



**Challenges of maintaining highly specialised infrastructure facilities at an institution of  
higher learning in South Africa**

By

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HLPBEA001

A minor dissertation

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presented to the

Department of Construction Economics and Management,  
in partial fulfilment of the requirements for the award of the degree  
Master of Science in Property Studies

December 2024

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## **Acknowledgements**

I extend my heartfelt gratitude to all those who have contributed to the completion of this dissertation, enriching my academic journey with their unwavering support and guidance.

First and foremost, I would like to express my deepest appreciation to my dedicated supervisor, Kathy Michell, whose invaluable insights, patient guidance, and unwavering encouragement have been instrumental in shaping the trajectory of this research. Your mentorship has been a beacon of light, and I am truly fortunate to have had the privilege of working under your tutelage.

I am profoundly indebted to the University of Cape Town (UCT) family, particularly the Maintenance & Operations and the entire Properties & Services for their continuous support and assistance. Their commitment to fostering an environment conducive to academic growth has been instrumental in realising the goals of this research. Tracy and Nobuzwe words cannot express my gratitude, you gave me hope when I was hopeless and wanted to give-up.

I extend my heartfelt gratitude to the vibrant community of “EMgoshongweni”, my village, and the mission of St. Francis Xavier. Your collective encouragement, prayers, and sense of community have been a source of strength, reminding me of the importance of rootedness and belonging.

To the Cape Town Parish of Resurrection, your spirit of inclusivity, camaraderie, and shared values have enriched my life in immeasurable ways. Your warm embrace and support have exemplified the essence of a united community. Lastly, I extend my thanks to all those who have played a part, no matter how small, in this academic endeavour. Your contributions have collectively shaped the mosaic of this dissertation, reflecting the power of collaboration and interconnectedness.

## **Dedication**

To my beloved family, my late daughter Mbali Hlophe, this is for you my guardian Angel, Princess Ntandoyenkosi Hlophe, boundless joy, and endless curiosity have infused every moment of my life with purpose. Your presence fills my days with inspiration and reminds me of the beautiful possibilities that lie ahead.

To my surviving dear siblings Leon Hlophe and Xolani Hlophe, your support and camaraderie have been a constant source of strength. Our shared memories, laughter, and shared experiences have shaped me into the person I am today. My late brother Mduduzi Hlophe I hear you brother, and I feel your presence.

To my cherished Aunt and Godmother, Sir Ritta Hlophe, your unyielding belief in my potential has been a constant source of motivation. Your wisdom, guidance, and unwavering support have been a guiding force in my life's journey. Allow me to extend my gratitude to your family at St Scholastica and your parish priest for their continuous prayers throughout my academic years. The yearly trips of long hours to Ngome Marine Shrine were not in vain.

My cousins, how can I forget you all? It wasn't easy and nothing has been easy for all of us, regardless of our background and upbringing, everything is in our hands; our parents did what they were supposed to do, within their means, let's move on and break all those family curses for our future generation. Let's spread the love and appreciate each other.

In loving memory of my late mom Agnes Hlophe and dad Boy Nzimande, your guidance, wisdom, and enduring love have left an indelible mark on my heart. Though you are no longer with us, your spirits continue to guide me, and your legacy lives on in everything I do.

This dissertation is a tribute to each of you - my family, my rock, and my greatest champions. Your belief in me and your unwavering support have been the driving force behind my journey. As I take this step forward, I carry your love and blessings with me, knowing that your presence is forever intertwined with my accomplishment.

## **Abstract**

Facilities management (FM) plays a crucial role in the success of higher education institutions. This study explores the challenges that facilities managers encounter in performing routine maintenance work and the impact of inadequate maintenance on highly specialised facilities at a South African higher education institution. The primary aim of this study was to understand the challenges associated with maintaining highly specialised infrastructure such as biosafety containment laboratories, pre-clinical laboratories, and research clean rooms. The objectives include investigating the reason senior academics are reluctant about routine maintenance, challenges experienced by the facility managers when conducting maintenance, assessing the impact of these challenges on academic activities, identifying key factors that contribute to maintenance difficulties, and to make recommendations towards improving infrastructure management. The study employed an interpretivist paradigm with an accompanying qualitative research approach. A single case study of a higher education institution in South Africa was utilised. Data was collected via semi-structured interviews with facilities managers, maintenance personnel, contractors as well as senior academics managing or using these highly specialised facilities at the selected higher education institution. A total of 22 interviews were undertaken and the data analysed using thematic analysis.

The study found that the primary reasons for senior academics' resistance to routine maintenance include disruptions to ongoing academic activities, lack of communication and stakeholder engagement, and concerns about expertise and safety, and their limited knowledge on the facility maintenance requirements. Facilities managers face significant challenges due to administrative bottlenecks, insufficient support from higher management, and ineffective project governance, including lack of formalised contractual agreements and regulatory frameworks. Budget constraints, communication barriers, fragmented communication systems, a lack of a centralised communication mechanism further exacerbate these issues as these impede the efficient dissemination of maintenance information to the relevant stakeholder(s). Furthermore, old infrastructure and a reactive maintenance culture led to frequent breakdowns. In addition, rapid technological advancements result in frequent equipment obsolescence and high maintenance costs resulting to further disruptions.

To address these challenges enhanced stakeholder engagement and involvement is needed together with improved communication channels and the establishment of robust governance frameworks to ensure timely and effective maintenance of highly specialised facilities. Recommendations emanating from this study include: adopting proactive maintenance strategies to prevent equipment failures before they occur; enhancing training for technical staff to ensure they are equipped to maintain specialised equipment; improving monitoring systems to better predict maintenance needs; securing sustainable funding models to support ongoing maintenance and equipment upgrades; and lastly, involving the facility managers in the design phase of the infrastructure and in the planning of the academic calendar. These strategies aim to promote timely implementation and completion of maintenance projects, reduce costs, and ensure sustainable maintenance practices in higher education institutions. This research provided valuable insights and a framework for other institutions facing similar challenges, contributing to the broader field of infrastructure management in higher education.

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## List of Abbreviations

BIFM	British Institute of Facilities Management
BIM	Building Information Modelling
CPS	Campus Protection Services
FM	Facility Management
HEI	Higher Education Institutions
IBM	International Business Machines Corporation.
ICRM	Ideal Clinic Realisation and Maintenance
ICT	Information and Communication Technology
IDM	Institute of Infectious Disease and Molecular Medicine
IFMA	International Facility Management Association
IWFM	The Institute of Workplace and Facilities Management
M&O	Maintenance and Operations
P&S	Properties and Services
RAF	Research Animal Facility
RICS	Royal Institution of Chartered Surveyors
SOP	Standard Operating Procedure
UCT	University of Cape Town

## **Chapter I. Introduction**

### **1.1 Introduction**

In the past few years, FM has become one of the most important tasks for organisations as they seek to optimise their built environments to comply with legislation on health and safety of occupants, reduce future costs and for the general aesthetics of buildings (Mewomo, Ndlovu and Iyiola, 2022). According to the International Facility Management Association (IFMA) (2023) FM “is an organisational function which integrates people, place and process within the built environment with the purpose of improving the quality of life of people and the productivity of the core business”. Alexander (2015: 7) defined FM as “the application of the total quality techniques to improve quality, add value and reduce the risks involved in occupying buildings and delivering reliable support services”.

The management and maintenance of physical assets and infrastructure involve two approaches, namely strategic or operational (Sharp, 2018). The two approaches are not in themselves different but complementary as a well-designed and executed strategic plan helps an organisation achieve its goals, while effective operational maintenance ensures that the facilities are able to support those goals daily (Sharp, 2018). Strategic facilities maintenance is the long-term planning and decision-making process that is used to align an organisation's facilities with its overall business objectives (Brown, 2018). This approach looks at the bigger picture and is aimed at aligning the organisation's facilities with its overall business strategy, and to ensure that the facilities are flexible, adaptable, and capable of supporting the organisation's future growth (Hamasha et al, 2023).

Operational facilities maintenance is concerned with the efficient and cost-effective day-to-day management and upkeep of facilities, whilst simultaneously providing a secure and comfortable working environment for employees and visitors alike (Blackburn, 2018). This function encompasses various facets, including but not limited to, cleaning and housekeeping, safety and security, energy management, communication, and coordination, as well as maintenance and repairs (Lewis, 2019). With a particular focus on one of the higher education institutions in South Africa, this study is focused on the maintenance and

repair domain, which plays a vital role in making sure that an organisation's facilities and equipment remain in optimal working order (Blackburn, 2018).

Higher education institutions can be defined as organisations that provide post-secondary education to students such as universities, colleges, and technical and vocational schools (Ogbeifun, 2016). This study focuses on maintenance and repair of infrastructure in universities which is fundamental for the smooth functioning and operation of the facilities so that they remain in good condition, safe and functional. In the higher education context in particular, FM plays a crucial role in delivering a safe and conducive environment for students and staff through the maintenance and upkeep of buildings, grounds, and equipment, as well as the management of energy and utilities (Hauashdh et al, 2024).

Previous research on FM in South Africa has yielded beneficial insights into the overall landscape of FM in the country (Awuzie and Emuze, 2017; Mavangwa, 2021; Mewomo et al. 2022; Ndlovu, 2021). However, despite these valuable contributions, several notable gaps still exist that require further exploration and theoretical development. It is worth noting that the majority of existing research in the field of FM in South Africa tends to be focused primarily on government-owned facilities (Mavangwa, 2021; Mewomo et al, 2022; Ndlovu, 2021). Additionally, a significant proportion of this research is overly focused on studying the carbon footprint of universities (Radebe and Ozumba, 2021) and lacks a strong theoretical and conceptual basis (Akinlolu, 2018; Ogbeifun, 2016). Furthermore, it is worth noting that some of these studies tend to attribute the deterioration of facilities solely on FM practitioners, blaming them for a lack of adherence to building procedures and mediocre management and maintenance of buildings (Mewomo et al, 2022). Such a narrow focus overlooks the complex and comprehensive nature of FM and neglects the various other factors that may impact effective FM within higher education and public sector institutions in South Africa.

In the context of this study, highly specialised infrastructure facilities are facilities at an institution of higher learning that have laboratories or research facilities that have research projects that may run for seven to ten years and may include but is not limited to “bio-repositories; radio-telescopes; research-focused forensic laboratories; research museums;

research clean-rooms; biosafety, biohazard and radiation containment facilities; and oceanographic facilities” (Ramoutar-Prieschl & Hachigonta, 2020:28). These facilities require a stable environment that any disruptions or maintenance work may result in a significant loss of data, which can set the research project back by months or even years, and ultimately result in loss of research funding.

## **1.2 Research Problem**

Highly specialised infrastructure facilities play a fundamental role in supporting teaching, research, and innovation in institutions of higher learning. However, maintaining these facilities poses significant challenges that can impact their functionality, efficiency, and longevity (Moyo & McKenna, 2021). In the context of South African higher education institutions, there is a need to address the specific challenges associated with maintaining highly specialised infrastructure facilities to ensure their optimal functioning and effectiveness.

These challenges encompass various dimensions, including limited financial resources, insufficient technical expertise, inadequate maintenance planning, and competing priorities (Alinaitwe et al, 2017; Mochoaene & Thwala, 2016). Furthermore, factors such as complex equipment, evolving technologies, regulatory compliance, and changing user requirements contribute to the complexity of maintenance in these specialised facilities (Nkado & Oyedele, 2020).

The consequences of ineffective maintenance of highly specialised infrastructure facilities are far-reaching (Au-Yong, Ali and Chua, 2018). Inefficient operation and functionality can hamper academic activities, compromise research outcomes, and impede the institution's capability to draw and maintain talented faculty and students. Moreover, the lack of regular maintenance may lead to equipment failure, safety hazards, and increased operational costs in the long run (Fenenga et al, 2019).

While studies have explored maintenance challenges in various contexts, there is a need for specific attention to be paid to the challenges faced in South African higher education institutions (Utomo & Ibadurrahman, 2022). The unique social, economic, and regulatory

factors in South Africa may contribute to distinct challenges in maintaining highly specialised infrastructure facilities.

### **1.3 Research Question**

The question to be answered in this research is:

What challenges face facilities managers in routine facilities maintenance work in highly specialised facilities in institutions of higher learning?

### **1.4 Research Proposition**

The study's proposition for this research is that the challenges faced by facilities managers in the maintenance of highly specialised facilities in institutions of higher learning can be identified.

### **1.5 Research Aim**

The overarching aim of this investigation is to explore the challenges that facilities managers encounter when trying to perform routine facilities maintenance work in highly specialised facilities at an institution of higher learning in South Africa and to identify strategies that can be used to mitigate these challenges.

### **1.6 Research Objectives**

Following from the problem focus area and the research question, the research objectives for this study are to:

- To explore the receptiveness of senior academics to routine maintenance work in highly specialised facilities at an institution of higher learning in South Africa.
- Identify the challenges that facilities managers encounter when trying to perform routine facilities maintenance work in highly specialised facilities at an institution of higher learning in South Africa.
- Propose a solution through engagement with all stakeholders and data collection on how these highly specialised facilities could be serviced.

## **1.7 Research Methodology**

This research adopts an overarching interpretivist philosophy and a qualitative approach. More specifically, the following research methodology was utilised for this study:

1.7.1. A critical literature review of FM with a particular focus on facilities maintenance of infrastructure particularly in higher education was conducted. Previous literature was reviewed. Gaps in existing literature and areas for further study were identified.

1.7.2 A study on challenges of maintaining highly specialised infrastructure facilities at an institution of higher learning in South Africa: A case of the University of Cape Town was undertaken. Data was collected through semi-structured interviews with stakeholders in the FM department and senior academics and/or grant holders in departments that house highly specialised infrastructure facilities.

1.7.3 The data was analysed using thematic analysis using computer aided qualitative analysis software.

1.7.4 Lastly, conclusions were drawn and recommendations made in terms of the challenges encountered by facilities managers when trying to carry out routine maintenance work in specialised facilities at an institution of higher learning.

## **1.8 Scope and Limitations**

The study focused on the challenges of maintaining highly specialised infrastructure facilities at an institution of higher learning in South Africa. A single case study of the University of Cape Town was undertaken. The limitations of the study are that it is limited to the case study and therefore the findings are not necessarily transferable. In addition, the researcher is a student and a staff member of the profiled institution. Measures were taken in the methodological approach to remove potential bias in the study. Further information is provided in chapter 3.

## **1.9 Dissertation Outline**

The dissertation comprises five chapters, a brief outline of each is provided below.

Chapter one provides a synopsis of the study, the problem argument, research question and research aims and an overview of the methodology and research findings.

Chapter two presents a critical literature review of FM with a particular focus on facilities maintenance of infrastructure and particularly in higher education.

Chapter three outlines the research philosophy adopted, the research methodology employed and details the design of the research and how the data was analysed.

Chapter four presents the data findings and discusses the emergent themes and sub-themes making reference to the literature.

Chapter five provides a conclusion of the study focussing on the key findings. It reflects on the answering of the research question and the achievement of the research objectives. The chapter further provides recommendations, areas of future research as well as limitations of the study.

## **Chapter II Literature Review**

### **2.1 Introduction**

Chapter one presented the background, problem, motivation, and rationale for this research. This chapter gives a review of the writing that helps to build a foundation that sets the tone to properly undertake this research study.

FM plays a critical role in ensuring that higher education institutions provide adequate infrastructure for learning and research. The provision of high-quality infrastructure is essential for creating a favourable learning environment that enables students to thrive and achieve their academic goals. This literature review chapter explores the role of FM in higher education institutions, the importance of adequate infrastructure for learning and research at universities, and the significance of uninterrupted research work in specialised facilities. The chapter also examines the importance of building maintenance for functionality, appearance, and durability of infrastructure, and the challenges and impacts of inadequate maintenance. Furthermore, the chapter reviews existing literature on FM in South Africa, highlighting previous research in this area, and identifies gaps in the existing literature.

### **2.2 Understanding Facilities Management**

FM plays a crucial role in the asset life cycle, encompassing everything related to the people within facilities and the surrounding grounds where they work, play, learn, and live (IBM, 2023). It is important to note that the concept of FM is often taken for granted, assuming that it is self-explanatory. However, scholars and professionals have provided diverse and contradictory interpretations, highlighting the breadth of the discipline and the need to understand its concept (Arrifin et al, 2022). According to Mthiyane (2018), FM enables viable enterprise functioning through the comprehensive life-cycle administration of efficient workplaces and effective business support services. The Institute of Workplace and Facilities Management (IWFM) defines it as "the integration of multi-disciplinary activities within the built environment and management of their impact upon the people and the workplace" (IWFM, 2023). The International Facility Management Association (IFMA) explains it as "an organisational function which integrates people, place, and process within the built

environment with the purpose of improving the quality of life of people and the productivity of the core business" (IFMA, 2023). According to IBM, FM refers to "the tools and services that support the functionality, safety, and sustainability of buildings, grounds, infrastructure, and real estate" (IBM, 2023:5). Arrifin et al, (2022) suggest that FM involves a wide range of tasks, responsibilities, and knowledge. It is involved in various aspects of a company, including occupancy management, capital project planning and management, operations and maintenance (M&O), energy management, letting and spatial planning and control, user experience, emergency handling and business viability and continuity, and real estate management (IBM 2023). Additionally, the concept of a triangle of "Ps" by IFMA highlights the interconnectedness of the key factors in today's workplace: people, process, and place (Arrifin et al, 2022). This interconnection fosters more efficient collaboration among relevant stakeholders.

The management and maintenance of physical assets and infrastructure involve two approaches: strategic and operational. These approaches are not inherently different but rather complementary. A well-designed and executed strategic plan helps an organisation achieve its goals, while effective operational maintenance ensures that the facilities can support those goals daily (Sharp, 2018).

### **2.3 Strategic Approaches to Facilities Management**

Facilities management (FM) is often viewed as a technically oriented and a reactive function, which contradicts the proactive service orientation required for creating a conducive environment to achieve core business objectives (Olugbade, 2023). Strategic FM spans conceptualising new building establishment, building development, arranging the services needed, to operating and maintaining the property for its entire useful life (RICS, 2023). Conversely, strategic approaches to FM recognise the importance of integrating non-core services that support the organisation's core objectives (Yahya Ts Wan, 2022). By adopting a strategic perspective, organisations can add value through the implementation of various strategic approaches and theoretical frameworks (National Academies of Sciences, Engineering & Medicine, 2019).

FM at conceptual level extends over a long planning horizon and decision-making processes aimed at aligning an organisation's facilities with its overall business objectives. This approach acknowledges the significance of having flexible and adaptable facilities capable of supporting the organisation's future growth (Brown, 2018). Nonetheless, it is widely accepted that FM often leans towards a technically oriented and reactive approach, rather than being proactive and service-oriented (Ndlovu, 2021). This stark contrast underscores the need for a strategic viewpoint (Ndlovu, 2021). To effectively fulfil the strategic role of FM, certain functions and responsibilities need to be emphasised. These include articulating and collaborating a facilities rule, deciding, and providing for on-going enhancement of service quality, recognising business goals and user needs and preferences, bargaining service level treaties, initiating effective procurement and contract plans, initiating service collaborations, and carrying out regular planned service evaluation (Gutterman, 2023).

Adaptation to change is a crucial requirement in FM as it involves foreseeing the future and effectively handling uncertainty (Hamasha et al, 2023). The inherent nature of FM necessitates the ability to anticipate and adjust to evolving circumstances. Furthermore, the profession of FM provides a unique opportunity to address significant societal challenges, such as climate change, energy efficiency, sustainable development, and green growth, at the organisational level (Lok et al, 2023). The principle of a strategic approach to FM sits in making decisions amid changing, unsure, unstable, and competitive circumstances (Lok et al, 2023). In a "defence mode," it involves safeguarding existing options, maintaining flexibility, generating new options, preparing likelihoods, and instituting response mechanisms, supported by intelligence systems to observe shifting conditions (Lok et al, 2023). On the other hand, in an "attack mode," it relies on adaptable responses, active alertness of abilities and limitations, swift assessment of options, and decisive actions aimed at achieving operational success and expanding manoeuvrability against challenges (Lok et al, 2023). Thus, the strategic approach focuses on effectively managing uncertainty and has two aims, namely: one negative, involving risk mitigation; and the other positive, involving capitalising on opportunities.

Apart from the strategic aspects, FM requires specific areas of focus. Risk management plays a pivotal role as organisations must identify and mitigate potential risks associated with their facilities (Benson, Obasi, Akinwande, Ile, 2024). The first area of focus involves implementing methods to contain, decrease, transfer, and avoid threats and constraints, whether known or unpredictable, imposed by properties and facilities (Vicente, 2024). The second area aims to maintain and capitalise on opportunities and advantages, both planned and unforeseen, that properties and facilities can offer. Assessing risks entails evaluating the types and significance of potential risks across various categories and the contingency measures in place to address unpredictable risks if they arise (Vicente, 2024). Similarly, opportunities can be assessed by considering the available areas and their significance, as well as establishing intelligence mechanisms to identify unforeseen opportunities as they emerge (Vicente, 2024).

Stakeholder engagement is also vital in strategic FM. Involving key stakeholders, such as employees, customers, and community members, in the decision-making processes ensures that facilities are responsive to their needs and preferences (Hauashdh et al, 2024; Owusu-Agyeman & Moroeroe, 2022). By considering the perspectives of stakeholders, organisations can create facilities that enhance their overall experience and satisfaction. Furthermore, strategic FM requires a holistic approach that considers various factors. This includes aligning facilities with the organisation's business strategy by understanding its goals, objectives, and future (Brown, 2018). Analysing space requirements, technological advancements, and changing work practices helps organisations make informed decisions about facility investments, renovations, or reconfigurations that support future growth and operational efficiency. Evaluating lifecycle costs and considering sustainability aspects are also critical in optimising facility performance (Hauashdh et al, 2024).

FM is often perceived as a technically oriented and reactive function, which contradicts the proactive service orientation required for creating a conducive environment to achieve core business objectives (Olugbade, 2023). However, strategic approaches to FM recognise the importance of integrating non-core services that support the organisation's core objectives (Tucker and Pitt, 2019). By adopting a strategic perspective, organisations can add value through the implementation of various strategic approaches and models (Hauashdh et al, 2022). Strategic FM encompasses the entire lifecycle of facilities, from considering a new

building, delivering it, and setting up the required services, to operating it over its lifespan (RICS, 2020). The strategic objective of FM is to provide better infrastructure and logistic support to businesses and public endeavours across all sectors (Lok et al, 2023). In addition to the strategic aspects, specific areas of attention are required in FM. Risk management plays a crucial role in identifying and mitigating potential risks associated with facilities (Benson et al, 2024). Similarly, opportunities should be identified and capitalised on to gain advantages. Stakeholder engagement is also vital, involving key stakeholders in the decision-making process to ensure facilities are responsive to their needs and preferences (Owusu-Agyeman & Moroeroe, 2022). Furthermore, a holistic approach is necessary in strategic FM, considering various factors such as aligning facilities with the organisation's business strategy, analysing space requirements, technological advancements, and changing work practices (Brown, 2018). Evaluating lifecycle costs and considering sustainability aspects are also critical in optimising facility performance (Taimu et al, 2020).

In the context of higher education, strategic approaches to facility FM should encompass a comprehensive and forward-thinking perspective aimed at aligning the physical infrastructure with the institution's educational mission and goals. It involves long-term planning and decision-making processes to ensure that the facilities support the evolving needs of students, faculty, staff, and other stakeholders. Strategic FM in higher education also entails considering factors such as student enrolment projections, academic program requirements, technological advancements, sustainability principles, and the overall student experience.

Moreover, it involves analysing space utilisation, optimising the allocation of resources, and incorporating flexible design solutions that allow for future adaptations and expansions. Additionally, strategic approaches involve risk management, ensuring the safety and security of facilities, and integrating stakeholder engagement practices to incorporate diverse perspectives and preferences.

## **2.4 Operational Approaches to Facilities Management**

Operations encompass the essential activities required for a building or built structure, its systems, equipment, and occupants to fulfil their intended functions (Noaman & Mohammed,

2022). The two aspects, maintenance and operations are often referred to as M&O as the efficient operation of a facility is dependent on its proper maintenance. Consequently, these aspects are commonly discussed and managed together to ensure optimal performance and functionality. Operational FM is concerned with the efficient and cost-effective day-to-day management and upkeep of facilities, while simultaneously providing a secure and comfortable working environment for employees and visitors alike (Blackburn, 2018). This function encompasses various facets, including but not limited to cleaning and housekeeping, safety and security, energy management, communication, and coordination, as well as maintenance and repairs (Hauashdh et al, 2022).

The scope of M&O encompasses the activities, processes, and workflows necessary to ensure that all components of the built environment remain in a usable condition throughout their life cycle (Noaman & Mohammed, 2022). Another important aspect is the daily operation of the building. Facilities managers ensure that all systems and equipment function smoothly. Real-time monitoring, such as using Building Information Modelling (BIM), allows for the continuous tracking of operational parameters (Hoang et al, 2020). Energy management is a crucial aspect of operational FM, and BIM technology plays a significant role in this area (Hoang et al, 2020). By utilising BIM as a cohesive and up-to-date computer model system, facility managers can effectively measure energy consumption and analyse various energy alternatives (Wafra et al, 2021). This enables them to identify opportunities for improving energy efficiency, reducing operating costs, and minimising the ecological footprint of the institution. The benefits of BIM extend to multiple aspects, including site plotting, maintenance strategies, design visualisation, utilisation, site scheduling, layout, and framework coordination (Wafra et al, 2021). Additionally, BIM offers advantages in maintenance operation, space planning, and reconstruction within the field of FM.

Maintenance is a fundamental aspect of operational FM. Facilities managers are responsible for implementing proactive maintenance strategies to ensure that all equipment and systems are in optimal working condition. Regular inspections, preventive maintenance schedules, and timely repairs are crucial to minimise downtime, extend the lifespan of assets, and prevent costly breakdowns. Through maintenance activities, facilities managers can enhance the operational efficiency and reliability of the facility (Hoang, Vu, Le, Nguyen, 2020). This

includes not only the facilities themselves but also the supporting infrastructure such as utility systems, parking lots, roads, drainage structures, and grounds (Noaman & Mohammed, 2022). Preventive maintenance involves a series of scheduled maintenance tasks based on time intervals, which serve as a foundation for planning, scheduling, and executing maintenance activities. The next section discusses the significance of facilities maintenance in greater detail.

## **2.5 Importance of Building Maintenance for Functionality, Appearance, and Durability of Infrastructure**

Ensuring the functionality, appearance, and durability of infrastructure heavily relies on facilities maintenance, which is a crucial aspect. For institutions or organisations that invest significantly in buildings, regular maintenance is imperative to ensure their longevity and retain their value. Adequate maintenance can help prevent expensive repairs and replacements, create safe and healthy conditions for occupants, and enhance the overall appearance of the infrastructure (Masengesho et al, 2020). According to García Márquez and Papaelias (2020), maintenance encompasses all administration activities that establish maintenance objectives, strategies, responsibilities, and their implementation through maintenance planning, control, and the improvement of maintenance activities and economics.

Masengesho et al, (2020) define building maintenance as the process of holding, sustaining, preserving, and protecting a building to an acceptable standard. Maintenance has technical, managerial, and administrative dimensions throughout the building infrastructure's life cycle (Falorca, 2021). Regular maintenance can prevent visible signs of wear and tear, such as peeling paint, cracks in walls and ceilings, and damaged flooring, through cleaning, painting, and repair, which contribute to the infrastructure's overall appeal. Inadequate maintenance of building facilities can lead to a host of functional problems that compromise the building's structural integrity and create safety hazards for occupants (Masengesho et al, 2021). Buildings are complex systems with interconnected parts, meaning that a failure in one component can quickly impact the rest of the structure. For example, a small leak in a pipe can cause water damage to walls and ceilings, leading to mould growth that can compromise the building's structural integrity (Falorca, 2021). Besides creating safety hazards, these functional problems can also render buildings less useful for their intended purposes.

Neglecting maintenance can also be an expensive proposition (Au-Yong and Chua, 2018). Buildings that are not regularly maintained require significant repairs and replacements, which can be both costly and time-consuming (Masengesho et al, 2021). A building's roof, for instance, may require complete replacement if not regularly inspected and maintained, leading to expenses ranging from tens to hundreds of thousands of dollars (Falorca, 2021). Apart from the cost of repairs, inadequate maintenance can also result in increased energy costs, as inefficient systems require more energy to operate. Therefore, it is critical to prioritise building maintenance and address any issues that arise promptly (Brown, 2018). Regular inspections and maintenance can identify trivial issues before they become major issues, reducing the risk of unexpected system failures, and minimising any downtime, thus ensuring the safety and well-being of building occupants (Masengesho et al, 2020). Neglecting maintenance can significantly reduce the lifespan of buildings, resulting in premature aging, wear and tear, and eventual demolition. Thus, a well-designed and executed strategic plan must align an organisation's facilities with its overall business objectives, while effective operational maintenance ensures that the facilities can support those goals daily (Sharp, 2018).

According to Mattern (2018), facilities maintenance has been practiced since medieval times, as evidenced by the maintenance of aqueducts and mud houses for centuries. This highlights the importance of regular inspections to extend the lifespan of any building, as all buildings inevitably deteriorate due to usage, weathering, and the natural aging process. Maintenance is necessary to restore them to their normal standards by addressing the deterioration, as stated by Au-Yong, Ali, Ahmad, Chua (2018). James et al, (2023) explain that maintenance also involves determining what needs to be done following a diagnosis, how to follow a specific protocol, and when to do so before a situation arises. Inadequate maintenance can be costly, as neglected buildings require more significant repairs and replacements that are expensive and time-consuming (Masengesho et al, 2020). For instance, if a building's roof is not regularly inspected and maintained, it may eventually require a complete replacement, which can cost tens or even hundreds of thousands of dollars (Mattern, 2018). Furthermore, inadequate maintenance can lead to increased energy costs, as inefficient systems require more energy to operate.

The bases of facilities maintenance can be traced back to its use in military contexts, where the primary objective was to maintain the readiness of combat units, military personnel, and equipment (Falorca, 2021). In modern times, the sounds of repair and maintenance are ever-present in our daily lives, with the constant drilling and clanging of maintenance equipment (Mattern, 2018). As a result, maintenance has become a subject of interest for various disciplines, including architecture, development economics, urban studies, information sciences, and even politics (Mattern, 2018). Neglecting maintenance can have a detrimental effect on the lifespan of buildings. Although buildings are constructed to last for many years, lack of maintenance can hasten their deterioration, leading to premature aging, wear and tear, structural failures, and ultimately, demolition (Masengesho et al, 2020).

Building maintenance is a fundamental component of the building infrastructure life cycle, and it is crucial even after minimising its need during the design phase (Masengesho et al, 2021). The key goal of building maintenance is to make sure that building facilities operate with minimal disruptions, such as mechanical, electrical, or security issues, to ensure the safety of building occupants and assets (Au-Yong et al, 2018). HVAC, electrical, plumbing, and elevator systems play a vital role in providing a comfortable, healthy, and functional environment for occupants to live, work, and study (Masengesho et al, 2020). Regular inspections and maintenance can help identify minor issues before they turn into major problems, reducing the risk of unexpected system failures, minimising any downtime, and ensuring the safety and well-being of building occupants. While buildings are designed to last for many years, neglecting maintenance can significantly reduce their lifespan, leading to premature aging and wear and tear that can cause structural failures and eventual demolition.

Facilities maintenance is an essential aspect of building management, and Masengesho et al, (2021) categorise maintenance into two main types: planned; and unplanned maintenance. Unplanned maintenance, also known as reactive maintenance, can be either condition-based or emergency maintenance. Condition-based maintenance is triggered by severe equipment degradation or performance limitations, while emergency maintenance addresses issues such as gas leaks, water leaks, or wind or rain damage. On the other hand, planned maintenance is proactive and involves using building information management systems or records to

prevent potential issues that may affect the building's lifespan in the future (Masengesho et al, 2021). Neglecting building maintenance can have serious negative consequences, including functional and aesthetic issues, safety hazards, and reputational damage (Au-Yong and Chua, 2018). Therefore, prioritising building maintenance is critical to ensure that buildings remain in good condition and meet the needs of their occupants.

Effective facilities maintenance involves two approaches: strategic and operational (Sharp, 2018). Strategic facilities maintenance entails long-term planning and decision-making processes used to align an organisation's facilities with its overall business objectives (Pampana, Jeon, Yoon, Weidner, and Hastak, 2022). This approach focuses on the bigger picture, ensuring that the facilities are flexible, adaptable, and capable of supporting the organisation's future growth. On the other hand, operational facilities maintenance is concerned with the day-to-day management and upkeep of facilities, providing a secure and comfortable working environment for employees and visitors alike (Blackburn, 2018). This function encompasses various facets, including cleaning and housekeeping, safety and security, energy management, communication and coordination, as well as maintenance and repairs (Lewis, 2019).

This study centres on maintenance and repair practices in one of South Africa's higher education institutions. The study has a specific focus on planned maintenance, which is a proactive approach to prevent potential issues that may arise and affect the building's lifespan in the future. By prioritising building maintenance and utilising both strategic and operational approaches effectively, an organisation can ensure that its facilities remain in optimal working order, meet the needs of its occupants, and support overall business objectives. As already alluded to before, inadequate maintenance and repair of facilities can have significant negative impacts on higher education institutions. A decrease in the quality of the learning environment negatively affects the learning outcomes of students. Moreover, poorly maintained facilities are unsafe and uncomfortable, leading to a negative learning experience for students and staff, resulting in decreased student satisfaction and retention rates. This has consequences for the reputation of the institution, leading to reduced enrolment, decreased funding, and limited opportunities for collaboration with other institutions.

## **2.6 Role of Facilities Management in Higher Education Institutions**

Ndlovu (2021) notes that FM is often perceived solely as a technical and maintenance issue, focusing primarily on the provision, operation, and maintenance of facilities, rather than being deeply involved in the fundamental business of the organisation. However, this perspective is problematic because FM should understand the core business of the organisation and actively contribute to achieving its objectives (Mewomo et al, 2022). In the context of higher education, the role of FM is paramount, as the core business of higher education revolves around teaching, research, and the development of both students and lecturers.

Ndlovu (2021) argues that the core business of higher education institutions can only thrive if the facilities adequately support teaching, learning, and research. Adequate infrastructure encompasses well-equipped classrooms, lecture halls, and teaching laboratories, which provide an environment conducive to effective teaching and learning (Ahmad et al, 2020). Such infrastructure also fosters collaborative learning spaces and encourages interactive teaching approaches that enhance student engagement and knowledge retention (Kristin, 2023).

FM plays a crucial role in contributing to the educational achievements of learners, as appropriate facilities support student engagement and knowledge acquisition (Kristin, 2023). Similarly, lecturers require facilities that support research and community engagement to effectively deliver their curriculum (Mafugu and Abel, 2022). These facilities include physical spaces and services such as classrooms, laboratories, libraries, residential halls, sports facilities, and administrative offices, all of which provide the necessary environment and resources to support teaching, research, and community engagement activities.

The quality of facilities in higher education significantly influences the quality and quantity of educational outcomes of universities (Abdullahi et al, 2019). An environment conducive to critical thinking and learning must facilitate the acquisition of information (Abdullahi et al, 2019). While research quality and outputs are often attributed to individual researchers, facilities play a pivotal role. Rusticus et al, (2023) argues that the nature and quality of the environment supports research, with key elements including equipment that facilitates the research enterprise. Universities require research infrastructure such as well-equipped

research laboratories, access to research databases, and state-of-the-art research equipment to enable high-quality research activities (Rusticus et al, 2023). Such infrastructure can foster research excellence, facilitate innovative research projects, and promote interdisciplinary research collaborations.

The significance of adequate infrastructure in higher education institutions cannot be overstated, given its pivotal role in enhancing the learning and research experience for both students and faculty members (Thondhlana and Garwe, 2021). Research productivity can suffer, and research outcomes may be compromised when higher education institutions lack sufficient infrastructure, leading to the deterioration of libraries, laboratories, and hostels (Thondhlana and Garwe, 2021). Atobauka and Jacob (2021) suggest that funding challenges faced by universities can render the environment unsuitable for both staff and students. Thus, FM assumes a critical role in providing a safe, functional, and conducive environment for teaching, learning, research, and administrative activities.

Rusticus et al, (2023) concur that the retention of staff and students serves as an indication of the quality of facilities. Institutions boasting modern, well-equipped facilities are more likely to attract and retain top talent, including students, faculty, and staff, who seek a high-quality learning and research environment. Therefore, facilities managers who maintain higher education infrastructure enhance an institution's reputation, foster a sense of community, and create an attractive environment for students, faculty, and staff. Additionally, modern infrastructure can bolster the reputation of a university and elevate its ranking in national and international academic standings. Consequently, it is crucial for facility managers to continuously invest in the maintenance and upgrade of their facilities.

Inadequate infrastructure can adversely impact teaching and research activities, resulting in overcrowded classrooms, insufficient equipment, and restricted access to resources that impede the effectiveness of teaching and learning (West and Meier, 2020). Insufficient research infrastructure can also curtail the quality and impact of research activities, leading to diminished research productivity and influence (Cali et al, 2023). Moreover, inadequate infrastructure can pose challenges for institutions in attracting and retaining top talent, undermining their reputation as leading academic institutions (Abdullahi et al, 2019).

Out-dated and poorly maintained facilities can pose safety risks to students and faculty members, disrupting the smooth operation of academic programs and research activities (Zurainan et al, 2021). Additionally, modern facilities can cater to the emotional needs of students, lecturers, and support staff by offering pleasant surroundings, inspiring environments, and friendly atmospheres, alongside meeting their physical needs through the provision of safe, adequate, and suitable shelter (Zurainan et al, 2021). In addition to managing the maintenance and repair of buildings, equipment, utilities, and grounds, FM plays a crucial role in ensuring that higher education institutions provide an environment that aligns with the needs of their students, faculty, and staff.

In summary, FM plays a pivotal role in the outcomes of higher education, as the quality of facilities directly impacts the quality of educational outcomes and research productivity. Well-maintained facilities support student engagement, knowledge acquisition, and critical thinking and learning. Similarly, research infrastructure facilitates research excellence and innovation, enabling universities to attract and retain top researchers and foster interdisciplinary research collaborations.

## **2.7 Importance of Uninterrupted Research Work in Specialised Facilities**

In recent years, there has been a surge in biomedical research focused on pathogenic agents, driven by the escalating burden of infectious diseases (Ichinose et al, 2019). This trend has prompted the establishment of highly specialised infrastructure facilities, including biosafety containment laboratories, pre-clinical laboratories, and pharmaceutical laboratories (Yeh et al, 2021). The on-going coronavirus pandemics have further shown the need for essential upgrades and the expansion of existing biosafety laboratories (Pawar, Kode, Keng, Tare, Abraham, 2020). These highly specialised facilities play an important role in the surveillance of pathogenic infectious agents, with research projects within them often spanning several years, involving extensive experimentation, data collection, and analysis (Wu, 2019).

Nevertheless, any disruptions to these research processes caused by interruptions or maintenance activities can lead to the loss of crucial data, necessitating the re-initiation of

experiments and thereby extending project timelines, resulting in additional costs (Wu, 2019). Moreover, highly specialised facilities demand highly skilled personnel to manage and operate them, including laboratory technicians, medical diagnosticians, clinical microbiologists, and pharmaceutical and biotech technicians specialising in pathogen handling (Yeh et al, 2021). Maintenance of these facilities demands a high level of technical expertise, specialised equipment, and proficient personnel. Kalam et al, (2021) asserts that ensuring safe and effective laboratory operations and pathogen handling is essential for the safety of laboratory workers and the lab environment. Therefore, facilities managers must possess a comprehensive understanding of the equipment and systems in these facilities, along with the skills required to execute maintenance and repair tasks effectively. Wu (2019) further contends that advances in research conducted in highly specialised facilities serve as the foundation for the development of new technologies, treatments, and interventions with significant social and economic impacts. Delays in these projects may have far-reaching implications for society, including postponed development of new drugs, technologies, or interventions, which could lead to substantial financial, social, and health consequences (Mamood et al, 2018).

Highly specialised infrastructures within higher education institutions are pivotal for the practical learning of students and the advancement of scientific knowledge, as they are equipped with various instruments and equipment necessary for experiments (Sadiq et al, 2018). According to Krishnaratne et al, (2022), the low incidence of infections originating from laboratories in universities worldwide underscores the level of safety measures and precautions implemented to minimise risks to students and staff. However, in the United States, multi-state infections of salmonella typhimurium have been traced back to teaching university laboratories.

Maintenance is important for managing facilities in higher education institutions, especially in highly specialised facilities. Neglecting maintenance can disrupt research activities, leading to costly consequences and harming the institution's reputation. Proper maintenance ensures that equipment operates efficiently, prolongs its lifespan, and prevents unexpected downtime. It also upholds the integrity of research and academic activities and maintains a safe working environment.

Furthermore, adequate maintenance of highly specialised facilities can bolster the institution's reputation, attracting top talent and funding for future research. Therefore, it's important for facilities managers to understand the risks associated with maintaining facilities containing microorganisms to minimise potential hazards to themselves, contractors, and others (Krishnaratne et al, 2021). Lastly, it's worth noting that research on maintenance of highly specialised infrastructure and biosafety labs is scarce in Africa, underscoring the need for increased focus on this area (Muneer et al, 2019).

## **2.8 Previous Research on Facilities Management in South Africa**

FM is a critical aspect of institutional management globally, with South Africa being no exception. Researchers have conducted extensive studies on FM in South Africa, identifying various challenges, opportunities, and best practices. For example, Mewomo et al, (2022) delved into challenges faced by facilities managers in public buildings in South Africa, such as occupants' understanding of FM, lack of policy guidance, and deteriorating facility conditions.

Furthermore, numerous studies have focused on nurses assuming FM roles in public healthcare clinics. Racheal (2023) explored nurse managers' experiences regarding health system barriers and facilitators to empowering and advancing nurses' careers. Muthathi, Levin, and Rispel (2020) analysed primary healthcare facility managers' decision-making autonomy and involvement in implementing the Ideal Clinic Realisation and Maintenance (ICRM) program. Additionally, Racheal (2023) investigated how different governance models influenced primary healthcare facility managers' use of information in decision-making processes.

Naidoo and Bayat (2020) assessed the growth and development of FM in aligning with organisational strategies to enhance overall performance. Leon, Bhunu, and Nxumalo (2018) conducted a study on performance management during periods of change, illustrating experiences with implementing performance assessment systems in South African districts. The study revealed transformative changes, with some facility managers turning unproductive environments into efficient ones.

Moreover, Okoro, Musonda, and Kruger (2020) examined motivations for adopting Building Information Modelling (BIM) in the facilities and asset management industry, identifying barriers to BIM implementation. Radebe and Ozumba (2020) investigated barriers to sustainable FM practices in higher education institutions. Finally, Simpeh, Mavangwa, and Wentzel (2022) proposed six main strategies to address public FM challenges, including: enhancing human resources capabilities; providing maintenance equipment; ensuring adequate budget allocation; reforming procurement systems; combating corruption; and establishing effective organisational structures.

## **2.9 Gaps in Existing Research on Facilities Management in South Africa**

The literature suggests that FM is crucial to institutional management in South Africa and worldwide. However, despite the growing body of research on FM in South Africa, significant gaps remain in understanding its operations and challenges, particularly in institutions such as universities and private organisations. Although some studies have investigated the challenges facing facilities managers in South Africa, such as the absence of policy guiding FM practice (Radebe and Ozumba, 2020) and the state of deterioration of facilities (Simpeh, Mavangwa, and Wentzel, 2022), more research is needed. To address these gaps, this study focuses on the challenges that facilities managers encounter when conducting routine maintenance in highly specialised infrastructures at an institution of higher learning in South Africa. These specialised facilities are those that provide a controlled environment for conducting highly specialised experiments and research, such as biosafety containment laboratories, pre-clinical laboratories, and research clean rooms.

While it is important to identify and address the operational challenges faced by management of highly specialised facilities in South African institution of higher learning, it is equally important to consider the human factors that impact and complicate the maintenance system. These human factors are covered in the following sections.

## **2.10 Senior Academics Reluctance to Routine Maintenance**

When considering how senior academics contribute to the poor maintenance of highly specialised facilities, one crucial thing to establish is the underlying factors that influence their

priorities and decision-making. Through deeper exploration, the specific challenges which were noted as their reasons were identified and presented in the following subsections.

### **2.10.1 Expertise and Time Constraints**

Senior academics often possess specialised knowledge and skills in their respective fields, focusing on teaching, research, and administrative responsibilities. Engaging in routine maintenance tasks may be perceived as outside their expertise, leading to concerns about diverting time and energy from core responsibilities (Villegas, 2021). The demands of teaching, research, and administrative duties can limit their availability for maintenance work. Recent studies have highlighted the impact of expertise and time constraints on senior academics' reluctance to engage in routine maintenance tasks, as it is perceived to fall outside their area of expertise and potentially divert time and energy from core responsibilities. In a study by Villegas (2021), which examined maintenance management in higher education institutions, it was found that senior academics often possess specialised knowledge and skills in their respective fields. Their primary focus is on teaching, conducting research, and fulfilling administrative responsibilities. These core duties require significant time and effort, leaving limited availability for additional tasks such as routine maintenance. The study emphasised that senior academics may view maintenance work as outside their expertise, leading to concerns about compromising the quality and effectiveness of their primary responsibilities.

Moreover, a recent study by Siva et al, (2022) explored the challenges faced by senior academics in balancing their workload in Malaysian universities. The findings revealed that senior academics perceived routine maintenance tasks as secondary to their primary responsibilities and expertise. They expressed concerns about the potential impact on their research output and teaching quality if they were to divert time and energy towards maintenance work. These findings highlight the time constraints faced by senior academics and their prioritisation of core duties over maintenance activities.

Research on importance of professional community engagement by Owusu-Agyeman and Moroeroe (2022) in an institution, though from the perspective of student engagement emphasised the need for continuous engagement between all parties (academics, students,

and professionals) to build a social-cultural environment that promote students' interest in institutional norms. Conversely, poor communication and delays in addressing concerns can hinder engagement. This underscores the importance of collaboration between professional staff and academics in resolving academic challenges. This research shed light on the importance of proper engagement with the academic to ensure their willingness to cooperate in maintenance discourse.

Similarly, a study conducted by Wang, Almassy, Wei, and Shohet (2022) investigated the factors influencing academic staff engagement in maintenance activities in Chinese higher education institutions. The study found that senior academics often prioritise research and teaching, considering them as critical components of their professional identity and career advancement. Engaging in routine maintenance tasks was seen as a potential disruption to their primary responsibilities, leading to concerns about a decreased focus on core duties.

Shakeri and Khalilzadeh (2020) identified an increasing number of project failures and sought to uncover the reason behind it and to find out the level of communication relationship between project managers and other managers of an organisation. The research found that ineffective communication was the contributing factor to the project failures. They suggested that organisations should invest more on communication planning and underscore the significance of establishing a communication plan to improve communication amongst managers and other stakeholders. These recent studies collectively emphasise that expertise and time constraints play a significant role in senior academics' reluctance to engage in routine maintenance work. Senior academics prioritise their core responsibilities, such as teaching, research, and administrative duties, which require considerable time and specialised knowledge. Engaging in maintenance tasks may be perceived as outside their area of expertise, potentially compromising their primary responsibilities. These findings highlight the need for institutions to consider the workload and expertise of senior academics when designing strategies to address routine maintenance in specialised facilities.

### **2.10.2 Research and Publication Pressures**

The emphasis on research productivity and publication output in academic careers can create significant pressure on senior academics. They may prioritise research activities over routine

maintenance work due to the need to secure funding, publish papers, and maintain a competitive edge in their respective fields (Liu et al, 2021). The pursuit of research excellence can overshadow the importance of routine maintenance tasks.

Recent studies have emphasised the impact of research and publication pressures on senior academics' reluctance to prioritise routine maintenance work. Research by Liu et al, (2021) examined the influence of academic factors on research productivity in Chinese higher education institutions. The findings revealed that senior academics face significant pressure to meet research targets and maintain a high level of publication output. As a result, they may prioritise research activities over routine maintenance work. The study highlighted that the pursuit of research excellence can overshadow the perceived importance of routine maintenance tasks, as research productivity is often a key factor in career advancement and securing research grants.

Furthermore, a recent study by Chen and Liu (2022) explored the challenges faced by senior academics in managing their research and teaching responsibilities in South African universities. The study found that senior academics experienced intense pressure to publish in high-impact journals and secure research funding. Consequently, routine maintenance tasks were often considered lower priority and received less attention. The study revealed that the pressure to excel in research led to a perceived trade-off between research productivity and engagement in maintenance work.

Additionally, a study by Adams and Peirce (2021) investigated the workload challenges of senior academics in Australian universities. The findings highlighted that the increasing pressure to publish and secure external research funding created a significant time demand for research-related activities. Consequently, senior academics may view routine maintenance work as a distraction from their research priorities, leading to their reluctance to engage in such tasks.

These recent studies collectively underscore the impact of research and publication pressures on senior academics' prioritisation of research activities over routine maintenance work. The pursuit of research excellence, securing funding, and maintaining publication productivity are

crucial for career advancement and institutional recognition. As a result, routine maintenance tasks may be perceived as lower priority and receive less attention.

### **2.10.3 Resource Allocation and Support**

Limited resources, including funding, staffing, and maintenance support, can impact senior academics' willingness to engage in routine maintenance work. Insufficient resources, such as inadequate training, lack of maintenance personnel, or out-dated equipment, may discourage their involvement (Villegas, 2021). When institutions fail to provide necessary support and resources, senior academics may be less inclined to take on maintenance responsibilities. Recent studies have highlighted the influence of resource allocation and support on senior academics' engagement in routine maintenance work. Limited resources, including funding, staffing, and maintenance support, can significantly impact their willingness to participate in maintenance activities.

Villegas (2021) examined maintenance management in higher education institutions and emphasised the role of resource allocation and support in facilitating or hindering senior academics' involvement in maintenance work. The study highlighted that inadequate resources, insufficient training, lack of maintenance personnel, or outdated equipment, can create barriers that discourage senior academics from taking on maintenance responsibilities. When institutions fail to provide the necessary support and resources, senior academics may perceive their involvement in routine maintenance as challenging or impractical.

A recent study by Almutairi, Adlan and Abdelsalam (2020) investigated the factors influencing academics' research productivity and maintenance in Saudi Arabian higher education institutions. The findings indicated that limited resources, such as a lack of maintenance staff and insufficient funding for maintenance activities, were significant barriers to senior academics' engagement in maintenance work. The study highlighted the importance of adequate resource allocation to support maintenance efforts and encourage senior academics' active participation.

Furthermore, a study conducted by Wang, Chen, Zuo, Zillante, and Cheung (2021) examined the performance of maintenance activities in Chinese higher education institutions. The study

revealed that inadequate resource allocation and support negatively impacted the engagement of senior academics in maintenance tasks. Insufficient training, limited availability of maintenance personnel, and budget constraints were identified as key factors that hindered their willingness to take on maintenance responsibilities.

#### **2.10.4 Time Management and Scheduling**

Routine maintenance requires careful planning, coordination, and scheduling to minimise disruption to teaching, research, and other activities within the facilities. Facilities managers often encounter challenges in effectively managing time and scheduling maintenance activities due to competing priorities, resource constraints, and the need to coordinate with various stakeholders (Winch, 2019). Balancing the requirements for routine maintenance with the operational needs of the facilities can be a complex task.

Effective time management and scheduling are crucial for facilities managers in performing routine maintenance work in highly specialised facilities. However, they often encounter challenges in managing time and coordinating maintenance activities due to various factors, including competing priorities, resource constraints, and stakeholder coordination.

A study by Winch (2019) emphasised the significance of time management and scheduling in the management of higher education facilities. Facilities managers face the challenge of balancing routine maintenance requirements with the operational needs of the facilities, such as teaching and research activities. The study highlighted that effective time management is essential to minimise disruptions and ensure that maintenance activities are carried out at the most appropriate times.

Furthermore, a study by Udejaja et al, (2019) investigated the challenges faced by facilities managers in time management and scheduling in the Nigerian construction industry. The findings revealed that facilities managers often struggle with conflicting priorities and limited resources, leading to difficulties in allocating time for routine maintenance. The study emphasised the need for effective scheduling strategies that consider the availability of resources, coordination with stakeholders, and the impact on facility operations.

Moreover, a study by Koskela and Howell (2020) focused on time management and scheduling challenges in construction projects. Although not specific to facilities maintenance, the findings are relevant as they highlight the complexities involved in managing time in dynamic project environments. The study identified factors such as unforeseen issues, changes in scope, and coordination with multiple parties as challenges that can affect time management and scheduling. These findings resonate with the challenges faced by facilities managers in balancing routine maintenance with other activities in highly specialised facilities. Additionally, a study by Olatunji et al, (2022) examined FM practices in higher education institutions in South Africa. The findings revealed that facilities managers encounter challenges in coordinating maintenance activities due to the need to align with academic schedules, research requirements, and other facility users' needs. Effective communication and stakeholder engagement were identified as key factors in overcoming time management challenges in scheduling maintenance activities.

#### **2.10.5 Equipment and Spare Parts Availability**

Access to appropriate equipment and spare parts is crucial for timely and effective routine maintenance. However, the availability of specialised equipment and spare parts for highly specialised facilities can be a challenge, particularly in South Africa where supply chain issues and limited local manufacturing capabilities may arise (Amaratunga et al, 2020; Babatunde, (2018). Facilities managers may face delays in obtaining necessary equipment and parts, which can hinder maintenance activities and increase equipment downtime.

Equipment and spare parts availability is a critical factor that can significantly impact the ability of facilities managers to perform routine maintenance work effectively in highly specialised facilities. Recent studies have highlighted the challenges arising from the availability of specialised equipment and spare parts, particularly in the context of South Africa's supply chain issues and limited local manufacturing capabilities. Amaratunga et al. (2020) investigated barriers to robust maintenance management in specialised buildings. The findings revealed that facilities managers often encountered difficulties in obtaining appropriate equipment and spare parts for routine maintenance. Supply chain issues and limited local manufacturing capabilities in South Africa posed challenges, leading to delays in acquiring necessary items. This hindered the facilities managers' ability to carry out

maintenance activities in a timely and effective manner, potentially resulting in increased equipment downtime.

Furthermore, Babatunde (2018) examined the challenges of facilities maintenance management in Nigeria. The study identified equipment and spare parts availability as a significant constraint faced by facilities managers. Limited access to specialised equipment and spare parts hampered their ability to perform routine maintenance work efficiently. The study emphasised the need for improved supply chain management strategies to ensure timely availability of necessary items and minimise equipment downtime.

Additionally, Cilliers et al, (2021) studied property maintenance management practices with particular focus on higher education institutions in South Africa. Their work highlighted the impact of equipment and spare parts availability on routine maintenance. The study revealed that the limited availability of specialised equipment and spare parts in South Africa's market posed challenges for facilities managers. This scarcity often led to delays in obtaining necessary items, which affected the maintenance activities and increased equipment downtime.

#### **2.10.6 Collaborative Decision-making**

Collaborative decision-making approaches, such as participatory workshops and focus groups, provide opportunities for stakeholders to contribute their expertise and insights in developing facility servicing solutions (Ibrahim et al, 2021; Oluwagbemi et al, 2019). These interactive sessions facilitate knowledge exchange, consensus building, and the co-creation of solutions. By involving stakeholders in decision-making processes, the resulting solutions are more likely to be practical, acceptable, and sustainable. This approach involves consultation and cooperation among various stakeholders, including facility managers, maintenance teams, and academic staff (Kalantari et al, 2017). This collaboration leads to improved planning and execution of maintenance activities. For instance, aligning maintenance schedules with academic calendars ensures minimal disruption to academic activities (Au-Yong et al, 2017). Effective collaboration also facilitates mutual assistance during emergencies, maintaining continuous oversight and problem-solving capabilities (Scott & Manning, 2024). Collaborative efforts in emergency scenarios help to ensure the

uninterrupted operation of essential facilities (Morakabati et al, 2017). This approach leverages the collective expertise of stakeholders to address maintenance challenges effectively. Moreover, according to Raj et al, (2022), engaging the procurement team in the decision-making method increases the flexibility and efficiency of purchasing necessary maintenance items.

Collaborative decision-making approaches play a vital role in developing facility servicing solutions by actively involving stakeholders in the decision-making process. Recent studies have highlighted the benefits of such approaches in gathering expertise and insights from stakeholders, promoting consensus building, and ensuring practical and sustainable solutions.

Ibrahim et al, (2021) conducted a study on sustainable FM in higher education institutions. The research emphasised the importance of collaborative decision-making in engaging stakeholders and developing effective FM solutions. Participatory workshops and focus groups were identified as valuable methods for involving stakeholders in the decision-making process. These interactive sessions provided a platform for stakeholders to share their expertise, exchange knowledge, and co-create solutions that address their specific needs and concerns.

Additionally, Oluwagbemi et al, (2019) focused on assessing stakeholder satisfaction in healthcare facilities. The study highlighted the significance of collaborative decision-making in developing solutions that meet the diverse requirements of stakeholders. Participatory workshops and focus groups were identified as effective methods for engaging stakeholders and obtaining their insights. These approaches facilitated knowledge sharing, built consensus among stakeholders, and enabled the co-creation of solutions that were acceptable and sustainable.

A study by Ruparathna et al, (2021) explored stakeholder engagement in sustainable building maintenance. The research emphasised the importance of collaborative decision-making approaches in involving stakeholders throughout the maintenance lifecycle. Participatory workshops and focus groups were recognised as effective methods for engaging

stakeholders, promoting knowledge exchange, and incorporating their perspectives into decision-making processes. The study highlighted that involving stakeholders in collaborative decision-making led to improved maintenance practices, increased stakeholder satisfaction, and enhanced sustainability outcomes.

In addition, Au-Yong et al, (2017) examined how to facilitate involvement of these key stakeholders in maintenance management to ensure continuous improvement. The effective management of maintenance of any infrastructure in an academic institution necessitates the engagement of all stakeholders. Collaborative decision-making driven by data and resource availability is essential to optimise maintenance practices and minimise costs and disruption.

Štok, Car-Puši'c, and Marenjak (2023) examined the views of different maintenance stakeholders on what they prioritise in Croatian school building maintenance. The findings from this study emphasised the need to identify key experts in the different aspects of building maintenance as well as the end user that interact daily with the facilities. This research outcome underscores the importance expertise involvement in building construction and most importantly, involving the end users in the maintenance processes.

A study by Gil et al, (2020) examined stakeholder involvement in the decision-making process of building energy renovation projects. The findings emphasised the benefits of collaborative decision-making methods, such as participatory workshops and focus groups, in ensuring the practicality and sustainability of energy renovation solutions. By involving stakeholders in the decision-making process, the resulting solutions were aligned with their needs, preferences, and expertise, leading to increased acceptance and successful implementation. However, Cherner and Fegely (2023) noted that engaging all stakeholders should come with the consideration that some relevant stakeholders do not have technical expertise. They suggested the use of detailed report with visual aids during presentations to aid the non-technical stakeholders' understanding.

Hauashdh et al, (2024) conducted research covering a wide range of factors leading to sustainable maintenance activities in connection to sustainability and technologies. The research highlighted and emphasised the importance of factors such as expert knowledge,

funding and budget allocation, contractors, facility user, communication, collaboration and data driven decision-making, et cetera, and they affect the outcome of maintenance project as well as how their shortfalls adversely affect the project. It further suggested adoption of an integrated framework that ensures all contributing factors are adequately taken care of during a maintenance project.

### **2.10.7 Continuous Monitoring and Feedback**

Engaging stakeholders and collecting data should be an iterative and ongoing process in facility servicing. Continuous monitoring and feedback mechanisms, such as regular surveys, user feedback platforms, and performance evaluations, enable the assessment of the implemented solutions and facilitate improvements based on stakeholder input (Ibrahim et al, 2021; Koh et al, 2018). These mechanisms foster transparency, accountability, and continuous improvement in facility servicing practices.

Continuous monitoring and feedback play a crucial role in facility servicing, ensuring that the implemented solutions remain effective and responsive to stakeholder needs. Recent studies have emphasised the importance of ongoing engagement with stakeholders and the implementation of monitoring and feedback mechanisms to foster transparency, accountability, and continuous improvement in facility servicing practices.

Ibrahim et al, (2021) conducted research on sustainable FM in higher education institutions and highlighted the significance of continuous monitoring and feedback. The study emphasised the importance of regular surveys, user feedback platforms, and performance evaluations to assess the effectiveness of implemented solutions. These mechanisms allowed stakeholders to provide feedback on the performance of the facility servicing initiatives, enabling improvements based on their input. By continuously monitoring and seeking feedback, facility managers can ensure that the solutions remain aligned with stakeholder expectations and address evolving needs.

Koh et al, (2018) focused on sustainable FM in public buildings and emphasised the role of continuous monitoring and feedback in driving improvements. The study highlighted that regular surveys and feedback mechanisms facilitated stakeholder engagement and provided

opportunities for stakeholders to express their concerns and suggestions. These mechanisms enabled facility managers to gather insights into the effectiveness of the implemented solutions and make necessary adjustments to enhance facility servicing practices.

Moreover, a study by Musco et al, (2021) investigated stakeholder engagement in the energy retrofitting of public buildings. The research underscored the importance of continuous monitoring and feedback as essential elements in the stakeholder engagement process. Through regular surveys and feedback mechanisms, stakeholders were able to provide input on the performance and effectiveness of the retrofitted buildings. This continuous feedback loop allowed facility managers to make data-driven decisions and implement improvements based on stakeholder input.

Additionally, a study by Dora et al, (2020) examined stakeholder engagement in the management of cultural heritage buildings. The findings highlighted the significance of continuous monitoring and feedback in maintaining stakeholder satisfaction. Regular surveys and feedback mechanisms were found to be effective tools for collecting stakeholder opinions and suggestions, which were used to identify areas for improvement and enhance the management of cultural heritage buildings.

#### **2.10.8 Stakeholder Mapping and Analysis**

Effective stakeholder engagement begins with stakeholder mapping and analysis. This process involves identifying and categorising stakeholders based on their interests, influence, and importance in facility servicing decisions (Koh et al, 2018; Nguyen et al, 2020). Mapping stakeholders helps prioritise engagement efforts and ensures representation of diverse perspectives. Through surveys, interviews, and workshops, stakeholders can be engaged to understand their needs, expectations, and concerns regarding facility servicing. Stakeholder mapping and analysis play a crucial role in effective stakeholder engagement for facility servicing. Recent studies have highlighted the significance of identifying and categorising stakeholders based on their interests, influence, and importance in decision-making processes, allowing for targeted engagement efforts and ensuring the inclusion of diverse perspectives.

Koh et al, (2018) conducted a study on sustainable FM in public buildings and emphasised the importance of stakeholder mapping and analysis. The study highlighted that stakeholder mapping helps identify key stakeholders who have a vested interest in facility servicing decisions. Categorising stakeholders based on their interests, influence, and importance enables facility managers to prioritise their engagement efforts and ensure that a broad range of perspectives is represented. This comprehensive understanding of stakeholders facilitates effective communication, collaboration, and decision-making throughout the facility servicing process.

Nguyen et al, (2020) focused on stakeholder engagement for sustainability in FM. The study emphasised the value of stakeholder mapping and analysis in understanding the needs, expectations, and concerns of stakeholders related to facility servicing. Through surveys, interviews, and workshops, stakeholders can be engaged to gather insights and feedback on their specific requirements. Stakeholder mapping ensures that a diverse range of stakeholders, including facility users, maintenance staff, administrators, and external partners, are considered in decision-making processes. This inclusive approach enhances the overall effectiveness and acceptance of facility servicing solutions.

Additionally, a study by Buurman et al, (2021) investigated stakeholder engagement in healthcare FM. The research highlighted the importance of stakeholder mapping and analysis in identifying stakeholders with varying degrees of influence and impact on facility servicing decisions. The study emphasised that stakeholder analysis helps facility managers understand the interests, concerns, and power dynamics among stakeholders, enabling effective engagement strategies to be developed. By recognising and addressing the specific needs and expectations of different stakeholder groups, facility managers can foster collaboration, build trust, and enhance the success of facility servicing initiatives.

The study by Alqaisi (2018) on the critical role of managing stakeholders' expectations and interests to ensure project's success emphasised the necessity of early identification, proactive planning, and effective communication with interested stakeholders. And most importantly training the project managers to effectively engage all relevant parties. This emphasis underscores the importance of equipping project managers with both human

management skills and technical knowledge to address stakeholder needs to ensure collaboration in the project. The study further points out the adverse effects of neglecting stakeholder management which includes wasted resources and potential project failure. It recommends continuous stakeholder engagement throughout the project lifecycle.

Furthermore, a study by Vrancken et al, (2021) examined stakeholder involvement in sustainable building projects. The research underscored the significance of stakeholder mapping and analysis in understanding the stakeholder landscape and dynamics. By identifying stakeholders and their respective interests, facility managers can tailor their engagement approaches to effectively address the concerns and expectations of each stakeholder group. This targeted engagement improves communication, enhances stakeholder satisfaction, and facilitates decision-making processes in facility servicing.

## **2.11 Theoretical and Conceptual Framework**

Maintenance encompasses all administrative activities that establish objectives, strategies, responsibilities and implementation (Gracia, Marquez & Papaalias, 2020). The maintenance function is done throughout the building life cycle (Farloca, 2021). FM can take a strategic perspective (National Academies of Science, Engineering & Medicine, 2019; Lok et al, 2023). FM should be proactive rather than reactive (Olugbade, 2023; Ndlovu, 2021; Lok et al, 2023). Non-core services that support the organisation's core objectives must be integrated in the FM process (Yahya Ts Wan, 2022; Tucker and Pitt, 2019). FM requires regular planned service evaluation and initiating service collaboration (Gutterman, 2023); flexibility (Hamasha et al, 2023; Lok et al, 2023); identifying and minimising risk (Benson, Obasi, Akinwande, Ile, 2004; Vicente, 2024); stakeholder engagement, costs and sustainability evaluation (Hauashdh et al, 2024; Owusu-Agyeman & Moroeroe, 2022; Taimu et al, 2020) and consideration of future growth, goals and objectives (Brown, 2018). Proactive maintenance activities enhance openness, efficiency and reliability (Hoang, Vu, Le, Nguyen, 2020). Effective maintenance ensures functionality, longevity, safety, avoidance of expensive repairs and hastened facilities deterioration (Masengesho et al, 2020). Poor maintenance culture leads to loss of structural integrity, expensive repairs, loss of work time, and reputational damage (Masengesho et al, 2020; Farloca, 2021; Au-Yong and Chua, 2018; Mattern, 2018).

In HEI's FM should support teaching, learning and research (Ndlovu, 2021; Ahmad et al, 2020); student engagement and knowledge acquisition (Kristin, 2023); research and community engagement (Mafugu & Abel, 2022); influences quality and quantity of educational outcomes including research outcomes (Abdullahi et al, 2019; Rusticus et al, 2023); facilitates critical thinking (Abdullahi, 2023), facilitates innovation (Rusticus, 2023) and retention of top talent (Rusticus et al, 2023). Rugarathna et al (2021) emphasised the importance of collaborative decision-making approaches in stakeholder engagement throughout the maintenance lifecycle for increased maintenance practices, stakeholder satisfaction and sustainability outcomes.

Poor FM in HEI's impedes effectiveness of teaching and learning (Cali et al, 2023), curtails ability to attract and retain top talent undermining reputation (Abdullahi et al, 2019); poses risk to students safety and disrupts smooth operation of programs (Zurainan et al, 2021). Disruption of research work can cause loss of data, restarting experiments, lost time, and more costs (Wu, 2019); postponement of drugs, technologies or interventions that could cause financial, social and health consequences (Mamood et al, 2018). Uninterrupted research work minimises hazard to researchers, contractors and other users (Krishnaratne et al, 2021).

In relation to challenges faced by facilities managers Mewomo et al (2022) found lack of policy guidance, occupants' lack of understanding of FM, and deteriorating facilities conditions as some of the major challenges. Lack of access to appropriate equipment and spare parts in South Africa is the other significant FM challenge faced by facilities managers in South Africa (Amaratunga et al, 2020; Babatunde et al, 2018; Cilliers et al, 2021). Simpeh, Mavangwa & Wentzel (2022) proposed 6 strategies to address FM challenges, that are enhancing human resource capabilities, providing maintenance equipment, ensuring adequate budget allocation, reforming procurement systems, combating corruption and establishing effective organisational structures.

This study investigates challenges faced by facilities managers when trying to perform routine facilities maintenance work in highly specialized facilities at a HEI in South Africa and to identify strategies that can be used to mitigate these challenges. The objectives of the study

are to explore the receptiveness of senior academics to routine maintenance work in highly specialised facilities and propose a solution through engagement with all stakeholders and data collection on how these specialised facilities could be serviced.

## **2.12 Chapter Summary**

In conclusion, this chapter examined the role of FM in higher education institutions, the importance of adequate infrastructure for learning and research at universities, and the significance of research work in specialised facilities. The chapter has also explored the importance of building maintenance for functionality, appearance, and durability of infrastructure, and the challenges and impacts of inadequate maintenance.

Based on the review of existing literature, it is clear that FM plays a critical role in contributing to the core business of higher education institution of teaching, learning and research. More so, it emphasised that uninterrupted research work in specialised facilities is important given the rise in zoonotic, communicable, and non-communicable diseases. Additionally, building maintenance is crucial for ensuring that infrastructure remains functional, attractive, and durability of facilities. Moreover, this literature review highlighted significant gaps on the need for further research in FM in South Africa, particularly in the context of challenges faced by facility managers trying to do maintenance work in highly specialised facilities.

Following the understanding and knowledge gained from this literature review chapter, the methodology employed for this research is presented in Chapter 3.

## **Chapter III – Research Methodology**

### **3.1 Introduction**

This chapter presents a systematic method, and procedures employed to investigate the study. The chapter presents the research philosophy and methodology employed, explaining how it aligns with the study objectives and facilitate the exploration of the identified questions for inquiry. The chapter further provides a comprehensive overview on how data was collected, analysed, and presented. In this study, which focuses on the challenges of maintaining highly specialised infrastructure facilities at an institution of higher learning in South Africa, selecting an appropriate research methodology is vital to obtain reliable and insightful findings.

### **3.2 Research Paradigm**

A research paradigm is a philosophical, theoretical framework of conceptualisation that give guidance on how to conduct research on the basis of existentialism, knowledge, methods and application of methods (Alhoussawi, 2023; Rehman & Alharthi, 2016). According to Creswell (2018), a research paradigm serves as a “worldview” or a “way by which researchers see the world” and shape how they design and conduct their research and interpret research outcomes. Furthermore, it encompasses the process of choosing a research philosophy based on research inquiries, objectives, and beliefs about competences and feasibility. This section outlines the philosophical underpinning of the study, discussing various research paradigms and justifying the selection of the most appropriate approach for the current study. There are three main research paradigms considered, and these are: positivism, constructivism and interpretivism.

#### **3.2.1 Positivism**

Positivism is a pattern that assumes that social realities are objective and can be measured (Babbie, 2016: 27). Positivists argues that scientific methods, including experimentation, observation, and statistical analysis, are comprehensive enough to understudy social phenomena, understand the phenomenon, and identify causal connections between variables (Park, Konge, Artino, 2020; Cheng et al, 2016). Positivism suggests that human behaviour

and phenomenon can be understood without input or involvement of research subjects; hence the researcher is armed with some philosophical ideas going the study (Cooksey & McDonald 2011: 30). Asghar (2013) argued that positivism is comprised of different belief systems that approach real life situations from a predetermined position using measurable instruments such as survey, questionnaire, and other experimental measuring instruments to gather data and to make an informed decision whether to accept or reject a set hypothesis. In this approach, both the researcher and the study are independent entities, with the researcher having no influence on the research process (Mack, Woodsong, Macqueen, Guest, Namey, 2005). The goal is to observe, measure, and describe phenomena objectively by dissociating itself from the phenomenon being studied. Positivist research relies on empirical evidence obtained through systematic and structured methods, often involving quantitative data and statistical analysis (Corry & McKenna, 2019).

The emphasis is on uncovering universal laws or patterns governing natural or social phenomena. The research under investigation deals with gathering real life data on how the maintenance personnel carryout their maintenance duty, their daily experiences as they navigate the institutional environment. Based on the posit of positivism, it was considered not suitable as an instrument to elicit the required research data to respond to the research question posed in this study.

### **3.2.2 Constructivism**

Constructivism is 'an approach to learning that holds that people actively construct or make their own knowledge and that reality is determined by the experiences of the learner (Tomaszewski et al, 2020:1). It places a stronger emphasis on the collaborative nature of the research process. Furthermore, constructivism emphasises the role of personal experiences, interactions, and cognitive processes in shaping an individual's understanding of the world. It seeks to understand in detail the research subject rather than predicting the outcome (Asghar, 2013; Park et al, 2020). This study seeks to understand participants' perspectives with minimal researcher interference thereby making constructivism not appropriate for this study.

### **3.2.3 Interpretivism**

According to Denzin and Lincoln (2011), interpretivism as a philosophical approach highlights the importance of understanding human experiences, behaviours, and social experience within specific social and cultural contexts. By adopting an interpretivist stance, the researcher aims to explore the subjective interpretations and meanings attributed to the challenges of maintaining highly specialised infrastructure facilities at an institution of higher learning in South Africa. Interpretivism is a philosophical perspective that emphasises the importance of understanding human behaviour and social phenomena within their specific social and cultural contexts (Kumar, 2019). It recognises that individuals' actions and experiences are shaped by their subjective interpretations and meanings.

### **3.2.4 Researcher Stance**

In this study on the challenges of maintaining highly specialised infrastructure facilities at an institution of higher learning in South Africa, the interpretivist perspective provides an environment for understanding the participants' subjective experiences and the social and cultural factors influencing those experiences (Kumar, 2019).

As an interpretivist, the study acknowledges that the challenges faced in maintaining specialised infrastructure facilities are not solely determined by objective factors but are also influenced by the interpretations and meanings attributed to those challenges by the individuals involved (Kumar, 2019). By adopting an interpretivist stance, the study aims to delve into the participants' perspectives, beliefs, and experiences related to the challenges, seeking to uncover the underlying reasons, motivations, and implications (Saunders et al, 2019). Furthermore, the interpretivist perspective recognises the role of language and communication in constructing and conveying meanings (Creswell, 2018).

The interpretivist perspective allows a deeper exploration of the subjective aspects of the challenges faced in maintaining specialised infrastructure facilities and provides insights into the participants' unique perspectives and contexts (Saunders et al, 2019). By adopting an interpretivist perspective, the study seeks to generate rich and contextualised findings that help in gaining a detailed understanding of the challenges of maintaining highly specialised

infrastructure facilities within the specific social and cultural context of an institution of higher learning in the Republic of South Africa.

### **3.3 Research Methodology**

Research design outlines the plans and the procedures that guide the research through the complex process of collecting, analysing, and interpreting data (Creswell, 2018). It focuses on the product and the plan for connecting the conceptual research problems to all the research variables (Mouton, 2001:55). Furthermore, Creswell (2014:18) defines a research approach as “the overall plan for addressing the research question or hypothesis”. The choice of research methodology is influenced by the researcher’s philosophy and the research question to be answered.

#### **3.3.1 Case Study**

A case study is a type of qualitative research study that focuses on specific subject, such as a person, group, place, event, organisation, or phenomenon (McCombes, 2022). According to Priya (2021), it is a method commonly employed by researchers in humanities and educational field and it is timely bound. The case approach has proven to be beneficial in practice-oriented disciplines including management and depending on the research objectives, research can either use single or multiple case approach (Mohajan, 2018).

A single-case study is a research method that examines a singular instance inside a defined setting that enables a researcher to thoroughly and exhaustively examine the chosen case to offer an intricate observations into the distinctive characteristics of the phenomenon under investigation (Lucas et al, 2018; Mohajan, 2018; Starman, 2013). According to Gustafsson (2017) and Priya (2021), engaging in a single case study, the research can have an in-depth understanding of the phenomenon being studied. Single case study has been criticised for difficulties pertaining to the interconnection between rigorous methodology, subjective bias of researchers, and external validity (Lobo et al, 2017; Willis, 2014). Hence it is less considered reliable when compared to multiple case study.

A multiple case study approach entails studying several phenomena at the same time. It is generally accepted to be more robust due to its consideration of different cases from which it generates its result (Priya, 2021). The multiple case consideration makes this more reliable

(Brink, 2018). However, multiple case study can be expensive, hence it is not easy to be undertaken (Brink, 2018; Priya, 2021).

### **3.3.2 Grounded Theory**

Grounded theory is an inductive research approach used to develop theories or explanations based on the data collected from the research participants. Researchers gather data without preconceived theories or hypotheses and systematically analyses the data to generate new theoretical insights. Grounded theory aims to build theories grounded in the data and participants' experiences, allowing for the emergence of novel concepts and relationships. Charmaz (2006) posited that this theory analysis refers to a systematic inductive analysis of data that is made from the bottom.

### **3.3.3 Phenomenological Approach**

The study adopted the phenomenological approach; phenomenology aims to investigate and understand the participants experience from their perspectives within a given context (Kumar, 2019). It seeks to uncover the real meaning based on participants' experience. Moustakas (2019) argues that the phenomenological research design is particularly suitable for exploring the essence and meaning of lived experiences within a specific phenomenon. By adopting a phenomenological approach, the study will gain insights from the subjective experiences of the participants' and gain a deeper understanding of the challenges of maintaining highly specialised infrastructure facilities at an institution of higher learning (Saunders et al, 2019). By adopting a phenomenological research design, the study will focus on capturing the first-hand accounts and subjective perspectives of individuals involved in maintaining highly specialised infrastructure facilities (Creswell, 2018). The design ensures the participants provide their perceptions, experiences, and interpretations. Through this approach, the study aims to gain a detailed understanding of the challenges from the partakers' lived experiences and views.

Furthermore, the research design will emphasise the function of active listening and interpreting of the participants' experiences conducted by the researcher (Creswell, 2018). The study will engage in reflective analysis, suspending preconceived notions and biases to allow the participants' voices and meanings to emerge (Trochim & Donnelly, 2018).

### **3.3.4 Researcher Stance**

This research seeks to establish the challenges encountered in maintaining highly specialised facilities within an institution of higher learning in South Africa. This objective can be effectively achieved through the case study approach since it is context specific. In particular, a single case study approach was adopted as it allows for an in-depth exploration of these specific but complex situations around the routine maintenance of the facilities. This method provides the flexibility to adapt to emerging insights from the study and ensures that the findings are both practically relevant and theoretically sound (Lobo et al, 2017; Priya, 2021; Willis, 2014).

University of Cape Town owns and operates highly specialised facilities spanning mortuary, science laboratories (prince lab, histology and skeleton lab & biosafety lab), tissue culture wash up area, tridium equipment, cold room refrigerator, confocal microscope rooms, wet specimen store for teaching, cardiovascular operating theatre, clean room to institutional data centre. The study seeks to establish challenges faced by facilities managers when trying to carryout routine maintenance work in these specialised facilities at the UCT in South Africa.

### **3.3.5 Research Design**

Research design is plans on how to collect, study, evaluate and interpret data (Creswell, 2018). Research design requires researchers to decide on the suitable methods of research for the research problem and research objectives thereby enhancing the chances of success of their studies. Research design is predominantly pre-occupied with the outcome and the means for linking the conceived research problems to all research variables (Mouton, 2001:55). Research design is the fountainhead of study validity, reliability, productivity of meaningful results and applicability of outcomes. Research design has two generic classes namely quantitative and qualitative research.

#### **3.3.5.1 Quantitative Approach**

Quantitative approach refers to the use of empirical assessment that is rooted on numerical measurements and aims to determine how phenomenon are interconnected and affects one another in a population (Olanrewaju et al, 2020). This method relies heavily on numerical data

to represent different opinions or concepts that are grounded in a strong academic (Borgstede & Scholz, 2021). In addition, Barroga and Matanguihan (2022) opined that quantitative approach relies on hypothesis derived independently from theory. Furthermore, quantitative approach focuses on testing the theory by observing a phenomenon at the same time collecting data which the findings will inform the decision of either to confirm or reject the theory (Casula et al, 2021). The data collection instrument is usually questionnaire, survey, observation, et cetera.

### **3.3.5.2 Qualitative Approach**

Qualitative research methods offer a diverse tool for delving into non-numerical data and understanding phenomena through the lens of participants. Creswell (2018) argues that the qualitative research approach is appropriate for exploring complex social experiences and gaining an in-depth understanding of participants' experiences and interpretations. By employing qualitative methods and collecting data through interview, the study can capture the richness and complexity of the challenges of maintaining highly specialised infrastructure facilities at an institution of higher learning (Kumar, 2019). While quantitative approach collects numerical data, qualitative approach collect text based data through interview (Casula et al, 2021).

### **3.3.5.3 Mixed Methods**

Mixed methods research combines the attributes of qualitative and quantitative approaches and are normally employed to study a complex research question that requires a more inclusive tactic to understanding the phenomenon being studied (Creswell 2014:214). This method came drawing from the point that understanding phenomenon cannot be well understood from one direction, say, qualitative or quantitative outlooks (Tegan George, 2023). That is, it helps a researcher gain complete picture and balanced perspective when compared to individual approach.

### **3.3.6 Researcher Stance**

By adopting a qualitative approach, the study aims to gather detailed and nuanced data about the challenges faced in maintaining highly specialised infrastructure facilities (Trochim & Donnelly, 2018). This approach will enable the search of the contributors' subjective

perceptions, and meanings attributed to the challenges (Bryman, 2019). It provides a platform to understand the context-specific factors that influence these challenges and allows for an in-depth examination of the social and cultural dynamics within the Key stakeholders which will be Properties & Services and Academics at the University of Cape Town (UCT) (Saunders et al, 2019).

The use of a qualitative research approach is justified for several reasons. First, the study aims to explore and understand the challenges of maintaining highly specialised infrastructure facilities, which are complex phenomena influenced by a range of factors (Trochim & Donnelly, 2018). The qualitative approach allows for an in-depth examination of these challenges, capturing the multiple dimensions and nuances associated with them. The study seeks to gain insights from the participants' subjective experiences and interpretations. By utilising qualitative methods, the study will delve into the participants' perspectives, beliefs, and emotions, providing a deeper understanding of their lived experiences related to the challenges (Saunders et al, 2019). The research was conducted within the natural setting of the key stakeholders which is Properties & Services and Academics/Scholars at UCT, allowing for an examination of the challenges in their real-world context. Qualitative design in this study promotes exploration of the social and cultural dynamics within the department, shedding light on the contextual factors that influence the challenges faced in maintaining specialised infrastructure facilities (Neuman, 2014).

### **3.3.7 Data Collection**

Data collection is the process of extracting information from various sources as defined by research design (Sekaran & Bougie, 2013:113).The information forms the basis for hypothesis testing or responding to research questions. In the history of research, document analysis, interviews, observation and surveys are the known useful data collection techniques (Creswell, 2014: 204). Surveys are a popular data collection tool where the researcher makes use of a questionnaire or a set of them depending on participants' characteristics and research objectives (Creswell, 2014:204). Interviews are multi-faceted. Researchers can use planned interviews, semi-structured interviews or unstructured interviews depending on a number of factors including but not limited to the study questions, challenges encountered, research approach and the information the researcher wants to gather (Ruslin et al, 2022).

This approach promotes originality in research as the researcher does not import pre-conceived conditions into the study but studies behaviour in its raw setting (Creswell, 2014:229). In this way the researcher does not influence the data sourced. According to Bryman (2016:98) observation is particularly useful and frequently used to gather facts on social relations and behaviour. Document analysis follows a sequential examination of written or recorded audio-visual resources including newsletters, directors' reports, podcasts, photographs and so forth. The extent of document analysis is governed by the research context. The purpose of document analysis is to identify study related themes and scrutinise their development (Bowen 2009:123).

This study used interviews for data collection.

### **3.3.7.1 Interview**

In undertaking interviews, there are three different types, namely: (1) unstructured interviews; (2) structured interviews; and (3) semi-structured interviews. Each of these are briefly discussed below.

#### **3.3.7.1.1 Structured Interviews**

Structured interviews are known for its strict and pre-determined set of inquiries (Ruslin, Mashuri, Abdul, Alhabsyi, Syam, 2022). The set of inquiries are developed in advance based on the research question. The interviewer adopts and follows a series of set questions throughout the interview, ensuring that all interviewees are posed with the same questions and in the same order they were prepared. According to Pollock (2019), structured interviews are more difficult to develop and manage due to the possibility of the question(s) leaking out to other interviewees. However, the systematic approach is designed to eliminate or minimise interviewer bias and ensure comparability across different interviewees. Based on the rigidity, structured interviews are more suitable for quantitative research to gather data that are easily analysed and compared.

#### **3.3.7.1.2 Unstructured Interviews**

In comparison to structured interview question, unstructured interview is more flexible and it gives room for conversational process (Pollock, 2019; Ruslin et al, 2022). This interview is

conducted using spontaneous questions developed by the interviewer based on the response of the interviewee. Conducting an unstructured interview, the conversation is centred on the general research problem. Then the interview is guided with the goal of exploring in-depth insights and understandings from the interviewees, capturing their perspectives in their own words (Ruslin et al, 2022). This method is useful when conducting qualitative research where the experience of the participant is sought.

#### **3.3.7.1.3 Semi-Structured Interviews**

According to Ruslin et al, (2022) semi-structured interviews combine elements of both structured and unstructured interviews. The interviewer asks a few leading questions to direct the conversation and then asks follow-up questions (probing questions) based on the response of the interviewee (Jamshed, 2014). They allow for flexibility in how and when these questions are asked. Interviewers can probe for more details and ask follow-up questions based on the interviewee's responses. Semi-structured interviews are commonly used in qualitative research as it flexibly captures rich and detailed data about the subject under investigation.

#### **3.3.7.2 Documentary Evidence**

Documentary evidence, also known as document analysis, is a data collection approach used to collect data through existing documents and records relevant to the research under investigation (Lune & Berg, 2017). This method is used when conducting a research based on secondary data where existing documents need to be examined to establish a historical perspective and context that might not be available through other data collection methods (Dalglish et al, 2020). In this case, the documents can range from official reports, articles, books, and archives to more informal sources such as letters, emails, and memos (Emerald Publishing, 2023). This method allows researchers to examine and track the trend in evolution of certain issues over time and understand the rationale behind decisions made in the past (McCulloch, 2004:19).

However, despite the importance of documentary evidence use in secondary data research, it has been criticised on the basis that accuracy and completeness of the documents used can be questionable, as they may have been produced with specific biases or omissions

(McCulloch, 2004:36). Additionally, interpretation of data collected through this method requires a careful and critical analysis from the researcher. This is particularly essential as the researcher must be aware of the context in which the documents were created and consider the potential for misrepresentation or selective reporting.

### **3.3.7.3 Photographic Materials**

Photographic materials are considered by researchers to be a unique and powerful method of qualitative research data collection (Cleland & MacLeod, 2021; Glaw et al, 2017). It entails the use of photographs, videos, and other visual media to capture and document some vital parts of the research or phenomenon under investigation (Cleland & MacLeod, 2021). This is a useful method that allows for the preservation of visual details that might be overlooked or difficult to describe through words alone. Photographs can capture the physical environment, behaviours, and expressions of individuals, providing a rich source of data that complements other forms of evidence (Turner et al, 2023). It also enables researchers to engage with participants in a more interactive way, as it involves engaging with participants to discuss the visual materials during interviews. It has received praise for its ability to elicit deeper insights and interpretations (Turner et al, 2023).

### **3.3.7.4 Researcher Stance**

Semi-structured interviews as a data collection method provide an opportunity to gather rich and detailed insights from the participants regarding their experiences and perspectives on the challenges of maintaining highly specialised infrastructure facilities. The interviews allow for flexibility, enabling participants to elaborate on their responses and share additional information based on their unique perspectives (Willig, 2013). This methodological approach aligns with the research aim of exploring the challenges in-depth and capturing the participants' lived experiences. Semi-structured interviews have been widely recognised as a valuable data collection method in qualitative research. This method provides an opportunity to gather rich and detailed insights from the participants regarding their experiences and perspectives on the challenges of maintaining highly specialised infrastructure facilities (Rubin & Rubin, 2019; Smith et al, 2019). The open-ended nature of semi-structured interviews allows participants to express themselves freely and provides the flexibility to explore their responses in more depth. This flexibility enables participants to elaborate on their answers,

share additional information, and provide nuanced insights based on their unique perspectives.

By utilising semi-structured interviews, the researcher can delve into the complex and multifaceted nature of the challenges faced in maintaining highly specialised infrastructure facilities at an institution of higher learning. The interviews allow for a deeper understanding of the participants' experiences, perceptions, and the contextual factors influencing their work (Braun & Clarke, 2019). The interactive nature of the interviews facilitates a dynamic and responsive exchange between the researcher and the participants, enabling a more comprehensive exploration of the research topic.

Moreover, semi-structured interviews align with the research aim of capturing the participants' lived experiences. This methodological approach acknowledges the importance of understanding the subjective realities and interpretations of the participants in relation to the challenges they encounter in maintaining highly specialised infrastructure facilities (Creswell, 2018). The open-ended nature of the interviews allows participants to reflect on their experiences, share personal anecdotes, and provide context-specific information that may not be captured through other data collection methods (Willig, 2019). In this study, the use of semi-structured interviews provided a robust and comprehensive data set that offers rich insights into the challenges faced by professionals involved in FM at an institution of higher learning (Willig, 2019). These insights can inform decision-making, policy development, and the implementation of effective strategies to address the identified challenges and improve the maintenance of highly specialised infrastructure facilities. The interview schedule was developed from the objectives with each objective having three sub-questions. The first part is entailed to capture personal detail of the participant such as their age, gender, education, and experience within the organisation.

Semi-structured interviews were the primary method to collect data from the participants. The interviews allowed participants to express their views, feelings and perceptions, share their experiences and challenges related to maintaining highly specialised infrastructure facilities (Trochim & Donnelly, 2018). The interviews were guided by a flexible interview guide (See Appendix C) that allows for probing deeper into specific areas of interest while also giving

participants the freedom to express their experiences in their own words. The developed interview guide consisted of 10 open-ended questions probing participants on their part in facilities management and maintenance, coordination of facilities maintenance, gaps in maintenance, challenges encountered in maintenance, changes they would want to see, effect of maintenance work on their operations, maintenance culture and priorities on maintenance tasks, among others. The guide allowed flexibility to probe deeper into specific areas of interest while also providing a consistent framework for data collection (Saunders et al, 2019).

Interviews were conducted at various times as per participant availability and preference. All interviews were conducted through Microsoft Teams video conferencing application that provided great convenience to the participants and the researcher. Before commencing the interview, the researcher gave an overview of what the research entails to remind the interviewee and obtain consent to ensure their continued willingness to participate in the study. The interviews were audio-recorded with the participants' consent to ensure accurate data capture (See Appendix E). During the interview, the researcher took notes to capture the non-verbal cues and contextual information (Saunders et al, 2019).

### **3.4 Population and Sampling**

#### **3.4.1 Population**

According to Neuman (2014) population refers to the entire group or set of individuals, objects, or events that possess the characteristics of interest and are the focus of a research study. It represents the larger target group to which the study's findings are intended to be generalised. The population can be finite, consisting of a specific and countable number, or infinite, with an unlimited or unknown number of elements (Neuman, 2014). The target population for this qualitative study was the key stakeholders which is Properties & Services (P&S) and Academics/Scholars at UCT. This department consists of individuals who are directly involved in the maintenance and management of highly specialised infrastructure facilities within the university. By focusing on this specific population, the study aims to gather insights and experiences directly related to the challenges faced in maintaining such facilities (Creswell, 2018).

### **3.4.1.1 Sampling Methods**

According to Etikan (2017) and Golzar et al, (2022) sampling is choosing partakers from the bigger pool of targeted population. In other terms it is defining research parameters in terms of characters, behaviour, activities, environment and procedures. There exists various sampling methods that can be applied in studies but for the sake of this research, the following commonly used sampling methods are presented and explained:

### **3.4.1.2 Simple Random Sampling**

Simple random sampling is a form of probability sampling where every member of a population has equal chance of being selected to participate in a study (Miles, 2022). This sampling method selects the participants at random from the population ensuring equal selection probability for every potential participant (Blanksby, 2018). Trochim and Donnelly (2008:197) suggest that simple random sampling technique can be quite useful when all potential participants have similar characteristics and when the selection criterion is applied consistently. This method is employed when every one of the populations is relatively knowledgeable about the subject under investigation.

### **3.4.1.3 Snowballing Sampling**

Known as chain referral sampling method employed when the member of the society that possess the knowledge of the subject under investigation is scarce and difficult to find (Miles, 2022). In this case, a member of the society with the knowledge is selected and tasked to identify other knowledgeable people who become participants in the study. This method however become difficult when the population is large or dispersed across different geographical area (Etikan, 2017). It is not useful when the participants for a study can easily be identified. Hence, it is not useful for this study.

### **3.4.1.4 Purposive Sampling**

In general, purposive sampling is employed to select participants from the population based on the set criteria depending on the nature of the study. The goal is to assemble a group of participants representing the whole or that makes the whole where feasible, and ensuring that the chosen partakers are best placed sources to extract data that answers the research question, (Etikan, 2017). According to Creswell (2014:157), goal-directed sampling is handy

when the study is focused on investigating and understanding a particular phenomenon, and where study results are not regarded as umbrella. Potential value from this technique is that researchers are able to choose participants with a wealth of data based on a strong background of experience and knowledge. This forms a solid foundation for effectively answering the research question at the end of the study.

This study employed purposive sampling in selecting participants from the key stakeholders which are Properties and Services and Academics/Scholars at UCT. Purposive sampling, also known as judgmental or selective sampling, is commonly used in qualitative research to select participants who possess specific knowledge, experiences, or characteristics relevant to the research topic (Saunders et al, 2018). In this case, the participants were selected based on their expertise and experience in maintaining highly specialised infrastructure facilities (Bryman, 2019).

The participants included a range of individuals from different roles within key stakeholders – Properties and Services and Academics/Scholars at UCT. These include facilities managers, maintenance staff, project managers, academics, researchers, and other relevant personnel who are actively involved in the day-to-day operations and management of the specialised infrastructure facilities (Saunders et al, 2019). By including participants with diverse roles and responsibilities, the study aims to capture a comprehensive understanding of the challenges faced from different perspectives within the department (Saunders et al, 2019).

#### **3.4.1.4.1 Rationale for Purposive Sampling**

In the current study on the challenges of maintaining highly specialised infrastructure facilities at an institution of higher learning in South Africa, purposive sampling is deemed appropriate for several reasons. The selection of participants with expertise and first-hand experience in managing and maintaining highly specialised facilities allows for a deeper understanding of the challenges encountered in such contexts. These individuals, including senior academics and facilities managers, possess valuable insights into the intricacies, complexities, and unique aspects of maintaining specialised infrastructure facilities within an academic setting.

Purposive sampling enables the identification of participants who can provide diverse perspectives and rich information that aligns with the research objectives. By purposefully selecting participants with varying roles, responsibilities, and experiences, the study can capture a broad range of viewpoints and experiences related to the challenges of maintaining specialised facilities. Furthermore, purposive sampling facilitates the selection of participants who are most likely to have encountered the specific challenges being investigated. The targeted approach increased the study findings relevance to the context of maintaining highly specialised infrastructure facilities in South African higher education institutions.

#### **3.4.1.5 Participants Recruitment Procedure**

The research study was conducted in a University in South Africa. Prior to participants' recruitment, ethical approval was obtained (See Appendix D) from the institution's ethical committee to conduct the study in the institution. The research participants were identified and recruited from among the institution's facility maintenance team, facility managers, procurement department, and external contractors.

After obtaining ethics approval, the letter of consent was distributed to prospective participants informing them about the research intention and the conditions for their participation on a voluntary basis (See Appendix A). The information brief also informed them of their freedom to withdraw their participation at any time without any prejudice. And that in the event of such withdrawal, all their personal information provided will be destroyed. All selected participants signed the consent form and returned it to the researcher. Interviews were then scheduled with each participant.

### **3.5 Data analysis**

Data analysis is a process of turning the raw qualitative or quantitative data collected during a research process into meaningful facts and ideas used to explain or understand the research problem (Alem, 2020). Additionally, it is studying data in its raw state to determine inherent facts or meanings. Medelyan (2021) posited that qualitative data analysis studies and interprets text data to determine the inherent meaning. It involves steps continuous, evolving, iterative, or non-linear process (Smit, 2002). To analyse qualitative data, thematic analysis is commonly utilised in identifying patterns, themes emerging from the data (Braun & Clarke,

2016). According to Dawadi (2020) thematic analysis help a researcher in exploring the collected data, to discover new perspectives, similarities, and differences in the collected data. Once the interviews were transcribed, and verified and validated for accuracy, these transcripts were imported into NVivo 14 qualitative data analysis software and were analysed.

The analysis follows a six-step approach as illustrated below:

- i. Data Familiarisation: The researcher read and re-read the interview transcripts to gain a deep knowledge with the subject. They read and re-read the transcripts, taking notes, and highlighting key ideas, experiences, and challenges related to the maintenance of highly specialised infrastructure facilities (Braun & Clarke, 2016).
- ii. Generating initial codes: codes were identified and labelling meaningful units of information. These codes captured the main ideas and concepts present in the data (Braun & Clarke, 2016). The coding process was logical, built on pre-defined themes from the research questions, and inductive, permitting for new themes to appear from the information itself.
- iii. Searching for themes: The coded data was organised into potential themes, grouping similar codes together. The studies examined the relationships between codes and identified overarching patterns and themes that represent the challenges of maintaining highly specialised infrastructure facilities. These themes were derived from the information and display the partakers' encounters and views (Braun & Clarke, 2016).
- iv. Reviewing and refining themes: The study reviewed the recognized themes, making sure it perfectly capture the substance of the information. Themes may be amended, merged, or split as necessary to build a rational and significant submission of the challenges. The researcher will also consider the relevance and importance of each theme in relation to the research aim and objectives (Braun & Clarke, 2016).
- v. Defining and naming themes: The study defined and described each theme, delivering clear justifications and instances to demonstrate their meaning. The themes were given descriptive names that encapsulate their content and convey their significance in relation to the challenges of maintaining highly specialised infrastructure facilities (Braun & Clarke, 2016).
- vi. Writing the analysis: The findings of the thematic analysis were presented in a clear and coherent manner. The study wrote a detailed narrative, incorporating quotations and excerpts from the interview records to support the identified themes. The analysis provided a

rich and nuanced understanding of the challenges faced by professionals in the FM department at the institution of higher learning (Braun & Clarke, 2016).

### **3.6 Pilot Study**

To ensure the effectiveness and feasibility of the research design and procedures, a pilot study was done before the main information gathering phase. The pilot study involved a small-scale version of the research, allowing for the identification and resolution of any issues or challenges that may arise.

The following steps were undertaken during the pilot study:

- i. **Sample Selection:** A small sample of participants was chosen based on similar characteristics to the intended participants of the main study. This sample was representative of the target population in terms of experience and expertise in managing specialised infrastructure facilities at higher education institutions in South Africa.
- ii. **Data Collection:** Semi-structured interviews were conducted with the pilot study participants, following the same interview guide and procedures that was used in the main study. The interviews were audio-recorded with participants' consent, transcribed, and analysed during the pilot study.
- iii. **Data Analysis:** Thematic analysis was conducted on the pilot study data using the same coding and analysis procedures that were employed in the main study. This analysis assisted with the identification of emerging themes and assessed the applicability of the research questions and coding framework.
- iv. **Evaluation:** The research team evaluated the pilot study process, including the data collection, analysis, and interpretation procedures. They assessed the clarity and comprehensiveness of the interview guide, the adequacy of the coding framework, and the overall effectiveness of the research design.
- v. **Refinements and Adjustments:** Based on the findings of the pilot study, necessary refinements and adjustments were made to the research design, interview guide, and data analysis procedures. This included modifying or adding questions, clarifying instructions, and refining coding categories or themes. Pilot study participants were not included in the main participants' sample and pilot study data was not included in the thematic analysis to aid in avoiding bias.

### **3.7 Reliability and Validity**

#### **3.7.1 Trustworthiness of the Study**

Trustworthiness is a way for a researcher to prove that their research study is accurate, authentic, and worthy to be adopted (Nowell, Norris, White, and Moules, 2017); is a way for qualitative researchers to prove that their research is worthy of attention. In this study, trustworthiness was attained through establishing credibility, dependability, transferability and confirmability.

The following trustworthiness criterion was incorporated into the research design:

- i. **Credibility:** To enhance credibility, the researcher established rapport with participants, spent sufficient time in the field, and maintain prolonged engagement during data collection. This process allowed for a deep understanding of participants' perspectives and experiences (Lincoln & Guba, 2019). Moreover, member checking was employed to ensure the accuracy and authenticity of the interpretations by seeking participants' feedback on the summary of their interview responses (Polit & Beck, 2016).
- ii. **Transferability:** To enhance transferability, the researcher provided a detailed description of the research context, participants, and methodology, allowing readers to assess the potential transferability of the findings to similar settings (Lincoln & Guba, 2019). Additionally, the inclusion of direct quotes from participants in the analysis and reporting of the findings contributed to the richness and depth of the data, enabling readers to make their own judgments about the transferability (Sandelowski, 2019).
- iii. **Dependability:** To ensure dependability, the researcher maintained a clear and transparent audit trail of the research process, documenting decisions, procedures, and changes made during the study (Lincoln & Guba, 2019). This record-keeping allowed for the traceability and reproducibility of the research, enhancing the trustworthiness of the findings.
- iv. **Confirmability:** To enhance confirmability, the researcher-maintained reflexivity throughout the study, critically reflecting on their own biases and preconceptions. Reflexivity was documented in a reflective journal, enabling an examination of the potential influence of the researcher on the data collection and analysis process (Finlay, 2020). Additionally, an external auditor or peer debriefer was engaged to review the research process and findings, providing an external perspective to validate the researcher's interpretations (Lincoln & Guba, 2019).

### **3.7.2 Elimination of Bias**

Reflexivity: Throughout the research process, the researcher practiced reflexivity, which involves maintaining an awareness of their own biases, assumptions, and personal experiences that may influence the research process and findings. This self-awareness allows the researcher to critically reflect on their role and potential impact on the study, thereby reducing the potential for bias in data collection and analysis (Finlay, 2021). By acknowledging their subjectivity, the researcher can take steps to minimise the influence of personal beliefs and ensure a more objective approach to the research (Sandelowski, 2019).

To maintain reflexivity, the study kept a reflective journal documenting their thoughts and emotions during various stages of the research, such as data collection, coding, and analysis. This study served as a tool to analyse the influence of the researcher's preconceptions on decision-making processes and interpretations (Holt, 2018). The act of recording and critically examining their reflections contributed to the transparency and credibility of the research process, helping readers understand the potential impact of the researcher's perspectives on the study's outcomes. To aid in limiting potential impact of emic bias the researcher discloses in section 1.8 the potential sources of such bias. Furthermore clear research objectives were formulated and data was analysed using NVivo 14, qualitative data analysis software that leaves little room for researcher influence.

Member Checking: In this study, member checking was employed as a strategy to enhance the accuracy and validity of the findings. After conducting the semi-structured interviews and analysing the data, participants were given the opportunity to review a summary of their responses. This process of member checking allowed participants to verify whether the researcher's interpretations align with their own experiences and perspectives (Polit & Beck, 2016).

Member checking fosters a sense of collaboration between the researcher and participants, ensuring that the data analysis accurately represents the participants' viewpoints (Lincoln & Guba, 2019). Discrepancies or misinterpretations identified during member checking were addressed by revisiting the data and refining the analysis accordingly. This feedback loop

promotes transparency and trustworthiness in the research process, as it demonstrates the researcher's commitment to representing participants' voices accurately.

### **3.7.3 Ethical Considerations**

Several ethical considerations were addressed to ensure the protection of participants and the integrity of the study. The researcher solicited for the ethical clearance from the EBE Ethics in research committee and permission to conduct the study from the executive director HR and submit HR194 (a) (See Appendix B). The following ethical considerations were incorporated into the research design:

- i. **Informed Consent:** Prior to participating in the study, all participants were provided with a clear and detailed explanation of the research purpose, procedures, potential risks, benefits, confidentiality measures, and their right to withdraw at any time. Informed consent was obtained from participants, indicating their voluntary agreement to participate (World Medical Association, 2013). The consent forms were written in plain language and address any potential language barriers or literacy issues among participants.
- ii. **Confidentiality and Anonymity:** Participants' privacy and confidentiality was strictly protected throughout the research process. All data collected, including audio recordings, transcripts, and any identifying information, was anonymised and stored securely. Only the research team had access to the data, and any reporting or publication of the findings ensured that participants' identities remain confidential (American Psychological Association, 2017).
- iii. **Protection of Vulnerable Participants:** In cases where participants were deemed vulnerable due to power dynamics or sensitive nature of the study topic, additional measures were taken to ensure their protection and well-being. This included providing a safe and supportive environment for participants to share their experiences and offering referral information for any necessary support services (British Educational Research Association, 2018).
- iv. **Ethical Approval:** The research study sought ethical approval from the relevant institutional ethics committee before commencing data collection. This ensures that the study meets ethical guidelines and standards set by the institution and relevant regulatory bodies (World Medical Association, 2013).

v. Acknowledgment of Participants' Contributions: The contributions of participants were acknowledged and respected throughout the research process.

### **3.8 Chapter Summary**

The chosen approach for this study was qualitative research, specifically utilising semi-structured interviews. Participant selection involved purposeful sampling, targeting senior academics, external contractors, and facilities managers with relevant experience in managing specialised facilities. Thematic inquiry was hired to probe the interview data and detect key themes and samples. Following below is chapter 4 which presents the analysed data and the interpretations.

## **Chapter IV: Data Analysis and Discussion**

### **4.1 Introduction**

Chapter 3 presented the methodology as well as the methods and ethical procedures employed during this research. This chapter presents findings from thematic analysis conducted with research participants as part of the study. The research instruments developed and presented in Chapter 3 were administered to the partakers for the role of collecting research data analysed and presented in this chapter. With the help of the pilot study, the instruments were fine-tuned to ensure they aid accurate and comprehensive data collection. The data analysis followed an approach that allowed the data itself to guide the findings, rather than imposing preconceived research objectives. This chapter presents thematic analysis of interview data, primarily consisting of direct quotes from participants to ensure their voices are accurately represented. The chapter commences with background information of the single case study, followed by the emergent themes and then a discussion of the results in terms of the literature.

### **4.2 Research Case Background**

UCT was chosen as the single case study for this research due to its high reputation as the top research university in Africa. As a maintenance manager at UCT, responsible for maintaining buildings that house highly specialised research facilities, the researcher has become well exposed to these facilities. However, due to a lack of expertise in maintaining these specialised facilities, we often rely on external experts for maintenance tasks. Driven by a desire to ensure that these facilities remain operational and recognising the challenges faced during maintenance, the researcher developed a keen interest in these facilities. This interest motivated this research to explore and understand the obstacles that hinder the proper maintenance of these critical research environments.

### **4.3 Overview of the Research Case**

The research institution hosts more than 80 specialised facilities that support various research activities within departments and faculties. Additionally, some of the specialised facilities support administrative activities and others support academic activities. These facilities span

diverse fields, including biomedical engineering, clinical trials, tissue culture, technology applications, cardiovascular research, biorepository management, and animal housing. The participants provided detailed descriptions of the specialised facilities at the institution of higher learning. In total, there are 10 specialised facilities that responded and are covered in this research and these are described in the following sections, each playing a crucial role in advancing the university's research capabilities. The facilities are captured in the network diagram (Figure 4.1) below.

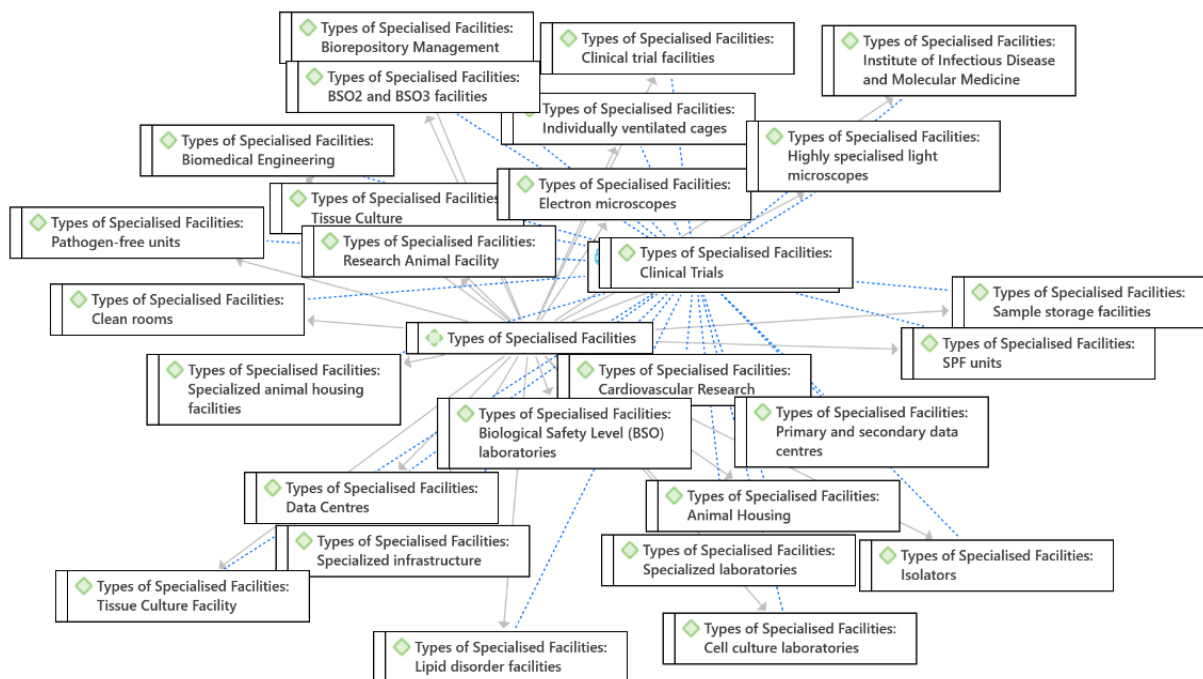


Figure 4.1: Types of Specialised Facilities

### 4.3.1 Biomedical Engineering Division

Participant 3 provided insight into the University's Biomedical Engineering division, alongside specialised subdivisions dedicated to Tissue Culture (TC), Clinical Anatomy and Biological Anthropology (CABA). Within these facilities, cutting-edge equipment and laboratories support a wide array of research activities. Biomedical Engineering focuses on designing and constructing rehabilitation devices essential for medical treatments and clinical trials. The Tissue Culture division undertakes vital research on cancer treatments and therapies, utilising advanced laboratory techniques and technologies. Clinical Anatomy and Biological

Anthropology serve as integral components of medical education and research, providing facilities for anatomical studies and biological anthropology research. Seen in Figure 4.2 is the mortuary and embalming unit used for the preservation of cadaver and unprocessed anatomical remains for research purposes within the anatomy building.



Figure 4.2: Mortuary

#### **4.3.2 Clinical Trial Division**

Participant 4 described the Clinical Trial Division's pivotal role in conducting rigorous clinical research at the university. This specialised infrastructure supports patient visits for various clinical trials, particularly those focusing on lipid disorders. The division prioritises reliable power and infrastructure maintenance to safeguard valuable trial drugs and ensure the integrity of research specimens. Figure 4.3 shows the lab space for conducting trails by researchers.



Figure 4.3: Prince lab

#### **4.3.3 Tissue Culture Facility**

Participant 5 offered insights into the university's Tissue Culture Facility, a beacon of excellence in research infrastructure. Originally established to support mammalian cell culture research, the facility has evolved into a world-class research hub. As shown in Figure 4.4, it is equipped with state-of-the-art technology and resources. The facility facilitates groundbreaking research in tissue culture, contributing significantly to scientific advancements and postgraduate education.



Figure 4.4: Tissue culture wash up area

#### 4.3.4 Technology Applications Division

Participant 9 discussed the Technology Applications Division's role in implementing innovative solutions to enhance campus operations and safety. Campus Protection Services (CPS) and Traffic Management applications streamline security and traffic control processes, ensuring efficient campus operations. Integration of Tridium technology (Figure 4.5) for building management reflects the university's commitment to advancing smart campus initiatives.

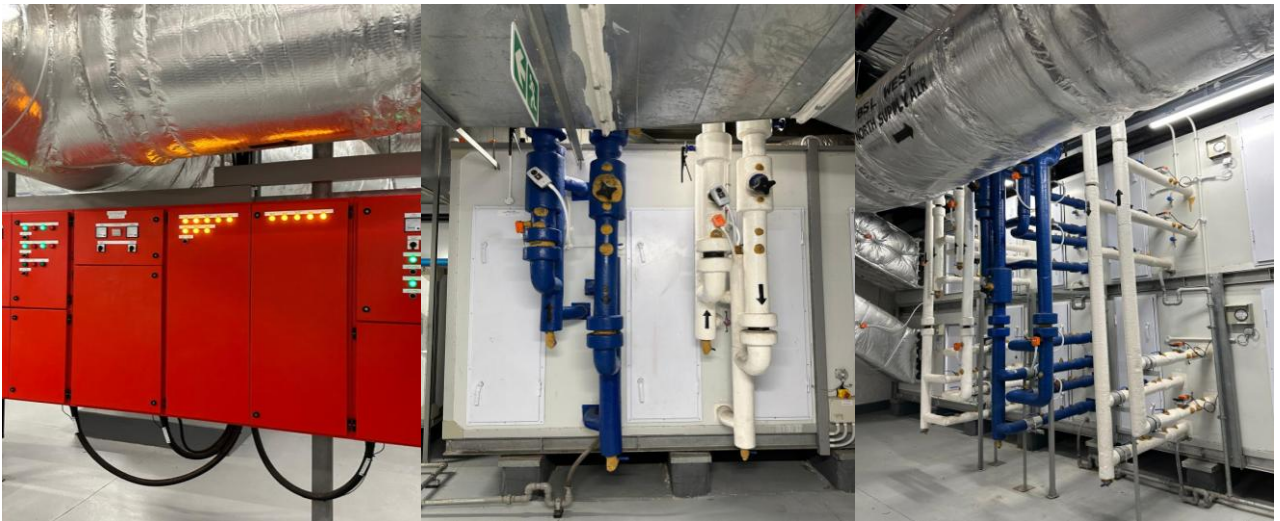


Figure 4.5: Tridium equipment

### 4.3.5 Cardiovascular Research Institute

Participant 11 highlighted how the university's Cardiovascular Research Institute's diverse research activities aim at addressing cardiovascular diseases. The institute's specialised laboratories and sample storage facilities support research ranging from cardiac signalling to clinical trials. The institute receives samples which are coming from other countries using import-export service which are then stored in freezers at -80 degrees Celsius. The institute is used by PhD and master's degree students to do their research. Some students come from other countries like Nigeria, Mozambique, and Uganda. They come to do clinical work at the Institute. For proper preservation of specimen used for clinical trial, Figure 4.6 shows the cryo refrigerator where the specimen is kept in a refrigerator at a controlled temperature.



Figure 4.6: Cryo room refrigerator

### 4.3.6 Biorepository Management

Participant 13 highlighted the crucial role of the university's Biorepository Management in preserving valuable research samples and supporting immunogenicity assays for clinical trials. Housing hundreds of thousands of priceless samples, the biorepository ensures the safety of personnel and the integrity of research materials. Specialised infrastructure and stringent protocols uphold the highest standards of sample preservation and management.

### 4.3.7 Research Spaces Overview

Participant 15 provides an overview of research spaces across various university buildings and locations. From the Chris Barnard Building to Groote Schuur Hospital, specialised facilities accommodate diverse research activities. The Observatory campus serves as a focal point for research, housing essential facilities such as RAF (Research Animal Facility) and IDM (Institute of Infectious Disease and Molecular Medicine). There are several research spaces and centres scattered around the campuses, utilised for various highly specialised research. Figure 4.6 shows the image of a confocal microscope, a specialised fluorescence microscope used for optical imaging for tissue examination. It allows the researchers the ability to image deep into tissues (Justyna, 2017). For teaching purpose, figure 4.8 shows a cross-section of the wet room. While Figure 4.9 shows the histology and skeleton lab.

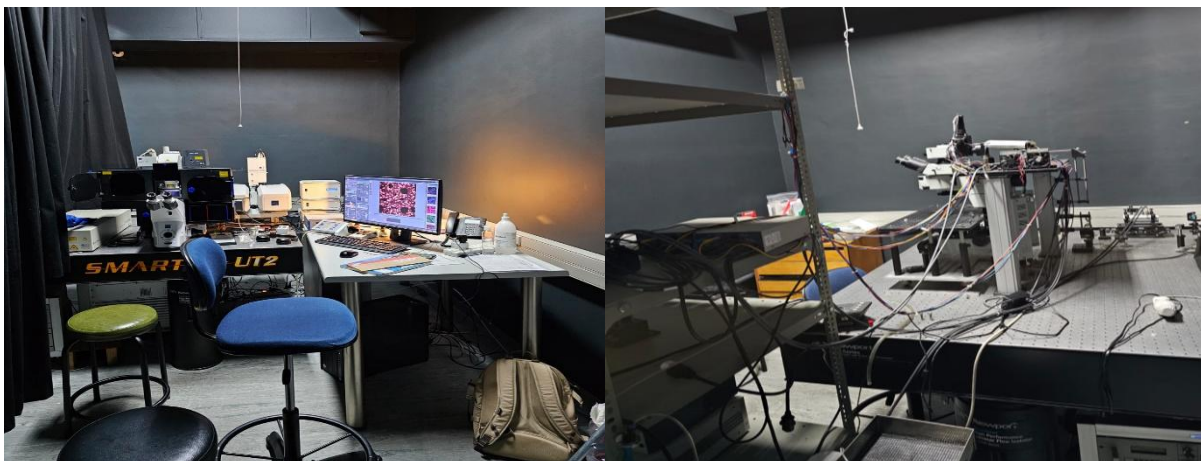


Figure 4.7: Confocal microscope rooms



Figure 4.8: Wet specimen store for teaching



Figure 4.9: Histology and skeleton lab

#### 4.3.8 Cardiovascular Surgical Research

Participant 16 discusses the university's Cardiovascular Surgical Research unit's pioneering efforts in tissue engineering and regeneration. With a focus on developing patient-specific cardiovascular prostheses, the unit utilises advanced laboratories and technologies to advance cardiac research. Collaborations with UCT spinoff companies further enhance the institute's capabilities in cardiovascular research. Supporting doctors to carryout implant, repair, and perform invasive procedures. This can be seen in Figure 4.10; Figure 4.11 shows the clean room.

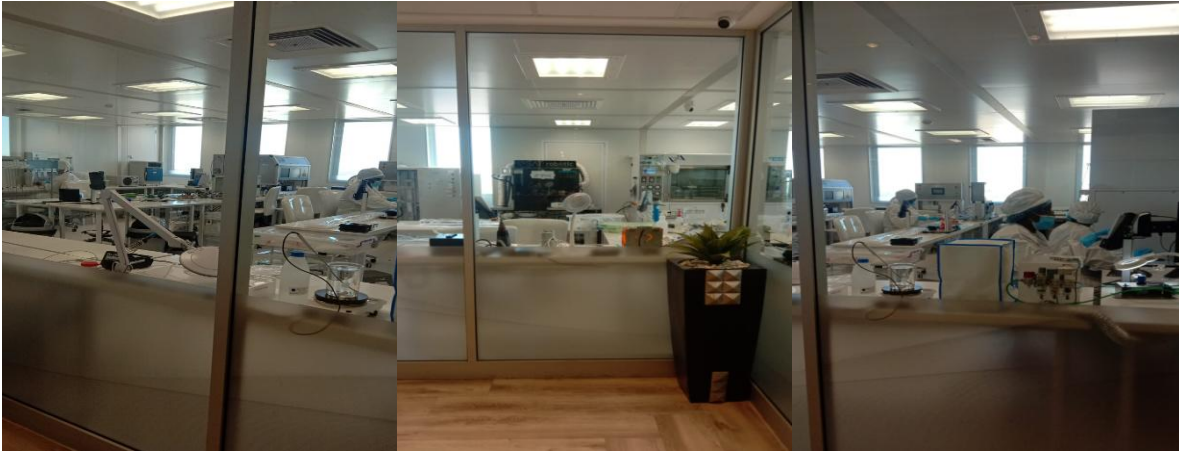


Figure 4.10: Cardiovascular operating theatre



Figure 4.11: Clean room

#### **4.3.9 University Data Centre**

Participant 18 elaborates on the university's primary and secondary data centres' critical role in supporting campus-wide networking and IT services (Figure 4.12). Located on upper and middle campuses, these centres ensure the reliability and security of university-wide data operations. Advanced technologies and infrastructure enable the seamless delivery of IT services, including Internet connectivity and cloud-based solutions.

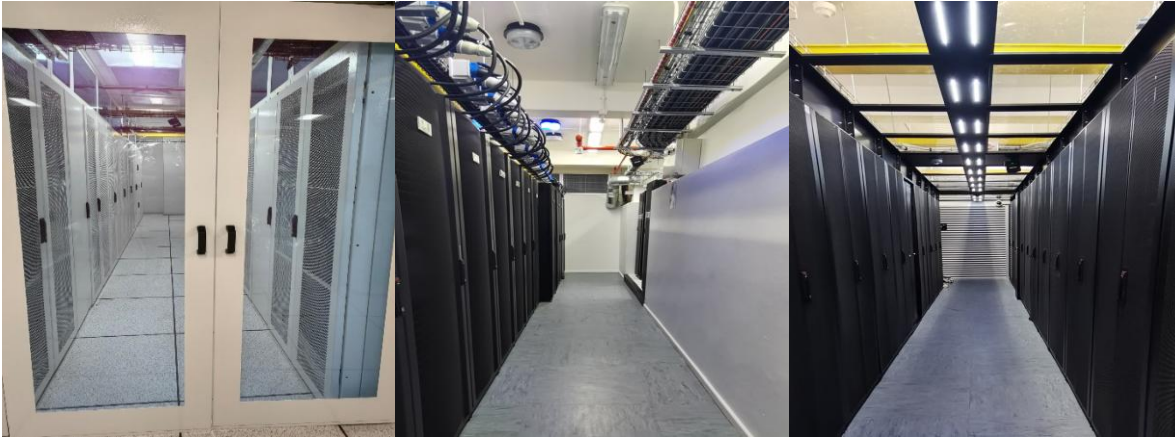


Figure 4.12: Institutional data centre

#### 4.3.10 Animal Housing Facilities

Participant 20 highlighted the university's specialised animal housing facilities, which cater for a diverse range of research needs. These facilities encompass specific pathogen-free units and Biological Safety Level (BSL) laboratories, ensuring a safe and controlled environment for conducting experiments with animals. Crucial for research involving infectious diseases and biological materials, these facilities shown in Figure 4.13, adhere to the highest standards of animal welfare and research integrity.



Figure 4.13: Biosafety laboratory

#### 4.4 Background Information of Participants

Participants were sampled from UCT maintenance team, facilities managers, procurement department and external contractors. Theoretical data saturation was achieved with 22

participants. The first section of the research delved into participants' demographic information. The participants consist of a diverse group of professionals holding various positions within and outside the institution. The demographic information collected includes gender, current position, years of experience, and their status as internal staff or external contractors.

The information collected on the gender distribution among the participants reveals that 18 (82%) are male and 4 (18%) are female. This distribution highlights a gender disparity that could reflect broader trends within the fields of engineering, FM, and research at UCT and beyond.

Participants hold a variety of positions as shown in Table 4.1. The participants' years of experience vary widely, providing a broad range of perspectives. The distribution of experience levels includes 3 to 5 years (3 participants), 8 to 10 years (8 participants), 15 to 20 years (5 participants), and over 30 years (4 participants). This suggests that the research will benefit from insights provided by both relatively new staff members and highly experienced professionals. The substantial representation of individuals with over a decade of experience provides the study with deep institutional knowledge and historical context.

Considering the number of years of experience, the findings showed that majority of participants (8: 36.36%) have 6-10 years of experience, followed by (5: 22.73%) 26-30 years of experience. While (3:13.64%) of the participants have over 30 years of working experience.

The findings also reveal that the participants are more in director positions: (6/27.27%), Academics/Researcher participants: (5/22.73%), Facility Managers participants: (5/22.73%), Engineering participants: (3/13.64%), Operations participants: (2/9.09%), Coordinators participant: (1/4.55%).

**Table 4.1 Background Information of Participants**

Participants number	Gender	Current position	Years of experience	Internal staff	External contractor
Participant 1	Male	Electrical Engineer	15	Yes	
Participant 2	Male	Programme Director	8	Yes	
Participant 3	Male	Procurement Director	9	Yes	
Participant 4	Male	Sustainability Director	30+	Yes	
Participant 5	Male	Technology Director	35	Yes	
Participant 6	Male	Health and Safety Manager	20	Yes	
Participant 7	Male	Facilities Manager	??	Yes	
Participant 8	Male	Facilities Coordinator	30	Yes	
Participant 9	Male	Lift Engineer	10		Yes
Participant 10	Male	Electrical Engineer	5		Yes
Participant 11	Male	Director Risk & Compliance	3	Yes	
Participant 12	Female	Facilities Manager	30	Yes	
Participant 13	Male	Senior Research Scholar	10	Yes	
Participant 14	Female	Professor & Director	20	Yes	
Participant 16	Male	WCG: Medical Specialist	10	Yes	
Participant 17	Male	Facilities Manager	30	Yes	
Participant 18	Male	Operations Director FHS	15	Yes	
Participant 19	Female	Chief Operations Officer SATVI: Operations	20	Yes	
Participant 20	Female	Designated Veterinarian HS: UCT RAF: Veterinary Scientific SERV	10	Yes	
Participant 21	Female	Principal Scientific Officer	8	Yes	
Participant 22	Male	GRM2	3	Yes	

#### **4.5 Overall Findings of the Study: Themes and Sub-Themes**

Based on the data collected and the analysis performed to answer the research questions, six (6) themes and 23 sub-themes were identified and are presented in Table 4.2 The emergent themes are discussed in detail in sections 4.5 through to section 4.10.

Table 4.2: Research Themes and Sub-themes

Themes	Sub-themes
Theme 1: Resistance to maintenance by different stakeholders – academics and non-academics	Sub-theme 1: Resistance due to academic activities
	Sub-theme 2: Delays and disruption of research, teaching and learning activities
	Sub-theme 3: The lack of communication and awareness
	Sub-theme 4: The perceived lack of expertise and safety compromise
	Sub-theme 5: Resistance to change and new technology
Theme 2: Challenges faced by facilities managers in performing routine maintenance	Sub-theme 1: Leadership and Contract Administration challenges
	Sub-theme 2: Contract Governance and Compliance Management
	Sub-theme 3: Operational challenges and resources dependency
Theme 3: Communication and its effect on Routine Maintenance	Sub-theme 1: Fragmented communication pathways
	Sub-theme 2: Ineffective and coordinated communication channels
	Sub-theme 3: The lack of a centralised and control communication mechanisms
	Sub-theme 4: The lack of clarity and feedback in communication
	Sub-theme 5: Effective communication channel
Theme 4: Poor maintenance culture and its consequences	Sub-theme 1: Delayed maintenance
	Sub-theme 2: Record keeping
	Sub-theme 3: Loss of revenue, specimen and reputation
Theme 5: Approach to overcome resistance to routine maintenance	Sub-theme 1: Relevant stakeholders' engagement
	Sub-theme 2: Engagement with academic stakeholders
	Sub-theme 3: Engagement with non-academic stakeholders
	Sub-theme 4: Identification of knowledgeable individuals
	Sub-theme 5: Stakeholders' education on maintenance
	Sub-theme 6: Stakeholders' Education on Maintenance Requirements
Theme 6: Strategies to a successful maintenance system	Sub-theme 1: Implemented strategies to improve maintenance and to minimise costs
	Sub-theme 2: Strategies to Minimising Disruption
	Sub-theme 3: Strategies to improve the current maintenance system
	Sub-theme 3: Strategies to improve the current maintenance system

#### 4.5.1 Emergent Theme 1: Resistance to Maintenance by Different Stakeholders – Academics and Non-academics

The emerging theme 1 (Figure 4.14) from this research was resistance dynamics posed by different stakeholders within and outside the university towards specialised infrastructure maintenance. When asked, the participants highlighted various factors contributing to the resistance they face, including academic and research reasons, executive meetings, prolonged maintenance periods and resistance to new technology. They expressed that these factors exacerbate the challenges faced by the maintenance team to keep up with their responsibilities. The reasons presented in the following sections are showcasing the resistance dynamics and the involvement of stakeholders.

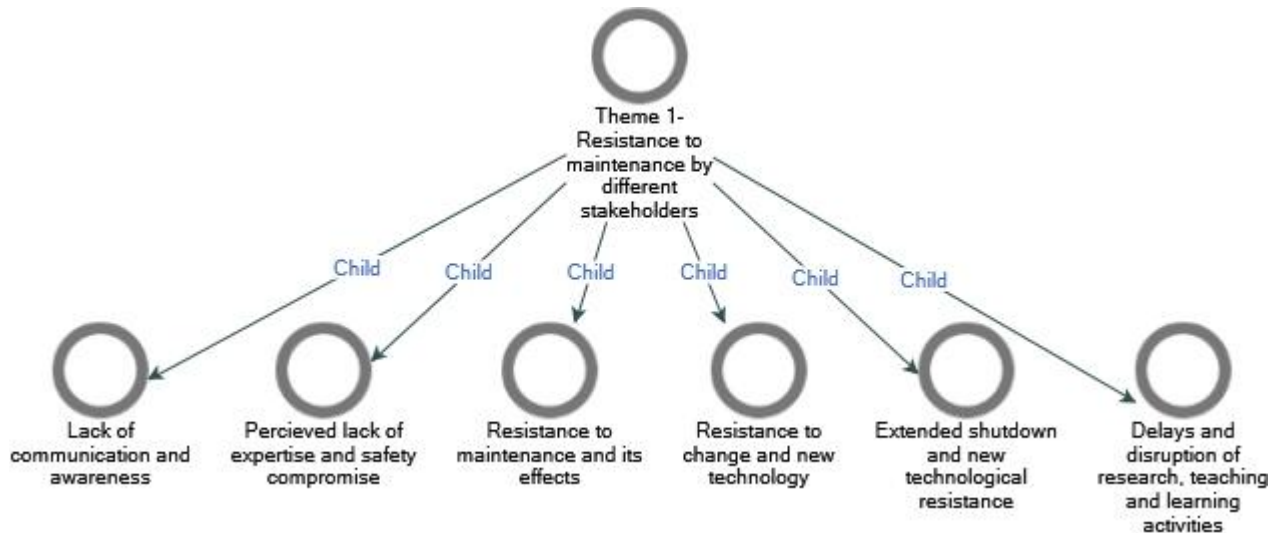


Figure 4.14: Code Map for Research Emergent Theme 1

##### 4.5.1.1 Delays and Disruption of Research, Teaching and Learning Activities

The insights gleaned from the interviews pointed to resistance from academics towards maintenance revealing challenges inherent in university settings. The interviews highlighted that there have been instances of resistance, albeit varying in nature and intensity. While some participants described minimal resistance or even a lack thereof, others explicitly mentioned encountering challenges and dissatisfaction from academics regarding maintenance activities. The challenges encountered hinged on various factors ranging from the lack of communication, perceived lack of expertise and safety compromise, research,

teaching and learning and staff unwillingness to cooperate. The findings for each factor are presented in the following sections.

To ensure the continuation of research, teaching and learning, academics tend to neglect the safety of students and the environment. The participants share their views as academics and maintenance personnel, highlighting the points below:

**Participant 4:** *“the issue with clinical trials is that they run like a train schedule. Once you start the trial, you can't stop, and you're committed to seeing that patient at that date. You can't delay it for three weeks or something. Basically, for us, the main issue is that we can't really cope with a shutdown or loss of access that goes beyond one or two days and then disruptions to our project because of routine maintenance”.*

**Participant 8:** *“So, if it's dust or noise, because we get that in certain other places where we have a huge project to deal with. But then the guys say, no, sorry, you can't work during the week, or you can't work during these times because we have to teach, which is fair enough”.*

**Participant 13:** *“It is being addressed on how I would say the minimalistic process, because now you go to the faculty and the faculty say providing services if not advisors appropriately. So, you find the challenge is, being part of a specialised group. So that is basically where the challenge is and you can address with the faculty, but the faculty has also had the argument but if you delay the process, you could then delay teaching and learning if you find there's breakdown there”.*

**Participant 4:** *“I'm sure the specialised units would want you to do your maintenance after hours or over weekends”.*

On the contrary, participant 14 expressed that the resistance could be due to the maintenance team not adhering to the academic calendar:

**Participant 14:** *“I don't remember having an issue with research space, teaching space. You may have an issue because you are affecting the academic calendar”.*

#### **4.5.1.2The lack of communication and awareness**

While academics resist maintenance activities due to their primary responsibilities, the communication gap between the faculty and the maintenance personnel, as well as the limited mutual awareness of the academics on maintenance requirements were noticed to be one of the contributing factors. In this regard and on the side of academic activities, the participants shared their views:

**Participant 20:**

1. *“We need an awareness, and our priorities need to be straight and unfortunately for our unit, animals come right at the bottom of the list, so other laboratories that I've been to other departments, they've got very nice facilities and even cafeterias as well”.*
2. *“I think there needs to be a fixed realisation of the importance and relevance of that equipment”.*

From the perspective of the maintenance team, the gap between them and the faculty members exacerbated their challenges:

**Participant 7:** *“What normally happens, and the bad part here is when we sign a contract, we are not informed that building can't have noise. Now we can't put a lifting without noise. It's just part of the installation. What we have done in the past, if I can mention Christian Barnard, which was a highly sensitive building, we worked at night to avoid daily disruptions in the building and that is the extra charge”.*

**Participant 13:** *“if health and safety fail it has some serious impact and that people don't really understand the impact”.*

**Participant 17:** *“if you have to work on that single point of failure, then we have to then shut down the whole facility and that becomes the whole negotiation and the time around how much downtime we need because it's not that we can switch something off and switch it back on. It takes hours to shut down the systems, takes hours to bring the systems back up again”.*

The responses presented above indicate that some of the resistance arise because both parties involved in the matter of maintenance are not in alignment on what is required and for what purpose. This misalignment underscores the critical need to improve communication and increased awareness among all stakeholders. Additionally, this will help resolve the dichotomy between the maintenance team and the academics, aligning them all into common objectives of ensuring the upkeep of the facilities.

#### **4.5.1.3 The Perceived Lack of Expertise and Safety Compromise**

The facilities in question are highly specialised and expensive from both the setting up and maintenance perspective. Participant 19's resistance was based on the premise of competency and the students' capacity to handle high value projects on a perception of the lack of capacity. The excerpt from the participant reads:

**Participant 19:** *“One that comes to mind is when we were handling equipment, I think with some two million, and we were relying on students to handle this. And I was quite taken aback*

*that we would rely on students to handle such expensive piece of equipment and then staff member said, “No but they've been doing it over time, and nothing has happened”.*

On the other hand, participants attributed the resistance to the involvement of individuals (facility knowledge experts) who lacked contextual knowledge of the facility environment in the key decisions around maintenance. One of the participant's responses is presented as follows:

**Participant 13:** *“we are only involved in some of them because most of the time specialists sort of voting and looking at it and the unfortunate thing about specialist, they are specialists in their field, but unfortunately, they don't understand the environment of the university. Because what you find is researchers are sort of, they're coming into a space, and they just want the space to be operational”.*

The two dynamics presented represents concerns about the safety of the people using these facilities and the environment in which they operate in. This underscores the key theme of the importance of safety and why it must be taken seriously in maintenance. Additionally, it validates the actors' stands as they resist the maintenance efforts. From an insurance perspective, stakeholders opposed the proposed student led improvement as seen in the case of Participant 19. In the case of Participant 13, the maintenance department opposed the involvement of facility experts in the maintenance on the premise that they do not take the university environment into account.

#### **4.5.1.4 Resistance to Change and New Technology**

Resistance to new technology came up from one of the participants as the reason why different stakeholders oppose maintenance. Participant 9 expressed an instance where they faced opposition from senior academics for trying to install new and improved technology:

**Participant 4:** *“In the urgent rollout of our COVID application, I've faced resistance from senior academics regarding the integration of new technology. So now this is something that we could do self-screening, and people could upload their temperatures, and the application would determine if they were fit to come back to the campus”.*

#### **4.5.1.5 Theme 1 Summary**

Resistance to maintenance activities by both academic and non-academic stakeholders was identified as a critical factor affecting the proper maintenance of highly specialised facilities. It was however, noted that their reasons are circled around the core business of the institution and their primary responsibilities such as research and teaching and learning which are time bound (based) on the academic calendar. A dichotomy is created between these two parties due to (1) communication gap between academic staff and maintenance teams, and (2) academics' poor knowledge or awareness on the necessity of maintenance. These factors were found to have exacerbated the challenges around maintenance within the institution. Additionally, due to the cost implication of the highly specialised facilities/equipment and the consequences should anything go wrong, senior academics were concerned about expertise in handling maintenance of their facilities. This is coupled with the processes involved and the disruption caused when onboarding new technologies into the existing space, making the senior academics' reluctance towards maintenance. This underscores the crucial need to address these challenges to ensure improved communication, alignment of schedules, and a thoughtful approach to introducing new technologies and involving skilled personnel in maintenance activities.

#### **4.5.2 Emergent Theme 2: Challenges Faced by Facilities Managers in Performing Routine Maintenance**

Facility managers at institutions under consideration as well as other institutions in South Africa face multiple challenges when performing routine maintenance and even more so when dealing with highly specialised infrastructure. These challenges span administrative and policy issues, operational dependencies – internal and external and procurement complexities. These are summarised, grouped and presented in Figure 4.15. However, Facility managers' ability to navigate the landscape of routine maintenance is dependent on their years of experience, specific role and their ability to develop relationships with the stakeholders. The following sections will highlight and delve into these various challenges and the critical factors that impact the routine maintenance activities of specialised facilities.

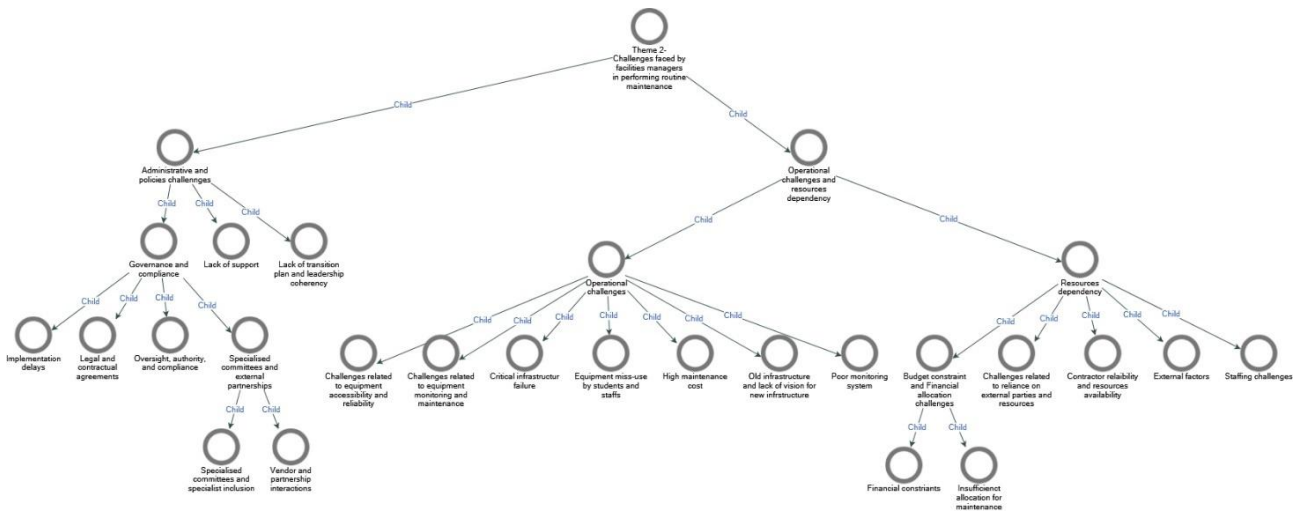


Figure 4.15: Code Map for Research Emergent Theme 2

#### 4.5.2.1 Leadership and Contract Administration Challenges

Administrative and policy related challenges were found to be a serious factor affecting facility managers and often hinder the efficiency of maintenance activities. These can include administrative bottlenecks, restrictive or porous policies and insufficient support from higher management. Such challenges can delay decision-making processes and the implementation of the necessary maintenance tasks to maintain a proper facility upkeep. The administrative challenges mentioned by the participants are categorised and presented as follows

#### 4.5.2.2 The Lack of Transition Plans in Leadership

Maintenance is a continuous process and often, depending on the facility, it could span long periods. The absence of a clear transition plan and coherency in leadership during leadership changes can disrupt maintenance operational processes. The participants expressed dissatisfaction with new leaders assuming office without the knowledge of what has been going on in the office as well as no synchrony in the activities going on with facilities they manage. This results in inconsistencies and delays in the process:

**Participant 2:**

1. "So, when there's a new person in the maintenance department and we log calls for some of the things to be done. So, if that new person is not aware of the arrangement in place with their service providers being used, then those calls delays. Maybe that person, when

*we log the calls, will assign it to different contractor. And only after that, then we realise maybe that okay, that's a new person or no, this is not contractor we use in our routine maintenance”.*

2. *“If there's a new person that we're dealing with, we still need to get that person on board as to understanding the environment and what is required in our environment when it comes to and who are the service providers that we are using or that capable of performing certain tasks. So, it's those budgeting and basically funds and onboarding a new person”.*

**Participant 9:** *“lack of agreements historically between P&S and ICTs on backup policies. we lost two or three work weeks of information because a backup didn't happen behind the scenes and there was amnesia from all parties on why this database should have been backed up as well”.*

A significant issue arises when research activities occur within a faculty without the leadership being aware. This causes problems and delays and often disrupt maintenance processes, especially when the leadership learns about ongoing projects for the first time:

**Participant 14:** *“We try to streamline information about the field works because when you find that Dean doesn't even sign on the field work and yet the people are doing dangerous work out there. ...you'll find Professor (name omitted) is highly doing research, but the Dean is not aware of it”.*

Looking at the occurrences one could conclude that there are lapses in the management. These lapses promote unethical practices within the system due to lack of accountability and oversight. The disconnection between the leadership and ongoing activities creates an environment where critical safety protocols and standard operating procedures may be overlooked.

#### **4.5.2.3 The Lack of Support**

A peculiar sentiment shared by most of the participants is the challenges they faced dealing with administrative matters surrounding maintenance. One of the participants working at the specialised research animal housing facility expressed his disdain on the level of struggle his line manager go through to get approval to carry out maintenance in the facility. When senior management does not support their subordinates, these occurrences are bound to happen. For facility managers, this creates a difficult situation where they must find a way to solve their maintenance problems independently. In this case, standards can be compromised:

**Participant 20:**

1. *“They [facility manager] don't get support from whoever that is supposed to support them. So, if they see something has broken down, they will make amends to fix it, but I feel they are sometimes let down from the higher level”.*
2. *“We need heating in here, so she has identified the problems. She's identified the potential solutions getting the solutions is what is the problem”.*
3. *“...she identified the problem, she was emailing people, she's speaking to properties and services, she's speaking to external contractors. But over the past month or two nothing has happened in terms of putting heat in that room and she will tell you that for six years she's been pursuing that issue”.*

**Participant 21:** *“Because most of the time they would say we didn't ask for this or it would be nice to have like now those plugs were all on normal plugs, but we've changed them to generator plugs and then we recently changed them to ups plugs. So, meaning if you've got a conference or a meeting that you don't want a cut off, then you can pull that drop down, and then you should be able to seamlessly go through your operational requirement without cutting power, which was an issue at first, because people on teams, they will drop because power comes back”.*

#### **4.5.2.4 Agreement and Policy Challenges**

Sometime the challenges stem from the improper constitution of administrative matters when entering contracts with the service providers or providing adequate policies, agreements and/or job scopes to backup any maintenance activities.

**Participant 9:** *“...so we have to now go back to legal. We need to go and create these agreements. We need to fund these agreements. We need to define how many hours, we need to define the scope, the meantime, to repair. So that's currently my main challenge is just the lack of SLAs that are in place. But I'd say we're also rectifying that very quickly by putting in a really solid governance routine around that. So, yeah, I mean, it's the SLA portion”. ...lack of agreements historically between P&S and ICTs on backup policies”.*

#### **4.5.2.5 Leadership onboarding**

What was found lacking is also policies on continuity when there is leadership change. This was expressed by one of the participants stating that they constantly encounter challenges when there is leadership change, and the new leader does not know about the calls logged

before they assume responsibility:

**Participant 2:**

1. *“Sometimes now if say there's a new person that we're dealing with, then now we still need to get that person on board as to understanding the environment and what is required in our environment when it comes to and who are the service providers that we are using or that capable of performing certain tasks. So, it's those budgeting and basically funds and onboarding a new person”.*
2. *“...we work with the maintenance department. So, when there's a new person in the maintenance department and we log calls for some of the things to be done. So, if that new person is not aware of the arrangement in place with their service providers being used, then those calls delays”.*

In some cases, the maintenance processes are halted to first formalise things to ensure adherence to standards, ethics and laid out maintenance procedures. In some cases, the research activities are not formally approved or signed off by the appropriate management. These lapses in institutional administration leads to poor activity monitoring, giving leeway to researchers to setup and carry out research that is risky to both humans and the environment:

**Participant 14:** *“...find that Dean doesn't even sign on the field work and yet the people are doing dangerous work out there”. ...you'll find Professor A is highly doing research, but the Dean is not aware of it he knows he's doing research, but he does not know the specifics about the research”.*

#### **4.5.2.6 Contract Governance and Compliance Management**

Facility maintenance is governed by various standards, regulatory frameworks as well as contractual agreement between the institution and the service providers. Strict adherence to these factors regarding facility governance – legal and contractual agreement, oversight and compliance is essential for maintaining operational integrity and regulatory requirements. The absence of this affects the entire maintenance process since the terms of reference for a contractual agreement must be sorted before any maintenance operation can commence.

##### **4.5.2.6.1 Legal and Contractual Agreements Problem**

A maintenance agreement outlines the requirements and tasks to be performed to keep the facility in good and functional condition. The absence of contractual agreement creates

challenges to the facility manager as they must halt any ongoing maintenance activities to formalise the agreement with the service providers or between other entities within the institution:

**Participant 9:** *“So, I think looking at it, as I mentioned previously, we found out some of our tasks is the database backup, or should I say it was the lack of agreements historically between P&S and ICTs on backup policies. And as you remember, Technology Services Department is only three years old this year. So, it's finding all these little guys that we haven't sorted out, like the radio systems that we've also taken over, finding out that there were no proper agreements in place. So, our challenges are just wanting to do these tasks, but finding out there was no budget, there was no SLA (Service Level Agreements). So, we must now go back to legal. We need to go and create these agreements. We need to fund these agreements. We need to define how many hours, we need to define the scope, the meantime, to repair. So that's currently my main challenge is just the lack of SLAs that are in place. But I'd say we're also rectifying that very quickly by putting in a solid governance routine around that. So, yeah, I mean, it's the SLA portion”.*

Furthermore, the quotation from Participant 15 emphasis that the problem of policies and agreement extends to the rental facilities used by the institution for their research activities, where there are no clear stipulations in the rental agreement concerning the maintenance and who is responsible. This creates unnecessary tension for the facility manager whose work is delayed indefinitely waiting for the matter to be resolved:

**Participant 15:** *“Because UCT is not landlord of the space they're occupying. So, they are using a different space. They were meant to have an SLA with the public works there, similar to Groote Schuur, but they initiated that project at that site and therefore they should be responsible for making sure they are compliant with that space. It's a current debate in terms of who's responsible for what, especially when it comes to vague areas like that. Let's go back to Groote Schuur Hospital. So, say for example, a researcher is doing research there and the roof isn't repaired and it's causing damage to the research results for example, they take the risk for conducting research in that space. So, they should be doing their risk assessment office site before they agree to conduct research at a site”.*

The issue of having no formal agreement in place as highlighted by Participant 9 and 15 creates significant challenges for the FM. And one of the challenges is diverting their attention from an ongoing project to sort out these administrative gaps.

#### **4.5.2.7 The Lack of Oversight, Authority and a Compliance System**

Every organisation has policies, procedures and regulatory standards that governs their maintenance operations. To uphold the stipulated standards, an oversight and authority structure is instituted as compliance with the set standards helps to mitigate maintenance risk. Participants raised concern on the lack of a competent authority to oversee the maintenance projects. This is evident in the excerpt of the participants' responses below:

***Participant 12:** "We have the system in place but checking it like let's say from the perspective of a director is not simple because I don't know how to check if they're doing it. How do I check if another professor has trained the student? I don't even have authority".*

#### **4.5.2.8 The Lack of Expertise in Specialised Committees and External Partnerships**

The formation of committees and the establishment of external partnerships can help streamline the maintenance process by assembling experts with specific knowledge set on the field. However, coordinating these committees and external partnerships to ensure adequate communication among various internal and external stakeholders and execution of their maintenance mandate is challenging. Additionally, the formation of committees with people with the right expertise is even more challenging. A Participant shared this sentiment:

***Participant 14:** "I think the most common issues is the formulation of that specialised committee that will be involved in the layout and the design of these specialised areas. As I alluded to earlier, you'll find that a PAC is set up, but you find that the relevant specialists are not part of it, so to give you an example. One of the lab in the upper campus, they set up the lab and everything, but they did not have a specialist around Biosafety they had an open safety person, but that guy did not, was not the specialist on biosafety that's where the breakdown is the component of the specialised group that is an area that it's always stressful for us because now you falling into that gap over the active process".*

#### **4.5.2.9 Implementation Delays**

Too many protocols and prolonged discussions delay the maintenance process implementation and contributes to facility managers' challenges. These delays do occur because of extensive consultations and approval processes that slow down the decision-

making process. This frustration was voiced by some of the facility managers interviewed:

**Participant 16:** “...the whole thing is just being discussed and discussed and they can't do anything”.

**Participant 20:** “we need heating in here, so she has identified the problems. She's identified the potential solutions getting the solutions is what is the problem. They now realise the importance because the work has stopped”.

#### **4.5.2.10 Operational Challenges and Resources Dependency**

One of the significant findings in the maintenance of highly specialised facilities gathered from the interviews is the array of operational challenges and the profound dependency on both internal and external resources. These issues emerge prominently as facilities managers navigate the complexities of maintaining the institutional equipment and infrastructure essential for advanced academic and research activities. Two facets of challenges emanating from this theme include complexity of maintenance task and resources dependency factors. These are presented as sub-themes in the following sections.

##### **4.5.2.10.1 Operational and Maintenance Challenges**

###### **(a) Complexity of Maintenance Tasks**

The complexity of maintenance tasks on these highly specialised facilities necessitates a highly skilled technical workforce, which presents a challenge in terms of both recruitment and retention. The specific technical expertise required for maintaining such equipment is scarce, making it difficult for institutions to find and keep qualified personnel. In some cases, the need for this technical staff is not recognised by the management as they leave easily:

**Participant 20:** “But you must remember that a specialised facility also needs an expert person to manage that facility. We're not going to fetch someone from the street. We're looking at experienced, qualified personnel. It costs money to attract and retain those people. So, it's not only the infrastructure. It's the skills that come with the maintenance of that infrastructure. So, they need to understand that whole dynamic so that at least they can appreciate the importance of maintenance”.

The level of technicality sometimes goes beyond the expertise of the facility managers, suggesting the need for a dedicated staff with expertise:

**Participant 3:** “So, like I said, every lab has a lab manager, whether they be scientific or

*technical officers. These people oversee those infrastructures, but sometimes they get to a point where they can't resolve the issues themselves. if they get to a point where they can't, I factor in and I give my advice as well on the way forward”.*

Technical expertise extends to the procurement department responsible for all procurement related to maintenance where they lack technical expertise that could guide them regarding the items being procured to ensure that it meets the minimum requirements for any specialised equipment or facility:

**Participant 18:**

1. *“...the procurement team lacks a technical expert with proficiency in the specifications of various highly specialised equipment”.*
2. *“I don't know what the researchers are thinking. I'm also not going to be able to often add value in terms of the specifications. Somebody says, I don't know. It's not mine, it's not my area. They would know that, so it's very difficult for me to kind of say that these things that they're looking to buy are not fit for purpose. They're the ones that do that. As I said we've got a very small team. It's unlikely that the team is going to increase in size. But perhaps a specialised person from a procurement perspective could sit in faculty to provide the knows, is this multidisciplinary which I would think would not be easy to find. But understand that culture, worked in that space and then you kind of layer the procurement”.*

Overall, some of the facility managers have different kinds of facilities or equipment that they manage and cannot be experts or cover them all. When they do not house expertise dedicated to maintaining specific equipment or facilities (when there is no dedicated expertise) maintenance can either be delayed while they are in the process of searching for experts or done poorly. This extends to the usage of the facilities where due to the high technicality, staff and students tend to misuse the facilities resulting in frequent breakdowns.

### **b) High Maintenance Costs**

Both procuring and maintaining specialised facilities especially those used in research incurs high costs, not only for regular upkeep but also for specialised repairs and replacements. This emerged as a major concern from the participants who stated that high maintenance costs amidst a tight budget is a major challenge facility managers face on their day-to-day maintenance requirements. Excerpts from the participants' responses are evidence of the problem of maintenance costs:

**Participant 20:**

1. *“...because it's specialised facilities with specific requirements it's not a quick fix solution, it's not like a light bulb where you say, OK, let's go to Pick 'n Pay and let's buy that bulb and put it back. It involves a lot of deliberations and expertise and thinking outside of the box because if you want to regulate environmental parameters, it's not an easy task. You need to maintain temperature within a certain range, humidity must be in a certain range and normally the equipment that is required to do that is very expensive”.*
2. *“I don't think maintenance was never prioritised. I think not enough income was generated to maintain the specialised facilities. So whatever money that you're bringing in and also the challenge, the way I've understood how UCT works, if we generate an income it goes into a central fund. The money doesn't directly come back to us, so even if it did, like, I'll give you an example just to replace the autoclave is at least 1.5 million Rand. Not 1.510 million. I think it's 10 million, ... you're looking at least 1.5 million to 10 million Rand. So even if we did generate an income, it may not even be enough to replace some of the infrastructure that is required to keep this running and the challenges were that whenever an income is generated, it goes into a central fund, it doesn't come back to our unit. So, we are still left at the mercy of whoever has the purse strings. So, something falls apart and if that money is not available, then that thing is not fixed. ...so, we're not really keeping our best with technology.”*

**Participants 4:** *“Because with us there was routine daily. But if I were to include the high-ticket items, which is the big service, the services to the big biosafety cabinets, then it's cost. For example, with the expensive biosafety cabinets, the prefilters. So, if you can keep your prefilter changed every six months, that reduces the likelihood of having to change your expensive HEPA filter, which I think ours lasted like ten or eight years”.*

What contributes to the high cost of maintaining this highly specialised infrastructure is the frequent upgrade and discontinuity in supporting the older version by the manufacturers. Ensuring that they support the facilities is to continue upgrading the technology which is quite difficult to keep up with due to costs:

**Participant 20:** *“When they [manufacturers] upgrade to a new system, they discard all together the cages that they used in the past. So now when a cage is broken for you to get a part to fix it, it becomes a challenge. You need to keep up with what's in the market and it can be very expensive, so even our isolators we have what we call isolators, so we keep our mice*

*in these isolators, because we don't want them to be exposed to pathogens, but if we really want to buy a proper isolator, it would be very expensive”.*

In a nutshell, high maintenance costs are a nightmare for the facility managers. With the level of use of these infrastructures, misuse from the students and staff, the financial constraints in academic institutions and the executives who make decisions on budget without fully understanding the importance of these facilities but only focusing on expenditure, it becomes evident why there is a struggle to keep up.

### **c) Equipment Misuse by Students and Staff**

The issue of misuse of the specialised facilities came up in the investigation and this was attributed to the lack of training in the use of the facilities:

***Participant 4:** “I think cost is a major challenge. And of course, students misusing the equipment, as expensive as the equipment was, that meant that if they didn't follow proper technique, that they could easily mess up and we have had not many, but there have been at least two or three incidences, I can think of that lead to a breakdown of a piece of equipment. So, what happens is the aim we can't supervise otherwise we'll be in the lab 24/7 watching students. So, what happens is I used to train them. On average it was about three, four-week training. And then we'd watch them again, say once or twice thereafter. But like anything, when you're competent, you can become and you think you know it or you think you've reached this competency level you slip, by the way, with everything you do, it can happen. Unfortunately, we can't be supervising people in the lab. They have to be trained sufficiently to work by themselves”.*

The issue of misuse, either due to lack of competency or complacency is also associated with staff. As a result, the facility managers are not only challenged by the scarcity of technical staff, but also by the need to continually train students and staff. Additionally, new students are admitted into these facilities every year. One can imagine the amount of work and challenges faced by the manager annually to ensure that equipment breakdowns are minimal, and maintenance standards are met.

### **d) Old Infrastructure and the Lack of Vision for New Infrastructure**

Part of effective infrastructure management is forward thinking to implement new facilities. Without a clear vision for upgrading and modernising infrastructure, institutions risk grappling

with outdated and inefficient facilities. This lack of foresight can lead to difficulties in maintenance, as well as increased costs associated with managing aging infrastructure due to frequent breakdowns. The participants echoed the challenges of dealing with old infrastructures:

**Participant 20:** *“We're falling behind. For example, our SPF unit uses outdated cages for housing animals. The industry has moved on to new systems, and manufacturers no longer support old models. This makes repairs challenging and costly. Even our isolators, essential for keeping mice pathogen-free, are outdated and hard to replace or repair without significant funds. We're not keeping up with technology”.*

Although the costs of implementing new facilities might not be within the reach of the institutions but the consequences of dealing with the old is even more as it disrupts academic activities due to frequent breakdowns:

**Participant 6:** *“lot of infrastructure is currently managed from breakdown to breakdown with no vision going ahead of implementing new infrastructure and upholding the current infrastructure”.*

**Participant 12:** *“I can also see the challenges; I mean this is an old building. It's not that you're getting a new building you cannot, you know the reality it is an old building it will have challenges. You will have to work with challenges”.*

The findings indicate that implementing new infrastructure may be expensive but maintaining the older ones can be more costly in the long run. The cost of maintaining old infrastructure involves not only the money spent on repairs but also the effects of the breakdown on academic work. The financial impact of constant repairs and the disruption caused by breakdowns affect academic work significantly, thereby affecting the student's learning experience. Therefore, having the foresight to gradually develop or buy new facilities to replace the old ones is crucial to ensure long-term institutional success.

#### **e) Poor Monitoring System**

Effective monitoring systems are crucial for proactive maintenance. Poor monitoring systems result in delayed identification of maintenance needs, leading to reactive measures that are less effective and more costly. Improving monitoring systems can help in timely detection and resolution of maintenance issues thereby enhancing the overall maintenance process:

**Participant 12:** *“There is SOP [standard operating procedure] but there is no control mechanism of the SOP. How do I know if ... is applying the SOP and I'm not even aligned with the action it's not my role to hold pathology student x who arrived yesterday, I cannot do that. You see you have the SOP but don't have an overarching system of checking so that is some risk to some extent”.*

**Participant 14:** *“...you will find what's going to end up happening is like somebody driving on the road is there's speed limit. They going to pass that speed limit because there's nobody monitoring that, you're going to find the same is going to be in your space, people are going to be performing functions where they don't have the necessary competency and necessary training”.*

**Participant 7:** *“certain percentage of the portfolio should be surveyed once a month and ensure that whatever the lift service provider has stated they've done, we follow up on that and we can then pre-empt if something's going to happen to the lift or if that lift is getting too many callbacks. So, because there will be monitoring in place, it will automatically improve the performance of the lifts”.*

The findings as stated by the Participant suggests that it is not enough to have systems in place without proper monitoring to ensure that the system is being used in an appropriate way stipulated. They insinuated that humans could neglect the laydown operating procedures and standard if they are left alone without standard monitoring mechanisms. The misuse of the facilities could result in damages and even compromise the health and safety of the people and that of the environment. It becomes imperative that the systems must be incorporated with monitoring systems that would help to minimise possible damages, causing more maintenance issues. Additionally, without the system, facility managers are isolated from the occurrences hence cannot respond swiftly to issues when they arise or even prevent the possibility of its occurrence.

#### **4.5.2.11 Resource Dependency**

Resource dependency significantly exacerbates these operational and maintenance challenges. Facilities managers often rely heavily on budget allocation, external vendors for parts and specialised services and other external factors such as current ESKOM power challenges, leading to equipment damage due to power surges. This reliance introduces vulnerabilities in the maintenance system especially in the supply chain. Delays or shortages

in the supply of essential maintenance materials or the unavailability of specialised services can result in prolonged downtimes, adversely affecting the institution's operations. Furthermore, fluctuations in economic conditions can also pose challenges, particularly regarding maintenance costs.

#### **4.5.2.12 Staffing Challenges**

The effective functioning of any maintenance system, hinges on the dedication and competency of the team. However, staffing challenges came up as formidable hurdles that impede the seamless operation of facility managers due to the volume of maintenance required to keep the facilities in good and full functional conditions to meet up with the daily demand of academic activities. The effects of the shortage of maintenance staff are captured in these Participants' comments:

**Participant 3:** *"If I look at maintenance, they are a small group of individuals, and they carry university on their shoulders, so they cannot be everywhere at the same time".*

Fewer staff or the lack of qualified personnel in a critical position poses a challenge to the managers as they struggle to effectively monitor all activities within their facility. This can result in oversight in some occurrences and delays in identifying maintenance challenges requiring urgent attention:

**Participants 12:** *"It's just not easy that we have no laboratory manager; we used to have one, but this post was cancelled five years ago. It brings real issues because we have no person whose job is to work through the different laboratories, check the plug points, check temperatures with freezers, and check the entire logistics of lab approval processes for radioactive approval. Even for maintenance issues which are for the entire building, it's not simple because you can see I checked with Paul. I checked with Sharene; luckily, they work well together, but we don't have clinical cardiologists and trust a doctor by training. Checking it like let's say from the perspective of a director is not simple because I don't know how to check if they're doing it. How do I check if another professor has trained the student? I don't even have authority. The institute would need a manager who can walk around and spot-check if SOPs are done; that's exactly where it would be needed".*

**Participant 13:** *"So at this stage there's very little sort of focus on getting into that much detail on specialised infrastructure like labs and things like that from a sustainability perspective but*

that's largely because we just can't allocate enough resources to get to that level of maturity. It's really the lack of availability of resources so both human resources”.

The findings showed that there is a serious conflict between the facility managers and the senior management on the issue of the addition of more staff to meet their needs. While management approach the issue from the expenditure point of view, meanwhile, they are failing to understand the impact of working without qualified personnel in strategic places on the upkeep of the facility.

#### **4.5.2.13 Budget Constraints and Financial Allocation Challenges**

Tight budgets restrict the ability to procure essential resources and maintain an adequately skilled team. Often, this financial strain or poor allocation forces facility managers into reactive maintenance rather than a proactive approach. Maintaining these infrastructures is expensive due to the cost of the spares and the specialised skills to maintain them. The participants expressed concerns around the tightness of the maintenance budget amidst the constant demand for the facilities due to ongoing academic activities:

**Participant 1:** “...obviously for the design installation side, the budgets are extremely tight. The university, you might know, is not in a great financial position”.

**Participant 10:** “...can describe systems that required maintenance and that the academic staff pushed for it, but maintenance couldn't provide the solution because of cost constraints. the challenge is to make things work with the available funds”.

**Participant 2:** “And then, well, budgeting issues. While we were waiting for that, an expansion valve failed on another unit. So now we ended up moving from having four units to two units. That's when now the systems engineers had to kind of switch off some of the machines, they were running to bring the temperature down”.

**Participant 14:** “You can highlight the risk and then you're trying to address the risk, addressing the risk is the challenge, especially when they come and they go back at you, there's no funds. ...I get an instruction, cancel all training for the rest of the year, understand due to budget”.

It might be assumed that the tightness of the budget is because of facility managers' unwillingness to fund maintenance activities. However, it is due to the facilities struggling to raise enough income to cover the maintenance costs while striving to provide affordable

services for education purposes. Furthermore, the income generated is not directly available to facility managers for maintenance planning:

**Participant 20:** *“I don't think maintenance was never prioritised. I think not enough income was generated to maintain the specialised facilities. So whatever money that you're bringing in and the challenge, the way I've understood how UCT works, if we generate an income it goes into a central fund. The money doesn't directly come back to us. So even if we did generate an income, it may not even be enough to replace some of the infrastructure that is required to keep this running and the challenges were that whenever an income is generated, it goes into a central fund, it doesn't come back to our unit. So, something falls apart and if that money is not available, then that thing is not fixed”.*

Knowing the importance of maintaining the facilities and the costs help for planning and executing the planned processes. However, when maintenance planning is done and costs decided without this knowledge, the issue of under budgeting arises. In most cases, facility managers complain of maintenance allocation not adequate to cater for maintenance needs. Furthermore, in some cases, they are met with opposition from the top management on their maintenance requests:

**Participant 17:** *“And probably the biggest problem is funding. Sometimes it's a large ticket item, and towards the end of the year, they have no budget for maintenance to replace a UPS that's close to a million rand”.*

#### **4.5.2.13 External Factors**

External factors such as ESKOM load shedding surfaced as one of the challenges facility managers are grappling with. This theme underscores the unique challenges posed by external circumstances beyond the institution's control. The current load shedding often left the managers with maintenance issues ranging from finding ways to keep up with those facilities that power loss interrupts their work, to dealing with damages caused by power surges. Furthermore, the activities of the equipment or service providers which are not within the control of the facility manager also stand on their way when exercising their maintenance duties. The frustration brought by this is presented in the Participants comments:

**Participant 4:** *“But probably the biggest disruption is kind of ESKOM load shedding. Obviously, we not like certain things”.*

**Participant 6:** *“That we find on a regular basis we've done a lot of repairs with regards to that, and the frequency of load shedding has got a very big effect”.*

**Participant 4:** *“The on and off electricity will damage our autoclave freezes quicker so I think there will be implications for the duration of our equipment”.*

**Participant 21:** *“Every time there was load shedding because there were no surge arresters on the incomer, and it takes about 480 watts. So, there was no surge arrester so if you cut the power and then restore the power, then it trips”.*

Certainly, it was acknowledged that the frequent power disruption has huge impact on the facilities and equipment, causing them to fail hence requiring constant maintenance attention. The participants noted that the lifespan of this equipment will be affected as they are not designed to handle frequent power interruptions. Indeed, this is a challenge as equipment fail even before their lifespan and considering the cost of acquiring a new one, the institution might be at risk of not having a functional system for some academic and other related activities.

#### **4.5.2.14 Contractor Reliability and Resources Availability**

Some of these facilities are meant to be in service during most parts of the day or even constantly throughout the year. Therefore, the reliability of contractors and the availability of resources are critical. Any form of inconsistency in performance and delays from contractors can severely impact maintenance schedules and operations. The participants alluded to the impact any of this could have or is having on them in their maintenance quest:

**Participant 7:** *“...it was a product design problem which came from the factory. And it so happened that the factory closed the month we found the problem, so that delayed us by a month. So, there was a negotiation back and forth and I think we've come up these penalties that were threatened by myself to the lift provider. it turned out to be quite a challenge for us because the company that provided those air conditioning equipment, they failed”.*

**Participant 8:** *“sometimes that cheapest contractor is either going to claim to try and make up the money that he isn't getting or he's just not going to have enough resources to complete the project on time”.*

The severity of the impact of a contractor's incompetence and inconsistency are illustrated by the following examples. For instance, Participant 3 describes a scenario where a contractor

inadequacy led to critical infrastructure failures, underscoring the importance of reliable contractor performance:

**Participant 3:** *“But I've had this experience, I had one last week as well, where something tripped and it tripped out the whole lab. And we just can't seem to identify where the issues are coming from. So, electrical infrastructure, it needs to change. It has shown some signs of change, but the boards are old. The legends don't even match what's happening in the building anymore. That is the two biggest concerns that I have in the building”.*

The facility manager or the contractors could be blamed for underperforming infrastructure. However, in some cases, the challenge lies on their inability to access spares to maintain the equipment as they rely on external vendors and original equipment manufacturers (OEM) overseas to provide them with the spares.

**Participant 17:** *“We are dependent on a lot of external third parties, contractors, and spares. UCT doesn't do its own maintenance on these things, and we rely on external people. We don't generally carry spares either. So, some critical areas, we may carry some spares. There's been problems in Europe and problems around the world, and we cannot get spares quickly”.*

Overall, the faith of the facility manager for ensuring the upkeep and full functional facilities depends on the contractor's competency and consistency in providing the top-notch maintenance services that keep the equipment and facilities in good condition and additionally on their ability to respond in time of emergency to sort out issues to avoid disruption in the academic processes.

#### **4.5.2.15 Procurement Challenges and Parts Availability**

Factors surrounding procurement came up when interviewing the procurement personnel. For context, virtually all maintenance equipment and component purchases go through the procurement department. One of the challenges picked up was disconnection between the departments, researchers and the procurement personnel. The department does not have experts with the knowledge of specifications to control and ensure that maintenance standards are upheld. One of the participants raised a concern on the lack of knowledge of specifications:

**Participant 18:** *"I'm also not going to be able to often add value in terms of the specifications. Somebody says, I don't know. It's not mine, it's not my area. They would know that, so it's very difficult for me to kind of say that these things that they're looking to buy are not fit for purpose. They're the ones that do that".*

The lack of awareness of the upcoming needs of researchers because they do not have access to their comprehensive demand plan was of major concern. The participants expressed that if the procurement team could receive the requirements from researchers early, they would be able to add more value and be able to prioritise and review the researchers' needs effectively. This is evident in the response of participant 18:

**Participant 18:** *"I don't always know what's out there. I don't have the demand plan. So, I don't know what the researchers are thinking. So, if we could get the requirements early, we can add more value, we can reprioritise, we can have a look at those things. So, I think demand planning is essential".*

#### **4.5.2.16 Theme 2 Summary**

Maintaining institutional specialised facilities comes with a huge challenge. Facility managers face challenges including administrative obstacles such as leadership transitions without proper handovers, insufficient support from higher management, and inadequate contractual agreements. These issues coupled with operational difficulties that arise from the complexity of maintaining specialised facilities, high maintenance costs, equipment misuse by students and staff, aging infrastructure, and poor monitoring systems, lead to delays and inefficiencies in their maintenance operations. This is further exacerbated by facility manager's reliance on external resources, such as contractors and suppliers, which complicates maintenance efforts due to delays in procurement and parts availability. The findings also highlighted challenges around staffing shortages and tight budget constraints that forces facility managers into a reactive maintenance approach, prioritising urgent repairs over proactive maintenance. Furthermore, external factors such as frequent power outages (load shedding), exacerbate these challenges, leading to equipment damage and increased maintenance demands. Addressing these issues requires attention to the aforementioned areas and developing strategies to improve them to ensure the effective and sustainable maintenance of specialised facilities.

### 4.5.3 Emergent Theme 3: Communication and its Effect on Routine Maintenance

The communication gap emerged as one of the contributing factors to the difficulties encountered in maintaining highly specialised facilities during the interview. Different facets of the challenges create barriers to conveying maintenance information to the relevant stakeholders. The sub-themes presented in Figure 4.16 and in this section, highlights the facets of communication challenges that need to be addressed to improve the overall maintenance processes.

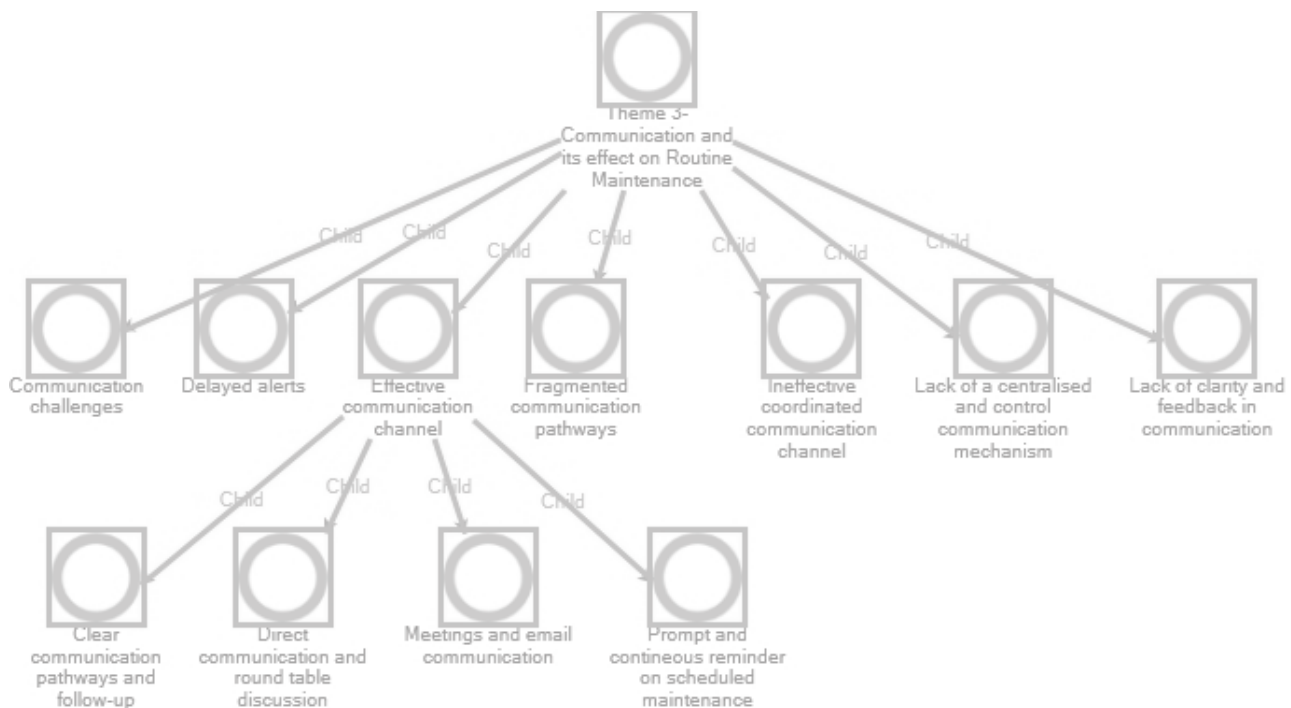


Figure 4.16: Code Map for Research Emergent Theme 3

#### 4.5.3.1 Fragmented Communication Pathways

The severity of communication fragmentation appears to be greatly affecting the maintenance processes as it impedes the flow of information among stakeholders. When communication is not streamlined, the critical part of the information can be lost or misunderstood. This poses coordination problems leading to inefficiencies in the maintenance process. The participants stated the following to buttress their frustrations around not streamlining the information system. Firstly, it is the issue of multi-step communication process:

**Participant 17:** *“ICTs have a communications team and they will send out to a communications list. So, there are certain people in each department, faculty which are on our communications list, and then we communicate to them, and then they then communicate to their department, their faculty, and then UCT has its own communications team so we will use that as the broader thing if it affects everybody on campus”.*

Secondly, it is the issue of gatekeeping information that forces the maintenance team to rely on the decentralised and specific pathways to disseminate information:

**Participant 19:** *“I try to get a campus announcement, but they said no, they don't cater for operational matters for campus announcement because if they do it for me, then there's going to be an expectation that it must be done for other departments”.*

The multi-layer communication approach stated by the participants, which prevents the use of central campus wide communication system for operational matters illustrate the challenges and underscores the need for more streamlined communication strategies. When communication is not streamlined, the risk of information loss or misunderstanding increases. Establishing clear and consistent communication pathways is vital to aid the proper understanding of relevant stakeholders in maintenance matters.

Furthermore, delays in sending alerts regarding maintenance activities or issues. The timely dissemination of maintenance information is essential for allowing stakeholders to prepare for the task to minimise disruption. This is not the case when an approval is required before action is taken towards resolving maintenance issues:

**Participant 19:** *“We have policies in place and of course, when things fail, we can also take the appropriate disciplinary action, and I've mentioned that we have taken disciplinary action, but we rely on faculty engagements, these structures like age red because we get our senior academics involved in research, particularly running the various centers”.*

**Participant 18:** *“I think we get very late alerts”.*

#### **4.5.3.2 Ineffective and Coordinated Communication Channels**

To perform maintenance activities accurately and adequately in a multi-stakeholder organisation such as a university, effective and coordinated communication channels are essential. When information is not well coordinated, it contributes to information dissemination

challenges and that would definitely affect the understanding of those receiving it and these lapses often leads to confusion and misalignment among stakeholders. Expressions in the responses from the participants show a lack of clarity or coordination in how information about facilities and their functionality or even maintenance issues are being communicated:

**Participant 21:** *“So, in the beginning, there was a mentality of, it's a green building, it won't use water, energy, it will use the solar system. So, then I've got now the academics who's the associate professor for HPI. In the beginning, she was misinforming the students on the building itself until I was invited. And then I shared a brief intro. And then I realised that after sharing it, there was more questions that came. Why is this doing this? Why is there a noise? Why do I walk in and then this happens. And why is that place hot and that place cold? Why is the lights close to the window dim and the other ones bright?”*

**Participant 12:** *“Even to understand this, you see I'm the director of an institute which is part of the entire building but the logistics of whom to deal with...”*

Even when the responsibility is assigned to a stakeholder, how other stakeholders get hold of information segment is a problem:

**Participants 19:** *“Staff member was not too impressed. I escalated and I addressed it also in the staff member concerned and, in the end, she agreed that they will have a staff member responsible for that piece of equipment now I cannot say for sure that when they go on field trips, that is the case, but the expectation and we have it in writing that that specialised equipment will be the responsibility of the staff member”*

#### **4.5.3.3 The Lack of a Centralised and Communication Control Mechanisms**

In the context of institutional maintenance, a centralised system ensures that all maintenance related communications are managed and disseminated from a single point to all stakeholders. This provides consistency and reliability in the information shared with stakeholders. Following the eminent challenges presented in Section 1.3.2 and 1.3.3, it is evident that the absence of a centralised, controlled and monitored communication mechanism can lead to inconsistent and unreliable communication:

**Participants 2:** *“They are normally sent out during using the CMD communication department. So those get communicated when there's going to be scheduled maintenance and also that gets displayed also on the CMD website, but on certain days it's going to be routine maintenance”*

**Participant 4:** *“The one issue that sometimes arises is that nobody quite knows who's responsible for what at UCT. Do we have to call security, or do we call (name omitted) directly or do we call (name omitted)? Because sometimes it's easier to just call the one person directly. And maybe if that can be very clear, like here's your pathway. And it's kind of, usually the problems arise is when there's something urgent”.*

**Participant 12:** *“We usually have no mechanism for communicating with all of us. Remember, we belong to different departments from pharmacology, haematology, cardiology surgery. There is no platform how all the people staying outside to communicate and there is no one with the right training who understands how to tackle the issue”.*

**Participant 14:** *“they might go up to the mountain to look for certain plants, but there's no control or communication in place, and then you go to the faculty, you go to the Dean and yet there's an expectation that she is responsible and accountable”.*

**Participant 21:** *“When you actually walk in with your old-fashioned way with a paper and pen just to check, do your normal checks, then you see that there's a deviation on what the BMS gives you and what the equipment is”.*

#### **4.5.3.4 The Lack of Clarity and Feedback in Communication**

The maintenance process requires precision to effectively address the challenges. And communication that lacks clarity and feedback mechanisms can create misunderstandings and hinder effective maintenance planning and execution. When this is the case, downtime is inevitable because there is no clarity on what to do and who to call. The lack of clarity was observed as one of the themes from the interview data:

**Participant 12:** *“if you have an alarm like that, I don't know who is reporting what and I don't get feedback on why we had an alarm”.*

**Participant 19:** *“I get asked so many questions that I have answered a lot. I know there's a staff member every year ask me almost the same questions every year”.*

**Participant 12:** *“...said he called someone, but I was talking to somebody, I had no clue who he called. You didn't send your message what it was. I don't want to ask your property services, did ... (name omitted) speak to you? It sounds very immature, you might agree. So, you see that, everyone walks down, standing up, we all don't know why. That's something we could definitely (inaudible) and at the end of the day it could be an E-mail explaining the event to all the key people, the alarm was you know due to x, and it has been resolved or not resolved or will be resolved. It could be a spokesperson who informed us. All we have is a*

*spokesperson who we inform, and the person says no this complaint must be registered there. So, we don't even know who to inform".*

#### **4.5.3.5. Effective Communication Channel**

Several key themes emerged from the data provided by the participants regarding effective communication channels to ensure proper communication within the institutional maintenance system. The communication channels utilised were equally mentioned and all relevant insights are presented here.

#### **4.5.3.6 Clear Communication Pathways and Follow-up**

There are multiple parties and so much information shared within the maintenance space. Having a pathway to communication was expressed by the participants to be a way to ease the enormous task of maintaining highly specialised infrastructure especially in a dynamic academic space:

**Participant 4:** *"....do we have to call security, or do we call ... directly or do we call ...? Because sometimes it's easier to just call the one person directly. And maybe if that can be very clear, like here's your pathway".*

To achieve this, there should be people dedicated to handle all maintenance related communication to ensure that concerned individuals know who to contact when an issue arises.

**Participant 9:** *"change management capabilities within technology services where we have an agent who is preparing the communications that is sending them out to the necessary deans or faculty heads that we are going live with functionality and then once again it's followed up as well".*

It all boils down to easy access to information and easy information transmission.

#### **4.5.3.7 Direct Communication and Round Table Discussion**

Some participants alluded to resorting to direct communication and round table discussions to communicate with other stakeholders as it helps with clarity and removes ambiguity in team communication. This approach plays a vital role in addressing maintenance issues and

facilitating immediate feedback:

**Participant 19:**

1. *“So, we do share with them, we presented at faculty boards, we presented at some departments, we presented to the Deans Forum, we presented to the governance structures, finance Committee, audit and risk committee, risk management committee”.*
2. *“...So, what I do is that I engage and present it to them. I present to them in addition to doing at the faculty... ..and these are people that run these units, and I go directly to them as an additional strategy, but I shared with them the guidelines, we’ve represented through the faculties, so we try to target when we are going to be getting people that can take the message and convey it. We also presented a culture”.*

**Participant 13:** *“So there's different structures, but obviously there's very direct communication which would just be like one-on-one dealing with issues with the relevant people by email or telephone or in person”.*

**Participant 3:** *“So the preferred way is email. WhatsApp takes a second, because that's just a quick find for somebody”.*

**Participant 20:** *“Well, there are different platforms you can use to communicate that as if I'm answering you correctly, it can be actually in the form of round table discussions or in the form of workshops,*

Direct communication becomes even more effective when it is adopted by Faculties and Executive Management:

**Participant 14:** *“other faculties have direct communication, and they just keep us up to date. The Deanery is quite effective in communication”.*

Direct communication is void of any ambiguity, facilitates understanding and encourages prompt response, feedback, as well as provides space for quick and collaborative decisions either to proceed with the maintenance plan or make some adjustment to accommodate all stakeholders.

#### 4.5.3.8 Meetings and Email Communication

Meetings and emails remain the official mode of communication for all organisational activities including infrastructure maintenance. Two of the participants expressly mentioned that they engage through these means as they remain effective:

**Participants 1:** *“I normally try to meet with the facilities managers to explain to them the maintenance that will be required upfront. And we sort of look at the drawings about how it could be done”.*

**Participants 20:** *“at the moment we have just been using e-mail to say look we have this challenge”.*

#### 4.5.3.9 Prompt and Continuous Reminder on Scheduled Maintenance

The challenges of late responses to emails about scheduled maintenance often cause disruption in the maintenance plan. The participants stated that academics usually respond to the maintenance emails few days before the scheduled maintenance date, sometimes with objections to the plan. To minimise occurrence and ensure that all stakeholders are prepared, participants mentioned that they send emails in advance and perform continuous follow-up. Excerpts of their responses are presented below:

**Participant 4:** *“you got to give people as longer lead time as you can, if you can, like two months ahead. But you probably even, because lots of people are busy and they sort of say, yeah, there was an email about something, but you probably almost need to do a schedule like two months in advance, blah, blah, blah, 7 December XYZ. And then like middle of November there's another email, then 48 hours. You're probably going to go on people's nerves, but with that, and probably you also need to just decide, you probably need to make sure you have the right people you're communicating with”.*

**Participant 6:** *“They need to prior to maintenance at these two which prior to maintenance they need to communicate. That area that that is going to go down and the work that needs to be done. So proper communication, you always have the odd one out of it that that comes and we”.*

#### 4.5.3.10 Theme 3 Summary

The communication theme and its effect on routine maintenance explored the significant role effective and centralised communication pathways play in ensuring a proper and functional maintenance culture that ensures a proper maintenance of highly specialised facilities within

academic institutions. The data revealed that there is frequent misunderstanding, and misalignment among stakeholders due to fragmented communication pathways, ineffective channels to engage the right stakeholders, and the lack of a centralised communication mechanism and this contributes to delays and inefficiencies in maintenance processes. These delays ultimately disrupt maintenance activities. The lack of clarity and feedback further complicates the situation, as stakeholders often face challenges in understanding and addressing maintenance issues promptly.

The findings further revealed the positive side and the importance of effective communication strategies, such as establishing clear pathways, utilising direct communication, and holding roundtable discussions, as essential for ensuring smooth maintenance operations. Overall, the findings underscore the importance of improving communication systems within institutions to enhance the efficiency and effectiveness of routine maintenance. This ensures that all stakeholders are aligned in their understanding and responsibilities.

#### **4.5.4 Emergent Theme 4: Poor Maintenance Culture and its Consequences**

The issues surrounding poor maintenance culture was evident in the responses gathered from the interviews. A poor maintenance culture often manifests as a lack of prioritisation for regular upkeep, insufficient training for maintenance staff and inadequate allocation of resources. This often led to the rapid deterioration of facilities, increased frequency of breakdown and downtime and the high impact on maintenance cost in the long run. Some of the identified factors that signify poor maintenance culture are categorised and discussed in this section and also presented in Figure 4.17.

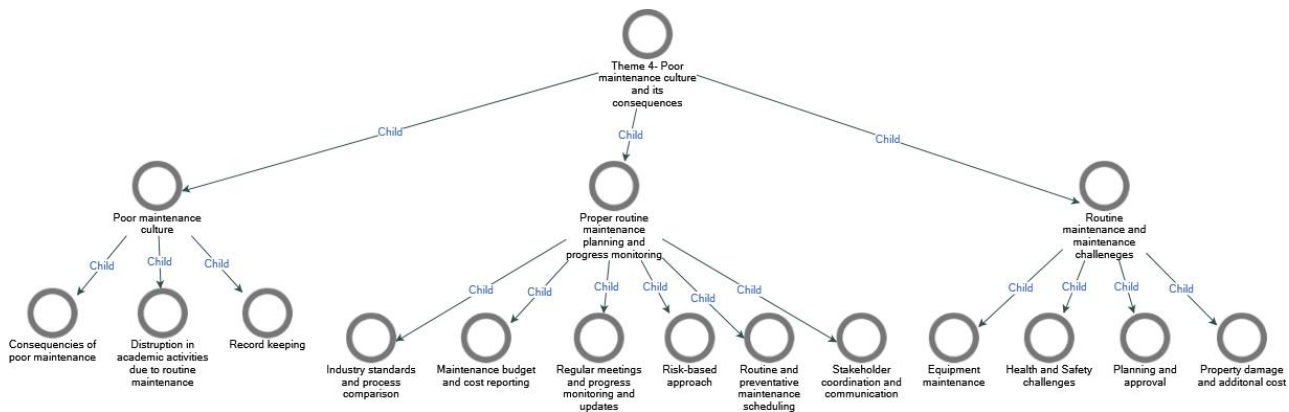


Figure 4.17: Code Map for Research Emergent Theme 4

#### 4.5.4.1 Delayed Maintenance

Instances of delayed maintenance occurred due to various reasons, including spare part availability, contractual agreement between the institution and the landlords in the cases of rented facilities or contractor unavailability. There were accounts of delayed maintenance which lasted for many years due to failure to spell out who is responsible to maintain the facilities in the lease agreement. The participants reported that these delays cause more damages thereby posing more maintenance challenges. Excerpt from the responses is outlined:

**Participant 15:** *“That caused a whole lot of other maintenance challenges because it caused other damage to the property, that caused additional cost and additional challenges to us as a faculty”.*

It was observed that the institution runs a complex and decentralised landscape of responsibility and accountability for maintenance. Some facilities are affiliated to the institution but used for highly classified research by students and researchers. In most cases, the institution is responsible for their maintenance including compliance. This decentralised approach introduces challenges in ensuring consistent maintenance standards and addressing maintenance needs across different facilities linked to the institution. This is particularly troubling since the health and safety of students and other researchers who are the direct responsibility of the institution are compromised due to non-compliance of these facilities. This observation was made through the response of participant stated below:

**Participant 15:** *“a researcher is doing research there and the roof isn't repaired and its causing damage to the research results for example, they take the risk for conducting research in that space. So, they should be doing their risk assessment office site before they agree to conduct research at a site. ... the responsibility comes back to the researcher. If they are aware that the space is not conducive to their research, then they shouldn't be doing the research there in the first place”.*

Other than the problem of who maintains the facility, participants noted that some delayed maintenance is due to factors beyond the control of the maintenance team. The infrastructures are highly specialised and sometimes the parts are not readily available. So, sometimes, when there is a failure requiring parts change, maintenance will not commence until the parts are sourced:

**Participant 2:** *“...can wait until we source the part...”.*

**Participant 17:** *“we are dependent on a lot of external third parties, contractors, and spares. We don't generally carry spares either. So, some critical areas, we may carry some spares. We're trying to go that way now, especially with long lead times. There's been problems in Europe and problems around the world, and we cannot get spares quickly”.*

Connecting the struggles of getting spare parts for maintenance during the Covid-19 pandemic, one could imagine the struggles of getting parts and how much delays were experienced and still experienced as things did not go back to normal as it were pre-Covid-19. Situations such as this leaves the facility managers in a difficult situation causing them to fall behind in their maintenance processes.

#### **4.5.4.2 Record Keeping**

While researcher's direct responsibility to maintain their equipment help to minimise reactive maintenance, independently performing this duty without the involvement of the operations department and without the maintenance record keeping by the department is observed as poor maintenance culture. This was evident in the response presented below:

**Participant 15:** *“...I don't keep any records of maintenance. So, it's kept either by the department because the thing is we don't manage the maintenance”.*

Furthermore, it was found that even the maintenance involving the factory, operations department sees no reason to maintain a record of such activities:

**Participant 15:** *"...they are logging maintenance calls and then these get attended too. But without keeping records, there's no need for us to keep records of maintenance".*

A good maintenance system involves proper record-keeping to track maintenance activities, including the particular equipment, the frequency, the personnel involved and the timing of each maintenance event. As a fact, each piece of equipment has a maintenance schedule stipulated by the manufacturer and an accurate record help keep track of when the next maintenance is due and how to trace problems from the equipment's history. The participant's response revealed a deeper problem in the system where there is no coordination and accountability in the maintenance system.

#### **4.5.4.3 Loss of Revenue, Specimen and Reputation**

There is a significant amount of critical research being conducted in some of these highly specialised facilities and one of them is drug development research. Effective performance of this research requires constant power as the trial drugs are refrigerated at a certain temperature. Poor maintenance can be detrimental to this process and could potentially lead to loss of revenue or even poor research outcomes. Participants provided the evidence of these effects, and they are presented below:

**Participant 4:**

1. *"We are very reliant on reliable power. We have trial drugs on site in our pharmacy fridge. And those drugs, that fridge could be worth like a million dollars' worth of drugs standing there. And obviously if the drugs exceed a certain temperature, then they must be destroyed".*
2. *"So, one of the floods, there's piping up in the ceiling, and one of the copper pipes developed a little pinpoint leak. But you'll be amazed how much water can come out through a pinpoint leak. I think from the 7th floor, one of the tanks there burst or leaked or something. And it was standing in a catch pan, but the drain from the catch pan was blocked or something. But at that stage we had water up till like 5cm of water on the floor. So that was obviously quite disruptive".*

In addition to the risk of losing the specimen, the participants also expressed concerns about the lifespan of the equipment and associated costs of running and maintaining the facility:

**Participant 22:** *“Currently the area they are situated in has inadequate temperature control. We have to run fans on the freezers in order to boost the colling power. This affects the lifespan of our freezers, puts out samples at risk and increase our costs associated with maintenance and repairs due to unnecessary breakdown”.*

Faculty daily operations and functionality are disrupted by appliance failure due to poor maintenance, directly impacting teaching and administrative activities:

**Participant 12:** *“...we have regular plug points that don't work. we noticed that every Wednesday at about 10:15 the entire computers shut down from the secretary section and zooms offices but even on the 6th floor it's a red plug that stopped working”.*

Continuous interruption was recorded to have affected the different equipment to the point where they are not usable anymore. And for the research to continue, the participants mentioned resorting to seeking alternatives even outside the country:

**Participant 16:** *“We have serious interruptions again and again, from air-conditioned side, and from the lift side. the animal facilities had to be closed down a few months ago because of the lack of air condition. We are going to a European centre now in November because we can't use our own. That is a terrible step because we have to fly five people to Europe, get accommodation there, pay European rates, just because our own animal facility was closed down because of lack of air conditioning”.*

Meanwhile, some of these facilities generate funds from supporting research work, contributing to the central purse and maintaining their workforce. When the facility is closed, the likelihood of losing skilled workers increases:

**Participant 20:**

1. *“Currently we have a farm unit that's shut down on the 1st floor. It would be termed the conventional unit, but then it has been shut down because there is no maintenance in terms of temperature regulation, humidity control and so forth, so we have no research where that is currently being conducted in that unit because we are not complying with the necessary infrastructure guidelines that need to be there. So that research has had to stop. So, we've actually lost research work, and researchers are moving their research work to other facilities because we don't have the right structures in place in that unit*

2. *“We generate an income from supporting research work we have been given a mandate to meet a certain quota in terms of revenue. Without that research, we don't meet that quota, so we are basically not doing what we are supposed to do. There's a risk that we may lose critical care staff because if the facility is shut down and if researchers take their work somewhere else, there's no guarantee that will continue to receive work because the facility is not functional”.*

While the effects on facilities, students and researchers are noted, the poor operation of the infrastructures also impacts the institution's relationships with external researchers and industrial partners. Given the institution's reputation as the number one university in Africa, encountering maintenance issues can significantly damage its image and credibility thereby raising strong competitors who are positioning themselves to attract researchers who are leaving the institution:

**Participant 20:** *“It's tarnishing the institutional reputation, so a lot of researchers here are taken their work to Stellenbosch. Stellenbosch is coming on strong, very much as a competitor, especially in animal research, because they currently have the facilities that are up and running and they don't have the facility issues that we currently have”.*

The data from participants clearly demonstrates the multifaceted consequences of neglecting maintenance in institutional research facilities. From running the risks of losing valuable research projects and reputations due to poor maintenance culture leading to increased operational costs and disruptions in daily operations. These findings highlight the importance of proactive maintenance practices as a cost-effective strategy to ensure the continued functionality, reliability and maintaining the financial health of these critical research infrastructures as well as preserving institutional reputation.

#### **4.5.4.4 Theme 4 Summary**

This theme highlights the detrimental effects of poor or inadequate maintenance practices in academic institutions. It further presents issues around lack of prioritisation of regular upkeep, insufficient training for maintenance staff, and inadequate resource allocation that leads to delayed maintenance, poor record-keeping, and significant losses in revenue, research specimens, and institutional reputation. The delayed maintenance is often caused by unclear responsibilities among the maintenance team, unavailability of spare parts, or contractor

unavailability. This results in more extensive damage and higher maintenance costs. Moreover, poor record-keeping in the system further exacerbates these challenges as it hinders tracking maintenance activities and ensuring equipment is properly serviced. The consequences of a poor maintenance culture include the deterioration of critical research facilities, disruption of academic and research activities, loss of valuable specimens, and increased operational costs that were equally highlighted. The findings emphasise the need for a proactive maintenance approach to ensure the long-term functionality, reliability, and financial health of research facilities while preserving institutional credibility.

#### 4.5.5 Emergent Theme 5: Approach to Overcome Resistance to Routine Maintenance

Overall, the participants acknowledged not having major resistance from the senior academics. However, they highlighted certain actions (merged into themes: Figure 4.18) that, if not done, could trigger resistance.

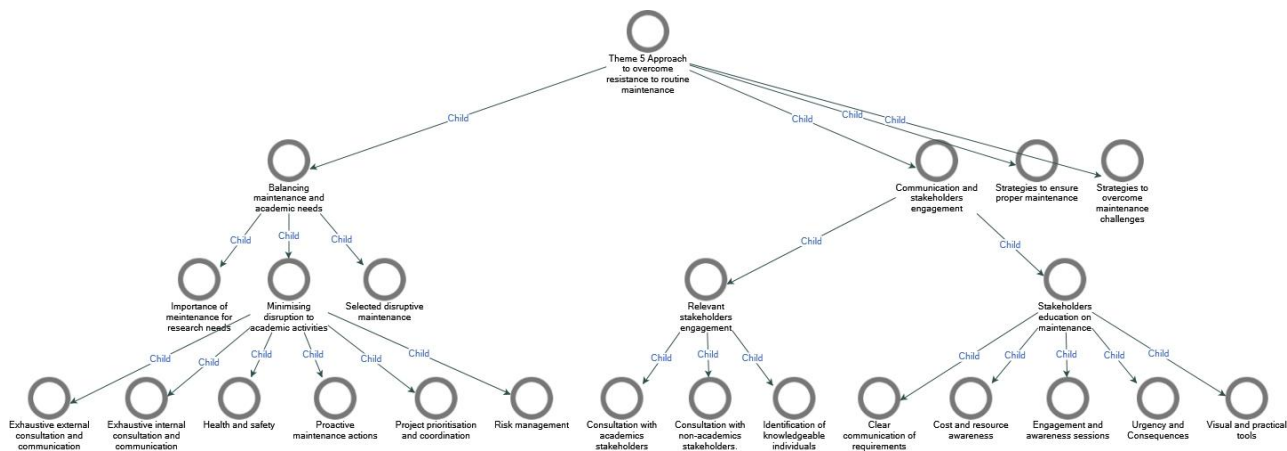


Figure 4.18: Code Map for Research Emergent Theme 5

##### 4.5.5.1 Sub-Theme 1: Relevant Stakeholders' Engagement

This factor forms an important part of any successful maintenance strategy, particularly in the context of academic institutions where the upkeep of critical infrastructure directly impact research, teaching and learning and the overall functionality of the institution. To address the objectives of this research, which aim to examine the factors affecting these critical aspects of the institutional activities, participants were drawn from academic staff, service providers, management staff and the maintenance department. The participants shed light on these

factors and the emanating themes presented in the following section serves as a guide towards devising strategies that promote collaborations and address existing challenges.

Effective maintenance in highly specialised facilities necessitates the active involvement of all stakeholders, including faculty members, facility directors and managers, maintenance personnel and external maintenance service providers. Engaging these key stakeholders ensures that they are in alignment with the institution on maintaining high standard infrastructures. Within this section, three important themes emerged: namely, engagement with academic stakeholders, engagement with non-academic stakeholders and the identification of knowledgeable individuals. These sub-themes provide nuanced perspectives on the dynamics of stakeholders' engagement that were observed.

#### **4.5.5.2 Sub-Theme 2: Engagement with Academic Stakeholders**

The key to maintaining a viable maintenance process in a university context is proper engagement with the academic stakeholders. Academic staff, including professors, researchers and students as the primary users of these facilities possess valuable insights into the facility's functional requirements. The interview elicited vital information concerning the level of engagement that ensued between the academics and the maintenance team and when it should be initiated and additionally, their opinions on this engagement and how it helped to shape the current system and processes. The first part of the quotations highlights participants' opinions on prior engagement and when it should start to ensure proper alignment and smooth processes:

**Participant 1:** *“But there has to be some proper consultation, otherwise the academics would resist having a shutdown, especially if they got lot of important experiments running and they can't really shut it off. ...the communication starts right at the beginning of the project, probably through project meetings and through email communication”.*

**Participant 17:**

1. *“The primary point is we negotiate directly with the researcher, the faculty, or the Prof. ...we then liaise with whatever users are within our data centre, and we inform them that, so we give them notice that in six weeks' time we would do XYZ, and we give*

*them the calendar up front, and so they are well aware of what is happening up front for the year”.*

2. “But our customers within our facility, we've got to get buy in from them so that they are also aware of what we must do and why we have to do it. So, there's less resilience from that side”.

**Participant 8:** *“I think it's important that the communication is done very well at the start, and you sensitise everybody because there are lots of stakeholders. So, you speak to each person individually, say, this is what's going to happen, this is what do you expect is going to happen? What do you need? And then you finalise that at a point you say, well, this is the project, guys, and this is how it's going to be. Basically, meeting with them as a start, helping them to understand what can be done within the budget, what will be done”.*

In addition, continuous communication and engagement throughout the duration of the project duration is essential to ensuring completion and success of the maintenance strategy:

**Participant 15:** *“Needs proper planning, advanced planning, communication with stakeholders, very important and also the continuous engagement with them because they have plans in terms of when they need to finish certain projects”.*

**Participant 13:** *“when problems arose, what's important is that there's proper engagement with all the users in the building”.*

The insights gathered highlighted that early and proper consultation mentioned by Participant 1, advanced notice by Participant 17 and continuous communication and engagement with the academic stakeholders by Participants 13 and 15 are key strategies that contribute to a smooth process. Conversely, the absence of such engagement can lead to miscommunication, misunderstanding and resistance from the academics:

**Participant 10:** *“lack of communication and that is the one thing that I think we can experience here, is that when the research projects start they are not aware of that they communicated with the maintenance people so that the maintenance people can be aware of the importance of that workplace and that it needs to be available so that they can plan either to do preventative maintenance beforehand, or are aware and do their planning so that when there's a failure they can timeously rectify it”.*

#### 4.5.5.3 Sub-Theme 3: Engagement with Non-Academic Stakeholders

Engagement in a university maintenance process is not only with the academic stakeholders but also with the non-academic stakeholders, including the executive staff, facility managers and external contractors/service providers. The participants shed light on this engagement and how it facilitated their success of maintenance:

**Participant 1:** *“We try as well to liaise with the maintenance department or people who are operating or maintaining the system, give them a chance to comment on the design, to see how they would actually maintain the system”.*

Participant 1 highlighted the importance of involving all concerned individuals from the design stage of the process. Furthermore, Participant 5 highlight the importance from the perspective of getting them to be key into the maintenance process:

**Participant 5:** *“we obviously had annual big meetings towards the latter part of my years at UCT, we started having annual meetings until we got people to buy into the whole...”.*

**Participant 13:** *“you've got sort of project management meetings where broader group of stakeholders involved that happen regularly”.*

Interestingly, executive management stakeholders are approached differently. Their engagement is centred on providing proof why the project is worth the cost:

**Participant 6:** *“We approached them differently because in the industry it's common knowledge that you do have bean counters, and they look at the money spent and not at the infrastructure. we do a well-documented report and with a lot of photographic evidence because you can see the problem. What it looked like prior to maintenance and then there after it is very easy, easy for somebody that has not got very difficult knowledge to assist the problem and the difference and. The value that you have added to performing”.*

**Participant 18:** *“it's about making sure that we work with them to get our stories straight. But the motivations are solid that when it gets to council, we don't want for it to be kicked out and they are not happy and we missed something, right?”.*

**Participant 20:** *“...whilst you're busy doing that you're also busy writing emails and copying relevant people so that they can see that you are at least trying to do something because you are hoping to keep these researchers on board”.*

The response from the participants underscores the critical position of wider consultation to enhance the maintenance process.

#### **4.5.5.4 Sub-Theme 4: Identification of Knowledgeable Individuals**

It is essential to engage, identify and assemble individuals with the right expertise and authority in specific areas of facility maintenance within academic and non-academic spheres. This ensures effective maintenance planning and execution. Participants expressed these sentiments that assembling the right people or even introducing the identified expertise to other parties ensures that people with knowledge are left to handle maintenance responsibilities:

***Participant 6:** “So, when it comes to maintenance, it is important to take the expertise that you have within a certain environment and to hand it over to the person on the other side of the of the table that he is comfortable to you”.*

***Participant 1:** “I try to obviously find specific people within the building or the Unit that has a lot of technical knowledge, but who also has some power in terms of talking to the academics and who is close to the process of actually doing the experimentation and is also quite knowledgeable about how it's maintained”.*

Interest in the facility maintenance is also another essential in this:

***Participant 4:** “And professor, whoever is in charge of the clean room, if you email him or her exclusively, they may just ignore it or kind of think that everybody else knows. So, you probably, almost like once a year or something need to check your contact list. Who is the lab manager, who is the supervisor on the floor, who is going to actually implement a shutdown prior to filter change or something and make sure that you got those correct people, that you are communicating with them, rather than just the kind of head of department who might not actually be that involved in the day-to-day kind of running of the system”.*

#### **4.5.5.5 Sub-Theme 5: Stakeholders' Education on Maintenance**

Maintaining highly specialised infrastructure facilities within an institution of higher learning presents a huge challenge due to the uniqueness and classified nature of these facilities. In this case, the stakeholders' knowledge of the maintenance requirements for these facilities impacts the outcome of maintenance activities hence, one crucial aspect that can significantly enhance this process is the level of education of the stakeholders on the importance and the risks associated with each facility. Additionally, educating stakeholders is essential in mitigating resistance and fostering a cooperative environment. The participants shared their

thoughts on this, emphasising its importance. Some support and recommend that it should be a common practice. The next sections present different facets of stakeholders' education that guarantees a successful outcome.

#### **4.5.5.6 Sub-Theme 6: Stakeholders' Education on Maintenance Requirements**

Stakeholders' education starts with a clear indication of maintenance requirements for each facility they are managing. Direct communication to the stakeholders (FM and users) explaining what a standard maintenance entails, what falls short of the minimum requirements and why this is the case will help align their knowledge with the facility's maintenance needs:

***Participant 4:** "One thing is that you got to convince people that this maintenance is necessary and that you're not just doing it to annoy them. And I guess there's nothing like bluntness. We basically say your clean room certification is not valid if you don't do X-Y-Z, or you can't do something if you don't have this type of maintenance done. So, I think there you got to just be very clear, like, this is what needs to be done and this is why it should be done".*

The intention is to educate and ensure that the stakeholders are appraised of all that they need to know about the maintenance of the facilities they either manage or use. This will eliminate any form of resistance when requests are made to perform the scheduled maintenance or respond to situational calls. Indeed, this level of engagement would assist the stakeholder in understanding and complying when need be and to ensure that their facilities are properly maintained and in full functional condition.

##### **4.5.5.6.1 Education on Urgency and Consequences of Routine maintenance**

In most cases, what creates misunderstandings and subsequently resistance to maintenance is when the urgency and consequences of not performing the maintenance as is supposed to be, is not spelt out. So, highlighting the urgency and consequences essential for conveying the critical nature of proposed maintenance of the highly specialised facilities is important. Pointing out the potential impacts of neglecting maintenance, such as equipment downtime, compromised research outcomes and safety consequences, all stakeholders can understand the importance of prioritising maintenance activities and obtaining full stakeholders'

commitment to proactive maintenance practices. In so doing, everyone will be aware that the consequences are felt by all and not just the academics or non-academics:

**Participant 1:** *“So it's more about explaining to people, look, this is the risk that we identified. You are the user in the building now. How do you want to acknowledge this risk? We need to do this either now and we can maybe delay for a week or two, but if you don't do it, then you possibly could be facing a downtime of six months to get the equipment fixed. So, yeah, it's very important for us to explain the risks upfront, and we try to do obviously a risk register for the users to make them understand when we need to do stuff”.*

It is important to back up the advance maintenance schedule and notification of stakeholders with information sessions explaining why the maintenance is necessary and important. These sessions should emphasise the benefits and necessity of the maintenance work thus ensuring that all stakeholders understand the importance of maintaining the highly specialised infrastructures:

**Participant 4:** *“The one is that you got to convince people that this maintenance is necessary and that you're not just doing it to annoy them. So, I think there you got to just be very clear, like, this is what needs to be done and this is why it should be done”.*

Again, educating all parties involved clears the path and sets the tone for a well-balanced and practiced maintenance system within the institution. This approach does not only ensure that maintenance tasks are completed efficiently but also promotes a culture of cooperation and shared responsibility among all stakeholders.

#### **4.5.5.6.2 Education on Cost and Resource Dependency of Routine maintenance**

In most cases, based on the interview data, the resistance experienced by either the academics, maintenance personnel or the external contractors is due to the lack of awareness on the facility maintenance requirements. Creating awareness about cost and resources involved in maintaining an infrastructure is crucial to garner support from the stakeholders. By transparently communicating the cost and resources implications, including the cost of repairs, replacement, the cost of carrying out preventive and reactive maintenance, the facility managers ensure a continued and proper functioning of the facilities.

Furthermore, it would enhance stakeholders' appreciation for the investment made and would be made to sustain the highly specialised facilities. Without clear communication and education, resistance is imminent:

**Participant 20:** *“There’s an outcry from the researchers that we’re too expensive and we are trying to say we charge so much because just to replace the cages is at least a million Rand. That’s why we charge you so much, so we also need that platform to be able to share with them what we have in our facilities, the importance of each piece of equipment that’s in there and how much it costs to just keep it up and running or to fix something that’s broken, because I think there’s also a disconnect in that regard”.*

The complaint about the high cost of animal care facility services and the challenges it posed to maintenance was because of the information gap between the facility and the researchers. Clear communication on the cost implications would help align everyone’s understanding on the expensive maintenance cost of the facility. Surely, this would reduce the maintenance challenges and would set the institution on the right trajectory.

#### **4.4.5.6.3 Engagement and Awareness Sessions**

Engagement and awareness sessions provide valuable opportunities to gather stakeholders in one room and educate them on maintenance practices and educating them on the importance of collaboration and cooperation in surmounting the enormous challenges of facility maintenance. These sessions offer a platform for interactive discussions, sharing of knowledge and addressing concerns thereby enhancing stakeholders' understanding of maintenance challenges and their role in supporting maintenance efforts:

**Participants 19:**

1. *“We have an awareness session where we informed stakeholders about particularly what was happening here, so we had an awareness session with the maintenance department and we told them about what is expected, particularly, even when the loss happens”.*
2. *You know, awareness is important because you don’t want the disruption to happen. You want that to be an exception to the norm, you want people to take the necessary preventative care. So, we do share with them, we presented at faculty boards, we presented at some departments, we presented to the Deans Forum, we presented to the governance structures, finance Committee, audit and risk committee, risk management committee”.*

**Participant 8:** "...sensitise everybody because there are lots of stakeholders. So, you speak to each person individually, say, this is what's going to happen, this is what do you expect is going to happen? What do you need? And then you finalise that at a point you say, well, this is the project, guys, and this is how it's going to be".

Some elements of willingness are required to make the awareness sessions possible and to achieve the intended goal or aligning all stakeholders and improving the maintenance of processes:

**Participants 18:** "trying to provide some guidance, some support for all the researchers, if they want".

#### 4.5.5.6.4 Visual and Practical Tools

This emerged as a key theme considering the diverse nature of the stakeholders. Most of the highly specialised facilities are highly technical and not all stakeholders have a technical background. Even for the technical ones, the level of technicality differs across facilities and technical stakeholders may not comprehend when the technicality goes outside their field of expertise. This will surely create friction within the team and would stir up some level of resistance. To bridge this gap, the stakeholders are encouraged to employ visual aids to aid the understanding of all. This approach also helps during emergencies, especially when the technical personnel are not available to attend to the situation. A non-technical staff can refer to the visual aid and attempt to address the situation:

**Participant 4:** "The generator hasn't started, stem cell lab next door starting to panic because of their stem cells, et cetera. And those things almost invariably then happen on a long weekend or something like that. So, I think that's what your emergency coverage is and what is your mechanism. And possibly even make a laminated flow chart or something that can be put up in various places so that even people that don't have that institutional knowledge kind of have a thingy to follow".

Although stressed by one participant, it stands out as it indirectly causes challenges between the maintenance personnel and their managers as well as other stakeholders who do not have a technical background and hence do not comprehend technical jargons. In most cases, resistance to maintenance is caused by this.

#### **4.5.5.7 Theme 5 Summary**

The theme “approach to overcome resistance to routine maintenance” explored strategies to mitigate resistance to maintenance activities in highly specialised facilities within academic institutions. Among all, engaging relevant stakeholders early in the process, particularly academic staff, to ensure their buy-in and cooperation were identified as key strategies to be adopted in order to mitigate/minimise resistance. To avoid misunderstandings and resistance, participants emphasised the need for continuous communication and proper planning as well as engaging non-academic stakeholders, always including executive management and external contractors to ensure a successful maintenance. Through these engagements, identifying and involving knowledgeable individuals in maintenance planning and execution will be made possible to ensure that the right expertise is applied, and resistance is minimised.

The theme equally noted the place of educating stakeholders on the importance, urgency, costs, and consequences of maintenance, in ensuring and fostering cooperative environment. Most importantly, using visual and practical tools to help align everyone’s understanding is crucial to ensure the buy-in of the executive stakeholders. These approaches collectively aim to create a culture of collaboration and shared responsibility, reducing resistance and ensuring the smooth execution of maintenance activities.

#### **4.5.6 Emergent Theme 6: Strategies to a Successful Maintenance System**

This section presents a robust data collected from engaging 21 participants on effective solutions for servicing highly specialised facilities. This involves understanding current infrastructure usage, fostering collaborative solutions, overcoming specific maintenance challenges, improving the overall maintenance system and planning for continuous improvement. This section covers (1) the facility managers and maintenance personnel’s implemented strategies to ensure that facility maintenance requirements for the highly specialised facilities and equipment are met, and (2) the suggestions made by the participants on how to improve the current maintenance system. This theme and sub-themes are captured in Figure 4.19.

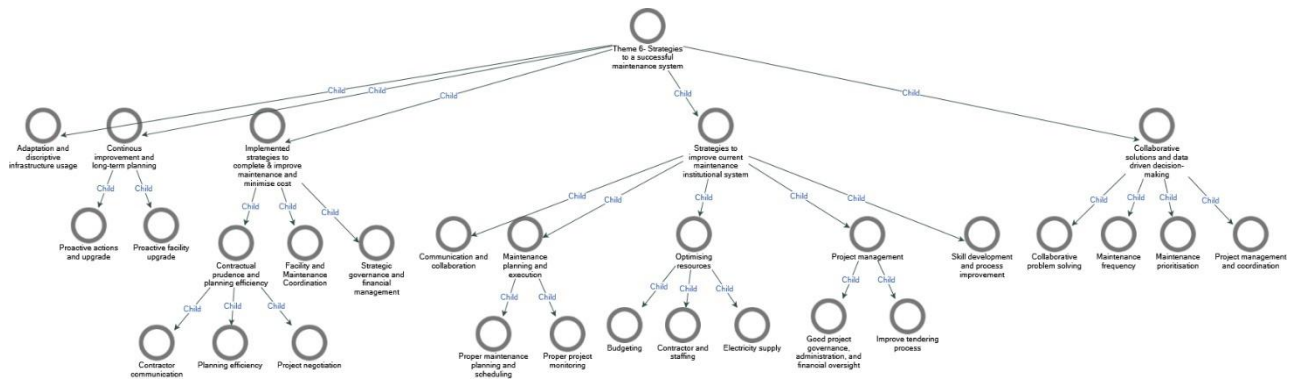


Figure 4.19: Code Map for Research Emergent Theme 6

#### 4.5.6.1 Sub-Theme1: Implemented Strategies to Improve Maintenance and to Minimise Costs

To successfully maintain these highly specialised facilities and meet their high demands, participants discussed various strategies to employ in order to complete and improve maintenance efficiency and minimise costs. The strategies are classified into:

##### 4.5.6.1.1 Adaptation and Descriptive Infrastructure Usage

This theme explores how the specialised facilities are currently being used; any modifications or adaptation approach employed by the stakeholders to meet academic and research needs and how these factors impact the facility usage and maintenance requirements. The participants expressed how they managed to navigate the difficult situation of system failure amidst the normal operations of the institution. In most cases, the participants acknowledged dealing with so much system failure that they had to either alternate usage of some units or run them intermittently. Confirmations of these actions are captured in the quotations below:

**Participant 2:** *“We had the two HVAC units failing. And because it's a high-performance computing that's happening, there's a whole lot more heat that gets generated by the equipment. And now without proper cooling you're going to get to a point where the machines get damaged. Some of them will just shut down on their own. So, in order to get around the cooling issue, sometimes some of the machines that run there's redundancy within the system engineers would have certain machine that would run with maybe, say, so many computing calls or something like that. And now to assist with the cooling, the inadequacy in cooling, then they would then also be shutting down either equipment that isn't like, especially on the critical levels within the DC so that at least the level of heat that has been generated is much lesser*

and then until we get to replace all HVAC units, so there's a lot of communication and collaboration with different stakeholders”.

**Participant 3:** *“but yet the lab manager tries to get away with Ups and inverters and things like that, and then he would run one inverter for three microscopes and switch off and then move to the other one because they also cannot be without power because what happens is, if there's an operation at the hospital and they harvest a piece of brain that's live tissue, they then bring that over into our building, and they put it under the microscope and they look at the neurons and they look at all these things in the brain. There cannot be a breakdown in communication with electricity network, anything like that. So, he's chopping and changing to try and keep the power up to make his research worthwhile at the end of the day. So, once again, it's electrical. It's a main challenge for us”.*

Furthermore, the maintenance team uses discretion to prioritise certain tasks over others based on their criticality, severity and health and safety concerns. Maintenance problems that could negatively impact humans or the environment are given higher priority:

**Participant 1:** *“We do a risk analysis to determine which ones must be done first or what's the biggest impact if we don't do it. Some might have a health and safety implication where it could be dangerous to people, which is also something we need to try and act on quickly”.*

**Participant 5:** *“But to prioritise the maintenance tasks, I think if you've done the work yourself, you know more or less instinctively what can wait until tomorrow”.*

The severity of the situation helps them to be flexible and adaptive especially in situations where there is ongoing research and other academic activities that should not be interrupted:

**Participant 5:** *“If there's a sensitive project on the go, we stop our project and extend it until they've finished whatever the sensitive stuff they're doing, and then we can carry on”.*

Despite challenges, the team is making flexible decisions to navigate and manage the challenges, supporting continued academic activities with minimal interruption.

#### **4.5.6.1.2 Collaborative Solutions and Data Driven Decision-making**

Effective navigation of maintenance landscape in an academic institution on the use of these highly demanded specialised infrastructure entail the involvement of all stakeholders to make

the best decisions in the interests of all. Such decisions are made based on the information before the team and the available resources at their disposal. Collaborative decision making came up several times during the interviews where the maintenance team engaged different stakeholders to ensure they get buy-in to perform certain tasks or in some cases suspended their planned routine maintenance where it was necessary.

### **a) Collaborative Maintenance Discussions**

Several instances were mentioned where the facility manager or the maintenance team had consultations with affected stakeholders to determine the best approach to continue the maintenance of the infrastructures. The participants reported so many positive outcomes from these sessions which include not just agreement to perform the maintenance but also leveraging their expertise to address maintenance challenges. Presented below is the feedback from the participants on the need for effective collaborative maintenance discussions. The response from a participant presented below illustrates the importance of planning and collaboration, where consulting the academic calendar and relevant stakeholders resulted in a well-timed maintenance shutdown:

**Participant 1:** *“what we had to do then to handle the situation was to try and have a widespread consultation process. We then consulted the UCT calendar of events, and we managed to, with the help of ICTs, find a slot during the maintenance slots to then have the shutdown implemented”.*

This level of consultation provides room for mutual assistance during emergencies and strategic leave planning to ensure continuous oversight and problem-solving:

**Participant 12:**

1. *“We are working very well together in the entire care park building which means if there is flooding on one floor, we help each other out and transport equipment samples to different floors”.*
2. *“They don't take leave all at the same time, so we have a leave plan to make sure that certain professors are here also over Christmas will be here and certain people do a walk around. So, we help each other out, picking up problems through the end and that works”.*

This means that stakeholders are properly engaged to understand their needs and find innovative solutions to their problems to ensure uninterrupted operations during maintenance:

**Participants 17:** *“We had to come up with an alternative plan to provide network connectivity for them for that meeting. We checked with them what systems they required for that and what could be run in the cloud. And we helped the administrative people to prepare all that stuff before that so that they wouldn't need their local IT service during that meeting. And we got ahead and got our kit sorted out during that time”.*

**Participant 18:** *“This process, it's not my decision which one must be done. We get input from, or I get input from whoever's going to procure and say we need a new installation. On that job we will do a survey, we will then look at the specifications of the unit, and then we will normally say that's a troublesome unit or it's an old unit and must be replaced. And the decision is then made collectively to attend to that unit. And then we go forth from there to specify and then sign the agreement for whatever installation it is”.*

Involving the procurement team also assisted in facilitating a smooth but flexible and quick purchase of the required items for maintenance especially when there are delays:

**Participant 18:**

1. *“it's very light touch but you would have specific things that you'd want to discuss, and you would build an action list, and you just send it and that would be for both. we've got this, it's three months overdue. What can you do about that so then somebody else phones the payments team and the admin in our back office and we try and flush out what that is”*
2. *“They may also say, you know, there's some innovation, here's a loan, think about it. So put that in your game”.*

The participants' actions and experiences shed light on the significance of consultation and collaboration in maintenance decision making. It leads to smooth and quick processes in resolving maintenance related issues.

## **b) Maintenance Frequency**

The maintenance frequency was better decided and agreed upon through consultation with relevant parties. Part of the decision involved determining how often maintenance activities should occur to ensure the optimal functioning of the facilities based on collaborative inputs, manufacturer's specifications and data analysis.

**Participant 6:** “if you for instance have a type of switch, the maintenance frequency of the world type switch here in accordance with the manufacturer’s regulation is 3 to five years. Now depending on the location of that switch, if it is installed close to the sea If it is equipment that’s standing in the warfront, the frequency of that maintenance is going to change. if it has been subjected to high volume fault conditions, the frequency of the maintenance and what the regulation states”.

**Participant 17:** “Sometimes maybe something happens on campus, and we can’t do our midyear maintenance status in the maintenance. We’d have to postpone it to the next month”.

### **c) Maintenance Prioritisation**

A key to meeting up and coping with the maintenance demand is a focus on how to prioritise different maintenance tasks based on urgency, impact and available resources ensuring that the most critical issues are addressed first. Effective prioritisation depends on how much the maintenance team can bring all stakeholders onboard to make decisions. Utilising technology, Participant 2 and their team were able to monitor their system and through the result made decisions:

**Participant 2:** “We also have monitoring for all the data centres, so depending on the alert that we get then we will get those attended to”.

Based on the information from the monitoring device, routine maintenance is collectively planned and what to prioritise is decided upon:

**Participant 2:** “Depending on what some of the things that need to be attended to, things that maybe can wait a day or two or can wait until we source the part, but for some they need to be attended to urgently. Maintenance wise, there is a schedule every month, for example, things like generators we are scheduled every month to be tested so that they can still start up normally”.

### **d) Maintenance Project Management**

A smooth and cost-effective maintenance entails proper planning. By planning the participant tried to tackle maintenance in a way that ensures its suitability and cost efficiency:

**Participant 3:** “We also have a project management meeting team in our building whereby we look at every fourth night. We have a meeting to discuss. We bring to the table. For example, I will bring something, say, from BME, somebody will bring something from TC, somebody will

*bring something from Caba. How are we going to work around that? And these projects are disseminated with other technical offices and scientists as well so that everything is not on me. It's kind of like spread thinly over the technical offices just to bring their part, because each one it brings it part, it creates a conclusion at the end of the day. And that's how we kind of manage the anatomy building”.*

**Participant 4:** *“I'm sure the specialised units would want you to do your maintenance after hours or over weekends, which then probably starts conflicting with budgets because it's generally going to be more expensive. And if you're using service providers, they may not be willing to come in and do something”.*

The findings show that a collaborative planning approach seems effective in maintenance processes. However, challenges arise when dealing with specialised facilities. In this case, implementing the suggested recommendations could lead to a more cost-effective and efficient overall maintenance strategy.

#### **4.5.6.1.3 Continuous Improvement and Long-Term Planning**

The participants alluded to the fact that long-term strategic planning is essential for a sustainable maintenance practice. It involves ongoing evaluation of the current situation and in conjunction with the futuristic outlook to make decisions on improvements needed to accommodate future conditions. This theme highlights the importance of continuous improvement initiatives and the development of long-term plans to ensure that the specialised facilities are maintained to the highest standards suitable to support the institution's academic and research goals. The participants, in their responses proved to have considered this and implemented facilities that are today serving their purposes:

**Participant 12:** *“I made an application to the physical Planning committee, and I got the funding. All the air-con, the ducts, and electricity had no central switch off, switch on the light when you switch on every individual light. So, in 2012, the entire floor was upgraded and then in 2015, the entire 5th floor was upgraded. And now in 2023 is the sixth floor I applied for all the funding. For all those upgrades via the planning committee”.*

**Participant 3:** *“So what we have there, we've started changing over the years slowly, for example, bringing in HVAC system to improve the air quality and that was all done through capex projects over a long period of time”.*

Likewise, a few of them are proactively acting now to implement upgrades to put up facilities that would serve purpose in the future. Especially when the capacity of usage increases to a point that outweighs the current system:

**Participant 4:** *“The environmental equipment, which is like cooling system, that we are planning because now, yes, that [current facility] was spec for the space and certain load. But now as time goes by, like, IT systems improve from time to time, and the computing power becomes more and more. And the more the computing power, the more heat gets generated. So now with the cooling that was spaced for the data centre, that is something that after some time now, that needs to be revisited to check that those units still cover or can cool the data centre even like with the load at that time”.*

**Participants 3:** *“so far the improvements that we are putting in place is like in premia that is working on adding redundancy, which is power wise and like, well, an extra generator and an additional up so that at least we have that bit of redundancy for the data centre”.*

However, Participant 3 noted that it is not enough to think of developing new facilities but to develop a high-quality facility that can stand the test of time hence he asked this question:

**Participants 3:** *“If we put up a new building, are we going to do the same thing or are we going to build a better infrastructure that's going to last much longer?”*

The participants past actions of implementing facility and equipment project which they are making use of today serves as evidence to the importance of forward thinking. The frequent breakdown experienced today is because of system overuse or overload because they are now working beyond their designed capacity and lifecycle or load limit.

#### **4.5.6.1.4 Contractual Prudence and Planning Efficiency**

Found as one of the major challenges faced by facility managers is their dependency on contractors, both service providers and spare parts dealers. To overcome these challenges, participants proactively employed good communication, project planning and negotiation strategies to achieve success in their maintenance activities.

### **a) Contractor Communication**

Effective communication leading to good relationship with the contractors throughout the maintenance process is crucial for achieving cost-efficiency and successful project completion. The participants in this study emphasised the importance of direct communication and managing the flow of information based on their experience and knowledge in the job to ensure cost-effectiveness. The following quotes illustrate how participants leveraged communication to build strong relationships and influence contractors' approach to maintenance projects:

***Participant 7:** "And as far as the budget goes, I monitor any finances. So, the service provider doesn't talk directly to UCT management. They talk through me so I can monitor any costs. If they come with a cost that I see is not relevant to the job, whether it's painting a wall and it was included in the contract, then I refuse payment, and we negotiate after that"*

***Participant 8:** "So it's a lot of communication, a lot of planning before you even bring the contractor on board".*

***Participant 17:** "Because they are our quadrants, we dictate to them that they need to come up front with the expected costs, the expected parts, et cetera, et cetera. So, we try and pre-empt whatever is coming up. So, we try and plan it".*

Facility managers' experience and technical knowledge with the facilities gives them a valuable advantage over the management stakeholders when communicating with contractors. This allows them to step into different areas of the project and ensure tasks are completed efficiently. Furthermore, by understanding the tasks better, they can prevent contractors from exploiting any knowledge gaps in the finance department. Overall, these findings highlight the importance of clear and managed communication with contractors which was a key strategy employed by the facility managers for cost-effective maintenance of the specialised facilities.

### **b) Planning and Execution Efficiency**

Thorough planning before engaging contractors is essential. This involves defining the scope of work, preparing detailed specifications and obtaining competitive bids. Additionally, planning, defining and dividing the project into manageable parts is crucial to achieving a completed maintenance or even new development project. The participants emphasised the

importance of a well-defined plan that helps to minimise the risk of unforeseen issues that might lead to cost overruns during project execution. The quotations below demonstrate how participants effectively planned for maintenance projects to minimise risk and ensure standard project execution:

**Participant 18:** *“we start off by writing our ideas or our approach through a strategy that frames what we want to do, which is visible. It is distributed through the senior levels; it is signed off and then we can do so. it is trying to make sure that we place the right people at the right time to ensure we do this properly”.*

**Participant 13:** *“...and then that would kind of be like a trial and a pilot for maybe we're going to take one laboratory and try sort of green the one laboratory and then see how it goes and then see if that's something we can roll out more extensively”.*

**Participant 3:** *“They're not just there at the drop of a hat. That's not the case. I have to be mindful of them. If we get X amount from them, bonus. But it's still up to us also to look at the department and how we budget and how we assist where we can. So, it's just not about maintenance, it's also about us as well, how we plan our projects and things like that going forward”.*

**Participant 8:** *“In other words, we didn't go through a tender process. So that's probably one of the differences to a typical project that sometimes you must find these specialized subcontractors or specialist contractors that do that type of work designing laboratories because there are only one or two in the country or maybe three maybe three in the whole country”.*

The findings clearly emphasised the importance of planning beyond just communication with contractors. By defining the scope of work, preparing detailed specifications and potentially upfront and breaking the project into smaller units and piloting it, facilities managers can mitigate risks and avoid costly contingencies during project execution. Furthermore, careful planning allows for realistic budgeting which ensures that maintenance project is executed at a reasonable cost. Ultimately, these strategies demonstrate how planning efficiency contributes to achieving cost-effective maintenance in specialized facilities.

### **c) Project Negotiation**

Project negotiation skills are vital when finalising contracts with contractors. Understanding

market rates and negotiating favourable terms can significantly impact project cost-effectiveness. Based on the data, partakers in this study emphasized the importance of proper negotiation with the contractors to ensure that the maintenance project is executed in a manner favourable to all parties:

**Participant 17:** *“we have to be a little bit agile, but everything's negotiated upfront”.*

**Participant 18:** *“We've stopped stuff at certain points where information is missing. They see the motivations don't match the value we were shown. And then we ask for greater details”.*

These findings show an act of being proactive at the onset of the project to negotiate things even before the commencement of the project. This ensures that there are no unforeseen costs that will be too much to stop the project halfway. This underscores the necessity of having an in-depth knowledge of what the project requires as that will aid the negotiation exercise.

#### **4.5.6.1.5 Strategic Governance and Financial Management**

Every project, regardless of size or scope, hinges on strategies in the governance and financial system. Without a well-defined plan and a robust system to manage finances, even the most promising maintenance system can fail. Anything that avoids this will result in failures or improper implementation.

#### **4.5.6.1.6 Strategic Governance**

To a facility manager or personnel, it is imperative to be able to defend the strategies put together to manage these key elements. The participants highlighted the importance of these elements and how they utilised it to ensure their maintenance exercises were successful. Presented in the quotes below are excerpts from the interview conducted in this study:

**Participant 13:**

1. *“We have sort of governance structures in place that report to the PIC (project implementation committee) and each project has its own PIC. And then there's also the PMC (project management committee) itself. So, all the PICs report into the Project Management Committee within PNS. So, in that way, it provides kind of a governance structure to the various projects and their staff and managers involved in that”.*

2. *“...it will be depending on what resources and budget they have in IDM to see what they can do. And then that would kind of be like a trial and a pilot. Maybe we're going to take one laboratory and try sort of green in one laboratory and then see how it goes and then see if that's something we can roll out more extensively”.*

**Participant 13:** *“Having a good relationship with colleagues and with also external contractors I think is really important, kind of so that there's a good relationship of trust between the different players and people are able to talk to each other sort of quite openly and without hesitation. And then making use of the right governance structures to help kind of facilitate maybe certain difficult challenges where you want broader input on, and you want kind of more formalised input as long as they are working effectively”.*

For a successful implementation, a strategic maintenance management structure needs strong advocacy and clear action plans to gain buy-in from stakeholders:

**Participant 9:** *“I had to go in front of the whole union and had to defend my decision that we are going with a proper solution, and we can't rely on students and computer science lecturers to write our applications for this thing. Then we did a very comprehensive RFP, we went out and we tested the entire market, and we allowed the best vendors to come and give us proposals.”*

**Participant 13:** *“we are taking a more strategic governance approach whereas in the past the approach was reactive, we now are more proactive. ...you must be quite aggressive with them and It's about going to the deanery, but you must just be firm, and I always believe that consistency in your message is very important”.*

Furthermore, effective leadership is crucial for any project's success. It equips the team to navigate challenges that could otherwise stall or derail progress entirely:

**Participant 13:** *“An important strategy is to make sure that the chairpersons of those relevant committees are also equipped in a way that allows them to help unlock some of those challenges”.*

To strengthen the governance system to be able to overcome project challenges, a sound project fund/funding management is crucial. This system allows the project team to keep track of all funding occurrences in the project and at a glance, see which project has the funding to commence immediately and those that could be delayed due to funding limitations. This ensures informed prioritisation and resource allocation:

**Participant 18:** *“we’ve got contracts trackers, so the contracts tracker is at most our planner looks after it. We have sourcing meetings every week and we work our way through the contract’s tracker. So, that’s kind of how priority levels work. Often it is high value. The higher the value, the more that kind of prices rises to the top. We’ve got multiple priority levels. Priority one is the stuff that we talk about, and we focus and priority three, let’s call it just routine. And then below that it’s on the list so we don’t want to lose sight of it. There may be contracts that we know, that are going to expire. It may be somebody says we want to do this; we don’t have the funding. OK, so put it there and that’s how we work. We’ve worked with the departments. If we need to try and resource up which we’ve done a few times in the maintenance perspective. We sometimes reach out to the purchasing consortium comment log in. We get a contract manager or a senior contract manager to help us just to get through the spirit. But generally, we try and manage the priority and its shifts or of the contracts track”.*

The findings give an indication that a strategic governance system thrives on open communication and strong relationships. This transparency builds trust, leaves no room for ambiguity, and ensures clear project execution processes and instructions. It fosters a collaborative environment where everyone feels comfortable to voice their concerns during the project planning and execution. Good financial management systems integrate seamlessly within this system. Real-time visibility into resources through a sound project fund/funding management system empowers informed decisions. This allows for prioritising projects based on available funding and identifying potential delays, ensuring optimal resource allocation and successful project implementation.

#### **4.5.6.1.7 Funding and Budget Management**

Funding and budgetary limitations significantly hinder facilities managers’ ability to perform routine maintenance. So, securing and managing funds is essential for a successful maintenance of the highly specialised facilities. As per the data from the interview, the participants shed light on how they navigated this funding challenge and how they were able to manage the available funds to ensure that the facilities are well maintained. The quotes presented serves as evidence of their implemented approaches to securing funding and to ensure that maintenance processes align with project budgets:

**Participant 3:**

1. *“One has to understand that there are budgetary constraints. It would be beneficial to us if we have Capex projects applications going. They’re not just there at the drop of a hat.*

*That's not the case. I have to be mindful of them. If we get X amount from them, bonus. But it's still up to us also to look at the department and how we budget and how we assist where we can. So, it's just not about maintenance, it's also about us as well, how we plan our projects and things like that going forward”.*

- 2. So, when we start planning, we look at Capex as a way forward to find funding for this. Because a lot of researchers come with the research money, but that research money cannot be put aside for maintenance of the infrastructure. So, they try a Capex route and a small fraction of the research money they throw into it as well to spruce the place up, basically.*

One thing is securing the project fund, and another is to manage the fund effectively. Planning expenditure is much more important in a project. Participant 13 adopted a pilot project strategy to help minimise waste:

**Participant 13:** *“Depending on what resources and budget they have we're going to take one trial and a pilot laboratory and try sort of green in one laboratory and then see how it goes and then see if that's something we can roll out more extensively”.*

For larger projects, a more strategic approach is needed. Careful planning that leverages the expertise of a qualified external team experienced in key maintenance areas can be a cost-effective way to manage these projects. Participants used a two-pronged approach, combining internal Project Network Structure (PNS) with outsourced expertise to reduce costs and ensure efficient oversight while maintaining strong budget control:

**Participant 13:** *“the bigger projects will typically be the project management will happen through PNS, but then also even that is outsourced then to an external project manager and a professional team who manage all of that”.*

Because they outsourced and managed these projects, they have a high degree of control to demand and manage whatever challenges that may arise:

**Participant 17:** *“because they are our quadrants, we dictate to them that they need to come up front with the expected costs, the expected parts, et cetera, et cetera. So, we try and pre-empt whatever is coming up. So, we try and plan it”.*

Overall, the presented findings in this section highlight a governance and financial management system that considers various funding options, adapts project execution

processes for specific needs. It emphasises upfront cost planning and the mode of execution suitable for any project considering the size.

#### **4.5.6.2 Sub-Theme 2: Strategies to Minimising Disruption**

##### **4.5.6.2.1 Exhaustive Internal Consultation and Communication**

To minimise the disruption of activities, a thorough internal consultation emerged as pivotal for effective planning, preparation and execution of maintenance activities within an institutional setting. The participants highlighted the necessity of open communication, regular meetings and collaborative efforts to address issues and ensure that all internal stakeholders are in alignment. Presented below are the excerpts from the participants as evidence of this:

**Participant 13:** *“I think that just comes down to good planning and preparation...open communication and regular meetings where any issues can be addressed just so that there's an immediate line of communication between the two parties and they can address any issues as they come up”.*

During communication, planning and preparation, negotiations can occur between the academic and maintenance personnel. This process helps both parties to understand each other's positions regarding academic activities and the maintenance needs to keep the facilities fully functional:

**Participant 7:** *“we negotiate with all parties, which is UCT management, which deals directly with the FM or the people carrying out the experiments”.*

**Participant 2:** *“So now, as I was saying, we had the two HVAC units failing... there's a lot of communication and collaboration with different stakeholders”.*

It is also necessary to consider the fact that there is a stipulated academic calendar that must be followed strictly to ensure that students or researchers do not fall out of track:

**Participant 1:** *“What we had to do then to handle the situation was to try and have a widespread consultation process. We then consulted the UCT calendar of events, and we managed to, with the help of ICTs, find a slot during the maintenance slots to then have the shutdown implemented”.*

To ensure that the academic calendar remains undisturbed, it is imperative to establish comprehensive consultations well in advance with academic and even the executives of any planned maintenance activities. This proactive approach helps align schedules and minimises

disruptions to academic activities. Furthermore, updating the academics timely as the scheduled maintenance is approaching to ensure that every party prepares and position themselves to accommodate the process:

**Participant 1:** *“I noticed that once you send out an email like there's going to be a shutdown of any sort, people tend to always reply like a day before that you're going to do the work to say you can't really do it now. So, what I try to do is send out an email at least like a month before, if possible, or even like six weeks before. And then you start to see people will maybe respond in two- or three-weeks' time, but it still gives you a time slot to try and reprogram your works and make sure everybody's aligned”.*

**Participant 15:**

1. *“It requires teamwork and engagement with all responsible parties to make sure that the issue is resolved timely so that research can continue”.*
2. *“Needs proper planning, advanced planning, communication with stakeholders, very important and also the continuous engagement with them because they have plans in terms of when they need to finish certain projects”.*

In the event of the academic not understanding or complying, involving an expert within the system who can mediate to facilitate the process becomes essential:

**Participant 17:** *“We always must check that UCT calendar... She negotiates our maintenance slots, so we have our set maintenance slot. So, we try and plan our work around those slots because they are published upfront a year ahead of the time, so people are aware of them, and they factor that into that calendar”.*

#### **4.5.6.2.2 Exhaustive External Consultation and Communication**

Effective external consultation and communication are crucial for leveraging specialised expertise, minimising downtime due to maintenance operations capable of disruptions to academic activities. The participants emphasised the importance of engaging with external vendors, subject matter experts and other stakeholders to enhance maintenance efficiency and effectiveness. Presented below are the excerpts from the participants as evidence of this:

**Participant 9:** *“The strategies used involved leveraging external vendors who are subject matter expert for technology implementation... ..scheduling go-lives on weekends to minimise*

*disruptions, and ensuring vendors maintain equipment and standards with zero disruption to services”.*

**Participant 1:** *“what works is a wide-ranging consultative process”.*

**Participant 2:** *“So now, as I was saying, we had the two HVAC units failing... so there's a lot of communication and collaboration with different stakeholders”.*

**Participant 7:** *“We negotiate with all parties, which is UCT management, which deals directly with the FM or the people carrying out the experiments. And then we alter our program to suit whatever's happening on the facility, whether it's exams, research they're doing. We will then alter our program”.*

**Participant 18:** *“If there's a preferred relationship, it means that it's called the fast-track procurement process, because they simply need one quote, and they can then check benchmark pricing”.*

The findings underscore the importance of optimising external experts within the specific areas of maintenance operations by tapping into their specialised expertise to enhance maintenance quality. Proper consultation will help to schedule major maintenance activities at a time that will minimise disruptions. Additionally, the flexible scheduling that aligns with facility needs, along with efficient procurement processes and preferred vendor relationships are crucial for maintaining operational continuity and reducing administrative burdens.

#### **4.5.6.2.3 Risk Management**

Risk management is pivotal to mitigating potential failures that could disrupt institutional activities. The participants highlighted various strategies to address and manage risks within their maintenance systems which are presented in the quotes below:

**Participant 5:**

1. *“We will do a risk register. So, if it comes out in the red, the risk is saying, look, if we don't do this now, we're going to have a catastrophic failure and the downtime”.*
2. *“There were weekly roster duties. There were things that the students had to do themselves. We have a huge risk, a high risk for bacterial contamination. So, the routine maintenance didn't only include getting and keeping the machines going, but it was also the technique and how they did things that was as important”.*

**Participant 2:** *“We had the two HVAC units failing. So, there's a whole lot more heat that gets generated by the equipment. And now without proper cooling you're going to get to a point*

*where the machines get damaged. Some of them will just shut down on their own. So, to get around the cooling issue, sometimes some of the machines that run there's redundancy within the system engineers would have certain machine that would run with maybe, say, so many computing calls or something like that. And now to assist with the cooling, the inadequacy in cooling, then they would then also be shutting down either equipment that isn't like, especially on the critical levels within the DC so that at least the level of heat that has been generated is much lesser and then until we get to replace all HVAC units, so there's a lot of communication and collaboration with different stakeholders”.*

From the research findings, the participants pointed out different avenues as key into risk management strategies such as risk registers, routine maintenance and contingency plans to mitigate risk and enhance the resilience and reliability of their maintenance systems thus ensuring continuous and efficient operation of their facilities.

#### **4.5.6.2.4 Project Prioritisation and Coordination**

To minimise disruption, prioritisation is essential for managing maintenance. Presented below are quotes from a participant highlighting the essence of prioritising and the importance of strategic planning, negotiation, teamwork and engagement with stakeholders to ensure the timely resolution of issues and uninterrupted research activities:

**Participant 7:** *“If there's a sensitive project on the go, we stop our project and extend it until they've finished whatever the sensitive stuff they're doing, and then we can carry on. ...we negotiate with all parties, which is UCT management, which deals directly with the FM or the people carrying out the experiments”.*

**Participant 14:** *“one of the strategies has been that we set up specialised committees to make sure that all the compliances are addressed in those areas”.*

**Participant 15:** *“it requires teamwork and engagement with all responsible parties to make sure that the issue is resolved timely so that research can continue”.*

**Participant 1:** *“what we had to do then to handle the situation was to try and have a widespread consultation process. We then consulted the UCT calendar of events, and we managed to, with the help of ICTs, find a slot during the maintenance slots to then have the shutdown implemented”.*

#### 4.5.6.2.5 Health and Safety

Health and safety procedures must be embedded in all operations within the specialised facilities in the university for the reasons of mitigating loss/damage to equipment/machines, disruption of operations, costly repairs or replacements and mitigating injury/at worst loss of life. Poor health and safety implementation can cause disruption of work activities and lead to lengthy and costly legal battles. Presented below is a quote from a participant emphasising the importance of health and safety considerations:

**Participant 10:** *"...to ensure that those mechanisms are implemented and to ensure that there's not new tasks or if there are new tasks, what has these new tasks on the health and safety of the machine as well as the health and safety of the operator of that machine, and if there is additional hazard that has come forward, it needs to be addressed. ...to ensure the supervision is to implement access control"*.

#### 4.5.6.2.6 Planning and Preparation

The foundational of effective maintenance starts with proper planning and preparation. The interviews data emphasised the importance of strategic planning, establishing appropriate specifications and fostering strong relationships between academic departments and project implementation teams to ensure the smooth execution of maintenance projects. The interview excerpts, revealing key strategies for minimising disruptions from the participants' perspective are presented:

**Participant 13:** *".... just comes down to good planning and preparation and then putting the appropriate specifications in place that allow contractors to either work outside normal working hours or during the vacation periods"*.

Planning from inception can help schedule maintenance in a way that does not interfere with the normal academic process.

**Participant 9:** *"We minimise the disruptions by doing it go lives on Friday evenings, running over Saturdays and some Sundays, and testing on the Sundays, so that by the time Monday comes, and the faculties come back"*.

Things work well and projects go as smoothly as possible when there are plans in place before the project starts. The chances of it failing are minimised:

**Participant 12:** *“What I have done is, in my research, I had a research officer, a doctor, and her job was to check that all ethical approvals were in place and certain equipment was tested. So, my research was going very well because I have a person who's supervising, importing, exporting samples, and transporting training my students so that is simple so there are no issues”.*

These findings suggest integrating strategic planning from the maintenance project's inception thus allowing flexible scheduling to accommodate both the contractors and the academics. By so doing, the contractors can schedule during non-peak hours and vacation periods, appointing dedicated personnel for compliance oversight and equipment testing. Implementing these practices can enhance the efficiency and effectiveness of maintenance systems and minimise disruptions.

#### **4.5.6.3 Sub-Theme 3: Strategies to Improve the Current Maintenance System**

Effective maintenance is the backbone of reliable operations. To achieve this, a comprehensive strategy that addresses various aspects of the maintenance process is needed. In this section, the key sub-themes that contribute to a stronger maintenance system are presented.

##### **4.5.6.3.1 Optimising Resources**

Effective M&O of specialised facilities can be achieved through resource optimisation. Interview data emphasised the importance of proper prioritisation in budgeting, effective cost control, good planning and execution, strict monitoring, good communication and collaboration and adoption of a thorough contractor selection process, to optimise resources.

##### **4.5.6.3.2 Budgeting**

Effective budgeting, budget management and ensuring adequate funding for maintenance activities are crucial. The participants based on their experiences highlighted the need to have a proper funding in a maintenance system:

**Participant 8:**

1. *“The most effective things that can be done in the way the university manages general projects, whether it's specialised or not, is to be very careful in the budgeting, to budget the*

*right numbers, which was a problem that they didn't budget properly and then be very tough on the budget”.*

2. *“If there's a cost overrun, then you force the professional team, the architects and engineers, to go back and try and fix it. Not just accepting extra cost because there's a temptation to keep accepting extra costs because of the environment that it's in. You have to be quite hard on the professional team just to say, guys, this is not acceptable. We need to get it right”.*

**Participant 15:** *“we don't budget for maintenance law only because we're paying our landlord being UCT. they need to make sure there's sufficient budget for maintenance”.*

Deep collaboration involving the researchers, the management, maintenance team and the suppliers could potentially address funding challenges. Their joint effort can lead to a shared value proposition that benefits all parties. Supporting this idea, a participant's response states:

**Participant 18:** *“I think that researchers work with some of the partners to get budget figures of that is folded into, the research proposal. Yeah, I mean, everything is going to be about how we can find this good, shared value proposition”.*

Furthermore, there should be allocation and full control of funds by key and strategic departments to enable them swiftly to respond to emergency “instead of us knocking on your door and asking maintenance at the last minute”:

**Participant 17:** *“My long-term thing I would say that the university itself just needs to set aside an operational emergency budget for IT. If we were controlling that budget so some of the stuff, we just cover out of IT budget, because it's just easier than having to fight with maintenance. We will fix it out of that emergency contingency fund”.*

As can be seen from the participants' responses, effective budgeting and funding strategies are essential for maintaining the functionality, reliability and efficiency of facilities and the development of their proper maintenance strategies. Proper financial planning, collaborative efforts and dedicated emergency funds are critical components of a robust maintenance system in a dynamic environment like institution of higher learning.

### a) Contractor and Staffing

Optimising the use of internal staff and external contractors for efficient resource allocation. Presented below are quotes from a participant highlighting their proposed ways to deal with issues around external contractors and other internal stakeholders in an institutional maintenance system:

**Participant 15:** *“There needs to be appropriate control of maintenance contractors to make sure that they're not charging you more than they should. Get reputable service providers on board, make sure there's no duplications of work, make sure there is warranty on work that's conducted and there's proper track of calls that are logged, they need to ensure that they hire the right people”.*

These findings from the improvement strategies highlight several and diverse critical implications for optimising the use of internal staff and external contractors. First, institutions must be diligent in selecting reputable contractors and continuously monitoring their performance. This ensures that only competent and reliable service providers are engaged, minimising risks associated with poor-quality work and overcharging.

Second, after the efficient selection of personnel to engage in the work, duplication of work should be prevented, and all maintenance activities tracked properly. By this, institutions can allocate resources more efficiently to minimise waste, reducing costs and improving overall maintenance effectiveness.

Third, securing warranties on work conducted by contractors provides a safety net against potential future defects. Together with ensuring competent and skilled internal and external contractors are engaged in key maintenance areas. This not only ensures quality but ensures that tasks are completed efficiently and effectively and also reduces long-term maintenance costs.

Fourth, maintaining detailed logs of maintenance activities promotes transparency and accountability. This allows for better tracking of work performed, identifying areas for improvement and ensuring that contractors are held accountable for their performance. Overall, optimising the use of internal staff and external contractors requires meticulous planning, monitoring and management to ensure efficient resource allocation and high-quality maintenance outcomes.

## **b) Electricity Supply**

Reliable and cost-effective power supply is essential for smooth maintenance operations hence the participants have this to say about improving the power supply within the institution to promote the effective running of the facilities and equipment:

**Participant 2:** *“so far the improvements that we are putting in place is like in premia that is working on adding redundancy, which is power wise and like, well, an extra generator and an additional up so that at least we have that bit of redundancy for the data centre”.*

These findings underscore several and diverse critical implications for improving electricity supply within institutional facilities. First, reliability is enhanced by implementing redundancy such as backup generators and UPS systems which improves the reliability of electricity supply. This reduces the risk of downtime due to power outages, ensuring continuous maintenance operations and minimising disruptions to facility services. Secondly, redundancy measures protect critical infrastructure against potential losses associated with power interruptions and ensure data integrity. Third, the inception of incorporating redundancy has high investment implications, however, the long-term benefits in terms of reduced downtime and maintenance costs outweigh the expenses. Redundancy is a proactive measure to address power supply vulnerabilities and institutions can avoid costly repairs and mitigate risks associated with equipment damage due to power fluctuations.

## **c) Communication and Collaboration**

Fostering clear communication, collaboration among teams and stakeholder engagement is vital for successful maintenance implementation. After highlighting the consequences of poor communication and stakeholders working in silos to the maintenance of these highly specialised infrastructures. The quotes highlighting their suggestions regard to help improve the maintenance system are presented below:

**Participant 14:** *“the main thing is communication. It’s all about communication and even your Deanery must know about it”.*

This mindset resonated with most participants. They think that proper communication and engagement on issues around maintenance especially at the beginning of the year would help to improve the maintenance activities. The participants have this to say:

**Participant 17:**

1. *“The first time it would be an issue because we would then have to explain this and explain that. But the next year we would just say, okay, we're doing that again, and this is why we're doing that maintenance would then know what we're doing and why we're doing it.*
2. *“It can become very expensive because you're replacing parts that are still working, but then you don't have any failures because you're replacing your parts all the time. And I suppose we're then building redundancy”.*

**Participant 18:** *“And the only way you are going to do that is I think that you need to be close to the supplier. I think constant engagement, although this is not always done in a very typical way, because it means nothing to people. When you go in, you talk and there's multiple other things. It's real when they need something, for me. When they need access to the right people”.*

The participants expressed their concerns on the institutional politics and administrative bottlenecks. However, it suggested that making things easier would ease maintenance challenges. According to Participant 17:

**Participant 17:** *“have to go to our exec director every time. let the two exec directors speak to each other to get things done. ...we had a single person and he or she then was okay with what the issues are, and then they would just say, well, they have a valid reason and then they would do that negotiation for us. I just think that will be the easiest way around that”.*

This section of data analysis revealed that poor communication and siloed operations hinder maintenance efforts. The participants emphasised the importance of clear communication across teams and stakeholders, highlighting benefits like improved planning, reduced redundant maintenance, stronger supplier relationships and streamlined bureaucracy. Fostering a culture of open communication and collaboration across teams and stakeholders is essential for effective maintenance. This approach leads to improved planning, cost-efficiency, stronger relationship with suppliers and streamlined administrative processes, ultimately ensuring the smooth operation of these specialised facilities.

## d) Project Management

- **Project Governance and Financial Oversight**

Establishing strong governance, streamlined administration and robust financial oversight ensures projects are delivered effectively. The participants' insights gathered from the interviews highlight the importance of proactive management and intervention during maintenance to maintain project timelines:

***Participant 8:** "If the program is missing deadlines or is not meeting milestones, you need to sit on the team, you need to sit on the contractor. When I say sit on, I mean you need to push them".*

***Participant 17:** "we primarily need is special concessions for critical repairs and maintenance".*

Through experiences, participants suggested and pointed out the importance of proactive oversight, active engagement with project teams and contractors and flexibility in project governance that ensures accountability and encourages timely delivery of project components. Special concessions, such as expedited approvals and dedicated funding are essential to address urgent maintenance needs efficiently. These findings and suggestions highlight the necessity of balancing stringent oversight with flexibility to ensure project success.

- **Improve the Tendering Process**

The tendering process is one of the nightmares of facility managers. Optimising the tendering process ensures the selection of the best contractors for specialised maintenance jobs in a highly specialised infrastructure. The research findings from the participants' responses highlight the current situation and challenges of the institutional tendering process and the necessary improvements needed to achieve better outcomes:

***Participant 1:** "Our tender process is very general. This needs to be adapted for specialised systems. Trying those specialist contractors needed for the specialised infrastructures and have a tender system that's still fair and robust and ties to meet all the procurement rules".*

***Participant 15:** "There needs to be appropriate control of maintenance contractors to make sure that they're not charging you more than they should".*

The current tender system is insufficient and does not accommodate specialised infrastructure and their stringent needs. The findings suggest that there is a need to adapt the tender process to accommodate specialised contractors while maintaining fairness and compliance with procurement rules while also mounting control mechanisms such as cost control and regular audits to monitor the process to prevent overcharging by external contractors. This ensures that the specific needs of specialised infrastructures are met effectively at a fair and cost-effective price.

- **Maintenance Planning and Execution**

- 1. Proper Maintenance Planning and Scheduling**

Developing well-defined plans and schedules for preventive maintenance activities minimises downtime and optimises resource utilisation. Presented quotes from the participants reveal the critical role of advanced planning and digital tools in enhancing maintenance efficiency:

***Participant 9:** So, what we're going to be introducing hopefully next year is the introduction of Service Now, which is UCT's ERP platform to help me digitise all of these technical its annual corrective maintenance type activities that I need to do on the IT systems within P&S.*

***Participant 12:** "Increase capacity of P&S and quality of maintenance".*

There is a need to enhance both the capacity and quality of maintenance operations through the introduction of digital tools which facilitate the digitisation of maintenance activities. This enhances the efficiency and accuracy of scheduling and tracking preventive and corrective maintenance tasks, ensuring all activities are performed effectively and timely, especially when manual errors are reduced leading to reduced downtime and prolonged equipment lifespan. These findings highlight the importance of incorporating digital solutions and expanding maintenance capabilities to achieve efficient and high-quality maintenance planning and scheduling.

- 2. Proper Project Monitoring**

Continuous monitoring of ongoing maintenance projects ensures that they stay on track and deliver the desired outcomes. The emphasis from the participants centred on the importance of comprehensive oversight from project inception to completion:

**Participant 8:** *“Then the final thing, which I think wasn't done before, various reasons, was that the project managers need to oversee the whole project right from the very start, from when they even conceptualise the project, when they meet with the client, when they decide what they're going to do right to the end”.*

It is evident from the response that effective project monitoring requires facility managers to be involved throughout the entire product lifecycle. From the conceptualisation stage and client meetings, through design and development, to implementation and final delivery, project managers involvement ensures continuous oversight and ensures alignment with project goals. This helps in the timely identification of issues in the process and to institute implementation of corrective actions. This comprehensive involvement helps in understanding the entire lifecycle of the product, allowing for better planning of maintenance standard processes and schedules based on anticipated potential issues. This finding also pointed out that the integration of the facility managers ensures that projects are completed within budget.

### **3. Continuous improvement**

Investing in skills development for the maintenance team and continuously improving processes leads to a more efficient and effective maintenance system. The participants emphasised the importance of enhancing capacity, quality and adaptability within maintenance operations:

**Participant 12:** *“Increase capacity of P&S and quality of maintenance”.*

**Participant 18:** *“The other thing is to try and get my team, potentially the contracts managers, to maybe the next level, so that I can deploy them into areas that are more, let's call it Nuance, right”.*

These findings highlight the critical implications for achieving continuous improvement within maintenance operations. Prioritising skills development through training programs to enhance team capabilities and efficiency alongside a focus on implementing robust quality assurance measures to ensure consistent high-quality service delivery.

#### **4.5.6.4 Theme 6 Summary**

The theme “strategies for a successful maintenance system” presented various approaches to improving maintenance practices for highly specialised facilities. The highlights from the

participants shed light on the importance of adapting infrastructure usage to meet operational demands, employing flexible maintenance strategies, and prioritising tasks based on risk and safety considerations. They emphasised collaborative decision-making and data-driven approaches where stakeholders work together to plan, prioritise, and execute maintenance tasks efficiently. In addition, cultivating the continuous improvement and long-term planning were identified as crucial with a focus on upgrading outdated facilities and implementing redundancy in power supply facilities to ensure reliability.

To achieve all these, effective communication with both contractors, internal, and external stakeholders was deemed essential for minimising disruptions and ensuring cost-effective maintenance project execution. The theme also underscores the significance of strategic governance, financial management, and proper budgeting to maintain the functionality and reliability of facilities. Finally, participants understand the importance of resource allocation, tendering processes and project monitoring in maintenance activities. They call for optimising, improving, and enhancing these factors to ensure successful maintenance outcomes.

## **4.6 Discussion of Findings in Terms of Literature**

### **4.6.1 Introduction**

The discussion of research findings is the section in study process, where interpretation is taken from scrutinised data. Through the interpretation and discussion of findings, researchers engage in the data in search of broader meanings (Kothari, 2019). The purpose of this study is to explore the challenges that facilities managers encounter when trying to perform routine facilities maintenance work in highly specialised facilities at an institution of higher learning in South Africa and to identify strategies that can be used to mitigate these challenges.

This section is segregated into three distinct subsections in the context of existing literatures. The first part looks at findings regarding senior academics' resistance to routine maintenance. The second aspect discusses the findings about the challenges faced by facilities managers in performing routine maintenance. The third and the last part deals with findings relating to strategies for a successful maintenance system.

## **4.6.2 Resistance to Routine Maintenance by Senior Academics**

This section discusses the findings related to the reasons behind senior academics' reluctance towards routine maintenance and the potential solutions derived from participants' engagement during the comprehensive data collection

### **4.6.2.1 Disruption of Ongoing Academic Activities**

The reluctance primarily stems from the disruption that maintenance work can cause to ongoing research and other academic activities. The findings revealed that senior academics do not inherently resist routine maintenance, but specific actions and lack of engagement can trigger resistance. Participants observed that such conflicts between maintenance needs and academic imperatives are associated with the pressure on the senior academics to keep up with the demand and set target. This prioritisation sometimes leads to neglect or even opposition of routine maintenance schedules, thereby causing delays or even downtime that disrupt essential academic activities.

### **4.6.2.2 Lack of Communication and Stakeholder Engagement**

This highlights the significance of timely and effective interaction and stakeholder engagement (Alqaisi, 2018). Based on the findings, the participants emphasised the need for early and continuous communication with the stakeholders to ensure alignment and smooth maintenance processes. This is consistent with literature that highlights the significance of communication in managing academic and non-technical stakeholders' expectations to reduce the possibility of resistance (Alqaisi, 2018). Supporting this view, Buurman et al. (2021), Langsdale and Cardwell (2022), and Vrancken et al, (2021) emphasised the need to holistically engage and involve all relevant parties in matters as they holds the influence to improve decisions that lead to successful strategy implementation.

Engagement with academic stakeholders, including professors, researchers, and students, is critical to ensure that maintenance of specialised facilities has their full support. Likewise, non-academic and external stakeholders (maintenance contractors) with specialised skills regarding the facilities and equipment in question ought to be engaged. Their insights into the functional requirements of the facilities are invaluable. Several participants highlighted the importance of early consultation and continuous interaction with all relevant stakeholders and

their sentiment aligns with the finding of Brown et al, (2021) and Langsdale and Cardwell (2022). Furthermore, Owusu-Agyeman and Moroeroe (2022) argued that engaging students, academics, and professional staff is essential to addressing the institutional challenges such as maintenance problems.

Furthermore, “regular and annual project management” meetings and involving the skilled maintenance personnel from “design stage” is needed to ensure buy-in from all interested and influential facilities parties in a particular academic environment. Research shows that involving the maintenance team from design stage is advantageous because it equips maintenance team with useful information for maintenance purposes (Hauashdh et al, 2022). Discoveries also emphasise the significance of identifying and engaging individuals with the right expertise and authority in facility maintenance is crucial. Having and dealing directly with such persons facilitates easier project approval. Furthermore, there is a necessity of regularly updating the contact list to ensure communication with the right individuals who are directly involved in the day-to-day operations. These findings are consistent with the thesis in the literature by (Štok et al, 2023) who stress the importance of involving skilled personnel in maintenance activities.

Engagement with executive management especially those without technical knowledge requires demonstrating the value of maintenance projects through well-developed reports equipped with photographic evidence, as noted by the participants. Similarly, Cherner and Fegely (2023) stated that the use of visual aids facilitates understanding of the non-technical stakeholders.

#### **4.6.2.3 Academic Priorities and Maintenance Needs**

One of the core results in this study is the conflict between academic priorities and maintenance needs. Academics often prioritise research and teaching commitments over maintenance requirements, leading to their reluctance in accepting routine maintenance in their facilities. This finding is in alignment with challenges of striking a balance between the need for maintenance and the organisational primary operational demand as presented in (DeGrendel, 2023; exertherm, n.d; Villegas, 2021).

The study further revealed that several high-level research activities by senior academics were in motion during investigation. This research cannot cope with shutdown which is evidence of how academic schedules and ongoing research projects often clash with maintenance activities. One of the participants stated, “The main issue is that we cannot cope with a shutdown or loss of access that goes beyond one or two days and then disruptions our project because of routine maintenance” This issue was noted during clinical trials due to the complexities of the process and the cost implications. The participants indicated that any disruption could destroy the drugs which cost millions of Rands. This situation is similar to experiences of hospital maintenance personnel facing challenges of determining appropriate time to schedule medical equipment maintenance due to round the clock patient support (FTMaintenance, 2024). Just as hospitals need backups when primary equipment is offline, research labs need alternatives when maintenance occurs, which is not always feasible.

Similarly, from the lift maintenance perspective where noise is eminent, one participant highlighted they were asked to stop maintenance work due to noise of the maintenance in a teaching facility as noise disrupts the classes or in a hospital facility where noise is totally prohibited. This inherent conflict underscores the difficulty of balancing the academic calendar with necessary infrastructure upkeep. The academic resistance often stems from a perceived interference with their core responsibilities, demonstrating the need for more effective scheduling and negotiation to minimise disruptions (Gutterman, 2023; Siva et al, 2022).

This level of engagement should commence from the inception of the project and all the situations and conditions surrounding a facility spelt out. From the maintenance perspective, the lack of information about restrictions and requirements during contract signing can lead to unforeseen challenges, as highlighted by Participant 7. This communication gap at the contract stage led to misalignment and unnecessary conflicts which was evident in the case where an academic instructed the contractor to cease maintenance operation due to noise during class time. What this means is lack of knowledge of the class activities in the facility by the contractor and lack of knowledge of the ongoing maintenance by the academics. This speaks to a gap in project information among stakeholders addressed by Shakeri and Khalilzadeh (2020), who suggest a critical need for improved dialogue and mutual

understanding between all stakeholders from inception. Additionally, this underscores the critical importance of proper communication that promotes awareness among stakeholders, leading to consultation and collaborative decision-making on matters relating to maintenance. Maintenance can be agreed upon and scheduled after hours or even during weekends to accommodate academic activities.

#### **4.6.2.4 Perceived Lack of Expertise and Safety Concerns**

Senior academics' concerns about expertise and safety play a significant role in their resistance to maintenance activities. For instance, they expressed apprehensions about the capability of students to handle expensive and complex equipment in the proposed student-led project. Additionally, the involvement of external facility experts who may not fully understand the university environment adds another layer to their reluctant stance. One of the participants pointed out that while specialists are knowledgeable, they may lack contextual understanding, leading to potential safety compromises. Meaning they desire someone with both equipment and environmental knowledge to conduct situational assessment on every facility before maintenance just as proposed by (Benson et al, 2024). This indicates a need for tailored training and involvement of personnel who are both skilled and familiar with the specific operational context of the university.

#### **4.6.2.5 Lack of Knowledge and Awareness of Facility Maintenance**

Research findings revealed that there is a direct link between academics' knowledge of their facility maintenance and operational requirements and their attitude towards maintenance of the facility. The finding emphasizes the necessity of aligning stakeholder understanding with the specific maintenance requirements of the facilities they manage or utilise. A lack of clarity regarding these needs can lead to misunderstandings and resistance to maintenance activities (Hauashdh et al, 2024; Obonadhuze et al, 2021). Buttressing on this, the participants emphasised the importance of clear communication to achieve this alignment. In addition, this communication should outline standard maintenance procedures, minimum requirements, and the potential consequences of neglecting these procedures. By fostering a shared understanding of maintenance needs, stakeholders are more likely to appreciate and be open to maintenance and cooperate with the process.

Another significant theme on maintenance education centres on the importance of cost and resource awareness among stakeholders. Upholding this view, Mewomo et al, (2022) posited that stakeholders understanding of maintenance requirements facilitates its uptake. A lack of awareness involving the financial and resource effects of maintaining specialised facilities as well as the consequences can lead to resistance. According to the participants, being transparent about maintenance cost such as repair costs, replacement costs, and the difference between preventive and reactive maintenance costs allows stakeholders to appreciate the value proposition of proper maintenance and the justification for associated expenses. Furthermore, it fosters a sense of shared responsibility for maintaining the facilities and the resources required to do so effectively. This sentiment holds true across the projects environments with diverse stakeholders as presented by Au-Yong et al, (2018) and Brown et al, (2021) whose study indicated that involvement of key stakeholders in maintenance activities promotes their awareness and appreciation of the process.

The results stress the significance of adopting regular engagement and awareness sessions with the stakeholders. Participants acknowledged that these sessions promote sense of collaboration when interactive discussions and improve their knowledge are shared to address stakeholder concerns. In addition, they alluded to the fact that the sessions help them to understand the challenges, urgency, and potential consequences (e.g. equipment downtime, compromised research outcome, etc.) of neglecting maintenance of these specialised facilities, their role in supporting these efforts, and importance of prioritising maintenance activities. This level of awareness from educating all parties involved clears the path and sets the tone for a well-balanced and practiced maintenance system within the institution (Au-Yong et al, 2018; Ensafi, Thabet, Afsari, and Yang, 2023). This approach does not only ensure that maintenance tasks are completed efficiently but also promotes a culture of cooperation and shared responsibility among all stakeholders

### **4.6.3 Challenges Faced by Facilities Managers in Performing Routine Maintenance.**

#### **4.6.3.1 Institutional Management Challenges**

##### **a. Administrative and Leadership Challenges**

As identified by this study, one of the challenges of facility managers to effectively perform their facility maintenance duty stem from institutional administration and policy-related matters. According to Desbalo et al, (2024), administrative and policy-related challenges significantly affect facility managers thereby impedes the efficiency of maintenance activities. These challenges encompass administrative bottlenecks, restrictive or porous policies, and insufficient support from higher management. These challenges results to delays in decision-making processes and the implementation of necessary maintenance tasks.

Maintenance is a continuous process, often spanning a long period. The absence of a clear transition plan and coherence in leadership during leadership changes can disrupt maintenance operational processes (Khaw et al, 2023). The study revealed that facility managers expressed dissatisfaction with new leaders assuming office without knowledge of ongoing office activities including the projects, contractors, et cetera, resulting in inconsistencies and delays in processes. Highlighting this issue, collectively participants stated that “when there’s a new person in the maintenance department and they are not aware of the arrangement in place with their service providers, maintenance call delays”. Alluding to this challenge, Sindell and Sindell (2024) opined that, to solve this problem, there is a need to establish a comprehensive leadership succession plan that contains all the necessary information on the office maintenance activities and clear communication channels.

Moreover, lack of support from senior management further exacerbates facility managers’ maintenance challenges as they are forced to independently address maintenance issues (Mewomo et al, 2022). When this is the case, maintenance may be delayed, and standards may be compromised This finding underscores the significance of upper-level leadership support in facilitating effective project within an organisation. Overall, addressing this administrative and policy challenges and ensure that transition of appointed leaders with active role in maintenance are smooth and offer support to facility managers can help to enhance operational efficiency and minimise disruption in maintenance and academic activities.

## **b. Project Governance**

Maintaining an efficient specialised facility is a complex task governed by different standards, contractual agreements, and regulatory frameworks. These elements form the foundation of

maintenance operations which ensure that they are undertaken within legal, procedural and contractual specifications. The lack of specific contractual agreements and regulatory framework may result in substantial issues as evidenced by the finding of this study.

The research found that facility managers faced serious maintenance governance challenges due to lack of formalised contractual agreements. A maintenance agreement typically outlines the tasks and requirements necessary to keep a facility in good condition. The absence of legal documentation prior to any maintenance activities impedes the process. This was the case when facility managers had to stop an ongoing maintenance process to get Service Level Agreements (SLAs) in place, as this is required before any maintenance project. This finding tallies with Dorasamy and Fagbadebo (2021) with a study to unravel non-standard practices in an organisation found that absence or inadequacy of governance system vis-à-vis contractual and legal agreement disturbs processes, leading to delays and inconsistencies in maintenance tasks. Moreover, according to Moji et al, (2022), this not only delays ongoing projects but also creates administrative burdens as facility managers must negotiate the scope, budget, and specific terms of these agreements from scratch.

Additionally, findings had it that the issue is worse in the institutional rented facilities where unclear rental agreements create confusion over maintenance responsibilities. For instance, at Groote Schuur Hospital, the absence of a defined SLA between the university and public works has led to debates and delays in addressing maintenance needs causing it to stand for several years. The prolonged delays were as a result of the facility manager awaiting resolutions to these contractual ambiguities. Literature on studies around project contracts such as Naughter (2021) and Tomassetti (2020) reported similar incidence. According to Hauashdh et al, (2024), this delay causes more damage to the facility. While Naughter (2021) further maintained that proper legal documentation from project inception and contract review and adjustment to suite current situation is the best practice to mitigate the disruption and delays. These findings pointed to the necessity of having robust and clear contractual frameworks that binds contractors and landlords of rented facilities to avoid such disruptions.

Another important aspect of project governance is oversight and compliance, a crucial element for ensuring that maintenance operations adhere to established standards and

regulations. Scott & Manning (2024) posited that inadequate oversight and authority hinders maintenance project management. The research highlighted significant gaps in this area. Participants expressed frustration over facility managers' difficulties in verifying compliance due to a lack of authority and clear oversight mechanisms within the maintenance system. Absence of this introduces potential risk and possibly substandard maintenance as adherence to standards is not guaranteed due to unmonitored process maintenance work.

#### **a) Formation of Committees with Unqualified Members**

Interestingly, a committee is an essential component of a well-structured maintenance system. The formation of specialised committees and external partnerships help to streamline maintenance processes by bringing together experts with specific knowledge. However, the study found otherwise, indicating that the committee is fraught with challenges as they often lack the necessary expertise, which undermines their effectiveness. For instance, it was observed that in one laboratory, there is no biosafety specialist in the committee which led to significant issues in maintaining safety standards. This is consistent with the gap in expertise in projects reported by (Garrick et al, 2024) This stresses the critical necessity for careful choice and coordination of committee members to ensure that all relevant expertise is represented and that maintenance processes are efficiently executed. Tijanić Štok et al, (2023)'s study found importance in facility users' inclusion in facility maintenance. Users' involvement ensures that their user requirements are maintained.

#### **b) Implementation Delays Due to Prolonged Administrative Process**

Another significant challenge identified in this study is the delay in implementing maintenance processes due to prolonged discussions and extensive protocols. In this case, urgent maintenance issues do not receive urgent response thereby frustrating facility managers' effort over the slow decision-making process. For example, the need for heating identified by one facility manager faced significant delays in implementation due to bureaucratic hurdles and prolonged consultations. Such delays not only hinder the maintenance process but also affect the functionality and usability of the facilities, causing operational disruptions.

In conclusion, the findings pertaining to management challenges underscore the critical challenges in facility maintenance governance and compliance. The absence of formal

agreements, project oversight, and well-equipped committees hinders effective maintenance and causes challenges for the facility managers. This is a confirmation of Knapik et al, (2024)'s finding that maintenance challenges are more of governance than technical. Addressing these issues requires a concerted effort to establish Facility Maintenance Project Management Framework (FMPRO) to tackle these challenges and improve the efficiency and effectiveness of facility maintenance operations.

### **c) Communication Barriers in Maintenance of Specialised Facilities**

Based on the finding, different facets of communication barriers or challenges including fragmented communication pathways, ineffective coordination, lack of a centralised communication mechanism, delayed alerts, and lack of clarity and feedback hinders the effective dissemination of maintenance information to relevant stakeholders in connection to maintenance of highly specialised facilities at the South African institution of higher learning.

Fragmented communication pathways significantly impede maintenance processes by disrupting the flow of information among stakeholders. When communication is not streamlined within the maintenance team, critical information can be lost or misunderstood which introduces inefficiencies in the system. Participants highlighted the multi-step and complex chain of communication process involving various departments and faculty representative as a key issue in maintenance information dissemination and often leads to delays and information loss. Similarly, the negative influence of information fragmentation on process efficiency is in agreement with van der Aa et al, (2017) and Alsayyari et al, (2019)'s findings. The authors further observed that these inefficiencies cause delays in the maintenance process, thereby resulting in increased maintenance cost due to extensive amount of time and effort required to correct the errors introduced.

Furthermore, participants expressed frustration over the lack of a centralised communication system and indicated that the current institutional system of dissemination of information remains problematic. Alluding to this, van der Aa et al, (2017) argued that effective and coordinated communication channels are essential for accurately performing maintenance activities in a multi-stakeholder organisation such as a university. Furthermore, the lack of

clarity and coordination in communication often leads to confusion and misalignment among stakeholders. Similarly, participants including senior academics and maintenance personnel highlighted the logistical challenges in identifying the right point of contact for maintenance issues. This does not only delay the process but increases the chance of downtime. Timely and promptly dissemination of maintenance information is essential to minimise disruption and allow stakeholders to prepare adequately. Similarly, delayed alerts can hinder maintenance activities and lead to significant downtime.

Additionally, participants raised concerns on information gatekeeping practices that further exacerbate these challenges. Obtaining campus-wide announcements for operational and maintenance matters is difficult, thereby forcing maintenance teams to rely on specific, decentralised pathways. According to Hauashdh et al, (2024), this fragmented system increases the risk of information loss or misunderstanding. This prompts the necessity of clear and consistent communication channels to facilitate proper understanding and coordination among stakeholders. These two statements: “We often miss critical updates because the information doesn't reach us in time.” and “We rely on faculty engagements and policies, which often delay the dissemination of critical maintenance information.” from participants underscore the challenges of decentralised and fragmented communication system.

These findings align with broader findings in the literature on organisational and process communication reported by van der Aa et al, (2017). Indeed, effective communication is crucial for efficient maintenance processes because it ensures that all stakeholders are well informed and prepare accordingly. Furthermore, it also underscores the need for institutional reforms to streamline communication pathways and reduce the risk of information fragmentation. This reform will ensure prompt and efficient alert system that ensures stakeholders receive timely notifications about maintenance activities to enable them to prepare to avoid disruption in their academic activities thereby reducing their possibility of resisting the scheduled maintenance.

The reforms are expected to include a feedback communication system as communication that lacks clarity and feedback mechanisms can create misunderstandings and hinder maintenance planning and execution. In this vein, participants mentioned this as a major

issue as they described the confusion caused by unclear alarm notifications and the absence of feedback on maintenance actions. This finding agrees with Alqaisi (2018) and Dwivedi and Dwivedi (2021) who maintained that receiving feedback ensures alignment between project objectives and the stakeholders. Moreover, Owusu-Agyeman and Moroeroe (2022) opined that prompt feedback fosters stakeholder engagement to support organisational project success. To further address these issues, participants emphasised the importance of dedicated personnel handling all maintenance-related communications to ensure that concerned individuals know who to contact when issues arise. These participants' suggestions are thoroughly covered in section 4.5, where their improvement recommendations are presented.

#### **4.6.3.2 Operational Challenges**

##### **4.6.3.2.1 Complexity of Maintenance Tasks**

Maintenance task complexity was found to be a serious challenge to facility managers especially for highly specialised facilities. The modern infrastructures require multi-disciplinary expertise for its maintenance and the scarcity of highly skilled technical personnel needed for maintaining such facilities is a critical issue facing facility managers. This finding agrees with the Ensafi et al, (2023) that reported the level of complexity in communicating with diverse skilled personnel separated by professional jargons. Molloy Adewunmi and Nelson (2023) also pointed out that complex structure of facility maintenance made it difficult to implement standard management system for FM quality assurance.

Furthermore, the rapid technological advancement sees the local available skilled experts falling short of the knowledge required to maintain the facilities. This further complements the finding in (Kvamsås, 2023; Mathenjwa, 2020), showing that expertise knowledge to maintain high-tech facilities pose a significant challenge. However, Kvamsås (2023) stated that the only way to overcome this is by training and skill development.

##### **4.6.3.2.2 Procurement and Equipment Challenges**

Moreover, the lack of technical expertise in procurement processes was also found to have added another layer of complication to maintenance efforts, as it leads to the acquisition of equipment that may not meet the required standards, thereby increasing maintenance

burdens. This is consistent with the finding of ABL-group (2023) where 39.9% of facility managers in a study indicated equipment reliability as a big challenge. It is in writer's judgement that the statement "when it comes to specification, I cannot help" by a participant and a procurement expert is evidence of this claim by participants in (ABL-group, 2023). Additionally, integrating technical experts into the procurement process can ensure that the equipment procured meets the necessary specifications and standards, thereby reducing maintenance issues.

#### **4.6.3.2.3 Staff Recruitment, Retention, and Training**

Participants indicated that, to address these challenges, institutions must invest in the recruitment and retention of highly skilled technical personnel as well as training and re-training of their personnel. This training suggestion agrees with that suggested by (Mewomo et al, 2022). However, the current staff treatment and retention are often inadequate. For example, one of the participants stated that "the staff are in a very serious psychological burden and eventually they will jump ship if things are not resolved timeously, then they will look for work elsewhere."

Furthermore, training is essential, and it should include all stakeholders, and the proper use of the facilities must be emphasised through this training programs for staff and students. This study recorded some instances of misuse from both student and academics. These programs should focus on the correct handling and maintenance procedures to minimise misuse and prevent frequent breakdowns. Executing these tactics can boost the operational efficiency and longevity of specialised facilities reported by (Hauashdh et al, 2024; Mewomo et al, 2022) for staff involved in maintenance as well as the users.

#### **4.6.3.2.4 Facility Condition and High Maintenance Cost Challenges**

High cost of maintaining specialised facilities used in research emanated as a theme in this research study. The specialised nature of these facilities and equipment necessitates high investment cost to cover the regular upkeep, repairs and replacements. From the findings, high maintenance costs are a major challenge faced by facility managers, particularly considering tight budgets and financial constraints. Likewise, the centralisation of the fund often prevents direct allocation of funds for facility manager maintenance activities. This

poses challenges in time of emergency especially when the situation requires parts replacement, and the parts are not readily available. One of the participants opined that the cost is not just equipment cost alone but also the cost of hiring trained, highly skilled personnel to manage the facility or equipment (Alsayyari, Alblawi, Nawab and Alosaimi, 2019), considering the rapid technological advancement. The sentiments shared tally with (Nyemba et al, 2017) who maintained that the high cost is associated with importation of spare parts.

Moreover, the prompt pace of technological advancement and the discontinuation of support for older equipment versions by manufacturers contribute to escalating costs. Keeping up with these advancements requires substantial investment, which is often not feasible within the tight budgets of academic institutions.

Findings further revealed the issue of old infrastructure and the lack of a vision for implementing new ones that further compounds the facility managers maintenance challenges. Participants indicated that dealing with outdated infrastructure leads to frequent breakdowns that disrupt academic activities. Lack of foresight to proactively replace aged infrastructure and minimise reactive maintenance contributes to current system of managing from breakdown to breakdown, leading to higher maintenance cost. Findings from literature support this, noting that old facilities incur high cost and can hinder institutional activities as they require constant care, leading to increased maintenance cost (Kadhim & Altaie, 2023).

#### **4.6.3.2.5 Poor Monitoring System**

Another important finding is that poor monitoring systems significantly hinder the effectiveness of maintenance activities in the specialised facilities. Effective monitoring is essential for proactive maintenance as it enables timely detection and resolution of potential issues before they escalate into costly and disruptive problems. However, the absence of robust monitoring mechanisms often lead to a reliance on reactive measures, which are generally less efficient and more expensive.

One of the participants acknowledged that there are set Standard Operating Procedures (SOPs) for their facility, however, there is no comprehensive control or monitoring

mechanisms to ensure it is being followed correctly. This lack of monitoring system can result in inconsistent application of maintenance protocols which will increase the risk of equipment failure and safety hazards. It as well isolates facility managers from real-time information about the state of the infrastructure. This finding supports with existing literature emphasising the importance of monitoring in maintaining operational standards and preventing equipment breakdown (Štok et al, 2023). Kraljević, Lacković, and Šojo (2020) also maintains that when maintaining a complex system such as this under investigation, a monitoring system that would eliminate any eventuality is essential to eliminate possibilities of individuals disregarding established procedures. It is therefore indicating the importance of human oversight in ensuring compliance with maintenance standards (Reason, 2016). According to Kopacz (2023) and Zamzam et al, (2021), routine maintenance schedules and the use of monitoring devices enable the maintenance team to plan and execute maintenance activities systematically.

#### **4.6.3.6 Resource Dependency**

The findings on resource dependency illustrate significant challenges faced by facilities managers in maintaining specialised academic infrastructure. Facility managers resource dependency encompasses several dimensions, including staffing challenges, budget constraints, external factors, and contractor reliability. Each of these aspects introduces vulnerabilities that complicate the maintenance process and can lead to operational inefficiencies and increased costs. Moreover, amidst this scarcity, facility managers are expected to execute their task meeting the high demand of these facilities and equipment (Ansmann et al, 2021).

#### **4.6.3.7 Staffing Challenge**

Due to the specialised nature of the facilities and equipment in question, shortage of maintenance staff and skilled personnel emerged as major culprit to facility manager difficulties. Most of the participants echoed this stating that lack of an adequately staffed team is a critical impediment to effective FM. Moreover, it is either the maintenance team is small, with large volume of maintenance work exceeding their capacity or there are no available skilled personnel to perform the classified maintenance activities. This highlights a common issue in many academic institutions. This shortage often led to delays in addressing

maintenance issues, resulting in prolonged downtimes and potential disruptions to academic activities. Shortage of staff was found to be a major challenge not only to the maintenance industry but across different fields (Ansmann et al, 2021). Moreover, skilled staff is essential for efficient and sustainable maintenance project operations (Hauashdh et al, 2022, 2024). Despite the mentioned staffing challenges, institutions are still downsizing, and this was confirmed by Participants' 2 response; "It's just not easy that we have no laboratory manager; we used to have one, but this post was cancelled five years ago", revealing a broader issue of institutional prioritisation and resource allocation and the vulnerable state it put facility managers. Meaning, there is no one specifically tasked with overseeing the maintenance of critical infrastructure, which can lead to oversight and neglect (Okereke, Zakariyau, and Eze, 2022).

The facilities and equipment in question are highly complex systems and most times present complex maintenance problems that outweigh the capability of the internal staff. As a result, most institutions rely heavily on external contractors for their maintenance need. This in no doubt increases maintenance cost and the process of selecting competent contractors amidst the tight budget is another bigger challenge faced by facility managers.

Overall, without sufficient personnel, it is challenging to maintain the necessary oversight and proactive maintenance strategies required to ensure the smooth operation of facilities. This aligns with existing literature (Matlala & Uwizeyimana, 2020) that emphasises the importance of adequate staffing for effective maintenance operations

#### **4.6.3.8 Budget Constraints and Financial Allocation Challenges**

Budget constraints emerged as a significant challenge, leaving facility managers with tight budgets restricting the ability to perform all the necessary activities of facility maintenance and maintain skilled team (internal and external). Participants stressed the budget allocation difficulty faced by facility managers who in most cases are forced to adopt a reactive rather than proactive maintenance approach. According to (Yoon et al, 2021) in some jurisdiction, a tone of \$26 billion is budgeted yearly for tackling backlogs of maintenance issues, signifying that the decision makers are ready to react but not prevent. It is sad to note that in addition to the huge cost (in monetary terms) of reactive maintenance, in most cases, academic activities

are disrupted, sometime indefinitely resulting to academics and students sourcing for alternatives. Proper and strategic budget allocation to critical maintenance issues helps maintenance team to proactively arrest maintenance issues that may lead to downtime and disruption of academic activities (Hauashdh et al, 2024).

In furtherance, findings show that some facilities make money when supporting academics but even when income is generated, it does not directly feed back into the facility's maintenance budget. Participants stressed that this centralised budgeting system can hinder the ability of facilities managers to address urgent maintenance needs promptly, aligning with findings from other studies that emphasise the importance of decentralised and flexible budgeting systems for effective organisational planning and aversion of risk (Hassanain et al, 2019).

#### **4.6.3.9 External and Economic Factors**

The current South African power challenges leading to frequent load shedding was uncovered by this study to pose additional challenges. Frequent power disruptions not only lead to immediate maintenance issues but also reduce the lifespan of sensitive equipment. As highlighted by participants, these disruptions cause frequent breakdown, fixes and replacements in addition to the overall maintenance burden and costs. Researchers such as (Berlinton, 2023) presented a detailed impact of power outage on facilities and equipment which agree with the findings of this study. This indicates that external factors like power stability are critical in the planning and execution of maintenance strategies.

#### **4.6.3.10 Contractor Reliability and Resource Availability**

From the findings, the challenge of external contractors encompasses, their reliability to keep to the terms of the project and their ability to deliver quality job as per the specification. These facets together with the availability of resources are crucial for maintaining specialised facilities and keeping to the maintenance standard. Any form of delay and inconsistencies from contractors can severely disrupt maintenance operations, leading to prolonged downtimes and increased costs. It becomes imperative to adequately select qualified and reliable contractors to commit to the project. Literature like Hassanain et al, (2019) reported

similar challenge but emphasises that the contractor selecting process and pre-qualifying contractors should be taken seriously.

Furthermore, selecting unqualified contractors leads to low performance, loss of time, and money. However, this task of contractor selection is difficult for facility managers owing to budget constraint because good contractors are expensive. Participants lamented about the issue of not being able to control the tendering process. They are meant to follow the standard institutional tendering process where projects are awarded to contractors with the lowest bid, leading to low quality output. This agrees with the findings in (Alahmadi & Alghaseb, 2022).

Additionally, there were so many remarks from the participants about dependency on external vendors for spares which underline a significant vulnerability in the supply chain. Similar situation with contractor selection, the lowest quote is selected and awarded spare supply contract, resulting to low quality spare parts supplied and more frequent emergencies due to component failure. This was also reported by Chima et al, (2021) who stated that Nigeria government procurement system requires three quotes and the lowest quote get the supply contract. Moreover, facility manager challenges are made worse with the reliance on international suppliers which often can result in delays, especially during global disruptions, emphasising the need for robust and reliable local supply chains (Gurtu & Johny, 2021).

#### **4.6.4 Strategies to a Successful Maintenance System**

##### **4.6.4.1 Implemented Strategies to Improve Maintenance and Minimise Cost**

Analysis of the findings revealed several strategies implemented by facilities managers to navigate the complex landscape of maintaining highly specialised facilities under investigation. These strategies were adopted to enhance maintenance processes, increase efficiency, and cost effectiveness. These strategies, classified into (1) adaptation and descriptive infrastructure usage; (2) collaborative solutions and data-driven decision-making; and (3) continuous improvement and long-term planning, presents a multifaceted approach required to ensure that operational efficiency is optimised while cost is minimised.

#### **4.6.4.2 Adaptation and Descriptive Infrastructure Assignment**

One of the primary strategies observed is the adaptive and efficient distribution of available infrastructure to manage the situation at hand. This demonstrated a pragmatic and temporary approach in managing system failures and operational challenges to address immediate need. These actions underscore the importance of agile project management approach that employs flexibility and application of sound judgement in dealing with project challenges. Campos (2024) agrees that project management is all about managing project ambiguity. For instance, one of the participants narrated how they tactically shutdown non-critical machines to reduce heat when HVAC units failed, thus preventing damage to high-performance computing equipment. Similarly, another participant, a lab manager maintained steady power using UPS and inverter to keep critical research equipment running during power outage. This adaptive approach is exactly the approach advocated by (Okereke et al, 2022), that adaptive FM and deployment is critical to project management as it leads to cost effectiveness amidst infrastructure limitations. For example, (Sipior, 2020). Additionally, findings showed that this descriptive facility assignment and usage is presided by risk analysis and prioritisation of maintenance tasks based, capturing a focus on health and safety implications in decision-making. This is consistent with the maintenance strategy reported in (Ameeri et al, 2023).

Without doubt, these adaptive strategies are crucial in maintaining facility operations in a resource-constrained environment. However, they also underscore the underlying issues of systemic inadequacies and the need for more robust and sustainable solutions. Hauashdh et al, (2022) believes that when strategies are developed and implemented, sustainability is guaranteed.

#### **4.6.4.3 Collaborative Solutions and Data-driven Decision-making**

According to the finding, effective implementation of adaptive facility usage approach presented in section 4.1.1 relies heavily on collaborative and data-driven decision-making that involves all key stakeholders (Kalantari et al, 2017). Stakeholder engagement and consultation are pivotal in planning and executing any maintenance activities especially with the constantly used research facilities and equipment. Participants highlighted the importance of widespread consultation processes, which involved aligning maintenance schedules with the academic calendar to minimise disruptions. This practice ensures that maintenance

activities are well-timed and have minimal impact on academic operations and that during critical infrastructure failure, the best strategy is adopted to ensure operational functionality. According to Au-Yong et al, (2017), this level of collaboration leading to decisions made based on available data is essential to minimising maintenance disruption and cost. Even in emergency situations, Scott and Manning (2024) maintained that collaboration absorbs all shock and produce effective and assistive solution that helps to manage the problem at hand.

Furthermore, through collaborative decision making, frequency of maintenance can easily be determined, fixed, and maintained. Based on the uniqueness of the facility or equipment, or even the environment of the facilities, collectively, a suitable maintenance schedule can be developed to accommodate all parties while ensuring adequate maintenance practices and facility upkeep. Literature such as (Jiang et al, 2024) agrees that this helps maintenance team to keep up with maintenance activities. Corroborating, Ensafi et al, (2023) added that user-driven decision-making approach minimises chances of disruption in the process.

#### **4.6.4.4 Continuous Improvement and Long-Term Planning**

To solve the current reactive and disruptive maintenance action caused by equipment breakdown because of old infrastructure, continuous improvement is the key. These initiatives are essential for maintaining the high standards required for specialised facilities by replacing older ones to keep the facilities constantly at full functional state. According to Camilleri (2017), long-term planning entails continuous evaluation of current system and plan to position the system for future use. In so doing upgrade system by incorporating redundancy measures and ensuring that facilities can handle increased future demand just as in the case of data centres where computing power and associated cooling requirements are expected to grow (Ewim et al, 2023).

#### **4.6.4.5 Contractual Prudence and Planning Efficiency**

Majorly, institutional maintenance system depends on external contractors. Lapses in this relationship necessitated that an adjustment be made in the manner the contractors are handled. This study finding shows that contractual prudence and planning efficiency address the challenges posed by dependency on contractors for services and spare parts. Effective

communication, thorough planning, and strategic negotiation are critical for achieving cost-effective and successful maintenance projects.

The findings indicates that direct communication and managing information flow to influence contractors' approaches to maintenance projects is the key to a successful and cost-effective project. Through direct engagement, facility manager can leverage their technical knowledge and experience to monitor finances, avoid potential exploitation by contractors, prevent unnecessary expenses, and to ensure efficient project execution within budget and timeline. This approach ensures that projects are executed effectively and on time (Gamage, 2022). Moreover, the research proved that actualising this depends on the effectiveness of facility managers planning, scoping the project, and preparing detailed specifications prior to meeting with the contractors to obtain competitive bids.

Further suggestion from the research hinged on the negotiation skills of the facility manager to effectively negotiate with competent contractors. The finding revealed the importance of facility managers understanding market rates and negotiating favourable terms to avoid unforeseen costs and the need to proactively do so to address potential issues before project commencement. This proactive approach ensures that maintenance risk is minimised while still executing the projects at a competitive pricing (Bhati et al, 2023).

#### **4.6.4.6 Minimising Disruption to Academic Activities**

The findings from this research shed light on the influences that assist to minimise disruption to academic activities within a university. Minimising disruption in this section mean to ensure that maintenance activities do not interfere with research, teaching, and learning responsibilities of academics.

#### **4.6.4.7 Exhaustive Internal Consultation and Communication**

Engagement with stakeholders in connection to maintenance cannot be overstated. This was found to be pivotal strategies for effective planning, preparing, and executing maintenance activities with minimal disruption. The study highlights the necessity of open communication, regular meetings, and collaborative efforts among internal stakeholders. Thorough consultation at the beginning and continuous consultation processes through the year

involving key stakeholders such as faculty members, maintenance teams, and university executives, are essential for aligning maintenance schedules with academic calendars. Furthermore, the finding indicates that inclusion of facility managers in the planning of academic calendar ensures proper alignment of maintenance plan with academic activities. This supports with literature emphasising the significance of stakeholder engagement in FM to ensure coordinated efforts and shared understanding of maintenance needs (Owusu-Agyeman & Moroeroe, 2022; Shakeri & Khalilzadeh, 2020).

Participants equally mentioned that flexibility is demanded from both parties as unforeseen emergencies may arise that will change the plan. This underscores the need for continuous consultation to uncover and negotiate between academic and maintenance personnel around those occurrences, allowing both parties to understand each other's positions and priorities. This process as identified also involves sending timely notifications about upcoming maintenance to ensure all parties are adequately prepared. The importance of early and transparent communication and negotiation in change management processes, particularly in educational settings, is well-documented in existing research (Štok et al, 2023).

Moreover, the involvement of mediators or experts to facilitate communication between academic and maintenance teams was noted as a strategy to ensure alignment and address potential misunderstandings. Especially in situations where the academic has no technical understanding on the maintenance implications. This approach is supported by the literature, which highlights the role of facilitators in bridging communication gaps and fostering collaborative problem-solving (Alhassan and Alghofaily, 2024; Matanhire et al, 2017). The findings by Alhassan and Alghofaily (2024) and Matanhire et al, (2017), although not directly related to maintenance, are applicable in this situation to dismantle barriers between the academics and maintenance teams, fostering a culture of collaboration and mutual support.

#### **4.6.4.8 Exhaustive External Consultation and Communication**

Leveraging specialised expertise in specific infrastructure through direct engagement with external vendors and subject matter experts is essential to minimise downtime during maintenance operations. Participants emphasised the importance of wide-ranging consultative processes involving external stakeholders including the suppliers, OEM (Original

Equipment Manufacturer) representatives and other specialised service providers to enhance maintenance efficiency and effectiveness. Literature on strategic FM supports this finding that external collaboration can provide access to advanced technical knowledge and resources, thereby improving maintenance outcomes. This agrees with the findings in Hauashdh et al, (2024)

#### **4.6.4.9 Planning, Preparation, and Prioritisation**

The foundation of effective maintenance and minimal disruption lies in meticulous planning and preparation. Participants underscored the importance of strategic planning and establishment of appropriate specifications which are presented to all stakeholders and ensure it aligns with activities of all concerned thereby forming a strong relationship with the project implementation teams. This finding is supported by literature on project management, which emphasises the critical role of planning in ensuring the successful execution of projects (Hauashdh et al, 2024; Shakeri & Khalilzadeh, 2020).

Furthermore, the research discovered that proper planning enables flexible scheduling, such as conducting maintenance during non-peak hours or vacation periods, as a key strategy to minimise disruptions. This approach is consistent with best practices in FM (Hauashdh et al, 2024), which advocate for minimising the impact of maintenance on core activities through careful scheduling.

To effectively manage this flexible schedule, the study also highlighted the importance of appointing dedicated personnel for compliance oversight to ensure that maintenance projects run smoothly and meet required standards. This practice is consistent with recommendations in the literature, which suggest that dedicated oversight can enhance the effectiveness and efficiency of maintenance operations (Scott & Manning, 2024).

#### **4.6.4.10 Health and Safety**

The issue around health and safety during facility usage and maintenance operations was emphasised in this study. Participants emphasised the need for implementing and monitoring safety protocols to protect both maintenance personnel and facility users. The importance of health and safety in FM is well-documented, with research highlighting the need for

comprehensive safety management systems to prevent accidents and ensure regulatory compliance (Benson et al, 2024; Noaman & Mohammed, 2022). Benson et al, states the importance of assessing new tasks' impact on both machine and operator safety perspective. This highlights the need to address any additional hazards promptly and by implementing access control measures further enhances supervision and safeguards against potential risks.

#### **4.7 Chapter Summary**

This chapter shed light on various aspects related to specialised facilities within higher education institutions. The examination of features of specialised facilities highlighted their unique characteristics, highlighting the need for tailored management approaches. This chapter showed that various maintenance challenges such as budgetary constraints, student misuse, lack of coordination, external dependencies, resistance from academics, and the impact of load shedding, further accentuate the complexities faced by institutions in ensuring the upkeep of these facilities. Moreover, the effects of delayed maintenance extend beyond equipment breakdowns to encompass loss of funding, inability to perform research work, risk of losing staff, tarnishing institutional reputation, poor research outcomes, repudiation of insurance pay-outs, and lifecycle management issues.

The discussion presented in this chapter delved into the multifaceted challenges and strategies associated with the maintenance of highly specialised facilities within academic institutions. The next chapter documents the conclusion and suggestions of this research.

## **Chapter V: Conclusion and Recommendations**

### **5.1 Introduction**

The purpose of this chapter is to present research findings, make conclusions, propose recommendations on how to mitigate challenges encountered in routine maintenance work in specialised facilities at an institution of higher learning in South Africa and lastly propose potential areas for future study.

The following sections, provides the key findings of the study, proposes recommendations aimed at mitigating these challenges and enhancing the resilience and sustainability of maintenance practices within specialised facilities. The chapter ends by proposing potential areas for future research.

### **5.2 Key Findings**

Interviews were conducted with stakeholders from P&S and Academics/Project Heads in laboratories. People interviewed comprised of individuals directly engaged in the maintenance and management of highly specialised infrastructure facilities within the university. This department includes electrical maintenance engineers, procurement officials, and health and safety officers, all of whom play crucial roles in ensuring the effective upkeep of specialised facilities. These stakeholders provided invaluable insights into the maintenance challenges and management practices associated with specialised facilities at the university.

The key findings of the study revealed several significant themes. Firstly, budgetary constraints emerged as a prominent challenge, hindering the implementation of proactive maintenance measures, and limiting resources for infrastructure upkeep. Additionally, the issue of student misuse and irresponsible behaviour was identified as a pressing concern, leading to equipment damage and safety hazards within specialised facilities. Furthermore, the impact of external dependencies, such as load shedding and procurement delays, exacerbated maintenance challenges, highlighting the need for robust contingency plans.

The effect of delayed maintenance challenges on specialised facilities ranges from equipment breakdowns, stemming from inadequate maintenance and budget constraints to the loss of funding and hindered research activities due to substandard facilities. Additionally, the inability to perform research work arises from the neglect of essential infrastructure maintenance, leading to lost work, revenue, and a compromised research environment. The risk of losing critical staff members and tarnishing institutional reputation emerges as researchers opt for better-equipped facilities elsewhere, contributing to a psychological burden on staff and undermining the institution's standing in the academic community. Moreover, the repudiation of insurance payouts due to foreseeable damage resulting from maintenance negligence further exacerbates the financial strain. Furthermore, the absence of effective lifecycle management practices aggravates resource inefficiencies, with ad hoc replacements and suboptimal maintenance strategies impacting operational efficiency and reliability.

### **5.3 Reconciliation of Research Objectives**

This part synthesises and reconciles the main findings in accordance with the objectives.

#### **5.3.1 To identify the reasons why senior academics are not open to routine maintenance work in highly specialised facilities at an institution of higher learning in South Africa.**

Of note, the study successfully and comprehensively addressed this objective revealing the reasons behind the stand of senior academics to act reluctantly towards routine maintenance. One major reason which most participants alluded to is centred on the disruption to ongoing academic activities which most requires uninterrupted focus. Contributing to this disruption as noted are lack or fragmented communication to allow them to plan. Another reason revolves around the expertise of the maintenance team to handle the complexity and sensitivity of some of the facilities or equipment as damage to the facility or equipment amounts to disruption in their research or teaching work. Additionally, senior academics are reluctant to adopt new technologies as they perceive disruption to their processes as they need to learn and optimise their knowledge and ability on the new technology which come with time investment and adjustments in the existing programs to accommodate the changes.

### **5.3.2 To identify the challenges that facilities managers encounter when trying to perform routine facilities maintenance work in highly specialised facilities at an institution of higher learning in South Africa.**

Through an in-depth interview and thematic data analysis, the study was able to identify the challenges faced by the facility managers thereby achieving this objective. The challenges are centred on the complexity and uniqueness of the highly specialised facilities. Included in the findings are the need for specialised knowledge which are scarce, the highly delicate and intricate nature of routine maintenance of these facilities as their disruption has negative consequences. As a result, the study found that leadership and contract administration contribute significantly to facility managers challenges. Absence of clear and formalised contractual agreements between the institution and the external parties, either landlords where the facilities or equipment are housed or the contractor to perform the maintenance activities on the facilities. Another challenge found has to do with their high dependence on external and internal resources especially scarcity of skilled personnel to perform routine maintenance which then complicates the existing operational challenges. Other challenges identified include rapid pace of technology and the slow adoption of technology by the management and academics further complicating the facility manager's ability to continuously maintain facilities to avoid interruption to the academic activities.

### **5.3.3 To propose a solution through engagement with all stakeholders and data collection on how these highly specialised facilities could be serviced.**

The participants of this study elaborately proposed solutions to the identified problems which addressed this objective. Based on the challenges identified linking senior academic reluctance to corporate unplanned routine maintenance to lack or fragmented communications, the study emphasised proper stakeholders' engagement to allow the stakeholders to gather insights and feedback on the eminent challenges and possible solutions for maintaining the facilities that supports their activities. Another factor emphasised as a solution is collaborating with all interested stakeholders in maintenance decision-making processes starting from maintenance planning stage to the execution to ensure the proposed solution and timing of implementation if practical, acceptable, and sustainable. By doing this,

the maintenance manager and his team is guaranteed of buy-in from the stakeholders. Additionally, the adoption of a data-driven approach, where maintenance decisions are made based on gathered and analysed data. This can improve the efficiency and effectiveness of maintenance activities. Given the above, this objective has been achieved.

#### **5.4 Answering the research question**

The research question posed at the outset of this study was:

*What challenges face facilities managers in routine facilities maintenance work in highly specialised facilities in institutions of higher learning?*

To answer the research question data was collected from 22 participants who were facilities managers, maintenance personnel, contractors and senior academics managing or using the highly specialised facilities at the selected higher education institution. Data was collected using semi-structured interviews and analysed using thematic analysis.

The study found that the primary reasons for senior academics' reluctance to routine maintenance include disruptions to ongoing academic activities, lack of communication and stakeholder engagement, and concerns about expertise & safety, and their limited knowledge on facility maintenance requirements.

Facilities managers and maintenance personnel face significant challenges due to administrative bottlenecks, insufficient support from higher management, and ineffective project governance, including lack of formalised contractual agreements and regulatory frameworks. Budget constraints, communication barriers, fragmented communication systems, a lack of a centralised communication mechanism further exacerbate these issues as these impede the efficient dissemination of maintenance information to the relevant stakeholder(s). Furthermore, old infrastructure and a reactive maintenance culture led to frequent breakdowns. In addition, rapid technological advancements result in frequent equipment obsolescence and high maintenance costs resulting to further disruptions. In the light of these findings the research question has been answered.

## 5.5 Recommendations

Based on the findings of the study, several recommendations are proposed to enhance FM practice for HEI's. The study recommends increased funding allocation specifically earmarked for the maintenance and upkeep of these facilities for equipment repair, replacement, and infrastructure upgrades to ensure the longevity and functionality of facilities. Furthermore, the study suggests enhancing training and awareness programs for both staff and students to promote responsible behaviour and adherence to safety protocols, thereby mitigating the risk of equipment damage and safety incidents. Furthermore, capacity-building initiatives and staff training programs are essential to ensure competent supervision and adherence to safe operating procedures. This will assist alleviate the risks associated with equipment misuse and irresponsible behaviour among staff and students.

In addition, the study stresses the significance of strengthened coordination and collaboration between the provincial department of health and academic departments at UCT. Closer collaboration can streamline maintenance processes and improve coordination, leading to prompt response to maintenance issues and reduced downtime.

There is a need for increased investment in maintenance and infrastructure upgrades to prevent equipment breakdowns and ensure a conducive research environment. This includes addressing budgetary constraints and implementing proactive maintenance schedules to mitigate risks. Additionally, measures should be taken to attract funding for infrastructure improvements and enhance collaboration with industry partners to support research initiatives.

Investment in alternative energy solutions, such as solar power or backup generators, is also recommended to mitigate the impact of load shedding on specialised facilities. In addition to solar power and backup generators, the study suggests exploring the implementation of energy storage systems, such as battery storage solutions, to make sure unflinching energy supply for specialised facilities. Battery storage systems can store excess energy generated during periods of high solar production or grid availability and discharge it during periods of load shedding or grid instability. This technology can provide a seamless transition to backup power sources, mitigating the risk of interruptions and fluctuations in energy supply that is

caused by generators. Moreover, integrating advanced monitoring and control systems with energy storage solutions can optimise energy management, enhance system resilience, and minimise disruptions to critical operations.

Furthermore, the study recommends the implementation of preventive maintenance strategies, including regular inspections and condition monitoring, to recognise and address prospective issues before they escalate into major problems. Predictive maintenance technologies can also be adopted to anticipate equipment failures and optimise resource allocation. Regular review and evaluation of maintenance practices and management strategies are crucial to recognizing areas for improvement and implementing corrective actions. Soliciting feedback from stakeholders and incorporating lessons learned can help continually refine maintenance processes and enhance operational efficiency.

## **5.6 Areas for Future Research**

Future research in the field of specialised facilities maintenance within higher education institutions holds promising opportunities for advancing our understanding and improving current practices. In addition to exploring the impact of emerging technologies on maintenance efficiency, there is a need to investigate sustainable maintenance practices. Such practices can include green building initiatives and energy-efficient upgrades to reduce environmental footprints and promote sustainability. Furthermore, understanding human factors and behavioural insights can provide valuable insights into staff and student behaviour, aiding in the development of effective maintenance protocols and decision-making processes.

Moreover, resilience and disaster preparedness in specialised facilities are critical areas that warrant further investigation. By examining strategies for enhancing resilience and mitigating the impact of natural disasters and technological failures, institutions can better prepare for unforeseen events.

Additionally, research into user-centric design principles and facility optimization strategies can enhance user experience and satisfaction within specialised facilities. Understanding the economic and financial implications of maintenance decisions is also crucial. Higher learning

institutions needs to adapt to the new system that is sustainable to accommodate climate change for highly specialized infrastructure, as climate change affects us Global. The study has proven that our highly specialized infrastructure was not looked beyond the current climate change. Heritage building bylaws also limit on sustainable development.

## **5.7 Conclusion**

Based on the findings and discussion of findings in terms of literature, the study concludes that the major challenge facilities managers face when trying to carryout routine maintenance work in specialised facilities at an institution of higher learning in South Africa is the lack of a shared vision among academics, facilities managers and top management. Because of this, stakeholders' interests conflict, communication is fragmented, maintenance planning and execution is not well coordinated resulting in administrative delays and insufficient support from top management. Other challenges include budgetary constraints, lack of a pro-active maintenance culture and lack of formal contractual agreements and legal frameworks that govern external contractors. The study recommends good coordination among academics, properties and services department, facilities managers and top management. In addition collaboration with industry partners such as the Provincial Department of Health is crucial in enhancing facilities management in HEI's. This is in addition to increased funding and investment in specialised facilities maintenance. In the light of the findings, conclusion and recommendations the objectives of the study were achieved.

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## **7 Letter of Consent: Appendix A**

Letter of consent

### **Re: Invitation to Participate in Research Study on Challenges of Maintaining Highly Specialised Infrastructure Facilities at an Institution of Higher Learning in South Africa.**

I hope this letter finds you well. I am writing to invite you to participate in a research study examining the challenges associated with maintaining highly specialised infrastructure facilities at an institution of higher learning in South Africa. This study is being conducted as a part of the MSc Property Studies degree at University of Cape Town - Faculty of Engineering & the Built Environment.

Before you decide about participating in this study, it is important that you understand the nature, purpose, and procedures involved. Please take the time to read the following information carefully. If you have any questions or concerns, please do not hesitate to contact me for clarification.

**Study Objective:** The main objective of this research is to explore and understand the challenges faced in maintaining highly specialised infrastructure facilities at an institution of higher learning in South Africa. By identifying these challenges, the aim is to develop strategies and recommendations for improving the maintenance processes in such facilities.

**Procedures:** If you agree to participate, you will be asked to take part in a semi-structured interview. The interview will be conducted either in person, via video conference, or over the telephone, based on your preference and availability. The interview is estimated to take approximately one hour and will be audio-recorded to ensure accuracy in data collection. The audio recordings will be securely stored and used solely for the purpose of transcription and analysis. Your identity will remain strictly confidential, and all data will be reported in an aggregated and anonymous manner.

**Voluntary Participation:** Participation in this study is entirely voluntary, and you have the right to withdraw at any time, without providing a reason, without penalty, and without affecting your relationship with University of Cape Town - Faculty of Engineering & the Built Environment. Your decision to participate or withdraw will in no way influence any future interactions or opportunities.

**Confidentiality and Anonymity:** Your privacy and confidentiality are of utmost importance. All personal identifiers will be removed from the data collected during the study, ensuring that

your responses remain anonymous. Only the research team will have access to the data, and the findings will be reported in a manner that does not allow individual identification.

**Benefits and Risks:** While there may not be any direct benefits to you as a participant, your contribution will help shed light on the challenges faced in maintaining highly specialised infrastructure facilities in higher education institutions. The findings from this study have the potential to inform policies, practices, and interventions aimed at improving maintenance processes in such facilities. There are minimal risks associated with participation in this study; however, in the unlikely event that you feel uncomfortable discussing certain topics during the interview, you are free to decline answering those questions.

**Ethical Considerations:** This research study has received ethical approval from the Faculty of Engineering and the Built Environment Ethics in Research Committee. In addition, the research has received approval from the Executive Director of Human Resources to interview the University of Cape Town staff. The study will be conducted in accordance with ethical guidelines to ensure your rights and well-being are protected throughout the research process. If you agree to participate, please sign the attached consent form, and return it to me, by Tuesday the 10<sup>th</sup> October 2023.

Thank you for considering participating in this study. Your valuable insights and perspectives will contribute significantly to our understanding of the challenges faced in maintaining highly specialised infrastructure facilities in higher education institutions. Should you have any further questions or require additional information, please do not hesitate to contact me at my email address: Matholi.hlophe@uct.ac.za and my contact information is 0623408627.

Sincerely,

Matholi Hlophe

[student: MSc Property Studies UCT]. I have read and understood the information provided above and voluntarily agree to participate in the research study.

Participant Name:

Participant's Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Please return the signed consent form to my email address: Matholi.hlophe@uct.ac.za.

## 8 hr194a data collection letter: Appendix B

### NOTES


- Forms must be downloaded from the UCT Administrative Forms website: <http://forms.uct.ac.za/forms.htm> .
- This form must be completed by applicants who are requesting to access UCT staff for the purpose of research for the fulfilment of a degree.
- A copy of the research proposal as well as the Ethics Committee approval must be attached.
- It is the **responsibility of the researcher/s to apply for ethical clearance** from the relevant Faculty's Research in Ethics Committee (RiEC).
- If you are requesting staff information, you are required to complete the [HR Information Request Form](#) (HR190) and submit it together with all the required documentation. **Please note that the invite to participate in research will only be distributed once per application.**
- The turnaround time for a reply is **approximately 10 working days unless specified as urgent.**
- Please submit your application including the completed application form and all the above documentation directly to Zoe Cosmopoulos via email ([zoe.cosmopoulos@uct.ac.za](mailto:zoe.cosmopoulos@uct.ac.za)) for the attention of the Director: Analytics, Risk, System, Payroll & Admin. Please do not submit these to the Director directly.

#### SECTION A: APPLICANT DETAILS

Title	Miss	Name	Matholi Hlophe
Telephone number	071 333 5239	Email address	matholi.hlophe@uct.ac.za
Student number	HLPBEA001	Staff number	01449898
Visiting researcher ID / passport number	7604150527085		
University or institution at which employed or a registered student	University of Cape Town		
Faculty or department in which you are registered or work	EBE		

#### SECTION B: SUPERVISOR DETAILS

	Title and name	Telephone number	Email address
Supervisor	Mrs Kathy Mitchell	021 650 3444	kathy.michell@uct.ac.za

HR194a	<b>ACCESS TO UCT STAFF FOR RESEARCH PURPOSES (Fulfilment of a Degree)</b>  <b>UNIVERSITY OF CAPE TOWN</b> IYUNIVESITHI YASEKAPA • UNIVERSITEIT VAN KAAPSTAD		
Co-Supervisor			

**SECTION C: APPLICANT'S FIELD OF STUDY / TITLE OF RESEARCH PROJECT / STUDY**

Degree	MSC Property Studies		
Research project or title	Challenges of maintaining highly specialised infrastructure facilities at an institution of higher learning in South Africa.		
Research proposal attached	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	
Target population	UCT Staff		
Number of UCT staff required	15		
Research method	<input checked="" type="checkbox"/> Interviews	<input checked="" type="checkbox"/> Questionnaire	
Amount of time required for the above			
Lead Researcher details			

**SECTION D: FOR OFFICE USE (Approval status to be completed by the Executive Director, Human Resources or**

UCT Proof of ethical clearance status attached		<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	
Proof of ethical clearance status from the University/Institution, if registered outside of UCT		<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input checked="" type="checkbox"/> Not Applicable
Support or approval		Role		Signature
Supported?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Zoe Cosmopoulos (Specialist: HR Analytics)		<i>Zoe Cosmopoulos</i>
Approved?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Naeema Brey (Director: Analytics, Risk, System, Payroll & Admin)		<i>NBrey</i>
				11/09/2023
				11/09/2023

**Nominee)**

## 9 Interview Guide: Appendix C

<b>Research Interview Guide</b>	
<b>Interview Questions for Director Faculty Operations</b>	
1	Can you describe your role as faculty operations director and the types of highly specialised infrastructures that you are responsible for maintaining?
2	How do you prioritise maintenance tasks for highly specialised infrastructures?
3	What are some of the most common routine maintenance tasks that need to be performed on highly specialised infrastructures?
4.	In your experience, what are some of the main challenges you face when it comes to routine maintenance of highly specialised infrastructures?
5	How do you ensure that routine maintenance tasks are completed on time and on budget?
6	Can you describe a time when you faced resistance from senior academics regarding routine maintenance of a highly specialised infrastructure? How did you handle the situation?
7	What strategies have you used in the past to successfully address challenges related to maintaining highly specialised infrastructures while minimizing disruptions to research projects?
8	How do you balance the need to maintain highly specialised infrastructures with the need to minimise disruptions to ongoing research projects?
9	How do you communicate with senior academics and other stakeholders about the importance of routine maintenance for highly specialised infrastructures?
10.	What improvements do you think could be made to the current system of maintaining highly specialised infrastructures?
<b>Interview Questions for Electrical Engineer</b>	
1	Can you describe your role as an electrical engineer that is responsible for the maintenance of UCT substations for highly specialised infrastructures that you are responsible for maintaining?
2	How do you prioritise the maintenance of UCT substations for highly specialised infrastructures?
3	What are some of the most common routine maintenances of UCT substations that need to be performed on highly specialised infrastructures?

4	In your experience, what are some of the main challenges you face when it comes to routine maintenance of UCT substations for highly specialised infrastructures?
5	How do you ensure that routine maintenance of UCT substations is completed on time and on budget?
6	Can you describe a time when you faced resistance from senior academics regarding routine maintenance of UCT substations for highly specialised infrastructures? How did you handle the situation?
7	What strategies have you used in the past to successfully address challenges related to maintaining UCT substations for highly specialised infrastructures while minimizing disruptions to research projects?
8	How do you balance the need to maintain UCT substations for highly specialised infrastructures with the need to minimise disruptions to ongoing research projects?
9	How do you communicate with senior academics and other stakeholders about the importance of routine maintenance of UCT substations for highly specialised infrastructures?
10	What improvements do you think could be made to the current system of maintaining UCT substations for highly specialised infrastructures?
<b>Interview Questions for Procurement Director</b>	
1	Can you describe your role as a procurement director that is responsible for procurement and chairing of specification committee for maintenance projects of a highly specialised infrastructure?
2	How do you prioritise procurement and chairing of specification committee for maintenance projects?
3	What are some of the most common routines for procurement and chairing of specification committee for maintenance projects that need to be performed on highly specialised infrastructures?
4	In your experience, what are some of the main challenges you face when it comes to routine procurement and chairing of specific committee for maintenance projects of highly specialised infrastructures?
5	How do you ensure that routine procurement and chairing of specification committee for maintenance projects are completed on time and on budget?
6	Can you describe a time when you faced resistance from senior academics regarding routine

	procurement and chairing of specification committee for maintenance projects of a highly specialised infrastructure? How did you handle the situation?
7	What strategies have you used in the past to successfully address challenges related to procurement and chairing of specification committee for maintenance projects of highly specialised infrastructures while minimizing disruptions to research projects?
8	How do you balance the need to procurement and chairing of specification committee for maintenance projects of highly specialised infrastructures with the need to minimise disruptions to ongoing research projects?
9	How do you communicate with senior academics and other stakeholders about the importance of routine procurement and chairing of specification committee for maintenance projects of highly specialised infrastructures?
10	What improvements do you think could be made to the current system for procurement and chairing of specification committee for maintenance projects of highly specialised infrastructures?
<b>Interview Questions for Sustainability Director</b>	
1	Can you describe your role as a Sustainability Director and the types of highly specialised infrastructures that you are responsible for sustaining?
2	How do you prioritise sustainability tasks for highly specialised infrastructures?
3	What are some of the most common routine sustainability tasks that need to be performed on highly specialised infrastructures?
4	In your experience, what are some of the main challenges you face when it comes to routine sustainability of highly specialised infrastructures?
5	How do you ensure that routine sustainability tasks are completed on time and on budget?
6	Can you describe a time when you faced resistance from senior academics regarding routine sustainability of a highly specialised infrastructure? How did you handle the situation?
7	What strategies have you used in the past to successfully address challenges related to sustaining highly specialised infrastructures while minimizing disruptions to research projects?
8	How do you balance the need to sustain highly specialised infrastructures with the need to minimise disruptions to ongoing research projects?
9	How do you communicate with senior academics and other stakeholders about the importance of routine sustainability for highly specialised infrastructures?

10	What improvements do you think could be made to the current system of sustaining highly specialised infrastructures?
<b>Interview Questions for Project Management Director</b>	
1	Can you describe your role as a project management director for university new projects of highly specialised infrastructures that you are responsible for managing?
2	How do you prioritise university new projects for highly specialised infrastructures?
3	What are some of the most common routine university new projects that need to be performed on highly specialised infrastructures?
4	In your experience, what are some of the main challenges you face when it comes to university new projects of highly specialised infrastructures?
5	How do you ensure that university new projects are completed on time and on budget?
6	Can you describe a time when you faced resistance from senior academics regarding management of university new projects of a highly specialised infrastructure? How did you handle the situation?
7	What strategies have you used in the past to successfully address challenges related to university new projects of highly specialised infrastructures while minimizing disruptions to research projects?
8	How do you balance the need to manage university new projects of highly specialised infrastructures with the need to minimise disruptions to ongoing research projects?
9	How do you communicate with senior academics and other stakeholders about the importance of routine management of university new projects of highly specialised infrastructures?
10	What improvements do you think could be made to the current system of managing university new projects of highly specialised infrastructures?
<b>Interview Questions for Risk and Compliance Director</b>	
1	Can you describe your role as a Risk and compliance director that is responsible for university compliance issues and insurance of highly specialised infrastructures that you are responsible for?
2	How do you prioritise university compliance issues and insurance for highly specialised infrastructures?

3	What are some of the most common routine university compliance issues and insurance that need to be performed on highly specialised infrastructures?
4	In your experience, what are some of the main challenges you face when it comes to routine university compliance issues and insurance for highly specialised infrastructures?
5	How do you ensure that routine university compliance issues and insurance are completed on time and on budget?
6	Can you describe a time when you faced resistance from senior academics regarding routine maintenance of university compliance issues and insurance for a highly specialised infrastructure? How did you handle the situation?
7	What strategies have you used in the past to successfully address challenges related to university compliance issues and insurance for highly specialised infrastructures while minimizing disruptions to research projects?
8	How do you balance the need to maintain the university compliance issues and insurance for highly specialised infrastructures with the need to minimise disruptions to ongoing research projects?
9	How do you communicate with senior academics and other stakeholders about the importance of maintaining routine university compliance issues and insurance for highly specialised infrastructures?
10	What improvements do you think could be made to the current system of maintaining university compliance issues and insurance for highly specialised infrastructures?
<b>Interview Questions for Technology Director</b>	
1	Can you describe your role as a Technology Director and the types of highly specialised infrastructures that you are responsible for providing technological direction to?
2	How do you prioritise technological tasks for highly specialised infrastructures?
3	What are some of the most common routine technological tasks that need to be performed on highly specialised infrastructures?
4	In your experience, what are some of the main challenges you face when it comes to routine technological tasks of highly specialised infrastructures?
5	How do you ensure that routine technological tasks are completed on time and on budget?
6	Can you describe a time when you faced resistance from senior academics regarding routine technological management of a highly specialised infrastructure? How did you handle the

	situation?
7	What strategies have you used in the past to successfully address challenges related to technological management of highly specialised infrastructures while minimising disruptions to research projects?
8	How do you balance the need to manage technological tasks of highly specialised infrastructures with the need to minimise disruptions to ongoing research projects?
9	How do you communicate with senior academics and other stakeholders about the importance of routine management of technological aspects for highly specialised infrastructures?
10	What improvements do you think could be made to the current system of managing technological aspects of highly specialised infrastructures?

## 10 Ethics Approval: Appendix D

RE: RE-Information: Approved with conditions



Harro Von Blottnitz

To Matholi Hlophe

Cc Kathy Michell

 You forwarded this message on 2023/09/05 16:04.

Dear Matholi,

Many thanks for sending this declaration!

I do note that you sign the email as a UCT employee, whilst your study focus also is on UCT. I would interpret this to mean that whilst there may not at this stage be a known conflict of interest, there could well be a latent or perceived conflict of interest, since your two duties to UCT (one as staff member, the other as research student) may potentially diverge.

May I urge you and your supervisor to be alert to any such conflict of interest appearing, lest it undermines your ability to carry out the planned study with the required diligence, objectivity and impartiality.

The conditional approval is hereby converted into a full approval.

In addition to ethics clearance, there are of course permissions to be obtained from HR in the event that you want to access other UCT staff for the research.

Best wishes for the research!

Harro

Prof. Harro von Blottnitz (Pr.Eng.)

Chair: Ethics in Research Committee

Faculty of Engineering and the Built Environment

University of Cape Town



Tue 2023/09/05 15:37

RE: Research Ethics Committee Project Approved with Condition(s) Letter

Dear Beauty Tholakele Hlophe,

Your application for ethics review of your project titled

Topic  
Challenges of maintaining highly specialised infrastructure facilities at an institution of higher learning in South Africa.

has been reviewed and evaluated by the

Engineering & Built Environment Committee.

Based on the information supplied your application has been conditionally approved.

Please note the following additional conditions associated with this approval:

- (i) Approved subject to two conditions:
  - 1) All necessary permissions to conduct the research are obtained.
  - 2) It is noted that both possible answers to the question of conflicts of interest were ticked under point 4. Please by email to the Chair of the EBE EIRC, Professor Harro von Blottnitz, copied to the supervisor, indicate which of the two applies.

Proof that you have met these conditions, in the form of letters of permission or other relevant documentation, should be supplied to the REC, via the eRA system.

Once you have met with the above condition(s), you may proceed with your research project titled:

Topic  
Challenges of maintaining highly specialised infrastructure facilities at an institution of higher learning in South Africa.

Please note that should:

- (i) any serious or adverse effects to participants occur and/or,
- (ii) aspect(s) of your current project change and/or
- (iii) any unforeseen events that might affect continued ethical acceptability of the project occur then you should immediately report this to the approving REC. You may be required to submit an amendment to this application, in order to determine whether the changed aspects increase the ethical risks of your project.

Regards,

Engineering & Built Environment Committee.

## 11 Interview Transcript – Appendix E

Audio file

**Participant 1** Electrical engineer (3).mp4

Transcript

Speaker 1

Oh, you have it, okay, now it's fine. Then we can go through question one if you're ready.

Speaker 2

That one.

Speaker 1

Also, can you describe your role as the electrical engineer for all university's new replacement maintenance of projects of highly specialized infrastructure that you are responsible for managing?

Speaker 2

So, I think from my side, as the electrical in here, my primary responsibility is design of all systems. It's the implementation and project managing of those systems that were designed. It's the procurement and tendering as well as the quality control for all electrical systems that we've designed or been assigned to undertake.

Speaker 1

Okay, how do you prioritize the university projects for highly specialized infrastructures?

Speaker 2

So generally, what I normally do, it will be a risk-based approach. So, we'll do a risk analysis to determine which ones must be done first or what's the biggest impact if we don't do it. I'm just going to give you an example, right? We take the data centre to be highly specialized, and if the data centre is not operational, for example, that affects every single student, every single staff member, all the security systems can't work in the university, all the telephones. So, it's something that based on your risk, you can see if you don't fix that or attend to that urgently, it's going to cause a major disruption. So just using that as an example, we would write do a risk analysis and see which ones have to be tackled first. Some might have a health and safety, health, and safety implication where it could be dangerous to people, which is also something we need to try and act on quickly. And there's others where, you know, where you might lose money. And other than that, it's also maybe they got very, what can I say, research-based outcome. So maybe a certain bit of research might not be able to be done, but that will affect a smaller portion of people than the entire data centre, for example. Okay, so in summary, we normally do a risk-

based approach. We write down all the risks and all the factors and all the outcomes and we therefore then give it a ranking as to which ones we can prioritize.

Speaker 1

OK. OK, what are some of the most common now routine university electric car maintenance projects that need to be performed on highly specialized infrastructures?

Speaker 2

So, I'd just like to clarify most of my role does not involve maintenance.

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Speaker 1

OK. Thank you.

Speaker 2

I'm

more on the installation and design side of new projects generally. However, what I can comment is that from our side, like generators now for example, require quite routine and specialized maintenance due to the critical functions it serves in most buildings. It keeps up the data system it provides. Health and safety, I think is the most important thing, the lights, et cetera. So those machines have to be kept in tip top shape. And you might be aware, like Peter Knott has a WhatsApp group that he sort of constantly updates about all the to make sure that those generators running. So, it's a highly specialized program, but in terms of the actual maintenance itself, I don't get involved in terms of my job description or role.

Speaker 1

Okay, but when you are designing now, will this project that you are designing be easily maintained? So, do you have that into mind on the design stage?

Speaker 2

Okay, absolutely. So, when we design by default, you must, or we try our best as well to make sure that the system is easily maintainable. For example, it must also be compliant with the health and safety regulations that workers are able to safely operate as well as escape from any danger should this propose any danger during operation. So that is part of the design process. We try as well to liaise with the maintenance department or people who are operating or maintaining the system, give them a chance to comment on the design, to see how they would actually maintain the system. We normally include in our design and our tenders, like a one-year maintenance period to ensure that these systems are working for at least a year before the maintenance team fully take over, if that makes sense.

Speaker 1

Okay, thanks. In your experience now, what are some of the main challenges you face when it comes to the university electrical project of highly specialized infrastructure?

Speaker 2

So, I can talk obviously for the design installation side, the budgets are extremely tight. The university, you might know, is not in a great financial position. So, the system we have to design might not have all the bells and whistles in terms of an ideal maintainable product, there may have to be some compromise on certain items to fit the budget. But as far as possible, we try to maintain a high standard that it's easily maintainable. We don't cut things that are absolutely necessary. We don't compromise on things that are going to be unsafe, but for maybe things that we can allow to be done at a later stage that's how we would try and cut some budgeting. In that regard, we might go maybe for a slightly smaller system, for example, than we would normally do, but we will definitely try to make sure that it's highly maintainable and works for the application that it's required.

Audio file

**Participant 2** (1).mp3

Transcript

Speaker 1

My name is Matholi Hlophe. I am currently a student at EBE Department doing Masters in Property studies. Currently, I'm conducting a research examining challenges associated with maintenance of highly specialized infrastructure. This study has been approved by EBE Ethics and also I've received approval from a human Resources Executive Director to interview University of Cape Town staff. If I'm talking about highly specialized infrastructure, I'm talking about those laboratories where we conduct highly specialized research, like the biosafety lab, the clean room, you see those labs where we also store highly poisonous equipment. So also, I think there is a data centre which I can also refer to it as highly specialized infrastructure because the data has provided a university with all the Internet and other issues. So, it's also a piece of very specialized infrastructure for the University of Cape Town. So I'm conducting my study at University of Cape Town because University of Cape Town currently in research, we are still number one. So I'm interested, how do we maintain the highly specialized infrastructure because previously there were studies that were done in general facilities management, not in highly specialized infrastructure. So, I've got a set of questions that have been approved by the committee that I will take you through. And I have shared the questions with you before this interview so that you can prepare yourself, and the meeting is being recorded.

Speaker 2

Your first question. OK. My role as facilities manager, I look after the data centres. We have three at UCT. One of those three is for research and the other one, which is the one at the upper campus, that's the main data centre basically. So, my duty is to ensure that environmentally that the data centres are in good condition and also every equipment that is in there is up and running smoothly and also safely.

Speaker 1

Okay, how do you prioritize the maintenance task for highly specialized infrastructure that you are responsible for?

Speaker 2

Okay, for those, we also have monitoring for all the data centres, so depending on the alert that we get then we will get those attended to.

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Speaker 1

OK.

Speaker 2

Depending on what some of the things that need to be attended to, things that maybe can wait a day or two or can wait until we source the part, but for some they need to be attended to urgently. Maintenance wise, there is a schedule every month, for example, things like generators we are scheduled every month to be tested so that they can still start up normally.

Speaker 1

OK. Thanks. OK, what are some of the most common routine maintenance tasks that needs to be paid for on this highly specialized infrastructure?

Speaker 2

Okay, routine maintenance, that's the generators to ensure that they start up properly when in need. And then you have the HVAC units those need to be serviced as well and then so is the BPS's that we have. Week we do, to keep those on our routine maintenance.

Speaker 1

Okay, in your experience now, what are some of the main challenges that you face when it comes to routine maintenance of highly specialized infrastructure?

Speaker 2

Routine maintenance.

Speaker 1

The challenges now.

Speaker 2

Challenges yeah, sometimes, although that's a new thing, previously we wouldn't have issues. Now it's like budget related issues that we experience from time to time and sometimes now if say there's a new person that we're dealing with, then now we still need to get that person on board as to understanding the environment and what is required in our environment when it comes to and who are the service providers that we are using or that capable of performing certain tasks. So it's those budgeting and basically funds and onboarding a new person.

Speaker 1

OK. Okay, so if you're talking about onboarding new person in your department, if a new person is coming in, I need to understand.

Speaker 2

No, it's not necessary on our side because remember, we work with the maintenance department. So, when there's a new person in the maintenance department and we log calls for some of the things to be done. So, if that new person is not aware of the arrangement in place with their service providers being used, then those calls delays.

Speaker 1

OK.

Speaker 2

Maybe that person, when we log the calls, will assign it to different contractor. And only after that, then we realize maybe that okay, that's a new person or no, this is not contractor we use in our routine maintenance.

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Audio file

**Participant 13** [mp3](#)

[Transcript](#)

[Speaker 1](#)

[Good morning. My name is Matholi Hlope. I'm currently a student at EBE department at the University of Cape Town where I'm doing my Masters in Property Studies. In order for me to fulfil my Master's degree, I need to conduct this dissertation research. So, the purpose of this interview now is to examine the challenges associated with maintenance of highly specialized infrastructure at University of Cape Town. If I'm talking about highly specialized infrastructure, I'm talking about the biomedical laboratories, there's also the clean room, the clinical laboratory. This interview has been approved by Ethics Committee at University of Cape Town and also the Executive Director of Human Resources for me to interview the University of Cape Town staff. Okay? So, as you can see, while I choose this topic also at University of Cape Town, because University of Cape Town still leads in research in Africa and also previously there were studies that were done, but those studies were only done in general facilities management, not in highly specialized infrastructure. That's why now I'm interested in highly specialized infrastructure.](#)

[Speaker 2](#)

[So it's targeted areas.](#)

[Speaker 1](#)

[Yes. So OK, the meeting is being recorded. So, I will go to my first question. Can you please describe your role now as the facilities manager and the type of highly specialized infrastructure that you are responsible for maintaining?](#)

[Speaker 2](#)

[OK, so my name is Charles Harris. I'm the facilities manager of the anatomy building slash new Learning Centre.](#)

[Speaker 1](#)

[OK.](#)

[Speaker 2](#)

[Our building is divided up into four subdivisions. One the head of department and divisional heads for all the other divisions. So one, the first division I can speak to is Biomedical Engineering. The second one is tissue culture cancer research, TC. And then we have Caba. Caba stands for clinical Anatomy and biological anthropology.](#)

[Speaker 1](#)

OK. OK.

Speaker 2

So the acronym is Caba. So the first one was BME. You've got that?

Speaker 1

OK. OK.

Speaker 2

And then the second one is Caba. And you've got that as clinical anatomy and biological anthropology. And then we also have Physiology. And that department is broken up into two divisions. One is based in the Anatomy Building, we refer to it as Hub North, and the other one is based at the Sports Science Institute, which we refer to as Hub South.

Speaker 1

Okay.

Speaker 2

So the researchers comes from both sides, but it still falls under the Department of Human Biology. And that department is broken up into two divisions. One is based in the anatomy building, referred to as Hub North, and the other one is based at the Sports Science Institute, which we refer to as Hub South. So the researchers comes from both sides, but it still. Falls under the Department of Human Biology. So that's basically the four divisions that encompasses our entire building. So I'm responsible for the buildings infrastructure. I'm responsible for the buildings external structure as well, and then I manage the mechanical workshops as well.

Speaker 1

OK. OK.

Speaker 2

So the mechanical workshop being similar to engineering in the building environment, we have lathes, milling machines, and that's the support infrastructure for our building. And it's basically a broad overview of the workshop because it entertains all the divisions in the building. So if I can go start off with Biomedical Engineering it's quite a big division. Inside that division we have Orthopedics, where they look at building devices for anything medical related, for rehabilitation and things like that. So it's rehabilitation devices that they build. We also have our Devices Lab, where we build medical devices for clinical use and clinical trials as well. And these are our postgraduate students, master students that entertain that section. We also look at NI, and that is the Neuro Institute up at the hospital that's headed by Professor Mankeys. And they look at MRI, CT scans, and that's a lot of

research that goes into that as well. So the workshop builds phantoms. It brings in an array of ideas that they use for patients and things like that also.

Speaker 1

OK.

Speaker 2

And then moving away from that, we also have the Child Development Unit also headed by Professor Mangis. And that looks at alcohol fetal syndrome. It looks at the broader Cape Town or the Western Cape metropol. And we look at the abuse of alcohol and how it impacts pregnancy fetal. And that gets taken over a period of two, three years, either post pregnancy or pre. It's quite a big division as well. We also do telemedicine there as well, whereby they look at ways of connecting with people.

Audio file

[Participant 21-\[AudioTrimmer.com\].mp3](#)

[Transcript](#)

[Speaker 1](#)

[Participant 21, my name is Matholi. I have explained in the ethics application form. I'm currently doing a study in the highly specialized infrastructure. I'm a student at EBE, I'm doing master's degree. So, my study is examining challenges associated with maintaining of highly specialized infrastructure. If I'm talking about highly specialized infrastructure, I'm talking about the research laboratories. Yes. The biosafety lab, the clinical lab, the clean room, all those research houses...](#)

[Speaker 2](#)

[Okay.](#)

[Speaker 1](#)

[... very dangerous chemicals. So that's how my studies focus, because previously the studies were done in facilities management, not generally highly specialized infrastructure. So that's why I'm interested in highly specialized infrastructure and I'm doing my studies here at University of Cape Town.](#)

[Speaker 2](#)

[Okay, so our division is probably not quite as highly specialized because I guess your issue with Chris Barnard building is it's quite diverse. You have some animals living here, then you have stem cell lab, and then you have like theatres, and then you have the clean rooms, et cetera. So, we are probably the division that has the simplest needs, because what we really do is mainly clinical trial work. So, we see patients with lipid disorders that come for their clinical trial visits. So, our needs are basically power, lifts that work, bridges that don't go hot, et cetera. So, we are definitely very reliant on reliable power, especially things like you know we have trial drugs on site in our sort of pharmacy fridge. And those drugs, that fridge could be worth like a million dollars' worth of drugs standing there. And obviously if the drugs exceed a certain temperature, then they must be destroyed.](#)

[Speaker 1](#)

[Okay.](#)

[Speaker 2](#)

[So there's a potential for quite a big loss. I'm not sure how far you've been involved with the generator issues, et cetera. That's obviously a problem. I think that's specific to this building that we have got quite old generators and especially generator one has been a](#)

little bit problematic at times. Essentially, we need to be able to get the patients in, we need to be able to get them to the 6th floor. Then we need power so that we have light, so that we can see and examine the patient. For instance, during load shedding obviously, not all our plugs are on emergency power. Then we have issues with things like ECG machines, et cetera, that won't work.

Speaker 1

OK.

Speaker 2

Then we obviously do take blood and process blood, but we kind of sharing the BSL facilities with the latter. And then we have specimens that we store. We don't do long term storage here for clinical trials. Those specimens, they get kept here for a couple of days and then they get sent off by courier to the overseas laboratories. From that point of view, as I said, we're probably one of the easier departments. Our needs are a little bit simpler and more basic to keep us happy. And then obviously we need all the other infrastructure, IT connectivity, WiFi, all those other things. But that's standard in academic buildings, that you have to have IT, et cetera. And so, we don't do anything. The main lipid lab with the laboratory, all of that is located in Falmouth building in chemical pathology. So, we actually don't have chemicals or other dangerous things that we store here.

Speaker 1

OK, OK.

Speaker 2

And all the other lab equipment is also over there. So, we basically just have like a centrifuge and a couple of minor things here. I think from that, as I say, we are fairly easy over the years. I don't know how much of the history of this building you know, it's been a little bit of a problematic building because I think people, when they designed this building, now we're going into the field of opinion, is they put animals and humans in the same building, which is probably not a good idea. It would kind of probably be better to run like a central animal house. And I know UCT's been talking about that for a long time. The Delft Animal facility, blah, blah, blah. So that all your breeding and your stock is in a central facility. And then you only bring what is the animals that are currently involved in experiments over here. Because for many years, there used to be, like, terrible smells in the building from the autoclave. And, I mean, that's where you ended up with these huge exhaust pipes put on the side of the building. They were really put there to try and get rid of. Again, I don't know all the details, but I think it must have had to do with the sort of

pressurization in the different parts of the building. Like when they opened the autoclaves after burning all the animal stuff, then the kind of fumes would just be sucked in and pushed to different parts of the building. We used to have many staff members complaining about allergies and headaches and sick building syndrome type of things. That's actually gotten, from my point of view, a lot better once the exhaust for the animal facility and then obviously with the renovations. Now we've had the new aircon system put up.

Speaker 1

Okay.

Speaker 2

Then I see you've got questions here. So, our research project is essentially clinical trials. We need the power, et cetera. Obviously, the issue you have with clinical trials is that they run like a train schedule. You have your visit now your next visit has to be four weeks later, plus, minus one or two days. Once you start at the trial, you can't stop, and you committed to seeing that patient at that date. You can't delay it for three weeks or something. Basically, for us, the main issue is that we can't really cope with a shutdown or loss of access that goes beyond one or two days and then disruptions to our project because of routine maintenance. I think we really haven't had, obviously there were disruptions associated with the building work, but I think that's a special situation. But otherwise, we haven't really had a major maintenance related issue except floods.

Audio file

**Participant 19**

[Research Interview- Maintenance of highly unavailable infrastructure-20231009 193434-Meeting Recording \(4\)-\[AudioTrimmer.com\].mp3](#)

[Transcript](#)

[Speaker 1](#)

[It recorded. I think it's a recording.](#)

[Speaker 2](#)

[Just trying to find the camera for my...](#)

[Speaker 3](#)

[Oh, OK.](#)

[Speaker 1](#)

[Because mine is right on top, then I just clicked on the camera I just click strike it off. It won't show my face check at the bottom.](#)

[Speaker 2](#)

[Yes, I have done that. I've been. Just look at the view. I'm going to look at the view first gallery on top.](#)

[Speaker](#)

[The view first.](#)

[Speaker 2](#)

[Gallery on top. Don't know why. There we go. There's a camera. There we go. Oh, thank you very much. Maybe we got this camera there.](#)

[Speaker 1](#)

[Doc. Okay, thank you. I think also I will share my screen so that you can follow up. Okay let me also reintroduce myself. My name is Matholi Hlophe. I'm currently a student at EBE doing MSc in Property Studies. So, I've done my coursework and then part of completing my degree is to conduct this minor dissertation. So, the topic that I'm currently researching is examining challenges associated with highly specialized infrastructure. So, your name popped up when I was searching for participant because I think I will say you were, because you just now said to me, working at MCB, of which at MCB, you are also working in one of the highly specialized facility that is conducting research. So that's how your name pick up and comes in. And thank you very much for agreeing to participate because I think for me, the more people I interview, I think I will have also a better outcome, although the outcome of this interview will be based on each individual's opinion. But for](#)

me also to have, I think I would rather collect more data than having less data, regardless of that time frame. I think I am very interested in this topic because previously there were research that were done in facilities management as a whole but there is no evidence that there was research that was done in highly specialized infrastructure. And also, this data will be anonymized, and it will only be used for the purpose of this research. And only researchers that are involved in this project will have access to this data. And also as a previous UCT employee, I think you also fall in UCT category because I've also received approval from EBE Ethics Committee to conduct this interview and also from the Human Resources executive director. So I have received this approval. So yeah, thank you very much. I have shared the question with you, but now as you have explained to me that the academic question does not apply to you. So I will go to the questions now. I think I will use their facilities because the questions also has been approved by the committee. So this is semi structured interview. So, I've submitted these questions so they were also approved. So, I will share my screen so that you can see the questions while I'm asking it. I will share. Can you see my screen?

Speaker 2

No, not yet. Not yet.

Speaker 1

Okay. Can you see my screen now?

Speaker 2

Yes, I can.

Speaker 1

Is it big enough for you to see?

Speaker 2

If possible. Can you enlarge it slightly more?

Speaker 1

Let me see. To add now.

Speaker 2

But I do have a copy in front of me, Matholi, so I'll be able to read. I can read it off my screen.

Speaker 1

You'll be able to follow? Okay, thanks Participant 19. So, I will go through the first question now, I think. Apologies for me that's referring to you as an ex, but sometimes I will not bring that in, if you can describe your role while you were a facilities manager at University

of Cape Town and the types of highly specialized infrastructure that you were responsible for.

Speaker 2

Yes, thank you. My name is Faezah, by the way. Matholi that's how you pronounce it.

Speaker 1

Okay. Yeah.

Speaker 2

So by the time I retired, the role had obviously grown quite tremendously. I had an advantage in that. I started already in the early eighty s in that very facility. At that time, it was only to do the research in the mammalian cell culture facility, that's what it's called. That gave me quite an advantage by 2000, when we got new academics into the department, and I think it was the first

Audio file

[Participant 14-Electrical maintenance engineer.mp3](#)

Transcript

Speaker 1

OK. OK, good morning. And it's also explaining my name is Matholi; I'm currently a master's student in the department doing a EBE Masters in property studies. In order for me to complete my degree, I need to complete this study. So, the topic that I've selected is examining the challenges associated with maintenance of highly specialized infrastructure, which is the laboratories, the biosafety lab all those facilities, those that do highly sensitive research. We are no1 in research; So, this is very important. And then the confidentiality of this interview data will be stored and anonymised. So this is a qualitative research and Semi structured question were prepared. OK, OK, so if. You allow it. I would like to start with the first question. I might rephrase the question as it is here, but it will purely base on what you are currently providing because I believe currently you are the electrical maintenance engineer who's responsible for all the university maintenance of substations. Substations play a very crucial role in those facilities, so I prepared these questions for you and feedback will be based on your opinion, so be your opinion.

Speaker 2

Before you start with the question, I want to commend you for choosing this subject, because with us being in the maintenance environment, that is one of the biggest problems that we come across because there is never allocation or sufficient allocation made for maintenance and a lot of infrastructure is currently managed from breakdown to breakdown with no. Vision going ahead of implementing new infrastructure and upholding the current infrastructure, so well done on your choice of subject and I will definitely support.

Speaker 1

OK. Thank you very much. OK, OK. So I will go to my first question. If you can describe your role as a maintenance electrical engineer that is responsible for the maintenance of all university substation that supports highly specialized infrastructure.

Speaker 2

OK. our roles first are determined by the appointment. So the appointment from the from UCT there's an appointment in writing and that appointment then gives me authority to act on behalf of UCT in accordance to the regulation. The electrical regulation as well as the manufacturer specification and then to uphold that regulation as well as the specification

so that we can have a proper well-maintained infrastructure. Especially when we bring in subcontractors where subcontractors work within the environment, the electrical environment, those subcontractors need to be well educated of the parameters of the of their work, and they need to be kept safe as well. So with regards to permits with regards to Access if there's any medium voltage involvement, or if there's any work in close proximity to live cables, underground infrastructure, then we will, we will be requested to come and make safe or to identify the underground infrastructure prior to any civil work happening that has happened before where a civil contractor did not adhere to the request and where we have lost power to the installation and we had to reboot power using the existing infrastructure. So that is imperative And if we Do that in the correct way and our infrastructure gets damaged, then the contractor, the service contractor, whoever is employed for that Term by UCT; They are being reliable across the UCT, then then have to have to spend to fix the infrastructure. So, our role in short, is to stand in the gap on your behalf Because this is our Field of expertise and to ensure that.

Speaker 1

So, OK, you just make an example now with the civil conductor who damages the cables so they don't communicate with you before those conductors come that they the conductor is coming to work so that they can be aware of the services.

Speaker 2

What we have done now, currently we have done GPS plotting of all the medium voltage cables within the infrastructure. If there is Any service contract, any building, any work that takes place, that documentation will be reviewed if It is in place Approximately 2 the actual red line on the on the drawing itself and the Earth to come and identify the cable underground. We will then issue them a permit to work outside of the boundaries of our infrastructure.

Speaker 1

Oh, OK. So, you don't supervise them, so you allow them to work?

Speaker 2

Work. We have done some supervision on site already where the cables have to be exposed.

Speaker 1

OK.

Speaker 2

For water and drainage to take place and for pipe work to be installed underneath our cabinet and the cabinet was still arrived in these special braces that need to be installed to hold the cable infrastructure. While there is hanging. But if it is A specialized job like that then We will come in; We will supervise and we will guide or we will do it ourselves.

Speaker 1

OK. I have no follow-up question. OK. How do you prioritize maintenance of university substation for highly specialized.

Speaker 2

OK, prioritizing maintenance is something that is very important.

Speaker 2

That depends on the type of infrastructure that. So for example, we have rail switched here and we have gas and vacuum switch here. With the Transformers we have got all type and drive type and the oil type. We also have sealed unit Transformers. So we need to have a different type of equipment. So I'm going to give you a couple of examples on that; If you for instance have a type switch, the maintenance frequency of the world type switch here in Accordance to the Manufacturers regulation is 3 to five years. Now depending on the location of that switch, if it is installed close to the sea If it is equipment that's standing in the warfront, the frequency of that maintenance is gonna change. OK, based on the position.

Audio file

**Participant 7** [REC001-\[AudioTrimmer.com\] \(1\).mp3](#)

[Transcript](#)

[Speaker 1](#)

[My name is Matholi Hlophe. I'm currently a master's student here at the University of Cape Town. I'm doing masters in Property Studies. In order for me to complete my degree I need to do this minor dissertation. So, I'm currently doing a study in examining challenges associated with maintaining highly specialized infrastructure. If I'm talking about highly specialized infrastructure, I'm talking about the laboratory where UCT conducts that research, like the Biosafety Lab, the clinical lab, the clean room, you see in those laboratories where they conduct those very sensitive experiments. So I'm concerning in those one because previously there were studies that was done in general facilities management, but not in highly specialized infrastructure because I think the highly specialized infrastructure also require a lot of certain skills. So, this has been approved by the Ethics Committee at EPE and it has been approved by Human Resources Executive director for me to interview the University of Cape Town staff. And you now as a lift engineer for the university, you are responsible for all our maintenance of all our lift. So those facilities now highly specialized facility. There is a lot of specialized equipment that are being transported through the lift. So, if the lift is not working it's also impacts the outputs in the laboratory. So that's why I would like to interview you. And this question also has been approved because these are semi structured question has been approved by the committee. So, I think I've shared the question with you so that you can prepare. So I will go through the question as it is. Then I might rephrase the question to suit your role based on how you're going to answer your question one. Okay Fred, if you can describe your role now as a lift engineer for all university new replacement, maintenance, of lift projects that supports the highly specialized infrastructure that you are responsible for.](#)

[Speaker 2](#)

[I've put down points here so that I could prepare a bit for the question. At present I'm only contracted to do the statutory inspections on UCD site. I get contracted in extra if there's an upgrade or replacement or renewal which then we contract per job.](#)

[Speaker 1](#)

[Okay.](#)

[Speaker 2](#)

At this present time, I'm meeting with ... after this meeting to discuss the final of UCT contracted me in to cover the whole portfolio over a period of time, which then will include installation, managing the maintenance, the callbacks and we still haven't come to an agreement yet on what exactly, but I think it's going to cover the whole SLA in that sense. So, we would then cover the whole portfolio as it is on maintenance and then of course the extras will be coming once we do the upgrade. So, with the upgrades we will specify for tenders for new upgrading or replacement of lifts and associated equipment. I will give you a copy of this, just so you could note.

Speaker 1

Okay.

Speaker 2

And the associated equipment is if the lift does not come out with an ARD device or the rescue device or the dialogue system that we will then specify and make sure that gets put in. We monitor the compliance of all the units according to the Occupation Health Safety act and whatever relevant standard of the day. Then we're going to monitor the compliance as per the SLA with the lift service provider and attend meetings with UCT and the liver service provider.

Speaker 1

Okay. You mentioned ... here. Who is ...?

Speaker 2

... is the manager of the Maintenance department.

Speaker 1

Thank you. How do you prioritize now the university lift project for highly specialized infrastructure?

Speaker 2

This process, it's not my decision which one must be done. We get input from, or I get input from whoever's going to procure and say we need a new installation. On that job we will do a survey, we will then look at the specifications of the unit, and then we will normally say that's a troublesome unit or it's an old unit and must be replaced. And the decision is then made collectively to attend to that unit. And then we go forth from there to specify and then sign the agreement for whatever installation it is. Okay. What are some of the most common routine university new lift maintenance projects that need to be performed on highly specialized infrastructure?

Speaker 2

Okay, that question, I was not sure exactly what it's referring to. So if you can elaborate a bit on exactly what you mean.

Speaker 1

What are the most common issues? It's either it's a new lift or it's either on the maintenance lift. What are the most common things in the lift? Let's talk about the goods lift, because the highly specialized infrastructure, it will rely on the goods lift and passenger lift because there is goods, there is equipment.

Speaker 2

Exactly.

Speaker 1

So I need to understand now, what is the most common routine things that you do?

Speaker 2

On the maintenance side that is prior arrangement, which how they do it today, I don't know, but we'll be finding out shortly. When I get allocated the position to do this work, we will then allocate it that they can only service on a certain date at a certain time in case of materials being used, so it doesn't affect the client.

Speaker 1

Audio file

**Participant 1** [Research Interview- Maintenance of Highly unavailable infrastructure-20231011\\_193055-Meeting Recording 1.mp4](#)

[Transcript](#)

[Speaker 1](#)

[My name is Matholi Hlophe. I'm currently doing master's degree at EBE so in Property Studies. So, in order for me to complete my master's degree, I need to do this minor dissertation. So, I'm currently doing a research in examining the challenges associated with maintenance of highly specialized infrastructure. If I'm talking about highly specialized infrastructure, I'm talking about those clinical lab, biosafety lab. Yes.](#)

[Speaker](#)

[OK.](#)

[Speaker 1](#)

[The clean room you see in those laboratories. They conduct very sensitive experiments that need proper supervision. Yes.](#)

[Speaker](#)

[OK.](#)

[Speaker 1](#)

[This research that I'm doing has been approved by the EBE Ethics Committee. And they also approved these questions. These are semi-structured questions. And also, I got approval from HR executive also to interact with UCT staff because I think this invitation was also sent to you when you were still at UCT. And the data that is collected here will only be used for the purpose of this research. And this will be anonymized. So it won't be used for anything else other than the purpose of this research. Thank you very much, Participant 1. So I've sent you the question, and I'm sharing my screen.](#)

[Speaker 2](#)

[Alright, no problem. I can see you're sharing screen so.](#)

[Speaker 1](#)

[Can you see the thanks, Participant 1. I think we can go to question one if you can describe your role, because you were a project management director for the University of Cape Town for all new projects, and especially now I'm interested in this highly specialized infrastructure that you were responsible for.](#)

[Speaker 2](#)

So in terms of the role of the project management director or the program management director, it was really overseeing all the new construction work. It wasn't the maintenance, but it was all the new construction work. That could be something as small as putting in a generator or putting in refurbishing a classroom, or it could be something as large as changing all the fire compliance issues in a building, or even as big as building a whole new building from scratch. So, it is quite a range of things, and I used to describe it as a range of from 1 million to maybe 200 million. That was the range of the different types of projects. And my role really involved managing a team of project managers and getting involved in the procurement of professionals such as architects, engineers, and so forth, as well as helping to procure the contractor and then overseeing the management of those projects from start to finish. So that's a simple explanation in terms of highly specialized infrastructure. So if you're talking about laboratories and maybe things like the data centre, which is also quite specialized.

Speaker 1

Yes, yes, yes, yes, yes.

Speaker 2

So obviously we had some of those projects from time to time. I know we did one in the centre levers building. I think it was there was a laboratory that was done there. I would say with the highly specialized stuff, it was really coming down to there's only a few people that can do that type of work for example, Lab Scheme is one of the companies. And in the end, we actually just picked one company and went with them. And we got comparative quotes after a lot of discussion with the academics, but we really just went with a sole source. In other words, we didn't go through a tender process. So that's probably one of the differences to a typical project that sometimes you have to find these specialized subcontractors or specialist contractors that do that type of work designing laboratories because there are only one or two in the country or maybe three maybe three in the whole country. So that's a quite important thing.

Speaker 1: OK.

Speaker 2: OK

The other thing is that they often involve quite a lot of different services. So they will have to have water, electricity, often gas, maybe even hazardous chemicals. They probably have fridges. They have quite a lot of specialized equipment that goes in there. And that would be different to, for example, designing a classroom or even lecture theatre. Electro theatre has got its own complexities, but it doesn't have to have water and gas of different

types. And maybe the electrical plus specialized refrigeration. It doesn't have all those specialist equipment. So that's probably what makes it a little more interesting or a little bit different.

Speaker 1: OK.

Speaker 2

And then on the data centre, which is, I think is another example of a specialized infrastructure, one of the big challenges we had not only just getting the IT equipment which was actually procured through ICTS, but it had to have a constant temperature. It had to be refrigerated, basically with air conditioning systems. So, it's got four very large air conditioning systems. And the temperature had to be the right temperature and the humidity had to be the right humidity because you couldn't have moisture coming on those IT servers. So, the climate control inside that space was very important. And actually, it turned out to be quite a challenge for us because the company that provided those air conditioning equipment, they actually failed. Those units failed. So, we were running around trying to find replacement units and then we had to order new ones. And so that actually because it was critical infrastructure.

Audio file

**Participant 17** [Meeting-20231013\\_120645-Meeting Recording.mp4](#)

[Speaker 1](#)

[Going to introduce myself. I think it's fine. Participant 17, yes. No, because I think I did send the concert form and then you did sign it. Everything was explained in the form. So yes, so if you have no issues, then we can jump it straight so that we mustn't also because now if the data is long so I must analyse all those data. But that's fine, we can go to the first question.](#)

[Speaker 2](#)

[No, that's fine. That's fine.](#)

[Speaker 1](#)

[You can describe your role.](#)

[Speaker 2](#)

[I don't think we need any more of an introduction between us.](#)

[Speaker 1](#)

[Yes, yes.](#)

[Speaker 2](#)

[So number one is, can I describe my role as a technology director and the types of highly specialized infrastructure that you're responsible for providing technological direction to? So, as you might know, my role is the director of Technology services for properties and services. So, I'm responsible for looking after every piece of IT system that looks after our life and safety and campus management technology system. So, when we say campus management, we're talking about the actual buildings themselves and that does not include the ICTs networking components. So, when it comes to the actual physical network cables that are running between the different buildings and any of the actual student systems that manages like the timetable or the teaching and learning systems or SAP. So the discipline that it's referred to in the market is real estate tech or real tech or a little bit of what you could call Proptech. But I don't like using Proptech because proptech speaks a little also but more about estate agents and how do they sell property administrate that. So it's better to call it Realtech, which is all of our systems that actually manage the physical buildings. So, I think my most important function right now is I'm responsible for properties and services integrated workspace management system which is our Archibus platform. Now this platform is going to be the heart and soul of all of our operations as properties and services. So this will look after each one of the individual](#)

departments from capital planning to program management to maintenance and basically ensuring that all of their processes they're running from a real estate is best practice and aligned to what we see. The successful entities that are running real estate portfolios around the world are utilizing to make sure that they've got a highly optimized property portfolio. So you are obviously very well aware of Archibus even though you just touching one little slither of it. When we are finished with the implementation, it's going to be so comprehensive that we'll be able to pull reporting that shows how our property portfolio is performing from a return on investment perspective. So taking into account every little piece of information that could potentially arrive from a building. So that doesn't just talk about the maintenance activities, but also talks about the water and electricity efficiency, it also talks about the occupancy that we have within the buildings, it talks about the climate within the building. So that's the HVAC systems which ties back to our building management systems which I'll touch on a little bit and yes, so the Integrated Workspace Management System pulls together all of the operational business related tasks that we need to be involved in. Thanks, I saw your message. Now I will refer to that accordingly as we move through. So RWS is, as I say, the core of the application that's needed to look after our most important customer facing services that we're providing. Now, looking at the other systems within properties and services that I'm also responsible for, I'm currently caretaking the PNS Access Control System. This shouldn't be something which Auntie is looking after, it should be sitting within Risk Services or what we call in any other property function which is our physical security entity. But I think just because of the lack of available product ownership within Risk Services, this is still sitting with myself as it so the Access Control System manages all of the access readers and the permissioning of rights to staff and students as they get inside of buildings. That is access control. Then also I'm looking after the CCTV systems from a platform perspective. So all of the cameras, the backend infrastructure, the relationship that PNS has with RTTS, who's once again, as I mentioned, responsible for the networking to keep all of the information flowing from those cameras to the backend server infrastructure and the availability and the data retention policies that's sitting on that. Then on top of CCTV we have the Online Intelligence platform which is a piece of software that services four different entities within property services as well as the Office of Inclusion which is outside of properties and services. So we're looking after a CPS application on Online Intelligence called Sims, which deals with raising of any security rated incidents. Then we have the Traffic Management application which also is a piece of technology which we've digitized the functions of the traffic officers to use smart devices to create tickets around campus for cars. And then we have the OHS

portion of the application which we're busy rolling out now for OHS in order them to capture any OHS related incidents back to an actual digital service as opposed to keeping everything on pen and paper. So that's looking after that. Then as well as these systems, there's a handful of other implementations which we are looking at improving on and it's something which is still in progress. On taking over the building management function because Maintenance and Operations is currently using a world class technology platform called Tritium to manage our HVACs. But I think the problem is that Tritium can manage an entire building, not just a portion of HVAC. So once we have our Archibus implementation completed, I'm going to be moving our project teams fully into heavily establishing the tritium platform and including all things like water and electricity meters, generator monitoring, inverter monitoring on top of the HVAC systems that we've got their lighting controls, gray water systems. So literally everything that needs to make our buildings smart buildings. We're going to be flipping the switch to put tridium onto overdrive mode so that we can start taking each one of these buildings that we fully upgraded and linking them all together in tritium and creating a smart campus. And a smart campus is a consolidation of, in our case, 200 or so smart buildings that are meshed together reporting. So if you think of that, we'll probably have the biggest digital twin on the African continent if we can get all of this right, because there's no other property portfolio, not Telcom or not even Liberty that has so many buildings that they've tried to digitize under one umbrella. So if you can think of what an exciting place it is to be with regards to technology, as regards to IoT, smart buildings, big data, all of these buzzwords that are currently floating around there in the technology space, we're going to be pulling those all together under one umbrella within the Properties and Services technology team. So it's a very big challenge that we need to try and achieve. And, yeah, I'm ultimately responsible, as the question says, providing technological direction, but from the IT strategy of how we're going to achieve all of these things getting the funding, putting the project teams together to resource and to make sure that we are able to run a project pipeline of all of these different activities that needs to happen in order to realize that view of our smart campus because ultimately what's driving that is part of our IT strategy within Properties and Services.

Audio file

**Participant 19 - [OHS.mp3](#)**

Transcript

Speaker 1

Good morning, Participant 19. My name is Matholi Hlophe as I explained in the ethics form, the purpose of this research is to examine the challenges associated with maintaining highly specialized infrastructure, thank you for agreeing to participate in this study. I've also explained in the ethics regarding confidentiality, so all data that is collected here will be anonymized and will be stored and only researchers will have access, and this will only be used for the study. So, this is a semi structured interview in which I've prepared a set of question I might rephrase the question a little bit but this is your opinion. What I'm trying to get here is your opinion on the challenges associated with highly specialized infrastructure. As I explained, the highly specialized infrastructure is a facility that must operate that does not shut down maybe they have got research that must carry on for more than two years. So as GRM2, which is responsible for the health and safety and the compliance of the equipment, because there is a lot of equipment that are in those facilities, I felt your role will be very crucial in assisting us on this research.

Speaker 1

I will go to the first question. As I've said to you, you play a very crucial role as a GRM2 for the university and occupational health and safety is also very important. So, I will go to the first question. Can you describe your role in the occupational health and safety that is responsible for all university compliance issues in highly specialized infrastructure.

Speaker 2

As an appointed GRM2 and I'm only looking at part of the occupational Health and safety. Occupational health and safety, as described in legislation, require that every owner of the business, CEO of the company. And if you break it down, head of the department is responsible for the health and safety of the workplace, where these employees are working now the workplace consists out of the area that the building therein or the room, that work is being performed. The work that is being performed is either operational or maintenance stuff. The operation in the university, we can say this is mainly out of academic people, they are using the infrastructure, the workplace to do education and from the university's perspective, that's also doing research in frontline technologies, so they need an environment or workplace that could try to their needs. There is no such thing as 100% availability. There is always a time for when thing are not going to be

available, everything does fail so the area that we are talking about the availability needs to be very high. Now that is one of the things that needs to be communicated between the people that's maintaining the environment and the people using the environment, they must be realistic in saying that they need an availability of 95% or 92% or 98%, and the methods or the mechanisms that the maintenance can use to get to that availability is either by redundancy or by maintenance, so that professor doing the research can stay with availability of 100%, which is not possible, but then you need to find out what is the time that you can spend on the workplace to get to his satisfaction. So, there must be communication between the people maintaining their place and the people using the workplace. The legislation say that the workplace needs to be safe. Well, safety is not only for the people, but also the machines from the two point of view that needs to be safe. So, if you procure a very expensive piece of equipment, you would like to have that piece of equipment available for its life expectancy and not being destroyed by somebody the first day of operation. So, to ensure that you need to make sure that the people using the machines know how to operate it, so they need to be competent on that machine and on competency I described. First, the person must have formal education on the machine, he must have experience on the machine where he can apply his knowledge gained by training on the machine, and you must be able to execute that knowledge over a period of time without risk and without supervision is needed. So, by saying that it is important to make sure that the machine are correctly operated and for that, as the GRM2 to make sure that that is the case, he must looked into the formal education of the operators, the experience and all those kind of things and like every person, forget about important things. I would say or I think it is standard in practice that you get something like safe operating procedures or other ways taking for the person that's doing the operations that they can quickly go through it just recap on what is important and what's not important to use the machine, to his safety as well as to the safety of the machine. My role is to ensure that compliance is to make sure that the operators are well trained, that the maintainers knows what they do, and that they have the necessary capability in maintaining those things, I need to have the mechanisms in place so that I can on a continuous basis say the machine are safe and the operators are safe and that can only be accomplished by a repetitive visit to the way the people operating the machines and the way things are maintained, because things does change and new tasks can be performed on the machine and then the risk needs to be mitigated for that to ensure that it is safe.

Speaker 1

How do you prioritize the university occupational health and safety for a highly specialized infrastructure?

Speaker 2

There is not a contrary between the use of the machine and safety, safety is more important than the usage of the machine, but I should request that it is for a highly sophisticated environment and the words that if I can use your words and while it is in a laboratory that they want it available for two years, which is not a practical outlet ready to be used, there are going to be failures, so we need to get that point acceptable by the users and the maintainers. There is no compromise between safety and the use of the machine, safety is always very important, but you need to manage your system to such an extent that it comply with the requirement. So, if it is unsafe to use the machine because of a battery repaired, but you need to plan it to disrupt the research topic as least as possible.

Speaker 1

OK. I think I'm going to go back I'm just interested in priority how do you prioritize that the highly specialized infrastructure, how do you give it priority in terms of occupational health and safety?

Speaker 2

Coming back and saying that there's no compromise on health and safety, if there's two ways of having things available, either by having a backup or fix it timeously so depending on the need for the availability of the highly sophisticated piece of equipment in use you must make the call when I have a backup for it or will I have enough time to repair it, now it is easy to say that you have to repair it, but you can't repair things, if you don't have the spares for it, if you don't have the knowledge to repair it, if you don't have the funds to procure the spares to repair. So, there's a few things that you need to prioritize, and depending on the criticality of the machine or the piece of equipment.

## **Participant 19**

Speaker 1

Good morning, as I've said, and my name is Matholi Hlophe, and I am currently doing master's degree at EBE. So, for me to complete this master's degree, I need to conduct this research. So, I've chosen this topic of examining challenges associated with highly specialized infrastructure, so it has been approved by the EBE Ethics Committee. So, I also got approval from human resource director to interview the University of Cape Town staff because this interview is based at the University of Cape Town the reason why I'm doing this study at university of Cape Town is because UCT is a leading university in research. And the previous studies have been done in facilities management as a whole but there is no evidence that there was research that was done in highly specialized infrastructure. That's why I'm interested in the highly specialized infrastructure which I'm referring to the clinical laboratory, biosafety lab, and clean room, so all those laboratories that conduct those highly experimental. The data of this interview will only be used for this research, and it will be stored, and it will be anonymized.

Speaker 1

So, I will go to my first question. I'm sure the question with you so that you can have a look at the question is because this is semi-structured interview. So, this question has been submitted and been approved. I might rephrase the question, or I might have a follow up question. Can you please describe your research projects and the highly specialized infrastructure that relies on?

Speaker 2

I'm the director of the Hatter Institute for Cardiovascular Research in Africa and we have currently seven different working groups and the research spans from Cardiac signal, Cardiac genetic to clinical trials, African population studies and I'm actually the principal investigator for two global trials. So that's why this cardiovascular institute is called Cape Heart Institute and Global Health because it's really quieted a big spectrum. That means we have specific requirements starting from we have 4 laboratories. We also received samples which are coming from other countries using import export service which are then stored in -80 freezers, and we also have, for instance, most of my PhD master students do their research in their own countries like Nigeria, Mozambique, and Uganda, and they're only coming for the clinical work in the countries. So that means we have really the spectrum type of research successfully.

Speaker 2

To have a very good infrastructure is very important because some of our research programs spend over a period of 10 years which means genetic material, serum plasma biomaterial which is linked to the clinic information is stored in freezers here. So, for instance, as you know we have an electricity problem with low traveling, so if it freezes, we don't have a sufficient power supply. It means that Clinical information the genetic material, and serum plasma from work which spent over 10 years is destroyed. Also, the funding for this project, I mean just an example for instance of the genetic projects cost about 15 to 20,000,000 rand. So, if you lose the samples the 20 million rand is gone because we must pay nurses to get this material, Doctors, and purchase equipment. So, it's nice how simple it is that the freezer melts but the whole package around the content of the freezer is many million rands.

Speaker 1

Have you ever experienced disruption to your research projects because of routine maintenance of a highly specialized infrastructure? Can you describe the situation and the impact it had on your research?

Speaker 2

Yes, I must say we are quite fortunate that we did not have a major disaster, but there is a reason for it I also have an extra 2 freezers, so I always have a backup plan. I'm quite a planning person so it means that I must spare 2 freezers if there is load shedding and damage in one area, we have an alarm system that can transfer the samples to another area. So, we are working very well together in the entire care park building which means if there is flooding on one floor, we help each other out and transport equipment samples to different floors. So, we have regular water damage in our building, we have regular plug points that don't work right now, and we had an alarm Because the electricity of the red box is not working. In 2 sections, and that must have tripped the alarm. So, we have our weekly infrastructure issues, but fortunately, over the last few years, we have never lost any material or equipment because of that.

Speaker 1

You said you just heard an alarm, so it was a false alarm?

Speaker 2

It was not a false alarm; I think it was an alarm because we didn't understand the problem. So, we noticed that every Wednesday at about 10:15 the entire computers shut down from the secretary section, and zooms offices but even on the 6th floor it's a red plug that

stopped working when the computer was connected, and then shortly after the alarm was set in. We assume that someone overloaded the system with some equipment during that time.

Speaker 1

And there was no communication?

Audio file

**Participant 4** [Meeting-20231013\\_130412-Meeting Recording.mp4](#)

[Transcript](#)

[Speaker 1](#)

[Examining the challenges associated with highly specialized infrastructure, with maintenance of highly specialized infrastructure at the University of Cape Town.](#)

[Speaker 2](#)

[Before we go into the questions, maybe are you able to describe a little bit more about what you would classify as high highly specialized infrastructure?](#)

[Speaker 1](#)

[Okay, yes, I'm examining challenges in maintaining highly specialized infrastructure. If I'm talking about highly specialized infrastructure, Participant 4, I'm talking about all those facilities where we conduct research, like the clinical lab, the biosafety lab, the data centre, those labs that provide those highly sensitive experiment that goes through that need a special skills, need a proper supervision, that also need a lot of compliance. So I'm interested in those facilities, not generally facilities management, like the highly specialized laboratories. I'm referring to those things and how you came in here because now you are also a director.](#)

[Speaker 2](#)

[OK.](#)

[Speaker 1](#)

[Yes, sustainability director. So, I think you also have to make sure that we comply with environment. And, I think your responsibilities also to make sure that you educate students, researchers, UCT community about the importance of maintaining sustainable environment, what improvement that can be made.](#)

[Speaker 2](#)

[Yeah. The only thing that maybe you'll pick it up as we go through the interview, but I don't know very much about the specialized infrastructure that you're referring to and I'm that involved at all more sort of on the periphery. But let's see how we go with the interview and how the questions are structured.](#)

[Speaker 1](#)

[OK, it's fine. Okay, if we can go to question one, if you can describe your role now as a sustainability director and the types of highly specialized infrastructure that you are responsible for sustaining.](#)

Speaker 2

Yeah, so my role is based in the office of Vice Chancellor, and it's essentially a strategic role. So it's not an operational role. So it's not in that sense where I become responsible for any equipment or any operational procedures myself or any equipment on campus because that remains the responsibility of properties and services. And so my role is more in an advisory role to the university in terms of the direction we should take with environmental sustainability.

Speaker

OK.

Speaker 2

Things like how we should lower our energy consumption, our water consumption, our greenhouse gas emissions. Our waste and sort of lead the strategy development around that and then help advise PNS, for example, but also influence things like teaching and research to be more environmentally sustainable and also to make sure that we have the right kind of governance structures in place that can assist the university with that. So it's quite broad, sort of cutting across the different areas of the university.

Speaker 1

Okay, then how do you prioritize now sustainability task now for highly specialized infrastructures?

Speaker 2

Yeah, it's a difficult question because I don't specifically look at highly specialized infrastructure in that sense. So it's not like something that I isolate in my strategy for the university.

Speaker 1

OK. You look into everything. Not specifically, only this. No, I understand.

Speaker 2

But that also has to do with where the university is at, I think in its environmental sustainability journey because as we kind of grow and grow along that journey then we'll start doing more and we will start getting into more kind of detailed work per different sector. As an example, I had my first meeting with the IDM unit at Faculty of Health Sciences about their laboratories and saying to them what can they do to change to make their laboratories more environmentally sustainable in terms of energy, water, waste? So it's kind of up to them and it will be depending on what resources and budget they have in IDM to see what they can do. And then that would kind of be like a trial and a pilot for

maybe we're going to take one laboratory and try sort of green the one laboratory and then see how it goes and then see if that's something we can roll out more extensively. That's why I say it's still very young along the journey and as the university allocates more resources within different departments and also within P.S actually roll all this out because it also needs capital and all of that so it can grow. So at this stage there's very little sort of focus on getting into that much detail on specialized infrastructure like labs and things like that from a sustainability perspective but that's largely because we just aren't able to allocate enough resources to get to that level of maturity.

Speaker 1

OK, now I understand. OK. In your experience now, what are some of the main challenges you face now when it comes to sustainability? Of the infrastructure, let me rephrase now the question. It mustn't be specific to highly specialized infrastructures.

## Participant 22

Interview Questions for Academics:

1. Can you describe your research project and the highly specialised infrastructure that it relies on?

Clinical TB immunology research – reliable constant electricity supply; fresh air supply; temperature control (HVAC); physical access for Liquid Nitrogen and Argon delivery and piping to the lab; CO<sub>2</sub> supply; access control;

2. How important is it to maintain highly specialised infrastructures for the success of your research project?

Incredibly important. We have hundreds of thousands of priceless samples in our biorepository which are critical to our work. We also conduct many assays that provide the results needed for immunogenicity objectives of numerous clinical trials. It is imperative that the facility is fit for purpose to protect the safety of personnel and the preserve integrity of reagents and consumables and maintenance on specialised equipment.

3. Have you ever experienced disruptions to your research project because of routine maintenance of a highly specialised infrastructure? Can you describe the situation and the impact it had on your research?

There have been many instances where the generator failed to kick in which means the lab had no power, this prevents lab work being conducted and puts our samples and reagents at risk. It also puts our staff at risk who may be working in biological safety cabinets at the time of the failure. The emergency engineer has expressed concerns about the quality of routine maintenance conducted on the generators.

Similarly, the HVAC in the laboratory is not on emergency power which means that during loadshedding, temperatures in the lab rise quickly and often exceed the limits. This puts reagents at risk and puts strain on equipment.

The area where our suite of -80°C freezers have been located, has always been sub-optimal. Currently the area they are situated in has inadequate temperature control. We have to run fans on the freezers in order to boost the cooling power. This affects the lifespan of our freezers, puts our samples at risk and increases our costs associated with maintenance and repairs due to unnecessary breakdown.

Fresh air supply in a laboratory is a critical requirement to replace air extracted for the safety of our personnel. Currently, our fresh air intake in one area of the laboratory is located adjacent to the generators exhaust. Consequently, we have inadvertently exposed staff to exhaust fumes and contaminated the laboratory and samples.

We pipe Argon gas into the lab. The piping was compromised when rust from birds spikes above caused the pipe to become corroded. We replaced the piping at our own cost and requested that P&S insulate the new piping to prevent reoccurrence however this has never been addressed.

The Argon tanks are very large. They have to be stored outside in a cage and a crane is needed to load/off load. The cage was frequently blocked by persons parking illegally. After much motivation, bollards were installed, however, there are still drivers that stop in front of the cage which can interfere with a safe delivery of these cylinders.

Biological Waste accounts are also a challenge as there is no proper system for generating invoices and statements. They are manually prepared and often have many errors and are delayed.

4.How do you balance the need to conduct your research with the need to ensure that facilities are properly maintained?

Not sure how to answer this one.

5.What strategies have you used in the past to minimize disruptions to your research project during routine maintenance of facilities?

We have had to compensate for these by either suspending work, moving samples/reagents to alternate freezers/locations, having multiple back up freezers, installing additional fans etc.

6.How do you suggest that facilities managers should communicate with academics about the importance of routine maintenance for facilities?

Our local facilities managers communicate well and understand our needs but are limited by the resources of P&S and or funding.

7.In your opinion, what improvements could be made to the current system of maintaining highly specialised infrastructures to minimize disruptions to ongoing research projects?

Increase capacity of P&S and quality of maintenance.

8.What types of support do you need from facilities managers to ensure that your research project can be completed successfully without disruptions?

Facilitate the interactions with P&S and their vendors.

9.What is your understanding of the importance of facilities management and how does it impact your research project?

Critical so that researches can focus their time and efforts on their own duties and objectives.

Audio file

**Participant 13** [OHS.mp3](#)

Transcript

Speaker 1

My name is Matholi Hlophe. I am currently a master's student at EBE. I am doing a masters in property studies, so thank you for agreeing to have this interview with me. For me to complete my degree, I need to conduct a research study. This study is to examine the challenges associated with maintenance of highly specialized infrastructure. If I'm talking about highly specialized infrastructure, I'm referring to the research laboratory that contains dangerous chemicals, like the clean rooms, clinical laboratories the Biosafety Lab, oceanography, all those labs that house very sensitive experiments, highly experiment they do research on. As you know University of Cape Town in Africa, we are still number 1 research university based on our research. So previously there were studies that were done in facilities management in general, I did not find anything related to this study that was done in highly specialized infrastructure. That's why I've selected this topic. So, this interview will be used specifically for this research, so the data will be anonymized to protect the participant. I would like to interview you as a health and safety manager for the University of Cape Town as health and safety plays a very crucial role in this highly specialised facilities to operate.

Speaker 1

Can you please describe your role in the occupational health and safety that is responsible for all university compliance issues in a highly specialized infrastructure.

Speaker 2

I'll always supposed to sign on any new design area and it also means it is specialized infrastructure biosafety lab that is your other research areas. Supposed to be part of the commissioning, unfortunately, we finally find that we only are involved in some of them because most of the time specialists sort of voting and looking at it and the unfortunate thing about specialist, they are specialists in their field, but unfortunately they don't understand the environment of the of the university because what you find is researchers are sort of, they're coming into a space and they just want the space to be operational. These academics, they're not interested on how it works. For example, if you look at a biosafety cabinet or biosafety field, you find these specialized elements as required so you find they will take a specification that will make sure that the machine works but they don't understand that the staff members should also be looked at and that's where we would

come in and we would look at all those interventions. So, for example, because of bio safety lab which is high level you also have to have that person on a medical surveillance program, and the reason why you have the personal medical clearance program because these mechanical automated systems, they are not always functional. So that's why we start with the people working in those areas, we identify we do a baseline risk assessment, so when they come into the system they help. If they have become ill and very symptomatic that way. We also then say, OK, specialized intervention is required now that we've been failing over here it was not hygienic assessment. We actually test the environment before it becomes operational. Now use our helping cyclists, who transformed in the last three years. Where we are taking a more strategic governance approach whereas in the past the approach was reactive, we now are more proactive. So, our role is more to make sure that there are policies and procedures in place. So, I am in that unit and obviously our unit consists of firstly we have the director who's more strategic and then the other operational functions, my function being operational and then we have a governance and monitoring manager that has been appointed and we also have an environmental risk management and her own especially is aligned to the operational functions within a laboratory. We have an institutional Biosafety committee that we all members of, so we sort of have to check all the highest research is doing taking place across the university campuses. There's also Ethics Committee that obviously make sure that your everything is signed off and approved. You also find that there's certain permits that you require if you're doing research on specialized items. So, our area responsibility is more from oversight point of view making sure that all those systems are in place.

Speaker 1

How do you prioritize the university occupational health and safety for highly specialized infrastructure?

Speaker 2

Basically, the way we address items now is we adjust to the faculties as well. So, we start putting the risk register and obviously making sure that you can quantify the risk either low risk, high risk, medium risk, or we are sometimes you can even now that our process is for example, we are doing a process for hygienic orders so that will be prioritized. We also have a program of doing baseline risk assessments, so that would also be prioritized, and you find the challenge is obviously funding so our motivation would be based on the IRS. And obviously we it's also important for us though we have this low, it's important for us to also engage with the faculties, because they must also be sensitive to the kind of research they do because they're creating the risk based on the kind of research that they do.

Speaker 1

What are some of the most common routine university occupational health and safety issues that need to be addressed on highly specialized infrastructure?

Speaker 2

I think the most common issues is the formulation of that specialized committee that will be involved in the layout and the design of these specialized areas. As I alluded to earlier, you'll find that a PAC is set up, but you find that the relevant specialists are not part of it, so to give you an example. One of the lab in the upper campus, they set up the lab and everything, but they did not have a specialist around Biosafety they had an open safety person, but that guy did not, was not the specialist on biosafety that's where the breakdown is the component of the specialized group that is an area that it's always stressful for us because now you falling into that gap over the active process. So, you come along and you, if you're invited in part of the commissioning and you say the guys you can't be because of this et cetera et cetera, and then the simple example is like going to an area and you find that there's gaps because you know, biosafety area it must be stabilized area. But when you look at the door, the door doesn't seal, you look at the windows, the windows are not shatterproof, or because if for example, there's a fire outside and there's heat buildup it will break the glass and you will find what research they're doing it can contaminate the air outside.

Audio file

**Participant 12** [-\[AudioTrimmer.com\].mp3](#)

[Transcript](#)

[Speaker 1](#)

[Thank you for agreeing. Thank you for agreeing to participate in this research study. Okay. My name is Matholi Hlope. I'm currently doing a master's degree in property studies at EBE. In order for me to fulfil my degree, I need to conduct this study. This has been approved by the Ethics Committee at APE and the Executive manager of Human Resources has approved for me to interview US staff. And then this data that is being collected here is going to be anonymized. It's going to be used only for the study. For the purpose of the study, only researchers that are working on the study will have access. Okay. All data will be anonymized. So, this will be based on your opinion. The EPA committee has approved the questions because these are semi structured questions. But I will rephrase. It's based on your role. Yes.](#)

[Speaker 2](#)

[Okay.](#)

[Speaker 1](#)

[Yes. My study is on examining the challenges associated with highly specialized infrastructure. If I'm talking about highly specialized infrastructure, I'm talking about their laboratories, the biosafety lab, where you are conducting the research, the clinical lab, the clean room, those mortuaries, all those highly laboratory, a lot of highly experimental are being conducted. And my study is at University of Cape Town. The reason why I choose University of Cape Town because University of Cape Town in research, they are still leading in Africa. And also, previously there were studies that were done in facilities management, but they've never been a study that has been conducted in highly specialized infrastructure that's why I was interested in choosing this topic. Ok Participant 12, the meeting is being recorded and as I said, the data will be stored, and this will be anonymous. So, I've sent you two sets of questions because I feel in your role it will apply both but this will be based on how you've answered my first question then I can rephrase the question, please.](#)

[Speaker 2](#)

[For the purpose.](#)

[Speaker 1](#)

Of the study, such as this. Working on the study will have access. That's. Yeah, that's how will be anonymized. So, this will be based on your opinion, so that the EPA Ethics Committee has approved the questions because these are the structured question that's already phrase. It's based on your role. Yes. OK. Yes. Yes. So, if I can go to the first question, can you describe your role as a faculty operations director and the type of highly specialized infrastructure that you are responsible for? Okay, so to answer the question, can you describe my role as a faculty operations director?

Speaker 2

So, this role oversees various areas within the faculty on campus and off campus. Areas on campus is this campus and observatories and off campus will include Red Cross Hospital, Groote Hospital, and off campus sites as well whether they are teaching sites or research sites. When it comes to highly specialized infrastructures, it all depends on which space we are referring to. So, the spaces here at Observatory, where the faculty is, will include research spaces within largely the Crispine Building, as we have most of our research activities there, which includes a major tenant called Set and includes RAF, the Animal research facility. The other area includes IDM, which has various research groupings. And besides that, we have research activities that are conducted in anatomy and Falmouth buildings. This is an observatory. And within Groote Schuur Hospital, there are various research that happens in all main buildings. At Red Cross Hospital, we have research that is conducted in the ICH building. So those are the spaces that we have oversight over. SAPI could be another site which is in. How do you pronounce it? In Worcester.

Speaker 1

In Worcester. Okay. Yes.

Speaker 2

So that could be another major area as well that we're thinking that we can refer to as a major site. Okay. So that's the first question.

Speaker 1

Okay. How do you prioritize now the maintenance task in this highly specialized infrastructure that you are responsible for?

Speaker 2

So, prioritization of maintenance. So, maintenance is conducted by, you are the student in this. So, maintenance is conducted by P & S maintenance because that's where the budget resides. Maintenance, as I understand, within UCT, is not planned maintenance.

but reactive maintenance. And that's only because budgets are constrained. So, it's all based on what becomes priority as and when it's required. There are areas where there's plan maintenance, such as the HVAC, such as the lift, the lifts, other areas within research spaces the department is meant to maintain themselves, especially if they require research results that are appropriate, because if they don't maintain and calibrate the equipment, so they will do their own maintenance within research spaces to ensure that the results of the research is accurate. So they will do routine maintenance within their lab spaces, which they are responsible for when it comes to other common use equipment such as the HVAC and lifts, et cetera, those that reside under PNS maintenance, then they would conduct that maintenance in terms of their allocation of which areas they can maintain, freezers. So it all depends on which equipment it is because then you have to segregate between who's responsible for maintenance. So it's either the department or it's PNS maintenance, or it is your landlord, depending on the space you occupy.

And that also comes down to what is in your lease agreement. Like Groote Schuur Hospital, it all depends on what our agreement is with the hospital as to who's responsible for which areas of maintenance. The same as at Red Cross Hospital. It depends on who's responsible for that maintenance.

Audio file

**Participant 6** [\(3\)-\[AudioTrimmer.com\].mp3](#)

[Transcript](#)

[Speaker 1](#)

[Go to question one, if you can describe your research projects and the highly specialized infrastructure that relies on.](#)

[Speaker 2](#)

[Okay, so we represent here all the cardiac surgical research at UCT, with one branch being the Cardiovascular research unit, which is the academic side of it, and the other one being a UCT spinoff company, Straight Access Technologies, which has been formed 15 years ago in order to get proper funding. On the UCT side of things, our main focus is on tissue engineering and tissue regeneration. That means to facilitate the incorporation of cardiovascular prosthesis into the body, heart valves, artificial arteries, that they turn from a plastic or metal structure into something which consists of the patient's own tissue.](#)

[Speaker 1](#)

[Okay](#)

[Speaker 2](#)

[That is what we have done here for the last 35 years. And in the beginning, it even led to the first globally first study of tissue engineering in patients, which we performed in Europe.](#)

[Speaker 1](#)

[Which year was that?](#)

[Speaker 2](#)

[That was 1990 to 2000.](#)

[Speaker 1](#)

[Okay.](#)

[Speaker 2](#)

[And on the startup company side, on the SAT side, we develop, and I speak in the present tense, it's still developing a heart valve for Africa, for the many patients with rheumatic heart disease. So there are about 200,000 patients in Africa alone dying each year of that, because they don't have heart surgery. So we are developing a valve which can be implanted without open heart surgery by a general surgeon anywhere in a small hospital. And we are ready for first patients in the next two or three months, hopefully.](#)

[Speaker 2](#)

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Speaker 1

Okay. How important it is to maintain highly specialized infrastructure for the success of your research project? Yeah, this is, of course, both are high tech projects. The academic one with the tissue engineering requires cell culture laboratories, electron microscopes, highly specialized light microscopes. And the spinout company requires clean rooms, custom made machines, even with robotic arms. And of course, both of them need the operating facilities which we had installed here 25 years ago, and which are state of the art surgeries.

Speaker 1

Okay. And then the question is how it is important now to maintain this highly specialized infrastructure. How important is maintenance?

Speaker 2

So these machines are all imported from overseas with a weak grant. They are even more expensive than they were before, and we have to use them, particularly on the academic side, far beyond their amortization replacement period. The previous electron microscope we had here for almost 40 years.

Speaker 1

Okay.

Speaker 2

And therefore, maintenance is, of course, essential. Are you including things like air conditioning? Because that also...

Speaker 1

Yes. In order for the laboratory to operate. Yes.

Speaker 2

...The part which the university needs to contribute, and this has been a challenge in this building.

Speaker 1

Okay. Have you ever experienced disruption to your research projects because of routine maintenance of highly specialized infrastructure? Can you describe the situation and the impact it had on your research?

Speaker 2

Audio file

Participant 2 REC003-[AudioTrimmer.com].mp3

Transcript

Speaker 1

My name Matholi, as I've sent you the contact form and explain the reason for this interview, I'm currently a student doing master's degree at EBE, so I'm conducting the study to fulfil my master's degree. So, the topic that I'm doing is examining challenges associated with highly specialized infrastructure. If I'm talking about highly specialized infrastructure, I'm talking about the clean room, the laboratory, and the data centre. So, this is under your responsibility and this data will be anonymized and this will be used for the purpose of this research and the feedback, it should be based on your opinion. Exactly, yes. I would like to understand your opinion on various things. So, the meeting is being recorded. Okay, I've shared a question with you. Then we will go to the first question. If you can describe your role as a facilities manager and the type of highly specialized infrastructure that you are responsible for maintaining.

Speaker 2

Being recording does not mean nodding and waving. All right. My primary role is to manage operational, well, I manage primarily data centres for ICTs, and we also manage the building ICTs on main and that includes the fleet custodial services within that building.

Speaker 1

Okay.

Speaker 2

So primarily my job is to manage operations, capacity management, environmental and physical infrastructure of the facilities that house our ICT equipment. And some of it is not ours. Some of it may be properties and services kit or some other faculty's kit, but because it's the same type of equipment, we sort of manage that facility and its primarily power, cooling, and the structure.

Speaker 1

How many data centres are you responsible for?

Speaker 2

For the universities of three.

Speaker 1

Okay, if you can describe for me those three data centre's that you are responsible for and the location.

Speaker 2

All right. On upper campus we have the university's primary data centre that runs basically all UCT networking services, IT services on campus and the link between those services and the cloud-based stuff. So, our primary Internet connection would also be there. And then it used to be a dual site, it's now active. We have another smaller data centre on middle campus at Bremner Building.

Speaker 1

OK.

Speaker 2

And because of uptime, we have them basically active, so services can fail over between the two. It used to be primarily a D Site. We run our backups from there, we still run our backups from there, et cetera. And then the third data centre is a research data centre which is located at the ICTs building ICTs online. It was primarily built for a university cloud that was going to get off, but it never quite got off the ground. And now, it's been used for research by astronomy.

Speaker 1

Okay, how do you prioritize the maintenance task for highly specialized infrastructure?

Speaker 2

Okay. We primarily schedule set dates. So, we work on set dates. We work around the UT calendar. We have set dates.

Speaker 1

Okay.

Speaker 2

And then we arrange that around, and we then liaise with whatever users are within our data centre, and we inform them that, so we give them notice that in six weeks' time we would do XYZ, and we give them the calendar up front, and so they are well aware of what is happening up front for the year.

Speaker 1

Okay.

Speaker 2

And often it has challenges. Those things change. I mean, we've got to be, what's the modern term now? Agile. So, we try and be agile, and sometimes we have to alter that. Sometimes maybe something happens on campus, and we can't do our midyear maintenance status in the maintenance. We'd have to postpone it to the next month.

Speaker 1

Okay.

Speaker 2

Exams may be postponed for some other reason, and then we'd have to do that. So, we have to be a little bit agile, but everything's negotiated upfront.

Audio file

**Participant 5** [.mp3](#)

Transcript

Speaker 1

Good morning, Participant 5. My name is Matholi Hlophe. I am currently doing my master's degree in Property Studies at EBE Department. So, for me to fulfill this degree, I need to conduct a study. So, this study has been approved by the EBE Ethics Committee and by the executive Director for Human Resources to interview UCT staff. Ok, the study that I'm currently doing. I'm examining the challenges associated with highly specialized infrastructure. If I'm talking about highly specialized infrastructure, I'm referring to the laboratories like the clinical lab, the clean room, the biosafety lab. Those laboratories that conduct research. They must operate and apparently, they've got research which goes from 2 to 10 years. So those facilities that does not shut down so. Those are the only ones that I'm referring to. Because previously there was a study that was done in facilities management, but it was done in general facilities not specifically on highly specialized infrastructure. So, this one I'm doing it on highly specialized infrastructure. And the data that is collected here will only be used for the purpose of the study and will be anonymized, so to be only available to the researchers. Thank you very much. I will take you through the questions because these are semi structured questions as well. They also have been approved; I might also rephrase to suit your role. But if you can describe to me your role as a procurement director who is responsible for all procurement of maintenance of this highly specialized infrastructure. Like the equipment, all those kinds of things that go with procurement for these facilities to run.

Speaker 2

OK, so I'm Participant 5, I'm the director of Procurement and Payment services, I think it's important to understand that we've got a very small sourcing team. It's I, we've got 2 senior contracts managers and sitting below them, we've got contracts managers, we've got a planner that basically she just. You know, looks off to our pipeline and we've got a BEE coordinator. We run in the devolved system. So, we are essentially the combination of the center of Excellence. We provide advisory we will run the tender processes in conjunction with the department. And so, for Procurement of this nature, I think that you know we, it'll be collaborative. It'll need to be within an overarching strategy, which I always think is a good place to start. So, whatever we wanting to do, what is our approach to the market? And just to flesh out the transparency from the get-go, so that shapes the approach. And

then we get into it. And that approach could be anything. From we're going to tender, how long? Is, you know, the service people, is it 3 + 1 + 1? Is, you know, is it a negotiated approach? Is it approach that we want to establish a panel of providers where we kind of fix a price? A price lists. And we. You know, manage an SLA post contract. So, this will be done I think in conjunction with the department and then of course with a good governor. So, for us, good governance would be you know the procurement provides valuable money, that we understand the risks associated, that we balance the transformation agenda and that it is fair, equitable and transparent. So, and then that's why we start off by writing our ideas or our approach through a strategy that frames what we want to do, which is visible. It is distributed through the senior levels; it is signed off and then we can do so. But when we go into this operational phase of what we are doing. We don't then at that stage get questions of why was this a selected bid list and not an open tender? Why have you chosen to benchmark and negotiate with this contractor? And there may be good valid reasons for all those things, but it would be, you know. We look out for the governance work I would in this instance either send ... or ... to work with the maintenance team and the maintenance team I guess you know works with ED colleagues and there's this group that you know kind of things to work through what we want to do. The specifications how are we going to evaluate stuff. We also have that within our policy, you know, deviations and I think that you know a deviation follows a certain process. And it is quite rigorous in terms of the waiting, you know, so it is not that you know where there's a deviation that isn't the procurement process and it might just mean that you know, we choose to do this. And it's with its slightly outside of ours you know our general policy. So, there are specialized kits, right? So it is, I don't know. They're doing this or conducting experiments and as they get money, so they add to the infrastructure footprint. They generally like on consistency to kind of work with one colleague. You know, in terms of the kits that they use, and you know. And so, in that instance we must prevent disadvantage. We need to make sure that you know there is spares are available, then you know we are getting a good price if the stuff is imported. You know are they local. You know, and their warranties expires if they are local. Companies that can kind of do the maintenance and the installation, so you know a collaborative very much a collaborative effort and as you, so I mean we are very aware that these experiments go on for a long time and you know these. But the procurement isn't always, let's call it typical in terms of, we are not buying furniture, we are not buying stationery, you know. So, it's not routine that requires an approach that is fit for purpose. And so, you know, so. We have tools. We try and ensure the governance and we try, and you know, in this instance, you would end up with, you

know, one of these contracts one that just manage this kind of guy, you know, these guys, no guy guides the process. And what could be useful, and this is not something that we always do or forget, is a demand plan. Right, so this is what we what we're looking to do and that goes on to our contract's tracker, our pipeline, you know tools, so we know that this is coming in you know that this is coming out and we could provide advisory you know. Sometimes these, most of these tenders are going to be 3 to 6 months. So, you know you need the runway and it's not so much that it's going to be on the market for six months. But you need to firm up the requirements, you need to make sure that you know the specifications are for the committees or for ballots that you know be a couple of iterations and potentially with the right subject matter. That, you know, experts say that we don't waste the market's time. We are very pointed in what we want to do so. So, there's a lot of upfront work that we haven't said that what we do, what we do get from demand planning is that I do ask for the **Cathics** they use every year, or we ask that the **cathics** are also consolidated. Those are reprioritized, that they put forward for the budgeting process and a certain value is approved and we will then, you know, have a list of those of those projects. So that is what we do both for infrastructure and for IT and that is, you know essentially the demand plan. You know we had a bigger team, and you know we probably working towards this, you know, business part is to have, you know, ongoing conversations you know. With some of the researchers so that we have an indication of what is coming, and we can provide early advice. We have said that you know those are the tools.

Maintenance Department or the small works or the major works all under the properties and services umbrella, we have got a very, very good relationship with them. And so, these constant communication and you know we would, you know we would get you. The more upfront work you can do the better the outcome.

Audio file

## Participant 15 [mp3](#)

Transcript

Speaker 1

Thank you very much for agreeing to this interview. My name is Matholi Hlophe, I'm currently doing my master's degree at EBE in MSC property studies. In order to fulfill this degree, I need to conduct this study. So, the topic is about examining challenges associated with maintaining of highly specialized infrastructure at the university of Cape Town. As you're aware it's still the leading university in the research in Africa. UCT house a lot of those highly specialized infrastructure and they generate a lot of income with those. This interview will only be used for the purpose of this research, and it will be anonymized. Yeah, it will only be available to the researchers.

Speaker 1

If you can describe your role as the risk compliance and relationship managing director that is responsible for all university compliance issues, including insurance of the equipment that is housed in the highly specialized infrastructure.

Speaker 2

First and foremost, insurance is part of our risk management strategy, things like our fixed assets which is buildings and highly specialized equipment, but equipment in general. we need to realize that there could be losses that happen, and the university may not have the financial means to respond to things like loss or a disaster, same as we had that 2021 fire. So, what do we do we get insurance in order to respond when there is a significant loss. So, my role is around making sure particularly when it comes to insurance some of our highest assets, there is cover for them and that cover will meet the terms and conditions so that it may respond in a case of an incident, and we've seen a number of incidents, some relating to FEESMUSTFALL where the Vice Chancellors office and some of the buses, and the buses at that time belonged to a service provider so it was not my problem they had their insurance needed to sort it out you know. So, we need to make sure that when it comes to protecting UCT highest assets we have insurance cover in place, because as I said, the university would not be in a position to financially respond to any loss or damage that may result from that, you know, so compliance is very important because compliance ensures that we are able to meet our terms and conditions when it comes to insurance cover, so I do have awareness sessions and I remember there was one that we had with the maintenance department. We have an awareness session where we informed you guys about particularly what was happening here, so we had an

awareness session with the maintenance department and we told them about what is expected, particularly, even when the loss happens because want it to be reported as soon as possible with the full details being provided. Sometimes we just want a note so that we are aware that there is a pending claim so that we don't risk the repudiation. The repudiation can happen when we claim outside a 30-day period that is given by the insurers. So, we may have suffered the loss, but we could be slow in terms of reporting that loss and that could result in a repudiation. Another one awareness was important is that there's been some policy changes to our insurance cover things like Load shedding, grid failure damage because of Load shedding or grid failure things like that they are being excluded from the insurance response. So, we needed to make colleagues aware that particularly where there's infrastructure, particularly key equipment that preventative measures are taken. You have your power backups; you take the necessary steps to make sure that this power surges is in place. You can minimize some of the potential and load shedding. And now we get a schedule for Load shedding, so we do encourage, and we also engage with cash who's the director who is responsible for occupational health and safety, we also presented to a committee with respect to that grid failure, and we've also communicated with the maintenance managers and the key faculty officials are also communicated with all the Deans. And I hope that the message is being spread to everybody concerned, we also have committees like risk management committee, auditor risk management committee where we talk about how we are managing this. So, the role of compliance becomes quite important, particularly to ensure that we have a policy response when it comes to insurance so that's the best way, we can protect our highly specialized infrastructure being buildings or equipment but over and above, I mean, I went to one of our centers, the neuroscience center and I was quite concerned that the water ingress. It's a building within the Groote Schuur building. Some of the issues are relating to maintenance from Groote Schuur, but they have an impact in terms of our equipment and houses some of the most expensive equipment, I'm told that some of it could be as much as 50 million rand. So, I get worried when I can see that lack of maintenance could result in a big claim that could be repudiated because we could foresee that damage or that loss was going to happen but we're not doing much about maintenance because the Groote Schuur and UCT who is responsible for the maintenance. So that is precisely my role with regards to insurance of highly specialized infrastructure, raising awareness because if we can prevent any loss or damage that's for me number one priority, insurance is in an event when we have failed to take the necessary preventative measures.

Speaker 1

As you have just highlighted the neuroscience issue to say that maintenance is being neglected, whereas a neuroscience is also one of your specialized facilities which conducts research. Are you only worried about the equipment where you've lost the research in impact that it will have because now if there is that maintenance issue, will that not compromise the entire research that has been conducted?

Speaker 2

You are right, I mean. The piece of equipment is quite central in terms of research and if it's damaged and you can see that it will take some time just to move it out and calibrate it, fix it and put it back. So, the impact on research is going to be quite huge, but also the reputational damage to UCT, because if it comes out, particularly if the claim is repudiated, that UCT did not take preventative measures to mitigate against this potential loss, the reputation of the universities is at stake, but I am worried because what they do in that center is about cutting edge research and in order for us to provide that cutting edge research, we need to be able to make sure that all our equipment are functioning. The inconvenience in terms of staff, in terms of the patience and also the center has been used to generate money because the other specialist that uses it and it generates money for that center, so it's so funny you know. So, the importance of heading it run 100% is quite important. So, the impact is not just from the equipment, but it's also on research, it's also on the reputation, it's also on the financial sustainability of that center because they generate quite substantial funding to be able to meet their daily operations so it's not just about the insurance on the equipment, but also the UCT brand, the impact on research, teaching as well you know, so it's multifaceted. It's just that I focus mostly on insurance because that is my area specialty.

Audio file

**Participant 20** [1.mp3](#)

Transcript

Speaker 1

As I've introduced myself, I am Matholi Hlophe. I am currently doing a study in examining maintenance of highly specialized infrastructure at the University of Cape Town. I am a student at EBE and currently I am doing masters in property studies, so this research has been approved by our Ethics Committee. And, I've got permission from HR, executive director to interview the UCT staff and thank you very much for agreeing to participate in this study. The reason why I chose this topic such is that, Previously, there were studies that were conducted in facilities management, but they have never been studies that was conducted specifically in the maintenance of highly specialized infrastructure. If I'm talking about highly specialized infrastructure, I'm referring to the laboratories that do the highly experiments which are housing, a very poisonous chemical. I'm talking about the biosafety labs which house those dangerous species. I'm talking about the clinical laboratories, I'm talking about, like the clean room. So those are the highly specialized infrastructure that I'm interested in, so I've got a set of questions that I've shared with you, and these are the questions I would like to ask you. There might be follow-up questions, there might be something that comes on, but this interview will be based on your opinion. Exactly. I'm conducting this interview as a student at the University of Cape Town.

Speaker 1

Question one: Can you describe your research projects and the highly specialized infrastructure that relies on?

Speaker 2

OK. Basically, we don't conduct research of our own, but we provide facilities and services to support academic research. So, we do have animal housing facilities that are highly specialized, OK to cater for the animals that we care for and for the animals that are enrolled in experiments. So, I'll give you an example that we have what's called a specific pathogen free unit that houses animals or for biological for certain biological disease status for the purposes of research. Then we have BSO 1 to BSO 3 laboratories where experiments on these animals are conducted. So, this could be with infectious material or potentially infectious material. So, whilst it may not necessarily be a laboratory in the true sense. It's housing animals, but the animal itself can be considered infectious because

they carry the pathogen when they're infected. So yes, we've got an SPF unit and BSO 1 to BSO 3 labs.

Speaker 1

How important it is to maintain the highly specialized infrastructure for the success of your research project?

Speaker 2

Well, without the maintenance of those infrastructure or academic research falls away because if you look at the SPF unit to maintain those animals at a certain biological health status, you need to maintain environmental parameters within specific ranges. So, we've got the use of what we call individually ventilated cages, we've got isolators. We need to keep the rooms in positive pressure. We need to keep the ultrasound levels at a consistent kind of level. So then if we move on to the BSO2 and BSO 3 facilities without maintenance of infrastructure or negative pressure or environmental parameters then you can't perform research in there because you have no guarantee that you are going to be able to contain pathogens within that room. So ideally with our SPF unit we need to make sure that we have kept pathogens out by maintaining the infrastructure in a sound state and then with BSO 2 and three facilities, pathogens need to be contained in and the infrastructure needs to be maintained in order to achieve that. So, we've got HVAC systems, we've got hyper filters that need to be changed and maintained. There's a whole lot of work involved to ensure that everything is running in the way that it's supposed to in order not to compromise on that biosecurity.

Speaker 1

So do you internally have facilities managers that oversee the facilities to see this maintenance is being done. So how do you keep track of the maintenance in those facilities, who keep track of it?

Speaker 2

So yes, we do have what we call unit managers. So, we do have managers for the facilities.

Speaker 1

OK, OK. So, they're the ones who look after those facilities. Have you ever experienced disruption to your research projects because of routine maintenance of a highly specialized infrastructure? Can you describe the situation and the impact it had on your research?

Speaker 2

Well, currently we have a farm unit that's shut down on the 1st floor, so it would be termed the conventional unit, but then it has been shut down because there is no maintenance in terms of temperature regulation, humidity control and so forth, so we have no research where that is currently being conducted in that unit because we are not complying with the necessary infrastructure guidelines that need to be there. So that research has had to stop. So, we've actually lost research work, and researchers are moving their research work to other facilities because we don't have the right structures in place in that unit.

Speaker 1

When were these facilities were shut down? during the year.

Speaker 2

Yeah, it's just a few months ago.

Speaker 1

So, researchers are now taking away their research projects because UCT does not have enough capacity to accommodate. Also, they're taking it to another universities. How does that impact your department if researchers are taking away their research projects?

Audio file

**Participant 21** [D school.mp3](#)

[Transcript](#)

[Speaker 1](#)

[Okay.](#)

[Hey, good morning. Thank you very much for agreeing to participate in the study. As I explained in the concept form, this study has been approved by EBE department and I've also received approval from HR executive to interview the UCT staff. So, this is a set of research questions that also has been approved by the faculty. If we can go to question one... Speaker 2 Before we can go on question one, I'll just give you a briefing. Speaker 1 The meeting is being is being recorded. Speaker 2 I'll just give you a brief building introduction and then because some of the questions will touch on the intro, but if you've got a broader spectrum of how the building works and how the building functions, then the questions will form into a puzzle. Speaker 1 OK](#)

[Speaker 1](#)

[OK.](#)

[Speaker 2](#)

[Okay, so the D-school is a six-star green building. It's a six-star design certified building with Green Building Council of South Africa. And at the moment we would love to pursue a six-star S built. For now, there is no requirement for any further submission after the SBU rating has been received. So there exists a different operational rating called the Greenstar Existing Building Performance Rating. Getting that correct and it's evaluation of maintenance and operations after the design of the building is standing. So if it operates within the six star green rating, that's still yet to be seen because that's a second phase. So this certification is valid for three years and I will be doing a six star existing building performance accreditation with Green Building Council of South Africa in order to pursue this type of rating for the building. And just to add, the building was named the Winner, I'm sure you know the winner of the 2023 South African Institution of Civil Engineering in Joburg under Technical Excellence Project of the Year Combination Award in September 2023. I am sure you have seen the news from UCT and the D-school was an overall winner, that's the second prize of the South African Property Owners Association. And it collected a sustainability and innovation award of the year, I am sure you have seen the news from UCT. So the D-school focuses on three things. So we try to champion saving energy, saving water and less waste to name a few. And then also we've added a](#)

component which is a good indoor air quality, where we'll monitor the quality of the air inside the building and then also encourage green transport to be utilized. So, with electricity, I'm going to take you through. So the building at its peak when we're heating and cooling it, it uses about 65 to 70 kW. So the solar system has 110 solar modules, with each module capable of generating 550 watts. And the total kilowatt peak is 59.4 kW. And it's got two inverters. And at this very moment, I'm displaying a dashboard that shows off the 59.4 kilowatt peak from the sun, we generating 31.8 kw, which is of the complete plant. We are harvesting 54% of the energy source and then 46% is from ESKOM. And then if you see at the bottom, the black line is the UCT, or the D-school load line. So, basically the power that is required to operationalize the building, either heating it up or cooling it down, and all the plugs and everything that needs that is needed by the building to fully operationalize. And then the blue quadrant is ESKOM. So this is what if you see here before the sun rises, everything was supplied by ESKOM, and then as soon as the sunrise, we actually needed less of ESKOM and less of ESKOM. And at this very moment, well, almost, the building was powered by solely the sun. And then we also comparing because the system was implemented in 2022 so we're trying to see the efficiency of the system, how efficient is it? Is it performing better? Is it getting worse? Can we improve anyway? So for now we are performing better because we are getting plus 14% comparing to the same month last year with this month of the sun's energy converted to usable energy for the building. And you might have noticed that there are no switches on the walls for the building and the lights in the spaces is actually controlled. Take your trip now and then if you do close your windows, your blinds, the lights will become brighter and if you open your blinds, they will become dimmer to achieve 190 luminance of light in the room.

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Speaker 1

Oh OK.

Speaker 2

And I will take you through the app just now. So, we program these devices which you can program and reprogram. So, this one I programmed for this room, it's all on or off.

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Speaker 1

OK.

Speaker 2

So, you can do that if you come into a room and there's enough light in the room, but you still don't get enough light, then you can use the switch to open more light.

Speaker 1

OK.

Speaker 2

I'll take you again to the same room that we are in. You can dim the light in the room with an app anywhere.

Speaker 1

Oh, OK, OK. Anyway, even if you are not here?

Speaker 1

Anywhere, even if you're not here with us.

Speaker 2

Even if you are not here. But what it needs, it needs a device which is here. We've installed the app in the PC in level two. So, as long as that PC is on, I can remote to the PC.

Speaker 1

OK. OK, OK, OK. Interesting. Yeah.

Speaker 2

Well, just come here. I have talked about solar there. Also the building has an energy efficient heating and cooling system. We don't have aircons or split units, so we're using a system called Thermally Active Building System, which cools down the floor slabs or heats up the floor slabs to heats up the space. And then we also have three air handling units, one in each level, and that is for only for fresh air.

Speaker 1

Okay, thank you very much. Let me stop my recording.

## 12 NVivo Codes – Appendix F

Name	Files	References	Created on	
Facility management	0	0	2024/05/27 08:25	M I
Specialised facilities-	3	8	2024/05/27 08:24	M I
Background information	1	1	2024/05/04 03:18	M I
Participants role	17	28	2024/05/04 18:20	M I
Number of years of experience	1	1	2024/05/04 19:26	M I
Theme 1- Resistance to maintenance by different stakeholders	0	0	2024/06/15 12:46	M I
Theme 2- Challenges faced by facilities managers in performing routine maintenance	0	0	2024/06/15 12:47	M I
Theme 3- Communication and its effect on Routine Maintenance	0	0	2024/06/15 12:47	M I
Theme 4- Poor maintenance culture and its consequences	0	0	2024/06/15 12:48	M I
Theme 5 Approach to overcome resistance to routine maintenance	0	0	2024/06/15 12:49	M I
Theme 6- Strategies to a successful maintenance system	0	0	2024/06/15 12:49	M I

Name	Files	References	Created on	
Insufficiency allocation for maintenance	1	8	2024/05/24 10:25	M I
Challenges related to reliance on external parties and resources	1	8	2024/05/24 10:25	M I
Contractor reliability and resources availability	0	0	2024/05/08 01:36	M I
Contractor reliability	3	5	2024/05/25 20:36	M I
Resources reliability	2	4	2024/05/25 20:38	M I
External factors	5	9	2024/05/05 11:47	M I
Equipment provider	2	2	2024/05/25 21:39	M I
Power loss - Load Shedding	4	12	2024/05/25 20:46	M I
Staffing challenges	3	10	2024/05/05 04:04	M I
Administrative and policies challenges	7	15	2024/05/11 17:53	M I
Governance and compliance	0	0	2024/05/30 21:55	M I
Implementation delays	2	3	2024/05/30 21:58	M I
Legal and contractual agreements	1	1	2024/05/30 21:57	M I
Oversight, authority, and compliance	2	3	2024/05/30 21:58	M I
Specialised committees and external partnerships	1	1	2024/05/30 21:56	M I
Specialised committees and specialist inclusion	1	4	2024/05/30 22:01	M I
Vendor and partnership interactions	1	1	2024/05/30 22:02	M I
Lack of support	2	2	2024/05/31 06:21	M I
Lack of transition plan and leadership coherency	4	8	2024/05/04 03:47	M I
Procurement challenges	0	0	2024/05/24 20:11	M I

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Files

Name	Codes	References	Modified on	Modified by	Classification
...transcribed final	29	57	2024/05/04 00:08	M HLOPHE	
Rongane Qawe transcribed final	32	43	2024/05/04 00:08	M HLOPHE	
Charles Harris - transcribed final	30	71	2024/05/04 00:08	M HLOPHE	
Dirk transcribed final	27	35	2024/05/04 00:08	M HLOPHE	
Faizah Transcribed final	17	30	2024/05/04 00:08	M HLOPHE	
Fanie Grong - Electrical maintenance engineer transcribed	31	86	2024/05/04 00:08	M HLOPHE	
Fred Webb transcribed final	26	36	2024/05/04 00:08	M HLOPHE	
Greg Skoen - Programme director transcribed final	36	55	2024/05/04 00:08	M HLOPHE	
Hyllon Director Technology transcribed final	31	52	2024/05/04 00:08	M HLOPHE	
John Modert - OHS transcribed	17	28	2024/05/04 00:08	M HLOPHE	
Karen Sileva - Transcribed	27	50	2024/05/04 00:08	M HLOPHE	
Manfred Braune - Sustainability director transcribed final	21	38	2024/05/04 00:08	M HLOPHE	
Mavonda questions and answers - Copy	12	13	2024/05/04 00:08	M HLOPHE	
Michael Langley - Transcribed	32	78	2024/05/04 00:08	M HLOPHE	
Nave Naidoo transcribed final	23	36	2024/05/04 00:08	M HLOPHE	
Peter Zilla transcribed final	10	12	2024/05/04 00:08	M HLOPHE	
Randolph Thompson - transcribed final	37	95	2024/05/04 00:08	M HLOPHE	
Robin Golding - Procurement Transcribed	30	48	2024/05/04 00:08	M HLOPHE	
Shai Makgoba transcribed	11	17	2024/05/04 00:08	M HLOPHE	
Tashie Maswawara - Transcribe	28	51	2024/05/04 00:08	M HLOPHE	
Wanda - Dschool transcribed final	7	7	2024/05/04 00:08	M HLOPHE	

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Codes

Name	Files	Referenc	Created	Created	Modified on	Modified	
Facility management	0	0	2024/05/2	M HLOP	2024/06/15 1	M HLOP	
Specialised facilities-	3	8	2024/05/2	M HLOP	2024/06/15 1	M HLOP	
Background information	1	1	2024/05/0	M HLOP	2024/05/04 0	M HLOP	
Participants role	17	28	2024/05/0	M HLOP	2024/05/25 0	M HLOP	
Number of years of experience	1	1	2024/05/0	M HLOP	2024/05/04 1	M HLOP	
Theme 1- Resistance to maintenance by different stakeholders	0	0	2024/06/1	M HLOP	2024/06/15 1	M HLOP	
Theme 2- Challenges faced by facilities managers in performing ro	0	0	2024/06/1	M HLOP	2024/06/15 1	M HLOP	
Theme 3- Communication and its effect on Routine Maintenance	0	0	2024/06/1	M HLOP	2024/06/15 1	M HLOP	
Theme 4- Poor maintenance culture and its consequences	0	0	2024/06/1	M HLOP	2024/06/15 1	M HLOP	
Theme 5 Approach to overcome resistance to routine maintenance	0	0	2024/06/1	M HLOP	2024/06/15 1	M HLOP	
Theme 6- Strategies to a successful maintenance system	0	0	2024/06/1	M HLOP	2024/06/15 1	M HLOP	

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IMPORT

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ORGANIZE

Coding

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- Sentiment
- Relationships
- Relationship Types

Cases

Notes

- Memos
- Framework Matrices
- Annotations
- See-Also Links

Sets

EXPLORE

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Codes

Search Project

Name	Files	Referenc	Created o	Created	Modified on	Modifie
Resistance to maintenance and its effects	14	34	2024/05/0	M HLOP	2024/05/24	M HLOP
Approval process, operational support, and budget resista	8	12	2024/05/2	M HLOP	2024/05/25	M HLOP
No resistance	8	10	2024/05/2	M HLOP	2024/05/25	M HLOP
planned maintenance and operational awareness	1	1	2024/05/2	M HLOP	2024/05/25	M HLOP
Resistance due to academic activities	0	0	2024/05/2	M HLOP	2024/05/25	M HLOP
Theme 2- Challenges faced by facilities managers in performing r	0	0	2024/06/1	M HLOP	2024/06/15	M HLOP
Operational challenges and resources dependency	2	10	2024/05/0	M HLOP	2024/05/24	M HLOP
Administrative and policies challenges	7	15	2024/05/1	M HLOP	2024/05/25	M HLOP
Procurement challenges	0	0	2024/05/2	M HLOP	2024/05/24	M HLOP
Theme 3- Communication and its effect on Routine Maintenance	0	0	2024/06/1	M HLOP	2024/06/15	M HLOP
Communication challenges	5	14	2024/05/2	M HLOP	2024/05/26	M HLOP
Effective communication channel	9	16	2024/05/0	M HLOP	2024/05/25	M HLOP
Theme 4- Poor maintenance culture and its consequences	0	0	2024/06/1	M HLOP	2024/06/15	M HLOP
Poor maintenance culture	7	7	2024/05/0	M HLOP	2024/05/25	M HLOP
Proper routine maintenance planning and progress monitorin	9	23	2024/05/0	M HLOP	2024/06/01	M HLOP
Routine maintenance and maintenance challengeges	7	20	2024/05/0	M HLOP	2024/05/24	M HLOP
Theme 5 Approach to overcome resistance to routine maintenanc	0	0	2024/06/1	M HLOP	2024/06/15	M HLOP
Strategies to ensure proper maintenance	2	2	2024/05/0	M HLOP	2024/05/24	M HLOP
Strategies to overcome maintenance challenges	0	0	2024/05/0	M HLOP	2024/05/25	M HLOP
Communication and stakeholders engagement	3	7	2024/05/0	M HLOP	2024/05/24	M HLOP
Balancing maintenance and academic needs	0	0	2024/05/0	M HLOP	2024/05/24	M HLOP

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