Research Article

AN INVESTIGATION IN IMPLEMENTATION OF MAINTENANCE MODELS IN HIGHER LEARNING INSTITUTIONS IN GABORONE

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ABSTRACT

Purpose: To investigate on the implementation of maintenance models and techniques used when executing facilities maintenance works by facility managers or external service providers' of higher learning institutions in Gaborone. The investigation was based or focused on outsourced maintenance works within identified institutions.
Methodology: The objectives of this study were; to find out why maintenance models are not used in higher learning institutions in Gaborone, to assess the challenges faced by maintenance personnel in carrying out maintenance models and techniques and lastly to recommend strategies that can be adopted by maintenance personnel to enhance use of maintenance models in higher learning institutions in Gaborone. In order to achieve these objectives both primary and secondary sources of data were used. Primary data was collected through the use of questionnaires from 30 facility managers, contract managers and maintenance personnel of higher learning institutions in Gaborone with a response rate of 50%. Secondary data on the other hand was collected from journal articles, published books, conference papers, periodicals and dissertations. Microsoft Excel was used to analyse and present the data.
Findings: The findings revealed that the majority of maintenance personnel in higher learning institutions are aware of facilities maintenance models and techniques. The incremental budget model and Computerised Maintenance Management System (CMMS) are the models widely used in higher learning institutions in Gaborone. The Navy long range maintenance planning methodology (NLRMP) is sometimes used in learning institutions as far as maintenance is concerned. The use of maintenance models enables increased useful life or building lifespan. The main challenges which are frequently encountered in efforts of implementing facilities maintenance models are the gap between theory and practice and lack of expert engineers and specialists. Corrective and preventive maintenance is often or frequently used in tertiary institutions. The main factor causing high cost in maintenance in learning institutions is human behaviour. Unethical behaviours expressed towards institutions equipment and building users contribute towards increased maintenance costs.
Research limitations/implications: The implication for this study is that if maintenance models and techniques are not effectively implemented by maintenance personnel, building occupants will not be satisfied with living in the building and building's lifecycle will ultimately reduce thus affecting the productivity of employees. In addition, implementation of maintenance models in higher learning institutions will result in minimal expenditure on maintenance activities.
Recommendations: Training maintenance personnel should be done in order to ensure that professionals are up-to-date with new technical methods of carrying out maintenance activities effectively. Property owners should be actively involved in construction of high rise buildings so that important information can be documented to eliminate the issue of facilities managers managing properties which they do not have full details about.
Value of the Study: This study has provided a context in which facilities maintenance models and techniques can be effectively implemented by facility managers during maintenance works in higher learning institutions in Gaborone.

Keywords: Maintenance; maintenance models; technique; higher learning institutions; outsourcing; and facility

1.0 Introduction and background of the study

Buildings of higher learning institutions require proper maintenance in order to create a good learning environment that will support and stimulate overall learning, teaching, research and innovation (Allen, 1993;Lavy & Bilbo, 2009; Lateef, Khamidi, & Idrus, 2010; Odeyemi, Adeniyi, & Amoo, 2019). The main objective of building or facilities maintenance is to ensure high level continuous performance of the building throughout its design life time (Ali, 2009)Facilities maintenance helps higher education institutions to face immediate pressure to protect existing facilities within their campuses (Ofide, Jimoh, & Achuenu, 2015) as well as the welbeing of learners (Graham, Zotter,

& Camacho , 2009). It also assists in enhancing the capacity of the higher education system which is needed to address increasing demands of an increasing influx of students and academic activities within the respective institutions (Lam, 2008; Lee & Wordswith, 2007; Mbutha, 2014). Wordsworth (2001) believes that the condition and quality of buildings in which we live, work and learn reflects a nation's well-being. It is elucidated in Olagunju (2012) that buildings or facilities cannot remain new throughout their entire lifespan. Facilities maintenance problems have to be taken into consideration immediately after buildings are completed. Maintenance is a key factor in sustaining the performance and lifespan of the buildings as it keeps them in good condition for the users (Obiegbu, 1998).

Most of higher learning institutions outsource the works of facilities maintenance as they believe it has lots of benefits (Herath & Ahsan, 2006). Outsourcing has for many years been at the very core of higher learning institutions efforts to improve service delivery to students or users. Sang (2010) citing Domberger (1998) pointed out that outsourcing is the process which search for and appoint contractors for the provision of goods and services and the execution of the contractual relations which are needed to support such activities. Outsourcing is considered as a cost reduction process together with freeing up the organisation resources to concentrate on their core business goals (David,1997; Barrie & Peter, 2007; Kurdia, et al., 2011). Outsourcing is the using of private contractors to provide support services for the organisation (SadiAssaf & Hassanain , 2011). Sometimes most of the work contracted out is the work that had been done by in-house staff. It involves the process of outsourcing non-core activities of the organisation to private contractors instead of using in house staff to free up resources for core activities of the organisation (Ikediashi, & Okwuashi, 2015). Resources which are freed up include cash, personnel and time. The process of contracting out helps the organisation or institution to focus on core business/objectives hence improving performance at large (Kremic, Tukel, & Rom, 2006).

Most of the organizations have limited resources and they must ensure that these limited resources are channeled towards the most important or core activities where the organization has good competitive advantage. As scholars and most related studies explain, that higher learning institutions around the world achieve or concentrate on their main mandates or goals when they have outsourced some if not all of their non-core activities. Outsourcing efforts are to ensure that the institution's task and long-term goals and objectives are reached. Ender and Mooney (1994) came up with the same conclusion that outsourcing is a form of privatization in which institutions of higher education contracts with an external organization to provide appropriate functions (e.g. maintenance). Sriyani and Laksiryi (2004)in their study believed that universities attempt to reduce costs and improve the quality of the service they provide. They continued by highlighting the reasons that were obtained by David (1997) in the survey he conducted.

In Lam (2008)'s view, outsourcing process comprises empowerment by which the service production responsibility is transferred to the external vendors in order to benefit customers or users. When it comes to outsourcing decisions, the organization decides and evaluate whether a certain activity can be done by in house staff or an external vendor through contracting out. Lonsdale (1999) had suggested that outsourcing failures are not due to inherent problems in outsourcing but rather the lack of guiding methodology for managers. He believed that managers have the impact in the failure or success of outsourcing functions. As facilities are considered to be assets that when not properly managed may become liabilities, they may also be hazardous which may lead to accidents, decline in production quality and quantity, excessive labour turnover and increased absenteeism among the organization (Ender & Mooney, 1994). Facilities maintenance should be proactive rather than reactive.

Effective facilities maintenance can only take place when maintenance models and techniques are implemented (Nipp, 2017). As a result of this facility managers and maintenance personnel utilize different models and methodologies to improve maintenance performance in buildings. Outsourced service providers also implement these models when providing their services. In an ideal scenario, top management which is responsible for making outsourcing maintenance works decisions will have to critically assess and evaluate the benefits of outsourcing a certain activity. They have to be in a good position to follow the desired processes involved in outsourcing. The benefits outlined have to be weighed with the short term and long term benefits in house staff so as to balance the benefits with effects of outsourcing within an organisation. The concept of outsourcing facilities maintenance works is considered to be effective world-wide when effective techniques and models are applied in the process. The models involve quantitative statistical framework which help the organisations to forecast or predict the factors associated with facilities maintenance such as cost analysis and performance analysis.

In Botswana, outsourcing of facilities maintenance works has been practiced in past years as it bring better if not best results to organisations (Moseki, Tembo, & Cloete, 2011). Though the process of outsourcing facilities maintenance works in Botswana had been done and is still done, there is still lack of implementation of the techniques or models which can be used to aid the success of outsourced maintenance works in higher learning institutions. Information or data about the facilities history are not available since techniques like CMMS are not used. Outsourcing of maintenance works has been carried out several times in higher learning institutions without taking into consideration the best techniques which can be used to maximize the benefits of the process. Most of the higher learning institutions here in Botswana outsource basing on qualitative methods or their own background experiences

without thoroughly analysing of the contracts to be given to the service providers.

The main consequence of not using the statistical or quantitative models and techniques in outsourcing of facilities maintenance is that organisations usually incur additional costs in outsourcing during the contract period. Non-use of the technique lead to not utilizing outsourcing benefits for good environments for facilities users. Sometimes outsourcing to an incompetent vendor or company can be experienced.

In terms of academia, outsourcing of facilities maintenance works in higher learning institutions together with appreciation of effective maintenance models or techniques has not been discussed in many studies that were reviewed. None of the studies had investigated if these models (maintenance models) are being appreciated by facilities managers and contractors when executing maintenance works (hard services) in higher learning institutions. Therefore, this research gap has necessitated for the investigation of outsourced maintenance works in higher learning institutions in Gaborone (perceptions of contractors and facilities managers in the use of maintenance models).

The main problem identified in this study is that there is lack of application of maintenance models in higher learning institutions. In order to address this problem several objectives were formulated at the beginning of the study. The objectives of the study were to:

1. To identify the reasons why facility maintenance models/techniques are not used in higher learning institutions in Gaborone.
2. To find out challenges associated with outsourcing maintenance works in higher learning institutions in Gaborone.
3. To come up with measures that can enhance the use of maintenance models and techniques in higher learning institutions in Gaborone.

The following hypothesis were formulated to provide guidelines for the research design, data collection and data analysis with the aim of meeting identified objectives.

Objective 1

Facility maintenance models are not used since both the contractor's and managers are not much aware of them. They can be aware but ignorant to implement or use when it comes to maintenance works,

Objective 2

The main challenges associated with outsourcing maintenance works in higher learning institutions are financial and management problems.

Objective 3

Adequate training of maintenance personnel through continuing professional development can enhance the application of maintenance models in building facilities of higher learning institutions.

The need for implementation of various facilities maintenance models or techniques is stressed as this will help to improve service delivery or maintenance in overall hence making facilities conducive for learning by students. Using facilities maintenance techniques can help to improve level of satisfaction of building occupants. The study highlights and give new ideas and strategies which can be implemented on efforts of obtaining good facilities maintenance through use of external vendors. Top management in higher learning institutions can end up adopting the techniques and strategies which they will emphasize in every contract they make concerning outsourcing. This can help to improve facilities maintenance works in higher learning institutions resulting in low level of health problems or accidents in buildings.

In addition, it provides solutions to the challenges that are faced by maintenance managers when implementing maintenance works. The buildings of educational institutions represent a substantial investment by government towards improving education, henceforth they need to be properly maintained in order to preserve the value and quality of the building. It is therefore important that maintenance personnel appreciate and implement maintenance models and techniques when carrying out maintenance works.

2.0 Literature review

The review of related literature is arranged into three themes. Theme one identifies the different types of maintenance models and techniques carried out in building maintenance. Theme two discusses the challenges associated with outsourcing of facilities maintenance works in higher learning institutions in Gaborone. Theme three explains strategies that can be adopted to enhance implementation of maintenance models.

2.1 Different methodologies and models used for facility maintenance

There are number of models and methodologies which have been developed to define requirements for facility maintenance, restoration and bottlenecks. Each model discusses different facility features and has different qualities. These models have been classified into four categories namely; formula based, plant value, lifecycle cost and condition assessment models. They are discussed below.

2.1.1 Formula based models: Formula based models depend on mathematical formulae and equations to predict maintenance costs. These are discussed below.

2.1.1.1 The Facility Infrastructure Sustainment Cost (FISC) model

According to Bello and Loftness (2010), another model which had been discovered is the Navy Long Range Maintenance Planning system which offers a detailed and clear documentation of facility maintenance and repair necessities. It uses a five year cost-estimating system.

2.1.1.2 The incremental budget model

According to Ottoman, Nixon, & Lofgren (1999), this model is generally preferred to be used as monetary managing tool. The model consists of budgets which were done in the past and also considers the last period's budget to be adequate and makes alterations for specific requirement variations and in cases of inflation. There are some of facilities elements or qualities which are excluded in this model. Barco (1994) in his studies believed that where the maintenance budget is used as the baseline is inadequate; the correlation with actual maintenance and backlog requirements is usually misplaced.

2.1.1.3 Square foot model

Square foot model is another methodology or method of facility maintenance which use the area of the facility inventory and a cost factor to determine maintenance and repair needs for a particular facility in consideration. According to Bello and Loftness (2010), facility historical data provides the cost factor. They went on to conclude that this model is one of the easier maintenance and renovation funding cost estimation technique and it is best when it is suitably applied to a list or register of facilities. This model can help facilities managers who manage properties in a portfolio.

Tolk (2007) developed a prediction equation where multiple regression analysis technique or method to estimate the facility required maintenance and renovation budget for a facility portfolio was used. The equation is as follows:

$$\textit{Annual Estimated Required Maintenance } (AERM) = (185 + 0.0143\ \textit{Size} - 2.06\ \textit{Age})$$

Tolk (2007) believed that the equation they developed was the best equation for the substantive portfolio of facilities they assessed including facility age, size, type and use as predicting factors. Facility age and size are the only two factors which are said to bring accurate result if used in the equation.

2.1.1.5 Summation methodology

According to Bello and Loftness (2010), summation methodology is the sum of all the estimated maintenance necessities for all the years in a facility's lifespan deducted by actual maintenance expenditure over each of individual years. The values which are obtained are considered to be maintenance backlog estimates for each of individual years. Bello and Loftness (2010) when explaining this model went on to agree that values can be adjusted with time and summed to arrive at an estimate of total maintenance backlog of individual facility. Estimates of total backlog facilitates one to find the distribution over a determined number of years based on feasibility and added to the estimated annual facility maintenance investment necessities for individual years.

2.1.1.6 Bello-Loftness model

In Bello and Loftness intentions, they developed this model in order to provide a more suitable estimation of facility maintenance necessities. They came up with an equation in order to determine the sufficient yearly facility maintenance investment level. The equation comprised equal add-on to account for backlog necessities. Through clear and perfect discussions of related literature review, investigations and evaluations, Bello-Loftness model was developed as an attempt to guess annual maintenance investment requirements to maintain the current service conditions of a facility. They believed that the model will serve as a facility maintenance budgeting guideline as compared to serving as a specification. The Bello and Loftness model uses both plant replacement value (PRV) and current replacement value (CPV) models as indicated below:

$$\textit{Annual Facility Maintenance Investment} = 2\%\ x\ ((0.35\ x\ PRV) + (0.65\ x\ CPV))$$

Bello and Loftness (2010) had a conclusion that PRV model was the most widely distributed, used and frequently quoted model that's the reason why the model was chosen. Bello & Loftness (2010) highlighted that this fact depicted its high level of awareness in facility maintenance community. The Bello-Loftness Model is said to be appropriate to all facility types including those ones found in universities or schools. The model is considered to be more effective and efficient on individual or facility by facility basis as it can be easily cumulated to yield the annual facility maintenance works for register of facilities.

2.1.2 Plant value methodologies: Plant Value Methodologies are used to determine the annual investment requirements for facility maintenance as a percentage of the facility value. Plant Replacement Value and Current Plant Value models are the two main models which apply different strategies to determine facility value (Bello & Loftness, 2010).

2.1.2.1 Planned replacement value (PRV) model

Plant Replacement Value (PRV) /Current Replacement Value (CRV) refer to current expenses associated with changing a facility or structure with one of similar capacity and purpose (Barco, 1994). This help to account for the type, size and location of the facility being measured. Kraft (1950) believed that this model is typically effective when used on a facility by facility basis and not on portfolios or group of facilities. It cannot be used in mass appraisal. Replacement cost is the cost of replacing the purpose or functionality and capacity of a facility. The PRV model is the mostly used when determining annual facility maintenance budgets and needs. The formula for the model is shown below:

$$\textit{Annual Facility Maintenance Budget} = X\%\ x\ PRV\ of\ Facility$$

The value of X is determined by the decision maker.

2.1.2.2 Current plant value (CPV) model

Current Plant Value (CPV) is considered to be the original expense of a facility time-adjusted to the current year (Barco, 1994). CPV indirectly accounts for facility age and time-adjusted values of add-ons and destructions have to be included. This approach is the same as the PRV

model. The CPV model is effective when used on an inventory of facilities as compared to PRV model (Barco 1994). The formula for the model is shown below:

Annual Facility Maintenance Budget
= X% x PRV of Facility
The value of X is determined by the decision maker.

2.1.3 Life cycle/ life span cost methodologies: The lifespan methodology predicts facility maintenance works requirements by factoring the service life expectancy and resulting maintenance requirement of facility systems and its components. When frequency of maintenance works is indicated, the cost data in cost guides will be used to predict the annual funding prerequisites (Ottoman et al, 1999).

2.1.3.1 Phillips (1989) model

This model was developed based on the expected life span of facility and utilizing the sum of the year's digits to account for facility age in order to determine the twelve-monthly facility renewal allowance. Phillips (1989) in his model also presented an equation where the age of the building can be adjusted to account for early renovations.

2.1.3.2 Dergis and Sherman (1981)

They developed a model to predict facility renewal finance requirements at the University of Michigan.The model assumed a facility lifecycle of 50 years. Another assumption was that building renewal expenses are on average, no more than two-thirds of the cost of new erection. The model categorizes that older facilities necessitate more maintenance work or investment by factoring the age of the building. According to Bello & Loftness (2010), the sum of year's digits tactic helps this function by increasing maintenance investment requirements as the facility ages. When building age is adjusted for renovations, it indirectly addresses facility state or condition. The equation takes into consideration the original cost of the facility. This model is also considered to be appropriate in portfolio or group of facilities as opposed to a single building or facilities.

2.1.3.3 DOD facility sustainment model

The DOD Facility Sustainment model estimates facility maintenance funding needs over a 50 year service lifespan employing area cost factors and inflation data. It uses 50 years life span as Dergis and Sherman (1981) model.

2.1.3.4 Leslie and Minkarah (1997) model

This model utilized a creation of approaching technique for preparing long term expenses and timing forecasts of renewal finance requirements for facilities. Hutson and Beidenweg (1989) model was developed in order to address the short and long term requirements. The model computes the anticipated yearly maintenance and repair expenses using projections provided for the performance of the facility and renewal costs in a certain period of time. According to Bello & Loftness, (2010), the Uniform Building Component Format (UNIFORMAT) model meanwhile employs a standard framework for organizing lifecycle or life span and repair or replacement expenses data.

2.1.4 Condition assessment methodologies: Condition assessment methodology is one of the models that consider deficiencies in individual facility or a portfolio of facilities (Horton, 1992). The equation allows for generation of an estimate of the total cost to renovate or renew and repair a facility to an acceptable or adequate condition. Computation of future maintenance and backlog needs by assessing the remaining service life of a facility and its systems can be reached by using this model (Bello & Loftness, 2010).

2.1.4.1 Computerized maintenance management system (CMMS)

Computerized maintenance management system (CMMS) had become very popular these days among building maintenance management teams in daily activities (Sharma & Gahlot, 2006). It ensures that facilities maintenance is done to its best level through using or analyzing the available information about buildings. They are designed to store information and complete data for each activity done on the building, system or equipment such as maintenance of buildings planned or unplanned, work orders, schedule of activities, maintenance history of the facility, parts suppliers, purchase orders and financial flows (Azahar and Mydin 2014). The recorded data issued in monitoring and control of maintenance work, budget planning and financial reporting. Stored data is used for referrals when needed as it is stored hence enabling users to critically analyze the building status by looking at history associated with the building. CMMS according to previous studies provide lot of benefits to users. It assists in reducing paperwork and manual tracking activities which are considered to be ineffective in current environments. Best functionality of a CMMS lies in its ability to collect and store information in an easily retrievable format when lost (Azahar and Mydin 2014).

2.2 Challenges associated with outsourcing of facilities maintenance works in higher learning institutions in Gaborone

Implementing improved ways of executing efficient and effective maintenance effort requires a shift in priorities and on-going and continuing leadership within the senior management. The implementation requires improved technical skills and delicate consideration to building performance. The idea can only be successful when cultural shift is considered and appreciated to be amongst the gears of well delivered work through use of techniques. Participants in the built environment have to be aware of the need of change in the way of delivering services in the changing environment.

According to Princeton Energy Resources International: HPowell Energy Associates: Alliance to Save Energy (2004), the typical obstacles that schools may face when developing and implementing an energy-efficient operating and maintenance program are as follows:

2.2.1 Administrators and staff are unaware of operations &maintenance energy savings opportunities: In

most schools, administrators and maintenance staff are unaware of the chances for large energy and cost savings through improved ways of doing maintenance works of their schools (Alshehri, Motawa, & Ogunlana, 2015). They are not aware of the tarnished energy performance of their facilities or building systems. The management is unaware of the energy cost implications of the operating, scheduling and maintenance practices.

2.2.2 Lack of clearly defined objectives: Alshehri, Motawa, & Ogunlana (2015) explain that lack of a clear and country-wide policy for all schools building operations virtually eliminates the ability of school districts to effectively maintain buildings. Without route or clear expectations from senior managers, building management practices will become decentralized and motivated by school-specific staff comfort and convenience. The strategic and fiscal goals of the school district as a whole not considered.

2.2.3 Under-investment in building staff training and incentives: Some facility managers are unfamiliar with basic operating and maintenance practices associated with energy-efficient use of building mechanical equipment and energy management systems. There is lack of continuing professional development or for proactive efforts to reduce building operating and maintenance costs.

2.2.4 Decision-makers are unaware of the consequences of inadequate operation & maintenance funding: Odeyemi, Adeniyi, & Amoo (2019) highlight that the facts are that regularly delayed maintenance and reduced focus on operational management do result in numerous and noteworthy near and long term costs to the whole community or country. The following are the invisible cost consequences of under-investment in operations and maintenance:

- Increased likelihood of unpredicted and unbudgeted capital expenses such as catastrophic equipment failures due to humble maintenance or humble operational control.
- Reduced equipment reliability and service life resulting from failure to follow maintenance schedules as defined by equipment manufacturers.
- Increased incidence of building mould and associated health impacts on students and staff.
- Diminished occupant comfort due to drafts and poor temperature control.
- Unnecessary environmental impacts from excessive fuel use.

2.2.5 Limited mission of facility departments: Facility branches or departments often lack the opportunity to effectively defend both the importance of good facility practices and the importance of adequate maintenance budgeting**.** Lack of strategic role or political clout of facilities departments within their district organizations is another issue aligned to hindrance of models implementation. Notwithstanding the costs involved, building operation tends to be a low profile purpose in the absenteeism of emergencies; senior administrators are rarely involved and thus play a slight role in day-to-day operations.

2.2.6 Data problems: It is difficult to apply maintenance models where there is lack of enough information or history of the building as a whole (Lofgren et al., 1999; Beidenweg, Seisburg-Swanson, Gardner, 1998; Tolk, 2007). When trying to implement models, some of the information is missed for example the type of materials used for construction at early stages. According to Decker (1996), the problems encountered in applying maintenance optimization models mentioned in the case studies frequently concern data collection and analysis. To analyze data without knowing the underlying or fundamental failure mechanisms can lead to completely incorrect or wrong results. One has to consider failures which are caused by wear out and those ones caused by operator faults.

2.3 To provide recommendations that can enhance the use of maintenance models and techniques in higher learning institutions in Gaborone

According to Decker (1996) publication of some achievements and researches should be given priority by organizations. Extensive research and publication of studies regarding maintenance practices in buildings can encourage other organizations to start utilizing maintenance models. Decker (1996) notes that although many good ideas have been developed in industry, only a small amount has appeared in scientific literature. Experts involved in maintenance have to be exposed to maintenance problems and to be rewarded if they solve them as these can increase their level of motivation when it comes to execution of maintenance works. Companies should stimulate researchers by offering them problems and allowing them to publish their results (Decker, 1996).

3.0 Methodology

Gaborone is the capital city of Botswana. It has transformed and evolved over the years into an economic hub. It comprises of complex infrastructure, shopping malls, hotels, schools and clinics. Gaborone was chosen as the study area because most of higher learning institutions are located in the city. As a result of these economic activities many higher learning institutions are located in the city. It was therefore of prime interest to investigate how maintenance techniques are carried out in these learning institutions.

A quantitative approach was adopted in order to achieve the objectives of this study. Best and Khan (2006) mention that the quantitative approach is useful in investigating a particular phenomenon. It is used to answer questions on relationships within measurable variables with the intention to explain, predict and control a phenomena (Creswell, 1994; Bryman & Bell, 2007; Apuke, 2017). This approach will therefore be useful to gain insight on how maintenance models are implemented in higher learning institutions in Gaborone.

TABLE 1.—Variables and indicators for the study

Number	OBJECTIVE	VARIABLES	INDICATORS	SCALE
1.	To identify the maintenance models	Maintenance models and techniques	The types of maintenance practices used in buildings The advantages and disadvantages	Interval scale
2.	To assess the challenges associated with outsourcing facilities maintenance works in learning institutions.	Maintenance challenges Maintenance strategies	The extent of challenges encountered by facilities managers The criteria used to curb the challenges and make solutions	Interval scale
3.	To come up with strategies that can improve implementation of maintenance models in higher learning institutions in Gaborone.	Strategies	Strategies or approaches that can enhance implementation of maintenance techniques and models in higher learning institutions.	Interval scale

The sampling size of the study comprised a number of higher learning institutions (eleven institutions) in Gaborone. The institutions were Botho University (BU), Botswana Accountancy College (BAC), University of Botswana (UB), MANCOSA, Boitekanelo College, New Era College, Gaborone Universal College of Law (GUC), Limkokwing University, DDT College, Botswana University of Agricultural and Natural Resources (BUAN) and lastly Institute of Development Management (IDM). A questionnaire was administered to 30 facility managers, contract managers and maintenance personnel of the chosen higher learning institutions in Gaborone. This was done in order to determine whether they appreciate the implementation of the maintenance models or technologies when executing maintenance works on facilities within the campuses. Facility managers and maintenance personnel are responsible for the regular upkeep and functioning of all building elements. Maintenance managers were enquired on information pertaining to the building background, maintenance services provided, systems used as well as problems and challenges that are faced by facilities managers when executing maintenance works in learning facilities. Contract managers on the other hand are responsible for outsourcing of maintenance services.

A total of 30 questionnaires were issued out to facility managers and maintenance personnel of the higher learning institutions in Gaborone. The number of facility managers, maintenance personnel and contract managers of higher learning institutions in Gaborone is small so a census was utilized to give a comprehensive sample to the investigation. A statistics is an approach that uses the whole populace as the example. As indicated by Check & Schutt, (2011) census extraordinarily decreases sampling blunder and gives information on every one of the people in the population. The study only covered thirty respondents from the following higher learning institutions. From all identified higher learning institutions, contract managers of companies doing outsourced maintenance works, other facilities maintenance personnel and facilities managers formed elements of target population of the study. The principle used for picking this sampling frame included companies with their prime activities being maintenance works in higher learning institutions together with facility managers in these institutions.

The questions required information regarding awareness of maintenance models by facility and maintenance personnel, challenges they face when carrying out maintenance techniques and the strategies that could be adopted to enhance the implementation of maintenance models in learning institutions. The questions in the questionnaires ensured that data relating to achieving objectives was collected. Table 1 shows the variables and the measurement scales that were adopted in measuring the variables from each objective.

A five point Likert scale rating system was utilized to rate the responses from the respondents. The Likert scale ranged from strongly disagree to strongly agree. Primary and secondary sources of data were used to collect data for this study. Primary data was collected from open and close ended questions that were administered to facility managers and maintenance personnel of the buildings. According to Leedy and Ormrod (2001) open ended questions urge the respondents to express their own sentiments by giving out answers using their own words. This would help the researcher to gain additional insightful information regarding maintenance practices in tertiary education that would have been otherwise not been captured in close ended questions. Close ended questions on the other hand give the respondents choices to select the answer. Secondary data was collected from books, journal articles, conference papers and published dissertations. These secondary sources were obtained through the use of internet and online databases such as Research Gate, Academia and Emerald-sight. Data collected was subsequently analysed using Microsoft Excel and presented through the use of tables.

4.0 Results and discussion of findings

This section discusses and analyses the data gathered intended to address the objectives of this study. It explains the background information of respondents, factors causing lack of implementation of facilities maintenance models, challenges faced by maintenance managers when executing maintenance works and strategies for improving implementation of maintenance models in tertiary educational buildings.

A total of 30 questionnaires were distributed to facility managers, contract managers and other maintenance

TABLE 2.—Level of awareness on facilities maintenance models

Level of awareness	Frequency	Percent	Cumulative Percent
Not aware	0	0.0	0.0
Slightly aware	4	26.7	26.7
Moderately aware	5	33.3	60.0
Very aware	2	13.3	73.3
Extremely aware	4	26.7	100.0
Total	15	100.0	

Source: Field survey

personnel of university buildings. Only 15 questionnaires were not completed by the respondents therefore resulting in a 50% response rate . This response directs a median/half level of response rate from the targeted population. The questionnaires that were not received or not filled in, was due to the fact that some respondents were reluctant to share information, while others were too busy to answer the questions.The response rate indicates the targeted population contributed to study.

The demographic characteristics of the respondents encompassed questions such as work experience and position or status of the respondent in the institution. The results from the survey revealed that 25% of the respondents have done maintenance works for 5-10 years while the other 75% have done maintenance works for more than 10 years. In terms of their status in the institutions, the survey showed that majority of the respondents, 46.67% are basic maintenance personnel while 33.33% are facilities managers. Lastly, the remaining 20% are contract managers. The demographic results indicate that these respondents can give credible results for the purposes of this study.

4.1 Findings addressing Objective 1

The first objective was to find out why facilities maintenance models are not implemented in higher learning institutions. In addressing the first objective, the respondents were asked to rate their level of awareness of maintenance models, reasons why they are not practicing maintenance techniques, benefits of maintenance models and type of maintenance models they practice in their learning facilities. The results are presented and discussed below.

Question 1: Indicate the level of awareness on facilities maintenance techniques in your institution.

The first question with regards to objective 1 required the respondents to indicate their level of awareness on facilities maintenance models and techniques. The results are shown in Table 2.

It is evident from Table 2 that majority of the respondents, 33.3% are moderately aware of maintenance models whilst 26.7% are slightly aware of the models. The remaining 40% indicated that they are very aware and knowledgeable about facilities maintenance models. All the respondents are aware about maintenance models and techniques.

Question 2: Are facilities maintenance techniques vital in execution of maintenance works?

TABLE 3.—Maintenance models used in higher learning facilities

Model /technique	N	Mean	Remark
Uniform building component format	15	1.20	Never used
Plant replacement value	15	1.27	Never used
Bello-Loftness model	15	1.27	Never used
DOD facility sustainment model	15	1.33	Never used
Multiple regression analysis	15	1.33	Never used
Square foot model	15	1.40	Never used
Summation methodology	15	1.67	Never used
Navy long range maintenance planning	15	2.60	Rarely used
Computerised maintenance management system	15	3.67	Sometimes used
The incremental budget model	15	3.80	Sometimes used
Valid N (list wise)	15		

Source: Filed survey

Based on the results, the respondents were required to show if maintenance models were important in execution of maintenance works. Majority of the respondents, 100% indicated that maintenance techniques are extremely important when conducting maintenance. The respondents stated that the techniques ensure that there is effective and efficient maintenance services delivered to clients.

Question 3: Indicate facilities maintenance technique(s) you use in your organisation when doing maintenance works.

The respondents were to indicate maintenance techniques they use in their respective institutions when doing maintenance works. The question wasin the form of a Likert Scale where by rating of 1 meant the respondent (never used), 2(rarely used), 3 (sometimes), and 4 (often) and lastly 5 meaning (always used). Table 3 b shows the mean scores obtained from all identified variables (maintenance techniques).

From Table 3, it is evident that facilities maintenance models are not utilised effectively in higher learning institutions. The survey revealed that the incremental budget model and Computerised maintenance management system (CMMS)are sometimes used when executing maintenance works in university buildings. This may be because the models are simple to use and can be applicable in tight budgetary environments. This was shown by a high mean score of 3.80 and 3.67.

Computerised maintenance management system was depicted to be the second occasionally used technique with a mean score of 3.67. The third technique which is said to be rarely used and appreciated is the navy long range maintenance planning with a mean of 2.60. From the survey, it can be concluded that models that are never used are Summation methodology, square foot model, multiple regression analysis, DOD facility sustainment model, Bello-Loftness model, plant replacement value and uniform building component format. These were indicated by the low mean scores of 1.67, 1.40, 1.33, 1.33, 1.27, 1.27 and 1.20 respectively. Concerns with the formula methods is that they are more cumbersome to use and that data is often not readily available to facilities managers. In summary

TABLE 4.—Challenges hindering implementation of facilities maintenance model in higher learning institutions

Challenges encountered in efforts of models implementation	Mean	Remark
Models focus on wrong maintenance	1.27	Least encountered
Top management considers savings from using models being insignificant	1.40	Least encountered
Maintenance models increase costs on maintenance	1.47	Least encountered
Administrators and staff are unaware of operations & maintenance energy savings opportunities	1.80	Slightly encountered
Lack of clearly defined objectives	1.87	Slightly encountered
Lack of awareness	1.87	Slightly encountered
Lack of finances	1.87	Slightly encountered
Under investment in building staff training and incentives	1.93	Slightly encountered
Decision makers are unaware of the consequences of inadequate operation & maintenance	1.93	Slightly encountered
Organisation culture change is difficult	2.07	Slightly encountered
Poor management of maintenance team	2.13	Slightly encountered
Poor construction quality	2.33	Slightly encountered
Data problems	2.47	Slightly encountered
The gap between theory and practice	2.73	Mostly encountered
Lack of engineers and specialist	2.80	Mostly encountered
Lack of maintenance software tool	2.87	Mostly encountered

Source: Field survey

maintenance models/ techniques are not adequately used in higher learning institutions in Gaborone.

Question 4: Indicate by ranking the challenge(s) you encounter in efforts of implementing these models. *Rank these factors from 1-3(1= least, 2 = Slightly & 3= mostly encountered)*

The respondents were asked to indicate the challenges they encounter in efforts of implementing maintenance models or techniques. The ranking ranged from 1(least encountered), 2 (slightly encountered) and 3 (mostly encountered). Table 4 shows the challenges causing lack of implementation of maintenance models together with their mean scores.

It can be concluded from the results that lack of maintenance software tool is mostly encountered challenge as compared to other challenges. It accumulates a highest mean score of 2.87. It is followed by lack of engineers and specialist and the gap between theory and practice with 2.80 and 2.73 mean scores, then data problems found itself in forth position with mean core of 2.47, the fifth and the sixth challenges are poor construction and poor management of maintenance team with mean scores of 2.33 and 2.13. It is followed by top management considering savings from using models being insignificant with a mean score of 1.40. From Table 4, it can be seen that the least encountered problem is models focus on wrong maintenance with a mean score of 1.27. The above challenges can be summarised as follows starting with mostly encountered challenge to least encountered challenges: lack of maintenance software tool, lack of engineers and specialist, the gap between theory and practice, data problems, poor construction quality, poor management of maintenance team, organisation culture change is difficult, administrators and staff are unaware of operations & maintenance energy savings opportunities, lack of awareness, lack of clearly defined objectives, lack of finances, under investment in building staff training and incentives, decision makers are unaware of the consequences of inadequate operation & maintenance, top management considers savings from using models being insignificant and lastly the view that models focus on wrong maintenance is said to be least encountered challenge. This may be due to the fact that all respondents have appreciated the importance of the maintenance models in execution of maintenance works.

TABLE 5.—Mode of maintenance practiced in higher learning institutions

Mode of maintenance	Mean	Remark
Unpredictable maintenance	2.27	Rarely used
Schedule maintenance	2.93	Sometimes used
Condition based maintenance	3.87	Often used
Corrective maintenance	4.00	Often used
Emergency maintenance	4.20	Often used
Preventive maintenance	4.40	Often used

Source: Field survey

Question 5: Please kindly indicate mode of maintenance management that is normally used in your institution

The respondents were asked to indicate the mode of maintenance management that is normally used in their institution. They were ranking the modes of maintenance based on the scale of 1 meaning never used, 2 rarely used, 3 sometimes used, 4 often used and 5 always used. The results were analysed in SPSS and the Table 5 was an output of the answers given highlighting their mean scores.

Amongst the top three normally used modes of maintenance, preventive maintenance is classified as widely normally used mode of maintenance management across the institutions which the survey covered. It is shown by a high mean core of 4.40 and it is followed by emergency maintenance with mean score of 4.20 and corrective maintenance with mean score of 4.00. Lastly, condition maintenance is often used in maintenance of university buildings with a mean score of 3.87. From Table 5, it is shown that unpredictable maintenance is rarely if not normally used by survey respondents. It has the lowest mean of 2.27 followed by schedule maintenance which is sometimes used with mean score of 2.93. The modes of maintenance can be summarised as follows starting with those ones which are said to be used frequently as far as maintenance is concerned in higher learning institutions: 1(preventive maintenance), 2 (emergency maintenance), 3 (corrective maintenance), 4 (condition based maintenance), 5 (schedule maintenance) and lastly 6 (unpredictable maintenance).

Question 6: Record keeping is vital in facilities maintenance. Please indicate your level of agreement or disagreement.

TABLE 6.—Descriptive analysis of benefits of using maintenance models

Benefits	Mean	Remark
Increased capacity	3.00	Important
Increased manpower or resource utilisation	3.07	Important
Elimination of unscheduled downtime caused by system failures	3.20	Important
Reduction of maintenance expenditure	3.27	Important
Increased useful life or building lifespan	3.73	Most important

Source: Field survey

The respondents were further asked to indicate their level of agreement or disagreement on the fact that record keeping is vital in facilities maintenance. The survey revealed that the majority of the respondents, (100%) agreed that record keeping is vital in execution of maintenance works.

Question 7: Do you have full details and records about the building maintenance within your institution together with structures or building details?

The respondents were asked if they do have full details about the building maintenance within their institutions. The survey revealed that only 20% of the respondents said they have full details of the building maintenance within their institutions while the majority (80%) of the respondents indicated that they did not have full details of the building maintenance within institutions. This contradicts their previous response where they believed that record keeping is important in facilities maintenance when in actual fact they do not have details of their building maintenance records.

Question 8: Please rank the following benefits of using maintenance models in your institution in order of importance from 1-4 where 1 is least important and 4 is most important.

The respondents were asked to rank the benefits of using maintenance models in their institutions in order of importance. The results are shown in Table 6.

It is evident from these results that the most ranked benefit associated with maintenance is increased useful life or building lifespan with a mean score of 3.73. The preceding benefit according to the of analysis is reduction of maintenance expenditure with a mean score of 3.27 followed by appreciation of techniques being able to eliminate unscheduled downtime caused by system failures with a mean score of 3.20. Increased manpower or resource utilisation and increased capacity are considered to be important to the respondents with mean scores of 3.07 and 3.00.

4.2 Findings addressing objective 2

The second objective of the study was to find out the challenges associated with maintenance works in higher learning institutions in Gaborone. To address this objective, questions such as causes of facilities maintenance and challenges associated with maintenance were included in the questionnaire in order to address this objective. The results are discussed below.

TABLE 7.—Direct cause of facilities maintenance

Cause of facility maintenance	Mean	Remarks
Chemical penetration in buildings	1.20	Least encountered
Moisture penetration	2.67	Rarely encountered
Faulty construction or design	3.47	Sometimes encountered
Human behaviour	4.53	Most encountered

Source: Field survey

Question one: What is the main/direct cause of facilities maintenance in your institution? Rank these challenges from 1-5. (1= least & 5= most)

Table 7 depicts the results from the survey on the main causes of maintenance in university buildings.

Amongst all causes of maintenance, human behaviour has the highest mean of 4.53 meaning that it is considered to be most cause or a highly influencing factor on facility maintenance. The survey reveals that faulty construction is ranked as the second direct cause of facility maintenance with a mean score of 3.47. It is followed by moisture penetration in buildings which is rarely encountered with a mean score of 2.67 and lastly chemical penetration in buildings is least encountered with a mean score of 1.20. Human behaviour and faulty construction are said to be the main challenges of facilities maintenance as compared to chemical and moisture penetration.

Question two: The most encountered challenge associated with outsourced maintenance works in your institution? Rank these challenges from 1-5. (1= never & 5= always)

The respondents were asked to indicate by ranking challenges associated with maintenance works in their institution. The challenges were ranked from 1=never encountered: 2= rarely encountered: 3= sometimes encountered, 4=often encountered and 5= always encountered. The table below shows a descriptive statistics of challenges associated with outsourced maintenance works.

From Table 8, it had been indicated that lack of maintenance software is the main challenge faced by maintenance personnel in tertiary institutions with the highest mean score of 4.00. It is followed by shortage of spare parts with 3.80 mean score and lack of engineers and specialist with a mean score of 3.67. Poor stakeholders' communications, unclear job description, lack of aware-

TABLE 8.—Challenges associated with outsourced maintenance work

Challenges	Mean	Remarks
Poor management of maintenance team	2.60	Sometimes encountered
Lack of finance	2.67	Sometimes encountered
Lack of awareness	2.67	Sometimes encountered
Unclear job description	2.73	Sometimes encountered
Poor stakeholders communications	3.00	Sometimes encountered
Lack of engineers and specialist	3.67	Often encountered
Shortage of spare parts	3.80	Often encountered
Lack of maintenance software	4.00	Often encountered

Source: Field survey

TABLE 9.—Descriptive Statistics of aspects driving performance measurement

Aspect	Mean	Remark
Informational aspect	3.07	Moderately influential
Strategic planning	3.67	Very influential
Tactical aspect	3.87	Very influential
Financial aspect	3.87	Very influential
Physical /operational aspect	4.13	Very influential

Source: Field survey

ness, and lack of finance sometimes encountered with mean scores of 3.00, 2.73, 2.67 and 2.67 respectively. Poor management of maintenance team was considered to be the least encountered challenge with the lowest mean score of 2.60. When discussing faulty construction, Azahar and Mydin (2014) highlighted that maintenance of buildings should be given severe courtesy at early stages of construction during and after a building is complete. Faulty construction being the second factor which causes maintenance to be done in this study highlights that faulty construction is a problem to many higher learning institutions. To minimize this problem, the point raised by Azahar and Mydin (2014) have to be taken into consideration. Newly built structures have to be constructed having maintenance ideas at the back of contractors' minds.

Question one: Who make decisions of outsourcing maintenance works in your organisation?

The survey had revealed that most of the institutions' administrations are the ones who are responsible of making outsourcing decisions. Majority of the respondents, (73%) indicated that their institutions' administrations are the ones responsible of making outsourcing decisions. Only (27%) of the respondents indicated that their facility managers are the ones who are responsible of making outsourcing decisions. This is a concern if the administrators without knowledge of outsourcing are the ones making outsourcing decisions.

Question two: Quantitative method is fit in facilities management?

The survey also requested respondents to show their level of agreement/ disagreement on the fact that quantitative method is fit for facilities management. From the results, 26.67% of the respondents agreed that quantitative method is fit for maintenance while 73.33% strongly agreed that quantitative method is fit for facilities management. They all agreed that quantitative method is appropriate in facilities maintenance management.

Question three: How difficult does your institution find the outsourcing process?

The survey requested respondents to indicate the difficulty that they experienced during outsourcing process in the respective institutions. The survey revealed that 20.00% of respondents regarded the process being very easy to carry, 53.33% considered the process to be easy and lastly 26.67% of the respondents said that they are neutral on whether outsourcing is difficult. None of the respondents had indicated if the process is difficult or very difficult which means that outsourcing process does not give much headache when it comes to its implementation.

TABLE 10.—Ways of improving maintenance models implementation

Ways of improving implementation of maintenance models	Mean	Remark
Observation	2.40	Disagree
Benchmarking	2.53	Neutral
Companies offering problems to researchers & allowing them to publish the results	3.07	Neutral
Continuing professional development encouragement	3.53	Agree

Source: Field survey

Question four: How is performance done or measured in your institution?

It is evident from the survey that output measure process is widely considered process when it comes to measuring performance of the buildings. 40% of the respondents as shown output measure as the strategy which measure performance in their institutions. Another 40% of respondents have indicated that they use both process and output measures to measure performance. 6.67% of the respondents indicated that they only use process output measure to measure performance of the buildings. Lastly 13.33% of the respondents said that they do not measure performance with either output or process measure.

Question five: Indicate the main aspect that drives performance measurement of buildings in your institution? Rank them. (**1**=not influential**, 2**=slightly influential**, 3**= moderately influential**, 4**= very influential**& 5**= most/ extremely influential)**.**

The respondents were further asked to indicate by ranking main aspect that drives performance measurement of buildings in their institutions. Table 9 shows the mean scores of aspects driving performance measurement.

It is evident in Table 9 that physical or operational aspect, financial, tactical, and strategic planning are the key driving factors of performance in institutions the study was focused on with their mean scores of 4.13, 3.87 and 3.67. Lastly that informational aspect influence performance measurement moderately with the lowest mean score of 3.07.

4.3 Findings addressing objective 3

The last objective was about coming up solutions that can help enhance application of facilities maintenance models in higher learning institutions. The results are discussed below.

Question 8: In your opinion, what is the principle or way in which your organisation can apply in order to implement or appreciate the use of maintenance techniques and models?

The respondents were asked to rank the opinions which were highlighted in the survey.

It is clear from Table 10 that continuing professional development encouragement is the most preferred principle or way of overcoming limited implementation of maintenance techniques with a mean score of 3.53. They

were also neutral on companies offering problems to researchers and allowing them to publish their results as well as benchmarking with mean scores of 3.07 and 2.53.Lastly observation was regarded to be a low priority principle with the lowest mean score of 2.40.

From the results above, it can be concluded and appreciated that all maintenance personnel in higher learning institutions are aware of maintenance techniques even though the level of implementation is not that high. The incremental budget model and CMMS are widely used maintenance methodologies in higher learning institutions maintenance. Corrective and preventive modes of maintenance management are used by many institutions according to the results. Maintenance decisions are often based on how urgent the case, is the issue for sustaining the structure future use. Maintenance can only be effective and efficient if facilities managers or construction personnel know the importance of recording and storing the information related to facilities. The next section presents conclusions and recommendations for the study.

5.0 Summary, conclusion and recommendations

This previous section presented, analyzed and discussed the data that was received from the questionnaire which was administered to 30 Facilities Managers, Contract Managers and maintenance personnel. The purpose of this section is to give a brief summary of findings, conclusions and recommendations that could be considered to ensure that maintenance models are effectively used in buildings of higher learning institutions in Gaborone, Botswana. In addition, a suggestion of further areas of study that could be embarked on by other academicians is outlined.

5.1 Summary of key findings of the study

The purpose of this study was to investigate the implementation of maintenance models or techniques in higher learning institutions in Gaborone, Botswana. There were three objectives that were posed at the beginning of this study. The results of each objective are summarized below.

5.1.1 To identify the reasons why facility maintenance models/techniques are not used in higher learning institutions in Gaborone: Results of the findings shows that some of facilities maintenance techniques are used in higher learning institutions in Gaborone. The following maintenance models are mostly used in higher learning institutions in Gaborone: the incremental budget model with a mean score of 3.80, computerised maintenance management system with a mean score of 3.67 and lastly the navy long range maintenance planning with a mean score of 2.60. The moderately used maintenance models are summation methodology, DOD facility sustainment model, multiple regression analysis and square foot model with mean scores of 1.67, 1.33, 1.33 & 1.40 respectively. Lastly, least used models are uniform building component format, Bello Loftness model and plant replacement value with mean scores of 1.20, 1.27 and 1.27 respectively. Bello and Loftness model and plant replacement value model have never been used in higher learning institution maintenance execution with a mean score of 1.27.

5.1.2 To assess challenges associated with maintenance works in higher learning institutions in Gaborone: In efforts of implementing maintenance models to a full extent, higher learning institutions mostly encounter the following challenges in their institutions: lack of maintenance software tool with the highest mean score of (2.87), the gap between theory and practice (2.73), lack of engineers and specialist (2.80), data problems (2.47), poor construction quality (2.33) and lastly poor management of maintenance team (2.13) while difficulty of organisation to change had a mean score of 2.07. Respondents have indicated that the least encountered challenges in models implementation are the opinions that models focus on wrong maintenance and maintenance models considered to be increasing maintenance costs with mean scores of 1.27 and 1.47.

5.1.3 To come up with measures that can enhance the use of maintenance models and techniques in higher learning institutions in Gaborone: Continuing professional development encouragement is the most preferred principle or way of overcoming limited implementation of maintenance techniques with a mean score of 3.53. Second choice on principles which can help in models implementation is depicted to be when companies will be offering problems to researchers & allowing them to publish their results with a mean score of 3.07. The third principles is benchmarking with a mean score of 2.53 and lastly observation was regarded to be a low priority principle with lowest mean score of 2.40.

5.2 Conclusions and implications of the study

The study has thoroughly addressed the objectives that were posed at the beginning of this study. Secondly, the research has contributed to new knowledge as no study has specifically investigated maintenance models in higher learning institutions in Botswana. The survey results provide a strong foundation for future research exercises aimed towards the successful maintenance of educational facilities in Botswana. The findings suggest that understanding these factors is extremely important as it ensures that the value and quality of buildings is achieved through effective application of maintenance models and techniques.

5.2.1 Implications on policy framework, theory and practice: The first implication of this study is that it may encourage the top management in learning institutions to recognize the importance of setting aside adequate funds for maintenance. Having enough funds for maintenance would enable facility managers and maintenance personnel to effectively carry out maintenance models and techniques in university buildings. This would then result in properly maintained buildings that are conducive for learning at the same time ensuring that learning institutions' save maintenance costs. The study also encourages for inclusion of maintenance models and techniques on building maintenance policy frameworks of

learning institutions. In terms of theory, this study explained the reasons why facility managers and maintenance personnel do not implement maintenance models in university buildings. It has explained how effective implementation can benefit learning institutions and bring about occupant satisfaction. The study also encourages facility managers and maintenance personnel to continuously apply maintenance models in learning institutions.

5.2.2 Implications on academia and society: This study improves the existing body of knowledge regarding maintenance models in university buildings. As previously explained most studies have been done on outsourcing maintenance services while there are a few regarding maintenance model and techniques in learning institutions. It paves way for further research to be undertaken on maintenance models, the potential risks and benefits of each type of model with particular emphasis on Botswana. This research can also benefit students and society at large as it promotes enhanced use of maintenance models and techniques by facility managers, thereby resulting in occupants' satisfaction with buildings.

5.3 Recommendations

The following recommendations are directed at addressing the issues and challenges recognised during the research process and suggestions are outlined to help improve the maintenance processes in high rise buildings. Below are some recommendations:

- Training maintenance personnel. Regular training (short and long) should be encouraged through continuing professional development so that facilities maintenance personnel can be up to date with modern changing methods of carrying out maintenance activities effectively.
- Post occupancy evaluation must be done by facilities and maintenance managers in order to obtain information from building occupants. This information will be used to help improve the way maintenance is carried out in high rise buildings within higher learning institutions.
- Higher learning institutions should adopt or implement new reporting system that allows for a single point of contact for users or anyone to report all problems. Fragmented reporting systems used in some institutions is a recipe for delays and increase maintenance prices pointlessly and worsen building user's frustration and disappointment on building performance.
- Senior management should improve their support on facilities management. Emphasize on improving their involvement in newly built structures so that the significant information can be documented. This will eliminate the issue of facilities managers managing properties which they do not have full details about as this may lead to using the corrective maintenance frequently thus increasing the maintenance costs.
- Maintenance managers should start using Computerised Maintenance Management System (CMMS) in educational facilities. This system helps managers to record and store information on maintenance activities. This helps managers to be able to make decisions regarding maintenance in the buildings.
- Higher learning institutions should opt to diversifying qualities and skills required from facilities managers as this can promote use of best practice methodologies and attitudes towards maintenance in order to reduce maintenance costs and raise the quality of output of maintenance.
- The government or top management of higher learning institutions should emphasize or improve their involvement in newly built structures so that all significant information can be documented to reduce or eliminate the issue of facilities managers managing properties which they do not know or do not have full details of such structures. Lack of full details of buildings lead to use of corrective maintenance frequently and also increase in maintenance costs due to building characteristics which are not easy to reach without having plans or details.

5.4 Further areas of the study

The research recommends on the areas to be further studied;

i. Maintenance management practices by maintenance personnel in higher learning institutions.
ii. Future research can be conducted on impact of the school type (private /public) on facilities maintenance. There might be differences or similarities in behaviours of students in relation to property.
iii. Another future study could be conducted on investigating the encounters or challenges faced by facilities maintenance departments in maintaining older school facilities to acceptable and suitable standards.
iv. Another area of study can be on identification of maintenance budgeting process in higher learning institutions. The issue of high maintenance cost is a huge challenge. It will aim at targeting the personnel that is directly involved in budgeting process. Who guide or lead budgeting process until the final decisions made.

REFERENCES

Ali, A. S. (2009). Cost Decision Making in Building Maintenance Practice in Malaysia. *Journal of Facilities Management, 7*(4), 298–306.

Ali, A.-S. K.-N. (2010). Factors Affecting Housing Maintenance Cost in Malaysia. *Journal of Facilities Management, 8*, 285–298.

Allen, D. (1993). What is building maintenance? *Facilities, 11*(2), 7–12.

Alshehri, A., Motawa, I., & Ogunlana, S. (2015). The common problems facing the building maintenance departments. *International Journal of Innovation Management and Technology, 6*(3), 4–10.

Apuke, O. D. (2017). Quantitative research methods: A synopsis approach. *Arabian Journal of Business and Management Review (Kuwait Chapter), 6*(10), 40–47.

Azahar , N. F., & Mydin , M. A. (2014). Potential of Computerized Maintenance Management System in Facilities Management, Journal. *AUEMR, 21*(1), 51–59.

Barco, A. L. (1994). Budgeting for facility repair and maintenance. *Journal of Management in Engineering, 10*(4), 28–34.

Barrie, C., & Peter, S. (2007). *Building maintenance management (2nd ed.)*. Oxford: United Kingdom: Blackwell Publishing.

Bello, M. A., & Loftnessy, V. (2010). *Addressing Inadequate Investment in School Facility Maintenance*. Technical paper, Carnegie Mellon University, School of Architecture.

Best, J. W., & Kahn, J. V. (2006). *Research in Education. 10th Edition*. Cape Town: Pearson Education Inc.

Bryman, A., & Bell, E. (2007). *Business research methods*. Oxford University Press, USA.

Check, J., & Schutt, R. K. (2011). *Research in education*. London, UK: Sage Publications.

Creswell, J. W. (1994). *Research Design Qualitative and Quantitative Approaches*. Thousand Oaks. CA Sage.

David , J. (1997). Strategic guidelines/or outsourcing decisions. *Strategic Change, 6*(1), 85–96.

Decker, R. (1996). Applications of maintenance optimization models: a review and analysis. *Reliability Engineering & System Safety, 51*(3), 229–240.

Ender, K. L., & Mooney, K. A. (1994). From outsourcing to alliances: strategies for sharing leadership and exploiting resources at metropolitan universities, Metropolitan Universities. *An International Forum, 5*(3), 51–60.

Graham, T., Zotter, J., & Camacho , M. (2009). Who's sick at school? : Linking poor school conditions and health disparities for Boston's children. *Journal of Environmental and Educational Health Policy, 19*(3), 355–364.

Herath , K. S., & Ahsan , M. F. (2006). Evaluation of Outsourcing in Higher Education: A Teaching Case. *International Journal of Strategic Cost Management, 12*(3), 37–48.

Horton, M. (1992). Optimum maintenance and RCM. *3rd EsReDa Seminar on Equipment Ageing and maintenance*, 14-15.

Hutson, R. E., & Biedenweg, F. M. (1982). Before the Roof Caves in: A Predictive Model for Physical Plant Renewal. *APPA, 30*(7), 7–10.

Ikediashi, D, D., & Okwuashi , O. (2015). Significant factors influencing outsourcing decision for facilities management (FM) services. *Property Management, 33*(1), 59–82.

Kraft, W. W. (1950). Budgeting for maintenance should be based on present replacement cost. *College & University Business, 5*(1), 37–43.

Kremic, T., Tukel, O. I., & Rom, W. O. (2006). Outsourcing decision support: a survey of benefits, risks, and decision factors. *Supply Chain Management: An International Journal, 11*(6), 467–482.

Kurdia, M. K., Abdul-Tharim, A. H., Jaffar, N., Azli, , M. S., Shuib, M. N., & Ab-wahid, A. M. (2011). Outsourcing of facilities maintenance: A literature review. *Procedia Engineering, 20*, 445–457.

Lam, T. Y. (2008). Optimization of performance management for housing services. , *Journal of Facilities Management, 6*(3), 226–240.

Lam, T. Y. (2008). The impact of management measures on performance of outsourced professional housing maintenance services. *Property Management, 26*(2), 111–124.

Lateef, O. A., Khamidi, M. F., & Idrus, A. (2010). Building Maintenance Management in Malaysian University campuses: A case Study. *Australia Journal of Construction Economics and Building, 1*(2), 76–89.

Lavy, S., & Bilbo, D. L. (2009). Facilities maintenance management practices in large public schools, Texas. *Facilities, 27*(1/2), 5–20.

Lee, R., & Wordswith, P. (2007). *Building Maintenance Management*. London, UK: Blackwell publishing.

Leedy, P., & Ormrod, J. (2001). *Practical Research: Planning and Design* (7th ed.). Upper Saddle River, NJ and Thousand Oaks, CA.: Merrill Prentice Hall and SAGE Publications,.

Leslie, S. E., & Minkarah, I. A. (1997). Forecasts of funding needs for infrastructure renewal. *Journal of Infrastructure Systems, 3*(4), 169–176.

Lonsdale , C. (1999). Effectively managing vertical supply relationships: a risk management model for outsourcing: Supply Chain Management. *An International Journal, 4*(4), 173–183.

Mbutha, N. N. (2014). An investigation into the maintenace of high-rise buildings, policies, practices and challenges. *A CASE STUDY OF NAIROBI*, 119.

Moseki , L. K., Tembo, E., & Cloete, C. E. (2011). The principles and practice of facilities maintenance in Botswana. *Journal of Corporate Real Estate, 13*(1), 48–63.

Nipp, T. J. (2017). *Development of a mathematical model for the estimation of required maintenance for a homogenous facilities portfolio using multiple linear regression*. Doctoral dissertation, University of Tennessee, Graduate school, Knoxville.

Odeyemi, S. O., Adeniyi , O. I., & Amoo, A. I. (2019). Assessment on building maintenace in Nigerian universities: A case study of University of Ilorin. *Nigerian Journal of Technology (NIJOTECH), 38*(3), 566–572.

Ofide , B., Jimoh , R., & Achuenu, E. (2015). Assessment of building maintenance management practices of higher education institutions in Niger State – Nigeria. *Journal of Design and Built Environment, 15*(2), 1–14.

Olagunju, K. (2012). Predictive modelling for sustainable residential building maintenance in developing countries: A Nigerian case. *Interdisciplinary Journal of Contemporary Research in Business, 4*(6), 1273–1274.

Ottoman, G. R., Nixon, W. B., & Lofgren, S. T. (1999). Budgeting for facility maintenance and repair: Methods and models. *Journal of Management in Engineering, 15*(4), 71–83.

Princeton Energy Resources International: HPowell Energy Associates: Alliance to Save Energy. (2004). School Operations and Maintenace: Best Practices of controlling energy costs. *A Guidebook for K-12 School System Business Officers and Facilities Managers*, 130.

SadiAssaf, M. A., & Hassanain, A. A. (2011). Factors affecting outsourcing decisions of maintenance services in Saudi Arabian universities. *Journal of Proprerty management, 29*(2), 195–212.

Sang, J. K. (2010). Outsourcing in Kenyan Universities: An Examination of Challenges and Opportunities. *International Journal of Business and Social Science, 1*(2), 1–9.

Sharma, S., & Gahlot, P. (2006). *Building Repairs and Maintenance Management*. London, UK: CBS Publishers and distributers.

Sriyani, G., & Laksiryi, W. (2004). Outsourcing in universities: A comparative analysis of in-house sourcing and outsourcing. *Proceedings of the Leonard Woolf Memorial International Conference*, (pp. 165-173).

Tolk, J. (2007). *Predicting required maintenance and repair funding based on standard facility data elements*. Dissertation, Texas Tech University, Lubbock, TX.

Trochim, W. M. (2006). Research Methods Knowledge Base. Retrieved from http://www.socialresearchmethods.net/kb/sampprob.php

Wordsworth, P. (2001). *Lee's building maintenance management. (4th Ed.)*. Oxford: Blackwell Science Ltd.