EXAMINING ISSUES INFLUENCING EFFECTIVE FACILITIES MANAGEMENT PRACTICE ON SELECTED PUBLIC SECTOR BUILDINGS IN SOUTH AFRICA

BY

PETRONELLA MINENHLE NDLOVU

A RESEARCH THESIS SUBMITTED IN FULFILMENT OF THE ACADEMIC REQUIREMENTS OF MASTER OF THE BUILT ENVIRONMENT

IN THE

DEPARTMENT OF CONSTRUCTION MANAGEMENT AND QUANTITY SURVEYING, FACULTY OF ENGINEERING AND THE BUILT ENVIRONMENT

AT THE

DURBAN UNIVERSITY OF TECHNOLOGY, SOUTH AFRICA

SUPERVISOR: DR MC MEWOMO

AUGUST 2021

EXAMINING ISSUES INFLUENCING EFFECTIVE FACILITIES MANAGEMENT PRACTICE ON SELECTED PUBLIC SECTOR BUILDINGS IN SOUTH AFRICA

PETRONELLA MINENHLE NDLOVU

SUPERVISOR: DR MC MEWOMO

DISSERTATION submitted in fulfilment of the requirements for the awarding of the degree: Master of the Built Environment in Construction Management in the Faculty of Engineering and the Built Environment, Durban University of Technology, Durban, Republic of South Africa.

AUGUST 2021

ABSTRACT

The facilities management (FM) industry has been confronted with a number of challenges and obstacles when it comes to the implementation of effective and efficient facilities management in public sector buildings. Thus, this study: investigates the current nature and extent of facilities management practice in public sector buildings; determines the technical roles of the facilities management team in the life cycle of public sector buildings; determines the competencies required for effective FM practices in public sector buildings; investigates the challenges inhibiting effective FM practice in public sector buildings, determines the drivers and enablers for effective FM practice in public sector buildings; and also recommends strategies for effective FM in public sector buildings in South Africa.

The study utilized primary and secondary data. Primary data was obtained from the respondents through a questionnaire survey of 39 inspectors of the provincial Public Works department in KwaZulu-Natal, South Africa. The questionnaire elicited information on issues influencing effective facilities management practices on selected public sector buildings. The secondary data was generated from literature from which the research instrument was developed. Data analysis was carried out using mean item score, percentage, factor analysis and T-test. The research findings indicated that most organizations were predominantly utilizing unplanned maintenance strategies and as such, involved repair work and corrective maintenance rather than predictive and preventive maintenance. The study also found insufficient funding, irregular, or fixed budgeting and the absence of a policy guideline for infrastructural development and maintenance of buildings as the major challenge affecting FM practices in the study area. The predominant drivers of FM practices are design of organizational structure, spirit of teamwork and sharing of FM knowledge and skills. The availability of policy/regulations supporting the maintenance of public buildings,

availability of funds, hiring of better skilled professionals and an increase in the level of awareness of FM benefits were found to be enablers of FM practices. Based on these findings, the study recommends the need to employ a planned maintenance strategy in the day-to-day maintenance of public sector buildings. Furthermore, there is a need to have a policy in place that stands as a guideline for all work, strategies and processes for FM in public sector buildings. This study adds to the existing body of knowledge by providing useful information on factors that could enhance the effectiveness of facilities management in public sectors buildings in South Africa and beyond.

Key words: Facilities Management, Public Buildings, FM challenges, Nature of Facilities Management

DECLARATION

I, **PETRONELLA MINENHLE NDLOVU,** declare that this thesis is the culmination of my investigation and research study. I also declare that the sources used in this research have been acknowledged in the References list and adequately cited in the body of the thesis. Copies of this study have in no way been submitted elsewhere for any similar purpose. This research was conducted at the Durban University of Technology as a requirement to obtain a **MASTER OF THE BUILT ENVIRONMENT** degree in Construction Management under the Supervision of Dr. M.C Mewomo.

Submitted by: Ms. Ndlovu Petronella Minenhle

Supervisor: Dr. M.C. Mewomo

DEDICATION

This thesis is dedicated to my creator, the Lord God Almighty, who has been my helper from the beginning. It is with His Grace that I have managed to do this amazing work that I did not even know I had the power and strength to accomplish. This thesis is also dedicated to my family: my parents, two brothers and sister and my niece and also most importantly, my new family, being my fiancé and our beautiful daughter.

ACKNOWLEDGEMENT

I would like to express my utmost gratitude to the Lord God Almighty for the endless strength, faith, and courage he has instilled in me throughout my whole academic life. My special gratitude goes to Dr M.C. Mewomo for her support, patience and dedication towards helping me finish this project. She believed in me in days where I thought I wouldn't make it. She also taught me about the importance of trusting in the Almighty God who never fails us. I am forever grateful and could not have asked for a better supervisor. The encouragement and painstaking effort in providing the much-needed guidance and leadership at every stage of my study are well appreciated.

I would also like to extend my gratitude to my friends and family for their support throughout this project. I would not have made it this far without their amazing support. My mother, your prayers are what kept me going always. My sister for her words of wisdom that gave me strength every time I felt like giving up. My beautiful daughter, Kuhlekonke, for allowing me to take some time off parenting and focusing on school work, I am so proud of you and the young independent human being you are becoming.

My fiancé, for all the support he has given me from the beginning of the project. Thank you for believing in me and for your words of encouragement in the days where I felt like giving up. I thank God for you and I could have not chosen a better life partner.

Lastly, I would like to thank all the staff in the Department of Construction Management and Quantity Surveying for their support during the course of this project. My Special thanks go to the Faculty of Engineering and the Built Environment as well as the Durban University of Technology for the tuition waiver and other facilities I enjoyed for the period of this study. Thank you for the opportunity bestowed on me to obtain this degree.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

BIFM	British Institute of Facilities Management
CR	Corporate Responsibility
CAFM	Computer Aided Facility Management
DPW	Department of Public Works
DUT	Durban University of Technology
EuroFM	European Facility Management
FM	Facilities Management
FMAA	Facilities Management Association of Australia
HKIFM	Hong Kong Institute of Facilities Management
IFMA	International Facility Management Association
JFMA	Japan Facilities Management Association
KM	Knowledge Management
KZN	KwaZulu-Natal
NDPW	National Department of Public Works
PFI	Private Finance Initiative
RICS	Royal Institute of Chartered Surveyors
RTPI	Royal Town Planner's Institute
SA	South Africa
SAFMA	South African Facilities Management Association
SFP	Strategic Facility Planning
SPSS	Statistical Package for Social Sciences
UK	United Kingdom

USA	United States of America
WTO	World Trade Organization

CHAPTER ONE
GENERAL BACKGROUND TO THE STUDY

1.1 Introduction

This chapter provides an introduction that highlights the research background and concomitant problems. This brief background led to the identification of gaps in previous studies which this research intended to fill. The chapter presents the significance of the study and an outline of the thesis structure. Thereafter the chapter states the aim and outlines the objectives of the study, defines the scope and limitations of the research as well as the research methodology employed in the investigation.

1.2 Background to the Study

The importance of buildings in human life cannot be overemphasized. Housing is vital to human survival because it is positioned together with the leading three needs of man. As a unit of the environment, housing has a profound influence on the health, efficiency, and social welfare of the community (Ebenehi *et al.* 2018). Also, rapid advancement in technology and increased competition in modern economics have forced the building industry to create an efficient supporting services system to achieve long-term building functionality and successful building operations. Meanwhile, the implementation of such an efficient system provided by facilities management (FM) is still a key challenge (Abu Jawdeh, 2013). Facilities management is still in the infancy stage in public sector buildings; notwithstanding this, it has great potential given the significant economic growth rate and the amount of property development. The discipline of facilities management (FM) is still considered to be evolving (Oladokun, 2011; Oladije, 2013). Thus, the practice of FM was still a new concept to many African countries like South Africa. Many of these developing countries had not been benefiting from the advantages that could be

derived from the practice of FM (Oladokun, 2011). Facilities management was described as a process that ensured that the building and other technical systems supported the operations of an organization as well as providing an integrated approach to operating, maintaining, improving and adapting the building and infrastructure of an organization to create an environment that supported the primary objectives of the organization (Lepkova *et al.* 2012). However, FM practices had grown from what was traditionally perceived to be the mere managing of buildings or the maintenance unit of an organization to the holistic reality of being woven into the core and support services of an organization (Pitt and Price, 2011). In the absence of FM practices, complex buildings could become dysfunctional at an early phase. Facilities management gathered knowledge from both design and building management so as to guarantee that long-term design activities and short-term management strategies did not ignore one another (McCarroll, 2017). The importance of FM has recently been recognized all over the world (Nordiana, Othman, Syahrul and Berawi, 2017). The result was that it was seen as common practice in business organisations in advanced countries like the United Kingdom (UK) and the United State of America (USA) (Marek, Milota and Martina, 2015). The spread of FM was attributable to the global embracement of the practice of outsourcing services in the public and private sectors. Therefore, it was now one of the fastest-growing professions in the UK (Nazali *et al.,* 2009; Oladokun, 2011; Olajide *et al,* 2013) and was even gradually being popularized in South Africa and other African countries. While the possession of sound professional training, as evidence of the competence and capabilities of facilities managers to handle facilities management, has been documented in advanced countries like the USA and the UK (Marek *et al.,* 2015), little was known about this in most African countries (Oladokun, 2011; Olajide, 2012). Meng (2013) pointed out that the connection between facility design and management was still weak and was affecting the operation

and maintenance cost of buildings. Also, Ganisen *et al.* (2015) noted that although the building sustainability agenda had gained importance and captured attention in undeveloped countries, only a small amount of practically applicable research had been conducted in the area of facilities management related to sustainable buildings. In addition, Oladokun (2011) questioned to what extent locally practicing facilities managers were professionally qualified to deliver efficient services and whether the professional traits that they possessed acted as a competitive edge against their foreign counterparts. However, Ikediashi *et al.* (2012) attributed the key challenges of FM practices in buildings to poor funding, lack of awareness, and lack of proper regulation, etc. Consequently, the move to better management of facilities was set to continue as buildings with their infrastructure and equipment elements became ever more sophisticated (Olanrele *et al.*, 2013). Therefore, incorporating facility management knowledge in the building design was considered essential to increase the overall performance of the building, including quality and cost as the management and operation processes of facilities could have a significant impact on energy, cost, health, quality and safety. Also, the need for better management practice of facilities in buildings was seen as a matter of urgency, as they were meant to support the core objective of sustained buildings. This research aims to evaluate the current nature and extent of facilities management practices, the technical roles of the facilities management team, the competencies required for effective facility management practices, the challenges affecting efficient and effective facilities management practices, and strategies to improve the efficiency of these facilities in public sector buildings in South Africa.

1.3 Problem Statement

This study deals with a key problem identified in South Africa and other developing countries. Currently, there is a rapid movement towards a sustainable built environment across the world. According to Abigo, Madgwick, Gidado and Okonji, (2012), developing countries were still

contending with design and project execution problems. The issues related to pollution as well as the use of harmful building materials and products together with poor management and maintenance of buildings still lingered. Moreover, the lack of adherence to building practices by various building professionals has negatively impacted the functionality and comfortability of buildings and the health of building occupants (Jiboye, 2012). This has resulted in the continual maintenance of poorly designed buildings and the dissatisfaction of the building users. According to Olaniyi (2017), facilities managers with good knowledge and vast experience in building management and building performance were not usually consulted during the design stage of a building. Consequently, facilities managers did not play a significant role during the design stage where decisions that affected the sustainability of the building were made. While the decision taken at the design stage was critical to the effective operation and utilization of the building, facility managers were only involved during the operations stage of the building (Olotuah, 2015).

According to Ikedaishi, Ogunlana, Boateng and Okwuashi (2012), facilities managers were not usually appraised by the services engineer about the operations, installation and maintenance of services within the building; therefore, FM services suffered. Regrettably, the building services engineers did not usually request feedback from the building users. Consequently, buildings deteriorated easily due to the unavailability of building performance information which the designer could use to improve on their designs. More often than not, building professionals usually terminated their professional roles at the end of the construction stage (Odediran, Gbadegesin and Babalola, 2015). Furthermore, Odediran *et al.*, (2015) noted the failure by institutions and organizations to recognise the FM's contributions to business success and performance. FM as a practice has grown from what was traditionally perceived to be the mere managing of buildings or the maintenance unit of an organization to the holistic reality of being woven into the core and

support services of organizations (Pitt and Price, 2011). Meanwhile, the practice of management of buildings to secure optimum returns has been dominant (Adewunmi, Ajayi and Ogunba, 2009).

Adewunmi *et al.* (2009) further confirmed that in general the practice had been focused on the management of buildings for their own sake and as an investment to secure optimum returns. NUC (2006) revealed that both the academic and physical facilities at Nigerian public and private sector buildings were in a parlous state. In addition, the key challenges to FM services in Nigerian tertiary institutions were attributed to poor funding, lack of awareness and lack of proper regulation, etc. (Ikediashi *et al.*, 2012) and overcrowding (Mohammed and Hussanain, 2010; Ogungbile and Oke, 2015). Research revealed that only on rare occasions did facilities receive explicit attention from management (Odediran *et al.*, 2015). Asiabaka (2008) noted that FM was an aspect of the education system that was generally being overlooked in undeveloped countries, and when new buildings were constructed and taken over by the appropriate authorities, practically no attention was paid to the maintenance and facilities of such buildings. Several educational buildings had not undergone renovation or any form of modernization for half a decade despite the changes in the educational system. Over the years, most educational administrators/authorities had complained that physical facilities available for academic and non-academic activities were grossly inadequate, the majority were regarded as architecturally obsolete and also could no longer satisfy present-day educational needs and, therefore, could not contribute to functional learning (Asiabaka, 2008). Hence, residential and public buildings, especially educational buildings, needed urgent attention in terms of the provision of functioning facilities to meet the increasing demands of occupants of such buildings.

Mohammed and Hassanain (2010) explained that the most dominant problem lay in the manner in which the occupiers or maintenance managers of a building maintained the building after

construction. Akinsola *et al.* (2012) explained that most buildings did not have a proper maintenance culture, a maintenance manual, or any practice of corrective maintenance. As the facility or building aged, it was expected that costly maintenance and emergency repair needs would eventually arise, and that was why preventative maintenance was critical. Hightower and Highsmith (2013) reported that some individuals considered facilities management as a profession that had taken a very big knock, not because the requirement for facilities managers had depreciated but because the need for proficient facilities managers had grown continuously each year. More positions were opening up in this profession each year yet there was a global shortage of young qualified entry-level professionals to place in these jobs. One of the potential drawbacks in this industry was the result of the declining number of students graduating with a facilities management accredited degree.

Adewunmi *et al.* (2009) appraised factors influencing the role of Nigerian building professionals in FM and established that training in FM and the type of the organization managed by the building professionals were significant factors that influenced building professionals' participation in the areas of core competence in FM. Asiabaka (2008) examined the need for effective FM in educational buildings. The paper suggested the methodologies necessary for FM and mooted that there was a relationship between the quality of the educational facilities and the quality of the products of the institution. It appeared that there was a paucity of research works that evaluated FM concerning its practices, level of satisfaction by users, factors influencing the practices and strategies for sustaining facilities in public sector buildings, and generally, any type of buildings. In addition, Kamaruzzaman *et al.* (2013) argued that the main problem in the maintenance management of buildings was that it had been unprofessionally applied by the facilities managers, which had subsequently triggered negative impacts on the building services and facilities. The

poor performance of building services and facilities potentially harmed the building users in the aspects of health, safety and comfortability (Lai and Yik, 2011). Furthermore, the risks attached to these aspects jeopardized the productivity of workers in office buildings and thus affected the operations or core business activities of organizations (Kwon *et al.*, 2011). Also, many public sector buildings in South Africa had not yet been benefiting from the advantages derivable from the practice of FM. The present study will fill this gap by presenting an in-depth application of FM to a major economic sector in South Africa, which is public sector buildings, with specific interest in analyzing the availability of the facilities, their efficiency and effectiveness, level of satisfaction and the major challenges inhibiting its efficiency as well as strategies for improving FM practices.

Therefore, based on the aforegoing, this study has attempted to provide answers to the following questions:

1. What is the current nature and extent of facilities management practice in public sector buildings in South Africa?
2. What are the technical roles of the facilities management team in the life cycle of a public sector building?
3. What are the competencies required for effective facilities management practice in public sector buildings?
4. What are the challenges inhibiting effective facilities management practice in public buildings?
5. What are the drivers and enablers for effective facilities management practice in public sector buildings in South Africa?
6. What strategies can be recommended for effective facilities management in public buildings in South Africa?

1.4 Research Aim and Objectives

The study aimed to examine issues influencing effective facilities management practice in selected public sector buildings in South Africa to establish strategies for efficient facilities management practices.

The research intendeds to accomplish the following objectives:

1. To investigate the current nature and extent of facilities management practice in public sector buildings in South Africa
2. To assess the technical roles of the facilities management team in the life cycle of a public sector building
3. To determine the competencies required for effective facilities management practice in public sector buildings
4. To investigate the challenges inhibiting effective facilities management practice in public buildings
5. To determine the drivers and enablers for effective facilities management practice in public sector buildings in South Africa
6. To recommend strategies for effective facilities management in public buildings in South Africa.

1.5 Significance of the Study

This study expresses the philosophy behind the FM concept as an emerging subject and area of specialization. The study focuses on public sector buildings in South Africa and suggests various ways to mitigate the challenges currently facing the maintenance of public sector buildings as well as the means to prevent or at least manage challenges that are likely to present themselves in the

near future. The study provides tools to assist facilities managers to anticipate and be prepared to deal with the various issues that are usually encountered in day-to-day facilities management services. Furthermore, the study provides a comprehensive approach towards creating more sustainable buildings and optimized services and enriches the knowledge of FM services managers at higher education institutions. In addition, this study provides inputs for implementation at the planning stage for improved operation and maintenance and for optimizing the allocation of resources. The study is also significant as it provides a FM strategy calculated to allow managers to gain an understanding of the elements essential for best practice FM services. In addition, the findings from the study will enable management and staff to anticipate some of the challenges they would likely face in managing facilities within both private and public sector buildings. The impact and contribution of FM could improve the overall performance and brand of an institution by ensuring timely delivery of positive contributions to an institution's mission. The study also provides feedback to other organizations on the problems that their counterparts might have faced and suggests innovative ways of addressing the problems. In addition, the study provides information on methods to maintain and improve FM service standards in South African buildings in general. This information will also be essential for authorities, management and building professionals in educational buildings in South Africa to provide improved FM service. The study will help policymakers and administrators to know more about the condition of facilities and understand the FM practice in all sectors of the country.

1.6 Literature Review

According to the South African Facilities Management Association (SAFMA) (2010), Facilities Management was a process that enabled the sustainable enterprise to assist the whole life management of the workplace to achieve productivity and support the business effectively. In addition, the Facilities Management Association of Australia (FMAA) defined facilities

management as a practice that assured the effectiveness of the operational management of the buildings in both public and private organizations. It also involved a wide range of activities from strategic operational planning to daily physical maintenance, cleaning and the management of environmental performance issues. The European Facility Management Network (EuroFM) described Facilities Management as the combination of various processes in an organization to develop and maintain services that supported and improved the effectiveness of the organization's activities. This definition was drafted and adopted by the European Facilities Management professionals (EuroFM, 2014).

However, the British Institute of Facilities Management (BIFM) and the International Facility Management Association (IFMA) defined Facilities Management as "an integration of people in the workplace and other processes". This is demonstrated in Figure 1. The IFMA (2014) also described FM as the integration of numerous disciplines to guarantee the functionality of the built environment by putting together people, process, place and technology. It further described FM as the combination of processes and practices within an organization in the built environment to maintain and develop the agreed services which supported and improved the effectiveness of the organization's primary activities and the management of the impact of these processes upon people and the workplace (BIFM, 2010). Facilities Management could also be defined as a profession that assists others to achieve their goals and it is primarily a people-oriented and customer-focused profession and industry.

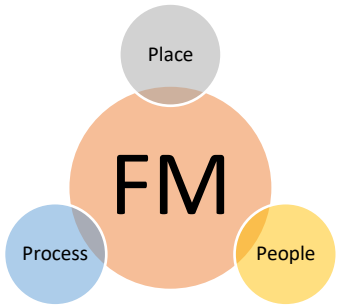

Figure 1.1: Place, Process, People FM model
Source: Euro FM (2014)

Atkin and Brooks (2002) stated that facilities management applied the principle of multi-disciplines to manage the functions of different people and processes as well as technology through time in the most cost-effective way. Facilities Management was involved with ensuring that the building was running in such a way that the organization could meet its business objectives and deliver customer satisfaction. Facilities Management also used information technology, to manage property portfolios in a way that could contribute to the management of the business as a whole, the conditions of facilities and the day-to-day operations such as hygiene or cleaning maintenance and repairs to assist the organization to meet and achieve its objectives, JFMA (2006). Maintenance could be differentiated into predictive, preventative, corrective and predictive maintenance. According to Al-Hammad *et al.* (1997), in any building, all the various types of maintenance arrangements were significant, and no one could be said to be better than the other depending on the nature of the building. Chew *et al.* (2004) opined that preventative maintenance was always the best approach to the maintenance of buildings.

Furthermore, Chew *et al.* (2004) established that planned or predictive and corrective maintenance could also to be utilised concurrently by maintenance officers together with preventative

maintenance, depending on the nature of the building. Chew *et al.* (2004) concluded that the choice of corrective maintenance posed a big threat to the maintenance life of any building and should be reduced to the minimum unless there was no alternative to use.

The Facility Management Association of Australia (2012) stated that facilities management for multi-unit residential buildings included: (1) the maintenance of grounds and gardening; (2) maintenance to improve building performance; (3) the maintenance of security for the property assets and occupants; (4) the provision of key services for proper operation of the building (lift services, fire systems, etc.); (5) waste, risk and space management; (6) sustainability projects and implementation; (7) efficient use of water and energy through proper tracking and monitoring systems; (8) the engagement of various stakeholders and (9) undertaking larger capital or maintenance projects.

Additionally, services delivered by facilities management in an organization promised to (1) increase employee and user satisfaction; (2) promote the occupier organization's culture and image; (3) increase flexibility; (4) support the various activities of the property users; (5) improve the quality of the property; (6) stimulate employee innovation; (7) stimulate collaboration between employees and employers; (8) provide better value for the facility; (9) promote the marketing and sales values of the organization (for corporate buildings); (10) control risk; (10) support a sustainable environment; (11) increase productivity and support employee wellbeing; and (12) support cost-effectiveness (De Vries, 2007; Jensen, 2009; Den Heijer, 2011). Therefore, it was not an exaggeration to declare that FM had great potential to provide a positive influence on our world more than ever before (Jensen *et al*., 2013).

According to Akinsola *et al.,* (2012), one of the major challenges facing facilities management practice was lack of funds and insufficient financial allocations allowed for maintenance and

facilities management. In a study on the critical factors affecting facilities maintenance in Nigerian tertiary institutions, Akinsola *et al*., (2012) observed that one of the challenges for public sector buildings was that funds for maintenance were generally allocated by the government and would have been minimized to the lowest possible amount or possibly not be approved at all due to the strict processes involved in the process of releasing funds in the government setting.

Hightower and Highsmith (2013) further explained that various reasons existed for the shortage of qualified FM candidates. Firstly, insufficient information and lack of public exposure to the facilities management profession was a problem. A large number of students including graduates had not been exposed to this career path until they had already spent years studying towards their respective chosen careers as schools in most cases tended to focus on more established career paths such as Social Sciences, Business and Medicine. Another contributing factor was the fact that schools did not mention a facility manager on career day because the average person might not even be aware what facility management was. Urgent attention needed to be given to the FM world to increase awareness.

1.7 Research Methodology

A research study was usually undertaken by adopting a quantitative, qualitative or mixed-method approach. It was critical to firstly establish alternative ways to collect and analyse the data to provide answers to the proposed research questions and framework for conducting the research study (Bryman and Bell, 2015). Participating in observation, case studies and interviews could be utilised when undertaking a qualitative research method as the method involved understanding a research problem or topic from the local population's perspective (Guest, Namey and Mitchell, 2013). Korrapati (2016) also explained that a quantitative research approach could be implemented to quantify various opinions, behaviours and any other relevant factors to generalise findings from

a bigger population sample. On the other hand, research could be undertaken through integrating both methods of data collection, namely quantitative and qualitative, and analysis was achieved in a single study to generate a better understanding of the research problem rather than using either approach alone. This method was commonly known as a mixed method approach (Creswell and Clark, 2011).

1.7.1 Research Method Approach

To answer the research questions and achieve the objectives of this proposed study, the researcher adopted the quantitative research approach using a questionnaire as a research instrument for data collection (Terrell, 2012). The reasons for doing so were that this approach allowed for a wider study, connecting a larger number of subjects and thereby providing room for the generalisation of the research findings. Furthermore, this approach allowed for greater objectivity and accuracy of results. To accomplish the objectivity and generalization of the study, prescribed and established procedures to ensure the validity and reliability of the study were used. Moreover, the utilization of the quantitative research approach allowed the researcher to summarize a large number of sources of information and enable comparisons across categories and over time (Kruger, 2003)

1.7.2 Sampling Method

According to the Encyclopaedia Britannica (2010), the sampling method was the technique of drawing a representative cluster of people from a specific population. Sampling and statistical inferences were utilised in circumstances where it was practically impossible to gather the data from each individual of the particular targeted population. Sampling was then divided into two processes: probability and non-probability sampling (Khan, 2014). The sampling method involved taking a representative choice of the population and using the data collected as research information. A sample was therefore a subgroup of a population (Meyer, 2009). Various forms of sampling methods could be adopted by the researchers for any various selection of the study;

however, for this study in particular the researcher decided to utilise the purposive sampling method for the collection of quantitative data. Purposive sampling was used to get reliable information from the participants involved in Facilities Management in South Africa. The targeted population for this research was the KZN Department of Public Works as it was the major implementing agency for the maintenance of government buildings. The targeted respondents were the KZN Department of Public Works inspectors who primarily dealt with maintaining government buildings. The questionnaires were sent via Google Forms to the 13 district offices across KZN (Please see attached Appendix A – Letter of Information). There were three work inspectors in charge of public sector facilities management in each of the 13 DPW district offices. The target population for the research was all the inspectors in each of the 13 district offices. Leedy *et al.*, (2005) had advised that small populations with fewer than 100 units should be surveyed, so there was no point in sampling the entire population. As such, all three categories of work inspectors in the 13 district offices were requested to participate in the research. Therefore, the total sample was 39 participants.

1.7.3 Survey Questionnaires

Abawi, (2013) defined a survey questionnaire as a primary source of data collection method that consisted of sequential questions with various choices of answers aimed at obtaining information from participants. In this study, a questionnaire was utilised as a research instrument to collect data from the prospective research participants. The survey questionnaire was designed to accomplish the abovementioned objectives through gathering data on effective facilities management in South African public sector buildings. The questionnaire was divided into five sections. Section one elicited biographical information from the respondents. Sections two to five elicited information that could provide solutions to the research objectives. The questionnaire took between 25 and 30 minutes to complete (Please see the attached questionnaire – Appendix B). The questionnaire was

distributed and collected electronically using the Google Forms link. There was no personal contact with the research participants.

1.7.4 The procedure for obtaining informed consent and questionnaire

The administration of the questionnaire was done through an online platform. The questionnaire was prepared, administered and collected online using Google Forms. The Letter of Information as well as the informed Consent Form were part of the information that was provided to the participants. Since the questionnaire was distributed electronically, the participants were requested to first read the informed consent form and confirm their voluntary participation. The questionnaire was designed in such a way that the participants would not have access to the questionnaire without first confirming that they had been duly informed about the research and that their participation in the research was voluntary. (Please see Appendix A that forms part of the supporting information to the questionnaire for the Consent Form and Letter of Information.)

1.7.5 Assurance of confidentiality and anonymity-

The data collected were treated anonymously and the findings of the survey were reported in this thesis for research purposes only. There were no risks, current or anticipated, to any research participant in this study. The researcher took the responsibility to protect the participants as an ethical commitment that considered the participant's rights. The confidentiality and anonymity of the research participants was of prime concern of the researcher. The confidentiality and anonymity of the research participants was achieved through the following means as stated in the Letter of Information (See Appendix A)

- No personal details of the research participants were required, e.g. names, ID number, cell phone number. (Please see Appendix B – Questionnaire – No personal information is required.)

- No names were required in the online survey (Google Forms is set not to collect participants' email addresses); consequently, the responses cannot be traced back to any particular participant.
- No sensitive biographical questions were asked that could suggest who the participant was.
- The data collection process did not involve access to confidential personal data.
- Participation in the research was voluntary and the participants were free to withdraw at any time without any consequences to them. This was stated in the Letter of Information (See Appendix A).
- Information given could never be linked to the research participant who supplied it.

1.7.6 Research data management procedure

Information received was to be kept confidential and securely password protected according to the approved DUT data management information. The data would be stored in the DUT premises for five (5) years and thereafter destroyed.

1.7.7 Data Analysis

Data collected were analysed using appropriate data analysis tools. Specifically, the Statistical Package for the Social Sciences (SPSS) software package was utilised for statistical analysis of the collected data. Both descriptive and inferential statistics were presented for this study. Mean score values were generated for various factors using the mean score items ranking technique. Other analyses that were carried out included a Factor analysis and Agreement analysis using Kendall's coefficient of concordance. Bartlett's Test of Sphericity was also carried out to test the presence of correlations between the variables. Lastly, the researcher utilised Cronbach's Alpha test to measure the reliability of the quantitative data and the consistency of the questionnaire

results. The Cronbach's Alpha test method was utilised to measure the average correlations of the survey questionnaire questions and the multiple levels of responses. This test was also used to determine that all the measuring scales measured the same construct reliability.

1.8 Limitations

This study was limited to surveying Facilities Management services in government schools in KZN maintained by the DPW.

1.9 Ethical Consideration

Ethics were the morals that distinguished right and wrongful conduct. Ethics were essential in deciding acceptable and unacceptable behaviour (Burgess, 1989). Before the collection of the research data, the research proposal and the research instrument were submitted to the University Ethics Committee for review in July 2020 and full approval was received in October 2020. The following ethical considerations were honoured:

- The research aim was not offensive, and did not disrespect nor discriminate against the rights of the participants. Each participant freely and voluntarily engaged in the research study.
- The research study honoured the requests and restrictions of the research site.
- The research study reported the research fully and honestly.
- The confidentiality and anonymity of the research participants were of great importance to the researcher.

1.10 Structure of Chapters

Chapter 1: Introduction

Chapter 1 of this thesis presents the research topic and outlines the background to the study and various problems are highlighted. Previous research, existing problems and gaps that need to be filled are discussed. The chapter also presents the research questions and the corresponding research objectives. The research methodology, ethical considerations, limitations, and the significance of the research study are also presented.

Chapter 2: Literature Review

Chapter 2 contains an extensive review of existing literature on the issues under consideration. The review covers all the identified areas of the research objectives namely: the nature and extent of facilities management services, the role players involved in FM practice, factors prohibiting the proper application of facilities management concepts as well as the drivers and enablers of effective facilities management practice.

Chapter 3: Research Methodology

Chapter 3 describes the appropriate method to achieve the research objectives. It provides definitions and brief descriptions of what research methodology was followed. The chapter then describes the population and the sample drawn from it. Furthermore, it states how the information is to be analysed and presented to assess the data collected.

Chapter 4: Data Collection and Analysis

This chapter presents the analysis of the data collected. The chapter first presents information on the data analysis tools, the data analysis method employed and the records of the findings from the processed data.

Chapter 5: Discussion of Findings

This chapter provides an in-depth discussion on the findings of the research study. The findings are scrutinized and discussed against the contents of existing literature. This chapter also confirms that all the identified objectives were researched and all research questions were answered.

Chapter 6: Conclusions and Recommendations

Chapter Six of this thesis presents the conclusions drawn based on the research findings. Thereafter recommendations for implementation and further research are stated.

1.11 Chapter Summary

This chapter has presented the various components of and the framework for the whole study on effective facilities management in South African public sector buildings. The research questions, aims and objectives as well as the overview of how the thesis was structured have been discussed.

The next chapter discusses effective facilities management in public sector buildings extensively, using knowledge of prior work done as documented in the research.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This chapter reviews a number of research works conducted on facilities management. Firstly, this chapter discusses the facilities management concept, the nature and extent of facilities management and the roles and responsibilities of a facility manager. Furthermore, this chapter examines the competencies that are needed for effective facilities management and the challenges that have inhibited effective facilities management. Lastly, this chapter looks deeper into the drivers and enablers of effective facilities management in public sector buildings.

2.2 Definition of Facilities Management

The term facilities management, according to Kamaruzzaman and Zawawi (2010), encompassed a broad variety of services such as real estate management, contract management, change management, human resource management, financial management, and health and safety management. Building repairs, utility supplies and domestic services were all included in the definition (e.g. cleaning and security). Facilities Management as described by the South African Facilities Management Association (SAFMA) was a process that enabled sustainable enterprises to implement lifelong management of the workplace in order to achieve efficiency and effectively support the business (SAFMA, 2012). According to the Facilities Management Association of Australia (FMAA, 2014), Facilities Management was a discipline that ensured the efficiency of the organizational management of buildings in both public and private organizations, involving a broad range of activities from strategic operational preparation to regular physical repair, cleaning and the management of environmental performance issues.

On the other hand, Facilities Management was described by the British Institute of Facilities Management (BIFM) and the International Facility Management Association (IFMA) as the incorporation of people in the workplace and other procedures, as seen in the IFMA model in

Figure 2.1. It was described as "the integration of multiple disciplines to ensure the functionality of the built environment by combining individuals, location, method and technology", according to IFMA (2014) and "the alignment of systems within an organization in the developed environment to sustain and expand agreed-upon services that help and enhance the efficacy of the organization's key operations" (IFMA, 2014) and "the control of the consequences of these systems on individuals and the workplace" (BIFM, 2014). Facilities management is often known as a career that assists everyone in achieving their objectives, and it is mainly a people-oriented and customer-focused business.

Definitions of Facilities Management

Business management, architecture, and behavioural and engineering sciences were among the practices that took place in an organization, as described by HKIFM (2010), as an art of science that promoted the synergy of successful individuals with their buildings and properties, thus increasing an organization's competitiveness (Armstrong, 2002). According to Alexander (2003), this was the secret to the organization's ability to adapt to changing circumstances. Facilities Management also oversaw information infrastructure, a property inventory that could help with overall corporate management, facility requirements and day-to-day activities such as sanitation, washing, upkeep and renovations to support the organization and achieve its objectives (JFMA, 2006).

Facilities Management, according to Alexander (2003) and Atkin and Brooks (2002), used multidisciplinary principles to coordinate the roles of different entities, systems and technologies over time in the most cost-effective manner. This demonstrated a new perspective on Facilities Management as an organized approach to upgrading, preserving and adapting an organization's

buildings and related resources so that the environment could meet the organization's primary objectives.

Facilities management also entailed implementing better corporate practices to reduce a company's running costs while increasing efficiency (RICS, 2014). Facilities Management, according to Atkin and Brooks (2002) and Alexander (2003), coordinated the function of the urban environment, and upgraded and managed buildings and their properties. Facilities Management was responsible for keeping the facility operational so that the company could achieve its corporate goals and have excellent customer service.

However, Spedding and Holmes (1994) noted that the primary goal of Facilities Management should not only be to reduce building operating expenses but also to improve the quality of room management and associated properties for persons and processes. This was largely achieved to accomplish the organization's aims and objectives cost-effectively. Facilities Management employed quality strategies to improve the building's quality, bring value to the structure, and reduce the costs associated with occupying the structure and providing dependable support facilities. According to Barret and Baldry (2003), this approach provided an organizational environment to meet an organization's strategic needs.

2.3 Nature and Extent of Facilities Management Practice in the Public Sector

Recently, the adoption of FM concepts in both public and private properties seems to have been increasing. However, the extent of usage appears to differ from one organisation to the other and from one country to another. This section presents the nature and extent of FM practices across the world, taking into consideration its concepts and features and the level of adoption of the FM concepts.

The current state of facilities management practice around the world could only be viewed as positive. Several academic findings have shed light on emerging developments and the essence of facility management (Moss, 2008; Adewunmi *et al.*, 2009; Jensen, 2010) Jensen (2008) discovered that facilities management had developed over a 20-year timeframe from being an internal feature of building administration and building client-related services to becoming an integrated, organizational role in a study that looked at how it had evolved in a dynamic public company in Denmark.

Facilities management, according to Noor and Pitt (2009), was one of the fastest developing professions in the UK and was one of the biggest cost-cutting initiatives in the 1970s. Moss (2008) agreed, stating that the industry had expanded dramatically in the UK over the last 15 years. According to Ama (2011), the facilities management outsourcing industry in the United Kingdom was nearing saturation and was becoming largely reliant on the economic climate and level of government spending. The author stated that the global economic crisis has had a negative effect on its growth over the past few years as a result of this.

In a study of facilities management in South-east Asia, Moor and Finch (2004) discovered that the field was gaining traction in the area, albeit with differing degrees of success. Globalization, information technology, high cost of land, labour costs, regional economy, property demand, general business climate, market sophistication, and procurement systems were among the drivers of facilities management in cities, according to the report.

2.3.2 Facilities Management in Building Contracts

The International Facility Management Association (IFMA) revealed explanations about why the bulk of systems had collapsed in terms of facilities management in recent years. According to the International Facility Management Association (IFMA), facility management failed when FM was

not adequately managed and treated; however, the majority of the systems collapsed as a result of the type of FM techniques used on the system or building. A contributing factor was the time, or point at which FM was incorporated into the structure. The stages and procedures of FM in a particular building are mentioned below.

2.3.3 Facilities Management at the Design Stage

The core discussion among some researchers into facilities management methods and results in the past has been about the rationale for including FM in the design stage of any facility or development job. Nonetheless, according to Enoma (2005) and Bosch and Pearce (2003), the primary concern for facility managers during the design stage would be the delivery of an efficient system or facility that was cost-effective and would adapt to their day-to-day positions in the facility. Enoma (2005) went on to say that to achieve the building's goals, cost-effective design strategies were created.

The future of facilities management would be based on a robust curriculum and research policy dedicated to further understanding and improving the profession, building a common knowledge base, and defining and codifying best practices. According to Jensen (2009), facilities management should be dependent on the viewpoint of the individual entity, and it should not be planned in such a way that it would adhere to the schedule of operations and works, and promote the key purpose of the occupier's organization from the system’s, or facility's design standpoint.

Furthermore, Bosch and Pearce (2003) drew on evidence that sustainable building and architecture had led to the establishment of energy-efficient, cost-effective and worker-productive facilities during their life cycle. As a result, the active involvement of facilities managers during the preparation, design and development processes was specified in the analysis of the nine guideline documents (Bosch and Pearce, 2003) that were considered to inform decision-makers in facilities

while providing a basis for a sustainable design process or practice to ensure that long-term goals were not jeopardized until the buildings were delivered and that the facility's future plans and practices were safeguarded.

2.3.4 Facilities Management at the Completion Stage

Although most facilities management experts believe that facilities management services should be implemented at the beginning of a building's construction, they also accept that implementation at the end is critical if the building had no facilities management in place at the design stage especially in the majority of public sector buildings, where contracts did not take FM into account until later in the construction process.

This arrangement could be categorised into two types:

- Private Finance Initiative (PFI) or Outsourcing of FM
- In-House FM Administration.

2.3.5 PFI or Outsourcing of FM

After the 1980s, according to the IFMA, organizations have tended to focus on their main market and, as a result, have considered outsourcing support services, which cover all FM services. The United States has dominated the outsourcing trend, with Europe falling behind by nearly five to 10 years. Outsourcing of FM services has become more popular in South-east Asia in the last five years, with Hong Kong leading the way, especially in the finance sector.

According to Bennett and Iossa (2006), PFI was a comparatively recent invention that was a variant of public-private collaboration that originated in the United Kingdom and has since gained widespread acceptance in the building industry worldwide. The bulk of public service funding was covered by PFI contracts, including education, housing, defence, highways and prisons. According to HM Treasury (2003), private sector spending in public utilities by PFI ranged between 10% and

13.5% of overall public infrastructure funding from 1998-1999 to 2003-2004 respectively with 451 PFI initiatives having been completed, including 34 hospitals and 119 other health facilities, as well as 239 new upgraded campuses. There were two major distinctions between PFI and conventional procurement according to Bennet and Iossa (2006). PFI entailed contracting out the planning, financing, construction and execution of a project to a group of private firms for a long period, usually 25 to 30 years. A building firm and a facilities maintenance company were part of the businesses responsible for all areas of operation. Secondly, a scheme of output criteria was used: the government was responsible for all facets of the services it required as well as some basic requirements but the group had control over how the services were delivered.

The consortium was responsible for the infrastructure facility over the contract term, during which it might introduce novel approaches to service delivery and use the facility for additional revenue-generating operations provided the minimum requirements of service provision were not breached, according to HM Treasury in Bennett and Iossa (2006).

According to Bennett and Iossa (2006), in conventional contracting the various stages of an infrastructure project were contracted out independently to multiple private contractors and a feedback specification strategy was then used, with the government maintaining control of the facility both during the contract duration and after it ended (HM Treasury, 1998). Several researchers into PFI and TR contracts have concluded that the PFI approach improved facilities management practices once the building phase was completed since the short-term owner continued to run the facility better than a government parastatal might. Since the consortium was profit-driven, the only way they could make money was to ensure that these services were well maintained to generate the necessary revenue, as opposed to government environments, which were typically not profit-driven.

2.3.6 In-House Facilities Management Administration

According to IFMA (2009), historically, facilities maintenance had been provided in-house by facilities management, property or corporate services departments, and the in-house department could range from a few employees to a multi-disciplinary team that was responsible for overseeing technical, security and cleaning personnel, depending on the scale of the building and the type of services provided. In public sector buildings, the facilities sector had not yet completely matured but the opportunity was enormous, particularly given the pace of economic growth and the amount of property creation.

2.4 Level of Awareness of Facilities Management Practice

Ogungbile and Oke (2015) examined and evaluated facility maintenance procedures in public and private sector buildings. The study found that private sector buildings had a higher level of FM sensitivity than public sector buildings and that FM activities were more prevalent in private sector buildings and while the two styles of buildings were substantially similar, the degree to which FM approaches were used in the buildings differed significantly. In the study, it was also discovered that in both private and public sector buildings, corrective and attentive FM activities were the norm.

Despite the substantial benefits of FM to the learning process, Odediran, Gbadegesin, and Babalola (2015) discovered that FM practice in Nigerian public sector universities lagged behind the private sector experience. In addition, even though certain buildings were outdated and had deteriorated, only passive measures were being taken to manage them. Low levels of infrastructure, inadequate financing and poor policy enforcement were all major barriers to FM practice, according to the results. According to the report, outsourcing technical staff was essential to improve the conditions of Nigeria's public sector university facilities.

Ikediashi, Ogunlana, Oladokun and Adewuyi (2012) evaluated the extent of dedication to safe facility management practices as well as the challenges of doing so. The study identified three obstacles to long-term FM practices: a lack of preparation and resources, a lack of applicable laws and regulations, and a lack of recognition, with mixed levels of engagement indicated among organizations.

2.4.1 Facility Management Services and its Level of Adequacy

The key goals of every university, according to Shafia, Yusoff, and Pawi (2012), were to have in-depth information, pursue intellectual advancement, inform students, and organize national development demands. Institutions had to provide substantial resources to successfully perform these main functions (facilities). However, just providing facilities was insufficient; optimizing the usage of such facilities by an effective management strategy was much more important. This was the case since human beings, processes and technologies were intertwined.

Okafor and Onuoha (2016) researched FM in educational institutions and discovered that although some facilities were provided, the quantity provided was insufficient, and most of the facilities were in poor condition due to major factors such as population growth and a shortage of funds. The report also discovered that the existing buildings were substandard and significantly under capacity. A significant number of respondents had expressed a desire for the FM practice to be changed. The study concluded that FM empowerment, structured instruction in FM, funds and improved preparation strategies could all be included in different tertiary institutions.

Similarly, McLaughlin and Faulkner (2012) looked at the aspirations of RMIT University students in Australia about campus facilities and found that students were more interested in open learning spaces that could accommodate both individual and collaborative study, with a focus on social

learning and advanced technology. This meant that the users' interests should be the driving tool in ensuring that buildings and services were used for the purpose for which they were designed. Furthermore, cleaning and repair services had been shown to have a direct impact on student's academic success, while catering and security services had an impact on both staff and student satisfaction (Kok, Mobach and Omta, 2011).

The impact of facilities and FM systems on users and the university system as a whole has been recorded. For example, there was a strong correlation between the quality of school facilities and the quality of school students (graduates) (Asiabaka, 2008). Furthermore, facilities considerations had been viewed as having a significant impact on students' decision to attend a certain school (Kobue, Oke, and Aigbavboa, 2017).

Bad FM practice, according to Wuni, Agyeman-Yeboah, and Boafo (2017), would lead to insufficiently functional facilities, surplus facilities that were not contributing to the organization's purpose and cost inefficiency, inadequacy and unavailability of facilities for potential needs. These were all indicators that FM had a significant effect on the performance of the staff and students.

2.4.2 Occupants Level of Satisfaction with FM Services

At the University of Peshawar in Pakistan, Khan, Bhatti, Khan, and Ismail (2014) conducted a report on customer satisfaction with the library facilities. The majority of respondents were pleased with the library's physical services, such as the lighting scheme, ventilation system and various other facilities, according to the survey. Some respondents, however, expressed dissatisfaction with the study corner, reading tables, reading room and computing facilities. Similarly, Basil and Okorodudu (2012) surveyed library users' satisfaction in Benin City, with the results revealing that users were pleased with the chairs, reading room, fans, air conditioners, lighting and airflow.

Users' perceptions of FM facilities in a public university were investigated by Oladokun and Ajayi (2018). Dissatisfaction with cleaning and security services was found to be more common among both staff and students than other FM services in the study field. The research also discovered a major disparity in worker and student perceptions. The study further recommended that tertiary institutions should adopt a more user-focused FM approach and conduct an all-inclusive performance evaluation of FM units.

Oyedum and Babalola (2014) evaluated the physical facilities and readers' satisfaction at the library at the Federal University of Technology, Minnasota. The visitors were dissatisfied with the library's physical services, according to the findings. Users' satisfaction with their sets, systems and facilities should be evaluated regularly, according to Liu and Allmang (2008), to ensure that the users' knowledge needs were being fulfilled at all times. The renovation of the physical facilities at the University of Jos' main library from conventional to new necessitated a survey of customer satisfaction with the facilities. This would enable the library to determine the degree to which the new facilities were improving learning to enhance the current situation and prepare for the future.

De Jager and Gbadamosi (2013) looked at the factors that influenced student satisfaction with their university and contrasted service users' real and perceived experiences. According to their findings, students had a worse real experience than they thought they had when it came to service efficiency. Karna and Julin (2015) investigated what constituted employee and student satisfaction. The authors assessed the responses of both staff and students from two campuses of a Finnish university using a statistical evaluation process. The findings showed that satisfaction characteristics varied between students and staff as well as between campuses. Karna and Julin (2015), on the other hand, looked at what staff and students wanted from facilities and FM services.

Najib, Yusuf, and Abiodun (2011) looked at student satisfaction with campus student housing facilities (SHF) at Malaysian Research Universities (RUs), as well as the relationship between satisfaction and loyalty. To explore residential satisfaction from the perspective of the students, the student residential satisfaction (SRS) system was suggested. Three RUs were used to assign questionnaires to respondents. Students were generally satisfied with the SHF offered, with an SRS index of 2.96 (or 74% satisfaction level), and there was a strong association between overall satisfaction and loyalty. The findings also proved that the proposed model was a good tool for measuring SRS.

According to Lepkova and Zukaite-Jefimoviene (2012), customer satisfaction was a term that was often misunderstood and exploited, with many companies intentionally or inadvertently struggling to properly assess and evaluate user satisfaction with their service quality. Ta (2014) pointed out that current FM practice had some flaws that affected all parties involved. The findings revealed that commercial properties had a low maintenance culture. This had led to the failure of several industrial properties to some or other degree.

Adewunmi, Omirin, Famutiwa and Farinloye (2011) used an investigative approach to post-occupancy assessment, focusing on major technological and practical success requirements for a postgraduate hostel's facilities. Users of the building were asked to report on their views and experiences of the facility through self-administered questionnaires which were used to collect data. The user satisfaction survey was created using input from students about their experiences with the specified success metrics gleaned from a literature review and an interview with a member of the university team. The user satisfaction survey revealed areas of weakness, especially in maintenance, and aided in the evaluation of the building's overall results.

Ishaq, Gambo, and Omirin (2012) used the SERVQUAL model to study FM operation in a postgraduate hostel. The findings revealed that there was a significant difference in the resources provided to students in the hostel, with the highest demands being placed on the assurance dimension. The study discovered that there was a need for improvement in the field of timely, high-quality service delivery in order to meet the prestigious learning centre's overarching mission of collaboration, as well as to leverage the goal of encompassing staff, operation and practice in outsourcing for student satisfaction.

Najib *et al.* (2011) investigated student satisfaction in residence halls at research universities. The study found that "cleanliness, safety, hall programmes and events, and opportunities to provide insight into decision-making in the hall" were all important predictors of student housing satisfaction. According to Ubong (2007), “high-quality services, supportive roommate partnerships, strong floor groups, and quiet study environments” were the most significant predictors of students' satisfaction with their hall. According to studies, allowing students to select their roommate also improved their living conditions satisfaction (Stern *et al.,* 2007).

Users' comfort with outsourced FM facilities in public residential towers in Nigeria was investigated by Olanrele, Ahmed, and Olatomiwa (2013). According to the report, outsourcing was the safest way to provide FM services because it was cost-competitive and provided efficient services that were suitable. Differences in satisfaction levels were also revealed by the satisfaction index. The result revealed that the lifts had a lower level of satisfaction due to the inadequate availability of electricity from the national grid, but that the lifts were equipped with a standby power generator.

Ajayi, Nwosu and Ajani (2015) studied students' satisfaction with hostel facilities. The study discovered that respondents were dissatisfied with the adequacy and functionality of some facilities such as the laundry, bathroom and toilet facilities due to the distance from rooms and the level of cleanliness. The study thereby recommended the need to provide more hostels with better design and current facilities through a public-private partnership to meet the needs of the growing student population.

2.5 Technical Roles of Facilities Management Team

There had been a growing body of literature in recent years emphasizing the relevance of FM participation during the pre-construction process of projects (Erdener, 2003; Tladi, 2012). Client satisfaction, energy consumption, service and upkeep, room utilization and sustainability were all essential factors for FM managers to consider during the pre-construction process, according to Jawdeh (2013) and Wang *et al.* (2013). According to Jawdeh (2013), FM administrators had to work with clients to understand the needs of consumers and small businesses. The relationship between FM and community would have an effect on the exchange of knowledge about different facets of FM with clients and designers.

Talib (2013) discovered that FM managers assisted in the preparation of project requirements in another report. To establish architectural considerations for future structures, information derived from previous developments and buildings should be analyzed. The aim of this project was to link Post-Occupancy Evaluations (POEs) to workplace architecture. According to Preiser (2003), POEs functioned based on facility design, which included: (i) the high-quality effect of workplace design on an organization's target outcomes; (ii) the commitment of workplace designs to reducing non-relevant expenses and increasing revenues; and (iii) the impacts of workplace designs on optimizing human capital growth.

Natural resource depletion, utility prices and global warming were all issues that the planet was now dealing with (Olanipekun and Iyiola, 2020). As a result, players in the urban environment had to contribute to environmental activities by designing buildings that used the least amount of energy to construct, run and maintain (Tladi, 2012). FM managers might have helped improve facility quality or cost-effectiveness by voicing questions early on in the design process. As a result, they would be able to competently meet their goals and incorporate cost-effective construction strategies that would support buildings over their entire life cycle (Enoma, 2005). As a result, FM managers had to ensure that utility facilities were appropriate during the design phase of a building.

Tladi (2012) stated that FM administrators would make substantial contributions to resource-constrained sustainability strategies. They would help with the construction of cost-effective facilities to do this. For example, water systems should be readily accessible for routine maintenance and to prevent unexpected accidents. Lehrer (2011) proposed that the architecture of any water system should prioritize ease of use, low operating costs, and ongoing maintenance. For example, an FM might advise switching from high-pressure flush toilets to low-pressure flush toilets to save water.

Energy efficiency would save energy and money, according to Hartungi and Jiang (2012) and Olanipekun and Iyiola (2020). As a result, facility operators should think about the energy efficiency of thermal issues. According to Wan-Hamdan, Hamid and Mohd-Radzaun (2011), the majority of companies chose to have enjoyable working conditions to boost staff and management morale, and this was one of the variables that influenced productivity. Finally, Mcauley *et al.*

(2015) developed a client brief that called for increased thermal efficiency, artificial lighting and acoustics, and the addition of a shop facility.

The benefits of FM, especially in hospitals and hotels, have been studied by Enoma (2005) and Che'Mat and Shah (2006). The study discovered that facility managers played a vital role in reducing maintenance costs and that was a considerable portion of any given building's facilities funds and central activity management. Similarly, Mustapa (2013) stated that FM managers should have control over conceptual architecture. The two levels of FM were defined by Kelly *et al.* (2005) and Mustapa (2013): (i) strategic FM, which was concerned with the function's course and involved setting goals in response to the function's aim, long-term planning, and was concerned with helping an FM enterprise run as a whole; (ii) tactical FM, which was concerned with the day-to-day decisions in operating facilities.

Tladi (2012) indicated that during the pre-construction period FM managers could predict the impacts of the cost of FM. Since delivering a facility at the lowest possible expense was no longer the most important factor in the building business, it was critical to understand and consider the cost of a facility's total life cycle. Furthermore, FM managers had to concentrate on areas that needed continuous upkeep to check up on permanently fixed components (Enoma, 2005). The project team should come up with resolutions to satisfy customer demands throughout a facility's life cycle as well as guidelines for potential facility upkeep. FM managers should recommend an innovative and cost-effective facility at the design stage, as well as complete regular activities related to other ad hoc functions within the facility (Enoma, 2005).

According to Mohd Isa, Kamaruzzaman, Othman and Jaapar (2017), the existing state of a building and ease of access affected its maintenance costs. Maintenance and cleaning expenses would be greater in a building that was poorly managed and had little access for maintenance and cleaning. Furthermore, cleaning and maintaining difficult-to-reach buildings could necessitate the use of specialized equipment. A well-organized service and maintenance plan, on the other hand, would draw more occupants and ensure the effective pursuit and completion of plans. As a result, the FM manager's responsibilities should cover critical elements of building administration, such as ensuring that the building was easy to clean and maintain.

The task of FM managers, according to Che'Mat and Shah (2006), was to ensure a high rate of utilization during the design stage. Hodge *et al.* (2005) and Yu (2006) concluded that organizations should be agile and change-focused in their analysis of organizations. Since the ability to adapt and respond to environmental changes was considered vital for long-term sustainability, the present industrial scenario had been described as stable and straightforward. As a result, according to Che'Mat and Shah (2006), the FM manager's function was to facilitate the efficient flow of movement. The FM manager, for example, could remind planners of any space-related detail, such as room use, functional categories, shared use, room capacities and room dimensions. They explained that during the design stage, the FM manager had to maintain a high degree of utilization (Che'Mat and Shah, 2006).

In the context of higher education institutions, Wan Hamdan *et al.* (2011) recommended that information on space should be given during the early stages of the design process to cause a positive impact on FM and ensure pride in the building. The FM process followed the National Higher Education Strategic Plan (NHESP), which called for early investigation and oversight in

the construction of facilities and services to maximize their use. Waste was minimized in terms of construction room, space capability, tasks, behaviour and occupancy when utilization was acceptable. In terms of timing, space preparation management would also accommodate simultaneous demands on a workspace to extend business exercises and availability (Mohd Isa *et al.,* 2017)

Online fault identification and persistent observation of continuous monitoring (CM) condition frameworks, according to Fraser (2014), were becoming increasingly important. This increasing value stemmed from the possible benefits of detecting component faults early on and avoiding performance decreases by allowing enough time to replace defective components. Strong and robust CM frameworks would eventually replace standard unit facilities due to cost-cutting steps. According to Mohd Isa *et al.* (2017), CM was also a thoughtful investment that facilitated the installation of hardware and software checking systems (which were charged at cost for each observation). As a result, facility administrators had to have input on advanced workplace management processes.

FM administrators, according to Abidin and Pasquire (2007), should contribute to sustainable development problems. However, focusing too heavily on sustainable development during the organizational stage could obscure problems at the macro-scale level, as any design had to be capable of minimizing maintenance costs and ensuring protection (Nawawi *et al.,* 2015). By including FM supervisors in the whole design process, sourcing costs might be reduced, as well as job changes and unwanted alterations (Nawawi *et al.*, 2015).

According to Nawawi *et al.* (2015), active engagement of FM management during the preconstruction processes would ensure that sustainability practices were not impacted until a

facility was delivered and that facility planning and policies were kept up-to-date. In order to resolve sustainability, the FM manager had to search for the appropriateness of different sustainability design aspects and provide guidance on waste disposal systems. According to Abidin and Pasquire (2005), respondents agreed that sustainability concerns were relevant and should be addressed in FM studies.

According to a report by Cheong, Azian, and Faizah (2017), facilities managers had a broad variety of responsibilities, ranging from managerial to technical. As a result, facility administrators played a critical part in the operation and maintenance of buildings and facilities.

The writers went on to say that facilities administrators were interested in maintenance preparation, execution, supervision and assessment in buildings. They should be able to use effective repair solutions for the building and systems by using the least amount of money possible. They also had to ensure that all maintenance activities were completed successfully by managing the tasks and personnel. Following that, they had to assess the maintenance result as well as the satisfaction of the clients and tenants.

According to Vyskocil (2009), a facilities manager's expertise and experience had to intervene in certain areas; they had to know enough about all managerial practices to be a reliable advisor for customers but they did not have to be extremely qualified professionals. Required skills of facility managers by IFMA in terms of their certification are captured in Table 2.2.

Table 2.1: Programme of certification tests for facility managers by IFMA association

FM processes	Area of activity
Running of the enterprise maintenance	supervision of procurement, installation, operation, maintenance and removal of technical building systems, maintenance management of structural elements of buildings and interiors, supervision of procurement, installation, operation, maintenance and removal of furniture and equipment, supervision of procurement, installation, operation, maintenance and removal of landscaping and outdoor elements
Real estate	preparation, management and implementation of the main plan of building administration, organize and manage the administration of immovable property
Human factors and environmental factors	development and implementation of practices to promote and protect the health and safety of persons and property, environmental quality, work environment and organizational effectiveness, organization and management of emergency procedures training
Planning	creation of facilities plans, planning and management of all phases of the project, organization and planning management and suggestion of projects, engineering, organization and management of construction works and removing
Facility function	definition and planning devices functionality, management of workforce who operate the equipment, management of equipment procurement organization and management of operating facilities (services)
Finance	ensuring financing for the operation and management (supervision over budget and economy of operation)
Management of quality and innovation	management of the processes of quality services assessing and effectiveness of the device, management processes using the benchmarking method, management of control processes and their evaluation (audit), supporting the development of facility management services through innovation and improvement of facilities and more quality services
Communication	development of more effective communication

Source: Vyskocil (2009)

The following table describes the duties and tasks that facilities management is responsible for in any facility or building where services need to be rendered.

Table 2.2: Facilities Management duties

Performance Area	Description	Reference
Built area	As already discussed, the built area of a facility has two opposing effects: On the one hand, increasing the floor area creates a wide basis for the execution of maintenance and decreases the expense per square meter; on the other hand, large structures (high-rise buildings or a large portfolio of buildings spread out over a wide area) create functional and statutory requirements for infrastructures (water reservoirs for water supply and fire protection, security, internal traffic, etc.), which influence the reinstatement value of the facility per square meter and increase maintenance expenditures of the facility. Based on FM experience, the built area can be optimised during the design stage to suit the FM strategy and intended operational requirements.	(Lavy, *et al.*, 2010); (Shohet, 2006)
Occupancy	This parameter reflects the facility's wear and tear rate. Therefore, this parameter will be used to define the facility design life (material and equipment selection) based on the intended occupancy. Therefore, FM strategy formulation based on lessons learned from practice can have input on material selection and equipment.	(Lavy, *et al.*, 2010); (Shohet, 2006)
Space planning	Proper room management should be affected early in the facilities planning process to ensure functionality, usability, and the most efficient use of available space.	(Lavy, *et al.*, 2010)
Resource consumption – energy: (1) energy use: total facility energy use; or building energy use;	(1) Total energy used by the whole plant, including stored fuels or gases, energy consumed in the heating, ventilation, and air conditioning operation, lighting, domestic hot water, plug loads, and other building energy use. This does not mention the electricity used in the production process (energy consumed in manufacturing, industrial, or commercial activities) (2) The difference between total facility energy consumption and total facility energy generation (includes energy production and energy savings as a result of using energy star-rated equipment and employing energy-efficient efforts) (3) Annual electricity demand (4) Total natural gas consumption by the facility (5) Total energy use in the building (6) The maximum amount of energy used by a building at any given time is known as	(Lavy, *et al.*, 2010); (Shohet, 2006)

(2) net energy consumption; (3) annual energy consumption; (4) total natural gas consumption; (5) building electrical consumption; or (6) building electrical demand, demand intensity, or peak electricity demand	building electrical demand. The highest energy consumption per unit area at any given time is known as the demand rate.	
Resource consumption – water: (1) water consumption; or (2) net water consumption	(1) Total building water use (2) Total water consumption minus reused, recycled and treated water	(Lavy, *et al.*, 2010); (Shohet, 2006)
Parking	Availability of parking space per person/occupant. Depending on the FM strategy, operational challenges with regard to parking can be forecasted and informed decisions made at an early stage of facility development. If parking fees are to be collected, cash generation can also be forecasted	(Lavy, *et al.*, 2010); (Shohet, 2006)
Security	Describes the condition of security and effectiveness of security measures. Depending on the site location and security risk assessment (fire, access, theft, damage to property), informed decisions can be made at an early design stage to determine the level of security required (technology and physical security).	(Lingard, *et al.*, 2013); (Lavy, *et al.*, 2010); (Shohet, 2006)
Facility design life	This will influence the FM strategy, resources required (personnel, life cycle costs, tools)	(Shohet, 2006)

Site location	Location: proximity to homes and other community facilities; Safety, sound and quality: site is away from dangerous facilities like freeways, railroads, dams, airports, industries, traffic intersections and electric lines, level of external noise; Accessibility: good vehicular and pedestrian connections; Contours: slopes allowing minimal modification of site; Utilities: proper utility connections.	(Lavy, *et al.*, 2010)
Selection of equipment and material	This parameter affects the maintenance efficiency and design life indicators	(Lavy, *et al.*, 2010); (Shohet, 2006)
Availability of equipment	Maintainability of equipment within acceptable timeframes is vital in FM contracts. Service level agreements (SLA) revolve around time	(Lavy, *et al.*, 2010)
Equipment of efficiency	Energy usage and associated costs cannot be ignored. Most organizations are striving to reduce their carbon footprint and drive costs down to stay competitive.	(Lavy, *et al.*, 2010)
Availability of parts	Maintainability of equipment within acceptable timeframes is vital in FM contracts. Service level agreements (SLA) revolve around time, costs, and customer satisfaction	(Lavy, *et al.*, 2010)
Capital cost	All costs required to purchase, upgrade or renovate facilities, to procure plant and equipment, and to operate the business or organization	(Lavy, *et al.*, 2010); (Shohet, 2006)
Operational cost	All costs related to facility operation, such as insurance, air-conditioning, ventilation, overheads and wages, energy, fire protection, lifts and escalators, repair and maintenance, security, cleaning and garbage, sundries, and other expenses and fees	(Lavy, *et al.*, 2010); (Shohet, 2006)
Occupancy cost	Total cost associated with building occupancy, from building occupation to disposal. It includes real estate and personal property taxes, insurance for the building and its contents, depreciation and amortization costs, etc. This may also be considered a subset of "operating costs".	(Lavy, *et al.*, 2010); (Shohet, 2006)

Maintenance cost	Costs for labour (in-house or contracted-out) and materials required for building monitoring, inspection, repairs, maintenance, and response to service requests	(Lavy, *et al.*, 2010); (Davis, *et al*., 2005); (Shohet, 2006)
Utility cost	Monthly or annual cost of utilities, including electricity, fuel oil, gas, steam, water, sewage, etc.	(Lavy, *et al.*, 2010); (Shohet, 2006)
Disposal cost	The budget required for decommissioning, demolishing and disposal of the building, its systems, subsystems, and components	(Davis, *et al.*, 2005)
Residual cost	The anticipated reserve price of the facility at the end of life.	(Davis, *et al.*, 2005)
Accessibility	The degree to which the facility is accessible and prepared to accommodate various needs of various users (i.e. public, disabled, employees, maintenance personnel, etc.).	(Schraven, *et al.*, 2011); (Lavy, *et al*., 2010)
Convenience	This is closely linked with ease of accessibility and minimal use of resources, suitability to its functions. Facilities that are convenient result in high performance and minimal wastage of resources.	(Schraven, *et al.*, 2011); (Lavy, *et al*., 2010)
Appearance	Exterior and interior visual qualities, harmony with surroundings, scale and proportion of spaces and visual stimulation of the facility. Appearance of the facility in relation to corporate strategy, e.g. use for marketing purpose, etc	(Schraven, *et al*., 2011); (Lavy, *et al*., 2010)
Quality of life	The ability to deliver quality products and services to customers, effectiveness of their delivery, timeliness, and overall customer satisfaction with building, building services, and building systems. Characteristics of facility's site in terms of size, location, safety, sound and quality, accessibility, contours, preservation and development.	(Schraven, *et al.*, 2011); (Lavy, *et al*., 2010)
The project team must carry out operational risk assessment and mitigation at the	Risk management; applicable to both PM and FM risk	(Lingard, *et al*., 2013); (Lavy, *et al*., 2010)

development stage		
The project team should design for both construction and operational hazards	Design for construction and operational hazards.	(Lingard, *et al.*, 2013)
Environmental impact	Measured in terms of indoor pollutants, noise, light and ventilation; thermal comfort: air temperature, mean radiant temperature, humidity and air speed; indoor air quality: fresh air distribution, restriction of mass pollution (gases, vapours, micro-organisms, smoke, dust, etc.); day lighting and views: views and natural day light through windows. Facility that is environmentally friendly and generating minimal wastage	(Schraven, *et al.*, 2011); (Lavy, *et al.*, 2010
Social Impact	Social benefits	(Lavy, *et al.*, 2010

2.6 Competencies Required for Effective Facilities Management Practices

Facilities managers and repair operators have progressed from professional craftsmen to people with both undergraduate and postgraduate degrees, and having completed improvement courses, according to Amorim *et al.* (2013).The advancement of facilities management has fulfilled the requirements that qualify a subject as an academic specialty, according to the authors, and several higher education institutions offered a facilities management curriculum. Institutions received accreditation and were expected to continue to develop the curriculum during the accreditation period, according to Dore *et al.* (2014).

Furthermore, according to Motamedi *et al.* (2014), the industry advanced and innovated new technology including Building Information Modelling and Computerised Maintenance Management systems to increase the performance of facilities management activities. As a result,

facility administrators had to continue to develop themselves by participating in seminars and workshops. For example, they learned about and become acquainted with emerging technology that could be used in the workplace that they were not exposed to during their studies.

FM competencies could be seen in leadership and planning, operations and construction, project management, communication, finance and industry, real estate and property management, technology, emergency preparedness and business continuity, and environmental stewardship and sustainability, according to the Facility Management Accreditation Commission (2014). Hebert and Chaney (2011) discovered that better coordination between seasoned facilities managers and their younger counterparts would make for a more effective talent transfer. Aside from that, in the areas of decision management, awareness and execution, seasoned facilities administrators might theoretically have control upwards with customers, downwards with building tenants, and sideways with external organizations (Goulden and Spence, 2015).

The scope of function for facilities managers, according to Williams and Sutrisna (2010), included full responsibility for clients' buildings, arranging and procurement of accommodation and support services to businesses and tenants, building protection and upkeep, people management and building efficiency. Meanwhile, Meng (2014) believed that the facilities manager would relate to the strategic and operational levels of building management to match fiscal, financial and social considerations.

According to Au Yong *et al.* (2014), a skilled and professional facilities manager was capable of providing above-satisfactory service as expected by the organization or customer, as well as ensuring that all projects were completed in a timely manner to provide excellent building results.

A leading facilities manager, according to Peters (2015), should be constructive, visionary, growth-oriented, and committed to quality improvement. As a result, in order to successfully execute facilities management activities, facilities managers had to continually develop their competencies.

Maintenance processes, financial planning, change management, user interfacing and support were among the five areas of FM competencies defined by Markus and Cameron (2002) as necessary to achieve the organization's goal. Payne (2000), on the other hand, identified four areas where FM practitioners were required. While he did not name these areas as competencies, researchers believed they could be used as a reference for determining FM competencies at Polytechnics: (i) Property and built environment experts, such as specialist engineers, legal services providers, space designers, and quantity surveyors, were among these fields (ii) The way people communicated with the urban world necessitated the involvement of professionals and environmental engineers, as well as construction services (iii) The maintenance staff's professional knowledge (iv) A process that takes place inside the building, such as washing/cleaning, protection/security, mail room, reprographics, and the realistic management of the activities of specialists from various backgrounds.

In a report, Payne (2005) identified ten main characteristics for a facilities manager to use as a guide for FM competencies. Understanding the organization, community, clients and their needs; understanding and expressing business expectations and targets; and providing brokerage services to other stakeholders were examples of such functions. Other examples were manage risk; manage contractors and monitor their performance; benchmark outsourcing services; build service supply

and delivery strategies; comprehend strategic planning; secure public funds if applicable. Internal skills could be developed through schooling, preparation and professional development.

Awang *et al.* (2012) conducted a report on facilities administration competencies in technical institutions in the same manner. According to the findings, all 24 components of facilities management competencies had mean ratings above 4.0. The competencies aspect was very necessary and was needed in carrying out the responsibility for facility management in technical institutions, according to this report. All 24 items of facilities management competencies received mean scores above 4.0, according to the report.

Property management, financial planning, organizational management, transformation management, creativity and human resource management were among the key competencies of Facilities Management (Atkin and Brooks, 2002). The specialist in this role should be well-versed in not just one area but also a variety of business practicesThis could be further simplified by describing competencies as school-based skills, while credentials were what employers wanted from workers. Communication competence, organizational skills and professionalism were the three most important qualities that employers looked for in facilities managers (Atkin and Brooks, 2002). These were the credentials that employers strove for. Effective facilities managers could combine estate-related expertise and experience with an understanding of organizations, operations and staff. These key points were also highlighted in Facility Management concepts.
Below is a list of competencies as listed by Atkin and Brooks:

- Real estate management: building performance, environmental services and workplace design
- Financial management: accounting, finance, purchasing and supply, and legal aspects

- Organizational management: organizational structure, behaviour, processes and systems
- Innovation and change management: technology, ICT and information management
- Human resource management: motivation, leadership, employment law, health and safety.

The field's curriculum was another basis for identifying key competencies for the industry. The article of updated competence profile for institutions of higher technical Facilities Management education in the Netherlands also contained a list of competencies. In this post, nine skills were considered to be the most important for facility managers. Because of the changes impacting the facilities management industry, these skills were needed (The Revised Competence Profile for Institutions of Higher Professional FM-education in the Netherlands, 2006, 262).

Table 2.3: Required competencies in FM

Areas of Competency	IFMA (2010)	BIFM (2010)	FMA Australia (2010)	HKIFM (2010)	APPA (2010)	Payne (2000)	Markus and Cameron (2002)	Artkin and Brooks (2005)	Van de Ende (2006)
1.Mangement and Leadership									
Management and leadership	✓				✓				
Change management			✓				✓		
Professional practice					✓	✓		✓	
Law				✓	✓	✓			
Real Estate Law				✓					
Management of the assigned personnel to the facility function	✓						✓		
2.Managing the Organization									
Having an understanding of the structure and administration of the organization		✓			✓			✓	
Understanding the organization's aims and procedures		✓	✓					✓	
Developing FM strategy in line with organizational procedures	✓	✓	✓				✓	✓	✓
3. Managing Human Resources									
Employment recruitment management in managing facilities work processes		✓	✓	✓	✓		✓		✓
Effective communication	✓	✓	✓		✓	✓			
Cooperation with suppliers and industry expects on issues relating to the facility or property		✓							

Areas of Competency	IFMA (2010)	BIFM (2010)	FMA Australia (2010)	HKIFM (2010)	APPA (2010)	Payne (2000)	Markus and Cameron (2002)	Artkin and Brooks (2005)	Van de Ende (2006)
Managing the place of work			✓					✓	✓
4. Managing Premises									
Overseeing issues relating to the organization's property	✓	✓	✓	✓	✓	✓	✓	✓	✓
Understanding the buildings design		✓			✓		✓		
Preservation of the various elements of the building		✓	✓				✓	✓	
Enhancing the performance of the building			✓					✓	
Managing the working environment					✓				

Nine competences stated by Marco van den Ende:

- Initiating and creating facility products and services, autonomous and entrepreneurial, on behalf of the organization
- Developing views on changes and trends in the external environment and developing relations, network groups and chains
- Analysing strategic problem areas, translating them into objectives and alternative options, and preparing for decision making
- Applying human resources management in the light of the strategy of the organization
- Organizing, controlling and improving business or organization processes
- Analysing financial and juridical aspects, internal processes and the business or organizational environment to enhance the relationship and interaction

- Developing, implementing and evaluating a change process
- Social and communicative competence (interpersonal, organizational)
- Self-controlling competence (interpersonal, practitioner or professional).

The above table shows the list of competencies and skills subsets that were gathered from pre-existing knowledge. It is a mixture of all the skills listed by numerous professional Facilities Management bodies like the HKIFM, APPA, IFMA, BIFM and FMA Australia, etc.

2.6.1 Required Skills for Facility Managers

As part of a project with the primary goal of setting out a training curriculum for future facility managers in Australia, the Facility Management Association of Australia (2012) identified the various types of skills required by a facility manager. These various definitions were also part of the FM profession's fundamental criteria. The Facilities Management Association of Australia's (2012) classification of qualifications categorized together with the criteria of the facility manager career in the industry determined whether the categories were precise. Below is the list of the competencies:

1. Management and Renewal
2. Shareholder Associations
3. Business Systems and Productivity
4. Industry Knowledge
5. Hazard Organization
6. Effective Activities
7. Strategic Activities.

Below is a detailed overview of the skills that fall under each of these categories: When the qualifications needed to become an effective facilities manager were recognized, a training curriculum for potential Facility Management practitioners could be quickly devised.

2.6.2 Leadership and Innovation

Facility management could be described as a people-oriented career, and in order to be an effective professional in this area, a person had to develop positive relationships with those who worked under them as well as peers and customers. According to Risan (2013), labour was extremely important in facility management, and it was critical for facility managers to establish positive relationships with their assistants in order to motivate them to work well, improve their commitment, and reduce the likelihood that they would quit. According to Hinxman and Clark (1999), a facilities manager had to possess the following leadership qualities: the ability to handle transition, decision-making capabilities, organizational skills, business development skills, customer support, and resource management. While the facilities manager was not actively concerned in organizational decisions, he or she played an important role in the implementation of policy related to the operation of the enterprise and the use of the building. A facilities manager's willingness to formulate appropriate management strategies and initiatives to improve the facility's functioning was a desirable feature.

To keep up with the industry's constant technical advances, innovation was needed. Facilities administrators could now save correct data (drawings, descriptions, asset positions and technical details) all the time given the advent of Computer Aided Facility Management (CAFM). Information processing using technologies, data recording and the opportunity to do predictive analysis on the data would be the key areas of performance (BIFM, 2009). “An effective facilities-management information system would help the primary company better maintain itself, enhance

the life expectancy and reliability of the facility, maximize appliance repairs, help plan regular maintenance operations, and enhance the efficiency of the working environment" (Urso, 2011). According to BIFM (2009), the facility manager should be aware of the more recent developments in information technology that might be used to improve Facilities Management's processes.

2.6.3 Stakeholder Relationships

Students, the government and the whole workforce were all players in the educational field (Hsin and Loosemore, 2001). According to Wiggins (2010), when it came to expectation management, the relationship between stakeholders and the facilities manager posed problems.

An overview of client needs, building supply networks, handling grievances, and delivering customer satisfaction were among the skills listed by the Facility Management Association of Australia (2012). One of the most important responsibilities of a facilities manager was to develop supply networks and oversee project recruitment. The practices, according to FAM (2012), included discovering new, cost-effective products as well as trustworthy suppliers of these products that were easy to do business with. Jensen (2009) described two case studies that demonstrated "that the demand side could be an effective initiator of supply chain innovation by developing procurement models with greater incentives for the concerned parties to be innovative".

The facilities manager also promoted positive stakeholder relationships in order to help provide a pleasant atmosphere for the building's tenants by listening to their concerns. A skilled facilities manager should have excellent leadership skills in order to maintain positive stakeholder relationships. In his research, Wiggins (2010) stated that problem-solving skills were often needed in order to resolve and handle disputes in the workplace.

2.6.4 Business Systems and Productivity

According to Redlein (2004), the proprietor, user and technician roles, as well as their demands on the facility, generated an area of tension that the facilities manager had to balance. This point was accurate if it was considered how the facilities manager was responsible for a variety of tasks, including maintaining the consistency of the programmes or goods used, implementing accreditation regimes, and analyzing market needs in order to devise procedures and structures that could be enforced on campus. According to BIFM (2009), it was also important that the facility manager had the requisite preparation to perform these tasks and had the necessary knowledge of quality control procedures, as this would lead to facility efficiency.

2.6.5 Industry Knowledge

According to Barnes (2010), trade association learning and accreditation services were the basis for technical competence, and the growing importance of degree and continuing education programmes in universities offered a way to strengthen Facilities Management's external reputation as a main career. Hiring experts with a broad understanding of the market and everything relevant to it would help to boost the reputation of FM professionals. Construction, land markets, real estate operations, regulatory regulations, inventory management, purchase and disposition of property, building facilities, and town planning requirements were all things that a facility manager should be familiar with (FMA, 2012).

2.6.6 Risk Management

Risk management was characterized as a systematic approach to the management of potential uncertainties in which an organization identified different strategies for dealing with threats that could threaten individuals, financial capital, property or reputation (Lavy and Bilbo 2010). Risk management in a facility could be a top priority for facility operators.

Controlling or mitigating risk in day-to-day activities was essential for a successful company. Emergency situations such as health and safety, health risks and fire could be handled positively and efficiently by facility management. The facility manager should be well-versed in the risks so that he or she was able to evaluate them. Facilities administrators had to be able to prepare for unforeseeable disasters and crises, since this was one of the most important facets of risk control in Facilities Management. The authors used the assault on the World Trade Organization as an example (Nor, 2014). Natural catastrophes might strike the campus at any moment, depending on the location of the buildings. As a result, lifelines had to be planned and applied with emergency planners and social scientists' help. To prepare various types of educational campus users for a variety of scenarios, training programmes and evacuation exercises had to be created. According to the OECD (2004), a facility manager should be able to identify risks, monitor and minimize them and have high emergency preparedness skills.

2.6.7 Operational Activities

According to Barnes (2010), administrators of the FM sector had to be tactful and they were responsible for the day-to-day activities of a plant. The Royal Town Planners Institute (RTPI) (as quoted by Clark and Hinxman, 1999) identified 15 competencies that managers had to possess, including well-developed political, networking, shaping, negotiating and people management, and partnership skills. When the Facilities Management group had to ensure transparent contact within the organization and establish a structured collaboration relationship between end customers and service providers, these capabilities might be integrated (Wiggins, 2010). A facility manager's job was to make sure that the day-to-day operations ran smoothly. Waste minimization, service optimization, energy management, water recycling programmes, and the development of a pleasant work atmosphere were among the required competencies (Shah, 2006).

Hsin and Loosemore (2001) listed the success areas in terms of educational campus operations. Parking, protection, learning facilities, space management, water and energy use, ground and building maintenance, building running costs and refurbishment projects were among the ten performance areas identified by the author.

2.6.8 Strategic Activities

The acts that contributed to the achievement of the organization's goals and priorities were known as strategic activities. These were important because they added to the organization's objectives. The disadvantages of the FM's career were that it focused more on economizing services and goods while lacking the business's strategic planning (Grimshaw, 2013). Kaya *et al.* (2004), who wrote years before Grimshaw's post, expressed a similar opinion, stating that they considered it difficult to represent Facilities Management as a discipline in terms of its competitive importance, despite it having evolved from a foundation of professional competence. By contributing management expertise, a facilities manager might help an organization achieve its goals. In most cases, the building owner gave the FM department inadequate details, incomplete procedures and poorly commissioned maintenance manuals when handing over the building. According to Shah (2007), this necessitated the involvement of Facilities Management in the decision-making phase.

According to Alexander (2003), the task of Facilities Management organizations included implementing and communicating a facility strategy, preparing for continual improvement of service efficiency, classifying customers' expectations or needs, negotiating service level agreements, forming service partnerships and drawing up contract plans.

2.7 Challenges Inhibiting Effective Facilities Management Practices in Public Buildings

According to Aliyu *et al.* (2016), the FM team did not properly manage more than 60% of the facilities in commercial properties. This was usually attributed to insufficient budgeted funds and a lack of facility maintenance preparation. Furthermore, the managers did not respond to tenants'

calls for repairs and renovation in a timely manner. It was also discovered that the number of complaints by commercial building tenants was growing. Furthermore, according to Xianhai (2013), a lack of early FM involvement during the pre-construction stage could result in issues such as inefficient use of building materials and equipment.

Changes in environmental conditions, as well as a lack of a maintenance culture, were to blame for the ageing and degradation of educational buildings, services and equipment in Nigeria, according to Asiabaka (2008). Repairs, on the other hand, were only carried out when complications occurred as a result of the original facility's failure. Adenuga, Odusami, and Faremi (2007) supported this conclusion, claiming that maintenance administration in the public sector had long been hampered by a shortage of funds and a general disregard for the buildings.

Adewunmi, Ajayi, and Ogunba (2009) investigated a variety of factors that affected estate surveyors' and valuers' (property managers) involvement in FM in Nigeria. Despite the fact that the research was not aimed at educational establishments, it was discovered that surveyors' involvement in areas of core FM expertise was influenced by their FM qualifications and the sort of company they worked for. Design mistakes, a lack of a maintenance schedule, a lack of awareness of FM, underestimating the impacts of FM, and poor maintenance efficiency, according to Islam, Nazifa, and Mohamad (2019), were significant factors that affected FM services in organizations.

Education, environmental policies/legislation and FM skills, according to Akinsola, Hussaini, Oyenuga, and Fatokun (2012), were needed to build a good working atmosphere for cost management services and monitoring of FM service output in order to ensure the country's successful economic climate. Lavy and Bilbo (2010) investigated facilities maintenance activities in large public schools in Texas by examining how those schools prepared, administered and

carried out maintenance. They found that facilities maintenance management procedures in large public schools in Texas were of poor quality. In contrast, Hopland and Nyhus (2015) discovered a connection between student satisfaction with school facilities and exam results. This demonstrated the significance of effective FM programmes in classrooms.

Odediran, Opatunji, and Eghenure (2012) found that the economy was the most important factor influencing maintenance practices, and that facility users in Nigeria only had access to a small maintenance community. In addition, Asiabaka (2008) described a lack of policy guidance for infrastructure growth, a lack of managerial process expertise, nonchalant or passive attitudes towards facilities deteriorating, a lack of qualified experts, insufficient qualifications and insufficient funding as fundamental factors affecting FM practice in Nigeria. Inadequate finances, as well as a lack of centralized intelligence on the state of the buildings, caused FM activities such as major renovations and replacements to be postponed (Chandrashekaran and Gopalakrishnan, 2008).

Overcrowding, according to Ogungbile and Oke (2015), had resulted in the degradation of public facilities buildings. Lack of understanding as well as a lack of adequate oversight and quality management were identified as significant factors by Ikediashi *et al.* (2012). Adenuga *et al*. (2007) supported this conclusion, claiming that FM in the public sector had long been hampered by a shortage of funding and a general disregard for the buildings.

According to Chandrashekaran and Gopalakrishnan (2008), a shortage of adequate funds for FM in organizations was a significant factor affecting FM, and this typically resulted in the postponement of major facility repairs and replacements. Other factors involved a lack of centralized intelligence in assessing defects and evaluating facility requirements, which forced renovation programmes to be carried out at the expense of essential replacements and renovations.

The main threat to FM in universities and colleges in the United States was a lack of progress in the original planning, architecture, and maintenance costs of a facility (Rose *et al.*, 2007).

Lack of awareness of managerial systems, nonchalant or passive attitudes towards the deterioration of facilities, the unavailability of qualified experts, insufficient expertise, and inadequate financing, according to Asiabaka (2008), were all dominant factors affecting FM activities, especially in Nigeria. This supported Adenuga's *et al.* (2007) assertion that FM in the public sector had long been hampered by a shortage of funds and a general disregard for the buildings. Ikediashi *et al.* (2012) described factors that affected FM in South Nigeria, including a lack of understanding, adequate supervision and quality control. Procurement procedures, skill/manpower shortages, distrust between management and service providers, type of employer, political barriers/ government interference, and personal and labour problems were among the others.

Most buildings, especially residential buildings, were occupied by more than the defined number of users that the building was built for during the design stage, according to Mohammed and Hussanain (2010). This had a significant impact on the building's structural and aesthetic integrity over time, as well as a direct impact on the expense of administering FM in that specific building.

According to Akinsola *et al.* (2012), most buildings lacked a decent maintenance culture and they also lacked a maintenance manual and corrective maintenance practices. Akinsola *et al.* (2012) investigated crucial factors impacting FM in Nigerian tertiary institutions and found that one of the major challenges in public buildings was that funds for renovation and other relevant works came mainly from the government, and which would have been limited to the bare minimum or not made available at all due to the strict procedures involved in releasing funds in line with government practice.

2.8 Drivers and Enablers for Effective Facilities Management Practices in Public Buildings

Identifying the core challenges and drivers of successful FM practice, according to Lee (2002), would contribute to the improvement and growth of sustainable practice in the FM industry. According to a study conducted by Sapri, Muin Ab, and Sipan (2016), teamwork was one of the most important drivers of successful FM practice. Organizational process planning, appointing a competent and professional facilities manager, exchanging FM information with all its advantages, and good change management were all identified as key factors for successful FM activities by the authors. As a result, the main drivers of efficient FM were addressed in broad terms as follows.

2.8.1 Organizational Structure

According to Sapri *et al.* (2016), an organization lacking a fixed structure was more likely to collapse. As a result, the aims, purpose and vision of an organization should be well identified. The author went on to say that it was important that the organization's framework did not hinder further growth opportunities. According to Chotipanich (2004), an organization's characteristics had a significant impact on the demands for infrastructure and support services. The characteristics of an organization could be discussed from time to time, according to Lee (2002) in Chotipanich (2004) because organizational goals and characteristics could be altered or modified by the market cycle and external setting. Elmualim, Valle and Kwawu (2012) believed that multiple players such as owners, senior management, government, staff, customers and the supply chain controlled the strategic behaviour and success of the organization, and that there was a need for cooperation between them. High ranking management's leadership style and engagement, according to Elmualim, Shockley, Ludlow and Shah (2010), could be a primary factor of organizational sustainability. The dedication of senior management helped to sustain the whole organization's success and priorities. According to the findings of Dubem, Stephen, Micheal and Timothy (2013), senior management leadership should be at the forefront of championing improved levels of

successful FM practice within organizations. According to the results, FM activities would only have a significant effect in an organization if FM values were completely integrated into the strategic role of the organization. As a result, this element could be a core driver for successful FM because it had the potential to adapt to changing conditions.

2.8.2 Knowledge and Skills of Facilities Manager

FM, according to the International Facilities Management Association (IFMA), was a multidisciplinary career that integrated individuals, location, operation and technology to ensure the efficiency of the built environment. Meanwhile, the British Institute of Facilities Management described FM as the management of multidisciplinary practices within the built environment and their effect on people and the workplace. Based on the term facilities manager, it could be inferred that the position of the facilities manager encompassed a broad range of responsibilities, and that decisions had to be taken at different management levels, including political, tactical, and operational. The facilities manager's knowledge, experience and abilities were needed to complete certain tasks (Sapri *et al.,* 2016) and it was important to ensure their efficiency and efficacy. Facilities managers had to strengthen their competencies to meet the needs and pressures of FM as well as the prospects for successful FM growth and practice when they were at the forefront of delivering their organization's mission and dedication (Elmualim, *et al.,* 2010). As a result, establishing an FM career in an organization with expertise and high-quality skills was critical to the advancement of successful FM practice (Mustapa, Adnan and Jusoff, 2008; Firdauz, Sapri and Mohammed, 2015).

2.8.3 Sharing of FM Knowledge

Knowledge was seen as the most valuable competitive resource in businesses. As a result, organizations were putting more work into purposefully managing information in a systemic manner (Pathirage, Haigh, Amaratunga, and Baldry, 2008), as it was seen as vital to their progress.

Knowledge was both tacit and explicit and both were distinct, according to Pathirage *et al.* (2008), because tacit knowledge was knowledge dependent on individual experiences reflected in human behaviour such as assessment, points of view, commitments and motivation. Explicit knowledge, on the other hand, was modifiable knowledge found in non-human storehouses such as organizational manuals, records and files. FM knowledge was critical for implementing the best FM practices (Pathirage *et al.,* 2008; Firdauz *et al.,* 2015). As a result, in order to ensure that FM was operational, FM awareness had to be established within the organization. Successful information exchange was important as part of the knowledge management systems, according to Mohammed, Cyril, Gerald, and Goh (2011), because it could promote creativity by promoting the free flow of ideas.

2.8.4 Team Working

Customer happiness, according to Kamaruzzaman and Zawawi (2010), was the primary goal of FM in providing good service efficiency. According to the authors, FM activities played a critical role in the demand-supply equation, so the team had to have a transparent and unambiguous brief, ensuring that FM was used in the strategic planning phase. Effective FM was mostly a collaborative endeavour (Hamilton, 2003). Effective FM teams would be able to speak the language of the central organization they represented, clarifying and serving their strategic commitment in terms of market related outcomes (Hallam, 2007 in the study by Kamaruzzaman *et al.,* 2010).

2.8.5 Change Management

Change was a transition from an organization's current state to a desired future state (Sapri *et al.,* 2016). The introduction of FM could be aided by these improvements. To accomplish this significant shift, high-level management skills, as well as learning and consolidating the skills base, were needed (Sapri *et al.,* 2016). As a result, adequate preparation for the implementation

and advancement of FM skills was needed. Facilities managers had to become transformation agents in terms of how programmes were delivered (Sapri *et al.,* 2016).

2.9 Facilities Management Adding Value to the Organization and the Society

Facilities management has evolved over the past few decades from having a cost-cutting emphasis to operating facilities as a competitive utility that added value to the organization and its customers, as well as contributing to the overall success of every nation's economy (Jensen, 2010).

This has necessitated an examination of some of the meritorious contributions of facilities management to organizations and society. One of the common findings reached by the Nordic FM Work Group (2006) was that there had been a shift in FM from concentrating solely on cost savings to focusing on adding value (Norton, 2000). The challenge of providing excellent workplace services had become exceedingly important as a primary prerequisite for facilities management, according to Jensen *et al.* (2013). As a result, facility management had been forced to rely more on how facilities could be operated to add/increase value to the core sector. According to Jensen (2010), other trends that pushed facilities management towards the emphasis on added value were the current focuses on sustainability and corporate social responsibility. Nonetheless, facility management had been able to include appealing facilities, streamlined service delivery and more proactive maintenance procedures, allowing public and private organizations to accomplish their objectives.

According to a UNEP report in 2009, buildings accounted for up to one-third of global greenhouse gas emissions, and the construction sector had the ability to reduce greenhouse gas emissions in a significant and cost-effective manner. However, according to Junnila *et al.*, (2006), over 80% of greenhouse gas emissions occurred during the operating period of buildings, as they were under the supervision of facilities management. Facilities management had dealt extensively with this in

recent years, when greenhouse gases were emitted inside buildings, mainly commercial centres, had been effectively regulated. Nonetheless, Sarasoja and Aaltonen (2012) in Jensen *et al.,* 2013 published a report on environmental protection from the occupier's perspective. Enhancing the environmental efficiency of buildings and utilities, according to Jensen, (2013), not only reduced electricity demand and greenhouse gas emissions but also benefited the organization in other areas. This was viewed as an example of how facilities administration had made a contribution to the benefit of society by aiding with the reduction of pollution.

Moreover, De Vries (2007), Jensen (2009), Den Heijer (2011), Sarasoja and Aaltonen (2012) in Jensen *et al.,* (2013) also stated that facilities management services had the potential to:

- Increase user satisfaction
- Increase employee satisfaction
- Support user activities
- Increase flexibility
- Support user activities
- Improve quality of place
- Control risk
- Increase the value of the facility
- Promote the marketing and sale values of the organization
- Support environmental stability
- Affect employee wellbeing and productivity, and

- Reduce costs.

2.9.1 Building Maintenance

The procedures required to keep a facility in good repair or in full operating order were known as routine maintenance (Taylor, 2015). Both preventative and corrective repair were used in this regular framework. Inspection of floors, air-conditioning and heating ventilation, as well as minor repairs, were examples of normal maintenance, according to Taylor (2015). When leaders failed to perform larger repairs when they were required or scheduled, they became deferred maintenance (Taylor, 2015).

According to Carnero (2014), corporate executives did not regard maintenance as a major factor in an organization's competitiveness and competitive edge until the last decade. Swanson (2001) went on to say that many companies and market executives saw repair and facility activities as a cost centre that had to be reduced in order to increase profit margins, so they implemented reactive strategies. This reactive tactic had the potential to lead to more expensive repair behaviour (Albarkoly and Park, 2015). Swanson (2001) described reactive maintenance as a fire-fighting strategy in which leaders postponed routine maintenance and upgrades before permanent repairs could be made. This postponement and delay of repairs raised costs and created confusion in other activities (Swanson, 2001).

Preventative repair and facility management were other forms of maintenance techniques. To reduce depreciation, FMs who used preventative maintenance techniques scheduled the maintenance and used data such as mean-time-to-loss, to monitor facilities and plant structures (Au-Yong, Ali and Ahmad, 2014; Swanson, 2001). Preventative maintenance was a data-driven technique in which maintenance officers analysed longitudinal data from facility equipment and processes to assess whether it was time to replenish something before it failed (Swanson, 2001).

According to Rahman, Hoque and Uddin (2014), planned preventative maintenance (PPM) was comprised of four groups:

- Preventative maintenance
- Breakdown maintenance
- Corrective maintenance, and
- Maintenance prevention.

Lubrication, corrosion prevention and component replacement in a time series dependent on a predetermined timeline for a single component were all examples of preventative maintenance (Au-Yong *et al.*, 2014). According to Au-Yong *et al.* (2014), optimum performance could increase customer loyalty as demonstrated in a case study on preventative maintenance of office buildings. In this case study, the building's tenants were customers.

The technique agressive repair, was described by Swanson (2001). Aggressive repair was a technique that focused on more than just preventing faults in facility structures and appliances. Total active maintenance (TPM), according to Piechnicki, Sola, and Trojan (2015), was one form of the aggressive repair technique. This technique was created in Japan to help with just-in-time production (Piechnicki, Sola and Trojan, 2015; Swanson, 2001). Although TPM was difficult to introduce, Attri, Grover, and Dev (2013) clarified that it was an innovative method of measuring the efficacy of manufacturing facilities that managers used to analyse maintenance and operations obstacles and challenges. Moreover, Bhalerao, Kale, Bhalerao and Mahire (2014) pointed out that a huge factor in implementing this strategy was comprised of two key components:

- Human orientated strategies

- Process orientated strategies.

Since it necessitated transition, the human-oriented aspect could be the more difficult of the two for managers to implement (Attri *et al.,* 2013; Bhalerao *et al.,* 2014). Managers might adopt techniques that had a positive impact on repair activities if they were well educated about the obstacles (Attri *et al.,* 2013). Institutional leaders in the twenty-first century, according to Attri, Grover, Dev, and Kumar (2013), should have sustained productive maintenance and competitive manufacturing strategies that incorporated both maintenance and efficiency roles to provide quality goods.

Maintenance costs should be assessed and adequately planned for by organizational management, as these costs might have either a significant positive or detrimental effect on the organization and its end users (Jain, Bhatti and Singh, 2014). In most cases, businesses purchased new machinery at a high cost without having a plan to operate it and evaluate its performance (Rahman *et al.,* 2014). TPM was considered by some researchers to be more than just a primary organizational practice (Jain *et al.,* 2014; Rahman *et al.,* 2014). TPM was a maintenance theory that established a life cycle approach to equipment maintenance (Rahman *et al.,* 2014).

Building maintenance was one of the most visible functions of facilities management in any building, and it was one of the most important contributions by FM to any building. Corrective, preventive, scheduled and predictive maintenance were the four types of maintenance. According to Al-Hammad *et al.* (1997), all types of maintenance procedures were necessary in any building, and no one type could be said to be the strongest, depending on the form and condition of the structure. According to Chew *et al.* (2004), preventative care was still the right way to keep buildings in good shape. According to Chew *et al.* (2004), maintenance officers could use scheduled and corrective maintenance, as well as preventative maintenance, in tandem, depending

on the form and function of the building. According to Chew *et al.* (2004), corrective maintenance had a significant impact on the maintenance life of every building and should be avoided unless there was no other choice.

MAINTENANCE WORK CLASSIFICATION
And Sub-Categories

Category	Sub-Category	Definition
Planned Maintenance	Preventative Service Maintenance	The actions performed to prevent failure by providing systematic inspection and monitoring to detect and prevent incipient deterioration or failure and includes testing to confirm correct operation.
	Condition-based Maintenance	Corrective maintenance work performed, as a result of significant deterioration or failure, to restore an asset to its required condition standard. The work may be programmed as a result of Condition Assessments or as random additions to the program based on priority.
	Statutory Maintenance	Both Preventative Service Maintenance and Condition-based Maintenance may contain elements of Statutory Maintenance which is defined as actions performed to provide the minimum level of maintenance to meet legal and other mandatory requirements contained in Commonwealth and State Regulations, Australian Standards and Codes of Practice.
Unplanned Maintenance	Routine & Breakdown Maintenance Incident Maintenance	Unplanned and reactive maintenance actions performed to restore an asset to operational condition, as a result of an unforeseen failure. Unplanned maintenance actions to restore an asset to an operational or safe condition as a result of property damage resulting from storms, fire, forced entry and vandal damage.
	Incident Maintenance	Unplanned maintenance actions to restore an asset to an operational or safe condition as a result of property damage resulting from storms, fire, forced entry and vandal damage.

Figure 2.1: Maintenance Classification
Source: Maintenance Management Framework, Department of public works, Queensland, Australia.

2.10 Conclusion

This chapter has reviewed a substantial body of relevant literature and discussed several perspectives on Facilities Management.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction

This chapter explains the systematic approaches adopted to arrive at meaningful solutions to the study research questions. It describes the types of data, the population of the study, the sampling frame, the sampling technique, including the sample size, the research instrument and the method adopted in the collection of research data. The statistical tools and techniques for data analysis, the method of data analysis and the presentation are also discussed.

3.2 The Study Population

The research population could be described as the totality of a well-defined set of common, binding characteristics or features of people or items (Majid, 2018). A population was described as all the components that fulfilled the sample requirements for incorporation in a research (people, items and occurrences). A population could be described in the same vein as the full set of topics that could be studied: individuals, items, livestock, animals and organizations from which to obtain a sample (Evan *et al.*, 2020). All individuals or objects with the trait one wished to know about were also described as a population. Gabriele (2018), described population as a whole group, or set of instances, that a researcher was interested in generalizing. For the purpose of this study, the population comprised the KZN Department of Public Works as it was the major implementing agency for the maintenance of government buildings. The targeted respondents were the KZN works inspectors who primarily dealt with maintaining government buildings. The study was conducted in all district offices of the KZNDPW (KwaZulu-Natal Department of Public Works) across the province.

3.3 Sampling Technique and Sampling Frame

An appropriate sample frame should be dependable and complete and be the precise representative of the entire population (Kothari, 2004). In determining the sample frame for the study, purposive sampling was utilized in order to get reliable information from the participants

involved directly in Facilities Management in South Africa. In total there were 13 locations and each location consisted of three works inspectors (structural, electrical and mechanical) who took part in the survey, thus making the total population for this study to be 39 inspectors. (Please See attached Appendix A – Letter of Information.) Purposive sampling relies on the judgement of the researcher in the choice of the population. It focuses on the particular characteristics of a population that are of interest. Most times the criteria for inclusion/selection form the basis for purposive sampling. In view of this, all the inspectors in the works department of the KwaZulu-Natal province were sampled in the study area used for the study. Therefore, the sample frame used for the study was a total of 39 inspectors from the works department.

3.4 Method of Data Collection

Data for this study were collected through a questionnaire which was sent via Google Forms to the Department of Public Works inspectors (structural, mechanical and electrical) stationed around the KZN province. The information provided by the respondents was compiled and formed the primary data for this research. The questionnaire was designed in a way that ensured clarity of expression that was easily understood by the study respondents. The questionnaires were administered to 39 inspectors from the Public Works department of the KwaZulu-Natal province. The Letter of Information as well as the Informed Consent Form formed part of the information that was provided to the participants. Since the questionnaires were distributed electronically, the participants were required to read the informed consent form and confirm their voluntary participation. The questionnaire was designed in such a way that the participants could not have access to the questions without first confirming that they had been duly informed about the research and that they were aware that their participation in the research was voluntary.

3.5 Questionnaire Design

The questionnaire consisted mainly of closed questions so as to ensure that quantitative data were adequately captured. The survey questionnaires were designed to accomplish the above-mentioned objectives through gathering data on effective facilities management in South African public sector buildings. A total of thirty-nine (39) questionnaires were distributed. The questionnaire contained seven sections (A-G). The first section (A) of the questionnaire elicited information on the demographic attributes of the study respondents. Those attributes were location of respondents, gender, age, academic qualifications and number of years spent at work among others. Section (B) of the questionnaire contained questions on the current nature and extent of facilities management in South African public sector buildings. Section (C) dealt with the technical roles of the facility management team in the life cycle of the building. Section (D) dealt with the competencies required for effective facilities management in public sector buildings. Section (E) asked about the challenges encountered in implementing effective facilities management in South African public sector buildings. Section (F) dealt with drivers for effective facilities management whilst section (G) dealt with the enablers of effective facilities management in South African public buildings. The questionnaire was estimated to take between 25 and 30 minutes to complete. There was no personal contact with the research participants as the questionnaires were distributed and collected electronically.

3.6 Assurance of Confidentiality and Anonymity

The data collected were treated anonymously in accordance with research ethics rules. The findings of the survey were used for research purposes only. There were no risks, current or anticipated, to any of the participants involved in this study. The researcher took on the responsibility of protecting the participants as an ethical commitment that considered the participant's rights. The confidentiality and anonymity of the participants was of the highest importance to the researcher. This was achieved through the following means as stated in the Letter of Information:

- No personal details of the participants were required (e.g. names, ID number, cell phone number).
- It was an online survey (Google Forms is set to not to collect participants' email addresses; consequently, the responses cannot be traced back to any particular participant).
- No sensitive biographical questions were asked that could identify the participants.
- The data collection process did not involve access to confidential personal data.
- Participation in the research was voluntary and the participants were allowed to withdraw whenever they liked without any consequences to them. This was stated in the Letter of Information (See Appendix A).
- Information could not be linked to the participant who supplied it.

3.7 Research Data Management Procedure

The information received was kept confidential and was adequately password protected according to the approved DUT data management information. (Please see the information provided in the Letter of Information (Appendix A)). All data acquired from the survey questionnaires were analysed by the researcher and sent in as part of the dissertation which will be stored in the DUT premises for five (5) years and thereafter destroyed

3.8 Validity and Reliability Tests

Content validity was achieved through a pilot test and construct validity was achieved with the aid of the principal component (factor) analysis (Newman and Benz, 1998); construct validity was achieved by examining the congruence between the results and existing theories; external validity was achieved through the use of an adequate sample size which could be generalized for the study area and other areas with similar conditions; and predictive validity was accomplished by employing a correlation analysis.

A reliability test was carried out for this study to express the consistency of data or a technique of measurement (Toncho and Julia, 2020). It measured the dependability of a method of measurement and it ascertained the consistency of a score derived from a measurement technique over a period of time (Uzer, 2020). For the purposes of this study, the reliability test was achieved with Cronbach's Alpha (α) reliability test. This was determined using the IBM Statistical Package for Social Science (SPSS), Version 26. The value of (α) varies from 0 to 1. The closer the value of (α) to 1, the more reliable the measurement technique (Newman and Benz, 1998). The Cronbach's Alpha test method was utilised to measure the average correlations of the survey questionnaire questions against the multiple levels of responses. This test was also used to determine that all the measuring scales measured the same construct reliability.

3.9 Method of Data Presentation and Analyse

Data for this study were presented using tables, and analyses of data were achieved using appropriate descriptive and inferential statistics. Descriptive statistical analysis extensively measures the characteristics of a study population, whereas inferential statistics draws conclusions or inferences about a population from data sets. The analyses of data were facilitated through the use of the Statistical Package for Social Sciences (IBM SPSS Statistics 20). In this study, the dependent variables were variables that could be predicted while the independent variables were the predictors. Mean score ranking technique, Factor analysis technique, and Agreement analysis technique using Kendall's coefficient of concordance were all carried out on the received data. In addition, Bartlett's test of sphericity was carried out to test the presence of correlations between the variables.

3.10 Summary

This chapter has presented the summary of the methodology and procedures employed in the process of conducting this research. The study made use of the descriptive design approach. The study population for this study comprised 39 Department of Public Works inspectors

(structural, mechanical and electrical) from the KZNDPW. Due to the uniqueness of the study, a purposive sampling technique was adopted. Data for this study were gathered from both primary and secondary sources. The research instrument used was a structured questionnaire and thirty-nine (39) copies of the questionnaire were administered in the study area. All data received were analysed using an appropriate statistical package. In addition, reliability was carried out for all the factors using the Cronbach's alpha (α) reliability test.

CHAPTER FOUR
DATA ANALYSIS AND DISCUSSION OF RESULTS

4.1 Introduction

This chapter describes the analyses of the data obtained from the field survey. Data were obtained in line with the objectives of the study and analysed accordingly. The demographic attributes of respondents were also analysed and presented. These demographic attributes were the respondents' gender, position in the company, area of specialization, academic qualification, years of experience in construction, years of experience in facilities management, involvement in public sector buildings maintenance, and the nature of FM processes. In addition, the chapter presents discussion and interpretation of the results on the current nature and extent of facilities management practice in public sector buildings in South Africa, the technical roles of the facilities management team in the life cycle of a public sector building, competencies required for effective facilities management practice in public sector buildings, challenges inhibiting effective facilities management practice in public sector buildings, and drivers and enablers of effective facilities management practice on public sector buildings and recommended strategies for effective facilities management in public sector buildings. Thirty-nine (39) copies of the questionnaire were administered to works inspectors at the Department of Public Works in the KwaZulu-Natal province and all thirty-nine (39) copies of the questionnaire were duly completed and returned and were found suitable for the analysis. The overall response rate for this study was 100.0%. This response rate was high and considered adequate for this study (Fincham, 2008).

4.2 Background Information of Respondents

This first section of the questionnaire dealt with the background information of the respondents. The information required included the respondents' age, gender, academic and professional qualifications, professional experience, position in the company, area of specialization, years of experience in construction and years of experience in facilities management. The survey report from the thirty-nine questionnaires revealed that 21 (53.8%) of the respondents were

females while the remaining 18 (46.2%) respondents were males. The survey report from the questionnaire showed that 13 (33.3%) respondents were structural inspectors, while 13 (33.3%) respondents were electrical inspectors and the remaining 13 (33.3%) respondents were mechanical inspectors. The findings also showed that 32 (82.1%) respondents had a national diploma as their highest level of education, while six (15.4%) respondents had a Bachelor's Degree/ Btech as their highest level of education. One (2.6%) of the respondents had an Honours degree as their highest level of education. The results also showed that one (2.6%) respondent was specialized in facilities management, three (7.7%) respondents were specialized in quantity surveying, while three (7.7%) had specialized in building technology. Five (12.8%) respondents had specialized in construction management while 26 (66.7%) respondents had specialized in engineering (structural, mechanical, civil and electrical) and the remaining one (2.6%) respondent had specialized in property development. From the results, it was apparent that a large number of the respondents who participated in the survey had specialized in engineering. The results also showed that 15 (38.5%) respondents had less than five years' experience in FM. A large portion of the respondents (23;59%) had between six to 10 years of experience in FM and the remaining one (2.6%) respondent had between 11-15 years of experience in FM. The findings also revealed that 38 (26.6%) respondents had worked in government schools, 37 (25.8%) respondents had worked in government clinics, 38 (26.6%) respondents had worked in government offices, and 30 (21%) respondents had worked on vacant lands. The results revealed that a large number of the respondents (21;53.8%) preferred outsourcing FM services, 11 (28.2%) respondents preferred utilising in-house FM, while 7 (17.9%) respondents preferred utilising both in-house and outsourced FM services.

Table 4.1: Background Information of Respondents

Demographic information	Categories	Frequency	Percentage (%)
Gender	Male	18	46.2
	Female	21	53.8
	Total	**39**	**100.0**
Position in company	Facilities Manager	0	0.0
	Maintenance Officer	0	0.0
	Works Inspector	39	100.0
	Total	**39**	**100.0**
Area of specialization	Works Inspector – Structural	13	33.3
	Works Inspector – Mechanical	13	33.3
	Works Inspector – Electrical	13	33.3
	Total	**39**	**100.0**
Education	National Science Certificate	0	0.0
	National Diploma	32	82.1
	Bachelor of Science/ BTech	6	15.4
	Master's Degree	0	0.0
	Honours Degree	1	2.6
	Doctorate (PhD)	0	0.0
	Total	**39**	**100.0**
Area of speciality	Facilities Management	1	2.6
	Quantity Surveying	3	7.7
	Estate management	0	0.0
	Building Technology	3	7.7
	Construction Management	5	12.8
	Property Development /Management	1	2.6
	Architecture	0	0.0
	Engineering (Electrical, Mechanical, Civil, Structural)	26	66.7
	Total	**39**	**100.0**
Years of experience in construction	Less than 5 years	10	25.6
	6-10 years	28	71.8
	11-15 years	1	2.6
	16-20 years	0	0.0
	More than 20 years	0	0.0
	Total	**39**	**100.0**
Years of experience in facilities management	Less than 5 years	15	38.5
	6-10 years	23	59.0
	11-15 years	1	2.6
	16-20 years	0	0.0
	More than 20 years	0	0.0
	Total	**39**	**100.0**
Public sector buildings involvement in maintenance	Government schools	38	26.6
	Government clinics	37	25.8
	Government offices	38	26.6
	Vacant land	30	21.0
	Total	**143**	**100.0**
Nature of FM process	Outsourcing of FM	21	53.8

Demographic information	Categories	Frequency	Percentage (%)
	In-house FM	11	28.2
	Both	7	17.9
	Total	**39**	**100.0**

4.3 Current Nature and Extent of FM Practice on Public Sector Buildings

This section presents the findings on the current nature and extent of FM practice on public sector buildings. Twelve major aspects were examined under this section and were analysed using the mean item score.

4.3.1 FM Strategies on Public Sector Buildings

Table 4.2 reveals the facilities management strategies adopted on public sector buildings. The table shows that "Unplanned maintenance strategy" ranked first (MS = 4.00, SD = 0.761) and "Planned maintenance strategy" ranked second (M = 3.615, SD = 0.963). The combination of both planned and unplanned maintenance strategy ranked third (M = 3.282, SD = 1.075). The results showed that organizations mostly adopted the "unplanned maintenance strategy" for FM.

Table 4.2 Frequency of FM Strategies in Organizations

FM strategies	Mean	SD	Rank
Unplanned maintenance strategy	4.000	0.761	1
Planned maintenance strategy	3.615	0.963	2
Both	3.282	1.075	3

4.3.2 Level of Awareness of FM Approaches

Table 4.3 shows the respondents' rankings on the awareness of facilities management in South Africa. The respondents were requested to indicate to what extent they agreed or disagreed with the statement regarding awareness of the approaches to facilities management. The results showed that the level of awareness of corrective maintenance was very high (M = 3.462, S.D = 0.822), the level of awareness of planned (M = 3.282, S.D = 0.999) and preventive maintenance (M = 3.231, S.D = 0.986) was also high compared to the level of awareness of preventive maintenance (M = 2.692, S.D = 0.977).

Table 4.3: Level of Awareness of FM Approaches

FM awareness	Mean	S.D.	Rank
Corrective Maintenance	3.462	0.822	1
Planned Maintenance	3.282	0.999	2
Preventive Maintenance	3.231	0.986	3
Predictive Maintenance	2.692	0.977	4

4.3.3 Extent of Usage of FM Approaches

Table 4.4 reveals the extent of usage of FM approaches. The result shows that corrective maintenance was the mostly used FM approach (M = 4.154, S.D = 1.014), followed by repairs (M = 4.051, S.D = 0.999) and then breakdown maintenance (M 4.000, S.D = 0.889). The results showed that most organizations did not have planned maintenance strategies in place and as a result they had to effect repairs and utilise corrective and breakdown maintenance in their daily operations.

Table 4.4: Extent of Usage of FM Approaches

FM strategies	Mean	S.D	Rank
Corrective Maintenance	4.154	1.014	1
Repair	4.051	0.999	2
Breakdown Maintenance	4.000	0.889	3
Replacement	3.974	1.013	4
Planned Maintenance	3.897	0.882	5
Building Simulation	3.795	0.833	6
Routine	3.718	0.857	7
Preventive Maintenance	3.513	1.167	8
Predictive Maintenance	3.077	1.061	9
Pro-active Maintenance	2.718	0.944	10

4.3.4 Facilities Management Policies Available

Table 4.5 shows respondents' responses to facilities management policies that were available. The results showed that there was no existing policy with guidelines on day-to-day

maintenance of the facility for the organization (M = 4.256, SD = 1.019). From the table it can be seen that the majority of the organizations did not have a maintenance policy in place as a guideline for day-to-day FM operations.

Table 4.5: FM Policies in the Organization

FM awareness	Mean	S.D.	Rank
There is no existing policy with guidelines on day-to-day maintenance of the facility for the organization	4.256	1.019	1
Our organisation is well aware of FM policy guidelines to follow when rendering FM services	3.077	1.036	2
Our organisation is not at all that well aware of FM policy guidelines to follow when rendering FM services	3.077	0.984	3
There is an existing policy with guidelines on day-to-day maintenance of the facility for the organization	2.641	1.246	4

4.3.5 Significance of Level of Facilities Management Strategies in Achieving Overall Building Efficiency and Business Success

Table 4.6 outlines the respondents' rankings on the significance level of facilities management strategies in achieving overall building efficiency and business success using the 5-point Likert scale of 1 = not significant; 2 = less significant; 3 = moderately significant; 4 = significant; 5 = very significant. The results showed that "Planned Maintenance", "Replacement" and "Repair" ranked first, second and third respectively with mean scores (M = 4.051, SD = 1.123); (M = 3.923, SD = 1.133); and (M =3.897, SD = 1.095). This showed that organizations were aware of the importance of utilising planned maintenance in their daily operations as it was ranked the most significant of all FM strategies.

Table 4.6: Significance Level of FM Strategies in Building Efficiency and Business Success

FM strategies	Mean	S.D.	Rank
Planned Maintenance	4.051	1.123	1
Replacement	3.923	1.133	2
Repair	3.897	1.095	3
Corrective /Responsive	3.897	1.046	4
Routine	3.872	1.005	5
Breakdown Maintenance	3.846	1.040	6
Pro-active Maintenance	3.821	1.275	7
Preventive Maintenance	3.744	1.141	8
Corrective Maintenance	3.718	0.999	9
Predictive Maintenance	3.718	1.146	10

Table 4.7 shows the results of a paired-sample T-test of the involvement and significance of facilities management strategies. The mean value of 3.077 for involvement of FM strategies and the mean value of 3.718 for importance of FM strategies was statistically significantly different at $p < 0.05$ for predictive maintenance. The result for pro-active maintenance was very highly significant at $p < 0.001$ for involvement and importance with mean values of 2.718 and 3.821 respectively.

Table 4.7: Paired Samples T-test for Involvement and Significance of FM Strategies

FM Strategies	Involvement		Significance		Mean Diff.	S.D.	T	Sig.
	Mean	S.D.	Mean	S.D.				
Preventive Maintenance	3.513	1.167	3.744	1.141	-0.231	0.902	-1.598	0.118
Corrective Maintenance	3.795	0.833	3.718	0.999	0.077	1.085	0.443	0.661
Predictive Maintenance	3.077	1.061	3.718	1.146	-0.641	1.597	-2.506	0.017*
Pro-active Maintenance	2.718	0.944	3.821	1.275	-1.103	1.683	-4.092	0.000***

FM Strategies	Involvement		Significance		Mean Diff.	S.D.	T	Sig.
	Mean	S.D.	Mean	S.D.				
Breakdown Maintenance	4.000	0.889	3.846	1.040	0.154	1.247	0.771	0.446
Planned Maintenance	3.897	0.882	4.051	1.123	-0.154	1.226	-0.784	0.438
Repair	4.154	1.014	3.897	1.095	0.256	1.117	1.433	0.160
Routine	3.718	0.857	3.872	1.005	-0.154	1.089	-0.882	0.383
Replacement	3.974	1.013	3.923	1.133	0.051	1.297	0.247	0.806
Corrective / responsive	4.051	0.999	3.897	1.046	0.154	1.159	0.829	0.412

***Correlation is significant at the 0.001 level (2-tailed); and *Correlation is significant at the 0.05 level (2-tailed).

4.3.6 Level of Availability of FM Equipment and Departments

Table 4.8 reveals the level of availability of facilities management equipment and departments. The table shows that fire extinguishers were the most available for users in organizations (M = 3.744, S.D = 0.751) while users' building evaluation forms were the least FM equipment that was readily available (M = 2.154, S.D = 0.933).

Table 4.8: Level of Availability of FM Equipment and Departments

FM structures	Mean	S.D	Rank
Fire Extinguishers	3.744	0.751	1
Maintenance Manual	2.769	1.135	2
Fire Alarms	2.744	1.163	3
FM Departments	2.590	1.069	4
Users' Building Evaluation Forms	2.154	0.933	5

4.3.7 Nature of FM Activities in Public Sector Buildings

Table 4.9 shows the nature of facilities management services in public sector buildings. The results showed that FM services were rarely carried out in public sector buildings except that regular inspection (M = 4.667, S.D = 0.779), waste management (M = 4.520, S.D = 1.155), adequate housekeeping standards (M = 4.327, S.D = 0.785), general environmental sanitation (M = 4.218, S.D = 0.718) and identifying users' needs (M = 4.106, S.D = 1.048) were mostly carried out in public sector buildings. Also, providing adequate support services (M = 1.615,

S.D = 0.161), energy management in buildings (M = 1.513, S.D = 1.048) and controlling the operating budget (M = 1.436, S.D = 0.940) were less apparent in public sector buildings.

Table 4.9: Nature of FM Activities in Public Sector Buildings

FM Activities	Mean	SD	Rank
Regular Inspection	4.667	0.779	1
Waste Management	4.520	1.155	2
Adequate Housekeeping Standards	4.327	0.785	3
General Environmental Sanitation	4.218	0.718	4
Identifying Users' Needs	4.106	1.048	5
Strategic Space Planning	3.462	1.097	6
Essential FM Service Provision	3.436	0.995	7
Set Corporate Planning Guidelines and Standards	3.256	1.019	8
Keeping of Reliable Records	3.205	0.801	9
Security for Property Occupants	2.949	1.123	10
Risk Management	2.923	1.345	11
Monitoring and Recording Water Consumption	2.795	1.281	12
Control of Capital Budgets	2.795	1.508	13
Health and Safety of Occupants	2.769	1.038	14
Conserving Assets Value	2.769	1.327	15
Select and Control Use of Furniture	2.641	1.224	17
Computer Aided Facility Management	2.641	1.478	18
Providing Adequate Support Services	1.615	0.161	19
Energy Management in Buildings	1.513	1.048	20
Control Operating Budget	1.436	0.940	21

4.3.8 Importance of FM Personnel during the Life Cycle of a Building

Table 4.10 reveals respondents' rankings on the importance of involving facility management personnel during the life cycle of a building. The results showed that it was considered very important to involve facilities management personnel at the design stage of the building process (M = 4.179, S.D = 0.756).

Table 4.10: Importance of FM Personnel during the Life Cycle of a Building

Stages of Building Life Cycle	Mean	S.D.	Rank
Design stage	4.179	0.756	1
Construction stage	3.590	1.163	2
Post-construction stage	3.462	1.295	3

Table 4.11 shows the results of a paired-sample T-test for importance and involvement of FM personnel in the stage of a building lifecycle. The mean value of 3.590 for importance of FM in a building life cycle and the mean value of 2.769 for involvement of FM personnel in the stages of a building's life cycle were significantly different ($p < 0.05$) for the post-construction stage. The results for the design stage and the construction stage were highly significant ($p < 0.001$) for involvement and importance with mean values of 3.462; 2.462 and 3.231; 2.590 respectively.

Table 4.11: Paired-Samples T-test for Importance of FM Plan and Involvement of Organization in Stages of Building Life Cycle

Stages of Building Lifecycle	Importance		Involvement		Mean Diff.	S.D.	T	Sig.
	Mean	S.D.	Mean	S.D.				
Design stages	3.462	1.295	2.462	1.502	1.000	1.522	4.104	**0.000*** **
Construction stage	3.231	1.135	2.590	1.390	0.641	1.038	3.855	**0.000*** **
Post construction stage	3.590	1.163	2.769	1.423	0.821	1.430	3.582	**0.001** **
Occupation	4.179	0.756	3.974	0.986	0.205	0.923	1.388	0.173

Note: ***Correlation is significant at the 0.001 level (2-tailed); and **Correlation is significant at the 0.01 level (2-tailed).

4.3.9 FM Services Needed in Public Buildings

Table 4.12 shows the facilities management services that should be provided by a facility management organization. The results showed that plumbing (M = 4.128, S.D = 0.894),

electrical services (M = 4.077, S.D = 0.984), and fire safety systems (M = 4.036, S.D = 0.951) were major facilities management services that should be provided in public sector buildings.

Table 4.12: Involvement of Organization in the Provision of FM Services

FM Services	Mean	S.D.	Rank
Plumbing Services	4.128	0.894	1
Electrical Services	4.077	0.984	2
Fire Safety Systems	4.036	0.951	7
Generator Services and Maintenance	3.949	1.025	3
HVAC Services	3.923	0.957	4
Lifts and Escalators	3.923	0.984	5
General Maintenance	3.923	0.984	6
Out-door and Gardening Services	3.769	1.038	8
Cleaning and Hygiene	3.231	0.842	9

4.4 Technical Roles of the FM Team in the Life Cycle of a Public Sector Building

This section presents the results of the analysis of the technical roles of the FM team in the life cycle of a public sector building. Two major aspects were considered and examined under this section. These included: familiarity with facility management personnel and the organization's involvement in facilities management technical roles. As previously noted, data were gathered using a well-designed questionnaire. The data collected was analysed using SPSS software and a 5-point Likert scale was utilised to measure the technical roles of the FM team in the life cycle of a public sector building. Both descriptive and inferential analysis was carried out on the data.

4.4.1 Technical Roles of the FM Team in the Life Cycle of a Public Sector Building

Table 4.13 shows the respondents' rankings on the technical roles of the facilities management team during the life cycle of a building process using a 5-point Likert scale 1= Never; 2 = Rarely; 3 = Sometimes; 4 = Often; 5 = Always. The results were first analysed using descriptive analysis. The table showed that 'Operational risk assessment and mitigation at the development stage' (M = 4.256, SD = 0.818), 'Maintainability of equipment within acceptable time frames'

(M = 4.000, SD = 0.973), and 'Define the facility design life i.e. material and equipment selection based on the intended occupancy' (M = 4.374, SD = 0.843) were ranked as the major technical roles of a FM team.

Table 4.13: Technical Roles of FM Team

FM technical roles	Mean	SD	Rank
Operational risk assessment and mitigation at the development stage	4.256	0.818	1
Maintainability of equipment within acceptable timeframes	4.000	0.973	2
Define the facility design life i.e. material and equipment selection based on the intended occupancy.	4.374	0.843	3
Optimising the built area during the design stage to suit the FM strategy and intended operational requirements for the organisation.	3.923	0.929	4
Ensure availability of materials and equipment	3.872	0.833	5
Co-ordinate the degree with to the facility is accessible and prepared to accommodate various needs of various users (i.e. public, disabled, employees, maintenance personnel, etc.).	3.872	1.080	6
Ensure efficiency of equipment used	3.795	0.978	7
Proper space management to ensure functionality, accessibility and optimisation of the available space	3.744	0.938	8
Ensure safety, sound and quality	3.667	1.034	9
Monitor building/ facility energy consumption	3.641	0.932	10
Monitor building/ facility water consumption	3.436	1.095	11
Calculation of all costs required to purchase, upgrade or renovate facilities	3.231	1.180	12
Calculation of costs for labour (in-house or contracted-out) and materials required for building monitoring, inspection, repairs,	3.051	1.213	13

FM technical roles	Mean	SD	Rank
maintenance, and response to service requests			
Calculation of monthly or annual cost of utilities, including electricity, fuel oil, gas, steam, water, sewage, etc.	3.051	1.191	14
Calculation of all costs related to facility operation, such as insurance, air-conditioning, ventilation, repair and maintenance, security, cleaning and garbage etc.	2.974	1.135	15
Calculation of the budget required for decommissioning, demolishing and disposal of the building, its systems, subsystems, and components	2.974	1.158	16
Calculation of total cost associated with building occupancy, from building occupation to disposal	2.897	1.095	17
Calculation of anticipated reserve price of the facility at the end of life.	2.897	1.095	18
Describe the condition of security and effectiveness of security measures.	2.846	1.387	19
Co-ordinate parking arrangements for the building occupants	2.564	1.273	20

The second objective was further subjected to principal component analysis (PCA) with the use of SPSS version 26 software. Prior to performing PCA the suitability of data for factor analysis was evaluated. The inspection of the correlation matrix showed the presence of a co-efficient of 0.6 and above, which was appropriate for factor analysis. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy is a degree of whether the distribution of values is suitable for proceeding with factor analysis. A measurement of < 0.5 is not acceptable, > 0.5 is miserable, > 0.6 is mediocre, >0.7 is fair, >0.8 is commendable and 0.9 is considered excellent.

Table 4.14 presents the results of the KMO with the data returning a value sampling adequacy of 0.686. According to Eiselen *et al.* (2007), this was considered suitable to conduct a factor analysis as any value above 0.6 (the cut-off point) was considered to be acceptable. The multivariate normality of the set of distribution is indicated by the *p*-value of Bartlett's test of sphericity (represented by 'Sig'). A value less than 0.50 indicated that the data did not produce an identity matrix and was therefore considered as acceptable for factor analysis (George and Mallery, 2003). This set of data returned a significance value of 0.000, indicating that the data was adequate for factor analysis.

Table 4.14: KMO and Bartlett's Test FM technical roles

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.686
Bartlett's Test of Sphericity	Approx. Chi-Square	805.726
	df	190
	Sig.	.000

4.4.2 Communalities Table

The communalities of the technical roles of FM team were established for the purpose of determining the extent to which the underlying factors accounted for the variance of the 20 variables. The results in Table 4.15 showed that all the variables had communalities greater than 0.4, implying that the variable actually measured the underlying factors.

Table 4.15: Communalities of Technical Roles after Extraction

Communalities	**Initial**	**Extraction**
Optimising the built area during the design stage to suite the FM strategy and intended operational requirements for the organization.	1.000	.793
Define the facility design life i.e. material and equipment selection based on the intended occupancy.	1.000	.764
Proper space management to ensure functionality, accessibility and optimisation of the available space	1.000	.841

Monitor building/ facility energy consumption	1.000	.768
Monitor building/ facility water consumption	1.000	.807
Co-ordinate parking arrangements for the building occupants	1.000	.821
Describe the condition of security and effectiveness of security measures.	1.000	.604
Ensure safety, sound and quality	1.000	.664
Ensure availability of materials and equipment.	1.000	.873
Maintainability of equipment within acceptable timeframes	1.000	.861
Ensure efficiency of equipment used.	1.000	.764
Calculation of all costs required to purchase, upgrade or renovate facilities	1.000	.814
Calculation of all costs related to facility operation, such as insurance, air-conditioning, ventilation, repair and maintenance, security, cleaning and garbage etc.	1.000	.787
Calculation of total cost associated with building occupancy, from building occupation to disposal	1.000	.880
Calculation of costs for labour (in-house or contracted-out) and materials required for building monitoring, inspection, repairs, maintenance, and response to service requests	1.000	.897
Calculation of monthly or annual cost of utilities, including electricity, fuel oil, gas, steam, water, sewage, etc.	1.000	.914
Calculation of the budget required for decommissioning, demolishing and disposal of the building, its systems, sub-systems, and components	1.000	.889
Calculation of anticipated reserve price of the facility at the end of life	1.000	.862
Co-ordinate the degree with which the facility is accessible and prepared to accommodate various needs of various users (i.e. public, disabled employees, maintenance personnel, etc.).	1.000	.656
Operational risk assessment and mitigation at the development stage	1.000	.661

Extraction Method: Principal Component Analysis.

4.4.3 Total Variance Explained

Table 4.16 shows the number of technical roles in facilities management and their respective eigenvalues. The latent root, or Kaiser's criterion, of retaining skill factors with eigenvalues greater than 1.0 was employed. Hence, four technical roles with eigenvalues exceeding one were retained, resulting in 7.779, 4.958, 2.052 and 1.5131, which explained 34.433%, 19.626%, 13.150% and 12.386% of the variance respectively. This infers that the first cluster

of technical role factors accounted for 34.433% of the total importance expected for technical roles involved in South African public sector building facilities management. In the same vein, the second cluster of technical roles accounted for 19.626% of technical roles involved in South African public sector building facilities management, the third cluster of technical roles accounted for 13.150% and lastly, the fourth cluster accounted for 12.386%. These four clusters of technical roles involved in South African public sector building facilities management have a total cumulative percentage of 79.595%, which highlights their significance from the twenty technical roles as shown.

4.4.4 Rotated Component Matrix

The significance of a factor loading gives an indication, albeit small, of the substantive importance of a given key driver to a given factor. Generally, the reliability and suitability of the dataset for factor analysis depends on several conditions, including sample size, number of variables and sample to variable ratio (Pallant, 2011; Tabachnick and Fidell, 2007; Hair *et al.,* 2010). Nunayon *et al.* (2020) reported that an obvious component structure was usually revealed when the factor loading of a variable was significant (loading > 0.5) on one component only. This was supported by Enshassi *et al.* (2018) who adopted a factor loading ≥ 0.5 for internal included in each component (factor). Therefore, the factor loading in this study could be considered significant based on the study by Nunayon *et al.* (2020).

Table 4.16: **Total Variance Explained**

	Initial Eigenvalues			Loadings			Loadings		
	Total	**% of variance**	**Cumulative %**	**Total**	**% of variance**	**Cumulative %**	**Total**	**% of variance**	**Cumulative %**
Optimising the built area during the design stage to suite the FM strategy and intended operational requirements for the organization.	7.779	38.895	38.895	7.779	38.895	38.895	6.887	34.433	34.433
Define the facility design life i.e. material and equipment selection based on the intended occupancy.	4.968	4.789	63.684	4.958	24.789	63.684	3.925	19626	54.059
Proper space management to ensure functionality, accessibility and optimisation of the available space	2.062	10528	73.942	2.052	10.258	73.942	2.630	13.160	67.209
Monitor building/ facility energy consumption	1.131	5.654	79.595	1.131	5.654	79.595	2.477	12.386	79.696
Monitor building/ facility water consumption	.874	4.371	83.967						
Co-ordinate parking arrangements for the building occupants	.705	3.54	87.490						
Describe the condition of security and effectiveness of security measures.	.609	3.044	90.534						
Ensure safety, sound and quality	.363	1.813	92.347						
Ensure availability of materials and equipment.	.288	1.439	93786						
Maintainability of equipment within acceptable timeframes	.243	1.213	94.999						
Ensure efficiency of equipment used.	.212	1.062	96.061						
Calculation of all costs required to purchase, upgrade or renovate facilities	.170	.852	96.914						
Calculation of all costs related to facility operation, such as insurance, air-conditioning, ventilation, repair and maintenance, security, cleaning and garbage etc.	.161	.804	97.718						

Calculation of total cost associated with building occupancy, from building occupation to disposal	.140	.698	98.416
Calculation of costs for labour (in-house or contracted-out) and materials required for building monitoring, inspection, repairs, maintenance, and response to service requests	.121	.604	99.020
Calculation of monthly or annual cost of utilities, including electricity, fuel oil, gas, steam, water, sewage, etc.	.075	.377	99.396
Calculation of the budget required for decommissioning, demolishing and disposal of the building, its systems, subsystems, and components	.047	.233	99.629
Calculation of anticipated reserve price of the facility at the end of life.	.036	.182	99.811
Co-ordinate the degree to which the facility is accessible and prepared to accommodate various needs of various users (i.e. public, disabled employees, maintenance personnel, etc.).	.025	.127	99.938
Operational risk assessment and mitigation at the development stage	.012	.082	100.000

To aid the clarification of the 20 factors, varimax rotation was performed, which gave rise to the rotated component matrix, as shown in Table 4.17. The varimax method of rotation was utilised because of the twenty factors which were uncorrelated with one another to a certain degree.

Table 4.17: Component Matrix

Component Matrix[a]	Component			
	1	2	3	4
Optimising the built area during the design stage to suite the FM strategy and intended operational requirements for the organization.	.911			
Define the facility design life i.e. material and equipment selection based on the intended occupancy.	.908			
Proper space management to ensure functionality, accessibility and optimisation of the available space	.877			
Monitor building/ facility energy consumption	.877			
Monitor building/ facility water consumption	.873			
Co-ordinate parking arrangements for the building occupants	.862			
Describe the condition of security and effectiveness of security measures.	.850			
Ensure safety, sound and quality	.818			
Ensure availability of materials and equipment.	.680			
Maintainability of equipment within acceptable timeframes	.601		.588	
Ensure efficiency of equipment used.		.814		
Calculation of all costs required to purchase, upgrade or renovate facilities		.794		
Calculation of all costs related to facility operation, such as insurance, air-conditioning, ventilation, repair and maintenance, security, cleaning and garbage etc.		.781		
Calculation of total cost associated with building occupancy, from building occupation to disposal		.725		.485
Calculation of costs for labour (in-house or contracted-out) and materials required for building monitoring, inspection, repairs, maintenance, and response to service requests		.716		
Calculation of monthly or annual cost of utilities, including electricity, fuel oil, gas, steam, water, sewage, etc.		.705	.427	
Calculation of the budget required for decommissioning, demolishing and disposal of the building, its systems, subsystems, and components		.656	-.514	
Calculation of anticipated reserve price of the facility at the end of life		.655		
Co-ordinate the degree to which the facility is accessible and prepared to accommodate various needs of various users (i.e. public, disabled employees, maintenance personnel, etc.).		.546	.620	
Operational risk assessment and mitigation at the development stage	.588		.593	
Extraction Method: Principal Component Analysis.				
4 components extracted.				

Table 4.18: Rotated Component Matrix

Rotated Component Matrix[a]	Component			
	1	2	3	4
Optimising the built area during the design stage to suite the FM strategy and intended operational requirements for the organization	.938			
Define the facility design life i.e. material and equipment selection based on the intended occupancy.	.933			
Proper space management to ensure functionality, accessibility and optimisation of the available space	.922			
Monitor building/ facility energy consumption	.920			
Monitor building/ facility water consumption	.908			
Co-ordinate parking arrangements for the building occupants	.852			
Describe the condition of security and effectiveness of security measures	.819			
Ensure safety, sound and quality	.774			
Ensure availability of materials and equipment	.521			.504
Maintainability of equipment within acceptable timeframes		.913		
Ensure efficiency of equipment used		.898		
Calculation of all costs required to purchase, upgrade or renovate facilities		.827		
Calculation of all costs related to facility operation, such as insurance, air-conditioning, ventilation, repair and maintenance, security, cleaning and garbage etc.		.777		
Calculation of total cost associated with building occupancy, from building occupation to disposal		.603	.498	
Calculation of costs for labour (in-house or contracted-out) and materials required for building monitoring, inspection, repairs, maintenance and response to service requests			.874	
Calculation of monthly or annual cost of utilities, including electricity, fuel oil, gas, steam, water, sewage, etc.			.775	.427
Calculation of the budget required for decommissioning, demolishing and disposal of the building, its systems, subsystems, and components		.413	.614	.465
Calculation of anticipated reserve price of the facility at the end of life		.506	.572	
Co-ordinate the degree with which the facility is accessible and prepared to accommodate various needs of various users (i.e. public, disabled employees, maintenance personnel, etc.).				.823
Operational risk assessment and mitigation at the development stage				.757

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.[a]
a. Rotation converged in 6 iterations.

i. Nine variables were loaded in Factor 1. These variables were: ‘Optimising the built area during the design stage to suite the FM strategy and intended operational requirements for the organization’, ‘Define the facility design life i.e. material and equipment selection based on the intended occupancy’, ‘Proper space management to ensure functionality, accessibility and optimisation of the available space’, ‘Monitor building/ facility energy consumption’, ‘Monitor building/ facility water consumption’, ‘Co-ordinate parking arrangements for the building occupants’, ‘Describe the condition of security and effectiveness of security measures’, ‘Ensure safety, sound and quality’, ‘Ensure availability of materials and equipment’. This is the set of FM technical roles that deals with building facility maintenance in SA public sector buildings. These variables were named ‘Building Facility Maintenance Management’. With a total variance of 34.433% of the total variance, this set of technical roles was identified as the most significant in the South African facilities management industry.

ii. A total of five variables were loaded in Factor 2. These variables were: ‘Maintainability of equipment within acceptable timeframes’, ‘Ensure efficiency of equipment used’, ‘Calculation of all costs required to purchase, upgrade or renovate facilities’, ‘Calculation of all costs related to facility operation, such as insurance, air-conditioning, ventilation, repair and maintenance, security, cleaning and garbage etc.’, ‘Calculation of total cost associated with building occupancy, from building occupation to disposal’. This is the set of FM technical roles that deals with building maintenance financing SA public sector buildings. These variables were named ‘Building Maintenance Financial Management’. With a total variance of 19.626% of the total variance, this set of technical roles was identified as also being significant in the South African facilities management industry.

iii. Four items were loaded in Factor 3. These variables were: ‘Building facility accounts management’, ‘Calculation of costs for labour (in-house or contracted-out) and materials required for building monitoring, inspection, repairs, maintenance, and response to service requests’, ‘Calculation of monthly or annual cost of utilities, including electricity, fuel oil, gas, steam, water, sewerage, etc.’, ‘Calculation of the budget required for decommissioning, demolishing and disposal of the building, its systems, subsystems, and components’, ‘Calculation of anticipated reserve price of the facility at the end of life.’. This is the set of FM technical roles that deals with building facility accounts SA public sector buildings. These variables were named ‘Building Facility Account Management’. With a total variance of 13.150% of the total variance, this set of technical roles was identified as also being significant in the South African facilities management industry.

iv. A total of two items were loaded in Factor 4. These variables were: ‘Building facility health and safety management co-ordinates the degree to which the facility is accessible and prepared to accommodate various needs of various users (i.e. public, disabled employees, maintenance personnel, etc.)’, and ‘Operational risk assessment and mitigation at the development stage’. This is the set of FM technical roles that deals with building facility health and safety SA public sector buildings. These variables were named ‘Building Facility Health and Safety Management’. With a total variance of 12.386% of the total variance, this set of technical roles was identified as being significant in the South African facilities management industry.

Table 4.19: Component Transformation Matrix

Component Transformation Matrix				
Component	1	2	3	4
1	.908	.205	.071	.358
2	-.246	.777	.576	.063
3	-.215	-.469	.462	.722
4	.262	-.366	.671	-.589

4.5 Competencies Required for Effective Facilities Management in Public Sector Buildings

This section presents the results of the analysis of the competencies required for effective facilities management in public sector buildings. As previously noted, data were gathered using a well-designed questionnaire. A five-point Likert scale was utilised to measure the competencies required for effective facilities management in public sector buildings.

4.5.1 Competencies Required for Effective Facilities Management in Public Sector Buildings

Table 4.20 reveals the respondents' rankings on competencies required for effective facilities management in South African public sector buildings. The respondents were required to indicate to what extent they agreed that operation and maintenance management, leadership and management, human resource management, organization management, premises management, service management, resource management and work environment management were competencies of facilities management using a five-point Likert scale 1= Strongly disagree; 2= Disagree; 3= Neutral; 4= Agree; 5= Strongly agree. The table shows that 'Operation and maintenance management' (M = 4.128, SD = 0.894); 'Work environment management' (M = 3.923, SD = 0.984); and 'Resource management' (M = 3.692, SD = 1.004) were ranked first, second and third respectively. These results showed that for an individual to take part in FM, these were the major competencies that they needed to have.

Table 4.20: Competencies for Effective FM in Public Sector Buildings

Competencies for FM	Mean	S.D.	Rank
Operation and maintenance management	4.128	0.894	1
Work environment management	3.923	0.984	2
Resource management	3.692	1.004	3
Premises management	3.641	0.843	4
Leadership and management	3.410	0.818	5
Service management	3.333	1.060	6
Organisation management	3.282	0.916	7
Human Resource management	2.718	0.887	8

4.5.2 Competencies Required for Effective Facilities Management in Public Sector Buildings regarding Operation and Maintenance

Competencies required for effective facilities management in public sector buildings with regard to competencies in operation and maintenance management, leadership and management, human resource management, organization management, premises management, service management, resource management and work environment management.

Table 4.21 shows the respondents' rankings on the competencies required for effective facilities management in South African public sector buildings. The respondents were required to indicate to what extent they agreed that real estate law, managing the assigned personnel to the facility function, professional practice, managing change, law, developing FM strategy in line with organizational strategy, understanding the organization structure and organizational administration, understanding organizational aim and strategy, human resource management in facility management work process, effective communication, cooperation with suppliers and specialists for matters or work processes related to facility management, monitoring the procurement, installation, operation, maintenance and disposition of internal building systems, managing the building structure and internal permanent fittings maintenance, monitoring the procurement installation, operation, maintenance and disposition of furniture and equipment,

monitoring the procurement, installation, operation, maintenance and disposition of exterior building elements, implementing operation and maintenance management, managing matters on organizational property, understanding of building design, maintenance of building elements (roof, floor, wall, stairs, etc.), improving facility performance, workplace management relation, managing building service systems (e.g. drainage, piping, sanitary, safety, or electrical systems, etc.), executing the contract management works, managing support services (e.g. cleaning team, caterer/ food supplier, landscaping, etc.), project management(includes minor renovations and repair or refurbishment etc.), environmental issues (e.g. recycling, energy saving, etc.), space management, regarding the health, safety and physical safety management in the organization, works related to resource procurement, risk management involved in the work process done, financial management in managing organizational resources, quality management in managing the organization's resources and information management in managing the organization's resources were competencies of facilities management using a five-point Likert scale 1 = Strongly disagree; 2 = Disagree; 3= Neutral; 4 = Agree; 5 = Strongly agree. The table shows that 'Manage building service systems (e.g. drainage, piping, sanitary, safety or electrical systems, etc.)' (M = 4.385, SD = 0.847); 'Maintenance of building elements (roof, floor, wall, stairs, etc.)' (M = 4.333, SD = 0.927); and 'Risk management involved in the work process done' (M = 4.256, SD = 0.966) ranked first, second and third respectively. These results showed that management of the building service system was a very essential competence in FM, and respondents agreed that in order to take part in FM it was essential that there was prior knowledge of the maintenance of the building element as well as risk management. However, the results also showed that respondents agreed that 'Managing support services (e.g. cleaning team, caterer/ food supplier, landscaping, etc.)' (M = 3.051, SD = 1.317); 'Human resource management in facility management work process' (M = 2.923, SD = 1.085); and 'Information management in

managing the organisation's resources' (M = 2.872, SD = 1.218) were not considered essential FM competencies as they ranked thirty-first, thirty-second and thirty-third respectively.

Table 4.21: Competencies in Leadership and Management for Effective FM in Public Sector Buildings

Competencies to Effective FM	Mean	S.D.	Rank
Manage building service systems (e.g. drainage, piping, sanitary, safety, or electrical systems, etc.)	4.385	0.847	1
Maintenance of building elements (roof, floor, wall, stairs, etc.)	4.333	0.927	2
Risk management involved in the work process done	4.256	0.966	3
Implement operation and maintenance management	4.154	0.844	4
Improve facility performance	4.128	0.833	5
Regarding the health, safety and physical safety management in the organisation	4.000	0.946	6
Project management (includes minor renovations and repair or refurbishment etc.)	3.974	0.843	7
Understanding of building design	3.949	0.944	8
Cooperation with suppliers and specialists for matters or work process related to facility management	3.923	1.010	9
Space management	3.923	0.900	10
Quality management in managing the organisation's resources	3.923	1.010	11
Develop FM strategy in line with organisational strategy	3.897	0.821	12
Monitor the procurement, installation, operation, maintenance and disposition of internal building system	3.897	0.788	13
Manage the building structure and internal permanent fittings maintenance	3.897	0.852	14
Manage matters on organisational property	3.872	0.894	15
Workplace management relation	3.872	1.080	16
Understand the organisation structure and organisation administration	3.846	0.745	17
Understand organisational aim and strategy	3.846	0.779	18
Monitor the procurement, installation, operation, maintenance and disposition of exterior building elements	3.795	1.031	19
Manage the assigned personnel to the facility function	3.769	0.777	20
Law	3.769	0.872	21

Execute the contract management works	3.744	0.850	22
Works related to resource procurement	3.744	0.938	23
Environmental issues (e.g. recycling, energy saving, etc.)	3.692	1.004	24
Professional practice	3.564	1.021	25
Effective communication	3.513	0.854	26
Managing change	3.487	0.914	27
Financial management in managing organisational resources	3.282	1.099	28
Monitor the procurement installation, operation, maintenance and disposition of furniture and equipment	3.256	1.069	29
Real estate law	3.205	0.894	30
Manage support services (e.g. cleaning team, caterer/ food supplier, landscaping, etc)	3.051	1.317	31
Human resource management in facility management work process	2.923	1.085	32
Information management in managing the organisation's resources	2.872	1.218	33

4.6 Challenges Inhibiting Effective Facilities Management in Public Sector Buildings

This section presents the results of an analysis of the challenges inhibiting effective facilities management in public sector buildings. Two major aspects were considered and examined under this section. These included: the challenges inhibiting effective facilities management in South African public sector buildings and the criticality of the challenges inhibiting effective facilities management in South African public sector buildings. As previously noted, data were gathered using a well-designed questionnaire. A five-point Likert scale was used to measure challenges inhibiting effective facilities management in South African public sector buildings.

4.6.1 Challenges Inhibiting Effective Facilities Management in South African Public Sector Buildings

Table 4.22 reveals the challenges inhibiting effective facilities management in South African public sector buildings using a 5-point Likert scale 1= Strongly disagree; 2= Disagree; 3= Neutral; 4= Agree; 5= Strongly agree. The table shows that the major challenges affecting

facilities management services were: ‘Funding’ (M = 4.205, SD = 1.005); ‘Irregular or fixed budget’ (M = 4.128, SD = 1.105); and ‘The absence of a policy guideline for infrastructural development and maintenance in buildings’ (M = 4.128, SD = 0.951); ‘Insufficient allocation of maintenance costs’ (M = 4.077, SD = 1.036) and ‘Unavailability of a proper maintenance manual’ (M =4.051, SD = 0.916).

Table 4.22: Challenges Inhibiting Effective FM in South Africa Public Buildings

Challenges to Effective FM	Mean	SD	Rank
Funding	4.205	1.005	1
Irregular or fixed budget	4.128	1.105	2
The absence of a policy guideline for infrastructural development and maintenance in buildings	4.128	0.951	3
Insufficient allocation of maintenance costs	4.077	1.036	4
Unavailability of a proper maintenance manual	4.051	0.916	5
Swapping of roles	3.769	0.959	6
Lack of proper maintenance system	3.744	1.019	7
Training and development of maintenance personnel	3.718	0.916	8
Lack of competent professionals with the adequate skills and qualifications to render facilities maintenance services	3.718	0.972	9
Lack of understanding of FM concepts and familiarisation with the opportunity to participate in FM by other professionals	3.513	0.997	10
Lack of understanding of FM management importance and the consequences of neglecting it by the management as an investment	3.410	1.044	11
Delay in reporting failures and executing repairs	3.077	1.109	12
Lack of motivation for maintenance staff	2.949	1.075	13
Inspection of facilities	2.923	1.156	14
Deterioration due to age of buildings or facilities	2.769	1.087	15

Challenges to Effective FM	Mean	SD	Rank
Poor workmanship	2.769	1.038	16
Construction of facilities	2.769	1.111	17
Lack of plant, equipment, materials and spare parts for maintenance operations:	2.744	1.186	18
Reckless use of facilities	2.744	1.251	19
Lack of discernible maintenance culture	2.744	1.019	20
Maintenance work priorities	2.692	1.104	21
Third-party vandalism	2.564	1.209	22

4.6.2 Factor Analysis for Drivers of Outsourcing

The challenges inhibiting facilities management that were identified were further subjected to principal component analysis (PCA). Prior to performing PCA, the suitability of the data for factor analysis was evaluated. The inspection of the correlation matrix had shown the presence of a co-efficient of 0.6 and above which was appropriate for factor analysis. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy is a degree of whether the distribution of values is suitable for proceeding with factor analysis. A measure of < 0.5 is not acceptable, > 0.5 is miserable, > 0.6 is mediocre, >0.7 is fair, >0.8 is commendable and 0.9 is considered excellent.

Table 4.23 presents the results of the KMO with the data returning a value sampling adequacy of 0.581. According to Eiselen *et al.* (2007), this was considered suitable to conduct a factor analysis as any value above 0.6 (the cut-off point) was considered to be acceptable. The multivariate normality of the set of distribution was indicated by the *p*-value of Bartlett's test of sphericity (represented by 'Sig'). A value <0.50 indicated that the data did not produce an identity matrix and was therefore considered as acceptable for factor analysis (George and Mallery, 2003). This set of data returned a significance value of 0.000, indicating that the data was adequate for factor analysis.

Table 4.23: KMO and Bartlett's Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.686
Bartlett's Test of Sphericity	Approx. Chi-Square	805.726
	df	190
	Sig.	.000

4.6.3 Communalities Table

Table 4.24 indicates the different items after extraction. The values consisted of items approximately equal to or greater than 0.4.

Table 4.24: Communalities

Communalities

	Initial	Extraction
Funding	1.000	.774
Deterioration due to age of buildings or facilities	1.000	.777
Lack of plant, equipment, materials and spare parts for maintenance operations:	1.000	.828
Reckless use of facilities	1.000	.837
Third-party vandalism	1.000	.857
Delay in reporting failures and executing repairs	1.000	.525
Swapping of roles	1.000	.703
Lack of understanding of FM management importance and the consequences of neglecting it by the management as an investment	1.000	.592
Poor Workmanship	1.000	.805
Lack of understanding of FM concepts and familiarisation with the opportunity to participate in FM by other professionals	1.000	.761
Training and development of maintenance personnel	1.000	.687
Lack of discernable maintenance culture	1.000	.817
Maintenance work priorities	1.000	.868
Irregular or fixed budget	1.000	.814
Lack of motivation for maintenance staff	1.000	.652
Construction of facilities	1.000	.897

Inspection of facilities	1.000	.752
Insufficient allocation of maintenance costs	1.000	.870
Lack of proper maintenance system	1.000	.655
Lack of competent professionals with the adequate skills and qualifications to render facilities maintenance services	1.000	.713
Unvaliability of a proper maintenance manual	1.000	.761
The absence of a policy guideline for infrastructural development and maintenance in buildings	1.000	.775

Extraction Method: Principal Component Analysis.

4.6.4 Total Variance Explained

The latent root, or Kaiser's criterion of retaining skill factors with eigenvalues greater than 1.0 was employed. Therefore, three FM challenges with eigenvalues exceeding one were retained, resulting in 8.482, 6.993 and 1.244, which explained 37.549%, 30.264% and 8.184% of the variance respectively. This concluded that the first cluster of challenges in FM accounted for 37.549% of the total importance expected for FM challenges in South African public sector buildings. In the same vein, the second cluster of FM challenges accounted for 30.264% of challenges inhibiting effective FM in South African public sector buildings whilst the third cluster accounted for 8.184% of FM challenges in South African public sector buildings. These three clusters of FM challenges in South African public sector buildings had a total cumulative percentage of 75.996%, which highlighted their significance from the twenty-two FM challenges shown.

Table 4.25: **Total Variance Explained**

	Initial Eigen Values			Loadings			Loadings		
	Total	**% of variance**	**Cumulative %**	**Total**	**% of variance**	**Cumulative %**	**Total**	**% of variance**	**Cumulative %**
Funding	8.482	38.556	38.556	8.482	38.556	38.556	8.261	37.549	37.549
Deterioration due to age of buildings or facilities	6.993	31.787	70.343	6.993	31.787	70.343	6.658	30.264	67.812
Lack of plant, equipment, materials and spare parts for maintenance operations:	1.244	5.654	75.996	1.244	5.654	75.996	1.801	8.184	75.996
Reckless use of facilities	.960	4.362	80.358						
Third-party vandalism	.787	3.575	83.993						
Delay in reporting failures and executing repairs	.688	3.128	87.061						
Swapping of roles	.521	2.370	89.431						
Lack of understanding of FM management importance and the consequences of neglecting it by the management as an investment	.484	2.201	91.632						
Poor workmanship	.385	1.749	93.381						

Lack of understanding of FM concepts and familiarisation with the opportunity to participate in FM by other professionals	.342	1.555	94.936
Training and development of maintenance personnel	.253	1.151	96.087
Lack of discernable maintenance culture	.185	.842	96.929
Maintenance work priorities	.174	.791	97.720
Irregular or fixed budget	.126	.574	98.294
Lack of motivation for maintenance staff	.110	.499	98.793
Construction of facilities	.090	.407	99.200
Inspection of facilities	.056	.253	99.454
Insufficient allocation of maintenance costs	.051	.232	99.686
Lack of proper maintenance system	.031	.140	99.826
Lack of competent professionals with the adequate skills and qualifications to render facilities maintenance services	.023	.105	99.931
Unavailability of a proper maintenance manual	.011	.050	99.981
The absence of a policy guideline for infrastructural development and maintenance in buildings	.004	.019	100.000

To aid the interpretation of these three factors, varimax rotation was performed, which presented the rotated component matrix, as shown in Table 4.26.

Table 4.26: Component Matrix

	Components		
	1	**2**	**3**
Maintenance work priorities	.885		
Poor workmanship	.885		
Lack of discernable maintenance culture	.864		
Construction of facilities	.848		
Inspection of facilities	.838		
Deterioration due to age of buildings or facilities	.830		
Reckless use of facilities	.817		
Lack of plant, equipment, materials and spare parts for maintenance operations:	.815		
Third-party vandalism	.815		
Lack of motivation for maintenance staff	.774		
Delay in reporting failures and executing repairs	.698		
Lack of understanding of FM management importance and the consequences of neglecting it by the management as an investment	.527	.484	
Insufficient allocation of maintenance costs		.913	
Irregular or fixed budget		.890	
The absence of a policy guideline for infrastructural development and maintenance in buildings		.848	
Unavailability of a proper maintenance manual		.825	
Funding		.809	
Lack of competent professionals with the adequate skills and qualifications to render facilities maintenance services		.765	
Training and development of maintenance personnel		.748	
Swapping of roles	.417	.700	
Lack of proper maintenance system	.407	.676	
Lack of understanding of FM concepts and familiarisation with the opportunity to participate in FM by other professionals		.581	.521

Table 4.27: Rotated Component Matrix

	Components		
	1	**2**	**3**
Maintenance work priorities	.931		
Poor workmanship	.919		
Lack of discernable maintenance culture	.890		
Construction of facilities	.876		
Inspection of facilities	.856		
Deterioration due to age of buildings or facilities	.856		
Reckless use of facilities	.854		
Lack of plant, equipment, materials and spare parts for maintenance operations:	.852		
Third-party vandalism	.843		
Lack of motivation for maintenance staff	.793		
Delay in reporting failures and executing repairs	.659		
Insufficient allocation of maintenance costs		.922	
The absence of a policy guideline for infrastructural development and maintenance in buildings		.875	
Irregular or fixed budget		.869	
Unavailability of a proper maintenance manual		.864	
Lack of competent professionals with the adequate skills and qualifications to render facilities maintenance services		.840	
Lack of proper maintenance system		.773	
Training and development of maintenance personnel		.731	
Funding		.696	.516
Swapping of roles		.696	.428
Lack of understanding of FM management importance and the consequences of neglecting it by the management as an investment		.496	.479
Lack of understanding of FM concepts and familiarisation with the opportunity to participate in FM by other professionals		.493	.703

4.6.5 Factor Analysis Reporting for the Three Clusters of Challenges in Facilities Management

i. Eleven items were loaded in Factor 1. These factors were ‘Maintenance work priorities’, ‘Construction of facilities’, ‘Poor workmanship’, ‘Lack of discernable maintenance culture’, ‘Reckless use of facilities’, ‘Third-party vandalism’, ‘Deterioration due to age of buildings or facilities’, ‘Inspection of facilities’, ‘Lack of plant, equipment, materials and spare parts for maintenance operations’, ‘Lack of motivation for maintenance staff’ and ‘Delay in reporting failures and executing repairs’. This is the set of FM challenges that deals with the structure of the public sector building; therefore they were labelled ‘Structural challenges’. With a total variance of 37.549% of the total variance, this set of competencies was identified as the most significant in the South African facilities management industry.

ii. Eight items were loaded in Factor 2. These factors were ‘Insufficient allocation of maintenance costs’, ‘Absence of a policy guideline for infrastructural development and maintenance in buildings’, ‘Irregular or fixed budget’, ‘Unavailability of a proper maintenance manual’, ‘Lack of competent professionals with the adequate skills and qualifications to render facilities maintenance services’, ‘Lack of proper maintenance system’, ‘Training and development of maintenance personnel’ and ‘Funding’. These challenges were labelled ‘Theoretical and Financial Challenges’. With a total variance of 30.264% of the total variance, this set of competencies was identified as also being significant in the South African facilities management industry.

iii. Three items were loaded in Factor 3. These factors were ‘Swapping of roles’, ‘Lack of understanding of FM management importance and the consequences of neglecting it by the management as an investment’ and ‘Lack of understanding of FM concepts and familiarisation with the opportunity to participate in FM by other professionals’. These challenges were labelled ‘Awareness Challenges’. With a total variance of 8.184% of

the total variance, this set of competencies was identified as also being significant in the South African facilities management industry.

4.7 Drivers and Enablers of Effective Facilities Management in Public Sector Buildings

This section presents the results of the analysis of the drivers and enablers for effective facilities management in public sector buildings. Two major aspects were considered and examined under this section. These included: the drivers of effective facilities management in South African public sector buildings, and the enablers of effective facilities management in South African public sector buildings. As previously noted, data were gathered using a well-designed questionnaire. The data collected were analysed using SPSS software. A five-point Likert scale was used to measure the drivers and enablers for effective facilities management in South African public buildings. Both descriptive and inferential analysis was carried out on the data.

4.7.1 Drivers for Effective Facilities Management in South African Public Sector Buildings

Table 4.28 reveals the respondents' rankings on the drivers of effective facilities management in South African public sector buildings. The respondents were required to indicate to what extent they agreed that environmental conditions, water services, security and life safety, space planning and management, building management system, maintenance, cleaning and ground maintenance and electrical services were drivers for effective FM using a five-point Likert scale 1 = Strongly disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5 = Strongly agree. The table shows that 'Building management system' was ranked first (M = 4.128, SD = 0.978), 'Maintenance, cleaning and ground maintenance' was ranked second (M = 4.077, SD = 0.839) and 'Electrical services' was ranked third (M = 4.077, SD = 0.957). The results showed that building management system, maintenance, cleaning and ground maintenance and electrical services were seen as the main drivers for effective facilities management practices in public buildings.

Table 4.28: Drivers of Effective FM in Public Buildings

FM Drivers	Mean	S.D.	Rank
Design of organisational structure	4.128	0.978	1
Spirit of teamwork	4.077	0.839	2
Sharing of FM knowledge and skills	4.077	0.957	3
Level of commitment	3.949	0.857	4
Good governance	3.872	0.978	5
Regular meetings on FM practices	3.872	0.951	6
Motivation for FM Team	3.821	1.048	7

4.7.2 Enablers for Effective Facilities Management Practices in Public Sector Buildings

Table 4.29 reveals the enablers of effective facilities management in South African public sector buildings. The table shows that 'Availability of policy/regulation supporting maintenance of public sector buildings' (M = 4.103, SD = 0.852); 'Availability of funds' (M = 4.077, SD = 0.957); 'Hiring more skilled professionals' (M = 4.026, SD = 0.873); and 'Increased level of awareness of FM benefits' (M = 4.026, SD = 0.959) were drivers for effective facilities management practices in public sector buildings. This showed that the availability of funds, the availability of an FM policy, hiring more skilled professionals, and increased level of awareness of FM benefits could make facilities management more effective in its application on public sector buildings.

Table 4.29: Enablers of Effective FM in South African Public Sector Buildings

FM Enablers	Mean	SD	Rank
Availability of policy/regulations supporting maintenance of public buildings	4.103	0.852	1
Availability of funds	4.077	0.957	2
Hiring more skilled professionals	4.026	0.873	3
Increased level of awareness of FM benefits	4.026	0.959	4
Availability of maintenance manual	3.949	0.999	5
Availability of maintenance plan	3.923	0.870	6
Training for staff	3.846	0.961	7
Availability of FM as a course in learning institutions	3.795	0.978	8
Availability of strategies and procedure to support FM	3.718	1.025	9
Availability of resources	3.385	1.067	10

CHAPTER FIVE
DISCUSSION OF FINDINGS

5.1 Introduction

This chapter discusses in depth the findings that were discovered from the data analysis in line with the research questions and objectives. The findings in this study were compared against the contents of the literature review. This was done to confirm that all the research questions outlined in Chapter One and listed below had been answered in the findings detailed in chapter 4.

5.2 Background Information

The feedback received from the thirty-nine questionnaires revealed there was a total of eighteen (18) male professionals from the KZN Department of Public Works, which represented 46.2% of the total population of the respondents and twenty-one females (21), which represented 53.8% of the total respondents. Furthermore, the feedback received about the background of the respondents revealed that there were 10 respondents (25.6%) with less than five years' experience in construction and 28 respondents (71.8%) with 6-10 years of experience in construction while only one respondent (2.6%) had 11-15 years of experience in construction. With regard to years of experience in facilities management, there are 15 respondents (38.5%) with less than five years of experience in FM, 23 respondents (59.0%) with 6-10 years of experience in FM and only one respondent (2.6%) with 11-15 years of experience in FM.

All 39 respondents worked as works inspectors, representing 100% of the total respondents. With regard to area of specialisation, 13 respondents worked as structural works inspectors, representing 33.3%; a further 13 respondents worked as mechanical works inspectors representing 33.3% and the remaining 13 respondents worked as electrical works inspectors, also representing 33.3%. Findings on the highest educational qualification of the respondents showed that 32 respondents had a National Diploma, representing 82.1%, six respondents had

a BSc/BTech, representing 15.4% and only one respondent had an Honours degree, representing 2.6%.

Responses from the survey further showed that only one respondent had specialised in facilities management, representing 2.6%, three respondents had specialised in quantity surveying, representing 7.7%, three respondents had specialised in building technology, representing 7.7%, five respondents had specialised in construction management, representing 12.8%, only one respondent had specialised in property development/management, representing 2.6% and 26 respondents had specialised in engineering (electrical, mechanical, civil, structural), which represented 66.7% of the total number of respondents. Findings on public sector building involvement in maintenance showed that 38 respondents, representing 26.6% had worked in government schools, 37 respondents, representing 25.8% had worked in government clinics and 38 respondents, representing 26.6% had worked with vacant land. With regard to the nature of FM, the responses from the survey showed that 21 respondents, representing 53.8% outsourced FM services, 11 respondents, representing 28.2% utilised in-house FM and seven respondents, representing 17.9% utilised both outsourced and in-house FM.

5.3 Discussion of Findings on Research Objectives

RO1: Current Nature and Extent of Facilities Management Practice on Public Sector Buildings in South Africa

The results in Table 4.1 showed that one (2.6%) of the respondents had specialised in facilities management, three (7.7%) of the respondents had specialised in quantity surveying, while three (7.7%) had specialised in building construction. Five (12.8%) of the respondents had specialised in construction management while the majority of the respondents (26;66.7%) had specialised in engineering works and one(2.6%) of the respondents had specialised in property development. Fifteen (38.5%) of the respondents had less than five years of experience in FM. The majority of the respondents (23;59%) had between 6 to 10 years of experience in FM and the remaining one (2.6%) respondent had between 11-15 years of experience in FM. The

findings also revealed that 38 (26.6%) of the respondents had worked in government schools, 37 (25.8%) of the respondents had worked in government clinics, 38 (26.6%) of the respondents had worked in government offices, and 30 (21%) of the respondents had worked on vacant land. The results revealed that a large number of the respondents (21;53.8%) preferred outsourcing FM services, 11 (28.2%) of the respondents preferred utilising in-house FM services, while seven (17.9%) of the respondents preferred utilising both in-house and outsourced FM services. The results in Table 4.2 show that an unplanned maintenance strategy was mostly used for public sector buildings in South Africa. This may be because that there was no formal strategy in place to address repairs, replacement or inspection before it was needed. It can also be observed in Table 4.3 and Table 4.4 that the level of awareness of corrective maintenance was very high and it was mostly used. The repair option was also high in terms of level of awareness but it was not commonly used. In addition, level of awareness of predictive maintenance was low and it was also not frequently used. Preventive maintenance and building simulation both showed a low level of awareness and these options were not frequently used. However, judging from past experience and the generally accepted position resulting from discussion on a proper maintenance programme and, as indicated in the results from the study, preventive maintenance was adjudged the best option of all. In a research by Ogungbile *et al.* (2015) in Nigeria, their findings also revealed that corrective maintenance and planned maintenance were the major maintenance approaches that were majorly used in public sector buildings. Therefore, it is important that preventive maintenance should be used more often than corrective maintenance as an approach to FM as it is more effective and prevents unnecessary repair costs. The results in Table 4.5 show that there was no existing policy and guidelines for facility management in the surveyed organizations although a small number of the respondents claimed that there was an existing policy and guidelines for facility management in their organizations. Table 4.8 shows that fire extinguishers were the most

readily available facility management infrastructure used in the public sector buildings. The results also showed that fire departments were available and that the purpose of their availability was known and they were used. Although fire alarms might have been available, the extent of their usage was not well known as can be seen in the results. Also, users' building evaluation forms and fire sprinklers might have been available but the extent of usage was limited as they were not frequently used. Table 4.9 reveals that regular inspection, waste management, adequate housekeeping standards, general environmental sanitation and identifying users' needs were the major facilities management activities that were performed in public sector buildings. These findings corroborated the findings of Ogungbile *et al.* (2015) who attributed common FM activities to maintenance of equipment, cleaning and general maintenance, record keeping, improving building maintenance, enhancing comfort and amenities for facility users, and essential service provision such as fire systems, plumbing services and so on. All these activities are necessary to keep the facilities in good shape and to prevent quick deterioration of the facilities. Provision of adequate support services, energy management in buildings and control of the operating budget appeared to be the lowest level of facilities management activities that were being performed in the public buildings. Table 4.10 reveals the importance of FM personnel during the life cycle of a building. The result signified the importance of consulting FM personnel at the design stage as being very important. Participation of FM personnel was also considered important at the construction and post-construction stages but their participation would be of the utmost importance at the design stage. Mohammed and Hassanain (2010) explained that the most dominant problem lay in the manner in which the occupiers or maintenance managers of a building maintained the building after construction. According to Olaniyi (2017), facilities managers with good knowledge and vast experience in building management and building performance were not usually consulted during the design stage of a building. Consequently, facilities managers did not play a

significant role during the design stage where decisions that affected the sustainability of the building were made. While the decisions taken at the design stage were critical to the effective operation and utilization of the building, facility managers were only involved during the operations stage of the building (Olotuah, 2015). Therefore, incorporating facility management knowledge in the building design was seen as essential to increase the overall performance of the building, including quality and cost, as the management and operation processes of facilities could have a significant impact on the energy, cost, health, quality and safety components of buildings. Ideally, FM should be implemented at the initial phase. Table 4.12 shows that with regard to organizations' involvement in terms of the provision of FM services, plumbing services, electrical services and fire safety system were the major services that were provided. Other services such as generator services and maintenance, HVAC services, general maintenance, lifts and escalators, outdoor and gardening services, cleaning and hygiene, were also provided by the organizations but to a lesser extent. This result is in accordance with the findings of the Facility Management Association of Australia (2012) where it was found that FM services for residential buildings included improving building performance, maintaining security for property occupants and assets, essential services provision (fire systems, plumbing services and so on), general maintenance, and undertaking larger capital or maintenance projects, etc. Jensen *et al.* (2013) further mentioned that provision of FM services by an organization had the potential to improve employee satisfaction, increase users' satisfaction, stimulate employees' innovation, increase the value of the facility, promote the marketing and sales values of the organization, affect employees' wellbeing and productivity and also support environmental sustainability.

RO2: To Assess the Technical Roles of the Facilities Management Team in the Life Cycle of Public Sector Buildings

The results from the study showed that maintenance management was recognized to be an important technical role for facility managers. Maintenance problems were difficult and costly

for facilities to control and maintain. These results corroborated the studies of Jawdeh (2013) and Wang *et al.* (2013) who found that FM managers played an important role in the pre-construction phase in terms of client satisfaction, energy efficiency, operation and maintenance, space management and sustainability. Kamaruzzaman and Zawawi (2010) mentioned that the term facilities management covered a wide range of services, including real estate management, contract management, human resource management, financial management, and health and safety management. FM managers could help improve facility quality or cost-effectiveness by voicing questions early on in the design process. As a result they would be able to competently meet their goals and incorporate cost-effective construction strategies that would support buildings over their entire life cycle (Enoma, 2005). In view of this, FM managers should ensure that utility facilities were appropriate during the design phase of a building. Maintenance management has been recognized in the study as an important technical facilities management role in public sector buildings. The maintenance of facilities, plants and equipment was an important aspect of the job for many facilities managers because breakdowns and outages could be very costly to an organization (Poor *et al.*, 2014). The use of facilities, plants and equipment was very important not only for the building occupants but also for improving the performance of buildings (Poor *et al.*, 2014). An established regime for maintenance and workplace safety was a recommendation that all facilities teams should prioritise. The maintenance and repair of buildings and plants, as well as fixtures, fittings and other working equipment was a major responsibility for facilities managers. It was their responsibility to ensure that the portfolio was statutorily efficient. It was important for senior managers to understand this and to realise that regular planned maintenance reduced the risk of breakdown and the potentially damaging failure of facilities.

Furthermore, the testing and maintenance of equipment and plants at the prescribed frequencies and the recording of the results were important steps in the health and safety regime (Bloch

and Geitner, 2019). It was also important for the facilities management team to be aware of the health and safety, and the employment and training standards of all the professionals involved. It was recognised that good property management practices included carrying out regular inspections of the condition of all buildings within a portfolio, or at least those facilities which had a key operational role and where failure would have substantial corporate implications. The results of such inspections would provide information to enable accurate operational planning and financial budgeting as schedules of future maintenance works were built up across a portfolio. The inspection analysis would also form part of the strategic review process for the whole operational portfolio. Effective maintenance programmes would help to ensure a safe working environment. Facilities managers had a legal duty, on behalf of the senior team, to ensure safe working conditions and compliance with legislation and regulations.

The study also found that financial management was a technical role that should be considered by facility managers. This was important as it constituted financial performance. The facilities manager would be involved, at the very least, with the preparation of budgets, an operational income and expenditure account for the portfolio, a system to pay suppliers and the benchmarking of immediate-term and whole-life costs. These were specialist areas with considerable amounts of money involved and in most businesses, the accounting team would look after such financial responsibilities. In addition, the study found that health and safety management was a technical role for the facilities management team to cover. The accommodation owned or occupied by all organizations and used by employees, customers or visitors had to comply with all relevant health and safety legislation and other regulations. The facility managers had to be given authority to cover administrative procedures to deal with all aspects of health and safety within the workplace and carry out risk assessments as necessary.

RO3: To Determine Competencies Required for Effective Facilities Management Practice on Public Sector Buildings

The results from both the descriptive analysis and exploratory factor analysis were used in answering the research question on the competencies required for effective facilities management practice in public sector buildings. The results showed the competencies of a facility manager, which are operation and maintenance management, work environment management, resource management, premises management, and leadership management among others. Although operation and maintenance management ranked the highest of all the listed roles, all the listed competencies were found to be relevant to the role of the facility manager. The tasks and competencies of a facility manager usually corresponded with the phase of building use such as building operations, especially when there was the need for operational costs management (Mrackova, Hitka and Sedmak, 2014). The study also corroborated the findings of the Facility Management Association of Australia (2012) who found that leadership and innovation, risk management, operational activities, and operational activities, etc. were important.

RO4: To Investigate the Challenges Inhibiting Effective Facilities Management Practice in Public Sector Buildings

The analysis in Table 2 revealed that FM was highly affected by funding allocated to FM. Irregular or fixed budgets, insufficient allocation of maintenance costs, absence of a policy guideline for infrastructural development and maintenance in buildings and unavailability of a proper maintenance manual were major challenges affecting effective facilities management practices in public sector buildings in South Africa. This result confirmed the opinions of Mohammed *et al.* (2010) and Akinsola *et al.* (2012). The owners of public sector buildings should endeavour to plan ahead and make sufficient funds available to facility managers because of the generally accepted fact that finance contributed substantially to the success of any tasks and procedures. Government in South Africa should also give more attention to FM by ensuring that legislation was passed on making FM practices mandatory in public sector buildings and stricter measures should be enforced to prevent the poor management and abuse

of public buildings by users. This finding was also supported by Ogungbile and Oke (2015). These results were further subjected to a principal component (factor) analysis (Table 6). The results in Table 6 which were grouped into components were classified as **structural factors/design errors** (maintenance work priorities, poor workmanship, lack of discernable maintenance culture, construction of facilities, inspection of facilities, deterioration due to the age of buildings or facilities, reckless use of facilities, lack of plant, equipment, materials and spare parts for maintenance operations, third-party vandalism, lack of motivation for maintenance staff, delay in reporting failures and executing repairs), **financial factors** (insufficient allocation of maintenance costs, the absence of policy guidelines for infrastructural development and maintenance in buildings, irregular or fixed budgets, unavailability of a proper maintenance manual, lack of competent professionals with the adequate skills and qualifications to render facilities maintenance services, lack of a proper maintenance system, lack of training and development of maintenance personnel, lack of funding and swapping of roles) and **awareness factors** (lack of understanding of FM management importance and the consequences of neglecting it by the management as an investment, and lack of understanding of FM concepts and lack of awareness by other professionals about the opportunity to participate in FM). From the results in Table 6 it was shown that structural factors/design errors were one of the major factors affecting effective FM practices in public sector buildings. Design errors were the result of incomplete drawings, detailing and specification by the design team. Due to this, building operations sometimes did not go according to plan and reworking often had to take place during the construction phase. Therefore, unexpected variations in design facilities and costly maintenance and repair, as well as the appearance of various defects in building components in the post-occupancy phase could occur. Femi (2014) found that improving the design quality could minimize FM costs significantly. Gatlin (2013) asserted that a large number of maintenance expenditures could be

minimized by reducing design errors. Moreover, Yap, Low and Wang (2017) concluded that cost-effectiveness could add value in building projects by minimizing the design error reoccurrence rate. The absence of this factor in the design phase was expected to generate high FM costs. This factor was a real threat to the structural and functional status of the building and consequently this would lead to more maintenance activities. Involvement of the facility manager in the design development phase would go a long way in minimizing maintenance issues (Ofori, Duodu and Bonney, 2015). Ali *et al.* (2016) highlighted that newly constructed buildings required a more complex maintenance system. Because the post-occupancy phase was the longest period and incurred the maximum life cycle costs, suitable maintenance management was vital for cost control and to facilitate more effective and efficient FM. Understanding of FM was another criterion required for the success of a building project. Lack of clear understanding of FM could cause complex and severe design and maintenance problems. In addition, maintainability and functionality issues would emerge in the post-occupancy phase. Lack of fundamental understanding of FM among design professionals would result in building defects and rework. Adequate skills and knowledge training programmes for FM could improve the competency among all building stakeholders.

RO5: To Determine Drivers and Enablers for Effective Facilities Management Practice on Public Sector Buildings in South Africa

From the results in Table 4.48 it was shown that design of organisational structure, spirit of teamwork and sharing of FM knowledge and skills were the main drivers for effective facilities management practices in public sector buildings. From the findings, it could be concluded that effective FM practice required a transformation, or a change, among management teams. In order for effective facility management to be successful, management should properly design their organisational structure, appointing knowledgeable and skilled facility managers, promote sharing of FM knowledge, increase the spirit of team working and have strong change management. Organization structure design has been classified as one of the key drivers for

effective FM practice. It shows that designing an effective organization structure is important as it helps top management to identify talent that need to be added to the organization. In addition, planning the structure ensures there are enough human resources within the organization to accomplish the goals, mission and vision. This was supported by Sapri, Muin and Sipan (2016) who mentioned that the strategic behaviour and performance of the organization was influenced by multiple actors like stakeholders, senior managers, government, employees and clients. Moreover, public sector buildings were buildings that brought individuals together to perform one task or another. Based on the findings, most of the respondents stressed the importance of team work that contributed to effective FM practice. Consequently, teamwork became the critical and important driver that contributed to an effective FM practice in public sector buildings. In addition, one respondent stressed that it was essential to consider change management. As mentioned by Syed, Adnan and Jusoff (2008), changes might boost the implementation of FM and it was a movement away from the present state of the organization to a desired future state.

Furthermore, the findings of this study were consistent with the argument that the knowledge and skill of facility managers was important in order to ensure the effectiveness and performance of FM practice (Firdauz, Sapri and Mohammad, 2015). Most of the respondents stated that it was necessary to appoint a facility manager with a FM background to enable and facilitate the implementation of FM practice in the context of public sector buildings. The reviewed literature also mentioned that increasing awareness of promoting the need of FM to be part of the business organization contributed to the development of FM (Syed *et al.*, 2015). Therefore, the findings of this study revealed that the benefits of sharing FM knowledge have become one of the key drivers that need to be considered. It is important especially for stakeholders of public sector buildings to understand how FM could and should contribute to supporting the function of public buildings.

The results also revealed that the availability of policy/regulation supporting the maintenance of public sector buildings, availability of funds, hiring of more skilled professionals and increased level of awareness of FM benefits were enablers of effective FM in public sector buildings. This finding was also supported by Kate (2020) who mentioned that providing sufficient funds and creating adequate awareness could help improve facilities management practice in buildings and benefit society at large.

CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

The study was conducted with the principal aim of examining effective facilities management practice in public sector buildings in South Africa. In this chapter, the conclusion and recommendations for further research are discussed and presented in relation to the set objectives which were evaluated in this study.

6.2 Conclusion

The objective of this research was to evaluate the current nature and extent of facilities management in public sector buildings in SA, the technical roles of the facilities management team in the life cycle of a public sector building, the competencies required for effective facilities management practice in public sector buildings, the challenges inhibiting effective facilities management practice in public sector buildings and the drivers and enablers for effective facilities management practice in public sector buildings in South Africa. The following conclusions were drawn from the research study.

1. Most organizations were predominantly utilising unplanned maintenance strategies rather than planned maintenance strategies or a combination of the two strategies. Furthermore, the results showed that organizations were not aware of the benefits of including facilities management in their organizations for day-to-day operations and as a result, most organizations were using unplanned maintenance strategies. Moreover, the results also showed that organizations were mostly involved in doing repair work, corrective maintenance and breakdown maintenance rather than preventive, predictive and proactive maintenance. This further emphasized the importance of having a planned maintenance strategy in place. The results further showed that there were no FM policies in place to act as a guideline for day-to-day maintenance. Also, facility managers were involved in activities such as regular inspection, waste management,

adequate housekeeping standards, general environmental sanitation and identifying users' needs. This was also supported by In-house Facilities Management Administration (2009), who mentioned that FM teams were responsible for managing technical, security and cleaning staff. The results also showed that organizations were primarily involved in maintaining the building fabric and supervising cleaning and decoration as well as waste management and recycling. In facility planning, organizations were mainly involved in identifying user needs, strategic space planning and monitoring the use of space. In general, in office planning the results revealed that organizations were mostly involved in health and safety, monitoring support services and housekeeping standards. The respondents also mentioned that they were largely involved in plumbing, electrical service and fire safety systems. Respondents also agreed that facility managers should be involved during the design stage of a building. This was also in line with the findings of Jensen (2009).

2. FM technical roles that were being conducted were operational risk assessment and mitigation at the development stage, maintenance of equipment within acceptable timeframes and defining the facility design life, i.e. material and equipment selection based on the intended occupancy.
3. FM competencies under operation and maintenance management such as leadership management, human resource management, organization management, premises management, service management, resource management and work environment management were: management of building service systems (e.g. drainage, piping, sanitary, safety, or electrical systems, etc.), maintenance of building elements (roof, floor, wall, stairs, etc.), risk management involved in the work process done, implementation of operation and maintenance management, improvement of facility performance taking into account the health, safety and physical safety management in

the organization, project management (including minor renovations and repair or refurbishment etc.), understanding of building design, cooperation with suppliers and specialists for matters or work processes related to facility management, space management, quality management in managing the organization's resources, development of a FM strategy in line with the organizational strategy, monitoring the procurement, installation, operation, maintenance and disposition of internal building systems, management of the building structure and internal permanent fittings maintenance, management of matters to do with organizational property, workplace management relations, understanding the organizational structure and organizational administration, understanding the organizational aim and strategy, monitoring the procurement, installation, operation, maintenance and disposition of exterior building elements, managing the personnel assigned to the facility function, law, executing the contract management works related to resource procurement, environmental issues (e.g. recycling, energy saving, etc.), professional practice, effective communication, managing change, financial management in managing organizational resources, monitoring the procurement installation, operational management, maintenance and disposition of furniture and equipment, real estate law, management of support services (e.g. cleaning team, caterer/ food supplier, landscaping, etc.), human resource management in facility management work processes and information management in managing the organization's resources.

4. The most predominant challenges in FM public sector buildings were insufficient funding, irregular or fixed budget and the absence of policy guidelines for infrastructural development and maintenance in buildings.
5. The most predominant drivers were design of organizational structure, spirit of teamwork and sharing of FM knowledge and skills.

6. The most important enablers of effective FM were availability of policy/regulations supporting the maintenance of public sector buildings, availability of funds, hiring of more skilled professionals and an increase in the level of awareness of FM benefits.

6.3 Recommendations

This research has evaluated facilities management in South African public sector buildings. This was achieved by identifying the nature of FM, the core competencies of FM, the challenges in the application of FM in public sector buildings and the main drivers and enablers of FM in South African public sector buildings. Therefore, based on the conclusions drawn from the study, the following recommendations were proposed:

1. Organizations need to employ a planned maintenance strategy in their day-to-day maintenance. Organizations also need to have preventive and predictive maintenance in place in order to avoid unnecessary continuous breakdowns and repairs in the facility. FM organizations also need to have a policy in place that serves as a guideline for all work, strategies and processes for FM in public sector buildings.
2. A facility manager needs to be competent enough to undertake work in FM. This individual should have in-depth knowledge of operation and maintenance management, leadership management, human resource management, organization management, premises management, service management, resource management and work environment management.
3. A facility manager needs to be equipped with the applicable technical roles in FM such as operational risk assessment and mitigation at the development stage, maintainability of equipment within acceptable timeframes and defining the facility design life. This would assist in enhancing the services delivered in the facility.
4. In a facility management organization, there needs to be a finance professional who oversees all the budgets and finances for all work and projects that need to be

undertaken. This would assist in preventing delays in the execution of work due to a lack of finances.

6.4 Areas for Further Study

The study provided an important foundation for further research on facilities management practices in public sector buildings. The research generated useful insight into facilities management practices in public buildings. Although findings from this study could be extended to other types of buildings, there is a need to replicate this study in other sectors to establish the possible differences in the way facilities management practices affect other sectors. For instance, the prevalence of facilities management practices in public sector buildings may not be the case in other types of buildings.

6.5 Limitations for the Study

The study was limited to 39 participants in KwaZulu-Natal province; further studies could consider a larger sample size and wider scope. It would also be useful to compare the results of the findings on facilities management practices to other buildings or sectors. This would facilitate a multi-sector comparison and have implications for future development.

REFERENCES

Abawi, K. 2013. Data collection instruments (Questionnaire & Interview). Training in Sexual and Reproductive Health Research Geneva, pp. 1-9.

Abidin, N.Z. and Pasquire, C.L. 2007. Delivering Sustainability through Value Management: Concept and Performance Overview. Engineering, Construction and Architectural Management, 12(2).

Abigo. A., Madgwick. D., Gidado. K. and Okonji. S. 2012. Embedding Sustainable FM in the Management of Public Buildings in Nigeria. EPPM 2012, University of Brighton, Brighton, UK, 10-11.

Adenuga, O.A., Odusami, K.T. and Faremi, J.O. 2007. Assessment of Factors Influencing Maintenance Management of Public Hospitals in Lagos State, Nigeria: The Construction and Building Research Conference (COBRA) of the Royal Institution of Chartered Surveyors, Georgia Tech, Atlanta, 6-7.

Adewunmi, Y., Ajayi, C. and Ogunba, O. 2009. "FM: Factors Influencing the Role of Nigerian Estate Surveyors". Journal of FM, 7(3), 246-258.

Adewunmi, Y., Omorin, M., Famutiwa, F. and Farinloye, O. (2011). Post-Occupancy Evaluation of Postgraduate Hostel Facilities. *Facilities.*

Ajayi, M., Nwosu, A. and Ajani, Y. (2015). Students' Satisfaction with Hostel Facilities in Federal University of Technology, Akure, Nigeria. European Scientific Journal, 11(34), 402-415.

Akinsola, O.E., Hussaini, P.O., Oyenuga, S.O. and Fatokun, A.O. 2012. Critical Factors Influencing Facility Maintenance Management of Tertiary Institutional Buildings in South-west Nigeria. Mediterranean Journal of Social Sciences, 3(11), 489-496.

Ali, M., Kan, K.A.S., Sarstedt, M. 2016. 'Direct and Configurational Paths of Absorptive Capacity and Organizational Innovation to Successful Organizational Performance' *Journal of Business Research* 69 (11), 5317-5323.

Albarkoly, K.M., Park, K.S. 2015. 'Implementing a Strategy of Reliability Centered Maintenance (RCM) in the Libyan Cement Industry' *International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering* 9(6), 1903-1912.

Alexander, P.A. 2003. The development of expertise: The journey from acclimation to proficiency, Educational researcher 32 (8), 10-4.

Alexander, K., Facilities management: a strategic framework. Facilities management: Theory and practice, 10-25, 1996.

Al-Hammad, A., Assaf, S. and Al-Shihah, M. (1997), "The effect of faulty design on building maintenance", Journal of Quality in Maintenance Engineering, Vol. 3 No. 1, pp. 29-39.

Aliyu, A.A., Funtua, H.A., Mammadi, A., Bukar, B.G., Garkuwa, A.I. and Abubakar, M.M. 2016. Management Problems Associated with Multi-Tenanted High-Rise Commercial Buildings in Kaduna Metropolis. Nigeria Civil and Environmental Research, 8(1).

Ama, M. 2011. 'Immigration to the Pure Land: The Modernization, Accuturation, and Globalization of Shin Buddihsm, 1898-1941' *University of Hawaii Press.*

Arkkelin, D.2014. Using SPSS to Understand Research and Data Analysis. Psychology Curricular Materials. Book 1. 1-195.

Armstrong, D.M. 2002. A Material Theory of the Mind, Routledge.

Amorim , A., Praplan, A.P., Adamov, A. 2013. 'Molecular Understanding of Sulphuric Acid–Amine Particle Nucleation in the Atmosphere.' *Nature*.

Asiabaka, I.P. 2008. The need for effective FM in schools in Nigeria", New York Science Journal, 1(2), 10-21.

Atkin, B. and Brooks, A. 2002 Total facilities management. Oxford: Blackwell science limited. pp 1.

Attri, R., Grover, S., Dev, N., Kumar, D. 2013. 'An ISM approach for modelling the enablers in the implementation of Total Productive Maintenance (TPM)' *International Journal of System Assurance Engineering and Management* 4 (4), 313-326.Barret, P. and Baldry, D. 2003. Facilities management: Towards best practice. 2nd ed. UK. Blackwell Science Ltd. pp 48. Au-Yong, P.C., Ali, A. S., Ahmad, F. 2014. Improving Occupants' Satisfaction with Effective Maintenance Management of HVAC systems in Office Buildings' *Automation in Construction* 43, 31-37.

Awang, Z. 2012. 'Research Methodology and Data Analysis Second Edition'. *UiTM Press*.

Basil, E.I. and Okorodudu, P. (2012). Public Library Information Resources Facilities and Services: User Satisfaction with the Edo State Capital Library, Benin-City, Nigeria. Library Philosophy and Practice, 747, 1-6.

Barnes, C., Mercer, G.2010. 'Exploring Disability'. *Polity*.

Bennett, J. and Iossa, E. 2006. Building and Managing Facilities for Public Services, *Journal of Public Economics.* 90 (10-11), 2143-2160, 2006.

Best, R., Langston, C.A. and De Valence, G. 2003. Workplace strategies and facilities management. (Eds.). Routledge. Butterworth Heinemann. (pp. 2).

Bloch, H.P. and Geitner, F.K., 2019. 'Machinery Component Maintenance and repair'. *Gulf Professional Publishing*

Bhalerao, K., Kale, P., Mahire, R. 2014. 'Implementation of Total Productive Maintenance Using Data Analysis, Actual Productive Utilization and Improved Communication Techniques for Improving Maintenance' *International Journal of Mechanical Engineering*.

Bonney, K.M. 2015 'Case Study Teaching Method Improves Student Performance and Perceptions of Learning Gains'. *Journal of Microbiology & Biology Education* 16 (1), 21-28.

Bosch, S.J. and Pearce, A.R. 2003. Sustainability in Public Facilities: Analysis of Guidance Documents, *Journal of Performance of Constructed Facilities,* 17(1), 9-18, 2003.

Braun, V. and Clarke, V. 2006. Using thematic analysis in psychology. Qualitative Research in Psychology, 3(2):77-101.

British Institution of Facilities Management (BIFM). 2010. British Institute of Facilities Management web-page, http://www.bifm.org.uk/bifm/home

Bryman, A. and Bell, E. 2015. Business research methods. 4th ed. USA. Oxford University Press. (pp. 12).

Carnero, A., Grassow, M.N., Aparicio, C.B. 2014. 'The PIM family of Serine/threonine Kinases in Cancer' *Medicinal research reviews 34 (1),* 136-159.

Chandrashekaran, A. and Gopalakrishnan, B. 2008. Maintenance Risk Reduction for Effective FM, Journal of Facilities Management, 6(1), 52-68.

Che'Mat, M.M. and Shah, Z.M. 2006. Value Management as an Effective and Efficient Tool for Space Management. Retrieved from http://www.vmacademy.com/seminar_paper_01.

Chew, M.Y.L., Tan, S.S. and Kang, K.H. 2004, "Building maintainability: review of state of the art". Journal of Architectural Engineering, Vol. 10 No. 3, pp. 80-87.

Chotipanich, S. 2004. 'Positioning Facility Management'. *Facilities*.

Creswell, J.W. and Clark, V.L.P. 2011. Designing and Conducting Mixed Methods Research. 2nd ed. USA. Sage Publishers. (pp. 1-18).

Clark, E., Hinxman, L.1999. 'Developing a Framework of Competencies for Facilities Management'. *Facilities*.

De Jager, J. and Gnadamosi, G. 2013. Predicting Students' Satisfaction through Service Quality in Higher Education. The International Journal of Management Education, 11, 107-118.

De Vries, J. 2007, "Presteren door vastgoed The influence of real estate on performance)", PhD Thesis, Delft University of Technology, Eburon,Delft.

Den Heijer, A. 2011, Managing the University Campus, Eburon Academic Book Publishers, Delft.

Dubem, I.I., Stephen, O.O., Michael, G.O and Timothy, A. 2013.'Assessment the Level of Commitment and Barriers to Sustainable Facilities Management Practice: A Case of Nigeria'. *International Journal of Sustainable Built Environment*. 1(2), 167-176

Ebenehi, I.Y., Mohamed, S., Sarpin, N., Wee, S.T. and Adaji, A.A. 2018. Building Users' Appraisal of Effective Fire Safety Management for Building Facilities in Malaysian Higher Education Institutions: A Pilot Study. International Electronic Scientific Journal, 4(12), 2001-2010.

Eiselen, S.2007. 'Adopting the Vienna Sales Conventions eight years down the Line' *SA Mercantile Law Journal* 19(1), 14-25

Elmualim, A., Shockley, D., Ludlow, G., Shah, S. 2010. 'Barriers and Commitment of Facilities Management Profession to the Sustainability Agenda'. *Building and environment* 45 (1), 58-64.

Elmualim, A., Valle, R., Kwawu, W. 2012. 'Discerning Policy and Drivers for Sustainable Facilities Management Practice' *International Journal of sustainable built environment* 1(1).

Erdener, E. 2003. 'Linking Programming and Design with Facilities Management'. *Journal of Performance of Constructed Facilities* 17(1), 4-8

Enoma, A. 2005. The Role of Facilities Management at the Design Stage. In Annual Conference - ARSOM, 1,421-430, London, England: Association of Researchers in Construction Management.

Facility Management Association of Australia 2012. Facilities Management: Good Practice Guide in Multi-Unit Residential, Facility Management Association of Australia, Melbourne.

FMAA. 2010. Facilities Management Association of Australia web-page, www.fma.com.au/cms/index

Femi, A.F. 2014. 'The Impact of Communication on Workers' Performance in Selected Organisations in Lagos State, Nigeria' *IOSR Journal of humanities and Social Science* 19 (8), 75-82.

Fincham, J.E. 2008. 'Response rates and responsiveness for Surveys, Standards, and the Journal' *American Journal of Pharmaceutical education* 72 (2)

Finch, P. 2004. Supply Chain Risk Management' *Supply Chain Management: An international Journal.*

Finch, J .2004. "Grass, Grass, Grass': Fox-hunting and the Creation of the Modern Landscape." *Landscapes* 5(2). 41-52.

Frankfort-Nachmias, C. and Nachmias, D. 1996. Research Methods in the Social Sciences, 5th Edition, Oxford University Press, New York.

Fraser, K. 2014. Facilities Management: The Strategic Selection of a Maintenance System. Journal of Facilities Management, 12(1), 18-37.

Firdauz, A.M., Sapri, I.S. Mohammad, I.S. 2015. 'Facility Management Knowledge Development in Malaysia: Added Value in Hospitality Managerial Competency' *Facilities.*

Gatlin, J.C., Hazel, J., Krutkramelis, K., Mooney, P., Tomschik, M., Gerow, K., Oakey, J. 2013. 'Changes in Cytoplasmic Volume Are Sufficient to Drive Spindle Scaling' *Science 342 (6160)*, 853-856.

Ganisen, G., Mohammed, A.H, Nesan, L.J and Kanniyapn, G. 2015. Critical Success Factors for Low Cost Housing Building Maintenance Organization. Journal Teknologi (Science & Engineering). 74(2): 31-40.

Goulden, M., Spence, A. 2015. Caught in the Middle: The Role of the Facilities Manager in Organisational Energy Use.' *Energy Policy* 85, 280-287.

Guest, G., Namey, E.E. and Mitchell, M.L. 2013. Qualitative research: Defining and designing. Collecting qualitative data: A field manual for applied research: Sage Publishing, 1-40.

Grimshaw, P., Ankrah, S.N., Burgess, T.F., Shaw, N.E., 2013. 'Asking Both University and Industry Actors about Their Engagement in Knowledge Transfer: What Single-Group Studies of Motives Omit' *Technovation* 33 (2-3), 50-65

Hair, J.F., Anderson, R.E., Babin, B.J. and Black, W.C. 2010, Multivariate Data Analysis, 7th ed., Pearson Prentice-Hall, NJ.

Hamilton, J.D. 2003. 'What is an Oil Shock?' *Journal of Econometrics 113 (2*), 363-398.

Hartungi, R. and Jiang, L. 2012. Energy Efficiency and Conservation in an Office Building: A Case Study. International Journal of Energy Sector Management, 6(2), 175-188.

Hightower, R., Highsmith, J. 2013. 'Investigating the Facility Management Professional Shortage' *International Journal of Facility Management* 4(3), 3.

Hinxman, L., Clark, E.1999. 'Developing a Framework of Competencies for Facilities Management'. *Facilities*.

Hodges, C.P. 2005. A Facility Manager's Approach to Sustainability. Journal of Facilities Management, 3(4), 312-324.

Holmes, A.P., Friston, K.J., Worsley, K.J., Poline, P.J., Frith, C.D. and Frackowiak, R.S.J. 1994. 'Statistical Parametric Maps in Functional Imaging: A general Linear Approach' *Human Brain Mapping* 2(4), 189-210.

Hopland, A.O. and Nyhus, O.H. 2015. Does Students' Satisfaction with School Facilities Affect Exam Results? An Empirical Investigation. Facilities, 17(1/2), 31-53.

Hsin, Y.Y., Loosemore, M.2001. 'Customer-Focused Benchmarking for Facilities Management'. *Facilities*.

Ikedaishi, D.I., Ogunlana, S.O., Boateng, P. and Okwuashi, O. 2012. "Analysis of Risks Associated with FM Outsourcing: A Multivariate Approach". Journal of FM, 10(4), 301–316.

Ikediashi, D.I., Ogunlana, S.O., Oladokun, M.G. and Adewuyi, T. 2012. Assessing the Level of Commitment and Barriers to Sustainable Facilities Management Practice: A case of Nigeria. *International Journal of Sustainable Built Environment,* 1 (2), 167-176.

International Facilities Management Association (IFMA). 2014. What is FM? Retrieved February 10, 2015, from http://www.ifma.org/know-base/browse/what-is-fm

International Facility Management Association. 2009. Strategic Facility Planning: A White Paper on Strategic Facility Planning. International Facility Management Association, Houston, TX.

Ishaq, M.M., Gambo, Y.L. and Omirin, M.M. 2012. Assessing FM Service in a Postgraduate Hostel Using Servqual Technique. Journal of Emerging Trends in Economics and Management Sciences (JETEMS), 3, 252-256.

Islam, R., Nazifa, T. H., Mohamad, S.F. 2019. 'Factors Influencing Facilities Management Cost Performance in Building Projects'. *Journal of Performance of Constructed Facilities* 33(3), 04019036.

Jager, J. and Gbadamosi G. 2013. Predicting Students' Satisfaction through Service Quality in Higher Education. *The International Journal of Management Education,* 11 (3), 107-118.

Jain, A., Bhatti, R., Singh, H.2014. 'Total Productive Maintenance (TPM) Implementation Practice: A Literature Review and Directions.' *International Journal of Lean Six Sigma*.

Jawdeh, H.B. 2013. Improving the Integration of Building Design and Facilities Management. Unpublished Thesis of School of the Built Environment, College of Science and Technology, University of Salford, Salford, UK.

Jensen, P.A. 2009. "Theoretical model demonstrating the value-adding contribution of facilities management"; Proceedings from EFMC 2009 Research Symposium, Amsterdam, 15-17 June.

Jensen, P.A., Sarasoja, A.L., Van der Voordt, T. and Coenen, C. 2013. "How can facilities management add value to organisations as well as to society?" Paper presented at the 2013 CIB World Building Congress, Brisbane, 5-9 May.

Jensen, J.B. and Gutin, G.Z. 2008. Digraphs: Theory, Algorithms and Applications. Springer Science & Business Media.

Jensen, R. 2010. The (Perceived) Returns to Education and Demand for Schooling. *The Quarterly Journal of Economics*, 125 (2), 515-548, 2010.

Jiboye, A.D. 2012. Post-occupancy evaluation of residential satisfaction in Lagos, Nigeria: feedback for residential improvement. Frontiers of Architectural Research, 1, 236–243.

Junnila, S., Horvath, A., Guggemos, A.A. 2006. 'Life-Cycle Assessment of Office Buildings in Europe and the United States'. *Journal of Infrastructure systems 12 (1),* 10-17.

Kallies, K., Hasbold, J., Tarlinton, D.M., Dietrich W., Corcoran, L.M., Hodgkin, P.D. and Nutt, S.L. 2004. Plasma Cell Ontogeny Defined by Quantitative Changes in Blim-1 Expression. *Journal of Experimental Medicine.* 200 (8), 967-977.

Kamaruzzaman, S.N. and Zawawi, E.M.A. 2010. Development of Facilities Management in Malaysia. *Journal of facilities management.*

Kate, M., Alida van de Kreeke, J., Nguyen, H., T., Konijnenberg, E., Tomassen, J., Braber, A, Yaqub, M., Bercke, B., Lammertsma, A.A., Boomsma, D.I.,Tan, S.H., Verbraa, F., Pieter Jelle Visser, P.J. 2020. 'Optical Coherence Tomography Angiography in Preclinical Alzheimer's Disease' *British Journal of Ophthalmology* 104(2), 157-161.

Kaya, N., Epps, H.H. 2004.' Relationship between Colour and Emotion: A Study of College Students' *College student Journal* 38(3), 396-405.

Karna, S. and Julin, P. 2015. A Framework for Measuring Student and Staff Satisfaction with University Campus Facilities. Quality Assurance in Education, 23(1), 47-66.

Khan, A., Bhatti, G., Khan, G. and Ismail, M. 2014. The Role of Academic Libraries in Facilitating Undergraduates and Postgraduates Studies: A Case Study of the University of Peshawar, Pakistan. Chinese Librarianship: An Internal Electronic Journal, 38.

Khan, S.N. 2014. Qualitative research method: Grounded theory. International Journal of Business and Management, 9(11), 224.

Kobue, T., Oke, A. and Aigbavboa, C. 2017. Understanding the Determinants of Students' Choice of Occupancy for Creative Construction. Procedia Engineering, 196(2017), 423-428.

Kok, H.B., Mobach, M. and Omta, O. 2011. The Added Value of FM in the Education Environment. Journal of FM, 9(4), 249-265.

Kothari, C.R. 2004. Research Methodology: Methods and Techniques' New Age International

Korrapati, R. 2016. Five Chapter Model for Research Thesis Writing: 108 Practical Lessons for MS/MBA/M. Tech/M. Phil/LLM/Ph. D Students. Diamond Pocket Books Pvt Ltd.

Kothari, C.R. 2012. Research Methodology: Methods and Techniques: New Delhi: Wiley Eastern Limited.

Kwon, J.E.K. and Park S.Y. 2011. 'Advanced Organic Optoelectronic Materials: Harnessing Excited-State Intramolecular Proton Transfer (ESIPT)'. *Advanced Materials* 23 (32), 3615-3642.

Latham, M. 2001. Classic Facilities Management. Building 12 January 2001.

Lavy, S. and Bilbo, D. 2010. Facilities Maintenance Management Practices in Large Public Schools, Texas, Facilities, 27(1/2), 5-20.

Lee, S.P., Chon, C.H., Kihm, K.D. and Choi, S.U.S. 2005. 'Empirical Correlation Finding the Role of Temperature and Particle Size for Nanofluid Therma Conductivity Enhancement' *Applied Physics Letters* 87(15), 153107.

Lee, H.L. 2002.' Aligning Supply Chain Strategies with Product Uncertainties'. *California management review* 44(3), 105-119.

Leedy, P.D., Ormrod, J.E. 2005. 'Practice Research.' *Pearson Custom*.

Lepkova, N. and Zukaite-Jefimoviene, G. 2012. Study on Customer Satisfaction with FM Services in Environment and Planning, 5, 461-476.

Liu, R. and Allmang, N. 2008. Assessing Customers' Satisfaction at the NIST Research Library: An Essential Tool for Future Planning. Issues in Science and Technology Librarianship, 54, 4-5.

Lingard, B., Martino, W., Rezai-Rashti, G. 2013. 'Testing Regimes, Accountabilities and Education Policy: Commensurate Global and Nation Development' *Journal of education policy* 28 (5)

Majdi, A. 2018. Medical Image Analysis Using Convolutional Neural Networks: A Review. *Journal of Medical Systems* 42 (11), 1-13.

Motamed, A., Montazeri, A.L.I., Tavousi, M., Rakhshani, F., Azin, S.A., Jajangiri, K., Ebadi, M. 2014. 'Health Literacy for Iranian Adults (HELIA): Development and Psychometric Properties.' *Payesh (Health Monitor)* 13(5), 589-599.

Marek, P., Milota, V. and Martina, B. 2015. Facility Management and its Importance in the Analysis of a Building Life Cycle. 4th World Conference on Business, Economics and Management (WCBEM). Procedia Economics and Finance, 26, 202-208.

Markus, T.A., Cameron, D. 2002. 'The Words between the Spaces: Buildings and Language.' *Psychology Press.*

Mcauley, B., Hore, A., West, R.P. and Horan, T. 2015. The Development of Key Performance Indicators to monitor Early Facilities Management Performance through the use of BIM Technologies in Public Sector Projects. In Proceedings of the 2nd Proceedings International Conference on Civil and Building Engineering Informatics, 1-8, Tokyo, Japan.

McCarroll, P. 2017. The House that Facilities Management Built: A Story of Identity and Metaphor in a Secondary Service. Culture and Organization, 23(4).

McLaughlin, P. and Faulkner, J. 2012. Flexible Space. What Students Expect from University Facilities. Journal of Facility Management, 10(2), 140-149.

Meng, X. 2013. Involvement of Facilities Management Specialists in Building Design: United Kingdom Experience. Journal of Performance of Constructed Facilities, 27(5), 500-507.

Mobach, M.P., Nardelli, G., Kok, H., Konkol, J. and Alexander, K. 2014. 'Facility Management Innovation (FMI)'. *Advancing Knowledge in Facilities Management, 13th EuroFM Research Symposium: Promoting Innovation in FM*, 378-386.

Mohammed, M.A. and Hassanain, M.A. 2010. Towards Improvement in Facilities Operation and Maintenance through Feedback to the Design Team. The Built and Human Environment Review 3.

Mohammed, N.F., Cyril, U.E., Gerald, G., Goh, G.2011. 'Key Determinants of Knowledge Sharing in an Electronics Manufacturing Firm in Malaysia'. *Library Review*.

Mohd Isa, N., Kamaruzzaman, S.N., Othman, M. and Jaapar, A. 2017. The Importance of Facilities Management in Value Management Process in Malaysia. Journal of Advanced Management Science, 5(6), 457-460.

Mustapa, A. 2013 Estimation of Stature by Using Lower Limb Dimensions in Malaysian Population. *Journal of Forensic and Legal Medicine* 20 (8), 947-952.

Mrackova, E., Hitka, M. and Sedmak, R. 2014 ‘Changes of anthropometric characteristics of the adult population in Slovakia and their influence on material sources and work safety’. *Advanced Materials Research* 1001, 401-406.

Najib, N.U.M., Yusuf, N. and Abiodun, N.Z. 2011. Student Residential Satisfaction in Research Universities. Journal of FM, 9(3), 200-212.

National Universities Commission (NUC) 2006, “Ban on admission into more programmes with denied accreditation”. Monday Memo, 4(18).

Nazali, M.M.N. and Michael, P. 2009. A Critical Review on Innovation in Facilities Management Service Delivery. Facilities, 27(5/6), 211-228.

Norton D.P., Kaplan, R.S. 2000. ‘Having Trouble with your Strategy? Then Map it’. *Focusing Your Organization on Strategy with the Balanced Scorecard 49 (5),* 167-176.

Noor, M.N.M., and Pitt, M. 2009. A Critical Review on Innovation in Facilities Management Service Delivery, *Facilities*, 27 (5-6), 211-228, 2009.

Nor, N.B.M., Shaikh, P.H., Nallagownden, P.,Elamvazuthi, I., Ibrahim, T. 2014. ‘A review on Optimized Control Systems for Building Energy and Comfort Management of Smart Sustainable Buildings’. *Renewable and Sustainable Energy Reviews* 34, 409-429.

Nordiana, M.I., Kamaruzzaman, S.N., Othman, M. and Berawi, M.A. 2017. ‘Review of Facilities Management Functions in Value Management Practices’. *Architecture* 8 (5).

Nunayon, S.S., Olanipekun, E.A. and Famakin, I.O. 2020 Determining key drivers of efficient electricity management practices in public universities in South-western Nigeria: an empirical study. *International Journal of Sustainability in Higher Education*, 21(2), 281-314.

Odediran, S.J., Gbadegesin, J.T. and Babalola, M.O. 2015. FM Practices in the Nigerian Public Universities. Journal of FM, 13(1), 5-26.

Odediran, S.J., Opatunji, O.A. and Eghenure, O.F. 2012. Maintenance of Residential Buildings: Users Practices in Nigeria, Journal of Emerging Trends in Economics and Management Sciences, 3(3), 261-265.

Ofori, I., Duodu, P., Bonney, S. 2015. ‘Establishing Factors Influencing Building Maintenance Practices: Ghanaian Perspective’ *Journal of economics and sustainable development 6 (24),* 184-193.

Ogbeifun, E. 2011. Facilities management in a multi-campus setting: A case study of the University of the Witwatersrand (Doctoral dissertation). pp. 57-58.

Ogungbile, A. and Oke, A.E. 2015. Sustainable FM Practices in Public Buildings in Nigeria. 2nd NIQS Research Conference at Federal University of Technology, Akure, Nigeria, 830-843.

Okafor, B.N. and Onuoha, D.C. 2016. FM in Educational Institutions: A Study of Nnamdi Azikwe University, Awka. Journal of Resources Development and Management, 22, 23-32.

Oladokun, S.O. and Ajayi, C.A. 2018. Assessing Users' Perception of FM Services in a Public University. Journal of FM and Research, 2(2), 62-73.

Oladokun, T.T. 2011. An Examination of the Practices of Facilities Management in Nigeria. Journal of International Real Estate and Construction Studies, 1(2), 167-182.

Olajide, F.J., Afolarin, A.O. and Beauty, J.I. 2013. Assessment of Factors Influencing Facility Management Procurement Route in Lagos State, Nigeria. Journal of Surveying, Construction and Property, 4(1), 1-13.

Olaniyi, O.O. 2017. Development of a FM Framework for Sustainable Building Practices in Nigeria [Doctoral dissertation]. University of Central Lancashire.

Olanipekun, E.A. and Iyiola, C.O. 2020. Comparative Assessment of Awareness and Knowledge of Impact of Energy Use Behaviour among Nigerian Higher Education Institutions Residence Students. *Journal of Energy Research and Reviews,* 1-19, 2020.

Olanrele, O.O., Ahmed, A. and Olatomiwa, L.J. 2013. A Study of User Satisfaction of Outsources (FM) Services in Public Residential Towers in Nigeria (A Case Study of Eko Court Towers and 27 Boyles Street/ Boyle's Street Flats). IOSR Journal of Humanities and Social Sciences (IOSR-JHSS), 15(3), 32-37.

Olotuah, A.O. 2015. Climate-Responsive Architecture and Sustainable Housing in Nigeria. Global Journal of Research and Review, 2(4), 94 – 99.

Oyedum, G.U. and Babalola, G.A. 2014. Assessment of Physical Facilities and Reader's Satisfaction. A Case Study of Federal University of Technology, Minna Library. Tin City Journal of Library, Archival and Information Science, 4(2), 6-7.

Pallant, J. 2011 *SPSS Survival Manual: A Step by Step Guide to Data Analysis using SPSS* (4th ed.). China: Everbest Printing Company.

Pathirage,C., Haigh, R., Amaratunga, D., Baldry, D. 2008. 'Knowledge Management Practices in Facilities Organisations: A Case Study' *Journal of Facilities Management*.

Payne, M.C., Milman, V., Wrinkler, B., White, J.A., Pickard, C.J., Akhmatskaya, E.V.,Nobes, R.H. 2000. 'Electronic Structure, Properties, and Phase Stability of Inorganic Crystals: A Pseudopotential Plane-Wave Study' *International Journal of Quantum Chemistry* 77 (5) 895-910.

Peters, R. S. 2015. 'Ethics and Education (routledge revivals)', *Routledge*

Piechnicki, A.S., Sola, A.V.H., Trojan, F. 2015. 'Decision-Making towards Achieving World-Class Total Productive Maintenance'. *International Journal of operations & production management*.

Pitt, M. and Price, S. 2011, "Implications of a sustainability policy for FM organisations". Facilities, 29(9/10), 391-410.

Polit, D.F. and Hungler, B.P. 1993, 'Essentials of Nursing Research: Methods, Appraisals and Utilisation, 3rd edition, Philadelphia, Lippincott-Raven Publisher.

Poor, H.V., Fan, P., Yang Z. and Ding, Z. 2014 'On the Performance of Non-Orthogonal Multiple Access in 5G Systems with Randomly Deployed Users'. *IEEE Signal Processing Letters* 21 (12), 1501-1505).

Preiser, G., Preiser, L., Madeo, L. 2003. 'An Outbreak of Cryptosporidiosis among Veterinary Science Students who Work with Calves.' *Journal of American College Health* 51(5), 213-215.

Rahman, C.M.L., Hoque, M.A., Uddin, S.M. 2014. 'Assessment of Total Productive Maintenance Implementation through Downtime and Mean Downtime Analysis.' *Assessment 4* (09).

Rose, R., Cain, D.A., Dempsey, J.J. and Schneider, R. 2007. Building: The Gift that keeps on taking a Framework for Integrated Decision Making". APPA and the Center for Facilities Research, Alexandria, VA.

Royal Institution of Quantity Surveyors (RICS). 2014. Assessment of Professional Competence: Quantity Surveying and Construction. London: Royal Institution of Quantity Surveyors.

Sapri, M., Muin, Z.A., Sipan, I. 2016. 'Key Drivers of an Effective Facilities Management Practice for Malaysia State Mosque'. *MATEC Web of Conferences* 66, 00082.

Sarasoja, A.L. and Aaltonen, A. 2012, "Green FM as a way to create added value"; in Jensen, P.A., Van Der Voordt, T. and Coenen, C. (Eds), The Added Value of Facility Management: Concept, Findings and Perspectives, Centre for Facility Management - Realdania Research, Lyngby, pp. 195-204.

Schraven, D. Hartmann, A., Dewulf, G. 2011. 'Effectiveness of Infrastructure Asset Management: Challenges for Public Agencies.' *Built environment project and asset management*.

Shafia, F., Yusoff, W.Z. and Pawi, S. 2012. Users' Satisfaction towards FM. FM Desk in Public Educational Institutions in Malaysia. Advances in Management and Applied Economics, 2(3), 59-69.

Shah, S.K. 2006. 'Motivation, Governance, and the Viability of Hybrid Form in Open Souce Software Development. *Management science* 52(7), 1000-1014.

Shao, A.T. 1999. Marketing Research, An Aid to Decision-making. Available at www.sbaer.uca.edn (Accessed: 16 October, 2015)

Sipan, M.S. and Shazmin, S.A.A. 2016. 'Property tax assessment incentives for green building: A review' *Renewable and Sustainable Energy Reviews* 60, 536-548.

South African Facilities Management Association (SAFMA). 2010. Facilities Management definition, roles and competencies. Retrieved 04 May 2018 from https://www.safma.co.za/content/images/what_is_fm_presentation.pdf

Shohet, I.M. 2006. 'Key Performance Indicators for Strategic Healthcare Facilities Maintenance.' *Journal of Construction Engineering and Management* 132 (4), 345-352

Spedding, A., Holmes, R. 1994.' Facilities Management' *CIOB Book of Facilities Management, Longman Scientific & Technical, London*.

Stern, L.A., Powers, J., Dhaene, K., Dix, A. and Shegos, S. 2007. Liking, Cooperation and Satisfaction between Roommates. Journal of College and University Student Housing, 34.

Swanson, S.A., Crow, S.J., Grange, D.L., Swendsen, J., Merikangas, K.R. 2001. 'Prevalence and Correlates of Eating Disorders in Adolescents Results From the National Comorbidity Survey Replication Adolescent Supplement' *Archives of general psychiatry 68(7),* 714-72.

Syed, A.H., Adnan, H., Jusoff , K. 2008. 'Facility Management Challenges and Opportunities in the Malaysian Property Sector' *Positioning the HIV/Aids Menance: Challenges for Marketing Communications Led Behavioural Change in Zimbabwe,* 79.

Redlein, A. 2004. 'Facility Management: Business Process Integration'. *Diplomica Verlag*.

Risan, H. 2013. 'Dyadic Relationships for Leaders in Facility Management' *Georgia Institute of Technology*.

Ta, A.G. 2014. 'Flourogenic Probes for Live-Cell Imaging of the Cytoskeleton.' *Nature methods* 11(7), 731-733

Tabachnick, B.G. and Fidell, L.S. 2007. Using Multivariate Statistics, Pearson Education, Boston.

Talib, Z. 2013. E-learning in Medical Education in Resource Constrained Low-and Middle-Income Countries'. *Human Resouces for Health* 11 (1), 1-15.

Tay, L. and Ooi, J.T.L. 2001 Facilities management: A "Jack of all trades"? Facilities, 19(10), p. 357–363.

Taylor, S.J., Bogdan, R., DeVault, M. 2015. 'Introduction to Qualitative Research Methods: A Guidebook and Resource'. *John Wiley & Son*.

Terrell, S.R. 2012. Mixed-methods research methodologies. The qualitative report, 17(1), 254-280.

Tladi, K. 2012. Evaluating the Facility Manager's Role in Project Design. (Master's Thesis), University of the Witwatersrand, Johannesburg.

Ubong, B. 2007. Hostel Accommodation in Tertiary Educational Institutions in Nigeria: To be or Not to Be. Available at www.basseyubong.com/HOSTEL %20ACCOMMODATION

Urso, P.D., Cooper, D.J., Rosenfeld, J.V., Murray, L., Arabi, Y. M., Kossmann, T., Ponsford, J., Seppelt, I., Reilly, P., Wolfe, R. 2011. 'DE compressive Craniectomy in Diffuse Traumatic Brain Injury'. *New England Journal of Medicine* 364(16), 1493-1502.

Vyskocil , S., Soucy, T.A., Smith, P.G., Milhollen, M.A., Berger, A.J., Gavin, J.M., Adhikan, S., Brownell, J.E., Burke, K.E. 2009.' An Inhibitor of NEDD8-Activating Enzyme as a New Approach to Treat Cancer' *Nature* 458 (7239), 732-736

Wang, Y., Wang, X., Wang, J., Yung, P. and Jun, G. 2013. Engagement of Facilities Management in Design Stage through BIM: Framework and a Case Study. Advances in Civil Engineering, 3, 1-8.

Wan-Hamdan, W.S.Z., Hamid, M.Y. and Mohd-Radzaun, N.A. 2011. Contribution of Facilities Management Processes in Supporting Malaysia. National Higher Education Strategic Plan. Procedia Engineering, 20, 180-187.

Wiggins, J.M. 2010. Facilities Manager's Desk Reference. Wiley-Blackwell.

Williams, D., Sutrisna, M.2010. 'An evaluation of the Role of Facilities Managers in Managing Sustainability and Remedial Actions in Reducing CO2 Emissions in Built Environment.' *The Construction, Building and Real Estate Research Conference of the Royal Institute of Chartered Surveyors, Dauphine Universite, Paris, France*.

Winkleman, M., Dole D., Pinkard, L., Molloy, J. *et al.* 1993 "The outsourcing source book". Journal of Business Strategy, 14(3), May/June, pp. 52-6.

Wood, B. 2003. Building care. Blackwell Publisher Limited.

Wuni, I.Y., Agyeman-Yeboah, S. and Boafo, H.K. 2017. Poor FM in the Public Schools of Ghana; Recent Empirical Discoveries. Journal of Sustainable Development Studies, 11(1).

Xianhai, H., Zhang, X., Liu, J., Dai, J. 2013. 'Synthesis, Characterization and Fluorescence Performance of a Waterborne Polyurethane-Based Polymeric Dye' *Journal of Luminescence* 142, 23-27.

Yap, A.L.L., Low, T.Y., Wong, K.O., De Haan, L.H.J. and Rietjens, I.M.C.M. 2017 'The Regulatory Framework Across International Jurisdictions for Risks Associated with Consumption of Botanical Food Supplements' *Comprehensive Reviews in Food Science and Food Safety* 16(5), 821-834.

APPENDICES

APPENDIX A

Letter of Information

Issues Influencing Effective Facilities Management Practices on Selected Public Sector Buildings in South African Public Buildings

I am Petronella Minenhle Ndlovu, a Master student in the Department of Construction Management and Quantity Surveying, Durban university of Technology, Steve Biko campus, Durban, South Africa. I am currently conducting research on '*Examining Issues Influencing Effective Facilities Management in South African Public Buildings'*.

The aim of this study is to determine strategies that can promote the effective facilities management on selected public buildings in South Africa. This questionnaire therefore seeks to:

1. investigate the current nature and extent of facilities management in South African public sector buildings;
2. survey the technical roles of the facilities management team in the life cycle of a selected public sector building;
3. determine the competencies required for effective facilities management practice on public sector buildings;
4. investigate the challenges inhibiting effective facilities management practice in public buildings;
5. identify drivers and enablers for effective facilities management practice on public sector buildings in South Africa in order to recommend strategies for effective facilities management for public buildings in South Africa.

You are kindly requested to complete the attached questionnaire. No names are required in this survey. Participation is voluntary and you are free to withdraw at any time with no negative consequences to you. The questionnaire will take about 20 to 25 minutes to complete. The data collected will be treated anonymously and the findings of the survey will be used for the research purposes only. Please note that there are no risks, current or anticipated, to you as a participant in this research. Your co-operation will be highly appreciated. For any queries or

comments regarding the survey, please contact 21351270@dut.ac.za or minenhlepndlovu1@gmail.com cell: 0790467454 or modupem@dut.ac.za

Your completion of the survey will be understood to have met the requirements of informed consent according to the following:

"I have been invited to participate in the above-named study and have also been informed about my involvement in the research and what is required of me. I understand that:

- My participation in this research is voluntary;
- I may withdraw from the research at any time with no negative consequences for myself;
- This study has been described to me in a language that I understand;
- My answers will be kept confidential;
- I agree that my responses to the questionnaire can be used for the research.

With full knowledge of all the aforegoing, I agree to participate in this study."

Thank you in anticipation of your positive response to this request.

APPENDIX B

Questionnaire Survey on Issues Influencing Effective Facilities Management Practices on Selected Public Sector Buildings in South African Public Buildings

I am Petronella Minenhle Ndlovu, a Master student in the Department of Construction Management and Quantity Surveying, Durban university of Technology , Steve Biko campus, Durban, South Africa. I am currently conducting research on '*Examining Issues Influencing Effective Facilities Management in South African Public Buildings'*.

The aim of this study is to determine strategies that can promote the effective facilities management on selected public buildings in South Africa. This questionnaire therefore seeks to:

6. investigate the current nature and extent of facilities management in South African public sector buildings;
7. survey the technical roles of the facilities management team in the life cycle of a selected public sector building;
8. determine the competencies required for effective facilities management practice on public sector buildings;
9. investigate the challenges inhibiting effective facilities management practice in public buildings;
10. identify drivers and enablers for effective facilities management practice in public sector buildings in South Africa in order to recommend strategies for effective facilities management for public buildings in South Africa.

You are kindly requested to complete the questionnaire. There are no names required in this survey. Participation is voluntary and you are free to withdraw at any time with no negative consequences to you. The questionnaire will take about 20 to 25 minutes to complete. The data collected will be treated anonymously and the findings of the survey will be used for the research purposes only. Please note that there are no risks, current or anticipated, to you as a participant in this research. Your co-operation will be greatly appreciated. For any queries or comments regarding the survey, please contact minenhlepndlovu1@gmail.com cell: 0790467454 or modupem@dut.ac.za

Your completion of the survey will be understood to have met the requirements of informed consent according to the following:

“I have been invited to participate in the above named study and have also been informed about my involvement in the research and what is required of me. I understand that:

- My participation in this research is voluntary;
- I may withdraw from the research at any time with no negative consequences for myself;
- This study has been described to me in a language that I understand;
- My answers will be kept confidential;
- I agree that my responses to the questionnaire can be used for the research.

With full knowledge of all the aforegoing, I agree to participate in this study.”

Thank you in anticipation of your positive response to this request.

Section A: Background information

This section of the questionnaire refers to background information. Please note that your response will remain anonymous. Your co-operation is appreciated.

1. Gender

□ Male

□ Female

2. Please indicate your position in the company.

□ Facilities Manager

□ Maintenance Officer

□ Works Inspector

□ Other (please specify)

3. If you are a works inspector, please specify your area of specialisation.

□ Works Inspector- Structural

□ Works Inspector- Mechanical

□ Works Inspector- Electrical

4. Indicate your highest educational qualification completed.

□ National Senior Certificate

□ National Diploma

□ Bachelor of Science Degree

□ Btech Degree

□ Masters Degree

□ Honours Degree

□ Doctorate (PHD)

□ Other (please specify)

5. Please indicate your discipline or area of speciality.

□ Facilities Management

□ Quantity Surveying

□ Construction Management

□ Property Development/ Property Management

□ Architecture

□Engineering (Electrical, Mechanical, Civil, Structural)

□ Other (please specify)

6. Years of experience in construction

□ Less than 5 years

□ 5 to 10 years

□ 11 to 15 years

□ 16 to 20 years

□ More than 20 years

7. Years of experience in facilities management

□ Less than 5 years

□ 5 to 10 years

□ 11 to 15 years

□ 16 to 20 years

□ More than 20 years

8. In which sector does your organization render its services?

□ Public sector

□ Private sector

□ Both

9. Kindly indicate the types of public sector buildings in which you have been previously involved in its maintenance.

□ Government schools

□ Government clinics

□ Government offices

□ Vacant Land

□ Other (please specify)

Section B: The current nature and extent of facilities management practices in South African public sector buildings

This section of the questionnaire explores the current nature and extent of facilities management practices in South African Public Sector buildings.

10. Please indicate the nature of the facilities management process usually adopted in your organization.

□ Outsourcing of FM

□ In-House FM

□ Both

□ Other (please specify)

11. What type of maintenance strategy does your organization utilise for day-to-day facilities management operations?

□ Unplanned maintenance strategy

□ Planned maintenance strategy

□ Other (please specify)

12. To what extent do you agree or disagree with the following statement regarding the awareness of FM in South Africa? Use the following rating scale: 1=strongly disagree; 2= disagree; 3= neutral; 4= agree; 5= strongly agree

FM Strategies	1	2	3	4	5
Facilities management is a widely known practice in SA organizations and organizations are utilising FM for day-to-day maintenance.					
Organizations are not well aware of the benefits of having FM for day to day maintenance.					

FM Strategies	1	2	3	4	5
Very few organizations are aware of facilities management and are utilising FM for day-to-day maintenance					
Organizations are not at all clued up about the benefits of having FM and thus are not using FM for day-to-day maintenance.					

13. Briefly explain where your organization receives funding from for day-to-day maintenance of facilities.

---

14. Please indicate the extent of your organization's involvement in the following FM strategies using the following 5-point scale where: 1= To no extent; 2= Small extent; 3=Moderate extent; 4= Large extent ; 5= Very large extent

FM Strategies	1	2	3	4	5
Preventive Maintenance					
Corrective Maintenance					
Predictive Maintenance					
Pro-active Maintenance					
Breakdown Maintenance					
Planned Maintenance					
Repair					
Routine					
Replacement					
Corrective / responsive					
Other (please specify)					

15. To what extent do you agree or disagree with the following statement regarding FM policies in your organization? Use the following rating scale: 1=strongly disagree; 2= disagree; 3= neutral; 4= agree; 5= strongly agree

FM Strategies	1	2	3	4	5
There is an existing policy with guidelines on day-to-day maintenance of the facility for the organization.					
There is no existing policy with guidelines on day-to-day maintenance of the facility for the organization.					
Our organization is well aware of FM policy guidelines to follow when rendering FM services.					
Our organization not at all well aware of FM policy guidelines to follow when rendering FM services.					

16. Please indicate the level of significance of the following facilities management strategies in achieving overall building efficiency and business success. Use the following rating scale: 1= Not significant; 2= Less significant; 3= Moderately significant; 4=Significant; 5= Very significant

FM Strategies	1	2	3	4	5
Preventive Maintenance					
Corrective Maintenance					
Predictive Maintenance					
Pro-active Maintenance					
Breakdown Maintenance					
Planned Maintenance					
Repair					
Routine					
Replacement					
Corrective / responsive					
Other (please specify)					

17. Facilities management can be categorised into different structures according to the type of organization where the services are rendered. Please indicate your familiarity with the following facility management structures. Use the following rating scale: .1=Not familiar; 2=Less familiar; 3=Neutral; 4=Familiar; 5= Very familiar

FM structures	1	2	3	4	5
Single site					
Office manager					
Localised site					
Multiple site					
International					
Other (please specify)					

18. Please indicate the level of your organization's involvement in the following facilities management structures. Use the following rating scale: 1= To no extent; 2= Small extent; 3= Moderate extent; 4=Large extent; 5= Very large extent

FM structures	1	2	3	4	5
Single site					
Office manager					
Localised site					
Multiple site					
International					
Other (please specify)					

19. Do South Africa public buildings have an existing facilities management department responsible for regular maintenance of their buildings?

□ Yes

□ No

Please briefly explain your answer given in Q19.

---

20. Please indicate the level of your organization's involvement in the following facilities management activities. Use the following rating scale: 1= Never; 2= Rarely; 3= Sometimes; 4=Often; 5= Always

FM Activities	1	2	3	4	5
Building operations and maintenance					
Real estate					
Facility planning					
General/ office planning					
Building and construction					
Other (please specify)					

21. Please indicate the level of your organization's involvement in the following facilities management activities in building operations and maintenance. Use the following rating scale: 1= Never; 2= Rarely; 3= Sometimes; 4=Often; 5= Always

FM Activities	1	2	3	4	5
Waste management and recycling					
Supervising cleaning and decoration					
Control operating budget					
Security					
Energy management					
Maintain building fabric					
Other (please specify)					

22. Please indicate the level of your organization's involvement in the following facilities management activities in real estate building and construction. Use the following rating scale: 1= Never; 2= Rarely; 3= Sometimes; 4=Often; 5= Always

FM Activities	1	2	3	4	5
New building design and construction management					
Acquisition and disposal of sites and buildings					
Negotiation and management of leases					
Advice on property investments					
Control of capital budgets					
Other (please specify)					

23. Please indicate the level of your organization's involvement in the following facilities management activities in facility planning. Use the following rating scale: 1= Never; 2= Rarely; 3= Sometimes; 4=Often; 5= Always

FM Activities	1	2	3	4	5
Strategic space planning					
Setting corporate planning guidelines and standards					
Identifying user needs					
Selecting and controlling use of furniture					
Monitoring space use					
Computer aided facility management					
Other (please specify)					

24. Please indicate the level of your organization's involvement in the following facilities management activities in general or office planning. Use the following rating scale: 1= Never; 2= Rarely; 3= Sometimes; 4=Often; 5= Always

FM Activities	1	2	3	4	5
Health and Safety					
Provide and monitor support services					
Office purchasing (stationary and equipment)					
Relocation					
Housekeeping standards					
Non-building contract services (catering , cleaning, etc)					
Other (please specify)					

25. Please indicate the level of importance of involving facilities management plans in the following stages of the lifecycle of a building. Use the following rating scale: 1=Not important; 2=Less important; 3=Moderately important; 4= Important; 5=Very important

Stages	1	2	3	4	5
Design stage					
Construction stage					
Post construction stage					
Occupation					

26. Please indicate the level of your organization's involvement in the following stages of a building's life cycle. Use the following rating scale: 1= Never; 2= Rarely; 3= Sometimes; 4=Often; 5= Always

Stages	1	2	3	4	5
Design stage					
Construction stage					
Post construction stage					
Occupation					

27. Please indicate the level of your organization's involvement in providing the following facilities management services. Use the following rating scale: 1= Never; 2= Rarely; 3= Sometimes; 4=Often; 5= Always

FM Services	1	2	3	4	5
Cleaning and Hygiene					
Plumbing services					
Electrical services					
HVAC services					
Fire systems					
Lifts and escalators					
Out-door and gardening services					
General maintenance					
Generator services and maintenance					
Other (please specify)					

Section C: Technical roles of the facilities management team in the life cycle of a public sector building

28. Please indicate your familiarity with the following facility management personnel. Use the following rating scale: .1=Not familiar; 2=Neutral; 3=Familiar; 4=Very familiar

FM Personnel	1	2	3	4	5
Senior management					
Middle level management staff					
Technicians					
Artisans					
Other (please specify)					

29. Please indicate the level of your organization's involvement in the following facilities management technical roles. Use the following rating scale: 1= Never; 2= Rarely; 3= Sometimes; 4=Often; 5= Always

FM Roles	1	2	3	4	5
Optimising the built area during the design stage to suit the FM strategy and intended operational requirements for the organization.					
Define the facility design life i.e., material and equipment selection based on the intended occupancy.					
Proper space management to ensure functionality, accessibility and optimisation of the available space					
Monitor building/ facility energy consumption					
Monitor building/ facility water consumption					
Co-ordinate parking arrangements for the building occupants					
Describe the condition of security and effectiveness of security measures.					
Ensure safety, and sound quality					
Ensure availability of materials and equipment.					
Maintainability of equipment within acceptable timeframes					
Ensure efficiency of equipment used					
Calculation of all costs required to purchase, upgrade or renovate facilities					
Calculation of all costs related to facility operation, such as insurance, air-conditioning, ventilation, repair and maintenance, security, cleaning and garbage disposal etc.					
Calculation of total costs associated with building occupancy, from building occupation to disposal					
Calculation of costs for labour (in-house or contracted-out) and materials required for building monitoring, inspection, repairs, maintenance, and response to service requests					
Calculation of monthly or annual cost of utilities, including electricity, fuel oil, gas, steam, water, sewerage, etc.					
Calculation of the budget required for decommissioning, demolishing and disposal of the building, its systems, subsystems, and components					
Calculation of anticipated reserve price of the facility at the end of life stage					
Co-ordinate the degree to which the facility is accessible and prepared to accommodate the various needs of various users (i.e. public, disabled, employees, maintenance personnel, etc.).					
Operational risk assessment and mitigation at the development stage					
Other (please specify)					

Section D: Competencies required for effective facilities management in South African public buildings

30. To what extent do you agree with the following as competencies required for effective facilities management in public sector buildings? Use the following rating scale: 1=strongly disagree; 2= disagree; 3= neutral; 4= agree; 5= strongly agree

FM Competencies	1	2	3	4	5
Operation and maintenance management					
Leadership and management					
Human Resource management					
Organization management					
Premises management					
Service management					
Resource management					
Work environment management					
Other (please specify)					

31. To what extent do you agree with the following as competencies required in leadership and management for effective facilities management in public sector buildings? Use the following rating scale: 1=strongly disagree; 2= disagree; 3= neutral; 4= agree; 5= strongly agree

FM leadership and management	1	2	3	4	5
Real estate law					
Manage the assigned personnel to the facility function					
Professional practice					
Managing change					
Law					
Other (please specify)					

32. To what extent do you agree with the following as competencies required in organization management: Use the following rating scale: 1=strongly disagree; 2= disagree; 3= neutral; 4= agree; 5= strongly agree

FM organization management	1	2	3	4	5
Develop FM strategy in line with organizational strategy					
Understand the organization structure and organization administration					
Understand organizational aim and strategy					
Other (please specify)					

33. To what extent do you agree with the following as competencies required in human resource management? Use the following rating scale: 1=strongly disagree; 2= disagree; 3= neutral; 4= agree; 5= strongly agree

FM human resource management	1	2	3	4	5
Human resource management in facility management work processes					
Effective communication					
Cooperation with suppliers and specialists for matters or work processes related to facility management					
Workplace management rapport					
Other (please specify)					

34. To what extent do you agree with the following as competencies required in operation and maintenance management? Use the following rating scale: 1=strongly disagree; 2= disagree; 3= neutral; 4= agree; 5= strongly agree

FM human operation and maintenance management	1	2	3	4	5
Monitor the procurement, installation, operation, maintenance and disposition of internal building system					
Manage the building structure and internal permanent fittings maintenance					
Monitor the procurement, installation, operation, maintenance and disposition of furniture and equipment					

FM human operation and maintenance management	1	2	3	4	5
Monitor the procurement, installation, operation, maintenance and disposition of exterior building elements					
Implement operation and maintenance management					
Other (please specify)					

35. To what extent do you agree with the following as competencies required in premises management? Use the following rating scale: 1=strongly disagree; 2= disagree; 3= neutral; 4= agree; 5= strongly agree

FM human premises management	1	2	3	4	5
Manage matters on organizational property					
Understanding of building design					
Maintenance of building elements (roof, floor, wall, stairs, etc.)					
Improve facility performance					
Workplace management relation					
Other (please specify)					

36. To what extent do you agree with the following as competencies required in service premises management: Use the following rating scale: 1=strongly disagree; 2= disagree; 3= neutral; 4= agree; 5= strongly agree

FM service management	1	2	3	4	5
Manage building service systems (e.g. drainage, piping, sanitary, safety, or electrical systems, etc.)					
Execute the contract management works					
Manage support services (e.g. cleaning team, caterer/ food supplier, landscaping, etc.)					
Project management (includes minor renovations and repair or refurbishment etc.)					
Other (please specify)					

37. To what extent do you agree with the following as competencies required in work environment management? Use the following rating scale: 1=strongly disagree; 2= disagree; 3= neutral; 4= agree; 5= strongly agree

FM work environment management	**1**	**2**	**3**	**4**	**5**
Environmental issues (e.g. recycling, energy saving, etc.)					
Space management					
Regarding the health, safety and physical safety management in the organization					
Other (please specify	**)**				

38. To what extent do you agree with the following as competencies required in resource management? Use the following rating scale: 1=strongly disagree; 2= disagree; 3= neutral; 4= agree; 5= strongly agree

FM resource management	**1**	**2**	**3**	**4**	**5**
Works related to resource procurement					
Risk management involved in the work process done					
Financial management in managing organizational resources					
Quality management in managing the organization's resources					
Information management in managing the organization's resources					
Other (please specify and rate)					

Section E: Challenges inhibiting effective facilities management in South African public buildings

39. To what extent do you agree that the following factors are challenges inhibiting effective facilities management in South African public buildings? Use the following rating scale: 1=strongly disagree; 2= disagree; 3= neutral; 4= agree; 5= strongly agree

FM challenges	1	2	3	4	5
Funding					
Deterioration due to age of buildings or facilities					
Lack of plant, equipment, materials and spare parts for maintenance operations:					
Reckless use of facilities					
Third-party vandalism					
Delay in reporting failures and executing repairs					
Swapping of roles					
Lack of understanding of FM management importance and the consequences of neglecting it by the management as an investment					
Poor workmanship					
Lack of understanding of FM concepts and familiarisation with the opportunity to participate in FM by other professionals					
Training and development of maintenance personnel					
Lack of discernable maintenance culture					
Maintenance work priorities					
Irregular or fixed budget					
Lack of motivation for maintenance staff					
Construction of facilities					
Inspection of facilities					
Insufficient allocation of maintenance costs					
Lack of proper maintenance system					
Lack of competent professionals with the adequate skills and qualifications to render facilities maintenance services					
Unavailability of a proper maintenance manual					
The absence of a policy guidelines for infrastructural development and maintenance in buildings					
Other (please specify)					

40. Please assess the criticality of the following challenges inhibiting the effectiveness of FM in South African public buildings. Use the following scale 1=not critical; 2=less critical; 3= neutral; 4= critical; 5= very critical

FM challenges	1	2	3	4	5
Funding					
Deterioration due to age of buildings or facilities					
Lack of plant, equipment, materials and spare parts for maintenance operations:					
Reckless use of facilities					
Third-party vandalism					
Delay in reporting failures and executing repairs					
Swapping of roles					
Lack of understanding of FM management importance and the consequences of neglecting it by the management as an investment					
Poor workmanship					
Lack of understanding of FM concepts and familiarisation with the opportunity to participate in FM by other professionals					
Training and development of maintenance personnel					
Lack of discernable maintenance culture					
Maintenance work priorities					
Irregular or fixed budget					
Lack of motivation for maintenance staff					
Construction of facilities					
Inspection of facilities					
Insufficient allocation of maintenance costs					
Lack of proper maintenance system					
Lack of competent professionals with the adequate skills and qualifications to render facilities maintenance services					
Unavailability of a proper maintenance manual					
The absence of a policy guideline for infrastructural development and maintenance in buildings					
Other (please specify)					

Section F: Drivers for effective facilities management in South African public buildings

41. Please indicate the drivers of effective facilities management in South African public buildings. Use the following rating scale: 1=strongly disagree; 2=disagree; 3=neutral; 4=agree; 5=strongly agree

FM drivers	1	2	3	4	5
Environmental conditions					
Water services					
Security and life safety					
Space planning and management					
Building management system					
Maintenance, cleaning and ground maintenance					
Electrical services					
Other (please specify)					

Section G: Enablers of effective facilities management in South African public buildings

42. To what extent do you agree with the following factors as enablers of effective facilities management in South African public buildings? Use the following rating scale: 1=strongly disagree; 2=disagree; 3=neutral; 4=agree; 5=strongly agree

FM Enablers	1	2	3	4	5
Availability of maintenance manual					
Availability of funds					
Availability of maintenance plan					
Hiring more skilled professionals					
Availability of policy/ regulation supporting maintenance of public buildings					

FM Enablers	1	2	3	4	5
Availability of resources					
Availability of strategies and procedure to support FM					
Training for staff					
Availability of FM as a course in learning institutions					
Increase level of awareness of FM benefits					
Other (please specify)					

Section H: Additional comments

43. If you have any additional comments based on this survey questionnaire, kindly add them in the section below.