintenance policy. Having a building maintenance policy, that is unique to each institution, will assist in the preparation of a proper maintenance budget that will further aid the implementation of sustainable building operations and maintenance practices.

There is dire need for user participation during the maintenance of the buildings. According to the Kenya Vision 2030, citizens are encouraged to value and respect public (as well as private) facilities and this can be done through a series of public awareness programmes that are aimed at engendering a sense of civic responsibility and foster nation building attitudes among all citizens.

5.5 Areas of further Research

The area for sustainable building operations and maintenance is a wide, therefore areas of further research will need to be done. The preceding section will endeavour at showing what these areas ought to be.

From the research carried out, although the area of energy efficiency was looked into, there is need to do further study on energy efficiency and its effect on the building maintenance costs.

After doing the research it became clear that there was very little awareness with regards to green cleaning and its benefits to the sustainable building operations and maintenance practices. Therefore further research could be done on green cleaning procedures in comparison to normal cleaning procedures in university buildings.

It was also revealed from the research done that in as much sustainably maintaining waste was of great importance to both the space users and the building manager, the effect of sustainable waste management in institutions of higher learning could be an area of further research.
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APPENDICES

APPENDIX A

QUESTIONNAIRE TO THE BUILDING MANAGER

Preamble

The purpose of this questionnaire is to aid in the study titled **THE EFFECT OF SUSTAINABLE BUILDING OPERATIONS AND MAINTENANCE ON BUILDING MAINTENANCE PRACTICES IN PRIVATE UNIVERSITIES.** All the information provided in this questionnaire as well as your identity will be treated as confidential, only to be used for the purpose of this research. Your assistance and cooperation will be highly appreciated.

Building Operations and Maintenance Practices

1. Name:____________________________________________________

2. What is your position in this organisation?

3. When was this institution established?

4. How many buildings does the institutions have?

5. What are the ages of each of the buildings?
6. What facilities are offered in the afore mentioned buildings?

7. What percentage of the institution’s budget goes towards building maintenance and operations?
   - [ ] 10-20%
   - [ ] 20-40%
   - [ ] 50-70%

8. What is the organisational structure of this institution?

9. Is there a specific maintenance department within the institution?
   - [ ] Yes
   - [ ] No
   - [ ] Other
   If other, please specify

10. What type of maintenance do you undertake to the buildings?
    - [ ] Planned preventive maintenance
    - [ ] Planned corrective maintenance
    - [ ] Unplanned maintenance
    - [ ] Deferred maintenance
    - [ ] Other
    If other, please specify

11. What necessitates the carrying out of maintenance on the buildings?
    - [ ] Upon inspection
    - [ ] Upon request
    - Other (Specify)

12. How often do you inspect the building to determine defects?
    - [ ] Weekly
83

Monthly
Yearly
Only when a defect is spotted
Other

If 'other' please specify

13. Who does the repairs of the defects in the buildings?

Inhouse management
Outsourced Management
Inhouse and outsourced management

If 'other' please specify

14. Do support staff receive training to conduct the condition assessments of the buildings?

Yes  No

15. Does the institution have a written long-range plan for building maintenance and repairs that extends out a minimum of three to five years?

Yes  No  Other

If 'other' please specify

16. What factors in your opinion are impeding the effective maintenance of buildings in the institution?

Sustainable Building Operations and Maintenance Practices

17. Are you familiar with the area of sustainable building operations and maintenance?

Yes  No
18. Do you think it's important to sustainably maintain a building and its operations?

☐ Yes  ☐ No

Please explain your response;

__________________________________________________________________________________________

19. Do you believe sustainably maintaining a building and its operations significantly affects current building operations and maintenance practices?

☐ Yes  ☐ No

Please explain your response

__________________________________________________________________________________________

20. Which sustainable building operations and maintenance aspects has this institution already adapted?

☐ Water efficiency
☐ Energy efficiency
☐ Sustainable waste management
☐ Purchasing of environmentally friendly materials and resources
☐ Improved indoor air quality
☐ Green cleaning programs
☐ Building occupant comfort
☐ None

21. Which other sustainable building operations and maintenance aspects would you incorporate into the institution?

__________________________________________________________________________________________

22. Why would you incorporate these sustainable operations and maintenance aspects? Please rank the following possible reasons (rating: 1- low, 5- high)

☐ To Increase building life
☐ To preserve the environment
☐ To conform with international standards
☐ To improve occupant comfort
23. What challenges do you think you will face when incorporating these sustainability aspects? Please rank the following probable challenges, (1- Low, 5- High)

- Institutional constraints
- User problems
- Equipment unavailability
- Financial constraints
- Other

If other please specify: __________________________________________________________

24. How can these challenges, in your opinion, be overcome?

________________________________________________________________________

25. Have any of the buildings within this institution been rated as green?

- Yes
- No

If yes, which rating system has been put to use?

- LEED (Leadership in Energy and Environmental Design)
- BREEAM (Building Research Establishment's Environmental Assessment Method)
- GREEN GLOBES
- CASBEE (Comprehensive Assessment System for Building Environmental Efficiency)
- Not sure
APPENDIX B

QUESTIONNAIRE TO THE SPACE USERS

Preamble

The purpose of this questionnaire is to aid in the study titled THE EFFECT OF SUSTAINABLE BUILDING OPERATIONS AND MAINTENANCE ON BUILDING MAINTENANCE PRACTICES IN PRIVATE UNIVERSITIES. All the information provided in this questionnaire as well as your identity will be treated as confidential, only to be used for the purpose of this research. Your assistance and cooperation will be highly appreciated.

Building Operations and Maintenance Practices

1. How long have you worked or studied here?

2. Does the building you work or study in have a maintenance manager?
   - [ ] Yes
   - [ ] No
   - [ ] Other

3. What does the maintenance manager do?
   - [ ] Carry out regular building inspections
   - [ ] Organise for building maintenance works
   - [ ] Budget for building maintenance works
   - [ ] Implementation of a maintenance policy

4. How often do the following maintenance tasks get done? (Please tick)

<table>
<thead>
<tr>
<th></th>
<th>Daily</th>
<th>Weekly</th>
<th>Annually</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cleaning of rooms</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cleaning of sanitary facilities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------------------------</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>Repair works</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gabbage collection</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5. Are any of these conducted by the space users?

- [ ] Yes
- [ ] No

6. When you detect any defect in the building, what do you do?

- [ ] Report the defect to the maintenance manager
- [ ] Fix the problem yourself
- [ ] Ignore the problem
- [ ] Other

If other, please specify

_________________________________________________________

7. How long does it take for maintenance request to be responded to?

- [ ] less than a month
- [ ] 1-6 months
- [ ] 6-12 months
- [ ] More than 12 months
- [ ] other

If other please specify

_________________________________________________________

8. Please indicate your level of satisfaction with the level building maintenance by checking the following

<table>
<thead>
<tr>
<th></th>
<th>Very satisfied</th>
<th>Satisfied</th>
<th>Neutral</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cleanliness of office areas</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cleanliness of restrooms</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cleanliness of classrooms</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Cleanliness of hallways and walkways
Condition of interior spaces
Professionalism and expertise of personnel

9. Are you generally satisfied with the current building and operations maintenance standards in the institution?
   [ ] Very satisfied  [ ] Satisfied  [ ] Neutral  [ ] Dissatisfied

Sustainable Building Operations and Maintenance Practices

10. Are you familiar with the term Sustainable development?
    [ ] Yes  [ ] No  [ ] Not sure

11. Do you think sustainably maintaining a building and its operations is important?
    [ ] Yes  [ ] No

12. Rank the importance of the following aspects of sustainable building maintenance?

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Very important</th>
<th>Important</th>
<th>Relatively important</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficiency in water use</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Efficiency in energy use</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Procuring environmentally friendly products</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cleaning using environmentally friendly products (Green Cleaning)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Improved indoor air quality</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
13. Do you think the buildings in this institutions are sustainably maintained?
   
   ☐ Yes   ☐ No

14. What aspects can be introduced to make building operations and maintenance more sustainable? Please rank the following sustainable building operations and maintenance aspects, (1- Low, 5-High)
   
   ☐ Water efficiency  ☐ Energy efficiency  ☐ Sustainable waste management  ☐ Purchasing of environmentally friendly materials and resources  ☐ Improved indoor air quality  ☐ Green cleaning programs

15. In your opinion, would the above aspects improve the current building operations and maintenance practices?
   
   ☐ Yes   ☐ No

16. What challenges do you think will be faced when doing this? Please rank the following probable challenges,(1-Low, 5-High)
   
   ☐ Lack of finance  ☐ Maintenance management constraints  ☐ Lack of institutional support  ☐ Lack of skilled and trained personnel  ☐ Lack of proper equipment