CURRENT MAINTENANCE STRATEGIES OF UNIVERSITY BUILDING FACILITIES IN THE WESTERN CAPE, SOUTH AFRICA

By

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DECLARATION

I, Fredrick Simpeh, declare that the contents of this thesis represent my own unaided work, and that the thesis has not previously been submitted for academic examination towards any qualification. Furthermore, it represents my own opinions and not necessarily those of the Cape Peninsula University of Technology.

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Signed **Date**

ABSTRACT

Universities generally have low budgets for building maintenance and this reality, often aggravated by further reductions, results in a decline in the condition and performance of buildings. This particular research investigated the current building maintenance strategies of Cape Peninsula University of Technology (CPUT). The aim of the research was to develop improvement, prioritisation and involvement strategies to guide the maintenance of the performance parameters of the lecture theatres to ensure a performance level that meets the satisfaction of students, thereby promoting their learning experience.

A mixed research design was used for the main study. A “case study” approach was adopted. CPUT was selected and three lecture theatres were selected as the cases for the research study. An exploratory study was carried out at the initial stage of the study, helping to formulate the research question and objectives for the main study. Observations, interviews and questionnaires were used to collect the primary data for the main study. A total of 430 questionnaires were distributed, out of which 283 representing a response rate of 65.8% were duly completed and returned. Importance Performance Analysis (IPA) model together with both descriptive and inferential statistics were used to analyse the data.

The findings revealed that the performance of lecture theatres affects learning experience, and that all identified performance parameters were important to students’ learning experience. However, lighting, structural safety, ventilation and cleanliness were more highly ranked than fire safety & exit and aesthetics. It also became evident that, while all the performance parameters appeared to be underperforming, the performance of structural safety and lighting seemed satisfactory in all the lecture theatres, whereas ventilation, temperature, fire safety & exit (particularly old lecture theatres) and sound control were clearly underperforming. Furthermore, the study revealed that students are not involved in the maintenance management process of the lecture theatres whereas their involvement could ensure their satisfaction. Students perceived that instituting maintenance coordinators would be the most effective way of ensuring their involvement, followed by placing suggestion box in the department, or possibly organising forums at departmental level.

To achieve better lecture theatre performance, the CPUT maintenance department needs to improve on the HVAC system (ventilation and temperature), fire safety & exit (particularly old lecture theatres) and sound control but without neglecting the other performance parameters. A further study to include teaching staff, additional lecture theatres and more parameters is highly recommended as it will provide a broader perspective to further help the CPUT maintenance department better maintain the lecture theatres.

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DEFINITION OF TERMS

Building: "Buildings are structures enclosing a space and providing protection from the elements; typically including walls, a roof and other components" (Bucher, 1996:69).

Facility: "Any portion of a building, structure or area, including the site on which the building, structure or area is located, wherein specific services are provided or activities are performed" (Virginia Polytechnic Institute and State University, 2011).

Maintenance: "The required processes and services carried out to preserve, repair, protect and care for a building's fabric and engineering services after completion, repair, refurbishment or replacement to current standards to enable it to serve its intended functions throughout its entire life span without drastically upsetting its basic features and use" (Olanrewaju, 2010a:201).

Performance: "The degree to which a building or other facility serves its users and fulfils the purpose for which it was built or acquired; the ability of a facility to provide the shelter and service for which it is intended" (Iselin & Lemer, 1993 cited from Douglas, 2006:587).

Planned maintenance: "Maintenance organized and carried out with forethought, control and the use of records, to a predetermined plan" (BS 3811cited from Chanter & Swallow, 2007:134).

University: "An academic institution at which research is conducted and teaching/learning is offered within the organized cadre of the contact between lecturer and student, and supported by networking, co-operation and collaboration with external academic partners to create, develop and transmit new knowledge" (Du Pre, 2009:14).

Unplanned maintenance: "Ad hoc maintenance carried out to no predetermined plan" (BS 3811cited from Chanter & Swallow, 2007:134).

LIST OF ABBREVIATIONS

CPUT:	Cape Peninsula University of Technology
IPA:	Importance Performance Analysis
PA system:	Public Address System
SA:	South Africa
SBS:	Sick Building Syndrome
SPSS:	Statistical Package for Social Science
SRC:	Student Representative Council

CHAPTER ONE
INTRODUCTION

1.1 Introduction

South Africa (SA) as a country has a total of 23 public universities, comprised of eleven traditional universities, six comprehensive universities and six universities of technology (Council on Higher Education, 2011). Education at all levels, including universities, is meant to develop the whole individual—the head, heart and hand—or in educational terms, cognitive, affective and psychomotor. The value and benefit of education, particularly university education, is not limited to the individual only, but extends to the society and the country as a whole. Universities are undeniably significant; they are instruments of social and economic change (Tirronen & Nokkala, 2009). They are key institutions that produce and transmit knowledge and produce workforce for the needs of the society (Sukirno & Siengthai, 2011; Tirronen & Nokkala, 2009). In other words, universities help a country to develop the intellectualism and employability of its citizens (Zakaria & Wan Yusoff, 2011). Universities are engines that propel the economy of every country; hence they affect every area of national development (Chauhan, 2008). Additionally, universities play an indispensable role in the innovation system, economic development and the competitiveness of every country (Tirronen & Nokkala, 2009). Unquestionably, university education accelerates the pace of development of a country (Chauhan, 2008).

The prominent objective of any university is to promote teaching, learning and research activities (Mat, Sopian, Moktar, Ali, Hashim, Rashid, Zain & Abdullah, 2009; Zakaria & Wan Yusoff, 2011). Universities cannot meet these objectives effectively without buildings (e.g. lecture theatres) (Olanrewaju, Khamidi & Arazi, 2011a). Buildings, in fact, are regarded as the largest and one of the most important physical assets of any university (Olanrewaju, 2010a; Olanrewaju, Khamidi & Arazi, 2010a; Olanrewaju *et al.,* 2011a; Olanrewaju, Khamidi & Arazi, 2011b). Buildings function as an enabling resource and facilitator (Douglas, 1996); consequently the entire learning process in a university is facilitated by its buildings (lecture theatres). Olanrewaju (2010a) and Olanrewaju *et al.* (2011a) emphasised that university buildings are procured to create a stimulating environment to support and encourage learning. However, buildings do not remain new forever and therefore requires maintenance to ensure continued performance (Olanrewaju, 2010b). The performance of a building relates to how the building contributes to fulfilling the expectation and functions required by the building users (Stanley, 2001; Williams, 1993). Douglas (1996) contended that the performance of buildings have direct impact on end users. Accordingly, the performance of a building is affected by the ways maintenance is carried out (Drouin, Hinum, Beeton, Nair and

Mayfield, 2000). In fact, a well-maintained building is vital for delivering the core objective of any university: education (Olanrewaju, 2010a).

1.2 Background to problem

Buildings, technology and human resources are the interrelated assets of every university (Olanrewaju *et al.,* 2011a). Buildings are perceived as the second most important asset of a university after the human resources (Olanrewaju, 2010a; Olanrewaju, 2010b). In fact, they are the major capital asset of a university (Chartered Institute of Building, 1990). Olanrewaju (2010a) and Olanrewaju *et al.* (2011a) explained that buildings are a source of value creation in a university if they facilitate the required services of teaching, learning and research activities. Chartered Institute of Building (1990) elaborated that buildings principally exist to satisfy the needs of the users. Quintessentially, university buildings (lecture theatres) must provide an environment which supports and stimulates teaching, learning and research activities (Olanrewaju, 2010a; Olanrewaju, 2010b). But buildings cannot be maintained and restored to a condition at which they continue to perform or fulfil their functions unless maintenance is carried out (Seeley, 1987). Effective building maintenance is vital for ensuring the provision of better built environments for users (Lee & Scott, 2009a).

Unfortunately, there is a general lack of concern for building maintenance (Chanter & Swallow, 2007; Chartered Institute of Building, 1990; Lee & Scott, 2009a; Lee & Wordsworth 2001). Building maintenance is usually perceived as a non-core (Olanrewaju *et al.,* 2011a), a "Cinderella" activity (Seeley, 1987), unproductive (Lam, 2000; Seeley, 1987), unattractive (Lee & Scott, 2009a), and seen to possess little glamour (Seeley, 1987). In addition, building maintenance has constantly been treated as the "poor relation" of the construction industry (Lee & Wordsworth 2001); hence, it is prioritised quite low (Chartered Institute of Building, 1990; Lam, 2000; Lee & Scott, 2009a) and attracts only an implicit recognition of its importance (Chanter & Swallow, 2007; Lee & Wordsworth, 2001). Other factors including inadequate funds, poor management of funds, poor strategies, insufficient proactive maintenance strategies and an absence of commitment from top and middle level management further exacerbate the problems of building maintenance (Drouin *et al.,* 2000; Smith & Hinchcliffe, 2004). Lee & Wordsworth (2001) added that situations may exist in an institution where management ignores the roles of buildings or considers them a burden. Buys and Nkado (2006) opined that maintenance management is neglected by the top management of tertiary educational institutions in South Africa. This neglect and lack of concern result in under-resourcing of maintenance which further affects building performance (Chanter & Swallow, 2007).

These assertions are confirmed by the results of a survey conducted by Buys and Nkado (2006) which revealed that the performance of existing maintenance management systems in South African tertiary institutions is below best practice standards. An initial survey demonstrated that managers of tertiary institutions in SA spend a very low proportion of their total budget on building maintenance (Buys, 2004 cited in Buys, Cumberledge & Crawford, 2009). Apart from low budget, Buys and Nkado (2006) further stated that reductions are often made to the maintenance budgets. Ashworth (1996a), Chartered Institute of Building (1990) and Olanrewaju (2010a) similarly indicated that when university budgets are reduced, the building maintenance budget is typically the first to suffer. Low budget, sometimes aggravated by reduction, often affect the building maintenance plans, thus resulting in a decline in the condition and performance of buildings (Buys & Nkado, 2006).

In 2006, Buys and Nkado expressed the need for improvement in the maintenance management systems of tertiary institutions in SA. Although maintenance management of South African tertiary institutions has improved from 2006 to 2009, it is still below best practice (Buys *et al*., 2009). There is, therefore, the clear need for improvement in the maintenance management systems at universities in SA.

1.3 Summary of problem

The background suggests that not much attention is given to building maintenance at top management level, resulting in under-resourcing of building maintenance activity. Apart from under-resourcing, reduction is occasionally made to the maintenance budget which affects the maintenance programmes and strategies of the institutions. On the other hand, maintenance is carried out to ensure that buildings support the needs of the users, with the aim that their satisfaction and productivity are enhanced. Therefore the problem is this: maintaining the lecture theatres, with budget constraints, at a performance level that meets the satisfaction of students and promotes their learning experience.

1.4 Research question

The question to be addressed in the study is as follows:
"Considering that maintenance budgets are low and occasionally reduced even further, what strategies could be adopted for maintaining university lecture theatres to ensure a performance level that meets the satisfaction of students and thereby promotes their learning experience?"

1.5 Aim and objectives

The aim of the research is to develop strategies for improving the maintenance of the performance parameters of lecture theatres to ensure a performance level that meets the satisfaction of students and consequently promotes their learning experience.

The specific objectives include the following:

- to investigate the maintenance management systems (students' involvement, prioritisation system and strategies) adopted by university maintenance departments for maintaining the lecture theatres;
- to assess the effect of lecture theatres performance on the learning experience of students;
- to determine the level of importance students attach to each specified building performance parameter and the overall performance of the lecture theatre;
- to determine how well the expectations of students are met in relation to each specified building performance parameter;
- to determine how satisfied the students are with each specified building performance parameter and the overall performance of the lecture theatre;
- to develop prioritisation and improvement strategies to guide the maintenance of the performance parameters of the lecture theatres; and
- to analyse the extent to which students are involved in the maintenance management process of the lecture theatres.

The first objective will help to develop an understanding of maintenance strategies of CPUT. The second objective helps to determine whether or not the performance of lecture theatres affects learning experience. The data from the third, fourth and fifth objectives will aid the development of the importance-performance (satisfaction) analysis which will help in developing the prioritisation and improvement strategies to guide the maintenance of the performance parameters of the lecture theatres. The final objective will help to assess the level of students' involvement and identify students' involvement strategies that can be incorporated to enhance the management of maintenance of the lecture theatres.

1.6 Significance

The research aims at developing (prioritisation, improvements and involvement) strategies to guide the maintenance of the performance parameters of the lecture theatres by the use of an IPA model. Practically, the findings and recommendations of the research could be applied by the CPUT maintenance department to enhance its maintenance management practices to ensure that the performance levels of the lecture theatres are maintained to meet the satisfaction of the students and thus promote their learning experience. The model could also be adopted by the maintenance department of other universities for improving the maintenance of the performance parameters of their lecture theatres. The research will also add to the body of knowledge in the field of facility maintenance management.

1.7 Delimitation

The research is conducted within the Western Cape Province of South Africa; however, the study will be limited to CPUT. The limitation to CPUT is because of the difficulty in securing permission for access to other institutions and constraints of time.

- Only three lecture theatres from the university will be used so as to allow for a more in-depth study.
- Questionnaires issued will be limited to sampled students of the selected lecture theatres in the university.
- The research does not focus on all teaching facilities but only on lecture theatres.
- The research does not focus on all aspects of building maintenance practices but only on maintenance prioritisation, user involvement and maintenance strategies.
- The research will only cover the effect of the performance of lecture theatres on the learning experience of students, and not administrative issues.

1.8 Key assumptions

- It is assumed that the university used for the study has maintenance or facility managers responsible for the maintenance management of the university's building facilities.
- It is assumed that all the respondents of the questionnaire will provide the required information.
- It is assumed that the interviewees will cooperate with the interviewer by providing the required information accurately.

1.9 Preliminary literature review

1.9.1 Framework

Importance performance analysis (IPA) is one of the tools used for analysing the relationship between the importance and performance (satisfaction) of parameters or attributes. It has increased in popularity since it was introduced by Martilla and James (1977). IPA uses a two-dimensional grid, where performance is represented on the x-axis and importance on the y-axis (Abalo, Varela & Manzano, 2007; Ainin & Hisham, 2008; Matzler, Sauerwein, & Heischmidt, 2003; and Matzler, Bailom, Hinterhuber, Renzl & Pichler, 2004). Fundamentally, data from satisfaction surveys and some form of importance measures are required to construct the model (Matzler *et al.,* 2003). Four specific quadrants are generated as the importance and performance data are plotted on the two dimensional matrix. Parameters in Quadrant I demonstrate high both in satisfaction and importance; in this area the maintenance department should "keep up the good work". Quadrant II represents low satisfaction on highly important parameters; this quadrant ought to be given top priority (concentrate here). Quadrant III represents parameters which are both low in satisfaction and importance; parameters in this quadrant do not require additional effort as they are considered "low priority". Parameters which have high satisfaction but low importance are located in Quadrant IV; resources invested on the parameters in this quadrant should rather be diverted elsewhere (Ainin & Hisham, 2008; Matzler *et al.,* 2003; Matzler *et al.,* 2004).

IPA is an important tool utilised by organisations to identify areas for improvement and determine strategies for reducing the gap between importance and satisfaction (Ainin & Hisham, 2008). It is also a useful tool for allocating scarce resources to maximise satisfaction (Matzler *et al.*, 2004). In this study, IPA is employed as a tool to aid the development of improvement and prioritisation strategies for guiding the maintenance of the performance parameters of the lecture theatres to ensure a performance level that meets the satisfaction of students and thus promotes their learning experience.

1.9.2 Effect of lecture theatres' performance on learning experience

The quality of education is largely a reflection of the performance of the place where teaching and learning takes place (Olanrewaju, 2010a). Smith, Tucker and Pitt (2011) were of the opinion that the workplace, the learning environment, can be viewed as a factor which contributes to engagement. Therefore, the physical learning environment of a university plays an important role in creating and sustaining a productive learning climate (Uline, Wolsey, Tschannen-Moran & Lin, 2010). Several researchers and studies also indicate that the performance of educational buildings (e.g. lecture theatres) have a significant impact on the learning experience and performance of students (Amaratunga & Baldry, 2000; Cash,1993; Earthman & Lemasters, 1996; Fianchini, 2007; Green & Turrell, 2005; Lavy & Bilbo, 2009; Leung & Fung, 2005; Uline *et al*., 2010).

1.9.3 Building performance

According to Bucher (1996), buildings are structures that enclose a space and provide protection from the elements, usually including walls, a roof and other parts. Buildings act primarily as a space enclosure, climate barrier and/or modifier, and ensure protection and privacy of the users (Douglas, 1996). Buildings are important assets of a university which are required to perform certain functions once procured. Olanrewaju *et al.* (2011c) perceives building performance as the ability of a building to support the functions for which it was designed. Building performance corresponds primarily to user requirements and satisfaction (Olanrewaju *et al.*, 2011a). Buildings, therefore, cease to be useful if they cannot perform the functions required by the users (Arazi *et al*., 2009).

1.9.4 Concept and scope of maintenance

The concept and scope of building maintenance is broad and complex (Lee & Scott, 2009a; Lee & Wordsworth 2001) and consequently viewed differently by different people (Arazi *et al*., 2009). Building maintenance, however, is not just a mixture of repairs and replacing individual components when they wear out (Al-Zubaidi, 1997; Chartered Institute of Building, 1990). It involves cleaning services (Chanter & Swallow, 2007; Seeley, 1976), preserving and initiating minor alterations to building assets (Department of Treasury and Finance, 2005), and also embracing some upgrading to raise the original standards up to current standards where necessary (Al-Zubaidi 1997; Chanter & Swallow, 2007; Lee & Wordsworth 2001).

According to Cripps (1984), building maintenance relates to the inspection of all parts of a building, including both internal and external decoration and executing the tasks necessary to keep the structure, finishes and fittings in a suitable and acceptable state of repair. Likewise, the British Standards Institution (1993) defines maintenance as "the effort in connection with different technical and administration actions to keep a physical asset in, or restore it to a condition where it can perform a required function" (cited in Lee & Scott, 2009b:270). Seeley (1976) explains building maintenance as work undertaken to keep, restore or improve *every* part of a building, the services and the surroundings to a currently accepted standard and to sustain the usefulness and value of the building. Douglas (2006) perceives maintenance as the act of keeping a building in a pre-determined condition. Wood (2009) regards building maintenance as the total actions required to keep a building functioning effectively. Olanrewaju (2010a) perceives maintenance as a process carried out to preserve, repair, protect and care for a building's fabric and engineering services to enable it to serve its intended functions. Two activities ensuing from these definitions are retaining the component in appropriate condition for use and restoring it to such a condition (Shohet & Lavy, 2004). For the purpose of this study, building maintenance management is defined as all the actions, both technical and administrative, required to ensure that a building is kept in, or restored to, a condition which sustains its utility and value.

1.9.5 Effect of building maintenance on building performance

Ashworth (1996b) opined that deterioration and obsolescence start their life cycle as soon as the construction of a building is started. Hence, maintenance problems begin to creep in before the construction of a building is even completed (Olanrewaju *et al.*, 2011a). Building maintenance is an important activity that helps to decelerate decay, defect, deterioration and failure to ensure that buildings perform optimally (Arazi *et al.,* 2009). Lee & Wordsworth (2001) added that maintenance also helps to preserve the asset value of a property stock. Drouin *et al.* (2000) and Olanrewaju *et al.* (2011a) indicated that the performance of a building is dependent on the manner in which maintenance is carried out. Building maintenance management is actually becoming a major tool for improving the performance of university buildings (Olanrewaju, 2010a).

1.9.6 User involvement, prioritisation system and strategies of building maintenance

Buildings are procured to serve the needs of the users; therefore the focus of building maintenance ought to be driven by the building users (Arazi *et al*., 2009). In fact, the two main stakeholders in the building maintenance management process are the maintenance organisations and the building users, students in the case of a university (Olanrewaju *et al.*, 2011b). There is, therefore, the need for a maintenance management system which emphasises the involvement of building users (Olanrewaju *et al.*, 2011a). Meeting the requirements of students, invariably affects their satisfaction level (Olanrewaju *et al.*, 2011b).

Universities frequently face constraints of resources; therefore, it is crucial to decide how these scarce resources will be best deployed to achieve the highest level of students' satisfaction (Matzler *et al.,* 2004). Prioritisation is thus vital when universities are faced with budget constraints; "scale of preference" is the term used in economics. Factors including statutory requirements, safety and health, environmental impact, contractual issues, strategic impact, operational impact, community perception and heritage issues all require critical consideration when prioritising maintenance tasks (Department of Treasury & Finance, 2005). Clatworthy and Convenor (2001), Earthman (2004) and Lackney (1999b) are examples of studies that prioritised the performance parameters in their order of importance. They identified and concluded that health and safety, the physical comfort (i.e. temperature and indoor air quality), acoustic consideration, lighting, classroom adaptability, aesthetics and appearance are all important factors that must be given serious consideration when a lecture theatre is designed and when initiating maintenance.

After the maintenance tasks have been identified and prioritised, strategies must then be adopted for maintaining them. Maintenance strategy pertains to how the maintenance needs and tasks are executed. It is essential to develop appropriate strategies for maintaining university building facilities (e.g. lecture theatres) (Drouin *et al.,* 2000) because of the level of investment universities make in the construction and development of their buildings (Olanrewaju, 2010a) and the important role buildings play in supporting the purpose of the universities (Lee & Scott, 2009a). There are several options of maintenance strategies available to management (Horner, El-Haram & Munns, 1997). The various strategies of maintenance are developed from three basic strategies (Chan, Lee & Burnett, 2001): 1) preventive; 2) corrective; and 3) condition-based (Horner *et al.,* 1997; Lee & Scott, 2009b). The building maintenance strategies selected by an institution are usually influenced by factors such as health and safety, fitness for use, law and value of users (Lee & Scott, 2009b). The formulation of the maintenance strategies fundamentally requires management directives (Lee & Scott, 2009a).

1.10 Methodology

A preliminary exploratory study was carried out to develop an understanding of the maintenance practices of universities in the Western Cape of SA. The exploratory study concentrated on maintenance management strategies, prioritisation system and student involvement strategies. The exploratory study aided the formulation of the research question and objectives for the main study to allow for a more precise and thorough investigation.

Struwig and Stead (2001) indicated that research design may be qualitative, quantitative or a combination of the two. The emphasis of qualitative research is on the quality and depth of information; it focuses on describing and understanding phenomenon within their natural context so as to develop understanding of the meanings conveyed by the respondent (Maree, 2007). Quantitative research, on the other hand, has more to do with studying the relationship among measurable variables so as to explain, predict or control a phenomenon (Leedy & Ormrod, 2010). The mixed method approach combines several research methods either across paradigms (e.g. qualitative and quantitative) or within paradigms (e.g. mixed qualitative methods) (Hennink, Hutter & Bailey, 2011). Some methodological options of qualitative research design include case study, ethnography, phenomenological study, grounded theory study and content analysis (Leedy & Ormrod, 2010). Case study, amongst others, is identified as one of the approaches used in quantitative research (Struwig & Stead, 2001).

This research is meant to determine the level of importance students attach to the building performance parameters they deem as critical to their learning experience, as well as their satisfaction level with these performance parameters, with the aim of developing strategies to guide the maintenance of the performance parameters of the lecture theatres. The maintenance management systems relating to user involvement, prioritisation system and strategies employed by the university will also be studied to achieve the aim of the study. A mixed research design (i.e. a combination of both a qualitative and quantitative approach) is therefore deemed appropriate for the main study. The approach will be a “case study” as this helps in studying a social phenomenon through a thorough analysis of an individual case; the case study may be a person, group, episode, community, society or any other unit of social life (Kumar, 2005). CPUT is the institution to be studied and three lecture theatres will be used as the “cases” for this research study.

The data collected for a research project consists mainly of two types: primary data and secondary data (Struwig & Stead, 2001). Both secondary and primary data collection techniques will be used in this research study. The secondary data (mainly literature review) to provide an overview of the research study will be obtained from various publications such as textbooks, articles, conference proceedings, dissertations and journals, all of which will form a substantial part of the literature on the topic. Two distinct literature studies—preliminary and a full literature review—will be used in the research study (Melville & Goddard, 1996). A preliminary literature is reviewed in this chapter to develop the framework of the study. Chapter Two will provide a full literature review on the study, conducted extensively to develop a logical and comprehensive view of the relevant topics for the research study. The primary data will be gathered by means of an empirical study. Triangulation of data collection techniques will be employed for this research study, because, triangulation brings together different methods of data collection techniques and helps to view a problem from several points rather than only one point (Thomas, 2011). Data will be collected from the maintenance and infrastructure managers, the students, as well as through observations. Interviews, questionnaires, observation and document review will be used to collect the primary data for the main study.

Data analysis consists of examination, testing, tabulating, categorising or examining evidence to address the purpose of a study (Yin, 2003). Content analysis will be used to analyse the data of the exploratory study. The data of the main study will be statistically analysed using the Statistical Package for Social Science (SPSS); both descriptive and inferential statistics will be used. Validity and reliability of the instruments will be tested. The Cronbach's Alpha test will be used for reliability test. To ensure respondent validation, the interviews will be transcribed and checked by each interviewee for accuracy.

1.11 Ethical consideration

In order to conform to internationally acceptable ethical standards, consent of all participants and respondents will be sought and no compensation will be given to any respondent or participant in the study. The confidentiality and privacy of each will also be maintained. The researcher will be critical about the following to ensure quality:

- general conduct and competence of interviewers;
- quality of data capturing and interpretation; and
- correctness and completeness of questionnaires to be used, especially where open-ended questions are concerned.

The research process will not endanger the society, environment, the research participants or the university itself.

1.12 Chapter outline

The dissertation will be structured as follows:

Chapter One: Introduction

The introductory chapter will comprise the background information, the research question, objectives, significance, delimitations, preliminary literature review, methodology and chapter outline.

Chapter Two: Literature Review

The literature review will emphasise the previous works of different researchers related to this study from publications such as textbooks, articles, dissertations and journals on the following: the effect of building performance on students' learning experience; the impact of building maintenance on building performance; the concept of building and building performance; the scope and value of building maintenance; and maintenance management practices (prioritisation, strategies and user involvement). The importance-satisfaction analysis will also be reviewed.

Chapter Three: Research Methodology

This chapter will explain the methodology used to carry out the study. It will discuss the research design, data collection instruments, sample size, how questionnaires will be administered and how the data will be analysed.

Chapter Four: Analysis of Exploratory Study

The analysis of the exploratory study will be presented in this chapter.

Chapter Five: Analysis and Discussion of Results

The analysis and interpretation of the data gathered will be presented in this chapter.

Chapter Six: Conclusions and Recommendations

This chapter concludes the study and offers recommendations based on the analysis.

1.13 Chapter summary

This chapter provided an overview of what is to be achieved in the research study. The background information, research question, objectives, significance, delimitations, preliminary literature review, methodology and the chapter outline of the research study were each briefly discussed. The remaining chapters will elaborate on the literature review, methodology, analysis and discussion of results, conclusions and recommendations stemming from the research.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

The literature review encompasses the importance-performance (satisfaction) analysis, the effect of building performance on students' learning experiences, the concept of building and building performance, scope and value of building maintenance and maintenance management practices (prioritisation, user involvement and strategies). The impact of building maintenance on building performance will also be reviewed. Throughout, special reference will be made to educational, but in particular, university building facilities.

2.2 Importance-performance analysis

Meeting the requirements of students is important to ensure that universities attain their objective. Since maintenance departments of universities may be constrained by limitations of funds (Buys & Nkado, 2006; Buys, 2004 cited in Buys *et al*., 2009; Olanrewaju, 2010a), priority setting becomes paramount to ensuring that the lecture theatres are maintained to meet the required satisfaction of students. The relationship between importance and performance (satisfaction) of parameters could be analysed to ensure that scarce resources are best disseminated to achieve the highest levels of satisfaction for students (Matzler *et al.,* 2004). The Importance performance analysis (IPA) is adopted for this study to aid the development of improvement and prioritisation strategies for guiding the maintenance of the performance parameters of the lecture theatres.

IPA is one of the tools used for analysing the relationship between the importance and performance (satisfaction) of parameters or attributes, a popular tool since its introduction by Martilla and James (1977). IPA uses a two-dimensional grid, where performance is on the x-axis and importance on the y-axis (Abalo *et al.,* 2007; Ainin & Hisham, 2008; Matzler *et al.,* 2003; Matzler *et al.,* 2004). To construct the model, data from satisfaction surveys are required; respondents rate each attribute on a satisfaction scale, and some form of importance measures are also required (Matzler *et al.,* 2003). Four specific quadrants are generated as the importance and satisfaction data are plotted on the two dimensional grid; the scaling of the axes as well as the location of the parameters into the four quadrants help to interpret the results (Matzler *et al.,* 2003).

Parameters in Quadrant I demonstrate high both in satisfaction and importance. Parameters in this quadrant represent opportunities for gaining or sustaining competitive advantage

(Matzler *et al.,* 2003). In this area, the maintenance department should 'keep up the good work'. Quadrant II, representing low satisfaction on highly important parameters, demands immediate attention (Matzler *et al.,* 2004). Ainin and Hisham (2008) pointed out that this quadrant ought to be given top priority as neglect may pose a serious threat and dissatisfaction (Matzler *et al.,* 2003). Parameters both low in satisfaction and importance are in Quadrant III. Matzler *et al.* (2003) were of the opinion that it is unnecessary to focus additional effort on parameters in this quadrant as these parameters are considered 'low priority'. However, parameters falling in this quadrant may cause discontinuation (Ainin & Hisham, 2008). Parameters which have high satisfaction but low importance fall into Quadrant IV. It is better that the resources invested in these parameters be diverted elsewhere (Ainin & Hisham, 2008). In other words, the resources committed to these parameters would be better applied on other parameters. High performance on unimportant parameters indicates a 'possible overkill' (Matzler *et al.,* 2003) (see Figure 2.1).

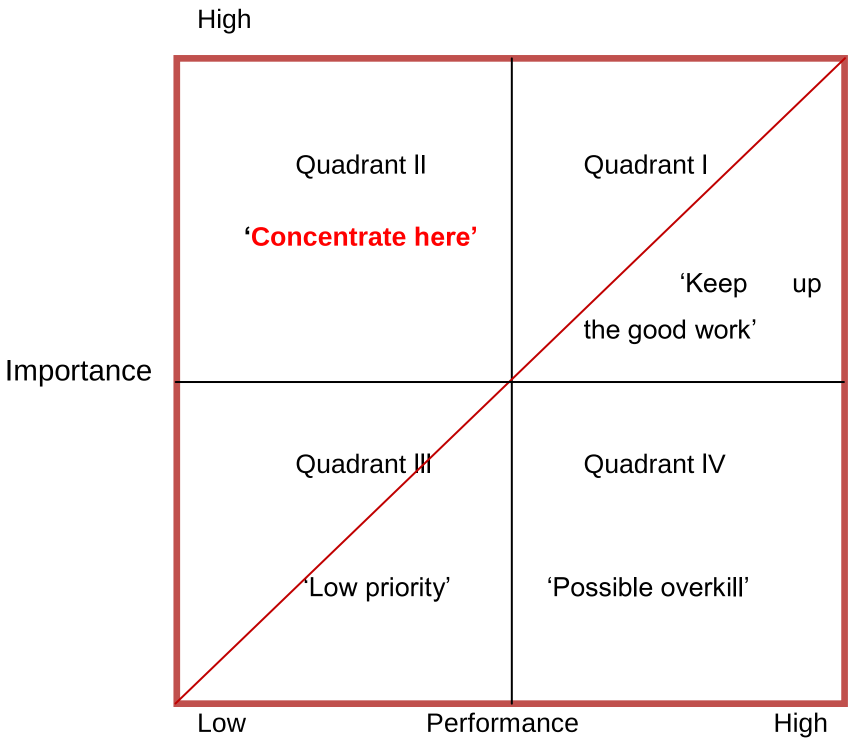


Figure 2.1: Importance performance model

(Adapted from Abalo *et al*., 2007:116)

The importance of IPA cannot be underestimated as it helps to identify parameters or attributes that are the most important to customers (students) and have the highest impact on their satisfaction, as well as those that have a low performance and need improvement (Matzler *et al.,* 2003). It is an important tool used by institutions to identify areas for improvement and to propose actions for reducing the gap between importance and satisfaction (Ainin & Hisham, 2008). IPA is also useful in decision-making particularly to allocate scarce resources to maximise satisfaction (Matzler *et al.*, 2004). Essentially, it aids in measuring customer satisfaction (Leong, 2008; Pezeshki, Mousavi & Grant, 2009). Ultimately then, IPA helps to identify parameters that enhance satisfaction, to formulate improvement priorities, and to find areas where resources need to be diverted elsewhere (Matzler *et al*., 2004).

IPA has been used in a number of settings (Sampson & Showalter, 1999). Ainin and Hisham (2008) reviewed several studies pertaining to the use of IPA. In fact, the IPA analysis rests on multi-attribute models (Kitcharoen, 2004). Although quite a number of modifications of the original IPA have been proposed, the structure has remained the same (Sampson & Showalter, 1999). Among the alternatives to the IPA grid is the incorporation of an iso-rating line which divides the graph into two great areas (Abalo *et al*., 2007; Eskildsen & Kristensen, 2006; Leong, 2008; Sampson & Showalter, 1999; Slack, 1994). Abalo *et al.* (2007) explained that the iso-rating line is an upward diagonal line representing points where ratings of importance and performance are exactly equal. With this approach, the points above the upward sloping (45°) line represent points where importance exceeds performance; any attribute above the upward sloping (45°) line does not meet customers' (students') satisfaction and therefore needs improvement (Leong, 2008). Abalo *et al.* (2007) added that the greater the difference between the importance and the performance of an attribute, the greater the need for remedial action. The interpretation of the areas below the diagonal (45°) line is similar to the original Martilla-James diagram (Abalo *et al*., 2007). Another technique for analysing importance satisfaction data is the analysis of variance to validate significant differences between parameters or attributes (Janes & Wisnom, 2003).

IPA uses factors or parameters. Pezeshki *et al.* (2009) pointed out that these factors may have different values of importance and performance that lead to variance in customer satisfaction. It is therefore essential to identify the critical factors that determine satisfaction (Matzler *et al.,* 2004). Pezeshki *et al.* (2009) highlighted that factors with different importance levels have varying impact on satisfying customer expectations. Principally, factors of high importance should have higher performance standards to meet the satisfaction of users than factors of low importance (Matzler *et al.,* 2003). The importance weights obtained may differ based on the existence of different satisfaction factors such as basic, performance and excitement factors (Matzler *et al.,* 2003). These factors are elaborated below:

Basic factors: these are core factors (Matzler *et al.,* 2003); the minimum that customers naturally expect from a service (Pezeshki *et al.,* 2009). Their performance above a certain level does not enhance satisfaction but they cause dissatisfaction if not fulfilled (Matzler *et al.,* 2003; Matzler *et al.,* 2004). They are therefore referred to as ‘dissatisfiers’ (Pezeshki *et al.,* 2009).

Performance factors: these factors lead to satisfaction if delivered or exceeded but cause dissatisfaction if not fulfilled. The performance factors are classified into two groups: 1) performance factors of high importance (high explicit/high implicit importance); and 2) performance factors of low importance (low explicit/low implicit importance) (Matzler *et al.,* 2003). Matzler *et al.* (2004) noted that performance factors are usually directly connected to customers’ explicit needs, hence the need to ensure that these factors are competitive.

Excitement factors: these are factors that increase satisfaction if delivered but do not cause dissatisfaction if unfulfilled (Matzler *et al.,* 2003; Pezeshki *et al.,* 2009). These factors are not expected to be delivered at a high performance level (Matzler *et al.,* 2003); however, if the performance of these factors is high, they greatly impact on the overall satisfaction than when their performance is low (Pezeshki *et al.,* 2009). According to Matzler *et al.* (2003) and Matzler *et al.* (2004), the excitement factors surprise and delight customers and thus increase satisfaction.

The relationship between expectation and satisfaction is a factor that can influence the discussion of the IPA model. Rood and Dziadkowiec (2010) were of the opinion that customers have expectations and the fulfilment of those expectations determine their level of satisfaction. Matzler *et al.* (2004) elaborated that if perceived performance is greater than expectations, a positive confirmation (satisfaction) occurs whereas a negative disconfirmation (dissatisfaction) occurs if performance is lower than expectations. However, moderate satisfaction or indifference occurs when performance equals satisfaction.

For the purpose of this study, the IPA model that incorporates an iso-rating line, disconfirmation theory and the analysis of variance will be applied.

2.3 Effect of lecture theatres’ performance on learning experience

The majority of people live and work in or make use of buildings every day (Douglas, 1996). Lee and Wordsworth (2001) shared a similar view and added that people actually spend over 95% of their time in or next to buildings. There is enough evidence to substantiate that the performance and quality of buildings *does* have a direct impact on the building users (Douglas 1996; Lee & Wordsworth, 2001; Lee & Scott, 2009a). Undoubtedly, dilapidated and poorly performing buildings do affect the quality of life of the building users and their health

(Lee & Wordsworth, 2001; Seeley, 1987) because the work environment is a factor that contributes to engagement and has the ability to influence building users either positively or negatively (Smith *et al*., 2011).

In a university environment, buildings, technology and human resources are regarded as interrelated assets (Olanrewaju *et al.,* 2011a). Buildings (e.g. lecture theatres) are actually an essential part of the physical environment (Mat *et al.*, 2009), and as part of the physical environment, they play a prominent role in creating and sustaining a productive learning climate (Uline *et al*., 2010). Zakaria and Wan Yusoff (2011) further explained that the interactions of several factors, including infrastructure of lecture theatres with the students often determine the outcome of the learning environment. Thus, the physical setting in which learning take place impacts on the whole learning process, the well-being of the students as well as their comfort and productivity level (Lackney, 1999a; Olanrewaju, 2010b). The brain is a physiological system and can be stimulated, either positively or negatively, by its physical environment (Chan & Petrie, 1998). Consequently, students will be affected by the performance of the lecture theatres. The quality of learning is indeed a reflection of the performance and functions of the teaching and learning facilities (e.g. lecture theatres) (Olanrewaju, 2010a). In any case, what is the value of a lecture theatre that is not conducive to the learning experience of students (Arazi *et al.*, 2009)?

Several other researchers have likewise indicated that the performance of educational buildings or facilities has a significant impact on students' learning. Cash (1993), for instance, studied the relationship between the condition of facilities and student behaviour and achievement and arrived at the conclusion that student achievement scores were higher in schools with better building conditions (performance). Uline and Tschannen-Moran (2008) also indicated that inadequate facilities are an indication of unclear academics focus and that such learning environments are unlikely to be perceived as orderly and serious. Other studies, including those of Amaratunga and Baldry, 2000; Bishop, 2009; Earthman and Lemasters, 1996; Green and Turrell, 2005; Lavy and Bilbo, 2009; Leung and Fung, 2005; Price, Matzdorf, Smith and Agahi, 2003; Uline and Tschannen-Moran 2008; Uline, Tschannen-Moran and Wolsey, 2009 and Uline *et al*., 2010 also revealed that the performance of buildings significantly impacts on student learning. The success of teaching, learning and other academic-related activities, like research, is indisputably dependent on the performance of the buildings (lecture theatres) wherein these activities take place.

2.4 Building and building performance

2.4.1 Understanding buildings

Buildings are simple, fairly unsophisticated, mainly static and much larger in scale compared to cars, computers and most other products (Douglas, 1996). They act as an envelope which buffers external environments to create an internal condition which supports internal needs (Watt, 2007). So buildings are not just bricks and mortar but are more like a skin which surrounds the occupants and modifies the conditions of an environment (Watt, 2007). Becker (1990) elaborated that buildings can be likened to living organisms that need to be understood, nurtured and possibly developed. Allen (1995 and 2005) also expressed the idea of buildings as living organisms, and posited that like all living organisms, buildings also go through the fundamental stages in natural cycles—birth, growth, maturity, decline, decay, death, and rebirth—and therefore require maintenance to keep the cycle under control (cited in Arazi *et al*., 2009). Buildings are "structures enclosing a space and providing protection from the elements; typically including walls, a roof and other components" (Bucher, 1996:69).

Buildings are comprised of several parts or layers. According to Watt (2007), the idea of buildings behaving as a skin is an indication that they are made up of a series of layers or parts. The definition of a building suggests that buildings are made up of walls, a roof and other components (Bucher, 1996) confirming that buildings are indeed made of layers or parts. Lam (2000) postulated that buildings consist of three major parts: the structure, the building element and the building services (i.e. mechanical and electrical element). Duffy (1990) is of the view that buildings are made up of four layers: shell, services, scenery and set. McGregor and Then (1999) share a similar view with Duffy but expand the idea by adding 'site' to the layers:

- *site:* the external surrounding of the building that sets its environmental context;
- *shell:* the structure that encloses the building;
- *services:* includes heating, ventilation and cable infrastructure of the building;
- *scenery:* the fitting out components, which adapt the shell of the building to the requirements of an organisation; and
- *set:* the management and rearrangement of furniture and other equipment to meet a particular work process and task.

Brand (1993) was of the opinion that there are six layers that make up the components of a building (cited in Douglas, 1996). These six layers have different rates of changes (Douglas, 1996; Watt, 2007). Table 2.1 shows the six layers of a building and their life spans.

Table 2.1: The six layers of building

Shearing layers	Description	Typical lifespan
Site	Location and context	Permanent
Structure	Bones	30-300 years
Skin	Envelope	20 years +
Services	Lifeblood	7-20 years
Space plan	Interior layout	3 years
Stuff	Furniture and equipment	less than 3 years

(Source: Douglas, 1996:24)

2.4.2 Purpose and Importance of buildings

Buildings are not procured for their own sake but rather to satisfy the needs of the users (Chartered Institute of Building, 1990). The purpose of a building is to provide shelter for activities that could otherwise not be carried out as effectively, or carried out at all, in the natural environment (Stanley, 2001). Thus, buildings create a condition and an atmosphere that is comfortable and healthy and allows human potential to develop in an unconstrained way as much as possible (Leaman & Bordass, 1993). Buildings are expected to perform certain functions after completion. Primarily buildings serve three interrelated functions: 1) enclosure of space; 2) climate barrier-modifier; and 3) protection and privacy (Douglas, 1996). Stanley (2001) shares a similar view as Douglas (1996) and expands on the functions of buildings as follows:

- to protect people and equipment from elements such as wind, rain, snow, and heat;
- to provide interior space whose pattern, furnishings, and environment (temperature, humidity, noise, light, air quality, materials) are suitable for the activities to take place within; and
- to provide the infrastructure and services (water, electricity, waste disposal systems, fire suppression) necessary to help carry out activities.

Although not insignificant, buildings were and are perceived even now as expensive overheads, and in some cases regarded as a liability (Douglas, 1996). They are also perceived as commonplace rather than an essential facility, as a result of which their value and function are often ignored (Watt, 2007). Although the perception of buildings is taking a turn in this era, Douglas (1996) expressed that there is still the danger of underestimating or overlooking the significance of buildings as an important resource. The importance of buildings should not be underestimated. Buildings are the main physical asset of any institution in terms of both size and cost (Douglas, 1996). Indeed they are not just assets, but valuable assets that provide shelter and facilities for work as well as leisure (Chartered Institute of Building, 1990). Buildings also help to provide the necessary internal environment for living in comfort and safety (Douglas, 1996) and increasing the potential of building users (Leaman & Bordass, 1993). Leaman and Bordass (1993) further indicated that buildings help to create an indoor condition which allows more activities to be carried out for longer periods of time. The point is that buildings play a significant role in sustaining and enhancing the core business of any institution (Douglas, 1996).

Douglas (1996) summarised the importance of buildings under these headings:

- *Economic:* they are durable fixed assets with good capital growth potential;
- *Environmental:* they provide suitable, internal environments which can resist the adverse effects of climatic conditions for people and commodities;
- *Functional:* they enable activities and tasks to be carried out and commodities to be housed under controlled conditions;
- *Cultural:* they reflect the architectural aspirations and historical characteristics of the community within which they reside; and
- *Legal:* they are required to enable owners and users to comply with certain statutory requirements.

2.4.3 Concept of building performance

Currently, people and organisations have higher performance expectations for buildings than before. Owners and building users want buildings that support their organisational mission, enhance worker productivity, enhance profits, and promote image; they also expect that buildings will be functional, comfortable and safe (Stanley, 2001). Once completed, buildings are expected to perform certain functions (Arazi *et al*., 2009). Though buildings may have several decades of service life (Douglas, 1996), the correct performance of buildings is desired by the users throughout their entire service life (Olanrewaju *et al.*, 2011a). Watt (2007) stated that buildings are expected to meet certain requirements, grouped as the following: functional, performance, statutory and user requirements. These interrelated requirements are narrowed into two groups by the researcher in line with the purpose of the study. The researcher will focus primarily on the user and performance requirements.

Functional and user requirements: this is more related to fitness for purpose and protection from the external environment, human comfort, and organisation of activity and space. For a building to be successful, it must satisfy the basic functional requirement.

Performance requirements: the statutory requirements fall under the performance requirements relates to the following:

- access
- appearance
- durability
- dimensional stability
- strength and stability
- weather exclusion
- sound control
- thermal comfort
- fire protection
- lighting and ventilation
- sanitation
- security
- cost

Building performance relates to “the degree to which a building or other facility serves its users and fulfils the purpose for which it was built or acquired; the ability of a facility to provide the shelter and service for which it is intended” (Iselin & Lemer, 1993, cited from Douglas, 2006:587). The performance concept has more to do with what buildings are required to do (Haupt, 2001). In other words, it determines how the building contributes to fulfilling the expectation and functions required by the building user over time (Williams, 1993; Stanley, 2001). Building performance, in essence, relates to user expectations, requirements and satisfaction (Olanrewaju *et al.*, 2011a).

It is imperative that as buildings outlive the usefulness of services delivered they are continually evaluated against service outputs and business strategies (Department of Treasury and Finance, 2005). Performance evaluation also referred to as ‘post occupancy evaluation’ is a systematic analysis of built environments so as to establish how the built environment satisfies and support its users’ needs (Fianchini, 2007). Douglas (1996) stated that building performance is receiving more attention because of its impact on the efficient use of buildings. The building performance assessment is conducted to ensure that users conveniently and permanently conduct their activities safely, satisfying their comfort requirement, without impairment of their health (Haupt, 2001). It also helps to improve the performance of a particular built environment (Fianchini, 2007).

The objective of building performance assessment according to the Department of Treasury and Finance (2005) concerns the following:

- to identify under-performing buildings;
- to identify specific elements of individual buildings that are under-performing;
- to provide data to aid prediction of future performance trends; and
- to help in determining appropriate levels of maintenance required for the building.

The Department of Treasury and Finance (2005) proposed a 4-pronged framework for evaluating the performance of a building: 1) strategic relevance; 2) financial performance; 3) service performance; and 4) technical performance. Two of these performance measures identified are relevant and would be applied for the study (see Table 2.2).

- *Service performance* (i.e. fit for purpose): this can be measured by determining user satisfaction in terms of criteria such as the building's ability to function, or comfort afforded by the building.
- *Technical performance:* this is generally measured through physical inspections such as Building Condition Assessments or other forms of asset condition assessment.

Table 2.2: Performance parameters

Performance criteria	**Performance factors**	**Issues to be evaluated**
Service performance	a. Location	× Accessibility × Proximity × Environmental appropriateness
	b. Function	× Capacity × Image × Layout × Standard
	c. Comfort	× Ambience × Thermal comfort × Visual comfort × Acoustic comfort × Ergonomics × Safety × Security × Amenities
Technical performance	a. Standard	× Compliance with law and codes × Conformance to benchmark standards
	b. Condition	× Maintenance requirements × Reliability of services

(Adopted from Department of Treasury and Finance, 2005:11)

2.5 Performance parameters critical for lecture theatre performance

The performance of a building is determined in relation to a number of defined performance measures or parameters (Watt, 2007). Indeed, there are a number of factors related to building performance (Lee & Scott, 2009a). The reviewed literature on the requirements of a building provided by Watt (2007) and the performance measures elaborated by the Department of Treasury and Finance (2005) suggest that there are several requirements that a building must meet; however, for the purpose of the study, the researcher will focus specifically on the performance requirements that are critical for lecture theatre performance. Generally speaking, buildings are expected to meet performance requirements such as indoor air quality, noise control, privacy, safety, hygiene standard, lighting comfort, spatial comfort, aesthetics, glare, accessibility, thermal comfort and ergonomics because of their impact on the building users (Atkin & Brooks, 2009; Department of Treasury and Finance, 2005; Lee & Scott, 2009a; Olanrewaju *et al.*, 2011c). The aforementioned factors are physiological in nature (Davis, 1986). And since the brain is a physiological system that can be stimulated by its physical surroundings (Chan & Petrie, 1998), it is vital that these parameters are taken care of to ensure a positive impact on the students. It is really essential that university lecture theatres provide the best conditions to enhance learning experience (Fleming & Storr, 1999).

Based on the works of numerous researchers (i.e. Bishop, 2009; Cash, 1993; Department of Treasury and Finance, 2005; Earthman & Lemasters, 1996; Earthman, 2004; Fleming & Storr, 1999; Green & Turrell, 2005; Lackney, 1999a; Lackney, 1999b; Leung & Fung, 2005; Uline & Tschannen-Moran, 2008; Uline, Tschannen-Moran & Wolsey, 2009; Uline *et al.*, 2010) a number of performance requirements critical for lecture theatre performance were identified. For the purpose of this research the following performance parameters will be discussed:

- Safety (structural and fire & exit safety)
- Temperature (thermal comfort)
- Ventilation
- Sound control (acoustics)
- Lighting
- Aesthetic
- Cleanliness

2.5.1 Safety (structural and fire & exit safety)

According to Earthman (2004), the first order of importance when prioritising issues concerning school building adequacy is safety. Similarly, Lackney (1999b), in his presentation entitled "Assessing School Facilities for Learning," placed 'health and safety' as the first and foremost factor that influences educational experience. It is obvious that teaching and learning should take place in a safe physical environment, hence the need to address safety issues as a first order of business (Earthman, 2004).

It is very important for one to be concerned about how safe a lecture theatre is. Lackney (1999a) identified some of the most important safety-related elements as accessibility, egress, material safety and fire safety. Other factors include security systems and a communication system to rely on in emergencies (Earthman, 2004). It is imperative to understand that the absence of health and safety measures can lead to accidents and sickness and even limited access for the disabled (Lackney, 1999a). Safety is actually a statutory consideration (Watt, 2007), consequently it demands prime attention.

2.5.2 Temperature (Thermal comfort)

Thermal comfort primarily depends on the heat transfer between the human body and the environment (Polh, 2011). Earthman (2004) prioritised 31 criteria for school building adequacy and postulated that after health and safety; the next most important building elements that affect student achievement are temperature control and air quality. In fact, environmental temperature is one of the most crucial factors that promote human comfort and survival (Polh, 2011). The temperature in a building influences thermal comfort, which subsequently affects working performance, health and social behaviour of the building users (Leung & Fung, 2005). It is therefore imperative to regulate the heat lost from the human body by cooling or heating the air surrounding the skin in order to achieve a comfortable thermal environment (Polh, 2011). It is worth noting that the range of temperature to which the human body can adjust without discomfort is quite minimal: between 75°F and 68°F (Polh, 2011). Leung and Fung (2005) explained that a slightly cool lecture theatre is more conducive to learning than a warm lecture theatre. One way of regulating the temperature of a room is the use of a heating, ventilation, and air conditioning (HVAC) systems. Any inadequacy of the HVAC systems can cause unnecessary distraction to students, who may spend more time sweating or shivering instead of learning (Bishop, 2009). Polh (2011) noted that both shivering and sweating are signs of discomfort. Thermal discomfort could also slow down the functioning of the brain (Polh, 2011). Density of occupation is amongst other factors that affect the thermal comfort of a lecture theatre (Polh, 2011).

2.5.3 Ventilation

Ventilation is very closely related to temperature control. Leung and Fung (2005) stated that a good ventilation system in a room can improve the indoor air quality and the working productivity of end-users, students in the case of a university. Polh (2011) was also of the view that ventilation helps not only to preserve the health and efficiency of occupants but also aids the removal of heat from a building. Polh (2011) explained that an increase in the movement of air causes the replacement of saturated air in a room with fresh air. In fact, the freshness or stuffiness of a building is partly influenced by air movement (i.e. ventilation). It is well known that the “sick building syndrome’’ (SBS), potentially resulting in respiratory illness, is caused by poor indoor air quality (Lackney, 1999a). The United States Environmental Protection Agency (1999) explained that the SBS is a term used to describe situations in which building occupants experience acute health and comfort effects that are somewhat linked to time spent in a building. There is certainly a correlation between health and air quality, hence Lackney (1999b) put ‘health and physical comfort’ as one factor when he prioritised the attributes of environmental quality that influence educational outcomes. The freshness of a room is partly influenced by the density of occupation (Polh, 2011). Apart from windows, the HVAC systems could be used to promote good ventilation of a lecture theatre.

2.5.4 Sound control (Acoustic)

Polh (2011) opined that acoustics are considered a critical environmental factor essential to the efficient functioning of school buildings (e.g. lecture theatres) because of the need of maintaining a conducive hearing condition at all times in a learning situation. Really, the lecture theatre serves as a communication channel for both teachers and students for their teaching and learning experiences (Sutherland & Lubman, 2001). The effectiveness of the teaching and learning experience involves intensive speech communication between teachers and students and amongst students (Lubman & Sutherland, 2001). The line between desirable sound and noise is not easy to delineate; whereas desirable sound is an important catalyst of communication, noise impedes communication (Polh, 2011). Leung and Fung (2005) described noise as an unwanted sound and reverberation. Noise is perceived as a serious pollutant of the environment (Polh, 2011). The ability to hear in lecture theatres can be affected by noise or promoted by desirable sound. The ability to hear clearly in a lecture theatre is certainly crucial for both student learning and teacher performance (Earthman, 2004); this hearing ability is dependent almost entirely on the acoustical conditions in the lecture theatres (Lubman & Sutherland, 2001).

Good lecture theatre acoustics facilitate communication, making learning easier, more sustained and less stressful, while the opposite, excessive noise and reverberation in lecture theatres, inhibit speech communication and hinder the learning process (Lubman & Sutherland, 2001). After citing numerous research studies, Earthman (2004) concluded that a higher level of noise, both inside and outside the classroom, can negatively impact the ability of students to perform well, hindering students from achieving their potential. Cash (1993) posited that acoustical installation or alternate facilities such as carpet and ceiling tiles are excellent internal insulators of sound to minimise and contain noise. Keeping doors and window closed, provided there is adequate ventilation and checking and removing the noise level of HVAC system can also help in creating learning-conducive lecture theatre acoustics.

2.5.5 Lighting

Light is one of the parameters of building design which necessitates a very important consideration (Polh, 2011). Polh (2011) further explained that vision (the ability to see) is only possible when light interacts with the eye and the brain. Lecture theatre lighting can be provided either naturally or artificially. Polh (2011) expressed that daylight alone cannot be adequate to satisfy the lighting requirements in a building, hence the need for artificial lighting. The importance of light is enormous, as poor indoor lighting can result in fatigue, eye strain, blurry vision and headaches (Lackney, 1999a). In other words, light can affect the health of building users (university students) (Leung & Fung, 2005). Light can also affect the mental concentration, productivity as well as the morale of building users (Lackney, 1999a; Leung & Fung, 2005). This is true because the retina sends signals to the brain before images are formed (Polh, 2011). Indoor lighting could be improved by the use of full spectrum fluorescent light, light controls and increasing daylight (Lackney, 1999a). For a lecture theatre, adequate lighting is paramount. Polh (2011) made an important point that the increase in illumination results in an increase in the ability to see fine details.

2.5.6 Aesthetics

Aesthetics relates to a sense of beauty and concerns human emotions and sensations which are determined by colours, shapes, textures and unique features (Uline *et al*., 2009). Smith *et al*. (2011) were of the view that the environment contributes to engagement. Since the environment contributes to engagement, and aesthetics plays a critical role in ensuring a comfortable environment (Leung & Fung, 2005), it implies that an aesthetically appealing lecture theatre has the ability to influence students' learning experiences positively. In fact, Cash (1993) found that aesthetically attractive building conditions do impact on student learning experiences, even more than structural building conditions.

2.5.7 Cleanliness

Uline and Tschannen-Moran (2008) identified cleanliness and neatness of a building as one of the crucial indicators of building quality as expressed by building users. In fact, cleaning servicing is carried out to keep buildings (lecture theatres) in an appropriate condition (Chanter & Swallow, 2007). As mentioned, indoor air quality is known to be one of the causes of SBS. A lecture theatre's air quality is partly influenced by dust and dirt (cleanliness) or lack thereof. Essentially, cleanliness has a health implication on students hence the need to ensure the provision of a clean lecture theatre.

2.6 Building maintenance management

2.6.1 Concept and value of building maintenance management

The concept of building performance relates to the utilisation period of a building (Haupt, 2001). It is at this stage that performance of a building is evaluated and required action taken. Adaptation and maintenance are the two responsive actions for keeping buildings performing optimally (Douglas, 1996). Shohet, Lavy, and Bar-On (2003) opined that maintenance has become a major phase in the life cycle of a building. The concept of building maintenance is broad and multifaceted (Arazi *et al*., 2009; Lee & Wordsworth, 2001; Lee & Scott, 2009a). Maintenance has been perceived and defined differently by several scholars; however, two important activities ensuing from the definitions are 'retaining' the component in appropriate condition for use and 'restoring' it to such a condition should deterioration have set in (Shohet & Lavy, 2004).

Secondly, the definitions of building maintenance balance both technical and management responsibilities (Arazi *et al*., 2009; Chartered Institute of Building, 1990; Lee & Wordsworth, 2001; Lee & Scott, 2009a; Miles & Syagga, 1987; Seeley, 1987; Shohet & Lavy, 2004). Chanter and Swallow (2007) elaborated that the definition relates not only to the physical execution of maintenance work, but also its initiation, financing and organisation. Miles and Syagga (1987) postulated that the technical criteria pertain to the physical characteristics of the building while the non-technical concern the managerial criteria including environmental, financial consideration, economic criteria, policy consideration and organisational consideration. Seeley (1987) expressed that the technical criteria helps to identify maintenance needs and specify right remedies, while the non-technical criteria are the management aspects which involve planning, directing, controlling and organising the maintenance process (Arazi *et al*., 2009). Computer application is becoming an important management tool. Maintenance efficiency can be improved by applying technologies such as computerised maintenance management systems (CMMS) (Lee & Scott, 2009a; 2009b). The managerial and technical requirements of maintenance involve a great level of creativity and skills (Seeley, 1987).

Building deterioration and obsolescence are inevitable and to be expected as part of the ageing process of a building (Mills, 1994; Douglas & Ransom, 2007). However, maintenance can help reduce the speed of deterioration and failure (Douglas, 2006; Douglas & Ransom, 2007; Mills, 1994; Seeley, 1987). Unfortunately, available evidence suggests that buildings are generally under-maintained, particularly due to the general lack of concern for building maintenance (Chanter & Swallow, 2007; Lee 1987; Lee & Wordsworth, 2001). Despite the lack of concern and the negative perceptions, the importance of building maintenance cannot be ignored. Arazi *et al*. (2009) were of the view that building maintenance helps to minimise decay, defect, deterioration and failure to ensure that buildings perform optimally during their life cycle and represent value to the users. The asset value of a building actually decreases unless maintenance is carried out (Lee & Wordsworth, 2001; Wood, 2009; Olanrewaju *et al*., 2011a). Additionally, maintenance helps in improving the performance of building systems, reducing operating cost, improving user satisfaction, ensuring compliance with statutory obligation and enhancing community perception (Queensland Department of Public Works, 2010). Maintenance is also carried out to ensure that the buildings and their associated services are in a safe condition, that the buildings are fit for use, that the condition of the building meets all statutory requirements, and to preserve the appearance of the building, to maintain the quality of the building and to maintain the value of the physical assets of the building stock (Alner & Fellows, 1990; Seeley, 1987).

Apart from these advantages, effective maintenance can help to reduce future resource requirements by prolonging a building’s life or by strengthening its disposal value (Department of Treasury and Finance, 2005). The objective of building maintenance is to ensure that buildings are preserved in a satisfactorily functional condition, with consideration giving to safety and economy (Sowden, 1990). Miles and Syagga (1987) postulated that the functional role is to retain the usefulness and the appearance of the building facility. Essentially, building maintenance is carried out in order to allow buildings to continue to perform their functions effectively and efficiently (Lee & Scott, 2009a; 2009b; Wood, 2009).

2.6.2 Scope of building maintenance

The scope of building maintenance is perceived and defined differently by several scholars, the categorisation or classification therefore varies from author to author. Cripps (1984), for example, classifies maintenance into the following headings:

- main fabric

- internal finishes
- specific features
- cleaning, and
- engineering services.

Miles and Syagga (1987) and Seeley (1987) were of the view that maintenance comprises three separate main components:

- servicing
- rectification, and
- replacement.

The Chartered Institute of Building (1990) categorised building maintenance this way:

- jobbing
- cyclic maintenance
- planned maintenance, and
- improvement work.

Al-Zubaidi (1997), on the other hand, categorised building maintenance work as the following:

- fabric maintenance
- improvement and modification, and
- day–to-day repairs.

Although not exactly the same themes, Beddington (1984) and Chotipanich (2004) identified the following as components of maintenance:

- refurbishment or restoration (including redecoration)
- building fabric maintenance
- repairs
- landscaping and landscape maintenance, and
- preventive maintenance (i.e. daily and periodic cleaning and servicing).

The classifications provided by these and other researchers are underscored by numerous common themes which overlap. The underpinning and common themes including routine or day-to-day cleaning services, repairs and replacements and minor work (improvements) are discussed below:

1. Routine or day-to-day (cleaning services)

Servicing is an operation undertaken at regular intervals of varying frequency; it is also referred to day-to-day maintenance. Servicing is essential because of the constant use of buildings, the effect of the weather and atmospheric conditions on the components of the building (Seeley, 1987). Hence servicing is carried out to keep the building in an appropriate condition (Chanter & Swallow, 2007). If more sophisticated equipment is introduced, more complicated service schedules become necessary too (Seeley, 1987). Although servicing generally results in small jobs, it caters for a significant proportion of the building maintenance time, and consequently, the building maintenance budget because of its labour-intensive nature (Al-Zubaidi 1997; Miles & Syagga, 1987).

This type of maintenance activity includes cleaning of floors, cleaning out gutters, polishing floors, and checking and cleaning drains (Miles & Syagga 1987). It also includes monthly washing and cleaning of windows and regular painting for both decoration and protection (Seeley, 1987). Cripps (1984) added that engineering services, including electrical and gas services, heating, ventilation and air-conditioning, lifts, escalators and mechanical handling equipment, security installations, and special equipment like refrigeration installations are all part of routine maintenance services. Landscaping and landscape maintenance also forms part of the routine day-to-day cleaning services (Clamp, 1994; Chotipanich, 2004).

2. Repairs and replacements

Repairs are mainly undertaken to make good or restore a building and its component to an acceptable working condition (Chartered Institute of Building, 1990; Douglas 2006). Repairs are inevitable since service conditions cause materials to decay at various and often unpredictable rates. Chanter and Swallow (2007) are of a similar view and added that repair and replacement are required due to natural deterioration and usual wear and tear. In the process of maintaining a building or its components some replacements would be required. Some rectification work could be remedied by repairs or replacement while some could result in a minor improvement. It is important to note that some repair tasks could form part of routine maintenance activity (Chartered Institute of Building, 1990; Chanter & Swallow, 2007) while others may form part of the minor sporadic upkeep.

3. Minor work (improvements)

Minor work or improvement is inherent in any maintenance operation (Chanter & Swallow, 2007; Mills, 1994). The Department of Treasury and Finance (2005) explained that minor improvements are alterations necessary to ensure that buildings remain functional, adjust to service delivery needs and meet changing legislative requirements. Given that maintenance is essentially expected to restore a building to its original design level (Lee & Scott, 2009b), it will be necessary to improve or upgrade a building to a standard appropriate for its intended use or even raise the original standards, where appropriate, to current acceptable standards (AL-Zubaidi 1997; Chartered Institute of Building, 1990; Chanter & Swallow, 2007; Lee & Wordsworth, 2001). Douglas (2006) also opined that minor work of beneficial improvement or upgrading that brings a building to an acceptable standard is an indispensable component of maintenance because replacing on a “like-to-like” basis may not be adequate to satisfy the users’ current and future requirements. Minor works embraces renovations which consist of work done to restore a structure, service and equipment to the original design and specification (Seeley 1987). However, any alteration that significantly changes the functionality or residual value of a building may not be considered a maintenance task but may more properly be considered a capital improvement (Department of Treasury and Finance, 2005). Douglas (2006) clarified that every maintenance work should fall short of adaptation (i.e. a “performance adjustment”). Chanter and Swallow (2007) also added that conversion, rehabilitation and refurbishment with the objective of adapting or increasing the utility of a building are to be excluded from the scope of maintenance.

Main fabric or internal finishes maintenance (fabric maintenance) may relate to routine maintenance activity, repair, replacement or even minor work. In summary, building maintenance management is not simply a mixture of repairs and replacing ‘like with like’ when individual components wear out (Al-Zubaidi, 1997; Chartered Institute of Building; 1990), but involves repairing, preserving and minor alterations to building assets (Department of Treasury and Finance, 2005). It embraces some upgrading and renovations to raise the original standards to current standards, as well as cleaning. It does not, however, include rehabilitation and refurbishing that significantly increases the utility or residual value of a building. This classification helps to understand the scope of building maintenance work, understanding what exactly is to be regarded as a maintenance activity and what is beyond the scope of maintenance.

The researcher therefore categorises maintenance work into three themes thus:

1. routine or day-to-day cleaning services
2. repairs, and
3. minor work.

2.6.3 Building Maintenance practices

There are several issues relating to building maintenance management. User involvement strategies, prioritisation system and maintenance strategies are the primary considerations for this study.

2.6.3.1 User involvement

Zakaria and Wan Yusoff (2011) were of the opinion that one of the main requirements for ensuring the attainment of quality university education is meeting the satisfaction of the students. In a university, several factors—including infrastructure, technology and educators—and the management of all such factors, influence student satisfaction (Olanrewaju *et al.,* 2011a; Zakaria & Wan Yusoff, 2011). Infrastructure (i.e. buildings) is one factor that impacts students' satisfaction. As a matter of fact, the main reason for initiating building maintenance is for the building users (Arazi *et al.*, 2009; Olanrewaju *et al.*, 2011a). Building maintenance is carried out to ensure that buildings support the needs of the users, with the aim that user productivity and satisfaction is enhanced (Olanrewaju, 2009). In any case, buildings are not procured for their own sake but for the services they offer the users (Douglas, 1996). Certainly, building users are the group interested in the adequate performance of the buildings since they are affected by them (Arazi *et al.*, 2009; Olanrewaju, 2010a; Olanrewaju *et al.*, 2010a). Meeting the requirements of building users, then, invariably affects their satisfaction (Olanrewaju *et al.*, 2011b). Building users are unsatisfied when buildings fail to meet their requirements, but on the other hand, they are satisfied if the management of buildings reflects and meets their requirements and interest (Arazi *et al.,* 2009; Olanrewaju, 2010a; Olanrewaju *et al.*, 2010a).

The primary concern of building maintenance management is to meet the requirements and satisfaction of the users (Arazi *et al*., 2009). In light of this, the focus of maintenance should in fact be driven by the building users (Arazi *et al.*, 2009). Therefore, user satisfaction information is a necessity in maintenance management (Olanrewaju, 2010b). Users actually measure the performance of their building in terms of various criteria that are consistent with their value systems (Olanrewaju, 2009); as a result, building maintenance management must stem from user performance requirements (Olanrewaju *et al.*, 2011b). After all, the two main stakeholders in the maintenance management value chain are the maintenance organisations (i.e. the service providers) and building users (i.e. students) (Olanrewaju, 2010a; Olanrewaju *et al.*, 2011b).

Efficient and effective building (e.g. lecture theatre) maintenance depends on the availability of information pertaining to the criteria that influences the users' requirements and satisfaction (Olanrewaju *et al.,* 2010b). Olanrewaju *et al.* (2011b) expressed that a 'gap' actually exists between what the users desire and require and what they receive from the service providers. Olanrewaju *et al.* (2011b) hypothesised that the performance of buildings could be enhanced if the maintenance organisations were aware of these 'gaps' and took them into consideration when initiating the maintenance process. The obvious means of identifying the gap is to seek information from the users. Essentially, users should be involved in the development of maintenance management systems to ensure that their satisfaction is taken into account while formulating maintenance policy (Olanrewaju, 2009). Watt (2007) was also of the view that the standard of maintenance is actually influenced by the building users. The building users should therefore participate in the maintenance process to increase their satisfaction (Shen & Spedding, 1998). In fact, a successful building is one that meets and even possibly exceeds the requirements of the users (Arazi *et al*., 2009). Accordingly, it is imperative that a consensus is reached by all participating parties of the maintenance management process (Shen & Spedding, 1998).

Undoubtedly, the involvement of building users is crucial for the success of managing the maintenance process and ensuring user satisfaction. Consequently, to ensure that students' requirements and satisfaction are duly met, involvement mechanisms ought to be incorporated in the maintenance processes for lecture theatres.

2.6.3.2 Prioritisation of maintenance

The cost of all required maintenance tasks in any one year usually exceeds the budget (NSW Heritage office, 2004). Matzler *et al.* (2004) reported that due to constraints of resources, institutions are forced to prioritise their scarce resources. Wood (2009) similarly indicated that institutions are unlikely to have enough resources to do all that is desirable to do in a year, hence the need to prioritise. In economics, "scale of preference" helps to utilise scarce resources efficiently, so does maintenance prioritisation help to utilise the available maintenance funds judiciously. After the conditions of a building are assessed, the maintenance tasks are then identified and prioritised, the prioritisation helps in deciding the best maintenance strategies to adopt for managing the building assets (Department of Treasury and Finance, 2005).

Although several studies have been conducted on the impact of the condition and performance of educational buildings on students, very few concentrate on priority setting. The works of Lackney (1999b), Clatworthy and Convenor (2001) and Earthman (2004) are examples of studies that resulted in prioritised design variables or performance parameters in order of importance. Lackney (1999b) identified and concluded that the physical comfort of the students is the most important consideration, followed by classroom adaptability, building functionality, aesthetics and appearance. Clatworthy and Convenor (2001), on the other hand, studied academics' and students' perceptions of the effect of the physical environment on learning, a study which revealed that students perceived, sequentially, ventilation, air conditioning, acoustic quality, seating comfort, amount of personal seating and writing space and quality of audio visual equipment as very important to their learning experience and hence ranked them very high. Earthman (2004) in his work entitled "prioritization of 31 criteria for school building adequacy", ranked the first five building features in this order of importance: 1) health and safety; 2) human comfort (i.e. temperatures within the human comfort range as regulated by appropriate HVAC systems); 3) indoor air quality (i.e. appropriate ventilation and filtering systems as regulated by appropriate HVAC systems); 4) lighting; and finally 5) acoustical control.

Quite a number of factors influence how maintenance tasks or needs are prioritised. NSW Heritage office (2004) and Department of Treasury and Finance (2005) identified factors such as health and safety, security of premises, statutory requirements, vandalism, increased operating costs, loss of revenue, disruption to business operations, likely failure of critical building fabric, policy decisions, environmental impact, contractual issues, strategic impact, community perception and heritage issues. Watt (2007) stated that most of the statutory requirements relate to the health, safety and the well-being of the building users. It is essential to give consideration to risk factors before final prioritisation of maintenance tasks is determined (Department of Treasury and Finance, 2005).

Horner *et al.* (1997) explained that the maintenance items in a building (e.g. lecture theatre) can be divided into two groups, significant and non-significant items, depending on the significance of the consequences of failure.

1. *Significant items*: items whose failure affects health, safety, environment or utility. The significant items are further divided into two categories:
   - Health, safety and environmentally significant items.
   - Utility significant items: in relation to the lecture theatre these are the items whose failure is likely to have an effect on the direct and indirect maintenance costs, user satisfaction, appearance and serviceability of the lecture theatre.
2. *Non-significant items*: items whose failure has no significant effect.

Shen and Spedding (1998) presented elaborative guidelines for prioritising building maintenance tasks, the sequence provided below:

1. High risk of health or safety: problems which pose serious potential danger to the building users;
2. Serious disruption of the normal activities in the building, or health or safety problems, but not posing immediate danger to the building users (e.g. failure of the heating system in the winter);
3. Serious discomfort to the building users;
4. Damage to the image of the organisation or decrease of morale due to frustration caused by the defects; and
5. Minor problems relating to aesthetics or convenience.

Wood (2009), likewise, listed the following as the order of priority;

1. health and safety;
2. wind and water tightness of the building;
3. continuity of business operation;
4. comfort of occupants; and
5. efficiency, effectiveness and economy of operation.

Wood (2009) further stated that the first two orders are not debatable; however, the last three may be ordered differently depending on several related factors.

Clearly it can be inferred from the opinions of Horner *et al.* (1997), Shen and Spedding (1998) and Wood (2009) that safety and statutory requirements ought to be given the first priority, followed by items which can affect the comfort level of users and continuity of business operation, and then the problems relating to aesthetics or convenience can follow.

2.6.3.3 Strategies of maintenance

There are several strategies of maintenance in general. Smith and Hinchcliffe (2004) listed some strategies including total productive maintenance, condition-based maintenance, economic value added maintenance and replacement asset value maintenance. Other strategies, including breakdown maintenance (BM), preventive maintenance (PM), predictive maintenance (PdM), corrective maintenance (CM), maintenance prevention (MP), reliability centered maintenance (RCM), productive maintenance (PrM), computerised maintenance management systems (CMMS) and total productive maintenance (TPM) were reviewed by Ahuja and Khamba (2008).

With specific reference to building maintenance strategies, a number of options exist from which management can select (Horner *et al.,* 1997). Chan *et al.* (2001) identified five types of maintenance strategies: time-based, performance-based, breakdown-based, renovation-based and integration-based. Some strategies of building maintenance have evolved over the years including just-in-time maintenance (Smyth and Wood, 1995), intelligent building maintenance (Wood, 1999a), sustainable building maintenance (Wood, 1999c), call-centre maintenance (Wood, 1999b), and value-based maintenance management (Arazi *et al.,* 2009). All the strategies of building maintenance are developed from the three basic maintenance strategies (Chan *et al.,* 2001): preventive, corrective and condition-based maintenance strategies (Horner *et al.,* 1997; Lee & Scott 2009b).

1. Corrective maintenance strategy

Corrective maintenance is the simplest type of maintenance strategy, initiated when an element in a building is used until it breaks down (Horner *et al.,* 1997). Corrective maintenance is also referred to as failure-based or unplanned maintenance strategy and covers activities such as replacement or repair of an element (Horner *et al.,* 1997). Corrective maintenance is done to restore a building or its element to its original condition after the building or its element has failed; hence, maintenance is initiated *only* when the building has failed to perform its intended function due to factors like decay, deterioration, defect or any combination of these (Arazi *et al*., 2009). In this sense, corrective maintenance tasks often take places in an ad hoc manner in response to breakdowns or user requests.

Corrective maintenance strategy has several weaknesses: it can be very expensive because the failure of an item can cause consequential damages to other elements in the building (Horner *et al.,* 1997; Olanrewaju, 2010a). Moreover, failure or breakdown of an item or component can occur at a time which neither the user nor the maintaining authority are anticipating, making manpower and spare parts planning very difficult (Horner *et al.,* 1997). Additionally, due to inadequacy of resources or unavailability or unpreparedness to address the maintenance needs, corrective maintenance strategy may create a lot of maintenance backlog (Olanrewaju, 2010a). Olanrewaju (2010a) indicated that the activities carried out in a building could be disrupted by corrective maintenance. Consequently, the building users are left dissatisfied if a corrective maintenance strategy is solely adopted for maintaining building and its services (Arazi *et al.*, 2009; Olanrewaju, 2010a).

Corrective maintenance is nonetheless not without its importance because it forms part of an overall maintenance strategy that an institution could implement. It helps to gather vital predictive information (Horner *et al.,* 1997), information which then becomes important data for implementing a preventive maintenance strategy. Furthermore, since buildings are made up of several parts (Duffy, 1990; Brand, 1993; McGregor & Then, 1999; Lam, 2000) the use of a corrective maintenance strategy might be required for some building parts or components. It could also be a strategy for disposing of a building or its component.

2. Preventive maintenance strategy

Preventive maintenance strategy requires that tasks are performed in accordance with a predetermined plan at regular fixed intervals (Horner *et al.,* 1997). It embraces the performance of inspection and servicing tasks pre-planned for accomplishment at specific points in time to retain the functional capabilities of a building (Smith & Hinchcliffe, 2004). Preventive maintenance strategy is also referred to as time-based maintenance, planned maintenance, planned preventive maintenance or cyclic maintenance (Horner *et al.,* 1997).

A preventive maintenance strategy helps to prevent or mitigate the occurrence of failure, detect inception of failure and discover hidden failure (Smith and Hinchcliffe, 2004). According to Lavy and Bilbo (2009), preventive maintenance strategy offers substantial help by providing resourceful information about building facilities and the amount of work required. Preventive maintenance strategy, however, has one major drawback: it frequently promotes too early and unnecessary replacement of components (Spedding, 1987).

3. Condition-based maintenance

Condition-based maintenance is initiated as a result of some knowledge of the condition of the building on the basis of inspection prior to failure (Arazi *et al.*, 2009). Condition-based maintenance is based on condition surveys and assessments (Lam, 2000) and can vary from simple visual inspections to more advanced inspections using a variety of condition monitoring tools and techniques (Horner *et al.,* 1997). With this strategy, maintenance tasks are determined and planned by proficiently monitoring the building's elements such as walls, floors, and roof, and service equipment such as boilers, pumps and heating system, to identify which element or equipment requires maintenance prior to a major failure occurring (Horner *et al.,* 1997). In this case, as long as the physical parameters of the building were found to be within specification, it would be considered as "okay" and no maintenance action would be taken (Arazi *et al.,* 2009).

Condition-based maintenance strategy has several shortcomings, particularly because maintenance is initiated if the physical condition of the building is deteriorating or failing (Olanrewaju, 2010a). However, the physical condition of the building is a symptom and not necessarily the cause of defects; it is therefore important to consider the root causes, otherwise the wrong solution could be administered (Arazi *et al.*, 2009). Olanrewaju (2010a) highlighted that what could have been identified as a non-critical problem during inspection might turn up to be more serious during the actual implementation, particularly because of the reliability and validity problems with the outcomes of the condition survey. In addition, condition-based maintenance may pose other problems like inconsistency in data collection, unrealistic assumptions regarding data accuracy, software not being able to interrogate or manipulate data and over-emphasised detail that might not even be required (Chapman & Beck, 1998). The concept of condition-based maintenance strategy also seems to regard maintenance as a burden, thus limiting maintenance to the technological aspect of the process (Arazi *et al.,* 2009). Furthermore, because condition-based maintenance is usually based on a periodic scale, maintenance could be initiated even if there were no problems with the building or its elements (Olanrewaju, 2010a).

The decision to use a particular maintenance strategy depends on some important factors: health and safety, fitness for use, law, value and quality (Lee & Scott, 2009b). Other factors include the design of the building, purpose of the building, forms of construction, building services systems, and expectations and perceptions of the customers (Lee & Scott, 2009a). The allocation of maintenance resources also has a great influence (Lee & Scott, 2009b). Alner and Fellows (1990) were of the view that the main concern for the planning of maintenance strategy is to ensure that building and related services are in safe condition, fit for use and comply with the law and all statutory requirements.

It is imperative to understand that there is no umbrella maintenance strategy suitable for all types of buildings and building parts or services (Lee & Scott, 2009a). This is because different types of buildings, services and fittings require different types of maintenance strategies (Lee & Scott, 2009b). It is therefore possible to combine and adhere to several strategies of maintenance for a building and its services. The selection of the maintenance strategies is meant to extend the life cycle of buildings and its fittings and services (Lee & Scott, 2009b). Considering the investment universities make on the development and operations of their building facilities (Olanrewaju, 2010) and the influence that a lecture theatre has on the students, it is imperative to develop proactive strategies for managing these lecture theatres (Drouin *et al.,* 2000).

2.7 Effect of building maintenance on building performance

As reviewed already, buildings are very important assets procured to perform specific functions required by the building users. However, several factors can and do affect how buildings perform during their service life. Buildings begin to lose their value and performance and become obsolete as soon as the activities of building users are threatened by discomfort, ill-health or excessive cost (Leaman & Bordass, 1993). Buildings may lose their performance due to functional obsolescence, unfavourable cost balance, physical degradation, or a combination of these factors. Arazi *et al*. (2009) reported that decay, deterioration or defect, or their combination, could cause a building to fail to perform its intended function. Both nature and human activities can cause buildings to lose their performance (Arazi *et al.,* 2009). But maintenance can help to reduce or possibly even stop the impact (Douglas, 2006). There is a strong connection between building maintenance and building performance (Shohet & Lavy, 2004). Optimum building performance is what any maintenance process aims for (Olanrewaju *et al.*, 2011).

The importance of building maintenance has been reviewed already (Alner & Fellows, 1990; Arazi *et al*., 2009; Department of Treasury and Finance, 2005; Lee, 2001; Olanrewaju *et al*., 2011; Seeley, 1987). Olanrewaju *et al.* (2011) stated that the performance of buildings decreases unless maintenance is carried out. Definitely, buildings need maintenance to ensure best performance over their life cycle (Arazi *et al*., 2009). Olanrewaju *et al.* (2010) also stated that the value of buildings as asset fluctuates in accordance with the quality and quantity of maintenance invested in them. Olanrewaju *et al.* (2011) were likewise emphatic that the performance of buildings is related to the maintenance strategy adopted by an institution. The point was also made that the performance of a building is affected by the manner in which maintenance and repairs are carried out (Drouin *et al.,* 2000). In fact, maintenance management is progressively becoming a major tool for improving the functional performance of university buildings (Olanrewaju, 2010a). Certainly, building maintenance has a substantial effect on building performance.

2.8 Chapter summary

The literature revealed that lecture theatres are integral component of the learning environment and that the performance of lecture theatres does affect the learning experience of students. As such, the lecture theatre is regarded as a very important physical asset in every university. The importance of the performance parameters under consideration to the learning experience of students and total lecture theatre performance was also highlighted. The performance of the lecture theatre is dependent on the performance of the individual parameters, which is influenced by how maintenance is carried out. Even though building deterioration and obsolescence are inevitable and to be expected, effective and sufficient maintenance *can* help to control the rate at which buildings deteriorate and become obsolete.

The literature also revealed that building users – students – are satisfied with their buildings (e.g. lecture theatres) if the buildings meet their expectations and reflect their value system, but are unsatisfied if the buildings do not meet their expectations. One sure way of ensuring students' satisfaction of lecture theatres is to involve them in the maintenance management process. Although it is unlikely to have enough resources to execute all the maintenance needs in a lecture theatre, priority setting can help in ensuring that a tightly constraint budget is judiciously dispersed. IPA is an important tool used by organisations to determining user preference to develop priorities and improvement strategies.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction

The previous chapter provided a review of the theoretical and empirical literature on the importance-performance (satisfaction) analysis, the effect of building performance on students' learning experiences, the concept of building and building performance, the scope and value of building maintenance and maintenance management practices (prioritisation, strategies and user involvement). The impact of building maintenance on building performance was also reviewed. This chapter describes the research methodology adopted for obtaining and analysing the data to execute the research project.

The first section of the chapter provides a theoretical overview of the different research methods available to the researcher, hence providing the basis for formulating the research methods chosen for this study. The subsequent section discusses the specific methods used for collecting and analysing the data for this research study and the rationale behind their selection.

3.2 Research methodology

Research is a systematic process of collecting, analysing and interpreting data with the aim of increasing understanding of a phenomenon of interest or concern (Leedy & Ormrod, 2010). As research requires a methodological approach, the research methodology chosen is an important part of any research project, since it gives the overall framework for collecting and formulating the data needed for the research (Bell, 2005). Collis and Hussey (2003) stated that research methodology is typically concerned with the following:

- why certain data was collected;
- what data was collected;
- from where the data was collected;
- when the data was collected;
- how the data was collected; and
- how the data will be analysed.

Clearly, the research methodology has a relationship with data collection. Leedy and Ormrod (2010) elaborated that data and methodology are interdependent; as such, a correlation needs to be established between the research methodology and the nature of the data that will be collected in resolving a research problem. Leedy and Ormrod (2010) further explained that there are four basic but principal questions concerning data whose answers brings the research planning and design into clear focus:

- "What data is needed?"
- "Where is the data located?"
- "How will the data be obtained?"
- "How will the data be interpreted?"

3.3 Research design

The main strategies to research are the quantitative, qualitative or a combination of the two methods (Struwig & Stead, 2001). The appropriate design is determined by the research problem and the aim and objectives of the research. The three designs are discussed below.

3.3.1 Quantitative research

Quantitative research strategy, also known as the traditional, experimental or positivist approach (Leedy & Ormrod, 2010) uses numerical data systematically and objectively from only a selected subgroup of a universe to generalise the findings (Maree & Pieterson 2007). According to Gomm (2008), a quantitative research approach counts things, analyses data statistically and quotes its results in numerical forms. The most important elements of quantitative research approach, according to Maree and Pieterson (2007) are as follows:

- objectivity
- numeric data, and
- generalisability.

Quantitative research strategy primarily tests hypotheses (Struwig & Stead, 2001). In other words, quantitative studies usually start with a statement of hypothesis to be tested and ends with a confirmation or disconfirmation of the hypothesis after being tested (Leedy & Ormrod, 2005). There are several methods for conducting quantitative research including exploratory, experimental studies, descriptive studies (case study, statistical method), and quasi-experimental studies (Struwig & Stead, 2001).

3.3.2 Qualitative research

Hennink, Hutter and Bailey (2011) expressed that qualitative research is broad and covers a wide range of techniques and philosophies. According to Leedy and Ormrod (2010), qualitative research involves looking at characteristics or qualities that cannot easily be reduced to numerical values. Qualitative research focuses on describing and understanding complex and particular phenomenon within their natural occurring context with the intent of developing an understanding of the meaning imparted by the respondents (Leedy & Ormrod, 2010; Nieuwenhuis, 2007). Nieuwenhuis (2007) further added that the emphasis of qualitative research approach is on the quality and depth of information and not on the scope of information provided.

Qualitative research strategy is also known as interpretive, constructivist, or post-positivist approach (Leedy & Ormrod, 2010). Several research strategies such as case study, ethnography, phenomenological study, grounded theory study and content analysis are used in qualitative research (Leedy & Ormrod, 2010). Nieuwenhuis (2007) also identified conceptual study, historical research and action research apart from the grounded theory study, ethnography and case study listed by Leedy and Ormrod (2010). Leedy and Ormrod (2010) argued that qualitative research is often exploratory in nature, and observations may be used to build theories. Qualitative study generally ends with tentative answers or hypotheses about what was observed or studied (Leedy & Ormrod, 2005).

3.3.3 Mixed methods research

Mixed research method is the strategy of research that combines alternative approaches (i.e. using both qualitative and quantitative methods) in a single research project (Denscombe, 2007). Hennink *et al.* (2011), however, pointed out that the mixed method approach is very broad and combines several research methods either across paradigms (e.g. qualitative and quantitative) or within paradigms (e.g. mixed qualitative methods). The decision to use a mixed method approach should be based on the research problem or question, the purpose and objectives of the research as well as the skills of the researcher (Hennink *et al.*, 2011; Leedy & Ormrod, 2010). In fact, research studies could be enhanced by a mixed method approach; however, the effectiveness of the strategy depends on effective combination of the methods which requires time, expertise and resources (Leedy & Ormrod, 2010).

The mixed method strategy of research is characterised by the following:

- The use of qualitative and quantitative methods within a single research project;
- The explicit focus on the link between approaches (triangulation; viewing things from more than one perspective); and
- The emphasis on practical approaches to research problems (Denscombe, 2007).

3.4 Research approach

Several research approaches for both qualitative, quantitative and mixed methods including case study, ethnography, phenomenological study, grounded theory study, content analysis conceptual study, historical research, and action research as well as exploratory, experimental studies, quasi-experimental studies and descriptive studies (case study, statistical method) have been reviewed by Denscombe (2007), Hennink *et al.* (2011), Leedy and Ormrod (2010), Nieuwenhuis (2007), Struwig and Stead (2001) and Thomas (2011).

3.5 Chosen Research Methodology for the Study

3.5.1 Research design for this study

A mixed research design was adopted to achieve the aim and objectives of this study; however, the approach to the study was more quantitative. The point is made that a mixed method approach can enhance research studies (Leedy & Ormrod, 2010). The mixed research design was selected because of the nature of the study, considering that the study is meant to determine the importance-satisfaction relationship of the building performance parameters that are critical to a lecture theatre's performance and to use the result to develop a maintenance prioritisation system and strategies for maintaining the lecture theatres.

The qualitative method was utilised to explore the maintenance system (user involvement, priorities and strategies) of the university, whereas the quantitative methods was used to collect data from the students, which helped to achieve the ranking of the performance parameters (features) of the lecture theatres based on their level of importance, determine how satisfied the students are with these performance parameters and also to construct the IPA model. Quantitative means of data collection was adopted for this purpose since it focuses on the systematic use of numerical data from a selected subgroup of a universe to generalise the findings (Maree & Pieterson 2007).

A preliminary exploratory study was conducted to gain more insight into the problem and to focus the problem statement. Struwig and Stead (2001) opined that the major purpose of exploratory research is the development and clarification of ideas and the formulation of questions and hypotheses for more precise investigation later. The major data collection technique used for the exploratory study was the questionnaire and the data was analysed by the content analysis technique. The findings of the study provided the basis for the research design of the main study and the formulation of the objectives.

3.5.2 Approach for this study

There are various approaches used to conduct research. The approach chosen for research depends on the nature of the information required and other circumstances pertaining to the topic and the area of study. Considering the nature of the study and the information required in relation to the setting of the institution that is studied, a case study approach was adopted.

The case study approach is not a method but a wrapper for different methods (Thomas, 2011). Case study utilises both qualitative and quantitative data gathering techniques, hence the gathered information includes both qualitative and quantitative data (Nieuwenhuis, 2007). Case study is the holistic study and analysis of persons, events, decisions, periods, projects, policies, institutions or other systems by one or more methods (Thomas, 2011). Hence it helps in studying a social phenomenon through a thorough analysis of an individual case: a person, group, episode, society or any other unit of social life (Kumar, 2005). Leedy and Ormrod (2010) explained that a case study is adopted for studying a particular individual, programme, or event in-depth for a defined period of time. The key is that a case study concentrates on the particular (i.e. one thing) in detail rather than the general (Thomas, 2011). With a case study approach, a unit is selected after which the researcher specifies and defines it and makes a case out of it for the purpose of the study (Khan, 2008). Leedy and Ormrod (2010) added that details including information about the physical environment, historical, economic and social factors that can influence the situation are also recorded when conducting a case study.

A major weakness of the case study approach is the difficulty of generalising the findings from the particular case studied to other cases, especially when only a single case is analysed (Khan, 2008; Leedy & Ormrod, 2010; Nieuwenhuis, 2007). However, a case study offers a multi-perspective analysis of a situation by making use of multiple sources and techniques in the data collection process, helping researchers to acquire a deeper understanding of the dynamics of a situation (Nieuwenhuis, 2007). Various data collection methods including interview, questionnaire survey, observations, document review, past records, audio visual materials and experimentation can be used for a case study (Leedy & Ormrod, 2010).

Interviews, questionnaire and observation were adopted to collect data for the cases to be studied in this research study. There are four universities in the Western Cape Province of South Africa; however, one institution in particular (i.e. CPUT Bellville campus) was selected and three lecture theatres were chosen as different cases for the study. The three cases selected for the study were as follows: LT2 in the Mechanical building (new building); ABC lecture theatre in the ABC building (intermediate building) and LT2 in the Business building (old building).

3.5.3 Sampling method for this study

A population is the set of people or collection of items under consideration in a research study (Collis & Hussey, 2003). The population for this study is quite large; therefore sampling was used to select the respondents for the study. Sampling, according to Kumar (2005), is the process of selecting a few from a bigger group to become the basis of estimating the prevalence of an unknown piece of information or outcome regarding the bigger group. When conducting sampling, it is necessary to obtain data from only a portion of the total population with which the research study is concerned (Fellows & Liu, 2008). The determination of the size of the sample to be studied is a vital aspect of sampling (Fellows & Liu, 2008). The sample size, according to Leedy (1997), is dependent on the degree to which the sample population approximates the qualities and characteristics of the general population.

Purposive sampling method was used to select the lecture theatres; in purposive sampling, the researcher chooses people or other units for a particular purpose (Leedy & Ormrod, 2010). Three lecture theatres at CPUT Bellville campus were selected. The selection was done purposively to include one old, one intermediate and one new lecture theatre with the intention of ensuring that all the different classes of lecture theatres were represented.

The quota and convenience sampling methods were used for the questionnaire survey. Struwig and Stead (2001) pointed out that when quota sampling is used; the sample is selected based on certain basic parameters or characteristics such as sex, age, income and socio-economic status that depict the character of the population. Only the size of each category within the sample is regulated but the selection of the sample is non-random and usually convenient (Leedy & Ormrod, 2005). Convenience sampling, also known as accidental sampling, is a type of sampling based on availability and/or convenience of people or other units; however, no attempt is made to identify a representative subset of a population (Leedy & Ormrod, 2005). Quotas were allocated for each lecture theatre after which the questionnaires were distributed to students by the convenience sampling methods. Ninety five questionnaires were issued to students of LT2 in the Mechanical building (New Lecture Theatre). Two hundred and sixty questionnaires were issued to students of the ABC building (Intermediate Lecture Theatre). Seventy five questionnaires were issued to students of LT2 in the Business building (Old Lecture Theatre).

3.5.4 Data collection techniques for this study

The data collected for a research project consist mainly of two types: primary data and secondary data (Struwig & Stead, 2001). Both secondary and primary data collection techniques are used in this research study.

1. ***Secondary data***

The secondary data (mainly literature review) provided an overview of what has been studied and previously concluded. Melville and Goddard (1996) identified two distinct literature studies: preliminary and a full literature review. A preliminary literature was reviewed to develop the framework of the study in Chapter One. The full literature review is shown in Chapter Two, an extensive literature review conducted to develop a coherent and comprehensive view of the relevant topics for the research study. The importance-performance (satisfaction) analysis, the effect of building performance on students' learning experiences, the concept of building and building performance, the scope and value of building maintenance, maintenance management practices (prioritisation, strategies and user involvement) and the impact of building maintenance on building performance were all reviewed. The sources of information for compiling the literature included textbooks, journals, articles, conference proceedings, dissertations and theses.

2. ***Primary data***

Primary data was gathered by means of an empirical study. A triangulation data collection technique was employed for this research study: data was collected not only from the maintenance and infrastructure managers but also from the students and through observations. Maxwell (2005:112) opined that triangulation "reduces the risk of chance associations and of systematic biases due to a specific method". Thomas (2011) added that triangulation collates different methods of data collection techniques and helps to view a problem from several points rather than only one point. Interviews, questionnaires and observations were used to collect the primary data for this study.

***Interview*:** Interviews for qualitative study are open-ended and semi-structured (Leedy & Ormrod, 2010). A semi-structured interview was used to allow the interviewer to probe the views and ideas of the interviewees. It also ensured that defined answers were obtained from defined questions, while allowing for the further development of the answers provided. Nieuwenhuis (2007) affirmed that a semi-structured interview indeed allows for probing and clarifying answers.

The respondents were first informed about the focus of the interview prior to the meeting, allowing them to adequately prepare for the interview in advance. The interview was not tape-recorded; rather, the interviewer recorded the responses of the questions with a pencil and paper.

The respondents were the infrastructure and maintenance managers of CPUT. They were interviewed to provide information on the maintenance strategies that are adopted in the institution and how they are combined, how the maintenance needs are prioritised, and how students are involved in the maintenance management process of the lecture theatres.

Observations**:** Observation is often combined with other methods to provide complementary data which helps to understand issues from different perspectives (Hennink *et al.*, 2011) and helps to gain a deeper insight of what is being studied (Nieuwenhuis, 2007). The researcher observed the conditions and features of the lecture theatres selected for the study; this helped to gain a deeper insight of what was being studied and complemented the discussions and proposals that were offered.

Questionnaire**:** Questionnaire is the main technique used for quantitative studies and can be utilised in mixed research method. A combination of open and closed-ended questions was used for the study. Closed-ended questions (5-point Likert scale) were used to restrict respondents to select answers that have been generated in advance by the researcher (Denscombe, 2007). The open-ended questions enabled respondents to elaborate answers based on their opinions and experience. The questions for the survey were formulated based on the research aim and objectives and the information gathered during the literature review. The structure of the questionnaire is shown below.

Table 3.1: Questionnaire design

Section	**Section Title**	**Objectives to be addressed**
A	Building performance of lecture theatre	Objective 2, 3 and 6
B	Satisfaction level of the lecture theatre performance	Objective 4, 5 and 6
C	Student’s involvement in the maintenance of lecture theatres	Objective 7

3.5.5 Data Analysis for this study

Data analysis consists of examining, testing, tabulating, categorising or examining evidence to address the initial preposition of a study (Yin, 2003). Techniques including pattern matching, explanation building, time-series analysis, logic models and cross-case synthesis can be used for analysing a case study (Yin, 2003). Statistical analysis (i.e. the use SPSS) is one very useful technique for analysing both qualitative and quantitative data.

1. ***Descriptive statistics***

Struwig and Stead (2001) stated that descriptive statistics provide statistical summaries of data. This is the simplest method of analysing data which provides a general overview of the result (Naoum, 2003) and provides an overall, coherent and straightforward picture of a large amount of data. Frequency distribution, measurement of central tendency and measurement of dispersion are three formal terms which are frequently used in descriptive statistics (Naoum, 2003; Leedy & Ormrod, 2005). Descriptive statistics used in this study are frequency distribution and measurement of central tendency (mean and standard deviation).

2. ***Inferential statistics***

Inferential statistics use samples of observations to infer observations probably found in a population. This assists in generalising the findings from the sample to the larger population. Inferential statistics includes statistics such as parametric and non-parametric (Struwig & Stead, 2001). Inferential statistics used are t-test and one way ANOVA test.

Both descriptive statistics (frequency distribution and measurement of central tendency) and inferential statistics (t-test and one way ANOVA test) are used to analyse the data of this study. A word processor was used in recording the data gathered from interview and observation, and SPSS was used to analyse the questionnaires. However, content analysis was used to analyse the explorative study and the interview.

3.6 Validity and reliability of the data

Validity and reliability take different forms depending on the nature of the research problem, the general methodology that will be used to address the problem and the nature of the data that is collected (Leedy & Ormrod, 2010). Silverman (2001) pointed out that validity and reliability are important because they determine the objectivity and credibility of any research. Yin (2003) opined that four tests—construct validity, internal validity, external validity and reliability—are relevant to case study.

3.6.1 Reliability

Leedy and Ormrod (2010) defined reliability as the consistency with which a measuring instrument yields a certain result when what is being measured has not changed. Kumar

(2010) pointed out that reliability will be high if the measuring instruments used are consistent and stable. The issue of reliability translate from ''would the research instrument produce the same result when used by different researchers (all other things being equal)?" to "if someone else did the research would he or she get the same result and arrived at the same conclusions?" (Denscombe, 2007:298). The goal of reliability is to minimise the errors and biases in a research study (Yin, 2003). Gomm (2008) suggested that internal consistency can be tested by the use of statistical tests like Kuder-Richardson formula 20(KR-20) or Conchbach's co-efficient alpha, split half techniques or factor analysis. To ensure reliability of this study, the Likert-scaled question was tested with the Conchbach's co-efficient alpha. The closer the coefficient is to 1, the more reliable the instrument item; an optimal Conchbach's co-efficient alpha value should be above 0.7. Also, documentation of the methods and procedures followed in this study to arrive at the conclusions is provided.

3.6.2 Validity

Research validity refers to the correctness or credibility of the research findings (Maxwell, 1996). In other words, it relates to the extent to which the instrument measures what it is supposed to measure (Leedy & Ormrod, 2010). Denscombe (2007) pointed out that validity could be addressed by the use of triangulation, respondent validation and grounded data. Construct validity, internal validity and external validity are important element of validity (Yin, 2003). For this study triangulation is used to collect data. To ensure respondent validation, the interview was transcribed. The data was then given to the respondent to check and resolve any discrepancies that may have arisen, eliminating interviewer misunderstanding or bias. Also, questionnaires were tested for content validity by first issuing them out for piloting.

3.7 Procedure for achieving the objectives of this study

The aim of the study is divided into seven specific objectives. The method to be used to collect data and the form of data needed for each sub objective is discussed below.

Objective 1

To investigate the maintenance management systems (students' involvement, prioritisation system and strategies) adopted by university maintenance departments for maintaining the lecture theatres

- The primary source of information for this objective was the maintenance and infrastructure managers; observation was also valuable.

- The data from the maintenance manager was collected by means of an interview. A semi-structured interview was deemed appropriate as it allows for clarification and interaction.

Objective 2

To assess the effect of lecture theatres performance on the learning experience of students.

- The first part of the questionnaire (closed-ended) helped to achieve this objective.
- Discussion was made in relation to the literature review.

Objective 3

To determine the level of importance students attach to each specified building performance parameter and the overall performance of the lecture theatre.

- This objective was achieved with the section 'A' part of the questionnaire (closed-ended in nature).
- The section aided the ranking of the building performance parameters based on their level of importance from the perspective of the students.
- The data gathered from this objective also aided the development of the IPA.

Objective 4

To determine how well the expectations of students are met in relation to each specified building performance parameter.

- Data gathered from this objective helped to establish a (dis)confirmation of the satisfaction of students and thus influenced the development of the improvement and prioritisation strategies.

Objective 5

To determine how satisfied the students are with each specified building performance parameter and the overall performance of the lecture theatre.

- The section 'B' part of the questionnaire, closed-ended, helped in achieving this objective.
- That segment of the questionnaire collected information on the satisfaction level of students with the specified building performance parameters and the overall performance of the lecture theatres.
- The data gathered from this objective also aided the development of IPA.

Objective 6

To develop prioritisation and improvement strategies to guide the maintenance of the performance parameters of the lecture theatres.

- Importance-satisfaction model was constructed based on the data obtained from the questionnaire survey (importance and satisfaction section).
- Four specific quadrants were generated as the importance and satisfaction data were plotted on the two-dimensional grid.
- The IPA model, observations, as well as the literature review established the basis of discussion and guided the development of the improvement and prioritisation strategies to be adopted for maintaining the performance parameters of the lecture theatres.

Objective 7

To analyse the extent to which students are involved in the maintenance management process of the lecture theatres.

- Section 'C' of the questionnaire helped to ascertain the extent to which the students are involved in the maintenance of the lecture theatres. Both open and closed-ended questions were used for this purpose.
- The first part helped to determine whether students were involved in the maintenance of the lecture theatres. The second part of the questionnaire, a close-ended type, provided a list of feedback options which respondents ranked, while the third section, open-ended, solicited ideas from the respondents about ways to ensuring their involvement in the maintenance of the lecture theatres.

3.8 Chapter summary

This chapter provided an overview of the research methodology adopted for this study. A mixed research design (i.e. a combination of both qualitative and quantitative) but biased somewhat towards quantitative was used to achieve the aim and objectives of this study. The approach was a 'case study'. Observations, interviews and questionnaires were used to collect the primary data for the study. How the aim and objectives of the study were achieved as well as the data analysis techniques were also discussed.

CHAPTER FOUR
ANALYSIS OF EXPLORATORY STUDY

4.1 Introduction

This chapter presents the analysis and discussions of the data gathered at the initial stage of the study. This was an exploratory study aimed at gaining meaningful insight into the maintenance strategies of universities in the Western Cape Province of SA. Particular consideration was given to prioritisation strategies, maintenance strategies and students' involvement strategies. The exploratory study identified a common problem faced by the maintenance department of universities and thus aided in the formulation of the research question and objectives for the study.

4.2 Methodology used for the exploratory study

The exploratory study was carried out with an open-ended questionnaire. The questionnaires were sent via electronic mail to all four universities in the Western Cape Province of SA. The respondents were the maintenance managers of the universities. Prior to the survey, the maintenance managers were contacted by phone and informed about the purpose of the survey. One university did not respond to the questionnaire. The results, therefore, reflect three out of the four universities in the Western Cape Province who participated in the study.

4.3 Findings and discussions

4.3.1 Prioritisation of maintenance

The respondents admitted that prioritising maintenance at strategic level is very important since it provides a direction that guides maintenance and helps to update management with costs to maintain facilities. Two of the respondents, however, pointed out that not very much attention is given to building maintenance at that level.

4.3.2 Maintenance strategy

All the respondents indicated that their institutions use integrated maintenance strategies: planned; unplanned; and condition-based which they all believe is the best strategy. But the ideal combination according to one manager has not yet been reached. Two respondents also pointed out that reduction was occasionally made to the maintenance budget which affected the planned maintenance programme and strategies of the institution.

With regards to maintenance task execution strategies, all the respondents indicated that their institutions use both in-house technical expertise and outsourced contractors for executing maintenance needs. According to the respondents of all the universities, an integrated approach is best for universities since universities may not have the expertise for all kinds of work. One of the respondents added that the integrated approach also helps the university to take control over the maintenance of its facilities as control is lost when the entire service is outsourced.

4.3.3 Feedback system (students' involvement strategies)

All the respondents were positive about the importance of a feedback and user involvement system, explaining that there is a feedback system at their institution. However, only one respondent clearly stated that a liaison meeting with faculties were held for feedback or to get input from building users.

4.3.4 Impact of building performance on students

All the respondents acknowledged that the performance of inadequate and poor quality building facilities does impact on the students' learning experiences. One respondent further added that the performance of building facilities also affects the image of the university and influences the quality of students who enrol in the university. Another respondent was of the view that setting policies and strategies can help to mitigate problems of maintenance management. All the respondents agreed that research into the building performance level in relation to teaching and learning experience is important and will most definitely add value to the university community.

4.4. Conclusion

The findings presented in the exploratory study indicate that little attention is given to building maintenance at management level resulting in under-resourcing of building maintenance activities. Apart from under-resourcing, reduction is occasionally made to the maintenance budget, severely affecting the maintenance strategies of the institutions. Also, user involvement strategies are unclear. However, all the respondents acknowledged that the performance of building facilities does impact on the students' learning experiences and as such, a study of this nature will add value to the university community.

CHAPTER FIVE
DATA ANALYSIS AND DISCUSSION

5.1 Introduction

This chapter presents the analysis and discussions of the data gathered. The chapter presents the description of cases, observations and the interview findings. The pilot questionnaire, response rate of the questionnaire survey and the responses of each question on the questionnaire are also presented in this chapter. Discussions are based on the objectives of the study enumerated in Chapter One and the related reviewed literature.

5.2 Description of cases
5.2.1 LT2 Mechanical building

LT2 in the Mechanical building (LT2MB), representing the new lecture theatre, has a total floor area of $121m^2$ and a capacity of 173 seats. Construction of the lecture theatre began in 2009 and was completed in 2010; it is built with bricks, plastered and painted white and purple on ceiling and walls respectively; the floor is finished with carpet tiles. The lecture theatre is used by the Mechanical and Industrial Engineering first year students; hence the questionnaires were distributed to include students from those two departments.

5.2.2 ABC Lecture Theatre

ABC lecture theatre in the ABC building (ABCLT), representing the intermediate lecture theatre, has a capacity of 232 seats and a total floor area of $297m^2$. Built in 1995 with bricks, plastered and painted (both internally and externally), the floor finished with carpet, this lecture theatre is used by the first and third year Civil Engineering students; questionnaires were therefore distributed to the first and third years.

5.2.3 LT2 Business building

LT2 in the Business building (LT2BB), representing the old lecture theatre, was built in 1986 with bricks, plastered and painted white inside and with the floor finished with carpet. The total internal floor area is $145m^{2,}$ with a capacity of 104 seats. The questionnaires were distributed to the first year students of the Department of Built Environment; distribution was made to the first years because they are the group that exclusively use this lecture theatre.

5.3 Observation of lecture theatres

Observations of the conditions of the parameters of the lecture theatres were made to complement the data provided by the students and the maintenance and facility managers. It also helped to develop understanding of issues from a different perspective and to gain a deeper insight of what is being studied. Observations were carried out on three different dates: Thursday 7 June, Wednesday 25 July, and Thursday 20 September 2012. Some students and lecturers were interviewed informally during these observation periods. The results of the observations are presented below.

5.3.1 LT2 Mechanical building

The LT2MB is built with bricks, plastered and painted both purple and white, with a capacity of 173 seats. The lecture theatre appears very stable structurally and has no cracks. It has three double exit doors (two in front which are clearly indicated by illuminated EXIT sign at the top and one at the rear without illuminated EXIT sign), but no illumination markings on the floor leading towards the doors. There are two fire extinguishers and one fire hose reel located outside the entrance of the lecture theatre. There is also a fire detector, fire sprinklers and fire alarm system in the lecture theatre.

The lecture theatre has no windows but has an installed HVAC system which is controlled by a central plant. Though the HVAC system can be regulated inside the lecture theatre, it does not usually produce the desired temperature since it is powered centrally. The theatre is designed to absorb sound; acoustic panelling (scantling boards) is fixed at the back of the lecture theatre. The theatre is also equipped with a Public Address (PA) system consisting of an amplifier, microphone and speakers, which is functioning but not usually used during lectures.

The lighting in the lecture theatre is adequate: all the florescent and board lights are functioning. However the design of the lecture theatre does not allow daylight into the room. The lecture theatre is usually neat and clean (the theatre was always neat and clean during the observations). The floor is finished with carpet tiles; the walls and ceiling are painted purple and white respectively, and the rear is covered with scantling boards which add to the beauty of lecture theatre. The lecture theatre is well-manicured although there are no exceptionally attractive features.

5.3.2 ABC Lecture Theatre

The ABCLT has a capacity of 232 seats. Built with bricks, plastered and painted inside and out, the lecture theatre appears structurally stable and has no cracks. It has four exit double doors which are clearly indicated by EXIT signs (two in front and two at the rear); however the rear doors are usually locked during lectures (they were locked on the days of observations). No illumination markings on the floor lead towards the doors. There are two fire extinguishers inside the lecture theatre, both in the front, and one outside the lecture theatre which is at the back. There are also fire sprinklers but there is no fire alarm in the lecture theatre.

The lecture theatre has no windows, but it is equipped with an HVAC system controlled by a central plant. Though the HVAC system can be regulated in a control room, it does not usually produce the desired temperature since it is powered centrally; the temperature produced by the HVAC system is usually either too cold or too hot. The theatre is designed to absorb and transmit sound: the sides are fixed with sound-absorbing boards, the rear of the theatre is rounded and covered with a carpet to absorb sound and the front has sloping white panels that spread sound. The theatre is also installed with a PA system consisting of a microphone, speakers and an amplifier which is functioning but, as with the previous theatre, barely used.

The lighting is adequate: all the florescent and board lights are functioning. However, the design of the theatre does not allow daylight into the room. The theatre is considerably clean, the floor is nicely carpeted, the walls and ceiling are painted light cream and white respectively, and the rear is rounded and carpeted. Although there are no special features in the lecture theatre, the rounded rear and shape of the front create a pleasant appearance.

5.3.3 LT2 Business building

The LT2BB is built with bricks, plastered and painted inside and outside and has a capacity of 104 seats. The lecture theatre looks structurally stable and has no major cracks. It has three exit double doors but the EXIT signs above the doors are not illuminated (two at the back and one by the side close to the front); however, the door at the side is usually locked even during lectures (it was locked on the days of observations). There are also no illumination markings on the floor leading towards the doors. There are no fire extinguishers, no fire detector and no fire alarm, but fire sprinklers are installed.

The lecture theatre has no windows but is equipped with an HVAC system. The HVAC system was not functioning on the first and second days of observation; however, it was functioning during the last day of observation. As with the other theatres, the HVAC system could not be regulated from the lecture theatre as it is centrally controlled. The lecture theatre is designed to absorb sound: the sides and rear are fixed with sound absorbing boards (acoustic panels) and the front has sloping white panels that spread sound. The theatre is also installed with a PA system but it was not functioning during the days of observation.

The florescent and board lights were all functioning during the first day of observation; however, it was observed that a number of the florescent lights were off during the last day of observation. The design of the theatre does not allow daylight into the room. The theatre was fairly clean during the observations. The walls and ceiling, painted white, were repainted later in June (that was observed on the second day of observation). Even though the floor was nicely carpeted, there are no special attractive features in the lecture theatre.

5.4 Interview

The infrastructure and maintenance managers of the institution were each interviewed on different days. A semi-structured interview was used to allow the interviewer to probe the views of the interviewees ensuring that clearly defined answers were obtained from the questions while allowing for the further elaboration of the answers provided. The interview focused on maintenance prioritisation policies, maintenance strategies and students' involvement strategies. The respondents were first informed about the focus of the interview prior to the meeting so as to allow them adequate preparation time for the interview in advance. The interview was not tape-recorded; the interviewer recorded the responses of the questions with a pencil and paper since the information required was minimal. After the interviewer finished transcribing the data of the interview, the transcribed data was then sent to the interviewees for verification via electronic mail; after verification, the interviewees were required to return the data by the same means.

5.4.1 Interview with maintenance manager

An appointment was booked with the maintenance manager telephonically and discussions for the interview were made. The interviewer then sent the questionnaire to the maintenance manager on 21 June 2012 to allow him to prepare adequately for the interview in advance. A date for the interview was established telephonically. The interview was conducted on 7 August 2012 between the hours of 13:00 and 14:00 at the interviewee's office. The interviewer transcribed the data and sent it via email for verification on 14 August 2012. The maintenance manager offered minor input and emailed it back to the interviewer on 15 August 2012.

The interview revealed that the CPUT maintenance department does not currently have a maintenance prioritisation policy or system that guides the maintenance of the lecture theatres. According to the manager, prioritisations of maintenance is presently based on the principle of FIFO (first in first out), the severity or urgency of the maintenance need and the impact the required maintenance task may have on the building users. The maintenance manager and foremen are responsible for ensuring that jobs are attended to. In the instance of budget constraints, the maintenance manager stated that maintenance needs relating to safety (structural and fire safety & exit) will be attended to first, followed by ventilation, lighting and temperature respectively, cleanliness, and sound and aesthetics will then follow in that diminishing order of priority.

The maintenance manager indicated that the CPUT maintenance department has a maintenance plan in place but the plan is a general plan for all the facilities at CPUT and not specific to lecture theatres. The department does not have a specific programme for inspections but relies mainly on building users. Although there is no comprehensive strategy, the department uses an integrated maintenance strategy (planned, reactive and condition-based). The HVAC systems in the lecture theatres are operated from a central plant which, according to the maintenance manager, understandably needs to be upgraded. The strategy used for the HVAC systems is condition-based; the HVAC system is serviced on a regular basis as per the original equipment manufacturer (OEM) specifications and lubrication schedules. With reference to lighting, the strategies used are condition monitoring and reliance on users to report those lights that are out. Regarding aesthetics, the manager pointed out that, painting schedules are not formalised but generally painting is done after at least five years; however, they rely on the users to report issues relating to floors and ceilings. He further pointed out that cleaning was done on a daily basis; planned strategy was used. However, no documentation confirming this was provided.

The maintenance manager noted that a computer is used to keep records of maintenance work done. The maintenance department follows up on the status of jobs by finding out if the job cards have been closed out or not. If not closed out, then the reasons are spelt out by the respective person allocated the job. The manager also highlighted that problems including: limited personnel, constant reduction of the maintenance budget, tedious and time-consuming procurement processes and the absence of a computerised maintenance management system affects the strategies of the maintenance department. The limited personnel results in the heavy reliance on external personnel.

The maintenance manager pointed out that the maintenance department does not deal with the students directly, but rather the student affairs department does. He indicated that there is no formal user involvement system currently in place. However, according to him, the requisition made from the academic departments could be one way by which the students are involved in the maintenance of the lecture theatres.

5.4.2 Interview with infrastructure manager

A discussion for the interview was made via emails and an appointment date for the interview was set. The interviewer then sent the questionnaire on 14 August 2012 to allow the interviewee to adequately prepare for the interview. The interview was conducted on 15 August 2012 between the hours of 11:00 and 12:00 at the interviewee’s office; the interviewer transcribed the data and sent it via email for verification on 26 September 2012.

The interview revealed that the maintenance department of CPUT does not currently have an official maintenance prioritisation policy or a system that guides the maintenance of the lecture theatres. However, the maintenance department has guidelines for the prioritisations of maintenance needs. In the instance of budget constraints, the infrastructure manager stated that structural safety will be attended to first, second will be fire & exit safety, third will be lighting, fourth will be ventilation, fifth will be cleanliness, sixth will be temperature, and then sound and aesthetics will then follow in diminishing order. He pointed out that cleaning relates to health and therefore requires similar attention as health and safety items.

He further stated that the CPUT maintenance department does not have a comprehensive strategy for maintaining the lecture theatres. Although there is no comprehensive strategy, the department uses an integrated maintenance strategy (planned, reactive and condition-based). He explained that the department utilises the following strategies:

- both planned and reactive strategy for the HVAC systems (a contractor services the HVAC system regularly);
- a planned strategy for cleaning service (occurring every day);
- both planned and reactive strategy for aesthetics; and
- a reactive approach for lighting.

It was also revealed that the CPUT maintenance department does not have a prescribed user involvement system. However, the infrastructure manager indicated that meetings are organised with the SRC; hence students get involved in the maintenance of the lecture theatre through the SRC. The main problem identified by the infrastructure manager is the issue of contractors making claims for money even when there is no evidence of work done.

5.5 Questionnaire survey

5.5.1 Pilot questionnaire

The questionnaire was piloted prior to the actual study to authenticate its appropriateness. Twenty questionnaires were distributed among a group of first, second and third year students at CPUT. The response rate was 100%. A few changes were made on the final questionnaire due to the difficulties students faced with some of the questions on the questionnaire.

5.5.2 Response rate of questionnaire

A total number of 430 questionnaires were distributed to three different lecture theatre users (group of students) at CPUT, out of which 283, representing a response rate of 65.8%, were duly completed and returned. The distribution to the different lecture theatres was as follows:

- 95 questionnaires were issued to students of LT2MB (New Lecture Theatre); 84, representing a response rate of 88.4%, were duly completed and returned.
- 260 questionnaires were issued to students of ABCLT (Intermediate Lecture Theatre); 131, representing a response rate of 50.4%, were duly completed and returned. ABCLT is the biggest lecture theatre among those used for the study hence more questionnaires issued in that respect.
- 75 questionnaires were issued to students of LT2BB (Old Lecture Theatre); 68, representing a response rate of 90.7%, were duly completed and returned.

5.6 Effect of lecture theatres' performance on learning experience

Table 5.1 and Figure 5.1 show that 174 of the total respondents (representing 62.1%) responded 'Yes', 85 (representing 30.4%) responded 'No', while 21 (representing 7.5%) responded 'Don't know' to the question 'Does the condition of lecture theatres affect your learning experience?'. The response within each lecture theatre was quite different. For LT2MB the difference between the two opposite responses was very close, 39 (representing 47.6%) responded 'Yes', while 37 (representing 45.1%) responded 'No'. LT2MB is a new theatre; students were likely influenced by the more pristine state of the lecture theatre. In the case of ABCLT, 85 (representing 64.9%) of the respondents responded 'Yes', while 38 (representing 29%) responded 'No'. LT2BB had the most positive response; 50 (representing 74.6%) responded 'Yes', while 10 (representing 14.9%) responded 'No'. The trend of the response reveals that, the older the lecture theatre the greater students feel its impact on their learning experience. However, the general trend and consensus is conclusive that the performance of a lecture theatre does indeed affect learning experience.

The participants of the survey from all the lecture theatres responded affirmatively and in accordance with the literature that the performance of lecture theatres affects learning experience (Table 5.1 and Figure 5.1). In fact, the literature revealed that lecture theatres are an integral part of the physical learning environment, playing a prominent role in creating and sustaining a productive learning climate (Mat *et al.*, 2009; Uline *et al.*, 2010). Hence the physical setting in which learning occur impacts on the whole learning process, the well-being of the students and their comfort and productivity (Lackney, 1999a; Olanrewaju, 2010b). The findings of the survey are also supported by the studies of Amaratunga and Baldry, 2000; Bishop, 2009; Earthman and Lemasters, 1996; Green and Turrell, 2005; Lavy and Bilbo, 2009; Leung and Fung, 2005; Price *et al*, 2003; Uline and Tschannen-Moran 2008; Uline, Tschannen-Moran and Wolsey, 2009 and Uline *et al*., 2010 who revealed that the condition of buildings (e.g. lecture theatres) does have an impact on the learning experience of students. Certainly, students are affected by the performance of lecture theatres. Because of this, it is incumbent on a university to provide a positive and stimulating lecture theatre to enhance the whole learning process of its students.

Table 5.1: Effect of lecture theatres' performance on learning experience

Response	LT2MB		LT2BB		ABCLT		Total	
	N	% Within	N	% Within	N	% Within	N	Total %
Yes	39	47.6%	50	74.6%	85	64.9%	174	62.1%
No	37	45.1%	10	14.9%	38	29.0%	85	30.4%
Don't know	6	7.3%	7	10.4%	8	6.1%	21	7.5%
Total	82	100.0%	67	100.0%	131	100.0%	280	100.0%

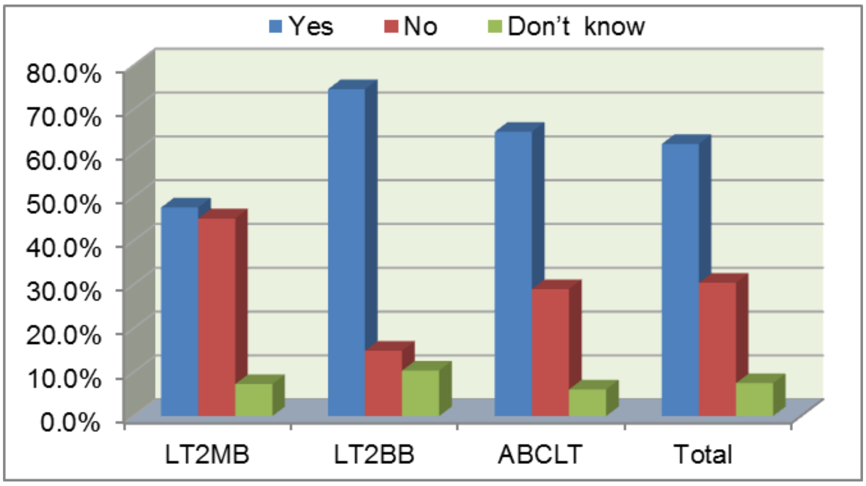


Figure 5.1: Effect of lecture theatres' performance on learning experience

5.7 Importance of building performance of lecture theatres

This section presents the level of importance students attach to the different performance parameters (features) and the overall performance of the lecture theatres. The section aids in ranking the building performance parameters based on their level of importance from students' perspectives and also helps in developing the importance-satisfaction analysis.

It was revealed that there is an array of parameters that impact on the whole performance of a lecture theatre. Atkin and Brooks (2009), Clatworthy and Convenor (2001), Department of Treasury and Finance (2005), Earthman (2004) and Lackney (1999a;1999b) highlighted a number of these parameters, including indoor air quality, noise control, privacy, lighting comfort, spatial comfort, seating comfort, amount of personal seating and writing space, quality of audio visual equipment, thermal comfort and ergonomics. Structural safety, fire safety & exit, temperature, ventilation, lighting, cleanliness, sound control and aesthetics are the parameters of concern for this survey. Students were requested to rate how important these performance parameters and overall performance of the lecture theatre were to their learning experience using a 5-point Likert scale where 1 = not relevant; 2 = unimportant; 3 = neutral; 4 = important; and 5 = very important. Each lecture theatre is presented separately.

5.7.1 New lecture theatre (LT2MB)

Table 5.2: Importance of performance parameter to learning experience (LT2MB)

Performance parameters	Not relevant		Un important		Neutral		Important		Very important		Total	Mean	Std. Dev	Rank
	N	%	N	%	N	%	N	%	N	%				
Lighting	0	0	1	1.2	6	7.3	35	42.7	40	48.8	82	4.39	0.68	1
Structural safety	0	0	2	2.4	6	7.3	42	51.2	32	39.0	82	4.27	0.70	2
Ventilation	2	2.5	3	3.7	10	12.3	22	27.2	44	54.3	81	4.27	0.99	3
Temperature	0	0	0	0	19	22.6	27	32.1	38	45.2	84	4.23	0.80	4
Cleanliness	0	0	4	4.8	15	17.9	24	28.6	41	48.8	84	4.21	0.91	5
Sound control	1	1.3	2	2.5	13	16.3	28	35.0	36	45.0	80	4.20	0.89	6
Fire safety & exit	4	4.8	1	1.2	17	20.5	19	22.9	42	50.6	83	4.13	1.09	7
Aesthetics	4	4.8	5	6.0	27	32.1	31	36.9	17	20.2	84	3.62	1.03	8
Overall	1	1.2	1	1.2	17	20.5	33	39.8	31	37.3	83	4.11	0.86	

In the case of LT2MB, more than 73% of the respondents responded in the range of important and very important for all the performance parameters, as well as the overall performance except aesthetics. Apart from aesthetics (mean score of 3.62), the mean scores obtained for all the parameters and the overall importance were above 4.0. The mean scores obtained indicate that all the parameters are important. From the mean scores obtained, students in LT2MB perceived lighting as the most important parameter, followed by structural safety, ventilation and temperature, while the least important is aesthetics (Table 5.2).

5.7.2 Intermediate lecture theatre (ABCLT)

The mean scores obtained for all the parameters for ABCLT were above 4.0 with the exception of aesthetics (mean score of 3.71). Also, more than 74% of the respondents responded in the range of important and very important for all the performance parameters except aesthetics (59.4%). Lighting appears to be the perceived most important parameter followed by ventilation, cleanliness, structural safety and the least important is aesthetics. The overall mean score obtained was 3.94. From the mean scores obtained, it is evident that all the parameters are perceived as important (Table 5.3).

Table 5.3: Importance of performance parameter to learning experience (ABCLT)

Performance parameters	Not relevant		Un important		Neutral		Important		Very important		Total	Mean	Std. Dev	Rank
	N	%	N	%	N	%	N	%	N	%				
Lighting	1	0.8	3	2.3	12	9.3	45	34.9	68	52.7	129	4.36	0.81	1
Ventilation	3	2.3	3	2.3	8	6.2	47	36.4	68	57.7	129	4.35	0.88	2
Cleanliness	3	2.3	1	0.8	12	9.3	48	37.2	65	50.4	129	4.33	0.86	3
Structural safety	3	2.3	5	3.9	8	6.3	47	36.7	65	50.8	128	4.30	0.93	4
Temperature	3	2.4	5	3.9	20	15.7	36	28.3	63	49.6	127	4.19	1.00	5
Sound control	5	3.8	4	3.1	14	10.8	55	42.3	52	40.0	130	4.12	0.99	6
Fire safety &exit	6	4.6	5	3.8	21	16.2	35	26.0	63	48.5	130	4.11	1.10	7
Aesthetics	2	1.6	15	11.7	35	27.3	42	32.8	34	26.6	128	3.71	1.04	8
Overall	6	4.6	3	2.3	26	20.0	53	40.8	42	32.3	130	3.94	1.02	

5.7.3 Old lecture theatre (LT2BB)

It is evident from the mean scores obtained that respondents from LT2BB perceived all the parameters as important. Apart from aesthetics (mean score of 3.85), the mean scores obtained for all the parameters and the overall importance were above 4.0. More than 70% of the respondents responded in the range of important and very important for all the performance parameters and the overall performance except aesthetics (55.9%). Structural safety is perceived to be the most important parameter, followed by cleanliness, lighting and ventilation respectively whereas aesthetics is the perceived least important parameter (see Table 5.4).

Table 5.4: Importance of performance parameter to learning experience (LT2BB)

Performance parameters	Not relevant		Un important		Neutral		Important		Very important		Total	Mean	Std. Dev	Rank
	N	%	N	%	N	%	N	%	N	%				
Structural safety	0	0	1	1.5	8	11.9	18	26.9	40	59.7	67	4.45	0.76	1
cleanliness	0	0	3	4.4	3	4.4	24	35.3	38	55.9	68	4.43	0.78	2
Lighting	1	1.5	1	1.5	3	4.4	30	44.1	33	48.5	68	4.37	0.77	3
Ventilation	0	0	4	5.9	4	5.9	25	36.8	35	51.5	68	4.34	0.84	4
Sound control	0	0	2	2.	9	13.2	22	32.4	35	51.5	68	4.32	0.82	5
Temperature	0	0	4	6.0	11	16.4	21	31.3	31	46.3	67	4.18	0.92	6
Fire safety& exit	4	5.9	4	5.9	12	17.6	13	19.1	35	51.1	68	4.04	1.22	7
Aesthetics	0	0	0	0	27	39.7	21	30.9	17	25.0	65	3.85	0.82	8
Overall	0	0	2	2.9	10	14.7	22	32.4	34	50.0	68	4.29	0.83	

5.7.4 Aggregate of lecture theatres

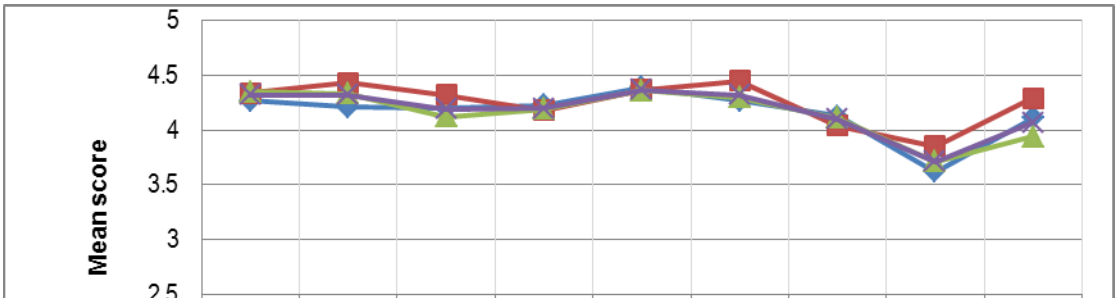
Table 5.5 shows the aggregate response obtained from the lecture theatres. The mean scores obtained were in the range of 4.37 (highest) and 3.71 (lowest) and the overall mean score was 4.07. With the exception of aesthetics, all the other performance parameters and the overall performance obtained a mean score higher than 4.0, with about 75% of the respondents responding in the range of important and very important. The standard deviations obtained are a confirmation of how concentrated the responses were. Lighting is perceived as the most important parameter, followed by structural safety, cleanliness and ventilation respectively, with same mean score of 4.32. The perceived least important parameter is aesthetics.

Table 5.5: Importance of performance parameter to learning experience (Total)

Performance parameters	Not relevant		Un important		Neutral		Important		Very important		Total	Mean	Std. Dev.	Rank
	N	%	N	%	N	%	N	%	N	%				
Lighting	2	0.7	5	1.8	21	7.5	110	39.4	141	50.5	279	4.37	0.76	1
Structural safety	3	1.1	8	2.9	22	7.9	107	38.6	137	49.5	277	4.32	0.83	2
Cleanliness	3	1.1	8	2.8	30	10.7	96	34.2	144	51.2	281	4.32	0.86	3
Ventilation	5	1.8	10	3.6	22	7.9	94	33.8	147	52.9	278	4.32	0.90	4
Temperature	3	1.1	9	3.2	50	18.0	84	30.2	132	47.5	278	4.20	0.92	5
Sound control	6	2.2	8	2.95	36	12.9	105	37.8	123	44.2	278	4.19	0.92	6
Fire safety & exit	14	5.0	10	3.6	50	17.8	67	23.8	140	49.8	281	4.10	1.12	7
Aesthetics	6	2.2	20	7.2	89	32.1	94	33.9	68	24.5	277	3.71	0.99	8
Overall	7	2.5	6	2.1	53	18.9	108	38.4	107	38.1	281	4.07	0.94	

Undoubtedly, the mean scores obtained for all the parameters as well as the overall importance in all the lecture theatres as shown in Figure 5.2 demonstrate a feeling of importance towards very important. Although the responses in the different lecture theatres varied, the variation was of no significance. With the exception of the overall satisfaction, the significance level of differences obtained as shown in Table 5.6 (ANOVA analysis) were all above 0.05, confirming that there were no statistically significant differences in the responses of the different lecture theatres.

Respondents in all the lecture theatres perceived all the performance parameters as important to their learning experience. The findings are very much supported by the literature. It was revealed that the absence of safety measures can lead to accidents (Lackney, 1999a). Bishop (2009) indicated that any inadequacy of the HVAC systems can cause unnecessary distraction for students. It was also made known that SBS, which may lead to respiratory illness, is caused by poor indoor air quality resulting from poor ventilation (Lackney, 1999a). Polh (2011) stated that light is one of the parameters of building design which requires very important consideration as light can affect the health of students, their mental concentration, their productivity as well as their morale (Lackney, 1999a; Leung & Fung, 2005). The importance of lecture theatre acoustics was also highlighted. In fact, good lecture theatre acoustics make learning easier, more sustained and less stressful, whereas excessive noise and reverberation inhibit speech communication and thereby hinder the learning process (Lubman & Sutherland, 2001). It was also revealed that aesthetics plays a critical role in ensuring a comfortable environment (Leung & Fung, 2005). Hence an appealing lecture theatre (aesthetics) has the ability to influence the students' learning experiences positively. Clatworthy and Convenor (2001), Department of Treasury and Finance (2005), Earthman (2004) and Lackney (1999a; 1999b) also highlighted the importance of these performance parameters to learning experience of students. Parameters whose failure affects health, safety, environment or utility are significant items (Horner *et al.*, 1997). The mean scores obtained from this survey and the literature clearly express that all these performance parameters are significant and therefore require careful attention.



	Ventilation	cleanliness	Sound control	Temperature	Lighting	Struct. safety	Fire safety	Aesthetics	Overall
(LT2MB)	4.27	4.21	4.2	4.23	4.39	4.27	4.13	3.62	4.11
(LT2BB)	4.34	4.43	4.32	4.18	4.37	4.45	4.04	3.85	4.29
(ABCLT)	4.35	4.33	4.12	4.19	4.36	4.3	4.11	3.71	3.94
(TOTAL)	4.32	4.32	4.19	4.2	4.37	4.32	4.1	3.71	4.07

Figure 5.2: Importance of performance parameters (compared)

Table 5.6: One way ANOVA test

Performance Parameters		Sum of Squares	df	Mean Square	F	Sig.
Performance parameter importance to your learning experience: fire safety	Between Groups	.308	2	.154	.121	.886
	Within Groups	352.902	278	1.269		
	Total	353.210	280			
Performance parameter importance to your learning experience: structural safety	Between Groups	1.375	2	.687	1.005	.367
	Within Groups	187.383	274	.684		
	Total	188.758	276			
Performance parameter importance to your learning experience: temperature	Between Groups	.101	2	.051	.059	.942
	Within Groups	234.018	275	.851		
	Total	234.119	277			
Performance parameter importance to your learning experience: ventilation	Between Groups	.316	2	.158	.193	.824
	Within Groups	224.548	275	.817		
	Total	224.863	277			
Performance parameter importance to your learning experience: lighting	Between Groups	.036	2	.018	.031	.970
	Within Groups	161.197	276	.584		
	Total	161.233	278			
Performance parameter importance to your learning experience: sound control	Between Groups	1.944	2	.972	1.148	.319
	Within Groups	232.952	275	.847		
	Total	234.896	277			
Performance parameter importance to your learning experience: aesthetics	Between Groups	1.894	2	.947	.973	.379
	Within Groups	266.576	274	.973		
	Total	268.469	276			
Performance parameter importance to your learning experience: cleanliness	Between Groups	1.711	2	.855	1.171	.312
	Within Groups	203.101	278	.731		
	Total	204.811	280			
How important is the condition of a lecture theatre to your learning experience?	Between Groups	5.781	2	2.891	3.353	.036
	Within Groups	239.649	278	.862		
	Total	245.431	280			

5.8 Expectation of lecture theatre performance

This section presents the extent at which the expectations of students with the different performance parameters of the lecture theatres are fulfilled. It provides a (dis)confirmation of expectation and will thus guide the prioritisation of the performance parameters. A 5-point Likert scale where 1 = not at all, 2 = not well, 3 = neutral, 4 = well, and 5 = very well was used for that purpose.

5.8.1 Expectation of performance parameters (LT2MB)

As depicted in Table 5.7, the mean scores obtained in LT2MB for the parameters ranged from 4.05 for lighting to 3.33 for aesthetics. The mean scores suggest that all the performance parameters met the expectations of the students except ventilation (3.41) and aesthetics (3.33) for which they expressed a feeling of neutrality. Apart from aesthetics, at least 39% of the respondents expressed that the performance parameters met their expectations well.

Table 5.7: Expectation of performance parameters (LT2MB)

Performance parameters	Not at all		Not well		Neutral		Well		Very well		Total	Mean	Std. Dev	Rank
	N	%	N	%	N	%	N	%	N	%				
Lighting	0	0	3	3.6	13	15.7	44	53.0	23	27.7	83	4.05	0.70	1
Structural safety	0	0	0	0	23	27.7	43	51.8	17	20	83	3.93	0.86	2
Fire safety & exit	1	1.2	3	3.6	20	23.8	39	46.4	21	25.0	84	3.90	0.86	3
Sound control	1	1.2	5	6.0	30	36.1	35	42.2	12	14.5	83	3.63	0.85	4
Temperature	3	3.7	7	8.5	25	30.5	32	39.0	15	17.9	82	3.60	1.00	5
Cleanliness	3	3.6	12	14.3	20	23.8	34	40.5	15	17.9	84	3.55	1.06	6
Ventilation	4	4.9	14	17.1	19	23.2	34	41.5	11	13.1	82	3.41	1.08	7
Aesthetics	1	1.2	12	14.3	37	44.0	26	31.0	8	9.5	84	3.33	0.88	8

5.8.2 Expectation of performance parameters (ABCLT)

The response obtained from ABCLT indicates that structural safety (3.67) and lighting (3.64) are the two parameters that met the expectations of the students. The mean scores obtained for the remaining parameters ranged from 3.39 and 3.12, demonstrating a state of neutrality. More than 40% of the respondents responded that structural safety and lighting met their expectations well (Table 5.8).

Table 5.8: Expectation of performance parameter (ABCLT)

Performance parameters	Not at all		Not well		Neutral		Well		Very well		Total	Mean	Std. Dev	Rank
	N	%	N	%	N	%	N	%	N	%				
Structural safety	4	3.1	6	4.7	28	22.0	58	45.7	31	24.4	127	3.83	0.96	1
Lighting	2	1.6	8	6.3	40	31.5	53	41.7	24	18.9	127	3.70	0.90	2
Cleanliness	8	6.2	20	15.5	36	27.9	44	34.1	21	16.3	129	3.39	1,12	3
Sound control	10	7.9	14	11.0	53	41.7	41	31.3	9	7.1	127	3.20	1.00	4
Aesthetics	8	6.3	15	11.9	57	45.2	37	29.4	9	7.1	126	3.19	0.96	5
Ventilation	4	3.2	25	19.8	52	41.3	34	27.0	11	8.7	126	3.18	0.96	6
Fire safety & exit	10	7.8	29	22.7	41	32.0	30	23.4	18	14.1	128	3.13	1.15	7
Temperature	8	6.2	26	20.2	47	36.4	38	29.5	10	7.8	129	3.12	1.02	8

5.8.3 Expectation of performance parameters (LT2BB)

The mean scores obtained for the parameters ranged from 3.45 for structural safety (highest) to 2.62 for temperature (lowest). The mean scores obtained indicate that none of the performance parameters actually met the expectations of students; a feeling of neutrality towards dissatisfaction was expressed. From Table 5.9, it is evident at least one-third of the respondents expressed a feeling of neutrality with all the performance parameters.

Table 5.9: Expectation of performance parameters (LT2BB)

Performance parameters	Not at all		Not well		Neutral		Well		Very well		Total	Mean	Std. Dev	Rank
	N	%	N	%	N	%	N	%	N	%				
Structural safety	3	4.5	6	9.1	22	33.3	28	42.2	7	10.6	66	3.45	0.96	1
Lighting	3	4.5	9	13.6	26	39.4	24	36.4	4	5.9	66	3.26	0.93	2
Cleanliness	4	6.0	12	17.9	29	43.3	19	28.4	3	4.5	67	3.07	0.94	3
Fire safety & exit	9	13.4	12	17.9	24	35.8	18	26.9	4	6.0	67	2.94	1.11	4
Ventilation	6	9.2	19	29.2	23	35.4	12	18.5	5	7.7	65	2.86	1.07	5
Aesthetics	7	11.1	14	22.2	35	55.6	5	7.9	2	3.2	63	2.70	0.89	6
Sound control	9	14.1	20	31.3	22	34.4	10	15.6	3	4.7	64	2.66	1.06	7
Temperature	9	13.6	19	28.8	28	42.4	8	12.1	2	3.0	66	2.62	0.97	8

5.8.4 Expectation of performance parameters (Total)

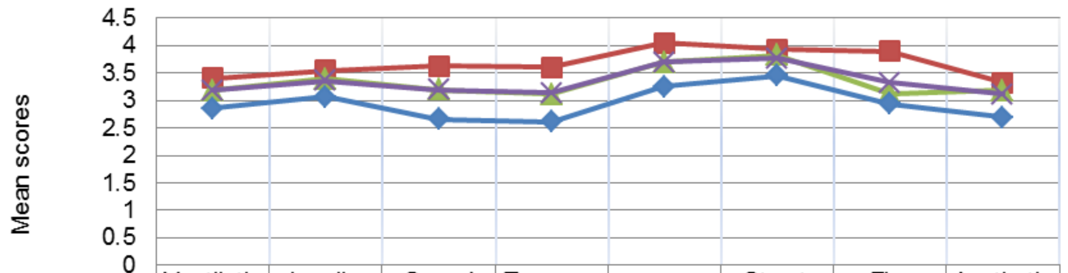
With regard to the aggregate expectation of the lecture theatres, the mean scores obtained as depicted in Table 5.10 were in the range of 3.77 (highest) and 3.12 (lowest). Students' expectations were well met with structural safety and lighting. The mean scores obtained for the remaining parameters suggest a feeling of neutrality (between 3.36 and 3.12). Students' expectations were well met with structural safety followed by lighting, cleanliness and fire safety & exit, whereas the least parameters were temperature and aesthetics.

Table 5.10: Expectation of performance parameter (Total)

Performance parameters	Not at all		Not well		Neutral		Well		Very well		Total	Mean	Std. Dev	Rank
	N	%	N	%	N	%	N	%	N	%				
Structural safety	7	2.5	12	4.3	73	26.4	129	46.7	55	19.9	276	3.77	1.13	1
Lighting	5	1.8	20	7.2	79	28.6	121	43.8	51	18.5	276	3.70	0.90	2
Cleanliness	15	5.4	44	15.7	85	30.4	97	34.6	39	13.9	280	3.36	1.06	3
Fire safety & exit	20	7.2	44	15.8	85	30.5	87	31.2	43	15.4	279	3.32	1.13	4
Sound control	20	7.3	39	14.2	105	38.3	86	31.4	24	8.8	274	3.20	1.03	5
Ventilation	14	5.1	58	21.2	94	34.4	80	29.3	27	9.9	273	3.18	1.04	6
Temperature	20	7.2	52	18.8	100	36.1	78	28.2	27	9.7	277	3.14	1.06	7
Aesthetics	16	5.9	41	15.0	129	47.3	68	24.9	19	7.0	273	3.12	0.95	8

5.8.5 Expectation of performance parameters compared

Olanrewaju *et al.* (2011b) indicated that meeting the requirements of building users invariably affects their satisfaction. Certainly, building users are dissatisfied when buildings fail to meet their requirements; on the other hand, they are satisfied if the management of buildings reflect and meet their requirements and interests (Arazi *et al.,* 2009; Olanrewaju, 2010a; Olanrewaju *et al.*, 2010a). Though there are differences in response, it is evident that respondents demonstrated a feeling of neutrality with ventilation and aesthetics in all the lecture theatres. Though structural safety and lighting met the expectation of students of LT2MB and ABCLT, those from LT2BB demonstrated a feeling of neutrality. The expectation of respondents in LT2MB regarding cleaning, sound control, temperature and fire safety & exit were also met, while those from ABCLT and LT2BB were neutral. Aggregately, respondents' expectations were met in two of the performance parameters of the lecture theatres: structural safety (a mean score of 3.77) and lighting (a mean score of 3.70). The mean scores obtained for the remaining parameters suggest a feeling of neutrality (between 3.36 and 3.12). Comparatively, the respondents from LT2MB representing the new lecture theatre had the highest mean scores, followed by ABCLT representing the intermediate lecture theatre, and lastly LT2BB representing the old lecture theatre. In essence the expectations of LT2MB are better met, followed by ABCLT and lastly LT2BB (Figure 5.3).



	Ventilation	cleanliness	Sound control	Temperature	Lighting	Struct. safety	Fire safety	Aesthetics
(LT2MB)	3.41	3.55	3.63	3.6	4.05	3.93	3.9	3.33
(ABCLT)	3.18	3.39	3.2	3.12	3.7	3.83	3.13	3.19
(LT2BB)	2.86	3.07	2.66	2.62	3.26	3.45	2.94	2.7
(TOTAL)	3.18	3.36	3.2	3.14	3.7	3.77	3.32	3.12

Figure 5.3: Expectation of performance parameters compared

5.9 Students' satisfaction level of lecture theatre performance

This section presents the satisfaction level of students with each specified building performance parameter as well as the overall performance of the lecture theatre. The satisfaction level of the building performance parameters obtained in this section will be used together with the one obtained from the importance to develop the IPA model which will aid the development of a maintenance prioritisation system and improvements strategies for maintaining the performance parameters of the theatre.

It was reviewed that building users are the group interested in the adequate performance of the buildings as they are affected by the performance of the buildings (Arazi *et al.*, 2009; Olanrewaju *et al.*, 2010a). Douglas (1996) concurred that buildings are not procured for their own sake but for the services they offer the users. It is therefore critical to ensure that students are satisfied with the performance of the lecture theatres. To determine the satisfaction level, students were asked to rate how satisfied they are with each performance parameter of the lecture theatres as well as the overall performance of the lecture theatres. They were requested to do the rating with a 5-point Likert scale where 1 = very unsatisfied; 2 = unsatisfied; 3 = neutral; 4 = satisfied; and 5 = very satisfied.

Students were also requested to provide comments on the satisfaction or dissatisfaction of the performance parameters of the lecture theatres. The concerns raised by the students relating to the satisfaction or dissatisfaction with the performance parameters of the lecture theatres are also presented. Each lecture theatre had particular comments on the performance parameters; therefore each theatre is discussed separately after which the aggregate discussion is made. Students' concerns relating to the satisfaction or dissatisfaction are first presented before the questionnaire (survey) table.

5.9.1 New lecture theatre (LT2MB)

Respondents of LT2MB had very few comments; students were mainly dissatisfied with the ventilation and temperature because of the difficulty in regulating the HVAC system. A few students expressed worries with cleanliness (because they felt the lecture theatre was not very clean) and sound control (because it was quite difficult to hear the lecturer when seated at the back of the lecture theatre).

As depicted in Table 5.11, the mean scores obtained in LT2MB for the parameters ranged from 3.89 for fire safety to 3.34 for ventilation. The mean scores indicate that students were satisfied with all the performance parameters except aesthetics (3.39) and ventilation (3.34) for which they expressed a feeling of neutrality. Over 40% of the students were satisfied with all the performance parameters except aesthetics and ventilation. Students in LT2MB were most satisfied with fire safety & exit, followed by lighting and structural safety respectively, but were least satisfied with ventilation. Regarding the overall satisfaction, a mean score of 3.71 expressing a state of satisfaction was obtained; a total of 58.2% of the students were satisfied while 29.1% were neutral. Respondents were most unsatisfied with the ventilation and also expressed concerns with cleanliness and sound control. The observation carried out confirms that though the HVAC system can be regulated in the lecture theatre, it does not usually produce desired temperature since it is powered centrally. However, it was observed that the lecture theatre was clean.

Table 5.11: Satisfaction of performance parameters (LT2MB)

Performance parameters	Very unsatisfied		Un satisfied		Neutral		Satisfied		Very satisfied		Total	Mean	Std. Dev	Rank
	N	%	N	%	N	%	N	%	N	%				
Fire safety & exit	1	1.2	5	6.0	19	22.6	36	42.9	23	27.4	84	3.89	0.92	1
Lighting	2	2.4	4	4.8	16	19.3	41	49.4	20	24.1	83	3.88	0.92	2
Structural safety	1	1.2	4	4.8	18	21.7	45	54.2	15	18.1	83	3.83	0.82	3
Temperature	4	4.8	10	11.9	18	21.4	35	41.7	17	20.2	84	3.61	1.09	4
Sound control	4	4.8	9	10.8	22	26.5	35	42.2	13	15.7	83	3.53	1.04	5
Cleanliness	5	6.0	9	10.7	21	25.0	36	42.9	13	15.5	84	3.51	1.07	6
Aesthetics	3	3.8	10	12.5	31	38.8	25	31.3	11	13.8	80	3.39	1.00	7
Ventilation	8	9.8	13	15.9	17	20.7	31	37.8	13	15.9	82	3.34	1.21	8
Overall	1	1.3	2	2.5	23	29.1	46	58.2	7	8.9	79	3.71	0.72	

5.9.2 Intermediate lecture theatre (ABCLT)

Most complaints from ABCLT were with regards to the HVAC system because although the HVAC system can be regulated in a control room, it does not typically produce desired temperatures since it is powered centrally; the temperature produced by the HVAC system is usually either too cold or too hot. Second was the fire safety & exit because the exit doors at the rear of the lecture theatre were always locked. Quite a number of students also raised concerns about cleanliness, aesthetics and sound control.

The response obtained from ABCLT indicates that respondents were satisfied with structural safety (3.67) and lighting (3.64). The mean scores obtained for the remaining parameters ranged from 3.39 and 3.04 demonstrating a state of neutrality. With the exception of fire safety, about one-third of the respondents expressed a feeling of neutrality with all performance parameters, while at least 32% of students expressed a feeling of satisfaction with all performance parameters. The most satisfying parameters were structural safety followed by lighting, sound control and cleanliness in that order whereas the least satisfying parameters were ventilation and temperature. Respondents from ABCLT had the most complaints with the HVAC system and fire safety & exit. The observations made confirm the survey findings: the HVAC system does not usually produce desired temperatures since it is powered centrally and the two doors at the rear of the theatre were locked during lectures. According to Shen and Spedding (1998), safety items present a high risk on safety and could pose serious potential danger to the building users. The overall mean score obtained was 3.31, thus evidencing a state of neutrality; a total of 40.2% were neutral while 41.8% were satisfied with the overall performance of the lecture theatre (Table 5.12).

Table 5.12: Satisfaction of performance parameter (ABCLT)

Performance parameters	Very unsatisfied		Un satisfied		Neutral		Satisfied		Very satisfied		Total	Mean	Std. Dev	Rank
	N	%	N	%	N	%	N	%	N	%				
Structural safety	5	3.9	3	2.3	43	33.3	57	44.2	21	16.3	129	3.67	0.91	1
Lighting	4	3.1	10	7.8	38	29.7	52	40.6	24	18.8	128	3.64	0.99	2
Sound control	6	4.7	14	11.0	45	35.4	48	37.8	14	11.0	127	3.39	0.99	3
Cleanliness	9	7.0	16	12.5	38	29.7	46	35.9	19	14.8	128	3.39	1.10	4
Fire safety & exit	11	8.5	26	20.2	32	24.8	45	34.9	15	11.6	129	3.21	1.15	5
Aesthetics	10	7.8	16	12.5	51	39.8	41	32.0	10	7.8	128	3.20	1.02	6
Ventilation	6	4.7	24	18.8	48	37.5	41	32.0	9	7.0	128	3.18	0.98	7
Temperature	10	7.9	29	22.8	39	30.7	44	34.6	5	3.9	128	3.04	1.03	8
Overall	6	4.9	11	9.0	49	40.2	51	41.8	5	4.1	122	3.31	0.88	

5.9.3 Old lecture theatre (LT2BB)

For LT2BB, the most complaints were with regard to the temperature and ventilation, with the main point concerning the malfunctioning HVAC system. Students were also highly unsatisfied with fire safety & exit because of the absence of fire extinguishers and the fact that the exit doors were locked. Problems relating to sound control, aesthetics and cleanliness were also highlighted.

The mean scores obtained for the parameters ranged from 3.19 to 2.43: the most satisfying parameters were structural safety followed by lighting, cleanliness and aesthetics whereas the least satisfying parameters were ventilation and temperature. The mean scores obtained are indicative that respondents were not satisfied with any of the performance parameters of the lecture theatre; a feeling of neutrality towards dissatisfaction was expressed. From Table 5.13, it is evident that more than 37% of the respondents expressed a feeling of dissatisfaction with ventilation, temperature and sound control. Unsurprisingly the majority of complaints lodged by students concerned temperature and ventilation (the HVAC system was not working) and fire safety & exit. For the number of times observations were made it was evident that the exit door in front of the lecture theatre was locked. According to Shen and Spedding (1998), safety items present a high risk and could pose serious potential danger to building users. Hence these items need critical attention. Also, the HVAC system was not functioning during the first and second days of observations, thereby confirming the findings. An overall mean score of 2.69, suggesting a state of neutrality towards dissatisfaction was obtained. Only 19.4% were satisfied, 38.8% were neutral and as many as 32.8% were unsatisfied with the overall performance on the lecture theatre.

Table 5.13: Satisfaction of performance parameters (LT2BB)

Performance parameters	Very unsatisfied		Un satisfied		Neutral		Satisfied		Very satisfied		Total	Mean	Std. Dev	Rank
	N	%	N	%	N	%	N	%	N	%				
Structural safety	4	5.9	10	14.7	26	38.2	25	36.8	3	4.4	68	3.19	0.95	1
Lighting	3	4.5	11	16.4	34	50.7	16	23.9	3	4.5	67	3.07	0.88	2
Cleanliness	4	5.9	17	25.0	24	35.3	21	30.9	2	2.9	67	3.00	0.96	3
Aesthetics	6	9.0	18	26.9	33	49.3	9	13.4	1	1.5	67	2.72	0.88	4
Fire safety & exit	11	16.2	15	22.1	28	41.2	12	17.6	2	2.9	68	2.69	1.04	5
Sound control	7	10.4	25	37.3	22	32.8	12	17.9	1	1.5	67	2.63	0.95	6
Ventilation	7	10.6	25	37.9	23	34.8	9	13.6	2	3.0	66	2.61	0.96	7
Temperature	12	17.6	26	38.2	19	27.9	11	16.2	0	0.0	68	2.43	0.97	8
Overall	6	9.0	22	32.8	26	38.8	13	19.4	0	0.0	67	2.69	0.89	

5.9.4 Aggregate of lecture theatres

The outstanding concern among all the lecture theatres was the HVAC system which students complained was either not functioning or not functioning effectively. Students also raised concerns about the cleanliness of the lecture theatres; they felt the lecture theatres were sometimes not particularly clean. Sound control was also a parameter which was highlighted in all the lecture theatres; students complained that it was difficult to hear lecturers when seated at the back. In addition, some students opined that noise from outside interfered with lectures. Students suggested the use of microphones for lectures. Aesthetics was also a concern for students; they indicated that the lecture theatres were dull, boring and unappealing. Another issue highlighted, though not directly a part of the scope of this study, was ergonomics (movement in lecture theatre, comfort of chair and writing space).

Table 5.14: Satisfaction of performance parameter (Total)

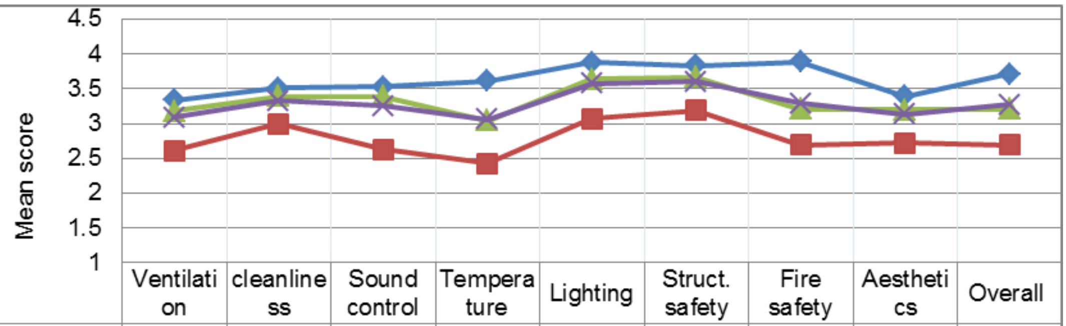
Performance parameters	Very unsatisfied		Un satisfied		Neutral		Satisfied		Very satisfied		Total	Mean	Std. Dev	Rank
	N	%	N	%	N	%	N	%	N	%				
Structural safety	10	3.6	17	6.1	87	31.1	127	45.4	39	13.9	280	3.60	1.15	1
Lighting	9	3.2	25	9.0	88	31.7	109	39.2	47	16.9	278	3.58	0.98	2
cleanliness	18	6.4	42	15.0	83	29.6	103	36.8	34	12.1	280	3.33	1.07	3
Fire safety & exit	23	8.2	46	16.4	79	28.1	93	33.1	40	14.2	281	3.29	1.15	4
Sound control	17	6.1	48	17.3	89	32.1	95	34.3	28	10.1	277	3.25	1.07	5
Aesthetics	19	6.9	44	16.0	115	41.8	75	27.3	22	8.0	275	3.13	1.01	6
Ventilation	21	7.6	62	22.5	88	31.9	81	29.3	24	8.7	276	3.09	1.08	7
Temperature	26	9.3	65	23.3	76	27.2	90	32.3	22	7.9	279	3.06	1.12	8
Overall	13	4.9	35	13.1	98	36.6	110	41.0	12	4.5	268	3.27	0.92	

Regarding the satisfaction of the aggregate lecture theatres, the mean scores obtained as depicted in Table 5.14 were in the range of 3.60 (highest) and 3.06 (lowest). The mean scores obtained suggest that students were satisfied with only two of the performance parameters of the lecture theatres: structural safety (a mean score of 3.60) and lighting (a mean score of 3.58). The mean scores obtained for the remaining parameters suggest a feeling of neutrality (between 3.33 and 3.06). An overall mean score of 3.27 was obtained suggesting a feeling of neutrality. Structural safety appears to be the most satisfying performance parameter, followed by lighting, then cleanliness and then fire safety. The least satisfying parameters are ventilation and temperature respectively. The observations support this finding; it was evident from the observations that the lecture theatres are structurally stable and have no cracks; also the lecture theatres have adequate lighting with fully functioning board lights and theatre lights. In fact, students had no negative comments on structural safety and lighting.

Although students expressed a feeling of neutrality with cleanliness, quite a number of concerns were raised concerning cleanliness. Students felt the lecture theatres were sometimes not clean; the observations, however, revealed that the lecture theatres were clean. Uline and Tschannen-Moran (2008) identified cleanliness as one of the crucial indicators of building quality. The infrastructure manager acknowledged that cleanliness is related to health. Again the previous findings established the high importance of cleanliness, hence the need for critical consideration.

The two least satisfying parameters were ventilation (3.09) and temperature (3.06). The observation revealed that the HVAC system was either malfunctioning or not functioning effectively; students also had the same opinion about the performance of the HVAC system. According to Horner *et al.* (1997), the failure of a utility significant item is likely to have an effect on user satisfaction. It was also pointed out that any inadequacy of heating, ventilation, and air conditioning can cause unnecessary distraction for students, who may spend more time sweating or shivering than learning (Bishop, 2009). Again, the "sick building syndrome" (SBS) which potentially leads to respiratory illness is exacerbated by poor indoor air quality (Lackney, 1999a). Leung and Fung (2005) stated that a good ventilation system in a room can improve the indoor air quality and the working productivity of end-users, students in this case. It is imperative that an HVAC system in a lecture theatre is efficiently functional.

There was quite a level of significant differences demonstrated in the responses of the three lecture theatres. Figure 5.4 compares the responses in the different lecture theatres while as Table 5.16 shows that there is a significant difference in the responses. The significance level obtained as shown in Table 5.16 (ANOVA analysis) were all below 0.05. Comparatively, the students from LT2MB representing the new lecture theatre had the highest mean scores. Second was the ABCLT representing the intermediate lecture theatre and last was LT2BB representing the old lecture theatre (see Figure 5.4). From the observations, LT2MB appeared to be in a comparatively better condition followed by ABCLT and lastly LT2BB. It was pointed out that building deterioration and obsolescence are inevitable and to be expected as part of the ageing process of a building (Mills, 1994; Douglas & Ransom, 2007). Therefore it is not surprising that students are satisfied more with new lecture theatres than old theatres, but it is worrying since all the parameters are significant items. Douglas (2006), Douglas and Ransom (2007), Mills (1994) and Seeley (1987) agreed that maintenance can help control the rate of building deterioration and failure.



	Ventilation	cleanliness	Sound control	Temperature	Lighting	Struct. safety	Fire safety	Aesthetics	Overall
(LT2MB)	3.34	3.51	3.53	3.61	3.88	3.83	3.89	3.39	3.71
(LT2BB)	2.61	3	2.63	2.43	3.07	3.19	2.69	2.72	2.69
(ABCLT)	3.18	3.39	3.39	3.04	3.64	3.67	3.21	3.2	3.21
(TOTAL)	3.09	3.33	3.25	3.06	3.58	3.6	3.29	3.13	3.27

Figure 5.4: Satisfaction of performance parameters compared

Table 5.15: One way ANOVA test

Performance Parameters		Sum of Squares	df	Mean Square	F	Sig.
Performance parameter satisfaction to your learning experience: fire safety	Between Groups	55.752	2	27.876	24.846	.000
	Within Groups	311.899	278	1.122		
	Total	367.651	280			
Performance parameter satisfaction to your learning experience: structural safety	Between Groups	16.380	2	8.190	10.181	.000
	Within Groups	222.820	277	.804		
	Total	239.200	279			
Performance parameter satisfaction to your learning experience: temperature	Between Groups	52.493	2	26.246	24.684	.000
	Within Groups	293.471	276	1.063		
	Total	345.964	278			
Performance parameter satisfaction to your learning experience: ventilation	Between Groups	21.672	2	10.836	9.892	.000
	Within Groups	299.064	273	1.095		
	Total	320.736	275			
Performance parameter satisfaction to your learning experience: sound control	Between Groups	35.151	2	17.575	17.792	.000
	Within Groups	270.661	274	.988		
	Total	305.812	276			
Performance parameter satisfaction to your learning experience: lighting	Between Groups	25.023	2	12.511	14.283	.000
	Within Groups	240.891	275	.876		
	Total	265.914	277			
Performance parameter satisfaction to your learning experience: aesthetics	Between Groups	17.305	2	8.653	9.027	.000
	Within Groups	260.717	272	.959		
	Total	278.022	274			
Performance parameter satisfaction to your learning experience: cleanliness	Between Groups	10.654	2	5.327	4.738	.009
	Within Groups	311.457	277	1.124		
	Total	322.111	279			
How satisfied are you with the overall performance of this lecture theatre?	Between Groups	38.230	2	19.115	27.105	.000
	Within Groups	186.886	265	.705		
	Total	225.116	267			

5.10 Expectations and satisfaction relationship ((dis)confirmation)

This section relates the fulfilments of the expectations of students with their satisfaction of the different performance parameters. Matzler *et al.* (2004) indicated that if perceived performance is greater than expectations a positive confirmation (satisfaction) occurs whereas a negative disconfirmation (dissatisfaction) occurs if performance is lower than expectations. However, if performance equals satisfaction, the comparison results in moderate satisfaction or indifference. This section, therefore, confirms the satisfaction or dissatisfaction of students with the performance parameters of the lecture theatres.

5.10.1 New lecture theatre (LT2MB)

Table 5.16 shows that apart from temperature and aesthetics, the satisfaction of all the parameters were below the expectation level of the students. Matzler *et al.* (2004) explained that if perceived performance is greater than expectations a positive confirmation (satisfaction) occurs, whereas a negative disconfirmation (dissatisfaction) occurs when performance is lower than expectations. It can thus be said that students are dissatisfied with all the performance parameters except temperature and aesthetics. It is important to note that the variance (t-test) between the expectation and satisfaction of ventilation was statistically significant, implying that student were most unsatisfied with ventilation.

Table 5.16: Satisfaction-expectation relationship (LT2MB)

Performance parameters	Sat. mean	Exp. mean	Means' diff.	T value	Sig. (2-tailed)
Ventilation	3.34	3.41	-0.07	0.842	0.042
Cleanliness	3.51	3.55	-0.04	0.324	0.747
Sound control	3.53	3.63	-0.10	1.155	0.252
Temperature	3.61	3.60	0.01	-0.217	0.829
Lighting	3.88	4.05	-0.17	1.866	0.660
Structural safety	3.83	3.93	-0.10	0.926	0.357
Fire safety & exit	3.89	3.90	-0.01	0.925	0.901
Aesthetics	3.39	3.33	0.06	-0.760	0.450

5.10.2 Intermediate lecture theatre (ABCLT)

Table 5.17 shows that the students' satisfaction levels of temperature, lighting and structural safety were below their expectation level, an indication of negative disconfirmation (dissatisfaction) (Matzler *et. al.*, 2004). Students, however, demonstrated a feeling of indifference with ventilation and cleanliness since their satisfactions were equal to their expectations. Although contradicting to the observations, the result shows that students were satisfied with fire safety & exit and sound control since their satisfactions were greater than their expectations level, indicating a positive confirmation (satisfaction) (Matzler *et al.*, 2004).

Table 5.17: Satisfaction-expectation relationship (ABCLT)

Performance parameters	Sat. mean	Exp. mean	Means' diff	t value	Sig. (2-tailed)
Ventilation	3.18	3.18	0.00	-0.114	0.910
Temperature	3.04	3.12	-0.08	1.010	0.314
Cleanliness	3.39	3.39	0.00	0.000	1.000
Fire safety& exit	3.21	3.13	0.08	-0.762	0.448
Sound control	3.39	3.20	0.19	-2.485	0.014
Lighting	3.64	3.70	-0.06	0.854	0.395
Structural safety	3.67	3.83	-0.16	2.693	0.080
Aesthetics	3.20	3.19	0.01	-0.095	0.924

5.10.3 Old lecture theatre (LT2BB)

Table 5.18 demonstrates that apart from aesthetics, the satisfaction levels of all the parameters were below the expectation level of the students. It can thus be said that students are dissatisfied with all the performance parameters except aesthetics. The variance (t-test) between the expectation and satisfaction of the parameters are however not significant.

Table 5.18: Satisfaction-expectation relationship (LT2BB)

Performance parameters	Sat. mean	Exp. mean	Means' diff.	t value	Sig. (2-tailed)
Temperature	2.43	2.62	-0.19	1.468	0.147
Ventilation	2.61	2.86	-0.25	2.028	0.470
Sound control	2.63	2.66	-0.03	0.743	0.460
Cleanliness	3.00	3.07	-0.07	0.948	0.347
Fire safety& exit	2.69	2.94	-0.25	2.337	0.220
Lighting	3.07	3.26	-0.19	2.259	0.027
Structural safety	3.19	3.45	-0.26	2.721	0.080
Aesthetics	2.72	2.70	0.02	0.341	0.735

5.10.4 Aggregate of lecture theatres

Table 5.19 also shows that apart from sound control and aesthetics, the satisfaction levels of all the parameters were below the expectation level of the students. Inference from the opinion of Matzler *et al.* (2004) implies that students are dissatisfied with all the performance parameters except sound control and aesthetics.

Table 5.19: Satisfaction-expectation relationship (Total)

Performance parameters	Sat. mean	Exp. mean	Means' diff.	t value	Sig. (2-tailed)
Ventilation	3.09	3.18	-0.09	1.428	0.154
Temperature	3.06	3.14	-0.08	1.266	0.206
Cleanliness	3.33	3.36	-0.03	0.597	0.551
Sound control	3.25	3.20	0.05	-0.809	0.420
Fire safety& exit	3.29	3.32	-0.03	0.602	0.548
Lighting	3.58	3.70	-0.12	2.680	0.008
Structural safety	3.60	3.77	-0.17	3.631	0.000
Aesthetics	3.13	3.12	0.01	-0.349	0.728

5.11 Importance performance (satisfaction) analysis

The IPA is employed to aid the development of a prioritisation system and strategies for improving the performance parameters of lecture theatres. Both the analysis of variance as well as the importance performance model is used. Janes and Wisnom (2003) stressed that analysis of variance is an applicable technique for analysing importance performance (satisfaction) data. The analysis of variance or mean score difference helps to determine how significant the importance means scores differ from the performance means scores. The iso-rating line (an upward diagonal line) is the variation of IPA model used for this study. For this approach, the points above the upward sloping (45°) line represent points where importance exceeds performance; therefore any parameter above the upward sloping (45°) line needs attention. The mean average is calculated with the eight performance parameters and does not include the overall mean value. Because of the level of differences demonstrated in the satisfaction level of the three different lecture theatres, each lecture theatre is analysed separately, after which the aggregate survey of the theatres is analysed.

5.11.1 New lecture theatre (LT2MB)

Table 5.20 show the findings with regard to the mean scores gap between the importance and satisfaction of the performance parameters among students. Figure 5.5 shows the plotting of the importance and satisfaction mean scores on a two-dimensional matrix (importance satisfaction model with the 45° line). The results of Table 5.20 indicate that students perceived that the satisfaction of all parameters were below their level of importance. Students' importance mean scores for all the parameters as well as the overall performance except aesthetics were statistically significantly higher than their performance mean scores. From the variance (gap scores) analysis, it can be deduced that parameters including ventilation, cleanliness, sound control and temperature have wide gap scores, a clear indication of big variations between importance and satisfaction. On the other hand, structural safety, fire safety & exit, lighting, overall performance and aesthetics obtained low gap scores suggesting that the current performance levels are acceptable, even though they are below students' satisfaction. The expectation and satisfaction analysis also revealed that students are dissatisfied with all the performance parameters except temperature and aesthetics. However ventilation had a significant gap difference implying high dissatisfaction.

Analysis of the four quadrants from Figure 5.5 also shows that cleanliness, sound control, ventilation and temperature fall in Quadrant II (low satisfaction on highly important parameters). These parameters ought to be given top priority, since their neglect may pose a serious threat and dissatisfaction (Matzler *et al.,* 2003). Lighting and structural safety are located in Quadrant I, high both in satisfaction and importance. Fire safety & exit is located in Quadrant IV. Ainin and Hisham (2008) indicated that parameters which have high satisfaction but low importance are placed in Quadrant IV and that it is better if the resources invested in these parameters are diverted elsewhere. On the other hand, aesthetics is located in Quadrant III (low in both satisfaction and importance). However, the introduction of the 45° line gives a different indication. It is evident that all the performance parameters except fire safety & exit fall above the 45° line. Leong (2008) pointed out that any parameter above the upward sloping 45° line needs improvement. The overall performance is situated in Quadrant IV (high satisfaction but low importance) but above the 45° line, implying that students are equally unsatisfied with the overall performance of the lecture theatre.

It was observed that the new lecture theatre (LT2MB) is attractive and neat with adequate lighting. The theatre is also installed with a PA system which is functioning but barely used by the lecturers. However, LT2MB has no windows; additionally, the installed HVAC system is controlled by a central plant and though it can be regulated from the lecture theatre, it does not usually produce desired thermal environment since it is powered centrally. It was also observed that the new lecture theatre (LT2MB) was comparatively in a better condition.

From all the analysis and observations, it can be inferred that sound control, ventilation and temperature appear to be the parameters that students are unsatisfied with; however, it is glaring that the most unsatisfactory parameter is ventilation. Clearly ventilation (the HVAC system) needs improvement. Whereas the performance levels of the other parameters are below students' satisfaction, their performance can be considered acceptable. The maintenance department does not need to over-invest resources on the new lecture theatre as it is comparatively in a better condition.

Table 5.20: Importance satisfaction relationship (LT2MB)

Performance parameters	Imp. means	Sat. mean	Mean diff.	T value	Sig. (2tailed)
Ventilation	4.27	3.34	-0.93	5.823	0.000
Cleanliness	4.21	3.51	-0.70	4.764	0.000
Sound control	4.20	3.53	-0.67	4.251	0.000
Temperature	4.23	3.61	-0.62	4.223	0.000
Lighting	4.39	3.88	-0.51	4.300	0.000
Structural safety	4.27	3.83	-0.44	4.276	0.000
Fire safety& exit	4.13	3.89	-0.24	2.070	0.042
Aesthetics	3.62	3.39	-0.23	1.933	0.057
Overall	4.11	3.71	-0.40	3.299	0.001
Mean average	**4.17**	**3.62**			

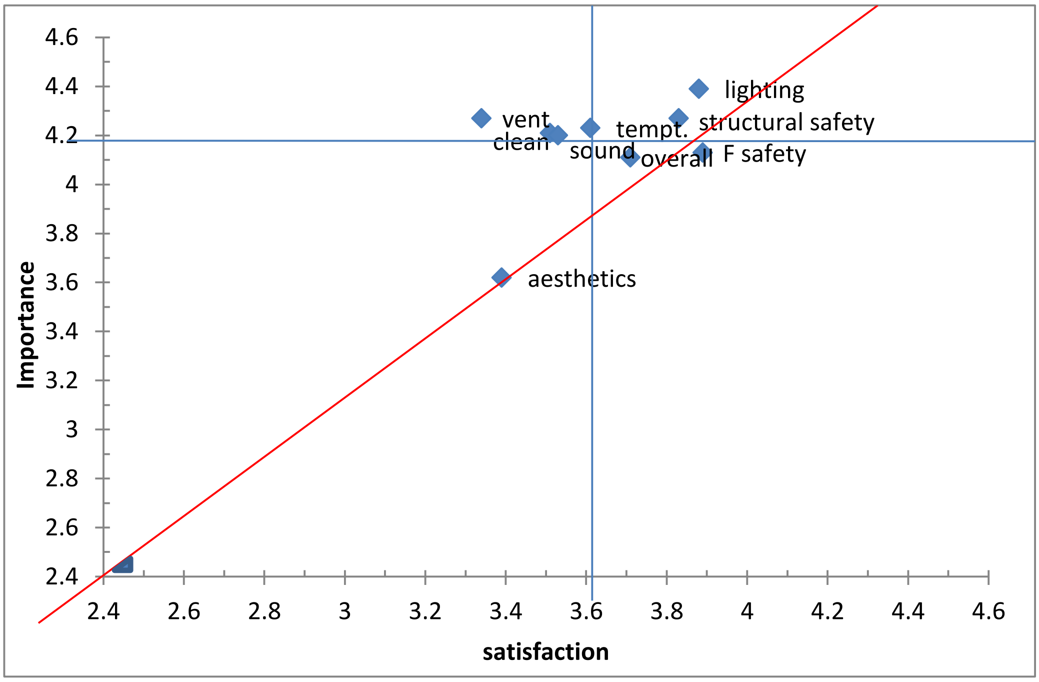


Figure 5.5: Importance satisfaction relationship: model (LT2MB)

5.11.2 Intermediate lecture theatre (ABCLT)

It is evident from Table 5.21 that respondents from ABCLT perceived the satisfaction of all parameters as below their level of importance. While the degree of difference demonstrated varies, the significant 2 tailed values obtained for all the parameters were less than 0.05 demonstrating that students' importance mean scores were significantly higher than the performance mean scores. From the variance analysis, it can be deduced that the CPUT maintenance department needs to work harder to achieve better satisfaction results for ventilation, temperature, cleanliness, sound control and fire safety & exit; these parameters have high gap scores indicating big variations between importance and satisfaction. On the other hand, structural safety, lighting and aesthetics obtained comparatively low gap scores suggesting that the current performance levels are acceptable, even though they are below students' satisfaction. The expectation and satisfaction analysis, to the contrary, indicated that the students are dissatisfied with temperature, lighting and structural safety. Students, however, demonstrated a feeling of indifference with ventilation and cleanliness but showed satisfaction with fire safety & exit and sound control.

The analysis of the IPA model (Figure 5.6) shows that all the parameters fall above the 45° line. According to Leong (2008) parameters above the 45° line need attention. However, the consideration of the four quadrants reveals that lighting, cleanliness and structural safety fall in Quadrant I, implying both high satisfaction and importance. Sound control is located in Quadrant IV. Ainin and Hisham (2008) suggested that parameters which have high satisfaction but low importance are placed in Quadrant IV and that it is better if the resources invested in these parameters are diverted elsewhere. This implies that the resources invested into sound control should rather be diverted. Also fire safety & exit and aesthetics are located in Quadrant III. Matzler *et al.* (2003) pointed out that it is unnecessary to focus additional effort on parameters in Quadrant III as these parameters are considered 'low priority'. However, parameters that fall in this quadrant may cause discontinuation (Ainin & Hisham, 2008). Ventilation and temperature fall in Quadrant II, low satisfaction on highly important parameters. These parameters ought to be given top priority, since their neglect may pose a serious threat and dissatisfaction (Matzler *et al.,* 2003). The overall performance is in Quadrant II, low both in satisfaction and importance, and above the 45° line. Even though parameters in this quadrant are regarded low priority they may cause discontinuation (Ainin & Hisham, 2008). Clearly the position of the overall performance is above the 45° line and hence needs improvement.

The observations revealed that the lecture theatre was quite attractive and considerably neat, the HVAC system (ventilation and temperature) was not functioning effectively; and rear exit doors were locked even during lectures. The PA system was functional but was not usually used. The comments given by students indicate that students seated at the back of the lecture theatre had difficulty hearing if the PA system was not properly utilised.

From all these analyses and observations, it can be concluded that the CPUT maintenance department needs to improve on ventilation, temperature and fire safety & exit and also give considerable attention to cleanliness and sound control in order to achieve better satisfaction results. Whereas the current performance levels of the other parameters are below students' satisfaction, their performance is adequate and acceptable. Also, the CPUT maintenance department needs to be careful how resources are utilised on the intermediate lecture theatre (ABCLT).

Table 5.21: Importance satisfaction relationship (ABCLT)

Performance parameters	Imp. mean	Sat. mean	Mean diff.	t value	Sig. (2-tailed)
Ventilation	4.35	3.18	-1.17	10.112	0.000
Temperature	4.19	3.04	-1.15	9.674	0.000
Cleanliness	4.33	3.39	-0.94	7.665	0.000
Fire safety& exit	4.11	3.21	-0.90	6.709	0.000
Sound control	4.12	3.39	-0.73	6.362	0.000
Lighting	4.36	3.64	-0.72	6.846	0.000
Structural safety	4.30	3.67	-0.67	6.222	0.000
Aesthetics	3.71	3.20	-0.51	3.929	0.000
overall	3.94	3.31	-0.63	4.934	0.000
Mean average	**4.18**	**3.34**			

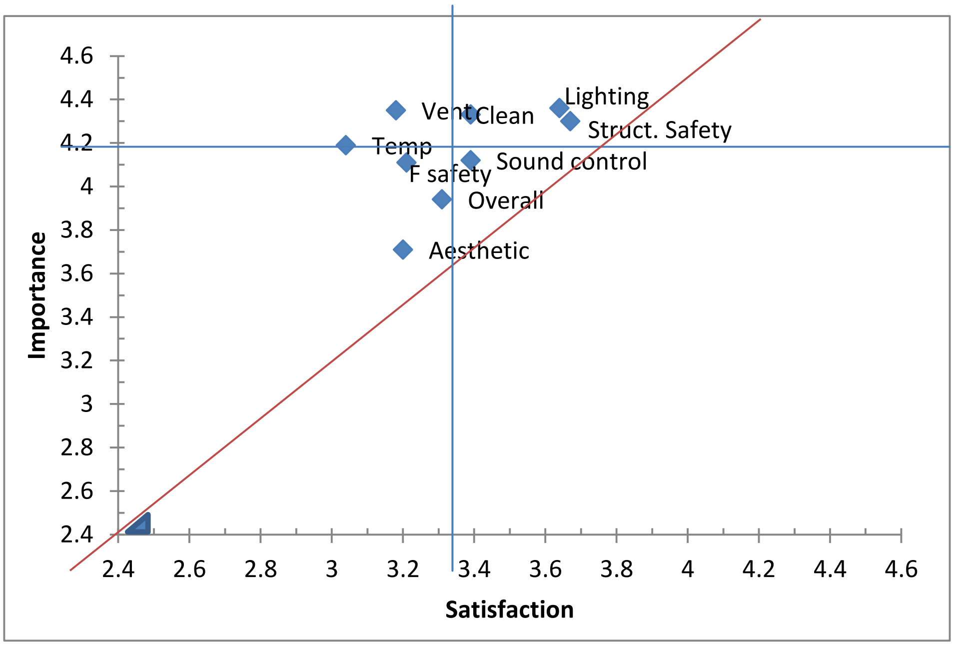


Figure 5.6: Importance satisfaction relationship: model (ABCLT)

5.11.3 Old lecture theatre (LT2BB)

Students from LT2BB perceived the satisfaction of all the performance parameters and the overall performance as below their level of importance. Although the degree of difference demonstrated varied, the gap between the mean scores were all high (see Table 5.22). The significant 2 tailed value obtained for all the parameters was less than 0.05, demonstrating that there is a statistically significant difference between the mean scores for importance and satisfaction. The variance analysis shows that all the parameters need serious consideration so as to achieve better satisfaction results. The expectation and satisfaction analysis also revealed that students are dissatisfied with all the performance parameters except aesthetics.

The IPA analysis (Figure 5.7) indicates that it is necessary to pay serious attention to ventilation and sound control, as they all fall in Quadrant II (low satisfaction on highly important parameters) and above the 45° line. Ainin and Hisham (2008) pointed out that this quadrant ought to be given top priority, since neglect may pose a serious threat and dissatisfaction (Matzler *et al.,* 2003). Although temperature, fire safety & exit and aesthetics are located in Quadrant III (low both in satisfaction and importance), their position in the quadrant (above the 45° line) indicates that they also need attention. Lighting, cleanliness and structural safety are in Quadrant I (high both in satisfaction and importance) but fall above the 45° line; this implies that students are unsatisfied with these parameters as well. The overall performance is located in the Quadrant II (low satisfaction on highly important parameters) and above the 45° line. Ainin and Hisham (2008) pointed out that this quadrant ought to be given top priority, since their neglect may pose a serious threat and dissatisfaction (Matzler *et al.,* 2003). Hence the CPUT maintenance department needs to invest more resources in the old lecture theatre in order to achieve better satisfaction results.

The observations revealed that the door at the side of the lecture theatre is usually locked even during lectures and there were also no fire extinguishers, no fire detector and no fire alarm in the lecture theatre. Cleanliness was observed as moderate; in fact, students had quite a few complaints with the level of cleanliness of the lecture theatre. The HVAC system was not functioning on the first and second days of observation, but it was functioning during the last day of observation. The PA system in the theatre was not functioning during the days of observation. The lecture theatre looked structurally stable and adequately lit.

Based on all these analyses and observations, it can be concluded that the CPUT maintenance department needs to improve on all the performance parameters of this lecture theatre to achieve better satisfaction results. The parameters which need serious attention are the HVAC system (ventilation and temperature), sound control and fire safety & exit. In essence, the CPUT maintenance department needs to invest more resources in the old lecture theatre in order to improve its performance and achieve better satisfaction results.

Table 5.22: Importance satisfaction relationship (LT2BB)

Performance parameters	Imp. mean	Sat. mean	Mean diff.	t value	Sig. (2-tailed)
Temperature	4.18	2.43	-1.75	9.760	0.000
Ventilation	4.34	2.61	-1.73	10.638	0.000
Sound control	4.32	2.63	-1.69	10.415	0.000
Cleanliness	4.43	3.00	-1.43	9.413	0.000
Fire safety& exit	4.04	2.69	-1.35	7.519	0.000
Lighting	4.37	3.07	-1.30	8.634	0.000
Structural safety	4.45	3.19	-1.26	9.399	0.000
Aesthetics	3.85	2.72	-1.13	6.709	0.000
Overall	4.29	2.69	-1.60	10.120	0.000
Mean average	**4.25**	**2.79**			

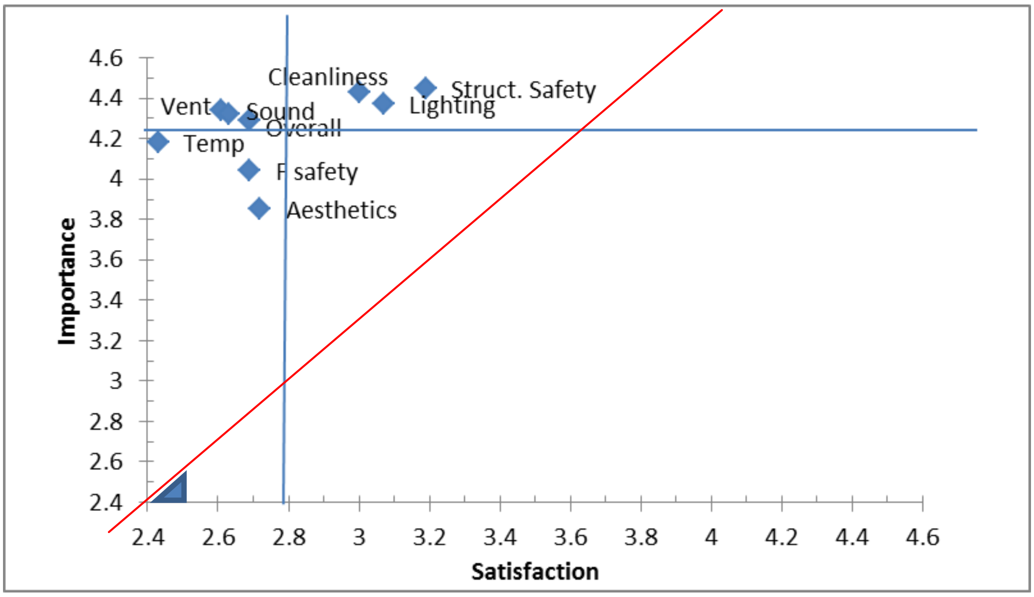


Figure 5.7: Importance satisfaction relationship: model (LT2BB)

5.11.4 Aggregate of lecture theatres

Like all the lecture theatres, the aggregated survey suggests that students perceived the satisfaction of all parameters as below their level of importance. Though the degree of differences demonstrated varied, the significant 2 tailed value obtained for all the parameters was less than 0.05, demonstrating that there are statistically significant differences between the mean scores for importance and satisfaction. From the variance (gap scores) analysis, it is obvious that ventilation, temperature, cleanliness, fire safety & exit and sound control have high gap scores, indicating big variations between importance and satisfaction. On the other hand, aesthetics, lighting and structural safety obtained comparatively low gap scores, suggesting that the current performance levels are quite satisfactory even though they are below students' satisfaction. The expectation and satisfaction analysis indicates that aggregately, students are dissatisfied with all the performance parameters except sound control and aesthetics.

The analysis of the IPA model shows that all the parameters fall above the 45° line. According to Leong (2008), parameters above the 45° line need attention. Clearly, there is the need to pay more attention to ventilation and temperature as they all fall in the Quadrant II. The observations support this analysis, revealing that the HVAC system (ventilation and temperature) was not functioning effectively. It is also evident that lighting, structural safety and cleanliness are all in Quadrant I (high both in satisfaction and importance) but also fall above the 45° line, implying that students are somewhat unsatisfied with these parameters. Aesthetics is located in Quadrant III. Matzler *et al.* (2003) suggested that it is unnecessary to focus additional efforts on parameters in Quadrant III. However, parameters that fall in this quadrant may cause discontinuation even though they are regarded low priority (Ainin & Hisham, 2008). Considering the location of aesthetics (above the 45° line), it is important to ensure careful deployment of resources so as to ensure better performance. Also, fire safety & exit falls above the 45° line, is located in between Quadrant III and Quadrant IV and is also close to the midpoint. The implication is that fire safety & exit also needs thoughtful attention. The aggregate overall performance is in Quadrant III (low both in satisfaction importance) but above the 45° line. Even though parameters in this quadrant are regarded as low priority they may cause discontinuation (Ainin & Hisham, 2008). Clearly the position of the aggregate overall performance (above the 45° line) implies that the CPUT maintenance department needs to be careful how resources are deployed to maintain the lecture theatres of the university.

It can be concluded, based on all the analyses and observations that the CPUT maintenance departments definitely needs to improve on the HVAC system (ventilation and temperature), fire safety & exit and sound control but without neglecting the other parameters. The aggregate overall performance shows that the CPUT maintenance department needs to improve on the performance of the lecture theatres, but there is need for a careful utilisation of resources.

Table 5.23: Importance satisfaction relationship (Total)

Performance parameters	Imp. mean	Sat. mean	Mean diff.	t value	Sig. (2-tailed)
Ventilation	4.32	3.09	-1.23	14.852	0.000
Temperature	4.20	3.06	-1.14	13.213	0.000
Cleanliness	4.32	3.33	-0.99	12.096	0.000
Sound control	4.19	3.25	-0.94	11.249	0.000
Fire safety& exit	4.10	3.29	-0.81	9.390	0.000
Lighting	4.37	3.58	-0.79	11.072	0.000
Structural safety	4.32	3.60	-0.72	10.868	0.000
Aesthetics	3.71	3.13	-0.58	6.824	0.000
Overall	4.07	3.27	-0.8	9.677	0.000
Mean average	**4.19**	**3.29**			

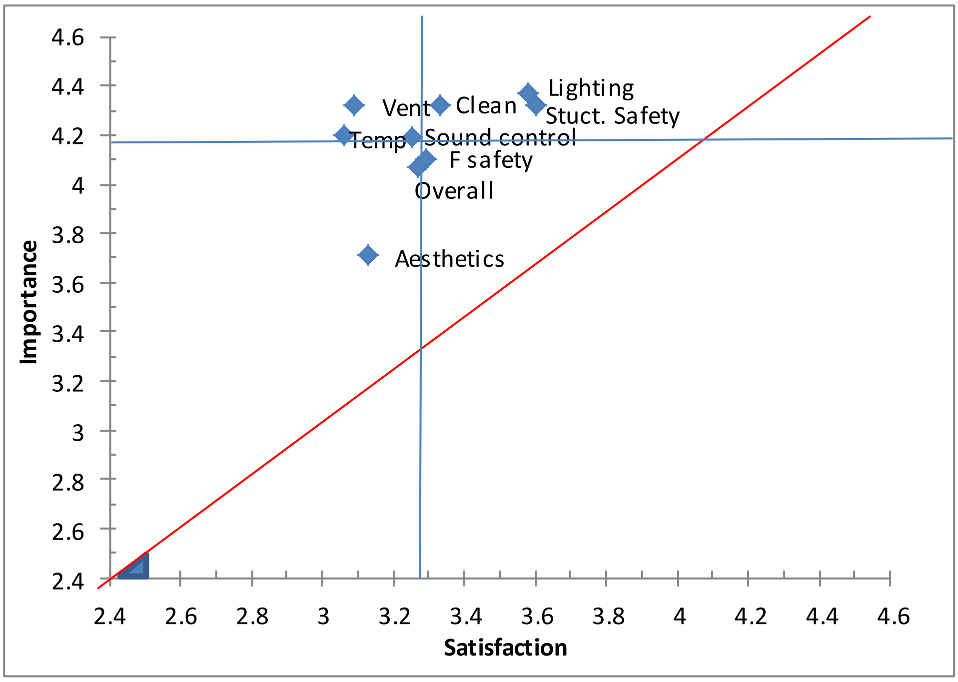


Figure 5.8: Importance satisfaction relationship: mode (Total)

5.12 Reliability test

The cronbach's alpha coefficient was used to check the reliability of the scale questions as well as the total number of scaled questions. Table 5.17 shows the summary of the reliability test for the questions. Gomm (2008) indicated that the closer the coefficient is to 1, the more reliable the instrument item; an optimal Conchbach's co-efficient alpha value should be above 0.7. It is evident that the questions satisfy the reliability test.

Table 5.24: summary of the reliability test

Question No	**Statement**	**No. of questions**	**Cronbach's alpha coefficient**
3	Importance of performance parameters to learning experience	8	0.80
5	Students expectation of performance parameters	8	0.84
6	Satisfaction of students' with performance parameters of theatre	8	0.83
	Total questions	24	0.87

5.13 Students' involvement in maintenance

This section presents the findings and discussions on the extent to which students are involved in the maintenance process, whether their involvement can ensure their satisfaction, and ways that could ensure their involvement in the maintenance of the lecture theatres. Ultimately, this section intends to illicit the students' view on how they could be involved in the maintenance process of the lecture theatres to ensure their satisfaction.

5.13.1 Level of student involvement in the maintenance process

Students were asked whether or not the maintenance department involves them in the maintenance management of the lecture theatres. Table 5.25 shows that a total of 41 (representing 15.1%) of the respondents responded 'Yes'; 161 (representing 59.2%) responded 'No'; and 70 (representing 25.7%) responded 'Don't know'. It is important to note that about one-fourth of the students were unsure whether they were involved or not. Though the responses in the different lecture theatres varied, it is evident from Table 5.20 and Figure 5.9 that there was a general consensus with the responses within the different lecture theatres: about 60% of the students in each lecture theatre responded 'No': 58.8% response for LT2MB, 57.6% for LT2BB, and 60.3% for ABCLT.

The literature revealed that building users are significant stakeholders in the maintenance management value chain. As a result, the performance of the lecture theatre could undoubtedly be enhanced if the maintenance department is able to recognise the gaps between what the students require and what they receive and take this into consideration when initiating maintenance (Olanrewaju *et al.*, 2011b). Olanrewaju (2009) insisted that building users ought to be involved in the maintenance management system to ensure that their satisfaction is proactively taken into account. Ideally, the focus of maintenance should be driven by the building users (Arazi *et al.*, 2009). Unfortunately the interview with the CPUT infrastructure and maintenance managers revealed that there is no prescribed user involvement system currently in place at CPUT. The interview findings are confirmed by the survey findings. The response indicates that the CPUT maintenance department does not involve the students nor seek their opinions in the maintenance of the lecture theatres.

Table 5.25: Level of student involvement in the maintenance process

Level of involvement	**LT2MB**		**LT2BB**		**ABCLT**		**Total**	
	N	% Within	N	% Within	N	% Within	N	Total %
Yes		18.8%	11	16.7%	15	11.9%	41	15.1%
No	47	58.8%	38	57.6%	76	60.3%	161	59.2%
Don't know	18	22.5%	17	25.8%	35	27.8%	70	25.7%
Total	80	100.0%	66	100.0%	126	100.0%	272	100.0%

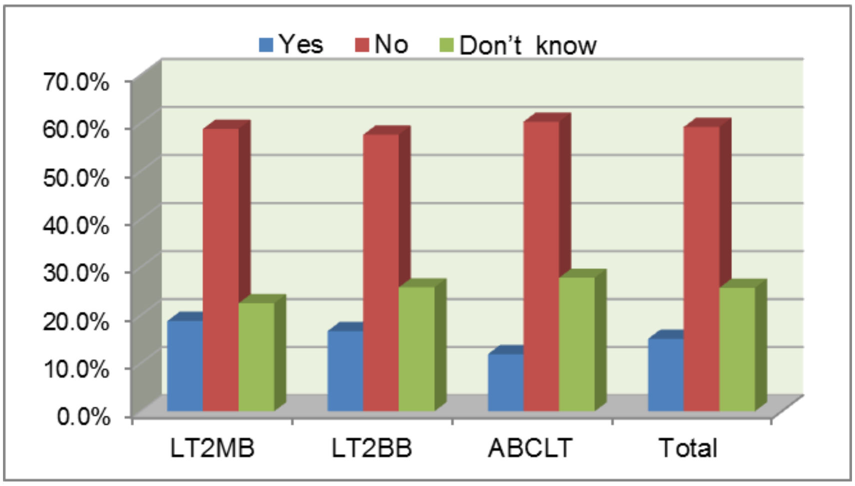


Figure 5.9: Level of student involvement in the maintenance process

5.13.2 Student involvement and satisfaction

Table 5.26 and Figure 5.10 show that 155 (representing 57.2% of the total respondents) responded 'Yes'; 51 (representing 18.8%) responded 'No'; while 65 (representing 24.0%) responded 'Don't know' to the question "do you think your involvement in the maintenance of the lecture theatre can ensure your satisfaction?". About one-fourth of the students were unsure and so responded 'Don't know'. The response suggests that the majority of students supposed their involvement in the maintenance of the lecture theatre could ensure their satisfaction. The response within the different lecture theatres were similar; however, students in LT2BB responded more affirmatively (66.7% "Yes" to 12.1% "No"); followed by LT2MB (59.5% "Yes" to 17.7% "No"); and lastly ABCLT (50.8% "Yes" to 23.0% "No").

Shen and Spedding (1998) insisted that building users ought to actively participate in the maintenance process to increase their satisfaction. Similarly, Olanrewaju (2009) elaborated that building users ought to be involved in the development of maintenance management system to ensure that their satisfaction is proactively taken into account. This finding is also supported by the literature. Surely involving students in the maintenance of the lecture theatre will ensure their satisfaction.

Table 5.26: Student involvement in relation to satisfaction

Effect of involvement	LT2MB		LT2BB		ABCLT		Total	
	N	% Within	N	% Within	N	% Within	N	Total %
Yes	47	59.5%	44	66.7%	64	50.8%	155	57.2%
No	14	17.7%	8	12.1%	29	23.0%	51	18.8%
Don't know	18	22.8%	14	21.2%	33	26.2%	65	24.0%
Total	79	100.0%	66	100.0%	126	100.0%	271	100.0%

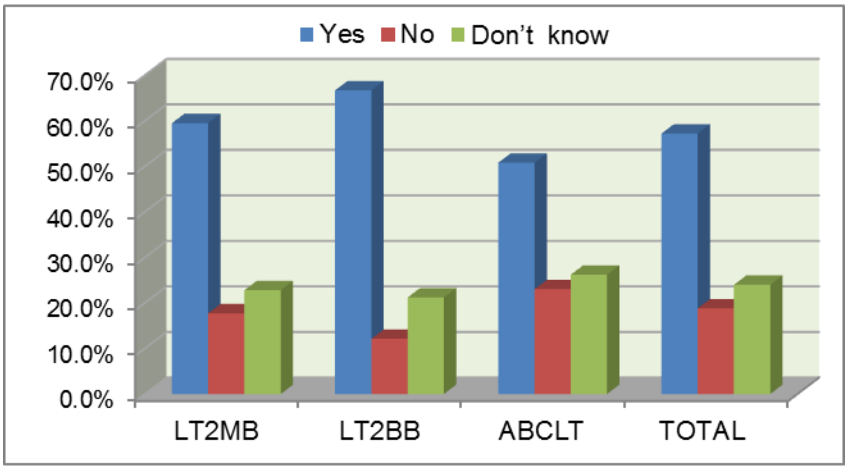


Figure 5.10: Student involvement in relation to satisfaction

5.13.3 Ways of ensuring students involvement

There was little information regarding how users could be involved in the maintenance process. Three different involvement strategies (suggestion box, maintenance coordinators, and forum at departmental levels) were identified and students were asked to rank these strategies, placing the most effective strategy for encouraging their effective involvement first. The response rate for this question was quite low; instead of ranking, some respondents ticked all the options provided. 52.7% of the respondents responded correctly; the response is presented aggregately and not by individual lecture theatre.

From Table 5.27, it is evident that students perceived that instituting a maintenance coordinator in the department will be the most effective way of ensuring their involvement (mean score of 2.19), followed by placing a suggestion box in the department (mean score of 1.91), and lastly, organising forums at departmental levels for students to provide information on problems in relation to maintenance of the lecture theatres (mean score of 1.89).

Table 5.27: Ranking feedback (involvement) options

Feedback system	Frequency & percentage N=149			Sum	Mean	Ranking
	First	Second	Third			
Maintenance coordinators	55 (36.9%)	68 (45.6%)	26 (17.4%)	327	2.19	1
Suggestion box	53 (35.6%)	29 (19.5%)	67 (45.0%)	284	1.91	2
Feedback forums	40 (26.8%)	53 (35.6%)	56 (37.6%)	282	1.89	3

Respondents were also requested to suggest other strategies that could be used to ensure their involvements. Strategies suggested by the students included the following:

- questionnaire survey and interview (the most suggested);

- creating a complaint form on the CPUT website/black board where students could log maintenance complaints;
- electronic mail; and
- class representative meeting.

Others also mentioned the need for regular inspections of the lecture theatres and follow-ups on work conducted in the lecture theatres by the CPUT maintenance department.

5.14 Proposed strategies

This section presents the proposed strategies that could be adopted by the CPUT maintenance department to guide and enhance lecture theatre maintenance. The section comprises proposed improvement priorities for the performance parameters, an order of prioritising the performance parameters, and involvement strategies to guide the maintenance of the lecture theatres.

5.14.1 Improvement priorities

Lecture theatres do influence students' learning experiences; hence it is vital to ensure that the performance of lecture theatres is conducive for students' learning. The mean scores obtained show that all the performance parameters of the lecture theatres are very important. To determine the parameters which need improvements, the analysis of variance, disconfirmation theory and the IPA model were applied to identify the well-performing and underperforming parameters. Improvement priorities were then proposed accordingly based on the analysis. To ensure proper deployments of maintenance resources of the university, the improvement priorities are proposed for each of the three different lecture theatres studied. It is hoped that the gap between importance and satisfaction will be reduced to ensure students' satisfaction if these proposals are implemented. The order of improvement for the identified underperforming parameters and the motivation for the order of improvement for each lecture theatre is presented.

5.14.1.1 New lecture theatre (LT2MB)

The IPA model shows that all the performance parameters are underperforming. The analysis of variance also indicates that all the parameters are underperforming; however, the parameters which have high gap scores are ventilation, sound control and cleanliness. The disconfirmation theory, though, indicates that students are actually satisfied with temperature and aesthetics but dissatisfied with the remaining parameters, particularly ventilation. It was also observed that LT2MB is in a good condition except that the HVAC system is controlled by a central plant and though can be regulated from inside, it does not usually produce desired thermal environment since it is powered centrally. Based on the analysis and observation, it can be concluded that the only parameter that really needs improvement is the ventilation. However, cleaning and sound control also need attention.

Ventilation appears to be the parameter that students are least satisfied with. The impact of ventilation (HVAC system) was reviewed in the literature: the freshness or stuffiness of a lecture theatre is somewhat influenced by ventilation. Inadequate ventilation also presents some health implications (Polh, 2011). The effectiveness of the HVAC system is dependent on how best it is regulated to achieve a continuous comfortable thermal environment. Polh (2011) noted that the range of temperature to which the human body can adjust without discomfort is quite minimal (i.e. between 75°F and 68°F); therefore, it is imperative to regulate the HVAC system to achieve a comfortable thermal environment. The HVAC system in the lecture theatre is controlled by a central plant; as such, the range of temperature obtained in the lecture theatres is beyond the control of either the lecturers or students (usually the temperature from the HVAC systems is either too hot or too cold). It is proposed that the central plant be upgraded as early as possible so that the HVAC systems will function properly at all times.

The CPUT maintenance department should also improve upon the supervision of the cleaning staff to ensure that the lecture theatres are always clean. Furthermore, the department should also recommend to teaching staff that they make use of the PA system to mitigate the problems students face with regard to hearing when seated at the back of the lecture theatre.

5.14.1.2 Intermediate lecture theatre (ABCLT)

The analysis of variance indicates that all the parameters are underperforming; however, the parameters which have high gap scores are ventilation, temperature, fire safety & exit, sound control and cleanliness. The IPA model confirms the analysis of variance. The disconfirmation theory on the other hand indicates that students are indifferent with the performance of ventilation and cleanliness but are dissatisfied with temperature and satisfied with sound control, aesthetics and fire safety & exit. The observations revealed that the installed HVAC system is controlled by a central plant and can only be regulated in a control room. Therefore, the temperature produced by the HVAC system is usually either too cold or too hot. Secondly, the rear doors are usually locked during lectures (they were locked on the dates of observations). Also the theatre is installed with a PA system which is functioning but not usually used. In addition, the theatre is usually fairly neat and clean, the floor is nicely carpeted and the rear is rounded and carpeted. Based on the analysis and observation, it can be concluded that the parameters that need improvement are fire safety & exit and temperature and ventilation (HVAC system). The maintenance department is also recommended to pay attention to cleanliness (supervision of cleaning staff) to ensure better performance. Also, the department should recommend to teaching staff to make use of the PA system.

Below is the proposed order of improvement for the identified underperforming parameters for the intermediate lecture theatre (ABCLT):

1 Fire safety and exit; and
2 Ventilation and temperature (HVAC system).

The first parameter for improvement is fire exit & safety. Fire safety & exit is not the least satisfying parameter; however, it is proposed that it be given first priority because of the danger it can pose to students. For the number of times observations were made, it was noticed that the rear doors were locked during lectures. According to Shen and Spedding (1998) safety items have a high risk on safety and could pose serious potential danger to the building users (students). Hence fire safety & exit need critical attention as their absence or malfunctioning could result in casualties. In addition, safety is a statutory requirement and requires immediate attention. It is recommended that all exit doors be unlocked during lectures.

The second parameter on the list for improvement is ventilation and temperature (HVAC system). The impact of ventilation and temperature (HVAC system) on students' learning experiences is highlighted already. It is proposed that the central plant be upgraded as early as possible so that the HVAC systems will function properly at all times. The possibility of developing a regulatory mechanism in the lecture theatre is also highly recommended.

5.14.1.3 Old lecture theatre (LT2BB)

The IPA model shows all the performance parameters are underperforming. The analysis of variance is also indicative that all the parameters are underperforming. The disconfirmation theory reveals that students are dissatisfied with all the parameters except aesthetics. From the observation, it appears that apart from lighting and structural safety, all the parameters and the overall performance of the old lecture theatre (LT2BB) are not performing well and for that matter need improvement.

Below is the proposed order of improvement for the identified underperforming parameters for the old lecture theatre (LT2BB). The motivation for the order is also presented.

1 Fire safety & exit
2 Ventilation and temperature (HVAC system)
3 Cleanliness
4 Sound Control
5 Aesthetics

The first parameter for improvement is fire exit & safety. Fire safety & exit is not the least satisfying parameter; however, it is proposed that it be given first priority because of the danger it can pose to students. For the number of times observations were made, it was noticed that one of the exit doors was locked and there were no fire extinguishers, fire detector or fire alarm in the lecture theatre. Safety items constitute high risk and could pose serious danger to the students. Hence it is recommended that fire extinguishers are placed in the lecture theatre and all exit doors are kept unlocked during lectures.

The second parameter on the list for improvement is ventilation and temperature (HVAC system). The effectiveness of the HVAC system is dependent on how best it is regulated to achieve a continuous comfortable thermal environment. It is proposed that a regulatory mechanism is developed in the lecture theatre so that lecturers and students can control the temperature of the HVAC system. The central plant should also be upgraded as early as possible so that the HVAC systems will function properly at all times.

The third on the list for improvement is cleanliness. Cleanliness appears to be a parameter that is often taken for granted. However, it is one of the crucial indicators of building quality (Uline & Tschannen-Moran, 2008). In addition, the lecture theatre's air quality can be positively influenced by cleanliness. Cleanliness does have a health implication and thus requires serious attention. The number of cleaning staff is not a problem. What is required is a level of supervision over the cleaning staff to ensure that they do their job competently.

The fourth consideration for improvement is the sound control system. The lecture theatre is designed to absorb sound; sound absorbing boards (acoustic panels) are fixed at the sides of the lecture theatre. The lecture theatre is also installed with a PA system but the system in the LT2BB is not functioning. The importance of acoustic control was highlighted in the literature review. It is recommended that the PA system should be repaired since some lecturers do not have voice loud enough to reach students who are seated at the back of the lecture theatre.

Fifth on the order for improvement is aesthetics. Some students of LT2BB had complaints about the appearance of the lecture theatres. It should be noted that LT2BB was painted after the questionnaire survey (painting was done during the vacation in July). Although the lecture theatre is now painted, there still remains a need to improve upon its general appearance. It is recommended that some level of attention be given to the old lecture theatre to improve its appearance.

5.14.1.4 Aggregate of lecture theatres

Aggregately, structural safety and lighting appear to be performing well in all the lecture theatres, whereas ventilation, temperature and sound control are underperforming. The current performance levels of the other parameters are acceptable, even though they are below students' satisfaction. The exception is fire safety & exit which is performing well in the new lecture theatre (LT2MB) but underperforming in the intermediate lecture theatre (ABCLT) and the old lecture theatre (LT2BB). Motivations have already been given for the order of improvement for the identified underperforming parameters of each lecture theatre. The order of priority below is proposed as a guide for improving the lecture theatres of the university.

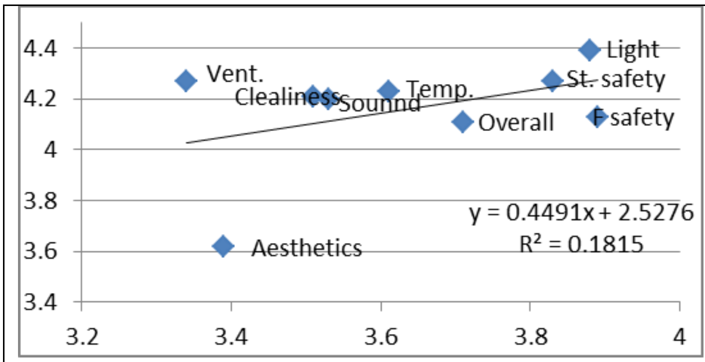
1. ***Fire safety and exit:*** safety is a statutory requirement and requires immediate attention. Safety items have a high risk and could pose serious danger to the students. The absence or malfunctioning of safety items could potentially result in casualties. It is recommended that all issues regarding safety be resolved immediately.
2. ***Ventilation and temperature (HVAC system):*** the maintenance manager indicated the need to upgrade the central plant which powers the HVAC systems in the lecture theatres. It is proposed that all malfunctioning HVAC systems be repaired and the central plant be upgraded as early as possible so that the HVAC systems function properly at all times.
3. ***Cleanliness:*** supervision of the cleaners is recommended. Placing dustbins in the lecture theatres will also be an inexpensive way of boosting the cleanliness of the lecture theatres.
4. ***Sound control:*** It is recommended that the PA systems which are not properly functional be repaired. Also, the teaching staff should be advised to make use of the PA system in each lecture theatre.

Building deterioration and obsolescence are inevitable and to be expected as part of the ageing process of a building (Mills, 1994; Douglas & Ransom, 2007). New lecture theatres, therefore, will naturally perform better than old ones. From the observations, LT2MB appeared to be in a comparatively better condition than the others, followed by ABCLT and then lastly LT2BB. Resources, therefore, need to be deployed accordingly for the maintenance of the lecture theatres. The old lecture theatre needs the most resources, followed by the intermediate and lastly the new.

5.14.2 Order of prioritisation

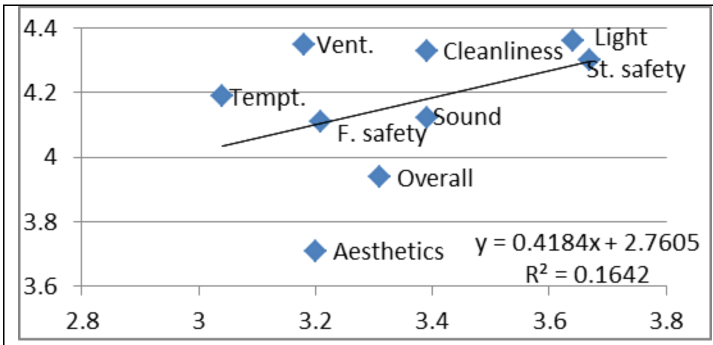
All the performance parameters of lecture theatres are very important, as the findings indicated. However, the cost of all required maintenance tasks in any given year is likely to exceed the budget. In fact, maintenance departments are not only faced with resource constraints but also with the constant reduction of the maintenance budget. Priority setting is thus vital for maintenance departments due to the constraints of resources. Matzler *et al.*, (2004) suggested that way forward when institutions face budget constraints is to decide on the manner by which scarce resources are deployed by prioritising. Therefore, an attempt was made to rank the parameters based on the mean scores obtained to help develop a prioritisation system for guiding the maintenance of the performance parameters of the lecture theatres. Both the explicit and implicit ranking is used. The satisfaction and explicit importance values are used to generate the implicit importance values. The decision to prioritise should be guided by both the implicit and explicit values. Matzler *et al.* (2003) explained that the performance factors are classified into two groups: 1) performance factors of high importance (high explicit/high implicit importance); and 2) performance factors of low importance (low explicit/low implicit importance). The tables below show how the implicit values for the lecture theatres were generated.

Table 5.28 Explicit and implicit importance values (LT2MB)



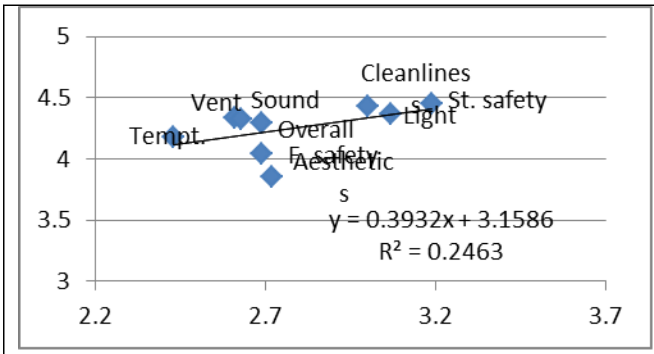
Performance parameters	Sat. mean	Explicit Imp. Mean	Implicit imp. Mean
Ventilation	3.34	4.27	4.03
Cleanliness	3.51	4.21	4.10
Sound control	3.53	4.20	4.11
Temperature	3.61	4.23	4.15
Lighting	3.88	4.39	4.27
Struct. safety	3.83	4.27	4.25
F. safety & exit	3.89	4.13	4.27
Aesthetics	3.39	3.62	4.05
Overall	3.71	4.11	4.19

Table 5.29 Explicit and implicit importance values (ABCLT)



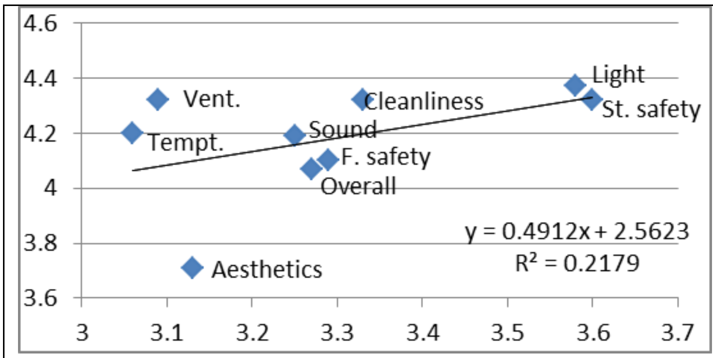
Performance parameters	Sat. mean	Explicit Imp. mean	Implicit imp. mean
Ventilation	3.18	4.35	4.09
Temperature	3.04	4.19	4.03
Cleanliness	3.39	4.33	4.18
F. safety & exit	3.21	4.11	4.10
Sound control	3.39	4.12	4.18
Lighting	3.64	4.36	4.28
Struct. safety	3.67	4.30	4.30
Aesthetics	3.20	3.71	4.10
overall	3.31	3.94	4.15

Table 5.30 Explicit and implicit importance values (LT2BB)



Performance parameters	Sat. mean	Explicit Imp. mean	Implicit Imp. mean
Temperature	2.43	4.18	4.11
Ventilation	2.61	4.34	4.18
Sound control	2.63	4.32	4.19
Cleanliness	3.00	4.43	4.34
F. safety& exit	2.69	4.04	4.22
Lighting	3.07	4.37	4.37
Struct. safety	3.19	4.45	4.41
Aesthetics	2.72	3.85	4.23
Overall	2.69	4.29	4.22

Table 5.31 Explicit and implicit importance values (Total)



Performance parameters	Sat. mean	Explicit Imp. mean	Implicit Imp. mean
Ventilation	3.09	4.32	4.08
Temperature	3.06	4.20	4.07
Cleanliness	3.33	4.32	4.20
Sound control	3.25	4.19	4.16
F. safety & exit	3.29	4.10	4.18
Lighting	3.58	4.37	4.32
Struct. safety	3.60	4.32	4.33
Aesthetics	3.13	3.71	4.10
Overall	3.27	4.07	4.17

Table 5.31 Ranking of performance parameters

Performance parameters	LT2MB		ABCLT		LT2BB		TOTAL	
	Explicit	Implicit	Explicit	Implicit	Explicit	Implicit	Explicit	Implicit
Lighting	1	1	1	2	3	2	1	2
Structural safety	2	3	4	1	1	1	2	1
Ventilation	3	8	2	7	4	7	4	7
Temperature	4	4	5	8	6	8	5	8
Cleanliness	5	6	3	3	2	3	3	3
Sound control	6	5	6	3	5	6	6	5
Fire safety & exit	7	1	7	5	7	5	7	4
Aesthetics	8	7	8	5	8	4	8	6

Table 5.28 shows the ranking, implicit and explicit, of the parameters as provided by students. Although the rankings obtained were not the same among the different lecture theatres, explicitly, lighting, structural safety, ventilation and cleanliness were highly ranked whereas fire safety & exit and aesthetics were ranked seventh and eighth respectively in all the lecture theatres. Contrary to the literature and the infrastructure and maintenance managers' ranking, respondents ranked fire safety & exit very low, likely because it does not have a direct effect on students' learning experience. It is worth noting that respondents ranked cleanliness very high; the infrastructure manager also pointed out that cleanliness is actually a health-related issue. Unsurprisingly, sound was ranked subsequent to lighting, ventilation and temperature, while aesthetics (i.e. appearance) was ranked last. Their position in the ranking is consistent with findings in literature. Clearly, respondents ranked the parameters that have a direct impact on their learning experience more highly than those that do not. The implicit ranking confirms the high importance of structural safety, lighting cleanliness and fire safety & exit; all these parameters were highly ranked implicitly. Matzler *et al.* (2003) underscored the high importance of the performance factors which are both high explicitly and implicitly. Sound control is implicitly ranked ahead of aesthetics. Surprisingly, ventilation and temperature are the lowest ranked parameters implicitly.

Based on the ranking, implicit and explicit, obtained from the findings of the survey, the literature review, as well as the opinion of the maintenance and infrastructure managers, an order of priority is proposed for adoption by the CPUT maintenance department as a guide for maintaining the parameters of lecture theatres. The order shows which parameter needs to be given first priority if there are numerous demands to be met. Motivation and sequence are enumerated thus:

1 Structural safety
2 Fire safety& exit
3 Cleanliness
4 Lighting
5 Ventilation
6 Temperature (Thermal Comfort)
7 Sound Control
8 Aesthetics (Appearance)

Structural safety and fire safety & exit (safety) are placed first and second respectively because they are health, safety and environmentally significant items (Horner *et al*., 1997). These items, according to Shen and Spedding (1998), have a high risk on health or safety that could pose serious potential danger to the building users. As a matter of fact, the absence of safety measures can lead to accidents and sickness (Lackney, 1999a). Additionally, safety is a statutory consideration and therefore requires prime attention (Watt, 2007). The literature of the Department of Treasury and Finance (2005), Earthman (2004), Lackney (1999b), Horner *et al.* (1997), NSW Heritage office (2004), Shen and Spedding (1998) and Wood (2009) endorses safety as the first order of importance when prioritising maintenance needs.

Cleanliness is placed third on the grounds that it is a health-related issue and requires critical attention equal to safety; the high mean scores obtained in the survey confirm that. The infrastructure manager also indicated that cleanliness is related to health. In fact, Uline and Tschannen-Moran (2008) identified cleanliness as one of the crucial indicators of building quality. Furthermore, SBS is somewhat connected with cleanliness, hence the need to pay significant attention to it.

The remaining parameters are utility significant items: their failure is likely to have an effect on user satisfaction, appearance and serviceability of the lecture theatre. Lighting assumes the forth position based on the high mean score obtained from the survey and the importance revealed by the literature. Polh (2011) stated that light is one of the parameters of building design which requires a very important consideration. Poor indoor lighting could result in fatigue, eye strain, blurry vision, headaches and other health issues (Lackney, 1999a). In other words, light can affect the health and learning of students (Leung & Fung, 2005).

Ventilation and temperature (thermal comfort) are ranked fifth and sixth respectively based on the mean scores obtained and the importance revealed by the literature. These two parameters are related; an effective HVAC system deals collectively with them. In fact, any inadequacy of the HVAC systems can cause unnecessary distraction to students, who may spend more time sweating or shivering instead of learning (Bishop, 2009). The “sick building syndrome’’ (SBS), potentially resulting in respiratory illness, is caused by poor indoor air quality (Lackney, 1999a) which is a factor of ventilation and temperature.

Sound control and aesthetics assume their respective seventh and eighth positions; the mean scores obtained in the survey and the literature of Earthman (2004), Lackney (1999b), Horner *et al.* (1997), Shen and Spedding (1998) and Wood (2009) also support their positions in the ranking.

5.14.3 Students' involvement strategies

Involving students in the maintenance process of the lecture theatres is one sure way to ensure their satisfaction. It also helps to best prioritise the parameters to be maintained according to the expectations of students. It became apparent from the survey and interviews that CPUT students are not involved in the maintenance process of the lecture theatres whereas their involvement could ensure their satisfaction. From the survey and the interview, these practical students' involvement strategies are proposed:

- The maintenance department should formally institute maintenance co-ordinators (or care-takers) in all academic departments who will coordinate the affairs of building maintenance. There seem to be coordinators in some departments, health and safety for example; however, there is the need for this to be formalised and made apparent to students. These co-ordinators could be tasked with simple observation of the lecture theatres and the building and could then meet with the maintenance department on regular basis to discuss issues relating to maintenance.

- Organising forums at departmental levels for students to provide information on problems in relation to maintenance of the lecture theatres could also be considered. This strategy will help the appointed maintenance co-ordinators interact with students and thus get valuable information from them.

- Thirdly, a suggestion box could be placed in all academic departments; students can then put their complaints in the box. Placing a suggestion box is an inexpensive strategy that could be easily implemented.

- An occasional questionnaire survey in a form of post-occupancy (performance) evaluation would be a valuable strategy that will also ensure student involvement and promote their satisfaction. Although it is quite an expensive strategy, the accrued value makes it worthwhile.

5.15 Chapter summary

This chapter discussed the findings of the study and the proposed strategies relative to the reviewed literature. SPSS and IPA model were utilised in this chapter. The findings revealed that the performance of lecture theatres affects learning experiences, and that all the performance parameters are important to students' learning experience. However, lighting, structural safety, ventilation and cleanliness were more highly ranked than fire safety & exit and aesthetics, which were ranked seventh and eight respectively in all the lecture theatres. It also became evident that students were satisfied with two of the parameters of the lecture theatres, structural safety and lighting. The mean scores obtained for the remaining parameters suggested a feeling of neutrality. It was also found that students' importance mean scores were significantly higher than their performance (satisfaction) mean scores.The IPA also revealed that all the performance parameters are underperforming. However structural safety and lighting seemed to be performing satisfactorily, whereas ventilation, temperature, sound control and fire safety & exit (particularly in ABCLT and LT2BB) need improvement. In essence, the CPUT maintenance department needs to work harder to achieve better satisfaction results for ventilation and temperature (HVAC system), fire safety & exit (particularly in ABCLT and LT2BB) and sound control.

It also became apparent that the majority of students are not involved in the maintenance management process of the lecture theatres even though their involvement could ensure their satisfaction. Students perceived that instituting a maintenance coordinator in the department would be the most effective way of ensuring their involvement, followed by placing a suggestion box in the department, and organising forums at departmental levels. An occasional questionnaire survey was highly recommended by students as well.

CHAPTER SIX
CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This chapter concludes the study, highlights the limitations and offers recommendations for further research.

The aim of the study was to develop strategies for maintaining the performance parameters of lecture theatres to ensure a performance level that meets the satisfaction of students and consequently promotes their learning experience. To achieve this aim, these specific objectives were formulated:

- Investigate the maintenance management systems (students' involvement, prioritisation system and strategies) adopted by the CPUT maintenance department for maintaining the lecture theatres.
- Assess whether or not the performance of lecture theatres affects the learning experience of students.
- Determine the level of importance students attach to each specified building performance parameter and the overall performance of the lecture theatre.
- Determine how well the expectations of students are met in relation to each specified building performance parameter.
- Determine how satisfied the students are with each specified building performance parameter and the overall performance of the lecture theatre.
- Apply the IPA model to develop prioritisation and improvement strategies to guide the maintenance of the performance parameters of the lecture theatres.
- Analyse the extent to which students are involved in the maintenance management process of the lecture theatres.

6.2 Conclusions

6.2.1 Maintenance management systems of the maintenance department

The purpose of this objective was to aid the discussions of the study and also help with the development of the prioritisation and improvements strategies. The objective was achieved by means of interviews and observations. It was discovered that the CPUT maintenance department does not currently have an official maintenance prioritisation policy or a system that guides the maintenance of the lecture theatres even though there is a guideline for the prioritisations of maintenance needs. Though the department uses an integrated maintenance strategy (planned, reactive and condition-based), this is not comprehensive. Also, the maintenance department does not have a prescribed user involvement system.

6.2.2 Effect of lecture theatres performance on students' learning experience

The initial exploratory study was indicative that the performance of a lecture theatre does impact students' learning experiences. It was also reviewed in the literature that any inadequacy with university lecture theatres will seriously affect the achievement of the university's prime objective, because as a factor that contributes to engagement, lecture theatres have the ability to influence students' learning. Olanrewaju (2010b) added that the physical setting in which learning takes place impacts on the whole learning process. Several studies reviewed in the literature also revealed that the condition or performance of university building facilities (e.g. lecture theatres) do have an impact on the learning experience of students. Similarly, this study also found that the performance of lecture theatres affects learning experience.

6.2.3 Importance of building performance parameters

The literature reviewed emphasised the importance of the individual performance parameters to students' learning experiences. Any inadequacy, malfunctioning or absence of these parameters can cause unnecessary distraction for students and possible health problems. The analysis of the response of the questionnaire also revealed that all the parameters are indeed important to students' learning. Although the responses in the different lecture theatres varied, the variation was of no significance. Respondents in all the lecture theatres perceive all the performance parameters as important to their learning experience.

The findings also revealed that respondents ranked lighting, structural safety, ventilation and cleanliness highly whereas fire safety & exit and aesthetics were ranked seventh and eighth respectively in all the lecture theatres. It is worth noting that respondents ranked cleanliness very high. In fact, Uline and Tschannen-Moran (2008) identified cleanliness as one of the crucial indicators of building quality. Unsurprisingly, sound was ranked lower than ventilation and temperature while aesthetics was ranked last; their position in the ranking is consistent with the literature and the infrastructure and maintenance managers' ranking. However, respondents ranked fire safety & exit comparatively low and lighting highest, which is contrary to the literature and the infrastructure and maintenance managers' ranking. Clearly, respondents ranked the parameters that have a more direct impact on their learning experience more highly than those that do not.

6.2.4 Expectation of performance parameters

It was highlighted in the literature that meeting the requirements of building users invariably affects their satisfaction, and that conversely, users are unsatisfied when buildings fail to meet their requirements. The findings of the studies suggest that respondents demonstrated a feeling of neutrality with ventilation and aesthetics in all the lecture theatres. While structural safety and lighting met the expectation of students in the new lecture theatre (LT2MB) and intermediate lecture theatre (ABCLT), those from the old lecture theatre (LT2BB) demonstrated a feeling of neutrality. The expectation of respondents in LT2MB regarding cleaning, sound control, temperature and fire safety & exit were also met while those from ABCLT and LT2BB were neutral. Comparatively, the expectations of students in the new lecture theatre (LT2MB) are better met, followed by the intermediate (ABCLT) and lastly the old (LT2BB).

6.2.5 Students' satisfaction level of lecture theatre performance

The literature revealed that deterioration and obsolescence are inevitable and to be expected as part of the ageing process of a building. New lecture theatres are thus expected to perform relatively better than old ones. The study found that there were statistically significant differences in the responses of the different lecture theatres. Comparatively, the students from the new lecture theatre (LT2MB) were more satisfied with the lecture theatre performance, followed by the intermediate lecture theatre (ABCLT) and lastly the old lecture theatre (LT2BB). From the observations, LT2MB appeared to be in a comparatively better condition followed by ABCLT and lastly LT2BB.

It became apparent from the findings of the survey that respondents from LT2MB were satisfied with all the performance parameters except aesthetics and ventilation for which they expressed a feeling of neutrality. Respondents in LT2MB were most satisfied with fire safety & exit, followed by lighting and structural safety respectively, but were least satisfied with ventilation. The responses obtained from ABCLT indicated that respondents were satisfied with structural safety and lighting but demonstrated a state of neutrality for the remaining parameters. The most satisfying parameter was structural safety while as the least satisfying parameters were ventilation and temperature. Students from LT2BB were not satisfied with any of the performance parameters of the lecture theatre; a feeling of neutrality towards dissatisfaction was expressed. The most satisfying parameter was structural safety whereas the least satisfying parameters were ventilation and temperature. Aggregately, students were satisfied with only two of the parameters of the lecture theatre: structural safety and lighting. The mean scores obtained for the remaining parameters suggested a feeling of neutrality. The least satisfying parameters were ventilation and temperature respectively. The outstanding complaints were with the HVAC system (ventilation and temperature) followed by fire safety & exit (particularly with ABCLT and LT2BB), sound control, cleanliness and finally aesthetics. Students had virtually no complaints pertaining to lighting and structural safety.

6.2.6 Importance performance analysis (IPA)

Though three groups of lecture theatres were used, the study showed that students perceived the satisfaction of all parameters as below their level of importance. Students' importance mean scores were significantly higher than their performance mean scores. Though all the performance parameters appear to be underperforming, the performance of structural safety and lighting seemed to be satisfactory in all the lecture theatres. But ventilation, temperature, sound control and fire safety & exit (particularly in ABCLT and LT2BB) are clearly underperforming and thus need improvement. Hence, the CPUT maintenance department needs to work harder to achieve better satisfaction results for ventilation and temperature (HVAC system), fire safety & exit (particularly in ABCLT and LT2BB) and sound control.

6.2.7 Students' involvement in the maintenance process

The literature reviewed suggested that students are part of the stakeholders in the maintenance management of a university and therefore should be actively involved in the maintenance management system to ensure that their satisfaction is taken into account. It also became apparent that the performance of the lecture theatre could be enhanced if the maintenance department is able to recognise the gaps between what the students require and what they receive and take this into serious consideration when initiating maintenance. The study found that CPUT students are not involved in the maintenance process of the lecture theatres whereas their involvement could ensure their satisfaction. Students perceived that instituting a maintenance coordinator in the department would be the most effective way of ensuring their involvement, followed by placing suggestion box in the department, and organising forums at departmental levels for students to provide information on problems relating to maintenance of the lecture theatre. Students also suggested that questionnaire survey or informal interview and creating a complaint form on the CPUT website/black board where they could log maintenance complaints could ensure their involvement and satisfaction.

6.3 Limitation

The research is conducted within the Western Cape Province of South Africa; however, the study was further limited to three lecture theatres of CPUT. The study did not focus on all teaching facilities but only on specific building parameters of the lecture theatres. Also, the focus of the interview was only on the building maintenance prioritisation, user involvement and maintenance strategies.

It was quite challenging to get respondents to participate in the study. Besides, some respondents did not complete the questionnaire entirely. Most respondents were also unable to respond correctly to one of the questions (Q.4) on the questionnaire; hence, it was ruled out. Also only 52.7% of the respondents were able to respond correctly to question 11 of the questionnaire and therefore the analysis was made based on that. Additionally, getting documents from the maintenance department proved difficult and therefore hampered the development of the maintenance strategies.

Some of the findings like students' satisfaction level of lecture theatre performance and IPA analysis are limited to the three lecture theatres which were used for the study and are not generalisable to all the lecture theatres in the institution and beyond. However, others like the effect of lecture theatres performance on students' learning experience, importance of building performance parameters and involvements strategies could be generalised.

6.4 Recommendation and further studies

Shen and Spedding (1998) emphasised that safety items have a high risk and could pose serious potential danger to the building users (students). Safety is actually a statutory consideration (Watt, 2007) and therefore requires crucial attention. Fire safety & exit needs to be given a critical attention because of the danger it can pose to students. It is recommended that the CPUT maintenance department or the authority responsible for ensuring safety in CPUT should ensure that all exit doors are unlocked during lectures and also provide fire extinguishers in all lecture theatres that are without.

The performance of lecture theatres as well as students is highly dependent on the effectiveness of the HVAC system installed. Any inadequacy of the HVAC systems can cause unnecessary distraction to students, who may spend more time sweating or shivering instead of learning (Bishop, 2009). Ventilation and thermal comfort also present some health consequences (Polh, 2011). Polh (2011) noted that the range of temperature to which the human body can adjust without discomfort is quite minimal (i.e. between 75°F and 68°F); therefore, it is imperative to regulate the HVAC system to achieve a comfortable thermal environment. The HVAC systems in the lecture theatres are controlled by a central plant; as such, the range of temperature obtained in the lecture theatres is beyond the control of either the lecturers or students. The maintenance manager indicated the need to upgrade the central plant which powers the HVAC systems in the lecture theatres. It is recommended that the central plant be upgraded as early as possible so that the HVAC systems will function properly at all times. Developing a regulatory mechanism in the lecture theatres that do not have such mechanism is also highly recommended.

The lecture theatre serves as a communication channel for both teachers and students for their teaching and learning experiences. The ability to hear clearly in a lecture theatre is certainly crucial for student learning experience (Earthman, 2004); this hearing ability is dependent almost entirely on the acoustical conditions in the lecture theatres (Lubman & Sutherland, 2001). It is therefore recommended that the PA systems which are not properly functional be repaired. Also, the teaching staff should be advised to make use of the PA system particularly when lecturing in the big lecture theatres.

Since the involvement of students in the lecture theatres maintenance could ensure their satisfaction, it is recommended that the CPUT maintenance department should adopt the proposed involvement strategies developed in this study.

A computerised maintenance management system is one of the tools that is gaining ground and promoting effective maintenance management. However, the interview revealed that the CPUT maintenance department does not currently have a computerised maintenance management system in place; it is highly recommended that the institution help the maintenance department to purchase one as that will help with the planning, strategies, documentation and monitoring of maintenance.

As this study concentrated on only the students, a further study to include teaching staff, additional lecture theatres and more performance parameters is highly recommended as it will provide a broader perspective to further help the CPUT maintenance department better maintain the lecture theatres with the intention of satisfying both students and teaching staff.

This study concentrated on specific parameters; however, students in particularly pointed out problems of ergonomics; it is recommended that a further study be conducted on the area of lecture theatre ergonomics as this has great influence on the comfort of students.

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APPENDICES

APPENDIX A- PERMISSION LETTER

Cape Peninsula
University of Technology

E-mail: laings@cput.ac.za
Tel. 0219596255
Fax: 0219596603

21st May 2012

To Whom It May Concern:

Re: Student F. Simpeh.

Mr. F. Simpeh, student number 209243775, is a student at the Built Environment Faculty of CPUT. He is currently busy with his research study, "A study of the Maintenance prioritization and feedback system of university institutions in the Western Cape". Ms Z. Khan is overseeing his research and can be contacted at X6630. This letter grants him permission to conduct interviews for his study. Your assistance will be appreciated.

Regards

S LAING
A/DIRECTOR: FACILITIES

APPENDIX B- INTERVIEW QUESTIONS

PRIORITIZATION OF MAINTENANCE NEEDS

1. Does the maintenance department have a policy on prioritising the maintenance needs of the lecture theatres?
2. If no, why is there no such policy?
    b. How do you decide on the maintenance need to attend to first when there are several needs to be attended to?
3. If yes, what are covered in the prioritisation policy?
    b. On what basis do you decide on the priorities?
    c. Why those basis?
    d. Who (monitor) ensures that the prioritisation system is adhered to?
4. What challenges do you encounter as a department with the implementation of the maintenance prioritisation system?
5. In the instance of budget constraints, how would you prioritized the following building features in a lecture theatre

Building performance parameters (features)	Ranking
Safety condition	
Temperature i.e. the coldness or warmness of the theatre	
Ventilation i.e. air circulation and indoor air quality of the theatre	
Sound (acoustical) control system of the theatre	
Lighting of the theatre i.e. adequacy of light	
Aesthetic features e.g. the ceiling, internal wall and floor finishes	
Cleanliness and neatness of the theatre	

MAINTENANCE MANAGEMENT STRATEGIES

1. Does the maintenance department have a strategy for maintaining the performance parameters of the lecture theatres?
2. If no, why don't you have maintenance strategies?
3. If yes, which maintenance strategies are used for each and why (what are considered before the choice is made)?

- Safety requirements of the theatre such as fire safety (extinguisher), emergency exit signage, security systems, structural safety etc.
- Temperature and ventilation i.e. HVAC systems (indoor air quality).
- Sound (acoustical) control system of the theatre.
- Lighting of the theater.

- Aesthetic features e.g. the ceiling, internal wall and floor finishes and decoration of the theatre.
- Cleanliness and neatness of the theatre.

4. How do the maintenance department follow up on the strategies?
5. What challenges do the department encounter with the implementation of the maintenance strategies of the institution?

FEEDBACK SYSTEM (USER INVOLVEMNET)

1. Are there feedback-systems (clear communication channels) used to ensure that students are involved in the maintenance (process) of the lecture theatres?
2. If no, why are there no feedback systems (why are they not involved)?
   b. How does the department determine the needs of the students?
   c. How does the department ensure that the needs of the students are satisfied?
3. If yes, what are some of the feedback systems used?
   b. How do you get the feedback from the students (how does the system work)?
   c. How well are they involved?

Information on the following lecture theatres

ABC lecture theatre

Business building LT2

Mechanical building (new lecture theatre LT2)

- When they were built (age)
- Size and number of seat
- Special features
- Maintenance plans for the theatres

APPENDIX C- QUESTIONNAIRE SURVEY

This research study is undertaken by a student at the Cape Peninsula University of Technology within the Department of the Built Environment for the purpose of pursuing a Master's degree in Construction Management (Facilities Management).

Aim and scope of this study

The research seeks to determine and rank the building performance parameters (features) of a lecture theatre based on their level of importance and how satisfied the students are with these performance parameters.

To complete the questionnaire

Please read these carefully and keep them in mind as you answer the questions.

For the purpose of the study, building performance is synonymous to building condition and the performance parameters are defined in terms of:

- **Fire safety & exit**: safety condition relating to fire such as fire extinguisher, fire alarm systems, emergency exit doors, illumination exist signs and direction.
- **Structural safety**: safety condition relating to the structure such as cracks in walls.
- **Temperature**: the coldness or warmness of the theatre.
- **Ventilation**: air circulation and indoor air quality of the theatre.
- **Sound (acoustical) control system**: the prevention of both internal and external noise from the theatre.
- **Lighting:** adequacy of light in the theatre.
- **Aesthetic features**: i.e. the ceiling, internal wall and floor finishes and decoration of the theatre.
- **Cleanliness and neatness** of the theatre.

The questionnaire should take about **10 minutes** to complete.

Please indicate your response by placing an (X) or a tick (√) in the appropriate column per item.

<u>SECTION A: BUILDING PERFORMANCE OF LECTURE THEATRES</u>

1. Does the condition of lecture theatres affect your learning experience?

☐ Yes ☐ No ☐ Don't know

2. How important is the condition of a lecture theatre to your learning experience?

not relevant (1)	Unimportant (2)	Neutral (3)	Important (4)	Very important (5)
1	2	3	4	5

3. Rate how important these building performance parameters (features) are to your learning experience in a lecture theatre by placing an (X) or a (√) in the appropriate column per item.

How important are these individual building performance parameters (features) to your learning experience in a lecture theatre		Not relevant (1)	Unimportant (2)	Neutral (3)	Important (4)	Very important (5)
3.1	Fire safety & exit	1	2	3	4	5
3.2	Structural Safety	1	2	3	4	5
3.3	Temperature	1	2	3	4	5
3.4	Ventilation	1	2	3	4	5
3.5	Sound (acoustical) control system	1	2	3	4	5
3.6	Lighting	1	2	3	4	5
3.7	Aesthetic features	1	2	3	4	5
3.8	Cleanliness and neatness	1	2	3	4	5

4. **Safety** (**fire, exit and structural) exempted**, kindly rank the performance parameters (features) that have the greatest impact on learning experience in a lecture theatre from **1 (least important)** to **6 (most important)** in the column provided**, <u>no number must be repeated.</u>**

Building performance parameters (features)		Ranking
4.1	Safety	
4.2	Temperature	
4.3	Ventilation	
4.4	Sound (acoustical) control system	
4.5	Lighting	
4.6	Aesthetic features	
4.7	Cleanliness and neatness	

SECTION B: SATISFACTION LEVEL OF LECTURE THEATRE PERFORMANCE

5. To what extent do the following building performance parameters of this lecture theatre meet your expectations in relation to your learning experience? Respond by placing an (X) or a tick (√) in the appropriate column per item.

Building performance parameters (features)		Expectations				
		Not at all	Not well	Neutral	Well	Very well
5.1	Fire safety & exit	1	2	3	4	5
5.2	Structure Safety	1	3	3	4	5
5.3	Temperature	1	2	3	4	5
5.4	Ventilation	1	2	3	4	5
5.5	Sound (acoustical) control system	1	2	3	4	5
5.6	Lighting of the theatre i.e. adequacy of light	1	2	3	4	5
5.7	Aesthetic features	1	2	3	4	5
5.8	Cleanliness and neatness of the theatre	1	2	3	4	5

6. Rate how satisfied you are with the following building performance parameters of this lecture theatre in relation to your learning experience by placing an (X) or a tick (√) in the appropriate column per item.

Building performance parameters (features)		Satisfaction level				
		Very unsatisfied	Unsatisfied	Neutral	Satisfied	Very satisfied
6.1	Fire safety & exit	1	2	3	4	5
6.2	Structure Safety	1	3	3	4	5
6.3	Temperature	1	2	3	4	5
6.4	Ventilation	1	2	3	4	5
6.5	Sound (acoustical) control system	1	2	3	4	5
6.6	Lighting of the theatre i.e. adequacy of light	1	2	3	4	5
6.7	Aesthetic features	1	2	3	4	5
6.8	Cleanliness and neatness of the theatre	1	2	3	4	5

7. How satisfied are you with the overall performance of this lecture theatre?

Very unsatisfied (1)	Unsatisfied (2)	Neutral (3)	Satisfied (4)	Very satisfied (5)
1	2	3	4	5

8. Please use the space below to provide additional comments about the level of satisfaction of the lecture theatre, (**<u>why you are or are not satisfied</u>**) if any.

Fire safety & exit ……………………………………………………………………………………………
……….

Structural safety……………………………………………………………………………………………..
……….

Temperature…………………………………………………………………………………………………
………
………

Ventilation……………………………………………………………………………………………………
………
………

Sound……
………

Lighting………………………………………………………………………………………………………
………

Aesthetic/decoration………………………………………………………………………………………
………

Cleanliness/**neatness**……………………………………………………………………………………
………

SECTION C: STUDENT'S INVOLVEMENT IN THE MAINTENANCE OF THE LECTURE THEATRE

9. Does the maintenance department involve you (by getting feedback information form you) in the maintenance of the lecture theatre?

☐ Yes   No ☐   Don't know ☐

10. Do you think your involvement in the maintenance of the lecture theatre (provision of feedback information) can ensure your satisfaction?

☐ Yes   No ☐   Don't know ☐

11. Which of the following can ensure effective feedback from users in the maintenance of the lecture theatres? Kindly respond by ranking the feedback systems from **1 (least important)** to **3 (most important)** in the column provided**<u>, no number must be repeated.</u>**

	Feedback systems	Ranking
11.1	Suggestion box in the departments	
11.2	Maintenance coordinators in departments	
11.3	Forum to provide feedback on problems in departments	

12. In your opinion, which other strategies can the maintenance department adopt to ensure feedbacks from students in the maintenance (process) of the lecture theatres?
……
……
……
……
………

<u>THANK YOU FOR YOUR PARTICIPATION AND COOPERATION</u>

APPENDIX D- OBSERVATION CHECKLIST

Parameters	**Observation**
Structural safety • Stability of structure • Cracks in building	
Fire safety & exit • Exit doors • Fire extinguishers • Signage/illumination • Fire alarm • Fire detector	
Ventilation and Temperature • Windows • HVAC system • Regulation of HVAC system	
Sound control • Noise level of HVAC system • PA system • Sound insulation	
Lighting • Emergency light • Board light • Natural light • Lecture room light	
Cleanliness • Walls and ceilings • Floor/ground	
Aesthetics • Floor finish • Wall and ceilings finish (colour) • Special features	