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**CHALLENGES IN STRATEGIC
FACILITIES MANAGEMENT:
ANALYSIS OF PROBLEMS FACED BY
UNIVERSITY FACILITIES MANAGERS
IN NEW ZEALAND AND AUSTRALIA**

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IN NEW ZEALAND AND AUSTRALIA**

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ABSTRACT

Like any set of professionals, the facilities managers (FMgrs) in universities face several challenges that constrain performance of their crucial roles. These range from internal managerial issues to external constraints which can be structured as PESTELI (i.e. political, economic, socio-cultural, technological, environmental, legal and institutional) constraints. The literature is replete with inexhaustible list of the challenges. However, a major gap in the literature is the lack of clear indications of the risk levels attached to these challenges or extent of their impact on the performance of the FMgrs. This study therefore aimed to contribute to filling this knowledge gap by exploring in depth the challenges and their relative levels of influences on the performance of university FMgrs. The specific objectives of the study were four-fold: (i) to identify the current internal and external challenges faced by universities facilities managers; (ii) to analyse the risk levels of the identified challenges based on their relative levels of impact on the achievement of the university strategic FM goals and their occurrence frequencies; (iii) to establish some innovative measures for addressing the key challenges; and (iv) to determine the key challenges facing tomorrow's university facilities managers.

Using the descriptive survey method, the study focused on the facilities managers in the Australasian universities. These comprised eight universities in New Zealand and forty universities in Australia. Views of facilities managers in these universities were obtained during three stages of data gathering: qualitative data gathering at the pilot interview stage, quantitative data gathering at the questionnaire survey stage, and some case studies at the model test survey stage. Descriptive statistics, multi-attribute analysis, rank correlation tests and statistical tests of significance were employed in the analysis of the research data and the tests of research hypotheses.

Results showed that the critical challenges facing the university facilities managers (UFMs) comprised issues relating to the following: finance-related current internal challenge, economic-related current external challenges and sustainability-related future challenges. Overall, poor funding was identified as the root of all other issues faced by the UFMs, hence majority of the suggested strategies for addressing the key challenges related largely to financial improvement measures. Other key measures included optimizing asset utilization, supporting business case for capital investment

with demonstrable returns on investment, improving FM's strategic relevance through linking FM and corporate strategies, and investment in efficient technologies such as the building automation and management systems.

The findings have contributed to filling an important knowledge gap by not only identifying the current and future challenges facing the UFM's, but also prioritising them based on their relative influences on the achievement of the strategic goals of the FM departments. This way, the limited resources at the disposal of the UFM's could be disbursed more cost-effectively in addressing the critical challenges in line with their identified risk levels. This would be of practical benefit to the facilities and property managers in formulating appropriate responses to the identified critical constraints with a view to achieving more satisfactory outcomes in their operations.

Keywords: Australasia, challenges, facilities managers, risk analysis, strategic facilities management, university facilities.

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DEDICATION

With joy in my heart, I specially dedicate this thesis to my father, Haji Kamarazaly Mohd Yunus and my mother, Hajjah Annizar Mohamed, who strived perpetually to see that I attain the education they were not privileged to have.

CHAPTER 1: INTRODUCTION

1.1 INTRODUCTION

Facilities management (FM) is constantly evolving. Facilities managers' role is ever-changing. It now encompasses more responsibility in delivering and sustaining a quality working environment and quality support services in order to meet strategic FM needs and organization's goals (IFMA, 2009, p.5). This study provides insight into the main challenges facing facilities professionals particularly in Australasian universities. It examines trends that shape future challenges in university facilities management with the aim of developing an analytical framework for addressing the key challenges constraining the achievement of strategic facilities management goals. Also strategies are explored for improvement and success of university FM operation.

This chapter introduces the structure of the thesis. It gives an overview of the background and justification of the research, benefits of the research findings, the problem statement, the research aims and objectives, research propositions, as well as the research scope and limitations.

1.2 BACKGROUND TO THE RESEARCH

The International Facility Management Association (IFMA, 2009, p.28) defines facilities management (FM) as "a profession that encompasses multiple disciplines to ensure functionality of the built environment by integrating people, process and technology". The key question is: How do universities identify and respond to the challenges in strategic facilities management in a rapidly growing and changing global environment within which higher education and research are conducted? A major part of the answer is by leveraging the potentials of strategic facilities management to meet corporate goals and stakeholder value propositions (Kamarazaly and Mbachu, 2007).

Several studies have examined the benefits of strategic facilities management. It has been confirmed that strategic FM offers an integrated approach to maintaining, improving and adapting the buildings and other infrastructure of an organization in order to create an environment that strongly supports the strategic corporate objectives (SFMS, 2006; Barret and Baldry, 2003; Alexander, 2003) while constantly adding value to the stakeholders (Alexander, 2003). It is in this perspective that strategic facilities management contributes to the achievement of organizational strategic goals through effective and efficient management of facilities, involving cost and waste minimisation, enhancement of business processes, creation and maintenance of workplace and delivery of superior value (Kamarazaly and Mbachu, 2010).

Furthermore, FM adds value to organizations from a number of other perspectives: recognizing and maximizing facilities' value and gaining competitive advantage (Alexander, 2003; Hamilton, 2004); generating persistent corporate values through dynamic facilities policy and efficient response to issues pertaining to space allocation and changing, environmental control and protection, as well as direct and contract employment (Amaratunga et al, 2000). FM also contributes in integrated management of workplace (Tay and Ooi, 2001), which being a prime source for management of infrastructure resources and services to sustain and support the operational strategy of an organization in both long-term and short-term (Nutt, 2004; Chotipanich, 2004), FM creates best value in delivering to customer satisfaction (Atkin and Brooks, 2005).

Levy (2008, p.303) states that "business success is characterised not only by annual revenue and profit margins, but also by the various ways the building portfolio and environment are maintained. This includes: monitoring daily maintenance, operations, and energy consumption; conducting condition assessments and benchmarking studies; adapting and aligning with policies; assisting with the implementation of the organization's strategic and tactical planning". Connors (2003) argues that the FM role aligns the facility strategic plans with the corporate strategic plans thereby ensuring the use of FM initiatives to achieve corporate objectives. Alexander (2003) further notes that the role of FM has evolved from merely helping organization to survive, to include enhancement of its potential to prosper in volatile commercial climate. This brings an increasing shift in emphasis from operational to a more strategic role for facilities managers. The role has surpassed the traditional duty of business process enhancement and now includes the enhancement of competitive advantage and the achievement of corporate goals.

However, the full potentials of strategic facilities management role may not be optimally leveraged due to inherent challenges. Kamarazaly and Mbachu (2010) observe that with increasing customer expectations, a more demanding and litigious society, and ever-changing business environment, today's facilities management professionals are facing enormous challenges which constrain the achievement of strategic FM goals. For instance, Sauve (2006) identifies changes with evolving technologies, pressure to reduce in-house technical support and lack of accurate data or planning and decision making as some of the internal problems faced by facilities managers. Further, Kadzis (2009) posits that facilities real estate managers grapple with the continuing influence of changing economic and market conditions. In addition, Alexander (2003) observe that the challenges facing facilities managers in the future are those related to finding new approach to leading, cultivating environments for performing and of finding new conversations with clients, customers and staff.

With the widely held but mistaken view that facilities are necessary evil rather than a strategic asset, senior managers expect facilities to be managed for minimum cost rather than optimum value (Alexander, 2003). The current global economic crisis has fuelled this view resulting in leaner budgets. Consequently, facilities managers are now expected to find ways of achieving so much value added results with so little resources – a scenario that demands pushing the boundaries of innovativeness to the limit.

Facilities managers also need to respond to the changing needs of business customers by leveraging the best practices in human resources management and change management. This could be inferred from Fenker's (2004) findings that since early 1980s, competitive positioning in a turbulent economy and the need to adapt to constantly varying conditions of survival, have set the management of change at the centre of business strategy. This statement is equally applicable to the intricate role of integrating people, place and processes – a key challenge facing the facilities manager. There is therefore the need to infuse the culture of change and flexibility in the workplace and adequately motivate and empower staff to respond more proactively to the changing needs of customers. Of critical importance is how to achieve adaptability of the physical setting during space design. Fenker (2004) and Grimshaw (2004) corroborate this by noting that internal political dynamics influence space design and allocation. Consequently a critical challenge facing facilities managers is on how to juggle between the need for optimum use of space and equipment on one hand, and the conflicting interests of the power-brokers on the other.

The key challenge for the facilities manager on the internal front is how to undertake the key role of integrating people, process, place and technology to minimise costs, and maximise value and competitive advantage. Figure 1 presents a graphical illustration of this challenge.

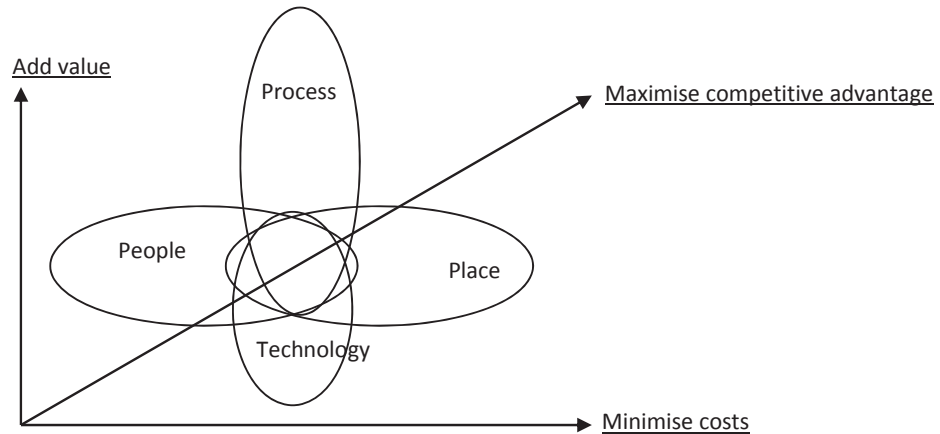


Figure 1: Key challenge for the facilities manager on the internal front (Source: Transfield and Akhlaghi, 1995)

Central to the internal challenges faced by facilities manager is the need to be technologically savvy. The facilities manager of the future will need to be much more technologically sophisticated than their predecessor. Technology will no longer be something that can be safely left to the technologists (Sloan School of Management, 2005). Facilities managers face the challenge of up-skilling and leveraging the potentials of the ever changing technology to enhance their planning and operations.

From the environmental perspectives, most organizations are now required to consider seriously the impact of their operations on the environment and take conscientious steps to reduce the negative impacts (Mbachu, 2009). A more proactive energy management is now required of most facilities managers to ensure a reduction in energy bills and improved environmental responsiveness. A typical example of the energy management challenge is how to review operations in order to minimise high energy bills associated with power factor penalties (PFP). Recent unpredictability of peak energy consumption rates contribute to high PFP (Retail Energy Back office, 2009).

The above instances of the challenges faced by facilities managers are only a tip of the iceberg. The literature is replete with inexhaustible list of these challenges. However, a major gap in the literature is the lack of clear indications of the risk levels associated to these challenges or the extent of their impact on the performance of the facilities managers.

1.3 JUSTIFICATION OF STUDY

University facilities present an ideal case for studying the risk levels associated with the challenges of strategic facilities management (sFM) due to their complexity and uniqueness. University facilities range from accommodation to complex laboratories, commercial kitchen, and lecture theatres. Many of the facilities are operated 24/7; while others have intense energy requirements for only 8 to 10 hours per day.

Kamarazaly and Mbachu (2010) observe that university facilities are unique in the sense that they are used to showcase and improve the university corporate image and enhance the university business processes and global competitiveness. Furthermore, Hudson (2004) posits that university provides an ideal environment for comprehensive FM as the principles; processes and skills involved in the management of university facilities are applicable to the management of other types of facilities. The author further concludes that the unique nature of universities facilities and the role of the university facilities management (uFM) include diverse and demanding customer groups who carry out a wide range of complex processes, as well as the diverse range of facilities that are involved. Kamarazaly *et al.* (2013) corroborate this by noting that “the uFM suffers the highest level of pressure from increasing customer expectations, a more demanding and litigious society, and ever-changing business environment” (p.7). These attributes justify delineating this group of professionals as an ideal focus for this research study. The overall methodology developed in this research study could also be applied to researching related phenomena in wider settings.

Like any other set of professionals, the university facilities managers (UFMs) face several challenges that constrain performance of their crucial role; which range from internal managerial issues to external constraints. While the internal constraints focus on the strengths and weaknesses which are controllable, the external constraints on the other

hand are not within the control of organization; they include the opportunities and threats that enhance or undermine the achievement of the strategic goals of an organization.

Rapid Business Information (RAPIDBI, 2009) identifies the PESTELI as a simple framework within which to consider external factors. PESTELI stands for political, economic, socio-cultural, technological, environmental, legal and institutional constraints that impact on an organization's ability to realize its aims, and for which it has no control. RAPIDBI (2009) further argues that by understanding the external environment in which an entity operates, an organization can take advantage of the opportunities and minimize the threats. From business perspectives, Alexander (2003) states that this beneficial tool offers great insights for strategic business planning, marketing propositions, product development and effective business operations. On the other hand, Prasad (1999) encapsulates the generic internal problems faced by organizations into the 6M's of business: manpower, money, management, machinery, materials and methods.

This study investigates the potential key internal and external constraints impacting on the achievement of strategic facilities management goals and their associated risks levels. The study also investigates key challenges facing tomorrow's UFM's. The outcome of the study is expected to be beneficial to facilities and property managers in formulating appropriate response to the identified risks with a view to achieving more effective and satisfactory outcomes in their operations.

The findings of the study could be used by university facilities managers to enable them re-engineer the plans and processes and hence shape their organization to keep pace with the changes in teaching and research requirements, consequently to satisfy the real needs and objectives of the university facilities users. The findings will also assist UFM's to anticipate and respond more proactively changes that will occur in the years ahead.

1.4 STATEMENT OF RESEARCH PROBLEM

Facilities are needed for the enhancement of business processes and to create a safe and conducive workplace for improved productivity and competitiveness. Consequently, investment in the organizational facilities and infrastructure constitutes a significant

part of any organizational expenditure (IFMA, 2009). Strategic facilities management contributes to the achievement of organizational strategic goals through effective and efficient management of the facilities, involving cost and waste minimisation, enhancement of business processes, creation and maintenance of workplace and delivery of superior value. Without a doubt, organizations can achieve high levels of competitiveness and success by leveraging the potentials of strategic facilities management (Kamarazaly and Mbachu, 2007). However, the full potentials of strategic facilities management role may not be optimally leveraged due to internal and external challenges that hinder the effectiveness and efficiency of strategic facilities management.

The management of university attracts a plethora challenges that cut across all spheres of FM. The unique nature of university facilities and the role of university facilities managers include catering for diverse and demanding customer groups who carry out a wide range of complex processes that require in diverse range of facilities, a significant number of which must be specialised in some ways. University facilities therefore, provide an ideal case study for gaining insights into the comprehensive range of issues faced by facilities managers in general.

Several other studies have investigated the challenges facing university facilities managers. However, there is a lack of clear indication of the risk levels associated with these challenges. In another words, these challenges unfortunately are not prioritised in terms of their relative levels of impact and frequencies of occurrence. Bajaj (2003) affirms this by stating that there is lack of research or little mention of risk ranking in the literature of managing risks in FM. This research aimed to contribute to narrowing this knowledge gap by exploring and responding to the current and future challenges facing UFM in ways that prioritise the challenges and potential solutions. This way, UFM are able to effectively and efficiently disburse their limited resources to addressing those challenges having the most profound impact on the achievement of their strategic goals.

1.4.1 Research aim questions and objectives

The primary aim of this research study is to develop an analytical framework for gaining understanding and responding cost-effectively to, the key challenges constraining the

achievement of strategic facilities management goals, using the Australasian university facilities management as a case study.

The specific objectives are to provide answers to the following research questions which direct focus on the research design, data gathering and hypotheses.

1. What are the key internal and external challenges constraining the achievement of strategic facilities management goals?
2. What are the associated risk levels of the challenges (i.e perceived frequencies of occurrence and levels of impact) on the achievement of the goals of strategic facilities management functions?
3. What practical solutions exist for addressing the challenges?
4. What are the key challenges facing tomorrow's university facilities managers (UFMs)?

Therefore, the objectives of the study are as follows:

1. To identify the key internal and external challenges constraining the achievement of strategic facilities management goals;
2. To determine the associated risk levels of the challenges in terms of the frequencies of occurrence and levels of impact on the achievement of the goals of SFM functions;
3. To establish practical solutions for addressing these challenges;
4. To ascertain the key challenges facing tomorrow's university facilities managers (UFMs).

1.4.2 Research motivations

The need for the study arose from a consideration of the following needs/ issues identified in the literature:

- There is no universal approach to managing and responding to issues in facilities management (Atkin and Brooks, 2000).
- Lack of research or little mention of risk ranking in the literature pertaining to managing risks in FM (Bajaj, 2003).
- Lack of tools for reviewing alternatives and making quicker informed decisions and recommendations (Alexander, 2003).

- Need for research on the practical issues of facilities management in higher education and suggested ways of improvement (Hamid et al., 2007).
- There has been little discussion on facilities management contributions in higher education sector (Hamid et al., 2007).
- Inadequacies of existing metrics that define and measure both current and future sustainability of the university's existing facilities (Buchanan, 2011).
- Absence or insufficient availability of analytical tool or consistent information that supports strategic FM planning (APPA, 2012).
- Not much effort has been made to identify the standardised approaches or practical solutions to overcome the challenges in managing university's facilities in constrained financial positions (Karp, 2012).

It is contemplated that the above issues could be responsible for the problems faced by facilities managers in strategic facilities management as frequently cited in the literature (Atkin and Brooks, 2000).

1.5 GAPS IN THE LITERATURE

An in depth review of literature to date suggests that identification of the challenges faced by facilities managers is not the issue. Myriads of challenges have been identified in the literature without rigorous attempt to prioritise them based on their risk levels. Mere identification of challenges or mitigation measures without any form of prioritisation adds to the facility managers' problem through information overload especially when the resources available are limited. Therefore, there is a need to research the priority issues that have high impact on the achievement of strategic FM goals. Bajaj (2009) also note a lack of understanding of the risk levels associated with the current and near-future challenges facing facilities managers in the universities. This knowledge gap constrains strategic responses to these challenges in a cost-effective manner. This research aimed to contribute to filling the identified knowledge gap by providing answers to the questions outlined in the Research Objectives section. This is expected to guide the university managers in refocusing efforts and resources on those critical challenges that have greatest impact on their ability to achieve set goals.

1.6 RESEARCH PROPOSITIONS

To direct focus on the nature, sources and analysis of the data required to provide answers to the above research questions posed in the study, the following propositions were put forward, some of which were restated at the data analysis stage of the study as hypotheses for statistical testing purposes.

Proposition 1

The research contends that there will be consensus of opinions would exist between the New Zealand and Australian members of the Tertiary Education Facilities Management Association (TEFMA) in their perceptions of the risk levels of the internal and external factors constraining the achievement of the strategic facilities management goals in universities.

The data for testing the proposition were the ratings of the levels of impact and frequencies of occurrence of the underlying variables in each broad category of internal and external constraints obtained through the questionnaire surveys.

First, the risk scores of the variables were computed from the two parameters of impact levels and frequencies of occurrence. The risk scores were used to rank-order the constraints within each subset – one for the New Zealand TEFMA members and the other for their Australian counterparts. Secondly, the Spearman's rank correlation coefficient test was used to test the level of significance of the differences in the rankings based on the computed correlation test statistic.

Proposition 2

Based on the recurring themes in the literature, finance and sustainability issues would constitute the most severe internal and external challenges faced by UFM's, respectively. Disbursing the bulk of available resources to addressing these problems would therefore be the most efficient and effective way of addressing these challenges.

The data for testing Proposition 2 were the relative risk scores (RRS) of the broad categories of the internal and external constraints to the achievement of strategic FM goals as computed from the ratings of the impact and frequency levels. From the RRS analysis, the emergent broad constraint categories having the highest ranking provided empirical evidence to accept or not to accept the proposition.

Proposition 3

There would be no significant differences between the views of UFM's identified in the main stream survey and the corresponding findings from the case studies, on the nature and risk levels of the internal and external constraints as well as the key challenges facing UFM's.

Data for testing Proposition 3 comprised the outcomes of the main stream survey and the case studies in relation to the nature, levels of impact and frequencies of occurrence of the internal and external constraints to the achievement of the strategic FM goals and the key challenges of the future. Again, the Spearman's rank correlation coefficient test was employed to test the levels of differences in the rankings of the risk scores of each set of variables identified in the survey and the case study stages.

Proposition 4

Significant agreement would exist between the views expressed by UFM's identified in the main stream survey, the case studies and also from the historic records, on the frequency of occurrence of the challenges constraining the achievement of strategic FM.

Data for testing Proposition 4 comprised the outcomes of the main survey, case studies and existing records in relation to the frequencies of occurrence of these identified challenges; since only data on the frequencies of occurrence were available in the historical records maintained by the UFM's.

Proposition 5

Based on the lead provided in the literature, statutory compliance issues would constitute the most significant challenges facing tomorrow's UFM's. Data for testing Proposition 5 were the relative importance index (RII) scores of the identified challenges facing tomorrow's UFM's as computed from the ratings of their relative levels of importance. From the RII scores, the emergent broad constraint categories having the highest rankings will provide the basis for disproving or accepting the proposition.

1.7 RESEARCH SCOPE AND LIMITATIONS

1.7.1 RESEARCH SCOPE

The study was limited to the views expressed by UFMs in the Australasian region (New Zealand and Australia); these were registered with the Tertiary Education of Facilities Management Association (TEFMA). The focus of this study was only on facilities owned or operated by Australasian universities. Polytechnics, colleges or any other private establishments are excluded from the research scope due to the differences between these tertiary education providers in comparison to universities. This was to minimise bias that could be introduced into the findings based on the different institutions/organisations. Recommendations for further studies drew upon wider issues which were not covered in the scope, but which could provide more balanced view of the problems being investigated.

1.7.2 LIMITATIONS OF STUDY

The limitations of the study included low response rates to questionnaire administered among UFMs. Also resources were insufficient to cover wider scope. The validity of the result of this study may diminish over time, since the findings represent snapshots of the problems facing facilities managers in the Australasian universities within the time frame for conducting this study (i.e. 2010 - 2012). However, the methodology developed could be followed in future studies to update the findings, engage in wider scope and study related phenomena.

1.8 BENEFITS OF RESEARCH FINDINGS

The study may assist the following key beneficiaries in the following ways.

University's departments

- Enrich the knowledge of facilities management administration and services for higher education.
- Provide inputs at the planning stage improved operation and maintenance and for optimize allocation of resources.
- Provide a strategic FM framework for gaining understanding of the elements essential for best practice in FM organization.
- Provide feedback at similar institutions on the problems that their counterparts faced and the innovative ways of addressing the problems.
- Provide information on methods to maintain and improve FM service standard in Australasian universities.

Tertiary institutions

- Provide a comprehensive approach towards creating a more sustainable building and optimized services.
- Provide a strategic guide on risk-based allocation of resources for addressing key FM problems; hence ensure more judicious use of limited funds.

To other beneficiaries

- Use of the developed methodology for studying related problems in the field of FM and elsewhere.

1.9 STRUCTURE OF THE REPORT

The thesis comprises 9 chapters and appendices as follows.

Chapter 1 introduces the background, statement of the research problem, objectives, propositions, scope and limitations and the importance of the research findings.

Chapter 2 is for reviews of related literature; this provided the background and insight of the nature of problem faced by universities facilities managers and the solutions identified in previous studies. The reviews also helped to provide insight into research strategies and methodologies that were considered appropriate to the research problem and objectives. A summary of the biases and contexts from which the research propositions were drawn from the literature is presented. The chapter ends with the statement of the research propositions.

The methodology employed in the study is reported in Chapter 3. The methodology section includes the overall research strategy adopted, the procedure used to select random samples from the sampling frames, the data-gathering instruments used, methods employed in data analyses, and model validations.

Chapter 4 presents the qualitative data obtained from the pilot surveys. Details of the interview planning, scheduling and implementation are also presented. Content analysis was carried out on the data to identify the recurring themes, which formed the basis for the questionnaire designs in the next chapter.

Results from the questionnaire are presented in Chapter 5. The preliminary analyses of the questionnaires data were used to produce the parameters to test the research propositions.

Chapter 6 presents data from the model test survey, with a view to testing the validity and reliability of the key empirical model developed.

Test of research propositions are reported in Chapter 7. An outline of the propositions and the statistical techniques employed in the tests are presented. The results of the tests are also presented.

Conclusions from the research findings are presented in Chapter 8. Recommendations for further investigations are also highlighted.

Appendices showing documents used for gathering the research data, duplicate tables used for data presentations, analyses and proposition tests, and summary of the key findings of the study, are included at the end of the report.

CHAPTER 2: LITERATURE REVIEW

2.1 OVERVIEW ON FACILITIES MANAGEMENT

A university is an institution of higher education established to create and communicate knowledge for the benefit of wider society, to promote democracy and sustainable growth (McMahon, 2009) and to improve self-awareness and ability (Daigneau, 2009). Universities in general face significant challenges in their development and evolution to meet increasing demand placed on them by learners, the society and the government. Externally, the challenges the universities face are driven by forces of globalisation and interconnectedness that are reshaping all of higher education. So now, more than ever, universities face critical financial constraints; changing demographics; demand of accountability; changing economic, social and political environments; ever-increasing customer expectations; a more demanding and litigious society; and ever-changing business environment (Alexander, 2003). These forces have challenged all segments of the university delivery system, including the provision and management of facilities (Daigneau, 2009).

The management of university facilities therefore attracts plethora of challenges that cut across all sphere of facilities management functions. Several of these challenges have been identified in previous studies These include issues around linking the facility management role to the corporate strategy; emergency preparedness, change management, emerging technology, globalization and broadening diversity in workplace (IFMA, 2007); inadequate funding (Lunday, 2007); skills development, business continuity, compliance management and environmental issues (BDO Stoy Hayward, 2007); adjusting to the new sustainability reality, meeting the challenges of workforce development, managing space and rising energy costs (APPA, 2010); continuing influence of changing economics and market conditions (Kadzis, 2009); high legislative compliance costs and constraints, particularly in relation to health and safety, property law, resource and waste management (Booty, 2009); inability to afford the development of new projects or to upgrade and maintain existing facilities due to spiraling costs (Alexander, 2003); and limitations on capital expenditures (Buonicore, 2012).

In order to provide anchors to the theoretical framework underpinning this study, this chapter reviews the literature on the following subject areas:

- i. FM in context
- ii. The uniqueness of university facilities and the role of university facilities managers
- iii. The key functions in the FM cycle
- iv. Internal current challenges constraining strategic facilities management goals
- v. External current challenges constraining strategic facilities management goals
- vi. Future challenges facing tomorrow's UFM's

The purpose of this chapter is to determine gaps in research concerning the challenges facing current and future facilities managers, which will be addressed further in this thesis.

2.1.1 Facilities management in context

Facilities management (FM), according to the International Facility Management Association (IFMA, 2006, p.28) is “a profession that encompasses multiple disciplines to ensure functionality of the built environment by integrating people, place, process and technology”. Tay and Ooi (2001) emphasize that FM is increasingly recognized as an element of the value chain of a business through which an organization provides and maintain the quality of the work environment for its human resources and materials. The role also contributes to the achievement of the corporate goals through enhancement of the core business of the organisation. The facilities manager's core role includes maintaining, improving and adapting the buildings and other infrastructure of an organization in order to create an environment that strongly supports the primary objectives of the organization (Strategic Facilities Management Section, 2006).

Alexander (2003) found that the role of facilities management has evolved from merely helping organization survive, to include enhancement of its potential to prosper in a volatile commercial climate. APPA (2013) affirm this view by stating that the positive evolution of facilities management role leads to increasing shift in emphasis from operational to a more strategic role of business process enhancement, which includes the escalation of competitive advantage and eventually the achievement of corporate goals and objectives.

Perspectives of other studies on FM and FM role are summarised as follows.

- Grimshaw and Cairns (2000): FM addresses the challenge of radical movement in demand size organizational structures which drives fundamental change in the relationship between business performance and effective application of infrastructure resources.
- IFMA (2000): FM is the practice of physical coordination of work between human capital development and corporate management in the organization. It integrates principles of business administration, architectural, behavioural and engineering services.
- Varcoe (2000): FM focuses on the management and delivery of the full two entities (real estate and construction industry) to ensure the provision and use of productive building assets and working place.
- BIFM (2003): FM is a practice of coordination of physical workplace between workers and professions in an organization.
- Then (2003): Practical FM is concerned with the delivery of enabling work environment and space to function optimally and to support business processes and human capital development.
- IFMA (2003): FM goal is to create, maintain and develop real estate and support services for the strategic and core business of the organization.
- IFMA (2005): FM is a profession that includes the integration of activities from different disciplines to ensure functionality of the environment with the integration of people, processes and technology.

With the extensiveness of FM definitions and FM functions, Atkin and Brooks (2005) argue that in the pursuit of sustaining and achieving the business objectives, an organization should holistically emphasize on the strategic potentials of FM as an integrative and interdependent discipline that aims to accomplish the following aspects: support people in their work and activities; enhance individual well-being; enable the organization to deliver effective and responsive services; allow for the future change in the use of space; provide competitive advantage to the organization's core business and enhance the organization's culture and image.

Kelly et al. (2002) argue that FM could mean different things to different parties, and the scopes of services could vary between organizations or departments. Lindholm (2008) further argues that the definition and scope of facilities management still remain debatable until now due to the fact that the nature or characteristics of the organization

strongly reflect its business objectives, organizational process and organizational culture.

In spite of the several definitions of the nature and role of FM, it is insufficient to formulate one holistic definition, which will capture the true essence and scope of FM functions. However, the above reviews provided some holistic insights into the wide spectrum of FM role upon which this study and the findings will be anchored.

2.1.2 The uniqueness of university facilities

Facilities are recognised as the backbone of higher education; as without adequate facilities and buildings, higher educational institutions particularly universities will encounter difficulties in meeting their fundamental societal purposes, which include developing talent and promoting the cause of equity (APPA, 2013; 2014). Price (2003) cautions that the operation and maintenance of facilities should not be seen as overhead, but rather as integral part of an ecosystem that is necessary to enable people perform at their best. Price (2003) further notes that the most valuable asset of an organization is its people and thus human resource management and facilities management are the two principal support activities in this regards. It is therefore crucial for universities to “maintain environments, places and spaces that demonstrate concern for safety, comfort and enjoyment of people” (Gratto et al, 2002, p.24).

The unique nature of university facilities and the role of UFM include diverse and demanding customer groups who carry out a wide range of complex processes in diverse range of facilities, some of which are highly specialised (Hudson, 2004). It is in this light that Facility Management of Australia Association (2002) affirms that the role of FM in the university focuses on integrating the management of people and the university business process with physical infrastructure to enhance corporate performance. Kamarazaly and Mbachu (2010) note that the distinguishing nature of university facilities is that they are used to showcase and improve the university corporate image and enhance the universities business processes and global competitiveness.

University facilities therefore provide an ideal case study for gaining insights into the comprehensive range of issues faced by facilities managers in general. Research into the current and future challenges faced by university facilities managers could yield

outcomes which the university facilities managers could utilize as strategic responses to the key challenges they face now and in the near future. In addition, the outcomes of this study could apply to the management of other types of facilities.

2.1.3 Roles of facilities managers

Facilities Management (FM) industry is now maturing and is in a position to offer real added-value improvements to an organisation's core business (Atkin and Brooks, 2000) through efficient management and improved technology (IFMA, 2007). As an emerging discipline, FM contributes up to 5% of the global GDP and currently embraces more than the operational concerns such as plumbing and lighting, to include the provision and maintenance of productive and comfortable work environment (Best et al, 2003). Facilities manager's role therefore significantly contributes to the economy by improving the gross domestic product (GDP) – a key economic indicator – in two ways: First by improving the long-term worth of the nation's infrastructure asset through proper maintenance, adaptation and upgrade; secondly by creating a conducive workplace that promotes productivity and worker's health and safety (Kamarazaly et al, 2013). Best et al (2003) and Alexander (2003) conclude that the focus of FM has now shifted towards the strategic management of facilities, which includes human resource management, real estate portfolio management and quality management.

Facilities managers are increasingly responsible for an extraordinary array of built environment facilities. Generally, the key role of a facilities manager encompasses the following: organizing, controlling and coordinating the strategic and operational management of buildings and facilities in both public and private organisations to ensure the proper and efficient operation of all physical aspects, including creating and sustaining safe and productive environments for occupants (Atkin and Brooks, 2000; Best et al, 2003; Booty, 2009). The evolution of these roles incorporates efficient operation at strategic, operational and tactical levels.

From the administrative perspectives, Then (2003) classifies facilities management into three distinctive categories: strategic FM, tactical FM and operational FM. From the strategic management perspectives, FM focuses on the integration between facilities and corporate objectives. This requires strategic alignment of the provision and operation of facilities to respond to the organization and business challenges. In recognition of this,

Kamarazaly (2007, p.11) further observe that “pitching FM at the strategic level has great impact on the decision making process, as it involves planning decisions and having direct communication with higher management or the senior personnel at corporate decision making level in order to ensure that facilities meet clearly defined business objectives”. Alexander (2003) notes that the strategic FM role includes the following:

- Formulating and communicating a facilities policy
- Planning and designing for continuous improvement of service quality
- Identifying business needs and user requirements
- Negotiating service level agreements
- Establishing effective purchasing and contract strategies
- Creating service partnerships
- Systematic service appraisal, quality, value and risk

Table 1: Categorisation of FM tasks (Source: Transfield and Akhlagi, 1995, p.45)

FM CATEGORY	EXECUTIVE RESPONSIBILITIES	MANAGEMENT ROLES	PROJECT TASKS
Strategic	<ul style="list-style-type: none"> • Mission statement • Business plan 	<ul style="list-style-type: none"> • Investment appraisal • Real estate decisions • Premises strategy • Facility master • Planning IT strategy 	<ul style="list-style-type: none"> • Strategic studies • Estate utilization • Corporate standards • FM operational • Structure corporate brief
Tactical	<ul style="list-style-type: none"> • Corporate structure • Procurement policy 	<ul style="list-style-type: none"> • Setting standards • Planning change • Resource management • Budget management • Database control 	<ul style="list-style-type: none"> • Guideline documents • Project programme • FM job description • Prototypical budgets • Database structure
Operational	<ul style="list-style-type: none"> • Service delivery • Quality control 	<ul style="list-style-type: none"> • Managing shared facilities • Building operations • Implementations • Audits • Emergencies 	<ul style="list-style-type: none"> • Maintenance • Procurement • Refurbishment • Inventories • Post-occupancy audits • Furniture procurement

FM organization holds the responsibility to manage the infrastructure/ facilities and property in order to achieve a range of benefits, including optimum productivity, constant quality improvement, cost reduction, risk minimization and ultimately

improved value for money (Kamarazaly, 2007). FM also focuses on corporate asset management as it provides environment for offering superior service quality in support of core business operations (Alexander, 2003). It also contributes to sharpening the corporate image through facilities development and operational efficiency (Kamarazaly, 2007).

As service providers, the role of facilities managers in FM organization covers the following (Hamilton, 2004):

- Communicating well at all levels
- Establishing procedures, schedules programmes, benchmarking and feedback
- To lead and be pro-active
- Identifying and providing the services essential to the organization and consider contracting out / partnering for others
- Utilizing existing expertise and be able to delegate and trust staff
- Essentially strategic and business directed, with focus on what the organization requires in the future
- Maximizing value and gaining competitive advantage
- Control and sustain computerized integrated management systems in order to achieve more informed decision-making from the vast amount of facilities data to be recorded
- Management of outsourcing and partnership agreements
- Environmental control
- Energy management
- Identifying customer needs and how to satisfy them.

The tactical FM works are more focused on the organization and administration procedures. These include: monitoring, controlling and managing the operational FM; implementing the policy, strategy and plan; and ensuring that the operations are well performed in accordance with the organization's requirements and standards. Comparatively, the scope of operational FM covers all types of daily and routine services and deals with the effectiveness of service functionality in an organization (Kamarazaly, 2007).

The general role of facilities manager in the wide-range of FM sector provides building blocks to the understanding of the role of facilities manager being applied in university context; this is the focus of this research.

2.1.4 The challenges facing university facilities managers

Review of literature to date reveals a number of key challenges facing university facilities managers. From a thematic mapping perspective, these challenges could be broadly categorised into 3:

- Internal challenges: These are issues driven by internal factors within the FM department;
- Institutional challenges: These are issues driven by factors outside of the FM department but within the organisation; and
- External challenges: These are issues driven by national and global factors.

These challenges are highlighted in the following subsections.

(A) Internal challenges

Several studies point to some internal challenges within the FM department, some of which are within the control of the university facilities managers. These are summarised in Table 2.

Table 2: Internal challenges faced by university facilities managers

INTERNAL CHALLENGES	ISSUES	LITERATURE SOURCES
Unrealistic user expectations	Stakeholders and other users place too high expectations from the FM services, whereas the resources to meet these expectations are inadequate. UFM face the challenge of finding ways to meet these expectations with the little and dwindling resources at their disposal.	(Karp, 2012; Dufresne, 2012).
Space management	FM faces challenges posed by open work plan arrangements, differing hours of operation & varying occupancy rates & densities.	APPA, 2012; APPA 2006
Safety & security,	With the increasing rate of crime, terrorism and vandalism, safety and security on campus will continue to rise in importance for facilities managers; Is the FM department adequately resourced to meet this challenge?	APPA, 2011
Lack of benchmarks for performance measurement and accountability	Facilities managers need to implement performance measurement tools backed by credible, accurate data. However, there is a lack of lack of standard metrics for measurement and benchmarking.	APPA, 2009
Changing demographics	University FM departments are expected to understand how the demographics of their student body and workforce are likely to change and develop strategies to address that change.	APPA, 2008
Workforce management and demographics	The workforce is getting older, more diverse and more in demand. How can the FM department recruit and retain new and younger blood as part of its business continuity plan? Is the department skilled to handle the complex leadership style required for the increasingly diverse and demanding workforce?	APPA, 2007
Aging building stock and deferred maintenance	UFMs face problems stemming from aging building stock. With limited resources and increasingly dwindling budgets, repairs or maintenance problems that are due are shelved. This causes more deterioration, frequent breakdowns and work disruptions. How the FM department addresses this issue is a big challenge, involving significant "repair/replace" decision dilemma;	APPA, 2006
Resource scarcity and affordability	Budgets for universities are tight and will remain so for the near future, forcing facilities managers to do more with less.	APPA 2006

B) Institutional challenges facing university facilities managers

University facilities managers face several challenges that are driven by institutional factors. Table 3 summarises some of these institutional challenges as gleaned from the literature.

Table 3: Institutional challenges facing UFM

INSTITUTIONAL CHALLENGES	ISSUES	LITERATURE SOURCES
Sustainability, Energy and environmental resource management	Facilities managers need to embrace sustainability and cultivate a sense of stewardship toward the university. Facilities need to be designed and operated with the goal of reducing energy costs. Meeting these needs requires a radical sustainability agenda and a robust environmental management plan that may be at odds with the existing culture of the university. Is the FM department equipped to manage this change?	APPA, 2007
Trendiness	To be competitive and maintain good corporate image, university facilities need to be upgraded to accommodate future changes in the way the university does its business. Developing the lab and classroom of the future and other smart facilities is an issue that the FM department must face with meagre resources.	APPA, 2007
Master plans	Lack of comprehensive master plans for facilities.	Manns and Katsinas, 2006

C) External challenges facing university facilities managers

University facilities managers face several challenges that are driven by external factors.

Table 4 summarises some of these external challenges as gleaned from the literature.

Table 4: External challenges facing university facilities managers

EXTERNAL CHALLENGES	ISSUES	LITERATURE SOURCES
Managing rising energy costs and energy volatility	UFMs face the challenge of how to adapt to rising energy costs and develop strategies that reduce the risk of energy price volatility.	APPA, 2011
Economic recession	Universities must confront the current recession and maintain forward momentum despite economic restraints. UFMs face the challenge of finding innovative strategies for achieving this.	APPA, 2009;
Rapidly changing and stricter regulatory compliance	UFMs struggle to keep up with rapidly changing and stricter regulatory compliance; these are often driven by some national and global issues such as, remodelling old buildings to meet specified standards of energy utilisation levels, and seismic strengthening requirements following the wake of earthquakes.	APPA, 2008
Rapid advances in Information Technology	IT increasingly is woven into the fabric of the university, with facilities required to be designed "smart". Keeping up with the rapid changes in these technologies is a big challenge for the FM department	APPA, 2007
Disaster management	The rising and unforeseen trends in natural disasters require the FM departments to formulate and implement robust emergency preparedness, disaster management and business continuity plan. Meeting this challenge require enormous amount of resources and training, which the FM department will struggle to meet.	Thatcher, 2006

2.1.5 Solutions to the challenges facing UFMs

Solutions have been proffered in the literature for addressing some of the problems articulated in the previous sections. Table 5 and Table 6 summarises some of these solutions.

Table 5: Solutions to the challenges faced by university facilities managers

Solution category	Details	Literature sources
Leadership	Facility managers need to be able to lead the development of a technological infrastructure for the organization and be able to work with the leadership team to achieve the goals;	APPA, 2002
Communications	Excellent communications skills are crucial “to make the case to senior management about FM as a strategic function”.	APPA, 2002
Impact of changing markets	Managers need to be able to deal with constantly changing costs.	APPA, 2002
Organization performance	Facility managers need to be competent to “deal with the increased emphasis on quantitative measures of the organization performance; this means that information systems will have to be in place to collect the necessary data on how FM improves organizational effectiveness”.	APPA, 2002
Securing business case	Due to the high intensity in securing funds, facility managers need to work harder to make case for resources; “proposals for action must make a clear economic case, must be quick to implement and have fast payback”.	APPA, 2002
Broader view of facility	Facility managers must ensure that “facilities must respond with innovative solution to maximize productivity, hence buildings will become more dynamic and adaptable”.	APPA, 2002

Table 6: Solutions to the challenges faced by university facilities managers (Cont'd)

Solution category	Details	Literature sources
Align space management to the mission of the institution	Space management should be a tool for the institution to fulfil its mission and become part of strategic planning for the future.	APPA, 2012
Make space one of the top assets of the institution	Space can no longer be an afterthought but must become one of the main priorities of institutional leadership. The entire campus must adopt the attitude that space is a key institutional asset.	APPA, 2012
Change the culture of space	Colleges and universities need to shift the culture space within their institution away from territorialism to appreciation of a shared resource.	APPA, 2012
Develop effective policies, processes and organizational structures to manage space	Institutions need a solid framework of policies and the people to manage space.	APPA, 2012
Implement space inventory system to understand resources and identify needs	Institutions need robust, detailed inventories of their space resources.	APPA, 2012
Address space utilization by assembling credible data and adopting best practices	Institutions can make significant improvements in the use of their space through reliable information management and effective space policies.	APPA, 2012
Externally driven trends	FM can leverage new technologies to better manage facilities with adequate training to educate practitioners on new systems.	APPA, 2011
Internally driven trends	Alignment with their organization's mission & emphasizing facility professionals' role as managers of significant asset & enablers of the organizations' mission, vision & values.	APPA, 2011
Data warehousing and data mining capability	Through new reporting protocols - more FM departments have added the ability to convert raw data into usable & meaningful information that fosters informed decision making	APPA, 2011
Organizationally-driven trends	Increased focus on business acumen will require facility professionals to think & act strategically & to communicate positions their positions in board level.	APPA, 2011

2.1.6 Key functions in the FM cycle

Facilities management encompasses a wide-range of activities. The scope of FM discipline covers all aspects of property and space management, environmental control, health and safety, support services and requires that appropriate monitoring and control centres are established in the organization (Alexander, 2003). Atkin and Brooks (2000) found that the practice of FM also covers a great variety of services including real

estate management, financial management, change management, human resource management, health and safety, and contract management, in addition to building maintenance, other domestic services such as cleaning and security as well as utilities supplies. Booty (2009) adds the following to the list of FM functions: master space planning; project management; space inventory, space and furniture standard settings; programming requirements; financial control (which emphasises on budgeting and forecasting); scheduling; layout and design; purchasing; construction management and ongoing maintenance management. In terms of the FM activities, Collings (2007) observes that the breadth of the activities covers the following: cleaning, ventilation, air-conditioning, electrical, building and plumbing trades, grounds or landscaping, concierge, call centre, tenant liaison, car parking, energy management, waste management, sustainability management, mail-room and pest control.

2.1.6.1 Space Management

Space management initially includes the establishment of standards for space use, inventory of existing space, evaluating space utilization; space allocation, space planning and supervising (APPA, 2012). Wustemann and Booty (2009) argue that space management is the essence in portraying the corporate image of an organization. The main challenge of space management is to ensure that the buildings, planning and space utilization conform to legal requirements and building codes for occupancy, health and planning standards.

2.1.6.2 Project Management

Project management involves the strategies and tools for programming, designing and delivery of construction projects with the aim of providing high quality facilities, structures and services (WBDG Project Management, 2009). The main challenge of project management is to ensure that the correct and effective management systems are being implemented as it influences the operational costs, schedule and quality of services and facilities.

2.1.6.3 Operations Management

Operations management encompasses the operations of all activities associated with operating facilities and services, and the maintenance of buildings or physical asset. IFMA (2009) identifies the scope of work within the operations management as including administration and routine maintenance of physical assets and services, ranging from custodial, fire protection and security, to insurance and utility provision.

The main challenge in operations management is for the facilities managers to be competent in dealing with incidental maintenance or repair work related to operational activities and user requested needs which initially may require effective emergency maintenance and unplanned maintenance.

2.1.6.4 Maintenance Management

Maintenance management primarily consists of planned maintenance, repairs and retrofits or upgrades. Booty (2009) emphasizes that maintenance management is the key to the achievement of facilities management role.

The main challenge in maintenance management is to assure that the maintenance activities are delivered effectively to anticipate all necessary planned, unplanned, predictive, preventive and emergency maintenance and repairs in order to eliminate unforeseen problems that could interrupt activities, or to protect life and property. Reynolds (2009) notes that technical issues impacting on facilities maintenance and operations personnel include keeping up with advances in information technology, maintaining sophisticated building environments to support research activities, dealing with antiquated facilities and meeting ever-increasing environmental and safety demands. Furthermore, it is crucial for facilities managers to ensure that all maintenance management activities are in compliance with statutory requirements.

2.1.6.5 Capital Asset Management

Capital asset management covers the following scope of activities: recognition and prioritization of facility and infrastructure functional and budgetary needs throughout

the useful service life with the aim to sustain the mission and vision of the organization (IFMA, 2009).

The challenges of capital asset management are as follows: to prolong the useful lives of facilities and to retrofit the facilities in order to consolidate space or accommodate new functions or technologies; meeting evolving facility-related standards for safety, environmental quality, and accessibility, downsizing, or changing demographics; as well as finding innovative ways and technologies to maximize limited resources.

2.1.7 Conceptual framework for the study

Booty (2009) identifies the key functions in the facilities management cycle as encompassing project management, operations management, maintenance management, capital asset management and space management. The facility manager faces in each of these functional areas on account of several internal and external factors; the former being within his or her control, while the latter present complex and often uncontrollable problems. Prasad (1999) encapsulates the generic internal problems faced by organizations into 6M's of management: money, manpower, management, machinery, materials and methods.

On the external front, Gillespie (2007) fits the external challenges faced by any business organization into the mould of PESTEL (political, economic, socio-cultural, technological, environmental and legal). Rapid Business Information (RAPIDBI, 2009) extends this by adding institutional challenges to the mould, to provide a 'PESTELI' framework for gaining robust understanding of the external factors.

Based on insights gleaned from the literature, an attempt was made in this study to model the functions or key role of the facilities manager and the internal and external challenges to the performance of these functions and ultimately the achievement of the strategic objectives. The conceptual framework formulated for the mainstream study is presented in Figure 2.

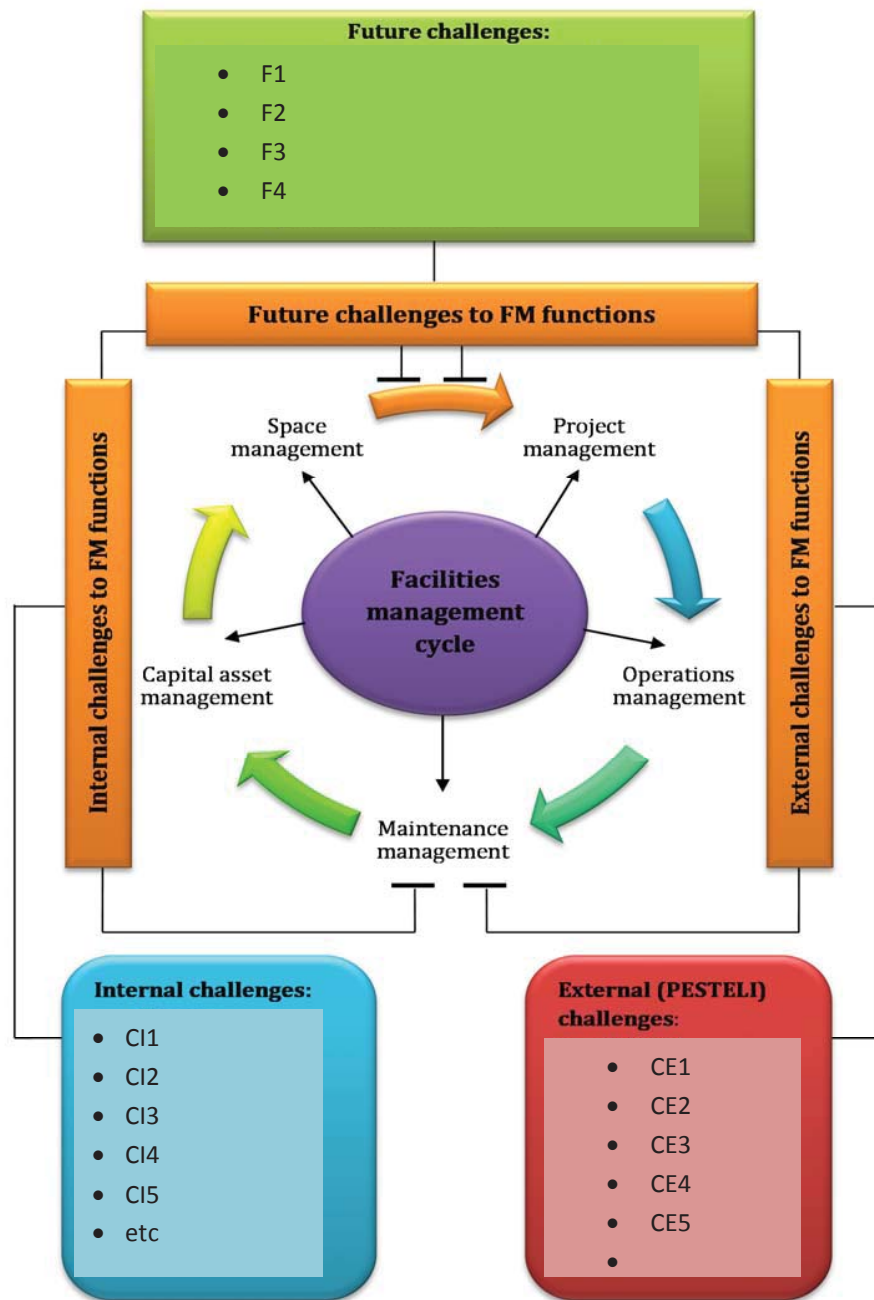


Figure 2: Model of the overall challenges facing facilities managers

2.1.8 Current Internal challenges

Internal challenges focus on the strengths and weaknesses which are controllable; the external constraints on the contrary are not within the control of the organization; they include the opportunities and threats that enhance or undermine the achievement of the strategic goals of an organization. Sasikumar (2009) encapsulates the generic internal problems faced by organizations into 6M's of management: money/ finance, materials, machine, manpower and methods/ operational process. Rose et al (2007) see as one of the major problems faced by US universities and colleges the fact that proper and timely maintenance of facilities and equipment is often deferred too late with repercussions on costs and work disruptions occurring more frequently due to neglect. Levy (2008) argues that there is a lack of planning to adequately fund FM activities along the full service life of institutional buildings. APPA (2011) also affirms that educational facilities need to be modified successively with the development of technological and societal changes.

Atkin and Brooks (2000) list the challenges faced by most of the organizations in managing their facilities as follows:

- *Inadequately resourced or inexperienced client function.*
- *Inadequate planning of the implementation – no analysis of implementation or allocation of related responsibilities.*
- *Poor relationship between contractor and contract manager (especially if the latter was once involved with preparing an in-house tender).*
- *Conflicts of interest when dealing with in-house tenders, arising from inadequate split between purchase and provider personnel.*
- *Unclear or imprecise roles, responsibilities and targets for effective team working.*
- *Possible loss of control over the facilities management function and ownership of, and access to, documents and knowledge.*
- *Lack of standard forms of facilities management contracts or inadequate conditions of contract.*
- *Inappropriate allocation of risks and rewards between client organization and service providers.*
- *Inadequate definition of the scope and content of services.*
- *Lack of consideration of all stakeholders in the facilities management sphere.*
- *Specifications that are over-prescriptive and or concentrate on procedures not outputs.*
- *Stakeholders “gold-plating” their requirements.*
- *Poorly controlled changes to user requirements.*
- *Excessive monitoring of contractor performance.*
- *Absence of or poor system for providing incentives for performance.*
- *Inflexible contracts unable to accommodate changes in user requirements during the contract and work outside specification.*
- *Failure to take account of relevant health and safety legislation at the correct time, leading to excessive cost later.*
- *Redundancy in the supply chain where cost is added without necessarily adding value.*
- *Poor bundling of activities to be outsourced.*
- *Absence of shared ownership outcomes.*
- *Poor cash flow position for client organization and for service providers.*
- *Financial failure of chosen service provider during contract period.*
- *Absence of benchmarks of cost and quality against which to measure performance and improvement.*
- *Lack of education and training in facilities management.*

Technology, regulation, and economics are among the prominent driving forces towards more sophisticated facilities management practices that need to be addressed in the management of university facilities (Daigneau, 2009). The above instances reinforce the statement that university facilities managers face internal challenges that constrain their performance in achieving strategic FM goals. These range from lack of adequate planning

capacity, through budgetary constraints and dwindling resources to the changing needs and infrastructure support of the tertiary education landscape.

2.1.9 Current External challenges

2.1.9.1 PESTELI in context

PEST concept

This study has adopted the concept of PESTELI analysis framework for identifying the current external challenges constraining the achievement of strategic FM goals. Generally, PESTELI analysis framework is widely used for analysing the historical evolution of an organization, stakeholders, service providers or even the clients (RAPIDBI, 2008). Analysis of external challenges includes identifying the opportunities and weaknesses that need to be taken into consideration in order to help formulate strategies that would lead to great success. Rapid Business Information (RAPIDBI, 2008) described PESTELI analysis as a useful tool for understanding the “big picture” of the environment, in which an organisation is operating, and the opportunities and threats that lie within it. Further, RAPIDBI (2008) argues that by understanding the external environment in which an entity operates, the organisation can take advantage of the opportunities and minimize the threats.

PESTELI stands for political, economic, socio-cultural, technological, environmental/ecological, legal and institutional factors. However, the interpretation of what a PESTELI or PESTLE stands for differs among industries. Some literature includes legal, environmental, sustainability and institutional factors in the analysis. Table 7 and Table 8 show the PESTLE Analysis Framework as described by Alexander (2009).

Table 7: PESTELI Analysis Framework (Source: Alexander, 2009)

FACTOR	DESCRIPTION	CONSIDERATIONS	LIKELY TO INCLUDE
POLITICAL	What are the key political drivers of relevance?	What is happening in the environment in which the facilities manager operate, including areas such as tax policy, employment laws, environmental regulations, trade restrictions and reform, tariffs and political stability?	World-wide, European and Government directives, funding council policies, national and local organisations' requirements, institutional policy.
ECONOMIC	What are the important economic factors?	What is happening within the economy? For instance: economic growth/ decline interest rates, exchange rates and inflation rate, wage rates, minimum wage, working hours, unemployment (local and national), credit availability, cost of living, etc.	Funding mechanisms and streams, business and enterprise directives, internal funding models, budgetary restrictions, income generation targets.
SOCIAL	What are the main societal and cultural aspects?	What is occurring socially in the markets in which facilities manager operate or expect to operate, cultural norms and expectations, health consciousness, population growth rate, age distribution, career attitudes, emphasis on safety, global warming.	Societal attitudes to education, particularly in relation to government directives and employment opportunities. Also general lifestyles changes, changes in populations, distributions and demographics and the impact of different mixes of cultures.

Table 8: PESTELI Analysis Framework (Cont'd) (Source: Alexander, 2009)

FACTOR	DESCRIPTION	CONSIDERATIONS	LIKELY TO INCLUDE
TECHNOLOGICAL	What are the current technology imperatives, changes and innovations?	What is happening technology-wise which can impact what facilities manager do; how this impact FM products or services, For instance, mobile phone technology, blogs, social networking websites etc. New technologies are continually being developed and the rate of change itself is increasing. There are also changes to barriers to entry in given markets, and changes to financial decisions like outsourcing and in-sourcing.	Major current and emerging technologies of relevance for practice, research and education.
LEGAL	Current and impending legislation affecting the role.	What is happening with changes to legislation? This may impact employment, access to materials, quotas, resources, imports/ exports, taxation, etc.	European and national proposed and passed legislation.
ENVIRONMENT	What are the environmental considerations, locally and further afield?	What is happening with respect to ecological and environmental aspects? Many of these factors will be economic or social in nature.	Local, national and international environmental impacts, outcomes of political and social factors.

The advantages of PESTLE analysis as provided by RAPIDBI (2008) include the following:

- (i) By using PESTLE analysis, an organization or individual will be ensured that the action being taken is aligned positively with the powerful forces of change;
- (ii) Helps avoid taking drastic action that is condemned to failure from the outset for some reasons beyond the control of an organization;
- (iii) It is used as a starting operating point which helps to cut loose from unconscious assumptions and enable oneself to adapt to the realities of the new environment.

2.1.9.2 PESTELI challenges faced by facilities managers

For the purpose of this research study, the following sections provide contextual interpretations of the key components of PESTELI as the adopted framework for analysing the external challenges facing university facilities managers.

Political constraints

Generally, 'politics' has been defined in several contexts to include, "social relations involving intrigue to gain authority or power" (Webster Dictionary, 2013); "regulation of a political unit" and "methods and tactics used to formulate and apply policy" (Farlex Dictionary, 2013). Political constraints, though prevailing in an organizational setting, are regarded as being external to the FM function as they involve having to deal with the diverse interests of several groups with varying levels of authority and control to which the FM department is accountable. Lim (1999) argues that significant intervention exists in the affairs of institutions, which undermines freedom and pursuit of excellence in the discharge of one's duty. Both Fenker (2004) and Grimshaw (2004) identify internal political dynamics that influence space design and allocation. Thus, on account of the dynamics of organizational politics, university facilities manager has to deal with the dilemma of having to meet the diverse interests of those who call the shots and the requirements of best practice and ethical standards in the discharge of FM duties. A typical example is the challenge of juggling between the need for optimum use of space and equipment on one hand, and meeting the conflicting interests of the power-brokers on the other.

There is no specific approach to the resolution of dilemma posed by political constraints. Perhaps, the way forward could be by making a case which elevates the overall strategic goal of the organization above parochial interests.

Economic constraints

A university can be considered as an organization that seeks to optimally allocate resources to maximise educational input which relates to the facilities, estates, human resources, curriculum and students (Price et al, 2003; Alexander, 2009). From an economic perspective, many governments are facing similar issues relating to higher education at the start of the 21st century. These issues include concerns for the amount of the time spent in tertiary education per participant; strong potential demand for the tertiary education level; the need to produce enough middle to high level skills to meet

the growing and complex demands of the modern workplace; and the increasing incentives being provided by governments globally in order for students to have equal access to tertiary education (Johnstone et al, 1998).

Economic constraints arise due to the scarcity of financial resources for meeting the FM goals (Dingley, 2008). Lunday (2007) identifies funding as the first and most critical challenge facing IFMs, as every department in an organization faces budget restrictions due to the global economic recession and cuts in education funding. Facilities managers are increasingly being required to achieve so much with so little resource, thereby stretching efficiency in asset management to the limit. Information technology (IT) promises a smarter way of addressing the problems of FM, but adequate funding in IT is seriously undermined by heavy budgetary restrictions (Lunday, 2007).

Not having adequate budget to meet the operational and maintenance requirements in the face of inflationary trends in the costs of materials, components, equipment and services sets up a vicious cycle, whereby, due to the limited budget, several planned and preventive maintenance operations are shelved, which engender further decay and deteriorations. The deferred maintenance in turn increases the budget for subsequent interventionist programmes.

Solutions to economic constraints involve finding innovative approaches to efficient and effective asset management through robust investment in IT. Often the use of outsourcing can deliver better value-added solution to FM needs in certain conditions than in-house approach, and vice versa (Kamarazaly and Mbachu, 2007). Also, having a systematic framework for decision making can save costly errors and ineffective solutions to the FM problems, thereby improving efficiency.

Socio-cultural constraints

Socio-cultural factors constrain the achievement of FM goals in several respects. The CIB Working Commission W070 (2009) argues that a major challenge facing facilities managers in an increasingly dynamic and borderless world – especially to those who offer FM solutions to global corporate organization – is how to address the ethnic diversity and differing cultural needs in space planning and design solutions. The Commission is of the view that increasingly, the application of global concepts in the performance of these FM functions are being affected by the local context which requires

taking on board the imperatives of the local socio-cultural and regulatory standards, which may be at odds with global best practice standards.

Roper and Yeh (2007) provide additional dimension to the socio-cultural constraints facing the IFMs, which is how to provide appropriate ergonomic solutions in the workplace design to compensate for the diminished physical capacities of the aging workforce. For instance, as a result of the Occupational Safety and Health Administration (OSHA) proposed ergonomic compliance program since 1999, facility managers in nearly every industry have had to ensure programs were in place in order to prevent health and safety risks to employees.

This OSHA program requires employers in organisations where workers may be exposed to musculoskeletal disorders (MSDs) to provide ergonomic training, remediation and reporting of any incidence. For a facility manager, ergonomics may be specifically defined as the study of how to improve fit between the physical demands of a workplace and the safety and well-being of the employees who perform the work. This involves considering the variability in human capabilities when selecting, designing, or modifying equipment, tools, work tasks, and the work environment.

Technological constraints

Technology helps to achieve better facility performance at reduced costs. Price (2003) states that technology underpins building systems, architectural structures, office automation, information technology, plug and play furniture systems, management practices and processes. The significant challenge facing facilities management professionals is to efficiently manage and utilise the multiple systems in operation to its fullest potential. IFMA (2007) identifies the emerging technology challenges as including the following:

- Changing user/tenant needs;
- Changing building technologies;
- Adapting Building Information Modelling (BIM) and Integrated Workplace Management Systems (IWMS);
- Underutilization of current technology and obsolescence;

Lunday (2007) finds that technology holds promise for solving the many problems of FM, necessitating adequate investment in IT. However, technological constraints present serious challenges to the facilities managers on account of the rapid changes in

technological development. A fundamental aspect is the impact that implementation of new technology has on the people in the organization (Lunday, 2007). A purely rational view is that technology relates to improving efficiency and creating substantive value; what is not clear is how the systems, processes, work practices and intra-organizational relationships between different functional groups are affected (Kingsman and Sibley, 2007).

Technological innovations and rapid changes render previous generations of technologies obsolete and can threaten the viability of businesses that do not adapt and manage their IT infrastructure (Kingsman and Sibley, 2007). Therefore, making strategic investments in IT infrastructure poses difficult but crucial problem for managers across an organization.

Solution to technological constraints often lies in the smart use of outsourcing, especially for those technological solutions that are more frequent in changes, while in-house investment could be targeted towards the key technologies that underpin the strategic operations of the organization but which are less exposed to obsolescence (Kamarazaly and Mbachu, 2007). Meehan (2013) identified the information technology (IT) services as the most frequently outsourced services of the universities' FM department.

The author notes that the outsourced IT services included the hardware and software for activities such as data centre operations, software development and maintenance, network operations and disaster recovery. Also photocopying and printing facilities are outsourced (Lunday, 2007). These strategies enable the FM department save significant budget for training, software licence renewal/ upgrade, trouble shooting and maintenance, which could cost up to 10% of the FM budget (Kingsman and Sibley, 2007). However, the danger in such outsourcing strategy is that if the specialist IT services provider's contract is terminated, the FM department and the entire organisation can jeopardise confidential and sensitive information, including business secrets. Also the FM Department loses full control of all operations to the vendors.

Cloud computing

An alternative solution to outsourcing of IT services is the use of 'cloud computing', i.e. working, storing and accessing of data on the Internet 'cloud' without the need for hardware storage. Viswanathan (2014) argues that the new cloud computing technology

is very cost effective as it is available at much cheaper rate and hence can significantly lower organisation's IT expenditure.

The most important advantage is the ability to backup and recovery data from the cloud in the case of emergency such as earthquake and fire. For instance the University of Canterbury would not have suffered so much loss if it adopted the cloud computing approach to its IT services, as that way, staff and students could continue to access data from the 'cloud' anywhere in the world, even if the IT infrastructure was ruined during the earthquake. However, Viswanathan (2014) cautions that the new technology is not without its downsides. For instance, there could be occasional problems of network and connectivity problems. Also security of sensitive data on the cloud cannot be 100% guaranteed, with threats of hackers and viral attacks.

Environmental/ sustainability constraints

From a facilities management perspective, FMAA (2002) describes sustainable development as the theoretical effective balance between economic progress and environmental conservation embodying intergenerational goals of maximizing wealth and utility and minimizing resource use and impact over the life of the development. Smith (2003) notes that the scope of sustainability covers social equity, corporate citizenship and relationships with organization's stakeholders which includes management, employees, the community, unions, government, investors, suppliers and customers. Without serious consideration of the scope of sustainability, universities may be unable to reduce the resource and development impact as well as fail to achieve utmost wealth and utility.

Today's educational facilities are more focused on defining 'real-life' solutions to fund and achieve the overall sustainability goals in the university and maintain the desired condition of the facilities within a given budget. The visibility of facilities operations and management is becoming more prominent as the enrolment becoming more competitive with sustainability practices and policies growing as criteria for university selection (Buchanan, 2011).

Facilities managers are expected to formulate robust environmental policy that promotes a clean, safe and healthy environment for all (VUW, 2009). The key challenge for the UFM's here is how to meet the minimum environmental standards within the organization's financial constraints. Strong commitment to environmental

responsibility is required, which involves concerns for both the natural and the built environments for effective and efficient use of resources.

For instance, Les Reynolds, the president of Higher Education Facilities Management Association (HEFMA) poses the question, “In the current environment where electricity prices are escalating, water resources lessening and global warming impacting the world negatively, how do you maintain a campus so that you continue to enable the enhancement of teaching, learning and research?” adding that there is a need to continually find new and innovative ways to manage university facilities in environmentally friendly manner” (p.3).

The solution here is one of a paradigm shift from seeing compliance to environmental standards as an added cost to one of a long-term view of the future benefits from environmental responsiveness that includes energy saving, healthier and safer workplace and minimized carbon footprint.

Legal constraints

One of the major concerns for facilities manager is how to keep up with the ever-increasing legislations and regulations impacting on the management of facilities. The facilities manager is required to ensure compliance to avoid breaches which could have far reaching cost and legal implications such as threatening the organization’s business and survival.

Booty (2009) sees laws and regulations regarding health and safety as well as employment in particular as fast changing and wide ranging. UFM’s are expected to cope with the needs of office workers especially the aging workforce for ergonomic workstations, access for the disabled, laboratory that may include radioactive substances, genetic material, large animals, toxic chemicals and many other hazards.

These compliance requirements add to the pressure on the IFMs to meet threshold expectations on all fronts, as non-compliance results in heavy fines and other stiffer penalties, including shutting down of the business and its premises (Booty, 2009).

The solution to these constraints lies in being abreast of the legislations and regulations and taking proactive steps to meeting the requirements.

Institutional constraints

These constraints could be viewed in two contexts: first, as part of the organizational setup and the way the leadership and organizational structure in place impacts on the achievement of FM strategic goals. Secondly, it could be viewed from the context of the self-regulatory framework within which the IFM has to operate as part of a regional, national or global affiliate. In the first context, institutional dynamics constrain best practice and relevance of FM where it plays a second fiddle in the scheme of things – especially in the traditional view of FM as a support rather than a strategic role. In this instance, the FM department receives little funding and attention which heavily constrain its proper function and progress.

In the second context, external regulatory framework imposes serious constraints in the way the IFM juggles the internal interests of the organization with the requirements for ethical and best practice standards as entrenched in the code of ethical conduct and professional practice for members. Solution to these constraints lies in being able to set the priorities right in the management, planning and implementation of the FM processes and in striking a balance amongst competing interests.

2.1.10 Future Challenges

In order to understand the future of facility management, the International Facility Management Association (IFMA, 2002) commissioned studies that examined the emerging trends and issues that will drive FM over the next five years. The outcomes from IFMA's studies provide useful insights for this study and are summarised as follows:

1. *Improvement of organization's performance*: Facilities managers are to be evaluated in terms of their financial performance and also their strategic contributions to their organizations' performance improvement.
2. *Technology*: facilities managers need to be well-prepared as change agents especially when new strategic and tactical initiatives are being introduced within their organizations.
3. *Global business environment*: Facilities managers need to be competitive in finding solutions to support their organization, employees, customers, suppliers and also partners.

4. *Knowledge management systems*: Facilities managers are required to have long-term goal in order to assist every individual in the organization to fully utilise and also share the information in helping the organization to improve their performance.
5. *Competencies*: Facilities managers need to adapt and improve their competencies and skill sets in order to succeed in rigorous and asset-oriented future.
6. *Responding to the changing nature of work*: Flexible, communal workspace, virtual work and physical facilities have great impact on employees' performance, quality of work and productivity.
7. *Emerging Issues*: Facility managers might need to emphasis their focus on critical issues such as energy management, move management, security, business continuity, and recycling in the workplace.
8. *Developing the business case for sustainability*: "Changing the paradigm from operating expense to total cost of ownership and maximizing ROI for facilities while satisfying workers and the community".
9. *More training for facility management*, bringing more technical expertise into the management role.
10. *A specialised approach to infrastructure, with more cohesiveness*. New position of CIO (Chief Infrastructure Office) – FM will rise up to take a position equal to CEO who understands the core business.
11. *Continuation of technology as a driver of change in FM practices*: Facility managers need to be highly competent to demonstrate value by applying technology to business planning and management.
12. *Create value for organization*: Facility managers must ensure that they expand their responsibilities and be more proficient project and people managers; this requires soft-skills for instance motivational training and team building for specific short-term projects. They also need to focus in developing expertise in areas around energy management, real estate, and productivity measurement with the aim to support strategic initiatives.
13. *Increasing management's expectations of FM's contribution to the organization*: Facility managers will normally be assessed on their financial performance and strategic contributions to performance improvement for the organization.
14. Progressive global business environment that will challenge facility managers to search for new approaches to support their organizations' employees, partners, suppliers and customers.

15. *Long-term success by creating and using knowledge management systems:* The effectiveness and efficiency of an organization can be improved by the initiative of facility managers in developing and adapting knowledge management systems which focus on “knowledge, increase connectivity between people and information, thereby allowing faster and more informed decision-making” (IFMA, 2005).

BDO Stoy Hayward (2007) also lists top ten crucial issues facing facility management in the future as follows:

1. *Increased scope and budgets.*
2. *Greater influence and board representation.*
3. *Stakeholders placing even greater emphasis on life cycle sustainability and environmental reporting.*
4. *Sustainability all businesses have quality business continuity plans covering all key activities.*
5. *Staff with the right skills readily available.*
6. *Higher retention to staff.*
7. *FM fully responsive to new working arrangements as dictated by social and economic factors.*
8. *Increased regulatory and compliance requirements.*
9. *Global suppliers offering consistent levels of service.*
10. *Greater supply chain complexity.*

2.2 SUMMARY

The reviewed literature has provided insights around facilities management and also on research methods. Insights on facilities management itself are presented and discussed in Section 2.1.

Further, related works of other previous researchers have been studied with a view to visualising gaps in the literature which the current study could contribute to filling. In

relation to the research objectives, the reviews have shed some lights and provided part answers as submitted by previous researchers. These are discussed as follows:

Findings in relation to the first objective

The first objective was to identify and prioritise the internal and external challenges facing university facilities managers, and which could impact on the achievement of strategic FM goals. Outcomes from the literature review show that the recurring crucial challenges associated with FM in general are: emergency preparedness, change management, emerging technology, globalization and broadening diversity in workplace; inadequate funding; skills development, business continuity, compliance management and environmental issues; adjusting to the new sustainability reality, meeting the challenges of workforce development, managing space and rising energy costs; continuing influence of changing economics and market conditions; high legislative compliance costs and constraints, particularly in relation to health and safety, property law, resource and waste management.

Literature also reveals the challenges impacting on the achievement of strategic FM goals can be categorised as internal and external challenges. Internal challenges focus on the strengths and weaknesses which are controllable; on the other hand, the external constraints are not within the control of the organization; they include the opportunities and threats that could enhance or undermine the achievement of the strategic goals of an organization. The generic internal problems faced by organizations encompass the 6M's of management: management, money/ finance, materials, machine, manpower and methods/ operational process; while the literature reports that PESTELI framework is widely used to identify the external constraints that impact on the organization's ability to realize its aims, and for which it has no control. PESTELI stands for political, economic, socio-cultural, technological, environmental, legal and institutional constraints.

Notwithstanding the above issues facing university facilities managers as gleaned from the literature, other equally crucial challenges or constraints might exist, especially those that are unique and applicable to the Australasian universities' context.

Findings in relation to the second objective

The second objective of the study was to determine the associated risk levels (i.e in terms of their perceived levels of impact and frequencies of occurrence). The literature reveals that there is a little mention of risk ranking in the literature. Hence there is a need for an informed view about risks particularly in the likelihood of its occurring and its potential impact; this enables facilities managers to reduce the risk to an acceptable level. The application of risk factor analysis would be a useful approach to determining the probability (or occurrence frequency) and the severity (or impact) of a particular risk. Results of the analysis will enable facilities managers to allocate resources and focus on areas with greatest risk and also better predict the severity of its consequences.

This study therefore explored additional constraints impacting on the achievement of strategic FM goals in the Australasian universities' context, over and above those gleaned in the literature. In addition, this study aimed to prioritise the challenges in order to establish their perceived risk levels in terms of impact levels and frequencies of occurrence.

Findings in relation to the third objective

The third objective of the study was to establish practical solutions for addressing the challenges. Literature provided insights on several solutions for addressing these challenges. However, there was a general lack of prioritisation of the proffered solutions, which make the solutions difficult to follow, given the limited resources at the disposal of the FM departments.

Findings in relation to the fourth objective

The fourth objective was to establish the key challenges facing tomorrow's universities facilities managers. Literature revealed that amongst the key challenges facing university facilities managers in years ahead are: increased scope and budgets; increased regulatory and compliance requirements; greater influence and board representation; stakeholders placing even greater emphasis on life cycle sustainability and environmental reporting; higher retention to staff; FM fully responsive to new

working arrangements as dictated by social and economic factors; and business continuity. The question that this study aimed to resolve in relation to these future challenges identified in the literature is whether or not they are relevant in the context of the Australasian universities and whether or not other critical challenges exist which have not been identified in the literature. The study also aimed to prioritise the challenges in terms of their perceived risk levels, as well as the relative levels of effectiveness of the solutions for addressing them.

2.3 ASSUMPTIONS UNDERLYING THE RESEARCH PROPOSITIONS

In the light of the insights from the literature review, the principal assumptions underlying the research propositions could be stated as follows:

1. Significant agreement or disagreement might exist between the New Zealand and Australian members of the Tertiary Education Facilities Management Association (TEFMA) in their perceptions of the risk levels of the internal and external factors constraining the achievement of the strategic facilities management goals in universities.
2. Of the identified current internal challenges, issues relating to finance could constitute the most critical risk factor. Sustainability issues on the other hand could constitute the most risky external challenges faced by university facilities managers.
3. Significant agreement or disagreement could exist between the views of university facilities managers identified during the main stream survey and the corresponding findings from the case studies, on the nature and risk levels of the internal and external constraints as well as the key challenges facing university facilities managers.
4. Significant agreement or disagreement could exist between the views expressed by university facilities managers identified during the main stream survey, the case studies and also from the historical records, on the frequencies of occurrence of the challenges constraining the achievement of strategic facilities management.

5. Of the identified future challenges facing tomorrow's university facilities managers, statutory compliance issues could constitute the most significant future constraints impacting on the achievement of strategic FM goals.

2.4 RESEARCH PROPOSITIONS

The following propositions were identified to guide the search for data, and to provide a framework for interpretation of results.

1. Consensus of opinions exists between the New Zealand and Australian members of the Tertiary Education Facilities Management Association (TEFMA) in their perceptions of the risk levels of the internal and external factors constraining the achievement of the strategic facilities management goals in universities.
2. Issues relating to finance and sustainability constitute the most risky internal and external challenges faced by university facilities managers, respectively. Disbursing the bulk of the available resources to addressing these problems could therefore be the most efficient and effective way of resource utilization and problem solving.
3. There would be no significant differences between the views of university facilities managers identified during the main stream survey and the corresponding findings from the case studies, on the nature and risk levels of the internal and external constraints as well as the key challenges facing UFM's.
4. Significant agreement exists between the views expressed by university facilities managers identified during the main stream survey, the case studies and also from the historical records, on the frequency of occurrence of the challenges constraining the achievement of strategic facilities management.
5. Statutory compliance issue constitutes the most significant challenges facing tomorrow's university facilities managers.

CHAPTER 3: RESEARCH METHOD

3.1 INTRODUCTION

This chapter discusses the methodology employed in this research. The qualitative and quantitative research processes are also presented. The key elements of the methodology are the overall research strategy adopted, the procedure used to select random samples from the sampling frames, the data-gathering instruments used, methods employed in the data analyses and the model validations. Compliance with the Massey University's policy on research ethics is also presented.

3.2 OVERVIEW OF RESEARCH METHOD

Descriptive survey method was used in the study, since achieving the research objectives requires the technique of observation (via interview schedules and questionnaires) as the principal means for collecting the empirical data (Saunders et al., 2009).

The data gathering stages comprised three stages: First stage: qualitative data gathering using pilot interviews; second stage: quantitative data gathering using questionnaire survey; and third stage: quantitative data gathering using model test surveys.

The scope of the study, especially the pilot and the model test surveys included the eight universities in New Zealand and the 40 universities in Australia. Wider views expressed by the university facilities managers registered with the Tertiary Education Facilities Management Association (TEFMA) were also gathered in the quantitative survey stage to enable comparison between the views of the focus groups and the rest of the TEFMA members on the subject.

The membership directories of TEFMA provided the target population for the study. The demographic section of the questionnaire served to identify and separate the responses from the focus groups and the other members of TEFMA.

A preliminary research approach comprising a qualitative method of data gathering was used to generate new constructs or themes from the target population of facilities managers. This approach involved the use of non-standardised scheduled preliminary interviews of a convenience sample (Saunders et al., 2009) of universities' facilities managers who were registered members of Tertiary Education of Facilities Management Association (TEFMA). The interviews, described in Section 3.5 served as the foundation for the qualitative data gathering.

3.3 OVERALL RESEARCH STRATEGY

Saunders et al (2009, p.600) defined research strategy as “a general plan of how the researcher will go about answering the research questions”. The research strategy adopted in this study began with the identification of the research problems, posing of the research questions and setting clear research objectives. This was followed by an in depth review of relevant literature to acquaint with previous related studies and to identify knowledge gaps to be filled. With further insights gathered from the literature related to the topic area, the research questions and objectives were later refined. Hypotheses/ propositions were subsequently formulated to guide the enquiries/ data search using designed and pre-tested interview schedules and questionnaires.

Qualitative data gathering phase

This phase involved the use of semi-structured pilot interviews and interview schedules to solicit for authoritative feedback on data needed to address the research questions. The interviewees included randomly selected convenience samples of 15 university facilities managers who were registered members with TEFMA; these comprised three facilities managers in New Zealand and 12 in Australia.

The aim of the interview was to generate some constructs or themes for the design of questionnaires to be used at the quantitative data gathering stage. The constructs included information on the potential key constraints faced by university facilities managers and their impact on the ability to achieve the strategic facilities management goals. Constructs obtained from the literature were presented for consideration by the interviewees, in order to test their applicability to the local context. Figure 3 represents the three stages of data gathering involved in this study.

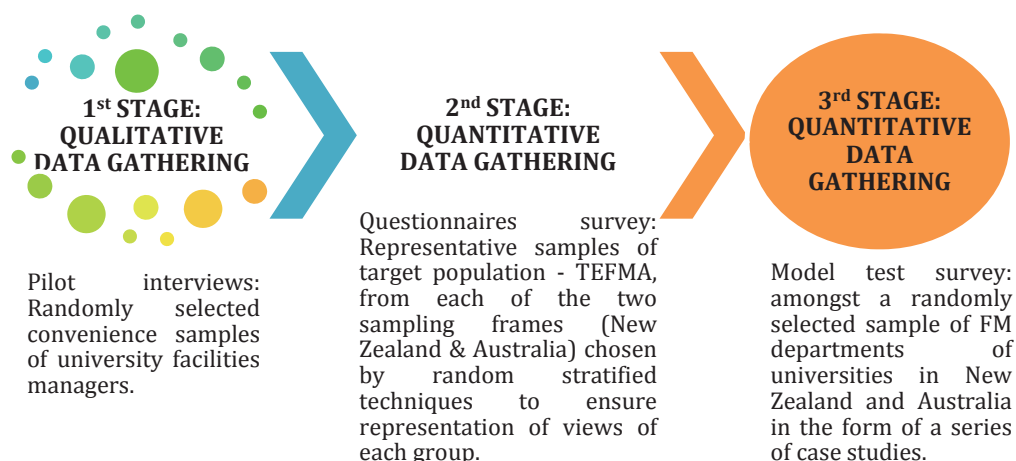


Figure 3: Three stages of data gathering involved in this study (Source: Adapted from Mbachu and Nkado, 2006).

Quantitative data gathering phase

Recurring themes on the key challenges constraining the achievement of strategic FM goals were analysed and incorporated into a questionnaire. The questionnaires were then pre-tested again to ensure that the questions were clear and relevant. Additional 6 randomly selected university facilities managers - comprising 2 respondents from New Zealand and 4 respondents from Australia - participated in the pre-tests. Feedback from the pre-tests included suggestions given by respondents on areas where the questionnaire could be improved upon to enhance its appeal, clarity and relevance with a view to achieving a good response rate.

The second stage of this study was the quantitative data gathering stage using structured but open-ended questionnaires. As earlier stated, the questionnaires were administered to the target population comprising of 800 facilities managers of TEFMA members in the

sampling frame who did not participated in the pilot interviews and pre-test surveys; with representative samples from each of the two sampling frames chosen by census survey techniques to ensure representation of views of each group.

It was intended initially to use randomized stratified sampling technique to obtain representative samples from each subgroup of New Zealand and Australia TEFMA membership directories. However, since directories of each subgroup and for the Australasia TEFMA could not be released due to privacy reasons, census survey was undertaken since TEFMA was willing to distribute the invitations to all members. This census survey approach with the 3 rounds of reminders gave every TEFMA member equal opportunity to participate in the surveys thereby eliminating bias. This also obviated the need for randomized stratified random sampling.

The demographic profile section was used to identify and segregate the sub-groups for comparative analysis. In a gesture of positive and strong support, the TEFMA Board agreed to assist in this study by circulating the questionnaire through TEFMA secretariat with strong encouragement to the members to participate in the survey.

In the questionnaire surveys, respondents were asked to rate the key challenges under each broad internal and external constraint in relation to following dimensions: (i) the level of impact and (ii) the frequency of occurrence of each underlying factor using the 5-point Likert scale as follows: (i) Level of Impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low and (ii) Frequency of occurrence: 5 = Very frequent; 4 = Frequent; 3 = Occasional; 2 = Rare; 1 = Very rare. The data gathered from the questionnaires were then analysed using multi attribute analysis (Saunders et al., 2009; Mbachu and Nkado, 2006). The mean ratings representing the majority opinions were computed and the findings were used to develop the research model.

Model test survey phase

The final stage of the study was the case studies for the model test. This stage was for testing the model developed from the survey data amongst randomly selected samples of FM departments in the universities in New Zealand and Australia. This comprised a series of 5 case studies, each involving FM departmental head/ director who did not take part in the pilot surveys or the questionnaire surveys.

The aim of the model test was to ascertain the extent of conformity or disparity between the generic results established at the main stream surveys and the results from the specific universities as established at the model test surveys. The robustness of the model was tested by analysing the extent to which the model captured the key challenges uncovered at the test surveys.

This model was tested for validity to a convenience sample of five Australasian universities: two universities in New Zealand and three universities in Australia as indicated in the case study. The data gathered from the case study were analysed in order to obtain parameters for refining the model through a rethink of assumptions and hypotheses. The results of these applications were compared with other index measures with a view to testing the criterion and construct validity of the developed models.

A schematic illustration of the details of the research process planned for, and implemented in the study is presented in Figure 4.

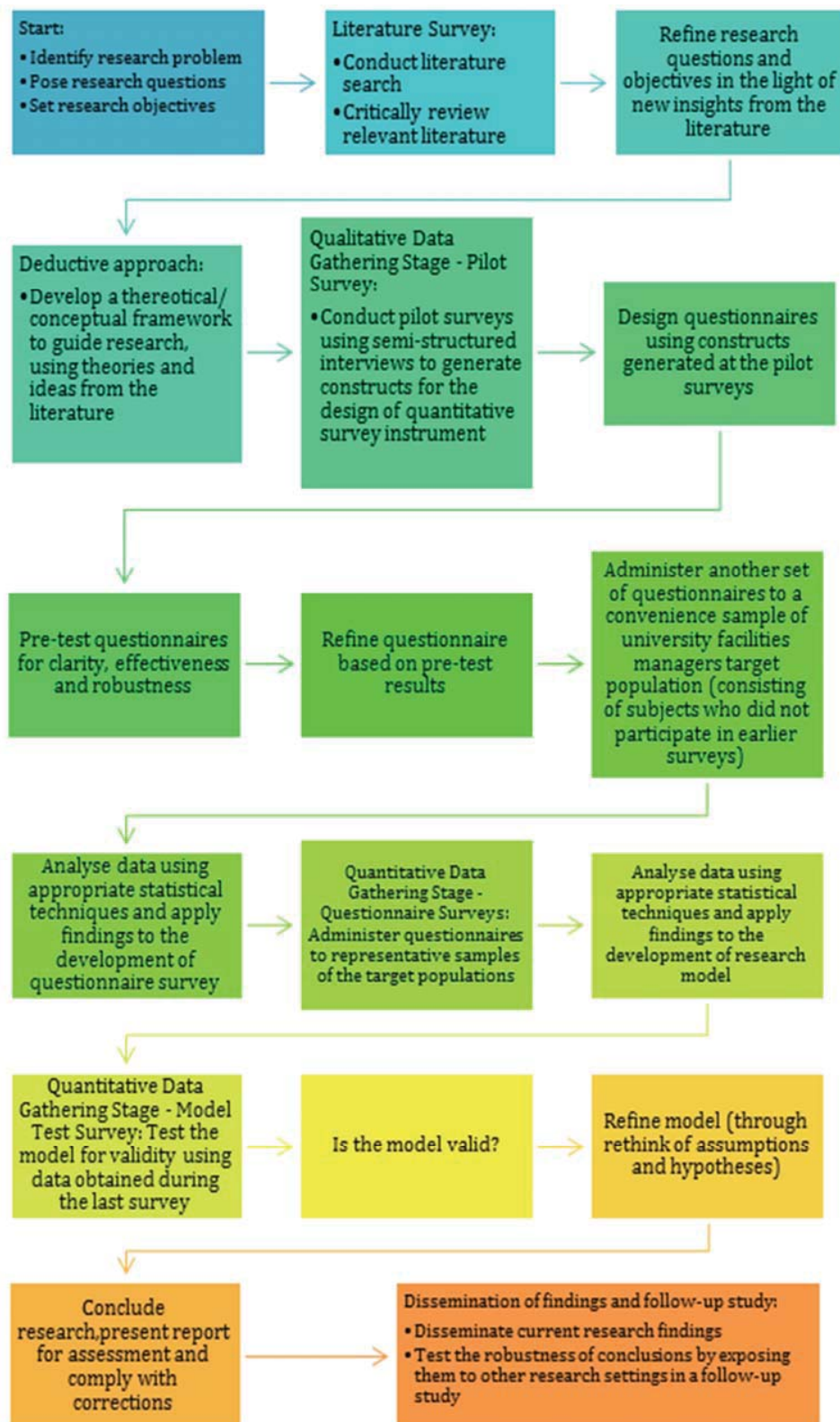


Figure 4: Schematic illustration of the research strategy adopted in this study.

3.4 PILOT SURVEY: PLANNING AND IMPLEMENTATION

3.4.1. INTRODUCTION

This section presents the methods used for planning and implementation of the pilot survey involving semi-structured interviews that were held with randomly selected samples of facilities managers of facilities management departments in their respective universities in New Zealand and Australia. The primary aim of the pilot survey was to test the relevance, clarity and validity of the themes identified from the literature and to generate some constructs for the questionnaire. Insights from the respondents at the pilot surveys provided the theoretical basis for the conceptual framework development.

3.4.2. INTERVIEW SCOPE AND SAMPLING FRAME

The scope of the study was delimited to the universities in New Zealand and Australia; other forms of tertiary institutions were not included. This was to ensure that 'apples' were compared with 'apples'. The sampling frame for the interview was constituted by university facilities managers in the Australasian region, comprising eight universities in New Zealand and forty universities in Australia. The facilities managers were registered members of the Australasian Tertiary Education Facilities Management (TEFMA). The pilot interviews were conducted with convenience samples of the university facilities managers from the TEFMA directory who granted the requests for participation in the interviews. Stratified sampling strategy would have been used to obtain samples from the New Zealand and Australian university facilities managers for the interviews. However, the focus at this stage was not on representation of views from the two clusters, but to generate constructs for designing the questionnaire survey. Saunders et al. (2003; 2009) recommend the use of 'convenience samples' for this purpose; these being willing participants drawn from the sampling frames. Nevertheless, requests for participation were sent to all the facilities management departments in the 8 New Zealand universities and 40 Australian universities. Only 15 facilities managers responded positively. The interviews proceeded with these 15 facilities managers – 2 from New Zealand and 13 from Australia.

3.4.3 INTERVIEW STRATEGY

Semi-structured and scheduled interviews were used to generate constructs underlying the research questions; the generated constructs subsequently formed the basis for the design of questionnaires used at the quantitative data gathering stage.

According to Saunders et al. (2003), the choice of semi-structured interview was appropriate given the need to exercise control over the direction of the interview discussions in order to exhaust responses to the vital areas within the available time schedules. Denscombe (2010, p.175) confirms that by using semi-structured interview “the interviewer is prepared to be flexible in terms of the order in which the topics are considered and perhaps more significantly, to let the interviewee develop ideas and speak more widely on the issues raised by the researcher”. Thus, the interviewees’ were given greater opportunity to elaborate points of interest as the answers were more open-ended.

The constructs sought included the following: key internal and external constraints impacting on the achievement of strategic facilities management goals; the key future challenges facing university facilities managers in the Australasian region, and the practical measures for addressing the challenges. Some of the ideas from the literature were also presented for consideration by the interviewees, in order to test their applicability in the local context.

It should be noted that feedback on the severity and occurrence frequencies of the identified constraint factors was not sought at the pilot interview stage; these were reserved for rating at the questionnaire survey stage. Based on the recommendations of Saunders et al. (2009), motivational measurement methods, involving the use of projective techniques were employed during the interviews in canvassing the views of interviewees on highly classified aspects of the information asked for. For instance, instead of posing direct question to the interviewee on the internal problems that they faced in managing their own university facilities, an indirect or general question was posed, such as, ‘from your experience in managing university facilities, what do you perceive to be the key internal factors constraining the achievement of strategic FM goals?’ In this way, the interviewees’ responses were assumed to be projections of own experiences, though attributions were made to facilities managers in general. Mbachu (2002) stated that “motivational research techniques may be helpful in uncovering the

real reasons for observed behaviour, as well as in developing information about highly classified or personal issues in situations where personal embarrassment, mistrust or compliance to appointment codes of conducts may inhibit candid answers to direct questioning” (p.35).

Furthermore, Saunders et al. (2003) confirms that projective techniques are useful in the exploratory stage of a research, where ideas and hypotheses are required, and when the research is concerned with beliefs, values, motivation, personality or other aspects related to individuals, their unique cognition and behaviour.

3.4.4 SAMPLING TECHNIQUE

Saunders et al. (2003) recommend a non-probability sampling which involves ‘convenience’ and ‘self-selection’ sampling techniques as the most sensible methods for the purpose of pilot survey. Mbachu (2002, p.178) also finds that “non-probability sampling provides the opportunity to select samples purposively and to reach difficult-to-identify members of the population”. The convenience sampling was therefore used to identify respondents who could grant sufficient time for in-depth exploration of the study during the pilot survey. The ‘self-selection’ sampling technique was used to distribute the requests for pilot surveys via postage, faxes or emails to the entire TEFMA members. The requests generated list of ‘self-selected’ individuals who were willing and disposed to be interviewed.

3.4.5 SAMPLING SIZE

Saunders et al. (2003) argue that non-probability sampling provides practical alternative to obtain samples in a rapid rate with little control of the content and without the need to obtain representative samples, as the actual size depends on merely the availability of resources (i.e. the ability to gain access to the organization or individual) and the sensibility, validity and understanding of the researchers from data gathered.

In this study, the sample size for the pilot survey was limited to fifteen facilities managers who responded positively to the interview request, indicating willingness to

participate in the pilot surveys. Nevertheless, the suitable representative sample size was met at the quantitative data gathering stage for the purposes of validation and generalizations over the populations.

3.4.6 INTERVIEW PLANNING AND SCHEDULING

At the inception of the interview planning, the university facilities managers' contact information was accessed from the staff directory list of each respective university website. Fax medium, augmented by email follow-up, was adopted for the contacts to avoid delays and uncertainties associated with postages. Most of the staff directory list for majority of the universities provided complete details of their FM staff (i.e names, postal addresses, contact numbers, fax numbers and email addresses). However, those that had no fax numbers in the directory were contacted using their telephone numbers, requesting them to indicate the fax numbers through which messages could be despatched to them.

Twelve out of forty-eight FM department involved (i.e those that had no fax numbers in the directory) supplied fax contact addresses. Forty-eight messages (each consisting of two-page document of interview request and interviewee's choice of dates and time slots) were despatched to the university facilities managers in the sampling frame (twenty-five through faxes and twenty-three through emails).

The covering letter set out the objectives and envisaged benefits of the study, the estimated time for interview (thirty-minutes) and a request to the interviewee to select two options from each set of possible dates and time slots, as well as to indicate a convenient venue for the interview.

At the outset of the interview scheduling, locations of the interviewees were taken into account; i.e. New Zealand and Australia. After the receipt of the completed interview schedules with indication of preferred dates and time slots, the interviews were scheduled for interview based on the options they supplied. Given the location and logistic constraints, and the interviewees' acceptance of phone interview via Skype, this medium was used for all the interviews.

In an attempt to compress the interview period, as well as to resolve some tied cases in the schedules, further requests were made to the few interviewees involved, asking them to reschedule, if possible, the dates and times within the vacant slots. The interviewees were also requested to indicate their willingness to be interviewed any day and time on notice deemed sufficient by them. This made it possible to reschedule all the interviews for both regions within two consecutive weeks, involving one interview per day. Confirmatory letters along with the interview questions were emailed or faxed to the interviewees one week in advance, with follow-up reminders the day before.

3.4.7 QUALITATIVE DATA GATHERING INSTRUMENT

The interview questions were aimed at exploring underlying issues facing facilities managers in managing university facilities within the domains of internal and external constraint categories. The focus was on the impacts of the constraints on the performance of university FM functions. Also the key future challenges faced by university facilities managers in the Australasian region were explored, along with potential strategies or practical solutions for addressing the constraints. Sample of the interview schedule is provided in Appendix A.

3.4.8 CONDUCT OF THE INTERVIEWS

As earlier mentioned, the sample size for the pilot survey was limited to the fifteen respondents from New Zealand and Australia – three from New Zealand and twelve from Australia – who granted the request to be interviewed. This section reports on the conduct of the interviews.

Audio recording of the interviews

As earlier indicated, the interviews were conducted by phone, since all the interviewees ticked this option in addition to face-to-face and skyping. This ensured consistency of approach and the minimisation of bias which combined interview mode could have introduced. All the interviewees granted consent to the recording of the interviews for more accurate transcription of the feedback. So the interviews were recorded using a digital voice recorder (DVR). The benefits of using audio recordings include the fact that

the interviewer could focus on leading the discussions and avoid the delays involved in jotting down the points. Also they lend to more accurate transcriptions of the feedback (Cavana et al, 2001; Denscombe, 2010).

Transcribing the audio recordings

At the end of the pilot interviews, the recorded feedback was transcribed. The transcribed feedback and a copy of the interview recording were sent to the interviewees for confirmation or modifications to eliminate transcription errors. Anonymity was maintained in the whole process. An authority to release the transcript was also enclosed (refer to Appendices A6). Signed release authorities were received from all interviewees. There were no requests made by any of the interviewees, to further amend or edit the interview transcripts.

3.5. QUESTIONNAIRE SURVEY: PLANNING AND IMPLEMENTATION

3.5.1. INTRODUCTION

This section presents the methods used for the planning and implementation of questionnaire survey of the target populations of university facilities and property managers in the Australasian region. The primary objective of questionnaire surveys was to attain consistent and representative feedback from the target populations on the issues being investigated.

3.5.2 RESPONDENT POPULATIONS AND SAMPLING FRAMES

Registered members of the Australasian Tertiary Education Facilities Management Association (TEFMA) constituted the target population for the study; but the sampling frames comprised only the TEFMA members who managed university facilities. The questionnaires were administered on the 800 registered members of TEFMA who belonged to this sampling frame. In a show of positive and strong support, the TEFMA Board agreed to assist in this study and therefore the questionnaires were circulated by

the TEFMA secretariat. This also encouraged member-response since the survey had the backing of the association. Those who participated in the pilot interviews and the questionnaire pre-tests were excluded from the questionnaire sampling frame.

3.5.3 SAMPLE SIZE

Saunders *et al* (2003) provide guideline for generating a suitable sample size that reflects the characteristics of populations at 95 percent level of confidence. The process requires the generating of two parameters: the minimum sample size and the adjusted minimum sample size; these are discussed in the following subsections.

3.5.3.1. The minimum sample size

The minimum sample size for this study was drawn from the various population values provided by Israel (2009) in the following Table 9.

Table 9: Sample sizes for different sizes of population (assuming data are collected from all cases of sample)

Note: Sample size for $\pm 3\%$, $\pm 5\%$, $\pm 7\%$ and $\pm 10\%$ Precision Levels Where Confidence Level is 95% and $P=.5$.				
Size of	Sample Size (n) for Precision (e) of:			
Population	$\pm 3\%$	$\pm 5\%$	$\pm 7\%$	$\pm 10\%$
500	a	222	145	83
600	a	240	152	86
700	a	255	158	88
800	a	267	163	89
900	a	277	166	90
1,000	a	286	169	91
2,000	714	333	185	95
3,000	811	353	191	97
4,000	870	364	194	98
5,000	909	370	196	98
6,000	938	375	197	98
7,000	959	378	198	99
8,000	976	381	199	99
9,000	989	383	200	99
10,000	1,000	385	200	99
15,000	1,034	390	201	99
20,000	1,053	392	204	100
25,000	1,064	394	204	100
50,000	1,087	397	204	100
100,000	1,099	398	204	100
>100,000	1,111	400	204	100
a = Assumption of normal population is poor (Yamane, 1967). The entire population should be sampled.				

3.5.3.2. Adjusted minimum sample size

Since the total population of this study is 800, Saunders *et al.* (2009) recommend that the 'adjusted minimum sample', involving a smaller sample size, could be used without affecting the accuracy of the sampling for the entire population when this is less than 1000. The adjusted minimum sample size was computed using Equation 1 provided by Saunders *et al.* (2009).

$$\frac{N}{1 + (\frac{N}{N_T})} \quad (1)$$

Where:

N' = Adjusted minimum sample size

N = Minimum sample size

N_T = Total population

The total population of this study is 800. By using the data for different sample sizes provided by Israel (2009), the minimum sample size of this study is 267. With the formula given in equation (1), the adjusted minimum sample size for this study is computed. Table 10 below portrays the adjusted minimum sample size for this study.

Table 10: Sample size of the study

Total Population (N_T)	Minimum sample size (N)	Adjusted minimum sample size
<i>(for 5% precision level; with 95% confidence level)</i>		
800	267	200

3.5.3.3. Required sample size

Saunders *et al.* (2009) provide the formula for computing the actual sample size required for a representation of the population at 95 percent level of confidence. This is given in Equation 2 below.

$$N^a = \frac{N \times 100}{R_e \%} \quad (2)$$

Where:

N^a = Sample size required

N = Adjusted minimum sample size estimated using equation (1) above

R_e = Estimated response rate expressed as a percentage.

Equation 2 was used to obtain the sample size for this study. The results in Table 11 show that the sample size required for this study is 1000. However, due to the relatively small size of the full sampling frames of this study which is 800, a census survey was undertaken as recommended by Saunders et al. (2003).

Table 11: Sample size required for this study

Adjusted minimum sample size (N)	Estimated response rate (Re) (%)	Required sample size	Questionnaire sent
200	20	1000	800

3.5.4 SAMPLING TECHNIQUE ADOPTED

This study adopted the stratified random sampling method to obtain representative samples of facilities and property managers who are registered and active members of TEFMA. Saunders et al. (2003, p.165) noted that by using stratified random sampling method, “the sample is more likely to be representative” and therefore, the strata of the study was proportionate. However, the need for stratified sampling was obviated by the use of census survey, given the relatively small population size of less than 1000 (Mbachu and Nkado, 2006).

3.5.5 QUESTIONNAIRE SURVEY

The research questionnaire was designed using the constructs identified during the exploratory interviews. Only those constructs which were mentioned by four or more interviewees were incorporated into the research questionnaire.

With the exception of demographic section of the questionnaire, which was aimed at obtaining information from the respondents for response eligibility and categorisation purposes, the main data parts of the questionnaire were designed with conjoint analysis in mind. Cooper and Emory (1995) submit that the objective of conjoint analysis is to secure *part-worth* or utility scores which represent the importance of each variable, in the subjects' overall preference ratings. Thus the essence of the questionnaire design is to obtain representative views of the respondents on the levels of importance or relative contributions of each attribute within the set of attributes being rated.

Likert scales were provided in the questionnaire for measuring varying degrees of the respondents' opinions on the relative worth of the attributes in the subset, relative to the rating continuum. DeVellis (1991) and Nkado (1999) support the use of Likert scale in measuring opinions, beliefs and attitudes.

Types and sections of the questionnaire

The questionnaire comprised two main sections - demographic and main data.

The demographic section of the questionnaire was designed to obtain information on the respondent's primary role in their organization, position in organization, years in professional practice, country and city. This section mainly served to assess the quality of the responses, to ensure reliability by being used to screen out responses from subjects who do not belong to the target populations, and to categorise the usable responses during the data analysis.

The main data section contained questions on the following:

- Potential internal factors constraining the achievement of strategic FM goals,
- Potential external factors constraining the achievement of strategic FM goals,

- Key challenges facing tomorrow's university facilities managers,
- Practical solutions for addressing the identified constraints.

Index measures

Saunders et al (2009) observe that measures of cognitive phenomena are often composite indices of set variables. In order to achieve a composite measure of a phenomenon, several attributes underlying the phenomenon or concept are combined.

The design of the questionnaire for this study drew on Saunders's (2009)) observation. As a result, three index measures were adopted in assessing the overall problems faced by university facilities (managers):

- Facilities managers' overview responses to broad categories of the constraints on the achievement of strategic facilities management goals (which were measured in each internal and external category through a single question at the end of the multi-attribute ratings),
- Multi-attribute analysis (which involved measuring overall risk levels associated with each category from the frequencies of occurrence and level of impacts ratings of the underlying factors).

The contents of the main data sections of the questionnaire were therefore designed to capture data for the computation of the above index measures. A section was provided at the end of the questionnaire for the respondents' general comments about the contents of the questionnaire or other issues relating to the research. Finally, the respondents were appreciated for time spent in completing the questionnaire, asking them to fax or email the completed questionnaire to the researcher.

Pre-testing is a way of improving clarity, relevance, desirability and the look and feel of the questionnaire to ensure good response rate (Nkado, 1999). The draft questionnaire for this study was pre-tested amongst convenience samples of some facilities professionals especially facilities managers within the target populations who did not participate in the preliminary interviews.

Six university facilities professionals; two from New Zealand and four from Australia participated in the pre-test. All of the participants in the pre-test were directors and

associate directors of facilities management departments in their respective universities. The pilot tests were conducted between 15th March 2010 and 26th March 2010.

During the pre-test, each participant was served the questionnaire and asked to respond to it in the same manner he or she would respond to a questionnaire received by fax or email. This helped to simulate conditions close to self-administered surveys through which the final questionnaire would be administered. The respondents were asked to go through the questions, respond to those questions which they found unambiguous, and note down those questions they considered ambiguous, ridiculous or simply unnecessary. Notes were made on the sections of the questionnaire where the respondents paused over for some time.

At the end of the questionnaire administration, the time taken for the questionnaire to be completed by each respondent was noted. The respondent were asked to comment on the areas where he or she considered being worthy of modification, re-phrasing, clarification or complete removal. Their views on issues such as what should be the appropriate length of the questionnaire, response time and other features pertinent to enhancing response rates when finally administered, were also canvassed.

Consensus in the respondents' feedback led to the following amendments to the first draft:

- The length of the questionnaire was limited to four pages from initial six pages.
- Inclusion of the "No idea" option next to the rating scales.
- Rephrasing some of the questions so the respondents would be required to provide feedback based on their perceptions of the identified factors constraining the achievement of strategic FM goals, rather than answering the questions based on what actually happened in their respective universities. This was to ensure that the information about each university involved was treated in strict confidence.

Having amended the first draft, fax and email were employed to administer the second draft to the remaining participants in four universities in Australia. An evaluation form was attached at the back of the questionnaire for useful feedback on the following attributes of the questionnaire:

- Extent of clarity and appropriateness of the questions, with provision for comments on the specific questions and the perceived inadequacies.
- Approximate range of completion time, which should be indicated in the covering letter for the final questionnaire draft.
- Appropriateness of the length of the questionnaire.
- Perceived level of interest which respondents might attach to the topic under study, and response to the questionnaire.
- Appropriateness of the contents of the covering letter in stimulating respondents' interest to participate in the final survey.

Feedback from the respondents at the second stage of the pilot test showed positive report on the above evaluation points, with the exception of the covering letter, which was modified to stimulate the respondents' interests in the study. Appendix B presents the final questionnaires that were sent to the survey participants.

Based on a census survey, emails attached with the questionnaire, covering letter, and separate form for receiving summary of key research findings were sent to all members of the Tertiary Education Facilities Management Association (TEFMA) through the TEFMA secretariat. The email invitations included supporting statements by the TEFMA Board encouraging members to respond within the cut-off date set for receiving the feedback.

Enclosures in the questionnaire package

Each of the questionnaire package circulated by the TEFMA secretariat consisted of the following:

- Covering letter: This described the research study and summarised the purpose and benefits of the study. . A sample of the covering letter is provided in Appendix B1.
- Four-page questionnaire for the study (Appendix B2).
- Request form for a summary of the key findings (shown in Appendix B3).

The questionnaires were administered between 22nd June and 31 August 2010.

Reminders and return-to-senders

The completed questionnaires were returned by the TEFMA Secretariat to the researcher via E-mail, without revealing the details of the respondents to the researcher (i.e. respondent's name, email address or contact number).

Daily returns of the questionnaires were monitored to observe the trend in the returns. Weekly reminder were emailed to the TEFMA Secretariat in order for the reminder to be circulated to the remaining TEFMA members who still had not completed the questionnaire, after the returns peaked in the third week and declined to trickles in the fourth week.

In the reminder E-mail, the electronic copies of the questionnaire package were attached. For those who had responded to the questionnaire and returned it to the TEFMA Secretariat, this E-mail served as platforms to thank them for their participation and insightful inputs as well as asking them to disregard the reminder. The emails sent by TEFMA carried a note advising that members who had participated in the pilot interviews and pre-test were not obliged to participate in the questionnaire surveys. Also this information was also relayed to the participants at any stage of survey. Perhaps, this could account for not getting 800 responses from all the Australia TEFMA members.

A copy of the reminder E-mail is shown in Appendix B4.

From the generated mailing list, the TEFMA Secretariat was also able to detect the non-response questionnaires which were initially due to a number of reasons including the respondents no longer practising, respondents no more using the email address or had left the organizations, or that the survey was not applicable to the respondents. Within the survey period, the researcher had received regular updates on the progress of the survey which were reported by the TEFMA Secretariat.

"Bias" is defined as "any influence, condition or set of conditions singly or together distort the data from what may have been obtained under the conditions of pure chance" (Leedy, 1997, p.219). It is in this light that Nkado (1999, p.57) cited in Mbachu (2002) submits that the "descriptive surveys are particularly susceptible to bias".

In eliciting information on the underlying problems or challenges facing facility managers in managing university facilities, a potential source of bias in the study could be the reluctance to release information which might be deemed highly classified, or for

which the respondent might be under oath of secrecy (as per code of conduct provisions) not to disclose to the third party (Mbachu, 2002).

As described in section 3.5.3, motivational measurement methods were employed under such conditions where the respondent might not give candid answers to some sensitive information (Denscombe, 2010).

Non-response was identified as another potential source of bias (Nkado, 1999). According to Saunders et al. (2009), significant cases of non-responses mean that the views of a significant number of subjects constituting the sampling frame are not obtained and used in the analysis, resulting in non-representation and ultimately to bias. Thus, in order to maximise the response rates, several steps were taken such as layout and brevity of the questionnaire, the composition of the covering letters and the administration of the questionnaire including assurance of anonymity. Constant reminders, enclosed with the questionnaire packages were further steps taken to enhance responses.

3.6 MODEL TEST SURVEY: PLANNING AND IMPLEMENTATION

3.6.1 INTRODUCTION

The model test surveys were carried out with some university facilities managers who did not take part in the pilot interviews, questionnaire pre-test and questionnaire surveys.

At this stage, the model developed from the survey data was tested amongst a randomly selected sample of FM departments of universities in New Zealand and Australia in the form of a series of case studies. The model test surveys were aimed to ascertain the extent of conformity or disparity between the generic results established at the main stream questionnaire surveys and the specific institutional results established at the model test surveys. The robustness of the model was also tested by analyzing the extent to which model had captured the key challenges uncovered at the test surveys.

The descriptive method involving structured questionnaire survey was used in obtaining data for the model test in order to ensure close resemblance to the method used in obtaining data at the second stage and upon which the model was developed. Fellows & Liu (2003) observe that descriptive case study is aimed at systematically identifying and recording a certain phenomenon; it is not directly aimed at testing theory but at recording an object of study in order to find new theoretical interpretations or to gain more in-depth knowledge pertaining to existing theoretical insights.

3.6.2 MODEL TEST SURVEY INSTRUMENT

Structured questionnaire was used to obtain the perceptions of the participating university facilities managers on the key internal and external challenges impacting on the achievement of strategic facilities management goals and the associated risks levels of these challenges from their perceived frequencies of occurrence and levels of impact. The questionnaire was designed to be as brief as possible to ensure favourable response rate, especially, given the reduced number of anticipated respondents.

A copy of the questionnaire used for the model test survey is given in Appendix C1, whilst the questionnaire survey reminder letter is given in Appendix C2.

3.6.3 TARGET POPULATION FOR THE MODEL TEST SURVEY

As earlier mentioned, the model test survey involved university facilities managers who did not participate in the pilot interviews, questionnaire pre-test and questionnaire survey. FM directors in 5 randomly selected universities had agreed to participate in the test surveys; two were from New Zealand and three from Australia.

The participants for the model test surveys were recruited via convenience sampling as recommended by Saunders et al (2009). It was known that universities in Australasia formed the TEFMA in this region, so it was a question of which FM department of the Australasia universities could grant request for model test. Further, the participants for this model test survey were to be excluded from the pilot interviews, pre-test and questionnaire survey by reminder emails sent by TEFMA Secretariat. As an

assurance to this, the emails sent carried a note advising that members who had participated in the pilot interviews and pre-test were not obliged to participate in the questionnaire surveys. Also this information was also relayed to the participants at any stage of the survey.

3.6.4 MODE OF SURVEY

The five interviewees were interviewed at each location on different preferred date and time. Each interview lasted for thirty-minutes. Structured questionnaire was used to obtain the perceptions of the interviewees on the key internal and external challenges as well as the key future challenges that had potentials for impacting on the achievement of strategic facilities management goals and the associated risks levels of these challenges. Skype was also used as a medium to survey respondents in distant locations who preferred this option due to logistical constraints.

3.7 METHODS EMPLOYED IN THE DATA ANALYSES

3.7.1 ASSUMPTIONS

The following assumptions underpinned the data gathering process:

- University facilities managers approached for the investigations were unbiased, well informed and well experienced to provide beneficial feedback on the information sought from them.
- Feedback on the challenges faced by the university facilities managers was based on organizational views rather than personal. This aligns with Mbachu's (2002) submissions that where an individual was vested with the authority to make representative statements, the individual's responses were assumed to be representative of the organizational voice on the matter under study.
- The respondents' or interviewees' perceptions as reflected in their responses were assumed to flow out of experiences within the industry, the collective pool

of which could give a more objective reflection on the ultimate truth about the subject matter under study.

- The responses were sincerely and thoughtfully made.

3.7.2 QUALITATIVE DATA ANALYSES

Content analyses which involved frequency computations and cross tabulations were used in the analysis of the qualitative data obtained at the exploratory stages. This helped to establish the profiles of the respondents. The qualitative data responses were tabulated in order of mentions to identify and prioritise key outcomes.

3.7.3 PRELIMINARY ANALYSIS OF THE QUANTITATIVE DATA

In order to ensure the accuracy of the quantitative data, all of the data gathered from the questionnaire responses were first scrutinised to screen out responses that did not meet the quality criteria set for the responses; the assumptions in section 3.8.1 underpinned the quality screening criteria.

The screened responses were then converted from raw form to reduced and classified forms that are more appropriate for the analyses. Subsequently, preliminary thematic analyses were performed which involved breaking down, inspecting and re-arranging the data in order to obtain meaningful descriptions, patterns and relationships. The end results of the preliminary data analyses were the parameters used for testing the propositions.

3.7.3.1 Data analyses

Content analysis (involving thematic analysis) and multi-attribute techniques were used in analysing the data obtained from the mainstream questionnaire survey and model test surveys. Content analysis serves the purpose of cross-tabulation and frequency counts, as well as data structuring into recurring themes. It was considered the best approach for this purpose as recommended by Zikmund (2003).

The multi-attribute rating technique espoused by Mbachu (2008) was used to analyse the ratings of the respondents with a view to establishing the mean values of the rating points. The multi-attribute utility analysis involved the computation of two parameters: (i) levels of impact which helped to establish the Impact Index (II) and the Relative Impact Index (RII) for each factor under a subset; and (ii) frequencies of occurrence which helped to determine the Frequency Index (FI) and the Relative Frequency Index (RFI) values for each factor under a subset.

The impact index (II) indicates the mean or average rating point assigned by all the respondents for the level of impact of each factor within a subset of factors. For each computation, the total number of respondents (TR) rating each attribute was used to calculate the percentages of the number of respondents associating a particular rating point to each factor as shown in Equation 3.

Similar concept applies to computation of the frequency index (FI) as shown in Equation 5. The value of II and FI were used to compute the Risk Score (RS) for assessing the risk level associated with each key factor constraining the achievement of strategic FM goals within a subset. The RS values were used as the basis for determining the extent to which the second objective of this study was achieved.

Figure 5 depicts the conceptual framework of the step-wise operational context for this study – from data analysis, through parameter computations to research objective-matching results.

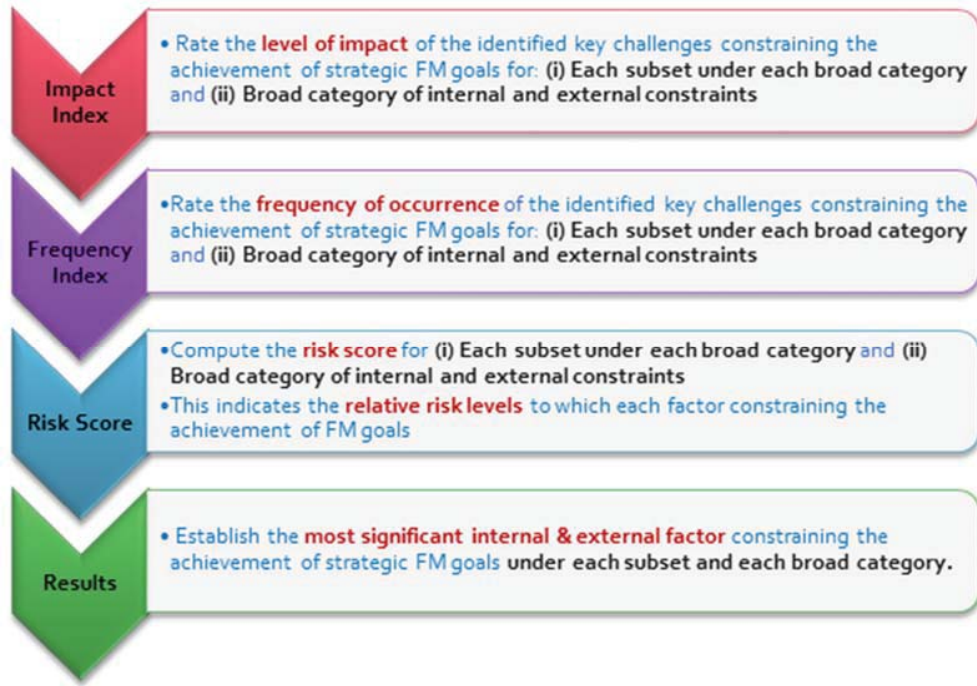


Figure 5: Conceptual framework - Operational context for this study

The following sections further highlight the computation of II, RII, FI, RFI, RS and RSS.

Impact Index (II)

This was computed as the sum of the products of each rating point (Rp) and the corresponding percentage response to it (R%), out of the total number of responses (TR) involved in the rating of the particular need. The computation of the impact index (II) is given in Equation (3) below:

$$II = \sum_{i=1}^5 (R_{p_i} \times R_{i\%}) \quad (3)$$

Where:

II = Impact index

R_{p_i} = Rating point *i* (ranging from 1 – 5)

R_{i%} = Percentage response to rating point *i*.

Relative Impact Index (RII)

The relative impact index (RII) as given by Mbachu (2008) was used to explore the relative contribution of the variables in a given set based on their II values obtained in Equation 3. Equation 4 presents the computation of the RII for a variable in a given set.

$$RII = II / (\sum II) \quad (4)$$

Where:

RII = Relative Impact Index

II = Impact index

$\sum II$ = Sum of all Impact Indices of the needs in the subset.

Frequency Index (FI)

The computation of FI is similar to that of impact index (II) given in equation (3) above.

$$= \sum_{i=1}^5 (R_{pi} \times R_{i\%}) \quad (5)$$

Where:

FI = Frequency index

R_{pi} = Rating point i (ranging from 1 – 5)

$R_{i\%}$ = Percentage response to rating point i .

Relative Frequency Index (RFI)

Computation of the RFI is similar to that of the impact index (RII) given in equation (4) above.

$$RFI = FI / (\sum FI) \quad (6)$$

Where:

RFI = Relative Frequency Index

FI = Frequency index

$\sum FI$ = Sum of all Frequency Indices of the needs in the subset.

Risk Score (RS)

RS value served to assess the risk level associated with each key factor constraining the achievement of strategic FM goals within a subset. The computation of RS is given in equation (7) below:

$$RS = II \times FI \quad (7)$$

Where:

$$\begin{aligned} RS &= \text{Risk score} \\ II &= \text{Impact index} \\ FI &= \text{Frequency index} \end{aligned}$$

Relative Risk Score (RRS)

The relative risk score provided the basis for prioritizing the risk levels associated with each of the underlying factors constraining the achievement of strategic FM goals in each subcategory of internal and external constraints. It was established by rank-ordering the risk scores (RSs) of the factors under a given subset, with the most risky factor being the one with the highest RS value.

Re-scaled rating continuum for the risk scores

As indicated in Equation 7, risks score (RS) for each risk factor was computed as the product of the impact index (II) and the frequency index (FI). The RS value obtained needed to be interpreted in a way that helped to understand the implied risk level corresponding to the 5-point Likert rating used in the study. To do this, the risk interval of 24 which is the difference between maximum risk score of 25 and the minimum risk score of 1 was re-scaled into 5-band interval rating for meaningful interpretation. The maximum risk score of 25 was obtained as the product of the maximum rating point of 5 for II and the corresponding maximum rating point of 5 for FI; while the minimum risk score of 1 was the product of the minimum rating point of 1 for both impact and frequency index values.

Re-scaling the 24 risk interval into 5-band risk interval rating required the use of an equal band interval of 4.8 (i.e. $24 \div 5$) to augment the risk score values from the minimum of 1 to the maximum of 25. E.g. the minimum risk score of 1 to 5.8 (i.e. $1 + 4.8$ equal

interval) then became the ‘Very Low Risk’ rating band. To avoid overlaps, the values were expressed in 4 decimals with 0.0001 as the incremental value. The 4 decimal point also ensured that the collective incremental values were not too large as to introduce errors in the rating scale. The resultant 5-band interval rating scale and the corresponding ordinal scale rating interpretation of the risk profiles are as follows.

5-point rating scale	Remark	Re-scaled 5-band rating	
		Min	Max
5	Very High	20.2	25
4	High	15.3999	20.1999
3	Moderate	10.5998	15.3998
2	Low	5.7997	10.5997
1	Very Low	0.9996	5.7996

3.7.4 ANALYTICAL PROCEDURES ADOPTED IN TESTING THE PROPOSITIONS

Choice of appropriate analytical procedure technique adopted for testing each proposition was guided by Sheskin 2003 and Miller 2014 recommendations documented in Appendix D. Statistical tests of significance were adopted in testing the propositions in order to obtain some measure of confidence in the conclusions reached, or inferences drawn from the results.

Non-parametric Spearman rho correlation coefficient (Sheskin, 2003; Miller, 2014) was calculated to determine whether any significant relationships existed between the perceptions of university facilities managers on the internal, external and future challenges analysed from two different sources - i.e. from the questionnaire survey and the model test survey.

Kendall’s W or Kendall’s coefficient of concordance (Sheskin, 2003; Miller, 2014) was calculated for assessing the level of agreement among the university facilities managers from three different sources: questionnaire survey, model test survey and analysed historical records. Figure 12 (see Chapter 7) shows a snapshot of the research objectives, propositions and the analytical techniques adopted in testing the propositions.

3.7.5 VALIDITY IN THE MEASUREMENT PROCEDURES

Validity is identified as the most crucial factor for the quality of a test. Validity is the degree to which a test measures what it is designed to measure (Donoghue, 2000). Cooper and Emory (1995) categorise validity into two major forms – i.e. the external validity and internal validity.

According to Cook & Campbell (2002), threats to validity could be from researcher(s) being wrong when making an inference in an experiment because of covariance, causation, constructs or whether the causal relationships holds over variations in persons, setting, treatments and outcomes.. Creswell (2012) further identifies four types of validity:

- (1) *Statistical conclusion validity*: This relates to appropriate use of statistics (for examples, violating statistical assumptions, restricted range on variable, low power of test) to infer whether or not the presumed independent and dependent variables relate in the experiment;
- (2) *Construct validity*: This refers to the validity of inferences about the constructs in the study.
- (3) *Internal validity*: This relates to the validity of inferences drawn about the cause and effect relationship between the independent and dependent variables;
- (4) *External validity*: This refers to the validity of the cause-and-effect relationship being generalized to other persons, settings, treatment variables and measure.

In this study, issues relating to validity in the measurement procedures were addressed by the use of statistical test of significance to conduct the tests and draw inferences on the basis of 95% confidence level assigned to the test results (i.e. the 5% level of significance under which the statistical tests were conducted). This approach was consistent with the recommendations of a number of authorities including Creswell (2012) and Cook & Campbell (2002).

3.7.5.1. External validity

The external validity of research findings refers to their “ability to be generalised across persons, settings and times” (Cooper and Emory, 1995, p.149). Creswell (2012) point out three threats that may affect this generalizability:

- (1) *Interaction of selection and treatment*: This involves the inability to generalize beyond the groups in the experiment; for instance other racial, social, geographical, age, gender or personality groups. The solution to this issue is by making participation in the experiment as convenient as possible for all individuals in a population.
- (2) *Interaction of setting and treatment*: This involves (a) the inability to generalize from the setting where the experiment occurred to another setting or (b) from trying to generalize results from one level to another in an organization.
- (3) *Interaction of history and treatment*: This develops when the researcher tries to generalize findings to past and future situations. The best solution is to replicate the study at a later time rather than trying to generalize results to other times.

The issue of external validity was addressed in the sampling design (Section 3.6.3) through the following measures:

- Random sampling from the sampling frame to ensure that each respondent in a given sampling frame had equal chance of being selected;
- Computation of required sampling size to ensure representation and for generalization purposes;

Adopting a census survey, which gave every facilities manager registered as a member of the Australasian TEFMA to participate in the survey via invitation and encouragement from the TEFMA secretariat.

3.7.5.2 Internal validity

In this context, validity is defined as “the ability of a scale or measuring instrument to measure what it is intended to measure” (Zikmund, 2003). Standards for Educational and Psychological Testing (1994/1995, 1966 and 1974) identify three types of internal validity as content, criterion and construct validity. Moss (2007) further distinguishes these three types of validity as follows:

- *Content validity*: This is a measure of how well a test samples the class of situations or subject matter about which conclusions are to be drawn. This was addressed in the study through census survey, whereby all units of the sampling frame were given the opportunity to participate in the survey.

Criterion validity: This compares test scores with one or more variables considered providing a direct measure of the characteristic or behaviour in question. This was addressed in the study by having multiple sources of evidence – i.e. feedback from the questionnaire survey, feedback from the model test surveys, and the results from analysed historical records maintained by the facilities departments of the universities. Kendall's coefficient of concordance score (Sheskin, 2003; Miller, 2014) was calculated for assessing the level of agreement or consistency among the results obtained from the sources.

- *Construct validity:* This aims at inferring the degree to which the individual possesses some hypothetical trait or quality construct that cannot be observed directly by determining the degree to which certain explanatory concepts or constructs account for performance on the test through studies that check on the theory underlying the test (Cavana et al., 2001).
- To achieve this, project technique was used in the interviews as explained in section 3.8.1. By asking the interviewees to reflect on the generic issues rather than issues specific to their universities; the feedback given were reflection of the true issues they were facing without the concern of divulging sensitive/ classified information.

3.7.5.3 Reliability

Reliability is established by testing both consistency and stability (Cavana et al., 2001). Reliability is “the degree to which measures are free from error and yield consistent results” (Zikmund, 2003). Frequently used perspectives on reliability are ‘stability’, ‘equivalence’ and ‘internal consistency’ (Cooper and Emory, 1995). These are explored in the following sections.

Equivalence reliability

Equivalence reliability measures the degree to which two items measure identical concepts at an identical level of difficulty. It is established by relating two sets of test scores to one another to highlight the degree of relationship or association. Cooper and Emory (1995) observe that a second perspective on reliability considers how much error may be introduced by different investigators (in observation), or different samples

of items being studied. Saunders et al (2003) confirms this statement by noting that item sample equivalence could be tested by using parallel forms of the same test administered to the same set of respondents simultaneously, and correlating the results of the two tests.

To achieve the equivalence reliability requirements in this study, the recommendations of Cavana et, al. (2001) was followed which involved the use of Spearman's rank correlation coefficient test to test the significance of the correlation between a dependent variable (the subject under study), and one or more independent variables.

Stability reliability

Stability reliability is the degree of instruments measurement over time. Cooper and Emory (1995) argue that a measure is said to be stable, if consistent results could be obtained with repeated measurements on the same subject and with the same instrument. Results are then compared and correlated with the initial test to give a measure of stability. This approach was not in tune with the strategy for this study. This is more so that this approach as cautioned by Cooper and Emory (1995) is easily beset with transient and situational factors which may interfere with the observations over time.

Internal Consistency

Internal consistency is the degree to which tests measure the same characteristics, skill or quality, by measuring the precision between the observers or of the measuring instruments used in the study. Mbachu (2013) noted that reliability uses only one administration of an instrument or test to assess consistency or homogeneity among the items.

For this study, the internal consistency requirements were achieved by using the Kendall's W test of concordance to test the level of agreement or consistency in the rankings of the sets of attributes (such as the finance attributes under the set of internal challenges) as rated by the individual respondents at the surveys.

Furthermore, the equivalence and internal consistency checks were conducted at two levels in the study:

- On the subcomponent level: This involved consistency checks on the rankings of the sets of attributes for internal, external and future challenges analysed from individual respondents' responses.
- On the major component level: This involved concordance tests on the overall rankings of the sets of attributes for internal, external and future challenges analysed from individual respondents' responses obtained from questionnaire survey, case studies and analysed historical records.

Overall, attempts were made to improve reliability by minimizing external sources of variations during measurement. These included the adoption of standardized measurement approaches, minimization of subject bias by the use of motivational research measurement techniques (involving indirect questioning) and by ensuring anonymity of responses.

3.8 RESEARCH ETHICS

In compliance with the Massey University's Policy on research involving human participants, application for permission to undertake the questionnaire survey was made to the Massey University's Human Ethics Committee (MUHEC) prior to any attempt to obtain data.

For this research study, a MUHEC application was lodged and approved by MUHEC Northern Committee on the 2nd June 2010. The application was approved on the basis of compliance with the following major ethical principles (Massey University, 2006):

- a) Respect for persons;
- b) Minimization of harm participants, researchers, universities and groups;
- c) Informed and voluntary consent;
- d) Respect for privacy and confidentiality;
- e) The avoidance of unnecessary deception;
- f) Avoidance of conflict of interest;

- g) Social and cultural sensitivity to the age, gender, culture, religion, social class of the participants'
- h) Justice.

During a brainstorming session involving the researcher and the supervisors, the potential harm to the participants, the university and the researcher in the research process was analysed in relation to the provisions of the Code of Ethical Conduct. It was found that the research design and intended data gathering procedure did not pose any risks or issues of ethical concern to the researcher, the university and the participants in the research project. It was further affirmed that the Code of Ethical Conduct had been adhered to at all stages of the research project, especially in relation to respect for the privacy and confidentiality of the participants, minimisation of risk of harm, and informed and voluntary consent. Research Information Sheet was provided to the participants explaining the purpose and background of the study and the benefits to and the rights of the participants. Prior consents of the participants were obtained using the appropriate forms. Confidentiality agreements and transcript release authority were also used to obtain agreement from the research assistants in issues relating to the handling and transcription of the project data. A copy of the ethical clearance granted by the MUHEC for the study is provided in Appendix I.

3.9 CHAPTER SUMMARY

This chapter has explored the methodology followed in this study and the rationale for the choice of approach followed. Discussions were in relation to the methods used to generate and analyse the research data. The research instruments used, data analyses techniques and model validations were also explained. Consideration was also given to ethical issues associated with the research investigation in compliance with the ethical requirements of the Massey University Human Ethics Committee for research conduct involving human participants.

CHAPTER 4: QUALITATIVE DATA PRESENTATION, RESULTS AND DISCUSSIONS

4.1 OVERVIEW

This chapter presents and analyses the qualitative data obtained from the pilot surveys. It also presents discussions of the results. The primary intent of the chapter is to establish the recurring themes that formed the basis for the design of the questionnaires used for quantitative data gathering at the second stage of the research.

The chapter comprises sections on the pilot survey responses, demographics of the interviewees and their feedback on the internal, external and future challenges facing university facilities managers. Practical solutions proffered by the interviewees for addressing the challenges were also discussed.

4.2 PILOT SURVEY RESPONSES

Out of the forty-eight requests for the interviews despatched, to the sampling frame of directors of the Australasian universities' facilities management departments, only fifteen (31%) yielded positive responses. The thirty-three negative responses (69%) included four (12%) from those who did not bother to respond at all; fifteen (45%) from those who gave reasons of lack of time; four (12%) who said they were not interested; six (18%) from those who said they would be away or on leave within the interview period; two (6%) who said they were on retirement; and two (6%) who returned blank schedules without any reasons or further information.

The pilot interview questions were categorised into two sections – i.e. demographics and main questions. The questions asked and the responses obtained are analysed in the following sections.

4.3 DEMOGRAPHIC DATA PRESENTATION, RESULTS AND DISCUSSIONS

4.3.1 Interviewee's office location

A question on this was asked with a view to establishing the interviewee's location. The results obtained are presented in Table 12.

Table 12: Interviewee's office location

INTERVIEWEE'S OFFICE LOCATION	
NEW ZEALAND	20%
AUSTRALIA	80%

Results of the analysis on the interviewees' locations showed that majority of interviewees (80%) were based in Australia in comparison to 20% that were based in New Zealand. This profile means that the responses were biased against the New Zealand members of the target sampling frame. However, this should be expected, given the smaller size of the New Zealand cluster compared to the Australian cluster.

4.3.2 Interviewee's designation in their respective FM departments

The interviewees were asked to indicate their official designations in their respective FM departments. Results of the analysed responses are presented in Table 13. . The table shows that majority of the interviewees were directors or executive directors (80%) of the FM departments in their respective universities. 20% of the remaining interviewees were managers or associate directors.

This profile means that the responses were from high ranking individuals who were in positions of authority to make strategic FM decisions in their respective universities. Their responses were therefore of high quality; this adds to the quality of the research findings and conclusions.

Table 13: Interviewee's designation in their respective organization

INTERVIEWEE'S DESIGNATION	
FM Manager	80%
FM Director	20%
Team Leader	0%
Facilities Officer	0%
Others	0%

4.3.3 Interviewee's length of experience

Table 14 presents the analysis of the interviewee's managerial experiences in the FM practice. Results showed that more than half of the interviewees (i.e 60%) had more than 15 years of working experience in FM role. This profile contributes to the quality of the responses received and to the reliability and validity of the conclusions drawn from the findings.

Table 14: Interviewee's length of experience

INTERVIEWEE'S LENGTH OF EXPERIENCE	
< 5 years	80%
5 – 10 years	20%
11 – 15 years	0%
> 15 years	0%

4.4 RESPONSES TO MAIN QUESTIONS, ANALYSIS, RESULTS AND DISCUSSIONS

In this section, the outcomes from the interviews in relation to the key internal and external challenges constraining the achievement of strategic FM goals as well as the potential challenges facing tomorrow's university facilities managers are presented and analysed.

4.4.1 Key internal challenges constraining the achievement of strategic FM goals

4.4.1.1 Broad categories of internal challenges

The interviewees were asked to state what they perceived as the main categories of internal challenges constraining the achievement of strategic FM goals. Results revealed six broad categories of internal challenges constraining the achievement of strategic FM goals as shown in Table 15.

Table 15: Broad categories of internal challenges constraining on the achievement of strategic FM goals

** Response frequency: Number of times each challenge was mentioned or alluded to by 15 interviewees.*

Broad categories of internal challenges		*Response frequency	% of Responses
A	Finance	15	100
B	Operational method/ process	15	100
C	Stakeholder needs/ service providers	15	100
D	Manpower	14	93
E	Machinery/ equipment	13	87
F	Materials	11	73

Results in Table 15 reveal that the six key areas of internal challenges constraining the achievement of strategic FM goals comprise finance, operational method/ process, stakeholder needs/ service providers, manpower, machinery / equipment and materials categories. These results agree with similar findings of Prasad's (1999) that the generic

internal problems faced by organizations in general fall into 6M's of management: money, materials, machinery, manpower, methods and management.

4.4.1.2 Components of the broad categories of internal challenges

Views of the interviewees on the key issues underlying each of the identified broad categories of key internal challenges constraining the achievement of strategic FM goals were also canvassed. Table 16 to Table 21 present the data and analyses of the responses in respect of these constructs. Frequently mentioned constructs were incorporated into the questionnaire.

Finance-related challenges constraining the achievement of FM goals

The thematic analysis of the interviewees' feedback on the subcategories of finance-related challenges constraining the achievement of strategic FM goals is presented in Table 16. Results reveal 8 frequently mentioned constructs. From the table it could be seen that majority of the interviewees perceived as the most recurring finance related issues, inadequate financial resources to procure new facilities or upgrade existing ones to meet user requirements, followed by inability to undertake required preventative or restorative maintenance.

Table 16: Internal challenges constraining the achievement of strategic FM goals – Finance

<i>* Response frequency: Number of times each challenge was mentioned or alluded to by 15 interviewees.</i>		
Internal challenges constraining the achievement of strategic FM goals	*Response frequency	% of Responses
A FINANCE		
Inadequate financial resources or budget to:		
1 Procure new or upgrade existing facilities to meet user requirements.	15	100
2 Undertake required preventive or restorative maintenance.	13	87
3 Provide needed outdoor spaces and grounds.	10	67
4 Provide needed internal spaces.	10	67
5 Procure equipment, plant or services.	9	60
6 Hire out-source personnel to undertake FM services	8	53
7 Train in-house personnel for improved performance.	8	53
8 Motivate personnel for improved quality and productivity.	8	53

The latter constraints accord with Booty's (2009) observation that it is very crucial for facilities managers to ensure that the planned and unplanned maintenance schedule programmes are effective as this helps to eliminate downtimes and hence results in cost saving. Other frequently mentioned constructs are also shown in Table 16.

Operational challenges constraining the achievement of FM goals

As analysed in Table 17, the most recurring internal operational method/ process constraints were quality assurance issues especially issues around compliance with the best practice standards, adequacy of technology, effectiveness of leadership and management style, as well as effectiveness of organisational structure and the impact on coordination and decision making processes. These results are consistent with similar findings of Kamarazaly and Mbachu (2007) to the end that that proper application of FM techniques enables organizations to provide conducive and productive environment for conducting their core business.

Table 17: Internal challenges constraining the achievement of strategic FM goals - Operational method / process

<i>* Response frequency: Number of times each challenge was mentioned or alluded to by 15 interviewees.</i>		
Internal challenges constraining the achievement of strategic FM goals	*Response frequency	% of Responses
OPERATIONAL METHOD/PROCESS		
Quality assurance issues, especially compliance with the best practice standards, e.g. ISO 14000, etc.	15	100
Adequacy of technology.	15	100
Effectiveness of Leadership and management style.	14	93
Effectiveness of organisational structure and impact on coordination and decision making processes.	14	93
Staff training and development processes and impact on workforce empowerment, motivation and productivity.	12	80
Compliance with legislations and regulations, especially in relation to environmental and waste management.	12	80
Effectiveness and efficiency of communication systems.	11	73
Organisational policies, strategies, values and missions and their impact on organisational effectiveness and efficiency.	9	60

Internal challenges related to stakeholder needs

Thematic analysis of the interviewees' feedback on the subcategories of internal challenges constraining the achievement of strategic FM goals shows issues relating to stakeholder needs as a recurring theme. The seven constructs under this category are presented in Table 18. It could be seen from the table that majority of the interviewees perceived inability to involve all stakeholders in the FM strategic and operational

planning as the most recurring issue under this category. The second most recurring issue is the difficulty in managing conflicting stakeholder interests and requirements, especially due to some stakeholders “gold plating” their requirements. This result agrees with the findings of Worthing (1994) that it is crucial for all stakeholders to be involved and play active role in the discussions regarding their facilities needs and the way they are met.

Table 18: Internal challenges constraining the achievement of strategic FM goals - Stakeholder needs / service providers

<i>* Response frequency: Number of times each challenge was mentioned or alluded to by 15 interviewees.</i>		
Internal challenges constraining the achievement of strategic FM goals	*Response frequency	% of Responses
STAKEHOLDER NEEDS / SERVICE PROVIDERS		
Lack of consideration of all stakeholders in the facilities management sphere.	15	100
Difficulties in managing conflicting stakeholder interests and requirements, especially due to some stakeholders "gold plating" their requirements.	15	100
Poorly controlled changes to user requirements.	14	93
Absence of, or poor system for providing incentives for performance.	14	93
Inflexible contracts; inability to accommodate changes in user requirements during the contract execution, especially those that fall outside agreed specifications and scope.	14	93
Inability to involve stakeholders from the outset in specifying the kinds of services required and the level of performance that will be acceptable to both in-house and external providers.	14	93
Difficulties in updating and improving service level agreements (SLAs) and service specifications to keep pace with the needed rate of change.	10	67

Manpower-related challenges constraining the achievement of FM goals

Thematic analysis of the interviewees’ feedback on the subcategories of internal challenges constraining the achievement of strategic FM goals also shows issues relating to manpower as a recurring theme. Seven recurring issues under this category are presented in Table 19. The table shows that inadequate skilled manpower was mentioned most frequently as the crucial challenge amongst the manpower set of constraints. This result corroborates Alexander (2003) and APPA (2014) finding that one of the most critical challenges facing facilities managers are those of finding skilled manpower with high level of competency.

Table 19: Internal challenges constraining the achievement of strategic FM goals – Manpower

<i>* Response frequency: Number of times each challenge was mentioned or alluded to by 15 interviewees.</i>		
Internal challenges constraining the achievement of strategic FM goals	*Response frequency	% of Responses
MANPOWER		
Inadequate skilled manpower.	15	100
High costs of wages, salaries and associated employee expenditures (e.g. Training, insurance, redundancy provisions, pensions, leave grants, etc).	13	87
Low productivity of the workforce due to issues such as low morale, job dissatisfaction, poor incentives, poor supervision, training, etc.	11	73
Worker absenteeism (sick, parental or bereavement leave).	11	73
High staff turnover (due to poor remuneration, etc) and its impact on resources and continuity of work flow.	11	73
Poor quality of workmanship (especially in relation to in-house staff).	10	67
Compliance with OSH requirements in the workplace.	10	67

Machinery/ equipment-related challenges constraining the achievement of FM goals

Recurring feedback from the interviewees also showed that issues relating to machinery/ equipment comprise a significant part of the internal challenges constraining the achievement of FM goals. Frequently mentioned constructs under this theme are presented in Table 20.

The table shows that majority of the interviewee perceived obsolescence and replacements costs for installed machines or equipment as the most recurring machinery/ equipment constraints. This result partly supports the observations of Lewis (2000) that in order to achieve set goals, a facilities manager needs to implement responsive and comprehensive control inspections on three year scheduled basis for the machinery, equipment and systems within specific budgetary constraints.

Table 20: Internal challenges constraining the achievement of strategic FM goals - Machinery / equipment

<i>* Response frequency: Number of times each challenge was mentioned or alluded to by 15 interviewees.</i>		
Internal challenges constraining the achievement of strategic FM goals	*Response frequency	% of Responses
MACHINERY / EQUIPMENT		
Obsolescence and replacement costs for installed machines or equipment.	13	87
Hiring/ acquisition of machinery / equipment and associated costs (e.g. installation, safety/security, insurance, etc).	11	73
Durability/ functionality problems and their impact on operational and maintenance costs.	10	67
Environmental performance issues and associated impacts on legal, operational and maintenance costs.	10	67
Logistics/ operational and maintenance problems: unavailability of parts and/ or repair technicians or high operator training costs.	9	60
Equipment selection dilemma: Fitness-for-purpose and its impact on user-requirements, and operational and maintenance cost.	8	53
Unavailability of machinery/ equipment to maintain buildings/ facilities.	7	47

Materials-related challenges constraining the achievement of FM goals

Analysis of the interviewees' feedback also showed that issues relating to materials featured as part of the recurring internal challenges constraining the achievement of FM goals. Six constructs were found to be recurring under this set. High cost or unavailability of materials and components was the most frequently mentioned constraint. Table 21 summarises the six constructs identified under this category.

Table 21: Internal challenges constraining the achievement of strategic FM goals – Materials

<i>* Response frequency: Number of times each challenge was mentioned or alluded to by 15 interviewees.</i>		
Internal challenges constraining the achievement of strategic FM goals	*Response frequency	% of Responses
MATERIALS		
High costs or unavailability of materials and components.	15	100
Durability problems and their impact on operational and maintenance costs.	14	93
Environmental performance problems and their impact on operational costs.	14	93
Compliance with OSH requirements, especially as it relates to hazardous /dangerous goods storage & safety precautions.	14	93
Unavailability or insufficiency of storage facility, especially for fragile and perishable materials & components.	10	67
Quality assurance/ selection dilemma in terms of fitness-for-purpose and impact on user-requirements, operational and maintenance cost.	10	67

4.4.2. Key external challenges constraining the achievement of strategic FM goals

4.4.2.1 Broad categories of external challenges

As discussed in section 2.1.7, the PESTELI framework recommended by authors such as Gillespie (2007) and Rapid Business Information (RAPIDBI, 2009) was adopted in the study for the analysis of the external challenges facing the university facilities managers. During the interviews, the participants were asked whether or not the underlying constructs were applicable as key constraints in their departments. The interviewees' feedback was analysed in Table 22.

Table 22: Broad categories of external challenges constraining the achievement of strategic FM goals

<i>* Response frequency: Number of times each challenge was mentioned or alluded to by 15 interviewees.</i>		
Broad categories of external challenges constraining the achievement of strategic FM goals	*Response frequency	% of Responses
Political	15	100
Economic	15	100
Legislative	15	100
Environmental and Sustainability	15	100
Technological	14	93
Socio-Cultural	11	73
Institutional	10	67

Results of the analysis revealed that almost all the interviewees confirmed that five of the underlying PESTELI constructs, namely, political, economic, legislative, and environmental/ sustainability as well as technological constraints was applicable in their own departments. Only a minority comprising 27% to 33% did not believe that socio-cultural and institutional constraints posed any real challenges to the achievement of their strategic goals. The results therefore validated the applicability of the PESTELI framework for use in studying the external challenges faced by university facilities managers in the Australasian universities.

4.4.2.2 Subcategories of the PESTELI constraints underlying external challenges

The recurring constructs underlying each subcategory of PESTELI external challenges constraining the achievement of strategic FM goals are presented in Table 23 to Table 29 and discussed in the following subsections.

Political factors constraining the achievement of FM goals

Thematic analysis of the interviewees' feedback on the key political constraints impacting on their ability to achieve their FM goals revealed six constructs which were mentioned by 87 – 100% of the interviewees. Table 23 shows that all of the interviewees mentioned or alluded to two sets of constraints: The first set relates to conflicting multi-stakeholder interests, and dealing with the diverse interests of several groups having varying levels of authority and control.

The second set relates to the issue of not having adequate level of authority to deal with the enormous FM responsibilities they were tasked with. These results are in agreement with Kamarazaly and Mbachu's (2010) finding that FM function involves anticipating and catering for current and future space needs of various stakeholders.

Table 23: External challenges constraining on the achievement of strategic FM goals – Political constraints

* Response frequency: Number of times each challenge was mentioned or alluded to by 15 interviewees.		
External challenges constraining the achievement of strategic FM goals	*Response frequency	% of Responses
A POLITICAL CONSTRAINTS		
Restrains inherent in the dynamics of organisational politics and tensions such as:		
1 Conflicting multi-stakeholder interests; dealing with the diverse interests of several groups having varying levels of authority and control.	15	100
2 Not having adequate level of authority to match the enormous FM responsibilities.	15	100
3 Influences/ pressures from different cliques of the top management.	14	93
4 Ethical dilemma: balancing the needs of the power blocs against requirements of best practice standards, especially in relation to space design and allocation.	14	93
5 Political bickering and power struggle that undermine freedom and best practice standards.	13	87
6 Not having enough influence over FM budget decisions to match critical FM expenditure needs.	13	87

Economic factors constraining the achievement of FM goals

The economic constructs supplied by the interviewees are summarised in Table 24. Analysis of the frequencies of mention in the table showed that four out of the five constructs were mentioned or alluded to by majority (i.e. 60% – 100%) of the interviewees. All the issues relate to the micro- and macro-economic restrictions on budget/ funding which have wider implications on the operation of the FM departments. The most frequently mentioned issues under this broad constraint category comprise inability to procure new projects to meet stakeholder space requirements, or to upgrade and maintain existing facilities for this purpose. The second most frequently mentioned issue was being forced to downsize or scale down operation and maintenance activities as a result of budgetary restrictions.

This result corroborates the findings of Lunday (2007) that as a result of the global financial crisis, inadequate budgetary allowances constitute the most critical challenge facing university facilities managers. Consequently, facilities managers are under pressure to achieve so much with so little resource, thereby stretching efficiency in asset management to the limit (Kamarazaly and Mbachu, 2010).

Table 24: External challenges constraining on the achievement of strategic FM goals – Economic constraints

<i>* Response frequency: Number of times each challenge was mentioned or alluded to by 15 interviewees.</i>		
External challenges constraining the achievement of strategic FM goals	*Response frequency	% of Responses
B ECONOMIC CONSTRAINTS		
Restrains of macro- and micro- economic dynamics (inflation, exchange rate, tax, interest rates, etc) on budget/ funding, resulting in:		
1 Unaffordability of new project, upgrade and maintenance costs.	15	100
2 Downsizing or scaling down of operation & maintenance activities.	12	80
3 Reduction in workforce size and skillsets.	11	73
4 Restriction on R&D and innovation.	9	60
5 Inability to meet user needs for vital space, grounds, equipment, etc.	7	47

Socio-cultural factors constraining the achievement of FM goals

Five socio-cultural factors constraining the achievement of FM goals were mentioned or alluded to by 73% to 100% of the interviewees. Analysis in Table 25 shows that the most frequently mentioned socio-cultural constraint relates to the challenge of catering for the diverse ethnic and cultural needs of the stakeholders, especially in relation to space planning and design solutions. Some of the practical examples given by the interviewees

under this category included the need to cater for the disabled especially in relation to building access, ergonomic issues for the aged staff members, and cultural sensitivities around space provisions to meet the needs of some ethnic groups. Some of these challenges are underpinned by the last construct relating to compliance with the occupational health and safety regulations in the workplace. Details of these analyses are shown in Table 25.

Kamarazaly and Mbachu (2007) and Booty (2009) affirmed this view by stating that FM organization is obliged to comply with the university's safety, health and environmental policies and procedures which include providing and creating environment that significantly promotes productivity and worker's health and safety, safe working procedures, materials handling and storage, and training of personnel.

Table 25: External challenges constraining on the achievement of strategic FM goals - Socio-cultural constraints

<i>* Response frequency: Number of times each challenge was mentioned or alluded to by 15 interviewees.</i>		
External challenges constraining the achievement of strategic FM goals	*Response frequency	% of Responses
C SOCIO-CULTURAL CONSTRAINTS		
Restraints inherent in dealing with socio-cultural issues in the workplace such as:		
1 Having to address the ethnic diversity and differing cultural needs, especially in relation to space planning and design solutions.	15	100
2 Socio-cultural sensitivity, social and racial profiling, etc.	13	87
3 Ergonomics: Catering for the special needs of the aged in the workplace.	12	80
4 Compliance with the occupational health & safety regulations in the workplace.	11	73

Technological factors constraining the achievement of FM goals

In terms of the technological set of external constraints as analysed in Table 26, majority of the interviewees mentioned the significant restraints inherent in technological trends being the dilemma of having to monitor and keep up with the rapid technological changes; technological obsolescence and impact on competitiveness; and huge capital investment required for acquisition and upgrading of technology.

Lunday (2007) corroborates this finding by confirming that inadequate funding for information technology (IT) is the most significant issue impacting on the operation of universities and their ability to respond to change. This is more so that university facilities management department are increasingly being required to do more with less

resource. Adequate investment in IT would have provided the ability to be innovative and do more with less resource.in the prevailing conditions of budget constraints.

Table 26: External challenges constraining on the achievement of strategic FM goals – Technological constraints

<i>* Response frequency: Number of times each challenge was mentioned or alluded to by 15 interviewees.</i>		
External challenges constraining the achievement of strategic FM goals	*Response frequency	% of Responses
D TECHNOLOGICAL CONSTRAINTS		
Restraints inherent in technological trends such as:		
1 The dilemma of having to monitor and keep up with the rapid technological changes/ developments.	15	100
2 Technological obsolescence and impact on competitiveness.	15	100
3 Huge capital investment required for acquisition and upgrading of technology.	13	87
4 Constant workforce training and re-training requirements.	11	73
5 Disruptions to operations inherent in installation, upgrades and trial runs.	10	67

Environmental and sustainability challenges constraining the achievement of FM goals

From the analysed responses on the environmental and sustainability constraints as presented in Table 27, majority of the interviewees indicated that rapid changes in legislations and by-laws and the challenges of having to meet the minimum environmental standards against dwindling resources are the crucial challenges in this set of external constraints.

This is in line with the views expressed by Bently & Long (2008) that facilities managers need to have better understanding and in-depth knowledge on the sustainable environmental practices as the sustainable issues and impact are becoming the major issue to the industry globally.

Table 27: External challenges constraining on the achievement of strategic FM goals – Environmental and sustainability constraints

<i>* Response frequency: Number of times each challenge was mentioned or alluded to by 15 interviewees.</i>		
External challenges constraining the achievement of strategic FM goals	*Response frequency	% of Responses
E ENVIRONMENTAL AND SUSTAINABILITY CONSTRAINTS		
1 Rapid changes in legislations and by-laws.	15	100
2 The challenge of having to meet the minimum environmental standards against dwindling resources.	15	100
3 High legislative compliance costs and constraints, especially in relation to health & safety, resource and waste management.	14	93
4 Resource and building consent restrictions on planning, development and operations, especially in relation to preserving historic places, need to minimise carbon footprints, pollution, energy consumption, etc.	14	93
5 Pressure arising from environmental audit and reporting requirements.	10	67

Legislative constraints to the achievement of FM goals

The most recurring legislative constraints were rapid changes in legislations, by-laws and standards affecting the FM planning and operations; and high legislative compliance costs and constraints in keeping pace with the regulatory changes. These are analysed in Table 28. In this context, Hazelkorn (2005) emphasizes the need for the government to produce effective and standard policy instruments which are essential in underpinning the university's mission and promote teaching, research and service which will encourage contributions from higher education institution to the national social and economic development.

Table 28: External challenges constraining on the achievement of strategic FM goals - Legislative constraints

<i>* Response frequency: Number of times each challenge was mentioned or alluded to by 15 interviewees.</i>		
External challenges constraining the achievement of strategic FM goals	*Response frequency	% of Responses
F LEGISLATIVE CONSTRAINTS		
1 Rapid changes in legislations, by-laws and standards/codes affecting the FM planning and operations.	15	100
2 High legislative compliance costs and constraints in keeping pace with the regulatory changes.	15	100
3 Uncertainties and risks to forward planning.	14	93
4 Compliance with the occupational health & safety regulations in the workplace.	13	87

Institutional challenges constraining the achievement of FM goals

As analysed in Table 29, the challenge of having to meet the minimum ethical and professional practice standards amidst conflicting pressures from within the organisation; undue influence/ excessive interference of the top management in FM affairs, which undermines freedom and pursuit of excellence in the discharge of FM duty; and unrealistic expectations of the top management were frequently mentioned as the major issues in the institutional set of constraints.

In regards to the latter constraint, IFMA (2005) strongly advocates that facilities managers should effectively establish a code of ethics and professional practice standards in order to foster trust and mutual respect within the organization.

Table 29: External challenges constraining on the achievement of strategic FM goals - Institutional constraints

<i>* Response frequency: Number of times each challenge was mentioned or alluded to by 15 interviewees.</i>		
External challenges constraining the achievement of strategic FM goals	*Response frequency	% of Responses
G INSTITUTIONAL CONSTRAINTS		
Restraints inherent in the internal(i.e. organisational dynamics) and external constraints(e.g. Professional/ethical code of practice)such as:		
1 The challenge of having to meet the minimum ethical and professional practice standards amidst conflicting pressures from within the organisation.	15	100
2 Undue influence/ excessive interference of the top management in FM affairs, which undermines freedom and pursuit of excellence in the discharge of FM duty.	13	87
3 Unrealistic expectations of the top management: "Achieve so much output with so little resources".	12	80
4 Dilemma of juggling the organisational/internal interests with the requirements for ethical and best practice standards imposed by the external/ professional regulatory framework.	10	67

4.4.3 Key challenges facing tomorrow's university facilities managers

Content analysis of the interviewees' feedback on the key challenges facing university facilities managers in the future is presented in Table 30. The table shows that almost all of the interviewees mentioned that statutory compliance, space management and sustainability issues as the most crucial challenges expected to face university facilities managers in the years ahead. The latter challenge accords with Bently and Long's (2008) observation that focusing on minimising the adverse impact of operations and reduction of carbon footprint are the most critical challenges facing tomorrow's university facilities managers.

Table 30: Key challenges facing tomorrow's university facilities managers

<i>* Response frequency: Number of times each challenge was mentioned or alluded to by 15 interviewees.</i>		
Key challenges facing tomorrow's institutional facilities manager: Issues relating to:-	*Response frequency	% of Responses
A Statutory compliance	15	100
B Space management	15	100
C Sustainability/ environment/ carbon neutrality/ ESD	14	93
D Security/emergency planning/fire safety/critical incidents	13	87
E Occupational health and safety	13	87
F Strategic asset management	12	80
G Information technology applications for facilities managers	12	80
H Leadership and innovation in facilities management	12	80
I Maintenance management	11	73
J Planning/Design/Construction/ project management	10	67
K Outsourcing/ service contract management	10	67
Facilities management solutions to future teaching & research needs.	10	67
L		
M Cleaning / waste management	9	60
N Business and financial management in facilities management	9	60

4.4.4 Practical solutions for addressing the challenges

The interviewees also made useful suggestions on possible practical solutions that could be adopted by the university facilities managers in addressing the challenges constraining the achievement of strategic FM goals. These suggestions, as well as approved constructs from literature sources, are presented in Table 31 to Table 33 for finance-related internal challenges, economic-related external challenges and emergency management related future challenges, respectively. Similar analyses were carried out for the rest of the remaining factors; these are presented in Appendix E: Table 190- Table 195 for internal challenges; Table 196 - Table 200 for external challenges and Table 201 - Table 209 for future challenges, respectively.

4.4.4.1 Practical solutions for addressing internal challenges

Finance-related internal challenges

Content analysis results in Table 31 show that majority (i.e 100%) of the interviewees alluded to three significant solutions for addressing finance-related internal challenge. These are (i) developing strategic management situations that bring about innovation and help the FM department to do more with less; (ii) developing energy efficiency strategies that will reduce utilities costs and benefit the environment and (iii) FM department needs to develop long-term strategies to make their organization more efficient and financially viable.

The latter accords with similar views expressed by APPA (2010), namely, a move beyond short-term cost cutting to true financial discipline; considering total cost ownership in assessing the facilities' value; understanding and satisfying customer values; and assessing and enhancing returns on investment of the university's facilities assets through higher utilization.

Table 31: Practical solutions for addressing internal challenges – Finance

<i>* Response frequency: Number of times each challenge was mentioned or alluded to by 15 interviewees.</i>		
Practical solutions for addressing internal challenges	*Response frequency	% of Responses
A Finance: How to 1) address low capital and operational budgetary allocations and 2) attract adequate funding for complete execution of FM works:		
1 Develop strategic management situations to do more with less.	15	100
2 Develop energy efficiency strategies that will reduce utilities costs and benefit the environment.	15	100
3 FM department need to develop long-term strategies to make their organization more efficient and financially viable.	15	100
4 Improving FM's strategic relevance, linking funding request to corporate goals.	14	93
5 Adequate life cycle costing when planning facilities.	13	87
6 Adequate space planning.	12	80

Operational efficiency-related internal challenge

Results (Table 190, Appendix E) of the analysed feedback on ways of addressing operational efficiency related challenges, show that regular meetings to set facilities goal and strategy as well as the use of innovation and creativity to achieve more with less, are two practical solutions for addressing the issue on how to improve efficiency in the work processes to lower operational costs, optimise resource utilization and achieve set goals. The latter solution accords with Taylor's (2014) observation that much of the efficiency gain comes from the shift in culture – from staff owning offices, desks, printers and the

like to adopting a model in which assets are shared at a much higher proportion. The overall effect is that space is used more effectively and efficiently. This practice contributes to operational efficiency.

Risk management-related internal challenge

In terms of the risk management-related challenge, results (Table 191, Appendix E) show that majority (i.e. 100%) of the interviewees were of the view that facilities managers need to prepare detailed and analytical specifications of the facility and the associated risks in order to improve the accuracy of risk analysis, contingency planning and the effectiveness of risk monitoring and risk response. This is in agreement with the views expressed by Bajaj (2003) that each individual major risk would need a detailed action schedule of its own in order to mitigate, reduce or manage the risk.

Stakeholder needs/ service providers-related internal challenge

Results of the analysed interviewees' responses (see Table 192, Appendix E) show that issues on how to assess and respond to the changing and complex needs of the different stakeholders/ service providers could be well-addressed by cultivating a culture of customer service, considering customer service and communications training for staff, as well as implementing communications programs to gather information and keep stakeholders informed. Taylor (2014) affirms this finding by stating that students now expect more in terms of academic delivery and the facilities they study in. It is vital for university's FM department to focus on best practice customer service in order to satisfy the diverse consumer groups they serve (APPA, 2007).

Maintenance-related internal challenge

Results of the analysed interviewees' feedback on how to address maintenance-related challenges are presented in Table 193 (Appendix E). The results show that majority (i.e. 100%) of the interviewees concurred that one of the practical solutions for addressing maintenance-related challenge is for facilities managers to develop consistent framework for defining and meeting maintenance and renewal needs as and when due.

In addition, the interviewees also mentioned that university should consider their backlog of renewal and renovation projects in the light of sustainability and increase the priority for the upgrade of inefficient structures by (i) using sustainability to advocate for renewal outdated buildings, (ii) include sustainability as a factor in facility assessments and put priority on structures that are getting in the way of achieving

university's sustainability goals, and (iii) develop decision-support criteria to determine which buildings are demolishing rather than being continuously maintained in a costly and unproductive way.

This accords with Booty's (2009) observation that facility maintenance comprises a set of ordered activities which, when properly managed, allow for the continual usefulness and value-addition of a facility to the organisation's business and corporate goals.

Manpower-related internal challenge

In order to address the problems associated with inadequate labour resource issues such as lack of skilled/ inexperienced manpower, majority of the interviewees (i.e 100%) suggested that facilities departments need to understand the demographic changes facing their universities and plan accordingly to avoid future skilled labour shortage problems. This finding partly aligns with APPA (2008) emphasis that the planning of workforce changes should include issues such as (i) understanding the demographic shifts in the city, state and region; (ii) assessing the future needs; and (iii) identifying the gaps between the universities' resources and needs. Full details on the suggested solutions for addressing manpower-related challenges are presented in Table 194 (Appendix E).

Materials-related internal challenge

To resolve materials-related challenges, analysed interviewees' suggested solutions are presented in Table 195 (Appendix E). Results shows that all the interviewees believed that materials-related challenges could be addressed in two ways: (i) through effective Just-In-Time (JIT) system for delivering materials to site when unpredictable requirements develop during the course of a job; and (ii) having good inventory management and planning whereby materials can be provided or stored on the job site only as and when needed. Perhaps, the major issues surrounding materials-related challenges are the high inventory costs of procuring materials and equipment for stakeholder use, with consequences such as unnecessary tying down of funds for long time, and damage in long-term storage.

4.4.4.2 Practical solutions for addressing external challenges

Analysed feedback of the interviewees on the various ways of addressing each broad category of external challenges constraining the achievement of the FM goals are presented and discussed in the following sections.

Practical solutions for addressing the economic constraints

Table 32 presents the result on the practical solutions for addressing economic-related external challenges. All the interviewees mentioned or alluded to four practical solutions that could potentially be used for addressing the economic challenge. These include (i) strive to set realistic expectations within the university; (ii) shun frugality and ensure prudential management of limited resources; (iii) as much as possible 'bootstrap' to accomplish more output; and (iv) optimise cost-cutting and efficiency in all processes (Taylor, 2014).

Table 32: Practical solutions for addressing external challenges - Economic constraints

<i>* Response frequency: Number of times each challenge was mentioned or alluded to by 15 interviewees.</i>		
Practical solutions for addressing external challenges	*Response frequency	% of Responses
A Economic: How to proactively manage the micro- and macro-economic climates that have disruptive effects on FM budget and operations, including fluctuations in the exchange rates, interest rates and inflation.		
Universities must confront the current recession and maintain forward momentum despite economic restraints by shifting expectations among stakeholders:		
1 Strive to set realistic expectations within the university.	15	100
2 Shun frugality and ensure prudential management of limited resources.	15	100
3 As much as possible 'bootstrap', i.e. use less (inputs) to accomplish more (output).	15	100
4 Optimise cost-cutting and efficiency in all processes.	15	100
5 Maintain sustainability focus in all aspects of FM operation.	14	93
6 Incorporate total cost of ownership into the decision-making process.	14	93

Practical solutions for addressing the environmental/ sustainability challenges

Aggregated responses of the interviewees on how to address the challenges of environmental/ sustainability constraints showed that all of them believed that the solution lies in devising innovative and sustainable ways of managing energy use, waste disposal, resource use and environmental pollution.

Further strategies include (i) building a culture of sustainability on campus with buy-in by all stakeholders including staffs, students, faculty, and administrators; (ii) ensuring that facilities officers play vital roles in sustainability discussions, helping shape policy and managing implementation; and (iii) ensuring that facilities managers are educated and upskilled in leadership abilities.

These findings are in agreement with APPA's (2010) observations that colleges and universities must continue to make progress toward environmental sustainability and energy efficiency in order to help deliver the climate change agenda of the 21st century. Further details presented in Table 196 (Appendix E).

Practical solutions for addressing the technology constraints

Table 197 (Appendix E) presents the practical solutions for addressing technology-related external challenges. Results show that integrating IT and facilities planning was the most recurring practical solution. This was perceived to maximize success and could enhance collaboration of the FM department and IT experts to better resolve existing issues, leveraging IT efficiency and innovation. IFMA (2005) agrees with these findings by stating that it is crucial for facilities managers to understand the real impact on the quality of facility and on the productivity and satisfaction of the people using the facility. This finding suggests that the current practice of separating the IT department from the FM department as is the case in most Australasian universities means that the FM departments will not have full access to leverage benefits of innovation hub that the IT department offers to resolving in a cost-effective and productive manner, majority of the challenges the FM departments face.

Practical solutions for addressing the legislation-related challenges

The most feasible solution for addressing regulatory-related external challenges was keeping up with the growing number of state and federal regulations that impact on the operations of the universities. This aligns with APPA's (2010) finding that universities need to lighten the burden of regulations on higher education by being proactive rather than reactive to the rapid regulatory changes. Further details are analysed and presented in Table 198 (Appendix E).

Practical solutions for addressing the socio-cultural challenges

Analysed feedback from the interviewees in Table 199 (Appendix E) shows that socio-cultural issues could be effectively addressed through three practical approaches: (i)

manage stakeholder expectations through dialogue and effective communication, (ii) aim to address only critical needs of the key stakeholders and (iii) make a strong case for senior management to prune down admissions to align with existing facility capacity. The dialogue strategy is in line with the views expressed by APPA (2007) that by improving communications, university facilities managers will be able to address a number of challenges they face, largely by communicating up the administrative chains, across the departmental boundaries and as well as across all stakeholders.

Addressing institutional challenges constraining the achievement of FM goals

Table 200 (Appendix E) presents the practical solutions suggested by the interviewees for addressing institutional-related challenges. The most recurring practical solution is the need to align facilities planning with institutional goals. APPA (2009) agrees with this finding by highlighting several approaches for elevating the relevance and influence of the FM department in the scheme of things within the university; these include (i) involving facilities early in the overall planning process, (ii) understanding where the institution wants to go and what it wants to be, (iii) evaluating the facilities implications including the financial implications of academic plans; and (iv) developing specific outcomes for generalized goals.

4.4.4.3 Practical solutions for addressing key future challenges facing tomorrow's university facilities managers

Thematic analysis of the interviewees' feedback on the practical solutions for addressing the key future challenges facing tomorrow's university facilities managers are presented in the following subsections. The solutions are in nine clusters: emergency management, statutory compliance, sustainability, technology, user needs and satisfaction, finance, occupational health and safety, leadership and innovation, space management, and outsourcing.

Practical solutions for addressing emergency management related challenges of the future

Table 33 shows the practical solutions suggested by the interviewees for addressing emergency-related future challenges. The most recurring practical solutions include the following: (i) the need for facilities managers to take active role in cross department business continuity activities and (ii) the need to retrofit buildings and infrastructure

against hazards in order to minimise damage and improve the chance of early re-opening of business premises in the event of disaster. These strategies corroborates the views expressed by IFMA (2007) that advanced planning and emergency preparedness are important in minimizing disruption and speeding the recovery process following a major disaster.

Table 33: Practical solutions for addressing future challenges - Emergency management

<i>* Response frequency: Number of times each challenge was mentioned or alluded to by 15 interviewees.</i>		
Practical solutions for addressing future challenges	*Response frequency	% of Responses
Emergency management: Challenges associated with disaster management and recovery plans; safety and security; business continuity and contingency arrangement.		
Facilities managers to take active role in cross-department business continuity activities.	15	100
Expect local, state and federal health and safety mandates to continue to change and evolve and plan for that expense in the budgeting process.	14	93
Engage in advocacy efforts to stem the increasing tide of code expansion.	14	93
Evaluate energy infrastructure for vulnerabilities.	14	93
Look for facilities to play a role in preventing terrorism and crime in protecting IT resources.	13	87
Need to provide a flexible and robust platform for working increases the speed to market for disaster recovery and business continuity.	11	73
Need to retrofit buildings and infrastructure against hazards (e.g. seismic retrofitting) to minimise damage and improve the chances of early re-opening of business premises in the event of disaster).	15	100

Practical solutions for addressing statutory compliance related challenges of the future

Table 201 (Appendix E) presents the practical solutions for addressing statutory compliance-related future challenges. Result of the content analysis of the interviewees' feedback shows that adequate staff knowledge of the compliance standards and legislations governing FM policies, proper communication and training on the required response, as well as keeping a tab on new and evolving legislations that have impact on the FM operations are the most frequently mentioned practical solutions among the six solutions suggested by the interviewees. This is in line with BDO Stoy Hayward's (2007) observations that compliance management is a real challenge for facilities managers and will continue to increase in the future.

Practical solutions for addressing environmental sustainability challenges of the future

Table 202 (Appendix E) shows the practical solutions for addressing sustainability-related future challenges. Result shows that the most recurring suggestions include the need for facilities managers to assess the institution and the department's current level of sustainability and make a strong business case for sustainable practice and for partnerships across the institution; set goals and timeframe to succeed; take on the leadership role for this strategic issues; consider creative strategies to reduce risk and manager energy costs; stay current on legislative discussions about energy and carbon costs.

These results are in agreement with the views expressed by APPA (2008) that major steps in making sustainability central to facilities operations are evaluating current operations and setting goals, hence it is vital for facilities managers to demonstrate that they are making responsible green decisions across all aspects of their operations.

Practical solutions for addressing technology-related challenges of the future

Table 203 (Appendix E) presents the suggested practical solutions for addressing technology-related future challenges. The most recurring solutions include the need for the facilities management department to work closely with IT experts to leverage IT skills in problem-solving; the need to develop goals and vision that are in alignment with the university's vision and mission. APPA (2010) agrees with these suggestions by stating that understanding potential transformations in campus technology will help the institution develop strategies to remain nimble".

Practical solutions for addressing challenges related to future user needs

Practical solutions for addressing user needs-related future challenges are analysed and presented in Table 204 (Appendix E). Result shows that the two most recurring solutions mentioned by the interviewees for addressing these challenges are: (i) engendering a culture of sustained high quality customer service and responsiveness that is supported by appropriate technologies, and (ii) routine user-needs assessment and satisfaction survey.

Taylor (2014) adds to this finding by arguing that having a culture of customer focus helps organisations to have a good understanding of the needs of the customers and how best to satisfy them from the customer perspectives.

Practical solutions for addressing business financial management-related challenges of the future

Table 205 (Appendix E) presents suggested solutions for addressing business financial management related future challenges. The most recurring solutions include keeping accurate data on asset useful lives, performance and maintenance requirements. This knowledge can support effective and efficient planning and risk prioritisation, as well as help to minimise business and operational costs of the large asset base of the university. Also advances in technology could be leveraged to re-engineer FM processes with a view to improving productivity.

Practical solutions for addressing occupational health and safety-related challenges of the future

Table 206 (Appendix E) presents the practical solutions suggested by the interviewees for addressing occupational health and safety-related future challenges. The most recurring suggestion relates to continuous development of effective policies, decision-making processes and standards to support cost-effective compliance with the increasingly rising occupational health and safety issues in future. This finding concurs with Atkin and Brooks' (2000) observation that it is essential that organizations anticipate and pro-actively plan on responding to future changes in legislation impacting on their operations.

Practical solutions for addressing leadership and innovation challenges of the future

The practical solutions for addressing future leadership and innovation challenges facing university facilities managers are analysed and presented in Table 207 (Appendix E). Articulation of sound vision and winning strategies and ensuring buy-in by top management and workforce as well as implementation of problem solving tools in the FM department are the two most frequently mentioned practical solutions.

Practical solutions for addressing space management related challenges of the future

Table 208 (Appendix E) presents the practical solutions for addressing space management-related future challenges. Result shows that aligning space management to the mission of the university is the most recurring practical solution suggested by the interviewees. This is in agreement with APPA's (2012) observation that communicating the connections between the mission and master plan of space management will help individuals across the campus understand the rationale for decisions about space.

Practical solutions for addressing outsourcing related challenges of the future

Table 209 (Appendix E) presents the practical solutions for addressing outsourcing-related future challenges. Preparing for outsourcing, understanding current client operations and effective communication at service level and budget expectations are among the practical solutions for addressing outsourcing issues. Katsanis (2003) provides the rationale for this by stating that outsourcing of FM peripheral operational services enables FM directors to concentrate on FM core business without being distracted by involvement in non-critical activities, which could be more cost-effectively provided by external vendors.

4.5 CHAPTER SUMMARY

The pilot interviews served to generate constructs for the design and subsequent administration of questionnaire in a second-stage quantitative (i.e. questionnaire) survey. The constructs included information on the key constraints impacting on the ability to achieve strategic facilities management goals.

CHAPTER 5: QUANTITATIVE DATA PRESENTATION, ANALYSIS, RESULTS AND DISCUSSIONS

5.1 OVERVIEW

In this chapter, data obtained from the questionnaire surveys are presented, analysed, and discussed in relation to the research objectives. The demographic data served not only to classify the responses but also to scrutinize particulars of the respondents to ensure compliance with the data acceptability criteria initially set for the responses. The analysed quantitative data provide variables for testing the research propositions.

5.2 QUESTIONNAIRE RESPONSES

Results of the analysis of the questionnaire responses received by the cut-off date are shown in Table 34. Result shows that out of 800 questionnaires sent to the facilities managers who were registered members of TEFMA, only 609 responses were received, out of which 528 were found usable. This presented an effective 66% response rate. Overall, most of the usable responses were from high ranking facilities managers with vast working experience in the FM practice, and who were involved in decision making in their respective organizations. This overall response rate obtained in the questionnaire surveys is reasonably high, considering the 21 percent responses rate which was described by Nkado (1999) as typical of the construction industry. Comparatively, Table 35 shows the analysis of non-response to questionnaire survey. The analysis showed that 18% of the questionnaire was returned to sender, 5% for no response and 2% of the responses were not applicable to the survey.

Table 34: Analysis of responses to questionnaire survey

Association	Sampling frame (sf)	Min sample	Questionnaire sent (Q)	Observed responses			Requests for summary	
				Received	Useful	% responses	No.	% Received
TEFMA	800	267	800	609	528	66	492	81
<i>Percentages (%):</i>		33	100					

Table 35: Analysis of non-response to questionnaire survey

Descriptions	Sampling frames (sf)	
	TEFMA	
	800	
	No	% td
<i>Response cases</i>		
Useful responses	528	66
Non-useful responses	81	10
	<i>Subtotal</i>	76
<i>Non-responses case</i>		
*Returned to sender	141	18
No response	38	5
No longer practising	0	0
Not applicable	12	2
	<i>Subtotal</i>	24
<i>Total distributed (td):</i>	800	
<i>*Returned to sender: Box closed; changed address; deceased; incorrect address</i>		

5.2.1 DEMOGRAPHIC BACKGROUND OF THE RESPONDENTS

The demographic profiles of the respondents are discussed in the following sub-sections.

5.2.1.1 Location of the respondents

Respondents were asked to indicate their office locations so as to be able to distinguish between New Zealand and Australian responses. Results showed that majority (83%)

were in Australia, while only 17% were in New Zealand. This profile means that the responses were more of the Australian university facilities managers and less of those in New Zealand. These disproportionate responses, though expected, necessitated a comparative analysis in a subsequent chapter on how the views of respondents on both sides of the Tasman compared.

5.2.1.2 Respondent's designation in their respective FM organization

Responses to this effect are presented and analysed in Table 36. Results showed that majority of the respondents (75%) are directors or executive directors in the FM roles in their respective universities. Results also revealed that the remaining respondents (17%) are managers or associate directors, team leaders (6%) and facilities officer (2%). This profile means that the responses were from high ranking individuals who are knowledgeable and well experienced in making strategic decisions in their respective organizations. The quality of the profiles could therefore increase the reliability and validity of the conclusions arising from the findings of this study.

Table 36: Respondents' designation in their organization

RESPONDENTS' DESIGNATION	
FM Director	75%
FM Manager	17%
Team Leader	6%
Facilities Officer	2%
Others	0%

5.2.1.3 Respondent's length of experience

The respondents' length of experience in FM related fields were analysed in Table 37. Results showed that 80% of the respondents have more than 15 years of working experience. It could therefore be concluded that the majority of the respondents were experienced enough to make significant contributions to the study. Again, this adds to the quality of the responses received and to the reliability and validity of the conclusions of this study.

Table 37: Respondents' length of experience

INTERVIEWEE'S LENGTH OF EXPERIENCE	
< 5 years	80%
5 – 10 years	20%
12 – 15 years	0%
> 15 years	0%

5.3 FINDINGS IN RELATION TO THE FIRST OBJECTIVE

The first objective of the study was to identify and prioritise the key internal and external challenges constraining the achievement of strategic FM goals.

Results from the questionnaire survey showed that majority of the respondents classified the current challenges constraining the achievement of strategic FM goals into two broad categories: (i) internal challenges as shown in Table 38 and (ii) external challenges as shown in Table 39, respectively.

The broad category of internal challenges comprises issues relating to: finance, operational method/process, stakeholder needs, materials, manpower and machinery/equipment. The broad category of external challenges on the other hand comprises issue relating to: political, economic, socio-cultural, technological, environmental, legal/regulatory and institutional constraints. The results partly align with Prasad's (1999) studies categorising the problems faced by organizations into 6M's of management: money, materials, manpower, machinery, methods and management. However, the gap in Prasad's (1999) work was non-inclusion of the external factors, which often are not within the control of the facilities managers (Mbachu and Nkado, 2006).

Table 38: Broad categories of current internal challenges (C1) and issues faced by university facilities managers

Code	Broad categories of Current Internal challenges	Issues faced by university facilities managers
CI-A	Finance	How to address poor capital and operational budgetary allocations and attract adequate funding for proper execution of FM works, procure new or upgrade existing facilities to meet user requirements, undertake required preventive or restorative maintenance, provide needed outdoor spaces & grounds, internal spaces, procure equipment, plant and services, hire out-source personnel to undertake FM services, train and motivate in-house personnel for improved performance, quality and productivity.
CI-B	Operational efficiency	How to improve efficiency in the work processes to lower operational costs, optimise resource utilization and achieve set goals; issues associated with quality assurance, adequate technology, effectiveness of leadership and management style, effectiveness of organisational structure and impact on coordination and decision making processes, staff training and development processes and impact on workforce empowerment & productivity, compliance with legislations and regulations, effectiveness and efficiency of communication systems, organisational policies & values and their impact on organisational effectiveness and efficiency.
CI-C	Stakeholder needs	How to assess and respond to the changing and complex needs of the different stakeholders (e.g. staff, students and visitors); how to address -with limited budget - compliance with ergonomics and accessibility issues in the workplace, especially for the aged and the handicapped; lack of consideration of all stakeholders in the FM sphere; difficulties in managing conflicting stakeholder interests and requirements; poorly controlled changes to user requirements; absence of or poor system; inflexible contracts; inability to involve stakeholders; difficulties in updating and improving service level agreements and service specifications.
CI-D	Manpower	How to address the problems associated with inadequate labour resource brought about by issues such as lack of skilled/ experienced manpower, organisation-wide freeze on employment and inadequate budgets; the challenge of attracting and retaining skilled manpower, and of keeping staff abreast of current technology advances and changes in legislations; low productivity of the workforce; high staff turnover due to poor remuneration; poor quality of workmanship; compliance with OSH requirements in the workplace.
CI-E	Machinery/ equipment	How to effectively manage the large stock of machinery and equipment to mitigate poor utilisation, frequent breakdowns and the associated disruptions to smooth operations and workplace productivity; durability problems and their impact on operational and maintenance costs; environmental performance issues and associated impacts; logistics and maintenance problems; equipment selection dilemma; obsolescence and replacement costs for installed machines or equipment.
CI-F	Materials	How to address to high costs of materials and components, insufficiency of storage facility, durability problems/ environmental performance and their impact on operational and maintenance costs, compliance with OHS requirements, quality assurance/ selection dilemma.

Table 39: Broad categories of current external challenges and issues faced by university facilities managers

Code	Broad categories of Current External (CE) challenges	Challenges faced by university facilities managers
CE-A	Political	Challenges relating to political constraints - Restraints inherent in the dynamic of organizational politics and tensions such as: conflicting multi-stakeholder interests; inadequate level of authority to match enormous FM responsibilities; influences from different cliques of top management; ethical dilemma; political bickering and power struggle that undermine freedom and best practice of standards; lack of influence over FM budget decisions.
CE-B	Economic	How to proactively manage the micro- and macro- economic climates having disruptive effects on FM budget and operations, including fluctuations in the exchange rates, interest rates and inflation resulting in: unaffordability of new project upgrade and maintenance costs; downsizing of operation and maintenance activities; reduction in workforce size and skillsets; restriction on R&D and innovation; inability to meet user needs for vital pace, grounds and equipment.
CE-C	Socio-cultural issues	The challenge of catering for the diverse needs of users of the facilities and infrastructure, including creating a safe and conducive environment for work and other uses for the facilities. Addressing the ergonomics and accessibility compliance issues, especially for the aged and the handicapped. How to address the ethnic diversity and differing cultural needs.
CE-D	Technological	Challenges related to rapid changes in technology, including technological obsolescence and the need to upgrade equipment and processes; how to leverage new and efficient technologies to improve on the FM management and operations; how to address to technological obsolescence and impact on competitiveness, huge capital investment, constant workforce training and re-training requirements and disruptions to operations inherent in installation, upgrades and trail runs.
CE-E	Legislative	Challenges arising from compliance with the legislations, by-laws and standards affecting FM planning and operations; high compliance costs associated with keeping pace with the regulatory changes and the associated uncertainties and risks to forward planning; compliance with the OHS regulations in the workplace.
CE-F	Sustainability/ environmental issues	The challenge of finding innovative and sustainable ways of managing energy use, waste disposal, resource use and environmental pollution/ contamination; achieving the Reduce, Re-use and Recycle mandate to waste management; rapid changes in legislation and by-laws; high legislative compliance constraints; resource and building consent restrictions on planning, development and operations; pressure arising from environmental audit and reporting requirements.
CE-G	Institutional	Challenges presented by organisational politics; catering for the diverse and often conflicting multi-stakeholder interests; lack of FM representation on the university management board; senior management's view of facilities as being part of the operational costs that must be minimised, rather than a strategic asset that must be optimised; undue influence of the top management; unrealistic expectations of the top management; dilemma of juggling the organizational interests - for ethical and best practice standards.

Prioritisation of the identified challenges of each broad category was made through multi-attribute analysis of Australasian university facilities professional's ratings of their levels of impact and frequencies of occurrence. Propositions were made to enable some statistical significance tests to be carried out as part of the analyses in Chapter 8. This was to enable evaluation of the measure of confidence to the results of the prioritisation process. The topmost priority issues within the internal challenges and external challenges in terms of the extent to which they constrain the achievement of strategic FM goals are discussed in sections 5.4.1 and 5.4.3.

5.4 FINDINGS IN RELATION TO THE SECOND OBJECTIVE

The second objective of the study was to determine the associated risk levels of the identified challenges based on their perceived frequencies of occurrence and levels of impact on the achievement of the strategic FM functions. The following sections present the analyses, results and discussions of the respondents' ratings on the levels of impact and frequencies of occurrence for each underlying issues relating to both broad category of internal (Section 5.4.1) and external challenges (Section 5.4.3), respectively.

5.4.1 BROAD CATEGORIES OF INTERNAL CHALLENGES

Table 40 to Table 42 present the overall results of the broad categories of internal challenges constraining the achievement of strategic FM goals in Australasian universities, in terms of their perceived levels of impact, frequencies of occurrence and also the risk levels from the respondents' ratings.

The outcome of the analyses contributed towards realizing the first and second research objective, namely, (i) to identify and prioritize respondents' views on the broad categories of internal challenges constraining the strategic FM goals, and (ii) to determine the associated risk levels in terms of the perceived levels of impact and frequencies of occurrence of the challenges.

5.4.1.1 Levels of impact for broad categories of internal challenges

Respondents' responses to the levels of impact of the broad categories of internal challenges are presented and analyzed in Table 40.

In terms of levels of impact, the overall result in Table 40 for broad categories of internal challenges shows that majority (97%) of the respondents perceived the challenges relating to financial issues as the biggest constraints to the achievement of strategic FM goals. This corroborates Lunday's (2007) observation that finance is the utmost critical challenge facing facilities managers. This is because facilities managers are often evaluated on their financial performance and the extent to which they contribute to strategic improvement of the entire enterprise (IFMA, 2002).

Asiabaka (2008) sees the root cause of university finance problems as inadequacy of government subventions as well as ceiling placed on internal fund generators such as enrolment fees and levies. Consequently, Asiabaka (2008) advises public institutions to seek alternative means of sourcing for funds through entrepreneurship.

Table 40: Levels of impact - Broad category of internal challenges

¹ Broad Internal categories	Level of Impact					² TR	³ II	Remark	⁴ RII	Rank
	VH	H	M	L	VL					
	%	%	%	%	%					
	5	4	3	2	1					
CI-A	97	3	0	0	0	528	4.968	Very High	0.190	1
CI-B	43	24	21	11	2	528	3.953	High	0.151	4
CI-C	92	8	0	0	0	528	4.920	Very High	0.188	2
CI-D	75	14	11	0	0	528	4.638	Very High	0.177	3
CI-E	38	25	28	8	2	528	3.883	High	0.149	5
CI-F	34	24	29	11	2	528	3.771	High	0.144	6
							<u>26.133</u>		<u>1.000</u>	

¹Broad internal categories:

CI-A) Financial; CI-B) Operational Method/ Process; CI-C) Stakeholder needs/ service providers; CI-D) Manpower; CI-E) Machinery; CI-F) Materials.

²TR = Total responses for a particular variable;

³II = Impact Index (See equation 1, Chapter 3)

⁴RII = Relative Impact Index (See equation 2, Chapter 3)

5.4.1.2. Frequencies of occurrence for broad categories of internal challenges

Table 41 presents the analyzed responses to the frequencies of occurrence of the broad categories of internal challenges constraining the achievement of strategic FM goals. The table shows that finance-related challenges were perceived as the most frequent factor constraining the achievement of FM goals. This is followed by stakeholder needs/ service provider issues based on the ratings by 59% of the respondents.

Table 41: Frequencies of occurrence - Broad category of internal challenges

[*Frequencies of occurrence: 5 = Very Frequent; 4 = Frequent; 3 = Occasional; 2 = Rare; 1 = Very Rare*]

¹ Broad Internal categories	Frequency of occurrence					² TR	³ FI	Remark	⁴ RFI	Rank
	VF	F	O	R	VR					
	%	%	%	%	%					
	5	4	3	2	1					
CI-A	79	21	0	0	0	528	4.792	Very Frequent	0.200	1
CI-B	38	22	33	6	0	528	3.917	Frequent	0.164	4
CI-C	59	28	12	0	0	528	4.470	Very Frequent	0.187	2
CI-D	52	27	7	14	0	528	4.172	Frequent	0.174	3
CI-E	19	20	50	11	0	528	3.468	Frequent	0.145	5
CI-F	9	20	51	10	9	528	3.106	Occasional	0.130	6
						<u>23.924</u>			<u>1.000</u>	

¹Broad internal categories:

CI-A) Financial; CI-B) Operational Method/ Process; CI-C) Stakeholder needs/ service providers; CI-D) Manpower; CI-E) Machinery; CI-F) Materials.

²TR = Total responses for a particular variable;

³FI = Impact Index (See equation 3, Chapter 3)

⁴RFI = Relative Impact Index (See equation 4, Chapter 3)

5.4.1.3 Risk levels for broad categories of internal challenges

Perceived risk levels of each broad category of internal challenges are also presented and analyzed in Table 42. This helps to realize the second objective of the study, which focused on determining the associated risk levels of the identified internal challenges.

Results in Table 42 show that financial issues, as rated by 97% of the respondents, are the most risky factors constraining the achievement of strategic FM goals. This result agrees with the findings of APPA (2013) that the FM departments face the most critical challenge of how to address poor capital and operational budgetary allocations and attract adequate funding for the execution of key FM works. APPA (2014) also observed that facilities managers are expected to manage facilities for minimum cost rather than

optimum value. Due to the current global economic crisis which results in slimmer budgets, Kamarazaly and Mbachu (2010) further concluded that facilities managers are now expected to find creative ways of achieving so much value added results with so little resources – a scenario which the authors argue entails pushing the boundaries of innovation to the limit.

Table 42: Risk levels - Broad categories of internal challenges

¹ Broad Internal categories	Impact Index	Frequency Index	Risk Score (RS)	Remark	Risk Ranking
	² (Ii)	³ (Fi)	⁴ (Ii x Fi)		
CI-A	4.968	4.792	23.804	Very high	1
CI-B	3.953	3.917	15.481	High	4
CI-C	4.920	4.470	21.993	Very high	2
CI-D	4.638	4.172	19.352	High	3
CI-E	3.883	3.468	13.464	Moderate	5
CI-F	3.771	3.106	11.712	Moderate	6

¹Broad internal categories:

CI-A) Financial; CI-B) Operational Method/ Process; CI-C) Stakeholder needs/ service providers; CI-D) Manpower; CI-E) Machinery; CI-F) Materials.

²Ii = Impact Index (See equation 1, Chapter 3)

³Fi = Frequency Index (See equation 3, Chapter 3)

⁴RS = Risk Score (See equation 5, Chapter 3)

5.4.2 SUBCOMPONENTS OF THE INTERNAL CHALLENGES CONSTRAINING THE ACHIEVEMENT OF STRATEGIC FM GOALS

The first objective of the study aimed at investigating the internal challenges constraining the achievement of strategic FM goals. In order to fully achieve this objective, the subcomponents of each broad category of internal constraints were further analysed. This helped to examine the various ways the broad categories impacted on the achievement of the strategic FM goals. Figure 6 shows the logical sequence adopted for the presentation of the questionnaire survey results for this purpose. Typical analysis was presented in this section only for the operational/ finance-related current internal challenges. The remaining current internal challenges are analysed and presented in Appendix F, Section F.1.1. However, the following subsections focus on discussing all the analysed feedback of the respondents to the survey questions for each current internal challenge posed for this purpose.

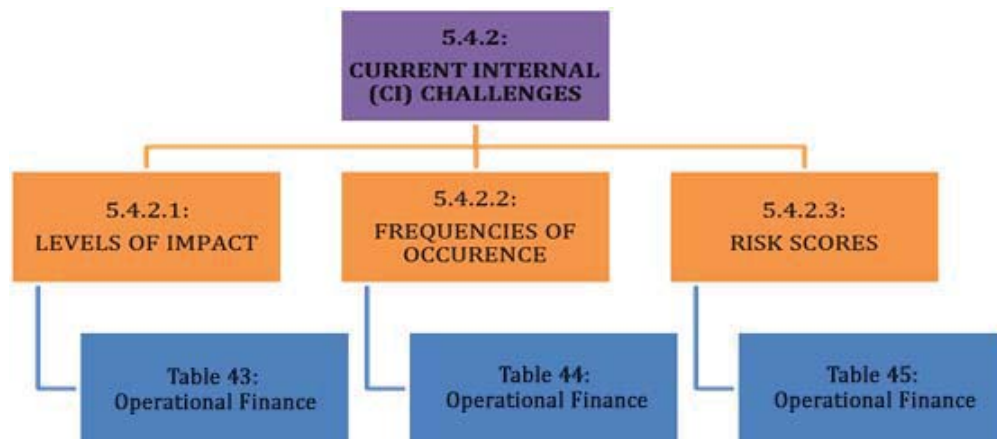


Figure 6: Flowchart of the presentation of main questionnaire survey results – Operational finance

5.4.2.1 Levels of impact for internal challenges

This section presents the respondents' responses to levels of impact of the underlying current internal challenges relating to operational finance/ budget as shown in Table 43. The analysis focused on prioritizing each issue relating to operational finance by computing their relative impact indices (RII) from the respondents' ratings as earlier described in Equation 4 in the Methodology section.

Results in Table 43 show that majority (i.e. 97%) of the respondents believed that issues relating to inadequate financial resources to procure new facilities or upgrade existing ones to meet user requirements was the most crucial challenge. The result is in agreement with the findings of OECD (2012) that today's facilities managers are facing more complex and challenging constraints in managing their dwindling resources and making decisions to support their institutional goals. In addition, APPA (2011) observes that FM departments face problems stemming from frequent maintenance costs and workflow disruptions associated with aging buildings. This problem has been compounded by the financial squeeze brought about by the global financial crisis. As facilities and mechanical systems reach and exceed their expected operating lives, significant issues arise around deferred maintenance and spiralling replacement and refurbishment costs, which further compound the dwindling resources available to the FM departments.

Table 43: Level of impact - Current internal (CI) challenges relating to inadequate operational finance

[Level of impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low]										
¹ Challenges relating to operational finance/ budget	Levels of impact					² TR	³ II	Remark	⁴ RII	Rank
	VH	H	M	L	VL					
	%	%	%	%	%					
	5	4	3	2	1					
CI-A-1	97	2	1	0	0	528	4.962	Very High	0.141	1
CI-A-2	95	4	2	0	0	528	4.932	Very High	0.140	2
CI-A-3	14	72	0	0	14	528	3.716	High	0.105	8
CI-A-4	76	18	6	1	0	528	4.682	Very High	0.133	3
CI-A-5	74	19	7	0	0	528	4.672	Very High	0.132	4
CI-A-6	73	19	6	2	0	528	4.634	Very High	0.131	5
CI-A-7	11	65	20	2	3	528	3.786	High	0.107	7
CI-A-8	19	63	10	8	0	528	3.919	High	0.111	6
							<u>35.303</u>			

¹Challenges relating to inadequate financial resources or budget to:

CI-A-1) procure new or upgrade existing facilities to meet user requirements; CI-A-2) undertake required preventive or restorative maintenance; CA-1-3) provide needed outdoor spaces and grounds; CA-1-4) provide needed internal spaces; CA-1-5) procure equipment, plant and services; CA-1-6) hire out-source personnel to undertake FM services; CA-1-7) train in-house personnel for improved performance; CI-A-8) motivate personnel for improved quality and productivity.

²TR = Total responses for a particular variable;

³II = Impact Index (See equation 1, Chapter 3)

⁴RII = Relative Impact Index (See equation 2, Chapter 3)

5.4.2.2 Frequencies of occurrence for internal challenges

This section presents the analyzed respondents' responses to frequencies of occurrence of the underlying current internal challenges relating to operational finance as shown in Table 44. The table shows that almost all the respondents alluded that challenges relating to inadequate financial resources to procure new facilities or upgrade existing ones to meet growing user requirements was the most frequently recurring issues facing facilities managers in managing university facilities. 80% of the respondents perceived that the next frequently occurring challenge under inadequate financial resources related to inability to undertake required preventive or restorative maintenance. Perhaps, the importance of maintenance as a key function of FM department hinges on Hassanain et al (2003) observation that regardless of the lack of funding or financial resources, required work around maintenance management must be treated with the utmost priority. Thus, whether for a condition-based or preventative approach, a very well maintenance plan must be scheduled in order to avoid any interference with usual business activities. Hassanain et al (2003) further stated that data concerning the frequency and cause of necessary repairs can assist greatly with future maintenance planning and cash flow forecasts.

Table 44: Frequencies of occurrence - Current Internal (CI) challenges relating to operational finance/ budget

[Frequencies of occurrence: 5 = Very Frequent; 4 = Frequent; 3 = Occasional; 2 = Rare; 1 = Very Rare]

¹ Challenges relating to operational finance/ budget	Frequency of occurrence					² TR	³ FI	Remark	⁴ RFI	Rank
	VF	F	O	R	VR					
	%	%	%	%	%					
	5	4	3	2	1					
CI-A-1	100	0	0	0	0	528	5.000	Very Frequent	0.182	1
CI-A-2	80	11	4	6	0	528	4.642	Very Frequent	0.169	2
CI-A-3	0	0	45	41	15	528	2.297	Rare	0.083	7
CI-A-4	2	76	22	0	0	528	3.795	Frequent	0.138	3
CI-A-5	3	71	16	10	0	528	3.665	Frequent	0.133	4
CI-A-6	5	52	25	17	0	528	3.460	Frequent	0.126	5
CI-A-7	0	0	36	57	8	528	2.280	Rare	0.083	8
CI-A-8	0	0	48	41	11	528	2.375	Rare	0.086	6
						<u>27.515</u>			<u>1.000</u>	

¹Challenges relating to inadequate financial resources or budget to:

CI-A-1) procure new or upgrade existing facilities to meet user requirements; CI-A-2) undertake required preventive or restorative maintenance; CA-1-3) provide needed outdoor spaces and grounds; CA-1-4) provide needed internal spaces; CA-1-5) procure equipment, plant and services; CA-1-6) hire out-source personnel to undertake FM services; CA-1-7) train in-house personnel for improved performance; CI-A-8) motivate personnel for improved quality and productivity.

²TR = Total responses for a particular variable;

³II = Impact Index (See equation 3, Chapter 3)

⁴RRI = Relative Impact Index (See equation 4, Chapter 3)

5.4.2.3. Risk levels for internal challenges

The risk scores for each internal challenge under each subset were computed and analyzed. The results indicate the relative risk levels of each factor constraining the achievement of strategic FM goals under each subset. The analysis focused on prioritizing these challenges by computing their risk scores (RS) from the respondents' ratings. This helped to realize the second objective of the study, which aimed to determine the perceived risk levels associated with the identified internal challenges facing university facilities managers.

Results in Table 45 show that, once again, challenges relating to inadequate financial resources or budget to procure new facilities or upgrade existing ones were the most risky constraints impacting on the achievement of strategic FM goals. This is evident from the highest risk score value of 24.8. The result is in agreement with the views expressed by APPA (2010) that financial-related constraint is the most critical concern for today's university facilities managers, the key expectation being that facilities departments need to develop long term strategies to make their organizations more efficient and financially viable.

To further elucidate the risk levels being analysed, some of the respondents' feedback in the open-ended sections of the question indicated that universities management were quick to invest in the procurement of new buildings, often designed to 'get the biggest bang for the buck' up front with little consideration for long-term upkeep. At the same time, they short-change maintenance and renewal, allowing existing buildings to decline into a state of disrepair, ignoring small maintenance problems until they ballooned into expensive maintenance and disruptive cases. It is therefore crucial for university facilities managers to advise the university management to procure facilities on the basis of life-cycle costs rather than cheap initial capital costs which often result in huge and frequent maintenance costs during the operation phase.

Table 45: Risk levels - Current Internal (CI) challenges relating to operational finance/ budget

¹ Challenges relating to operational finance/ budget	Impact Index	Frequency Index	Risk Score (RS)	Remark	Risk Ranking
	² (Ii)	³ (Fi)	⁴ (Ii x Fi)		
CI-A-1	4.962	5.000	24.811	Very high	1
CI-A-2	4.932	4.642	22.894	Very high	2
CI-A-3	3.716	2.297	8.537	Low	8
CI-A-4	4.682	3.795	17.770	High	3
CI-A-5	4.672	3.665	17.123	High	4
CI-A-6	4.634	3.460	16.036	High	5
CI-A-7	3.786	2.280	8.633	Low	7
CI-A-8	3.919	2.375	9.307	Low	6

¹Challenges relating to inadequate financial resources or budget to:

CI-A-1) procure new or upgrade existing facilities to meet user requirements; CI-A-2) undertake required preventive or restorative maintenance; CA-1-3) provide needed outdoor spaces and grounds; CA-1-4) provide needed internal spaces; CA-1-5) procure equipment, plant and services; CA-1-6) hire out-source personnel to undertake FM services; CA-1-7) train in-house personnel for improved performance; CI-A-8) motivate personnel for improved quality and productivity.

²Ii = Impact Index (See equation 1, Chapter 3)

³Fi = Frequency Index (See equation 3, Chapter 3)

⁴RS = Risk Score (See equation 5, Chapter 3)

Overall results and discussions of current internal challenges

Figure 7 shows the logical sequence adopted for the overall presentation of the levels of impact, frequencies of occurrence and risk levels of the internal challenges based on the analysed questionnaire survey results. The approach for the operational method/ process was showcased. Similar analyses were carried out for the remaining internal

challenges and presented in Appendix F (Section F.1.1, Table 210 - Table 224). The discussions on the overall results are presented in the following sections.

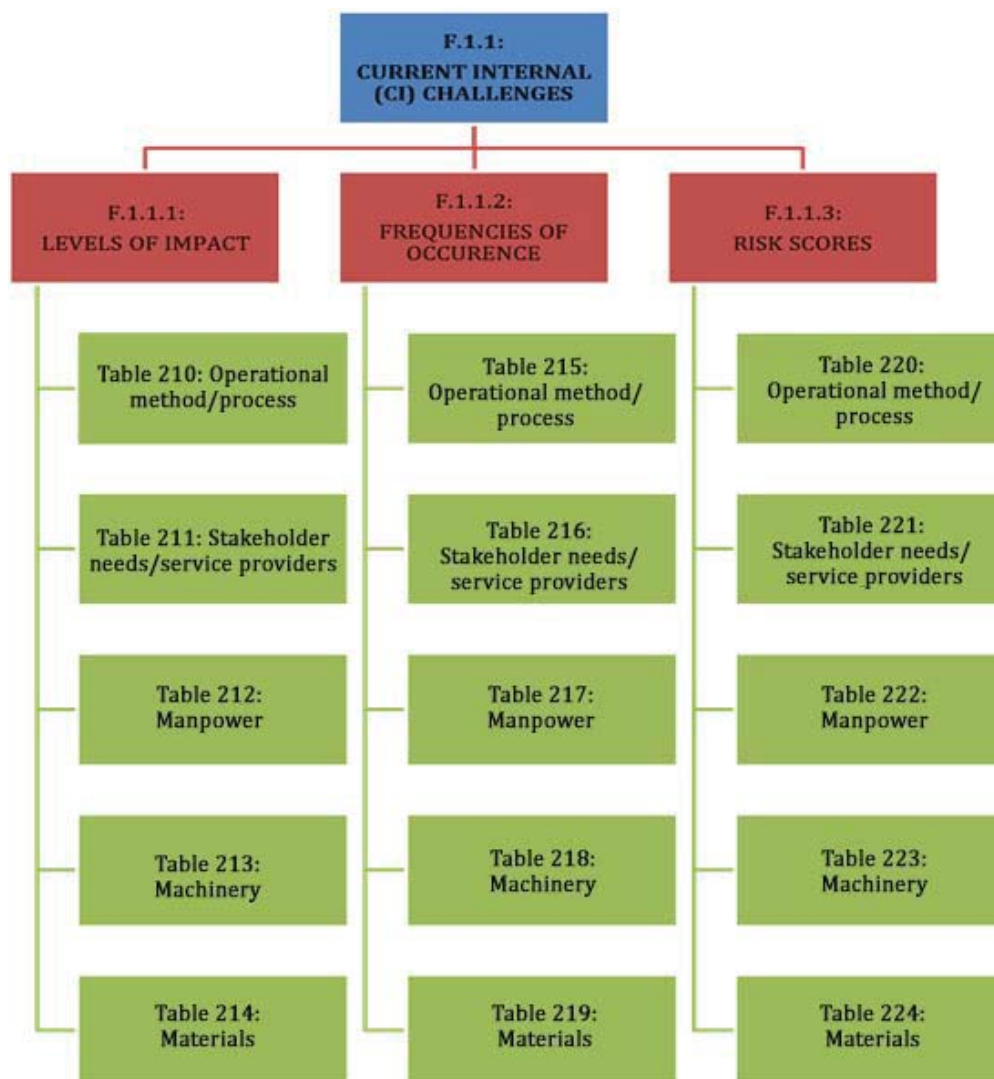


Figure 7: Flowchart of mainstream surveys data presentation of current internal challenges.

Current internal challenges relating to operational method/ process

In terms of challenges relating to operational method/ process, result (Table 210, Appendix F, Section F.1.1.1) shows that majority of the respondent (i.e. 80%) perceived effectiveness of organisational structure and impact on coordination and decision making processes as the most important factor that have very high level of impact on the

achievement of strategic FM goals. In term of the frequencies of occurrence, Table 215 (Appendix F, Section F.1.1.2) shows that organizational policies, strategies, values and missions and their impact on organizational effectiveness and efficiency was perceived as the most frequently occurring challenge as perceived by majority of the respondents (i.e. 78%). Consequently, results (Table 220, Appendix F, and Section F.1.1.3) show that organizational policy, strategies, values and missions and their impact on organizational effectiveness and efficiency was perceived as the most risky challenge relates to operational method/ process.

IFMA (2002) accords these results by stating that facility is considered as the strategic key that leads to the success of a business, thus it is important for FM to be recognized as business function in order for the organization to achieve maximum effectiveness. Further, IFMA (2002) also added that “management will continue to flatten management structures and consequently increase outsourcing”. On the contrary, IFMA (2005) stated that facility managers need to translate corporate requirements and strategy into operations; nonetheless, “as financial considerations push more businesses to reduce their capital risk and outsource more of their non-core business assets and services, there is a greater need for facility managers to forge partnerships without outsourcing vendors”.

Current internal challenges relating to stakeholder needs/ service providers

Result (Table 211, Appendix F, Section F.1.1.1) shows that in term of challenges relating to stakeholder needs/ service providers, 79% of respondents perceived difficulties in managing conflicting stakeholder interest and requirements especially due to some stakeholders “gold plating” their requirements as the most crucial factor impacting on the achievement of FM goals. Table 216 (Appendix F, Section F.1.1.2) presents the results on the frequencies of occurrence; 74% of respondents perceived difficulties in managing conflicting stakeholder interests and requirements as the most frequently occurring constraints. Hence, the most risky challenge relating to stakeholder needs/ service providers, (Table 221, Appendix F, Section F.1.1.3). OECD (2012) gives credence to these results by stating that today’s students and academic staff are more demanding and “increasingly expect state-of-the-art facilities and optimal support for education and research purposes”.

Current internal challenges relating to manpower

The current internal challenges relating to manpower are analysed and presented in (Appendix F, Section F.1.1): Table 212 (levels of impact), Table 217 (frequencies of occurrence) and Table 222 (risk levels). Results show that majority of respondent perceived inadequate skilled manpower as the most crucial factor and the most frequently occurring factor impacting on the achievement of strategic FM. Hence, the most risky current internal challenges relating to manpower facing university facilities managers (Table 222, Appendix F, and Section F.1.1.3). APPA (2009) agrees manpower as the most risky factor by observing that “facilities department need to confront workforce development issues in order to be prepared for these challenges”.

Current internal challenges relating to machinery

The levels of impact on the current internal challenges relating to machinery are analysed and presented in Table 213 (Appendix F, Section F.1.1.1). Results show that durability/ functionality problems and their impact on operational and maintenance costs was perceived by majority of respondents (79%) as the most crucial factor facing universities facilities managers. This accords the views expressed by Hassanain et al (2003) that it is important to maintain an asset of a building or an investment of an organization in order to retain its optimal value over its life cycle”. In terms of the frequencies of occurrence, Table 218 (Appendix F, Section F.1.1.2) shows that 77% of respondents perceived obsolescence and replacement costs for installed machines or equipment as the most frequently occurring factor. Hence, was perceived as the most risky manpower constraints impacting on the achievement of strategic FM goals (Table 223, Appendix F, and Section F.1.1.3).

Current internal challenges relating to materials

Table 214 (Appendix F, Section F.1.1.1) shows that high costs or unavailability of materials and components was perceived by 97% of respondents as the most crucial constraint, while Table 219 (Appendix F, Section F.1.1.2) shows that environmental performance problems and their impact on operational costs was perceived as the most frequently occurring constraint facing university facilities managers by majority of the respondents (i.e. 57%).

Hence, environmental performance problems and their impact on operational costs was perceived as the most risky constraint impacting on the achievement of strategic FM goals (Table 224, Appendix F, Section F.1.1.3). Mate (2003) agreed with this by opining

that “putting systems and strategies in place that reduce resource is not difficult and when included as part of environmental policy and environmental management system (EMS), can set high quality standards within a company and a philosophy for staff and stakeholders to adopt for now and the future”.

5.4.3 BROAD CATEGORIES OF EXTERNAL CHALLENGES

The overall results of the broad categories of external challenges constraining the achievement of strategic FM goals in Australasian universities, in terms of their perceived levels of impact, frequencies of occurrence and also the risk levels from the respondents' ratings, were also analyzed and presented in Table 46 - Table 48.

The outcome of the analyses contributed towards realizing the first and second research objective, which aimed to (i) identify and prioritize respondents' views on the broad categories of external challenges constraining the strategic FM goals and (ii) to determine the associated risk levels in terms of the perceived levels of impact and frequencies of occurrence of the challenges.

5.4.3.1 Levels of impact for broad categories of external challenges

Respondents' responses to the levels of impact of the broad categories of internal challenges are presented and analyzed in Table 46. Results show that majority of the respondents (i.e. 82%) perceived legislative/ regulatory compliance as the most critical constraint impacting on the achievement strategic FM goals. This is evident from the highest impact index (II) value of 4.769.

This result is in agreement with other past studies. For instance, Moore and Finch (2010) found that legislative compliance was the most critical challenge facing university facilities managers. The authors further noted that in addition to increasing regulatory/ legislative compliance in the workplace, there are also increasing emphasis on environmental/ sustainability issues such as energy conservation, waste reduction, salvage and recycling.

Table 46: Respondents' responses on the levels of impact on the broad categories of external challenges

<i>[Level of impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low]</i>										
¹ Broad External categories	Level of Impact (%)					² TR	³ II	Remark	⁴ RII	Rank
	VH	H	M	L	VL					
	5	4	3	2	1					
CE-A	55	40	5	0	0	528	4.496	Very High	0.149	2
CE-B	53	38	9	0	0	528	4.449	Very High	0.147	3
CE-C	41	21	38	0	0	528	4.038	High	0.134	6
CE-D	23	35	42	0	0	528	3.805	High	0.126	7
CE-E	52	28	20	0	0	528	4.328	Very High	0.143	4
CE-F	82	13	5	0	0	528	4.769	Very High	0.158	1
CE-G	52	28	20	0	0	528	4.328	Very High	0.143	4
<u>30.212</u>							<u>1.000</u>			
¹ Broad External challenges: CE-A) Political; CE-B) Economic; CE-C) Socio-cultural; CE-D) Technological; CE-E) Environmental and sustainability; CE-F) Legislative/ Regulatory compliance; CE-G) Institutional.										
² TR = Total responses for a particular variable;										
³ II = Impact Index (See equation 1, Chapter 3)										
⁴ RII = Relative Impact Index (See equation 2, Chapter 3)										

5.4.3.2. Frequencies of occurrence for broad categories of external challenges

Respondents' responses to the frequencies of occurrence of the broad categories of external challenges are presented and analyzed in Table 47. Results show that 75% of respondents perceived economic challenge as the most frequent external challenge facing university facilities managers.

This is evident from the highest frequency index value of 4.752. In agreement with this finding, APPA (2010) observed that economic challenges only grow worse when everyone in the organization is fighting for scarce resources; individual units within universities have typically valued their autonomy and operated independently, but that approach isn't viable when the stability of the entire institution is at stake".

Table 47: Respondents' responses on the frequencies of occurrence on the broad categories of external challenges

[Frequencies of occurrence: 5 = Very Frequent; 4 = Frequent; 3 = Occasional; 2 = Rare; 1 = Very Rare]										
¹ Broad External categories	Frequency of occurrence (%)					² TR	³ FI	Remark	⁴ RFI	Rank
	VF	F	O	R	VR					
	5	4	3	2	1					
CE-A	57	19	24	0	0	528	4.322	Very Frequent	0.152	3
CE-B	75	25	0	0	0	528	4.752	Very Frequent	0.167	1
CE-C	17	35	48	0	0	528	3.691	Frequent	0.130	6
CE-D	9	43	38	9	0	528	3.527	Frequent	0.124	7
CE-E	38	24	38	0	0	528	4.000	Frequent	0.140	4
CE-F	52	29	18	0	0	528	4.343	Very Frequent	0.153	2
CE-G	19	46	35	0	0	528	3.839	Frequent	0.135	5
						<u>28.473</u>			<u>1.000</u>	

¹Broad External challenges:

CE-A) Political; CE-B) Economic; CE-C) Socio-cultural; CE-D) Technological; CE-E) Environmental and sustainability; CE-F) Legislative/ Regulatory compliance; CE-G) Institutional.

²TR = Total responses for a particular variable;

³FI = Impact Index (See equation 3, Chapter 3)

⁴RFI = Relative Impact Index (See equation 4, Chapter 3)

5.4.3.3 Risk levels of broad categories of external challenges

Perceived risk levels of each broad category of external challenges are also presented and analyzed in Table 48 below. This helps to realize the second objective of the study in which to determine the associated risk levels of the identified external challenges.

Result shows that economic challenge was perceived as the most risky external challenge facing university facilities managers. This is evident from the highest risk score value of 21.141. APPA (2010) accords this result by stating that the combination of economic challenges, such as rising energy costs, inadequate training for unskilled manpower, higher interest rates and inflation, with “the long-term decline in state appropriations” would potentially lead to financial unsustainability.

Table 48: Respondents' responses on the risk levels on the broad categories of external challenges

¹ Broad External categories	Impact Index	Frequency Index	Risk Score (RS)	Remark	Risk Ranking
	² (Ii)	³ (Fi)	⁴ (Ii x Fi)		
CI-A	4.496	4.322	19.432	High	3
CI-B	4.449	4.752	21.141	Very high	1
CI-C	4.038	3.691	14.905	Moderate	6
CI-D	3.805	3.527	13.418	Moderate	7
CI-E	4.328	4.000	17.311	High	4
CI-F	4.769	4.343	20.711	Very high	2
CI-G	4.328	3.839	16.614	High	5

¹ Broad External challenges:

CE-A) Political; CE-B) Economic; CE-C) Socio-cultural; CE-D) Technological; CE-E) Environmental and sustainability; CE-F) Legislative/ Regulatory compliance; CE-G) Institutional.

²Ii = Impact Index (See equation 1, Chapter 3)

³Fi = Frequency Index (See equation 3, Chapter 3)

⁴RS = Risk Score (See equation 5, Chapter 3)

5.4.4 EXTERNAL CHALLENGES CONSTRAINING THE ACHIEVEMENT OF STRATEGIC FM GOALS

This section presents the respondents' responses to levels of impact, frequencies of occurrence and risk levels of the underlying current external challenges relating to political as shown in Table 49 - Table 51. The analysis focused on prioritizing each issue relating to operational finance by computing their relative impact indices (RII) from the respondents' ratings. Similar analyses were carried out for the remaining external challenges and are presented and analyzed in Table 225 (refer to Appendix F, Section F.1.2).

5.4.4.1. Levels of impact of external challenges

The respondents' responses to levels of impact of the underlying political-related external challenges constraining the achievement of strategic FM goals are presented and analyzed in Table 49. Similar to the analysis done for internal challenges, this analysis focused on prioritizing the external challenges by computing their relative importance indices (RII) from the respondents' ratings. This helped to realize the first and second objective of the study.

Result shows that majority of the respondents (i.e. 94%) perceived conflicting multi-stakeholder interests (i.e. dealing with the diverse interest of several groups having varying levels of authority and control) as the most critical political-related constraint facing university facilities managers. This is also evident from the highest impact index value of 4.936. APPA (2010) stated that “government and political interference pose a particular challenge for universities, since so much of their funding is tied to government sources”.

Table 49: Level of impact - Current External (CE) challenges relating to political constraints

<i>[Level of impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low]</i>										
¹ Challenges relating to political constraints	Level of Impact					² TR	³ II	Remark	⁴ RII	Rank
	VH	H	M	L	VL					
	%	%	%	%	%					
	5	4	3	2	1					
CE-A-1	94	6	0	0	0	528	4.936	Very High	0.191	1
CE-A-2	59	38	3	0	0	528	4.557	Very High	0.176	4
CE-A-3	77	15	8	0	0	528	4.691	Very High	0.181	2
CE-A-4	22	28	35	15	0	528	3.570	High	0.138	5
CE-A-5	19	26	36	19	0	528	3.453	High	0.134	6
CE-A-6	75	17	5	2	0	528	4.653	Very High	0.180	3
							<u>25.860</u>		<u>1.000</u>	

¹Political constraints - restraints inherent in the dynamic of organisational politics and tensions such as:

CE-A-1) Conflicting multi-stakeholder interests; dealing with the diverse interests of several groups having varying levels of authority and control; CE-A-2) Not having adequate level of authority to match the enormous FM responsibilities; CE-A-3) Influences/ pressures from different cliques of the top management; CE-A-4) Ethical dilemma: balancing the needs of the power blocs against requirements of best practice standards, especially in relation to space design and allocation; CE-A-5) Political bickering and power struggle that undermine freedom and best practice standards; CE-A-6) Not having enough influence over FM budget decisions to match critical FM expenditure needs.

²TR = Total responses for a particular variable;

³II = Impact Index (See equation 1, Chapter 3)

⁴RII = Relative Impact Index (See equation 2, Chapter 3)

5.4.4.2 Frequencies of occurrence of external challenges

The respondents’ responses to frequencies of occurrence of the underlying political-related external challenges constraining the achievement of strategic FM goals are presented and analyzed in Table 50 below. The analysis focused on prioritizing these challenges by computing their relative frequency indices (RFI) from the respondents’ ratings. These dimensions are targeted towards realizing the first and second objective of the study.

Table 50: Frequencies of occurrence - Current External (CE) challenges relating to political constraints

[*Frequencies of occurrence: 5 = Very Frequent; 4 = Frequent; 3 = Occasional; 2 = Rare; 1 = Very Rare*]

¹ Challenges relating to political constraints	Frequency of occurrence					² TR	³ FI	Remark	⁴ RFI	Rank
	VF	F	O	R	VR					
	%	%	%	%	%					
	5	4	3	2	1					
CE-A-1	91	9	0	0	0	528	4.909	Very Frequent	0.214	1
CE-A-2	8	34	32	26	0	528	3.231	Occasional	0.141	4
CE-A-3	23	57	15	5	0	528	3.970	Frequent	0.173	3
CE-A-4	53	43	4	0	0	528	4.492	Very Frequent	0.196	2
CE-A-5	8	21	52	19	0	528	3.182	Occasional	0.138	6
CE-A-6	10	17	55	18	0	528	3.193	Occasional	0.139	5
							<u>22.977</u>		<u>1.000</u>	

¹Political constraints - restraints inherent in the dynamic of organisational politics and tensions such as:

CE-A-1) Conflicting multi-stakeholder interests; dealing with the diverse interests of several groups having varying levels of authority and control; CE-A-2) Not having adequate level of authority to match the enormous FM responsibilities; CE-A-3) Influences/ pressures from different cliques of the top management; CE-A-4) Ethical dilemma: balancing the needs of the power blocs against requirements of best practice standards, especially in relation to space design and allocation; CE-A-5) Political bickering and power struggle that undermine freedom and best practice standards; CE-A-6) Not having enough influence over FM budget decisions to match critical FM expenditure needs.

²TR = Total responses for a particular variable;

³FI = Impact Index (See equation 3, Chapter 3)

⁴RFI = Relative Impact Index (See equation 4, Chapter 3)

Result (Table 50) shows that majority (i.e. 91%) of the respondents also perceived conflicting multi-stakeholder interests (i.e. dealing with the diverse interest of several groups having varying levels of authority and control) as the most frequently occurring political-related constraint impacting on the achievement of strategic FM goals. This is evident from the highest frequency index value of 4.909. The rapid changes in political shifts may eventually “lead to either reduced or increase environmental regulations” (APPA, 2010).

5.4.4.3. Risk levels of external challenges

The risk scores for each external challenge under each subset were also computed and analyzed. The results indicate the relative risk levels to which each factor constraining the achievement of strategic FM goals under each subset.

The associated risk levels of political-related external challenges constraining the achievement of strategic FM goals are analyzed and presented in the following Table 51

below. The analysis focused on prioritizing these challenges by computing their risk scores (RS) from the respondents' ratings. This helped to realize the second objective of the study.

Table 51: Risk levels - Current External (CE) challenges relating to political constraints

¹ Challenges relating to political constraints	Impact Index	Frequency Index	Risk Score (RS)	Remark	Risk Ranking
	² (Ii)	³ (Fi)	⁴ (Ii x Fi)		
CE-A-1	4.936	4.909	24.229	Very high	1
CE-A-2	4.557	3.231	14.723	Moderate	5
CE-A-3	4.691	3.970	18.623	High	2
CE-A-4	3.570	4.492	16.038	High	3
CE-A-5	3.453	3.182	10.986	Moderate	6
CE-A-6	4.653	3.193	14.859	Moderate	4

¹Political constraints - restraints inherent in the dynamic of organisational politics and tensions such as:

CE-A-1) Conflicting multi-stakeholder interests; dealing with the diverse interests of several groups having varying levels of authority and control; CE-A-2) Not having adequate level of authority to match the enormous FM responsibilities; CE-A-3) Influences/ pressures from different cliques of the top management; CE-A-4) Ethical dilemma: balancing the needs of the power blocs against requirements of best practice standards, especially in relation to space design and allocation; CE-A-5) Political bickering and power struggle that undermine freedom and best practice standards; CE-A-6) Not having enough influence over FM budget decisions to match critical FM expenditure needs.

²Ii = Impact Index (See equation 1, Chapter 3)

³Fi = Frequency Index (See equation 3, Chapter 3)

⁴RS = Risk Score (See equation 5, Chapter 3)

Result (Table 51) shows that conflicting multi-stakeholder interests (i.e dealing with the diverse interest of several groups having varying levels of authority and control) was perceived as the most risky political-related challenge facing university facilities managers. This is evident from the highest risk score (RS) value of 24.229. APPA (2007) agreed with this result by stating that “as stakeholders of all types become more vocal and persistent concerning their demands, facilities departments need to be more proactive about seeking stakeholder input and responding to stakeholder expectations”.

Overall results and discussions of current external challenges

The following Figure 8 portrays the flowchart of the presentation of main questionnaire survey results which presents the levels of impact, frequencies of occurrence and risk levels of the remaining current internal challenges: economic, socio-cultural, technological, legislative, environmental/ sustainability and institutional. These details

are analysed and presented in Appendix F (Table 225 – Table 243).The discussions on the overall results are presented in following section.

Current external challenges relating to economic

Table 225, Table 231 and Table 237 (Appendix F, Section F.1.2.) present the results for economic-related current external challenges in terms of their perceived levels of impact, frequencies of occurrence and risk levels, respectively. Result shows that majority of respondents (i.e. 58%) perceived unaffordability of new project, upgrade and maintenance costs was perceived as the most critical economic-related external challenge facing university facilities managers. 84% of the respondents perceived this factor as being the most frequently occurring economic-challenge facing university facilities managers. Hence, the overall result of risk levels (Table 237, Appendix F and Section F.1.2.1) show that unaffordability of new project, upgrade and maintenance costs was perceived as the most risky factor.

This is evident from the from the highest risk score value of 21.537. Rogers (2012) accords this result by stating that “as interesting as it is to be living through historic economic drama, facilities managers can’t just stand by and watch; they need to act as so much of today’s turmoil is unprecedented that they can’t find guidance by looking to the past”.

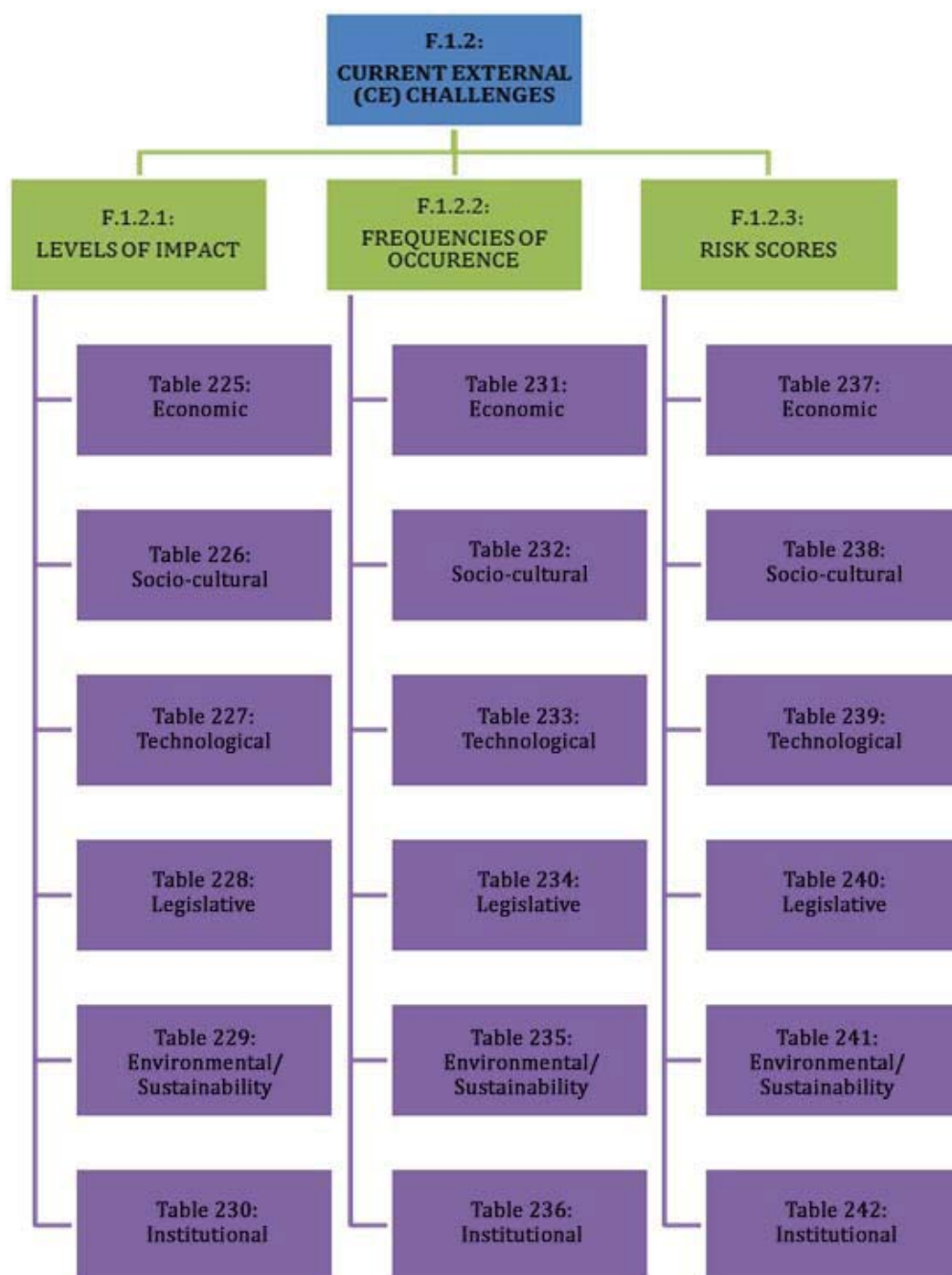


Figure 8: Flowchart of mainstream surveys data presentation of current external challenges.

Current external challenges relating to socio-cultural

Table 226 (Appendix F, Section F.1.2.1) shows that majority of the respondents (i.e 50%) perceived compliance with the occupational health and safety regulations in the workplace as the most critical socio-cultural related-challenge. However, 81% of the respondents perceived having to address the ethnic diversity and differing cultural needs especially in relation to space planning and design solutions, as the most frequently recurring challenge facing university facilities managers (Table 232, Appendix F, Section F.1.2.2). Hence, Table 238 (Appendix F, Section F.1.2.3) shows the latter socio-cultural related challenge was perceived as the most risky factor impacting on the achievement of strategic FM goals. This is evident from the highest risk score value of 20.242.

This result is in agreement with the findings from other studies. For instance, Bradley et al (2008) opines that “higher education providers in Australia for example, should ensure that the institutional culture, the culture competence of staff and the nature of the curriculum recognises and supports the participation of indigenous students; indigenous knowledge should be embedded into curriculum to ensure that all students have an understanding of indigenous culture”.

Current external challenges relating to technological

Table 227 (Appendix F, Section F.1.2.1) shows that the dilemma of having to monitor and keep up with the rapid technological changes developments was alluded as the most critical factor facing university facilities managers. 76% of respondents also perceived this factors as being the most frequently recurring factor, (Table 233, Appendix F, Section F.1.2.2); hence the most risky technological-related challenge impacting on the achievement of strategic FM (Table 239, Appendix F, Section F.1.2.3). This is evident from the highest risk score value of 21.706.

This result is in line with other past studies. For instance, IFMA (2007) agrees that a critical technology-related challenge facing university facilities managers is to keep abreast of rapid changing technology such as Building Information Management (BIM) and Integrated Workplace Management Systems (IWMS). APPA (2010) observed that “universities must continue to address the shifting impacts of technology on campuses, as well as plan for disaster management and facilities integration”.

Current external challenges relating to legislative

Table 228, Table 234 and Table 240 (Appendix F, Section F.1.2.) present the results for legislative-related current external challenges in terms of their perceived levels of impact, frequencies of occurrence and risk levels. Result show that rapid changes in legislations, by-laws and standards/ codes affecting the FM planning and operations costs was perceived as the most critical, frequently recurring and risky legislative-related external challenge facing university facilities managers.

APPA (2010) agrees with this result by stating that higher education face more regulations challenges compared to any other type of organization such as: regulations pertaining to laws; environmental rules (i.e. hazardous waste disposal); financial constraints; and research organizations (i.e. human subject research rules, animal regulations, patent law). Although the regulations are “rooted in reasonable, understandable desires for safety, privacy and fairness”, the result of these rapid changes “is a major burden on colleges and universities”.

Current external challenges relating to environmental/ sustainability

Table 229 (Appendix F, Section F.1.2.1) shows that the rapid changes in legislation and by-laws was alluded as the most critical factor facing university facilities managers. 76% of respondents also perceived this factors as being the most frequently recurring factor, (Table 235, Appendix F, Section F.1.2.2); hence the most risky technological-relate challenge impacting on the achievement of strategic FM (Table 242, Appendix F, Section F.1.2.3).

This is evident from the highest risk score value of 22.526. To guard against this result, APPA (2010) agrees that sustainability and energy efficiency have long been a priority in issues in higher education institutions however “the importance of the issues has only grown”. APPA suggested that “universities must continue to make progress toward environmental sustainability and energy efficiency”.

Current external challenges relating to institutional

Table 230 (Appendix F, Section F.1.2.1) shows that majority of the respondents (i.e 72%) perceived unrealistic expectations of the top management: "Achieve so much output with so little resources" as the most critical socio-cultural related-challenge. 53% of the respondents also perceived this factor as the most frequently recurring challenge facing

university facilities managers (Table 236, Appendix F, Section F.1.2.2). Hence, Table 242 (Appendix F, Section F.1.2.3) shows the latter institutional related challenge was perceived as the most risky factor impacting on the achievement of strategic FM goals.

This is evident from the highest risk score value of 20.328. Rogers (2012) agrees with that the most crucial challenge facing facilities managers is “doing more with less” in which facilities managers need to efficiently leverage the FM value in order to establish “much stronger position to prosper from new opportunities that sit beyond the current economic drama”.

5.5 FINDINGS IN RELATION TO THE THIRD OBJECTIVE

The third objective of the study aimed at exploring practical solutions for addressing the identified key challenges facing university facilities managers. The following subsections present the findings in relation to this objective.

5.5.1 PRACTICAL SOLUTIONS FOR ADDRESSING THE CHALLENGES

Respondents’ feedback to the levels of importance of the practical solutions for addressing the challenges are presented and analyzed in Table 52 to Table 79. For ease of presentation, the results are presented in two sections. The first section (Section 5.5.1.1; Table 52 to Table 67) presents the analysis of levels of effectiveness for prioritizing the suggested mitigation measures for addressing the internal challenges while the second section (Section 5.5.1.2; Table 68 – Table 79) presents the analysis of levels of effectiveness for prioritizing the suggested mitigation measures for addressing the external challenges.

Each solution suggested is coded for use in thematic content analysis (Cooper and Emory, 1995). For instance, the code ‘SCI-A-1’ means solutions for current internal challenge (i.e. SCI-1, ‘SCI’ means solution for current internal; ‘A’ refers to subcategory (issue-related) of current internal challenge; ‘1’ refers to the numbers of solution mentioned as practical solution for the challenge).

The aim of the analyses is to prioritize respondents' views on ways of addressing the challenges facing university facilities managers in the Australasian region. The third objectives of the study may be realized by the consensus of opinions on the identification of solutions in this respect.

5.5.1.1 Practical solutions for addressing the internal challenges

Practical solutions for addressing the identified issues under each broad category of internal challenges are presented in this subsection.

Practical solutions for addressing the finance-related current internal challenges

Table 52 lists the top six practical solutions for addressing finance-related current internal challenges.

Table 52: Practical solutions for addressing Current Internal (CI) challenges - Finance

Code	Practical solutions for addressing Current Internal Challenges (CI)
A	Finance: How to 1) address low capital and operational budgetary allocations and 2) attract adequate funding for complete execution of FM works:
SCI-A-1	Develop strategic management situations to do more with less.
SCI-A-2	Develop energy efficiency strategies that will reduce utilities costs and benefit the environment.
SCI-A-3	FM department need to develop long-term strategies to make their organization more efficient and financially viable: 1) Move beyond short-term cost cutting to true financial discipline; 2) Consider Total Cost Ownership in assessing the facilities' value; 3) Understand the value to their customers; 4) Assess and enhance the Return on Investment of the university's facilities assets through higher utilization.
SCI-A-4	Improving FM's strategic relevance, linking funding request to corporate goals.
SCI-A-5	Adequate life cycle costing when planning facilities.
SCI-A-6	Adequate space planning.

Finance (SCI-A-1):

SCI = Solution for Current Internal (CI) challenge

SCI-A = 'A' refers to subcategory (issue-related) of current internal challenge

SCI-A-1 = '1' refers to the numbers of solution mentioned as practical solution for the challenge

Results in Table 53 show that almost all respondents believed that developing strategic management situations to do more with less was the most significant solution for addressing finance-related challenges. This is in line with Then's (2003) observation that strategic management is a core competency for facility manager, which brings with it issues around value identification, cost benefit analysis, risk assessment and stakeholder negotiation. In a recent study, APPA (2014) found that the most frequently recurring solution for addressing funding and budgetary issues in the Australasian universities was having a representation of the FM department on the university's board

that makes decisions about funding. APPA (2013) also noted that this contrasts with the traditional view that FM is a 'boiler room' activity – not a 'boardroom' activity.

Table 53: Rating on impact levels of practical solutions for current internal challenges – Finance

<i>[Level of impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low]</i>										
Practical solutions for addressing Current Internal Challenges (CI) Code	Rating on impact levels (%)									
	Frequency of mention (F)		VH	H	M	L	VL			
	% F	^a R	5	4	3	2	1	^b TR	^c MR	^d R
Finance										
SCI-A-1	100	VH	76	24	0	0	0	528	4.758	VH
SCI-A-2	81	VH	47	35	18	0	0	428	4.285	VH
SCI-A-3	72	H	52	26	16	5	0	380	4.253	VH
SCI-A-4	66	H	43	26	20	11	0	350	4.000	VH
SCI-A-5	63	H	30	24	30	15	0	330	3.697	H
SCI-A-6	57	M	17	20	43	20	0	300	3.333	H
^a R = Rating for occurrence frequency: VH (Very High, 80 < %F < 100); H (High: 60 < %F < 80); M (Medium, 40 < %F < 60); L (Low, 20 < %F < 40); VL (Very Low, %F < 20); ^a TR = Total number of respondents identifying a variable; ^c MR = Mean rating of the variable; ^d R = Rating for impact level: VH (Very High, 4 < MR < 5); H (High: 3 < MR < 4); M (Medium, 2 < MR < 3); L (Low, 1 < MR < 2); VL (Very Low, MR < 1).										

Practical solutions for addressing the operational efficiency-related current internal challenges

Table 54 shows the practical solutions for addressing operational efficiency-related current internal challenges. The issues around this are: how to improve efficiency in the work processes to lower operational costs, optimize resource utilization and achieve set goals.

Table 54: Practical solutions for addressing Current Internal (CI) challenges - Operational efficiency

Code	Practical solutions for addressing Current Internal Challenges (CI)
B	Operational efficiency: How to improve efficiency in the work processes to lower operational costs, optimise resource utilization and achieve set goals:
SCI-B-1	Regular meetings are essentials to set the facilities goal, strategy, communicate solutions that lead to energy efficiency.
SCI-B-2	Use of innovation and creativity to achieve more with less.
SCI-B-3	Recognising needs for improvements through 'know' information or benchmark information, or both.
SCI-B-4	Setting out goals and provide best qualified solutions.
SCI-B-5	Staff training for operational improvements.

Operational efficiency (SCI-B-1):
SCI = Solution for Current Internal (CI) challenge
SCI-B = 'B' refers to subcategory (issue-related) of current internal challenge
SCI-B-1 = '1' refers to the numbers of solution mentioned as practical solution for the challenge

Result (Table 55) shows that majority of the respondents (i.e. 100%) perceived regular meetings are essentials to set the facilities goal, strategy, communicate solutions that lead to energy efficiency as the most significant solution for addressing issues around operational-efficiency-related challenge. IFMA (2005) accords this result by stating that university facilities managers need to generate corporate value by “pioneering technology, measuring productivity of knowledge workers and providing information for corporate strategic planning”.

Table 55: Rating on impact levels of practical solutions for current internal challenges – Operational efficiency

[Level of impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low]											
Practical solutions for addressing Current Internal Challenges (CI)	Frequency of mention (F)	Rating on impact levels (%)							^b TR	^c MR	^d R
		VH	H	M	L	VL					
		Code	% F	^a R	5	4	3	2			
Operational efficiency											
SCI-B-1	100	VH	72	28	0	0	0	528	4.720	VH	
SCI-B-2	91	VH	63	19	18	0	0	478	4.444	VH	
SCI-B-3	66	H	59	23	18	0	0	348	4.414	VH	
SCI-B-4	57	M	60	20	7	13	0	300	4.267	VH	
SCI-B-5	53	M	37	19	19	26	0	270	3.667	H	

^aR = Rating for occurrence frequency: VH (Very High, 80 < %F < 100); H (High: 60 < %F < 80); M (Medium, 40 < %F < 60); L (Low, 20 < %F < 40); VL (Very Low, %F < 20); ^aTR = Total number of respondents identifying a variable; ^cMR = Mean rating of the variable; ^dR = Rating for impact level: VH (Very High, 4 < MR < 5); H (High: 3 < MR < 4); M (Medium, 2 < MR < 3); L (Low, 1 < MR < 2); VL (Very Low, MR < 1).

Practical solutions for addressing the risk management-related current internal challenges

Table 56 shows the practical solutions for addressing risk management-related current internal challenges. Four practical solutions are identified by the respondents for addressing issues around risk management. Result (Table 57) shows that majority of the respondents (i.e. 100%) perceived preparing detailed and analytical specifications of the facility as well as all associated risks as the most significant solution for addressing risk management challenges.

Bajaj (2003) agreed with this result by stating that managing risk in FM is central to delivery of value in all aspects of service provision” thus with the comprehensive and analytical specifications of the facility and its associated risk, facility managers could expect improvement in “productivity, quality, environment, image, business financial position and control of facility services”.

Table 56: Practical solutions for addressing Current Internal (CI) challenges - Risk Management

Code	Practical solutions for addressing Current Internal Challenges (CI)
C	Risk management: How to improve on the accuracy of risk analysis, contingency planning and the effectiveness of risk monitoring and risk response:
SCI-C-1	Facilities managers need to prepare detailed and analytical specifications of the facility, and all associated risks.
SCI-C-2	Identification and allocation of risks involved on a rational basis to help clarify relationships between stakeholders, service providers and facilities managers.
SCI-C-3	Facilities managers need to have clear perception of the risks being borne by each party.
SCI-C-4	Facilities managers need to have motivation to manage risks that require a clear linkage between a party's management of risks and the party's receipt of award.
<i>Risk management (SCI-C-1):</i>	
<i>SCI = Solution for Current Internal (CI) challenge</i>	
<i>SCI-C= 'C' refers to subcategory (issue-related) of current internal challenge</i>	
<i>SCI-C-1 = '1' refers to the numbers of solution mentioned as practical solution for the challenge</i>	

Table 57: Rating on impact levels of practical solutions for current internal challenges – Risk management

[Level of impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low]										
Practical solutions for addressing Current Internal Challenges (CI) Code	Frequency of mention (F) % F	aR	Rating on impact levels (%)					bTR	cMR	dR
			VH	H	M	L	VL			
			5	4	3	2	1			
			Risk management							
SCI-C-1	100	VH	66	34	0	0	0	528	4.663	VH
SCI-C-2	77	H	67	25	8	0	0	404	4.584	VH
SCI-C-3	72	H	53	26	21	0	0	380	4.316	VH
SCI-C-4	57	M	53	20	27	0	0	300	4.267	VH
aR = Rating for occurrence frequency: VH (Very High, 80 < %F < 100); H (High: 60 < %F < 80); M (Medium, 40 < %F < 60); L (Low, 20 < %F < 40); VL (Very Low, %F < 20); aTR = Total number of respondents identifying a variable; cMR = Mean rating of the variable; dR = Rating for impact level: VH (Very High, 4 < MR < 5); H (High: 3 < MR < 4); M (Medium, 2 < MR < 3); L (Low, 1 < MR < 2); VL (Very Low, MR < 1).										

Practical solutions for addressing the stakeholder needs/ service provider-related current internal challenges

Table 58 present the six practical solutions for addressing stakeholder needs/ service provider-related current internal challenges.

Table 58: Practical solutions for addressing Current Internal (CI) challenges - Stakeholder needs/ Service providers

Code	Practical solutions for addressing Current Internal Challenges (CI)
D	Stakeholder needs/Service providers: How to assess and respond to the changing and complex needs of the different stakeholders (e.g. staff, students and visitors); how to address - with limited budget - compliance with ergonomics and accessibility issues in the workplace, especially for the aged and the handicapped.
SCI-D-1	Facilities managers need to recognize that they are in the customer service business: cultivate an atmosphere of customer service; consider customer service and communications training for staff; and implement communications programs to gather information and keep stakeholders informed.
SCI-D-2	Understand communications challenges both up administrative chain and across departments, use a variety of forms of communications and be prepared for a two-way exchange.
SCI-D-3	Facilities departments need to become more proactive about seeking stakeholders input and responding to stakeholder expectations: be upfront about soliciting input, seek out stakeholder groups beyond the obvious parties and honestly listen to new ideas.
SCI-D-4	Assess customer satisfaction to establish a baseline and to measure future progress.
SCI-D-5	Consider the customer relationship management technology to streamline customer service.
SCI-D-6	Enhancing client capability and quality of provision, and proper assessment of requirements for the scope and content of services.
<i>Stakeholder needs/ service provider (SCI-D-1):</i> <i>SCI = Solution for Current Internal (CI) challenge</i> <i>SCI-D = 'B' refers to subcategory (issue-related) of current internal challenge</i> <i>SCI-D-1 = '1' refers to the numbers of solution mentioned as practical solution for the challenge</i>	

Table 59 presents that majority of the respondents perceived that the most significant solution for addressing stakeholder needs/ service provider challenges is the need for facilities managers to recognize that they are in the customer service business. APPA (2006) noted that this could be achieved through: cultivating an atmosphere of customer service; considering customer service and communications training for staff; and implementing communications programs to gather information and keep stakeholders informed. IFMA (2005) agrees to this result by stating it is of critical importance for facilities managers to increase stakeholder value.

Table 59: Rating on impact levels of practical solutions for current internal challenges – Stakeholder needs/ Service providers

[Level of impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low]										
Practical solutions for addressing Current Internal Challenges (CI)	Frequency of mention (F)	Rating on impact levels (%)								
			VH	H	M	L	VL			
Code	% F	^a R	5	4	3	2	1	^b TR	^c MR	^d R
Stakeholder needs/ Service providers										
SCI-D-1	100	VH	76	24	0	0	0	528	4.758	VH
SCI-D-2	91	VH	63	21	17	0	0	480	4.458	VH
SCI-D-3	87	VH	43	24	33	0	0	460	4.109	VH
SCI-D-4	76	H	38	23	33	8	0	400	3.900	H
SCI-D-5	68	H	30	24	36	10	0	360	3.742	H
SCI-D-6	57	M	30	23	33	13	0	300	3.700	H

^aR = Rating for occurrence frequency: VH (Very High, 80 < %F < 100); H (High: 60 < %F < 80); M (Medium, 40 < %F < 60); L (Low, 20 < %F < 40); VL (Very Low, %F < 20); ^aTR = Total number of respondents identifying a variable; ^cMR = Mean rating of the variable; ^dR = Rating for impact level: VH (Very High, 4 < MR < 5); H (High: 3 < MR < 4); M (Medium, 2 < MR < 3); L (Low, 1 < MR < 2); VL (Very Low, MR < 1).

Practical solutions for addressing the maintenance-related current internal challenges

Table 60 shows the practical solutions for addressing the maintenance-related current internal challenges.

Result (Table 61) shows that the most frequently recurring solution proffered by the respondents for addressing maintenance issues was considering university's backlog of renewal and renovation projects in light of sustainability and increase the priority for the upgrade of inefficient structures by: (i) using sustainability to advocate for renewal outdated buildings; (ii) include sustainability as a factor in facility assessments and put priority on structures that are getting in the way of achieving university's sustainability goals and (iii) developing criteria to determine which building are not worth saving.

APPA (2007) suggested that it is important for facilities managers to efficiently manage their maintenance and adaptive reuse by: 1) *prioritizing deferred maintenance needs according to the institution's overall goals*; 2) *considering the use of priority indices to help determine facility goals*; and, 3) *considering total cost of ownership for existing facilities whenever improvements are made*.

Table 60: Practical solutions for addressing Current Internal (CI) challenges - Maintenance

Code	Practical solutions for addressing Current Internal Challenges (CI)
E	Maintenance: How to address the dilemma in managing aging buildings and infrastructure, especially as it relates to deciding between "retain and maintain" versus "upgrade or replace"; addressing the problem of deferred/backlog of maintenance that has arisen due to diversion of funding to higher priority areas.
SCI-E-1	Develop consistent categories to define maintenance and renewal needs.
SCI-E-2	University should consider their backlog of renewal and renovation projects in light of sustainability and increase the priority for the upgrade of inefficient structures by: (i) using sustainability to advocate for renewal outdated buildings; (ii) include sustainability as a factor in facility assessments and put priority on structures that are getting in the way of achieving university's sustainability goals and (iii) developing criteria to determine which building are not worth saving.

Maintenance (SCI-E-1):
SCI = Solution for Current Internal (CI) challenge
SCI-E = 'E' refers to subcategory (issue-related) of current internal challenge
SCI-E-1 = '1' refers to the numbers of solution mentioned as practical solution for the challenge

Table 61: Rating on impact levels of practical solutions for current internal challenges - Maintenance

[Level of impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low]										
Practical solutions for addressing Current Internal Challenges (CI)	Frequency of mention (F)	Rating on impact levels (%)								
		VH	H	M	L	VL				
Code	% F	^a R	5	4	3	2	1	^b TR	^c MR	^d R
Maintenance										
SCI-E-1	81	VH	58	21	16	5	0	428	4.332	VH
SCI-E-2	100	VH	57	24	19	0	0	528	4.381	VH

^aR = Rating for occurrence frequency: VH (Very High, 80 < %F < 100); H (High: 60 < %F < 80); M (Medium, 40 < %F < 60); L (Low, 20 < %F < 40); VL (Very Low, %F < 20); ^aTR = Total number of respondents identifying a variable; ^cMR = Mean rating of the variable; ^dR = Rating for impact level: VH (Very High, 4 < MR < 5); H (High: 3 < MR < 4); M (Medium, 2 < MR < 3); L (Low, 1 < MR < 2); VL (Very Low, MR < 1).

Practical solutions for addressing the manpower-related current internal challenges

Table 62 presents the practical solutions for addressing manpower issues. Result (Table 63) shows that majority of the respondents (i.e. 100%) alluded that the need for FM department to confront workforce development issues by: (i) assessing the impact of the recession on the facilities workforce; (ii) helping current staff adjust to change; (iii) developing strategies to bring new skills into organization and (iv) creating knowledge transfer system so the expertise of retiring workers is preserved, could improve manpower quality and performance. This is in line with the findings from other studies (APPA, 2008 and APPA, 2009).

IFMA (2007) further observes “unique generation work styles are creating more challenges for facilities managers” and this issue could be addressed by few ways such as: promoting leadership development and transition planning; maintaining sensitivity to variety of workers and work styles; recruiting and training skilled labour pool, developing training programs in promoting and maintaining educational standards across the industry.

Table 62: Practical solutions for addressing Current Internal (CI) challenges - Manpower

Code	Practical solutions for addressing Current Internal Challenges (CI)
F	Manpower: How to address the problems associated with inadequate labour resource brought about by issues such as lack of skilled/ experienced manpower, organisation-wide freeze on employment and inadequate budgets; the challenge of attracting and retaining skilled manpower and of keeping staff abreast of current technology and legislations.
SCI-F-1	Facilities departments need to understand the demographic changes facing their university and the plan accordingly to avoid future problems: (i) understand the demographic shifts in the city, state and region; (ii) assess the future needs; (iii) identify the gaps between the university have and need.
SCI-F-2	Facilities managers need to (i) assess employee satisfaction and act on the results; (ii) work with the university to develop and implement new strategies and programs; (iii) provide a professional career path for employees so new leaders can be fostered.
SCI-F-3	Facilities department need to confront workforce development issues by: (i) assessing the impact of the recession on the facilities workforce; (ii) helping current staff adjust to change; (iii) developing strategies to bring new skills into organization and (iv) creating knowledge transfer system so the expertise of retiring workers is preserved.
SCI-F-4	The workforce is getting older, more diverse and more in demand thus facilities managers need to (i) understand how changes in the population will affect the workforce and (ii) develop strategies to pass the wisdom of mature workers onto new leaders.
SCI-F-5	Delivering a vibrant work environment that attracts and retains talented staff or labour.

Manpower (SCI-F-1):

SCI = Solution for Current Internal (CI) challenge

SCI-F = 'F' refers to subcategory (issue-related) of current internal challenge

SCI-F-1 = '1' refers to the numbers of solution mentioned as practical solution for the challenge

Table 63: Rating on impact levels of practical solutions for current internal challenges - Manpower

[Level of impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low]										
Practical solutions for addressing Current Internal Challenges (CI)	Frequency of mention (F)	Rating on impact levels (%)								
		VH	H	M	L	VL				
Code	% F	^a R	5	4	3	2	1	^b TR	^c MR	^d R
Manpower										
SCI-F-1	70	H	24	36	24	15	0	370	3.703	H
SCI-F-2	95	VH	46	36	18	0	0	500	4.272	VH
SCI-F-3	100	VH	57	43	0	0	0	528	4.568	VH
SCI-F-4	83	VH	27	32	23	18	0	440	3.682	H
SCI-F-5	87	VH	39	35	26	0	0	460	4.130	VH

^aR = Rating for occurrence frequency: VH (Very High, 80 < %F < 100); H (High: 60 < %F < 80); M (Medium, 40 < %F < 60); L (Low, 20 < %F < 40); VL (Very Low, %F < 20); ^aTR = Total number of respondents identifying a variable; ^cMR = Mean rating of the variable; ^dR = Rating for impact level: VH (Very High, 4 < MR < 5); H (High: 3 < MR < 4); M (Medium, 2 < MR < 3); L (Low, 1 < MR < 2); VL (Very Low, MR < 1).

Practical solutions for addressing the health and safety-related current internal challenges

Table 64 presents the four practical solutions for addressing health and safety-related current internal challenges. Result (Table 65) shows that policies, detailed safety rules and safe working practices to ensure compliance with health and safety legislation must be devised, implemented and regularly reviewed was perceived as the most frequently recurring solution proffered by majority of the respondents for addressing issues around health and safety. Perry (2009) observed that university facilities managers need to ensure the health, safety and welfare at the workplace of all staff (in accordance to the Health and Safety at Work Act 1974), by:

In accordance to Employers' duties, s.2

"Providing safe equipment and working practices; ensuring safe handling, storage and transportation of goods and substance, providing information, training and supervision; providing safe workplace with safe access and egress and providing safe working environment and facilities".

Table 64: Practical solutions for addressing Current Internal (CI) challenges - Health and Safety

Code	Practical solutions for addressing Current Internal Challenges (CI)
G	Health and safety: How to address to the health and safety issues concern on harm to staff and student due to accidents and disasters:
SCI-G-1	All staffs in the workplace need to have adequate knowledge and aware of the compliance with health and safety legislation. It includes shared parts of buildings and the grounds in which the organisation's buildings are set.
SCI-G-2	A competent person must be appointed to the university or facilities department itself, or act as a consultant to assist in implementing and complying with health and safety legislation, whether services are retained in house or out-sourced.
SCI-G-3	Policies, detailed safety rules and safe working practices to ensure compliance with health and safety legislation must be devised, implemented and regularly reviewed.
SCI-G-4	A general policy statement must be produced and this must be communicated well to all stakeholders.
<i>Health & Safety (SCI-G-1):</i> <i>SCI = Solution for Current Internal (CI) challenge</i> <i>SCI-G= 'G' refers to subcategory (issue-related) of current internal challenge</i> <i>SCI-G-1 = '1' refers to the numbers of solution mentioned as practical solution for the challenge</i>	

Table 65: Rating on impact levels of practical solutions for current internal challenges – Health and safety

[Level of impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low]										
Practical solutions for addressing Current Internal Challenges (CI)	Rating on impact levels (%)									
	Frequency of mention (F)	VH	H	M	L	VL				
Code	% F	^a R	5	4	3	2	1	^b TR	^c MR	^d R
Health and safety										
SCI-G-1	92	VH	51	31	18	0	0	488	4.332	VH
SCI-G-2	74	H	38	28	21	13	0	390	3.923	H
SCI-G-3	100	VH	66	34	0	0	0	528	4.663	VH
SCI-G-4	76	H	50	31	14	5	0	400	4.263	VH
^a R = Rating for occurrence frequency: VH (Very High, 80 < %F < 100); H (High: 60 < %F < 80); M (Medium, 40 < %F < 60); L (Low, 20 < %F < 40); VL (Very Low, %F < 20); ^a TR = Total number of respondents identifying a variable; ^c MR = Mean rating of the variable; ^d R = Rating for impact level: VH (Very High, 4 < MR < 5); H (High: 3 < MR < 4); M (Medium, 2 < MR < 3); L (Low, 1 < MR < 2); VL (Very Low, MR < 1).										

In accordance to Duties to non-employees (s.3)

University facilities managers must ensure that “high risk workplace have adequate security and fencing” hence they do not expose their staffs at risk from activities.

In accordance to Suppliers' duties (s.6)

"Those who design, manufacture, import or supply goods or substances for use at work must ensure that they are safe when used properly and provide instructions on how to use them safely".

In accordance to Employees' duties (s.7)

Employees or staff must take care of their own health and safety and other individual at their workplace as well as ensure the legal obligations being met by each individual at the workplace (i.e. wearing personal protective equipment).

In accordance to Personal liability (s.37)

Company directors or facilities managers "may be personally liable for a health and safety offence committed with their consent.

Practical solutions for addressing the materials-related current internal challenges

Table 66 presents the practical solutions for addressing materials related current internal challenges.

Result (Table 67) shows that majority of the respondents (i.e. 100%) perceived that the need to have an effective system that delivers the materials to the site when unpredictable requirements develop during the course of a job, rather than one that requires the mechanic to leave the job site to obtain materials, as the most significant solution for addressing issues around materials.

IFMA (2007) accords this result by observing that another solution to overcome the material issues is "analyzing presence of hazardous materials and develop appropriate strategies to deal with these materials; either to abate, encapsulate or leave-as-is".

Table 66: Practical solutions for addressing Current Internal (CI) challenges - Materials

Code	Practical solutions for addressing Current Internal Challenges (CI)
H	Materials: The challenge to having the correct materials available to maintenance personnel when needed for effective operations.
SCI-H-1	Need to have an effective system that delivers the materials to the site when unpredictable requirements develop during the course of a job, rather than one that requires the mechanic to leave the job site to obtain materials.
SCI-H-2	Need to have a good planning where materials can be provided or stored on the job site or the maintenance worker can take all materials needed to the site at the start of the job.
SCI-H-3	Embraces the "just-in-time" concept, whereby on-hand inventories are reduced and materials are made available through arrangements or contracts with vendors, either on scheduled basis or on short notice as needed.
SCI-H-4	Preventive maintenance consumables should always be readily available before work started.
SCI-H-5	All materials used in maintenance should be charged out against the building or specific building systems and equipment where appropriate. These costs along with labour costs should be accumulated in a hierarchy file to maintain accurate maintenance and repair costs for specific buildings and building components.
SCI-H-6	Regardless of the system used, materials should be made available to field personnel with minimum effort.
SCI-H-7	Maintenance vehicles to be outfitted with commonly required materials.
SCI-H-8	Explore the system for delivering materials to the work sites in cases where workers are making frequent trips from work sites to obtain materials.
SCI-H-9	Provision of emergency spare parts and equipment which must be stored in secure areas but be readily available to after-hours maintenance and repair crews. The items should be carefully inventoried, and usage data should be maintained and periodically reviewed to ensure that only items used for emergencies are carried in the inventory.
SCI-H-10	Need to provide secure spaces in buildings or in mechanical rooms to pre-positioned materials for preventive maintenance work such as lubricants, filters, drive belts and fluorescent tubes.

Materials (SCI-H1):

SCI = Solution for Current Internal (CI) challenge

SCI-H = 'H' refers to subcategory (issue-related) of current internal challenge

SCI-H-1 = '1' refers to the numbers of solution mentioned as practical solution for the challenge

Table 67: Rating on impact levels of practical solutions for current internal challenges – Materials

[Level of impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low]										
Practical solutions for addressing Current Internal Challenges (CI)	Frequency of mention (F)	Rating on impact levels (%)					VL			
		VH	H	M	L					
Code	% F	^a R	5	4	3	2	1	^b TR	^c MR	^d R
Materials										
SCI-H-1	100	VH	43	57	0	0	0	528	4.432	VH
SCI-H-2	95	VH	40	40	20	0	0	500	4.200	VH
SCI-H-3	78	H	32	27	22	20	0	410	3.707	H
SCI-H-4	70	H	27	24	27	22	0	370	3.568	H
SCI-H-5	91	VH	35	38	27	0	0	480	4.083	VH
SCI-H-6	55	M	28	28	16	15	13	290	3.407	H
SCI-H-7	51	M	22	26	17	14	21	270	3.144	H
SCI-H-8	53	M	25	31	18	14	12	281	3.423	H
SCI-H-9	85	VH	33	27	22	18	0	450	3.756	H
SCI-H-10	63	H	27	27	21	18	6	330	3.515	H

^aR = Rating for occurrence frequency: VH (Very High, 80 < %F < 100); H (High: 60 < %F < 80); M (Medium, 40 < %F < 60); L (Low, 20 < %F < 40); VL (Very Low, %F < 20); ^bTR = Total number of respondents identifying a variable; ^cMR = Mean rating of the variable; ^dR = Rating for impact level: VH (Very High, 4 < MR < 5); H (High: 3 < MR < 4); M (Medium, 2 < MR < 3); L (Low, 1 < MR < 2); VL (Very Low, MR < 1).

5.5.1.2 Practical solutions for addressing the external challenges

This section discusses results of the analyzed responses on the practical solutions for addressing the broad categories of external challenges facing university facilities managers.

Practical solutions for addressing the economic-related external challenges

Table 68 lists the solutions for addressing economic-related challenges. Result (Table 69) shows that the most frequently recurring solution for addressing economic issues proffered by respondents was facilities managers to strive realistic expectations within the university. APPA (2009) accords this by suggesting strategies to overcome economic issues: (i) leveraging sustainability to elevate its priority; (ii) incorporate total cost of ownership into the decision making process; and (iii) engage legislators in discussions about sustainability.

Table 68: Practical solutions for addressing Current External (CE) challenges - Economic

Code	Practical solutions for addressing Current External Challenges (CE)
A	Economic: How to proactively manage the micro- and macro- economic climates that have disruptive effects on FM budget and operations, including fluctuations in the exchange rates, interest rates and inflation. Universities must confront the current recession and maintain forward momentum despite economic restraints by shifting expectations among stakeholders:
SCE-A-1	Strive to set realistic expectations within the university.
SCE-A-2	Shun frugality and ensure prudential management of limited resources.
SCE-A-3	As much as possible 'bootstrap', i.e. use less (inputs) to accomplish more (output).
SCE-A-4	Optimise cost-cutting and efficiency in all processes.
SCE-A-5	Maintain sustainability focus in all aspects of FM operation.
SCE-A-6	Incorporate total cost of ownership into the decision-making process.
<i>Economic (SCE-A-1):</i>	
<i>SCE = Solution for Current External (CE) challenge</i>	
<i>SCE-A = 'A' refers to subcategory (issue-related) of current internal challenge</i>	
<i>SCE-A-1 = '1' refers to the numbers of solution mentioned as practical solution for the challenge</i>	

Table 69: Rating on impact levels of practical solutions for current external challenges - Economic

[Level of impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low]										
Practical solutions for addressing Current External Challenges (CE)			Rating on impact levels (%)							
Frequency of mention (F)			VH	H	M	L	VL			
Code	% F	^a R	5	4	3	2	1	^b TR	^c MR	^d R
Economic										
SCE-A-1	100	VH	88	12	0	0	0	428	4.883	VH
SCE-A-2	85	VH	67	22	11	0	0	450	4.556	VH
SCE-A-3	76	H	50	28	23	0	0	400	4.275	VH
SCE-A-4	66	H	51	14	34	0	0	350	4.171	VH
SCE-A-5	57	M	50	23	17	10	0	300	4.133	VH
SCE-A-6	45	M	42	21	29	8	0	240	3.958	H

^aR = Rating for occurrence frequency: VH (Very High, 80 < %F < 100); H (High: 60 < %F < 80); M (Medium, 40 < %F < 60); L (Low, 20 < %F < 40); VL (Very Low, %F < 20); ^bTR = Total number of respondents identifying a variable; ^cMR = Mean rating of the variable; ^dR = Rating for impact level: VH (Very High, 4 < MR < 5); H (High: 3 < MR < 4); M (Medium, 2 < MR < 3); L (Low, 1 < MR < 2); VL (Very Low, MR < 1).

Practical solutions for addressing the sustainability/ environmental-related external challenges

Table 70 presents the practical solutions for addressing sustainability/ environmental-related external challenges. Result (Table 71) shows that majority of the respondents (i.e. 100%) perceived build a culture of sustainability on campus to include staffs, students, faculty, administrators and sustainability influences decision-making across campus, as the most significant solution for addressing sustainability issues.

Table 70: Practical solutions for addressing Current External (CE) challenges – Sustainability/ environmental issues

Code	Practical solutions for addressing Current External Challenges (CE)
B	Sustainability/ environmental issues: Challenge of finding innovative and sustainable ways of managing energy use, waste disposal, resource use and environmental pollution/ contamination; achieving reduce, re-use and re-cycle mandate to waste management.
SCE-B-1	Build a culture of sustainability on campus to include staffs, students, faculty, administrators and sustainability influences decision-making across campus.
SCE-B-2	Ensure the facilities department is leading the charge for campus sustainability - senior facilities officers play vital roles in sustainability discussions, helping shape policy and managing implementation in order to assess their role on campus and where to step up to increase their impact on sustainability discussion.
SCE-B-3	Ensure that facilities managers have the education, skills and leadership abilities to take their place among university decision makers.
SCE-B-4	Develop and implement an energy policy to cut consumption, manage use and reduce volatility.
SCE-B-5	Make a business case for energy efficiency and sustainability.
SCE-B-6	Facilities managers need to communicate the value of the sustainability and energy management effort.
SCE-B-7	Use the campus as a proving ground for new sustainability and energy projects.
SCE-B-8	Leverage sustainability efforts to promote and grow higher education as well as to fuel large-scale social change.
SCE-B-9	Facilities managers need to leverage existing facilities operations and programs to support sustainability.
SCE-B-10	Accept that sustainability focus is not a temporary trend but a long-term shift in the culture.
<i>Sustainability/ environmental (SCE-B-1):</i>	
<i>SCE = Solution for Current External (CE) challenge</i>	
<i>SCE-B= 'B' refers to subcategory (issue-related) of current internal challenge</i>	
<i>SCE-B-1 = '1' refers to the numbers of solution mentioned as practical solution for the challenge</i>	

APPA (2007) suggested several ways for university facilities managers to address sustainability issues such as:

- 1) *Analyzing sustainability trends,*
- 2) *Assessing their university's level of commitment & taking initiative to implement environmentally sustainable strategies;*
- 3) *Offering substantive support for sustainability programs & even curricula within the institution - FM have a lot to offer environmental studies programs, architecture & engineering schools - partnerships with student & faculty groups can be very valuable. FM can earn a lot of goodwill by seeking out student groups that are committed to environmental action & working with them on sustainability initiative.*

Table 71: Rating on impact levels of practical solutions for current external challenges – Sustainability/ environmental

[Level of impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low]										
Practical solutions for addressing Current External Challenges (CE)	Frequency of mention (F)	Rating on impact levels (%)					VL	L	M	H
		VH	H	M	L	VL				
Code	% F	^a R	5	4	3	2	1	^b TR	^c MR	^d R
Sustainability/ environmental										
SCE-B-1	100	VH	72	28	0	0	0	528	4.720	VH
SCE-B-2	80	H	60	21	19	0	0	420	4.405	VH
SCE-B-3	73	H	52	23	15	10	0	388	4.155	VH
SCE-B-4	64	H	44	18	24	6	9	340	3.824	H
SCE-B-5	93	VH	65	27	8	0	0	490	4.571	VH
SCE-B-6	89	VH	64	23	13	0	0	470	4.511	VH
SCE-B-7	57	M	33	17	13	23	13	300	3.333	H
SCE-B-8	55	M	28	14	21	14	24	288	3.083	H
SCE-B-9	49	M	27	12	15	27	19	260	3.000	H
SCE-B-10	38	L	25	15	25	25	10	200	3.200	H

^aR = Rating for occurrence frequency: VH (Very High, 80 < %F < 100); H (High: 60 < %F < 80); M (Medium, 40 < %F < 60); L (Low, 20 < %F < 40); VL (Very Low, %F < 20); ^bTR = Total number of respondents identifying a variable; ^cMR = Mean rating of the variable; ^dR = Rating for impact level: VH (Very High, 4 < MR < 5); H (High: 3 < MR < 4); M (Medium, 2 < MR < 3); L (Low, 1 < MR < 2); VL (Very Low, MR < 1).

Practical solutions for addressing the technological-related external challenges

The practical solutions for addressing technological-related external challenges which are related to rapid changes in technology, including technological obsolescence and the need to upgrade equipment and processes; how to leverage the latest technology to improve on the FM management and operations, are coded and described as follows:

- SCE-C-1: Integrate IT & facilities planning to maximize success.
- SCE-C-2: Seek ways to work with IT to resolve existing issues.
- SCE-C-3: Identify the experts who can help.
- SCE-C-4: Make the right investments to ensure IT resources can withstand disaster.
- SCE-C-5: Assess how technologies in IT will affect all aspects of teaching, learning, research, communications and the built environment.
- SCE-C-6: Develop strategies that will help the institution remain nimble & flexible in the face of rapid technological change.
- SCE-C-7: Strive to develop common goals and a vision that is in alignment with the university's vision and mission.

Result (Table 72) shows majority of the respondents (i.e. 100%) suggested integrate IT and facilities planning to maximize success as the most substantial solution for addressing technological issues. APPA (2010) agrees with this result by opining that “universities should work to better integrate their IT and facilities efforts; insight from the IT side into what students, faculty, and staff want and need from technology is critical for facilities staff as they design new buildings and update old ones”.

Table 72: Rating on impact levels of practical solutions for current external challenges - Technological

[<i>Level of impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low</i>]										
Practical solutions for addressing Current External Challenges (CE)	Frequency of mention (F)	Rating on impact levels (%)								
			VH	H	M	L	VL			
Code	% F	^a R	5	4	3	2	1	^b TR	^c MR	^d R
Technological										
SCE-C-1	100	VH	66	34	0	0	0	528	4.663	VH
SCE-C-2	57	M	30	20	17	20	13	300	3.333	H
SCE-C-3	38	L	25	20	20	10	25	200	3.100	H
SCE-C-4	75	H	38	23	23	16	0	394	3.827	H
SCE-C-5	84	VH	45	32	23	0	0	444	4.225	VH
SCE-C-6	76	H	48	28	25	0	0	400	4.225	VH
SCE-C-7	66	H	35	23	22	14	6	346	3.665	H

^aR = Rating for occurrence frequency: VH (Very High, 80 < %F < 100); H (High: 60 < %F < 80); M (Medium, 40 < %F < 60); L (Low, 20 < %F < 40); VL (Very Low, %F < 20); ^bTR = Total number of respondents identifying a variable; ^cMR = Mean rating of the variable; ^dR = Rating for impact level: VH (Very High, 4 < MR < 5); H (High: 3 < MR < 4); M (Medium, 2 < MR < 3); L (Low, 1 < MR < 2); VL (Very Low, MR < 1).

Practical solutions for addressing the regulatory/ compliance-related external challenges

Table 73 presents the practical solutions for addressing regulatory/ compliance related external challenges. Table 74 shows the most frequently recurring solution proffered by the respondents is to keep on top of the growing number of state and federal regulations that apply to the universities and organization.

APPA (2010) suggested some measures to deal with regulatory burden as follows: “(i) Universities need to provide up-to-date, detailed information on the shifting regulatory an landscape; (ii) Choose to start measuring the cost of regulations as they keep track of their compliance and (iii) should consider advocacy to expressed concern on regulatory burden”.

Table 73: Practical solutions for addressing Current External (CE) challenges - Regulatory/ compliance

Code	Practical solutions for addressing Current External Challenges (CE)
D	Regulatory/ compliance: Challenges arising from compliance with the legislations, by-laws and standards/ codes affecting the FM planning and operations; high compliance costs associated with keeping pace with the regulatory changes; uncertainties and risks to forward planning.
SCE-D-1	Keep on top of the growing number of state and federal regulations that apply to the universities and organization.
SCE-D-2	Advocate for streamlined regulations that are more relevant and less burdensome.
SCE-D-3	Need to better manage existing regulations, start measuring cost of regulations as they keep track of the compliance.
<i>Technological (SCE-D-1):</i>	
<i>SCE = Solution for Current External (CE) challenge</i>	
<i>SCE-D= 'D' refers to subcategory (issue-related) of current internal challenge</i>	
<i>SCE-D-1 = '1' refers to the numbers of solution mentioned as practical solution for the challenges</i>	

Table 74: Rating on impact levels of practical solutions for current external challenges – Regulatory/ compliance

<i>[Level of impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low]</i>										
Practical solutions for addressing Current External Challenges (CE)			Rating on impact levels (%)							
	Frequency of mention (F)		VH	H	M	L	VL			
Code	% F	^a R	5	4	3	2	1	^b TR	^c MR	^d R
Regulatory/ compliance										
SCE-D-1	100	VH	61	39	0	0	0	528	4.606	VH
SCE-D-2	80	H	67	24	10	0	0	420	4.571	VH
SCE-D-3	68	H	44	22	33	0	0	360	4.111	VH
^a R = Rating for occurrence frequency: VH (Very High, 80 < %F < 100); H (High: 60 < %F < 80); M (Medium, 40 < %F < 60); L (Low, 20 < %F < 40); VL (Very Low, %F < 20); ^b TR = Total number of respondents identifying a variable; ^c MR = Mean rating of the variable; ^d R = Rating for impact level: VH (Very High, 4 < MR < 5); H (High: 3 < MR < 4); M (Medium, 2 < MR < 3); L (Low, 1 < MR < 2); VL (Very Low, MR < 1).										

Practical solutions for addressing the socio-cultural related external challenges

Table 75 presents the six practical measures for addressing socio-cultural related external challenges. Respondents' responses on the practical solutions are presented in Table 76. Result shows that managing stakeholder expectations through dialogue and effective communication is perceived by 100% of the respondents as the most significant solution for addressing socio-cultural issues.

APPA (2010) agrees with this result by stating that facilities managers need to ensure that all communication around strategic plans must be efficiently distributed throughout campus community, staff and other stakeholders; so that they will be able to better understand the plan and their associated role within it.

Table 75: Practical solutions for addressing Current External (CE) challenges - Socio-cultural issues

Code	Practical solutions for addressing Current External Challenges (CE)
E	Socio-cultural issues: The challenge of catering for the diverse needs of facilities and infrastructure users, including creating a safe and conducive environment for work and other uses for the facilities. Addressing the ergonomics and accessibility compliance issues, especially for the aged and the handicapped.
SCE-E-1	Manage stakeholder expectations through dialogue and effective communication.
SCE-E-2	Aim to address only critical needs of the key stakeholders; focus on real needs rather than 'wants'.
SCE-E-3	Make a strong case for senior management to prune down admissions to align with existing facility capacity.
SCE-E-4	Optimise space allocation and space utilisation.
SCE-E-5	Leverage alumni and external donations to fund major infrastructure development for communal services.
SCE-E-6	Strategic engagement of the university community in volunteer services for public good such as environmental management, campus cleaning, recycling and waste disposal.
<i>Socio-cultural (SCE-E-1):</i>	
<i>SCE = Solution for Current External (CE) challenge</i>	
<i>SCE-E= 'E' refers to subcategory (issue-related) of current internal challenge</i>	
<i>SCE-E-1 = '1' refers to the numbers of solution mentioned as practical solution for the challenge</i>	

Table 76: Rating on impact levels of practical solutions for current external challenges – Socio-cultural

<i>[Level of impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low]</i>										
Practical solutions for addressing Current External Challenges (CE)			Rating on impact levels (%)							
Code	% F	^a R	VH	H	M	L	VL	^b TR	^c MR	^d R
Socio-cultural										
SCE-E-1	100	VH	66	34	0	0	0	528	4.659	VH
SCE-E-2	70	H	60	25	8	7	0	370	4.381	VH
SCE-E-3	80	H	61	24	15	0	0	420	4.462	VH
SCE-E-4	61	H	50	25	22	3	0	320	4.219	VH
SCE-E-5	57	M	33	20	27	10	10	300	3.567	H
SCE-E-6	93	VH	61	28	12	0	0	490	4.492	VH

^aR = Rating for occurrence frequency: VH (Very High, 80 < %F < 100); H (High: 60 < %F < 80); M (Medium, 40 < %F < 60); L (Low, 20 < %F < 40); VL (Very Low, %F < 20); ^aTR = Total number of respondents identifying a variable; ^cMR = Mean rating of the variable; ^dR = Rating for impact level: VH (Very High, 4 < MR < 5); H (High: 3 < MR < 4); M (Medium, 2 < MR < 3); L (Low, 1 < MR < 2); VL (Very Low, MR < 1).

Practical solutions for addressing the institutional-related external challenges

Table 77 presents the practical solutions for addressing institutional-related external challenges. Result (Table 78) shows that majority of the respondents (i.e. 100%) perceived the most significant solution for addressing institutional issues is facilities managers need to demonstrate their value and the value of facilities to get a seat at the highest tables of decision making within the university by: (i) understanding the current situation; (ii) considering what need to do to raise the profile of facilities; (iii) ensuring that facilities strategic plan is in alignment with the vision, mission and strategies of the university and this alignment can be demonstrated with quantifiable results.

This result is in line with the findings from other past studies. For instance, APPA (2007) said that the issue around aligning facilities planning with institutional goals can be addressed by “(i) getting facilities involved early in the overall planning process, (ii) understanding where the institution want to go and what it wants to be, (iii) evaluating the facilities implications including the financial implications of academic plans; and (iv) develop specific outcomes for generalized goals”.

Table 77: Practical solutions for addressing Current External (CE) challenges - Institutional

Code	Practical solutions for addressing Current External Challenges (CE)
F	Institutional: Challenges presented by organisational politics; catering for the diverse and often conflicting multi-stakeholder interests; lack of FM representation on the university management board; senior management's view of facilities as being part of the operational cost that must be minimised, rather than a strategic asset that must be optimised.
SCE-F-1	Aligning facilities planning with institutional goals: (i) get facilities involved early in the overall planning process, (ii) understand where institutions want to go and what it wants to be, (iii) evaluate the facilities implications including the financial implications of academic plans; (iv) develop specific outcomes for generalized goals.
SCE-F-2	Crafting integrated strategic plan: (i) create a strategic plan that will help the organization focus on its top priorities even during hard financial times; (ii) focus on aligning the organization with the mission of the universities to ensure continuity of focus and direction; (iii) confront the challenges of cost, access and competition; (iv) analyse the organization, structure and financial system for their long-term sustainability and economic viability.
SCE-F-3	Facilities managers need to demonstrate their value and the value of facilities to get a seat at the highest tables of decision making within the university: (i) understand the current situation; (ii) consider what need to do to raise the profile of facilities; (iii) ensure that facilities strategic plan is in alignment with the vision, mission and strategies of the university and this alignment can be demonstrated with quantifiable results.
SCE-F-4	Facilities departments must respond to increased demands for accountability with information that demonstrates how well they are managing the university's resources: (i) develop strategies to demonstrate the facilities department's responsibilities of caretaking the campus of built environment; (ii) determine how best to evaluate the intangibles that contribute to the value of the facilities; (iii) use smart public relations and marketing strategies to communicate your results.

Institutional (SCE-F-1):

SCE = Solution for Current External (CE) challenge

SCE-F= 'F' refers to subcategory (issue-related) of current internal challenge

SCE-F-1 = '1' refers to the numbers of solution mentioned as practical solution for the challenge

Table 78: Rating on impact levels of practical solutions for current external challenges – Institutional

<i>[Level of impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low]</i>										
Practical solutions for addressing Current External Challenges (CE)	Rating on impact levels (%)									
	Frequency of mention (F)		VH	H	M	L	VL			
Code	% F	^a R	5	4	3	2	1	^b TR	^c MR	^d R
Institutional										
SCE-F-1	49	M	46	23	31	0	0	260	4.154	VH
SCE-F-2	76	H	53	28	20	0	0	400	4.325	VH
SCE-F-3	100	VH	61	39	0	0	0	528	4.606	VH
SCE-F-4	57	M	53	23	23	0	0	300	4.300	VH

^aR = Rating for occurrence frequency: VH (Very High, 80 < %F < 100); H (High: 60 < %F < 80); M (Medium, 40 < %F < 60); L (Low, 20 < %F < 40); VL (Very Low, %F < 20); ^aTR = Total number of respondents identifying a variable; ^cMR = Mean rating of the variable; ^dR = Rating for impact level: VH (Very High, 4 < MR < 5); H (High: 3 < MR < 4); M (Medium, 2 < MR < 3); L (Low, 1 < MR < 2); VL (Very Low, MR < 1).

5.6 FINDINGS IN RELATION TO THE FOURTH OBJECTIVE

This section presents and discusses the results of the analyzed responses for meeting the fourth objective of the study; the objective aimed to explore the key future challenges facing university facilities managers in the future.

5.6.1 Key future challenges facing tomorrow's university facilities managers

Tables in this section present the analyzed responses on the key challenges facing tomorrow's university facilities managers in terms of their levels of impact (Table 79), frequencies of occurrence (Table 80) and risk levels (Table 81). The suggested practical solutions for addressing the potential future challenges were also presented in this section (see Table 82 to Table 101).

The analyses serve to prioritize the respondents' views on the key challenges in managing university facilities in the years ahead. The outcome of these analyses will contribute towards realizing the fourth objective of the study.

5.6.1.1 Levels of impact for future challenges

Result (Table 79) shows that majority (i.e. 95%) of the respondents perceived strategic asset management as the most critical future challenge that tomorrow's university facilities managers would face. This is also evident from the highest impact index value of 4.95 achieved by this constraint factor in the analysis. Devine (2003) agrees with the result by observing that one of the priority future challenges facing tomorrow's university facility managers is strategic asset management. Devine (2003) argued that the key success to strategic asset management will depend on the extent to which FM processes align with the strategic objectives of the organization, the quality of those processes and how well technology is leveraged to bring about efficiency and effectiveness in the process.

Table 79: Predicted levels of impact for key future challenges facing tomorrow's university facilities managers

<i>[Level of impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low]</i>										
¹ Future challenges	Level of Impact (%)					² TR	³ II	Remark	⁴ RII	Rank
	VH	H	A	L	VL					
	5	4	3	2	1					
F-1	43	37	20	0	0	528	4.222	Very High	0.078	6
F-2	54	30	17	0	0	528	4.367	Very High	0.080	4
F-3	95	5	0	0	0	528	4.949	Very High	0.091	1
F-4	72	19	10	0	0	528	4.619	Very High	0.085	3
F-5	34	20	19	20	7	528	3.547	High	0.065	10
F-6	16	33	31	12	9	528	3.360	Moderate	0.062	11
F-7	30	33	12	11	13	528	3.564	High	0.066	9
F-8	32	31	18	15	4	528	3.731	High	0.069	8
F-9	17	32	12	29	10	528	3.155	Moderate	0.058	12
F-10	76	14	10	0	0	528	4.659	Very High	0.086	2
F-11	30	13	17	16	24	528	3.070	Moderate	0.056	13
F-12	52	27	20	0	0	526	4.321	Very High	0.079	5
F-13	10	14	36	29	10	528	2.858	Moderate	0.053	14
F-14	39	31	16	11	2	528	3.956	High	0.073	7
54.380							1.000			

¹Future challenges:

F-1) Statutory compliance; F-2) Space management; F-3) Strategic asset management; F-4) Sustainability/environment/ carbon neutrality/ ESD; F-5) Planning/design/ construction/ project management; F-6) Information technology applications for facilities managers; F-7) Maintenance management; F-8) Security/ emergency planning/ fire safety/ critical incidents; F-9) Occupational health and safety; F-10) Leadership and innovation in FM; F-11) Outsourcing/ service contract management; F-12) FM solutions to future teaching & research needs; F-13) Cleaning and waste management; F-14) Business and financial management in FM.

²TR = Total responses for a particular variable;

³II = Impact Index (See equation 1, Chapter 3)

⁴RII = Relative Impact Index (See equation 2, Chapter 3)

5.6.1.2 Frequencies of occurrence for future challenges

Result (Table 80) shows that majority (i.e. 53%) of the respondents predicted statutory compliance as the most frequently occurring key future challenge that will be faced by tomorrow's university facilities managers.

This is also evident from the highest frequency index value of 4.292. APPA (2010) suggested three strategies for addressing statutory compliance: firstly, facilities managers need to "keep on top of the growing number of state and federal regulations that apply to their universities/ organization"; secondly, "advocate for streamlined regulations that are more relevant and less burdensome" and thirdly facilities managers need to better manage existing regulations, start measuring cost of regulations as they keep track of the compliance.

Table 80: Predicted frequencies of occurrence for key future challenges facing tomorrow's university facilities managers

<i>[Frequencies of occurrence: 5 = Very Frequent; 4 = Frequent; 3 = Occasional; 2 = Rare; 1 = Very Rare]</i>										
¹ Future challenges	Frequency of occurrence (%)					² TR	³ FI	Remark	⁴ RFI	Rank
	VF	F	O	R	VR					
	5	4	3	2	1					
F-1	53	23	24	0	0	528	4.292	Very High	0.083	1
F-2	54	20	26	0	0	528	4.284	Very High	0.083	2
F-3	29	38	34	0	0	528	3.947	High	0.076	7
F-4	44	38	18	0	0	528	4.265	Very High	0.082	3
F-5	7	34	23	18	18	528	2.949	Moderate	0.057	13
F-6	34	17	27	16	6	528	3.564	High	0.069	8
F-7	43	41	10	6	0	528	4.208	Very High	0.081	5
F-8	46	41	8	5	1	528	4.252	Very High	0.082	4
F-9	44	26	19	11	0	528	4.019	High	0.078	6
F-10	8	57	20	11	5	528	3.513	High	0.068	9
F-11	9	49	27	9	5	528	3.481	High	0.067	10
F-12	4	42	33	12	9	528	3.188	Moderate	0.062	11
F-13	5	38	26	17	14	528	3.023	Moderate	0.058	12
F-14	2	19	40	30	9	528	2.735	Moderate	0.053	14
							<u>51.720</u>		<u>1.000</u>	

¹Future challenges:

F-1) Statutory compliance; F-2) Space management; F-3) Strategic asset management; F-4) Sustainability/environment/ carbon neutrality/ ESD; F-5) Planning/design/ construction/ project management; F-6) Information technology applications for facilities managers; F-7) Maintenance management; F-8) Security/ emergency planning/ fire safety/ critical incidents; F-9) Occupational health and safety; F-10) Leadership and innovation in FM; F-11) Outsourcing/ service contract management; F-12) FM solutions to future teaching & research needs; F-13) Cleaning and waste management; F-14) Business and financial management in FM.

²TR = Total responses for a particular variable;

³FI = Impact Index (See equation 3, Chapter 3)

⁴RFI = Relative Impact Index (See equation 4, Chapter 3)

5.6.1.3 Risk levels for future challenges

Result (Table 81) shows that university facilities managers predicted sustainability/ environment issues as the most risky challenge that will be faced by tomorrow's university facilities managers. This is evident by the highest risk score value of 19.702. APPA (2006) stated that "facilities managers need to embrace sustainability and cultivate a sense of stewardship toward the university".

Table 81: Predicted risk levels for key future challenges facing tomorrow's university facilities managers

¹ Future challenges	Impact Index	Frequency Index	Risk Score (RS)	Remark	Risk Ranking
	² (Ii)	³ (Fi)	⁴ (Ii x Fi)		
F-1	4.222	4.292	18.118	High	4
F-2	4.367	4.284	18.710	High	3
F-3	4.949	3.947	19.533	High	2
F-4	4.619	4.265	19.702	High	1
F-5	3.547	2.949	10.461	Low	13
F-6	3.360	3.564	11.976	Moderate	10
F-7	3.564	4.208	15.000	Moderate	7
F-8	3.731	4.252	15.864	High	6
F-9	3.155	4.019	12.681	Moderate	9
F-10	4.659	3.513	16.369	High	5
F-11	3.070	3.481	10.687	Moderate	12
F-12	4.321	3.188	13.774	Moderate	8
F-13	2.858	3.023	8.639	Low	14
F-14	3.956	2.735	10.820	Moderate	11

¹ Future challenges:

F-1) Statutory compliance; F-2) Space management; F-3) Strategic asset management; F-4) Sustainability/environment/ carbon neutrality/ ESD; F-5) Planning/design/ construction/ project management; F-6) Information technology applications for facilities managers; F-7) Maintenance management; F-8) Security/ emergency planning/ fire safety/ critical incidents; F-9) Occupational health and safety; F-10) Leadership and innovation in FM; F-11) Outsourcing/ service contract management; F-12) FM solutions to future teaching & research needs; F-13) Cleaning and waste management; F-14) Business and financial management in FM.

²Ii = Impact Index (See equation 1, Chapter 3)

³Fi = Frequency Index (See equation 3, Chapter 3)

⁴RS = Risk Score (See equation 5, Chapter 3)

5.6.1.4 Practical solutions for addressing the future challenges

Table 82 to Table 101 present the practical solutions for addressing key future challenges facing tomorrow's university facilities managers.

Practical solutions for addressing emergency management related future challenges

Table 82 shows seven solutions for addressing emergency management related future challenges for addressing emergency management issues. Result (Table 83) shows that majority of the respondents (i.e 100%) suggested facilities managers to take active role in cross-department business continuity activities, as the most significant solution for addressing this issue.

Table 82: Practical solutions for addressing Future (F) challenges - Emergency management

Code	Practical solutions for addressing Future Challenges (F)
A	Emergency management: Challenges associated with disaster management and recovery plans; safety and security; business continuity and contingency arrangement.
SF-A-1	Facilities managers to take active role in cross-department business continuity activities.
SF-A-2	Expect local, state and federal health and safety mandates to continue to change and evolve and plan for that expense in the budgeting process.
SF-A-3	Engage in advocacy efforts to stem the increasing tide of code expansion.
SF-A-4	Evaluate energy infrastructure for vulnerabilities.
SF-A-5	Look for facilities to play a role in preventing terrorism and crime in protecting IT resources.
SF-A-6	Need to provide a flexible and robust platform for working increases the speed to market for disaster recovery and business continuity.
SF-A-7	Need to retrofit buildings and infrastructure against hazards (e.g. seismic retrofitting) to minimise damage and improve the chances of early re-opening of business premises in the event of disaster).

This result is in agreement with other findings from other studies. For instance, a study by IFMA (2011) examined the level of emergency preparedness among IFMA members worldwide.

This study found that in order to keep business continuity across department, constant support from the top management is required – “Emergency preparedness, disaster recovery and business continuity planning requires senior management support and collaboration across the company; it’s not just facility management function”. In addition, facilities managers need to sustain emergency preparedness in the forefront – “Overall, facilities managers have a greater awareness and are better prepared than 10 years ago, but still need to fight to keep disaster preparedness on the table with resources that have other primary jobs”.

Table 83: Rating on impact levels of practical solutions for emergency management challenges

[Level of impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low]										
Practical solutions for addressing Future Challenges (F)	Frequency of mention (F)	Rating on impact levels (%)								
			VH	H	M	L	VL			
Code	% F	^a R	5	4	3	2	1	^b TR	^c MR	^d R
Emergency management										
SF-A-1	100	VH	57	43	0	0	0	528	4.568	VH
SF-A-2	95	VH	60	36	4	0	0	500	4.560	VH
SF-A-3	72	H	67	33	0	0	0	300	4.667	VH
SF-A-4	91	VH	63	25	13	0	0	480	4.500	VH
SF-A-5	93	VH	20	43	37	0	0	490	3.837	H
SF-A-6	76	H	28	43	30	0	0	400	3.975	H
SF-A-7	89	VH	36	43	21	0	0	470	4.149	VH

^aR = Rating for occurrence frequency: VH (Very High, 80 < %F < 100); H (High: 60 < %F < 80); M (Medium, 40 < %F < 60); L (Low, 20 < %F < 40); VL (Very Low, %F < 20); ^aTR = Total number of respondents identifying a variable; ^cMR = Mean rating of the variable; ^dR = Rating for impact level: VH (Very High, 4 < MR < 5); H (High: 3 < MR < 4); M (Medium, 2 < MR < 3); L (Low, 1 < MR < 2); VL (Very Low, MR < 1).

Practical solutions for addressing statutory compliance related future challenges

Table 84 shows the practical measures for addressing statutory compliance related future challenges. Result (Table 85) shows that majority of the respondents (i.e 100%) suggested the most significant solution for addressing statutory compliance is by ensuring adequate staff knowledge of the compliance standards and legislations governing the FM policies and operations.

To guard against this result, APPA (2010) stated that university facilities managers need to ensure that all of FM staff to “keep on top of growing number of state and federal regulations that apply to their universities and department”.

Table 84: Practical solutions for addressing Future (F) challenges - Statutory compliance

Code	Practical solutions for addressing Future Challenges (F)
B	Statutory compliance: Keeping pace with the rapid changes in the legislations and standards that affect the FM planning and operations; associated high compliance costs and the uncertainties and risks these changes introduce to forward planning.
SF-B-1	Adequate staff knowledge of the compliance standards and legislations governing the FM policies and operations.
SF-B-2	Adequate up-to-date training and courses on skills and communication with regard to the changes in legislations and standards, especially in relation to health & safety issues, energy management and building maintenance.
SF-B-3	Keeping a tab on new and evolving legislations that have significant impact on the FM operations through monitoring relevant bills being passed in the parliament and taking proactive steps in planning for the imminent changes/ effects.
SF-B-4	Use of approved certifiers for the routine checks on building services, appliances and buildings.
SF-B-5	Having designated responsibilities for monitoring and reporting on in-house and vendor awareness of and compliance with standards and legislations affecting FM services.
SF-B-6	Use of external vendor services in outsourcing and limiting the exposure to statutory compliance risks.

Table 85: Rating on impact levels of practical solutions for statutory compliance challenges

[Level of impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low]										
Practical solutions for addressing Future Challenges (F)			Rating on impact levels (%)							
Code	% F	^a R	VH	H	M	L	VL	^b TR	^c MR	^d R
Statutory compliance										
SF-B-1	100	VH	76	24	0	0	0	528	4.758	VH
SF-B-2	91	VH	63	38	0	0	0	480	4.625	VH
SF-B-3	78	H	52	39	10	0	0	413	4.419	VH
SF-B-4	57	M	50	40	10	0	0	301	4.399	VH
SF-B-5	47	M	24	40	20	16	0	250	3.720	H
SF-B-6	42	M	23	45	19	14	0	222	3.766	H

^aR = Rating for occurrence frequency: VH (Very High, 80 < %F < 100); H (High: 60 < %F < 80); M (Medium, 40 < %F < 60); L (Low, 20 < %F < 40); VL (Very Low, %F < 20); ^bTR = Total number of respondents identifying a variable; ^cMR = Mean rating of the variable; ^dR = Rating for impact level: VH (Very High, 4 < MR < 5); H (High: 3 < MR < 4); M (Medium, 2 < MR < 3); L (Low, 1 < MR < 2); VL (Very Low, MR < 1).

Practical solutions for addressing sustainability related future challenges

Table 86 shows the practical measures for addressing sustainability related future challenges. Table 87 shows that majority of the respondents (i.e. 100%) suggested the most significant solution for addressing sustainability issues is by assessing the institution and the department's current level of sustainability; make business case for sustainable practice and for partnerships across the institution. This result is in line with the findings from other past studies. For instance, APPA (2009) suggests that university facilities managers should make a business case for energy efficiency and sustainability

with effective communication around the “value of facilities leaders in the sustainability and energy management effort” as well as “leveraging existing facilities operations and programs to support sustainability”.

Table 86: Practical solutions for addressing Future (F) challenges - Sustainability

Code	Practical solutions for addressing Future Challenges (F)
C	Sustainability: Challenge of minimising the ecological footprint of the facility operation and maintenance; conservation of non-renewable energy; alternative sourcing of renewable energy; waste minimisation, recycling and re-use; pollution and toxic waste management; and resource use optimisation.
SF-C-1	Assess the institution and the department's current level of sustainability; make business case for sustainable practice and for partnerships across the institution.
SF-C-2	Facilities managers need to (i) make sustainability central to all facilities decision making; (ii) set goals and timeframe to succeed; (iii) determine who needs to get involved and how and (iv) take on the leadership role for this strategic issues.
SF-C-3	Facilities managers need to (i) consider creative strategies to reduce risk and manager energy costs; (ii) find ways to include carbon dioxide emissions in the campus growth and energy decisions; (iii) stay current on legislative discussions about energy and carbon costs.
SF-C-4	Facilities need to be designed and operated with the goal of reducing energy costs: (i) adopt strategies to reduce cost for electricity and heating water; (ii) widely use available technologies for reducing utility costs include solar power, wind energy, geothermal heating and cooling biomass.
SF-C-5	Ensure that facilities managers have the (i) education, skills and leadership abilities to take their place among university decision maker; (ii) communicate the value of facilities leaders in the sustainability and energy management effort; (iii) leverage existing facilities operations and programs to support sustainability.

Table 87: Rating on impact levels of practical solutions for sustainability challenges

[Level of impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low]										
Practical solutions for addressing Future Challenges (F)		Rating on impact levels (%)								
Code	% F	^a R	VH	H	M	L	VL	^b TR	^c MR	^d R
Sustainability										
SF-C-1	100	VH	57	24	19	0	0	528	4.379	VH
SF-C-2	91	VH	52	33	15	0	0	480	4.375	VH
SF-C-3	76	H	50	36	14	0	0	400	4.363	VH
SF-C-4	73	H	41	26	22	10	0	387	3.982	H
SF-C-5	66	H	29	28	27	16	0	350	3.689	H

^aR = Rating for occurrence frequency: VH (Very High, 80 < %F < 100); H (High: 60 < %F < 80); M (Medium, 40 < %F < 60); L (Low, 20 < %F < 40); VL (Very Low, %F < 20); ^bTR = Total number of respondents identifying a variable; ^cMR = Mean rating of the variable; ^dR = Rating for impact level: VH (Very High, 4 < MR < 5); H (High: 3 < MR < 4); M (Medium, 2 < MR < 3); L (Low, 1 < MR < 2); VL (Very Low, MR < 1).

Practical solutions for addressing technology related future challenges

Table 88 shows the practical measures for addressing technology related future challenges. Result (Table 89) shows that majority of the respondents (i.e. 100%) suggested the most significant solution for addressing technology issues is by assessing how technologies in IT will affect all aspects of teaching, learning, research, communications and the built environment. APPA (2010) accords this result by suggesting that this measure could be successful by “developing strategies that will help the institution remain nimble and flexible in the face of rapid technological change; making the right investments to ensure IT resources can withstand disaster; and integrating IT and facilities planning to maximize success”.

Table 88: Practical solutions for addressing Future (F) challenges - Technology

Code	Practical solutions for addressing Future Challenges (F)
D	Technology: The challenge of keeping track of and responding proactively to the increasing advances in technology; managing technological obsolescence; the dilemma of choosing between replacing and upgrading to new and efficient technologies, versus retaining and maintaining existing ones that are inefficient.
SF-D-1	Seek ways to work with IT to resolve existing issues; 2) Identify the experts who can help; 3) Strive to develop common goals and a vision that is in alignment with the university's vision and mission.
SF-D-2	Assess how technologies in IT will affect all aspects of teaching, learning, research, communications and the built environment; 2) Develop strategies that will help the institution remain nimble & flexible in the face of rapid technological change; 3) Make the right investments to ensure IT resources can withstand disaster; 4) Integrate IT & facilities planning to maximize success.
SF-D-3	Stay abreast of changing technologies to enhance technologies to enhance productivity and improve operations.

Table 89: Rating on impact levels of practical solutions for technology challenges

[Level of impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low]										
Practical solutions for addressing Future Challenges (F)	Frequency of mention (F)	Rating on impact levels (%)								
		VH	H	M	L	VL				
Code	% F	^a R	5	4	3	2	1	^b TR	^c MR	^d R
Technology										
SF-D-1	86	VH	42	26	32	0	0	454	4.101	VH
SF-D-2	100	VH	57	30	13	0	0	528	4.439	VH
SF-D-3	91	VH	53	25	22	0	0	480	4.308	VH

^aR = Rating for occurrence frequency: VH (Very High, 80 < %F < 100); H (High: 60 < %F < 80); M (Medium, 40 < %F < 60); L (Low, 20 < %F < 40); VL (Very Low, %F < 20); ^aTR = Total number of respondents identifying a variable; ^cMR = Mean rating of the variable; ^dR = Rating for impact level: VH (Very High, 4 < MR < 5); H (High: 3 < MR < 4); M (Medium, 2 < MR < 3); L (Low, 1 < MR < 2); VL (Very Low, MR < 1).

Practical solutions for addressing user needs assessment and satisfaction related future challenges

Table 90 shows the practical measures for addressing user needs assessment and satisfaction related future challenges. Result (Table 91) shows that majority of the respondents (i.e. 100%) suggested the most significant solution for addressing user needs assessment and satisfaction issues is by efficient stakeholder expectation management and enlightenment. APPA (2007) accords this by stating part of user needs assessment and satisfaction challenge is around the establishment of facilities master plans which university facilities managers need to ensure that the master plan reflects university's plans in order to achieve and support academic mission. Thus this measure may include: "getting facilities involve early in the overall planning process; understand where the university wants to go and what it wants to be; evaluating the facilities implications, including the financial implications of academic plans and also developing specific outcomes for generalized goals".

Table 90: Practical solutions for addressing Future (F) challenges - User needs assessment and satisfaction

Code	Practical solutions for addressing Future Challenges (F)
E	User needs assessment and satisfaction: How to effectively identify and satisfy the key needs of users of the university's facilities; how to manage the rapidly changing and complex user needs and expectations. The challenge of adapting the facilities and infrastructure to meet the special needs of some user groups such as the aged and the handicapped.
SF-E-1	Demonstrating a culture of sustained high quality customer service and responsiveness that is supported by appropriate technologies and a clear set of written and well understood standards and benchmarks.
SF-E-2	Routine user-needs assessment and satisfaction surveys, especially, post-occupancy evaluations (POE).
SF-E-3	User and wider stakeholder consultations in making prime decisions and in formulating action plans for infrastructure procurement and space allocation.
SF-E-4	Active engagement of key stakeholder representative groups in crucial FM forums with a view to building and maintaining good communication flow and cordial relations.
SF-E-5	Prompt and satisfactory response to user requests and needs within the constraints of available resources.
SF-E-6	Stakeholder expectation management and enlightenment.

Table 91: Rating on impact levels of practical solutions for user needs assessment and satisfaction challenges

[Level of impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low]										
Practical solutions for addressing Future Challenges (F) Code	Frequency of mention (F) % F	^a R	Rating on impact levels (%)					^b TR	^c MR	^d R
			VH	H	M	L	VL			
			5	4	3	2	1			
User needs assessment and satisfaction										
SF-E-1	57	M	27	30	33	10	0	299	3.732	H
SF-E-2	48	M	36	32	23	9	0	252	3.940	H
SF-E-3	76	H	50	25	15	10	0	400	4.150	VH
SF-E-4	93	VH	54	20	14	11	0	490	4.173	VH
SF-E-5	71	H	48	26	16	11	0	376	4.106	VH
SF-E-6	100	VH	57	24	19	0	0	528	4.381	VH

^aR = Rating for occurrence frequency: VH (Very High, 80 < %F < 100); H (High: 60 < %F < 80); M (Medium, 40 < %F < 60); L (Low, 20 < %F < 40); VL (Very Low, %F < 20); ^aTR = Total number of respondents identifying a variable; ^cMR = Mean rating of the variable; ^dR = Rating for impact level: VH (Very High, 4 < MR < 5); H (High: 3 < MR < 4); M (Medium, 2 < MR < 3); L (Low, 1 < MR < 2); VL (Very Low, MR < 1).

Practical solutions for addressing business and financial management related future challenges

Table 92 shows the practical measures for addressing business and financial related future challenges. Result (Table 93) shows that majority of the respondents (i.e. 100%) suggested the most significant solution for business and financial management issues is by having robust granular asset data and history to support planning/prioritisation based on risk. This result is in agreement with findings from other studies.

For instance, APPA (2006) suggests that business and financial management issues could be addressed by having “comprehensive and credible data about the operations and performance” in which this information is useful in establishing priorities and strategic decisions. APPA (2011) lends credence to this statement by observing that with the “increasing quantity and complexity of data available to facility managers through new reporting protocol”, most of the FM departments now “have added the ability to convert raw data into usable and meaningful information that fosters informed decision making”.

APPA (2011) also observes that “the increased focus on business acumen will require facility professionals to think and act strategically as well as to communicate positions their positions in board level”.

Table 92: Practical solutions for addressing Future (F) challenges - Business and financial management

Code	Practical solutions for addressing Future Challenges (F)
F	Business and financial management issues: How to minimise the operational costs of the large asset base of the university especially as it relates to energy use; how to leverage the advances in technology to re-engineer FM processes with a view to improving productivity, lowering operational costs and ensuring efficient and innovative facilities management, replacement of inefficient facilities and equipment with smart technologies as part of the maintenance and procurement agenda.
SF-F-1	Robust granular asset data and history to support planning/prioritisation based on risk.
SF-F-2	Accurate data collection. Strategies to reduce. Spend to save initiatives to be budgeted for.
SF-F-3	Financial planning, monitoring and control to ensure that expenditures are kept within budget.
SF-F-4	Leverage of technology in the FM processes with a view to improving speed and accuracy and minimising operational costs.
SF-F-5	Strategic use of outsourcing to minimise operational costs.

Table 93: Rating on impact levels of practical solutions for business and financial management challenges

[Level of impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low]										
Practical solutions for addressing Future Challenges (F)	Frequency of mention (F)	Rating on impact levels (%)								
		VH	H	M	L	VL				
Code	% F	^a R	5	4	3	2	1	^b TR	^c MR	^d R
Business and financial management										
SF-F-1	100	VH	76	24	0	0	0	528	4.758	VH
SF-F-2	72	H	63	24	13	0	0	378	4.497	VH
SF-F-3	87	VH	65	22	13	0	0	460	4.522	VH
SF-F-4	80	H	24	45	21	10	0	420	3.833	H
SF-F-5	57	M	17	30	33	20	0	300	3.433	H

^aR = Rating for occurrence frequency: VH (Very High, 80 < %F < 100); H (High: 60 < %F < 80); M (Medium, 40 < %F < 60); L (Low, 20 < %F < 40); VL (Very Low, %F < 20); ^aTR = Total number of respondents identifying a variable; ^cMR = Mean rating of the variable; ^dR = Rating for impact level: VH (Very High, 4 < MR < 5); H (High: 3 < MR < 4); M (Medium, 2 < MR < 3); L (Low, 1 < MR < 2); VL (Very Low, MR < 1).

Practical solutions for addressing occupational health and safety related future challenges

Table 94 shows the practical measures for addressing occupational health and safety related future challenges. Result (Table 95) shows that majority of the respondents (i.e. 100%) suggested the most significant solution for occupational health and safety issues is by having developing effective policies, decision-making processes and standards.

Atkin and Brooks (2000) agrees with the result by stating that “policies, detailed safety rules and safe working practices to ensure compliance with health and safety legislation must be devised, implemented and regularly reviewed”.

Table 94: Practical solutions for addressing Future (F) challenges - Occupational health and safety

Code	Practical solutions for addressing Future Challenges (F)
G	Occupational health and safety: Challenge of providing conducive, safe and healthy work environment that supports productivity and excellence in the key activities of the institution, especially research, teaching and learning and how to manage compliance with security, ergonomics and occupational health and safety issues such as poor indoor air quality and musculo-skeletal disorders (MSD).
SF-G-1	Develop effective policies, decision-making processes and standards.
SF-G-2	Establish metrics to better measure and allocate space.
SF-G-3	Create effective organizational governance structures.
SF-G-4	Implement incentives to encourage smart space management.
SF-G-5	Provide high level of services over a minimum facility and encourage users to manage a lot more of their own needs through user-education. with users.
SF-G-6	Facilities departments must provide and maintain as far as practicable, a healthy and safe place at work.

Table 95: Rating on impact levels of practical solutions for occupational health and safety challenges

[Level of impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low]										
Practical solutions for addressing Future Challenges (F)			Rating on impact levels (%)							
	Frequency of mention (F)		VH	H	M	L	VL			
Code	% F	^a R	5	4	3	2	1	^b TR	^c MR	^d R
Occupational health and safety										
SF-G-1	100	VH	58	23	19	0	0	528	4.383	VH
SF-G-2	42	M	32	21	19	28	0	528	3.572	H
SF-G-3	73	H	56	19	25	0	0	528	4.318	VH
SF-G-4	53	M	33	25	19	22	0	528	3.693	H
SF-G-5	81	VH	57	19	24	0	0	528	4.326	VH
SF-G-6	57	M	42	36	22	0	0	528	4.197	VH

^aR = Rating for occurrence frequency: VH (Very High, 80 < %F < 100); H (High: 60 < %F < 80); M (Medium, 40 < %F < 60); L (Low, 20 < %F < 40); VL (Very Low, %F < 20); ^aTR = Total number of respondents identifying a variable; ^cMR = Mean rating of the variable; ^dR = Rating for impact level: VH (Very High, 4 < MR < 5); H (High: 3 < MR < 4); M (Medium, 2 < MR < 3); L (Low, 1 < MR < 2); VL (Very Low, MR < 1).

Practical solutions for addressing leadership and innovation in FM related future challenges

Table 96 shows the practical measures for addressing leadership and innovation in FM -related future challenges. Result (Table 97) shows that majority of the respondents (i.e. 100%) suggested the most significant solution for leadership and innovation in FM issues is by creating a "learning culture" in which opportunities for formal and informal learning can occur among employees up and down the organization chart. APPA (2010) observes that facilities managers need to have "education, knowledge, skills and leadership abilities to take their place among institutional decision-maker".

Table 96: Practical solutions for addressing Future (F) challenges - Leadership and innovation in FM

Code	Practical solutions for addressing Future Challenges (F)
H	Leadership and innovation in facilities management: How to lead and motivate the workforce to greater levels of productivity and performance amidst organisational socio-cultural and political barriers
SF-H-1	Articulate sound vision and winning strategies and ensure buy-in by top management and workforce.
SF-H-2	Implement problem-solving tools in the FM department in concert with industry innovators.
SF-H-3	Ensuring that personal development remains a key performance objective for all staff.
SF-H-4	Creating cross-disciplinary learning opportunities.
SF-H-5	Matching the competencies needed for achieving organizational objectives against the skill inventories of incumbents.
SF-H-6	Keeping the development and advancement of subordinates a meaningful metric for the assessment of leaders.
SF-H-7	Maintaining close ties between hiring managers and recruitment professionals; in cases in which core competencies are in short supply in the labor pool, internal training programs might be an economical solution.
SF-H-8	Monitoring performance appraisal tools for trends in employee development needs.
SF-H-9	Considering the value of knowledge management programs to identify, harvest, archive, retrieve and transfer organizational knowledge.
SF-H-10	Delivering a vibrant work environment that attracts and retained talented staff or labour.
SF-H-11	Creating a "learning culture" in which opportunities for formal and informal learning can occur among employees up and down the organization chart.
SF-H-12	Building learning opportunities into every post-project evaluation.

APPA (2007) observed that the key success in creating "learning culture" among employees and top management is by having effective and wide range of communications such as emails, websites and newsletters in which the "new communication technology available on campus makes dispersal of information much easier". University facilities managers need to "focus on the big picture for senior administrators, on the bottom line for a financial audience and pedagogical themes for faculty".

Table 97: Rating on impact levels of practical solutions for leadership and innovation in FM challenges

[Level of impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low]										
Practical solutions for addressing Future Challenges (F)	Frequency of mention (F)	Rating on impact levels (%)								
			VH	H	M	L	VL			
Code	% F	^a R	5	4	3	2	1	^b TR	^c MR	^d R
Leadership and innovation in FM										
SF-H-1	85	VH	67	33	0	0	0	450	4.667	VH
SF-H-2	76	H	64	36	0	0	0	380	4.637	VH
SF-H-3	91	VH	79	21	0	0	0	480	4.792	VH
SF-H-4	44	M	30	22	13	22	13	230	3.348	H
SF-H-5	57	M	33	30	27	10	0	300	3.867	H
SF-H-6	45	M	33	29	8	29	0	240	3.667	H
SF-H-7	38	L	20	25	20	20	15	200	3.150	H
SF-H-8	70	H	62	38	0	0	0	369	4.623	VH
SF-H-9	54	M	35	31	18	16	0	284	3.849	H
SF-H-10	61	H	31	38	31	0	0	320	4.000	VH
SF-H-11	100	VH	76	24	0	0	0	528	4.758	VH
SF-H-12	48	M	35	34	16	15	0	255	3.886	H

^aR = Rating for occurrence frequency: VH (Very High, 80 < %F < 100); H (High: 60 < %F < 80); M (Medium, 40 < %F < 60); L (Low, 20 < %F < 40); VL (Very Low, %F < 20); ^aTR = Total number of respondents identifying a variable; ^cMR = Mean rating of the variable; ^dR = Rating for impact level: VH (Very High, 4 < MR < 5); H (High: 3 < MR < 4); M (Medium, 2 < MR < 3); L (Low, 1 < MR < 2); VL (Very Low, MR < 1).

Practical solutions for addressing space management related future challenges

Table 98 shows the practical measures for addressing space management related future challenges. Result (Table 99) shows that majority of the respondents (i.e. 100%) suggested the most significant solution for space management issues is by developing effective policies, processes, and organizational structures to manage space.

APPA (2012) suggests key strategies for the development of effective policies and processes which involves: (i) assessing and revising the space management current processes, policies and organizational structures; (ii) prioritizing what should change in the campus space management system; (iii) take time to research for key best practices in space management by considering the policies and processes that will succeed in the campus and (iv) seek out experts in space management and case studies of successful universities to find models for new policies”.

Table 98: Practical solutions for addressing Future (F) challenges - Space management

Code	Practical solutions for addressing Future Challenges (F)
I	Space management: The challenge of optimising the utilisation of space, plant, equipment and grounds; elimination of redundancy in asset use.
SF-I-1	Align space management to the mission of the university: (i) assess how well the facilities department and university mission, master plan and space management program are in alignment today; (ii) identify key priorities from the mission and master plan need to be incorporated into space management; (iii) build relationships between groups and individuals in charge of updating and implementing both the master and the space management plan; (iv) deal with the challenge of integrating space planning and scenario-based strategic planning for the future.
SF-I-2	Make space one of the top assets of the university: (i) understand how the space is valued now within the university; (ii) reach out to the right individual; (iii) gather data about the value of space to make the case.
SF-I-3	Change the culture of space: (i) assess the current culture of space; (ii) describe the sort of changes the facilities department and university want to see and (iii) develop concrete steps to move toward the vision.
SF-I-4	Develop effective policies, processes, and organizational structures to manage space: (i) assess current processes, policies and organizational structures; (ii) prioritize what should change in the campus space management system and (iii) emphasize key best practices.
SF-I-5	Implement a space inventory system to understand resources and identify needs: (i) outline priorities for a space inventory system; (ii) assess the pros and cons of the current system; and (iii) move toward a robust, flexible, accessible inventory.
SF-I-6	Address space utilization by assembling credible data and adopting best practices: (i) integrate inventory and scheduling systems to automate utilization tracking; (ii) examine best practices for improve utilization.
SF-I-7	The future needs single service space control as opposed to multi user space control. Space would be managed with the mandate for efficient use and run a timetabling service. Flexible space is also key to future space.
SF-I-8	Ensure all existing space is fully utilised and regularly assess the utilisation of space through audits, teaching room utilisation surveys and comparison with standards.
SF-I-9	Encourage communal rather than territorial attitudes to space.
SF-I-10	Explore innovative ways of meeting space and facility needs that are based around existing assets e.g. development of furniture and layout options to use corridor spaces as informal learning spaces.
SF-I-11	All developments designed as generically as possible, providing a range spaces (type, size, function) to enable space to be easily re-allocated or adapted.
SF-I-12	Encourage units to identify desk space for new positions from within existing allocations.
SF-I-13	Ensuring timetabling policies optimise usage of teaching rooms.
SF-I-14	Specialised rooms to be fully utilised before a duplicate is built.
SF-I-15	Storage spaces, meeting rooms, copy areas and tea facilities to be shared where possible to avoid duplication. Copy rooms and storage located only in spaces unsuitable for other uses.
SF-I-16	Minimise the duplication of support services across campuses.
SF-I-17	Encouraging open plan, multiple room occupancy and hot-desking where appropriate.

Table 99: Rating on impact levels of practical solutions for space management challenges

[Level of impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low]										
Practical solutions for addressing Future Challenges (F)	Frequency of mention (F)	Rating on impact levels (%)								
			VH	H	M	L	VL			
Code	% F	^a R	5	4	3	2	1	^b TR	^c MR	^d R
Space management										
SF-I-1	91	VH	73	27	0	0	0	480	4.729	VH
SF-I-2	55	M	28	24	17	17	14	290	3.345	H
SF-I-3	85	VH	71	22	7	0	0	450	4.644	VH
SF-I-4	100	VH	77	23	0	0	0	528	4.775	VH
SF-I-5	95	VH	76	24	0	0	0	500	4.760	VH
SF-I-6	82	VH	69	23	8	0	0	432	4.616	VH
SF-I-7	38	L	25	20	25	22	9	200	3.295	H
SF-I-8	61	H	53	22	25	0	0	320	4.281	VH
SF-I-9	38	L	24	20	30	17	9	198	3.333	H
SF-I-10	47	M	20	16	32	16	16	250	3.080	H
SF-I-11	51	M	30	22	19	11	19	270	3.333	H
SF-I-12	36	L	16	11	26	18	29	190	2.658	M
SF-I-13	28	L	19	13	13	27	29	150	2.660	M
SF-I-14	76	H	63	25	13	0	0	400	4.500	VH
SF-I-15	27	L	18	16	21	14	31	140	2.757	M
SF-I-16	72	H	53	21	21	5	0	380	4.211	VH
SF-I-17	34	L	17	20	21	26	17	180	2.939	M
^a R = Rating for occurrence frequency: VH (Very High, 80 < %F < 100); H (High: 60 < %F < 80); M (Medium, 40 < %F < 60); L (Low, 20 < %F < 40); VL (Very Low, %F < 20); ^a TR = Total number of respondents identifying a variable; ^c MR = Mean rating of the variable; ^d R = Rating for impact level: VH (Very High, 4 < MR < 5); H (High: 3 < MR < 4); M (Medium, 2 < MR < 3); L (Low, 1 < MR < 2); VL (Very Low, MR < 1).										

Practical solutions for addressing outsourcing related future challenges

Table 100 shows the practical measures for addressing outsourcing related future challenges. Result (Table 101) shows that majority of the respondents (i.e. 100%) suggested the most significant solution for outsourcing issues is by understanding current client operations in order to obtain good picture of current operations which includes developing and documenting a baseline from financial, performance and service level perspectives in order to measure possible gains in efficiency as well as cost savings from outsourcing.

Table 100: Practical solutions for addressing Future (F) challenges – Outsourcing

Code	Practical solutions for addressing Future Challenges (F)
J	Outsourcing: The challenge of striking an intricate balance between outsourcing of peripheral facilities services and the in-house provision of core FM operations.
SF-J-1	Preparing for outsourcing: established Client's mandate to outsource services, gathered baseline information and established the business case at the early stage for a better guide to building a solid service contract.
SF-J-2	Understanding current Client operations: To obtain good picture of current operations which includes developing and documenting a baseline from financial, performance and service level perspectives in order to measure possible gains in efficiency as well as cost savings from outsourcing.
SF-J-3	Effective communication at service level and budget expectations to a service provider: critical systems and services must be clearly identified, required operating procedures documented and critical service levels established.
SF-J-4	Verify the best fit service provider in terms of the service provider's organization and capabilities; and evaluating the service provider's proposed service delivery solution.
SF-J-5	Negotiate a contract structure with strong Client rights and service provider obligations. Transfer risk with responsibility.
SF-J-6	Actively manage the transition as it sets the tone for the relationship.
SF-J-7	Have a longer term transformation plan as well as the near term transition (or implementation) plan.
SF-J-8	Ensure post-deal continuity. Manage according to the contract and ensure that there good communications across multiple levels in the partnering relationship. Define and follow an agreed upon dispute resolution process.
SF-J-9	Create a post-deal service provider management program. Include regular reviews of performance and have a clear process to resolve disputes.
SF-J-10	Need to improve service delivery by specialist.
SF-J-11	Need to improve management of existing resources and transformational initiatives.
SF-J-11	Need to have better attraction and retention of staff.

Kamarazaly (2007) observed that “outsourcing creates competitive advantage when products or services are produced more effectively and efficiently by outside suppliers” and this could enhance the competitiveness of an organization (Gilley and Rasheed, 2000).

Katsanis (2003) stated that outsourcing helps university facilities managers and the FM departments to: “re-examine their mission and strategic aspects of their activities base on organizational strengths and existing core competencies; focus on the development of core competences; allows rapid response to problems by virtue access to already available teams of experts; and promote access to innovation by doing away with the risks an cost associated with the incubation and development of innovation”.

Table 101: Rating on impact levels of practical solutions for outsourcing challenges

[Level of impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low]										
Practical solutions for addressing Future Challenges (F)	Frequency of mention (F)	Rating on impact levels (%)					VL			
		VH	H	M	L					
Code	% F	^a R	5	4	3	2	1	^b TR	^c MR	^d R
Outsourcing										
SF-J-1	57	M	33	50	17	0	0	300	4.167	VH
SF-J-2	100	VH	80	20	0	0	0	528	4.801	VH
SF-J-3	95	VH	80	20	0	0	0	499	4.800	VH
SF-J-4	76	H	75	25	0	0	0	400	4.750	VH
SF-J-5	49	M	35	38	15	12	0	260	3.962	H
SF-J-6	44	M	30	35	17	17	0	230	3.783	H
SF-J-7	29	L	17	22	32	23	6	155	3.213	H
SF-J-8	47	M	32	36	12	20	0	250	3.800	H
SF-J-9	38	L	15	20	35	30	0	200	3.200	H
SF-J-10	68	H	61	25	14	0	0	360	4.472	VH
SF-J-11	32	L	19	21	25	29	6	170	3.171	H
SF-J-11	28	L	13	27	27	30	4	150	3.140	H

^aR = Rating for occurrence frequency: VH (Very High, 80 < %F < 100); H (High: 60 < %F < 80); M (Medium, 40 < %F < 60); L (Low, 20 < %F < 40); VL (Very Low, %F < 20); ^bTR = Total number of respondents identifying a variable; ^cMR = Mean rating of the variable; ^dR = Rating for impact level: VH (Very High, 4 < MR < 5); H (High: 3 < MR < 4); M (Medium, 2 < MR < 3); L (Low, 1 < MR < 2); VL (Very Low, MR < 1).

5.7 CHAPTER SUMMARY

In this chapter, university facilities managers' ratings of the impact levels, frequencies of occurrence and risk scores of internal, external and future challenges facing university facilities managers in Australasian region have been presented, analyzed and discussed. The perceived practical solutions for addressing these challenges were also presented and analyzed. The analyses served to provide parameters for testing the significance of divergence between the views of university facilities managers on the challenges they faced in managing their universities' facilities. The analysis also helped to explore areas of consensus of opinions, as well as provide multiple sources of evidence for evaluating issues of reliability and validity of the research design and findings. In the following chapters, attention is turned to the results gathered from the model test surveys among Australasian universities (see Chapter 6).

CHAPTER 6: MODEL TEST SURVEYS

6.1 INTRODUCTION

The objective of the second stage of quantitative data gathering was to test the model developed from the questionnaire survey data amongst a randomly selected sample of university FM departments in New Zealand and Australia. The data gathering was carried out via case studies as described in the Methodology section. The essence of the analyses presented in this chapter is to obtain parameters for testing significance of the differences between the results obtained from the questionnaire surveys and those obtained from the model test surveys. The key focus was on whether the variables identified in the quantitative questionnaire surveys are robust enough to define the set of challenges faced by university facilities managers in the Australasian region or whether significant amount of variables have surfaced in the model test surveys, which were not identified in the quantitative surveys. Also the model test surveys served to examine the applicability of the findings in the larger scale quantitative surveys in the context of individual facilities management departments.

Five randomly selected universities had agreed to participate in the model test surveys - two from New Zealand and three from Australia. Details of the model test design; implementation and analysis approaches were explained in section 3.7 of the Methodology chapter.

6.2 MODEL TEST SURVEYS RESPONSES

In this section, the respondents' feedback for each case study is presented and analyzed in the following tables for three streams of analysis: (i) the levels of impact; (ii) the frequencies of occurrence; and (iii) risk scores of the underlying challenges constraining the achievement of strategic FM goals for each broad category of identified internal, external and future challenges.

6.2.1 CASE STUDY I: UNIVERSITY A

In the first case study (of University 'A'), a total of five responses were obtained from the director and senior managers of the FM department. Responses on the broad categories of current internal (CI), current external (CE) and expected future (F) challenges are presented and analyzed in the following sub-sections.

6.2.1.1 Current Internal (CI) challenges constraining the achievement of strategic FM goals

Table 102 – Table 104 present the analysis of respondents' ratings of (i) levels of impact; (ii) frequencies of occurrence; and (iii) risk scores for the identified current internal (CI) challenges constraining the achievement of strategic FM goals.

Table 102 shows that the first case study university rated finance (CI-1) as the broad category of internal challenge having the most profound impact on the strategic goals of the university facilities managers. Table 103 shows that finance was also perceived as the most frequently occurring broad category of internal challenge, hence the most risky of all the 7 broad categories identified in the study (Table 104).

This result is consistent with the findings in other studies. For instance, Hazelkorn (2011) found that decreasing funding is the most critical of the key challenges facing higher education in Ireland, adding that the focus is on "ensuring sustainable higher education systems at the same time that public funding is decreasing and competitiveness is increasing" (p.1).

Table 102: University A - Levels of impact for CI challenges

Code	* Rating for impact levels (%)					TR	II	Remark	RII	Rank
	VH 5	H 4	M 3	L 2	VL 1					
CI-1	0	100	0	0	0	5	4.00	High	0.211	1
CI-2	0	80	20	0	0	5	3.80	High	0.200	2
CI-3	0	0	20	60	20	5	2.00	Low	0.105	5
CI-4	0	40	60	0	0	5	3.40	High	0.179	3
CI-5	0	20	60	20	0	5	3.00	Moderate	0.158	4
CI-6	0	0	20	40	40	5	1.80	Low	0.095	6
CI-7	0	0	0	0	100	5	1.00	Very Low	0.053	7
							<u>19.00</u>		<u>1.000</u>	

Broad categories of Current Internal (CI) challenges:

CI-1) Finance; CI-2) Operational efficiency; CI-3) Risk management; CI-4) Stakeholder needs/ Service providers; CI-5) Maintenance; CI-6) Manpower; CI-7) Machinery/ equipment.

Table 103: University A - Frequencies of occurrence for CI challenges

Code	Rating for frequency of occurrence					TR	FI	Remark	RII	Rank
	VF %	F %	O %	R %	VR %					
	5	4	3	2	1					
CI-1	100	0	0	0	0	5	5.00	Very High	0.238	1
CI-2	0	0	40	40	20	5	2.20	Low	0.105	5
CI-3	0	20	40	40	0	5	2.80	Moderate	0.133	4
CI-4	40	60	0	0	0	5	4.40	Very High	0.210	2
CI-5	40	40	20	0	0	5	4.20	Very High	0.200	3
CI-6	0	0	0	40	60	5	1.40	Very Low	0.067	6
CI-7	0	0	0	0	100	5	1.00	Very Low	0.048	7
							<u>21.00</u>		<u>1.000</u>	

Broad categories of Current Internal (CI) challenges:

CI-1) Finance; CI-2) Operational efficiency; CI-3) Risk management; CI-4) Stakeholder needs/ Service providers; CI-5) Maintenance; CI-6) Manpower; CI-7) Machinery/ equipment.

Table 104: University A - Risk scores for CI challenges

Code	Impact Index (Ii)	Frequency Index (Fi)	Risk Score (RS) (Ii x Fi)	Remark	Risk Ranking
CI-1	4.000	5.000	20.000	High	1
CI-2	3.800	2.200	8.360	Low	4
CI-3	2.000	2.800	5.600	Very low	5
CI-4	3.400	4.400	14.960	Moderate	2
CI-5	3.000	4.200	12.600	Moderate	3
CI-6	1.800	1.400	2.520	Very low	6
CI-7	1.000	1.000	1.000	Very low	7

Broad categories of Current Internal (CI) challenges:
 CI-1) Finance; CI-2) Operational efficiency; CI-3) Risk management; CI-4) Stakeholder needs/ Service providers; CI-5) Maintenance; CI-6) Manpower; CI-7) Machinery/ equipment.

6.2.1.2. Current External (CE) challenges constraining the achievement of strategic FM goals

Table 105 to Table 107 in this section present the respondents' ratings of (i) levels of impact; (ii) frequencies of occurrence; and (iii) risk scores for the identified current external challenges (CE) constraining the achievement of strategic FM goals.

Table 105 shows that regulatory/ compliance (CE-4) has been rated by the first case study university as the broad external challenge category having the most profound impact on the strategic FM goals. Table 106 shows that regulatory/ compliance was perceived as the most frequently occurring broad external challenge category, thus being rated as the most risky factor among 7 others identified in this study (Table 107).

The result is in harmony with the view expressed by APPA (2010) that regulatory compliance is the most crucial of the key challenges facing higher education in US, as "higher education institutions face more regulations than almost any other type of organization" such as regulations concerning adequate security, proper fire protection for laboratories and dorms, students' privacy protection, proper disposal system for hazardous waste and etc. APPA (2010) pointed out that "institution needs to work to lighten the burden of regulations on higher education" (p.25).

Table 105: University A - Levels of impact for CE challenges

Code	* Rating for impact levels (%)					TR	II	Remark	RII	Rank
	VH 5	H 4	M 3	L 2	VL 1					
CE-1	0	40	60	0	0	5	3.40	High	0.140	4
CE-2	0	20	40	20	20	5	2.60	Moderate	0.107	6
CE-3	0	0	40	40	20	5	2.20	Low	0.091	7
CE-4	100	0	0	0	0	5	5.00	Very High	0.207	1
CE-5	0	40	20	40	0	5	3.00	Moderate	0.124	5
CE-6	0	60	40	0	0	5	3.60	High	0.149	3
CE-7	60	20	20	0	0	5	4.40	Very High	0.182	2
							<u>24.20</u>		<u>1.000</u>	
<i>Broad categories of Current External (CE) challenges:</i> CE-1) Economic; CE-2) Sustainability / environmental issues; CE-3) Technological; CE-4) Regulatory/ compliance; CE-5) Socio-cultural issues/ CE-6) Institutional; CE-7) Government/ TEC influence.										

Table 106: University A - Frequencies of occurrence for CE challenges

Code	Rating for frequency of occurrence					TR	FI	Remark	RII	Rank
	VF	F	O	R	VR					
	% 5	% 4	% 3	% 2	% 1					
CE-1	60	40	0	0	0	5	4.60	Very High	0.177	2
CE-2	0	60	40	0	0	5	3.60	High	0.138	5
CE-3	0	0	0	40	60	5	1.40	Very Low	0.054	7
CE-4	80	20	0	0	0	5	4.80	Very High	0.185	1
CE-5	0	60	40	0	0	5	3.60	High	0.138	5
CE-6	20	40	40	0	0	5	3.80	High	0.146	4
CE-7	20	80	0	0	0	5	4.20	Very High	0.162	3
							<u>26.00</u>		<u>1.000</u>	
<i>Broad categories of Current External (CE) challenges:</i> CE-1) Economic; CE-2) Sustainability / environmental issues; CE-3) Technological; CE-4) Regulatory/ compliance; CE-5) Socio-cultural issues/ CE-6) Institutional; CE-7) Government/ TEC influence.										

Table 107: University A - Risk scores for CE challenges

Code	Impact Index	Frequency Index	Risk Score (RS)	Remark	Risk Ranking
	(Ii)	(Fi)	(Ii x Fi)		
CE-1	3.400	4.600	15.640	High	3
CE-2	2.600	3.600	9.360	Low	6
CE-3	2.200	1.400	3.080	Very low	7
CE-4	5.000	4.800	24.000	Very high	1
CE-5	3.000	3.600	10.800	Moderate	5
CE-6	3.600	3.800	13.680	Moderate	4
CE-7	4.400	4.200	18.480	High	2

Broad categories of Current External (CE) challenges:
CE-1) Economic; CE-2) Sustainability / environmental issues; CE-3) Technological; CE-4) Regulatory/ compliance; CE-5) Socio-cultural issues/ CE-6) Institutional; CE-7) Government/ TEC influence.

6.2.1.3. Predicted Future (F) challenges constraining the achievement of strategic FM goals

Table 108 to Table 110 in this section present the respondents' ratings of (i) levels of impact; (ii) frequencies of occurrence; and (iii) risk scores for the anticipated future challenges (F) constraining the achievement of strategic FM goals.

The first case study university rated emergency management (FI-1) as the key future challenge category (Table 108) as the most profound impact on the strategic FM goals of the university facilities managers. Table 109 shows that majority of the interviewees in the first case study university predicted emergency management will be the most frequently occurring key future challenge, hence the most risky of all the 12 broad categories in this study (Table 110).

IFMA (2007) agrees with this finding being rated as the most critical of the key challenges facing university facilities managers; emphasizing that the issue concerning emergency management is more on emergency preparedness such as data protection, natural disasters, basic safety and security, acts of terrorism, workplace violence, pandemic crises, and chemical/biological incidents. The challenges for university facilities managers around this issue are "how to quantify value of advance planning to core business and what are the advance planning and preparation for core business and failures of other supporting infrastructure" in order to minimize the disruption and consequently expedite the recovery process (IFMA, 2007).

In comparison to four other case studies, the first case study (University A) has mentioned geographical condition as another additional critical issue concerning key future challenges that need to be taken into account by the university facilities managers in years to come. This is mainly due to the fact that the geographic nature of New Zealand and Australia's universities are located in the areas combined significant rainfall and active seismic / earthquake activity, or even near the coastal areas. Forrest et al, (2012) confirmed this result by stating that overall risk analysis FM is vital in order to minimize the risk of geotechnical failure and to identify the seismic performance status, in and around the portfolio (i.e. earthquake prone buildings and earthquake risks).

Table 108: University A - Levels of impact for Future challenges

Code	* Rating for impact levels (%)					TR	II	Remark	RII	Rank
	VH 5	H 4	M 3	L 2	VL 1					
FI-1	100	0	0	0	0	5	5.00	Very High	0.123	1
FI-2	60	40	0	0	0	5	4.60	Very High	0.113	2
FI-3	40	20	40	0	0	5	4.00	High	0.098	4
FI-4	0	20	60	20	0	5	3.00	Moderate	0.074	7
FI-5	20	40	40	0	0	5	3.80	High	0.093	5
FI-6	0	20	40	40	0	5	2.80	Moderate	0.069	9
FI-7	0	20	20	40	20	5	2.40	Low	0.059	11
FI-8	0	0	40	40	20	5	2.20	Low	0.054	12
FI-9	0	20	20	60	0	5	2.60	Moderate	0.064	10
FI-10	40	40	20	0	0	5	4.20	Very High	0.103	3
FI-11	0	0	100	0	0	5	3.00	Moderate	0.074	7
FI-12	0	40	40	20	0	5	3.20	Moderate	0.078	6
							<u>40.80</u>		<u>1.000</u>	
<i>Future (F) challenges:</i>										
FI-1) Emergency management; FI-2) Statutory compliance; FI-3) Sustainability; FI-4) Technology; FI-5) User needs assessment and satisfaction; FI-6) Business and financial management; FI-7) Occupational health & safety; FI-8) Corporate image; FI-9) Leadership and innovation; FI-10) Space management; FI-11) Outsourcing; FI-12) Geographical condition.										

Table 109: University A - Frequencies of occurrence for Future challenges

Code	Rating for frequency of occurrence					TR	FI	Remark	RII	Rank
	VF	F	O	R	VR					
	% 5	% 4	% 3	% 2	% 1					
FE-1	60	40	0	0	0	5	4.60	Very High	0.110	1
FE-2	40	40	20	0	0	5	4.20	Very High	0.100	3
FE-3	20	20	60	0	0	5	3.60	High	0.086	7
FE-4	0	0	40	60	0	5	2.40	Low	0.057	10
FE-5	20	20	20	40	0	5	3.20	Moderate	0.077	9
FE-6	0	0	20	60	20	5	2.00	Low	0.048	12
FE-7	20	40	40	0	0	5	3.80	High	0.091	5
FE-8	0	0	40	40	20	5	2.20	Low	0.053	11
FE-9	20	40	20	20	0	5	3.60	High	0.086	7
FE-10	60	20	20	0	0	5	4.40	Very High	0.105	2
FE-11	20	40	40	0	0	5	3.80	High	0.091	5
FE-12	20	60	20	0	0	5	4.00	High	0.096	4
							41.80		1.000	

Future (F) challenges:

FE-1) Emergency management; FE-2) Statutory compliance; FE-3) Sustainability; FE-4) Technology; FE-5) User needs assessment and satisfaction; FE-6) Business and financial management; FE-7) Occupational health & safety; FE-8) Corporate image; FE-9) Leadership and innovation; FE-10) Space management; FE-11) Outsourcing; FE-12) Geographical condition.

Table 110: University A - Risk scores for Future challenges

Code	Impact Index	Frequency Index	Risk Score (RS)	Remark	Risk Ranking
	(Ii)	(Fi)	(Ii x Fi)		
F-1	5.000	4.600	23.000	Very high	1
F-2	4.600	4.200	19.320	High	2
F-3	4.000	3.600	14.400	Moderate	4
F-4	3.000	2.400	7.200	Low	10
F-5	3.800	3.200	12.160	Moderate	6
F-6	2.800	2.000	5.600	Very low	11
F-7	2.400	3.800	9.120	Low	9
F-8	2.200	2.200	4.840	Very low	12
F-9	2.600	3.600	9.360	Low	8
F-10	4.200	4.400	18.480	High	3
F-11	3.000	3.800	11.400	Moderate	7
F-12	3.200	4.000	12.800	Moderate	5

Future (F) challenges:

F-1) Emergency management; F-2) Statutory compliance; F-3) Sustainability; F-4) Technology; F-5) User needs assessment and satisfaction; F-6) Business and financial management; F-7) Occupational health & safety; F-8) Corporate image; F-9) Leadership and innovation; F-10) Space management; F-11) Outsourcing; F-12) Geographical condition.

Summary of results for Case Study I (University A)

Overall, for the first case study university, finance, regulatory compliance and emergency management were perceived to be the most critical / risky challenges facing university facilities managers and which had the most severe impact on the achievement strategic FM goals.

6.2.2. CASE STUDY II – UNIVERSITY B

In case study II, a total of six responses were obtained from University B. Respondents' responses on the broad categories of current internal (CI), current external (CE) and predicted future (F) challenges are presented and analyzed in (Table 243 to Table 251, Appendix F2, Section F.2.1). The results are discussed in the following sections.

6.2.2.1 Current Internal (CI) challenges constraining the achievement of strategic FM goals

Table 243 to Table 245 (Appendix F2, Section F.2.1.1) present the respondents' responses on the ratings of (i) levels of impact; (ii) frequencies of occurrence; and (iii) risk scores for the broad internal challenges (CI) constraining the achievement of strategic FM goals.

Table 243 shows that the second case study university rated finance (CI-1) as the broad category of internal challenge having the most profound impact on the strategic goals of the university facilities managers. Table 244 shows that finance was also perceived as the most frequently occurring broad category of internal challenge, hence the most risky of all the 7 broad categories identified in the study (Table 245).

6.2.2.2 Current External (CE) challenges constraining the achievement of strategic FM goals

Table 246 to Table 248 (Appendix F2, Section F.2.1.2) present the respondents' responses on the ratings of (i) levels of impact; (ii) frequencies of occurrence; and (iii) risk scores for the broad external challenges (CE) constraining the achievement of strategic FM goals.

Result (Table 246) shows that, the second case study university rated regulatory/compliance (CE-4) as having the most profound impact on the strategic goals of FM for the broad category of external challenges. This result is consistent with the findings in other studies. For instance, Bajaj (2003) found that "failure to comply with regulatory guidelines and standards" may cause high risks to the organization in which "such failure may result in economic loss such as fines or compensation, or reputation loss such as bad press or consumer anger" (p.129).

However, interviewees perceived that sustainability/ environmental issues (CE-2) as the most frequently occurring broad category of external challenge (Table 247). This result corroborates APPA's (2006) submission that higher education institutions are now directing its interest and more focus on sustainability issues, including "competition (as institutions strive to be the most 'green'), student expectations (many student groups strongly advocate sustainable practices) and accountability (universities need to prove that they are providing a responsible return on the investment made by states, students, parents and donors)" (p.17).

Hence, the current critical issue concerning sustainability facing university facilities managers is "to embrace sustainability and cultivate a sense of stewardship toward the university" (APPA, 2006, p.16). Table 248 consequently shows that sustainability / environmental issues as the most risk of all 6 broad external challenges categories. The result is in harmony with the views expressed by IFMA (2007) that "sustainability continues to grow in importance and has rather quickly moved from an optional nicety to a fundamental requirement and expectation across many industries, primarily universities" (p.8).

6.2.2.3. Predicted Future (F) challenges constraining the achievement of strategic FM goals

Table 249 to Table 251 (Appendix F2, Section F.2.1.3) present the respondents' responses on the ratings of (i) levels of impact; (ii) frequencies of occurrence; and (iii) risk scores for the predicted future challenges (F) constraining the achievement of strategic FM goals.

Table 249 shows that the second case study university rated emergency management (F-1) as the key future challenge having the most profound impact on the strategic goals FM. Table 250 shows that emergency management was also perceived as the most frequently occurring broad category of future challenge, hence the most risky of all the 11 broad categories identified in the study (Table 251). The result is in harmony with other studies. For instance, APPA (2006) states that "safety and security will continue to rise in importance for facilities managers and business continuity entails cross-functional communication and assessment". In addition, APPA (2010) observes that university facilities managers as well as its FM department itself may help to prevent security threats in the first place rather than only focusing on managing the emergencies when they occur.

Summary of results for Case Study II (University B)

Overall, for the second case study university, finance, sustainability / environmental and emergency management are perceived to be the most critical challenges facing university facilities manager impacting on the achievement strategic FM goals.

6.2.3 CASE STUDY III – UNIVERSITY C

For case study III, a total of five responses were obtained from University C. Respondents' responses on the broad categories of current internal (CI), current external (CE) and predicted future (F) challenges are presented and analyzed in (Table 252 to Table 261, Appendix F2, Section F.2.1). The results are discussed in the following sections.

6.2.3.1. Current Internal (CI) challenges constraining the achievement of strategic FM goals

This section presents the respondents' responses on the ratings of (i) levels of impact; (ii) frequencies of occurrence; and (iii) risk scores for the identified current internal (CI) challenges constraining the achievement of strategic FM goals. The results are presented and analyzed in Table 252 to Table 254 (Appendix F2, Section F.2.1.1).

Table 252 shows that the third case study university rated maintenance (CI-5) as the broad category of internal challenge having the most profound impact on the strategic goals of the university facilities managers. APPA (2007) agrees with this result by stating it is crucial for higher education institutions to "prioritize maintenance needs while evaluating facilities for potential adaptive reuse". Hassanain et al (2003) further note that "maintenance management demands prioritizing required work within available funding constraints" (p.178).

Table 253 shows that, finance (CI-1) was perceived as the most frequently occurring broad category of internal challenges impacting on FM goals. The most risky of all the 7 broad categories identified in the study was perceived to be maintenance issues (Table 254). The result is in agreement with other past studies. For instance, Rogers (2012) observes that maintenance management should be more proactive and well planned which focus more on "maintaining asset availability, utility and uptime as well as prolonging the asset lifecycle as long as possible". Thus, a "balanced between inspection, planned and reactive maintenance to best optimize the lifecycle of the equipment, facilities or buildings" (Rogers, 2009) will be the best approach where "higher education finances is in a precarious state; as no one expect those dollars to be budgeted in any time soon" (APPA, 2007).

6.2.3.2. Current External (CE) challenges constraining the achievement of strategic FM goals

Table 255 to Table 257 (Appendix F2, Section F.2.1.2) present the respondents' responses on the ratings of (i) levels of impact; (ii) frequencies of occurrence; and (iii) risk scores for the identified current external challenges (CE) constraining the achievement of strategic FM goals.

Table 255 shows that the third case study university rated regulatory (CE-4) as the broad category of external challenge having the most profound impact on the strategic goals FM. IFMA (2005) concurs with this result by stating that “globally there is increasing accountability in term of regulations, hence increment in comprehensive regulatory frameworks” which affect all areas of FM in higher education institutions.

In contrast, Table 256 shows that sustainability / environmental issues (CE-2) were perceived as the most frequently occurring broad category of external challenge. Thus, sustainability / environmental issues were perceived to be the most risky of all the 6 broad categories identified in the study (Table 257). These results are in agreement with other studies. For example, APPA (2007) found that sustainability is the most critical issues in higher education, and adding that university facilities managers are facing the ultimate pressure to increase sustainable policies and practices within the universities.

6.2.3.3. Predicted Future (F) challenges constraining the achievement of strategic FM goals

Table 258 to Table 260 (Appendix F2, Section F2.1.3) present the respondents' responses on the ratings of (i) levels of impact; (ii) frequencies of occurrence; and (iii) risk scores for the predicted future challenges (F) constraining the achievement of strategic FM goals.

Table 258 shows that the third case study university rated sustainability (F-3) as the future challenge having the most profound impact on the strategic goals FM. This result concurs with the observations of APPA (2010) that sustainability have long been a priority since year 2006 but the importance of sustainability has only mature recently. Table 259 shows that sustainability (F-3) was perceived as the most frequently occurring future challenge hence was perceived to be the most risky of all the 11 broad categories identified in the study (Table 260). Langston and Ding (2003) agree to these results by observing that “sustainability and environmental is a critical change driver for the FM discipline worldwide including higher education institution”. In addition, APPA (2009) sees the challenge facing university facilities managers is in “developing an institutional vision of sustainability that drive decision making and ensuring the vision remains a priority over time”.

Summary of results for Case Study III (University C)

Overall, for the third case study university, maintenance and sustainability are perceived to be the most critical challenges facing university facilities manager impacting on the achievement strategic FM goals.

6.2.4 CASE STUDY IV – UNIVERSITY D

A total of six responses were obtained from University D for case study IV. Respondents' responses on the broad categories of current internal (CI), current external (CE) and predicted future (F) challenges are presented and analyzed in Table 262 – 269 (Appendix F, Section F.2.3). The following sections will be on the discussions of the results.

6.2.4.1. Current Internal (CI) challenges constraining the achievement of strategic FM goals

Table 261 – Table 263 (Appendix F, Section F.2.3.1) present the respondents' responses on the ratings of (i) levels of impact; (ii) frequencies of occurrence; and (iii) risk scores for the identified current internal (CI) challenges constraining the achievement of strategic FM goals.

Table 261 shows that the fourth case study university rated finance (CI-1) as the broad category of internal challenge having the most profound impact on the strategic goals FM. Table 262 shows that finance was perceived as the most frequently occurring broad category of internal challenge, hence was perceived to be the most risky of all the 7 broad categories identified in the study (Table 263).

These results are in line with other past studies. For instance, APPA (2006) found that universities in US are facing extreme financial constraints including “rising costs and declining funding resulted in increased tuition fees; state universities are affected by declining state support; state universities turn to private funding sources, advocates express concern about the privatization of the public institution and also federal funding has diminished and is very specific to fields such as science and technology”.

6.2.4.2. Current External (CE) challenges constraining the achievement of strategic FM goals

Table 264 - Table 266 (Appendix F, Section F2.3.2) present the respondents' responses on the ratings of (i) levels of impact; (ii) frequencies of occurrence; and (iii) risk scores for the identified current external challenges (CE) constraining the achievement of strategic FM goals.

Table 264 shows that the fourth case study university rated regulatory (CE-4) as the broad category of external challenge having the most profound impact on the strategic goals FM. Table 265 shows that regulatory was perceived as the most frequently occurring broad category of external challenge, hence was perceived to be the most risky of all the 6 broad categories identified in the study (Table 266).

These results are in agreement with the findings by APPA (2010) that regulatory compliance is the most critical / risky challenge facing university facilities managers impacting on the strategic FM goals, and adding that "some higher education institutions have begun attempting to measure cost of regulations to make clear their impact on college and university budgets". Jones (2010) urges higher education institutions to not only trace the cost of regulations but also to include the 'regulatory compliance fee' in the tuition fees; emphasizing "tracking costs is the only real way to make their impact clear".

6.2.4.3. Predicted Future (F) challenges constraining the achievement of strategic FM goals

Table 267 to Table 269 (Appendix F, Section F.2.3.3) present the respondents' responses on the ratings of (i) levels of impact; (ii) frequencies of occurrence; and (iii) risk scores for the predicted future challenges (F) constraining the achievement of strategic FM goals.

Table 267 shows that the fourth case study university rated statutory compliance (F-2) as the future having the most profound impact on the strategic goals FM. Table 268 shows that sustainability (F-3) was perceived as the most frequently occurring future challenge, hence sustainability was perceived to be the most risky of all the 11 broad categories identified in the study (Table 269). These results are in line with APPA (2010)

observations, that statutory compliance is the utmost critical challenge for future university facilities managers, and pointing out “regulations wouldn’t be so onerous if so many of them didn’t seem outdated, inconsistent, unclear, duplicative or an exercise in paperwork”

Summary of results for Case Study IV (University D)

Overall, for the fourth case study university, finance, regulatory and statutory compliance are perceived to be the most critical/ risky challenges facing university facilities manager impacting on the achievement strategic FM goals.

6.2.5 CASE STUDY V – UNIVERSITY E

In case study V, a total of seven responses were obtained from University E. Respondents’ responses on the broad categories of current internal (CI), current external (CE) and predicted future (F) challenges are presented and analyzed in Table 210 - Table 278 (Appendix F2, Section F.2.4).

6.2.5.1. Current Internal (CI) challenges constraining the achievement of strategic FM goals

Table 270 to Table 272 (Appendix F, Section F2.4.1) in this section present the respondents’ responses on the ratings of (i) levels of impact; (ii) frequencies of occurrence; and (iii) risk scores for the identified current internal (CI) challenges constraining the achievement of strategic FM goals.

Table 270 shows that the fifth case study university rated finance (CI-1) as the broad category of internal challenge having the most profound impact on the strategic goals FM. Table 271 shows that finance was perceived as the most frequently occurring broad category of internal challenge, hence being perceived to be the most risky of all the 7 broad categories identified in the study (Table 272). These results align with APPA (2006) observations that finance is the most critical challenge facing university facilities managers constraining on the achievement of strategic FM goals, and submitting

“budgets for universities will remain tight for the near future, forcing facilities managers to do more with less”. APPA (2007) further suggest that “higher education finance and budgeting needs to be adjusted so that it values long-term investment and incorporated total cost of ownership” and consequently be able to better managed their campus portfolio (APPA, 2006).

6.2.5.2. Current External (CE) challenges constraining the achievement of strategic FM goals

Table 273 to Table 275 (Appendix F, F2.4.2) in this section present the respondents’ responses on the ratings of (i) levels of impact; (ii) frequencies of occurrence; and (iii) risk scores for the identified current external (CE) challenges constraining the achievement of strategic FM goals.

Table 273 shows that the fifth case study university rated sustainability (CE-2) as the broad category of external challenge having the most profound impact on the strategic goals FM. Table 274 shows that sustainability was perceived as the most frequently occurring broad category of external challenge, hence being perceived to be the most risky of all the 6 broad categories identified in the study (Table 275). These results are in agreement with other past studies. For instance, APPA (2010) found that sustainability is the most critical challenge impacting on the achievement of strategic FM goals, and stating that given the great expectations placed on universities, universities need to “make progress toward environmental sustainability and energy efficiency” and “need to adjust to the new reality of sustainability as a permanent way of doing business” (APPA, 2009).

6.2.5.3. Predicted Future (F) challenges constraining the achievement of strategic FM goals

Table 276 - Table 278 (Appendix F, F.2.4.3) present the respondents’ responses on the ratings of (i) levels of impact; (ii) frequencies of occurrence; and (iii) risk scores for the predicted future challenges (F) constraining the achievement of strategic FM goals. Table 276 shows that the fifth case study university rated emergency management (F-1) as the key future challenge having the most profound impact on the strategic goals

FM. APPA (2006) agrees to this result by stating that, emergency management and preparedness which include safety and security will continue to emerge in importance for university facilities managers.

In comparison, Table 277 shows that sustainability (F-3) was perceived as the most frequently occurring future challenge, hence was perceived to be the most risky of all the 11 broad categories identified in the study (Table 278). These results are aligning with other past studies. For instance, APPA (2008) found that sustainability is the utmost critical future challenge facing university facilities managers, and adding that “sustainability needs to move from an isolated endeavor to become a major element in all elements”. Thus, it is vital for university facilities managers to take up leadership roles in their respective universities’ sustainability initiatives (APPA, 2009).

Summary of results for Case Study V (University E)

Overall, for the fifth case study university, finance, sustainability and emergency management are perceived to be the most critical/ risky challenges facing university facilities manager impacting on the achievement strategic FM goals.

Summary of overall results

The following Table 111 to Table 112 summarise the overall results of model test surveys. The overall results provided parameters for testing significance of divergence in the results obtained from the two quantitative data sources: the questionnaire surveys and the case studies.

Table 111: Summary of Model Test Survey Results (Case Study I - III)

CASE STUDY	Broad Challenges Category	Ratings	Results
I (University A)	Internal	Level of impact	Finance
		Frequency of occurrence	Finance
		Risk level	Finance
	External	Level of impact	Regulatory /compliance
		Frequency of occurrence	Regulatory /compliance
		Risk level	Regulatory /compliance
	Future	Level of impact	Emergency management
		Frequency of occurrence	Emergency management
		Risk level	Emergency management
II (University B)	Internal	Level of impact	Finance
		Frequency of occurrence	Finance
		Risk level	Finance
	External	Level of impact	Regulatory / compliance
		Frequency of occurrence	Sustainability / environmental
		Risk level	Sustainability / environmental
	Future	Level of impact	Emergency Management
		Frequency of occurrence	Emergency Management
		Risk level	Emergency Management
III (University C)	Internal	Level of impact	Maintenance
		Frequency of occurrence	Finance
		Risk level	Maintenance
	External	Level of impact	Regulatory
		Frequency of occurrence	Sustainability
		Risk level	Regulatory
	Future	Level of impact	Sustainability
		Frequency of occurrence	Sustainability
		Risk level	Sustainability

Table 112: Summary of Model Test Survey Results (Case Study IV - V) (Cont'd)

CASE STUDY	Broad Challenges Category	Ratings	Results
IV (University D)	Internal	Level of impact	Finance
		Frequency of occurrence	Finance
		Risk level	Finance
	External	Level of impact	Regulatory
		Frequency of occurrence	Regulatory
		Risk level	Regulatory
	Future	Level of impact	Statutory compliance
		Frequency of occurrence	Sustainability
		Risk level	Sustainability
V (University E)	Internal	Level of impact	Finance
		Frequency of occurrence	Finance
		Risk level	Finance
	External	Level of impact	Sustainability
		Frequency of occurrence	Sustainability
		Risk level	Sustainability
	Future	Level of impact	Emergency management
		Frequency of occurrence	Sustainability
		Risk level	Sustainability

6.2.6 PRACTICAL SOLUTIONS FOR ADDRESSING THE CHALLENGES FACING UNIVERSITY FACILITIES MANAGERS

In this section, the respondents' feedback on the practical solutions for addressing the challenges facing university facilities managers from each case study is presented and analyzed in the following tables, covering three sets of analysis: (i) current internal challenges; (ii) current external challenges; and (iii) future challenges.

Thematic analysis (Anderson, 2007) of the feedback from the case study universities are presented in the following tables:

1. Table 113 - Table 124: shows the recurring themes of the practical solutions for addressing each category of internal challenges facing university facilities managers;
2. Table 125 – Table 130: shows the recurring themes of the practical solutions for addressing each category of external challenges facing university facilities managers;
3. Table 131 – Table 140: shows the recurring themes of the practical solutions for addressing each category of future challenges facing tomorrow's university facilities managers.

The solutions for each category of challenges are further discussed in the following subsections. Each solution suggested by the case study university is coded for use in thematic content analysis (Cooper and Emory, 1995). For instance, the code 'SCI-1-UA' means solutions for finance related current internal challenge (i.e. SCI-1, 'UA' means the first university (University 'A' that provided the practical solution for addressing this challenge).

6.2.6.1 Practical solutions for addressing current internal challenges

Table 113 - Table 124 present the feedback from each university on the practical solutions for addressing current internal challenges. The feedback is in relation to nine sub-categories of current internal challenges facing the university facilities managers:

- | | | |
|-------------------------|---------------------------|--------------------|
| a) Finance | b) Operational efficiency | c) Risk Management |
| d) Stakeholder needs | e) Maintenance | f) Manpower |
| g) Machinery/ equipment | h) Health & safety | i) Materials |

(a) Practical solutions for addressing current internal challenges related to finance

Feedback from the case study universities on the practical solutions for addressing current internal challenges related to finance is presented in Table 113. The six recurring themes below are the practical solutions for addressing finance related current internal challenges faced by university facilities managers. Each is discussed in the following subsections.

1. Business case backed budget (compelling & evidence-based)
2. Backlog maintenance risk & costs (strongly emphasized to management)
3. FM strategic relevance (Linkage to corporate goals)
4. Life cycle costing & efficient technologies (high capital but low operation & maintenance costs)
5. Robust space planning (Inclusive of current & future space needs)
6. Activity based FM service (user pay approach to FM services)

1) Business case backed budget

The interviewees suggested that capital expenditure budget to be presented to the top management must be thoroughly articulated and must be based on planned work, if it must succeed. In addition, the budget must be supported with compelling business case which should clearly show evidence of optimized asset utilization, and how the proposed expenditure should recoup adequate returns on investment. This is more so that universities currently operate within capped funding environment.

For instance, in New Zealand, the Victoria University of Wellington (VUW, 2009) stated that “tertiary funding system, which has been in place since 2008 requires universities to operate within a capped funding environment” (p.8), adding that government revenue is not adjusted for inflation, which equates to a drop in real income for the university of at least \$2.4 million per annum.

Table 113: Practical solutions to finance-related current internal FM challenges

University	Code	Practical solutions for addressing current internal challenges
<i>Finance (SCI-1)</i>		
University A	SCI-1-UA	Robust planning with granular data to support recommendations to senior management highlighting risk of non-expenditure.
University B	SCI-1-UB	The FM budget based on planned work and needs and constantly is underfunded. The FM Team raises this issue of funding shortage at executive level, highlighting this as risks to the University and outlining the possible issue. The problem is that the ideal maintenance budget would give the ideal service across all services and with a budget short fall we end up dealing with essential critical issues, and other work that would be ideal is simply left and becomes backlog. The ideal way to attract funding is to have user pay for the level of service, that is each department states or sets out the level of service required and facilities provide that at a cost that is levied to the department. The charge would be on a m2 rate of occupied space and level of service cost meaning if equipment requires specialist needs then this is provided.
University C	SCI-1-UC	Adequate life cycle costing when planning facilities. Adequate space planning.
University D	SCI-1-UD1	1) Business case to be supported with evidence of optimised asset utilization, and adequate returns on investment.
	SCI-1-UD2	2) Improving FM's strategic relevance, linking funding request to corporate goals.
	SCI-1-UD3	3) Investment in efficient technologies.
University E	SCI-1-UE1	1) Develop long-term strategies for organization to be more efficient and financially feasible.
	SCI-1-UE2	2) Adequate life cycle-costing for facilities planning.
	SCI-1-UE3	3) Enhance Return on Investment (ROI) of university's facilities.
	SCI-1-UE4	4) Develop more energy efficiency strategies to reduce utilities costs.
<i>Finance (SCI-1):</i> <i>SCI = Solution for Current Internal challenge</i> <i>SCI-1 = '1' refers to 1st subcategory (issue) of current internal challenge</i> <i>UA = University (i.e University A or first case study university)</i> <i>UD1 = '1' refers to 1st solution mentioned as practical solution for the CI challenge</i>		

2) *Strongly emphasized backlog maintenance risks and costs*

The interviewees argued that one effective way of overcoming budget shortfall and minimized financial constraint is to strongly emphasize the risks and costs associated with deferred maintenance to the university executive. One interviewee argued that “the problem is that the ideal maintenance budget would give the ideal service across all services and with a budget short fall we end up dealing with essential critical issues, and other work that would be ideal is simply left and becomes backlog”. One of the interviewees hinted that maintenance budget for university facilities comprises the operating, maintenance and capital development budgets, adding that annual maintenance funding has been inadequate for several years while more than 65% of the building stock were over 50 years of age. This has resulted in ‘ballooning’ maintenance

costs with implications for health and safety, strategic operation of the facilities and rapid decay.

University of Virginia's Budget Office (2005) defined 'deferred maintenance' as "maintenance that has been shelved on a planned or unplanned basis to a future budget cycle or postponed until funds are available" (p.2). The issue of deferred maintenance backlog is common among universities especially during periods of harsh economic conditions when maintenance budget is among the first to be sliced. For instance, University of Virginia's Budget Office (2005) reports that the University's deferred maintenance backlog stands at \$144 million for the University's educational and general (E&G) buildings as at 2004. University of Virginia's Budget Office (2005) advises that the value of facility condition index (FCI) and benchmark deterioration rate (BDR) are effective tools for making a compelling case against the problem of excessive deferred maintenance backlog. The International Facilities Management Association (IFMA, 2006) defines FCI as follows:

Facility Condition Index (FCI)

$$= \frac{\text{Deferred maintenance (DM)} + \text{Capital renewal (CR)}}{\text{Current replacement value (CRV)}}$$

IFMA (2006) expressed the benchmark deterioration rate (BDR) as a percentage of the current replacement value (CRV) per annum, adding a BDR for a reasonably well maintained facility is approximately 2.5% per annum. IFMA (2006) advised that an FCI value under 5 percent is considered "good condition"; an FCI value between 5 percent and 10 percent is considered "fair condition"; and an FCI value of over 10 percent is considered "poor condition". The fair and poor condition maintenance budget should receive prompt funding attention by the university executive.

3) FM strategic relevance – linkage to corporate goals

The interviewees also suggested that, to minimize insufficient funding and the associated financial constraints, the facilities management department should endeavor to have a representative voice at the executive level where financial decisions are made. The FM representative, usually the Director of Facilities, should present the alignment of funding requests and goals of the FM department to the strategic goals of the university. This way, the FM department should not be looked at as a mere supporting function whose budgetary needs are costs that should be subject to constant pruning.

4) Life cycle costing and investment in efficient technologies

To minimize endemic budget shortfalls and financial constraints, the interviewees also suggested that the FM departments should consider whole-of-life cycle costing and the use of efficient technologies in their budget development. The argument is that though the initial costs will be high, the operation and maintenance costs will be quite low, with lesser need for frequent maintenance, minimized failures, and associated disruptive and expensive corrective maintenance. These benefits minimize the need for large budgetary requirements at the operation and maintenance phase of the facility. This suggestion is in accord with a number of studies. For instance, Korpi and Ala-Risku (2008) found that for a building designed for 50 year life span the operating and maintenance costs constitute 90 percent of the life cycle costs, while the initial costs comprise only 10 percent, yet the latter is focused on in investment decision making.

5) Adequate space planning

The interviewees also hinted that to minimize elaborate expenditure and financial constraints down the line, the FM department should be thorough in their space planning exercise. Current and future space needs should be thoroughly researched and the associated expenditure included in the budget. This way, the FM department will minimize budget blow-out due to emergent space needs. Related to this is the need to ensure that current space is utilized to its full capacity before new space needs are budgeted for.

6) Activity-based management of FM services

A point that was raised by one interviewee, and which was considered relevant in follow-up enquiries among the interviewees is that the ideal way to attract funding is to adopt the 'user pay' approach for the level of service required. This means that each department should state or set out the level of service required, and then the FM department can provide the service at a cost that is levied to the department. The interviewee suggested a workable mechanism for this approach as involving the charge on a m2 gross floor area rate of occupied space and level of service cost. If equipment requires specialist needs then this is provided on an add-on basis.

This approach is commonly referred to activity based costing (ABC). Edwards (2008), quoting the Chartered Institute of Management Accountants (CIMA) defines activity based costing as a method of costing that is at variance to the conventional costing approach whereby each activity in an organization is identified and assigned a cost of

the resources (i.e. materials, labor, overheads) in accordance to the actual consumption. Mbachu (2013) argues that ABC helps organizations to identify production or service processes that are inefficient or ineffective and either eliminate or re-engineer those production or service processes for improved productivity.

(b) Practical solutions for addressing current internal challenges related to operational efficiency

Feedback from the case study universities on the practical solutions for addressing current internal challenges related to operational efficiency is presented in Table 114. Six recurring themes as the practical solutions for addressing operational efficiency related current internal challenges faced by university facilities managers are discussed in the following subsections.

1) *Appropriate risk / reward incentives & performance development frameworks*

To maximize the operational efficiency, interviewees suggested that FM departments should consider having appropriate risk or reward incentives for outsourced services/ processes; this may include lump sum fixed fees and outcome based contracts. In addition, robust performance development frameworks are considered by the interviewees as the best approach for monitoring and assessing the performance of in-house staff. This suggestion is in accord with a number of studies. For instance, Hassanain et al (2003) found that “another competency that provides value-adding to facilities management is the efficiency of operations coordination”; hence it is crucial for university facilities managers to be competent as they are often judged based on their performance especially in areas pertaining operation and maintenance management, irrespective of whether it is performed in-house or outsourced.

2) *Regular team meetings*

The interviewees suggested that regular team meetings are vital to set the facilities goal, strategy, communicate solutions that lead to efficiency improvements. Regular meetings will help them to recognize the appropriate measure or needs for improvements through known information and/ or benchmark information. University facilities managers and the FM team will be able to come out with the best practical solution to overcome any operational issues, thus adding value to the organization’s operation and business (Best et al, 2003).

In order to maximize the operational efficiency, the interviewees also suggested that another important measure that should be highly considered by university facilities managers and the FM team is having more staff training on operational improvements; which this gives benefit to FM staff and professionals.

3) *Effective communication*

The interviewees also hinted that to minimize operational efficiency constraints, facilities managers should ensure that effective communication is widely used across department limits and both up administrative chain. The use of innovation and creativity in communication helps facilities managers to develop strategic management situations by achieving more with less resource. This suggestion is in accord with a number of studies.

For instance, APPA (2007) suggested that in order to confront and improve communications, facilities managers need to take a further initiative in identifying and better understanding communication challenges that already exist. "Savvy managers target their communications to different audiences, in which they focus on the big picture for senior administrators, on the bottom-line for a financial audience, and on pedagogical themes for faculty". Effective communication could be easily achieved with the aid of variety forms of communication tools such as emails, websites and newsletters. A proactive facilities manager would normally make an effort to push communications out to the targeted audiences rather than hold back and waiting for the audiences to come forward.

Table 114: Practical solutions for addressing current internal challenges - Operational efficiency

University	Code	Practical solutions for addressing current internal challenges
<i>Operational efficiency (SCI-2)</i>		
University A	SCI-2-UA	For outsourced services/processes: appropriate risk/reward incentives for efficiency/effectiveness e.g. lump sum fixed fees, outcome based contracts. For in-house staff: robust performance development frameworks. General: request process reviews.
University B	SCI-2-UB	Firstly regular team meetings are essential to set the facilities goal, strategy, communicate solutions that lead to efficiency improvements. Then the team have got to find out where they are and this is usually measure i.e. how much electricity do they used, this applies to all items for improvement. Recognising needs for improvements can be through known information or benchmark information and the team use both. Setting out the goals and this can be as simple as it is far too high and the team need it reduce this then set about making those best qualified to come up with solutions and in some cases seeking external advice. Staff training for operational improvements is again an important step and this gives a lot of buy in. Other aspects include tuning the system not entire re-commission but make sure plant and service are functioning efficiently.
University C	SCI-2-UC	Use of innovation, creativity and effective communication to achieve more with less.
University D	SCI-2-UD	Regular meetings are essentials to set the facilities goal, strategy, communicate solutions that lead to energy efficiency.
University E	SCI-2-UE1	Develop robust strategy within the context of organisation's strategic plan and accommodation strategy, this include differentiating between core and non-core business activities. Establish effective and manageable processes for meeting those needs.
	SCI-2-UE2	Establish resource needs for providing services, whether obtained internally and externally. Identify source of funds and establish budget for both short-term and long-term value for money.
	SCI-2-UE3	Establish effective management of information to control FM activities.
<i>Operational efficiency (SCI-2):</i> <i>SCI = Solution for Current Internal challenge</i> <i>SCI-2 = '2' refers to 2nd subcategory (issue) of current internal challenge</i> <i>UA = University (i.e University A or first case study university)</i> <i>UD1 = '1' refers to 1st solution mentioned as practical solution for the CI challenge</i>		

4) Robust strategy planning

The interviewees also opined that a robust strategy planning should be developed within the context of organization's strategic plan and accommodation strategy, in order to help address the operational-efficiency challenge. This strategy plans include differentiating between core and non-core FM business activities. To guard against this, APPA (2010) stated that "*without a plan for implementing new strategies, policies and an ultimate goal in sight, facilities managers would not make much progress*". One of the interviewee also suggested that facilities managers should establish and efficiently

manage the processes involved for meeting those needs. APPA (2007) accords this result by suggesting strategies in addressing this issue: *“get facilities involved early in the overall planning process; understand where the universities wants to go and what it wants to be; evaluate the facilities implications including the financial implications of academic plans; and also develop specific outcomes for generalized goals”*.

5) *Establish resource and funding sources*

To minimize the operational-efficiency challenge, the interviewees suggested that university facilities managers must establish resource needs for providing efficient internal and external services. In addition, it is of crucial importance that they also secure source of funding to establish budget allocation for FM activities (APPA, 2008), for both short-term and long-term value for money (APPA, 2010).

Initially, long-term financial restraint could be addressed with Total Cost of Ownership (TCO) in which according to APPA (2010), “total cost of facilities over their entire life cycle requires a balance sheet for facilities that includes not just initial costs of materials and systems but also the continuing costs for energy, upkeep, replacement and eventual decommissioning. Making TCO as a key facilities policy will go a long way in achieving financial discipline for facilities programs”.

6) *Effective information management*

The interviewees also suggested that university facilities managers need to establish effective management of information to control FM activities. This suggestion is in agreement with other past studies. For example, APPA (2006) found that it is crucial for universities facilities managers to “develop strategies to integrate technology into their campuses in cost-effective and timely ways; since the use of technology is expected to increase the productivity and streamline operations”.

(c) *Practical solutions for addressing current internal challenges related to risk management*

Feedback from the case study universities on the practical solutions for addressing current internal challenges related to risk management is presented in Table 115. Each solution suggested by the case study university is coded for use in thematic content analysis (Cooper and Emory, 1995) and further discussed in the following subsections.

1) Formal risk management framework

In order to minimize the risk management constraints, interviewees suggested the university facilities managers need to have a formal risk management framework with regular, timetabled review process. FMAA (2004) observed that “formalizing risk is all about communicating risk information; determine why, how and to whom at the outset”. It is important for university facilities managers to make certain that “the level of formalization matches the significance, complexity and or potential consequences of the activity under consideration” (FMAA, 2004).

2) Identify and allocate risk on rational basis

The interviewees also suggested that, to address the risk management challenge, university facilities managers need to determine the risk associated with all type of sources and the perspective of all stakeholders (both internally and externally). This helps university facilities managers to consider the likelihood and the potential consequences of the risk of each contribution. Thus, a comprehensive list of risks that contribute significant impact on the universities’ goals and objectives could be established. FMAA (2004) provided tips for effective risk identification which covers the following:

- (i) Select a proper risk identification methodology for the type of risk and the nature of activity;
- (ii) Involve the right individual/ experts in identifying risk;
- (iii) Take a life cycle approach to risk identification and define the trend of change and evolve during the cycle.

3) Prioritize and revise risk plans

The interviewees also hinted that, university facilities managers need to ensure that they prioritize and revise risk plans for implementation in the event of hazard occurring to minimize risk exposure. This involves analyzing associated risk in the context of existing measures by considering the sources of risk, consequences and likelihood of the risk to occur.

In order to achieve effective risk analysis process, university facilities managers need to ensure that the “risk analysis methodology selected where possible be comparable to the significance and complexity of the risk being analyzed (i.e. the higher the potential consequence the more rigorous the methodology)” (FMAA, 2004). This enable university facilities managers to prioritize or rank the risk or even helps in making

decision between available options provided that the risk analysis tools are “designed for specific context and the risk dimension under analysis” (FMAA, 2004).

Table 115: Practical solutions for addressing current internal challenges - Risk management

University	Code	Practical solutions for addressing current internal challenges
<i>Risk management (SCI-3)</i>		
University A	SCI-3-UA	Formal risk management framework with regular, timetabled review process.
University B	SCI-3-UB	By using resource to identify the risk and implement mitigation measures.
University C	SCI-3-UC	Effective University Risk Management - dedicated resources.
University D	SCI-3-UD1	Identification and allocation of risks on rational basis. Proper monitoring and assessment of performance.
	SCI-3-UD2	Prioritise and revise risk plans for implementation in the event of hazard occurring to minimise risk exposure.
University E	SCI-3-UE1	Appropriate allocation of risks and rewards between client, service providers and contractors.
	SCI-3-UE2	Clear and precise roles, responsibilities and targets for effective teamwork.
	SCI-3-UE3	Adequate planning and implementation with sufficient allocation of related responsibilities.
<i>Risk management (SCI-3):</i> <i>SCI = Solution for Current Internal challenge</i> <i>SCI-3 = '3' refers to 3rd subcategory (issue) of current internal challenge</i> <i>UA = University (i.e University A or first case study university)</i> <i>UD1 = '1' refers to 1st solution mentioned as practical solution for the CI challenge</i>		

4) *Clear and precise roles and responsibilities*

The key question here is “who will do the work and how will the risk management role be structured?” The interviewees suggested that risk management issues could be addressed by having clear and precise roles, responsibilities and targets for effective teamwork. Each individual involved in managing university’s facilities have their own specific roles and responsibilities. To guard against this, FMAA (2004) reported that the Facility Management Accreditation System (FMAS) identified the risk management role as listed in the following table (Table 116 - Table 118):

Table 116: Roles in risk management (FMAS Level: Lead) (Source: FMAA, 2004; Adapted from Enterprise Wide Risk Management, CPA Australia, Melbourne, 2002)

FMAS LEVEL	GROUP	ROLE IN FM
LEAD	Chief Executive	<ul style="list-style-type: none"> Ensure risk management framework is implemented and adopted. Endorse risk management vision. Endorse the current and planning approach to managing the significant and critical risk areas.
	Senior management group	<ul style="list-style-type: none"> Review of corporate-wide n business unit risk profiles. Review and assess current and planning approach to managing significant and critical risk areas. Review and monitor completion of risk profiles and action plans. Ensure risk management framework is implemented in individual business units.
	Internal audit committee	<ul style="list-style-type: none"> Independently oversee risk management framework Review and approve risk profiles and action plans. Independently monitor the implementation of a risk management program against an endorsed implementation strategy or plan.

Table 117: Roles in risk management (FMAS Level: Manage) (Source: FMAA, 2004; Adapted from Enterprise Wide Risk Management, CPA Australia, Melbourne, 2002)

FMAS LEVEL	GROUP	ROLE IN FM
MANAGE	Facility manager	<ul style="list-style-type: none"> Continually validate business objectives, identify and assess risk to facility management and manage those risks. Establish a monitor risk action plans.
	Risk manager	<ul style="list-style-type: none"> Coordinate the implementation of the risk management framework, risk profiles an action plans. Facilitate, challenge and drive risk management. Report to senior management group and/or audit committee.

Table 118: Roles in risk management (FMAS Level: Practice) (Source: FMAA, 2004; Adapted from Enterprise Wide Risk Management, CPA Australia, Melbourne, 2002)

FMAS LEVEL	GROUP	ROLE IN FM
MANAGE	Contractor, subcontractor or supplier	<ul style="list-style-type: none"> • Work within the risk management framework of the organization that they are contracting to. • Identify, assess and manage risks within area of responsibilities. • Develop risk management plan or profile for contract.
	Individual personnel	<ul style="list-style-type: none"> • Recognize, communicate a respond to new, changing or anticipated risks. • Contribute to the process of developing risk profiles for relevant business unit.

5) Adequate planning & implementation

The interviewees also suggested that adequate planning and implementation with sufficient allocation of related responsibilities is another measure to minimize the risk management challenge. This helps to provide university facilities managers with “direction and instruction on how the management system and program will be developed, establishes and maintained within the universities as well as The FM departments” (FMAA, 2004). Eight important factors of a risk management planning and implementation includes: (i) top level support, ii) identify requirement and set objectives, (iii) policy definition and endorsement; (iv) risk management system, (v) education, promotion and training; (vi) risk reporting; (vii) audit and evaluation; and (viii) measure effectiveness, review and improvement (FMAA, 2004).

(d) Practical solutions for addressing current internal challenges related to stakeholder needs/ service providers

Feedback from the case study universities on the practical solutions for addressing current internal challenges related to stakeholder needs/ service providers is presented in Table 119. The solutions are and further discussed in the following subsections.

Table 119: Practical solutions for addressing current internal challenges - Stakeholder needs/ service providers

University	Code	Practical solutions for addressing current internal challenges
<i>Stakeholder needs / service providers (SCI-4)</i>		
University A	SCI-4-UA	Regular consultation programme e.g. surveys, workshops.
University B	SCI-4-UB	This is very difficult and the FM team simply do not do this well because there are consistent changes in levels of service and level of compliance yet no changes or conversely a reduction in budgets and this seems to be a constant. FM team manage by setting priorities and minimising costs.
University C	SCI-4-UC	Improved planning in new builds and renovations.
University D	SCI-4-UD1	Controlling stakeholder input and changes once the specification has been agreed and agreed.
	SCI-4-UD2	Prioritisation by stakeholders of their requirements.
	SCI-4-UD3	Involving stakeholders, as far as practicable, in identifying their requirements, for example, through the use of questionnaire surveys and in contributing to the drafting of service specifications and service level agreements.
University E	SCI-4-UE	Understand communications challenges both up administrative chain and across departments, use a variety of forms of communications and be prepared for a two-way exchange.
<i>Stakeholder needs/ service providers (SCI-4):</i> <i>SCI = Solution for Current Internal challenge</i> <i>SCI-4 = '4' refers to 4th subcategory (issue) of current internal challenge</i> <i>UA = University (i.e. University A or first case study university)</i> <i>UD1 = '1' refers to 1st solution mentioned as practical solution for the CI challenge</i>		

1) *Regular consultation programme*

The interviewees suggested that, to minimize stakeholder needs/ service provider challenges, university facilities managers need to ensure consultation programme is held on regular basis. This consultation programme may be in a form of surveys, workshops, seminars or even meetings.

2) *Setting priorities and minimising costs*

One of the interviewees hinted that, by setting priorities and minimising costs, the challenge related to stakeholder needs/ service provider can be reduced. According to the interviewee, “stakeholder needs/ service provider issues are quite difficult to overcome and the FM team do not do this well because there are consistent changes in levels of service and level of compliance. Yet no changes or conversely a reduction in budgets and this seems to be a constant”. Remington (2003) accords this result by stating that “it is essential to uncover stakeholders need from the project; as this may be different from what the stakeholders actually want”.

3) *Improved planning in new builds and renovations*

One of the interviewees also hinted that, improved planning in new builds and renovations could reduce the stakeholder needs/ service provider related issues. The

reason being, OECD (2012) stated that today's students and academic staff are more demanding and "increasingly expect state-of-the-art facilities and optimal support for education and research purposes".

4) Stakeholders involvement

The interviewees also suggested that, to minimize the stakeholders need/ service provider challenges, stakeholders must be involved (as far as practicable) in identifying their requirements and set the level of performance that are acceptable according to their standard. Atkin and Brooks (2000) agrees to this result by adding that the involvement of stakeholders must starts "from the outset in specifying the kind of services required and the level of performance that will be acceptable to them, both from in-house and external services providers".

This could be achieved through the use of questionnaire surveys, service specifications and service level agreements (SLA); which are considered as tools for managing the performance, quality and value of services procured. The benefit of having service specification is that, it sets a target in which the level of services delivered to the customers, will be assessed.

Atkin and Brooks (2000) defined service specification as "a document that quantifies the minimum service levels that are acceptable if the customers' requirements are to be met". On the other hand, an SLA according to Atkin and Brooks, "is a commitment by the service provider (in-house or outsourced) to the customer to deliver an agreed level of service" in which "it should specify rewards and penalties, yet retain flexibility so that the customer's changing requirements can be taken into account should circumstances change".

5) Effective communications for two way exchange

Another measure to minimize stakeholder needs/ service provider issues as suggested by the interviewees is by ensuring effective communications for two-way exchange. Strategies than can be adopted by university facilities managers for effective communications are as identified by Atkin and Brooks (2000):

- (i) Soliciting all input from stakeholders before making any vital decisions;
- (ii) Sustaining stakeholders' requirements at the very early stage of decision process will enhance FM department's responsiveness – "reasonable

accommodation of truly good ideas will go a long way to improving community engagement & involvement”.

- (iii) Quantifying the decision making for stakeholders (i.e state legislatures & commissions, community college boards, donors, alumni) looking forward for answers on “why new plans are being pursued and which investments in the institutions will bring higher return and rewards”. University facilities managers need to make certain that cost and benefits are in specific and translated into a language that can be easily understood by the stakeholders”.

(e) Practical solutions for addressing current internal challenges related to maintenance

Feedback from the case study universities on the practical solutions for addressing current internal challenges related maintenance is presented in Table 120. Thematic analysis (Anderson, 2007) of the feedback from the case study universities on the solutions are discussed in the following subsections.

1) Accurate, granular condition data and future renewal profiling

One of the interviewees suggested that, by having accurate, granular condition data and future renewal profiling, university facilities managers would be able to minimize the maintenance-related issues. APPA (2009) agrees with this result by stating that university facilities managers “need to ensure that they are keeping the right metrics so that they have the necessary data”.

2) Life cycle costing

The interviewees also suggested that, to address the issue related to maintenance, university facilities managers should ensure that they have adequate life cycle costing of the buildings, facilities or services. Life cycle costing provides solid information and clear guidelines “to determine when a building no longer serves a purpose or can’t be renovated within a reasonable budget” (APPA, 2009).

3) Consistent maintenance and renewal needs

Another measure that can be used to minimize maintenance-related issues is by developing constant categories to help define maintenance and renewal needs. APPA (2009) agrees with this result by suggesting that university facilities managers should “use sustainability to advocate for renewal of outdated buildings” in which sustainability

should be included in as a criteria for facility assessment and therefore would be able to place importance on structures that are impacting on the achievement of university's sustainability goals. Further, university facilities managers need to seek for additional funds from sustainability sources for the purpose of additional funds.

4) *Backlog of renewal and renovation projects*

One of the interviewees suggested that, to minimize the maintenance constraints, university facilities managers need to consider backlog of renewal and renovation projects. This will helps them to focus on upgrading the inefficient structures and concentrate more on sustainability efforts. In addition, university facilities managers will be able to establish criteria to identify which buildings, projects or services that are no longer worth saving (APPA, 2009).

Table 120: Practical solutions for addressing current internal challenges – Maintenance

University	Code	Practical solutions for addressing current internal challenges
<i>Maintenance (SCI-5)</i>		
University A	SCI-5-UA	Accurate, granular condition data and future renewal profiling. The retaining/maintaining situation is easier. Firstly the FM team have limited capital to replace building and therefore the replacement programme is long term and the FM team simply maintain the service until renewal. For replacement the FM team use a whole of life calculation and if the cost of refurbishment exceeds 75% of new then one should consider complete new. Deferred/backlog is managed through priorities and this includes safety/compliance/service needs as the priority in that order. There are other priorities such as strategic needs and this instrumental making work happen. Backlog issues are not addressed well and this is simply a budgeting issue and what the FM team have done or do is to maintain a list of backlog activities and manage the list appropriately.
University B	SCI-5-UB	
University C	SCI-5-UC	Life cycle costing. Adequate sinking funds. Improved space planning. Removing mothballed buildings.
University D	SCI-5-UD	Develop consistent categories to define maintenance and renewal needs.
University E	SCI-5-UE	Backlog of renewal and renovation projects in light of sustainability and increase the priority for the upgrade of inefficient structures.
<i>Maintenance (SCI-5):</i> <i>SCI = Solution for Current Internal challenge</i> <i>SCI-5 = '5' refers to nth subcategory (issue) of current internal challenge</i> <i>UA = University (i.e University A or first case study university)</i> <i>UD1 = '1' refers to 1st solution mentioned as practical solution for the CI challenge</i>		

(f) Practical solutions for addressing current internal challenges related to manpower

Feedback from the case study universities on the practical solutions for addressing current internal challenges related manpower is presented in Table 121. Five recurring themes as the practical solutions for addressing manpower related current internal challenges faced by university facilities managers are discussed in the following subsections.

1) *Robust performance development framework*

The interviewees suggested that, to address manpower-related issues, university facilities managers should have a robust performance development framework which is used for identifying skill or competency gaps and provides better plan for opportunities development. To guard against this, APPA (2006) observed that by having robust performance development framework, university facilities managers are able to “understand how changes in the population will affect the workforce and hence develop strategies to pass the wisdom of mature workers onto new leaders”.

Table 121: Practical solutions for addressing current internal challenges - Manpower

University	Code	Practical solutions for addressing current internal challenges
Manpower (SCI-6)		
University A	SCI-6-UA	Robust performance development framework identifying skill/ competency gaps and planned development opportunities.
University B	SCI-6-UB	Basically where there is a specialist service requirement this service will be contracted. In the case of skill set changes for trades and the like we address this through up-skill training courses where and when we have the money. The budget is the biggest issues and basically the way is operating in the University is through under resourcing and under budgeting. This is not good and the eventual outcome is of course poorly maintained assets. How the FM team manage this is simply by setting priorities and using a breakdown mentality for fixing rather than a preventative arrangement for less important and less risky services. Priorities - safety/legal, costly etc.
University C	SCI-6-UC	Recognition of skill sets in remuneration. Ability to meet the market and compete with private enterprise. Continued training and improvement.
University D	SCI-6-UD	Developing strategies to bring new skills into organization, helping current staff to adjust to change, creating knowledge transfer system so the expertise of retiring workers is preserved.
University E	SCI-6-UE	Delivering a vibrant work environment that attracts and retains talented staff or labour.
<i>Manpower (SCI-6):</i> <i>SCI = Solution for Current Internal challenge</i> <i>SCI-6 = '6' refers to nth subcategory (issue) of current internal challenge</i> <i>UA = University (i.e University A or first case study university)</i> <i>UD1 = '1' refers to 1st solution mentioned as practical solution for the CI challenge</i>		

2) Setting priorities rather than preventative arrangement

One of the interviewees hinted that setting priorities rather than having preventative arrangement would be a good measure to minimize the manpower-related challenge. According to the interviewee, “basically where there is a specialist service requirement this service will be contracted. In the case of skill set changes for trades and the like we address this through up-skill training courses where and when we have the money.

The budget is the biggest issues and basically the way is operating in the University is through under resourcing and under budgeting. This is not good and the eventual outcome is of course poorly maintained assets. How the FM team manage this is simply by setting priorities and using a breakdown mentality for fixing rather than a preventative arrangement for less important and less risky services”. These priorities are more focus on occupational health and safety, legislative and financial matters.

3) Recognition of skill sets in remuneration

The interviewees also suggested that, by having recognition of skill sets in remuneration, university facilities managers are able to meet the market and compete with private enterprise. Recognition in skill sets could be achieved by conducting continued training and improvement among the workforce.

IFMA (2007) advised that besides “maintaining the sensitivity issues to variety of workers and work styles”, university facilities managers also need to “promote leadership development and transition planning”, by having more training programs to enhance workers’ performance and skills development which helps to promote and retain educational values across the academic industry.

4) Developing strategies

A point that was raised by one of the interviewees was that by having developed strategies, university facilities managers are able to bring new skills into organization, helping current staff to adjust to efficiently adopt to change management, creating knowledge transfer system so the expertise of retiring workers is preserved.

This result is in line with the views expressed by APPA (2006) that, by having developing strategies, university facilities managers would be able to “keep the mature workers challenge and engaged”. As for the younger workers, university facilities managers need

to ensure they have creative ways to train and educate the younger workers for “leadership roles and to pass on the universities wisdom of the older staff”.

5) *Deliver vibrant work environment*

One of the interviewees also hinted that by delivering a vibrant work environment, university facilities managers would be able to attract and retain talented staff or labor especially the younger ones.

APPA (2006) argued that today’s younger workers have great demands and expectations such as “flexibility in their jobs”, “fitness programs, childcare facilities, employee food service” (IFMA, 2007) and etc. Consequently, “only organizations that are willing to be flexible, will be able to keep top staff” (APPA, 2006).

(g) *Practical solutions for addressing current internal challenges related to machinery/ equipment*

Feedback from the case study universities on the practical solutions for addressing current internal challenges related machinery/ equipment is presented in Table 122 and further discussed in the following subsections.

1) *Extending life of equipment*

One of the interviewees argued that “all services are performed in outsource contracts, hence no stock of machinery/ equipment sits with the FM team”. Another interviewee points out that “poor utilization will simply be handled by extending the life of the equipment in other words less frequent replacement and maintenance.

However the FM team basically minimizes the amount of equipment purchased for the reasons of underutilization. The major money is in building plant and this has a high utilization and is maintained to the minimum level of services as per the building act. There are certain items that one needs to function and this equipment would include items that are multipurpose i.e. a portable pump that can be used for maintenance and in emergency situations therefore the FM team are quite selective in what they hold”.

2) *Maintain regular maintenance and replacement program*

The interviewees also suggested that, to minimize the machinery/ equipment related challenges, university facilities managers need to have regular program of maintenance and replacement. This helps to minimize the amount of equipment purchased by the FM departments.

This result is in agreement with the views expressed by APPA (2007) that, in order to manage maintenance, university facilities managers need to ensure that they “prioritize deferred maintenance needs according to the institutions’ overall goals; consider the use of priority indices to help determine facility goals and to include consideration of total cost of ownership for existing facilities whenever improvements are made”.

Table 122: Practical solutions for addressing current internal challenges - Machinery/ equipment

University	Code	Practical solutions for addressing current internal challenges
<i>Machinery / Equipment (SCI-7)</i>		
University A	SCI-7-UA	All services performed in outsource contracts so no stock of machinery/ equipment sits with the FM team.
University B	SCI-7-UB	Poor utilisation will simply be handled by extending the life of the equipment in other words less frequent replacement and maintenance. However the FM team basically minimise the amount of equipment purchased for the reasons of underutilisation. The major money is in building plant and this has a high utilisation and is maintained to the minimum level of services as per the building act. There are certain items that one needs to function and this equipment would include items that are multipurpose i.e. a portable pump that can be used for maintenance and in emergency situations therefore the FM team are quite selective in what they hold.
University C	SCI-7-UC	Regular programs of maintenance and replacement.
University D	SCI-7-UD	Minimise the amount of equipment purchased; maintain regular maintenance and replacement programme.
University E	SCI-7-UE	Minimise the utilisation of equipment, maintain regular maintenance and replacement schedule.
<i>Machinery/ equipment (SCI-7):</i> <i>SCI = Solution for Current Internal challenge</i> <i>SCI-7 = '7' refers to nth subcategory (issue) of current internal challenge</i> <i>UA = University (i.e University A or first case study university)</i> <i>UD1 = '1' refers to 1st solution mentioned as practical solution for the CI challenge</i>		

(h) *Practical solutions for addressing current internal challenges related to health & safety*

Feedback from the case study universities on the practical solutions for addressing current internal challenges related health & safety is presented in Table 123. Four recurring themes as the practical solutions for addressing health & safety related current

internal challenges faced by university facilities managers are discussed in the following subsections.

1) *Early warning and emergency training*

One of the interviewees suggested that, to minimize the health and safety related challenges, early warning and emergency training should be implemented among the FM teams. IFMA (2011) accords this by stating that this measure can be achieved by having “more formalized emergency preparedness planning”.

2) *Adequate knowledge of the compliance with health and safety legislation*

One of the interviewees suggested that, to minimize the health and safety related challenges, university facilities managers need to ensure that all staff is well-knowledgeable and keep abreast on any changes pertaining to the compliance with health and safety legislation.

Table 123: Practical solutions for addressing current internal challenges - Health & Safety

University	Code	Practical solutions for addressing current internal challenges
Health and safety (SCI-8)		
University A	SCI-8-UA	Early warning & emergency training.
University B	SCI-8-UB	Adequate knowledge of the compliance with health and safety legislation.
University C	SCI-8-UC	Emergency training and must be aware of the health and safety legislation updates.
University D	SCI-8-UD	Policies, detailed safety rules and safe working practice to ensure compliance with health and safety legislation must be devised, implemented and regularly reviewed.
University E	SCI-8-UE	Adequate knowledge on any changes on the health and safety legislation. The policy must be well communicated among stakeholders. Adequate emergency training.
<i>Health & safety (SCI-8):</i> <i>SCI = Solution for Current Internal challenge</i> <i>SCI-8 = '8' refers to nth subcategory (issue) of current internal challenge</i> <i>UA = University (i.e University A or first case study university)</i> <i>UD1 = '1' refers to 1st solution mentioned as practical solution for the CI challenge</i>		

3) *Policies, detailed safety rules and safe working practice*

Another interviewee also hinted that by having policies, detailed safety rules and safe working practice, university facilities managers would be able to minimize the health and safety related challenges. IFMA (2011) observed that another measure taken by university facilities managers in addressing health and safety related issues is by

preparing “better documentation of policies and procedures related to emergency management”.

4) *Well communicated on any changes of health & safety legislation*

The interviewees also suggest that, to minimize the issues around health and safety, university facilities managers need to ensure that any changes pertaining to health and safety legislation are well-communicated among the FM teams, the university itself and key stakeholders. This suggestion is in line with the views expressed by IFMA (2007) that, besides “advance response planning and preparation are important in minimizing the disruption and speeding the recovery process”, university facilities managers need to enhance communications among all related stakeholders and staff (IFMA, 2011).

(i) *Practical solutions for addressing current internal challenges related to materials*

Feedback from the case study universities on the practical solutions for addressing current internal challenges related materials is presented in Table 124. Five recurring themes as the practical solutions for addressing materials related current internal challenges faced by university facilities managers are discussed in the following subsections.

Table 124: Practical solutions for addressing current internal challenges - Materials

University	Code	Practical solutions for addressing current internal challenges
<i>Materials (SCI-9)</i>		
University A	SCI-9-UA	Maintain regular maintenance and repair programme.
University B	SCI-9-UB	Good planning where materials can be provided or stored on site whenever is needed.
University C	SCI-9-UC	Provision of emergency spare parts, equipment or materials on site and readily available to after-hours maintenance and repair work.
University D	SCI-9-UD	Maintain effective system for delivering materials.
University E	SCI-9-UE	Preventive maintenance need to be readily available on site.
<i>Maintenance (SCI-9):</i> <i>SCI = Solution for Current Internal challenge</i> <i>SCI-9 = '9' refers to nth subcategory (issue) of current internal challenge</i> <i>UA = University (i.e University A or first case study university)</i> <i>UD1 = '1' refers to 1st solution mentioned as practical solution for the CI challenge</i>		

1) Maintain regular maintenance and repair program

The interviewees suggested that, to minimize the materials-related challenges, university facilities managers need to maintain regular maintenance and repair program.

2) Good planning where materials can be provided or stored on site

A point that was raised by one of the interviewees was, to minimize the materials-related issues, university facilities managers need to develop a good planning where materials can be provided or stored on site.

3) Provision of emergency spare parts, equipment or material on site

One of the interviewees suggested that, by having provision of emergency spare parts, equipment or material on site, the university facilities managers are able to minimize the materials-related issues. This helps to support maintenance program in which “a minimum spares holding” is highly recommended (Booty, 2009).

4) Maintain effective system for delivering materials

One of the interviewees hinted that, by maintaining effective system for delivering materials, university facilities managers are able to address to materials-related issues. Booty (2009) argued that it is vital for university facilities managers to ensure “that all systems and components essential to the company’s business continuity plan are known and that they are properly included in maintenance priorities”. This helps to enhance the delivery of materials system and therefore improve FM operations.

5) Preventive maintenance need to be readily available on site

One of the interviewees suggested that by ensuring preventive maintenance needed to be readily on site, university facilities managers are able to minimize the materials related challenges. Booty (2009) agrees with this suggestion by adding that it is important for university facilities managers to “develop a planned preventive maintenance schedule for all essential items of equipment, systems and fittings”.

6.2.6.2 Practical solutions for addressing current external challenges

Table 125 – Table 130 feedbacks from each university on the practical solutions for addressing current external challenges. Each solution suggested by the case study university is coded for use in thematic content analysis (Cooper and Emory, 1995; Anderson 2007). The feedback is in relation to six sub-categories of current external challenges facing the university facilities managers:

- a) Economic b) Sustainability/environmental c) Technological
- d) Regulatory/compliance e) Socio-cultural f) Institutional

a) Practical solutions for addressing current external challenges related to economic

Feedback from the case study universities on the practical solutions for addressing current external challenges related to economic is presented in Table 125. Four recurring themes as the practical solutions for addressing economic related current external challenges faced by university facilities managers are discussed in the following subsections.

Table 125: Practical solutions for addressing current external challenges - Economic

University	Code	Practical solutions for addressing current external challenges
<i>Economic (SCE-1)</i>		
University A	SCE-1-UA	Annual Strategic Asset Management Plan (SAMP) review demands scan of micro/macro environments and necessary analysis of effect on FM budgets/operations.
University B	SCE-1-UB	Most of these do not affect the FM team with the exception of inflation. The FM team manage effectively and efficiently at budget round. In the case of all spend lines and capital re-questions the FM team include an allowance for inflation. For large capital projects which take years to complete the team build cost escalations into the budget. CPI adjustments are quite common and in some cases make PPI adjustments for sector increases although financial department do question PPI more because it is sector specific.
University C	SCE-1-UC	Not an issue.
University D	SCE-1-UD	Optimise cost-cutting and efficiency in all processes.
University E	SCE-1-UE	Maintain sustainability focus in all FM activities and ensure prudential management of limited resources.
<i>Economic (SCE-1):</i> <i>SCE = Solution for Current External challenge</i> <i>SCE-1 = '1' refers to nth subcategory (issue) of current external challenge</i> <i>UA = University (i.e University A or first case study university)</i> <i>UD1 = '1' refers to 1st solution mentioned as practical solution for the CE challenge</i>		

2) Annual Strategic Asset Management Plan (SAMP) review

One of the interviewees suggested that, to minimize economic-related challenges, university facilities managers should establish Annual Strategic Asset Management Plan (SAMP) review which demands scan of micro/macro environments and necessary analysis of effect on FM budgets/operations. The annual review will help to provide information on funding and development pertaining to facilities asset base with a conceptual framework approach in managing the strategic contribution of the property portfolio.

3) Manage budget efficiently

A point was raised by one of the interviewees that, to address economic-related issues, the FM team manage effectively and efficiently at budget round. According to the interviewee, “most of these do not affect the FM team with the exception of inflation. In the case of all spend lines and capital re-questions, the FM team include an allowance for inflation. For large capital projects which take years to complete the team build cost escalations into the budget. CPI adjustments are quite common and in some cases make PPI adjustments for sector increases although financial department do question PPI more because it is sector specific”. APPA (2009) observed that in order to address economic-related issues, university facilities manager need to “set realistic expectations within the universities; consequently make certain that their budgets reflect their priorities”. In addition, university facilities managers also need to consider “incorporating total cost of ownership (TCO) into the decision making process”.

4) Optimise cost-cutting and efficiency

Another interviewee hinted that by optimising cost-cutting and efficiency in all processes, university facilities managers are able to minimize economic-related issues. In times of economic hardship, Atkin and Brooks (2000) stated that “cost savings cannot be looked at in isolation from value. Universities must be able to demonstrate what they are getting for their money”.

5) Maintain sustainability focus in all FM activities

The interviewees also suggested that, to minimize economic-related issues, university facilities managers need to maintain sustainability focus in all FM activities and ensure wise management of limited resources. APPA (2009) observed that “universities need to adjust to the new reality of sustainability as a permanent way of doing business”.

(b) Practical solutions for addressing current external challenges related to sustainability/ environmental issues

Feedback from the case study universities on the practical solutions for addressing current external challenges related to sustainability/ environmental issues is presented in Table 126. There are five recurring themes as the practical solutions for addressing sustainability related current external challenges faced by university facilities managers and each is discussed in the following subsections.

1) Analysis, implementation and management of initiatives.

The interviewees suggest that, to minimize sustainability-related challenges, Formal Environmental Policy should be used for analysis, implementation and management of initiatives. To achieve success in sustainability, university facilities managers could make use of the sustainability and environmental assessment or evaluation tools within the universities.

For instance, Building Research Establishment Environmental Assessment Method system (BREEAM) is widely used “to set a list of environmental criteria against which building performances are checked and evaluated” (Langston and Ding, 2003); Building Environmental Performance Assessment Criteria (BEPAC) - launched in year 1993 by University of British Columbia – considered as “more detailed and comprehensive assessment method; which includes a set of criteria spanning global, local and indoor environments (Cole, 1994); Leadership in Energy and Environmental Design (LEED) – developed in year 1999 by the U.S Green Building Council – “it is a voluntary and market-based assessment method that is intended to define and rate ‘green’ buildings (Crawley and Aho, 1999); Australian Building Greenhouse Rating Scheme – a very specialized assessment tool which only focus on energy performance and “apply only to existing buildings” compared to other assessment tools which can be apply in broader context for design development activities and completed buildings (SEDA, 2002).

Table 126: Practical solutions for addressing current external challenges - Sustainability/ environmental issues

University	Code	Practical solutions for addressing current external challenges
<i>Sustainability/ environmental issues (SCE-2)</i>		
University A	SCE-2-UA	Formal Environmental Policy and FTE responsible for analysis, implementation and management of initiatives.
University B	SCE-2-UB	The challenge is to raise money to make the necessary changes that will result in a saving. The University has not been good at the raising to save and instead the FM team simply uses the maintenance and where applicable capital to implement changes that result in energy savings. The story gets a little worse because the energy use is an operating cost and operating budgets are usually set on previous year operational expenses or history plus CPI. Therefore if the team save the budget invariably gets cut. There are a few capital projects that the FM team have implemented on the basis of energy cost savings however the FM team have very little success in the University of raising money to save energy it is all undertaken at a local level.
University C	SCE-2-UC	Utilise academics to develop and test new initiatives. Use technology to best manage energy. Develop environmental programs and awareness. Adopt incentive system to reduce demand.
University D	SCE-2-UD	Make a business case for energy efficiency and sustainability. Leverage existing facilities operations and programs to support sustainability.
University E	SCE-2-UE	Develop and implement energy policy to cut consumption, manage use and reduce volatility.
<i>Sustainability/ environmental issues (SCE-2):</i> <i>SCE = Solution for Current external challenge</i> <i>SCE-2 = '2' refers to nth subcategory (issue) of current external challenge</i> <i>UA = University (i.e University A or first case study university)</i> <i>UD1 = '1' refers to 1st solution mentioned as practical solution for the CE challenge</i>		

2) Implementation on the basis of energy cost savings

One of the interviewees suggested that, by implementing an energy cost savings initiative, university facilities managers will be able to minimize the sustainability-related issues. According to the interviewee, “the challenge is to raise money to make the necessary changes that will result in a saving. The University has not been good at the raising to save and instead the FM team simply uses the maintenance and where applicable capital to implement changes that result in energy savings. The story gets a little worse because the energy use is an operating cost and operating budgets are usually set on previous year operational expenses or history plus CPI. Therefore if the team save the budget invariably gets cut. There are a few capital projects that the FM team have implemented on the basis of energy cost savings however the FM team have very little success in the University of raising money to save energy it is all undertaken at a local level”.

APPA (2006) stated that “energy efficient design and operations go hand-in-hand with sustainability efforts; thus university facilities managers should adopt strategies to reduce energy costs such as cost for electricity and heating water” by turning to

technologies such as “solar power from photovoltaic arrays or wind energy from turbines or wind farms, geothermal heating and cooling as well as biomass”. The widely usage of these technologies lead to energy costs reduction.

3) Utilise academics to develop and test new initiatives

The interviewees also hinted that, to minimize sustainability-related challenges, university facilities managers should efficiently utilise academics by using technology to best manage energy in order to develop and test new initiatives for sustainability. In addition, one of the interviewees also suggested that university facilities managers should develop environmental programs and awareness. APPA (2010) agrees with the suggestion, by adding that university facilities managers need to “build a culture in which environmental awareness is widespread among students, faculty, staff and administrators and sustainability influences decision making across the campus”.

Adopt incentive system to reduce demand.

4) Make a business case for energy efficiency and sustainability

The interviewees also suggest that, making a business case for energy efficiency and sustainability by leveraging existing facilities operations and programs to support sustainability, could help minimize the sustainability-related issues. APPA (2010) suggested that, university facilities managers need to ensure “the facilities department is leading the charge for campus sustainability; in which senior facilities officers should play leading roles in sustainability discussions. For instance, helping shape policy and managing implementation”.

Consequently, university facilities managers have to go extra miles in assessing their role on campus and determine where to step up to boost their impact on sustainability discussion.

5) Develop and implement energy policy

The interviewees suggested that, to minimize sustainability challenges, comprehensive campus energy plans and policies should be developed and implemented by the university facilities managers. The purpose of these policies is to “examine campus energy use, assess the associated costs of this use (both financial and environmental), and propose strategies to reduce energy across board (to include: buildings, transportation, IT and other elements)” (APPA, 2010). These plans help provide universities “an overall policy directive as well as specific goals and strategies”.

(c) Practical solutions for addressing current external challenges related to technological

Feedback from the case study universities on the practical solutions for addressing current external challenges related to technological is presented in Table 127. Four recurring themes as the practical solutions for addressing technological related current external challenges faced by university facilities managers are discussed in the following subsections

1) *Monitor technology needs and gaps and liaise with IT staff/experts*

One of the interviewees suggest that, to minimize technology-related issues, university facilities manager need to cosier having a dedicated FM systems co-ordinator role to monitor technology needs and gaps as well as liaise with the IT experts to effect requirements. This suggestion is in line with the findings from other studies. For instance, university facilities managers would be able to effectively monitor the technology needs and gaps associated with IT issues by “keeping abreast of changing technology and work closely with tenants/ users” (IFMA, 2007). In addition, university facilities managers need to make certain of the collaboration between FM team and IT staffs in order to “better integrate their IT and facilities efforts”.

Table 127: Practical solutions for addressing current external challenges - Technological

University	Code	Practical solutions for addressing current external challenges
<i>Technological (SCE-3)</i>		
University A	SCE-3-UA	Dedicated FM Systems Co-ordinator role to monitor technology needs and gaps and liaise with ITS to effect requirements.
University B	SCE-3-UB	Changes due to technology advances are becoming more common. Basically we implement new technology through capital works and this could be refurbishments, new replacements of building and or equipment. Technology changes are introduced at an operational level and again this is usually to achieve cost savings light new lights, movements sensors to control lights etc.
University C	SCE-3-UC	Not an issue.
University D	SCE-3-UD	Integrate IT and facilities planning to maximize success.
University E	SCE-3-UE	Ensure FM team seek ways to work with IT to resolve existing issues and develop strategies to help university in facing the rapid technological change.
<i>Technological (SCE-3):</i> <i>SCE = Solution for Current External challenge</i> <i>SCE-3 = '3' refers to nth subcategory (issue) of current external challenge</i> <i>UA = University (i.e University A or first case study university)</i> <i>UD1 = '1' refers to 1st solution mentioned as practical solution for the CE challenge</i>		

2) Implementation of new technology

A point was raised by one of the interviewees that, the implementation of new technology helps to minimize the technology-related issues. “Changes due to technology advances are becoming more common. Basically we implement new technology through capital works and this could be refurbishments, new replacements of building and or equipment.

Technology changes are introduced at an operational level and again this is usually to achieve cost savings light new lights, movements’ sensors to control lights”. APPA (2010) agrees with this suggestion by adding that it is important for university facilities managers to “assess how changes in IT will affect all aspects of teaching, learning, research, communications and the built environment”.

3) Integrate IT and facilities planning

One of the interviewees also suggest that, to minimize the challenges around technology, university facilities managers need to integrate IT and facilities planning for maximizing success. APPA (2010) adds to this by stating that university facilities managers need to “make the right investments to ensure IT resources can withstand disaster”.

4) Resolve existing issues and develop new strategies

Another interviewee hinted that, by resolving existing issues around information technology (IT), the technology-related challenges could be minimized. This could be successfully achieved by strong collaboration between FM team and IT expert in resolving IT problems and disruptions.

According to APPA (2010), it is of crucial importance that university facilities managers to consider on investing in IT security by having comprehensive strategies to security matters such as “physical theft, hacking, viruses to natural disasters, securing remote access, keeping virus definitions up to date, patching systems, monitoring intrusions and managing passwords”. Besides, university facilities managers also need to take highly consideration on developing necessary plans to overcome “crises and catastrophes from fires and floods to massive security breaches, terrorist attacks and on-campus violence” (APPA, 2010). University facilities managers could therefore consider implementing extensive analysis such as security audits in order to achieve effective IT security plans.

(d) Practical solutions for addressing current external challenges related to regulatory/ compliance

Feedback from the case study universities on the practical solutions for addressing current external challenges related to regulatory/ compliance is presented in Table 128. Four recurring themes as the practical solutions for addressing regulatory/ compliance-related current external challenges faced by university facilities managers are discussed in the following subsections.

1) Strong relationship with key consultants/ industry networks

One of the interviewees suggested that, to minimize statutory compliance-related issues, university facilities managers should consider having subscription to various publications/ alerts and also maintaining strong relationships with key consultants or industry networks (both on the state and national level) with explicit expectation of advice for potential or actual legislative changes. This helps to minimize the burden of regulatory compliance (APPA, 2010).

Table 128: Practical solutions for addressing current external challenges - Regulatory/ compliance

University	Code	Practical solutions for addressing current external challenges
<i>Regulatory/ compliance (SCE-4)</i>		
University A	SCE-4-UA	Subscription to various publications/ alerts; strong relationships with key Consultants/industry networks with explicit expectation of advice of potential or actual legislative changes.
University B	SCE-4-UB	This is a very difficult one and we simply have to comply with any mandatory compliance requirements. The net effect is that the nice to have jobs such as keep the campus tidy and the light take a back seat as the safety and compliance requirements increase along with the cost of compliance. We manage this where ever possible by tendering and obtaining the best prices thereby stretching the budget.
University C	SCE-4-UC	Ensure adequate staff knowledge in compliance and legislation.
University D	SCE-4-UD	Advocate streamlined regulations be more aware and updated with the latest changes of regulations.
University E	SCE-4-UE	Take serious consideration on the cost associated with regulations as they keep track of the compliance. Thus, existing regulations need to be managed efficiently.
<i>Regulatory compliance (SCE-3):</i> <i>SCE = Solution for Current External challenge</i> <i>SCE-3 = '3' refers to nth subcategory (issue) of current external challenge</i> <i>UA = University (i.e University A or first case study university)</i> <i>UD1 = '1' refers to 1st solution mentioned as practical solution for the CE challenge</i>		

2) Adequate staff knowledge in compliance and legislation

The interviewee also hinted that, to minimize statutory compliance-related issues, university facilities managers need to ensure adequate staff knowledge in compliance and legislation. This helps FM staff to effectively response to any drastic changes in compliance and legislation. APPA (2010) stated that university facilities managers should starts by “better manage existing regulations; as it is not easy to keep up with all of the rules and requirements, but the job need to be done consistently and carefully”. Further, in APPA Thought Leaders Series 2010 report, the study suggested that universities “may choose to start measuring the cost of regulations as they keep track of their compliance”.

3) Advocate streamlined regulations

One of the interviewees also suggest that, to reduce regulatory / compliance-related challenges, university facilities managers should advocate streamlined regulations and be more alert and updated with the latest changes of regulations. APPA (2010) agrees with this suggestion by stating that “universities concerned about federal regulations

should consider some form of advocacy to make their point; however, it will take a sustained effort by numerous universities to have a real impact”.

4) Take serious consideration on the cost associated with regulations

The interviewees suggested that, by taking serious consideration on the cost associated with regulations, university facilities managers are able to effectively address to the regulatory/ compliance issues. One of the interviewee stated that, “this is a very difficult one and our FM team simply have to comply with any mandatory compliance requirements. The net effect is that the nice to have jobs such as keep the campus tidy and the light take a back seat as the safety and compliance requirements increase along with the cost of compliance. We manage this where ever possible by tendering and obtaining the best prices thereby stretching the budget”.

(e) Practical solutions for addressing current external challenges related to socio-cultural issues

Feedback from the case study universities on the practical solutions for addressing current external challenges related to socio-cultural issues is presented in Table 129. There are 4 recurring themes as the practical solutions for addressing socio-cultural related current external challenges faced by university facilities managers. Each is discussed in the following subsections.

1) Regular consultation with key stakeholders and effective communications

One of the interviewees suggested that, to minimize socio-cultural issues, university facilities managers should ensure that they maintain regular consultation with key stakeholders through effective communication. This helps to address and determine to the key stakeholders’ vital needs rather than their ‘wants’. Hence, to successfully achieve this strategy, the implementation of annual Strategic Asset Management Plan (SAMP) is important as it “highlights how the university approaches the management of the built environment and natural environment to ensure existing assets and potential future assets are managed effectively across their life cycle” (University of Tasmania, 2005).

Table 129: Practical solutions for addressing current external challenges - Socio-cultural issues

University	Code	Practical solutions for addressing current external challenges
<i>Socio-cultural issues (SCE-5)</i>		
University A	SCE-5-UA	Annual Strategic Asset Management Plan (SAMP) review demands regular consultation with key stakeholders and ensure that we are aware of their needs.
University B	SCE-5-UB	This is again very difficult - on one occasion we were told that we had to have a lift in a building because of disabled access - our arrangement was simply to help disabled staff to their location using our venue assistants where required (as this was not often at all) and three years after the notification we raised the money \$300k to install the lift. There is lots of pressure from different groups and we simply check the actual requirement and apply this as required in the most cost effective way and in some cases we use work around until we have secured funding to make the long terms changes. Where there are more serious issues such as seismic compliance then there is a risk assessment of the situation and funding applied on the basis of the case.
University C	SCE-5-UC	Not an issue
University D	SCE-5-UD	Better manage stakeholder expectations; focus on the critical needs of key stakeholders.
University E	SCE-5-UE1	Maintain regular consultation and effective communication with key stakeholders and addressing to their vital needs rather than their 'wants'.
	SCE-5-UE2	Make a strong case for senior management to prune down admissions to align with existing facility capacity.
<i>Socio-cultural issues (SCE-5):</i> <i>SCE = Solution for Current External challenge</i> <i>SCE-5 = '5' refers to nth subcategory (issue) of current external challenge</i> <i>UA = University (i.e University A or first case study university)</i> <i>UD1 = '1' refers to 1st solution mentioned as practical solution for the CE challenge</i>		

2) Regulatory compliance

One of the interviewees suggested that, to address to the socio-cultural related issues, university facilities managers need to comply with the changes in regulatory compliance. The interviewee mentioned that, “this is again very difficult - on one occasion we were told that we had to have a lift in a building because of disabled access - our arrangement was simply to help disabled staff to their location using our venue assistants where required (as this was not often at all) and three years after the notification we raised the money \$300k to install the lift. There is lots of pressure from different groups and we simply check the actual requirement and apply this as required in the most cost effective way and in some cases we use work around until we have secured funding to make the long terms changes. Where there are more serious issues such as seismic compliance then there is a risk assessment of the situation and funding applied on the basis of the case”.

3) Better manage stakeholder expectations

One of the interviewees hinted that, to address to the socio-cultural related issues, facilities managers need to better manage stakeholder expectations, in which the focus must be on the critical needs of key stakeholders. APPA (2010) agrees with this suggestion by stating that, university facilities managers need to fully embrace the student demographic changes, for instance, “how the university’s student population is changing in term of age, income, ethnicity, experience and goals”. University facilities managers need to be aware that “different students want and need different things from higher education, and these new needs create new opportunities for the universities” (APPA, 2010).

4) Make a strong case for senior management

Other interviewees suggested that, by making a strong case for senior management to prune down admissions to align with existing facility capacity, university facilities managers are able to effectively address to the socio-cultural related challenges. APPA (2011) observes that, “organizations are expanding their expectations of FM to include both technical and business acumen drives for an evolving skill set; thus the increased focus on business acumen will require facility professionals to think and act strategically as well as to communicate positions their positions in board level”.

(f) Practical solutions for addressing current external challenges related to institutional factors

Feedback from the case study universities on the practical solutions for addressing current external challenges related to institutional issues is presented in Table 130. There are 4 recurring themes as the practical solutions for addressing institutional-related current external challenges faced by university facilities managers. Each is discussed in the following subsections.

1) Regular consultation with key stakeholders

The interviewee suggested that, to minimize institutional-related challenges, university facilities managers need to review the Annual Strategic Asset Management Plan (SAMP) which demands regular consultation with key stakeholders.

For instance, The University of Tasmania (2005) further observed that, the SAMP helps “provide a framework to manage all assets which includes: an asset base that matches and supports the business needs of the university; consolidate existing corporate capital assets and optimizing asset utilization; meet statutory compliance obligations; and align asset operating costs with business planning and service delivery requirements”.

Table 130: Practical solutions for addressing current external challenges - Institutional

University	Code	Practical solutions for addressing current external challenges
<i>Institutional (SCE-6)</i>		
University A	SCE-6-UA	Annual Strategic Asset Management Plan (SAMP) review demands regular consultation with key stakeholders and ensure that we are aware of their needs.
University B	SCE-6-UB	The structure associated with an organisation is the key to implementing good or poor management across the board. Facilities, in most organisations are not properly represented on Executive management. The result is underfunding, poor or no strategic direction. The challenge for FM Directors is to make this known and present information that will offer better outcomes with an FM executive on the Board. The major question has always been about costs minimisation. All of this has come about because FM is fundamentally not recognised as a profession and up until recently most FM Directors are sub professional whereas others such as accountants and business analysts are professionals. The change will universally take place as services and building become more complex. This is happening in IT industry.
University C	SCE-6-UC	Data integrity to provide information relating to FM. Appropriate benchmarking. Must sell the message.
University D	SCE-6-UD	Demonstrate Facilities Managers value and the value of facilities to get a seat at highest tables of decision making within the university.
University E	SCE-6-UE	Crafting integrated strategic plan.
<i>Institutional issues (SCE-6):</i> <i>SCE = Solution for Current External challenge</i> <i>SCE-6 = '6' refers to nth subcategory (issue) of current external challenge</i> <i>UA = University (i.e. University A or first case study university)</i> <i>UD1 = '1' refers to 1st solution mentioned as practical solution for the CE challenge</i>		

2) *Data integrity to provide information on FM*

One of the interviewee also suggested that, by ensuring data integrity to provide information relating to FM, university facilities managers are able to effectively address to the institutional issues. This helps to set an appropriate benchmarking for establishing priorities and decision-making (APPA, 2006).

3) *Demonstrate Facilities Managers value and the value of facilities*

Interviewees also suggest that, to minimize the institutional-related challenges, university facilities managers need to successfully demonstrate their value as facilities managers and also the value of university's facilities in order to get a seat at the highest

tables of decision making within the university. This could be achieved through the following strategies identified by APPA: “(i) understand the current situation; (ii) consider what need to do to raise the profile of facilities; (iii) ensure that facilities strategic plan is in alignment with the vision, mission and strategies of the university and this alignment can be demonstrated with quantifiable results”.

One of the interviewee pointed out that, “The structure associated with an organization is the key to implementing good or poor management across the board. Facilities, in most organizations are not properly represented on Executive management. The result is underfunding, poor or no strategic direction. The challenge for FM Directors is to make this know and present information that will offer better outcomes with an FM Executive on the Board. The major question has always been about costs minimization. All of this has come about because FM is fundamentally not recognized as a profession and up until recently most FM Directors are sub professional whereas others such as accountants and business analyst are professionals. The change will universally take place as services and building become more complex. This is also happening in IT industry”.

4) Crafting integrated strategic plan

The interviewee also suggested that, by crafting an integrated strategic plan, university facilities managers are able to minimize the institutional-related issues. This helps to evaluate the overall condition of the university built environment which the FM department intended to manage and maintain it. It is important for university facilities managers to ensure that the plans are align to universities’ strategic goals. APPA (2010) stated that by having strategic plan, universities are able to “confront the challenges of cost, access and competition” as well as efficiently “analyze the organization, structure and financial system for their long-term sustainability and economic viability”.

6.2.6.3 Practical solutions for addressing future challenges

This section presents the respondents’ responses from each university on the practical solutions for addressing future challenges. Each solution suggested by the case study university is coded for use in thematic content analysis (Cooper and Emory, 1995). Thematic analysis (Anderson, 2007) of the feedback from the case study universities as presented in Table 131 - Table 140 shows the recurring themes of the practical solutions

for addressing each category of future challenges facing university facilities managers. The solutions are discussed in the following subsections, respectively.

The feedback is in relation to ten sub-categories of future challenges facing the university facilities managers in years to come:

- | | |
|-------------------------------------------|--------------------------------------|
| a) Emergency management | e) Business and financial management |
| b) Statutory compliance | f) Occupational health & safety |
| c) Sustainability | g) Leadership & innovation in FM |
| d) Technology | h) Space management |
| e) User needs assessment and satisfaction | i) Outsourcing |

(a) Practical solutions for addressing future challenges related to emergency management

Feedback from the case study universities on the practical solutions for addressing current external challenges related to economic is presented in Table 131. Two recurring themes as the practical solutions for addressing emergency management-related future challenges faced by university facilities managers are discussed in the following subsections.

1) *Emergency management (EM) and business continuity*

The interviewee suggested that, by ensuring regular review on strong, mandated emergency management and Business Continuity Planning policies and frameworks, university facilities managers are able to address to future EM-related issues. Other interviewee also suggested, university facilities managers need to provide flexible and comprehensive platform for speedy disaster recovery and business continuity. One of the interviewee also hinted that, by having retrofit buildings and infrastructure against hazards, university facilities managers are able to minimize the potential damage and thus enhance the opportunities of early re-opening of business premises in the event of disaster. IFMA (2007) agrees to these suggestions and sums up that, it is important for facilities managers to “analyze vulnerabilities, develop and implement protection strategies, develop response plans in advance and communicate them to all stakeholders as well as leverage resources”.

2) Preparedness, plans in place and training

A point that was raised by the interviewee was that, by having great level of preparedness, plans in place and adequate training related to EM, university facilities managers are able to minimize the emergency management-related challenges.

The interviewee mentioned that, “The challenge for this area is to facilitate a balance associated with the needs and risks. Most public service organization will have enough information in a form that will support a good structure. One has to implement testing and verification of operations and ensure staff are experience and available to meet the needs. With the recent event in NZ the University has collectively put together the information for most events. Investments need to continue in training and optimizing the use of services and resources. There are some challenges in the business continuity area because level of disaster will have level of effect and long term solution may mean generators and the like to keep the services operating. This backup service is available where there are expensive issue samples and the like for research but the challenge is the balance of cost to implement and maintain the emergency services with respect to the likely hood and risk”.

This suggestion is in line with the findings from other studies. For instance, APPA (2006) suggests strategies to encounter safety, security and business continuity related issues: “1) Expect local, state and federal health and safety mandates to continue to change and evolve, and plan for that expense in the budgeting process; 2) Engage in advocacy efforts to stem the increasing tide of code expansion; 3) Take an active role in cross-department business continuity activities; 4) Evaluate energy infrastructure for vulnerabilities; 5) Look for facilities to play a role in preventing terrorism and crime - in protecting IT resources”.

APPA (2010) also observed that in order to tackle this issue, university facilities managers need to “conduct a building security audit to understand potential threats; look to technology to help balance openness with security; and work with security personnel to develop a comprehensive communications plan”.

Table 131: Practical solutions for addressing future challenges - Emergency management

University	Code	Practical solutions for addressing future challenges
<i>Emergency management (SF-1)</i>		
University A	SF-1-UA	Strong, mandated EM and Business Continuity Planning policies and frameworks demanding regular review.
University B	SF-1-UB	The challenge for this area is to facilitate a balance associated with the needs and risks. Most public service organisation will have enough information in a form that will support a good structure. One has to implement testing and verification of operations and ensure staff are experience and available to meet the needs. With the recent event in NZ the University has collectively put together the information for most events. Investments need to continue in training and optimising the use of services and resources. There are some challenges in the business continuity area because level of disaster will have level of effect and long term solution may mean generators and the like to keep the services operating. This backup service is available where there are expensive issue samples and the like for research but the challenge is the balance of cost to implement and maintain the emergency services with respect to the likely hood and risk.
University C	SF-1-UC	Preparedness. Plans in place. Training.
University D	SF-1-UD	Provide flexible and robust platform for speed disaster recovery and business continuity.
University E	SF-1-UE	Retrofit buildings and infrastructure against hazards to reduce damage and improve chances of early re-opening of business premises in the event of disaster.
<i>Emergency management (SF-1):</i> <i>SF = Solution for Future (F) challenge</i> <i>SF-1 = '1' refers to nth subcategory of future challenge</i> <i>UA = University (i.e University A or first case study university)</i> <i>UD1 = '1' refers to 1st solution mentioned as practical solution for the future challenge</i>		

(b) Practical solutions for addressing future challenges related to statutory compliance

Feedback from the case study universities on the practical solutions for addressing current external challenges related to statutory compliance is presented in Table 132. There are 3 recurring themes as the practical solutions for addressing statutory compliance-related future challenges faced by university facilities managers. Each is discussed in the following subsections.

1) *Strong relationships with key Consultants/ industry networks*

One of the interviewees suggested that, to minimize future statutory compliance-related issues, university facilities managers should consider having subscription to various publications/ alerts and also maintaining strong relationships with key consultants or industry networks (both on the state and national level) with explicit expectation of

advice for potential or actual legislative changes. This helps to reduce the encumbrance of regulatory compliance within the universities (APPA, 2010).

2) Keep up with latest legislation on FM policies

The interviewee also hinted that, tomorrow's university facilities managers need to keep up with the rapid changes in latest legislation on FM policies. According to the interviewee, "The FM team simply makes the management aware of the higher levels costs and resource needs to meet the future requirements. In addition the FM team tries and keeps up with the latest in standards and legislation information that will and does affect their services. Training and communicating this or any change is a challenge and the team simply send those needed on courses to update the skills and communication changes through meetings and in house committees such as health and safety/energy/technical maintenance group meetings. The down side of all this admin is lower productivity".

Other interviewee also suggest that, to minimize future statutory compliance issues, it is advisable for university facilities manager to keeping tab on new evolving legislations and taking proactive measures in planning for the imminent effects.

3) Adequate training and courses

The interviewee also suggest that, one of the measures to reduce potential issues related to statutory compliance is by having adequate up-to-date training and courses on skills and communication with regards to the changes in legislations and standards, especially in relation to health and safety issues, energy management and building maintenance.

IFMA (2011) agrees to this suggestion by adding some other related strategies for addressing future statutory-related challenges, to include: "more formalized emergency preparedness planning; better documentation of policies and procedures related to EM; enhanced communications with staff; enhanced security measures; more simulation drills to test plans; modified plans to eliminate/ minimize weaknesses; increased FM training related to emergency planning and preparation".

Table 132: Practical solutions for addressing future challenges - Statutory compliance

University	Code	Practical solutions for addressing future challenges
<i>Statutory compliance (SF-2)</i>		
University A	SF-2-UA	Subscription to various publications/ alerts; strong relationships with key Consultants/industry networks with explicit expectation of advice of potential or actual legislative changes.
University B	SF-2-UB	The FM team simply make the management aware of the higher levels costs and resource needs to meet the future requirements. In addition the team try and keep up with the latest in standards and legislation information that will and does affect their services. Training and communicating this or any change is a challenge and the team simply send those needed on courses to update the skills and communication changes through meetings and in house committees such as health and safety/energy/technical maintenance group meetings. The down side of all this admin is lower productivity.
University C	SF-2-UC	Ensure adequate staff knowledge in compliance and legislation governing FM policies and operations.
University D	SF-2-UD	Adequate up-to-date training and courses on skills and communication with regards to the changes in legislations and standards, especially in relation to health and safety issues, energy management and building maintenance.
University E	SF-2-UE	Keeping a tab on new evolving legislations and taking proactive measures in planning for the imminent effects.
<i>Statutory compliance (SF-2):</i> <i>SF = Solution for future (F) challenge</i> <i>SF-2 = '2' refers to nth subcategory of future challenge</i> <i>UA = University (i.e University A or first case study university)</i> <i>UD1 = '1' refers to 1st solution mentioned as practical solution for the future challenge</i>		

(c) Practical solutions for addressing future challenges related to sustainability

Feedback from the case study universities on the practical solutions for addressing current external challenges related to sustainability is presented in Table 133. Four recurring themes as the practical solutions for addressing sustainability-related future challenges faced by university facilities managers are discussed in the following subsections.

1) Analysis, implementation and management initiatives

The interviewee suggested that, to minimize sustainability-related challenges, Formal Environmental Policy should be used for analysis, implementation and management of initiatives. To achieve success in sustainability, university facilities managers could make use of the sustainability and environmental assessment or evaluation tools within the universities.

This strategy enables university facilities managers to identify “what sustainability means for their universities and what going green means to their students, faculty, and staff so that they can focus their efforts rather than going off in a dozen different directions” (APPA, 2009). In a broader perspective, this helps universities to establish a vision of sustainability that pushes decision-making (APPA, 2009).

2) Strategies to reduce risk and stay update on legislation changes

The interviewee also suggested that, to minimize sustainability-related challenges, university facilities managers need to consider creative strategies to reduce risk and manager energy costs. This helps universities facilities managers to search for effective approaches to include carbon dioxide emissions in the campus growth and energy decisions. It is vital for facilities managers to stay abreast on legislative discussions around energy and carbon costs matters.

3) Develop environmental and program awareness

One of the interviewee hinted that, utilizing academics to develop and testing new initiatives results in the minimization of sustainability-related issues. The widely use of technology helps to better manage energy. Other measures suggested, include developing environmental awareness and programs as well as adopting incentive system to reduce demand.

According to APPA (2009), the development of environmental awareness could be achieved by “harnessing the enthusiasm and commitment of student and faculty environmental advocates” which “help build consensus on campus on the importance of energy conservation and build a base support”. The incentives programs help motivate the universities toward energy efficiency and therefore enable universities to establish a standard metric to measure sustainability progress.

4) Facilities managers to have education, skills and leadership abilities

Other interviewee also suggested that, university facilities managers need to have education, skills and leadership abilities to take their place among university decision maker in order to address to sustainability issues. Further, they are required to be able to effectively communicate the value of facilities leaders in the sustainability and energy management effort as well as leverage existing facilities operations and programs to support sustainability.

This suggestion is in line with findings from other studies. For instance, to achieve the objectives and meeting the targets of environmental and sustainability, Mate (2003) agreed that education and communication across the whole of university are vital, by adding that “the aims, objectives, targets and solutions must be clearly understood by all stakeholders. Staff and supply chain involvement in setting these objectives and strategies is highly recommended as this only communicates the concepts at an early stage but also establishes ownership of solutions an awareness of environmental issues which may not otherwise be clear to everyone within an organization”.

APPA (2009) noted in its report The Educational Facilities Professional's Practical Guide to Reducing the Campus Carbon Footprint, Karla Hignite stated that, "today's facilities professional must understand that today's efforts to address climate change require campus-wide collaboration among many stakeholders for the benefits of tomorrow's generation. Facilities professionals must be willing to serve in new capacities - acting as subject experts with unique understanding issues surrounding sustainability, academic liaisons ready to help faculty and students fulfill academic goals relating to climate change initiatives, strategic administrative partners working to ensure the required resources are devoted to sustainability initiatives; communicators and motivators promoting the importance of climate change on campus.

Table 133: Practical solutions for addressing future challenges - Sustainability

University	Code	Practical solutions for addressing future challenges
<i>Sustainability (SF-3)</i>		
University A	SF-3-UA	Formal Environmental Policy and FTE responsible for analysis, implementation and management of initiatives.
University B	SF-3-UB	Consider creative strategies to reduce risk and manager energy costs; find ways to include carbon dioxide emissions in the campus growth and energy decisions; stay current on legislative discussions about energy and carbon costs.
University C	SF-3-UC	Utilise academics to develop and test new initiatives. Use technology to best manage energy. Develop environmental programs and awareness. Adopt incentive system to reduce demand.
University D	SF-3-UD	Facilities managers need to have education, skills and leadership abilities to take their place among university decision maker; be able to communicate the value of facilities leaders in the sustainability and energy management effort; and leverage existing facilities operations and programs to support sustainability.
University E	SFE-UE	Aim to reducing energy costs by adopt strategies to reduce cost for electricity and heating water; widely use available technologies for reducing utility costs include solar power, winder energy, geothermal heating and cooling biomass.
<i>Sustainability (SF-3):</i> <i>SF = Solution for Future (F) challenge</i> <i>SF-3 = '3' refers to nth subcategory of future challenge</i> <i>UA = University (i.e University A or first case study university)</i> <i>UD1 = '1' refers to 1st solution mentioned as practical solution for the future challenge</i>		

(d) Practical solutions for addressing future challenges related to technology

Feedback from the case study universities on the practical solutions for addressing current external challenges related to technology is presented in Table 134. Three recurring themes as the practical solutions for addressing technology-related future challenges faced by university facilities managers and are discussed in the following subsections.

1) *Monitor technology needs and gaps*

The interviewee suggested that, to minimize potential future technology related challenges, university facilities managers should consider having and maintaining the role of dedicated FM Systems coordinator in monitoring technology needs and gaps.

This could be successfully achieved by constantly liaising with IT experts to effect requirements and develop strategies for improvement in teaching, learning, research and communication. Tomorrow's university facilities managers need to make certain of the collaboration between FM team and IT staffs in order to "better integrate their IT and facilities efforts" (IFMA, 2007).

2) *Stay abreast with technology improvement*

One of the interviewee hinted that, technology improvement also helps to reduce the technology-related issues. The interviewee mentioned that, "This is mainly a cost consideration and with almost all new replacement items of service or equipment there is an improvement in technology. The FM team do replace like for like as required but in most cases the changes from a simply light fitting to a more complex controller will have built in technology improvements. The real challenge is to decide to make technological improvement changes before end of life of the current technology and this is a cost or cost benefit for large equipment decisions. The University model is to simply limit the money available and the changes as well as introduction of new is hence self-limiting and therefore the changes are a function of need and priority".

Other interviewee also suggest that, by staying abreast with the evolvement and rapid changes in IT, universities as well as the FM departments are able to enhance productivity and improve FM operations. Therefore, it is vital for university facilities managers to make certain that universities' facilities are designed for current and future technology requirements which contribute to costs savings in years to come.

3) Develop strategic plans

In order to address to future technology-related challenges, the interviewee suggest that, university facilities managers need to develop a strategic plan "that incorporates student and academic input that provides for greater transparency both inside and outside the university" (APPA, 2007). To achieve this, university facilities managers must establish a formal mechanism seeking input from all stakeholders and incorporate the input into the strategic plan provided that it must aligns with the universities' goals.

APPA (2007) further observed that universities possess its own strengths; reserves of intellectual capital, strong and diverse relationships with experts from various industry and also prestige and the reputation of the universities. These criteria therefore give "immediate credibility to the universities when they explore innovative solution and increased access to resources". APPA (2010) added that "understanding potential transformation in campus technology will help the institution develop strategies to remain nimble".

Table 134: Practical solutions for addressing future challenges - Technology

University	Code	Practical solutions for addressing future challenges
Technology (SF-4)		
University A	SF-4-UA	Dedicated FM Systems Co-ordinator role to monitor technology needs and gaps and liaise with ITS to effect requirements.
University B	SF-4-UB	This is mainly a cost consideration and with almost all new replacement items of service or equipment there is an improvement in technology. The FM team do replace like for like as required but in most cases the changes from a simply light fitting to a more complex controller will have built in technology improvements. The real challenge is to decide to make technological improvement changes before end of life of the current technology and this is a cost or cost benefit for large equipment decisions. The University model is to simply limit the money available and the changes and introduction of new is hence self-limiting and therefore the changes are a function of need and priority.
University C	SF-4-UC	Not an issue.
University D	SF-4-UD	Stay abreast of changing to enhance productivity and to improve operations.
University E	SF-4-UE	Liaise with IT experts in resolving technologies issues and develop strategies for improvement in teaching, learning, research and communication.
<i>Technology (SF-4):</i> <i>SF = Solution for Future (F) challenge</i> <i>SF-4 = '4' refers to nth subcategory of future challenge</i> <i>UA = University (i.e University A or first case study university)</i> <i>UD1 = '1' refers to 1st solution mentioned as practical solution for the future challenge</i>		

(e) Practical solutions for addressing future challenges related to user needs assessment and satisfaction

Feedback from the case study universities on the practical solutions for addressing current external challenges related to technology is presented in Table 135. The 4 recurring themes as the practical solutions for addressing user needs assessment and satisfaction-related future challenges faced by university facilities managers are further discussed in the following subsections.

1) *Regular consultation with key stakeholders*

The interviewee suggested that, to minimize future user needs assessment and satisfaction-related challenges, university facilities managers need to review the Annual Strategic Asset Management Plan (SAMP) which demands regular consultation with key stakeholders. Regular consultations with wider stakeholders help in making decisions and formulating action plans pertaining to issues around infrastructure procurement and space allocation.

2) Better utilization of space and services

One of the interviewees suggest that, by improving the utilization of space and services, university facilities managers are able to reduce the challenges in relation to user needs assessment and satisfaction in years to come.

The interviewee mentioned that, “This challenge needs to be addressed through user pays. This would be through a space charging or service charging regime where the users and the FM team suggest in this kind of case the college pays for uses of classrooms as an example on a per seat per hours basis. This cost would cover the usual capital and OPEX on a campus wide basis and would set the way to a more efficient operation and better utilization of space and services”.

Table 135: Practical solutions for addressing future challenges - User needs assessment and satisfaction

University	Code	Practical solutions for addressing future challenges
<i>User needs assessment and satisfaction (SF-5)</i>		
University A	SF-5-UA	Annual Strategic Asset Management Plan (SAMP) review demands regular consultation with key stakeholders and ensure that we are aware of their needs.
University B	SF-5-UB	This challenge needs to be addressed through user pays. This would be through a space charging or service charging regime where the users and the FM team suggest in this kind of case the college pays for uses of classrooms as an example on a per seat per hours basis. This cost would cover the usual capital and OPEX on a campus wide basis and would set the way to a more efficient operation and better utilisation of space and services.
University C	SF-5-UC	Data integrity to provide information relating to FM. Appropriate benchmarking. Must sell the message.
University D	SF-5-UD	Wider stakeholder consultations in making decisions and formulating action plans for infrastructure procurement and space allocation.
University E	SF-5-UE	Prompt and satisfactory response to user requests and needs within the constraints of available resources.
<i>User needs assessment and satisfaction (SF-5):</i> <i>SF = Solution for Future (F) challenge</i> <i>SF-5 = '5' refers to nth subcategory of future challenge</i> <i>UA = University (i.e University A or first case study university)</i> <i>UD1 = '1' refers to 1st solution mentioned as practical solution for the future challenge</i>		

3) Data integrity to provide information relating to FM

The interviewee also hinted that, to minimize the user needs assessment and satisfaction-related future issues, university facilities managers must ensure data integrity to provide information relating to FM. “Credible data, consistent terminology and definitions, appropriate standards, and common metrics” are the key to data integrity and accountability of facilities (APPA, 2006).

APPA's Strategic Assessment Model (SAM) was established in 1999, which helps university facilities managers to efficiently gather and organize important data to that enlightens the understanding of senior administrators in their organizations. APPA (2006) highlighted four categories of data that creates performance metrics of the universities:

<p>FINANCIAL PERSPECTIVE</p> <ul style="list-style-type: none"> Assess the universities' performance to measure: financial integrity, cost effective delivery services, stewardship responsibility for capital financial and capital resources. 	<p>INTERNAL PROCESS PERSPECTIVE</p> <ul style="list-style-type: none"> Evaluates delivery primary processes (i.e. handling work orders, procurement, billing & relationships with suppliers) in terms of efficiency and effectiveness to meet customer needs.
<p>INNOVATION & LEARNING PERSPECTIVE</p> <ul style="list-style-type: none"> Addresses practices to establish effective workforce for knowledge & capabilities improvement. Evaluates elements: work environment, compensation, performance management, training & organizational culture. 	<p>CUSTOMER PERSPECTIVE</p> <ul style="list-style-type: none"> Measures organizational responds to customers' expectations, build customers relationships & measures satisfaction.

4) *Prompt and satisfactory response to user requests and needs*

A point was raised by interviewee that, by having prompt and satisfactory response to user requests and needs within the constraints of available resources, university facilities managers are able to minimize the issues around user needs assessment and satisfaction in future. The key success to this strategy is by ensuring that "a customer service attitude prevails in their organization and improve communication channels with all stakeholders" (APPA, 2006).

(f) *Practical solutions for addressing future challenges related to business and financial management*

Feedback from the case study universities on the practical solutions for addressing current external challenges related to business and financial management is presented in Table 136. The five recurring themes as the practical solutions for addressing business and financial management-related future challenges faced by university facilities managers are discussed in the following subsections.

Table 136: Practical solutions for addressing future challenges - Business and financial management

University	Code	Practical solutions for addressing future challenges
<i>Business and financial management (SF-6)</i>		
University A	SF-6-UA	Robust granular asset data and history to support planning/prioritisation based on risk; outcome based contracts that incentivise innovation/efficiency; Energy Management FTE actively analysing and implementing energy savings.
University B	SF-6-UB	User pays will help in minimising cost and improving utilisation and effectively lead to a smaller asset base or an asset base that meets the organisations actual needs. Employing energy managers/specialists who will target less efficient operations and make cases for improvements that will have long term benefits is essential to a modern organisation. One of the biggest challenges going forward for a University today is the large asset based of buildings and equipment and there is a need to auto identify the needs and actual use and this can easily be undertaken by a cost effective user pays scheme where the academic side will pay and use only as required and will internally become more efficient through use and the organisation can then dispose of low use assets etc. The overall effect is a reduction in assets and asset related cost such as energy. Energy management programmes and the like can still be applied to all aspect of the fit whether large or small over and above the strategic model for a fit of the assets to meet the organisation's needs.
University C	SF-6-UC	Accurate data collection. Strategies to reduce. Spend to save initiatives to be budgeted for.
University D	SF-6-UD	Financial planning, monitoring and control to ensure expenditures are kept within budget.
University E	SF-6-UE	Strategic use of outsourcing in minimising operational costs.
<i>Business and financial management (SF-6):</i> <i>SF = Solution for Future (F) challenge</i> <i>SF-6= '6' refers to nth subcategory of future challenge</i> <i>UA = University (i.e University A or first case study university)</i> <i>UD1 = '1' refers to 1st solution mentioned as practical solution for the future challenge</i>		

1) Robust granular asset data and history

The interviewee suggested that, by having robust granular asset data and history, university facilities managers are able to reduce the business and financial management-related future challenges. This could be achieved through strong support planning or prioritization based on risk. Langston (2003) agrees with this suggestion, by adding that, university facilities managers need to “continually do more with less and budget cuts are sadly routines but it is more important than ever to identify areas of potential saving that can reduce cost without lowering quality standards or increasing risk exposure”.

2) Assets meet organization' needs

A point was raised by one of the interviewees that, it is important for university facilities managers to ensure that the asset base must meet universities' needs. The interviewee

further explained, “User’s pays will help in minimizing cost and improving utilization and effectively lead to a smaller asset base or an asset base that meets the organizations actual needs. Employing energy managers/specialists who will target less efficient operations and make cases for improvements that will have long term benefits is essential to a modern organization. One of the biggest challenges going forward for a University today is the large asset based of buildings and equipment and there is a need to auto identify the needs and actual use and this can easily be undertaken by a cost effective user pays scheme where the academic side will pay and use only as required and will internally become more efficient through use and the organization can then dispose of low use assets etc. The overall effect is a reduction in assets and asset related cost such as energy. Energy management programs and the like can still be applied to all aspect of the fit whether large or small over and above the strategic model for a fit of the assets to meet the organization’s needs”.

Langston (2003) agrees with this suggestion by observing that, financial management has significant impact on effective positioning and operation of university facilities as it involves generation process of an idea, which demands in-depth understanding of the matters, associated challenges and externalities that apply (Langston, 2003). It is therefore important for university facilities managers and the FM department to strategically manage the funding allocation so that it will meet universities’ needs and creates saving in costs for future years to cover major expenditures within universities.

3) Accurate data collection and strategies to reduce costs

One of the interviewees also suggested that, by having accurate data collection, university facilities managers are able to minimize the future challenges pertaining to business and financial management. “Feasibility studies, budgets and life-cost studies” are key elements in financial management as it covers comprehensive information on “estimating, economic forecasting, quantification, adjustment, accounting, reporting, monitoring and benchmarking activities as well as understanding broader business context” (Langston, 2003). Thus, by having a life cost methodology, university facilities managers will be able to establish strategies on available alternatives and initiatives for costs savings, operational resources and expenditure timing.

4) Financial planning, monitoring and control

The interviewee also hinted that, to minimize the future challenges around business and financial management, university facilities managers need to ensure financial planning,

monitoring and control to ensure expenditures are kept within budget. Consequently, Langston (2003) states that it is vital for university facilities managers to “possess appropriate financial capabilities to perform the full range of tasks outlined previously, or at least to effectively participate in and understand the output provided by specialist consultants”.

Financial management process involves budgeting, cost planning and cost control. Budgeting and cost planning are more towards guiding and assisting university facilities managers to control their activity cost. For instance, budgeting provides universities with the exact tool for effective use of universities’ capital which helps “make comparison and decision of actual results and so is useful in controlling all aspects of cost both now and future” (Langston, 2003).

Cost planning on the other hand, provides university facilities managers with action statements that helps to make necessary decisions to successfully achieve agreed targets. With the use of life-cost planning (life cycle cost), university facilities managers are able to know the cost associated with FM activities such as maintenance and replacement, construction, cleaning, and energy over the total life span of the facility. Langston (2003) further states, the benefit of life-cost planning is that, it “offers the opportunity to optimize total cost by perhaps increasing initial expenditure with a view to lowering annual expenditure, which over a number of years may produce a significant saving”.

Cost control is all about monitoring and continuously comparing budget forecast on the actual performance related to FM activities within the university. Regular review of the performance is crucial. Langston (2003) observes that, “routine data collection concerning actual costs and the reasons for variations to original targets is an important activity that assists future budget preparation, cost estimation and risk assessment”.

5) Strategic use of outsourcing

The interviewee also suggested that, the strategic use of outsourcing is another practical measure for addressing business and financial management-related future challenges. Outsourcing “creates competitive advantage when services or products are produce more effectively and efficiently” (Kamarazaly, 2007), as it is being performed by external suppliers.

This helps to minimize universities' operational costs in the long run (Alexander, 2003); prompt response to changes in environment (APP, 2010) and increased university facilities manager's attention on universities' core competencies (; APPA, 2014). Greavor (2007) further highlighted the significant reasons for outsourcing, as follows:

1. <i>Organizationally Driven</i>	<ul style="list-style-type: none"> • Enhance effectiveness by focusing on what the organization do best • Increase flexibility to meet changing business conditions, demand for products/services and technologies • Organization transformation • Increase product/service, customer satisfaction and shareholder value
2. <i>Improvement Driven</i>	<ul style="list-style-type: none"> • Improve operating performance • Obtain expertise, skills and technologies, which would not otherwise be available • Improve management and control • Improve risk management • Receive innovative ideas for improving the business, products, services, etc. • Improve credibility and image by associating with superior providers
3. <i>Financially driven</i>	<ul style="list-style-type: none"> • Reduce investments in assets freeing up these resources for other purposes • Generate cash by transferring assets to provider
4. <i>Revenue driven</i>	<ul style="list-style-type: none"> • Gain market access and business opportunities through the provider's network • Accelerate expansion by tapping into the provider's developed capacity, processes and systems • Expand sales and production capacity during periods when such expansion could not be financed • Commercially exploit the existing skills
5. <i>Cost driven</i>	<ul style="list-style-type: none"> • Reduce costs through superior provider performance and the provider's lower cost structure • Turn fixed costs into variable costs
6. <i>Employee driven</i>	<ul style="list-style-type: none"> • Give employees a stronger career path • Increase commitment and energy in non-core areas • While it is not an exhaustive list, it should provide food for thought

(g) Practical solutions for addressing future challenges related to occupational health and safety

Feedback from the case study universities on the practical solutions for addressing current external challenges related to occupational health & safety is presented in Table 137. Four recurring themes as the practical solutions for addressing occupational health and safety-related future challenges faced by university facilities managers are further discussed in the following subsections.

Table 137: Practical solutions for addressing future challenges - Occupational health & safety

University	Code	Practical solutions for addressing future challenges
<i>Occupational health & safety (SF-7)</i>		
University A	SF-7-UA	Annual Strategic Asset Management Plan (SAMP) review demands regular consultation with key stakeholders and ensure that we are aware of their needs.
University B	SF-7-UB	This would be to provide a high level of services over a minimum facility and encourage users to manage a lot more of their own needs for education. This will include education from home on stream information and improved communications with users.
University C	SF-7-UC	Not an issue.
University D	SF-7-UD	Establish effective policies, decision making processes and standards.
University E	SF-7-UE	Establish metrics to better measure space allocation, provide more incentives to encourage smart space management, provide better quality of services over minimum facility.
<i>Occupational health & safety (SF-7):</i> <i>SF = Solution for Future (F) challenge</i> <i>SF-7 = '7' refers to nth subcategory of future challenge</i> <i>UA = University (i.e. University A or first case study university)</i> <i>UD1 = '1' refers to 1st solution mentioned as practical solution for the future challenge</i>		

1) *Regular consultation with key stakeholders*

The interviewee suggested that, to minimize occupational health and safety related future issues, annual Strategic Asset Management Plan (SAMP) should be reviewed by having regular consultation with key stakeholders. This enables university facilities managers to determine stakeholder's needs with regards to occupational health and safety requirements. University of Tasmania (2005) agrees with this suggestion by stating that SAMP helps university to focus on meeting its statutory compliance obligations on matters including occupational health and safety.

2) *Establish effective policies, decision making processes and standards.*

One of the interviewees also hinted that, by establishing effective policies, decision making processes and standards, university facilities managers are able to address to the future issues pertaining to occupational health and safety. This suggestion is in harmony with findings from other studies. For instance, Atkin and Brooks (2000) agreed that universities must have a standard policy on health and safety, in which all policies, detailed safety rules and safe working practices must comply with the relevant legislation and it is to be developed, implemented and reviewed in a regular basis. University facilities managers might want to consider seeking for professional advice in this regard. It is also important that universities confirm the scope to which legislation might relate to them.

3) *Establish metrics to better measure space allocation*

The interviewee also recommended that, by having more incentives to encourage smart space management, university facilities managers will be able to provide better quality of services over minimum facility, and thus minimize the related occupational health and safety constraints in future. APPA (2012) agrees with the suggestion that there is a need to establish some metrics to better measure space allocation issues, by stating two strategies could be used; first, “implementing a space inventory system to understand resources and identify needs” and second, “assembling credible data and adopting best practices”.

Universities must ensure that they have robust and specific inventories of their space resources. With regards to the implementation of space inventory system, university facilities managers are advised to identify their universities’ priorities for a space inventory system, evaluate the advantages and disadvantages of their current system and also support towards the enhancement of comprehensive, flexible and manageable inventory system (APPA, 2012).

By having reliable information management and effective space policies, universities are able to achieve substantial space utilization. APPA (2012) suggested that, university facilities managers to “integrate inventory and scheduling systems to automate utilization tracking”, which can be successfully achieved by having accessible comprehensive data on space inventories and scheduling systems. With the appropriate metrics and the right implementation of policies, university facilities managers are able to “maximize productivity, limit new construction and tackle sustainability concerns” (APPA, 2012).

The following four strategies have proven significant improvements in space utilization, as described by APPA (2012):

<i>CENTRALIZED SCHEDULING</i> <ul style="list-style-type: none">• Enhances the quality of data collection.• Improves space utilization.	<i>DEDICATED STAFF</i> <ul style="list-style-type: none">• Dedicated space managers with the skills to evaluate and manage space as well as the authority to make key decisions.
<i>STANDARDIZED MEETING TIMES</i> <ul style="list-style-type: none">• Creates better and standardized scheduling class start times and lengths, across the campus.	<i>INCENTIVIZED OFF-PEAK CLASSES</i> <ul style="list-style-type: none">• Simple incentives boost off-peak utilization.

(h) Practical solutions for addressing current external challenges related to leadership and innovation in FM

Feedback from the case study universities on the practical solutions for addressing current external challenges related to leadership and innovation in FM is presented in Table 138. The following subsections present the discussion of 4 recurring themes as the practical solutions for addressing leadership and innovation in FM-related future challenges faced by university facilities managers.

Table 138: Practical solutions for addressing future challenges - Leadership & innovation in FM

University	Code	Practical solutions for addressing future challenges
<i>Leadership and innovation in FM (SF-10)</i>		
University A	SF-10-UA	Annual Strategic Asset Management Plan (SAMP) review demands regular analysis of financial affordability and key issues, priorities and trade-offs.
University B	SF-10-UB	A good work ethic throughout the organisation, with a strong people structure that has pride and respect in what they are doing and open approach to development. Up-skilling in training and exposure to new technologies and information.
University C	SF-10-UC	Not an issue.
University D	SF-10-UD	Implement problem solving tools in the FM department in concert with industry innovators.
University E	SF-10-UE	Articulate sound vision and winning strategies and ensure buy-in by top management and workforce.
<i>Leadership & innovation in FM (SF-10):</i> <i>SF = Solution for Future (F) challenge</i> <i>SF-10 = '10' refers to nth subcategory of future challenge</i> <i>UA = University (i.e University A or first case study university)</i> <i>UD1 = '1' refers to 1st solution mentioned as practical solution for the future challenge</i>		

1) *Regular analysis of financial affordability and key issues*

The interviewee suggested that, by having the annual Strategic Asset Management Plan (SAMP), university facilities managers are able to have regular review on the analysis of financial affordability and key issues, priorities and trade-offs. Effective application of SAMP results in comprehensive life-cycle approach, minimization of the associated maintenance costs in the longer term, greater utilization of the latest design techniques and environmental standards and efficient energy and cleaning delivery as well as better space utilization. Consequently, this helps to minimize the future leadership and innovation-related challenges.

Benchmark is a method for making comparison between performance and best practice within organizations, in which “facilities managers routinely use benchmarking to

highlight areas of potential improvement and to demonstrate successful achievements” (Langston, 2003). For example, Australasian universities have widely exercised the TEFMA (Tertiary Education Facilities Management Association) FM cost benchmarking to compare Building Operating costs (BOC) which includes information on key building operations (such as energy, maintenance, cleaning and security) and management performance indicators between Australian and New Zealand universities.

2) Up-skilling in training and exposure to new technologies

The interviewee also indicated that, up-skilling in training and exposure to new technologies and information help to minimize the leadership and innovation in FM-related future challenges. These could be achieved by a positive work ethic the organization, with strong people structure that has pride and respect in what they are doing and open approach to development. Atkin and Brooks (2000) agrees with the suggestion by stating that university facilities managers and FM team “will need to keep abreast of developments in all areas of their work” so that they will be equipped with adequate knowledge, skill and experienced in managing universities’ facilities.

Successful university facilities managers are those who are highly competent in FM areas such as real estate management, financial management, organizational management, human resource management, change management and innovation. According to Atkin and Brooks (2000), universities need to be “informed or intelligent clients; in which the Informed Client Function (ICF) function should be the vital driven-factor “to have personnel who are trained to act as competent client representatives, irrespective of whether or not services are outsourced”.

In addition, universities need to implement policies related to recruitment that determine the FM specialization. This helps to differentiate between individuals who have attended necessary education and up-skilling training and those who should undergo continuous professional development (CPD) (Atkin and Brooks, 2000).

3) Implementation of problem solving tools

One of the interviewee also suggested that, university facilities managers can minimize the leadership and innovation in FM by effectively implementing problem solving tools in the FM department in concert with industry innovators. For instance, one of the significant tools in FM is the ‘Mirco-Scan^{fm}’. It helps university facilities managers to enhance their understanding and evaluating the context for universities improvement

and potential gain. This tool adopted the same concept of Balance Scorecard (Kaplan & Norton, 1996), based on these four perspectives (Atkin and Brooks, 2000):

CUSTOMER <ul style="list-style-type: none"> Focus on the perceptions of users and occupiers of the facility with regards to FM department, the management and university as a whole. 	FINANCIAL <ul style="list-style-type: none"> Focus on the achievement of best value.
OPERATIONAL <ul style="list-style-type: none"> Focus on the efficiency and effectiveness of the delivery of estate-related and facilities services. 	INNOVATION <ul style="list-style-type: none"> Focus on the FM function that contributes to improve and assist the core business in creating value.

4) *Articulate sound vision and winning strategies*

One of the interviewee hinted that, by articulating sound vision and winning strategies, university facilities managers are able to address to the future issue of leadership an innovation in FM.

This suggestion gives credence to the views expressed by APPA (2008) that, two solutions that can be adopted by university facilities managers to overcoming the leadership and innovation in FM-related issues are (i) establishing more flexible and adaptable built environment within the universities and (ii) benefiting from universities' sense of identity and place.

With respect to the first strategy, university facilities managers should ensure that flexibility value and long-term adaptability for the universities' facilities. The reason being, single-use of facilities are considered obsolete since universities are facing rapid "shifting purposes and changes of audiences" (APPA, 2008).

The second strategy is to capitalize universities' sense of identity and place. APPA (2008) observes that, "the physical environment of a university is a reflection of the personality of the campus. As workforce and student population change, the built environment can remain a touchstone of the identity of the institution".

(i) *Practical solutions for addressing current future related to space management*

Feedback from the case study universities on the practical solutions for addressing current external challenges related to space management is presented in Table 139. Five recurring

themes as the practical solutions for addressing space management-related future challenges faced by university facilities managers are discussed in the following subsections.

1) *Regular analysis of financial affordability and key issues*

One of the interviewee suggested that, to minimize the space management-related issues in future, university facilities managers should consider regular analysis of financial affordability and key issues, priorities and trade-offs through annual Strategic Asset Management Plan (SAMP) review.

2) *Efficient use of space management*

The interviewee also suggested that, to minimize the impact of space-management-related future issues, tomorrow's university facilities need to ensure the implementation of the future needs single service space control as opposed to multi user space control. Space should be managed with the mandate for efficient use and run a timetabling service.

Flexible space is also the key to future space. APPA (2012) agrees with this suggestion by stating that in order to successfully achieve effective use of space management, university must ensure continuous “development of space allocation standards for the University and a mechanism for forecasting future space requirements in a changing environment”.

Table 139: Practical solutions for addressing future challenges - Space management

University	Code	Practical solutions for addressing future challenges
<i>Space management (SF-11)</i>		
University A	SF-11-UA	Annual Strategic Asset Management Plan (SAMP) review demands regular analysis of financial affordability and key issues, priorities and trade-offs.
University B	SF-11-UB	The future needs single service space control as opposed to multi user space control. Space would be managed with the mandate for efficient use and run a timetabling service. Flexible space is also important to future space.
University C	SF-11-UC	Not an issue.
University D	SF-11-UD1	Integrate inventory and scheduling systems to automate utilization tracking and examine best practices for improve utilization.
	SF-11-UD2	Ensure all existing space is fully utilised and regularly assess the utilisation of space through audits, teaching room utilisation surveys and comparison with standards.
University E	SF-11-UE	Develop effective policies, processes, and organizational structures to manage space
<i>Space management (SF-11):</i> <i>SF = Solution for Future (F) challenge</i> <i>SF-11 = '11' refers to nth subcategory of future challenge</i> <i>UA = University (i.e University A or first case study university)</i> <i>UD1 = '1' refers to 1st solution mentioned as practical solution for the future challenge</i>		

3) *Integrate inventory and scheduling systems*

One of the interviewee also suggested, by having integrated inventory and scheduling systems, tomorrow's university facilities managers will be able to reduce the issues related to space management. APPA (2012) agrees with this suggestion by proposing strategies for the integration purpose, which include: "outlining universities' priorities for a space inventory system; assessing the advantages and disadvantages of current system; and moving towards a robust, flexible and accessible inventory". These help university facilities managers to enhance the utilization of tracking systems and determine the best practices available for the improvement of space management.

4) *Regularly assess the utilization of space*

The interviewee also mentioned that, by ensuring all existing space is fully utilized and regularly assess the utilization of space through audits, teaching room utilization surveys and comparison with standards, tomorrow's university facilities managers will be able to reduce the issues pertaining to space management.

This suggestion is in line with the findings from other studies. For instance, Muir (2003) agrees that regular assessment on the space utilization is vital in space management, by observing that, space indicators are the perfect tools to frequently "check progress at various stages throughout the planning and occupancy phases". This includes: "preparation of the building surveyor's report; preparation of the initial space planning diagram; before commitment to lease or purchase; after final space planning is completed; as part of post occupancy evaluation after construction is complete; as part of ongoing space and churn management; and as part of maintenance management". Efficiency, flexibility and space utilization are the three key space performance indicators (Muir, 2003).

5) *Develop effective, processes and organizational structures*

One of the interviewees hinted that, by developing effective policies, processes, and organizational structures to manage space, will inevitably help to minimize the space management related future challenges. This could be successfully achieved through "assessing current processes, policies and organizational structures; prioritizing what should change in the campus space management system and emphasizing key best practices" (APPA, 2012). Tomorrow's university facilities managers are responsible to ensure that the policies, processes and space standards are clearly developed and wholly depends on the overall priorities of the university. APPA (2012) further states that,

“space policies need to be aligned with the campus master plan, which should be aligned with the universities’ mission and vision”.

With respect to the issues in creating effective organizational structures, most of the universities have their own measures for addressing to this issue. APPA (2012) observes that “no one structure will work for every campus; instead campus leaders must consider the needs of the institution and implement a structure that can succeed”. Thus, it is very crucial for university facilities managers to make certain that their universities implement systematic best practice for space management, as “no other issue has potential to transform the university than that of the policies and practices related to effective space management and utilization” (APPA, 2012).

(j) Practical solutions for addressing current external challenges related to outsourcing

Feedback from the case study universities on the practical solutions for addressing current external challenges related to outsourcing is presented in Table 140. Five recurring themes as the practical solutions for addressing outsourcing-related future challenges faced by university facilities managers are listed and further discussed in the following subsections.

1) *Investigation of like organizations*

The interviewee suggested that, to minimize outsourcing-related challenges, university facilities managers should consider performing investigation of like organisations; in which all aspects must be taken into consideration, for instance, design, construction, fit-out, identification of requirements and adjustment.

Katsanis (2003) agrees with this suggestion by adding the potential benefits derived from this strategy, which include, “(i) enables universities to re-examine their mission and strategic aspects of their activities based on organizational strengths and existing core competencies as well as (ii) allows universities to focus on the development of core competences and develop world best expertise”.

Table 140: Practical solutions for addressing future challenges - Outsourcing

University	Code	Practical solutions for addressing future challenges
<i>Outsourcing (SF-12)</i>		
University A	SF-12-UA	Investigation of like organisations.
University B	SF-12-UB	There is one must for large organisations and this is retaining the intellectual property information - it is important to have control of this information. However the FM team would opt for contracted services as the best model for a large organisation. Although this is not the University Model, it is the best in terms of efficiency and effectiveness. There is less liability for the organisations and so on. The University is using a mixed model with specialist services contracted out and a minimum core trades service in house with a management structure. The challenge for FM is effective management of the in-house resources and the conflicting priorities and pressures of the organisation. There is no real issue in striking a balance between in and outsourced services, it is fair to say that reactive service work can easily be managed in-house and other work outsourced including PPM work/installation/compliance checking etc.
University C	SF-12-UC	Suitable investigation of project. All aspects considered.
University D	SF-12-UD1	Effective communication at service level and budget expectations to a service provider: critical systems and services must be clearly identified, required operating procedures documented and critical service levels established.
	SF-12-UD2	Improvement in service delivery by specialist, existing resources and transformational initiatives.
University E	SF-12-UE1	Established Client's mandate to outsource services, gathered baseline information and established the business case at the early stage for a better guide to building a solid service contract.
	SF-12-UE2	Developing and documenting a baseline from financial, performance and service level perspectives in order to measure possible gains in efficiency as well as cost savings from outsourcing.

Outsourcing (SF-12):

SF = Solution for Future (F) challenge

SF-12 = '1' refers to nth subcategory of future challenge

UA = University (i.e. University A or first case study university)

UD1 = '1' refers to 1st solution mentioned as practical solution for the future challenge

2) Retaining intellectual property information

The interviewee also suggested that, tomorrow's university facilities managers should retain intellectual property information to minimize the outsourcing-related future challenges. According to the interviewee, this strategy is normally applicable to in-house resources. Nonetheless, FM team would opt for contracted services as the best model for a large organization. Although this is not the University Model, it is the best in terms of efficiency and effectiveness. Using outsourced services, one can command a much wider skill set for the work within an organisation. The FM department can also change pace as money or needs arise then contracted resources are easier to pick up and of course drop off. Hence, there is less liability for the organisation.

The University is using a mixed model with specialist services contracted out and a minimum core trades service in-house with a management structure. The challenge for FM is effective management of the in-house resources and the conflicting priorities and pressures of the organisation. There is no real issue in striking a balance between in and outsourced services, it is fair to say that reactive service work can easily be managed in-house and other work outsourced including installation, compliance checking or etc.

Invariably this structure or balance will determine the success of an FM team and each industry sector will be different. For example a hospital should have a higher percentage of in-house resources compared to a university and this is due to the higher technical needs of the hospital with 24 hour needs and the associated risk. Whereas the risk in a University is significantly less and hence the FM department can focus more on cost effectiveness and initiate a high proportion of outsourced services.

3) *Effective communication*

One of the interviewees also hinted that, by having effective communication at service level and budget expectations to a service provider, tomorrow's university facilities would be able to effectively address outsourcing-related constraints. In this regard, university facilities managers need to clearly ascertain critical systems and services, required operating procedures documented and critical service levels established.

Communication between university facilities managers and all stakeholders is the key to fostering long-term relationships with the outsourcing company (Booty, 2009). This is because, "all stakeholders must be involved in the process of outsourcing if their needs, as well as those identified in the facilities management strategy, are to be fully addressed and communicated; success depends on commitment to the process from all who could possibly contribute" (Atkin and Brooks, 2000).

4) *Improvement in service delivery*

One of the interviewees also hinted that, by ensuring improvement in service delivery by specialist, existing resources and transformational initiatives, university facilities managers would be able to minimize the outsourcing-related future challenges.

Katsanis (2003) sees "integration of service while affording single-point responsibility for the delivery of final products or services", as a strategy for service delivery improvement. This strategy could be successfully achieved by establishing client's obligation to outsource services, collecting of key information and also creating the

business case at the early stage for better guide in building a solid service contract (Atkin and Brooks, 2000).

Booty (2009) further noted that university facilities managers need to take into account the following aspects: “client should ensure that the supplier’s nest people are working in the relationship; there should be contractual terms and conditions spelling out certain processes and disciplines; and the client should also have the first right of refusal for members of the supplier’s team”.

5) Develop and documenting a baseline

The interviewee also suggested that, by developing and documenting a baseline from financial, performance and service level perspectives, university facilities managers would be able to measure possible gains in efficiency as well as cost savings from outsourcing. This consequently helps to minimize the drawback effects related to outsourcing challenges such as: “the need for well thought out upfront specifications for the deliverables; and loss of quality control resulting from lack of direct influence” (Katsanis, 2003).

6.3 RESEARCH MODEL

6.3.1 Overview

Part of the aim of this study was to develop an integrative model which provides guidelines for the methodological response to the challenges faced by university facilities managers in the design and operation of their facilities. The integrative model also structures the key challenges constraining the achievement of strategic FM goals and provides practical solutions for addressing the problems and improving the performance of the university FM departments. This section presents and discusses the research model.

6.3.2 Research model

The model formulated for the study is presented in Figure 10. Based on the insights gleaned from the literature, an attempt was made in the study to model the functions or key role of the facilities manager and how these functions are impacted upon by the current (for instance internal and external) and future challenges, and consequently, the achievement of the strategic FM goals.

Booty (2009) identifies the key functions in the facilities management cycle as encompassing project delivery management, operations management, maintenance management, capital asset management and space management. As typical of every profession, the facility manager faces internal and external constraints; the former being within his or her control, while the latter present complex and often uncontrollable problems.

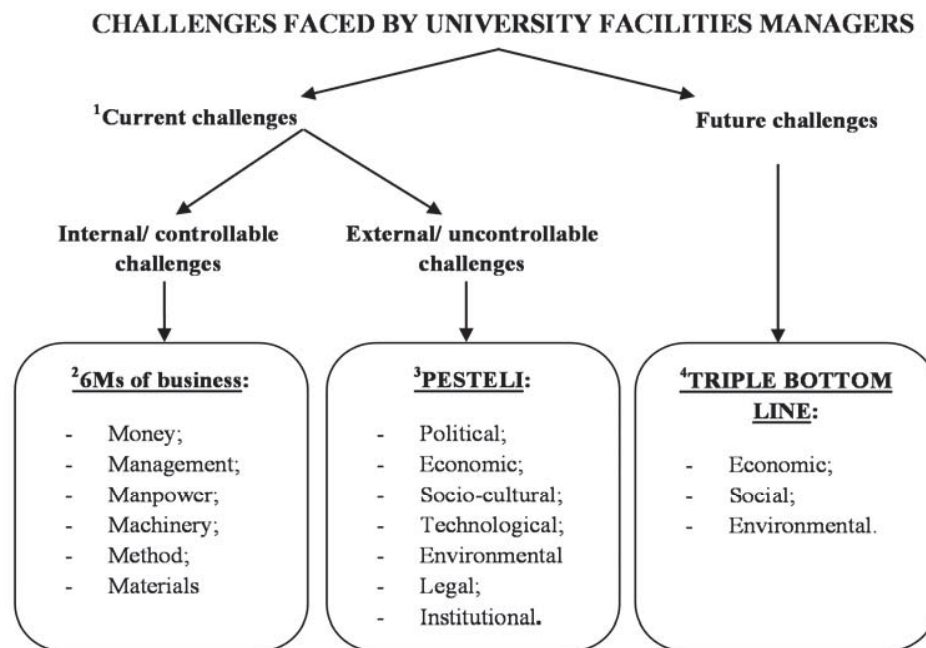
Sasikumar (2009) encapsulated the generic internal problems faced by organizations into 5M's of management: money/ finance, materials, machine, manpower and methods/ operational process. On the external front, Gillespie (2007) fits the external constraints facing any business organization into the mould of PESTEL (political, economic, socio-cultural, technological, environmental and legal); Rapid Business

Information (RAPIDBI, 2009) extends this by adding institutional constraints to the mould.

The triple bottom line (3BL) is the basis for the key future challenges (Elkington, 1998); the 3BL is an acronym that considers and prioritises on equal basis the economic, social and environmental targets set for every endeavour of an organisation. However, Kamarazaly et al (2013) argued that the 3BL schematic proposed by Elkington (1998) was not to be followed rigidly because some of the challenges that may occur in the future for some universities such as emergency management (APPA, 2006); legislative/regulatory compliance (Booty, 2009); technology (APPA, 2010); space management (APPA, 2012); outsourcing (Kamarazaly, 2007) and wider issues, cannot be discretely segregated into one of the facets of the 3BL.

Kamarazaly et al (2013) presented the simplified conceptual framework that captures the contemporary and future challenges facing university facilities managers, as shown in Figure 9. Though 3BL concept is not firmly followed, the conceptual framework introduced by Kamarazaly et al (2013) has provided some strategic guidelines for the empirical investigations followed in this study.

Based on the insights gleaned from literatures, respondents' feedback on questionnaire surveys and the model test surveys, this study has incorporated some other current and future constraints facing university facilities managers into an integrative model, as shown in Figure 9.



Sources: 1) Kamarazaly and Mbachu (2010); 2) Prasad (1999); 3) RAPIDBI (2009); 4) Elkington (1998).

Figure 9: Contemporary and future challenges facing university facilities managers
(Source: adapted from Kamarazaly et al, 2013)

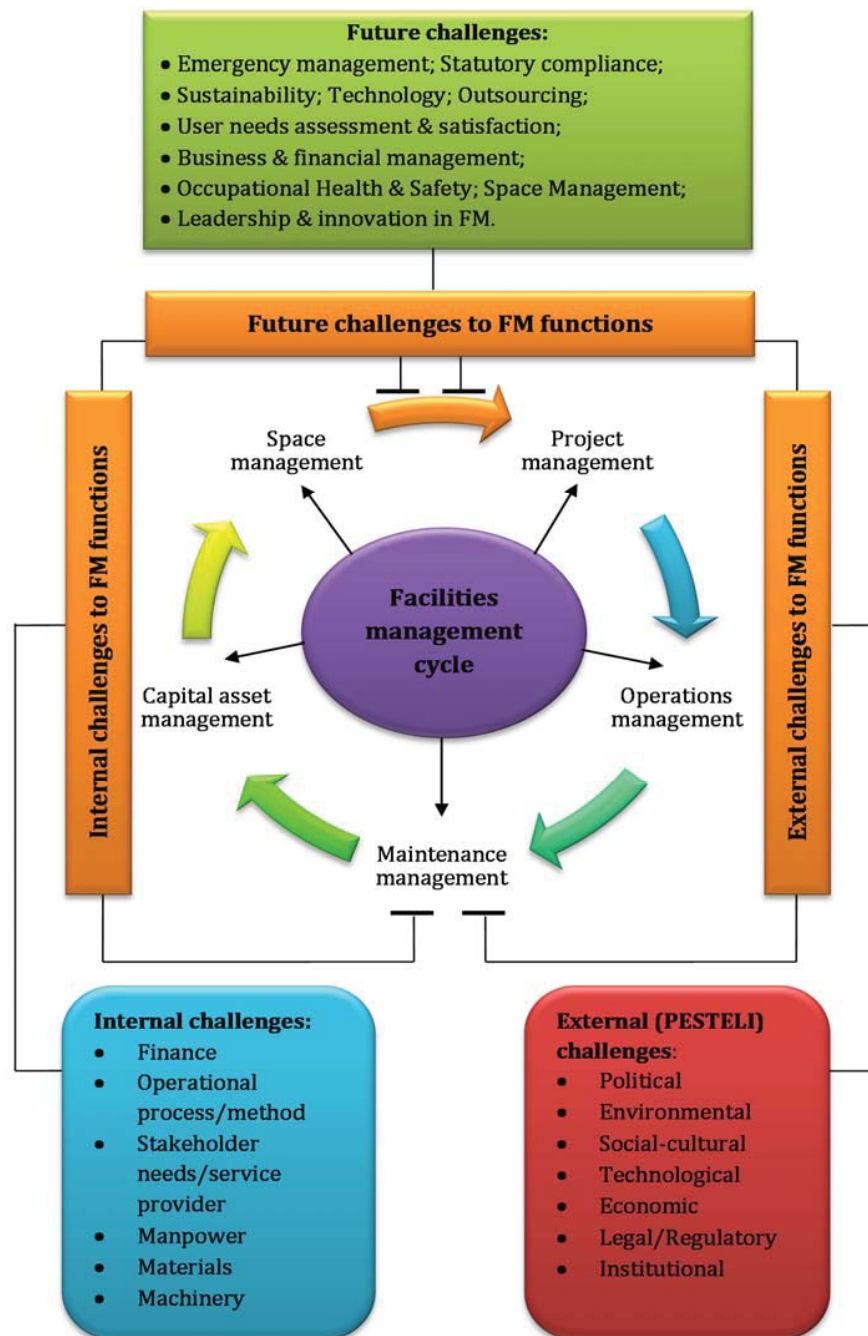


Figure 10: Research model for this study

A model as in Figure 10 was developed in this study from parameters formulated in Equations 1 – 5 (see Chapter 3). The Risk Score (RS) was used for assessing the risk levels associated with the identified internal, external and key future challenges. The Impact Index (II) was used for assessing the average rating point of respondents for the level of impact of each factor within a subset of factors. The Frequency Index (FI) was used for computing the average rating point of respondents for the frequencies of occurrence of each factor within a subset of a factor. The Risk Score (RS) was used to determine the risk level associated with each of the key factor constraining the achievement of strategic FM goals within a subset. A flowchart of the process for identifying the risk levels associated with the challenges facing university facilities managers is developed for use by university facilities managers and the FM team as a decision support system (see Figure 10).

Figure 11 represents the fundamental process formulated for determining the risk levels associated with the key challenges facing university facilities managers, and which constrain the achievement of strategic FM goals. The process started by identifying the key challenges facing university facilities managers. This includes: current internal and current external challenges as well as future challenges facing tomorrow's university facilities managers. Each challenge or subset under each broad category was rated according to the levels of impact (Impact Index) and frequencies of occurrence (Frequency Index). The similar process was applied for assessing the Impact Index (II) and Frequency Index (FI) of the identified broad category of internal and external challenges impacting on the performance of FM functions as well as future challenges facing tomorrow's university facilities managers. The Relative Impact Index (RII) and Relative Frequency Index (RFI) were also computed to explore the relative contribution of the variables in a given set based on their II and FI values.

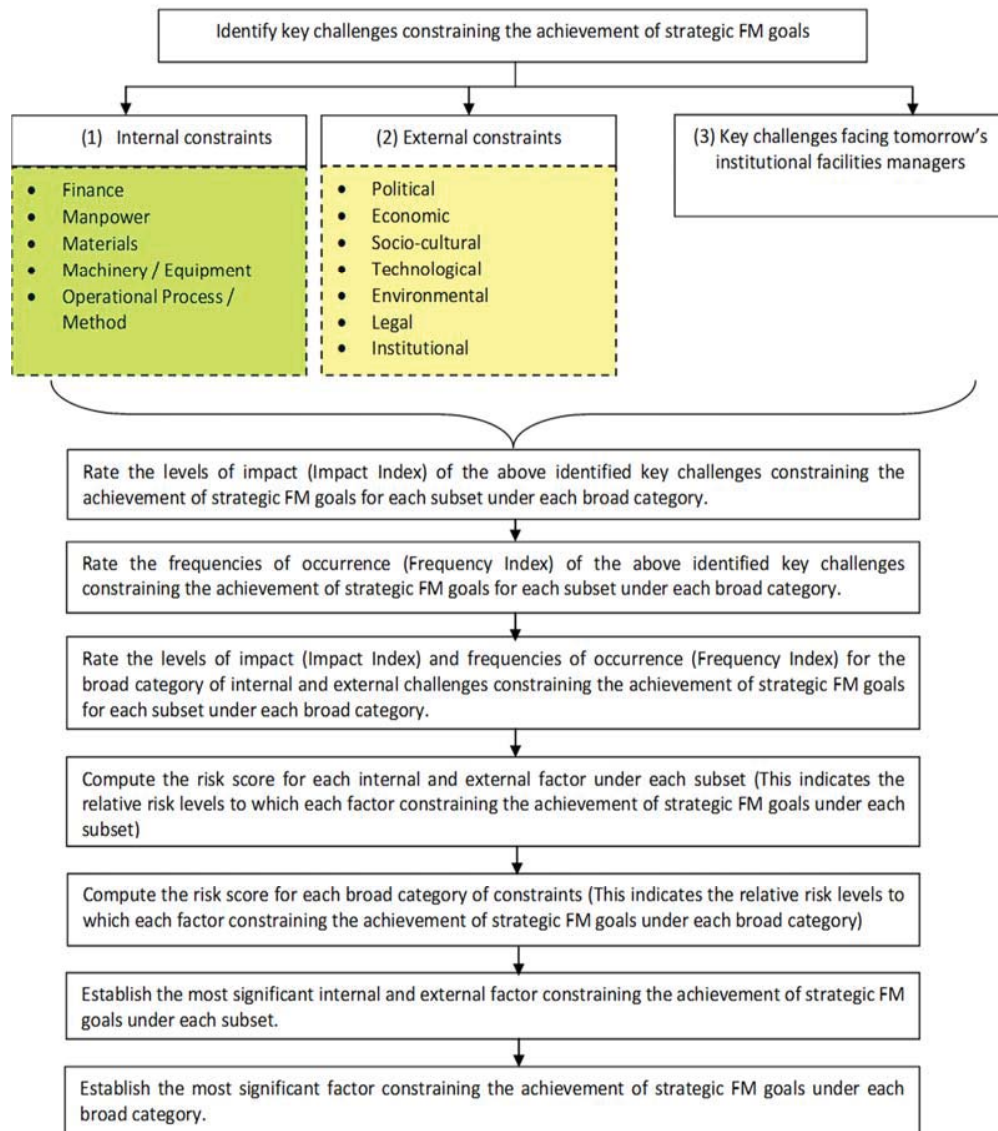


Figure 11: Flow chart process for identifying risk levels of challenges impacting on the achievement of strategic FM goals.

In order to successfully obtain the risk levels associated with the identified key challenges constraining the achievement of strategic FM goals within a subset, the computation of Risk Score (RS) and Relative Risk Score (RSS) were used in this regards. The Relative Risk Score (RRS) value therefore provided the basis for establishing the risk levels associated with each of the underlying factors constraining the achievement of FM

goals in each subcategory of internal, external and future challenges. As a result, a comprehensive set of risk levels (in terms of their perceived level of impact and frequencies of occurrence) for all categories of challenges under each FM functions was methodically compiled. These challenges will then be prioritized and short listed prior to its severity of risk levels. These steps initially assist in establishing the most significant internal, external and future challenges constraining the achievement of strategic FM goals. Enormous results derived from both RS and RRS analyses therefore propose effective solution for realizing the most critical challenges for specific FM functions that requires immediate response.

6.4 SUMMARY

Results obtained from the model test surveys helped to ascertain the extent of conformity or disparity between the generic results established at the questionnaire surveys and the specific universities' results established at the model test surveys. The overall results of the model test surveys therefore provided parameters for testing significance of divergence in results between views of university facilities managers gathered from both empirical sources – the questionnaire surveys and model test surveys (see Chapter 7).

CHAPTER 7: TESTS OF RESEARCH PROPOSITIONS

7.1 INTRODUCTION

The research propositions are tested in this Chapter. The choice of an appropriate analytical technique adopted in each test was guided by Cooper and Emory's (2009) recommendations documented in Appendix D. The research objectives were re-stated for clarity of linkages with the propositions.

In general, the propositions were postulated to shed light on pertinent areas of investigations from which data were obtained and analysed with a view to realizing the research objectives (Saunders et al, 2009). Statistical tests of significance were adopted to obtain some measure of confidence in the conclusions reached or inferences drawn from the results. Where the analysis involved statistical test of significance, the term "hypothesis" was used as synonymous with "proposition" (Cooper and Emory, 2009). Hypothesis is defined by Chambers English Dictionary as (i) a supposition; (ii) a proposition assumed for the sake of argument; (iii) theory to be proved or disapproved by reference to facts; and (iv) provisional explanation or anything.

Initially, "hypotheses are statements in quantitative research in which researcher makes a prediction or a conjecture about the outcome of a relationship among attributes or characteristics" (Creswell 2012). The aim of hypotheses is to narrow the objective statement to specific predictions. It is also considered as a hunch, a speculation or even as an educated guess (Fellows & Liu, 2010; Creswell, 2012). In carrying out hypothesis, five crucial steps have been identified by Creswell (2012):

- (i) Identifying a null and alternative hypothesis;
- (ii) Setting the level of significance, or alpha level;
- (iii) Collecting data;
- (iv) Computing the sample statistic; and
- (v) Making a decision about rejecting or failing to reject the null hypothesis.

Figure 12 shows a snapshot of the research objectives, propositions and the analytical techniques adopted in testing the propositions. The abbreviated objectives and key propositions are explained below.

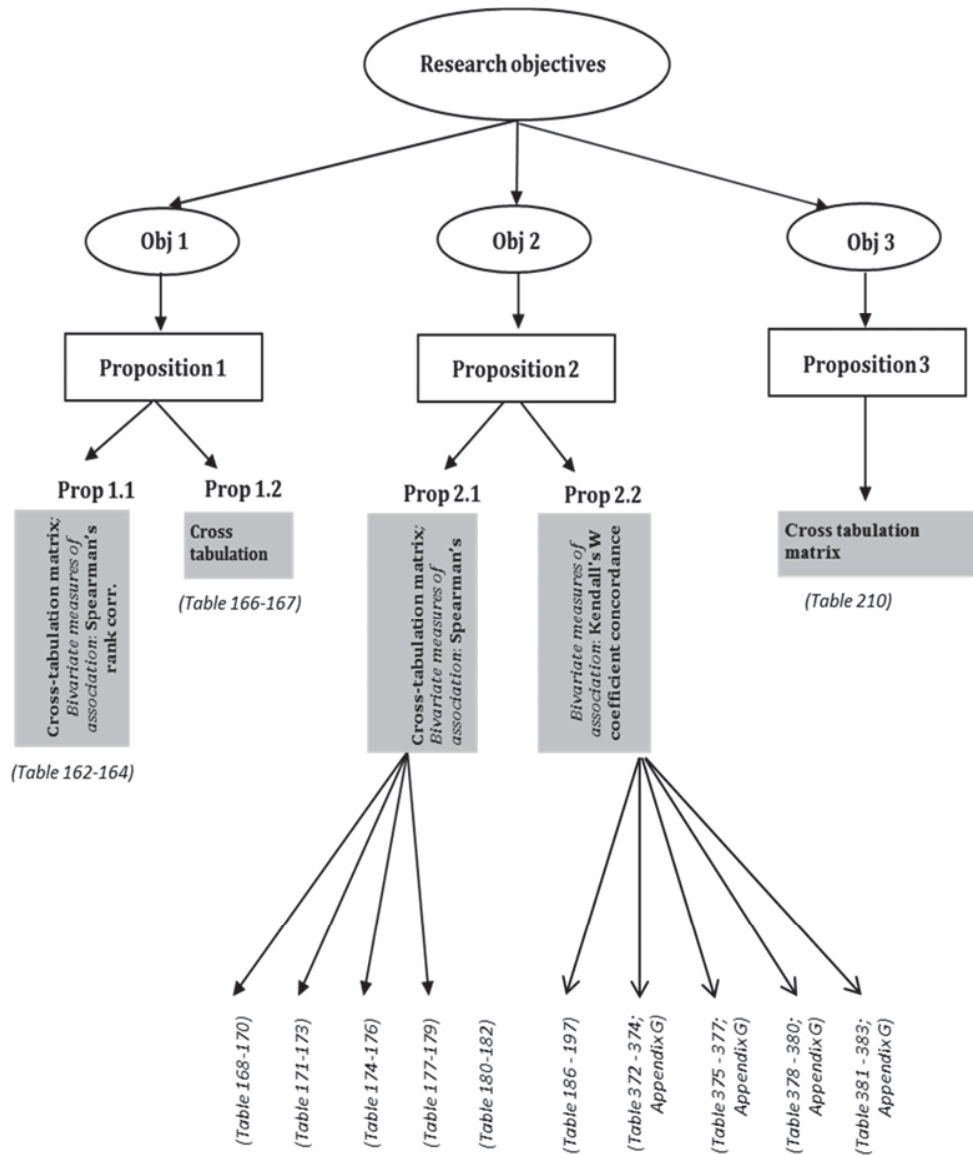


Figure 12: Snapshot of research objectives, propositions and analytical methods adopted.

Research questions:

1. What key internal and external challenges impact significantly on the achievement of strategic facilities management goals?
2. What level of risks could be associated to the challenges in the context of their perceived frequencies of occurrence and levels of impact on the achievement of the goals of the strategic management functions?
3. What are the key challenges facing tomorrow's universities facilities managers?
4. What practical solutions exist for addressing the challenges?

Research objectives:

The research objectives aim to provide answers to the above research questions, namely:

1. To identify and prioritize the key internal and external challenges impacting on the achievement of strategic facilities management goals.
2. To determine their associated risk levels as analysed from their perceived frequencies of occurrence and levels of impact on the achievement of the goals of the strategic management functions.
3. To establish the key challenges facing tomorrow's universities facilities managers.
4. To establish practical solutions for addressing the challenges.

Key research propositions:

1. Consensus of opinions exist between the New Zealand and Australian members of the Tertiary Education Facilities Management Association (TEFMA) in their perceptions of the risk levels of the internal, external and future factors constraining the achievement of the strategic facilities management goals in universities.
2. Issues relating to finance, and sustainability issues on the other hand constitute the most severe internal and external challenges faced by university facilities managers, respectively. Disbursing the bulk of the available resources to addressing these problems will therefore be the most efficient and effective way of resource utilization and problem solving.

3. There are no significant differences between the views of university facilities managers identified during the main stream survey and the corresponding findings from the case studies, on the nature and risk levels of the internal and external constraints as well as the key challenges facing university facilities managers.
4. Significant agreement exists between the views expressed by university facilities managers identified during the main stream survey, the case studies and also from the history records, on the frequency of occurrence of the challenges constraining the achievement of strategic facilities management.
5. Statutory compliance issue constitutes the most significant challenges facing tomorrow's university facilities managers.

The above propositions were formulated to tie with the objectives. This way, the nature of the research data required and how they will be analysed are made clear. Also some hypotheses serve as basis for testing the reliability and validity of the research instrument, research design and concordance in the outcomes from the multi-sources of evidence. This is to ensure triangulation of evidence.

7.2 TESTS OF PROPOSITION 1.1

The first objective of the research is to identify and prioritize the key internal and external challenges impacting on the achievement of strategic facilities management goals.

To realize this objective, Proposition 1.1 was aimed at canvassing the opinions of university facilities managers on the broad categories of the identified FM challenges on their relative impact levels and frequencies of occurrence. To direct data gathering and analysis, the proposition assumes consensus of opinions exist between the New Zealand and Australian members of the Tertiary Education Facilities Management Association (TEFMA) in their perceptions of the risk levels of the internal and external factors constraining the achievement of the strategic facilities management goals in universities.

Analytical method employed

The data for testing the proposition are the ratings of the levels of impact and frequencies of occurrence of the underlying variables in each broad category of internal and external constraints as obtained during the questionnaire surveys. First, the risk scores of the variables were computed from the two parameters of impact levels and frequencies of occurrence. The risk scores were used to rank-order the constraints within each subset – one for the New Zealand TEFMA members and the other for their Australian counterparts. Secondly, the Spearman's rank correlation coefficient test was used to test the level of significance of the differences in the rankings based on the computed correlation test statistic.

Based on Zikmund's (1994) recommendations, the choice of this statistical technique was made since the test requires a bivariate measure of association involving the measurement of two-sample matched pairs. The proposition was reformulated as a hypothesis in order to enable statistical test of significance. The hypothesis involved in this test is highlighted as follows:

Spearman's rank correlation test

The Spearman's rank correlation test was used to test the significance correlation between ranks of the risk scores (RS) for each broad category of internal, external and future challenges ratings computed from university facilities managers in New Zealand and Australia.

Test hypotheses

- H_0 : $t_{\text{score}} \leq t_{\text{critical}}$ (region of acceptance H_0) (i.e. no significant correlation exists between both sets of paired ranks) The rank correlation between ranks computed from university facilities managers in New Zealand and Australia rating is zero.
- H_1 : $t_{\text{score}} > t_{\text{critical}}$ (region of rejection H_0) (i.e. significant correlation exists between both sets of paired ranks) Positive correlation exists between the two sets of ranks.

Decision rule:

Accept H_0 if $t_{\text{score}} \leq t_{\text{critical}}$; reject H_0 otherwise and accept H_1 (i.e. if $t_{\text{score}} > t_{\text{critical}}$)

Where:

- t_{score} : Student T-test statistic computed as a transformation of the Spearman's rank correlation coefficient correlating both sets of paired ranks of the RS scores, as computed from university facilities managers' ratings.
- t_{critical} : Critical value of Student T-test statistic for a give degree of freedom, df (i.e. $n-2$) corresponding to n number of pairs of ranked objects at 0.05 level of significance.

Table 141 presents a typical rank correlation and student T-tests employed in testing the proposition in respect of the broad categories of internal challenges constraining the achievement of strategic FM goals. Similar tests were conducted for the broad categories of external challenges and future challenges in Table 142 and Table 143, respectively.

Table 141: Opinions of New Zealand and Australia's university facilities managers on the broad internal challenges

¹ Broad Internal categories	NEW ZEALAND				AUSTRALIA			
	Impact Index	Frequency Index	Risk Score (RRS)	Rank	Impact Index	Frequency Index	Risk Score (RRS)	Rank
	(Ii)	(Fi)	(Ii x Fi)		(Ii)	(Fi)	(Ii x Fi)	
CI-A	4.750	5.000	23.750	1	4.735	5.000	23.676	1
CI-B	3.917	4.250	16.646	4	4.118	4.152	17.096	3
CI-C	4.525	4.750	21.494	2	4.490	4.735	21.262	2
CI-D	4.083	4.500	18.375	3	4.245	3.980	16.897	4
CI-E	3.567	4.200	14.980	5	3.637	4.311	15.681	5
CI-F	3.250	3.417	11.104	6	3.500	3.824	13.382	6

¹Broad internal categories for both New Zealand and Australia are given in Section 6.2.7.3, Chapter 6.

Number of objects ranked, n	=	6
Spearman's rank correlation coefficient, R	=	0.9429
t -score	=	5.6595
degree of freedom, $df = n-2$	=	4
Acceptance region	=	$t \leq 2.132$
Result: $t_{\text{score}} \leq t_{\text{critical}}$	=	Accept H_0 if $t_{\text{score}} \leq t_{\text{critical}}$
H_0 : The rank correlation between ranks computed from university facilities managers in New Zealand and Australia rating is zero.		
H_1 : Positive correlation exists between the two sets of ranks.		
Decision: Reject H_0 and conclude that statistical evidence suggests that there are positive correlations between the two sets of ranks.		

Result

In terms of the broad internal challenges, the result (Table 141) shows that there are positive correlations between the ranks of university facilities managers in New Zealand and in Australia. Therefore there is statistical evidence that there is no divergence

between both regions on the risk levels of broad internal challenges facing facilities managers in Australasian universities.

Table 142: Opinions of New Zealand and Australia's university facilities managers on the broad external challenges

¹ Broad External categories	NEW ZEALAND				AUSTRALIA			
	Impact Index	Frequency Index	Risk Score (RRS)	Rank	Impact Index	Frequency Index	Risk Score (RRS)	Rank
	(Ii)	(Fi)	(Ii x Fi)		(Ii)	(Fi)	(Ii x Fi)	
CI-A	4.583	4.250	19.479	3	4.711	4.201	19.790	3
CI-B	4.500	5.000	22.500	1	4.527	4.733	21.425	1
CI-C	3.958	3.583	14.184	6	3.904	3.515	13.723	6
CI-D	3.917	3.417	13.382	7	3.618	3.132	11.332	7
CI-E	4.542	4.083	18.545	4	4.662	3.696	17.230	4
CI-F	4.667	4.583	21.389	2	4.735	4.490	21.262	2
CI-G	4.167	4.000	16.667	5	4.223	3.578	15.112	5

¹Broad external categories for both New Zealand and Australia are given in Section 6.2.15.3, and Chapter 6.

Number of objects ranked, n	=	7
Spearman's rank correlation coefficient, R	=	0.6786
t-score	=	2.0657
degree of freedom, df = n-2	=	5
t-critical (at 5% level of significant)	=	2.015
Acceptance region	=	$t \leq 2.132$
Result: $t_{\text{score}} \leq t_{\text{critical}}$	=	Accept H_0 if $t_{\text{score}} \leq t_{\text{critical}}$

H_0 : The rank correlation between ranks computed from university facilities managers in New Zealand and Australia rating is zero.

H_1 : Positive correlation exists between the two sets of ranks.

Decision: Reject H_0 and conclude that statistical evidence suggests that there are positive correlations between the two sets of ranks.

Result

In terms of the broad external challenges, the result (Table 142) shows that there are positive correlations between the ranks of both New Zealand and Australia's university facilities managers. This implies that there is no divergence between both regions on the risk levels of broad external challenges facing facilities managers in Australasian universities.

Table 143: Opinions of New Zealand and Australia's university facilities managers on the future challenges

¹ Future challenges	NEW ZEALAND				AUSTRALIA			
	Impact Index	Frequency Index	Risk Score (RRS)	Rank	Impact Index	Frequency Index	Risk Score (RRS)	Rank
	(Ii)	(Fi)	(Ii x Fi)		(Ii)	(Fi)	(Ii x Fi)	
F-1	4.667	4.583	21.389	1	4.735	4.078	19.313	1
F-2	4.292	4.375	18.776	4	4.201	3.912	16.433	4
F-3	4.467	3.750	16.750	5	4.103	3.265	13.395	5
F-4	4.583	4.500	20.625	2	4.686	3.814	17.872	2
F-5	3.083	2.925	9.019	13	2.765	2.775	7.671	14
F-6	4.250	3.617	15.371	6	3.985	3.248	12.942	6
F-7	3.625	3.917	14.198	8	3.250	3.799	12.347	7
F-8	4.650	4.383	20.383	3	4.324	3.858	16.679	3
F-9	3.583	4.158	14.901	7	3.338	3.620	12.085	8
F-10	4.375	3.208	14.036	9	3.196	3.083	9.855	11
F-11	3.425	3.308	11.331	12	2.971	2.895	8.599	12
F-12	4.167	3.000	12.500	10	3.392	2.936	9.960	9
F-13	2.250	2.950	6.638	14	2.811	2.846	8.000	13
F-14	3.950	2.942	11.620	11	3.588	2.755	9.885	10

¹Future challenges for both New Zealand and Australia are given in Section F.2.12.3, Appendix F.

Number of objects ranked, n	=	14
Spearman's rank correlation coefficient, R	=	0.9780
t-score	=	16.2491
degree of freedom, df = n-2	=	12
t-critical (at 5% level of significant)	=	1.782
Acceptance region	=	$t \leq 1.782$
Result: $t_{\text{score}} \leq t_{\text{critical}}$	=	Accept H_0 if $t_{\text{score}} \leq t_{\text{critical}}$

H_0 : The rank correlation between ranks computed from university facilities managers in New Zealand and Australia rating is zero.

H_1 : Positive correlation exists between the two sets of ranks.

Decision: Reject H_0 and conclude that statistical evidence suggests that there are positive correlations between the two sets of ranks.

Result

Result (Table 143) shows that there are positive correlations between the ranks of both New Zealand and Australia's university facilities managers on the key future challenges. Thus, the statistical evidence suggests that there is no divergence between both regions on the risk levels of future challenges facing facilities managers in Australasian universities.

Conclusion on test of Proposition 1.1

Table 144 shows the overall result derived from the tests of Proposition 1.1. Results of the Spearman's rank correlation test (Table 141 - Table 143) show that positive correlation exists between both sets of rank-ordered risk scores computed from

university facilities managers' ratings from both New Zealand and Australia for each broad category of internal and external challenges as well as the key future challenges constraining the achievement of strategic FM goals. Purdey (2012) stated that "the higher education sector in Australasian region overall is being presented with its own set of issues and challenges".

Table 144: Overall result tests of Proposition 1.1

Broad categories of challenges	Correlation test results: University facilities managers: New Zealand versus Australia
Internal challenges	Positive correlation
External challenges	Positive correlation
Future challenges	Positive correlation

The proposition that there is consensus of opinions exist between the New Zealand and Australian members of the Tertiary Education Facilities Management Association (TEFMA) in their perceptions of the risk levels of the internal and external factors constraining the achievement of the strategic facilities management goals in universities, as well as the key future challenges facing tomorrow's university facilities managers, is therefore supported empirically at five percent level of significance.

Consequently, it could be concluded that significant correlation existed in the views of university facilities managers in both New Zealand and Australia regarding the risk levels of internal and external challenges as well as the key future challenges constraining the achievement of strategic FM goals.

7.3 TESTS OF PROPOSITION 1.2

This propositions tests whether university facilities managers prioritise the key internal and external challenges on the achievement of strategic facilities management goals.

To direct data gathering and analysis, issues relating to finance, and economic issues on the other hand constitute the most severe internal and external challenges faced by university facilities managers, respectively. Disbursing the bulk of the available

resources to addressing these problems will therefore be the most efficient and effective way of resource utilization and problem solving.

Analytical method employed

Multi-attribute analytical technique was employed in testing Proposition 1.2 in Table 145 and Table 146. The data for testing Proposition 2 are the relative risk scores (RRS) of the broad categories of the internal and external constraints to the achievement of strategic FM goals as computed from the ratings of the impact and frequency levels. From the RRS analysis, the emergent broad constraint categories having the highest ranking provided statistical evidence to accept or reject the proposition.

The purpose of the categorization and cross-tabulation is to enable assessment of divergences among groups through comparisons (Cooper and Emory, 2009).

Table 145: Cross tabulation for testing Proposition 1.2 - Broad internal challenges

* Broad Internal categories	Impact Index	Frequency Index	Risk Score (RRS)	Risk Ranking
	(Ii)	(Fi)	(Ii x Fi)	
CI-A	4.968	4.792	23.804	1
CI-B	3.953	3.917	15.481	4
CI-C	4.920	4.470	21.993	2
CI-D	4.638	4.172	19.352	3
CI-E	3.883	3.468	13.464	5
CI-F	3.771	3.106	11.712	6

(*Broad internal categories are stated in Chapter 5, Section 5.3).

Table 146: Cross tabulation for testing Proposition 1.2 - Broad external challenges

*Broad External categories	Impact Index	Frequency Index	Risk Score (RRS)	Risk Ranking
	(Ii)	(Fi)	(Ii x Fi)	
CI-A	4.496	4.322	19.432	3
CI-B	4.449	4.752	21.141	1
CI-C	4.038	3.691	14.905	6
CI-D	3.805	3.527	13.418	7
CI-E	4.328	4.000	17.311	4
CI-F	4.769	4.343	20.711	2
CI-G	4.328	3.839	16.614	5

(*Broad internal categories are stated in Chapter 5, Section 5.3).

Results

For the broad internal categories, financial issues was perceived as the most critical challenges constraining the achievement of strategic FM goals, with RRS value of 23.804. The finding that inadequate financial resources or budget was perceived as the greatest internal financial constraints is in line with the views by Booty (2009) that “facilities managers are very concerned with comprehensive variety of costs related to the provision of premises or building, business and staff support services” (P.190) and “although FM budget may appear to be smaller in comparison to organizational turnover or profit, it is worth considering the impact of facilities services on an organization” (P.191).

For the broad external categories, economic constraints marked as the most severe factors constraining the achievement of strategic FM goals, with RRS value of 21.141. This finding affirmed the views of APPA (2007) that “universities must confront the current recession and maintain forward momentum despite economic restraints by shifting expectations among stakeholders”. Kadzis (2009) stated that facilities and real estate managers are now grappling with the continuing influence of changing economics and market conditions.

Conclusion on test of Proposition 1.2

Result of the multi-attribute analytical test (Table 145) shows that financial issue is perceived as the most severe internal challenges, and economic issue on the other hand (Table 146), is perceived as the most severe external challenges faced by university facilities managers. Proposition 1.2 is therefore supported.

7.4 TESTS OF PROPOSITION 2.1

The second objective of this study was to determine the level of risks could be associated to the challenges in the context of their perceived frequencies of occurrence and levels of impact on the achievement of the goals of the strategic management functions.

There are no significant differences between the views of university facilities managers identified during the main stream survey and the corresponding findings from the case studies, on the nature and risk levels of the internal and external constraints as well as the key future challenges facing university facilities managers.

Analytical method employed

Data for testing Proposition 2.1 comprised the outcomes of the main stream survey and the case studies in relation to the nature, levels of impact and frequencies of occurrence of the internal and external constraints to the achievement of the strategic FM goals as well as also the key challenges of the future. Again, the Spearman's rank correlation coefficient test will be employed to test the levels of differences in the rankings of the risk scores of each set of variables identified during the survey and the case study stages.

7.4.1 Case Study I: University A

Broad internal challenges

Spearman's correlation test (Table 147) shows that t-score, 3.5762 is greater than t-critical, it falls within the region of rejection in the one-tailed test. This implies that there is a positive association between the ranks of university facilities managers during the main stream survey and case study (I) interview on the broad internal challenges sets.

Table 147: Cross tabulation and Spearman's correlation test for testing Proposition 2.1 - Broad internal challenges (University A)

¹ Code	CASE STUDY 1				MAINSTREAM SURVEY			
	Impact Index	Frequency Index	Risk Score (RS)	Rank	Impact Index	Frequency Index	Risk Score (RS)	Rank
	(Ii)	(Fi)	(Ii x Fi)		(Ii)	(Fi)	(Ii x Fi)	
CI-1	4.000	5.000	20.000	1	4.968	4.792	23.804	1
CI-2	3.800	2.200	8.360	3	3.953	3.917	15.481	4
CI-4	3.400	4.400	14.960	2	4.920	4.470	21.993	2
CI-6	1.800	1.400	2.520	4	4.638	4.172	19.352	3
CI-7	1.000	1.000	1.000	5	3.883	3.468	13.464	5

¹Broad categories of Current Internal (CI) challenges:

CI-1) Finance; CI-2) Operational efficiency; CI-4) Stakeholder needs/ Service providers; CI-6) Manpower; CI-7) Machinery/ equipment.

Number of objects ranked, n	=	5
Spearman's rank correlation coefficient, R	=	0.9000
t-score	=	3.5762
degree of freedom, df = n-2	=	3
t-critical (at 5% level of significant)	=	2.353
Acceptance region	=	$t \leq 2.353$
Result: $t_{\text{score}} \leq t_{\text{critical}}$	=	Accept H ₀ if $t_{\text{score}} \leq t_{\text{critical}}$
H ₀ : The rank correlation between ranks computed from mainstream survey and case study interview rating is zero.		
H ₁ : Positive correlation exists between the two sets of data sources.		
Decision: Reject H ₀ and conclude that statistical evidence suggests that there are positive correlations between the two data sources.		



Broad external challenges

Spearman's correlation test (Table 148) shows that t-score, 2.4244 is greater than t-critical, it falls within the region of rejection in the one-tailed test. This implies that there is a positive association between the ranks of university facilities managers during the main stream survey and case study (I) interview on the broad external challenges sets.

Table 148: Cross tabulation and Spearman's correlation test for testing Proposition 2.1
- Broad external challenges (University A)

¹ Code	CASE STUDY 1				MAINSTREAM SURVEY			
	Impact Index	Frequency Index	Risk Score (RS)	Rank	Impact Index	Frequency Index	Risk Score (RS)	Rank
	(Ii)	(Fi)	(Ii x Fi)		(Ii)	(Fi)	(Ii x Fi)	
CE-1	3.400	4.600	15.640	2	4.449	4.752	21.141	1
CE-2	2.600	3.600	9.360	5	4.328	4.000	17.311	3
CE-3	2.200	1.400	3.080	6	3.805	3.527	13.418	6
CE-4	5.000	4.800	24.000	1	4.769	4.343	20.711	2
CE-5	3.000	3.600	10.800	4	4.038	3.691	14.905	5
CE-6	3.600	3.800	13.680	3	4.328	3.839	16.614	4

¹Broad categories of Current External (CE) challenges:

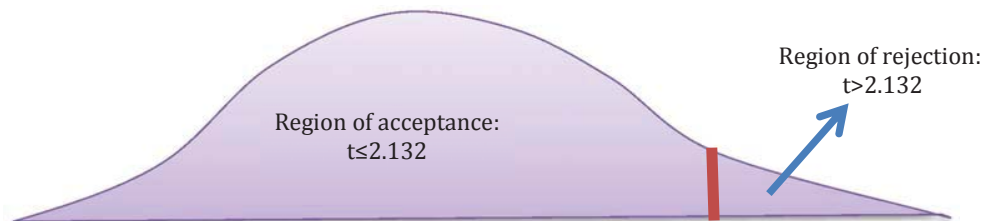
CE-1) Economic; CE-2) Sustainability / environmental issues; CE-3) Technological; CE-4) Regulatory/ compliance; CE-5) Socio-cultural issues/ CE-6) Institutional.

Number of objects ranked, n	=	6
Spearman's rank correlation coefficient, R	=	0.7714
t _{score}	=	2.4244
degree of freedom, df = n-2	=	4
t-critical (at 5% level of significant)	=	2.132
Acceptance region	=	$t \leq 2.132$
Result: $t_{\text{score}} \leq t_{\text{critical}}$	=	Accept H ₀ if $t_{\text{score}} \leq t_{\text{critical}}$

H₀ : The rank correlation between ranks computed from mainstream survey and case study interview rating is zero.

H₁ : Positive correlation exists between the two sets of data sources.

Decision: Reject H₀ and conclude that statistical evidence suggests that there are positive correlations between the two data sources.



Future challenges

Table 149: Cross tabulation and Spearman's correlation test for testing Proposition 2.1 - Future challenges (University A)

¹ Code	CASE STUDY 1				MAINSTREAM SURVEY			
	Impact Index	Frequency Index	Risk Score (RS)	Rank	Impact Index	Frequency Index	Risk Score (RS)	Rank
	(Ii)	(Fi)	(Ii x Fi)		(Ii)	(Fi)	(Ii x Fi)	
F-1	5.000	4.600	23.000	1	3.731	4.252	15.864	5
F-2	4.600	4.200	19.320	2	4.222	4.292	18.118	3
F-3	4.000	3.600	14.400	4	4.619	4.265	19.702	1
F-4	3.000	2.400	7.200	9	3.360	3.564	11.976	8
F-5	3.800	3.200	12.160	5	4.321	3.188	13.774	6
F-6	2.800	2.000	5.600	10	3.956	2.735	10.820	9
F-7	2.400	3.800	9.120	8	3.155	4.019	12.681	7
F-9	2.600	3.600	9.360	7	4.659	3.513	16.369	4
F-10	4.200	4.400	18.480	3	4.367	4.284	18.710	2
F-11	3.000	3.800	11.400	6	3.070	3.481	10.687	10

¹Future (F) challenges:

F-1) Emergency management; F-2) Statutory compliance; F-3) Sustainability; F-4) Technology; F-5) User needs assessment and satisfaction; F-6) Business and financial management; F-7) Occupational health & safety; F-9) Leadership and innovation; F-10) Space management; F-11) Outsourcing.

Number of objects ranked, n	=	10
Spearman's rank correlation coefficient, R	=	0.6606
t-score	=	2.4889
degree of freedom, df = n-2	=	8
t-critical (at 5% level of significant)	=	1.860
Acceptance region	=	$t \leq 1.860$
Result: $t_{\text{score}} \leq t_{\text{critical}}$	=	Accept H0 if $t_{\text{score}} \leq t_{\text{critical}}$

H₀ : The rank correlation between ranks computed from mainstream survey and case study interview rating is zero.

H₁ : Positive correlation exists between the two sets of data sources.

Decision: Reject H₀ and conclude that statistical evidence suggests that there are positive correlations between the two data sources.



Spearman's correlation test (Table 149) shows that t-score, 2.4889 is greater than t-critical, it falls within the region of rejection in the one-tailed test. This implies that there is a positive association between the ranks of university facilities managers during the main stream survey and case study (I) interview on the future challenges sets.

Summary of results for Case Study I

For university A, results (Table 147 - Table 149) show that there are significant agreement between the views of university facilities managers identified during the main stream questionnaire survey and corresponding findings from Case Study I on the nature (i.e. level of impact and frequencies of occurrence) and risk levels of the internal, external and future challenges facing their facilities managers.

It can be concluded that, for University A, there is statistical evidence that there is no divergence between both data sources on the impact levels of challenges facing their institution. Hence, Case Study I reinforces the findings of the main stream survey and provides reliability/ validity evidence in the earlier study.

7.4.2 Case Study II: University B

Broad internal challenges

Table 150: Cross tabulation and Spearman's correlation test for testing Proposition 2.1 – Broad categories of Current Internal challenges (University B)

¹ Broad categories of Current Internal challenges	CASE STUDY 2				MAINSTREAM SURVEY			
	Impact Index	Frequency Index	Risk Score (RS)	Rank	Impact Index	Frequency Index	Risk Score (RS)	Rank
	(Ii)	(Fi)	(Ii x Fi)		(Ii)	(Fi)	(Ii x Fi)	
CI-1	5.000	5.000	25.000	1	4.968	4.792	23.804	1
CI-2	2.333	2.000	4.667	5	3.953	3.917	15.481	4
CI-4	4.667	4.667	21.778	2	4.920	4.470	21.993	2
CI-6	4.333	4.333	18.778	3	4.638	4.172	19.352	3
CI-7	1.833	4.167	7.639	4	3.883	3.468	13.464	5

¹Broad categories of Current Internal (CI) challenges:

CI-1) Finance; CI-2) Operational efficiency; CI-4) Stakeholder needs/ Service providers; CI-6) Manpower; CI-7) Machinery/ equipment.

Number of objects ranked, n	=	5
Spearman's rank correlation coefficient, R	=	0.900
t-score	=	3.576
degree of freedom, df = n-2	=	2
t-critical (at 5% level of significant)	=	3
Acceptance region	=	2.353
	=	t ≤ 2.353
Result: $t_{score} \leq t_{critical}$	=	Accept H ₀ if $t_{score} \leq t_{critical}$

H₀ : The rank correlation between ranks computed from mainstream survey and case study interview rating is zero.

H₁ : Positive correlation exists between the two sets of data sources.

Decision: Reject H₀ and conclude that statistical evidence suggests that there are positive correlations between the two data sources.

Spearman's correlation test (Table 150) shows that t-score, 3.5762 is greater than t-critical, it falls within the region of rejection in the one-tailed test. This implies that there is a positive association between the ranks of university facilities managers during the main stream survey and case study (II) interview on the broad internal challenges sets.

Broad external challenges

Table 151: Cross tabulation and Spearman's correlation test for testing Proposition 2.1 – Broad categories of Current External challenges (University B)

¹ Broad categories of Current External challenges	CASE STUDY 2				MAINSTREAM SURVEY			
	Impact Index	Frequency Index	Risk Score (RS)	Rank	Impact Index	Frequency Index	Risk Score (RS)	Rank
	(Ii)	(Fi)	(Ii x Fi)		(Ii)	(Fi)	(Ii x Fi)	
CE-1	4.333	4.500	19.500	2	4.449	4.752	21.141	1
CE-2	4.167	4.833	20.139	1	4.328	4.000	17.311	3
CE-3	3.667	3.667	13.444	5	3.805	3.527	13.418	6
CE-4	4.667	4.000	18.667	3	4.769	4.343	20.711	2
CE-5	3.833	3.500	13.417	6	4.038	3.691	14.905	5
CE-6	3.833	4.167	15.972	4	4.328	3.839	16.614	4

¹Broad categories of Current External (CE) challenges:

CE-1) Economic; CE-2) Sustainability / environmental issues; CE-3) Technological; CE-4) Regulatory/ compliance; CE-5) Socio-cultural issues/ CE-6) Institutional.

Number of objects ranked, n

= 6

Spearman's rank correlation coefficient, R

= 0.8285

71

t-score

= 2.9598

degree of freedom, df = n-2

= 4

t-critical (at 5% level of significant)

= 2.132

Acceptance region

= $t \leq 2.13$

2

Result: $t_{\text{score}} \leq t_{\text{critical}}$

= Accept H0 if $t_{\text{score}} \leq t_{\text{critical}}$

H₀ : The rank correlation between ranks computed from mainstream survey and case study interview rating is zero.

H₁ : Positive correlation exists between the two sets of data sources.

Decision: Reject H₀ and conclude that statistical evidence suggests that there are positive correlations between the two data sources.

Spearman's correlation test (Table 151) shows that t-score, 2.9598 is greater than t-critical, it falls within the region of rejection in the one-tailed test. This implies that there is a positive association between the ranks of university facilities managers during the main stream survey and case study (II) interview on the broad external challenges sets.

Future challenges

Table 152: Cross tabulation and Spearman's correlation test for testing Proposition 2.1 – Future challenges (University B)

¹ Future challenges	CASE STUDY 2				MAINSTREAM SURVEY			
	Impact Index	Frequency Index	Risk Score (RS)	Rank	Impact Index	Frequency Index	Risk Score (RS)	Rank
	(Ii)	(Fi)	(Ii x Fi)		(Ii)	(Fi)	(Ii x Fi)	
F-1	5.000	4.667	23.333	1	3.731	4.252	15.864	5
F-2	4.000	4.000	16.000	4	4.222	4.292	18.118	3
F-3	4.667	4.500	21.000	2	4.619	4.265	19.702	1
F-4	3.667	3.667	13.444	5	3.360	3.564	11.976	8
F-5	3.000	3.000	9.000	8	4.321	3.188	13.774	6
F-6	2.500	3.333	8.333	10	3.956	2.735	10.820	9
F-7	3.167	3.833	12.139	7	3.155	4.019	12.681	7
F-9	3.500	3.500	12.250	6	4.659	3.513	16.369	4
F-10	4.500	4.333	19.500	3	4.367	4.284	18.710	2
F-11	2.833	3.167	8.972	9	3.070	3.481	10.687	10

¹Future (F) challenges:

F-1) Emergency management; F-2) Statutory compliance; F-3) Sustainability; F-4) Technology; F-5) User needs assessment and satisfaction; F-6) Business and financial management; F-7) Occupational health & safety; F-9) Leadership and innovation; F-10) Space management; F-11) Outsourcing.

Number of objects ranked, n = 10

Spearman's rank correlation coefficient, R = 0.7696

t-score = 3.4100

degree of freedom, df = n-2 = 8

t-critical (at 5% level of significant) = 1.860

Acceptance region = $t \leq 1.86$

Result: $t_{\text{score}} \leq t_{\text{critical}}$ = Accept H0 if $t_{\text{score}} \leq t_{\text{critical}}$

H₀ : The rank correlation between ranks computed from mainstream survey and case study interview rating is zero.

H₁ : Positive correlation exists between the two sets of data sources.

Decision: Reject H₀ and conclude that statistical evidence suggests that there are positive correlations between the two data sources.

Spearman's correlation test (Table 152) shows that t-score, 3.4101 is greater than t-critical, it falls within the region of rejection in the one-tailed test. This implies that there is a positive association between the ranks of university facilities managers during the main stream survey and case study (II) interview on the future challenges sets

Summary of results for Case Study II

For university B, results (Table 150 - Table 152) show that there are significant agreements between the views of university facilities managers identified during the main stream questionnaire survey and corresponding findings from the Case Study II on the nature (i.e. level of impact and frequencies of occurrence) and risk levels of the internal, external and future challenges facing their facilities managers.

It can also be concluded that, there is statistical evidence that there is no divergence between both data sources on the impact levels of challenges facing their institution. Thus, Case Study II reinforces the findings of the main stream survey and provides reliability/ validity evidence in the earlier study.

7.4.3 Case Study III: University C

Broad internal challenges

Table 153: Cross tabulation and Spearman's correlation test for testing Proposition 2.1 – Broad categories of Current Internal challenges (University C)

¹ Broad categories of Current Internal challenges	CASE STUDY 3				MAINSTREAM SURVEY			
	Impact Index	Frequency Index	Risk Score (RS)	Rank	Impact Index	Frequency Index	Risk Score (RS)	Rank
	(Ii)	(Fi)	(Ii x Fi)		(Ii)	(Fi)	(Ii x Fi)	
CI-1	4.000	5.000	20.000	1	4.968	4.792	23.804	1
CI-2	4.000	3.400	13.600	3	3.953	3.917	15.481	4
CI-4	3.000	4.400	13.200	4	4.920	4.470	21.993	2
CI-6	4.600	3.800	17.480	2	4.638	4.172	19.352	3
CI-7	4.000	2.800	11.200	5	3.883	3.468	13.464	5

¹Broad categories of Current Internal (CI) challenges:

CI-1) Finance; CI-2) Operational efficiency; CI-4) Stakeholder needs/ Service providers; CI-6) Manpower; CI-7) Machinery/ equipment.

Number of objects ranked, n	=	5
Spearman's rank correlation coefficient, R	=	0.7000
t-score	=	1.6977
degree of freedom, df = n-2	=	3
t-critical (at 5% level of significant)	=	2.353
Acceptance region	=	$t \leq 2.35$
Result: $t_{score} \leq t_{critical}$	=	Accept H0 if $t_{score} \leq t_{critical}$
H ₀ : The rank correlation between ranks computed from mainstream survey and case study interview rating is zero.		
H ₁ : Positive correlation exists between the two sets of data sources.		
Decision: Accept H ₀ and conclude that statistical evidence suggests there are divergence in views exists between two data sources in their ratings.		

Spearman's correlation test (Table 153) shows that t-score, 1.6977 is less than t-critical; it falls within the region of acceptance in the one-tailed test. This implies that there is no consensus of opinions between the ranks of university facilities managers during the main stream survey and case study (III) interview on the broad internal challenges sets.

Broad external challenges

Table 154: Cross tabulation and Spearman's correlation test for testing Proposition 2.1 – Broad categories of Current External challenges (University C)

¹ Broad categories of Current External challenges	CASE STUDY 3				MAINSTREAM SURVEY			
	Impact Index	Frequency Index	Risk Score (RS)	Rank	Impact Index	Frequency Index	Risk Score (RS)	Rank
	(Ii)	(Fi)	(Ii x Fi)		(Ii)	(Fi)	(Ii x Fi)	
CE-1	4.000	4.200	16.800	2	4.449	4.752	21.141	1
CE-2	4.200	5.000	21.000	1	4.328	4.000	17.311	3
CE-3	1.800	3.600	6.480	5	3.805	3.527	13.418	6
CE-4	4.400	3.800	16.720	3	4.769	4.343	20.711	2
CE-5	2.800	1.600	4.480	6	4.038	3.691	14.905	5
CE-6	3.800	2.600	9.880	4	4.328	3.839	16.614	4

¹Broad categories of Current External (CE) challenges:

CE-1) Economic; CE-2) Sustainability / environmental issues; CE-3) Technological; CE-4) Regulatory/ compliance; CE-5) Socio-cultural issues/ CE-6) Institutional.

Number of objects ranked, n = 6

Spearman's rank correlation coefficient, R = 0.942857

t-score = 5.659453

degree of freedom, df = n-2 = 4

t-critical (at 5% level of significant) = 2.132

Acceptance region = $t \leq 2.132$

Result: $t_{score} \leq t_{critical}$ = Accept H0 if $t_{score} \leq t_{critical}$

H₀ : The rank correlation between ranks computed from mainstream survey and case study interview rating is zero.

H₁ : Positive correlation exists between the two sets of data sources.

Decision: Reject H₀ and conclude that statistical evidence suggests that there are positive correlations between the two data sources.

Spearman's correlation test (Table 154) shows that t-score, 5.6594 is greater than t-critical, it falls within the region of rejection in the one-tailed test. This implies that there is a positive association between the ranks of university facilities managers during the main stream survey and case study (III) interview on the broad external challenges sets.

Future challenges

Table 155: Cross tabulation and Spearman's correlation test for testing Proposition 2.1 – Broad categories of Future challenges (University C)

¹ Future challenges	CASE STUDY 3				MAINSTREAM SURVEY			
	Impact Index	Frequency Index	Risk Score (RS)	Rank	Impact Index	Frequency Index	Risk Score (RS)	Rank
	(Ii)	(Fi)	(Ii x Fi)		(Ii)	(Fi)	(Ii x Fi)	
F-1	3.000	3.400	10.200	4	3.731	4.252	15.864	5
F-2	4.200	4.000	16.800	2	4.222	4.292	18.118	3
F-3	4.400	5.000	22.000	1	4.619	4.265	19.702	1
F-4	2.800	3.200	8.960	6	3.360	3.564	11.976	8
F-5	3.800	3.000	11.400	3	4.321	3.188	13.774	6
F-6	4.000	2.200	8.800	7	3.956	2.735	10.820	9
F-7	3.000	2.000	6.000	10	3.155	4.019	12.681	7
F-9	3.600	2.800	10.080	5	4.659	3.513	16.369	4
F-10	2.000	3.600	7.200	8	4.367	4.284	18.710	2
F-11	2.600	2.600	6.760	9	3.070	3.481	10.687	10

¹Future (F) challenges:

F-1) Emergency management; F-2) Statutory compliance; F-3) Sustainability; F-4) Technology; F-5) User needs assessment and satisfaction; F-6) Business and financial management; F-7) Occupational health & safety; F-9) Leadership and innovation; F-10) Space management; F-11) Outsourcing.

Number of objects ranked, n	=	10
Spearman's rank correlation coefficient, R	=	0.600
t-score	=	2.1213
		2
degree of freedom, df = n-2	=	8
t-critical (at 5% level of significant)	=	1.860
Acceptance region	=	$t \leq 1.860$
		0
Result: $t_{score} \leq t_{critical}$	=	Accept H0 if $t_{score} \leq t_{critical}$
H ₀ : The rank correlation between ranks computed from mainstream survey and case study interview rating is zero.		
H ₁ : Positive correlation exists between the two sets of data sources.		
Decision: Reject H ₀ and conclude that statistical evidence suggests that there are positive correlations between the two data sources.		

Spearman's correlation test (Table 155) shows that t-score, 2.12132 is greater than t-critical, it falls within the region of rejection in the one-tailed test. This implies that there is a positive association between the ranks of university facilities managers during the main stream survey and case study (III) interview on the future challenges sets.

Summary of results for Case Study III

For university C, results (Table 153 - Table 155) show that there are positive correlation between the views of university facilities managers identified during the main stream questionnaire survey and corresponding findings from the Case Study III on the nature (i.e level of impact and frequencies of occurrence) and risk levels of the external and future challenges facing their facilities managers. However, in terms of broad internal challenges, there is negative consensus of opinions between the ranks. In conclusion therefore, there is statistical evidence that divergence in views exists between the two data sources in their ratings.

7.4.4 Case Study IV: University D

Broad internal challenges

Table 156: Cross tabulation and Spearman's correlation test for testing Proposition 2.1 – Broad categories of Current Internal challenges (University D)

¹ Broad categories of Current Internal challenges	CASE STUDY 4				MAINSTREAM SURVEY			
	Impact Index	Frequency Index	Risk Score (RS)	Rank	Impact Index	Frequency Index	Risk Score (RS)	Rank
	(Ii)	(Fi)	(Ii x Fi)		(Ii)	(Fi)	(Ii x Fi)	
CI-1	4.667	5.000	23.333	1	4.968	4.792	23.804	1
CI-2	3.500	3.000	10.500	3	3.953	3.917	15.481	4
CI-4	4.500	4.500	20.250	2	4.920	4.470	21.993	2
CI-6	3.333	2.667	8.889	4	4.638	4.172	19.352	3
CI-7	2.500	2.167	5.417	5	3.883	3.468	13.464	5

¹Broad categories of Current Internal (CI) challenges:

CI-1) Finance; CI-2) Operational efficiency; CI-4) Stakeholder needs/ Service providers; CI-6) Manpower; CI-7) Machinery/ equipment.

Number of objects ranked, n	=	5
Spearman's rank correlation coefficient, R	=	0.9000
t-score	=	3.5762
degree of freedom, df = n-2	=	3
t-critical (at 5% level of significant)	=	2.353
Acceptance region	=	$t \leq 2.353$
Result: $t_{score} \leq t_{critical}$	=	Accept H0 if $t_{score} \leq t_{critical}$
H ₀ : The rank correlation between ranks computed from mainstream survey and case study interview rating is zero.		
H ₁ : Positive correlation exists between the two sets of data sources.		
Decision: Reject H ₀ and conclude that statistical evidence suggests that there are positive correlations between the two data sources.		

Spearman's correlation test (Table 156) shows that t-score, 3.5762 is greater than t-critical, it falls within the region of rejection in the one-tailed test This implies that there is a positive association between the ranks of university facilities managers during the main stream survey and case study (IV) interview on the broad internal challenges sets.

Broad external challenges

Table 157: Cross tabulation and Spearman's correlation test for testing Proposition 2.1 – Broad categories of Current External challenges (University D)

¹ Broad categories of Current External challenges	CASE STUDY 4				MAINSTREAM SURVEY			
	Impact Index	Frequency Index	Risk Score (RS)	Rank	Impact Index	Frequency Index	Risk Score (RS)	Rank
	(Ii)	(Fi)	(Ii x Fi)		(Ii)	(Fi)	(Ii x Fi)	
CE-1	3.500	4.667	16.333	3	4.449	4.752	21.141	1
CE-2	4.667	4.500	21.000	2	4.328	4.000	17.311	3
CE-3	2.167	3.167	6.861	6	3.805	3.527	13.418	6
CE-4	4.833	4.833	23.361	1	4.769	4.343	20.711	2
CE-5	2.600	3.000	7.800	5	4.038	3.691	14.905	5
CE-6	3.500	3.500	12.250	4	4.328	3.839	16.614	4

¹Broad categories of Current External (CE) challenges:

CE-1) Economic; CE-2) Sustainability / environmental issues; CE-3) Technological; CE-4) Regulatory/compliance; CE-5) Socio-cultural issues/ CE-6) Institutional.

Number of objects ranked, n	=	6
Spearman's rank correlation coefficient, R	=	0.82857
t-score	=	2.9598
degree of freedom, df = n-2	=	4
t-critical (at 5% level of significant)	=	2.132
Acceptance region	=	$t \leq 2.132$
Result: $t_{score} \leq t_{critical}$	=	Accept H0 if $t_{score} \leq t_{critical}$
H ₀ : The rank correlation between ranks computed from mainstream survey and case study interview rating is zero.		
H ₁ : Positive correlation exists between the two sets of data sources.		
Decision: Reject H ₀ and conclude that statistical evidence suggests that there are positive correlations between the two data sources.		

Spearman's correlation test (Table 157) shows that t-score, 2.9598 is greater than t-critical, it falls within the region of rejection in the one-tailed test This implies that there is a positive association between the ranks of university facilities managers during the main stream survey and case study (IV) interview on the broad external challenges sets.

Future challenges

Table 158: Cross tabulation and Spearman's correlation test for testing Proposition 2.1 – Broad categories of Future challenges (University D)

¹ Future challenges	CASE STUDY 4				MAINSTREAM SURVEY			
	Impact Index	Frequency Index	Risk Score (RS)	Rank	Impact Index	Frequency Index	Risk Score (RS)	Rank
	(Ii)	(Fi)	(Ii x Fi)		(Ii)	(Fi)	(Ii x Fi)	
F-1	3.500	4.000	14.000	5	3.731	4.252	15.864	5
F-2	5.000	4.667	23.333	2	4.222	4.292	18.118	3
F-3	4.833	5.000	24.167	1	4.619	4.265	19.702	1
F-4	3.333	3.833	12.778	7	3.360	3.564	11.976	8
F-5	4.500	4.167	18.750	3	4.321	3.188	13.774	6
F-6	4.000	4.333	17.333	4	3.956	2.735	10.820	9
F-7	3.833	3.500	13.417	6	3.155	4.019	12.681	7
F-9	3.000	2.333	7.000	9	4.659	3.513	16.369	4
F-10	3.000	3.667	11.000	8	4.367	4.284	18.710	2
F-11	2.500	2.500	6.250	10	3.070	3.481	10.687	10

¹Future (F) challenges:

F-1) Emergency management; F-2) Statutory compliance; F-3) Sustainability; F-4) Technology; F-5) User needs assessment and satisfaction; F-6) Business and financial management; F-7) Occupational health & safety; F-9) Leadership and innovation; F-10) Space management; F-11) Outsourcing.

Number of objects ranked, n = 10

Spearman's rank correlation coefficient, R = 0.8909

t-score = 5.5482

degree of freedom, df = n-2 = 8

t-critical (at 5% level of significant) = 1.860

Acceptance region = $t \leq 1.86$

Result: $t_{\text{score}} \leq t_{\text{critical}}$ = Accept H0 if $t_{\text{score}} \leq t_{\text{critical}}$

H₀ : The rank correlation between ranks computed from mainstream survey and case study interview rating is zero.

H₁ : Positive correlation exists between the two sets of data sources.

Decision: Reject H₀ and conclude that statistical evidence suggests that there are positive correlations between the two data sources.

Spearman's correlation test (Table 158) shows that t-score, 5.5482 is greater than t-critical, it falls within the region of rejection in the one-tailed test. This implies that there is a positive association between the ranks of university facilities managers during the main stream survey and case study (IV) interview on the future challenges sets.

Summary of results for Case Study IV

For university D, results (Table 156 - Table 158) show that there are positive correlations between the views of university facilities managers identified during the main stream questionnaire survey and corresponding findings from the Case Study IV.

In conclusion therefore, there is statistical evidence that there is no divergence between both data sources on the nature (i.e level of impact and frequencies of occurrence) and risk levels of the internal, external and future challenges facing their facilities managers.

Putting it in another way, the case study reinforces the findings of main survey and provides reliability/ validity evidence of earlier study.

7.4.5 Case Study V: University E

Broad internal challenges

Table 159: Cross tabulation and Spearman's correlation test for testing Proposition 2.1 – Broad categories of Current Internal challenges (University E)

¹ Broad categories of Current Internal challenges	CASE STUDY 5				MAINSTREAM SURVEY			
	Impact Index	Frequency Index	Risk Score (RS)	Rank	Impact Index	Frequency Index	Risk Score (RS)	Rank
	(Ii)	(Fi)	(Ii x Fi)		(Ii)	(Fi)	(Ii x Fi)	
CI-1	5.000	5.000	25.000	1	4.968	4.792	23.804	1
CI-2	3.000	3.571	10.714	4	3.953	3.917	15.481	4
CI-4	4.571	3.714	16.980	3	4.920	4.470	21.993	2
CI-6	4.286	4.000	17.143	2	4.638	4.172	19.352	3
CI-7	3.000	3.286	9.857	5	3.883	3.468	13.464	5

¹Broad categories of Current Internal (CI) challenges:

CI-1) Finance; CI-2) Operational efficiency; CI-4) Stakeholder needs/ Service providers; CI-6) Manpower; CI-7) Machinery/ equipment.

Number of objects ranked, n = 5

Spearman's rank correlation coefficient, R = 0.9000

t-score = 3.5762

degree of freedom, df = n-2 = 3

t-critical (at 5% level of significant) = 2.353

Acceptance region = $t \leq 2.353$

Result: $t_{score} \leq t_{critical}$ = Accept H0 if $t_{score} \leq t_{critical}$

H₀ : The rank correlation between ranks computed from mainstream survey and case study interview rating is zero.

H₁ : Positive correlation exists between the two sets of data sources.

Decision: Reject H₀ and conclude that statistical evidence suggests that there are positive correlations between the two data sources.

Spearman's correlation test (Table 159) shows that t-score, 3.5762 is greater than t-critical, it falls within the region of rejection in the one-tailed test This implies that there is a positive association between the ranks of university facilities managers during the main stream survey and case study (V) interview on the broad internal challenges sets.

Broad external challenges

Table 160: Cross tabulation and Spearman's correlation test for testing Proposition 2.1 – Broad categories of Current External challenges (University E)

¹ Broad categories of Current External challenges	CASE STUDY 5				MAINSTREAM SURVEY			
	Impact Index (Ii)	Frequency Index (Fi)	Risk Score (RS) (Ii x Fi)	Rank	Impact Index (Ii)	Frequency Index (Fi)	Risk Score (RS) (Ii x Fi)	Rank
CE-1	4.000	4.571	18.286	2	4.449	4.752	21.141	1
CE-2	4.429	4.714	20.878	1	4.328	4.000	17.311	3
CE-3	3.143	3.143	9.878	5	3.805	3.527	13.418	6
CE-4	3.857	4.143	15.980	3	4.769	4.343	20.711	2
CE-5	2.429	2.714	6.592	6	4.038	3.691	14.905	5
CE-6	3.714	3.714	13.796	4	4.328	3.839	16.614	4

¹Broad categories of Current External (CE) challenges:

CE-1) Economic; CE-2) Sustainability / environmental issues; CE-3) Technological; CE-4) Regulatory/ compliance; CE-5) Socio-cultural issues/ CE-6) Institutional.

Number of objects ranked, n = 6

Spearman's rank correlation coefficient, R = 0.7714

t-score = 2.4247

degree of freedom, df = n-2 = 4

t-critical (at 5% level of significant) = 2.132

Acceptance region = $t \leq 2.132$

Result: $t_{score} \leq t_{critical}$ = Accept H0 if $t_{score} \leq t_{critical}$

H₀ : The rank correlation between ranks computed from mainstream survey and case study interview rating is zero.

H₁ : Positive correlation exists between the two sets of data sources.

Decision: Reject H₀ and conclude that statistical evidence suggests that there are positive correlations between the two data sources.

Spearman's correlation test (Table 160) shows that t-score, 2.4247 is greater than t-critical, it falls within the region of rejection in the one-tailed test This implies that there is a positive association between the ranks of university facilities managers during the main stream survey and case study (V) interview on the broad external challenges sets.

Future challenges

Table 161: Cross tabulation and Spearman's correlation test for testing Proposition 2.1 – Broad categories of Future challenges (University E)

¹ Future challenges	CASE STUDY 5				MAINSTREAM SURVEY			
	Impact Index	Frequency Index	Risk Score (RS)	Rank	Impact Index	Frequency Index	Risk Score (RS)	Rank
	(Ii)	(Fi)	(Ii x Fi)		(Ii)	(Fi)	(Ii x Fi)	
F-1	5.000	3.143	15.714	5	3.731	4.252	15.864	5
F-2	4.429	4.000	17.714	2	4.222	4.292	18.118	3
F-3	4.571	4.714	21.551	1	4.619	4.265	19.702	1
F-4	4.286	2.714	11.633	8	3.360	3.564	11.976	8
F-5	3.571	4.571	16.327	3	4.321	3.188	13.774	6
F-6	3.286	2.571	8.449	9	3.956	2.735	10.820	9
F-7	3.286	3.571	11.735	7	3.155	4.019	12.681	7
F-9	3.714	4.000	14.857	6	4.659	3.513	16.369	4
F-10	4.143	3.857	15.980	4	4.367	4.284	18.710	2
F-11	2.571	2.571	6.612	10	3.070	3.481	10.687	10

¹Future (F) challenges:

F-1) Emergency management; F-2) Statutory compliance; F-3) Sustainability; F-4) Technology; F-5) User needs assessment and satisfaction; F-6) Business and financial management; F-7) Occupational health & safety; F-9) Leadership and innovation; F-10) Space management; F-11) Outsourcing.

Number of objects ranked, n = 10
Spearman's rank correlation coefficient, R = 0.7333
t-score = 3.050851
degree of freedom, df = n-2 = 8
t-critical (at 5% level of significant) = 1.860
Acceptance region = $t \leq 1.860$
Result: $t_{\text{score}} \leq t_{\text{critical}}$ = Accept H0 if $t_{\text{score}} \leq t_{\text{critical}}$

H₀ : The rank correlation between ranks computed from mainstream survey and case study interview rating is zero.

H₁ : Positive correlation exists between the two sets of data sources.

Decision: Reject H₀ and conclude that statistical evidence suggests that there are positive correlations between the two data sources.

Spearman's correlation test (Table 161) shows that t-score, 3.050851 is greater than t-critical, it falls within the region of rejection in the one-tailed test This implies that there is a positive association between the ranks of university facilities managers during the main stream survey and case study (V) interview on the future challenges sets.

Summary of results for Case Study V

For university E, results (Table 159 - Table 161) show that there are positive correlations between the views of university facilities managers identified during the main stream questionnaire survey and corresponding findings from the Case Study V on the nature (i.e. level of impact and frequencies of occurrence) and risk levels of the internal, external and future challenges facing their facilities managers.

Thus, it can be concluded that there is statistical evidence that there is no divergence between both data sources on the nature (i.e level of impact and frequencies of occurrence) and risk levels of the internal, external and future challenges facing their facilities managers.

In other words, the case study reinforces the findings of main survey and provides reliability/ validity evidence of earlier study.

Conclusion on test of Proposition 2.1

Table 162 shows the overall result derived from the tests of Proposition 2.1. Result of the Spearman's rank correlation test shows that no divergence between both data sources on the risk levels of the challenges facing facilities managers in Australasian universities.

Table 162: Overall result of tests of Proposition 2.1

CASE STUDY	UNIVERSITY	CORRELATION TEST RESULTS: MAIN SURVEY versus CASE STUDY		
		Internal challenges	External challenges	Future challenges
I	A	Positive	Positive	Positive
II	B	Positive	Positive	Positive
III	C	No correlation	Positive	Positive
IV	D	Positive	Positive	Positive
V	E	Positive	Positive	Positive

However, only one divergence of views pertaining to broad internal challenges category exist between the ranks of facilities managers during the main stream survey and case

study III interviews. Putting it in another way, the case study reinforces the findings of the main stream survey and provides a reliability/ validity evidence of the earlier study.

In conclusion, the proposition (2.1) that there are no significant differences between the views of university facilities managers identified during the main stream survey and the corresponding findings from the case studies, on the nature and risk levels of the internal and external constraints as well as the key challenges facing university facilities managers, is therefore empirically supported at five percent level of significance.

7.5 TESTS OF PROPOSITION 2.2

Significant agreement exists between the views expressed by university facilities managers identified during the main stream survey, the case studies and also from the history records, on the frequency of occurrence of the challenges constraining the achievement of strategic facilities management.

Analytical method employed

Data for testing Proposition 2.2 comprised the outcomes of the main stream survey, case studies and history of records in relation to the frequency of occurrence of these identified challenges; since there are only data on the frequency of occurrence were made available in the history records.

Kendall's W coefficient concordance test

Another non-parametric statistic used in this study is Kendall's W , which is also known as Kendall's coefficient of concordance. It is used for assessing agreement among raters. Kendall's W ranges from 0 (no agreement) to 1 (complete agreement) (Dodge, 2003).

In general, according to Dodge (2003), Kendall's W tests whether k related samples are from the same population, in which W is a measure of agreement among raters, where each case is one rater's rating of several variables and the output includes: the mean

rank for each variable in the Ranks table, the valid number of cases, Kendall's W , chi-square, degrees of freedom, and also probability in the Test Statistics table.

In this study for example, a number of respondents have been asked to rank a list of internal challenges, from very risky to least risky. Kendall's W can be calculated from these data. If the test statistic W is 1, thus all the respondents have been unanimous, and each respondent has assigned the same order to the list of challenges. If W is 0, then there is no evidence of agreement among the respondents, and thus their responses may be regarded as essentially random. Intermediate values of W indicate a greater or lesser degree of unanimity among the responses.

Table 163 shows the generic matrix of variables for multivariate related sample analysis of concordance using Kendall's W .

Table 163: Generic matrix of variables for multivariate related sample analysis of concordance using Kendall's W

Judges (or raters) (Y_j)	Objects being ranked (X_i)				
	X_1	..	X_i	..	X_n
Y_1	X_{11}	..	X_{i1}	..	X_{n1}
\vdots	\vdots		\vdots		\vdots
Y_j	X_{1j}	..	X_{ij}	..	X_{nj}
\vdots	\vdots		\vdots		\vdots
Y_k	X_{1k}	..	X_{ik}	..	X_{nk}
Sum of ranks (R_i):	R_1	..	R_i	..	R_n

Formula:

$$R_i = \sum_{j=1}^k X_{ij}$$

$$\bar{R} = k(n+1)/2$$

Ri deviations from mean: $R_i - \bar{R}$	$R_1 - \bar{R}$..	$R_i - \bar{R}$..	$R_n - \bar{R}$
Square of deviations	$(R_1 - \bar{R})^2$..	$(R_i - \bar{R})^2$..	$(R_n - \bar{R})^2$

Sum of squared deviations (S):

$$S = \sum_{i=1}^n (R_i - \bar{R})^2$$

Coefficient of concordance $W =$

$$W = 12S/[K^2(n^3-n)]$$

Where:

$$[0 \leq W \leq 1]$$

$W = 0$ (= maximum disagreement/ not concordance)

$W = 1$ (=maximum agreement/ concordance)

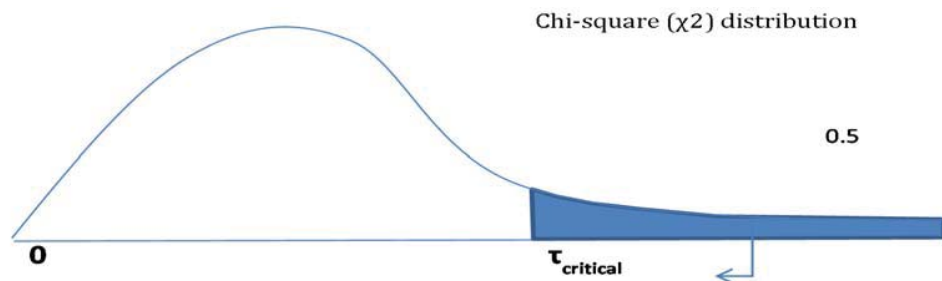
For statistical test of significance:

[Transforming W into chi-square (χ^2) test statistic (τ) with $n-1$ degrees of freedom]:

$\tau_{\text{calculated}} = K(n-1)W$ (i.e. chi-square transformed value of the W value).

τ_{critical} : evaluated from table of critical values of chi-square at an alpha value level and $n-1$ degrees of freedom.

τ_{critical} : could also be evaluated using Excel function CHIINV at an alpha value level and $n-1$ degrees of freedom (df); syntax =CHIINV(α ,df) or =CHIINV(0.05, $n-1$) for 0.05 or 5% significant level for which most statistical tests are carried out.



Hypothesis testing:

H_0 (null hyp): (assumes that no significant concordance or agreement exists among the judges or raters; i.e. raters rate independently by chance and not in accordance with a common pattern)

This is true if and only if one of the following is true:

$\tau_{\text{calculated}} \leq \tau_{\text{critical}}$ (i.e. falls within zone of acceptance), OR:

$p \geq \alpha$ [i.e. the probability associated with the $\tau_{\text{calculated}} \geq \alpha$ value of test (usually 0.05)]

H_A (alt hyp): (assumes that significant concordance or agreement exists among the judges or raters; i.e. raters rate in accordance with a common pattern)

This is true if and only if one of the following is true:

$\tau_{\text{calculated}} > \tau_{\text{critical}}$ (i.e. falls within zone of rejection), OR:

$p < \alpha$ [i.e. the probability associated with the $\tau_{\text{calculated}} < \alpha$ value of test (usually 0.05)]

NOTE that the p [i.e. the probability associated with the $\tau_{\text{calculated}}$ could be evaluated using the Excel CHIDIST at the given $\tau_{\text{calculated}}$ value and degree of freedom (df = n-1)]

[the syntax is =CHIDIST($\tau_{\text{calculated}}$,df)]

The following Table 164 presents the example of analysis carried for testing proposition 2.2, aimed at analysing the level of agreement of the sets of relative occurrence frequency rankings of the internal challenges faced by facilities managers as obtained from three sources: main survey, case study (I) and records.

Table 164: Example of analysis of the level of agreement of the sets of relative occurrence frequency rankings of the internal challenges faced by facilities managers as obtained from three sources.

RANKINGS: INTERNAL CHALLENGES					
Empirical data sources (k _j)	FMgrs challenges (n _i)				
	CI-1	CI-2	CI-4	CI-6	CI-7
Main survey	1	4	2	3	5
Case study X	1	4	3	2	5
Records	1	4	2	3	5
Sum of ranks (R _i):	3	12	7	8	15
k = number of judges (i.e. data sources)				=	3
n = no of objects being rated				=	5
Mean ranks, \bar{R}					
$\bar{R} = k(n+1)/2$	= [3*(5+1)/2]			=	9
R _i deviations from mean: R _i - \bar{R}	-6	3	-2	-1	6
Square of deviations	36	9	4	1	36
Sum of squared deviations (S):				S =	86
Coefficient of Concordance W =					
$W = 12S/[K^2(n^3-n)]$				=	0.956
Where:	$[0 \leq W \leq 1]$				
$W = 0$ (=maximum disagreement/ disconcordance)					
$W = 1$ (=maximum agreement/ concordance)					
FOR STATISTICAL TEST OF SIGNIFICANCE:					
[transforming W into chi-square (χ^2) test statistic (τ) with n-1 degrees of freedom]:					
$\tau_{\text{calculated}} = K(n-1)W$ (i.e. chi-square transformed value of the W value)				=	11.47
α				=	0.05
df = degrees of freedom = n-1				=	4.00
$\tau_{\text{critical}} : = \text{CHIINV}(0.05,n-1)$				=	9.4877
p (prob associated with $\tau_{\text{calculated}}$) = CHIDIST($\tau_{\text{calculated}}$,df)				=	0.02179

Therefore, the following hypothesis was used for the rest of the tests for proposition 2.2.

Hypothesis testing:

H_0 (<i>null hyp</i>)	: (assumes that no significance concordance or agreement exists among the judges or raters; i.e. raters rate independently by chance and not in accordance with a common pattern) This is true if and only if one of the following is true: $\tau_{\text{calculated}} \leq \tau_{\text{critical}}$ (i.e. falls within zone of acceptance), OR: $p \geq \alpha$ [i.e. the probability associated with the $\tau_{\text{calculated}} \geq \alpha$ value of test (usually 0.05)]
H_A (<i>alt hyp</i>)	: (assumes that significant concordance or agreement exists among the judges or raters; i.e. raters rate in accordance with a common pattern) This is true if and only if one of the following is true: $\tau_{\text{calculated}} > \tau_{\text{critical}}$ (i.e. falls within zone of rejection), OR: $p < \alpha$ [i.e. the probability associated with the $\tau_{\text{calculated}} < \alpha$ value of test (usually 0.05)]
Results	: $\tau_{\text{calculated}} > \tau_{\text{critical}}$ (i.e. falls within zone of rejection), OR: $p < \alpha$ [i.e. the probability associated with the $\tau_{\text{calculated}} < \alpha$ value of test (usually 0.05)]
Decision	: Accept H_A ; Reject H_0
Conclusion	: There is no statistical evidence to support the null hypothesis that any agreement among the findings from the three sources of evidence is by chance variation. Therefore, it can be concluded that there is some measure of consistency of triangulation among the three sources. This also accords some measure of reliability and validity to the findings; the test instrument and the procedure adopted in the research.

Similar tests were carried out for each set of relative occurrence frequency rankings of the external challenges and future challenges; comparing the data from main survey, records and each case study (comprising of Case study 1 to Case study 5).

The following sections showcase the results for Kendall's W coefficient concordance tests carried out for Case Study I (Section 7.5.1). The remaining results on other case studies are presented in Appendix G: Case Study II (Table 279 - Table 281); Case Study III (Table 282 - Table 284); Case Study IV (Table 285 - Table 287) and Case Study V (Table 288 - Table 290).

7.5.1 Case Study I: University A

Results on the Kendall's W coefficient concordance for Case Study I (University A) are analysed and presented in Table 165 - Table 176; which aimed to identify the level of agreement of the sets of relative frequency of occurrence rankings of the broad internal (Section 7.5.1.1), broad external (Section 7.5.1.2) and future challenges (Section 7.5.1.3) faced by university facilities managers as obtained from three different data sources, namely mainstream survey, Case Study (I) and also records.

7.5.1.1 Broad internal challenges

Results for the broad internal challenges analysed from the three empirical data sources are shown in Table 165 - Table 168. Kendall's W coefficient concordance test result shows that τ -calculated (11.47) is greater than t -critical. This means that this falls within the zone of rejection. Results also show that the probability associated with the τ -calculated is less than the alpha value ($p < \alpha$) of test. This implies that there is no statistical evidence to support the null hypothesis that any agreement among the findings from the three sources of evidence is by chance of variation.

Table 165: Case Study I - Level of agreement of the sets of relative occurrence frequency rankings of the broad internal challenges faced by facilities managers as obtained from three sources.

RANKINGS: INTERNAL CHALLENGES					
Empirical data sources (k _j)	FMgrs challenges (n _i)				
	CI-1	CI-2	CI-4	CI-6	CI-7
Main survey	1	4	2	3	5
Case study 1	1	3	2	4	5
Records	1	4	2	3	5
Sum of ranks (R _i):	3	11	6	10	15
k = number of judges (i.e. data sources)				=	3
n = no of objects being rated				=	5
Mean ranks, \bar{R}					
$\bar{R} = k(n+1)/2$		= [3*(5+1)/2]		=	9
R _i deviations from mean: R _i - \bar{R}	-6	2	-3	1	6
Square of deviations	36	4	9	1	36
Sum of squared deviations (S):				S =	86
Coefficient of Concordance W =					
$W = 12S/[K^2(n^3-n)]$				=	0.956
Where:	[0≤W≤1]				
W = 0 (=maximum disagreement/ disconcordance)					
W = 1 (=maximum agreement/ concordance)					
FOR STATISTICAL TEST OF SIGNIFICANCE:					
[transforming W into chi-square (χ ²) test statistic (τ) with n-1 degrees of freedom]:					
$\tau_{\text{calculated}} = K(n-1)W$ (i.e. chi-square transformed value of the W value)				=	11.47
α				=	0.05
df = degrees of freedom = n-1				=	4.00
$\tau_{\text{critical}} = \text{CHIINV}(0.05,n-1)$				=	9.4877
p (prob associated with $\tau_{\text{calculated}}$) = CHIDIST(τ _{calculated} ,df)				=	0.02179

SPSS Output: Case Study I (Broad Internal Challenges)

SPSS tests on Kendall's W coefficient concordance were also carried out on the same data and the results were presented in this section.

(i) Descriptive statistics

Table 166: Descriptive statistics: Broad internal challenges for Case Study I (University A)

Descriptive Statistics								
	N	Mean	Std. Deviation	Min	Max	Percentiles		
						25th	50th (Median)	75th
CI-1	3	1.0000	.00000	1.00	1.00	1.0000	1.0000	1.0000
CI-2	3	3.6667	.57735	3.00	4.00	3.0000	4.0000	4.0000
CI-4	3	2.0000	.00000	2.00	2.00	2.0000	2.0000	2.0000
CI-6	3	3.3333	.57735	3.00	4.00	3.0000	3.0000	4.0000
CI-7	3	5.0000	.00000	5.00	5.00	5.0000	5.0000	5.0000

(ii) Mean Ranks

Table 167: Mean ranks: Broad internal challenges for Case Study I (University A)

Ranks	
	Mean Rank
CI-1	1.00
CI-2	3.67
CI-4	2.00
CI-6	3.33
CI-7	5.00

(iii) Test Statistics

Table 168: Test Statistics: Broad internal challenges for Case Study I (University A)

Test Statistics			
N			3
Kendall's W ^a			.956
Chi-Square			11.467
df			4
Asymp. Sig.			.022
	Sig.		.001 ^b
Monte Carlo Sig.		Lower Bound	.000
	95% Confidence Interval	Upper Bound	.001

a. Kendall's Coefficient of Concordance

b. Based on 10000 sampled tables with starting seed 2000000.

7.5.1.2 Broad external challenges

Results for the broad external challenges analysed from the three empirical data sources are presented in Table 169 - Table 172. Kendall's W coefficient concordance test results show that τ -calculated (13.48) is greater than t-critical. This falls within the zone of rejection. Results also show that the probability associated with the τ -calculated is less than the alpha value ($p < \alpha$) of test. This implies that there is no statistical evidence to support the null hypothesis that any agreement among the findings from the three sources of evidence is by chance of variation.

Table 169: Case Study I - Level of agreement of the sets of relative occurrence frequency rankings of the broad external challenges faced by facilities managers as obtained from three sources.

RANKINGS: EXTERNAL CHALLENGES						
Empirical data	FMgrs challenges (n _i)					
sources (k _j)	CE-1	CE-2	CE-3	CE-4	CE-5	CE-6
Main survey	1	5	6	3	2	4
Case study 1	2	4	6	5	1	3
Records	1	5	6	3	2	4
Sum of ranks (R _i):	4	14	18	11	5	11
k = number of judges (i.e. data sources):					=	3
n = no of objects being rated:					=	6
Mean ranks, \bar{R}						
$\bar{R} = k(n+1)/2$	= [3*(6+1)/2]				=	10.5
R _i deviations from mean: R _i - \bar{R}	-6.5	3.5	7.5	0.5	-5.5	0.5
Square of deviations	42.25	12.25	56.25	0.25	30.25	0.25
Sum of squared deviations (S):					S =	141.5
Coefficient of Concordance W =						
W = 12S/[K ² (n ³ -n)] =						0.898
Where:		[0≤W≤1]				
W = 0 (=maximum disagreement/ disconcordance)						
W = 1 (=maximum agreement/ concordance)						
FOR STATISTICAL TEST OF SIGNIFICANCE:						
[transforming W into chi-square (χ ²) test statistic (τ) with n-1 degrees of freedom]:						
τ _{calculated} = K(n-1)W (i.e. chi-square transformed value of the W value)					=	13.48
α					=	0.05
df = degrees of freedom = n-1					=	5.00
τ _{critical} : =CHIINV(0.05,n-1)					=	11.07
p (prob associated with τ _{calculated}) =CHIDIST(τ _{calculated} ,df)					=	0.0193

SPSS Output: Case Study I (Broad External Challenges)

(i) Descriptive statistics

Table 170: Descriptive statistics - Broad external challenges for Case Study I (University A)

Descriptive Statistics								
	N	Mean	Std. Deviation	Minimum	Maximum	Percentiles		
						25th	50th (Median)	75th
CE1	3	1.3333	.57735	1.00	2.00	1.0000	1.0000	2.0000
CE2	3	4.6667	.57735	4.00	5.00	4.0000	5.0000	5.0000
CE3	3	6.0000	.00000	6.00	6.00	6.0000	6.0000	6.0000
CE4	3	3.6667	1.15470	3.00	5.00	3.0000	3.0000	5.0000
CE5	3	1.6667	.57735	1.00	2.00	1.0000	2.0000	2.0000
CE6	3	3.6667	.57735	3.00	4.00	3.0000	4.0000	4.0000

(ii) Mean ranks

Table 171: Mean ranks - Broad external challenges for Case Study I (University A)

Ranks	
	Mean Rank
CE1	1.33
CE2	4.67
CE3	6.00
CE4	3.67
CE5	1.67
CE6	3.67

(iii) Test Statistics

Table 172: T Test Statistics - Broad external challenges for Case Study I (University A)

Test Statistics			
N			3
Kendall's W ^a			.898
Chi-Square			13.476
df			5
Asymp. Sig.			.019
	Sig.		.001 ^b
Monte Carlo Sig.		Lower Bound	.001
	95% Confidence Interval	Upper Bound	.002

a. Kendall's Coefficient of Concordance

b. Based on 10000 sampled tables with starting seed 1502173562.

7.5.1.3 Future challenges

Results for the broad external challenges analysed from the three empirical data sources are presented in Table 173 - Table 176. Kendall's W coefficient concordance test results show that τ -calculated (21.69) is greater than t-critical. This falls within the zone of rejection. Results also show that the probability associated with the τ -calculated is less than the alpha value ($p < \alpha$) of the test. This implies that there is no statistical evidence to support the null hypothesis that any agreement among the findings from the three sources of evidence is by chance of variation.

Table 173: Case Study I - Level of agreement of the sets of relative occurrence frequency rankings of the future challenges faced by facilities managers as obtained from three sources.

RANKINGS: FUTURE CHALLENGES										
Empirical data sources (k_i)	F1	F2	F3	F4	F5	F6	F7	F9	F10	F11
Main survey	5	3	1	8	6	9	7	4	2	10
Case study 1	1	2	4	9	5	10	8	7	3	6
Records	4	1	3	6	9	10	5	7	2	8
Sum of ranks (R_i):	10	6	8	23	20	29	20	18	7	24
k = number of judges (i.e. data sources):									=	3
n = no of objects being rated:									=	10
Mean ranks, \bar{R}										
$\bar{R} = k(n+1)/2$	[3*(10+1)/2]=								=	16.5
Ri deviations from mean: $R_i - \bar{R}$	-6.5	-10.5	-8.5	6.5	3.5	12.5	3.5	1.5	-9.5	7.5
Square of deviations	42.25	110.25	72.25	42.25	12.25	156.25	12.25	2.25	90.25	56.25
Sum of squared deviations (S):									S =	596.5
Coefficient of Concordance W =										
$W = 12S/[K^2(n^3-n)] =$									=	0.803
Where:										
$[0 \leq W \leq 1]$										
$W = 0$ (=maximum disagreement/ discordance)										
$W = 1$ (=maximum agreement/ concordance)										
FOR STATISTICAL TEST OF SIGNIFICANCE:										
[transforming W into chi-square (χ^2) test statistic (τ) with n-1 degrees of freedom]:										
$\tau_{\text{calculated}} = K(n-1)W$ (i.e. chi-square transformed value of the W value)									=	21.69
α									=	0.05
df = degrees of freedom =										
n-1									=	9.00
$\tau_{\text{critical}} = \text{CHIINV}(0.05, n-1)$									=	16.919
p (prob associated with $\tau_{\text{calculated}}$) = $\text{CHIDIST}(\tau_{\text{calculated}}, df)$									=	0.00991

SPSS Output: Case Study I (Future Challenges)

(i) Descriptive statistics

Table 174: Descriptive statistics - Future challenges for Case Study I (University A)

Descriptive Statistics								
	N	Mean	Std. Deviation	Minimum	Maximum	Percentiles		
						25th	50th (Median)	75th
F1	3	3.3333	2.08167	1.00	5.00	1.0000	4.0000	5.0000
F2	3	2.0000	1.00000	1.00	3.00	1.0000	2.0000	3.0000
F3	3	2.6667	1.52753	1.00	4.00	1.0000	3.0000	4.0000
F4	3	7.6667	1.52753	6.00	9.00	6.0000	8.0000	9.0000
F5	3	6.6667	2.08167	5.00	9.00	5.0000	6.0000	9.0000
F6	3	9.6667	.57735	9.00	10.00	9.0000	10.0000	10.0000
F7	3	6.6667	1.52753	5.00	8.00	5.0000	7.0000	8.0000
F9	3	6.0000	1.73205	4.00	7.00	4.0000	7.0000	7.0000
F10	3	2.3333	.57735	2.00	3.00	2.0000	2.0000	3.0000
F11	3	8.0000	2.00000	6.00	10.00	6.0000	8.0000	10.0000

(ii) Mean ranks

Table 175: Mean ranks - Future challenges for Case Study I (University A)

Ranks	
	Mean Rank
F1	3.33
F2	2.00
F3	2.67
F4	7.67
F5	6.67
F6	9.67
F7	6.67
F9	6.00
F10	2.33
F11	8.00

(iii) *Test statistics*

Table 176: T Test statistic - Future challenges for Case Study I (University A)

Test Statistics				
N			3	
Kendall's W ^a			.803	
Chi-Square			21.691	
df			9	
Asymp. Sig.			.010	
Sig.			.000 ^b	
Monte Carlo Sig.	95% Confidence Interval		Lower Bound	.000
			Upper Bound	.000

a. Kendall's Coefficient of Concordance

b. Based on 10000 sampled tables with starting seed 303130861.

7.5.2 Case Study II: University B

Results obtained from SPSS on the Kendall's W coefficient concordance for Case Study II (University B) are analysed and presented in Table 177 - Table 179. For Case Study II, the results on the analysis of agreement of the sets of relative occurrence frequency rankings of the internal, external and future challenges faced by facilities managers as obtained from three sources are presented in Appendix G (Table 279 - Table 281).

7.5.2.1 Broad internal challenges

Table 177 shows the result on the SPSS output of the sets of relative occurrence frequency rankings of the broad internal challenges faced by university facilities managers as obtained from mainstream survey, Case Study II and records.

Table 177: SPSS Output: Broad internal challenges for Case Study II (University B)

Test Statistics			
N			3
Kendall's W ^a			.956
Chi-Square			11.467
df			4
Asymp. Sig.			.022
	Sig.		.001 ^b
Monte Carlo Sig.		Lower Bound	.000
	95% Confidence Interval	Upper Bound	.001

a. Kendall's Coefficient of Concordance

b. Based on 10000 sampled tables with starting seed 926214481.

7.5.2.2 Broad external challenges

Table 178 shows the result on the SPSS output of the sets of relative occurrence frequency rankings of the broad external challenges faced by university facilities managers as obtained from mainstream survey, Case Study II and records.

Table 178: SPSS Output: Broad external challenges for Case Study II (University B)

Test Statistics			
N			3
Kendall's W ^a			.924
Chi-Square			13.857
df			5
Asymp. Sig.			.017
	Sig.		.000 ^b
Monte Carlo Sig.		Lower Bound	.000
	95% Confidence Interval	Upper Bound	.000

a. Kendall's Coefficient of Concordance

b. Based on 10000 sampled tables with starting seed 743671174.

7.5.2.3 Future challenges

Table 179 shows the result on the SPSS output of the sets of relative occurrence frequency rankings of the broad external challenges faced by university facilities managers as obtained from mainstream survey, Case Study II and records.

Table 179: SPSS Output: Future challenges for Case Study II (University B)

Test Statistics			
N			3
Kendall's W ^a			.857
Chi-Square			23.145
df			9
Asymp. Sig.			.006
Sig.			.000 ^b
Monte Carlo Sig.	Lower Bound		.000
	Upper Bound		.000
95% Confidence Interval			

a. Kendall's Coefficient of Concordance

b. Based on 10000 sampled tables with starting seed 92208573.

7.5.2.4 Summary of results: Case study II (University B)

Overall, Kendall's W coefficient concordance test results (Table 177 - Table 179; Table 279 - Table 281, Appendix G) show that the τ -calculated is greater than t-critical in which this falls within the zone of rejection, for broad internal, external and future challenges. Results also show that the probability associated with the τ -calculated is less than the alpha value ($p < \alpha$) of the tests. The tests therefore, reject null hypothesis and accept alternative hypothesis. This implies that there are no statistical evidences to support the null hypothesis that any agreement among the findings from the three sources of evidence is by chance of variation.

7.5.3 Case Study III: University C

Results obtained from SPSS on the Kendall's W coefficient concordance for Case Study III (University C) are analysed and presented in Table 180 - Table 182. For Case Study

III, the results on the analysis of agreement of the sets of relative occurrence frequency rankings of the internal challenges faced by facilities managers as obtained from three sources are presented in Appendix G (Table 282 - Table 284).

7.5.3.1 Broad internal challenges

Table 180 shows the result on the SPSS output of the sets of relative occurrence frequency rankings of the broad internal challenges faced by university facilities managers as obtained from mainstream survey, Case Study III and records.

Table 180: SPSS Output: Broad internal challenges for Case Study III (University C)

Test Statistics			
N			3
Kendall's W ^a			1.000
Chi-Square			12.000
df			4
Asymp. Sig.			.017
Sig.			.000 ^b
Monte Carlo Sig.	95% Confidence Interval		.000
	Lower Bound		.000
	Upper Bound		.000

a. Kendall's Coefficient of Concordance

b. Based on 10000 sampled tables with starting seed 1314643744.

7.5.3.2 Broad external challenges

Table 181 shows the result on the SPSS output of the sets of relative occurrence frequency rankings of the broad external challenges faced by university facilities managers as obtained from mainstream survey, Case Study III and records.

Table 181: SPSS Output: Broad external challenges for Case Study III (University C)

Test Statistics			
N			3
Kendall's W ^a			.975
Chi-Square			14.619
df			5
Asymp. Sig.			.012
	Sig.		.000 ^b
Monte Carlo Sig.		Lower Bound	.000
	95% Confidence Interval	Upper Bound	.000

a. Kendall's Coefficient of Concordance

b. Based on 10000 sampled tables with starting seed 957002199.

7.5.3.3 Future challenges

Table 182 shows the result on the SPSS output of the sets of relative occurrence frequency rankings of the future challenges faced by university facilities managers as obtained from mainstream survey, Case Study III and records.

Table 182: SPSS Output: Future challenges for Case Study III (University C)

Test Statistics			
N			3
Kendall's W ^a			.701
Chi-Square			18.927
df			9
Asymp. Sig.			.026
	Sig.		.004 ^b
Monte Carlo Sig.		Lower Bound	.003
	95% Confidence Interval	Upper Bound	.005

a. Kendall's Coefficient of Concordance

b. Based on 10000 sampled tables with starting seed 1335104164.

7.5.3.4 Summary of results: Case study III (University C)

Overall, Kendall's W coefficient concordance test results (Table Table 180 - Table 182; Table 282 - Table 284, Appendix G) show that the τ -calculated is greater than t-critical in which this falls within the zone of rejection, for broad internal, external and future challenges. Results also show that the probability associated with the τ -calculated is less

than the alpha value ($p < \alpha$) of the tests. The tests therefore, reject null hypothesis and accept alternative hypothesis. This implies that there are no statistical evidences to support the null hypothesis that any agreement among the findings from the three sources of evidence is by chance of variation.

7.5.4 Case Study IV: University D

Results obtained from SPSS on the Kendall's W coefficient concordance for Case Study IV (University D) are analysed and presented in Table 183 - Table 185. For Case Study IV, the results on the analysis of agreement of the sets of relative occurrence frequency rankings of the broad internal challenges, broad external challenges and future challenges faced by facilities managers as obtained from three sources are presented in Appendix G (Table 285 - Table 287).

7.5.4.1 Broad internal challenges

Table 183 - Table 185 shows the result on the SPSS output of the sets of relative occurrence frequency rankings of the broad internal challenges faced by university facilities managers as obtained from mainstream survey, Case Study IV and records.

Table 183: SPSS Output: Broad internal challenges for Case Study IV (University D)

Test Statistics			
N			3
Kendall's W ^a			.956
Chi-Square			11.467
df			4
Asymp. Sig.			.022
Sig.			.001 ^b
Monte Carlo Sig.	Lower Bound		.000
	Upper Bound		.001

a. Kendall's Coefficient of Concordance

b. Based on 10000 sampled tables with starting seed 624387341.

7.5.4.2 Broad external challenges

Table 184 shows the result on the SPSS output of the sets of relative occurrence frequency rankings of the broad external challenges faced by university facilities managers as obtained from mainstream survey, Case Study IV and records.

Table 184: SPSS Output: Broad external challenges for Case Study IV (University D)

Test Statistics			
N			3
Kendall's W ^a			.924
Chi-Square			13.857
df			5
Asymp. Sig.			.017
Sig.			.000 ^b
Monte Carlo Sig.	Lower Bound		.000
	Upper Bound		.000
95% Confidence Interval			

a. Kendall's Coefficient of Concordance

b. Based on 10000 sampled tables with starting seed 112562564.

7.5.4.3 Future challenges

Table 185 shows the result on the SPSS output of the sets of relative occurrence frequency rankings of the broad external challenges faced by university facilities managers as obtained from mainstream survey, Case Study IV and records.

Table 185: SPSS Output: Future challenges for Case Study IV (University D)

Test Statistics			
N			3
Kendall's W ^a			.841
Chi-Square			22.709
df			9
Asymp. Sig.			.007
Sig.			.000 ^b
Monte Carlo Sig.	Lower Bound		.000
	Upper Bound		.000
95% Confidence Interval			

a. Kendall's Coefficient of Concordance

b. Based on 10000 sampled tables with starting seed 329836257.

7.5.4.4 Summary of results: Case study IV (University D)

Overall, Kendall's W coefficient concordance test results (Table 183 - Table 185; Table 285 - Table 287, Appendix G) show that the τ -calculated is greater than t -critical in which this falls within the zone of rejection, for broad internal, external and future challenges. Results also show that the probability associated with the τ -calculated is less than the alpha value ($p < \alpha$) of the tests. The tests therefore, reject null hypothesis and accept alternative hypothesis. This implies that there are no statistical evidences to support the null hypothesis that any agreement among the findings from the three sources of evidence is by chance of variation.

7.5.5 Case Study V: University E

Results obtained from SPSS on the Kendall's W coefficient concordance for Case Study V (University E) are analysed and presented in Table 187 – Table 189. For Case Study V, the results on the analysis of agreement of the sets of relative occurrence frequency rankings of the broad internal, broad external and future challenges faced by facilities managers as obtained from three sources are presented in Appendix G (Table 288 - Table 290).

7.5.5.1 Broad internal challenges

Table 186 shows the result on the SPSS output of the sets of relative occurrence frequency rankings of the broad internal challenges faced by university facilities managers as obtained from mainstream survey, Case Study V and records.

Table 186: SPSS Output: Broad internal challenges for Case Study V (University E)

Test Statistics			
N			3
Kendall's W ^a			.956
Chi-Square			11.467
df			4
Asymp. Sig.			.022
	Sig.		.001 ^b
Monte Carlo Sig.	95% Confidence Interval		
		Lower Bound	.000
		Upper Bound	.001

a. Kendall's Coefficient of Concordance

b. Based on 10000 sampled tables with starting seed 334431365.

7.5.5.2 Broad external challenges

Table 187 shows the result on the SPSS output of the sets of relative occurrence frequency rankings of the broad external challenges faced by university facilities managers as obtained from mainstream survey, Case Study V and records.

Table 187: SPSS Output: Broad external challenges for Case Study V (University E)

Test Statistics			
N			3
Kendall's W ^a			.898
Chi-Square			13.476
df			5
Asymp. Sig.			.019
	Sig.		.001 ^b
Monte Carlo Sig.	95% Confidence Interval		
		Lower Bound	.000
		Upper Bound	.001

a. Kendall's Coefficient of Concordance

b. Based on 10000 sampled tables with starting seed 221623949.

7.5.5.3 Future challenges

Table 189 shows the result on the SPSS output of the sets of relative occurrence frequency rankings of the future challenges faced by university facilities managers as obtained from mainstream survey, Case Study V and records.

Table 188: SPSS Output: Future challenges for Case Study V (University E)

Test Statistics			
N			3
Kendall's W ^a			.739
Chi-Square			19.945
df			9
Asymp. Sig.			.018
Sig.			.002 ^b
Monte Carlo Sig.	Lower Bound		.001
	Upper Bound		.003

a. Kendall's Coefficient of Concordance

b. Based on 10000 sampled tables with starting seed 1535910591.

7.5.5.4 Summary of results: Case study V (University E)

Overall, Kendall's W coefficient concordance test results (Table 187 – Table 189; Table 289 – Table 291; Appendix G) show that the τ -calculated is greater than t-critical in which this falls within the zone of rejection, for broad internal, external and future challenges. Results also show that the probability associated with the τ -calculated is less than the alpha value ($p < \alpha$) of the tests. The tests therefore, reject null hypothesis and accept alternative hypothesis. This implies that there are no statistical evidences to support the null hypothesis that any agreement among the findings from the three sources of evidence is by chance of variation.

Conclusion on proposition 2.2

In conclusion, the overall results shows there are statistical evidences showing that significant agreement exists between the views expressed by university facilities managers identified during the main stream survey, the case studies and also from the history records, on the frequency of occurrence of the challenges constraining the achievement of strategic facilities management. Therefore, it can be concluded that there is some measure of consistency or triangulation among the three empirical data sources. This also accords some measure of reliability and validity to the findings, the instrument and procedure adopted in the research. Proposition 2.2 is therefore supported in this case.

7.6 TESTS OF PROPOSITION 3.1

The third objective of this study is to establish the key challenges facing tomorrow's universities facilities managers. To realize this objective, Proposition 3.1 was aimed at canvassing the views of university of facilities managers on the key future challenges on their relative impact and frequencies of occurrence.

To direct data gathering and analysis, the proposition assumes that statutory compliance issue constitutes the most significant challenges facing tomorrow's university facilities managers.

Analytical method employed

Data for testing Proposition 3.1 are the relative importance index (RIImp) scores of the identified challenges facing tomorrow's university facilities managers as computed from the ratings of their relative levels of importance. From the RII scores, the emergent broad constraint categories having the highest rankings provided the basis for confuting or accepting the proposition.

Result

Table 189 shows that statutory compliance issues was not perceived as the most significant challenges facing tomorrow's university facilities managers as assumed in Proposition 3.1. The cross tabulation result shows that strategic asset management was perceived to be the most significant challenges in years ahead. This is evident from its higher RII value of 0.091 compared to the value of 0.078 for statutory compliance issue.

The finding that strategic asset management was perceived to be the most significant challenges in years to come concurs the views of Then (2003) who sees that strategic management is a vital competency for facilities managers in all sectors, including universities; the key concern related to strategic management that need to be dealt by facilities managers in future will be "to exercise strategic thinking in relation to all aspects of the facility portfolio and failure to do so undermines the ability to deliver significant value enhancement". It is therefore essential for facility managers to develop methods that could be used to identify and better understands the (i) needs of the current and future business; (ii) identify the competencies and restraints of current

facilities' portfolio; and (iii) resolve the balance between supply and demand (Then, 2003). This also in line with the views of Tay and Ooi (2001, p.360) who emphasize that “core competencies of facilities manager is strategic level FM matters while overseeing operational matters” and “FM must play a bigger part in overall business development, becoming a strategic rather than operational issue”.

On the other hand, the finding that statutory compliance issues was not perceived as the most significant challenges facing tomorrow's university facilities managers is contrary to the views of Booty (2009) who sees that laws and regulations with regards to health and safety as well as employment is a great concern to facilities managers, especially in higher education sectors, as these legislations are fast changing from time to time. BDO Stoy Hayward (2007) also agrees that the real issue that facilities managers need to work on in future is, grappling with the rapid changes in compliance or regulatory framework within the FM department. However, the formulation of the proposition and the result of the test serve to provide insights into the importance of key future challenges – a vital lesson for all university facilities managers.

Table 189: Cross tabulation for testing Proposition 3.1 - Future challenges

¹ Future challenges	² Level of Importance (%)					³ TR	⁴ II	Remark	⁵ RII	Rank
	VH	H	A	L	VL					
	5	4	3	2	1					
F-1	43	37	20	0	0	528	4.222	Very High	0.078	6
F-2	54	30	17	0	0	528	4.367	Very High	0.080	4
F-3	95	5	0	0	0	528	4.949	Very High	0.091	1
F-4	72	19	10	0	0	528	4.619	Very High	0.085	3
F-5	34	20	19	20	7	528	3.547	High	0.065	10
F-6	16	33	31	12	9	528	3.360	Moderate	0.062	11
F-7	30	33	12	11	13	528	3.564	High	0.066	9
F-8	32	31	18	15	4	528	3.731	High	0.069	8
F-9	17	32	12	29	10	528	3.155	Moderate	0.058	12
F-10	76	14	10	0	0	528	4.659	Very High	0.086	2
F-11	30	13	17	16	24	528	3.070	Moderate	0.056	13
F-12	52	27	20	0	0	526	4.321	Very High	0.079	5
F-13	10	14	36	29	10	528	2.858	Moderate	0.053	14
F-14	39	31	16	11	2	528	3.956	High	0.073	7
							<u>54.380</u>		<u>1.000</u>	

¹Future challenges are given in Chapter 5

²Level of impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low

³TR = Total respondents

⁴II = Impact Index (See Equation 1)

⁵RII = Relative Impact Index (See Equation 2)

Conclusion on test of Proposition 3.1

Overall, there is no empirical evidence to accept the proposition that statutory compliance is the most important or significant factors constraining the achievement of strategic FM goals in future ahead. Proposition 3.1 is therefore not supported in this case.

7.7 SUMMARY OF PROPOSITION TESTING

The proposition/ hypotheses tests aimed to direct research towards achieving the research objectives and tests of reliability and validity through relevant investigations and analyses.

Guidelines to choice of appropriate analytical which comprises of both statistical and non-statistical techniques used in the propositions testing drew from Cooper and Emory's (2005) recommendations documents in Appendix D. Adoption of statistical test of significance in the tests served to provide some measure of confidence to the conclusions or inferences to be drawn from the results.

Initially, four out of five propositions made in this study were supported:

- (i) Proposition 1.1, which states that consensus of opinions exist between the New Zealand and Australian members of the Tertiary Education Facilities Management Association (TEFMA) in their perceptions of the risk levels of the internal and external factors constraining the achievement of the strategic facilities management goals in universities;
- (ii) Proposition 1.2, which states that issues relating to finance, and sustainability issues on the other hand constitute the most severe internal and external challenges faced by university facilities managers, respectively;
- (iii) Proposition 2.1, which states that there are no significant differences between the views of university facilities managers identified during the main stream survey and the corresponding findings from the case studies, on the nature and risk levels of the internal and external constraints as well as the key challenges facing university facilities managers was partially

supported as there exists a slight divergence in views pertaining to internal broad categories in the ratings; and

- (iv) Proposition 2.2, which states significant agreement exists between the views expressed by university facilities managers identified during the main stream survey, the case studies and also from the history records, on the frequency of occurrence of the challenges constraining the achievement of strategic facilities management.

On the other hand, Proposition 3.1, which state statutory compliance issue constitutes the most significant challenges facing tomorrow's university facilities managers, is not supported.

CHAPTER 8: CONCLUSIONS AND RECOMMENDATIONS

8.1 KEY FINDINGS OF THE STUDY

This study aimed to identify and prioritize the key internal and external challenges impacting on the achievement of strategic facilities management goals. The key objectives were to establish the risks levels associated with the identified key challenges in terms of their relative levels of impact and occurrence frequencies. Also practical solutions were explored to provide guidance to university facilities managers on innovative approaches to addressing the key challenges, achieving their strategic goals, and improving their overall performance.

The following sub-sections summarise the findings in relation to the study objectives.

Findings in relation to first objective

The first objective of the study was to identify and prioritize the key internal and external challenges impacting on the achievement of strategic FM goals.

Results of the investigations and analyses revealed that the internal constraints comprised internal managerial issues related to following, in diminishing order of influence: finance, stakeholder needs/ service providers, manpower, operational method/ process, manpower, machinery and materials constraints.

It was also found that the external constraints could be structured into PESTELI framework: Political, economic, socio-cultural, technological, environmental, legislative and institutional constraints. Results of analysis showed that, in diminishing order of influence, legislative/ regulatory compliance, political and economic and environmental were perceived to be the most significant external factors contributing to the achievement of strategic FM goals.

Findings in relation to second objective

The second objective of this study was to establish the risks levels associated with the identified key challenges in terms of their relative levels of impact and frequencies of occurrence.

Results showed that following sub-categories of internal challenges were perceived to pose most significant risks to achievement of FM strategic goals (see Chapter 5, Section 5.4.2):

- (i) Financial constraints: inadequate financial resources or budget to procure new facilities or upgrade existing ones with a view to meeting growing user requirements;
- (ii) Operational method/ process: organizational policy, strategies, values and missions and their impact on organizational effectiveness and efficiency;
- (iii) Stakeholder needs/ service providers: organizational policy, strategies, values and missions and their impact on organizational effectiveness and efficiency;
- (iv) Manpower: inadequate skilled manpower;
- (v) Machinery: obsolescence and replacement costs for installed machines or equipment;
- (vi) Materials: environmental performance problems and their impact on operational costs.

In the sub-categories of external challenges (Chapter 5, Section 5.4.3), results revealed that the following factors were perceived to be risky:

- (j) Political constraints: conflicting multi-stakeholder interests (i.e dealing with the diverse interests of several user groups having varying levels of authority and control);
- (k) Economic constraints: unaffordability of new project, or lack of sufficient funds to upgrade and maintain existing facilities as and when due;
- (l) Socio-cultural constraints: having to address the ethnic diversity and differing cultural needs especially in relation to space planning and design solutions;
- (m) Technological constraints: dilemma of having to monitor and keep up with the rapid technological changes and dealing with associated technological obsolescence;
- (n) Legislative constraints: rapid changes in legislations, by-laws and standards/ codes affecting the FM planning and operations costs;

- (o) Environmental/ sustainability: rapid changes in legislation and by-laws driven by the need to respond to climate change effects and national environmental obligations under the Kyoto Protocol;
- (p) Institutional: unrealistic expectations of the top management; need to achieve so much output with so little resources.

Overall, results revealed that financial-related constraints were perceived as the most importance and influential set of factors associated with the broad internal challenges (Chapter 5, Section 5.4.1). This set also achieved the highest risk score in terms of their impact on the achievement of strategic FM goals. Economic-related constraints were perceived as the most importance set of factors associated with the broad external challenges impacting on the achievement of strategic FM goals (see Chapter 5, Section, 5.4.3); this set of constraints also had the highest impact level, occurrence frequency and risk ranking.

Findings in relation to third objective

The third objective of this study was to establish practical solutions for addressing the identified challenges facing university facilities managers. Details of the investigations, analyses and discussions were provided in Chapter 5, Section 5.5.

Results revealed that the following were perceived to be the most significant practical solutions for addressing the sub-category of internal challenges (Section 5.5.1.1):

- (i) Finance: develop innovative strategic management solutions through the application of technology with a view to being able to do more with less;
- (ii) Operational-efficiency: hold regular meetings to set the facilities goals and strategy, and communicate solutions that lead to energy efficiency;
- (iii) Risk management: preparing detailed and analytical specifications of the facility as well as all associated risks; constantly monitor and update the risk plan.
- (iv) Stakeholder needs: Conduct proper user needs survey and aim to meet user needs, including user needs satisfaction survey, complaints handling protocol and user education on realistic expectations.

- (v) Maintenance: considering university's backlog of renewal and renovation projects in light of sustainability and budget and prioritize upgrading or disposing inefficient structures;
- (vi) Manpower: Ensure adequate training and motivation of workforce for peak performance; maintain continuous development/ upskilling plan for workers.
- (vii) Health and safety: detailed safety rules and safe working practices to ensure compliance with health and safety legislations. Implement and regularly review health and safety plan.
- (viii) Materials: Have in place an effective just-in-time (JIT) system that delivers the materials to the site when unpredictable requirements develop during the course of a job; avoid long term storage due to associated inventory and wastage costs.

In term of the sub-category of external challenges (Section 5.5.1.2), the following practical solutions were proffered for effectively addressing the identified issues:

- (i) Economic: Manage realistic expectations through effective stakeholder negotiation and communication within the university;
- (ii) Sustainability/ environmental: Foster and maintain a culture of sustainability on campus in concert with staff, students, and faculty, administrators. Ensure sustainability influences decision-making across campus;
- (iii) Technology: integrate IT and facilities planning to leverage IT efficiencies and effectiveness to maximize success;
- (iv) Regulatory/ compliance: keep on top of the changing regulations that apply to the universities and proactively plan for their compliance.
- (v) Socio-cultural: manage stakeholder expectations through dialogue and effective communication;
- (vi) Institutional: Align facilities goals and strategy with the university goals and strategy and demonstrate the value of facilities as a key medium for the achievement of the university goals and vision. Ensure the FM department has a voice at highest decision making body within the university.

Findings in relation to fourth objective

The fourth objective of this study was to determine the key challenges facing tomorrow's university facilities managers.

Results of investigations and analyses revealed that the key challenges facing tomorrow's university facilities managers comprise the following in decreasing order of significance/ severity: sustainability, strategic asset management, space management, statutory compliance, leadership and innovation in FM, security/ emergency planning, and maintenance management. Others include FM solutions to future teaching and research needs, occupational health and safety, information technology, business and financial management, and outsourcing.

Surprisingly, project development (involving planning, design, construction, and project management), and cleaning and waste management issues were perceived to be the least of the challenges facing university facilities managers in future. Perhaps, this could be attributed to the success in the current delivery approach used, which centred on outsourcing.

Results also revealed that the most significant practical solutions (Chapter 5, Section 5.6.1.4) for addressing future challenges include the following:

- (i) Emergency management: to take active role in cross-department business continuity activities;
- (ii) Statutory compliance: ensuring adequate staff knowledge of the compliance standards and legislations governing the FM policies and operations;
- (iii) Sustainability: assessing the institution and the department's current level of sustainability performance; make business case for sustainable practice and for buy-in by all stakeholders across the institution;
- (iv) Technology: assessing how technologies in IT can affect all aspects of teaching, learning, research, communications and the built environment, and invest on the most cost-effective IT solutions;
- (v) User needs: ensuring efficient stakeholder expectation management and enlightenment;
- (vi) Business and financial management: Maintaining robust granular asset data and history to support planning/prioritisation based on risk profiles;

- (vii) Occupational health and safety: developing effective policies, decision-making processes and standards;
- (viii) Leadership and innovation in FM: creating a "learning culture" in which opportunities for formal and informal learning can occur among employees up and down the organizational chart;
- (ix) Space management: developing effective policies, processes, and organizational structures to manage space.
- (x) Outsourcing: Outsource non-strategic or peripheral services to vendors, effectively manage the delivery process and measure possible gains in efficiency as well as cost savings from outsourcing.

8.2 IMPLICATIONS OF THE FINDINGS TO THE FM PRACTICE & CONTRIBUTIONS TO KNOWLEDGE

Through the findings and the developed conceptual response framework, this study has contributed to bridging existing knowledge gap. Review of existing literature showed that challenges identified in previous studies were not logically integrated to provide a coherent and clear picture of the big issues. Also the risk profiles of the challenges were not properly analysed and quantified to enable prioritisation of the high-impact challenges for selective disbursement of the limited resources of the FM department in devising cost-effective response to the issues. Consequently, various improvement efforts have remained sub-optimal and ineffective in addressing the key constraints to the performance of FM in the universities. By establishing the risk profiles in the current study, university facilities managers are able to identify the critical challenges within the three domains of internal, external and future challenges, and so are able to disburse available resources to addressing the challenges in line with their risk levels. This is more so that university facilities managers are increasingly being expected to do more with less resource (OECD2012; APPA, 2013; APPA, 2014).

The findings on the key future challenges will prepare university facilities managers well for the future. The findings reveal where future emphasis lies and the key areas that will shape future space planning and compliance needs. Consequently, uFMs are able to roll-out short, medium and long term planning to future-proof their facilities and

infrastructure investment, thereby guarding them from technological obsolescence, surprises that come from being unprepared for future user needs and regulatory requirements amidst dwindling resources. The bottom line is, 'to be forewarned is to be forearmed'.

A conceptual framework was developed (see Chapter 6), which provides guidelines for the methodological response to the challenges faced by university facilities managers in the planning and operation of their facilities. The framework also models the key challenges that significantly impact on the achievement of strategic FM goals, as well as provide guidelines for assessing the efficiency and needed improvement of FM performance. Furthermore, the established levels of impact, frequencies of occurrence and risks level of each key challenge underlying the internal and external constraints as well as key future challenges will guide facilities and property managers to foresee the upcoming opportunities and threats in advance and so enable them to proactively respond by leveraging the opportunities and minimizing the threats through the practical solutions provided. In fact, the conceptual framework provides a structured approach for responding to any type of FM challenges at both strategic and operational levels of management. The integrated nature of the problem-solving and decision-making framework showcased by the framework is what is missing in existing stock of knowledge in the university facilities management area (APPA, 2011; APPA, 2013; APPA, 2014).

Overall, the outcome of this study will therefore be of use to facilities and property managers in formulating appropriate response to the identified risks with a view to achieving more satisfactory solutions in their operations.

In addition, the methodology developed in the study could be used in studying related phenomena in wider settings.

8.3 RECOMMENDATIONS

The developed conceptual framework and the prioritised challenges are recommended to be used as guidelines to university facilities managers to have better understanding

of the current and future challenges and to innovatively deliver on the strategic goals with limited budgetary and wider constraints.

Specifically, the following recommendations are put forward in relation to the current internal and external challenges as well as the near-future challenges.

Recommendations in relation to the internal challenges

UFMs should pay particular attention to the following constraints which have been found in this study to have the most profound impact on their ability to achieve their strategic objectives:

- i. Finance constraints: financial resources or budget to procure new or upgrade existing facilities to meet user requirements.
- ii. Operational method/ process: organizational policy, strategies, values and missions and their impact on organizational effectiveness and efficiency.
- iii. Stakeholder needs/ service providers: difficulties in managing conflicting stakeholder interests and requirements Manpower
- iv. Machinery: obsolescence and replacement costs for installed machines or equipment.
- v. Materials: environmental performance problems and their impact on operational costs.

Recommendations in relation to the external challenges

To optimise their resources in their external risk-response efforts, UFMs should focus on addressing the following external challenges which have been found to have the most profound impact on abilities to meet strategic goals of the FM departments:

- i. Political constraints: conflicting multi-stakeholder interests (i.e. dealing with the diverse interest of several groups having varying levels of authority and control.
- ii. Economic constraints: unaffordability of new project, upgrade and maintenance.
- iii. Socio-cultural constraints: having to address the ethnic diversity and differing cultural needs especially in relation to space planning and design solutions.
- iv. Technological constraints: dilemma of having to monitor and keep up with the rapid technological changes developments.
- v. Legislative constraints: rapid changes in legislations, by-laws and standards/ codes affecting the FM planning and operations costs.
- vi. Environmental/ sustainability: unrealistic expectations of the top management: “Achieve so much output with so little resources”.

vii. Institutional:

Recommendations in relation to the future challenges

The study found the following as the future challenges having the most profound impact on the goals of the UFM, and so merit careful attention and resource dedication by the UFM:

- i. Sustainability
- ii. Strategic asset management
- iii. Space management
- iv. Statutory compliance
- v. Leadership and innovation in FM
- vi. Security/ emergency planning/ fire safety/ critical incidents
- vii. Maintenance management
- viii. FM solutions to future teaching and research needs
- ix. Occupational health and safety
- x. Information technology
- xi. Business and financial management
- xii. Outsourcing

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APPENDICES

- A. Documents used in planning and conducting pilot interviews**
- B. Documents used in planning and conducting questionnaire surveys**
- C. Documents used in planning and conducting model test surveys**
- D. Guidelines to choice of appropriate statistical techniques for hypothesis testing**
- E. Summary of key research findings and the accompanying charts and tables – Qualitative data results presentation**
- F. Summary of key research findings and the accompanying charts and tables – Quantitative data results presentation**
- G. Summary of the key research findings and the accompanying charts and tables – Tests of propositions results**
- H. MUHEC low risk notification**

APPENDIX A:
DOCUMENTS USED IN PLANNING AND CONDUCTING PILOT
INTERVIEWS

- A1: Letter of request for interview**
- A2: Interviewee's choice of date and time slots**
- A3: Letter of confirmation of interview schedule**
- A4: Interview questions**
- A5: Participant consent form**
- A6: Authority to release the transcript**
- A7: Research assistant confidentiality agreement**
- A8: Transcriber's confidentiality agreement**

Appendix A1: Letter of request for interview



MASSEY UNIVERSITY
School of Engineering & Advanced Technology
Private Bag 102 904, North Shore City 0745, Auckland, New Zealand

John Cameron
Head of Facilities Management
University of Waikato
New Zealand

Date: 26th April 2010

Dear John Cameron,

Research survey:

Challenges in strategic facilities management: Analysis of problems faced by university facilities managers

I am Myzatul Aishah, a provisional PhD student of the School of Engineering and Advanced Technology, College of Sciences, Massey University, Auckland.

My research is entitled, "Challenges of strategic facilities management: Analysis of problems faced by university facilities managers". I have designed a questionnaire which will be sent out to the Tertiary Education Facilities Management Association (TEFMA) – my target population. Before administering the questionnaire, there is a need to conduct a pilot interview to test the relevance, clarity and validity of the themes identified from the literature and to generate some constructs for the questionnaire, which were used to gather quantitative data among the target population in the survey. The beneficial insights from the respondents and the outcomes of the pilot survey provided the theoretical ground of the study for the conceptual framework development.

I would therefore appreciate if you could participate in about 15-20 minutes pilot interview survey for this purpose. Your input based on your own experiences in your respective organization and your personal comments on the questionnaire are very essential in assisting me to improve the questionnaire design. I have attached the cover letter and the semi-structured pilot survey questionnaire for your perusal.

We assure that your responses will be treated with strictest confidentiality and will be used solely for the purpose of this research. Please find attached a copy of the interview questions, which provide lead to the lines of questioning on the day.

Enclosed is a schedule of possible appointment dates, times and preferred mediums for the interview. Kindly indicate any two preferred appointments and return the completed Schedule by email or fax using the supplied contact details.

Free online video conferencing using the KAREN Bridge (<http://sds.karen.net.nz/scopia/entry/index.jsp>) or Skype provide alternative medium which can be used for the interview. If you're choosing KAREN Bridge, you will be receiving another email with further details of the meeting including your meeting ID.

I'll look forward to your kind response at your earliest convenience.

Thank you.

Yours truly,
Myzatul Aishah Kamarazaly
Provisional PhD Student (SID: 05172667)
School of Engineering & Advanced Technology
College of Sciences
Massey University
Auckland.

Appendix A2: Interviewee's choice of date and time slots

Massey University
Private Bag 102 904, North Shore 0745, Auckland, New Zealand; Mobile: +64 21 077 9067; Fax: +64 9 443 9774
M.A.Kamarazaly@massey.ac.nz

CHALLENGES IN STRATEGIC FACILITIES MANAGEMENT: ANALYSIS OF PROBLEMS FACED BY UNIVERSITY FACILITIES MANAGERS

By:
Myzatul Aishah Kamarazaly

INTERVIEWEE'S CHOICE OF DATE AND TIME SLOTS

Kindly tick any two dates and time slots among the options indicated below:

PREFERRED DATE:

<input type="checkbox"/> 26/04/2010 (Mon)	<input type="checkbox"/> 27/04/2010 (Tues)	<input type="checkbox"/> 28/04/2010 (Wed)
<input type="checkbox"/> 29/04/2010 (Thurs)	<input type="checkbox"/> 30/04/2010 (Fri)	<input type="checkbox"/> 03/05/2010 (Mon)
<input type="checkbox"/> 04/05/2010 (Tues)	<input type="checkbox"/> 05/05/2010 (Wed)	<input type="checkbox"/> 06/05/2010 (Thurs)
<input type="checkbox"/> 07/05/2010 (Fri)	<input type="checkbox"/> 10/05/2010 (Mon)	<input type="checkbox"/> 11/05/2010 (Tues)
<input type="checkbox"/> 12/05/2010 (Wed)	<input type="checkbox"/> 13/05/2010 (Thurs)	<input type="checkbox"/> 14/05/2010 (Fri)
<input type="checkbox"/> 17/05/2010 (Mon)	<input type="checkbox"/> 18/05/2010 (Tues)	<input type="checkbox"/> 19/05/2010 (Wed)
<input type="checkbox"/> 20/05/2010 (Thurs)	<input type="checkbox"/> 21/05/2010 (Fri)	<input type="checkbox"/> 24/05/2010 (Mon)
<input type="checkbox"/> 25/05/2010 (Tues)	<input type="checkbox"/> 26/05/2010 (Wed)	<input type="checkbox"/> 27/05/2010 (Thurs)
<input type="checkbox"/> 28/05/2010 (Fri)	<input type="checkbox"/> Other date(s), kindly specify:	

PREFERRED TIME:

<input type="checkbox"/> 8.30 - 9.00 am	<input type="checkbox"/> 9.30 - 10.00 am	<input type="checkbox"/> Australian Time
<input type="checkbox"/> 11.30 - 12.00 noon	<input type="checkbox"/> 12.30 - 1.00 pm	<input type="checkbox"/> 10.30 - 11.00 am
<input type="checkbox"/> 2.30 - 3.00 pm	<input type="checkbox"/> 3.30 - 4.30 pm	<input type="checkbox"/> 1.30 - 2.00 pm
<input type="checkbox"/> Other time(s), kindly specify:	<input type="checkbox"/> 5.00 - 5.30 pm	

PREFERRED MEDIUM:

<input type="checkbox"/> Face-to-face interview	<input type="checkbox"/> Online Vide Conferencing via KAREN Bridge
<input type="checkbox"/> Phone interview	<input type="checkbox"/> Skype

Name: _____
Physical contact address: _____
Skype username: _____
Contact number: _____
Email: _____

Kindly return this sheet via email (M.A.Kamarazaly@massey.ac.nz) or fax (+64 9 443 9774, Attention to: Myzatul Kamarazaly). Thank you for your participation!

A3: Letter of confirmation of interview schedule



School of Engineering and Advanced Technology
Private Bag 102 904 Albany, North Shore City 0745, Auckland, New Zealand
Fax: +64 9 443 9774; Tel: +64 210 779 067; Email: M.A.Kamarazaly@massey.ac.nz

Glenn Huggard
Director
Facilities Management
Unitec New Zealand

Date: 22 April 2010

Dear Mr Glenn Huggard,

CONFIRMATION OF INTERVIEW SCHEDULE

This is to thank you for granting my request for research interview and to notify you the exact date and time scheduled out of the two preferences you earlier indicated.

The schedule details are as follows:

1. Date: Monday, 26th April 2010
2. Time: 9.00am
3. Venue: 139 Carrington Road, Mount Albert, Auckland 1025, New Zealand.

Please find attached a copy of the interview questions.

If you have any reservations in respect of the above, please don't hesitate to inform us. Once again, thank you for your co-operation. I look forward to meeting with you.

Sincerely yours,

Myzatul Aishah

Miss Myzatul Aishah Kamarazaly

JasperMbachu

Dr. Jasper Mbachu

Appendix A4: Interview questions

<p>Massey University School of Engineering & Advanced Technology Private Bag 102 904 North Shore 0745, Auckland, New Zealand; Tel: +64 210 799 067; Fax: +64 9 443 9774 M.A.Kamarazaly@massey.ac.nz</p> <p>Research Survey Challenges in strategic facilities management: Analysis of the problems faced by university facilities managers By: Myzatul Aishah Kamarazaly</p>															
<p>SECTION I : FACILITIES AND PROPERTY MANAGERS' PERCEPTIONS</p> <p>1 Listed below are some of the internal factors constraining the achievement of strategic facilities management goals in tertiary institutions. Based on your experience with the facilities management (FM) organization in your respective tertiary institution, please rate under each broad category of constraints, (i) the level of impact and (ii) the frequency of occurrence of each underlying factor using the 5-point rating scale provided. It will be appreciated if you could include additional constraints underlying each broad category in the spaces provided.</p> <p><i>[* Level of impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low]</i> <i>[** Frequencies of occurrence: 5 = Very frequent; 4 = Frequent; 3 = Occasional; 2 = Rare; 1 = Very rare]</i></p>															
Potential internal factors constraining the achievement of strategic FM goals					* Level of impact <i>Rating: 5(very high) - 1(very low)</i>					** Frequencies of occurrence <i>Rating: 5(very frequent) - 1(very rare)</i>					No Idea
					5	4	3	2	1	5	4	3	2	1	
A FINANCE <i>Inadequate financial resources or budget to:</i>															
1 procure new or upgrade existing facilities to meet user requirements															
2 undertake required preventive or restorative maintenance,															
3 provide needed outdoor spaces and grounds,															
4 provide needed internal spaces,															
5 procure equipment, plant or services,															
6 hire out-source personnel to undertake FM services															
7 train in-house personnel for improved performance.															
8 motivate personnel for improved quality and productivity.															
<i>Any suggestions? Please add other ways in which finance could be a barrier to achieving FM goals.</i>															

Appendix A4: Interview questions (cont'd)

Potential internal factors constraining the achievement of strategic FM goals	* Level of impact <i>Rating: 5(very high) - 1(very low)</i>	* Level of impact <i>Rating: 5(very high) - 1(very low)</i>	* Level of impact <i>Rating: 5(very high) - 1(very low)</i>	* Level of impact <i>Rating: 5(very high) - 1(very low)</i>	* Level of impact <i>Rating: 5(very high) - 1(very low)</i>	** Frequencies of occurrence <i>Rating: 5(very frequent) - 1(very rare)</i>	** Frequencies of occurrence <i>Rating: 5(very frequent) - 1(very rare)</i>	** Frequencies of occurrence <i>Rating: 5(very frequent) - 1(very rare)</i>	** Frequencies of occurrence <i>Rating: 5(very frequent) - 1(very rare)</i>	** Frequencies of occurrence <i>Rating: 5(very frequent) - 1(very rare)</i>	No Idea
	5	4	3	2	1	5	4	3	2	1	
B MANPOWER											
1 Inadequate skilled manpower.											
2 High costs of wages, salaries and associated employee expenditures (e.g. Training, insurance, redundancy provisions, pensions, leave grants, etc.).											
3 Low productivity of the workforce due to issues such as low morale, job dissatisfaction, poor incentives, poor supervision, training, etc.											
4 Worker absenteeism (sick, parental or bereavement leave).											
5 High staff turnover (due to poor remuneration, etc.) and its impact on resources and continuity of work flow.											
6 Poor quality of workmanship (especially in relation to in-house staff).											
7 Compliance with OSH requirements in the workplace.											
<i>Any suggestions? Please add other ways in which manpower could be a barrier to achieving FM goals.</i>											
C MATERIALS											
1 High costs or unavailability of materials and components.											
2 Unavailability or insufficiency of storage facility, especially for fragile and perishable materials & components.											
3 Durability problems and their impact on operational and maintenance costs.											
4 Environmental performance problems and their impact on operational costs.											
5 Compliance with OSH requirements, especially as it relates to hazardous/dangerous goods storage & safety precautions.											
6 Quality assurance/ selection dilemma in terms of fitness-for-purpose and impact on user-requirements, operational and maintenance cost.											
<i>Any suggestions? Please add other ways in which materials could be a barrier to achieving FM goals.</i>											

Appendix A4: Interview questions (cont'd)

Potential internal factors constraining the achievement of strategic FM goals	* Level of impact <i>Rating: 5(very high) - 1(very low)</i>	** Frequencies of occurrence <i>Rating: 5(very frequent) - 1(very rare)</i>	No Idea
	5 4 3 2 1	5 4 3 2 1	
D MACHINERY / EQUIPMENT			
1 Unavailability of machinery / equipment to maintain buildings / facilities.			
2 Hiring/ acquisition of machinery / equipment and associated costs (e.g. installation, safety/security, insurance, etc.).			
3 Durability/ functionality problems and their impact on operational and maintenance costs.			
4 Environmental performance issues and associated impacts on legal, operational and maintenance costs.			
5 Logistics/ operational and maintenance problems: unavailability of parts and/ or repair technicians or high operator training costs.			
6 Equipment selection dilemma: Fitness-for-purpose and its impact on user-requirements, and operational and maintenance cost.			
7 Obsolescence and replacement costs for installed machines or equipment.			
<i>Any suggestions? Please add other ways in which machinery could be a barrier to achieving FM goals.</i>			
E OPERATIONAL METHOD/PROCESS			
1 Quality assurance issues, especially compliance with the best practice standards, e.g. ISO 14000, etc.			
2 Adequacy of technology.			
3 Effectiveness of Leadership and management style.			
4 Effectiveness of organisational structure and impact on coordination and decision making processes.			
5 Staff training and development processes and impact on workforce empowerment, motivation and productivity.			
6 Compliance with legislations and regulations, especially in relation to environmental and waste management.			
7 Effectiveness and efficiency of communication systems.			
8 Organisational policies, strategies, values and missions and their impact on organisational effectiveness and efficiency.			
<i>Any suggestions? Please add other ways in which operational method/process could be a barrier to achieving FM goals.</i>			

Appendix A4: Interview questions (cont'd)

2 In terms of the broad constraint categories above, how would you rate their relative levels of impact as constraint factors on the achievement of strategic facilities management goal in your institution? Please use the 5-point rating scale provided as before.

Broad categories of internal constraints	* Level of impact <i>Rating: 5(very high) - 1(very low)</i>	* Level of impact <i>Rating: 5(very high) - 1(very low)</i>	* Level of impact <i>Rating: 5(very high) - 1(very low)</i>	* Level of impact <i>Rating: 5(very high) - 1(very low)</i>	* Level of impact <i>Rating: 5(very high) - 1(very low)</i>	** Frequencies of occurrence <i>Rating: 5(very frequent) - 1(very rare)</i>	** Frequencies of occurrence <i>Rating: 5(very frequent) - 1(very rare)</i>	** Frequencies of occurrence <i>Rating: 5(very frequent) - 1(very rare)</i>	** Frequencies of occurrence <i>Rating: 5(very frequent) - 1(very rare)</i>	** Frequencies of occurrence <i>Rating: 5(very frequent) - 1(very rare)</i>	No Idea
	5	4	3	2	1	5	4	3	2	1	
A Finance											
B Manpower											
C Materials											
D Machinery											
E Method/Process											

3 Listed below are some of the **external** factors constraining the achievement of strategic facilities management goals in tertiary institution. Based on your experience as a facility manager in the Under each broad category of constraints, please rate (i) the level of impact and (ii) the frequency of occurrence of each underlying factor using the 5-point rating scale provided. It will be appreciated if you could include additional constraints underlying each broad category in the spaces provided.

Potential external factors constraining the achievement of strategic FM goals	* Level of impact <i>Rating: 5(very high) - 1(very low)</i>	* Level of impact <i>Rating: 5(very high) - 1(very low)</i>	* Level of impact <i>Rating: 5(very high) - 1(very low)</i>	* Level of impact <i>Rating: 5(very high) - 1(very low)</i>	* Level of impact <i>Rating: 5(very high) - 1(very low)</i>	** Frequencies of occurrence <i>Rating: 5(very frequent) - 1(very rare)</i>	** Frequencies of occurrence <i>Rating: 5(very frequent) - 1(very rare)</i>	** Frequencies of occurrence <i>Rating: 5(very frequent) - 1(very rare)</i>	** Frequencies of occurrence <i>Rating: 5(very frequent) - 1(very rare)</i>	** Frequencies of occurrence <i>Rating: 5(very frequent) - 1(very rare)</i>	No Idea
	5	4	3	2	1	5	4	3	2	1	
A POLITICAL CONSTRAINTS											
<i>Restraints inherent in the dynamics of organisational politics and tensions such as:</i>											
1 Conflicting multi-stakeholder interests; dealing with the diverse interests of several groups having varying levels of authority and control.											
2 Not having adequate level of authority to match the enormous FM responsibilities.											
3 Influences/ pressures from different cliques of the top management.											
4 Ethical dilemma: balancing the needs of the power blocs against requirements of best practice standards, especially in relation to space design and allocation.											
5 Political bickering and power struggle that undermine freedom and best practice standards.											
6 Not having enough influence over FM budget decisions to match critical FM expenditure needs.											
<i>Any suggestions? Please add other ways in which political issues could be a barrier to achieving FM goals.</i>											

Appendix A4: Interview questions (cont'd)

Potential external factors constraining the achievement of strategic FM goals	* Level of impact	** Frequencies of occurrence	No Idea
	Rating: 5(very high) - 1(very low)	Rating: 5(very frequent) - 1(very rare)	
	5 4 3 2 1	5 4 3 2 1	
B ECONOMIC CONSTRAINTS			
<i>Restraints of macro- and micro- economic dynamics (inflation, exchange rate, tax, interest rates, etc) on budget/ funding, resulting in:</i>			
1 Unaffordability of new project, upgrade and maintenance costs ,			
2 Downsizing, or scaling down of operation & maintenance activities,			
3 Reduction in workforce size and skillsets,			
4 Restriction on R&D and innovation,			
5 Inability to meet user needs for vital space, grounds, equipment, etc.			
<i>Any suggestions? Please add other ways in which economic issues could be a barrier to achieving FM goals.</i>			
C SOCIO-CULTURAL CONSTRAINTS			
<i>Restraints inherent in dealing with socio-cultural issues in the workplace such as:</i>			
1 Having to address the ethnic diversity and differing cultural needs, especially in relation to space planning and design solutions.			
2 Socio-cultural sensitivity, social and racial profiling, etc.			
3 Ergonomics: Catering for the special needs of the aged in the workplace.			
4 Compliance with the occupational health & safety regulations in the workplace.			
<i>Any suggestions? Please add other ways in which socio-cultural issues could be a barrier to achieving FM goals.</i>			
D TECHNOLOGICAL CONSTRAINTS			
<i>Restraints inherent in technological trends such as:</i>			
1 The dilemma of having to monitor and keep up with the rapid technological changes/ developments.			
2 Technological obsolescence and impact on competitiveness.			
3 Huge capital investment required for acquisition and upgrading of technology.			
4 Constant workforce training and re-training requirements.			
5 Disruptions to operations inherent in installation, upgrades and trial runs.			
<i>Any suggestions? Please add other ways in which technological issues could be a barrier to achieving FM goals.</i>			

Appendix A4: Interview questions (cont'd)

Potential external factors constraining the achievement of strategic FM goals	* Level of impact <i>Rating: 5(very high) - 1(very low)</i>	** Frequencies of occurrence <i>Rating: 5(very frequent) - 1(very rare)</i>	No Idea
	5 4 3 2 1	5 4 3 2 1	
E LEGISLATIVE AND ENVIRONMENTAL CONSTRAINTS <i>Restraints inherent in meeting up with legal and environmental responsibility/ responsiveness such as:</i>			
1 Rapid changes in legislations and bye-laws.			
2 The challenge of having to meet the minimum environmental standards against dwindling resources.			
3 High legislative compliance costs and constraints, especially in relation to health & safety, resource and waste management.			
4 Resource and building consent restrictions on planning, development and operations, especially in relation to preserving historic places, need to minimise carbon footprints, pollution, energy consumption, etc.			
5 Pressure arising from environmental audit and reporting requirements.			
<i>Any suggestions? Please add other ways in which legislative and environmental issues could be a barrier to achieving FM goals.</i>			
F INSTITUTIONAL CONSTRAINTS <i>Restraints inherent in the internal(i.e. organisational dynamics) and external constraints(e.g. Professional/ethical code of practice)such as:</i>			
1 The challenge of having to meet the minimum ethical and professional practice standards amidst conflicting pressures from within the organisation.			
2 Undue influence/ excessive interference of the top management in FM affairs, which undermines freedom and pursuit of excellence in the discharge of FM duty.			
3 Unrealistic expectations of the top management: "Achieve so much output with so little resources".			
4 Dilemma of juggling the organisational/internal interests with the requirements for ethical and best practice standards imposed by the external/ professional regulatory framework.			
<i>Any suggestions? Please add other ways in which institutional issues could be a barrier to achieving FM goals.</i>			

Appendix A4: Interview questions (cont'd)

4	In terms of the broad external constraint categories above, how would you rate their relative levels of impact as constraint factors on the achievement of strategic facilities management goal in your tertiary institution? Please use the 5-point rating scale provided as before.											
Broad categories of external constraints		* Level of impact <i>Rating: 5(very high) - 1(very low)</i>					** Frequencies of occurrence <i>Rating: 5(very frequent) - 1(very rare)</i>					No Idea
		5	4	3	2	1	5	4	3	2	1	
A	Political											
B	Economic											
C	Socio-Cultural											
D	Technological											
E	Legislative/ environmental											
F	Institutional											

5	Listed below are some of the key challenges facing tomorrow's institutional facilities manager, as adapted from the 2008 TEFMA membership Survey Report. Please rate your level of impact with each challenge using the 5-point rating scale ranging from 5 (i.e. "Very high") down to 1 (i.e. "Very low"). We'll appreciate additional inputs as to your own perceptions of these challenges - please list them in the spaces provided.											
Key challenges facing tomorrow's institutional facilities manager: Issues relating to:		* Level of impact <i>Rating: 5(very high) - 1(very low)</i>					No Idea					
		5	4	3	2	1						
A	Statutory compliance											
B	Space management											
C	Strategic asset management											
D	Sustainability/ environment/ carbon neutrality/ ESD											
E	Planning/Design/Construction/ project management											
F	Information technology applications for facilities managers											
G	Maintenance management											
H	Security/emergency planning/fire safety/critical incidents											
I	Occupational health and safety											
J	Leadership and innovation in facilities management											
K	Outsourcing/ service contract management											
L	Facilities management solutions to future teaching & research needs.											
M	Cleaning / waste management											
N	Business and financial management in facilities management											
<i>Additional challenges? Please list below:</i>												

Appendix A4: Interview questions (cont'd)

SECTION II: DEMOGRAPHIC BACKGROUND	
1	What category of tertiary institutional facilities/property do you manage? <div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <input type="checkbox"/> University <input type="checkbox"/> Other (please specify): _____ </div> <div style="width: 45%;"> <input type="checkbox"/> Polytechnic <input type="checkbox"/> College of Education </div> </div>
2	Which job category most closely represents your primary role in your organisation? <div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <input type="checkbox"/> Risk/security/emergency/health & safety/crisis management <input type="checkbox"/> Planning: Campus/space/ other planning <input type="checkbox"/> General facilities management <input type="checkbox"/> Design/Drafting/Construction/Project management <input type="checkbox"/> Environmental/energy management <input type="checkbox"/> Other (please specify): _____ </div> <div style="width: 45%;"> <input type="checkbox"/> Maintenance/Asset management <input type="checkbox"/> Transport/Traffic/ Parking <input type="checkbox"/> Grounds <input type="checkbox"/> Services: Cleaning/Waste/other <input type="checkbox"/> Admin/HR/IT/Management </div> </div>
3	Please indicate the country and city in which your institution is located: Country: <div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <input type="checkbox"/> New Zealand <input type="checkbox"/> Others (please specify): _____ </div> <div style="width: 45%;"> <input type="checkbox"/> Australia <input type="checkbox"/> Town/ City (Please specify): _____ </div> </div>
4	Kindly indicate your position in your organization: <div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <input type="checkbox"/> Director / Executive Director <input type="checkbox"/> Manager / Associate Director <input type="checkbox"/> Head <input type="checkbox"/> Other (please specify): _____ </div> <div style="width: 45%;"> <input type="checkbox"/> Team Leader / supervisor <input type="checkbox"/> Facilities & Services Officer </div> </div>
APPRECIATION Thank you for your time. Kindly fax the filled questionnaire to : +64 9 443 9774 ; Attention: Myzatul Aishah Kamarazaly . If you have any further inputs or comments in relation to this study, you may wish to contact the researcher +64 21 077 9067 (cell); Email: M.A.Kamarazaly@massey.ac.nz. Else, please state your overall comments below, if any: <div style="border: 1px solid black; height: 40px; margin-top: 5px;"></div>	
This project has been reviewed and approved by the Massey University Human Ethics Committee: Northern, Application 10/014. If you have any concerns about the conduct of this research, please contact Dr Dianne Gardner, Acting Chair, Massey University Human Ethics Committee: Northern, telephone +64 9 414 0800 x41225, email: humanethicsnorth@massey.ac.nz.	

Appendix A5: Participant consent form



Project Title:

Challenges in strategic facilities management: Analysis of problems faced by university facilities managers

PARTICIPANT CONSENT FORM - INDIVIDUAL

I have read the Information Sheet and have had the details of the study explained to me. My questions have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I agree/do not agree to the interview being sound recorded. *(Please strike out the inapplicable option)*

I wish/do not wish to have my recordings returned to me. *(Please strike out the inapplicable option)*

I agree to participate in this study under the conditions set out in the Information Sheet.

Signature: _____ Date: _____

Full Name -
printed _____

Appendix A6: Authority to release of transcripts



Project Title:

Challenges of strategic facilities management: Analysis of problems faced by university facilities managers.

AUTHORITY FOR THE RELEASE OF TRANSCRIPTS

I confirm that I have had the opportunity to read and amend the transcript of the interview(s) conducted with me.

I agree that the edited transcript and extracts from this may be used in reports and publications arising from the research.

Signature:

Date:

Full Name -
printed

Appendix A7: Research assistant confident



Project Title:
Challenges of strategic facilities management: Analysis of problems faced by institutional facilities managers

CONFIDENTIALITY AGREEMENT

I,(Full Name – printed)
agree to keep confidential all information on concerning the project
.....

I will not retain or copy any information involving the project.

Signature:

Date:

.....

.....

Appendix A8: Transcriber's confidentiality agreement



TRANSCRIBER'S CONFIDENTIALITY AGREEMENT

I (Full Name - printed)

agree to transcribe the recordings provided to me.

I agree to keep confidential all the information provided to me.

I will not make any copies of the transcripts or keep any record of them, other than those required for the project.

Signature:

Date:

.....

.....

APPENDIX B:
DOCUMENTS USED IN PLANNING AND CONDUCTING
QUESTIONNAIRE SURVEY

- B1: Covering letter for the questionnaire administration (Information sheet)**
- B2: Sample copy of the questionnaire**
- B3: Form for requesting summary of the key findings of the research**
- B4: Questionnaire survey reminder letter**
- B5: Supporting letter from TEFMA**

Appendix B1: Covering letter for the questionnaire administration (Information sheet)



Stephanie Forrest
2010
Associate Director Facilities Management
Victoria University of Wellington
Wellington
New Zealand

Date: 30th September

Dear Stephanie Forrest,

**Research survey:
Challenges in strategic facilities management: Analysis of problems faced by institutional facilities managers**

The facilities manager's role contributes significantly to the economy by improving the gross domestic product (GDP) – a key economic indicator - in two ways: First, by improving the long-term worth of the nation's infrastructure asset through proper maintenance, adaptation and upgrade; secondly by creating a conducive workplace or environment that promotes productivity and workers' health and safety. Like any other set of professionals, the facilities managers face several challenges that constrain performance of their crucial role, which range from internal managerial and technical issues to external PESTELI constraints, i.e. political, economic, social-cultural, technological, environmental, legal, and institutional constraints. In-depth understanding of the nature of these constraints to FM role constitutes a crucial process of risk identification and analysis – which is a fundamental step towards proper facilities/ property risk management and risk response development. Unfortunately, the existing literature offers little insights on these constraints as applicable to the institutional facilities management discipline; there is therefore the need to explore these challenges and their relative influences on the performance of facilities/ property management role using institutional facilities as case study.

The outcome of the study is expected to be of benefit to facilities and property managers in formulating appropriate response to the identified risks with a view to achieving more satisfactory outcomes in their operations. To meet the objectives of the research, the attached questionnaire has been designed to obtain feedback from members of the Tertiary Education of Facilities Management Association (TEFMA). It will take approximately 15 to 20 minutes to complete.

We would like you to participate in the survey by completing the questionnaire. Your responses will be treated in strict confidence, and will be used solely for the purpose of the study. Kindly fax or email the filled questionnaire to the address indicated. If you would be interested in the key findings of this study and prefer anonymity, kindly fill the attached Summary Request Form and return it separately. Thank you in anticipation of your helpful response.

Yours sincerely,

Myzatul Aishah Kamarzaly
(Researcher)

This project has been reviewed and approved by the Massey University Human Ethics Committee: Northern, Application 10/014. If you have any concerns about the conduct of this research, please contact Dr Dianne Gardner, Acting Chair, Massey University Human Ethics Committee: Northern, telephone 09 414 0800 x41225, email humanethicsnorth@massey.ac.nz.

Appendix B2: Sample copy of the questionnaire

Massey University
School of Engineering & Advanced Technology

Private Bag 102 904 North Shore 0745, Auckland, New Zealand; Tel: +64 210 799 0673; Fax: +64 9 443 9774

M.A.Kamarazaly@massey.ac.nz

Research Survey

Challenges in strategic facilities management: Analysis of the problems faced by university facilities managers

By:

Myzatul Aishah Kamarazaly

SECTION I : FACILITIES AND PROPERTY MANAGERS' PERCEPTIONS

- 1 Listed below are some of the internal factors constraining the achievement of strategic facilities management goals in tertiary institutions. Under each broad category of constraints, please rate the level of impact of each underlying factor using the 5-point rating scale provided. It will be appreciated if you could include additional constraints underlying each broad category in the spaces provided.

*Level of impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low

**Frequencies of occurrence: 5 = Very Frequent; 4 = Frequent; 3 = Occasional; 2 = Rare; 1 = Very Rare

Potential internal factors constraining the achievement of strategic facilities management goals	*Level of impact					** Frequencies of occurrence					No idea
	5	4	3	2	1	5	4	3	2	1	

A FINANCE

Inadequate financial resources or budget to:

- 1 procure new or upgrade existing facilities to meet user requirements
- 2 undertake required preventive or restorative maintenance,
- 3 provide needed spaces and grounds,
- 4 procure equipment, plant or services,
- 5 hire, train or motivate personnel for improved performance.

Additional constraints? Please specify:

B MANPOWER

- 1 Inadequate skilled manpower
- 2 High costs of wages, salaries and associated employee expenditures (e.g. Training, insurance, redundancy provisions, pensions, leave grants)
- 3 Low productivity of the workforce due to issues such as low morale, job dissatisfaction, poor incentives, poor supervision, training, etc.
- 4 Worker absenteeism (sick, parental or bereavement leave)
- 5 High staff turnover (due to poor remuneration, etc.) and its impact on resources and continuity of work flow
- 6 Poor quality of workmanship (especially in relation to in-house staff)
- 7 Compliance with OSH requirements in the workplace.

Additional constraints? Please specify:

Appendix B2: Sample copy of the questionnaire (cont'd)

*Level of impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low

** Frequencies of occurrence: 5 = Very Frequent; 4 = Frequent; 3 = Occasional; 2 = Rare; 1 = Very Rare

Potential internal factors constraining the achievement of strategic facilities management goals		*Level of impact					** Frequencies of occurrence					No idea
		5	4	3	2	1	5	4	3	2	1	
C	MATERIALS											
1	High costs or unavailability of materials and components											
2	Unavailability or insufficiency of storage facility, especially for fragile and perishable materials & components											
3	Durability problems and their impact on operational and maintenance costs											
4	Environmental performance problems and their impact on operational costs											
4	Compliance with OSH requirements, especially as it relates to hazardous/dangerous goods storage & safety precautions											
5	Quality assurance/ selection dilemma: Fitness-for-purpose and impact on user-requirements and operational and maintenance cost											
Additional constraints? Please specify:												
D	MACHINERY											
1	Hiring/ acquisition and associated costs (e.g. installation, safety/security, insurance, etc.)											
2	Durability/ functionality problems and their impact on operational and maintenance costs											
3	Environmental performance issues and associated impacts on legal, operational and maintenance costs.											
4	Operational and maintenance logistic problems: availability of parts and repair technician/ operator training costs.											
5	Selection dilemma: Fitness-for-purpose and its impact on user-requirements and operational and maintenance cost											
6	Obsolescence and replacement costs.											
Additional constraints? Please specify:												

Appendix B2: Sample copy of the questionnaire (cont'd)

*Level of impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low

** Frequencies of occurrence: 5 = Very Frequent; 4 = Frequent; 3 = Occasional; 2 = Rare; 1 = Very Rare

Potential internal factors constraining the achievement of strategic facilities management goals		*Level of impact					** Frequencies of occurrence					No idea
		5	4	3	2	1	5	4	3	2	1	
E	METHOD/PROCESS											
1	Quality assurance issues, especially compliance with the best practice standards, e.g. ISO 140000, etc.											
2	Adequacy of technology											
3	Effectiveness of Leadership and management style											
4	Effectiveness and efficiency of organisational structure and impact on coordination and decision making processes											
5	Staff training and development processes and impact on workforce empowerment, motivation and productivity											
6	Compliance with legislations and regulations, especially in relation to environmental and waste management.											
7	Effectiveness and efficiency of communication systems											
8	Organisational policies, strategies, values and missions and their impact on organisational effectiveness and efficiency.											
Additional constraints? Please specify:												

- 2 In terms of the broad constraint categories above, how would you rate their relative levels of impact as constraint factors on the achievement of strategic facilities management goal? Please use the 5-point rating scale provided as before.

Broad Internal Constraints Categories		*Level of impact					** Frequencies of occurrence					No idea
		5	4	3	2	1	5	4	3	2	1	
A	Finance											
B	Manpower											
C	Materials											
D	Machinery											
E	Method/Process											

Appendix B2: Sample copy of the questionnaire (cont'd)

- 3 Listed below are some of the external factors constraining the achievement of strategic facilities management goals in tertiary institution. Under each broad category of constraints, please rate the level of impact of each underlying factor using the 5-point rating scale provided. It will be appreciated if you could include additional constraints underlying each broad category in the spaces provided.

*Level of impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low

** Frequencies of occurrence: 5 = Very Frequent; 4 = Frequent; 3 = Occasional; 2 = Rare; 1 = Very Rare

Potential external factors constraining the achievement of strategic facilities management goals		*Level of impact					** Frequencies of occurrence					No idea
		5	4	3	2	1	5	4	3	2	1	No idea
A POLITICAL CONSTRAINTS												
<i>Restraints inherent in the dynamics of organisational politics and tensions:</i>												
1	Conflicting multi-stakeholder interests; dealing with the diverse interests of several groups with varying levels of authority and control											
2	Not having enough power/authority to go with the enormous FM responsibilities											
3	Ethical dilemma: balancing the needs of the power blocs against requirements of best practice standards, especially in relation to space design and allocation.											
4	Political bickering and power struggle that undermine freedom and best practice standards.											
<i>Additional constraints? Please specify:</i>												
<hr/>												
B ECONOMIC CONSTRAINTS												
<i>Restraints of macro- and micro- economic dynamics (inflation, exchange rate, tax, interest rates, etc) on budget/ funding, resulting in:</i>												
1	Unaffordability of new project, upgrade and maintenance costs											
2	Downsizing, or scaling down of operation & maintenance activities,											
3	Reduction in workforce size and skillsets,											
4	Restriction on R&D and innovation											
5	Inability to meet user needs for vital space, grounds, equipment, etc.											
<i>Additional constraints? Please specify:</i>												
<hr/>												
C SOCIO-CULTURAL CONSTRAINTS												
<i>Restraints inherent in dealing with socio-cultural issues in the workplace:</i>												
1	Having to address the ethnic diversity and differing cultural needs, especially in relation to space planning and design solutions											
2	Socio-cultural sensitivity, social and racial profiling, etc.											
3	Ergonomics: Catering for the special needs of the aged in the workplace.											
4	Compliance with the occupational health & safety regulations in the workplace.											
<i>Additional constraints? Please specify:</i>												
<hr/>												

Appendix B2: Sample copy of the questionnaire (cont'd)

*Level of impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low

** Frequencies of occurrence: 5 = Very Frequent; 4 = Frequent; 3 = Occasional; 2 = Rare; 1 = Very Rare

Potential external factors constraining the achievement of strategic facilities management goals		*Level of impact					** Frequencies of occurrence					No idea
		5	4	3	2	1	5	4	3	2	1	
D TECHNOLOGICAL CONSTRAINTS												
<i>Restraints inherent in technological trends:</i>												
1	The dilemma of having to monitor and keep up with the rapid technological changes/ developments											
2	Technological obsolescence and impact on competitiveness.											
3	Huge capital investment required for acquisition and upgrading of technology.											
4	Constant workforce training and re-training requirements											
5	Disruptions to operations inherent in installation, upgrades and trial runs.											
<i>Additional constraints? Please specify:</i>												
<hr/>												
E LEGISLATIVE AND ENVIRONMENTAL CONSTRAINTS												
<i>Restraints inherent in meeting up with legal and environmental responsibility/ responsiveness:</i>												
1	Rapid changes in legislations and bye-laws.											
2	The challenge of having to meet the minimum environmental standards against dwindling resources											
3	High legislative compliance costs and constraints, especially in relation to health & safety, resource and waste management											
4	Resource and building consent restrictions on planning, development and operations, especially in relation to preserving historic places, need to minimise carbon footprints, pollution, energy consumption, etc.											
5	Pressure arising from environmental audit and reporting requirements.											
<i>Additional constraints? Please specify:</i>												
<hr/>												
F INSTITUTIONAL CONSTRAINTS												
<i>Restraints inherent in the internal (i.e. organisational dynamics) and external constraints (e.g. Professional/ ethical code of practice)</i>												
1	The challenge of having to meet the minimum ethical and professional practice standards amidst conflicting pressures from within the organisation.											
2	Undue influence/ excessive interference of the top management in FM affairs, which undermines freedom and pursuit of excellence in the discharge of FM duty											
3	Unrealistic expectations of the top management: "Achieve so much output with so little resources".											
4	Dilemma of juggling the organisational/internal interests with the requirements for ethical and best practice standards imposed by the external/ professional regulatory framework.											
<i>Additional constraints? Please specify:</i>												

Appendix B2: Sample copy of the questionnaire (cont'd)

- 4 In terms of the broad external constraint categories above, how would you rate their relative levels of impact as constraint factors on the achievement of strategic facilities management goal? Please use the 5-point rating scale provided as before.

Broad External Constraints Categories	*Level of impact					** Frequencies of occurrence					No idea
	5	4	3	2	1	5	4	3	2	1	
A Political											
B Economical											
C Socio-Cultural											
D Technological											
E Environmental											
F Legal											
G Institutional											

- 5 Listed below are some of the key challenges facing tomorrow's institutional facilities manager, as adapted from the 2008 TEFMA membership survey report. Please rate your level of agreement or disagreement with each challenge using the 5-point rating continuum which ranges from 1 (i.e. "Strongly Disagree") to 5 (i.e. "Strongly Agree"). We'll appreciate your additional inputs as to your own perceptions of these challenges - please list them in the spaces provided.

Key challenges facing tomorrow's institutional facilities manager: Issues relating to:	Rating: 1(strongly disagree) - 5(strongly agree):					Rating: 1(strongly disagree) - 5(strongly agree):					No idea
	1	2	3	4	5	1	2	3	4	5	
A Statutory compliance											
B Space management											
C Strategic asset management											
D Sustainability/ environment/ carbon neutrality/ ESD											
E Planning/Design/Construction/ project management											
F Information technology applications for facilities managers											
G Maintenance management											
H Security/emergency planning/fire safety/critical incidents											
I Occupational health and safety											
J Leadership and innovation in facilities management											
K Outsourcing/ service contract management											
L Facilities management solutions to future teaching & research needs.											
M Cleaning / waste management											
N Business and financial management in facilities management											
Additional challenges? Please list below:											

Appendix B2: Sample copy of the questionnaire (cont'd)

SECTION II: DEMOGRAPHIC BACKGROUND																									
1	<p>What category of tertiary institutional facilities/property do you manage?</p> <table border="0"> <tr> <td><input type="checkbox"/></td> <td>University</td> <td><input type="checkbox"/></td> <td>Polytechnic</td> </tr> <tr> <td><input type="checkbox"/></td> <td>Other (please specify): _____</td> <td><input type="checkbox"/></td> <td>College of Education</td> </tr> </table>	<input type="checkbox"/>	University	<input type="checkbox"/>	Polytechnic	<input type="checkbox"/>	Other (please specify): _____	<input type="checkbox"/>	College of Education																
<input type="checkbox"/>	University	<input type="checkbox"/>	Polytechnic																						
<input type="checkbox"/>	Other (please specify): _____	<input type="checkbox"/>	College of Education																						
2	<p>Which job category most closely represent your primary role in your organisation?</p> <table border="0"> <tr> <td><input type="checkbox"/></td> <td>Risk/security/emergency/health & safety/crisis management</td> <td><input type="checkbox"/></td> <td>Maintenance/Asset management</td> </tr> <tr> <td><input type="checkbox"/></td> <td>Planning: Campus/space/ other planning</td> <td><input type="checkbox"/></td> <td>Transport/Traffic/ Parking</td> </tr> <tr> <td><input type="checkbox"/></td> <td>General facilities management</td> <td><input type="checkbox"/></td> <td>Grounds</td> </tr> <tr> <td><input type="checkbox"/></td> <td>Design/Drafting/Construction/Project management</td> <td><input type="checkbox"/></td> <td>Services: Cleaning/Waste/other</td> </tr> <tr> <td><input type="checkbox"/></td> <td>Environmental/energy management</td> <td><input type="checkbox"/></td> <td>Admin/HR/IT/Management</td> </tr> <tr> <td><input type="checkbox"/></td> <td colspan="3">Other (please specify): _____</td> </tr> </table>	<input type="checkbox"/>	Risk/security/emergency/health & safety/crisis management	<input type="checkbox"/>	Maintenance/Asset management	<input type="checkbox"/>	Planning: Campus/space/ other planning	<input type="checkbox"/>	Transport/Traffic/ Parking	<input type="checkbox"/>	General facilities management	<input type="checkbox"/>	Grounds	<input type="checkbox"/>	Design/Drafting/Construction/Project management	<input type="checkbox"/>	Services: Cleaning/Waste/other	<input type="checkbox"/>	Environmental/energy management	<input type="checkbox"/>	Admin/HR/IT/Management	<input type="checkbox"/>	Other (please specify): _____		
<input type="checkbox"/>	Risk/security/emergency/health & safety/crisis management	<input type="checkbox"/>	Maintenance/Asset management																						
<input type="checkbox"/>	Planning: Campus/space/ other planning	<input type="checkbox"/>	Transport/Traffic/ Parking																						
<input type="checkbox"/>	General facilities management	<input type="checkbox"/>	Grounds																						
<input type="checkbox"/>	Design/Drafting/Construction/Project management	<input type="checkbox"/>	Services: Cleaning/Waste/other																						
<input type="checkbox"/>	Environmental/energy management	<input type="checkbox"/>	Admin/HR/IT/Management																						
<input type="checkbox"/>	Other (please specify): _____																								
3	<p>Please indicate the country and city in which your institution is located:</p> <p>Country:</p> <table border="0"> <tr> <td><input type="checkbox"/></td> <td>New Zealand</td> <td><input type="checkbox"/></td> <td>Australia</td> </tr> <tr> <td><input type="checkbox"/></td> <td colspan="3">Others (please specify): _____</td> </tr> <tr> <td><input type="checkbox"/></td> <td colspan="3">Town/ City (Please specify): _____</td> </tr> </table>	<input type="checkbox"/>	New Zealand	<input type="checkbox"/>	Australia	<input type="checkbox"/>	Others (please specify): _____			<input type="checkbox"/>	Town/ City (Please specify): _____														
<input type="checkbox"/>	New Zealand	<input type="checkbox"/>	Australia																						
<input type="checkbox"/>	Others (please specify): _____																								
<input type="checkbox"/>	Town/ City (Please specify): _____																								
4	<p>Kindly indicate your position in your organization:</p> <table border="0"> <tr> <td><input type="checkbox"/></td> <td>Director / Executive Director</td> <td><input type="checkbox"/></td> <td>Team Leader / supervisor</td> </tr> <tr> <td><input type="checkbox"/></td> <td>Manager / Associate Director</td> <td><input type="checkbox"/></td> <td>Facilities & Services Officer</td> </tr> <tr> <td><input type="checkbox"/></td> <td>Head</td> <td></td> <td></td> </tr> <tr> <td><input type="checkbox"/></td> <td colspan="3">Other (please specify): _____</td> </tr> </table>	<input type="checkbox"/>	Director / Executive Director	<input type="checkbox"/>	Team Leader / supervisor	<input type="checkbox"/>	Manager / Associate Director	<input type="checkbox"/>	Facilities & Services Officer	<input type="checkbox"/>	Head			<input type="checkbox"/>	Other (please specify): _____										
<input type="checkbox"/>	Director / Executive Director	<input type="checkbox"/>	Team Leader / supervisor																						
<input type="checkbox"/>	Manager / Associate Director	<input type="checkbox"/>	Facilities & Services Officer																						
<input type="checkbox"/>	Head																								
<input type="checkbox"/>	Other (please specify): _____																								
<p>APPRECIATION</p> <p>Thank you for your time. Kindly fax the filled questionnaire to : +64 9 443 9774 ; Attention: Myzatul Aishah Kamarazaly. If you have any further inputs or comments in relation to this study, you may wish to contact the researcher +64 21 077 9067 (cell); Email: M.A.Kamarazaly@massey.ac.nz. Else, please state your overall comments below, if any:</p> <hr/> <hr/>																									
<p><i>This project has been reviewed and approved by the Massey University Human Ethics Committee: Northern, Application 10/014. If you have any concerns about the conduct of this research, please contact Dr Dianne Gardner, Acting Chair, Massey University Human Ethics Committee: Northern, telephone +64 9 414 0800 x41225, email: humanethicsnorth@massey.ac.nz.</i></p>																									

Appendix B3: Form for requesting summary of the key research findings

ATTENTION: MYZATUL KAMARAZALY FAX: +64 9 443 9774						
REASEARCH ON: <i>Challenges in strategic facilities management: Analysis of the problems faced by institutional facilities managers</i>						
I would like to receive a summary of the key findings of the research. My contact details are as follows.						
<table border="1"><tr><td rowspan="4">Name and address of company (optional):</td><td>_____</td></tr><tr><td>_____</td></tr><tr><td>_____</td></tr><tr><td>_____</td></tr></table>		Name and address of company (optional):	_____	_____	_____	_____
Name and address of company (optional):	_____					

<table border="1"><tr><td>Fax:</td></tr></table>		Fax:				
Fax:						
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Appendix B4: Questionnaire survey reminder letter



John Cameron
Head of Facilities Management
University of Waikato
New Zealand

Date: 12th November 2011

Dear John Cameron,

Research survey:

Challenges in strategic facilities management: Analysis of problems faced by university facilities managers

I sent you an email on 20th October 2011, in which I attached a copy of a questionnaire on Facilities Management survey. However, I have not received your response.

Your input is very valuable for my research; I would appreciate it if you could find some time (about 15 - 20 minutes) to complete the questionnaire (see attached document) and return it to me by fax or as an email attachment as soon as possible. Your comments on the relevance or clarity of the questions will also be appreciated.

Thank you for your anticipated participation and assistance; I look forward to your feedback ASAP.

Best regards,
Myzatul Aishah Kamarazaly
School of Advanced Engineering & Technology
Massey University
Auckland, New Zealand

Appendix B5: Supporting Letter from TEFMA

12 June 2010

Dear TEFMA Member

The TEFMA Board has agreed to assist a PhD candidate at Massey University with an in-depth survey of the main problems that concern Facilities Managers. The candidate is Myzatul Aishah Kamarazaly.

We have attached four documents. The first describes the project. The second is an explanatory letter and invitation to participate from the Candidate and his PhD Supervisor. The third is the four-page questionnaire. The fourth is a form for requesting a summary of the key research findings.

We urge you to take part in this project which we believe will yield some useful results.

Best wishes

A handwritten signature in black ink, appearing to read 'M Smith', with a stylized flourish at the end.

Matt Smith
President

APPENDIX C:

DOCUMENTS USED IN PLANNING AND CONDUCTING MODEL TEST SURVEY

C1: Covering letter

C2: Interview reminder letter

C3: Interviewee's choice of date and time slots

C4: Confirmation on interview schedule

C5: Interview questions

Appendix C1: Covering Letter



MASSEY UNIVERSITY
School of Engineering & Advanced Technology
Private Bag 102 904, North Shore City 0745, Auckland, New Zealand

Mick Serena,
Director
Facilities and Services
The Australian National University
Australia

8th August 2011

Dear Mr Mick Serena,

Research survey: Challenges of strategic FM: Analysis of problem faced by university facilities managers

I am Myzatul Kamarazaly, a PhD student at the School of Engineering and Advanced Technology, College of Sciences, Massey University, Auckland. My research is entitled, “**Challenges of strategic facilities management: Analysis of problems faced by institutional facilities managers**”. The study aims to explore the key challenges and the innovative solutions for addressing them. The outcome of the study is expected to be of practical use to facilities managers in formulating appropriate response to the identified risks in their day-to-day operations with a view to achieving more satisfactory outcomes.

I am currently at the final stage of my research study which involves model test case studies. This stage will be for testing the model developed from the survey data which was provided by heads of FM departments in some New Zealand and Australian universities. The aims of the model test case studies are: (1) to ascertain the extent of conformity or disparity between the generic results established at the main surveys and the model test case studies; and (2) to analyze the extent to which the developed model has captured the key challenges uncovered at the case studies.

In order to test the robustness of the model, there is a need to carry out some interviews with additional number of heads of FM departments in the New Zealand and Australian universities who did not participate in the earlier surveys. Your participation in the interview will help to achieve the objectives of the study. I would therefore be grateful if you could grant about 15-30 minutes interview session for this purpose. We assure that your responses will be treated with strictest confidentiality and will be used solely for the purpose of this research. Please find attached a copy of the interview questions, which provide lead to the lines of questioning on the day.

Enclosed is a schedule of possible appointment dates, times and preferred mediums for the interview. Kindly indicate any two preferred appointments and return the completed Schedule by email or fax using the supplied contact details. Free online video conferencing using the KAREN Bridge (<http://sds.karen.net.nz/scopia/entry/index.jsp>) or Skype provide alternative medium which can be used for the interview. If you're choosing KAREN Bridge, you will be receiving another email with further details of the meeting including your meeting ID. I'll appreciate it if you could also indicate your preferred medium as an alternative to the face-to-face interview in the attached Schedule – just in case some logistic issues constrain the face-to-face meeting.

I anticipate your kind response at your earliest convenience.

Thank you.

Appendix C2: Interview Reminder Letter



MASSEY UNIVERSITY
School of Engineering & Advanced Technology
Private Bag 102 904, North Shore City 0745, Auckland, New Zealand

Mick Serena,
Director
Facilities and Services
The Australian National University
Australia

8th September 2011

Dear Mr Mick Serena,

Research survey: Challenges of strategic FM: Analysis of problem faced by university facilities managers

I sent you an email on 8th August 2011, in which I attached a copy of the interview questions (refer to attachment) on analysis of problems faced by institutional facilities managers. However, I have not received your response.

Your input is very valuable for my research; I would appreciate it if you could find some time (about 15 – 30 minutes) to participate in the interview on your preferred date and time. Enclosed is a schedule of possible appointment dates, times and preferred mediums for the interview. Kindly indicate any two preferred appointments and return the completed Schedule by email or fax using the supplied contact details.

Otherwise, if you are unable to participate in the interview, it would be much appreciated if you could spend no longer than 10 minutes to share your thoughts on the following issues based on your FM experience to date, by completing the interview questions (refer to attachment) and kindly return to me via email.

Thank you for your anticipated participation and assistance; I look forward to your feedback at your earliest convenience.

Best regards,

Myzatul Aishah Kamarazaly
School of Engineering & Advanced Technology
Massey University
Auckland, New Zealand

Appendix C3: Interviewee's choice of date and time slots

Massey University
Private Bag 102 904, North Shore 0745, Auckland, New Zealand; Mobile: +64 21 077 9067; Fax: +64 9 443 9774
M.A.Kamarazaly@massey.ac.nz

CHALLENGES IN STRATEGIC FACILITIES MANAGEMENT: ANALYSIS OF PROBLEMS FACED BY UNIVERSITY FACILITIES MANAGERS

By:
Myzatul Aishah Kamarazaly

INTERVIEWEE'S CHOICE OF DATE AND TIME SLOTS

Kindly tick any two dates and time slots among the options indicated below:

PREFERRED DATE:

<input type="checkbox"/> 21/11/2011 (Mon)	<input type="checkbox"/> 22/11/2011 (Tues)	<input type="checkbox"/> 23/11/2011 (Wed)
<input type="checkbox"/> 24/11/2011 (Thurs)	<input type="checkbox"/> 25/11/2011 (Fri)	<input type="checkbox"/> 28/11/2011 (Mon)
<input type="checkbox"/> 29/11/2011 (Tues)	<input type="checkbox"/> 30/11/2011 (Wed)	<input type="checkbox"/> 1/12/2011 (Thurs)
<input type="checkbox"/> 2/12/2011 (Fri)	<input type="checkbox"/> 5/12/2011 (Mon)	<input type="checkbox"/> 6/12/2011 (Tues)
<input type="checkbox"/> 7/12/2011 (Wed)	<input type="checkbox"/> 8/12/2011 (Thurs)	<input type="checkbox"/> 9/12/2011 (Fri)
<input type="checkbox"/> 12/12/2011 (Mon)	<input type="checkbox"/> 13/12/2011 (Tues)	<input type="checkbox"/> 14/12/2011 (Wed)
<input type="checkbox"/> 15/12/2011 (Thurs)	<input type="checkbox"/> 16/12/2011 (Fri)	<input type="checkbox"/> 19/12/2011 (Mon)
<input type="checkbox"/> 20/12/2011 (Tues)	<input type="checkbox"/> 21/12/2011 (Wed)	<input type="checkbox"/> 22/12/2011 (Thurs)
<input type="checkbox"/> 23/12/2011 (Fri)	<input type="checkbox"/> Other date(s), kindly specify:	

PREFERRED TIME:

<input type="checkbox"/> 8.30 - 9.00 am	<input type="checkbox"/> 9.30 - 10.00 am	<input type="checkbox"/> 10.30 - 11.00 am
<input type="checkbox"/> 11.30 - 12.00 noon	<input type="checkbox"/> 12.30 - 1.00 pm	<input type="checkbox"/> 1.30 - 2.00 pm
<input type="checkbox"/> 2.30 - 3.00 pm	<input type="checkbox"/> 3.30 - 4.30 pm	<input type="checkbox"/> 5.00 - 5.30 pm
<input type="checkbox"/> Other time(s), kindly specify: _____		

PREFERRED MEDIUM:

<input type="checkbox"/> Face-to-face interview	<input type="checkbox"/> Online Video Conferencing via KAREN Bridge
<input type="checkbox"/> Phone interview	<input type="checkbox"/> Skype

Name: _____
Physical contact address: _____
Skype username: _____
Contact number: _____
Email: _____

Kindly return this sheet via email (M.A.Kamarazaly@massey.ac.nz) or fax (+64 9 443 9774,
Attention to: Myzatul Kamarazaly) .
Thank you for your participation!

Appendix C4: Confirmation of interview schedule

Mick Serena,
Director
Facilities and Services
The Australian National University
Australia

25th September 2011

Dear Mr Mick Serena,

CONFIRMATION OF INTERVIEW SCHEDULE

This is to thank you for granting my request for research interview and to inform you about the date and time scheduled out of the two preferences you earlier indicated.

The schedule details are as follows:

- 1 Date :
- 2 Time :
- 3 Medium :
- 4 Venue :

Please find attached a copy of the interview questions, which provide lead to the lines of questioning on the day.

If you have any reservations in respect of the above, please don't hesitate to inform me. Once again, thank you for your co-operation. I look forward to our interview session.

Sincerely yours,

Myzatul Aishah Kamarazaly
School of Engineering & Advanced Technology
Massey University
Auckland, New Zealand

Appendix C5: Interview Questions

Massey University
School of Engineering and Advanced Technology, College of Sciences,
Private Bag 102 904, North Shore 0745, Auckland, New Zealand; Mobile: +64 21 079 9067; Email:
M.A.Kamarazaly@massey.ac.nz

Research Title: Challenges of strategic facilities management: Analysis of problems faced by university facilities managers.

By Myzatul Aishah Kamarazaly

Overview of the study:

Facilities managers face critical challenges in creating and sustaining the conducive environment for the achievement of learning, teaching and research goals. The challenges range from the internal managerial issues to external constraints which have profound impact on the achievement of strategic facilities management goals. These include inadequate financial budget and skilled manpower, high operation and maintenance costs, adequacy of technology, conflicting multi-stakeholders interests, etc. This study aims to explore the key challenges faced by facilities managers and the mitigation measures.

The key objectives of the study are as follows:

1. To **identify and prioritize the key internal and external constraints** impacting on the achievement of strategic facilities management goals.
2. To **determine the risk levels of the constraints** based on their **frequencies of occurrence and levels of impact** on the ability to achieve strategic management goals.
3. To **establish practical solutions for addressing the key challenges** constraining the achievement of strategic FM goals.
4. To **identify the key challenges facing tomorrow's facilities manager.**

Interview questions

Based on your facilities management (FM) experience, I'll appreciate feedback to the following questions:

1. What are the key **internal** challenges in the management of facilities within your company?

a) _____

b) _____

c) _____

d) _____

e) _____

2. Based on a 10-point rating scale, how would you prioritize these constraints in the table below in terms of their relative levels of risks as constraint factors to the achievement of strategic FM goals? (Rating points ranges from 1 for the very low risk constraint, through to 10 for the very high risk constraint):

	Internal challenges	Perceived risk level (1 – 10)
a)		
b)		
c)		
d)		
e)		

3. What are the key **external** challenges in the management of facilities within your company?

- a) _____
- b) _____
- c) _____
- d) _____
- e) _____

4. Using a 10-point rating as before, how would you prioritize these external constraints in terms of their relative levels of risk to the achievement of FM goals?

	External challenges	Perceived risk level (1 – 10)
a)		
b)		
c)		
d)		
e)		

5. Based on your experience, what practical solutions would you recommend for addressing the internal and external challenges?

- a) _____
- b) _____

c)

d)

e)

6. If you were to look into the future, what would you see as the most probable key challenges facing tomorrow's facilities manager?

a)

b)

c)

d)

e)

7. Do you have further general comments about the problems faced by FM managers or any useful hints to the researcher concerning this research?

APPRECIATION

Thank you for your time and support for this research.

APPENDIX D:

GUIDELINE TO CHOICE OF APPROPRIATE STATISTICAL TECHNIQUE FOR HYPOTHESIS TESTING

GUIDELINE TO CHOICE OF APPROPRIATE STATISTICAL TECHNIQUE FOR HYPOTHESIS TESTING

D.1 OVERVIEW

Zikmund (1994) and Cooper and Emory (1995) argue that it is important to adopt a systematic approach in selecting an appropriate statistical technique for hypothesis (or proposition) testing. This section presents the guidelines, which informed selections of the statistical techniques used for testing the research propositions.

D.2 STATISTICAL HYPOTHESES TESTING

D.2.1 NEED FOR STATISTICAL HYPOTHESIS TESTING

In carrying out descriptive analysis, Zikmund (1994) argues that it is important to go beyond the simple tabulation of frequencies and the calculation of averages to find some sort of criterion for answering questions about differences between what one expected to find (as reflected in the propositions) and the actual results of research. This is to ensure reliability of conclusions or inferences drawn from the results.

D.2.2 PRELIMINARY DESCRIPTIVE ANALYSIS

For most research projects having complex raw data structure such as this study, Zikmund (1994) recommends that analysis should begin with some form of descriptive analysis to reduce the raw data into a summary format. This is usually in form of simple tabulation of frequency distributions and calculation of averages.

D.2.2.1 Univariate tests of statistical significance

The foundation of univariate statistical estimation of parameters involves hypothesis testing when the research focuses on one variable at a time (Zikmund, 1994).

Zikmund (1994) defines hypothesis as “an unproven proposition or supposition that tentatively explains certain facts or phenomena; a proposition that is empirically testable. With statistical techniques we are able to decide whether or not our theoretical hypotheses are confirmed by empirical evidence.

The choice of the method of statistical analysis depends on (Zikmund, 1994):

The type of question to be answered

The number of variables

The scale of measurement

Type of question to be answered

The type of question the researcher is attempting to answer is a consideration in the choice of statistical technique. For example, a researcher may be concerned about the central tendency of a variable or the distribution of that variable. Also the choice of research design and the type of data to collect should anticipate the method of statistical analysis.

Number of variables

The number of variables that should be simultaneously investigated is a primary consideration in the choice of statistical techniques:

Univariate data analysis: An analysis that assesses the statistical significance of a hypothesis about a single variable. It is conducted when the researcher wishes to generalize from a sample about one variable at a time.

Bivariate data analysis: Data analysis and hypothesis testing when the investigation concerns simultaneous investigation of two variables using tests of differences or measures of association between two variables at a time. It is useful when there is a need to statistically describe the relationship between two variables at a time.

Multivariate data analysis: Statistical methods that allow the simultaneous investigation of more than two variables.

3. Scale of measurement

The scale of measurement on which the data are based or the type of measurement reflected in the data determines the permissible statistical technique and the appropriate empirical operation that may be performed (see Table D.1 below). Testing a hypothesis about a mean requires interval- or ratio-scaled data. The use of mode as the measure of central tendency is recommended (Zikmund, 1994) when the data structure reflects nominal scale. When the data are measured on an ordinal scale, the median may be used as the average, or percentiles may be used as measures of dispersion. Generally, ranking uses ordinal scale of measurement.

Table D.1: Measures of central tendency and dispersion permissible with each type of measurement (Source: Zikmund, 1994, p. 494)

Type of scale`	Measure of central tendency	Measure of dispersion
Nominal	Mode	None
Ordinal	Median	Percentile`
Interval or ratio	Mean	Standard deviation

4. Nature of the data to be analysed (Parametric versus Nonparametric hypothesis tests)

The major distinction between these two groups of procedures lies in the underlying assumptions about the data to be analysed. When the data are interval-scaled or ratio-scaled and the sample size is large, parametric statistical procedures are appropriate.

These procedures are based on the assumption that the data in the study are drawn from populations with normal distributions and/or normal sampling distribution. When researchers do not make this assumption of normality, it is appropriate to use nonparametric methods. When data are either ordinal or nominal, it is generally inappropriate to make the assumption that the sampling distribution is normal (thus nonparametric statistics are referred to as distribution-free).

Data analysis of both nominal and ordinal scales typically uses nonparametric statistical tests.

D.3.1 GENERAL CLASSES OF SIGNIFICANCE TESTS

Maxwell (19975) suggests two general classes of significance tests: parametric and nonparametric. Parametric tests are more powerful because their data are derived from interval and ratio measurements. Nonparametric tests are used to test hypotheses with nominal and ordinal data.

Parametric techniques are the tests of choice if their assumptions are met. Some of these assumptions, as given by Cooper and Emory (1995), include:

- The observations must be independent. That is, the selection of any one case should not affect the chances for any other case to be included in the sample.
- The observations should be drawn from normally distributed populations.
- These populations should have equal variances
- The measurement scale should be at least interval so that arithmetic operations can be used with them.

Cooper and Emory (1995) further argue that the researcher is responsible for reviewing the assumptions pertinent to the chosen test and performing diagnostic checks on the data to assure the selection's appropriateness. As a guide to choosing between parametric and nonparametric tests, Marascuilo and McSweeney (19977) advise that it is when the assumptions for the classical parametric tests (as listed above) cannot be satisfied that one should seek out nonparametric tests as substitutes. However, Marascuilo and McSweeney (1977) were quick to add that, "If the test selected does the job, and does it more efficiently than competing procedures, then the most relevant choice of test has been made" (p. 6).

D.3.2 UNIVARIATE ANALYSIS

Table D.2 below presents some guidelines for selecting the appropriate univariate statistical method. The list is by no means exhaustive.

Table D.2: Guidelines to selecting appropriate univariate statistical method (Source: Zikmund, 1994, p. 495)

Typical research problem	Statistical question to be asked	Possible test of statistical significance
Interval or ratio scale		
Compare actual and hypothetical values of average salary	Is the sample mean significantly different from the hypothesized population mean?	Z-test (if sample is large); t-test (if sample is small)
Ordinal scale		
Compare actual and expected evaluations	Does the distribution of scores for a scale with the categories excellent, good, fair, and poor differ from the expected distribution?	Chi-square test
Determine ordered preferences for all brands in a product class	Does a set of rank orderings in a sample differ from an expected or hypothetical rank ordering?	Kolmogorov-Smirnov test
Nominal scale		
Identify sex of key executives	Is the number of female executives equal to the number of male executives?	Chi-square test
Indicate percentage of key executives who are male	Is the proportion of male executives the same as the hypothesized proportion?	t-test of a proportion

D.3.3 BIVARIATE ANALYSIS

D.3.3.1 Tests of differences

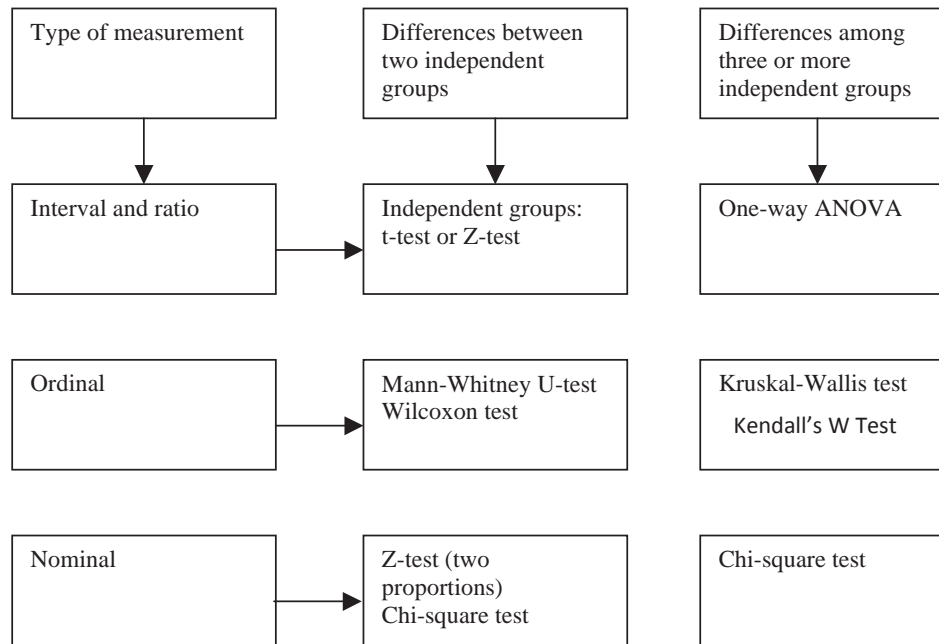


Figure D.1: Common bivariate tests of differences (Source: Zikmund, 1994, p. 516)

D.3.3.2 Bivariate analysis: Measures of association

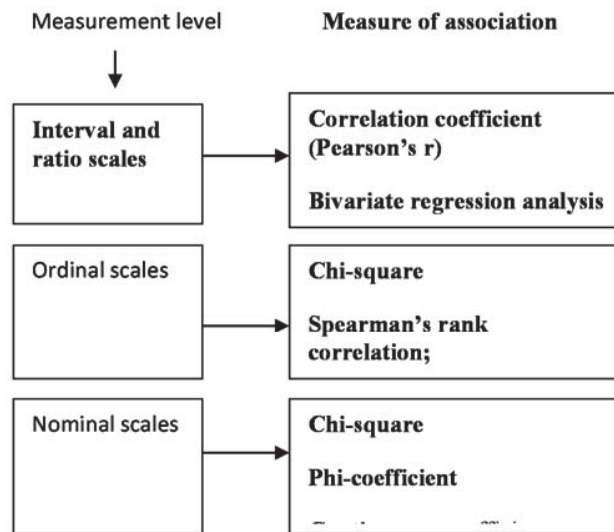


Figure D.2: Bivariate analysis – Common procedures for testing association

(Source: Zikmund, 1994, p. 551)

D.3.4 MULTIVARIATE ANALYSIS

D.3.4.1 General classification

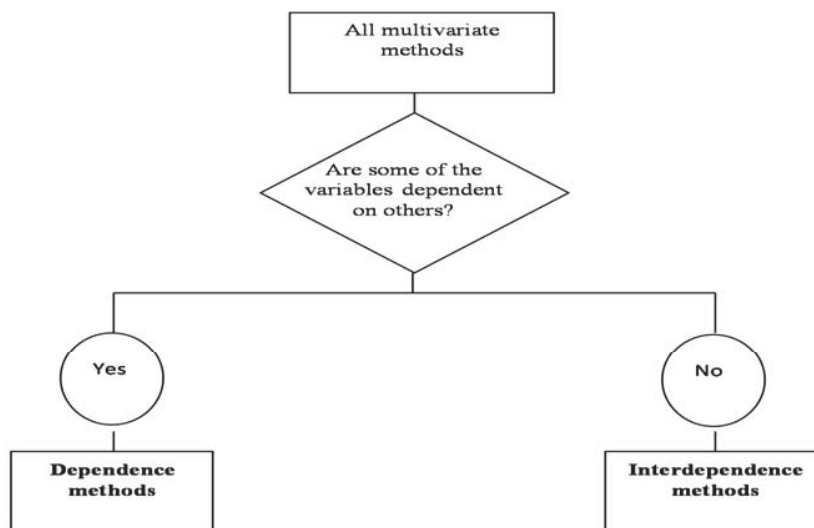


Figure D.3: General classification of multivariate analytical methods

(Source: Zikmund, 1994, p. 576)

D.3.4.2 Dependence methods

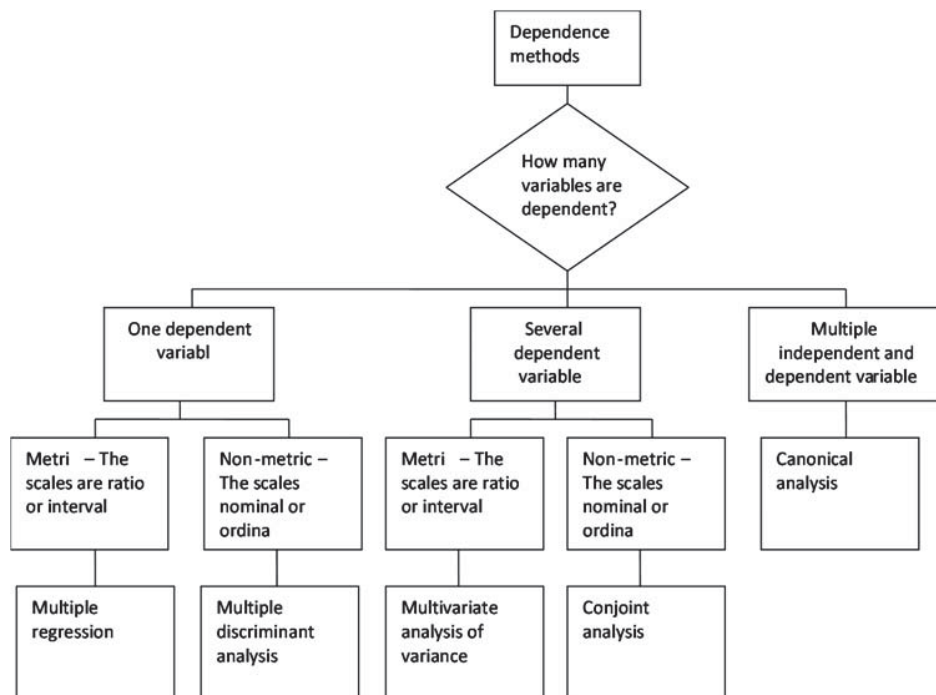


Figure D.4: Multivariate analysis: Classification of dependence methods

(Source: Zikmund, 1994, p. 576)

D.3.4.3 Interdependence methods

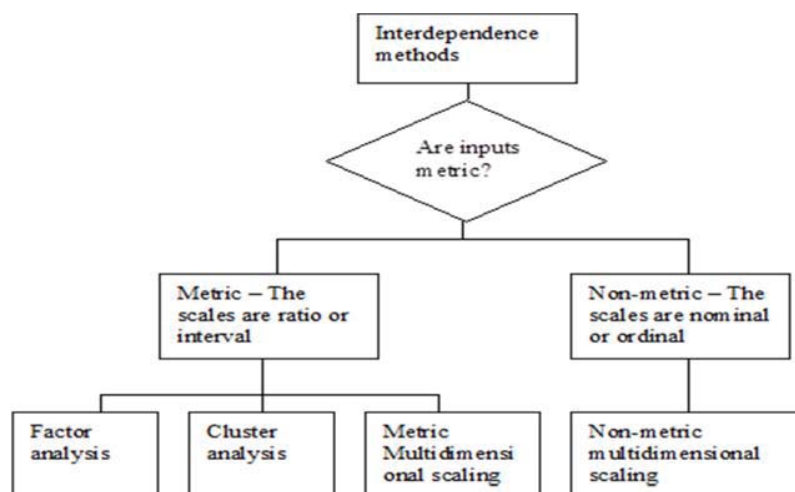


Figure E.5: Multivariate analysis: Classification of interdependence methods (Source: Zikmund, 1994, p. 577)

D.3.5 RECOMMENDED STATISTICAL TECHNIQUES BY MEASUREMENT LEVEL AND TESTING SITUATION

Using the criteria of measurement scale and testing situation, Cooper and Emory (1995) developed a classification of the major parametric and nonparametric tests and measures. This is shown in Table D3 below.

Table D3: Recommended statistical techniques by measurement level and testing situation (Source: Cooper and Emory, 1995, p. 445)

Measurement level	One-sample case	<u>Two-sample case</u>		<u>K-sample case</u>	
		Related samples	Independent samples	Related samples	Independent samples
Nominal	Binomial χ^2 one-sample test	McNemar	Fisher exact test; χ^2 two-sample	Cochran Q	χ^2 for K-samples
Ordinal	Kolmogorov-Smirnov one-sample test	Sign test; Wilcoxon matched pairs; Spearman's rank correlation.	Median test; Mann-Whitney U-test; Kolmogorov-Smirnov; Wald-Wolfowitz	Friedman two-way ANOVA; Kendall's W Coefficient Concordance	Median extension; Kruskal-Wallis one-way ANOVA
Interval and ratio	t -test; Z-test	t -test for paired samples	t -test; Z-test	Repeated measures ANOVA	One-way ANOVA

APPENDIX E: SUMMARY OF KEY RESEARCH FINDINGS AND THE ACCOMPANYING CHARTS & TABLES – QUALITATIVE DATA RESULTS PRESENTATION

E.1. PRACTICAL SOLUTIONS FOR ADDRESSING THE CHALLENGES IMPACTING ON STRATEGIC FACILITIES MANAGEMENT GOALS

E.1.1 Practical solutions for addressing internal challenges

Table 190: Practical solutions for addressing internal challenges - Operational efficiency

** Response frequency: Number of times each challenge was mentioned or alluded to by 15 interviewees.*

Practical solutions for addressing internal challenges	*Response frequency	% of Responses
Operational efficiency: How to improve efficiency in the work processes to lower operational costs, optimise resource utilization and achieve set goals:		
Regular meetings are essentials to set the facilities goal, strategy, communicate solutions that lead to energy efficiency.	15	100
Use of innovation and creativity to achieve more with less	15	100
Recognising needs for improvements through 'know' information or benchmark information, or both.	14	93
Setting out goals and provide best qualified solutions.	13	87
Staff training for operational improvements.	13	87

Table 191: Practical solutions for addressing internal challenges – Risk management

** Response frequency: Number of times each challenge was mentioned or alluded to by 15 interviewees.*

Practical solutions for addressing internal challenges	*Response frequency	% of Responses
Risk management: How to improve on the accuracy of risk analysis, contingency planning and the effectiveness of risk monitoring and risk response:		
Facilities managers need to prepare detailed and analytical specifications of the facility, and all associated risks.	15	100
Identification and allocation of risks involved on a rational basis to help clarify relationships between stakeholders, service providers and facilities managers.	14	93
Facilities managers need to have clear perception of the risks being borne by each party.	12	80
Facilities managers need to have motivation to manage risks that require a clear linkage between a party's management of risks and the party's receipt of award.	10	67

Table 192: Practical solutions for addressing internal challenges – Stakeholder needs/ Service providers

<i>* Response frequency: Number of times each challenge was mentioned or alluded to by 15 interviewees.</i>		
Practical solutions for addressing internal challenges	*Response frequency	% of Responses
Stakeholder needs/Service providers: How to assess and respond to the changing and complex needs of the different stakeholders (e.g. staff, students and visitors); how to address - with limited budget - compliance with ergonomics and accessibility issues in the workplace, especially for the aged and the handicapped.		
Facilities managers need to recognize that they are in the customer service business: cultivate an atmosphere of customer service; consider customer service and communications training for staff; and implement communications programs to gather information and keep stakeholders informed.	15	100
Understand communications challenges both up administrative chain and across departments, use a variety of forms of communications and be prepared for a two-way exchange.	14	93
Facilities departments need to become more proactive about seeking stakeholders input and responding to stakeholder expectations: be upfront about soliciting input, seek out stakeholder groups beyond the obvious parties and honestly listen to new ideas.	14	93
Assess customer satisfaction to establish a baseline and to measure future progress.	13	87
Consider the customer relationship management technology to streamline customer service.	13	87
Enhancing client capability and quality of provision, and proper assessment of requirements for the scope and content of services.	13	87

Table 193: Practical solutions for addressing internal challenges – Maintenance

<i>* Response frequency: Number of times each challenge was mentioned or alluded to by 15 interviewees.</i>		
Practical solutions for addressing internal challenges	*Response frequency	% of Responses
Maintenance: How to address the dilemma in managing aging buildings and infrastructure, especially as it relates to deciding between "retain and maintain" versus "upgrade or replace"; addressing the problem of deferred/ backlog of maintenance that has arisen due to diversion of funding to higher priority areas.		
Develop consistent categories to define maintenance and renewal needs.	15	100
University should consider their backlog of renewal and renovation projects in light of sustainability and increase the priority for the upgrade of inefficient structures by: (i) using sustainability to advocate for renewal outdated buildings; (ii) include sustainability as a factor in facility assessments and put priority on structures that are getting in the way of achieving university's sustainability goals and (iii) developing criteria to determine which building are not worth saving.	15	100

Table 194: Practical solutions for addressing internal challenges – Manpower

<i>* Response frequency: Number of times each challenge was mentioned or alluded to by 15 interviewees.</i>		
Practical solutions for addressing internal challenges	*Response frequency	% of Responses
Manpower: How to address the problems associated with inadequate labour resource brought about by issues such as lack of skilled/ experienced manpower, organisation-wide freeze on employment and inadequate budgets; the challenge of attracting and retaining skilled manpower and of keeping staff abreast of current technology and legislations.		
Facilities departments need to understand the demographic changes facing their university and the plan accordingly to avoid future problems: (i) understand the demographic shifts in the city, state and region; (ii) assess the future needs; (iii) identify the gaps between the university have and need.	15	100
Facilities managers need to (i) assess employee satisfaction and act on the results; (ii) work with the university to develop and implement new strategies and programs; (iii) provide a professional career path for employees so new leaders can be fostered.	13	87
Facilities department need to confront workforce development issues by: (i) assessing the impact of the recession on the facilities workforce; (ii) helping current staff adjust to change; (iii) developing strategies to bring new skills into organization and (iv) creating knowledge transfer system so the expertise of retiring workers is preserved.	12	80
The workforce is getting older, more diverse and more in demand thus facilities managers need to (i) understand how changes in the population will affect the workforce and (ii) develop strategies to pass the wisdom of mature workers onto new leaders.	11	73
Delivering a vibrant work environment that attracts and retains talented staff or labour.	10	67

Table 195: Practical solutions for addressing internal challenges – Materials

<i>* Response frequency: Number of times each challenge was mentioned or alluded to by 15 interviewees.</i>		
Practical solutions for addressing internal challenges	*Response frequency	% of Responses
Materials: The challenge to having the correct materials available to maintenance personnel when needed for effective operations.		
Need to have an effective system that delivers the materials to the site when unpredictable requirements develop during the course of a job, rather than one that requires the mechanic to leave the job site to obtain materials.	15	100
Need to have a good planning where materials can be provided or stored on the job site or the maintenance worker can take all materials needed to the site at the start of the job.	15	100
Embraces the "just-in-time" concept, whereby on-hand inventories are reduced and materials are made available through arrangements or contracts with vendors, either on scheduled basis or on short notice as needed.	14	93
Preventive maintenance consumables should always be readily available before work started.	13	87
All materials used in maintenance should be charged out against the building or specific building systems and equipment where appropriate. These costs along with labour costs should be accumulated in a hierarchy file to maintain accurate maintenance and repair costs for specific buildings and building components.	13	87
Regardless of the system used, materials should be made available to field personnel with minimum effort.	12	80
Maintenance vehicles to be outfitted with commonly required materials.	12	80
Explore the system for delivering materials to the work sites in cases where workers are making frequent trips from work sites to obtain materials.	12	80
Provision of emergency spare parts and equipment which must be stored in secure areas but be readily available to after-hours maintenance and repair crews. The items should be carefully inventoried, and usage data should be maintained and periodically reviewed to ensure that only items used for emergencies are carried in the inventory.	12	80
Need to provide secure spaces in buildings or in mechanical rooms to pre-positioned materials for preventive maintenance work such as lubricants, filters, drive belts and fluorescent tubes.	11	73

E.1.2 Practical solutions for addressing external challenges

Table 196: Practical solutions for addressing external challenges - Sustainability/ environmental issues

<i>* Response frequency: Number of times each challenge was mentioned or alluded to by 15 interviewees.</i>		
Practical solutions for addressing external challenges	*Response frequency	% of Responses
Sustainability/ environmental issues: Challenge of finding innovative and sustainable ways of managing energy use, waste disposal, resource use and environmental pollution/ contamination; achieving reduce, re-use and recycle mandate to waste management.		
Build a culture of sustainability on campus to include staffs, students, faculty, administrators and sustainability influences decision-making across campus.	15	100
Ensure the facilities department is leading the charge for campus sustainability - senior facilities officers play vital roles in sustainability discussions, helping shape policy and managing implementation in order to assess their role on campus and where to step up to increase their impact on sustainability discussion.	15	100
Ensure that facilities managers have the education, skills and leadership abilities to take their place among university decision makers.	15	100
Develop and implement an energy policy to cut consumption, manage use and reduce volatility.	14	93
Make a business case for energy efficiency and sustainability.	12	80
Facilities managers need to communicate the value of the sustainability and energy management effort.	12	80
Use the campus as a proving ground for new sustainability and energy projects.	11	73
Leverage sustainability efforts to promote and grow higher education as well as to fuel large-scale social change.	11	73
Facilities managers need to leverage existing facilities operations and programs to support sustainability.	11	73
Accept that sustainability focus is not a temporary trend but a long-term shift in the culture.	10	67

Table 197: Practical solutions for addressing external challenges - Technological issues

<i>* Response frequency: Number of times each challenge was mentioned or alluded to by 15 interviewees.</i>		
Practical solutions for addressing external challenges	*Response frequency	% of Responses
Technological: Challenges related to rapid changes in technology, including technological obsolescence and the need to upgrade equipment and processes; how to leverage the latest technology to improve on the FM management and operations.		
Integrate IT & facilities planning to maximize success.	15	100
Seek ways to work with IT to resolve existing issues.	15	100
Identify the experts who can help.	15	100
Make the right investments to ensure IT resources can withstand disaster.	14	93
Assess how technologies in IT will affect all aspects of teaching, learning, research, communications and the built environment.	13	87
Develop strategies that will help the institution remain nimble & flexible in the face of rapid technological change.	13	87
Strive to develop common goals and a vision that is in alignment with the university's vision and mission.	13	87

Table 198: Practical solutions for addressing external challenges - Regulatory/ compliance constraints

<i>* Response frequency: Number of times each challenge was mentioned or alluded to by 15 interviewees.</i>		
Practical solutions for addressing external challenges	*Response frequency	% of Responses
Regulatory/ compliance: Challenges arising from compliance with the legislations, by-laws and standards/ codes affecting the FM planning and operations; high compliance costs associated with keeping pace with the regulatory changes; uncertainties and risks to forward planning.		
Keep on top of the growing number of state and federal regulations that apply to the universities and organization.	15	100
Advocate for streamlined regulations that are more relevant and less burdensome.	14	93
Need to better manage existing regulations, start measuring cost of regulations as they keep track of the compliance.	14	93

Table 199: Practical solutions for addressing external challenges - Socio-cultural issues

<i>* Response frequency: Number of times each challenge was mentioned or alluded to by 15 interviewees.</i>		
Practical solutions for addressing external challenges	*Response frequency	% of Responses
Socio-cultural issues: The challenge of catering for the diverse needs of facilities and infrastructure users, including creating a safe and conducive environment for work and other uses for the facilities. Addressing the ergonomics and accessibility compliance issues, especially for the aged and the handicapped.		
Manage stakeholder expectations through dialogue and effective communication.	15	100
Aim to address only critical needs of the key stakeholders; focus on real needs rather than 'wants'.	15	100
Make a strong case for senior management to prune down admissions to align with existing facility capacity.	15	100
Optimise space allocation and space utilisation.	14	93
Leverage alumni and external donations to fund major infrastructure development for communal services.	13	87
Strategic engagement of the university community in volunteer services for public good such as environmental management, campus cleaning, recycling and waste disposal.	13	87

Table 200: Practical solutions for addressing external challenges - Institutional constraints

<i>* Response frequency: Number of times each challenge was mentioned or alluded to by 15 interviewees.</i>		
Practical solutions for addressing external challenges	*Response frequency	% of Responses
Institutional: Challenges presented by organisational politics; catering for the diverse and often conflicting multi-stakeholder interests; lack of FM representation on the university management board; senior management's view of facilities as being part of the operational cost that must be minimised, rather than a strategic asset that must be optimised.		
Aligning facilities planning with institutional goals: (i) get facilities involved early in the overall planning process, (ii) understand where institutions want to go and what it wants to be, (iii) evaluate the facilities implications including the financial implications of academic plans; (iv) develop specific outcomes for generalized goals.	15	100
Crafting integrated strategic plan: (i) create a strategic plan that will help the organization focus on its top priorities even during hard financial times; (ii) focus on aligning the organization with the mission of the universities to ensure continuity of focus and direction; (iii) confront the challenges of cost, access and competition; (iv) analyse the organization, structure and financial system for their long-term sustainability and economic viability.	14	93
Facilities managers need to demonstrate their value and the value of facilities to get a seat the at highest tables of decision making within the university: (i) understand the current situation; (ii) consider what need to do to raise the profile of facilities; (iii) ensure that facilities strategic plan is in alignment with the vision, mission and strategies of the university and this alignment can be demonstrated with quantifiable results.	12	80
Facilities departments must respond to increased demands for accountability with information that demonstrates how well they are managing the university's resources: (i) develop strategies to demonstrate the facilities department's responsibilities of caretaking the campus of built environment; (ii) determine how best to evaluate the intangibles that contribute to the value of the facilities; (iii) use smart public relations and marketing strategies to communicate your results.	12	80

E.1.3 Practical solutions for addressing future challenges

Table 201: Practical solutions for addressing future challenges - Statutory compliance

<i>* Response frequency: Number of times each challenge was mentioned or alluded to by 15 interviewees.</i>		
Practical solutions for addressing future challenges	*Response frequency	% of Responses
Statutory compliance: Keeping pace with the rapid changes in the legislations and standards that affect the FM planning and operations; associated high compliance costs and the uncertainties and risks these changes introduce to forward planning.		
Adequate staff knowledge of the compliance standards and legislations governing the FM policies and operations.	15	100
Adequate up-to-date training and courses on skills and communication with regard to the changes in legislations and standards, especially in relation to health & safety issues, energy management and building maintenance.	15	100
Keeping a tab on new and evolving legislations that have significant impact on the FM operations through monitoring relevant bills being passed in the parliament and taking proactive steps in planning for the imminent changes/ effects.	15	100
Use of approved certifiers for the routine checks on building services, appliances and buildings.	14	93
Having designated responsibilities for monitoring and reporting on in-house and vendor awareness of and compliance with standards and legislations affecting FM services.	14	93
Use of external vendor services in outsourcing and limiting the exposure to statutory compliance risks.	14	93

Table 202: Practical solutions for addressing future challenges – Sustainability

<i>* Response frequency: Number of times each challenge was mentioned or alluded to by 15 interviewees.</i>		
Practical solutions for addressing future challenges	*Response frequency	% of Responses
Sustainability: Challenge of minimising the ecological footprint of the facility operation and maintenance; conservation of non-renewable energy; alternative sourcing of renewable energy; waste minimisation, recycling and re-use; pollution and toxic waste management; and resource use optimisation.		
Assess the institution and the department's current level of sustainability; make business case for sustainable practice and for partnerships across the institution.	15	100
Facilities managers need to (i) make sustainability central to all facilities decision making; (ii) set goals and timeframe to succeed; (iii) determine who needs to get involved and how and (iv) take on the leadership role for this strategic issues.	15	100
Facilities managers need to (i) consider creative strategies to reduce risk and manager energy costs; (ii) find ways to include carbon dioxide emissions in the campus growth and energy decisions; (iii) stay current on legislative discussions about energy and carbon costs.	15	100
Facilities need to be designed and operated with the goal of reducing energy costs: (i) adopt strategies to reduce cost for electricity and heating water; (ii) widely use available technologies for reducing utility costs include solar power, wind energy, geothermal heating and cooling biomass.	14	93
Ensure that facilities managers have the (i) education, skills and leadership abilities to take their place among university decision maker; (ii) communicate the value of facilities leaders in the sustainability and energy management effort; (iii) leverage existing facilities operations and programs to support sustainability.	13	87

Table 203: Practical solutions for addressing future challenges – Technology

<i>* Response frequency: Number of times each challenge was mentioned or alluded to by 15 interviewees.</i>		
Practical solutions for addressing future challenges	*Response frequency	% of Responses
Technology: The challenge of keeping track of and responding proactively to the increasing advances in technology; managing technological obsolescence; the dilemma of choosing between replacing and upgrading to new and efficient technologies, versus retaining and maintaining existing ones that are inefficient.		
1) Seek ways to work with IT to resolve existing issues; 2) Identify the experts who can help; 3) Strive to develop common goals and a vision that is in alignment with the university's vision and mission.	15	100
Assess how technologies in IT will affect all aspects of teaching, learning, research, communications and the built environment; 2) Develop strategies that will help the institution remain nimble & flexible in the face of rapid technological change; 3) Make the right investments to ensure IT resources can withstand disaster; 4) Integrate IT & facilities planning to maximize success.	14	93
Stay abreast of changing technologies to enhance technologies to enhance productivity and improve operations.	13	87

Table 204: Practical solutions for addressing future challenges - User needs assessment and satisfaction

<i>* Response frequency: Number of times each challenge was mentioned or alluded to by 15 interviewees.</i>		
Practical solutions for addressing future challenges	*Response frequency	% of Responses
E User needs assessment and satisfaction: How to effectively identify and satisfy the key needs of users of the university's facilities; how to manage the rapidly changing and complex user needs and expectations. The challenge of adapting the facilities and infrastructure to meet the special needs of some user groups such as the aged and the handicapped.		
1 Demonstrating a culture of sustained high quality customer service and responsiveness that is supported by appropriate technologies and a clear set of written and well understood standards and benchmarks.	15	100
2 Routine user-needs assessment and satisfaction surveys, especially, post-occupancy evaluations (POE).	15	100
3 User and wider stakeholder consultations in making prime decisions and in formulating action plans for infrastructure procurement and space allocation.	14	93
4 Active engagement of key stakeholder representative groups in crucial FM forums with a view to building and maintaining good communication flow and cordial relations.	14	93
5 Prompt and satisfactory response to user requests and needs within the constraints of available resources.	13	87
6 Stakeholder expectation management and enlightenment.	12	80

Table 205: Practical solutions for addressing future challenges - Business and financial management issues

<i>* Response frequency: Number of times each challenge was mentioned or alluded to by 15 interviewees.</i>		
Practical solutions for addressing future challenges	*Response frequency	% of Responses
Business and financial management issues: How to minimise the operational costs of the large asset base of the university especially as it relates to energy use; how to leverage the advances in technology to re-engineer FM processes with a view to improving productivity, lowering operational costs and ensuring efficient and innovative facilities management, replacement of inefficient facilities and equipment with smart technologies as part of the maintenance and procurement agenda.		
Robust granular asset data and history to support planning/prioritisation based on risk.	15	100
Accurate data collection. Strategies to reduce. Spend to save initiatives to be budgeted for.	14	93
Financial planning, monitoring and control to ensure that expenditures are kept within budget.	13	87
Leverage of technology in the FM processes with a view to improving speed and accuracy and minimising operational costs.	12	80
Strategic use of outsourcing to minimise operational costs.	11	73

Table 206: Practical solutions for addressing future challenges - Occupational health and safety

<i>* Response frequency: Number of times each challenge was mentioned or alluded to by 15 interviewees.</i>		
Practical solutions for addressing future challenges	*Response frequency	% of Responses
Occupational health and safety: Challenge of providing conducive, safe and healthy work environment that supports productivity and excellence in the key activities of the institution, especially research, teaching and learning and how to manage compliance with security, ergonomics and occupational health and safety issues such as poor indoor air quality and muscular-skeletal disorders (MSD).		
Develop effective policies, decision-making processes and standards.	15	100
Establish metrics to better measure and allocate space.	14	93
Create effective organizational governance structures.	14	93
Implement incentives to encourage smart space management.	13	87
Provide high level of services over a minimum facility and encourage users to manage a lot more of their own needs through user-education.	12	80
Facilities departments must provide and maintain as far as practicable, a healthy and safe place at work.	11	73

Table 207: Practical solutions for addressing future challenges - Leadership and innovation in FM

<i>* Response frequency: Number of times each challenge was mentioned or alluded to by 15 interviewees.</i>		
Practical solutions for addressing future challenges	*Response frequency	% of Responses
I Leadership and innovation in facilities management: How to lead and motivate the workforce to greater levels of productivity and performance amidst organisational socio-cultural and political barriers		
1 Articulate sound vision and winning strategies and ensure buy-in by top management and workforce.	15	100
2 Implement problem-solving tools in the FM department in concert with industry innovators.	15	100
3 Ensuring that personal development remains a key performance objective for all staff.	14	93
4 Creating cross-disciplinary learning opportunities.	14	93
5 Matching the competencies needed for achieving organizational objectives against the skill inventories of incumbents.	14	93
6 Keeping the development and advancement of subordinates a meaningful metric for the assessment of leaders.	14	93
7 Maintaining close ties between hiring managers and recruitment professionals; in cases in which core competencies are in short supply in the labour pool, internal training programs might be an economical solution.	14	93
8 Monitoring performance appraisal tools for trends in employee development needs.	14	93
9 Considering the value of knowledge management programs to identify, harvest, archive, retrieve and transfer organizational knowledge.	14	93
10 Delivering a vibrant work environment that attracts and retained talented staff or labour.	13	87
11 Creating a "learning culture" in which opportunities for formal and informal learning can occur among employees up and down the organization chart.	13	87
12 Building learning opportunities into every post-project evaluation.	13	87

Table 208: Practical solutions for addressing future challenges - Space management

<i>* Response frequency: Number of times each challenge was mentioned or alluded to by 15 interviewees.</i>		
Practical solutions for addressing future challenges	*Response frequency	% of Responses
J Space management: The challenge of optimising the utilisation of space, plant, equipment and grounds; elimination of redundancy in asset use.		
2 Align space management to the mission of the university: (i) assess how well the facilities department and university mission, master plan and space management program are in alignment today; (ii) identify key priorities from the mission and master plan need to be incorporated into space management; (iii) build relationships between groups and individuals in charge of updating and implementing both the master and the space management plan; (iv) deal with the challenge of integrating space planning and scenario-based strategic planning for the future.	15	100
3 Make space one of the top assets of the university: (i) understand how the space is valued now within the university; (ii) reach out to the right individual; (iii) gather data about the value of space to make the case.	15	100
4 Change the culture of space: (i) assess the current culture of space; (ii) describe the sort of changes the facilities department and university want to see and (iii) develop concrete steps to move toward the vision.	15	100
5 Develop effective policies, processes, and organizational structures to manage space: (i) assess current processes, policies and organizational structures; (ii) prioritize what should change in the campus space management system and (iii) emphasize the best practices.	15	100
6 Implement a space inventory system to understand resources and identify needs: (i) outline priorities for a space inventory system; (ii) assess the pros and cons of the current system; and (iii) move toward a robust, flexible, accessible inventory.	15	100
7 Address space utilization by assembling credible data and adopting best practices: (i) integrate inventory and scheduling systems to automate utilization tracking; (ii) examine best practices for improve utilization.	15	100
8 The future needs single service space control as opposed to multi user space control. Space would be managed with the mandate for efficient use and run a timetabling service. Flexible space is also the key to future space.	14	93
9 Ensure all existing space is fully utilised and regularly assess the utilisation of space through audits, teaching room utilisation surveys and comparison with standards.	12	80
10 Encourage communal rather than territorial attitudes to space.	12	80
11 Explore innovative ways of meeting space and facility needs that are based around existing assets e.g. development of furniture and layout options to use corridor spaces as informal learning spaces.	12	80
12 All developments designed as generically as possible, providing a range spaces (type, size, function) to enable space to be easily re-allocated or adapted.	11	73
13 Encourage units to identify desk space for new positions from within existing allocations.	11	73
14 Ensuring timetabling policies optimise usage of teaching rooms.	11	73
15 Specialised rooms to be fully utilised before a duplicate is built.	10	67
16 Storage spaces, meeting rooms, copy areas and tea facilities to be shared where possible to avoid duplication. Copy rooms and storage located only in spaces unsuitable for other uses.	10	67
17 Minimise the duplication of support services across campuses.	10	67

Table 209: Practical solutions for addressing future challenges – Outsourcing

<i>* Response frequency: Number of times each challenge was mentioned or alluded to by 15 interviewees.</i>		
Practical solutions for addressing future challenges	*Response frequency	% of Responses
Outsourcing: The challenge of striking an intricate balance between outsourcing of peripheral facilities services and the in-house provision of core FM operations.		
Preparing for outsourcing: established Client's mandate to outsource services, gathered baseline information and established the business case at the early stage for a better guide to building a solid service contract.	15	100
Understanding current Client operations: To obtain good picture of current operations which includes developing and documenting a baseline from financial, performance and service level perspectives in order to measure possible gains in efficiency as well as cost savings from outsourcing.	15	100
Effective communication at service level and budget expectations to a service provider: critical systems and services must be clearly identified, required operating procedures documented and critical service levels established.	15	100
Verify the best fit service provider in terms of the service provider's organization and capabilities; and evaluating the service provider's proposed service delivery solution.	15	100
Negotiate a contract structure with strong Client rights and service provider obligations. Transfer risk with responsibility.	15	100
Actively manage the transition as it sets the tone for the relationship.	14	93
Have a longer term transformation plan as well as the near term transition (or implementation) plan.	14	93
Ensure post-deal continuity. Manage according to the contract and ensure that there good communications across multiple levels in the partnering relationship. Define and follow an agreed upon dispute resolution process.	14	93
Create a post-deal service provider management program. Include regular reviews of performance and have a clear process to resolve disputes.	14	93
Need to improve service delivery by specialist.	13	87
Need to improve management of existing resources and transformational initiatives.	12	80
Need to have better attraction and retention of staff.	12	80

APPENDICES F:

QUANTITATIVE DATA RESULTS PRESENTATION

F.1 MAINSTREAM QUESTIONNAIRE RESPONSES

F.1.1 INTERNAL CHALLENGES CONSTRAINING THE ACHIEVEMENT OF STRATEGIC FM GOALS

F.1.1.1 Levels of impact of current internal challenges

Table 210: Levels of impact - Current Internal (CI) challenges relating to operational method/ process

<i>[Level of impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low]</i>										
¹ Challenges relating to operational method/ process	Levels of impact					² TR	³ II	Remark	⁴ RII	Rank
	VH	H	M	L	VL					
	%	%	%	%	%					
	5	4	3	2	1					
CI-B-1	0	24	46	19	11	528	2.824	Moderate	0.092	7
CI-B-2	0	19	42	35	4	528	2.765	Moderate	0.090	8
CI-B-3	47	23	13	18	0	528	3.977	High	0.129	5
CI-B-4	81	17	2	0	0	528	4.786	Very High	0.155	1
CI-B-5	9	16	69	6	0	528	3.292	Moderate	0.107	6
CI-B-6	56	24	16	2	2	528	4.290	Very High	0.139	3
CI-B-7	54	20	20	6	0	528	4.223	Very High	0.137	4
CI-B-8	71	24	2	3	0	528	4.633	Very High	0.150	2
							<u>30.790</u>		<u>1.000</u>	

¹Challenges relating to operational method / process:

CI-B-1) Quality assurance issues, especially compliance with the best practice standards, e.g. ISO 14000, etc; CI-B-2) Adequacy of technology; CI-B-3) Effectiveness of leadership and management style; CI-B-4) Effectiveness of organisational structure and impact on coordination and decision making processes; CI-B-5) Staff training and development processes and impact on workforce empowerment, motivation and productivity; CI-B-6) Compliance with legislations and regulations, especially in relation to environmental and waste management; CI-B-7) Effectiveness and efficiency of communication systems; CI-B-8) Organisational policies, strategies, values and missions and their impact on organizational effectiveness and efficiency.

²TR = Total responses for a particular variable;

³II = Impact Index (See equation 1, Chapter 3)

⁴RII = Relative Impact Index (See equation 2, Chapter 3)

Table 211: Levels of impact - Current Internal (CI) challenges relating to stakeholder needs/ service providers

[Level of impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low]										
¹ Challenges relating to stakeholder needs / service providers	Levels of impact					² TR	³ II	Remark	⁴ RII	Rank
	VH	H	M	L	VL					
	%	%	%	%	%					
	5	4	3	2	1					
CI-C-1	56	24	16	4	0	528	4.311	Very High	0.157	2
CI-C-2	79	19	2	0	0	528	4.769	Very High	0.174	1
CI-C-3	54	20	20	6	0	528	4.225	Very High	0.154	3
CI-C-4	36	25	21	18	0	528	3.788	High	0.138	5
CI-C-5	0	24	38	27	11	528	2.741	Moderate	0.100	7
CI-C-6	33	23	24	20	0	528	3.699	High	0.135	6
CI-C-7	43	23	15	20	0	528	3.883	High	0.142	4
27.415							1.000			

CI-C-1) Lack of consideration of all stakeholders in the FM sphere; CI-C-2) Difficulties in managing conflicting stakeholder interests and requirements, especially due to some stakeholders "gold plating" their requirements; CI-C-3) Poorly controlled changes to user requirements; CI-C-4) Absence of, or poor system for providing incentives for performance; CI-C-5) Inflexible contracts; inability to accommodate changes in user requirements during the contract execution, especially those that fall outside agreed specifications and scope; CI-C-6) Inability to involve stakeholders from the outset in specifying the kinds of services required and the level of performance that will be acceptable to both in-house and external providers; CI-C-7) Difficulties in updating and improving service level agreements (SLAs) and service specifications to keep pace with the needed rate of change.

²TR = Total responses for a particular variable;

³II = Impact Index (See equation 1, Chapter 3)

⁴RII = Relative Impact Index (See equation 2, Chapter 3)

Table 212: Levels of impact - Current Internal (CI) challenges relating to manpower

[Level of impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low]										
¹ Challenges relating to manpower	Levels of impact					² TR	³ II	Remark	⁴ RII	Rank
	VH	H	M	L	VL					
	%	%	%	%	%					
	5	4	3	2	1					
CI-D-1	95	5	0	0	0	528	4.955	Very High	0.227	1
CI-D-2	0	14	84	1	0	528	3.129	Moderate	0.143	3
CI-D-3	2	21	53	13	11	528	2.902	Moderate	0.133	4
CI-D-4	0	0	7	77	16	528	1.915	Low	0.088	7
CI-D-5	2	16	45	25	13	528	2.693	Moderate	0.123	6
CI-D-6	4	17	43	24	13	528	2.750	Moderate	0.126	5
CI-D-7	14	40	27	17	2	528	3.472	High	0.159	2
21.814							1.000			

¹Challenges relating to manpower:

CI-D-1) Inadequate skilled manpower; CI-D-2) High costs of wages, salaries and associated employee expenditure (e.g. training, insurance, redundancy provisions, pensions, leave grants, etc); CI-D-3) Low productivity of the workforce due to issues such as low morale, job dissatisfaction, poor incentives, poor supervision, training, etc; CI-D-5) High staff turnover (due to poor remuneration, etc) and its impact on resources and continuity of workflow; CI-D-6) Poor quality of workmanship (especially in relation to in-house staff); CI-D-7) Compliance with OSH requirements in the workplace.

²TR = Total responses for a particular variable;

³II = Impact Index (See equation 1, Chapter 3)

⁴RII = Relative Impact Index (See equation 2, Chapter 3)

Table 213: Levels of impact - Current Internal (CI) challenges relating to machinery

[Level of impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low]										
¹ Challenges relating to machinery	Levels of impact					² TR	³ II	Remark	⁴ RII	Rank
	VH	H	M	L	VL					
	%	%	%	%	%					
	5	4	3	2	1					
CI-E-1	1	19	38	23	19	517	2.615	Moderate	0.098	7
CI-E-2	1	20	56	18	6	517	2.923	Moderate	0.109	6
CI-E-3	79	13	4	4	0	517	4.673	Very High	0.175	1
CI-E-4	50	19	17	13	1	517	4.050	High	0.152	4
CI-E-5	47	15	15	19	3	517	3.855	High	0.144	5
CI-E-6	58	17	15	10	0	517	4.244	Very High	0.159	3
CI-E-7	58	26	11	6	0	517	4.354	Very High	0.163	2
							<u>26.714</u>		<u>1.000</u>	

¹Challenges relating to machinery:

CI-E-1) Unavailability of machinery/ equipment to maintain buildings/ facilities; CI-E-2) Hiring/ acquisition of machinery/ equipment and associated costs (e.g. installation, safety/ security, insurance, etc; CI-E-3) Durability/functionality problems and their impact on operational and maintenance costs; CI-E-4) Environmental performance issues and associated impacts on legal, operational and maintenance costs; CI-E-5) Logistics/ operational and maintenance problems: unavailability of parts and or repair technicians or high operator training costs; CI-E-6) Equipment selection dilemma: fitness-for-purpose and its impact on user requirements, and operational and maintenance cost; CI-E-7) Obsolescence and replacement costs for installed machines or equipment.

²TR = Total responses for a particular variable;

³II = Impact Index (See equation 1, Chapter 3)

⁴RII = Relative Impact Index (See equation 2, Chapter 3)

Table 214: Levels of impact - Current Internal (CI) challenges relating to materials

[Level of impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low]										
¹ Challenges relating to materials	Levels of impact					² TR	³ II	Remark	⁴ RII	Rank
	VH	H	M	L	VL					
	%	%	%	%	%					
	5	4	3	2	1					
CI-F-1	97	2	1	0	0	528	4.958	Very High	0.208	1
CI-F-2	2	11	21	56	9	528	2.400	Low	0.101	6
CI-F-3	4	30	49	9	8	528	3.121	Moderate	0.131	5
CI-F-4	64	23	9	4	0	528	4.470	Very High	0.188	3
CI-F-5	61	19	7	10	4	528	4.231	Very High	0.178	4
CI-F-6	68	28	5	0	0	528	4.629	Very High	0.194	2
							<u>23.809</u>		<u>1.000</u>	

¹Challenges relating to materials:

CI-F-1) High costs or unavailability of materials and components; CI-F-2) Unavailability or insufficiency of storage facility, especially for fragile and perishable materials and components; CI-F-3) Durability problems and their impact on operational and maintenance costs; CI-F-4) Environmental performance problems and their impact on operational costs; CI-F-5) Compliance with OSH requirements, especially as it relates to hazardous/ dangerous goods storage and safety precautions; CI-F-6) Quality assurance/ selection dilemma in terms of fitness-of-purpose and impact on user-requirements, operational and maintenance cost.

²TR = Total responses for a particular variable;

³II = Impact Index (See equation 1, Chapter 3)

⁴RII = Relative Impact Index (See equation 2, Chapter 3)

F.1.1.2 Frequencies of occurrence of current internal challenges

Table 215: Frequencies of occurrence – Challenges relating to operational method/ process

[Frequencies of occurrence: 5 = Very Frequent; 4 = Frequent; 3 = Occasional; 2 = Rare; 1 = Very Rare]										
¹ Challenges relating to operational method/ process	** Frequency of occurrence					² TR	³ FI	Remark	⁴ RFI	Rank
	VF	F	O	R	VR					
	%	%	%	%	%					
	5	4	3	2	1					
CI-B-1	0	21	56	19	4	528	2.943	Occasional	0.109	5
CI-B-2	0	23	28	42	8	528	2.659	Occasional	0.099	6
CI-B-3	71	0	20	9	0	528	4.318	Very Frequent	0.160	2
CI-B-4	0	48	23	19	9	528	3.110	Occasional	0.115	4
CI-B-5	0	17	45	21	17	528	2.623	Occasional	0.097	8
CI-B-6	0	19	42	23	17	528	2.633	Occasional	0.098	7
CI-B-7	44	33	4	19	0	528	4.017	Frequent	0.149	3
CI-B-8	78	11	11	0	0	528	4.670	Very Frequent	0.173	1
							<u>26.973</u>		<u>1.000</u>	

¹Challenges relating to operational method / process:

CI-B-1) Quality assurance issues, especially compliance with the best practice standards, e.g. ISO 14000, etc; CI-B-2) Adequacy of technology; CI-B-3) Effectiveness of leadership and management style; CI-B-4) Effectiveness of organisational structure and impact on coordination and decision making processes; CI-B-5) Staff training and development processes and impact on workforce empowerment, motivation and productivity; CI-B-6) Compliance with legislations and regulations, especially in relation to environmental and waste management; CI-B-7) Effectiveness and efficiency of communication systems; CI-B-8) Organisational policies, strategies, values and missions and their impact on organisational effectiveness and efficiency.

²TR = Total responses for a particular variable;

³FI = Impact Index (See equation 3, Chapter 3)

⁴RFI = Relative Impact Index (See equation 4, Chapter 3)

Table 216: Frequencies of occurrence - Challenges relating to stakeholder needs/ service providers

[Frequencies of occurrence: 5 = Very Frequent; 4 = Frequent; 3 = Occasional; 2 = Rare; 1 = Very Rare]										
¹ Challenges relating to stakeholder needs / service providers	** Frequency of occurrence					² TR	³ FI	Remark	⁴ RFI	Rank
	VF	F	O	R	VR					
	%	%	%	%	%					
	5	4	3	2	1					
CI-C-1	56	24	16	4	0	528	4.311	Very Frequent	0.154	3
CI-C-2	74	19	8	0	0	528	4.663	Very Frequent	0.167	1
CI-C-3	57	21	22	0	0	528	4.348	Very Frequent	0.156	2
CI-C-4	33	19	24	20	4	528	3.574	Frequent	0.128	6
CI-C-5	43	22	11	20	5	528	3.778	Frequent	0.135	4
CI-C-6	28	21	24	21	5	528	3.472	Frequent	0.124	7
CI-C-7	38	23	19	21	0	528	3.765	High	0.135	5
							<u>27.911</u>		<u>1.000</u>	

¹Challenges relating to stakeholder needs / service providers:

CI-C-1) Lack of consideration of all stakeholders in the FM sphere; CI-C-2) Difficulties in managing conflicting stakeholder interests and requirements, especially due to some stakeholders "gold plating" their requirements; CI-C-3) Poorly controlled changes to user requirements; CI-C-4) Absence of, or poor system for providing incentives for performance; CI-C-5) Inflexible contracts; inability to accommodate changes in user requirements during the contract execution, especially those that fall outside agreed specifications and scope; CI-C-6) Inability to involve stakeholders from the outset in specifying the kinds of services required and the level of performance that will be acceptable to both in-house and external providers; CI-C-7) Difficulties in updating and improving service level agreements (SLAs) and service specifications to keep pace with the needed rate of change.

²TR = Total responses for a particular variable;

³FI = Impact Index (See equation 3, Chapter 3)

⁴RFI = Relative Impact Index (See equation 4, Chapter 3)

Table 217: Frequencies of occurrence - Challenges relating to manpower

[Frequencies of occurrence: 5 = Very Frequent; 4 = Frequent; 3 = Occasional; 2 = Rare; 1 = Very Rare]										
¹ Challenges relating to manpower	** Frequency of occurrence					² TR	³ FI	Remark	⁴ RFI	Rank
	VF	F	O	R	VR					
	%	%	%	%	%					
	5	4	3	2	1					
CI-D-1	94	6	0	0	0	528	4.941	Very Frequent	0.190	1
CI-D-2	19	38	33	10	0	528	3.653	Frequent	0.140	4
CI-D-3	21	34	25	17	4	528	3.511	Frequent	0.135	5
CI-D-4	0	19	5	47	28	528	2.148	Rare	0.082	7
CI-D-5	19	68	13	0	0	528	4.059	Frequent	0.156	3
CI-D-6	2	44	22	13	19	528	2.981	Occasional	0.114	6
CI-D-7	82	15	3	0	1	528	4.765	Very Frequent	0.183	2
							<u>26.059</u>		<u>1.000</u>	

¹Challenges relating to manpower:

CI-D-1) Inadequate skilled manpower; CI-D-2) High costs of wages, salaries and associated employee expenditure (e.g. training, insurance, redundancy provisions, pensions, leave grants, etc; CI-D-3) Low productivity of the workforce due to issues such as low morale, job dissatisfaction, poor incentives, poor supervision, training, etc; CI-D-5) High staff turnover (due to poor remuneration, etc) and its impact on resources and continuity of workflow; CI-D-6) Poor quality of workmanship (especially in relation to in-house staff); CI-D-7) Compliance with OSH requirements in the workplace.

²TR = Total responses for a particular variable;

³FI = Impact Index (See equation 3, Chapter 3)

⁴RFI = Relative Impact Index (See equation 4, Chapter 3)

Table 218: Frequencies of occurrence - Challenges relating to machinery

[Frequencies of occurrence: 5 = Very Frequent; 4 = Frequent; 3 = Occasional; 2 = Rare; 1 = Very Rare]										
¹ Challenges relating to machinery	** Frequency of occurrence					² TR	³ FI	Remark	⁴ RFI	Rank
	VF	F	O	R	VR					
	%	%	%	%	%					
	5	4	3	2	1					
CI-E-1	10	20	48	19	3	517	3.133	Occasional	0.117	6
CI-E-2	12	23	46	17	2	517	3.253	Occasional	0.122	5
CI-E-3	6	19	48	23	4	517	2.996	Occasional	0.112	7
CI-E-4	54	32	9	5	0	517	4.354	Very Frequent	0.163	2
CI-E-5	42	31	17	9	0	517	4.066	Frequent	0.152	4
CI-E-6	47	35	15	4	0	517	4.244	Very Frequent	0.159	3
CI-E-7	77	15	4	3	0	517	4.669	Very Frequent	0.175	1
							<u>26.716</u>		<u>1.000</u>	

¹Challenges relating to machinery:

CI-E-1) Unavailability of machinery/ equipment to maintain buildings/ facilities; CI-E-2) Hiring/ acquisition of machinery/ equipment and associated costs (e.g. installation, safety/ security, insurance, etc; CI-E-3) Durability/functionality problems and their impact on operational and maintenance costs; CI-E-4) Environmental performance issues and associated impacts on legal, operational and maintenance costs; CI-E-5) Logistics/ operational and maintenance problems: unavailability of parts and or repair technicians or high operator training costs; CI-E-6) Equipment selection dilemma: fitness-for-purpose and its impact on user requirements, and operational and maintenance cost; CI-E-7) Obsolescence and replacement costs for installed machines or equipment.

²TR = Total responses for a particular variable;

³FI = Impact Index (See equation 3, Chapter 3)

⁴RFI = Relative Impact Index (See equation 4, Chapter 3)

Table 219: Frequencies of occurrence - Challenges relating to materials

[Frequencies of occurrence: 5 = Very Frequent; 4 = Frequent; 3 = Occasional; 2 = Rare; 1 = Very Rare]										
¹ Challenges relating to materials	** Frequency of occurrence					² TR	³ FI	Remark	⁴ RFI	Rank
	VF	F	O	R	VR					
	%	%	%	%	%					
	5	4	3	2	1					
CI-F-1	35	29	25	11	0	528	3.888	Frequent	0.181	3
CI-F-2	7	19	34	20	21	528	2.705	Occasional	0.126	6
CI-F-3	19	19	12	36	14	528	2.922	Occasional	0.136	5
CI-F-4	57	40	3	0	0	528	4.536	Very Frequent	0.212	1
CI-F-5	19	23	31	20	7	528	3.271	Occasional	0.153	4
CI-F-6	35	40	25	0	0	528	4.104	Frequent	0.192	2
							<u>21.426</u>		<u>1.000</u>	

¹Challenges relating to materials:

CI-F-1) High costs or unavailability of materials and components; CI-F-2) Unavailability or insufficiency of storage facility, especially for fragile and perishable materials and components; CI-F-3) Durability problems and their impact on operational and maintenance costs; CI-F-4) Environmental performance problems and their impact on operational costs; CI-F-5) Compliance with OSH requirements, especially as it relates to hazardous/ dangerous goods storage and safety precautions; CI-F-6) Quality assurance/ selection dilemma in terms of fitness-of-purpose and impact on user-requirements, operational and maintenance cost.

²TR = Total responses for a particular variable;

³FI = Impact Index (See equation 3, Chapter 3)

⁴RFI = Relative Impact Index (See equation 4, Chapter 3)

F.1.1.3 Risk levels of current internal challenges

Table 220: Risk levels - Challenges relating to operational method/ process

¹ Challenges relating to operational method/ process	Impact Index ² (Ii)	Frequency Index ³ (Fi)	Risk Score (RS) ⁴ (Ii x Fi)	Remark	Risk Ranking
CI-B-1	2.824	2.943	8.311	Low	7
CI-B-2	2.765	2.659	7.353	Low	8
CI-B-3	3.977	4.318	17.175	High	2
CI-B-4	4.786	3.110	14.884	Moderate	4
CI-B-5	3.292	2.623	8.634	Low	6
CI-B-6	4.290	2.633	11.293	Moderate	5
CI-B-7	4.223	4.017	16.966	High	3
CI-B-8	4.633	4.670	21.636	Very high	1

¹Challenges relating to operational method/ process:

CI-B-1) Quality assurance issues, especially compliance with the best practice standards, e.g. ISO 14000, etc; CI-B-2) Adequacy of technology; CI-B-3) Effectiveness of leadership and management style; CI-B-4) Effectiveness of organisational structure and impact on coordination and decision making processes; CI-B-5) Staff training and development processes and impact on workforce empowerment, motivation and productivity; CI-B-6) Compliance with legislations and regulations, especially in relation to environmental and waste management; CI-B-7) Effectiveness and efficiency of communication systems; CI-B-8) Organisational policies, strategies, values and missions and their impact on organisational effectiveness and efficiency.

²Ii = Impact Index (See equation 1, Chapter 3)

³Fi = Frequency Index (See equation 3, Chapter 3)

⁴RS = Risk Score (See equation 5, Chapter 3)

Table 221: Risk levels - Challenges relating to stakeholder needs/ service providers

¹ Challenges relating to stakeholder needs/ service providers	Impact Index ² (Ii)	Frequency Index ³ (Fi)	Risk Score (RS) ⁴ (Ii x Fi)	Remark	Risk Ranking
CI-C-1	4.311	4.311	18.581	High	2
CI-C-2	4.769	4.663	22.237	Very high	1
CI-C-3	4.225	4.348	18.374	High	3
CI-C-4	3.788	3.574	13.537	Moderate	5
CI-C-5	2.741	3.778	10.355	Low	7
CI-C-6	3.699	3.472	12.841	Moderate	6
CI-C-7	3.883	3.765	14.618	Moderate	4

¹Challenges relating to stakeholder needs/ service providers:

CI-C-1) Lack of consideration of all stakeholders in the FM sphere; CI-C-2) Difficulties in managing conflicting stakeholder interests and requirements, especially due to some stakeholders "gold plating" their requirements; CI-C-3) Poorly controlled changes to user requirements; CI-C-4) Absence of, or poor system for providing incentives for performance; CI-C-5) Inflexible contracts; inability to accommodate changes in user requirements during the contract execution, especially those that fall outside agreed specifications and scope; CI-C-6) Inability to involve stakeholders from the outset in specifying the kinds of services required and the level of performance that will be acceptable to both in-house and external providers; CI-C-7) Difficulties in updating and improving service level agreements (SLAs) and service specifications to keep pace with the needed rate of change.

²Ii = Impact Index (See equation 1, Chapter 3)

³Fi = Frequency Index (See equation 3, Chapter 3)

⁴RS = Risk Score (See equation 5, Chapter 3)

Table 222: Risk levels - Challenge relating to manpower

¹ Challenges relating to manpower	Impact Index ² (Ii)	Frequency Index ³ (Fi)	Risk Score (RS) ⁴ (Ii x Fi)	Remark	Risk Ranking
CI-D-1	4.955	4.941	24.482	Very high	1
CI-D-2	3.129	3.653	11.431	Moderate	3
CI-D-3	2.902	3.511	10.188	Low	5
CI-D-4	1.915	2.148	4.112	Very low	7
CI-D-5	2.693	4.059	10.931	Moderate	4
CI-D-6	2.750	2.981	8.198	Low	6
CI-D-7	3.472	4.765	16.543	High	2

¹Challenges relating to manpower:

CI-D-1) Inadequate skilled manpower; CI-D-2) High costs of wages, salaries and associated employee expenditure (e.g. training, insurance, redundancy provisions, pensions, leave grants, etc); CI-D-3) Low productivity of the workforce due to issues such as low morale, job dissatisfaction, poor incentives, poor supervision, training, etc; CI-D-5) High staff turnover (due to poor remuneration, etc) and its impact on resources and continuity of workflow; CI-D-6) Poor quality of workmanship (especially in relation to in-house staff); CI-D-7) Compliance with OSH requirements in the workplace.

²Ii = Impact Index (See equation 1, Chapter 3)

³Fi = Frequency Index (See equation 3, Chapter 3)

⁴RS = Risk Score (See equation 5, Chapter 3)

Table 223: Risk levels - Challenges relating to machinery

¹ Challenges relating to machinery	Impact Index ² (Ii)	Frequency Index ³ (Fi)	Risk Score (RS) ⁴ (Ii x Fi)	Remark	Risk Ranking
CI-E-1	2.615	3.133	8.194	Low	7
CI-E-2	2.923	3.253	9.508	Low	6
CI-E-3	4.673	2.996	14.001	Moderate	5
CI-E-4	4.050	4.354	17.635	High	3
CI-E-5	3.855	4.066	15.673	High	4
CI-E-6	4.244	4.244	18.009	High	2
CI-E-7	4.354	4.669	20.330	Very high	1

¹Challenges relating to machinery:

CI-E-1) Unavailability of machinery/ equipment to maintain buildings/ facilities; CI-E-2) Hiring/ acquisition of machinery/ equipment and associated costs (e.g. installation, safety/ security, insurance, etc; CI-E-3) Durability/functionality problems and their impact on operational and maintenance costs; CI-E-4) Environmental performance issues and associated impacts on legal, operational and maintenance costs; CI-E-5) Logistics/ operational and maintenance problems: unavailability of parts and or repair technicians or high operator training costs; CI-E-6) Equipment selection dilemma: fitness-for-purpose and its impact on user requirements, and operational and maintenance cost; CI-E-7) Obsolescence and replacement costs for installed machines or equipment.

²Ii = Impact Index (See equation 1, Chapter 3)

³Fi = Frequency Index (See equation 3, Chapter 3)

⁴RS = Risk Score (See equation 5, Chapter 3)

Table 224: Risk levels - Challenges relating to materials

¹ Challenges relating to materials	Impact Index ² (Ii)	Frequency Index ³ (Fi)	Risk Score (RS) ⁴ (Ii x Fi)	Remark	Risk Ranking
CI-F-1	4.958	3.888	19.279	High	2
CI-F-2	2.400	2.705	6.490	Low	6
CI-F-3	3.121	2.922	9.121	Low	5
CI-F-4	4.470	4.536	20.274	Very high	1
CI-F-5	4.231	3.271	13.839	Moderate	4
CI-F-6	4.629	4.104	18.997	High	3

¹Challenges relating to materials:

CI-F-1) High costs or unavailability of materials and components; CI-F-2) Unavailability or insufficiency of storage facility, especially for fragile and perishable materials and components; CI-F-3) Durability problems and their impact on operational and maintenance costs; CI-F-4) Environmental performance problems and their impact on operational costs; CI-F-5) Compliance with OSH requirements, especially as it relates to hazardous/ dangerous goods storage and safety precautions; CI-F-6) Quality assurance/ selection dilemma in terms of fitness-of-purpose and impact on user-requirements, operational and maintenance cost.

²Ii = Impact Index (See equation 1, Chapter 3)

³Fi = Frequency Index (See equation 3, Chapter 3)

⁴RS = Risk Score (See equation 5, Chapter 3)

F.1.2 EXTERNAL CHALLENGES CONSTRAINING THE ACHIEVEMENT OF STRATEGIC FM GOALS

F.1.2.1 Levels of impact for external challenges

Table 225: Levels of impact - Challenges relating to economic constraints

<i>[Level of impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low]</i>										
¹ Challenges relating to economic constraints	Level of Impact (%)					² TR	³ II	Remark	⁴ RII	Rank
	VH	H	M	L	VL					
	5	4	3	2	1					
CE-B-1	58	34	8	0	0	528	4.500	Very High	0.227	1
CE-B-2	45	38	18	0	0	528	4.265	Very High	0.215	2
CE-B-3	35	36	18	11	0	528	3.949	High	0.199	3
CE-B-4	4	38	47	11	0	528	3.348	Moderate	0.169	5
CE-B-5	24	37	26	12	0	528	3.733	High	0.189	4
							<u>19.795</u>		<u>1.000</u>	

¹Restraints of macro- and micro-economic dynamics (inflation, exchange rate, tax, interest rates, etc) on budget/funding, resulting in:

CE-B-1) Unaffordability of new project, upgrade and maintenance costs; CE-B-2) Downsizing or scaling down of operation and maintenance activities; CE-B-3) Reduction in workforce size and skillsets; CE-B-4) Restriction on R&D and innovation; CE-B-5) Inability to meet user needs for vital space, grounds, equipment, etc.

²TR = Total responses for a particular variable;

³II = Impact Index (See equation 1, Chapter 3)

⁴RII = Relative Impact Index (See equation 2, Chapter 3)

Table 226: Levels of impact - Challenges relating to socio-cultural constraints

<i>[Level of impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low]</i>										
¹ Challenges relating to socio-cultural constraints	Level of Impact (%)					² TR	³ II	Remark	⁴ RII	Rank
	VH	H	M	L	VL					
	5	4	3	2	1					
CE-C-1	45	30	25	0	0	528	4.205	Very High	0.274	2
CE-C-2	19	32	27	17	5	528	3.415	High	0.222	3
CE-C-3	19	29	30	16	5	528	3.407	High	0.222	4
CE-C-4	50	33	17	0	0	528	4.335	Very High	0.282	1
							<u>15.362</u>		<u>1.000</u>	

¹Restraints inherent in dealing with socio-cultural issues in the workplace such as:

CE-C-1) Having to address the ethnic diversity and differing cultural needs, especially in relation to space planning and design solutions; CE-C-2) Socio-cultural sensitivity, social and racial profiling, etc; CE-C-3) Ergonomics: catering for the special needs of the aged in the workplace; CE-C-4) Compliance with the occupational health and safety regulations in the workplace.

²TR = Total responses for a particular variable;

³II = Impact Index (See equation 1, Chapter 3)

⁴RII = Relative Impact Index (See equation 2, Chapter 3)

Table 227: Levels of impact - Challenges relating to technological constraints

[Level of impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low]										
¹ Challenges relating to technological constraints	Level of Impact (%)					² TR	³ II	Remark	⁴ RII	Rank
	VH	H	M	L	VL					
	5	4	3	2	1					
CE-D-1	59	38	3	0	0	528	4.563	Very High	0.234	1
CE-D-2	19	80	2	0	0	528	4.172	High	0.214	3
CE-D-3	59	35	6	0	0	528	4.521	Very High	0.232	2
CE-D-4	11	35	33	16	4	528	3.333	Moderate	0.171	4
CE-D-5	14	19	12	52	2	528	2.907	Moderate	0.149	5
							<u>19.496</u>		<u>1.000</u>	

¹Restrains inherent in technological trends such as:

CE-D-1) The dilemma of having to monitor and keep up with the rapid technological changes/ developments; CE-D-2) Technological obsolescence and impact on competitiveness; CE-D-3) Huge capital investment required for acquisition and upgrading of technology; CE-D-4) Constant workforce training and re-training requirements; CE-D-5) Disruptions to operations inherent in installation, upgrades and trial runs.

²TR = Total responses for a particular variable;

³II = Impact Index (See equation 1, Chapter 3)

⁴RII = Relative Impact Index (See equation 2, Chapter 3)

Table 228: Levels of impact - Challenges relating to legislative constraints

[Level of impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low]										
¹ Challenges relating to legislative constraints	Level of Impact (%)					² TR	³ II	Remark	⁴ RII	Rank
	VH	H	M	L	VL					
	5	4	3	2	1					
CE-E-1	78	20	2	0	0	528	4.761	Very High	0.277	1
CE-E-2	58	19	18	5	0	528	4.290	Very High	0.249	3
CE-E-3	55	25	19	2	0	528	4.326	Very High	0.251	2
CE-E-4	30	38	16	16	0	528	3.833	High	0.223	4
							<u>17.210</u>		<u>1.000</u>	

¹Challenges relating to legislative/ regulatory compliance:

CE-E-1) Rapid changes in legislations, by-laws and standards/ codes affecting the FM planning and operations; CE-E-2) High legislative compliance costs and constraints in keeping pace with the regulatory changes; CE-E-3) Uncertainties and risks to forward planning; CE-E-4) Compliance with the occupational health and safety regulations in the workplace.

²TR = Total responses for a particular variable;

³II = Impact Index (See equation 1, Chapter 3)

⁴RII = Relative Impact Index (See equation 2, Chapter 3)

Table 229: Levels of impact - Challenges relating to environmental/ sustainability constraints

[Level of impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low]										
¹ Challenges relating to environmental and sustainability constraints	Level of Impact (%)					² TR	³ II	Remark	⁴ RII	Rank
	VH	H	M	L	VL					
	5	4	3	2	1					
CE-F-1	77	23	0	0	0	528	4.775	Very High	0.235	1
CE-F-2	57	22	18	4	0	528	4.313	Very High	0.213	2
CE-F-3	38	32	24	5	0	528	4.025	High	0.198	3
CE-F-4	31	38	19	11	0	528	3.900	High	0.192	4
CE-F-5	15	38	10	33	4	528	3.278	Moderate	0.162	5
							<u>20.290</u>		<u>1.000</u>	
¹ Challenges relating to environmental and sustainability constraints:										
CE-F-1) Rapid changes in legislation and by-laws; CE-F-2) The challenge of having to meet the minimum environmental standards against dwindling resources; CE-F-3) High legislative compliance and constraints, especially in relation to health and safety, resource and waste management; CE-F-4) Resource and building consent restrictions on planning, development and operations, especially in relation to preserving historic places, need to minimise carbon footprints, pollution, energy consumption, etc; CE-F-5) Pressure arising from environmental audit and reporting requirements.										
² TR = Total responses for a particular variable;										
³ II = Impact Index (See equation 1, Chapter 3)										
⁴ RII = Relative Impact Index (See equation 2, Chapter 3)										

Table 230: Levels of impact - Challenges relating to institutional constraints

[Level of impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low]										
¹ Challenges relating to institutional constraints:	Level of Impact (%)					² TR	³ II	Remark	⁴ RII	Rank
	VH	H	M	L	VL					
	5	4	3	2	1					
CE-G-1	19	6	71	4	0	528	3.398	Moderate	0.217	4
CE-G-2	48	27	15	9	0	528	4.148	High	0.265	2
CE-G-3	72	28	0	0	0	528	4.716	Very High	0.301	1
CE-G-4	19	7	70	5	0	528	3.402	High	0.217	3
							<u>15.663</u>		<u>1.000</u>	
¹ Restraints inherent in the internal(i.e. organisational dynamics) and external constraints(e.g. Professional/ethical code of practice)such as:										
CE-G-1) The challenge of having to meet the minimum ethical and professional practice and standards amidst conflicting pressures from within the organisation; CE-G-2) Undue influence/ excessive interference of the top management in FM affairs, which undermines freedom and pursuit of excellence in the discharge of FM duty; CE-G-3) Unrealistic expectations of the top management: "Achieve so much output with so little resources"; CE-G-4) Dilemma of juggling the organisational/ internal interests with the requirements for ethical and best practice standards imposed by the external/ professional regulatory framework.										
² TR = Total responses for a particular variable;										
³ II = Impact Index (See equation 1, Chapter 3)										
⁴ RII = Relative Impact Index (See equation 2, Chapter 3)										

F.1.2.2 Frequencies of occurrence for external challenges

Table 231: Frequencies of occurrence - Challenges relating to economic constraints

[Frequencies of occurrence: 5 = Very Frequent; 4 = Frequent; 3 = Occasional; 2 = Rare; 1 = Very Rare]										
¹ Challenges relating to economic constraints	Frequency of occurrence (%)					² TR	³ FI	Remark	⁴ RFI	Rank
	VF	F	O	R	VR					
	5	4	3	2	1					
CE-B-1	84	11	5	0	0	528	4.786	Very Frequent	0.235	1
CE-B-2	38	28	19	15	0	528	3.894	Frequent	0.191	4
CE-B-3	28	43	24	5	0	528	3.941	Frequent	0.194	3
CE-B-4	2	16	82	0	0	528	3.199	Occasional	0.157	5
CE-B-5	78	5	10	8	0	528	4.532	Very Frequent	0.223	2
<u>20.352</u>							<u>1.000</u>			
¹ Restraints of macro- and micro-economic dynamics (inflation, exchange rate, tax, interest rates, etc) on budget/funding, resulting in:										
CE-B-1) Unaffordability of new project, upgrade and maintenance costs; CE-B-2) Downsizing or scaling down of operation and maintenance activities; CE-B-3) Reduction in workforce size and skillsets; CE-B-4) Restriction on R&D and innovation; CE-B-5) Inability to meet user needs for vital space, grounds, equipment, etc.										
² TR = Total responses for a particular variable;										
³ FI = Impact Index (See equation 3, Chapter 3)										
⁴ RFI = Relative Impact Index (See equation 4, Chapter 3)										

Table 232: Frequencies of occurrence - Challenges relating to socio-cultural constraints

[Frequencies of occurrence: 5 = Very Frequent; 4 = Frequent; 3 = Occasional; 2 = Rare; 1 = Very Rare]										
¹ Challenges relating to socio-cultural constraints	Frequency of occurrence (%)					² TR	³ FI	Remark	⁴ RFI	Rank
	VF	F	O	R	VR					
	5	4	3	2	1					
CE-C-1	81	19	0	0	0	528	4.814	Very Frequent	0.267	1
CE-C-2	78	15	7	0	0	528	4.714	Very Frequent	0.261	2
CE-C-3	41	34	21	4	0	528	4.127	Frequent	0.229	4
CE-C-4	57	29	11	3	0	528	4.398	Very Frequent	0.244	3
<u>18.053</u>							<u>1.000</u>			
¹ Restraints inherent in dealing with socio-cultural issues in the workplace such as: CE-C-1) Having to address the ethnic diversity and differing cultural needs, especially in relation to space planning and design solutions; CE-C-2) Socio-cultural sensitivity, social and racial profiling, etc; CE-C-3) Ergonomics: catering for the special needs of the aged in the workplace; CE-C-4) Compliance with the occupational health and safety regulations in the workplace. ² TR = Total responses for a particular variable; ³ FI = Impact Index (See equation 3, Chapter 3) ⁴ RFI = Relative Impact Index (See equation 4, Chapter 3)										

Table 233: Frequencies of occurrence - Challenges relating to technological constraints

<i>[Frequencies of occurrence: 5 = Very Frequent; 4 = Frequent; 3 = Occasional; 2 = Rare; 1 = Very Rare]</i>										
¹ Challenges relating to technological constraints	Frequency of occurrence (%)					² TR	³ FI	Remark	⁴ RFI	Rank
	VF	F	O	R	VR					
CE-D-1	76	24	0	0	0	528	4.758	Very Frequent	0.230	1
CE-D-2	51	38	7	4	0	528	4.364	Very Frequent	0.211	2
CE-D-3	38	38	15	9	0	528	4.047	Frequent	0.195	3
CE-D-4	5	57	32	6	0	528	3.619	Frequent	0.175	5
CE-D-5	15	65	17	3	0	528	3.919	Frequent	0.189	4
							<u>20.706</u>		<u>1.000</u>	
¹ Restrains inherent in technological trends such as: CE-D-1) The dilemma of having to monitor and keep up with the rapid technological changes/ developments; CE-D-2) Technological obsolescence and impact on competitiveness; CE-D-3) Huge capital investment required for acquisition and upgrading of technology; CE-D-4) Constant workforce training and re-training requirements; CE-D-5) Disruptions to operations inherent in installation, upgrades and trial runs. ² TR = Total responses for a particular variable; ³ FI = Impact Index (See equation 3, Chapter 3) ⁴ RFI = Relative Impact Index (See equation 4, Chapter 3)										

Table 234: Frequencies of occurrence - Challenges relating to legislative constraints

<i>[Frequencies of occurrence: 5 = Very Frequent; 4 = Frequent; 3 = Occasional; 2 = Rare; 1 = Very Rare]</i>										
¹ Challenges relating to legislative constraints	Frequency of occurrence (%)					² TR	³ FI	Remark	⁴ RFI	Rank
	VF	F	O	R	VR					
CE-E-1	76	19	5	0	0	528	4.705	Very High	0.282	1
CE-E-2	57	19	19	6	0	528	4.259	Very High	0.255	2
CE-E-3	38	28	20	13	0	528	3.879	High	0.233	3
CE-E-4	30	32	28	9	0	528	3.830	High	0.230	4
							<u>16.673</u>		<u>1.000</u>	
¹ Challenges relating to legislative/ regulatory compliance: CE-E-1) Rapid changes in legislations, by-laws and standards/ codes affecting the FM planning and operations; CE-E-2) High legislative compliance costs and constraints in keeping pace with the regulatory changes; CE-E-3) Uncertainties and risks to forward planning; CE-E-4) Compliance with the occupational health and safety regulations in the workplace. ² TR = Total responses for a particular variable; ³ FI = Impact Index (See equation 3, Chapter 3) ⁴ RFI = Relative Impact Index (See equation 4, Chapter 3)										

Table 235: Frequencies of occurrence - Challenges relating to environmental and sustainability constraints

[Frequencies of occurrence: 5 = Very Frequent; 4 = Frequent; 3 = Occasional; 2 = Rare; 1 = Very Rare]										
¹ Challenges relating to environmental and sustainability constraints	Frequency of occurrence					² TR	³ FI	Remark	⁴ RFI	Rank
	VF	F	O	R	VR					
	%	%	%	%	%					
	5	4	3	2	1					
CE-F-1	76	20	4	0	0	528	4.718	Very Frequent	0.241	1
CE-F-2	69	19	5	6	0	528	4.515	Very Frequent	0.231	2
CE-F-3	38	34	15	11	2	528	3.947	Frequent	0.202	3
CE-F-4	19	17	38	26	0	528	3.288	Occasional	0.168	4
CE-F-5	13	19	38	25	6	528	3.091	Occasional	0.158	5
							<u>19.559</u>		<u>1.000</u>	

¹Challenges relating to environmental and sustainability constraints:

CE-F-1) Rapid changes in legislation and by-laws; CE-F-2) The challenge of having to meet the minimum environmental standards against dwindling resources; CE-F-3) High legislative compliance and constraints, especially in relation to health and safety, resource and waste management; CE-F-4) Resource and building consent restrictions on planning, development and operations, especially in relation to preserving historic places, need to minimise carbon footprints, pollution, energy consumption, etc; CE-F-5) Pressure arising from environmental audit and reporting requirements.

²TR = Total responses for a particular variable;

³FI = Impact Index (See equation 3, Chapter 3)

⁴RFI = Relative Impact Index (See equation 4, Chapter 3)

Table 236: Frequencies of occurrence - Challenges relating to institutional constraints

[Frequencies of occurrence: 5 = Very Frequent; 4 = Frequent; 3 = Occasional; 2 = Rare; 1 = Very Rare]										
¹ Challenges relating to institutional constraints:	Frequency of occurrence (%)					² TR	³ FI	Remark	⁴ RFI	Rank
	VF	F	O	R	VR					
	5	4	3	2	1					
CE-G-1	32	55	13	0	0	528	4.191	Frequent	0.265	2
CE-G-2	31	43	26	0	0	528	4.051	Frequent	0.256	3
CE-G-3	53	25	22	0	0	528	4.311	Very Frequent	0.272	1
CE-G-4	19	16	37	27	0	528	3.269	Occasional	0.207	4
							<u>15.822</u>		<u>1.000</u>	

¹Restraints inherent in the internal(i.e. organisational dynamics) and external constraints(e.g. Professional/ethical code of practice)such as:

CE-G-1) The challenge of having to meet the minimum ethical and professional practice and standards amidst conflicting pressures from within the organisation; CE-G-2) Undue influence/ excessive interference of the top management in FM affairs, which undermines freedom and pursuit of excellence in the discharge of FM duty; CE-G-3) Unrealistic expectations of the top management: "Achieve so much output with so little resources"; CE-G-4) Dilemma of juggling the organisational/ internal interests with the requirements for ethical and best practice standards imposed by the external/ professional regulatory framework.

²TR = Total responses for a particular variable;

³FI = Impact Index (See equation 3, Chapter 3)

⁴RFI = Relative Impact Index (See equation 4, Chapter 3)

F.1.2.3 Risk levels for external challenges

Table 237: Risk levels - Challenges relating to economic constraints

¹ Challenges relating to economic constraints	Impact Index ² (Ii)	Frequency Index ³ (Fi)	Risk Score (RS) ⁴ (Ii x Fi)	Remark	Risk Ranking
CE-B-1	4.500	4.786	21.537	Very high	1
CE-B-2	4.265	3.894	16.608	High	3
CE-B-3	3.949	3.941	15.564	High	4
CE-B-4	3.348	3.199	10.711	Moderate	5
CE-B-5	3.733	4.532	16.918	High	2

¹ Restraints of macro- and micro-economic dynamics (inflation, exchange rate, tax, interest rates, etc) on budget/funding, resulting in:

CE-B-1) Unaffordability of new project, upgrade and maintenance costs; CE-B-2) Downsizing or scaling down of operation and maintenance activities; CE-B-3) Reduction in workforce size and skillsets; CE-B-4) Restriction on R&D and innovation; CE-B-5) Inability to meet user needs for vital space, grounds, equipment, etc.

²Ii = Impact Index (See equation 1, Chapter 3)

³Fi = Frequency Index (See equation 3, Chapter 3)

⁴RS = Risk Score (See equation 5, Chapter 3)

Table 238: Risk levels - Challenges relating to socio-cultural constraints

¹ Challenges relating to socio-cultural constraints	Impact Index ² (Ii)	Frequency Index ³ (Fi)	Risk Score (RS) ⁴ (Ii x Fi)	Remark	Risk Ranking
CE-C-1	4.205	4.814	20.242	Very high	1
CE-C-2	3.415	4.714	16.097	High	3
CE-C-3	3.407	4.127	14.061	Moderate	4
CE-C-4	4.335	4.398	19.065	High	2

¹ Restraints inherent in dealing with socio-cultural issues in the workplace such as:

CE-C-1) Having to address the ethnic diversity and differing cultural needs, especially in relation to space planning and design solutions; CE-C-2) Socio-cultural sensitivity, social and racial profiling, etc; CE-C-3) Ergonomics: catering for the special needs of the aged in the workplace; CE-C-4) Compliance with the occupational health and safety regulations in the workplace.

²Ii = Impact Index (See equation 1, Chapter 3)

³Fi = Frequency Index (See equation 3, Chapter 3)

⁴RS = Risk Score (See equation 5, Chapter 3)

Table 239: Risk levels - Challenges relating to technological constraints

¹ Challenges relating to technological constraints	Impact Index ² (Ii)	Frequency Index ³ (Fi)	Risk Score (RS) ⁴ (Ii x Fi)	Remark	Risk Ranking
CE-D-1	4.563	4.758	21.706	Very high	1
CE-D-2	4.172	4.364	18.207	High	3
CE-D-3	4.521	4.047	18.297	High	2
CE-D-4	3.333	3.619	12.064	Moderate	4
CE-D-5	2.907	3.919	11.392	Moderate	5

¹ Restraints inherent in technological trends such as:

CE-D-1) The dilemma of having to monitor and keep up with the rapid technological changes/ developments; CE-D-2) Technological obsolescence and impact on competitiveness; CE-D-3) Huge capital investment required for acquisition and upgrading of technology; CE-D-4) Constant workforce training and re-training requirements; CE-D-5) Disruptions to operations inherent in installation, upgrades and trial runs.

²Ii = Impact Index (See equation 1, Chapter 3)

³Fi = Frequency Index (See equation 3, Chapter 3)

⁴RS = Risk Score (See equation 5, Chapter 3)

Table 240: Risk levels - Challenges relating to legislative constraints

¹ Challenges relating to legislative constraints	Impact Index ² (Ii)	Frequency Index ³ (Fi)	Risk Score (RS) ⁴ (Ii x Fi)	Remark	Risk Ranking
CE-E-1	4.761	4.705	22.400	Very high	1
CE-E-2	4.290	4.259	18.272	High	2
CE-E-3	4.326	3.879	16.780	High	3
CE-E-4	3.833	3.830	14.680	Moderate	4

¹ Challenges relating to legislative/ regulatory compliance
CE-E-1) Rapid changes in legislations, by-laws and standards/ codes affecting the FM planning and operations;
CE-E-2) High legislative compliance costs and constraints in keeping pace with the regulatory changes; CE-E-3) Uncertainties and risks to forward planning; CE-E-4) Compliance with the occupational health and safety regulations in the workplace.
²Ii = Impact Index (See equation 1, Chapter 3)
³Fi = Frequency Index (See equation 3, Chapter 3)
⁴RS = Risk Score (See equation 5, Chapter 3)

Table 241: Risk levels - Challenges relating to environmental and sustainability constraints

¹ Environmental and sustainability constraints	Impact Index ² (Ii)	Frequency Index ³ (Fi)	Risk Score (RS) ⁴ (Ii x Fi)	Remark	Risk Ranking
CE-F-1	4.775	4.718	22.526	Very high	1
CE-F-2	4.313	4.515	19.472	High	2
CE-F-3	4.025	3.947	15.885	High	3
CE-F-4	3.900	3.288	12.821	Moderate	4
CE-F-5	3.278	3.091	10.133	Low	5

¹ Environmental and sustainability constraints
CE-F-1) Rapid changes in legislation and by-laws; CE-F-2) The challenge of having to meet the minimum environmental standards against dwindling resources; CE-F-3) High legislative compliance and constraints, especially in relation to health and safety, resource and waste management; CE-F-4) Resource and building consent restrictions on planning, development and operations, especially in relation to preserving historic places, need to minimise carbon footprints, pollution, energy consumption, etc; CE-F-5) Pressure arising from environmental audit and reporting requirements.
²Ii = Impact Index (See equation 1, Chapter 3)
³Fi = Frequency Index (See equation 3, Chapter 3)
⁴RS = Risk Score (See equation 5, Chapter 3)

Table 242: Risk levels - Challenges relating to institutional constraints

¹ Challenges relating to institutional constraints	Impact Index ² (Ii)	Frequency Index ³ (Fi)	Risk Score (RS) ⁴ (Ii x Fi)	Remark	Risk Ranking
CE-G-1	3.398	4.191	14.241	Moderate	3
CE-G-2	4.148	4.051	16.803	High	2
CE-G-3	4.716	4.311	20.328	Very high	1
CE-G-4	3.402	3.269	11.119	Moderate	4

¹ Restraints inherent in the internal(i.e. organisational dynamics) and external constraints(e.g. Professional/ethical code of practice)such as:

CE-G-1) The challenge of having to meet the minimum ethical and professional practice and standards amidst conflicting pressures from within the organisation; CE-G-2) Undue influence/ excessive interference of the top management in FM affairs, which undermines freedom and pursuit of excellence in the discharge of FM duty; CE-G-3) Unrealistic expectations of the top management: "Achieve so much output with so little resources"; CE-G-4) Dilemma of juggling the organisational/ internal interests with the requirements for ethical and best practice standards imposed by the external/ professional regulatory framework.

²Ii = Impact Index (See equation 1, Chapter 3)

³Fi = Frequency Index (See equation 3, Chapter 3)

⁴RS = Risk Score (See equation 5, Chapter 3)

F.2 MODEL TEST SURVEYS

F.2.1 CASE STUDY II – UNIVERSITY B

F.2.1.1 Current Internal (CI) challenges constraining the achievement of strategic FM goals

Table 243: University B - Levels of impact for CI challenges

Code	* Rating for impact levels					TR	II	Remark	RII	Rank
	VH	H	M	L	VL					
	%	%	%	%	%					
	5	4	3	2	1					
CI-1	100	0	0	0	0	6	5.00	Very High	0.199	1
CI-2	0	0	33	67	0	6	2.33	Low	0.093	5
CI-3	0	0	33	50	17	6	2.17	Low	0.086	6
CI-4	83	0	17	0	0	6	4.67	Very High	0.185	3
CI-5	83	17	0	0	0	6	4.83	Very High	0.192	2
CI-6	50	33	17	0	0	6	4.33	Very High	0.172	4
CI-7	0	0	0	83	17	6	1.83	Low	0.073	7
							<u>25.167</u>		<u>1.000</u>	
Broad categories of Current Internal (CI) challenges: CI-1) Finance; CI-2) Operational efficiency; CI-3) Risk management; CI-4) Stakeholder needs/ Service providers; CI-5) Maintenance; CI-6) Manpower; CI-7) Machinery/ equipment.										

Table 244: University B - Frequencies of occurrence for CI challenges

Code	Rating for frequency of occurrence					TR	FI	Remark	RII	Rank
	VF	F	O	R	VR					
	%	%	%	%	%					
	5	4	3	2	1					
CI-1	100	0	0	0	0	6	5.00	Very Frequent	0.190	1
CI-2	0	0	17	67	17	6	2.00	Rare	0.076	6
CI-3	0	0	0	33	67	6	1.33	Very Rare	0.051	7
CI-4	67	33	0	0	0	6	4.67	Very Frequent	0.177	3
CI-5	83	17	0	0	0	6	4.83	Very Frequent	0.184	2
CI-6	33	67	0	0	0	6	4.33	Very Frequent	0.165	4
CI-7	50	17	33	0	0	6	4.17	Frequent	0.158	5
							<u>26.33</u>		<u>1.000</u>	
Broad categories of Current Internal (CI) challenges: CI-1) Finance; CI-2) Operational efficiency; CI-3) Risk management; CI-4) Stakeholder needs/ Service providers; CI-5) Maintenance; CI-6) Manpower; CI-7) Machinery/ equipment.										

Table 245: University B - Risk scores for CI challenges

Code	Impact Index (Ii)	Frequency Index (Fi)	Risk Score (RS) (Ii x Fi)	Remark	Risk Ranking
CI-1	5.000	5.000	25.000	Very high	1
CI-2	2.333	2.000	4.667	Very low	6
CI-3	2.167	1.333	2.889	Very low	7
CI-4	4.667	4.667	21.778	Very high	3
CI-5	4.833	4.833	23.361	Very high	2
CI-6	4.333	4.333	18.778	High	4
CI-7	1.833	4.167	7.639	Low	5

Broad categories of Current Internal (CI) challenges:

CI-1) Finance; CI-2) Operational efficiency; CI-3) Risk management; CI-4) Stakeholder needs/ Service providers; CI-5) Maintenance; CI-6) Manpower; CI-7) Machinery/ equipment.

F.3.1.2 Current External (CE) challenges constraining the achievement of strategic FM goals

Table 246: University B - Levels of impact for CE challenges

Code	* Rating for impact levels					TR	II	Remark	RII	Rank
	VH	H	M	L	VL					
	%	%	%	%	%					
	5	4	3	2	1					
CE-1	50	33	17	0	0	6	4.33	Very High	0.177	2
CE-2	33	50	17	0	0	6	4.17	High	0.170	3
CE-3	17	33	50	0	0	6	3.67	High	0.150	6
CE-4	67	33	0	0	0	6	4.67	Very High	0.190	1
CE-5	17	50	33	0	0	6	3.83	High	0.156	4
CE-6	0	83	17	0	0	6	3.83	High	0.156	5
							<u>24.50</u>		<u>1.000</u>	

Broad categories of Current External (CE) challenges:

CE-1) Economic; CE-2) Sustainability / environmental issues; CE-3) Technological; CE-4) Regulatory/ compliance; CE-5) Socio-cultural issues/ CE-6) Institutional.

Table 247: University B - Frequencies of occurrence for CE challenges

Code	Rating for frequency of occurrence					TR	FI	Remark	RII	Rank
	VF	F	O	R	VR					
	%	%	%	%	%					
	5	4	3	2	1					
CE-1	50	50	0	0	0	6	4.50	Very Frequent	0.182	2
CE-2	83	17	0	0	0	6	4.83	Very Frequent	0.196	1
CE-3	17	33	50	0	0	6	3.67	Frequent	0.149	5
CE-4	33	33	33	0	0	6	4.00	Frequent	0.162	4
CE-5	17	33	33	17	0	6	3.50	Frequent	0.142	6
CE-6	33	50	17	0	0	6	4.17	Frequent	0.169	3
							<u>24.67</u>		<u>1.000</u>	
<i>Broad categories of Current External (CE) challenges:</i>										
CE-1) Economic; CE-2) Sustainability / environmental issues; CE-3) Technological; CE-4) Regulatory/ compliance; CE-5) Socio-cultural issues/ CE-6) Institutional.										

Table 248: University B - Risk scores of CE challenges

Code	Impact Index (Ii)	Frequency Index (Fi)	Risk Score (RS) (Ii x Fi)	Remark	Risk Ranking
CE-1	4.333	4.500	19.500	High	2
CE-2	4.167	4.833	20.139	High	1
CE-3	3.667	3.667	13.444	Moderate	5
CE-4	4.667	4.000	18.667	High	3
CE-5	3.833	3.500	13.417	Moderate	6
CE-6	3.833	4.167	15.972	High	4
<i>Broad categories of Current External (CE) challenges:</i>					
CE-1) Economic; CE-2) Sustainability / environmental issues; CE-3) Technological; CE-4) Regulatory/ compliance; CE-5) Socio-cultural issues/ CE-6) Institutional.					

F.2.1.3 Predicted Future (F) challenges constraining the achievement of strategic FM goals

Future (F) challenges:

F-1) Emergency management; F-2) Statutory compliance; F-3) Sustainability; F-4) Technology; F-5) User needs assessment and satisfaction; F-6) Business and financial management; F-7) Occupational health & safety; F-8) Corporate image; F-9) Leadership and innovation; F-10) Space management; F-11) Outsourcing.

Table 249: University B - Levels of impact for Future challenges

Code	* Rating for impact levels					TR	II	Remark	RII	Rank
	VH	H	M	L	VL					
	% 5	% 4	% 3	% 2	% 1					
F-1	100	0	0	0	0	6	5.00	Very High	0.129	1
F-2	33	33	33	0	0	6	4.00	High	0.103	4
F-3	67	33	0	0	0	6	4.67	Very High	0.120	2
F-4	17	33	50	0	0	6	3.67	High	0.094	5
F-5	0	33	33	33	0	6	3.00	Moderate	0.077	8
F-6	0	17	17	67	0	6	2.50	Low	0.064	10
F-7	0	33	50	17	0	6	3.17	Moderate	0.082	7
F-8	0	0	17	67	17	6	2.00	Low	0.052	11
F-9	0	50	50	0	0	6	3.50	High	0.090	6
F-10	50	50	0	0	0	6	4.50	Very High	0.116	3
F-11	0	17	50	33	0	6	2.83	Moderate	0.073	9
							<u>38.83</u>		<u>1.000</u>	

Table 250: University B - Frequencies of occurrence for Future challenges

Code	Rating for frequency of occurrence					TR	FI	Remark	RII	Rank
	VF	F	O	R	VR					
	%	%	%	%	%					
	5	4	3	2	1					
F-1	67	33	0	0	0	6	4.67	Very Frequent	0.115	1
F-2	17	67	17	0	0	6	4.00	Frequent	0.099	4
F-3	50	50	0	0	0	6	4.50	Very Frequent	0.111	2
F-4	17	33	50	0	0	6	3.67	Frequent	0.091	6
F-5	0	33	33	33	0	6	3.00	Occasional	0.074	10
F-6	17	17	50	17	0	6	3.33	Occasional	0.082	8
F-7	33	17	50	0	0	6	3.83	Frequent	0.095	5
F-8	0	0	50	50	0	6	2.50	Rare	0.062	11
F-9	0	50	50	0	0	6	3.50	Frequent	0.086	7
F-10	50	33	17	0	0	6	4.33	Very Frequent	0.107	3
F-11	0	33	50	17	0	6	3.17	Occasional	0.078	9
							<u>40.50</u>		<u>1.000</u>	

Table 251: University B - Risk scores for Future challenges

Code	Impact Index (Ii)	Frequency Index (Fi)	Risk Score (RS) (Ii x Fi)	Remark	Risk Ranking
F-1	5.000	4.667	23.333	Very high	1
F-2	4.000	4.000	16.000	High	4
F-3	4.667	4.500	21.000	Very high	2
F-4	3.667	3.667	13.444	Moderate	5
F-5	3.000	3.000	9.000	Low	8
F-6	2.500	3.333	8.333	Low	10
F-7	3.167	3.833	12.139	Moderate	7
F-8	2.000	2.500	5.000	Very low	11
F-9	3.500	3.500	12.250	Moderate	6
F-10	4.500	4.333	19.500	High	3
F-11	2.833	3.167	8.972	Low	9

F.2.2 CASE STUDY III – UNIVERSITY C

F.2.2.1 Current Internal (CI) challenges constraining the achievement of strategic FM goals

Broad categories of Current Internal (CI) challenges:

CI-1) Finance; CI-2) Operational efficiency; CI-3) Risk management; CI-4) Stakeholder needs/ Service providers; CI-5) Maintenance; CI-6) Manpower; CI-7) Machinery/ equipment.

Table 252: University C - Levels of impact for CI challenges

<i>* Level of impact : 5 = Very High; 4 = High; 3 = Medium; 2 = Low; 1 = Very Low</i>										
Code	* Rating for impact levels					TR	II	Remark	RII	Rank
	VH	H	M	L	VL					
	%	%	%	%	%					
	5	4	3	2	1					
CI-1	0	100	0	0	0	5	4.00	High	0.143	3
CI-2	0	100	0	0	0	5	4.00	High	0.143	3
CI-3	0	60	40	0	0	5	3.60	High	0.129	6
CI-4	0	0	100	0	0	5	3.00	Moderate	0.107	7
CI-5	80	20	0	0	0	5	4.80	Very High	0.171	1
CI-6	60	40	0	0	0	5	4.60	Very High	0.164	2
CI-7	0	100	0	0	0	5	4.00	High	0.143	3
							28.00		1.000	

Table 253: University C - Frequencies of occurrence for CI challenges

Code	Rating for frequency of occurrence					TR	FI	Remark	RII	Rank
	VF	F	O	R	VR					
	%	%	%	%	%					
	5	4	3	2	1					
CI-1	100	0	0	0	0	5	5.00	Very High	0.188	1
CI-2	20	20	40	20	0	5	3.40	High	0.128	5
CI-3	0	0	100	0	0	5	3.00	Moderate	0.113	6
CI-4	40	60	0	0	0	5	4.40	Very High	0.165	2
CI-5	40	40	20	0	0	5	4.20	Very High	0.158	3
CI-6	20	40	40	0	0	5	3.80	High	0.143	4
CI-7	0	20	40	40	0	5	2.80	Moderate	0.105	7
							26.60		1.000	

Table 254: University C - Risk scores for CI challenges

Code	Impact Index (Ii)	Frequency Index (Fi)	Risk Score (RS) (Ii x Fi)	Remark	Risk Ranking
CI-1	4.000	5.000	20.000	High	2
CI-2	4.000	3.400	13.600	Moderate	4
CI-3	3.600	3.000	10.800	Moderate	7
CI-4	3.000	4.400	13.200	Moderate	5
CI-5	4.800	4.200	20.160	High	1
CI-6	4.600	3.800	17.480	High	3
CI-7	4.000	2.800	11.200	Moderate	6

F.2.2.2. Current External (CE) challenges constraining the achievement of strategic FM goals

Broad categories of Current External (CE) challenges:

CE-1) Economic; CE-2) Sustainability / environmental issues; CE-3) Technological; CE-4) Regulatory/ compliance; CE-5) Socio-cultural issues/ CE-6) Institutional.

Table 255: University C - Levels of impact for CE challenges

<i>* Level of impact : 5 = Very High; 4 = High; 3 = Medium; 2 = Low; 1 = Very Low</i>										
Code	* Rating for impact levels					TR	II	Remark	RII	Rank
	VH	H	M	L	VL					
	% 5	% 4	% 3	% 2	% 1					
CE-1	20	60	20	0	0	5	4.00	High	0.190	3
CE-2	40	40	20	0	0	5	4.20	Very High	0.200	2
CE-3	0	0	0	80	20	5	1.80	Low	0.086	6
CE-4	40	60	0	0	0	5	4.40	Very High	0.210	1
CE-5	0	0	80	20	0	5	2.80	Moderate	0.133	5
CE-6	0	80	20	0	0	5	3.80	High	0.181	4
							21.00		1.000	

Table 256: University C - Frequencies of occurrence for CE challenges

** Frequencies of occurrence: 5 = Very frequent; 4 = Frequent; 3 = Occasional; 2 = Rare; 1 = Very Rare.*

Code	Rating for frequency of occurrence					TR	FI	Remark	RII	Rank
	VF	F	O	R	VR					
	% 5	% 4	% 3	% 2	% 1					
CE-1	40	40	20	0	0	5	4.20	Very High	0.202	2
CE-2	100	0	0	0	0	5	5.00	Very High	0.240	1
CE-3	0	60	40	0	0	5	3.60	High	0.173	4
CE-4	20	40	40	0	0	5	3.80	High	0.183	3
CE-5	0	0	0	60	40	5	1.60	Very Low	0.077	6
CE-6	0	0	60	40	0	5	2.60	Moderate	0.125	5
							<u>20.80</u>		<u>1.000</u>	

Table 257: University C - Risk scores for CE challenges

Code	Impact Index (Ii)	Frequency Index (Fi)	Risk Score (RS) (Ii x Fi)	Remark	Risk Ranking
CE-1	4.000	4.200	16.800	High	2
CE-2	4.200	5.000	21.000	Very high	1
CE-3	1.800	3.600	6.480	Low	5
CE-4	4.400	3.800	16.720	High	3
CE-5	2.800	1.600	4.480	Very low	6
CE-6	3.800	2.600	9.880	Low	4

F.2.2.3. Predicted Future (F) challenges constraining the achievement of strategic FM goals

Future (F) challenges:

F-1) Emergency management; F-2) Statutory compliance; F-3) Sustainability; F-4) Technology; F-5) User needs assessment and satisfaction; F-6) Business and financial management; F-7) Occupational health & safety; F-8) Corporate image; F-9) Leadership and innovation; F-10) Space management; F-11) Outsourcing.

Table 258: University C - Levels of impact for Future challenges

<i>* Level of impact : 5 = Very High; 4 = High; 3 = Medium; 2 = Low; 1 = Very Low</i>										
* Rating for impact levels										
Code	VH %	H %	M %	L %	VL %	TR	II	Remark	RII	Rank
	5	4	3	2	1					
F-1	0	0	100	0	0	5	3.00	Moderate	1.154	3
F-2	20	80	0	0	0	5	4.20	Very High	1.615	2
F-3	40	60	0	0	0	5	4.40	Very High	1.692	1
F-4	0	0	80	20	0	5	2.80	Moderate	1.077	4
F-5	0	80	20	0	0	5	3.80	High	0.109	6
F-6	0	100	0	0	0	5	4.00	High	0.114	5
F-7	0	0	100	0	0	5	3.00	Moderate	0.086	8
F-8	0	0	0	60	40	5	1.60	Very Low	0.046	11
F-9	0	60	40	0	0	5	3.60	High	0.103	7
F-10	0	0	0	100	0	5	2.00	Low	0.057	10
F-11	0	0	60	40	0	5	2.60	Moderate	0.074	9
							35.00		6.127	

Table 259: University C - Frequencies of occurrence for Future challenges

<i>* Frequencies of occurrence: 5 = Very frequent; 4 = Frequent; 3 = Occasional; 2 = Rare; 1 = Very Rare.</i>										
Rating for frequency of occurrence										
Code	VF %	F %	O %	R %	VR %	TR	FI	Remark	RII	Rank
	5	4	3	2	1					
F-1	0	40	60	0	0	5	3.40	High	0.099	4
F-2	0	100	0	0	0	5	4.00	High	0.117	2
F-3	100	0	0	0	0	5	5.00	Very High	0.146	1
F-4	0	40	40	20	0	5	3.20	Moderate	0.094	5
F-5	0	20	60	20	0	5	3.00	Moderate	0.088	6
F-6	0	0	40	40	20	5	2.20	Low	0.064	10
F-7	0	0	20	60	20	5	2.00	Low	0.058	11
F-8	0	0	60	20	20	5	2.40	Low	0.070	9
F-9	0	20	40	40	0	5	2.80	Moderate	0.082	7
F-10	20	40	20	20	0	5	3.60	High	0.105	3
F-11	0	0	60	40	0	5	2.60	Moderate	0.076	8
							34.20		1.000	

Table 260: University C - Risk scores for Future challenges

Code	Impact Index (Ii)	Frequency Index (Fi)	Risk Score (RS) (Ii x Fi)	Remark	Risk Ranking
F-1	3.000	3.400	10.200	Low	4
F-2	4.200	4.000	16.800	High	2
F-3	4.400	5.000	22.000	Very high	1
F-4	2.800	3.200	8.960	Low	6
F-5	3.800	3.000	11.400	Moderate	3
F-6	4.000	2.200	8.800	Low	7
F-7	3.000	2.000	6.000	Low	10
F-8	1.600	2.400	3.840	Very low	11
F-9	3.600	2.800	10.080	Low	5
F-10	2.000	3.600	7.200	Low	8
F-11	2.60	2.60	6.76	Low	9

F.2.3 CASE STUDY IV – UNIVERSITY D

F.2.3.1. Current Internal (CI) challenges constraining the achievement of strategic FM goals

Broad categories of Current Internal (CI) challenges:

CI-1) Finance; CI-2) Operational efficiency; CI-3) Risk management; CI-4) Stakeholder needs/ Service providers; CI-5) Maintenance; CI-6) Manpower; CI-7) Machinery/ equipment.

Table 261: University D - Levels of impact for CI challenges

<i>* Level of impact : 5 = Very High; 4 = High; 3 = Medium; 2 = Low; 1 = Very Low</i>										
Code	* Rating for impact levels					TR	II	Remark	RII	Rank
	VH	H	M	L	VL					
	%	%	%	%	%					
	5	4	3	2	1					
CI-1	67	33	0	0	0	6	4.67	Very High	0.178	1
CI-2	0	50	50	0	0	6	3.50	High	0.134	5
CI-3	0	67	33	0	0	6	3.67	High	0.140	4
CI-4	50	50	0	0	0	6	4.50	Very High	0.172	2
CI-5	17	67	17	0	0	6	4.00	High	0.153	3
CI-6	0	33	67	0	0	6	3.33	Moderate	0.127	6
CI-7	0	0	50	50	0	6	2.50	Low	0.096	7
							<u>26.17</u>		<u>1.000</u>	

Table 262: University D - Frequencies of occurrence for CI challenges

<i>* Frequencies of occurrence: 5 = Very frequent; 4 = Frequent; 3 = Occasional; 2 = Rare; 1 = Very Rare.</i>										
Code	Rating for frequency of occurrence					TR	FI	Remark	RII	Rank
	VF	F	O	R	VR					
	%	%	%	%	%					
	5	4	3	2	1					
CI-1	100	0	0	0	0	6	5.00	Very High	0.203	1
CI-2	0	33	33	33	0	6	3.00	Moderate	0.122	5
CI-3	17	17	33	33	0	6	3.17	Moderate	0.128	4
CI-4	50	50	0	0	0	6	4.50	Very High	0.182	2
CI-5	33	50	17	0	0	6	4.17	High	0.169	3
CI-6	0	0	67	33	0	6	2.67	Moderate	0.108	6
CI-7	0	17	17	33	33	6	2.17	Low	0.088	7
							<u>24.67</u>		<u>1.000</u>	

Table 263: University D - Risk scores for CI challenges

Code	Impact Index (Ii)	Frequency Index (Fi)	Risk Score (RS) (Ii x Fi)	Remark	Risk Ranking
CI-1	4.667	5.000	23.333	Very high	1
CI-2	3.500	3.000	10.500	Low	5
CI-3	3.667	3.167	11.611	Moderate	4
CI-4	4.500	4.500	20.250	Very high	2
CI-5	4.000	4.167	16.667	High	3
CI-6	3.333	2.667	8.889	Low	6
CI-7	2.500	2.167	5.417	Very low	7

F.2.3.2. Current External (CE) challenges constraining the achievement of strategic FM goals

Broad categories of Current External (CE) challenges:

CE-1) Economic; CE-2) Sustainability / environmental issues; CE-3) Technological; CE-4) Regulatory/ compliance; CE-5) Socio-cultural issues/ CE-6) Institutional.

Table 264: University D - Level of impacts for CE challenges

* Level of impact : 5 = Very High; 4 = High; 3 = Medium; 2 = Low; 1 = Very Low

Code	* Rating for impact levels					TR	II	Remark	RII	Rank
	VH	H	M	L	VL					
	%	%	%	%	%					
	5	4	3	2	1					
CE-1	0	50	50	0	0	6	3.50	High	0.165	3
CE-2	67	33	0	0	0	6	4.67	Very High	0.219	2
CE-3	0	0	33	50	17	6	2.17	Low	0.102	6
CE-4	83	17	0	0	0	6	4.83	Very High	0.227	1
CE-5	0	20	20	60	0	5	2.60	Moderate	0.122	5
CE-6	0	50	50	0	0	6	3.50	High	0.165	3
							<u>21.27</u>		<u>1.000</u>	

Table 265: University D - Frequencies of Occurrence for CE Challenges

* Frequencies of occurrence: 5 = Very frequent; 4 = Frequent; 3 = Occasional; 2 = Rare; 1 = Very Rare.

Code	Rating for frequency of occurrence					TR	FI	Remark	RII	Rank
	VF	F	O	R	VR					
	%	%	%	%	%					
	5	4	3	2	1					
CE-1	67	33	0	0	0	6	4.67	Very High	0.197	2
CE-2	50	50	0	0	0	6	4.50	Very High	0.190	3
CE-3	0	33	50	17	0	6	3.17	Moderate	0.134	5
CE-4	83	17	0	0	0	6	4.83	Very High	0.204	1
CE-5	0	17	67	17	0	6	3.00	Moderate	0.127	6
CE-6	0	50	50	0	0	6	3.50	High	0.148	4
							<u>23.67</u>		<u>1.000</u>	

Code	Impact Index (Ii)	Frequency Index (Fi)	Risk Score (RS) (Ii x Fi)	Remark	Risk Ranking
CE-1	3.500	4.667	16.333	High	3
CE-2	4.667	4.500	21.000	Very high	2
CE-3	2.167	3.167	6.861	Low	6
CE-4	4.833	4.833	23.361	Very high	1
CE-5	2.600	3.000	7.800	Low	5
CE-6	3.500	3.500	12.250	Moderate	4

Future (F) challenges:

F-1) Emergency management; F-2) Statutory compliance; F-3) Sustainability; F-4) Technology; F-5) User needs assessment and satisfaction; F-6) Business and financial management; F-7) Occupational health & safety; F-8) Corporate image; F-9) Leadership and innovation; F-10) Space management; F-11) Outsourcing.

* Level of impact : 5 = Very High; 4 = High; 3 = Medium; 2 = Low; 1 = Very Low										
Code	* Rating for impact levels					TR	II	Remark	RII	Rank
	VH	H	M	L	VL					
	%	%	%	%	%					
	5	4	3	2	1					
F-1	0	50	50	0	0	6	3.50	High	1.400	3
F-2	100	0	0	0	0	6	5.00	Very High	2.000	1
F-3	83	17	0	0	0	6	4.83	Very High	1.933	2
F-4	0	33	67	0	0	6	3.33	Moderate	1.333	4
F-5	50	50	0	0	0	6	4.50	Very High	0.110	5
F-6	33	33	33	0	0	6	4.00	High	0.098	6
F-7	17	50	33	0	0	6	3.83	High	0.094	7
F-8	0	33	67	0	0	6	3.33	Moderate	0.082	8
F-9	0	33	33	33	0	6	3.00	Moderate	0.073	9
F-10	0	17	67	17	0	6	3.00	Moderate	0.073	9
F-11	0	0	50	50	0	6	2.50	Low	0.061	11
							40.83		7.259	

Table 268: University D - Frequencies of occurrence for Future challenges

<i>* Frequencies of occurrence: 5 = Very frequent; 4 = Frequent; 3 = Occasional; 2 = Rare; 1 = Very Rare.</i>										
Code	Rating for frequency of occurrence					TR	FI	Remark	RII	Rank
	VF	F	O	R	VR					
	% 5	% 4	% 3	% 2	% 1					
F-1	17	67	17	0	0	6	4.00	High	0.098	5
F-2	67	33	0	0	0	6	4.67	Very High	0.114	2
F-3	100	0	0	0	0	6	5.00	Very High	0.122	1
F-4	33	17	50	0	0	6	3.83	High	0.093	6
F-5	17	83	0	0	0	6	4.17	High	0.102	4
F-6	50	33	17	0	0	6	4.33	Very High	0.106	3
F-7	17	33	33	17	0	6	3.50	High	0.085	8
F-9	0	33	33	33	0	6	3.00	Moderate	0.073	9
F-10	0	0	50	33	17	6	2.33	Low	0.057	11
F-11	17	33	50	0	0	6	3.67	High	0.089	7
F-12	0	17	33	33	17	6	2.50	Low	0.061	10
							<u>41.00</u>		<u>1.000</u>	

Table 269: University D - Risk scores for Future challenges

Code	Impact Index (Ii)	Frequency Index (Fi)	Risk Score (RS) (Ii x Fi)	Remark	Risk Ranking
F-1	3.500	4.000	14.000	Moderate	5
F-2	5.000	4.667	23.333	Very high	2
F-3	4.833	5.000	24.167	Very high	1
F-4	3.333	3.833	12.778	Moderate	7
F-5	4.500	4.167	18.750	High	3
F-6	4.000	4.333	17.333	High	4
F-7	3.833	3.500	13.417	Moderate	6
F-8	3.333	3.000	10.000	Low	9
F-9	3.000	2.333	7.000	Low	10
F-10	3.000	3.667	11.000	Moderate	8
F-11	2.500	2.500	6.250	Low	11

F.2.4 CASE STUDY V – UNIVERSITY E

F.2.4.1. Current Internal (CI) challenges constraining the achievement of strategic FM goals

Broad categories of Current Internal (CI) challenges:

CI-1) Finance; CI-2) Operational efficiency; CI-3) Risk management; CI-4) Stakeholder needs/ Service providers; CI-5) Maintenance; CI-6) Manpower; CI-7) Machinery/ equipment.

Table 270: University E - Levels of impact for CI challenges

* Level of impact : 5 = Very High; 4 = High; 3 = Medium; 2 = Low; 1 = Very Low										
Code	* Rating for impact levels					TR	II	Remark	RII	Rank
	VH	H	M	L	VL					
	% 5	% 4	% 3	% 2	% 1					
CI-1	100	0	0	0	0	7	5.00	Very High	0.187	1
CI-2	0	29	43	29	0	7	3.00	Moderate	0.112	5
CI-3	0	43	29	14	14	7	3.00	Moderate	0.112	7
CI-4	57	43	0	0	0	7	4.57	Very High	0.171	2
CI-5	29	29	43	0	0	7	3.86	High	0.144	4
CI-6	29	71	0	0	0	7	4.29	Very High	0.160	3
CI-7	0	29	43	29	0	7	3.00	Moderate	0.112	5
							26.71		1.00	

Table 271: University E - Frequencies of occurrence for CI challenges

* Frequencies of occurrence: 5 = Very frequent; 4 = Frequent; 3 = Occasional; 2 = Rare; 1 = Very Rare.										
VF	Rating for frequency of occurrence					TR	FI	Remark	RII	Rank
	F	O	R	VR						
	% 5	% 4	% 3	% 2	% 1					
100	0	0	0	0	0	7	5.00	Very Frequent	0.179	1
29	29	14	29	0	0	7	3.57	Frequent	0.128	6
14	43	43	0	0	0	7	3.71	Frequent	0.133	5
29	14	57	0	0	0	7	3.71	Frequent	0.133	4
57	43	0	0	0	0	7	4.57	Very Frequent	0.164	2
43	14	43	0	0	0	7	4.00	Frequent	0.144	3
14	29	29	29	0	0	7	3.29	Occasional	0.118	7
							27.86		1.000	

Table 272: University E - Risk scores for CI challenges

Code	Impact Index (Ii)	Frequency Index (Fi)	Risk Score (RS) (Ii x Fi)	Remark	Risk Ranking
CI-1	5.000	5.000	25.000	Very high	1
CI-2	3.000	3.571	10.714	Moderate	6
CI-3	3.000	3.714	11.143	Moderate	5
CI-4	4.571	3.714	16.980	High	4
CI-5	3.857	4.571	17.633	High	2
CI-6	4.286	4.000	17.143	High	3
CI-7	3.000	3.286	9.857	Low	7

F.2.4.2. Current External (CE) challenges constraining the achievement of strategic FM goals

Broad categories of Current External (CE) challenges:

CE-1) Economic; CE-2) Sustainability / environmental issues; CE-3) Technological; CE-4) Regulatory/ compliance; CE-5) Socio-cultural issues/ CE-6) Institutional.

Table 273: University E - Levels of impact for CE challenges

<i>* Level of impact : 5 = Very High; 4 = High; 3 = Medium; 2 = Low; 1 = Very Low</i>										
<i>* Rating for impact levels</i>										
Code	VH %	H %	M %	L %	VL %	TR	II	Remark	RII	Rank
CE-1	29	43	29	0	0	7	4.00	High	0.185	2
CE-2	57	29	14	0	0	7	4.43	Very High	0.205	1
CE-3	0	43	29	29	0	7	3.14	Moderate	0.146	5
CE-4	29	29	43	0	0	7	3.86	High	0.179	3
CE-5	0	0	43	57	0	7	2.43	Low	0.113	6
CE-6	14	43	43	0	0	7	3.71	High	0.172	4
							<u>21.57</u>		<u>1.000</u>	

Table 274: University E - Frequencies of occurrence for CE challenges

** Frequencies of occurrence: 5 = Very frequent; 4 = Frequent; 3 = Occasional; 2 = Rare; 1 = Very Rare.*

Code	Rating for frequency of occurrence					TR	FI	Remark	RII	Rank
	VF	F	O	R	VR					
	% 5	% 4	% 3	% 2	% 1					
CE-1	57	43	0	0	0	7	4.57	Very Frequent	0.199	2
CE-2	71	29	0	0	0	7	4.71	Very Frequent	0.205	1
CE-3	0	43	29	29	0	7	3.14	Occasional	0.137	5
CE-4	43	29	29	0	0	7	4.14	Frequent	0.180	3
CE-5	0	29	29	29	14	7	2.71	Occasional	0.118	6
CE-6	14	43	43	0	0	7	3.71	Frequent	0.161	4
							<u>23.00</u>		<u>1.000</u>	

Table 275: University E - Risk scores for CE challenges

Code	Impact Index (Ii)	Frequency Index (Fi)	Risk Score (RS) (Ii x Fi)	Remark	Risk Ranking
CE-1	4.000	4.571	18.286	High	2
CE-2	4.429	4.714	20.878	Very high	1
CE-3	3.143	3.143	9.878	Low	5
CE-4	3.857	4.143	15.980	High	3
CE-5	2.429	2.714	6.592	Low	6
CE-6	3.714	3.714	13.796	Moderate	4

F.2.4.3. Predicted Future (F) challenges constraining the achievement of strategic FM goals

Future (F) challenges:

F-1) Emergency management; F-2) Statutory compliance; F-3) Sustainability; F-4) Technology; F-5) User needs assessment and satisfaction; F-6) Business and financial management; F-7) Occupational health & safety; F-8) Corporate image; F-9) Leadership and innovation; F-10) Space management; F-11) Outsourcing.

Table 276: University E - Levels of impact for Future challenges

<i>* Level of impact : 5 = Very High; 4 = High; 3 = Medium; 2 = Low; 1 = Very Low</i>										
Code	* Rating for impact levels					TR	II	Remark	RII	Rank
	VH	H	M	L	VL					
	% 5	% 4	% 3	% 2	% 1					
F-1	100	0	0	0	0	7	5.00	Very High	0.121	1
F-2	43	57	0	0	0	7	4.43	Very High	0.107	3
F-3	57	43	0	0	0	7	4.57	Very High	0.111	2
F-4	29	71	0	0	0	7	4.29	Very High	0.104	4
F-5	29	14	43	14	0	7	3.57	High	0.087	7
F-6	14	29	29	29	0	7	3.29	Moderate	0.080	8
F-7	29	14	14	43	0	7	3.29	Moderate	0.080	9
F-8	0	29	14	29	29	7	2.43	Low	0.059	11
F-9	29	29	29	14	0	7	3.71	High	0.090	6
F-10	29	57	14	0	0	7	4.14	High	0.100	5
F-11	0	14	43	29	14	7	2.57	Low	0.062	10
41.29									1.000	

Table 277: University E - Frequencies of occurrence for Future challenges

<i>* Frequencies of occurrence: 5 = Very frequent; 4 = Frequent; 3 = Occasional; 2 = Rare; 1 = Very Rare.</i>										
Code	Rating for frequency of occurrence					TR	FI	Remark	RII	Rank
	VF	F	O	R	VR					
	% 5	% 4	% 3	% 2	% 1					
F-1	43	29	29	0	0	7	4.14	Frequent	0.096	5
F-2	57	29	14	0	0	7	4.43	Very Frequent	0.103	3
F-3	71	29	0	0	0	7	4.71	Very Frequent	0.110	1
F-4	29	29	29	14	0	7	3.71	Frequent	0.086	9
F-5	57	43	0	0	0	7	4.57	Very Frequent	0.106	2
F-6	29	29	43	0	0	7	3.86	Frequent	0.090	7
F-7	14	71	14	0	0	7	4.00	Frequent	0.093	6
F-9	0	14	14	43	0	7	1.86	Rare	0.043	11
F-10	0	57	43	0	0	7	3.57	Frequent	0.083	10
F-11	43	43	14	0	0	7	4.29	Very Frequent	0.100	4
F-12	29	29	43	0	0	7	3.86	Frequent	0.090	7
43.00									1.000	

Table 278: University E - Risk scores for Future challenges

Code	Impact Index (Ii)	Frequency Index (Fi)	Risk Score (RS) (Ii x Fi)	Remark	Risk Ranking
F-1	5.000	3.143	15.714	High	5
F-2	4.429	4.000	17.714	High	2
F-3	4.571	4.714	21.551	Very high	1
F-4	4.286	2.714	11.633	Moderate	8
F-5	3.571	4.571	16.327	High	3
F-6	3.286	2.571	8.449	Low	9
F-7	3.286	3.571	11.735	Moderate	7
F-8	2.429	3.286	7.980	Low	10
F-9	3.714	4.000	14.857	Moderate	6
F-10	4.143	3.857	15.980	High	4
F-11	2.571	2.571	6.612	Low	11

APPENDIX G:

TABLES FOR PROPOSITIONS TESTS RESULTS

Tests of Proposition 2.2

Case study II (University B): Broad internal challenges

Table 279: Case Study II - Level of agreement of the sets of relative occurrence frequency rankings of the broad internal challenges faced by facilities managers as obtained from three sources.

RANKINGS: INTERNAL CHALLENGES					
Empirical data sources (k _j)	FMgrs challenges (n _i)				
	CI-1	CI-2	CI-4	CI-6	CI-7
Main survey	1	4	2	3	5
Case study 2	1	5	2	3	4
Records	1	4	2	3	5
Sum of ranks (R _i):	3	13	6	9	14
k = number of judges (i.e. data sources)				=	3
n = no of objects being rated				=	5
Mean ranks, \bar{R}					
$\bar{R} = k(n+1)/2$	= [3*(5+1)/2]			=	9
R _i deviations from mean: R _i - \bar{R}	-6	4	-3	0	5
Square of deviations	36	16	9	0	25
Sum of squared deviations (S):				S =	86
Coefficient of Concordance W =					
$W = 12S/[K^2(n^3-n)]$				=	0.956
Where:	[0≤W≤1]				
W = 0 (=maximum disagreement/ disconcordance)					
W = 1 (=maximum agreement/ concordance)					
FOR STATISTICAL TEST OF SIGNIFICANCE:					
[transforming W into chi-square (χ ²) test statistic (τ) with n-1 degrees of freedom]:					
$\tau_{\text{calculated}} = K(n-1)W$ (i.e. chi-square transformed value of the W value)				=	11.47
α				=	0.05
df = degrees of freedom = n-1				=	4.00
$\tau_{\text{critical}} : = \text{CHIINV}(0.05,n-1)$				=	9.4877
p (prob associated with $\tau_{\text{calculated}}$) = CHIDIST(τcalculated,df)				=	0.02179

Hypothesis testing (Case study II: Broad internal challenges):

<i>H₀</i> (null hyp):	<p>(assumes that no significant concordance or agreement exists among the judges or raters; i.e. raters rate independently by chance and not in accordance with a common pattern)</p> <p>This is true if and only if one of the following is true:</p> <p>$\tau_{\text{calculated}} \leq \tau_{\text{critical}}$ (i.e. falls within zone of acceptance), OR:</p> <p>$p \geq \alpha$ [i.e. the probability associated with the $\tau_{\text{calculated}} \geq \alpha$ value of test (usually 0.05)]</p>
<i>H_A</i> (alt hyp):	<p>(assumes that significant concordance or agreement exists among the judges or raters; i.e. raters rate in accordance with a common pattern)</p> <p>This is true if and only if one of the following is true:</p> <p>$\tau_{\text{calculated}} > \tau_{\text{critical}}$ (i.e. falls within zone of rejection), OR:</p> <p>$p < \alpha$ [i.e. the probability associated with the $\tau_{\text{calculated}} < \alpha$ value of test (usually 0.05)]</p>
Results:	<p>$\tau_{\text{calculated}} > \tau_{\text{critical}}$ (i.e. falls within zone of rejection), OR:</p> <p>$p < \alpha$ [i.e. the probability associated with the $\tau_{\text{calculated}} < \alpha$ value of test (usually 0.05)]</p>
Decision:	Reject H ₀
Conclusion:	<p>There is no statistical evidence to support the null hypothesis that any agreement among the findings from the three sources of evidence is by chance variation;</p> <p>Therefore it can be concluded that there is some measure of consistency or triangulation among the 3 sources;</p> <p>This also accords some measure of reliability and validity to the findings, the test instrument and the procedure adopted in the research.</p>

Case study II (University B): Broad external challenges

Table 280: Case Study II - Level of agreement of the sets of relative occurrence frequency rankings of the broad external challenges faced by facilities managers as obtained from three sources.

RANKINGS: EXTERNAL CHALLENGES						
Empirical data sources (k_j)	FMgrs challenges (n_i)					
	CE-1	CE-2	CE-3	CE-4	CE-5	CE-6
Main survey	1	5	6	3	2	4
Case study 2	2	6	5	4	1	3
Records	1	5	6	3	2	4
Sum of ranks (R_i):	4	16	17	10	5	11
k = number of judges (i.e. data sources):					=	3
n = no of objects being rated:					=	6
Mean ranks, \bar{R}						
$\bar{R} = k(n+1)/2$	= $[3*(6+1)/2]$				=	10.5
R_i deviations from mean: $R_i - \bar{R}$	-6.5	5.5	6.5	-0.5	-5.5	0.5
Square of deviations	42.25	30.25	42.25	0.25	30.25	0.25
Sum of squared deviations (S):					$S =$	145.5
Coefficient of Concordance $W =$						
$W = 12S/[K^2(n^3-n)] =$						0.924
Where: $[0 \leq W \leq 1]$						
$W = 0$ (=maximum disagreement/ discordance)						
$W = 1$ (=maximum agreement/ concordance)						
FOR STATISTICAL TEST OF SIGNIFICANCE:						
[transforming W into chi-square (χ^2) test statistic (τ) with $n-1$ degrees of freedom]:						
$\tau_{\text{calculated}} = K(n-1)W$ (i.e. chi-square transformed value of the W value)					=	13.86
α					=	0.05
$df = \text{degrees of freedom} = n-1$					=	5.00
$\tau_{\text{critical}} = \text{CHIINV}(0.05, n-1)$					=	11.07
p (prob associated with $\tau_{\text{calculated}}$) = $\text{CHIDIST}(\tau_{\text{calculated}}, df)$					=	0.01654

Hypothesis testing (Case study II: Broad external challenges):

<i>H₀</i> (null hyp):	<p>(assumes that no significant concordance or agreement exists among the judges or raters; i.e. raters rate independently by chance and not in accordance with a common pattern)</p> <p>This is true if and only if one of the following is true:</p> <p>$\tau_{\text{calculated}} \leq \tau_{\text{critical}}$ (i.e. falls within zone of acceptance), OR:</p> <p>$p \geq \alpha$ [i.e. the probability associated with the $\tau_{\text{calculated}} \geq \alpha$ value of test (usually 0.05)]</p>
<i>H_A</i> (alt hyp):	<p>(assumes that significant concordance or agreement exists among the judges or raters; i.e. raters rate in accordance with a common pattern)</p> <p>This is true if and only if one of the following is true:</p> <p>$\tau_{\text{calculated}} > \tau_{\text{critical}}$ (i.e. falls within zone of rejection), OR:</p> <p>$p < \alpha$ [i.e. the probability associated with the $\tau_{\text{calculated}} < \alpha$ value of test (usually 0.05)]</p>
Results:	<p>$\tau_{\text{calculated}} > \tau_{\text{critical}}$ (i.e. falls within zone of rejection), OR:</p> <p>$p < \alpha$ [i.e. the probability associated with the $\tau_{\text{calculated}} < \alpha$ value of test (usually 0.05)]</p>
Decision:	Reject H ₀
Conclusion:	<p>There is no statistical evidence to support the null hypothesis that any agreement among the findings from the three sources of evidence is by chance variation;</p> <p>Therefore it can be concluded that there is some measure of consistency or triangulation among the 3 sources;</p> <p>This also accords some measure of reliability and validity to the findings, the test instrument and the procedure adopted in the research.</p>

Case study II (University B): Future challenges

Table 281: Case Study II - Level of agreement of the sets of relative occurrence frequency rankings of the future challenges faced by facilities managers as obtained from three sources.

Empirical data sources (k_i)	RANKINGS: FUTURE CHALLENGES									
	FMgrs challenges (n_i)									
	F1	F2	F3	F4	F5	F6	F7	F9	F10	F11
Main survey	5	3	1	8	6	9	7	4	2	10
Case study 2	1	4	2	5	8	10	7	6	3	9
Records	4	1	3	6	9	10	5	7	2	8
Sum of ranks (R_i):	10	8	6	19	23	29	19	17	7	27
k = number of judges (i.e. data sources):									=	3
n = no of objects being rated:									=	10
Mean ranks, \bar{R}										
$\bar{R} = k(n+1)/2$		$[3*(10+1)/2]=$								= 16.5
Ri deviations from mean: $R_i - \bar{R}$	-6.5	-8.5	-10.5	2.5	6.5	12.5	2.5	0.5	-9.5	10.5
Square of deviations	42.25	72.25	110.25	6.25	42.25	156.25	6.25	0.25	90.25	110.25
Sum of squared deviations (S):									S =	636.5
Coefficient of Concordance W =										
$W = 12S/[K^2(n^3-n)] =$									=	0.857
Where:										
$[0 \leq W \leq 1]$										
$W = 0$ (=maximum disagreement/ discordance)										
$W = 1$ (=maximum agreement/ concordance)										
FOR STATISTICAL TEST OF SIGNIFICANCE:										
[transforming W into chi-square (χ^2) test statistic (τ) with n-1 degrees of freedom]:										
$\tau_{\text{calculated}} = K(n-1)W$ (i.e. chi-square transformed value of the W value)									=	23.15
α									=	0.05
df = degrees of freedom = n-1									=	9.00
$\tau_{\text{critical}} = \text{CHIINV}(0.05, n-1)$									=	16.919
p (prob associated with $\tau_{\text{calculated}}$) = CHIDIST($\tau_{\text{calculated}}$, df)									=	0.00588

Hypothesis testing (Case study II: Future challenges):

<i>H₀</i> (null hyp):	<p>(assumes that no significant concordance or agreement exists among the judges or raters; i.e. raters rate independently by chance and not in accordance with a common pattern)</p> <p>This is true if and only if one of the following is true:</p> <p>$\tau_{\text{calculated}} \leq \tau_{\text{critical}}$ (i.e. falls within zone of acceptance), OR:</p> <p>$p \geq \alpha$ [i.e. the probability associated with the $\tau_{\text{calculated}} \geq \alpha$ value of test (usually 0.05)]</p>
<i>H_A</i> (alt hyp):	<p>(assumes that significant concordance or agreement exists among the judges or raters; i.e. raters rate in accordance with a common pattern)</p> <p>This is true if and only if one of the following is true:</p> <p>$\tau_{\text{calculated}} > \tau_{\text{critical}}$ (i.e. falls within zone of rejection), OR:</p> <p>$p < \alpha$ [i.e. the probability associated with the $\tau_{\text{calculated}} < \alpha$ value of test (usually 0.05)]</p>
Results:	<p>$\tau_{\text{calculated}} > \tau_{\text{critical}}$ (i.e. falls within zone of rejection), OR:</p> <p>$p < \alpha$ [i.e. the probability associated with the $\tau_{\text{calculated}} < \alpha$ value of test (usually 0.05)]</p>
Decision:	<p>Reject H₀</p>
Conclusion:	<p>There is no statistical evidence to support the null hypothesis that any agreement among the findings from the three sources of evidence is by chance variation;</p> <p>Therefore it can be concluded that there is some measure of consistency or triangulation among the 3 sources;</p> <p>This also accords some measure of reliability and validity to the findings, the test instrument and the procedure adopted in the research.</p>

Case study III (University C): Broad internal challenges

Table 282: Case Study III - Level of agreement of the sets of relative occurrence frequency rankings of the broad internal challenges faced by facilities managers as obtained from three sources.

RANKINGS: INTERNAL CHALLENGES					
	FMgrs challenges (n _i)				
Empirical data sources (k _i)	CI-1	CI-2	CI-4	CI-6	CI-7
Main survey	1	4	2	3	5
Case study 3	1	4	2	3	5
Records	1	4	2	3	5
Sum of ranks (R _i):	3	12	6	9	15
k = number of judges (i.e. data sources)				=	3
n = no of objects being rated				=	5
Mean ranks, \bar{R}					
$\bar{R} = k(n+1)/2$	= [3*(5+1)/2]			=	9
Ri deviations from mean: R _i - \bar{R}	-6	3	-3	0	6
Square of deviations	36	9	9	0	36
Sum of squared deviations (S):				S =	90
Coefficient of Concordance W =					
$W = 12S/[K^2(n^3-n)]$				=	1.000
Where:	$[0 \leq W \leq 1]$				
$W = 0$ (=maximum disagreement/ disconcordance)					
$W = 1$ (=maximum agreement/ concordance)					
FOR STATISTICAL TEST OF SIGNIFICANCE:					
[transforming W into chi-square (χ^2) test statistic (τ) with n-1 degrees of freedom]:					
$\tau_{\text{calculated}} = K(n-1)W$ (i.e. chi-square transformed value of the W value)				=	12.00
α				=	0.05
df = degrees of freedom = n-1				=	4.00
$\tau_{\text{critical}} : = \text{CHIINV}(0.05,n-1)$				=	9.4877
p (prob associated with $\tau_{\text{calculated}}$) = CHIDIST($\tau_{\text{calculated}}$,df)				=	0.01735

Hypothesis testing (Case Study III: Broad internal challenges)

H₀ (null hyp): (assumes that no significant concordance or agreement exists among the judges or raters; i.e. raters rate independently by chance and not in accordance with a common pattern)

This is true if and only if one of the following is true:

$\tau_{\text{calculated}} \leq \tau_{\text{critical}}$ (i.e. falls within zone of acceptance), OR:

$p \geq \alpha$ [i.e. the probability associated with the $\tau_{\text{calculated}} \geq \alpha$ value of test (usually 0.05)]

H_A (alt hyp): (assumes that significant concordance or agreement exists among the judges or raters; i.e. raters rate in accordance with a common pattern)

This is true if and only if one of the following is true:

$\tau_{\text{calculated}} > \tau_{\text{critical}}$ (i.e. falls within zone of rejection), OR:

$p < \alpha$ [i.e. the probability associated with the $\tau_{\text{calculated}} < \alpha$ value of test (usually 0.05)]

Results: $\tau_{\text{calculated}} > \tau_{\text{critical}}$ (i.e. falls within zone of rejection), OR:
 $p < \alpha$ [i.e. the probability associated with the $\tau_{\text{calculated}} < \alpha$ value of test (usually 0.05)]

Decision: Reject H₀

Conclusion: There is no statistical evidence to support the null hypothesis that any agreement among the findings from the three sources of evidence is by chance variation;
We can therefore conclude that there is some measure of consistency or triangulation among the 3 sources;
This also accords some measure of reliability and validity to the findings, the test instrument and the procedure adopted in the research.

Case study III (University C): Broad external challenges

Table 283: Case Study III - Level of agreement of the sets of relative occurrence frequency rankings of the broad external challenges faced by facilities managers as obtained from three sources.

RANKINGS: EXTERNAL CHALLENGES						
Empirical data sources (k _j)	FMgrs challenges (n _i)					
	CE-1	CE-2	CE-3	CE-4	CE-5	CE-6
Main survey	1	5	6	3	2	4
Case study 3	2	5	6	3	1	4
Records	1	5	6	3	2	4
Sum of ranks (R _i):	4	15	18	9	5	12
k = number of judges (i.e. data sources):					=	3
n = no of objects being rated:					=	6
Mean ranks, \bar{R}						
$\bar{R} = k(n+1)/2$	= [3*(6+1)/2]				=	10.5
Ri deviations from mean: Ri- \bar{R}	-6.5	4.5	7.5	-1.5	-5.5	1.5
Square of deviations	42.25	20.25	56.25	2.25	30.25	2.25
Sum of squared deviations (S):					S =	153.5
Coefficient of Concordance W =						
$W = 12S/[K^2\{n^3-n\}] =$						0.975
Where:	[0≤W≤1]					
W = 0 (=maximum disagreement/ disconcordance)						
W = 1 (=maximum agreement/ concordance)						
FOR STATISTICAL TEST OF SIGNIFICANCE:						
[transforming W into chi-square (χ ²) test statistic (τ) with n-1 degrees of freedom]:						
τ _{calculated} = K(n-1)W (i.e. chi-square transformed value of the W value)					=	14.62
α					=	0.05
df = degrees of freedom = n-1					=	5.00
τ _{critical} = :CHIINV(0.05,n-1)					=	11.07
p (prob associated with τ _{calculated})=CHIDIST(τ _{calculated} ,df)					=	0.01212

Hypothesis testing (Case Study III: Broad external challenges)

H₀ (null hyp): (assumes that no significant concordance or agreement exists among the judges or raters; i.e. raters rate independently by chance and not in accordance with a common pattern)

This is true if and only if one of the following is true:

$\tau_{\text{calculated}} \leq \tau_{\text{critical}}$ (i.e. falls within zone of acceptance), OR:

$p \geq \alpha$ [i.e. the probability associated with the $\tau_{\text{calculated}} \geq \alpha$ value of test (usually 0.05)]

H_A (alt hyp): (assumes that significant concordance or agreement exists among the judges or raters; i.e. raters rate in accordance with a common pattern)

This is true if and only if one of the following is true:

$\tau_{\text{calculated}} > \tau_{\text{critical}}$ (i.e. falls within zone of rejection), OR:

$p < \alpha$ [i.e. the probability associated with the $\tau_{\text{calculated}} < \alpha$ value of test (usually 0.05)]

Results: $\tau_{\text{calculated}} > \tau_{\text{critical}}$ (i.e. falls within zone of rejection), OR:
 $p < \alpha$ [i.e. the probability associated with the $\tau_{\text{calculated}} < \alpha$ value of test (usually 0.05)]

Decision: Reject H₀

Conclusion: There is no statistical evidence to support the null hypothesis that any agreement among the findings from the three sources of evidence is by chance variation;
We can therefore conclude that there is some measure of consistency or triangulation among the 3 sources;
This also accords some measure of reliability and validity to the findings, the test instrument and the procedure adopted in the research.

Case study III (University C): Future challenges

Table 284: Case Study III: Level of agreement of the sets of relative occurrence frequency rankings of the future challenges faced by facilities managers as obtained from three sources.

Empirical data sources (k_i)	RANKINGS: FUTURE CHALLENGES									
	FMgrs challenges (n_i)									
	F1	F2	F3	F4	F5	F6	F7	F9	F10	F11
Main survey	5	3	1	8	6	9	7	4	2	10
Case study 3	4	2	1	6	3	7	10	5	8	9
Records	4	1	3	6	9	10	5	7	2	8
Sum of ranks (R_i):	13	6	5	20	18	26	22	16	12	27
k = number of judges (i.e. data sources):									=	3
n = no of objects being rated:									=	10
Mean ranks, \bar{R}										
$\bar{R} = k(n+1)/2$						[3*(10+1)/2]=			=	16.5
Ri deviations from mean: $R_i - \bar{R}$	-3.5	-10.5	-11.5	3.5	1.5	9.5	5.5	-0.5	-4.5	10.5
Square of deviations	12.25	110.25	132.25	12.25	2.25	90.25	30.25	0.25	20.25	110.25
Sum of squared deviations (S):									S =	520.5
Coefficient of Concordance W =										
$W = 12S/[K^2(n^3 - n)] =$									=	0.701
Where:										
$[0 \leq W \leq 1]$										
$W = 0$ (=maximum disagreement/ discordance)										
$W = 1$ (=maximum agreement/ concordance)										
FOR STATISTICAL TEST OF SIGNIFICANCE:										
[transforming W into chi-square (χ^2) test statistic (τ) with n-1 degrees of freedom]:										
$\tau_{\text{calculated}} = K(n-1)W$ (i.e. chi-square transformed value of the W value)									=	18.93
α									=	0.05
df = degrees of freedom = n-1									=	9.00
$\tau_{\text{critical}} = \text{CHIINV}(0.05, n-1)$									=	16.919
p (prob associated with $\tau_{\text{calculated}}$) = CHIDIST($\tau_{\text{calculated}}$, df)									=	0.02582

Hypothesis testing (Case Study III: Future challenges)

H_0 (null hyp): (assumes that no significant concordance or agreement exists among the judges or raters; i.e. raters rate independently by chance and not in accordance with a common pattern)

This is true if and only if one of the following is true:

$\tau_{\text{calculated}} \leq \tau_{\text{critical}}$ (i.e. falls within zone of acceptance), OR:

$p \geq \alpha$ [i.e. the probability associated with the $\tau_{\text{calculated}} \geq \alpha$ value of test (usually 0.05)]

H_A (alt hyp): (assumes that significant concordance or agreement exists among the judges or raters; i.e. raters rate in accordance with a common pattern)

This is true if and only if one of the following is true:

$\tau_{\text{calculated}} > \tau_{\text{critical}}$ (i.e. falls within zone of rejection), OR:

$p < \alpha$ [i.e. the probability associated with the $\tau_{\text{calculated}} < \alpha$ value of test (usually 0.05)]

Results: $\tau_{\text{calculated}} > \tau_{\text{critical}}$ (i.e. falls within zone of rejection), OR:
 $p < \alpha$ [i.e. the probability associated with the $\tau_{\text{calculated}} < \alpha$ value of test (usually 0.05)]

Decision: Reject H_0

Conclusion: There is no statistical evidence to support the null hypothesis that any agreement among the findings from the three sources of evidence is by chance variation;
We can therefore conclude that there is some measure of consistency or triangulation among the 3 sources;
This also accords some measure of reliability and validity to the findings, the test instrument and the procedure adopted in the research.

Case study IV (University D): Broad internal challenges

Table 285: Case Study IV: Level of agreement of the sets of relative occurrence frequency rankings of the broad internal challenges faced by facilities managers as obtained from three sources.

RANKINGS: INTERNAL CHALLENGES					
Empirical data sources (k _j)	FMgrs challenges (n _i)				
	CI-1	CI-2	CI-4	CI-6	CI-7
Main survey	1	4	2	3	5
Case study 4	1	3	2	4	5
Records	1	4	2	3	5
Sum of ranks (R _i):	3	11	6	10	15
k = number of judges (i.e. data sources)				=	3
n = no of objects being rated				=	5
Mean ranks, \bar{R}					
$\bar{R} = k(n+1)/2$	= [3*(5+1)/2]			=	9
R _i deviations from mean: R _i - \bar{R}	-6	2	-3	1	6
Square of deviations	36	4	9	1	36
Sum of squared deviations (S):				S =	86
Coefficient of Concordance W =					
$W = 12S/[K^2(n^3-n)]$				=	0.956
Where:	[0≤W≤1]				
W = 0 (=maximum disagreement/ discordance)					
W = 1 (=maximum agreement/ concordance)					
FOR STATISTICAL TEST OF SIGNIFICANCE:					
[transforming W into chi-square (χ ²) test statistic (τ) with n-1 degrees of freedom]:					
τ _{calculated} = K(n-1)W (i.e. chi-square transformed value of the W value)					= 11.47
α					= 0.05
df = degrees of freedom = n-1					= 4.00
τ _{critical} : = CHIINV(0.05,n-1)					= 9.4877
p (prob associated with τ _{calculated}) = CHIDIST(τ _{calculated} ,df)					= 0.02179

Hypothesis testing (Case Study IV: Broad internal challenges)

H₀ (null hyp): (assumes that no significant concordance or agreement exists among the judges or raters; i.e. raters rate independently by chance and not in accordance with a common pattern)

This is true if and only if one of the following is true:

$\tau_{\text{calculated}} \leq \tau_{\text{critical}}$ (i.e. falls within zone of acceptance), OR:

$p \geq \alpha$ [i.e. the probability associated with the $\tau_{\text{calculated}} \geq \alpha$ value of test (usually 0.05)]

H_A (alt hyp): (assumes that significant concordance or agreement exists among the judges or raters; i.e. raters rate in accordance with a common pattern)

This is true if and only if one of the following is true:

$\tau_{\text{calculated}} > \tau_{\text{critical}}$ (i.e. falls within zone of rejection), OR:

$p < \alpha$ [i.e. the probability associated with the $\tau_{\text{calculated}} < \alpha$ value of test (usually 0.05)]

Results: $\tau_{\text{calculated}} > \tau_{\text{critical}}$ (i.e. falls within zone of rejection), OR:
 $p < \alpha$ [i.e. the probability associated with the $\tau_{\text{calculated}} < \alpha$ value of test (usually 0.05)]

Decision: Reject H₀

Conclusion: There is no statistical evidence to support the null hypothesis that any agreement among the findings from the three sources of evidence is by chance variation;
We can therefore conclude that there is some measure of consistency or triangulation among the 3 sources;
This also accords some measure of reliability and validity to the findings, the test instrument and the procedure adopted in the research.

Case study IV (University D): Broad external challenges

Table 286: Case Study IV: Level of agreement of the sets of relative occurrence frequency rankings of the broad external challenges faced by facilities managers as obtained from three sources.

RANKINGS: EXTERNAL CHALLENGES						
Empirical data sources (k _i)	FMgrs challenges (n _i)					
	CE-1	CE-2	CE-3	CE-4	CE-5	CE-6
Main survey	1	5	6	3	2	4
Case study 4	3	5	6	2	1	4
Records	1	5	6	3	2	4
Sum of ranks (R _i):	5	15	18	8	5	12
k = number of judges (i.e. data sources):					=	3
n = no of objects being rated:					=	6
Mean ranks, \bar{R}						
$\bar{R} = k(n+1)/2$	= [3*(6+1)/2]				=	10.5
R _i deviations from mean: R _i - \bar{R}	-5.5	4.5	7.5	-2.5	-5.5	1.5
Square of deviations	30.25	20.25	56.25	6.25	30.25	2.25
Sum of squared deviations (S):					S =	145.5
Coefficient of Concordance W =						
$W = 12S/[K^2(n^3-n)] =$						0.924
Where:	[0≤W≤1]					
W = 0 (=maximum disagreement/ disconcordance)						
W = 1 (=maximum agreement/ concordance)						
FOR STATISTICAL TEST OF SIGNIFICANCE:						
[transforming W into chi-square (χ ²) test statistic (τ) with n-1 degrees of freedom]:						
τ _{calculated} = K(n-1)W (i.e. chi-square transformed value of the W value)					=	13.86
α					=	0.05
df = degrees of freedom = n-1					=	5.00
τ _{critical} : =CHIINV(0.05,n-1)					=	11.07
p (prob associated with τ _{calculated})=CHIDIST(τ _{calculated} ,df)					=	0.01654

Hypothesis testing (Case Study IV: Broad external challenges)

H_0 (null hyp): (assumes that no significant concordance or agreement exists among the judges or raters; i.e. raters rate independently by chance and not in accordance with a common pattern)
This is true if and only if one of the following is true:
 $\tau_{\text{calculated}} \leq \tau_{\text{critical}}$ (i.e. falls within zone of acceptance), OR:
 $p \geq \alpha$ [i.e. the probability associated with the $\tau_{\text{calculated}} \geq \alpha$ value of test (usually 0.05)]

H_A (alt hyp): (assumes that significant concordance or agreement exists among the judges or raters; i.e. raters rate in accordance with a common pattern)
This is true if and only if one of the following is true:
 $\tau_{\text{calculated}} > \tau_{\text{critical}}$ (i.e. falls within zone of rejection), OR:
 $p < \alpha$ [i.e. the probability associated with the $\tau_{\text{calculated}} < \alpha$ value of test (usually 0.05)]

Results: $\tau_{\text{calculated}} > \tau_{\text{critical}}$ (i.e. falls within zone of rejection), OR:
 $p < \alpha$ [i.e. the probability associated with the $\tau_{\text{calculated}} < \alpha$ value of test (usually 0.05)]

Decision: Reject H_0

Conclusion: There is no statistical evidence to support the null hypothesis that any agreement among the findings from the three sources of evidence is by chance variation;
We can therefore conclude that there is some measure of consistency or triangulation among the 3 sources;
This also accords some measure of reliability and validity to the findings, the test instrument and the procedure adopted in the research.

Case study IV (University D): Future challenges

Table 287: Case Study IV: Level of agreement of the sets of relative occurrence frequency rankings of the future challenges faced by facilities managers as obtained from three sources.

Empirical data sources (k_i)	RANKINGS: FUTURE CHALLENGES									
	FMgrs challenges (n_i)									
	F1	F2	F3	F4	F5	F6	F7	F9	F10	F11
Main survey	5	3	1	8	6	9	7	4	2	10
Case study 4	5	2	1	8	3	9	7	6	4	10
Records	4	1	3	6	9	10	5	7	2	8
Sum of ranks (R_i):	14	6	5	22	18	28	19	17	8	28
k = number of judges (i.e. data sources):									=	3
n = no of objects being rated:									=	10
Mean ranks, \bar{R}										
$\bar{R} = k(n+1)/2$						$[3*(10+1)/2]=$			=	16.5
Ri deviations from mean: $R_i - \bar{R}$	-2.5	-10.5	-11.5	5.5	1.5	11.5	2.5	0.5	-8.5	11.5
Square of deviations	6.25	110.25	132.25	30.25	2.25	132.25	6.25	0.25	72.25	132.25
Sum of squared deviations (S):									S =	624.5
Coefficient of Concordance W =										
$W = 12S/[K^2(n^3-n)] =$									=	0.841
Where:										
$[0 \leq W \leq 1]$										
W = 0 (=maximum disagreement/ discordance)										
W = 1 (=maximum agreement/ concordance)										
FOR STATISTICAL TEST OF SIGNIFICANCE:										
[transforming W into chi-square (χ^2) test statistic (τ) with n-1 degrees of freedom]:										
$\tau_{\text{calculated}} = K(n-1)W$ (i.e. chi-square transformed value of the W value)									=	22.71
α									=	0.05
df = degrees of freedom = n-1									=	9.00
$\tau_{\text{critical}} = \text{CHIINV}(0.05, n-1)$									=	16.919
p (prob associated with $\tau_{\text{calculated}}$) = CHIDIST($\tau_{\text{calculated}}$, df)									=	0.00688

Hypothesis testing (Case Study IV: Future challenges)

H_0 (null hyp):	<p>(assumes that no significant concordance or agreement exists among the judges or raters; i.e. raters rate independently by chance and not in accordance with a common pattern)</p> <p>This is true if and only if one of the following is true:</p> <p>$\tau_{\text{calculated}} \leq \tau_{\text{critical}}$ (i.e. falls within zone of acceptance), OR:</p> <p>$p \geq \alpha$ [i.e. the probability associated with the $\tau_{\text{calculated}} \geq \alpha$ value of test (usually 0.05)]</p>
H_A (alt hyp):	<p>(assumes that significant concordance or agreement exists among the judges or raters; i.e. raters rate in accordance with a common pattern)</p> <p>This is true if and only if one of the following is true:</p> <p>$\tau_{\text{calculated}} > \tau_{\text{critical}}$ (i.e. falls within zone of rejection), OR:</p> <p>$p < \alpha$ [i.e. the probability associated with the $\tau_{\text{calculated}} < \alpha$ value of test (usually 0.05)]</p>
Results:	<p>$\tau_{\text{calculated}} > \tau_{\text{critical}}$ (i.e. falls within zone of rejection), OR:</p> <p>$p < \alpha$ [i.e. the probability associated with the $\tau_{\text{calculated}} < \alpha$ value of test (usually 0.05)]</p>
Decision:	Reject H_0
Conclusion:	<p>There is no statistical evidence to support the null hypothesis that any agreement among the findings from the three sources of evidence is by chance variation;</p> <p>We can therefore conclude that there is some measure of consistency or triangulation among the 3 sources;</p> <p>This also accords some measure of reliability and validity to the findings, the test instrument and the procedure adopted in the research.</p>

Case study V (University E): Broad internal challenges

Table 288: Case Study VVV: Level of agreement of the sets of relative occurrence frequency rankings of the broad internal challenges faced by facilities managers as obtained from three sources.

RANKINGS: INTERNAL CHALLENGES					
Empirical data sources (k _j)	FMgrs challenges (n _i)				
	CI-1	CI-2	CI-4	CI-6	CI-7
Main survey	1	4	2	3	5
Case study 5	1	4	3	2	5
Records	1	4	2	3	5
Sum of ranks (R _i):	3	12	7	8	15
k = number of judges (i.e. data sources)				=	3
n = no of objects being rated				=	5
Mean ranks, \bar{R}					
$\bar{R} = k(n+1)/2$	= [3*(5+1)/2]			=	9
R _i deviations from mean: R _i - \bar{R}	-6	3	-2	-1	6
Square of deviations	36	9	4	1	36
Sum of squared deviations (S):				S =	86
Coefficient of Concordance W =					
$W = 12S/[K^2(n^3-n)]$				=	0.956
Where:	$[0 \leq W \leq 1]$				
W = 0 (=maximum disagreement/ disconcordance)					
W = 1 (=maximum agreement/ concordance)					
FOR STATISTICAL TEST OF SIGNIFICANCE:					
[transforming W into chi-square (χ^2) test statistic (τ) with n-1 degrees of freedom]:					
$\tau_{\text{calculated}} = K(n-1)W$ (i.e. chi-square transformed value of the W value)					= 11.47
α					= 0.05
df = degrees of freedom = n-1					= 4.00
$\tau_{\text{critical}} : = \text{CHIINV}(0.05,n-1)$					= 9.4877
$p \text{ (prob associated with } \tau_{\text{calculated}} \text{)} = \text{CHIDIST}(\tau_{\text{calculated}},df)$					= 0.02179

Hypothesis testing (Case Study V: Broad internal challenges)

H_0 (null hyp): (assumes that no significant concordance or agreement exists among the judges or raters; i.e. raters rate independently by chance and not in accordance with a common pattern)
This is true if and only if one of the following is true:
 $\tau_{\text{calculated}} \leq \tau_{\text{critical}}$ (i.e. falls within zone of acceptance), OR:
 $p \geq \alpha$ [i.e. the probability associated with the $\tau_{\text{calculated}} \geq \alpha$ value of test (usually 0.05)]

H_A (alt hyp): (assumes that significant concordance or agreement exists among the judges or raters; i.e. raters rate in accordance with a common pattern)
This is true if and only if one of the following is true:
 $\tau_{\text{calculated}} > \tau_{\text{critical}}$ (i.e. falls within zone of rejection), OR:
 $p < \alpha$ [i.e. the probability associated with the $\tau_{\text{calculated}} < \alpha$ value of test (usually 0.05)]

Results: $\tau_{\text{calculated}} > \tau_{\text{critical}}$ (i.e. falls within zone of rejection), OR:
 $p < \alpha$ [i.e. the probability associated with the $\tau_{\text{calculated}} < \alpha$ value of test (usually 0.05)]

Decision: Reject H_0

Conclusion: There is no statistical evidence to support the null hypothesis that any agreement among the findings from the three sources of evidence is by chance variation;
We can therefore conclude that there is some measure of consistency or triangulation among the 3 sources;
This also accords some measure of reliability and validity to the findings, the test instrument and the procedure adopted in the research.

Case study V (University E): Broad external challenges

Table 289: Level of agreement of the sets of relative occurrence frequency rankings of the broad external challenges faced by facilities managers as obtained from three sources

RANKINGS: EXTERNAL CHALLENGES						
Empirical data sources (k_i)	FMgrs challenges (n_i)					
	CE-1	CE-2	CE-3	CE-4	CE-5	CE-6
Main survey	1	5	6	3	2	4
Case study 5	2	6	5	1	3	4
Records	1	5	6	3	2	4
Sum of ranks (R_i):	4	16	17	7	7	12
k = number of judges (i.e. data sources):					=	3
n = no of objects being rated:					=	6
Mean ranks, \bar{R}						
$\bar{R} = k(n+1)/2$	$= [3*(6+1)/2]$				=	10.5
R_i deviations from mean: $R_i - \bar{R}$	-6.5	5.5	6.5	-3.5	-3.5	1.5
Square of deviations	42.25	30.25	42.25	12.25	12.25	2.25
Sum of squared deviations (S):					$S =$	141.5
Coefficient of Concordance $W =$						
$W = 12S/[K^2(n^3-n)] =$						0.898
Where: $[0 \leq W \leq 1]$						
$W = 0$ (=maximum disagreement/ discordance)						
$W = 1$ (=maximum agreement/ concordance)						
FOR STATISTICAL TEST OF SIGNIFICANCE:						
[transforming W into chi-square (χ^2) test statistic (τ) with $n-1$ degrees of freedom]:						
$\tau_{\text{calculated}} = K(n-1)W$ (i.e. chi-square transformed value of the W value)					=	13.48
α					=	0.05
df = degrees of freedom = $n-1$					=	5.00
$\tau_{\text{critical}} = \text{CHIINV}(0.05, n-1)$					=	11.07
p (prob associated with $\tau_{\text{calculated}}$) = $\text{CHIDIST}(\tau_{\text{calculated}}, df)$					=	0.0193

Hypothesis testing (Case Study V: Broad external challenges)

H_0 (null hyp):	<p>(assumes that no significant concordance or agreement exists among the judges or raters; i.e. raters rate independently by chance and not in accordance with a common pattern)</p> <p>This is true if and only if one of the following is true:</p> <p>$\tau_{\text{calculated}} \leq \tau_{\text{critical}}$ (i.e. falls within zone of acceptance), OR:</p> <p>$p \geq \alpha$ [i.e. the probability associated with the $\tau_{\text{calculated}} \geq \alpha$ value of test (usually 0.05)]</p>
H_A (alt hyp):	<p>(assumes that significant concordance or agreement exists among the judges or raters; i.e. raters rate in accordance with a common pattern)</p> <p>This is true if and only if one of the following is true:</p> <p>$\tau_{\text{calculated}} > \tau_{\text{critical}}$ (i.e. falls within zone of rejection), OR:</p> <p>$p < \alpha$ [i.e. the probability associated with the $\tau_{\text{calculated}} < \alpha$ value of test (usually 0.05)]</p>
Results:	<p>$\tau_{\text{calculated}} > \tau_{\text{critical}}$ (i.e. falls within zone of rejection), OR:</p> <p>$p < \alpha$ [i.e. the probability associated with the $\tau_{\text{calculated}} < \alpha$ value of test (usually 0.05)]</p>
Decision:	Reject H_0
Conclusion:	<p>There is no statistical evidence to support the null hypothesis that any agreement among the findings from the three sources of evidence is by chance variation;</p> <p>We can therefore conclude that there is some measure of consistency or triangulation among the 3 sources;</p> <p>This also accords some measure of reliability and validity to the findings, the test instrument and the procedure adopted in the research.</p>

Case study V (University E): Future challenges

Table 290: Case Study V: Level of agreement of the sets of relative occurrence frequency rankings of the future challenges faced by facilities managers as obtained from three sources.

Empirical data sources (k_i)	RANKINGS: FUTURE CHALLENGES									
	FMgrs challenges (n_i)									
	F1	F2	F3	F4	F5	F6	F7	F9	F10	F11
Main survey	5	3	1	8	6	9	7	4	2	10
Case study 5	9	3	1	7	2	8	6	4	5	10
Records	4	1	3	6	9	10	5	7	2	8
Sum of ranks (R_i):	18	7	5	21	17	27	18	15	9	28
k = number of judges (i.e. data sources):									=	3
n = no of objects being rated:									=	10
Mean ranks, \bar{R}										
$\bar{R} = k(n+1)/2$						[3*(10+1)/2]=			=	16.5
Ri deviations from mean: $R_i - \bar{R}$	1.5	-9.5	-11.5	4.5	0.5	10.5	1.5	-1.5	-7.5	11.5
Square of deviations	2.25	90.25	132.25	20.25	0.25	110.25	2.25	2.25	56.25	132.25
Sum of squared deviations (S):									S =	548.5
Coefficient of Concordance W =										
$W = 12S/[K^2(n^3 - n)] =$									=	0.739
Where:										
$[0 \leq W \leq 1]$										
W = 0 (=maximum disagreement/ discordance)										
W = 1 (=maximum agreement/ concordance)										
FOR STATISTICAL TEST OF SIGNIFICANCE:										
[transforming W into chi-square (χ^2) test statistic (τ) with n-1 degrees of freedom]:										
$\tau_{\text{calculated}} = K(n-1)W$ (i.e. chi-square transformed value of the W value)									=	19.95
α									=	0.05
df = degrees of freedom = n-1									=	9.00
$\tau_{\text{critical}} = \text{CHIINV}(0.05, n-1)$									=	16.919
p (prob associated with $\tau_{\text{calculated}}$) = CHIDIST($\tau_{\text{calculated}}$, df)									=	0.01825

Hypothesis testing (Case Study V: Future challenges)

H_0 (null hyp): (assumes that no significant concordance or agreement exists among the judges or raters; i.e. raters rate independently by chance and not in accordance with a common pattern)
This is true if and only if one of the following is true:
 $\tau_{\text{calculated}} \leq \tau_{\text{critical}}$ (i.e. falls within zone of acceptance), OR:
 $p \geq \alpha$ [i.e. the probability associated with the $\tau_{\text{calculated}} \geq \alpha$ value of test (usually 0.05)]

H_A (alt hyp): (assumes that significant concordance or agreement exists among the judges or raters; i.e. raters rate in accordance with a common pattern)
This is true if and only if one of the following is true:
 $\tau_{\text{calculated}} > \tau_{\text{critical}}$ (i.e. falls within zone of rejection), OR:
 $p < \alpha$ [i.e. the probability associated with the $\tau_{\text{calculated}} < \alpha$ value of test (usually 0.05)]

Results: $\tau_{\text{calculated}} > \tau_{\text{critical}}$ (i.e. falls within zone of rejection), OR:
 $p < \alpha$ [i.e. the probability associated with the $\tau_{\text{calculated}} < \alpha$ value of test (usually 0.05)]

Decision: Reject H_0

Conclusion: There is no statistical evidence to support the null hypothesis that any agreement among the findings from the three sources of evidence is by chance variation;
We can therefore conclude that there is some measure of consistency or triangulation among the 3 sources;
This also accords some measure of reliability and validity to the findings, the test instrument and the procedure adopted in the research.

APPENDIX H: SUMMARY OF RESEARCH FINDINGS

Research objectives 1

To identify and prioritize the key internal and external challenges impacting on the achievement of strategic facilities management goals

Findings

A current thinking on the subject reveals that the key challenges facing university facilities managers that constraining on the achievement of strategic FM goals comprise of two distinctive broad categories:

1. Internal constraints range from internal managerial issues related to finance, stakeholder needs/ service providers, manpower, operational method/ process, manpower, machinery and materials constraints, in order of their significance level, respectively
2. External constraints, the challenges can be structured into PESTELI constraints: political, economic, socio-cultural, technological, environmental, legislative and institutional, which in this context legislative/ regulatory compliance, political and economic and environmental were perceived to be the most significant external factors contributing to the achievement of strategic FM goals.

Table 1-2 illustrates the broad categories of internal and external challenges and issues faced by university facilities managers, respectively.

Results for research objectives 1

Broad categories of current internal challenges and issues faced by university facilities managers

Code	Broad categories of Current Internal (CI) challenges	Issues faced by university facilities managers
CI-A	Finance	How to address poor capital and operational budgetary allocations and attract adequate funding for proper execution of FM works, procure new or upgrade existing facilities to meet user requirements, undertake required preventive or restorative maintenance, provide needed outdoor spaces & grounds, internal spaces, procure equipment, plant and services, hire out-source personnel to undertake FM services, train and motivate in-house personnel for improved performance, quality and productivity.
CI-B	Operational efficiency	How to improve efficiency in the work processes to lower operational costs, optimise resource utilization and achieve set goals; issues associated with quality assurance, adequate technology, effectiveness of leadership and management style, effectiveness of organisational structure and impact on coordination and decision making processes, staff training and development processes and impact on workforce empowerment & productivity, compliance with legislations and regulations, effectiveness and efficiency of communication systems, organisational policies & values and their impact on organisational effectiveness and efficiency.
CI-C	Stakeholder needs	How to assess and respond to the changing and complex needs of the different stakeholders (e.g. staff, students and visitors); how to address -with limited budget - compliance with ergonomics and accessibility issues in the workplace, especially for the aged and the handicapped; lack of consideration of all stakeholders in the FM sphere; difficulties in managing conflicting stakeholder interests and requirements; poorly controlled changes to user requirements; absence of or poor system; inflexible contracts; inability to involve stakeholders; difficulties in updating and improving service level agreements and service specifications.
CI-D	Manpower	How to address the problems associated with inadequate labour resource brought about by issues such as lack of skilled/ experienced manpower, organisation-wide freeze on employment and inadequate budgets; the challenge of attracting and retaining skilled manpower, and of keeping staff abreast of current technology advances and changes in legislations; low productivity of the workforce; high staff turnover due to poor remuneration; poor quality of workmanship; compliance with OSH requirements in the workplace.
CI-E	Machinery/ equipment	How to effectively manage the large stock of machinery and equipment to mitigate poor utilisation, frequent breakdowns and the associated disruptions to smooth operations and workplace productivity; durability problems and their impact on operational and maintenance costs; environmental performance issues and associated impacts; logistics and maintenance problems; equipment selection dilemma; obsolescence and replacement costs for installed machines or equipment.
CI-F	Materials	How to address the problems associated with high costs of materials and components, insufficiency of storage facility, durability problems/ environmental performance and their impact on operational and maintenance costs, compliance with occupational, safety and health requirements, and quality assurance/ selection dilemma.

Results for research objectives 1 (continued)

Broad categories of current external challenges and issues faced by university facilities managers

Code	Broad categories of		Challenges faced by university facilities managers
	Current	External (CE) challenges	
CE-A	Political		Challenges relating to political constraints - Restraints inherent in the dynamic of organizational politics and tensions such as: conflicting multi-stakeholder interests; inadequate level of authority to match enormous FM responsibilities; influences from different cliques of top management; ethical dilemma; political bickering and power struggle that undermine freedom and best practice of standards; lack of influence over FM budget decisions.
CE-B	Economic		How to proactively manage the micro- and macro- economic climates having disruptive effects on FM budget and operations, including fluctuations in the exchange rates, interest rates and inflation resulting in: unaffordability of new project upgrade and maintenance costs; downsizing of operation and maintenance activities; reduction in workforce size and skillsets; restriction on R&D and innovation; inability to meet user needs for vital pace, grounds and equipment.
CE-C	Socio-cultural issues		The challenge of catering for the diverse needs of users of the facilities and infrastructure, including creating a safe and conducive environment for work and other uses for the facilities. Addressing the ergonomics and accessibility compliance issues, especially for the aged and the handicapped. How to address the ethnic diversity and differing cultural needs.
CE-D	Technological		Challenges related to rapid changes in technology, including technological obsolescence and the need to upgrade equipment and processes; how to leverage new and efficient technologies to improve on the FM management and operations; how to address to technological obsolescence and impact on competitiveness, huge capital investment, constant workforce training and re-training requirements and disruptions to operations inherent in installation, upgrades and trial runs.
CE-E	Legislative		Challenges arising from compliance with the legislations, by-laws and standards affecting FM planning and operations; high compliance costs associated with keeping pace with the regulatory changes and the associated uncertainties and risks to forward planning; compliance with the OHS regulations in the workplace.
CE-F	Sustainability/ environmental issues		The challenge of finding innovative and sustainable ways of managing energy use, waste disposal, resource use and environmental pollution/ contamination; achieving the Reduce, Re-use and Recycle mandate to waste management; rapid changes in legislation and by-laws; high legislative compliance constraints; resource and building consent restrictions on planning, development and operations; pressure arising from environmental audit and reporting requirements.
CE-G	Institutional		Challenges presented by organisational politics; catering for the diverse and often conflicting multi-stakeholder interests; lack of FM representation on the university management board; senior management's view of facilities as being part of the operational costs that must be minimised, rather than a strategic asset that must be optimised; undue influence of the top management; unrealistic expectations of the top management; dilemma of juggling the organizational interests for ethical and best practice standards.

Research Objective 2:

To determine their associated risk levels as analysed from their perceived frequencies of occurrence and levels of impact on the achievement of the strategic goals of FM functions.

Findings

Results showed that the following factors were perceived to be risky factors in each sub-category of internal challenges: (i) finance constraints: inadequate financial resources or budget to procure new or upgrade existing facilities to meet user requirements; (ii) operational method/ process: organizational policy, strategies, values and missions and their impact on organizational effectiveness and efficiency; (iii) stakeholder needs/ service providers: organizational policy, strategies, values and missions and their impact on organizational effectiveness and efficiency; (iv) manpower: inadequate skilled manpower; (v) machinery: obsolescence and replacement costs for installed machines or equipment; (vi) materials: environmental performance problems and their impact on operational costs.

In the sub-category of external challenges, results showed that the following factors were perceived to be risky: (i) political constraints: conflicting multi-stakeholder interests (i.e dealing with the diverse interest of several groups having varying levels of authority and control); (ii) economic constraints: unaffordability of new project, upgrade and maintenance; (iii) socio-cultural constraints: having to address the ethnic diversity and differing cultural needs especially in relation to space planning and design solutions; (iv) technological constraints: dilemma of having to monitor and keep up with the rapid technological changes developments; (v) legislative constraints: rapid changes in legislations, by-laws and standards/ codes affecting the FM planning and operations costs; (vi) environmental/ sustainability: that the rapid changes in legislation and by-laws; (vii) institutional: unrealistic expectations of the top management: "Achieve so much output with so little resources".

Overall, results showed that financial-related constraint was perceived as the most importance factor associated with the broad internal challenges. Meanwhile, economic-related constraint was perceived as the most importance factor associated with the broad external challenges impacting on the achievement of strategic FM goals.

Table 3-8 illustrates the risk levels (in terms of their perceived levels of impact and frequencies of occurrence) associated with the broad internal and broad external categories challenges, respectively.

Results for research objectives 2

Levels of impact - Broad category of internal challenges

¹ Broad Internal categories	Level of Impact					² TR	³ II	Remark	⁴ RII	Rank
	VH	H	M	L	VL					
	%	%	%	%	%					
	5	4	3	2	1					
CI-A	97	3	0	0	0	528	4.968	Very High	0.190	1
CI-B	43	24	21	11	2	528	3.953	High	0.151	4
CI-C	92	8	0	0	0	528	4.920	Very High	0.188	2
CI-D	75	14	11	0	0	528	4.638	Very High	0.177	3
CI-E	38	25	28	8	2	528	3.883	High	0.149	5
CI-F	34	24	29	11	2	528	3.771	High	0.144	6
							<u>26.133</u>		<u>1.000</u>	

¹Broad internal categories:

CI-A) Financial; CI-B) Operational Method/ Process; CI-C) Stakeholder needs/ service providers; CI-D) Manpower; CI-E) Machinery; CI-F) Materials.

²TR = Total responses for a particular variable;

³II = Impact Index (See equation 1, Chapter 3)

⁴RII = Relative Impact Index (See equation 2, Chapter 3)

Frequencies of occurrence - Broad category of internal challenges

[**Frequencies of occurrence:** 5 = Very Frequent; 4 = Frequent; 3 = Occasional; 2 = Rare; 1 = Very Rare]

¹ Broad Internal categories	** Frequency of occurrence					² TR	³ FI	Remark	⁴ RFI	Rank
	VF	F	O	R	VR					
	%	%	%	%	%					
	5	4	3	2	1					
CI-A	79	21	0	0	0	528	4.792	Very Frequent	0.200	1
CI-B	38	22	33	6	0	528	3.917	Frequent	0.164	4
CI-C	59	28	12	0	0	528	4.470	Very Frequent	0.187	2
CI-D	52	27	7	14	0	528	4.172	Frequent	0.174	3
CI-E	19	20	50	11	0	528	3.468	Frequent	0.145	5
CI-F	9	20	51	10	9	528	3.106	Occasional	0.130	6
							<u>23.924</u>		<u>1.000</u>	

¹Broad internal categories:

CI-A) Financial; CI-B) Operational Method/ Process; CI-C) Stakeholder needs/ service providers; CI-D) Manpower; CI-E) Machinery; CI-F) Materials.

²TR = Total responses for a particular variable;

³FI = Impact Index (See equation 3, Chapter 3)

⁴RFI = Relative Impact Index (See equation 4, Chapter 3)

Respondents' responses on the frequencies of occurrence on the broad categories of external challenges

[Frequencies of occurrence: 5 = Very Frequent; 4 = Frequent; 3 = Occasional; 2 = Rare; 1 = Very Rare]**

¹ Broad External categories	** Frequency of occurrence (%)					² TR	³ FI	Remark	⁴ RFI	Rank
	VF	F	O	R	VR					
	5	4	3	2	1					
CE-A	57	19	24	0	0	528	4.322	Very Frequent	0.152	3
CE-B	75	25	0	0	0	528	4.752	Very Frequent	0.167	1
CE-C	17	35	48	0	0	528	3.691	Frequent	0.130	6
CE-D	9	43	38	9	0	528	3.527	Frequent	0.124	7
CE-E	38	24	38	0	0	528	4.000	Frequent	0.140	4
CE-F	52	29	18	0	0	528	4.343	Very Frequent	0.153	2
CE-G	19	46	35	0	0	528	3.839	Frequent	0.135	5
						<u>28.473</u>			<u>1.000</u>	

¹Broad External challenges:

CE-A) Political; CE-B) Economic; CE-C) Socio-cultural; CE-D) Technological; CE-E) Environmental and sustainability; CE-F) Legislative/ Regulatory compliance; CE-G) Institutional.

²TR = Total responses for a particular variable;

³FI = Impact Index (See equation 3, Chapter 3)

⁴RFI = Relative Impact Index (See equation 4, Chapter 3)

Risk levels on the broad categories of external challenges

¹ Broad External categories	Impact Index	Frequency Index	Risk Score (RS)	Remark	Risk Ranking
	² (Ii)	³ (Fi)	⁴ (Ii x Fi)		
CI-A	4.496	4.322	19.432	High	3
CI-B	4.449	4.752	21.141	Very high	1
CI-C	4.038	3.691	14.905	Moderate	6
CI-D	3.805	3.527	13.418	Moderate	7
CI-E	4.328	4.000	17.311	High	4
CI-F	4.769	4.343	20.711	Very high	2
CI-G	4.328	3.839	16.614	High	5

¹ Broad External challenges:

CE-A) Political; CE-B) Economic; CE-C) Socio-cultural; CE-D) Technological; CE-E) Environmental and sustainability; CE-F) Legislative/ Regulatory compliance; CE-G) Institutional.

²Ii = Impact Index (See equation 1, Chapter 3)

³Fi = Frequency Index (See equation 3, Chapter 3)

⁴RS = Risk Score (See equation 5, Chapter 3)

Research Objective 3:

To establish practical solutions for addressing the challenges

Findings

Results revealed that the following were perceived to be the most significant practical solutions for the sub-category of internal challenges: (i) finance: develop strategic management situations to do more with less; (ii) operational-efficiency: regular meetings are essentials to set the facilities goal, strategy, communicate solutions that lead to energy efficiency; (iii) risk management: preparing detailed and analytical specifications of the facility as well as all associated risks; (iv) stakeholder needs/ service provider: facilities managers to recognize that they are in the customer service business; (v) maintenance: considering university's backlog of renewal and renovation projects in light of sustainability and increase the priority for the upgrade of inefficient structures; (vi) manpower: the need for FM department to confront workforce development issues; (vii) health and safety: detailed safety rules and safe working practices to ensure compliance with health and safety legislation must be devised, implemented and regularly reviewed; (viii) materials: the need to have an effective system that delivers the materials to the site when unpredictable requirements develop during the course of a job, rather than one that requires the mechanic to leave the job site to obtain materials.

In term of the sub-category of external challenges, the following practical solutions were perceived to be the most significant for addressing the identified issues: (i) economic: strive realistic expectations within the university; (ii) sustainability/ environmental: build a culture of sustainability on campus to include staffs, students, faculty, administrators and sustainability influences decision-making across campus; (iii) technology: integrate IT and facilities planning to maximize success; (iv) regulatory/ compliance: keep on top of the growing number of state and federal regulations that apply to the universities and organization; (v) socio-cultural: managing stakeholder expectations through dialogue and effective communication; (vi) institutional: demonstrate their value and the value of facilities to get a seat at the highest tables of decision making within the university.

Results for research objectives 3

Practical solutions for addressing Current Internal (CI) challenges - Finance

Code	Practical solutions for addressing Current Internal Challenges (CI)
A	Finance: How to 1) address low capital and operational budgetary allocations and 2) attract adequate funding for complete execution of FM works:
SCI-A-1	Develop strategic management situations to do more with less.
SCI-A-2	Develop energy efficiency strategies that will reduce utilities costs and benefit the environment.
SCI-A-3	FM department need to develop long-term strategies to make their organization more efficient and financially viable: 1) Move beyond short-term cost cutting to true financial discipline; 2) Consider Total Cost Ownership in assessing the facilities' value; 3) Understand the value to their customers; 4) Assess and enhance the Return on Investment of the university's facilities assets through higher utilization.
SCI-A-4	Improving FM's strategic relevance, linking funding request to corporate goals.
SCI-A-5	Adequate life cycle costing when planning facilities.
SCI-A-6	Adequate space planning.

Finance (SCI-A-1):

SCI = Solution for Current Internal (CI) challenge

SCI-A = 'A' refers to subcategory (issue-related) of current internal challenge

SCI-A-1 = '1' refers to the numbers of solution mentioned as practical solution for the challenge

Practical solutions for addressing Current Internal (CI) challenges - Operational efficiency

Code	Practical solutions for addressing Current Internal Challenges (CI)
B	Operational efficiency: How to improve efficiency in the work processes to lower operational costs, optimise resource utilization and achieve set goals:
SCI-B-1	Regular meetings are essentials to set the facilities goal, strategy, communicate solutions that lead to energy efficiency.
SCI-B-2	Use of innovation and creativity to achieve more with less.
SCI-B-3	Recognising needs for improvements through 'know' information or benchmark information, or both.
SCI-B-4	Setting out goals and provide best qualified solutions.
SCI-B-5	Staff training for operational improvements.

Operational efficiency (SCI-B-1):

SCI = Solution for Current Internal (CI) challenge

SCI-B = 'B' refers to subcategory (issue-related) of current internal challenge

SCI-B-1 = '1' refers to the numbers of solution mentioned as practical solution for the challenge

Results for research objectives 3 (continued)

Practical solutions for addressing Current Internal (CI) challenges - Risk Management

Code	Practical solutions for addressing Current Internal Challenges (CI)
C	Risk management: How to improve on the accuracy of risk analysis, contingency planning and the effectiveness of risk monitoring and risk response:
SCI-C-1	Facilities managers need to prepare detailed and analytical specifications of the facility, and all associated risks.
SCI-C-2	Identification and allocation of risks involved on a rational basis to help clarify relationships between stakeholders, service providers and facilities managers.
SCI-C-3	Facilities managers need to have clear perception of the risks being borne by each party.
SCI-C-4	Facilities managers need to have motivation to manage risks that require a clear linkage between a party's management of risks and the party's receipt of award.

Risk management (SCI-C-1):

SCI = Solution for Current Internal (CI) challenge

SCI-C= 'C' refers to subcategory (issue-related) of current internal challenge

SCI-C-1 = '1' refers to the numbers of solution mentioned as practical solution for the challenge

Practical solutions for addressing Current Internal (CI) challenges - Stakeholder needs/ Service providers

Code	Practical solutions for addressing Current Internal Challenges (CI)
D	Stakeholder needs/Service providers: How to assess and respond to the changing and complex needs of the different stakeholders (e.g. staff, students and visitors); how to address - with limited budget - compliance with ergonomics and accessibility issues in the workplace, especially for the aged and the handicapped.
SCI-D-1	Facilities managers need to recognize that they are in the customer service business: cultivate an atmosphere of customer service; consider customer service and communications training for staff; and implement communications programs to gather information and keep stakeholders informed.
SCI-D-2	Understand communications challenges both up administrative chain and across departments, use a variety of forms of communications and be prepared for a two-way exchange.
SCI-D-3	Facilities departments need to become more proactive about seeking stakeholders input and responding to stakeholder expectations: be upfront about soliciting input, seek out stakeholder groups beyond the obvious parties and honestly listen to new ideas.
SCI-D-4	Assess customer satisfaction to establish a baseline and to measure future progress.
SCI-D-5	Consider the customer relationship management technology to streamline customer service.
SCI-D-6	Enhancing client capability and quality of provision, and proper assessment of requirements for the scope and content of services.

Stakeholder needs/ service provider (SCI-D-1):

SCI = Solution for Current Internal (CI) challenge

SCI-D = 'D' refers to subcategory (issue-related) of current internal challenge

SCI-D-1 = '1' refers to the numbers of solution mentioned as practical solution for the challenge

Results for research objectives 3 (continued)

Practical solutions for addressing Current Internal (CI) challenges - Maintenance

Code	Practical solutions for addressing Current Internal Challenges (CI)
E	Maintenance: How to address the dilemma in managing aging buildings and infrastructure, especially as it relates to deciding between "retain and maintain" versus "upgrade or replace"; addressing the problem of deferred/backlog of maintenance that has arisen due to diversion of funding to higher priority areas.
SCI-E-1	Develop consistent categories to define maintenance and renewal needs.
SCI-E-2	University should consider their backlog of renewal and renovation projects in light of sustainability and increase the priority for the upgrade of inefficient structures by: (i) using sustainability to advocate for renewal outdated buildings; (ii) include sustainability as a factor in facility assessments and put priority on structures that are getting in the way of achieving university's sustainability goals and (iii) developing criteria to determine which building are not worth saving.

Maintenance (SCI-E-1):

SCI = Solution for Current Internal (CI) challenge

SCI-E = 'E' refers to subcategory (issue-related) of current internal challenge

SCI-E-1 = '1' refers to the numbers of solution mentioned as practical solution for the challenge

Practical solutions for addressing Current Internal (CI) challenges - Manpower

Code	Practical solutions for addressing Current Internal Challenges (CI)
F	Manpower: How to address the problems associated with inadequate labour resource brought about by issues such as lack of skilled/ experienced manpower, organisation-wide freeze on employment and inadequate budgets; the challenge of attracting and retaining skilled manpower and of keeping staff abreast of current technology and legislations.
SCI-F-1	Facilities departments need to understand the demographic changes facing their university and the plan accordingly to avoid future problems: (i) understand the demographic shifts in the city, state and region; (ii) assess the future needs; (iii) identify the gaps between the university have and need.
SCI-F-2	Facilities managers need to (i) assess employee satisfaction and act on the results; (ii) work with the university to develop and implement new strategies and programs; (iii) provide a professional career path for employees so new leaders can be fostered.
SCI-F-3	Facilities department need to confront workforce development issues by: (i) assessing the impact of the recession on the facilities workforce; (ii) helping current staff adjust to change; (iii) developing strategies to bring new skills into organization and (iv) creating knowledge transfer system so the expertise of retiring workers is preserved.
SCI-F-4	The workforce is getting older, more diverse and more in demand thus facilities managers need to (i) understand how changes in the population will affect the workforce and (ii) develop strategies to pass the wisdom of mature workers onto new leaders.
SCI-F-5	Delivering a vibrant work environment that attracts and retains talented staff or labour.

Manpower (SCI-F-1):

SCI = Solution for Current Internal (CI) challenge

Results for research objectives 3 (continued)

Practical solutions for addressing Current Internal (CI) challenges - Health and Safety

Code	Practical solutions for addressing Current Internal Challenges (CI)
G	Health and safety: How to address to the health and safety issues concern on harm to staff and student due to accidents and disasters:
SCI-G-1	All staffs in the workplace need to have adequate knowledge and aware of the compliance with health and safety legislation. It includes shared parts of buildings and the grounds in which the organisation's buildings are set.
SCI-G-2	A competent person must be appointed to the university or facilities department itself, or act as a consultant to assist in implementing and complying with health and safety legislation, whether services are retained in house or out-sourced.
SCI-G-3	Policies, detailed safety rules and safe working practices to ensure compliance with health and safety legislation must be devised, implemented and regularly reviewed.
SCI-G-4	A general policy statement must be produced and this must be communicated well to all stakeholders.

Health & Safety (SCI-G-1):

SCI = Solution for Current Internal (CI) challenge

SCI-G= 'G' refers to subcategory (issue-related) of current internal challenge

SCI-G-1 = '1' refers to the numbers of solution mentioned as practical solution for the challenge

Practical solutions for addressing Current Internal (CI) challenges - Materials

Code	Practical solutions for addressing Current Internal Challenges (CI)
H	Materials: The challenge to having the correct materials available to maintenance personnel when needed for effective operations.
SCI-H-1	Need to have an effective system that delivers the materials to the site when unpredictable requirements develop during the course of a job, rather than one that requires the mechanic to leave the job site to obtain materials.
SCI-H-2	Need to have a good planning where materials can be provided or stored on the job site or the maintenance worker can take all materials needed to the site at the start of the job.
SCI-H-3	Embraces the "just-in-time" concept, whereby on-hand inventories are reduced and materials are made available through arrangements or contracts with vendors, either on scheduled basis or on short notice as needed.
SCI-H-4	Preventive maintenance consumables should always be readily available before work started.
SCI-H-5	All materials used in maintenance should be charged out against the building or specific building systems and equipment where appropriate. These costs along with labour costs should be accumulated in a hierarchy file to maintain accurate maintenance and repair costs for specific buildings and building components.
SCI-H-6	Regardless of the system used, materials should be made available to field personnel with minimum effort.
SCI-H-7	Maintenance vehicles to be outfitted with commonly required materials.
SCI-H-8	Explore the system for delivering materials to the work sites in cases where workers are making frequent trips from work sites to obtain materials.
SCI-H-9	Provision of emergency spare parts and equipment which must be stored in secure areas but be readily available to after-hours maintenance and repair crews. The items should be carefully inventoried, and usage data should be maintained and periodically reviewed to ensure that only items used for emergencies are carried in the inventory.
SCI-H-10	Need to provide secure spaces in buildings or in mechanical rooms to pre-positioned materials for preventive maintenance work such as lubricants, filters, drive belts and fluorescent tubes.

Materials (SCI-H1):

SCI = Solution for Current Internal (CI) challenge

SCI-H= 'H' refers to subcategory (issue-related) of current internal challenge

SCI-H-1 = '1' refers to the numbers of solution mentioned as practical solution for the challenge

Results for research objectives 3 (continued)

Practical solutions for addressing Current External (CE) challenges - Economic

Code	Practical solutions for addressing Current External Challenges (CE)
A	Economic: How to proactively manage the micro- and macro- economic climates that have disruptive effects on FM budget and operations, including fluctuations in the exchange rates, interest rates and inflation. Universities must confront the current recession and maintain forward momentum despite economic restraints by shifting expectations among stakeholders:
SCE-A-1	Strive to set realistic expectations within the university.
SCE-A-2	Shun frugality and ensure prudential management of limited resources.
SCE-A-3	As much as possible 'bootstrap', i.e. use less (inputs) to accomplish more (output).
SCE-A-4	Optimise cost-cutting and efficiency in all processes.
SCE-A-5	Maintain sustainability focus in all aspects of FM operation.
SCE-A-6	Incorporate total cost of ownership into the decision-making process.

Economic (SCE-A-1):

SCE = Solution for Current External (CE) challenge

SCE-A = 'A' refers to subcategory (issue-related) of current internal challenge

SCE-A-1 = '1' refers to the numbers of solution mentioned as practical solution for the challenge

Practical solutions for addressing Current External (CE) challenges – Sustainability/ environmental issues

Code	Practical solutions for addressing Current External Challenges (CE)
B	Sustainability/ environmental issues: Challenge of finding innovative and sustainable ways of managing energy use, waste disposal, resource use and environmental pollution/ contamination; achieving reduce, re-use and re-cycle mandate to waste management.
SCE-B-1	Build a culture of sustainability on campus to include staffs, students, faculty, administrators and sustainability influences decision-making across campus.
SCE-B-2	Ensure the facilities department is leading the charge for campus sustainability - senior facilities officers play vital roles in sustainability discussions, helping shape policy and managing implementation in order to assess their role on campus and where to step up to increase their impact on sustainability discussion.
SCE-B-3	Ensure that facilities managers have the education, skills and leadership abilities to take their place among university decision makers.
SCE-B-4	Develop and implement an energy policy to cut consumption, manage use and reduce volatility.
SCE-B-5	Make a business case for energy efficiency and sustainability.
SCE-B-6	Facilities managers need to communicate the value of the sustainability and energy management effort.
SCE-B-7	Use the campus as a proving ground for new sustainability and energy projects.
SCE-B-8	Leverage sustainability efforts to promote and grow higher education as well as to fuel large-scale social change.
SCE-B-9	Facilities managers need to leverage existing facilities operations and programs to support sustainability.
SCE-B-10	Accept that sustainability focus is not a temporary trend but a long-term shift in the culture.

Sustainability/ environmental (SCE-B-1):

SCE = Solution for Current External (CE) challenge

Results for research objectives 3 (continued)

Practical solutions for addressing Current External (CE) challenges - Technological

Code	Practical solutions for addressing Current External Challenges (CE)
C	Technological: Challenges related to rapid changes in technology, including technological obsolescence and the need to upgrade equipment and processes; how to leverage the latest technology to improve on the FM management and operations.
SCE-C-1	Integrate IT & facilities planning to maximize success.
SCE-C-2	Seek ways to work with IT to resolve existing issues.
SCE-C-3	Identify the experts who can help.
SCE-C-4	Make the right investments to ensure IT resources can withstand disaster.
SCE-C-5	Assess how technologies in IT will affect all aspects of teaching, learning, research, communications and the built environment.
SCE-C-6	Develop strategies that will help the institution remain nimble & flexible in the face of rapid technological change.
SCE-C-7	Strive to develop common goals and a vision that is in alignment with the university's vision and mission.

Technological (SCE-C-1):

SCE = Solution for Current External (CE) challenge

SCE-C= 'C' refers to subcategory (issue-related) of current internal challenge

SCE-C-1 = '1' refers to the numbers of solution mentioned as practical solution for the challenge

Practical solutions for addressing Current External (CE) challenges - Regulatory/ compliance

Code	Practical solutions for addressing Current External Challenges (CE)
D	Regulatory/ compliance: Challenges arising from compliance with the legislations, by-laws and standards/ codes affecting the FM planning and operations; high compliance costs associated with keeping pace with the regulatory changes; uncertainties and risks to forward planning.
SCE-D-1	Keep on top of the growing number of state and federal regulations that apply to the universities and organization.
SCE-D-2	Advocate for streamlined regulations that are more relevant and less burdensome.
SCE-D-3	Need to better manage existing regulations, start measuring cost of regulations as they keep track of the compliance.

Technological (SCE-D-1):

SCE = Solution for Current External (CE) challenge

SCE-D= 'D' refers to subcategory (issue-related) of current internal challenge

SCE-D-1 = '1' refers to the numbers of solution mentioned as practical solution for the challenge

Results for research objectives 3 (continued)

Practical solutions for addressing Current External (CE) challenges - Socio-cultural issues

Code	Practical solutions for addressing Current External Challenges (CE)
E	Socio-cultural issues: The challenge of catering for the diverse needs of facilities and infrastructure users, including creating a safe and conducive environment for work and other uses for the facilities. Addressing the ergonomics and accessibility compliance issues, especially for the aged and the handicapped.
SCE-E-1	Manage stakeholder expectations through dialogue and effective communication.
SCE-E-2	Aim to address only critical needs of the key stakeholders; focus on real needs rather than 'wants'.
SCE-E-3	Make a strong case for senior management to prune down admissions to align with existing facility capacity.
SCE-E-4	Optimise space allocation and space utilisation.
SCE-E-5	Leverage alumni and external donations to fund major infrastructure development for communal services.
SCE-E-6	Strategic engagement of the university community in volunteer services for public good such as environmental management, campus cleaning, recycling and waste disposal.
<i>Socio-cultural (SCE-E-1):</i>	
<i>SCE = Solution for Current External (CE) challenge</i>	
<i>SCE-E= 'E' refers to subcategory (issue-related) of current internal challenge</i>	
<i>SCE-E-1 = '1' refers to the numbers of solution mentioned as practical solution for the challenge</i>	

Results for research objectives 3 (continued)

Practical solutions for addressing Current External (CE) challenges - Institutional

Code	Practical solutions for addressing Current External Challenges (CE)
F	Institutional: Challenges presented by organisational politics; catering for the diverse and often conflicting multi-stakeholder interests; lack of FM representation on the university management board; senior management's view of facilities as being part of the operational cost that must be minimised, rather than a strategic asset that must be optimised.
SCE-F-1	Aligning facilities planning with institutional goals: (i) get facilities involved early in the overall planning process, (ii) understand where institutions want to go and what it wants to be, (iii) evaluate the facilities implications including the financial implications of academic plans; (iv) develop specific outcomes for generalized goals.
SCE-F-2	Crafting integrated strategic plan: (i) create a strategic plan that will help the organization focus on its top priorities even during hard financial times; (ii) focus on aligning the organization with the mission of the universities to ensure continuity of focus and direction; (iii) confront the challenges of cost, access and competition; (iv) analyse the organization, structure and financial system for their long-term sustainability and economic viability.
SCE-F-3	Facilities managers need to demonstrate their value and the value of facilities to get a seat at the highest tables of decision making within the university: (i) understand the current situation; (ii) consider what need to do to raise the profile of facilities; (iii) ensure that facilities strategic plan is in alignment with the vision, mission and strategies of the university and this alignment can be demonstrated with quantifiable results.
SCE-F-4	Facilities departments must respond to increased demands for accountability with information that demonstrates how well they are managing the university's resources: (i) develop strategies to demonstrate the facilities department's responsibilities of caretaking the campus of built environment; (ii) determine how best to evaluate the intangibles that contribute to the value of the facilities; (iii) use smart public relations and marketing strategies to communicate your results.

Institutional (SCE-F-1):

SCE = Solution for Current External (CE) challenge

SCE-F= 'F' refers to subcategory (issue-related) of current internal challenge

SCE-F-1 = '1' refers to the numbers of solution mentioned as practical solution for the challenge

Research Objective 4:

To establish the key challenges facing tomorrow's universities facilities managers.

Findings

Results revealed that the key challenges facing tomorrow's university facilities managers are identified as follows in their decreasing order of significance/ severity: sustainability, strategic asset management, space management, statutory compliance, leadership and innovation in FM, security/ emergency planning/ fire safety/ critical incidents, maintenance management, FM solutions to future teaching and research needs, occupational health and safety, information technology, business and financial management, and outsourcing. On the other hand, planning/ design/ construction/ project management and cleaning and waste management issues were perceived to be the least vital challenges that need to be encountered by university facilities managers in future ahead.

Results also revealed that the most significant practical solutions for addressing future challenges are as follows: (i) emergency management: to take active role in cross-department business continuity activities; (ii) statutory compliance: ensuring adequate staff knowledge of the compliance standards and legislations governing the FM policies and operations; (iii) sustainability: assessing the institution and the department's current level of sustainability; make business case for sustainable practice and for partnerships across the institution; (iv) technology: assessing how technologies in IT will affect all aspects of teaching, learning, research, communications and the built environment; (v) user needs assessment and satisfaction: ensuring efficient stakeholder expectation management and enlightenment; (vi) business and financial management: robust granular asset data and history to support planning/prioritisation based on risk; (vii) occupational health and safety: developing effective policies, decision-making processes and standards; (viii): leadership and innovation in FM: creating a "learning culture" in which opportunities for formal and informal learning can occur among employees up and down the organization chart; (ix) space management: developing effective policies, processes, and organizational structures to manage space and (x) outsourcing: understanding current client operations in order to obtain good picture of current operations which includes developing and documenting a baseline from financial, performance and service level perspectives in order to measure possible gains in efficiency as well as cost savings from outsourcing.

Results for research objectives 4

Predicted levels of impact for key future challenges facing tomorrow's university facilities managers

[Level of impact: 5 = Very high; 4 = High; 3 = Moderate; 2 = Low; 1 = Very low]

¹ Future challenges	Level of Impact (%)					² TR	³ II	Remark	⁴ RII	Rank
	VH	H	A	L	VL					
	5	4	3	2	1					
F-1	43	37	20	0	0	528	4.222	Very High	0.078	6
F-2	54	30	17	0	0	528	4.367	Very High	0.080	4
F-3	95	5	0	0	0	528	4.949	Very High	0.091	1
F-4	72	19	10	0	0	528	4.619	Very High	0.085	3
F-5	34	20	19	20	7	528	3.547	High	0.065	10
F-6	16	33	31	12	9	528	3.360	Moderate	0.062	11
F-7	30	33	12	11	13	528	3.564	High	0.066	9
F-8	32	31	18	15	4	528	3.731	High	0.069	8
F-9	17	32	12	29	10	528	3.155	Moderate	0.058	12
F-10	76	14	10	0	0	528	4.659	Very High	0.086	2
F-11	30	13	17	16	24	528	3.070	Moderate	0.056	13
F-12	52	27	20	0	0	526	4.321	Very High	0.079	5
F-13	10	14	36	29	10	528	2.858	Moderate	0.053	14
F-14	39	31	16	11	2	528	3.956	High	0.073	7
							<u>54.380</u>		<u>1.000</u>	

¹Future challenges:

F-1) Statutory compliance; F-2) Space management; F-3) Strategic asset management; F-4) Sustainability/environment/ carbon neutrality/ ESD; F-5) Planning/design/ construction/ project management; F-6) Information technology applications for facilities managers; F-7) Maintenance management; F-8) Security/ emergency planning/ fire safety/ critical incidents; F-9) Occupational health and safety; F-10) Leadership and innovation in FM; F-11) Outsourcing/ service contract management; F-12) FM solutions to future teaching & research needs; F-13) Cleaning and waste management; F-14) Business and financial management in FM.

²TR = Total responses for a particular variable;

³II = Impact Index (See equation 1, Chapter 3)

⁴RII = Relative Impact Index (See equation 2, Chapter 3)

Results for research objectives 4 (continued)

Predicted frequencies of occurrence for key future challenges facing tomorrow's university facilities managers

[**Frequencies of occurrence:** 5 = Very Frequent; 4 = Frequent; 3 = Occasional; 2 = Rare; 1 = Very Rare]

¹ Future challenges	Frequency of occurrence (%)					² TR	³ FI	Remark	⁴ RFI	Rank
	VF	F	O	R	VR					
	5	4	3	2	1					
F-1	53	23	24	0	0	528	4.292	Very High	0.083	1
F-2	54	20	26	0	0	528	4.284	Very High	0.083	2
F-3	29	38	34	0	0	528	3.947	High	0.076	7
F-4	44	38	18	0	0	528	4.265	Very High	0.082	3
F-5	7	34	23	18	18	528	2.949	Moderate	0.057	13
F-6	34	17	27	16	6	528	3.564	High	0.069	8
F-7	43	41	10	6	0	528	4.208	Very High	0.081	5
F-8	46	41	8	5	1	528	4.252	Very High	0.082	4
F-9	44	26	19	11	0	528	4.019	High	0.078	6
F-10	8	57	20	11	5	528	3.513	High	0.068	9
F-11	9	49	27	9	5	528	3.481	High	0.067	10
F-12	4	42	33	12	9	528	3.188	Moderate	0.062	11
F-13	5	38	26	17	14	528	3.023	Moderate	0.058	12
F-14	2	19	40	30	9	528	2.735	Moderate	0.053	14
							<u>51.720</u>			
								<u>1.000</u>		

Results for research objectives 4 (continued)

Predicted risk levels for key future challenges facing tomorrow's university facilities managers

¹ Future challenges	Impact Index ² (Ii)	Frequency Index ³ (Fi)	Risk Score (RS) ⁴ (Ii x Fi)	Remark	Risk Ranking
F-1	4.222	4.292	18.118	High	4
F-2	4.367	4.284	18.710	High	3
F-3	4.949	3.947	19.533	High	2
F-4	4.619	4.265	19.702	High	1
F-5	3.547	2.949	10.461	Low	13
F-6	3.360	3.564	11.976	Moderate	10
F-7	3.564	4.208	15.000	Moderate	7
F-8	3.731	4.252	15.864	High	6
F-9	3.155	4.019	12.681	Moderate	9
F-10	4.659	3.513	16.369	High	5
F-11	3.070	3.481	10.687	Moderate	12
F-12	4.321	3.188	13.774	Moderate	8
F-13	2.858	3.023	8.639	Low	14
F-14	3.956	2.735	10.820	Moderate	11

¹ Future

challenges:

F-1) Statutory compliance; F-2) Space management; F-3) Strategic asset management; F-4) Sustainability/environment/ carbon neutrality/ ESD; F-5) Planning/design/ construction/ project management; F-6) Information technology applications for facilities managers; F-7) Maintenance management; F-8) Security/ emergency planning/ fire safety/ critical incidents; F-9) Occupational health and safety; F-10) Leadership and innovation in FM; F-11) Outsourcing/ service contract management; F-12) FM solutions to future teaching & research needs; F-13) Cleaning and waste management; F-14) Business and financial management in FM.

²Ii = Impact Index (See equation 1, Chapter 3)

³Fi = Frequency Index (See equation 3, Chapter 3)

⁴RS = Risk Score (See equation 5, Chapter 3)

Results for research objectives 4 (continued)

Practical solutions for addressing Future (F) challenges - Emergency management

Code	Practical solutions for addressing Future Challenges (F)
A	Emergency management: Challenges associated with disaster management and recovery plans; safety and security; business continuity and contingency arrangement.
SF-A-1	Facilities managers to take active role in cross-department business continuity activities.
SF-A-2	Expect local, state and federal health and safety mandates to continue to change and evolve and plan for that expense in the budgeting process.
SF-A-3	Engage in advocacy efforts to stem the increasing tide of code expansion.
SF-A-4	Evaluate energy infrastructure for vulnerabilities.
SF-A-5	Look for facilities to play a role in preventing terrorism and crime in protecting IT resources.
SF-A-6	Need to provide a flexible and robust platform for working increases the speed to market for disaster recovery and business continuity.
SF-A-7	Need to retrofit buildings and infrastructure against hazards (e.g. seismic retrofitting) to minimise damage and improve the chances of early re-opening of business premises in the event of disaster).

Practical solutions for addressing Future (F) challenges - Statutory compliance

Code	Practical solutions for addressing Future Challenges (F)
B	Statutory compliance: Keeping pace with the rapid changes in the legislations and standards that affect the FM planning and operations; associated high compliance costs and the uncertainties and risks these changes introduce to forward planning.
SF-B-1	Adequate staff knowledge of the compliance standards and legislations governing the FM policies and operations.
SF-B-2	Adequate up-to-date training and courses on skills and communication with regard to the changes in legislations and standards, especially in relation to health & safety issues, energy management and building maintenance.
SF-B-3	Keeping a tab on new and evolving legislations that have significant impact on the FM operations through monitoring relevant bills being passed in the parliament and taking proactive steps in planning for the imminent changes/ effects.
SF-B-4	Use of approved certifiers for the routine checks on building services, appliances and buildings.
SF-B-5	Having designated responsibilities for monitoring and reporting on in-house and vendor awareness of and compliance with standards and legislations affecting FM services.
SF-B-6	Use of external vendor services in outsourcing and limiting the exposure to statutory compliance risks.

Results for research objectives 4 (continued)

Practical solutions for addressing Future (F) challenges - Sustainability

Code	Practical solutions for addressing Future Challenges (F)
C	Sustainability: Challenge of minimising the ecological footprint of the facility operation and maintenance; conservation of non-renewable energy; alternative sourcing of renewable energy; waste minimisation, recycling and re-use; pollution and toxic waste management; and resource use optimisation.
SF-C-1	Assess the institution and the department's current level of sustainability; make business case for sustainable practice and for partnerships across the institution.
SF-C-2	Facilities managers need to (i) make sustainability central to all facilities decision making; (ii) set goals and timeframe to succeed; (iii) determine who needs to get involved and how and (iv) take on the leadership role for this strategic issues.
SF-C-3	Facilities managers need to (i) consider creative strategies to reduce risk and manager energy costs; (ii) find ways to include carbon dioxide emissions in the campus growth and energy decisions; (iii) stay current on legislative discussions about energy and carbon costs.
SF-C-4	Facilities need to be designed and operated with the goal of reducing energy costs: (i) adopt strategies to reduce cost for electricity and heating water; (ii) widely use available technologies for reducing utility costs include solar power, wind energy, geothermal heating and cooling biomass.
SF-C-5	Ensure that facilities managers have the (i) education, skills and leadership abilities to take their place among university decision maker; (ii) communicate the value of facilities leaders in the sustainability and energy management effort; (iii) leverage existing facilities operations and programs to support sustainability.

Practical solutions for addressing Future (F) challenges - Technology

Code	Practical solutions for addressing Future Challenges (F)
D	Technology: The challenge of keeping track of and responding proactively to the increasing advances in technology; managing technological obsolescence; the dilemma of choosing between replacing and upgrading to new and efficient technologies, versus retaining and maintaining existing ones that are inefficient.
SF-D-1	Seek ways to work with IT to resolve existing issues; 2) Identify the experts who can help; 3) Strive to develop common goals and a vision that is in alignment with the university's vision and mission.
SF-D-2	Assess how technologies in IT will affect all aspects of teaching, learning, research, communications and the built environment; 2) Develop strategies that will help the institution remain nimble & flexible in the face of rapid technological change; 3) Make the right investments to ensure IT resources can withstand disaster; 4) Integrate IT & facilities planning to maximize success.
SF-D-3	Stay abreast of changing technologies to enhance technologies to enhance productivity and improve operations.

Results for research objectives 4 (continued)

Practical solutions for addressing Future (F) challenges - User needs assessment and satisfaction

Code	Practical solutions for addressing Future Challenges (F)
E	User needs assessment and satisfaction: How to effectively identify and satisfy the key needs of users of the university's facilities; how to manage the rapidly changing and complex user needs and expectations. The challenge of adapting the facilities and infrastructure to meet the special needs of some user groups such as the aged and the handicapped.
SF-E-1	Demonstrating a culture of sustained high quality customer service and responsiveness that is supported by appropriate technologies and a clear set of written and well understood standards and benchmarks.
SF-E-2	Routine user-needs assessment and satisfaction surveys, especially, post-occupancy evaluations (POE).
SF-E-3	User and wider stakeholder consultations in making prime decisions and in formulating action plans for infrastructure procurement and space allocation.
SF-E-4	Active engagement of key stakeholder representative groups in crucial FM forums with a view to building and maintaining good communication flow and cordial relations.
SF-E-5	Prompt and satisfactory response to user requests and needs within the constraints of available resources.
SF-E-6	Stakeholder expectation management and enlightenment.

Practical solutions for addressing Future (F) challenges - Business and financial management

Code	Practical solutions for addressing Future Challenges (F)
F	Business and financial management issues: How to minimise the operational costs of the large asset base of the university especially as it relates to energy use; how to leverage the advances in technology to re-engineer FM processes with a view to improving productivity, lowering operational costs and ensuring efficient and innovative facilities management, replacement of inefficient facilities and equipment with smart technologies as part of the maintenance and procurement agenda.
SF-F-1	Robust granular asset data and history to support planning/prioritisation based on risk.
SF-F-2	Accurate data collection. Strategies to reduce. Spend to save initiatives to be budgeted for.
SF-F-3	Financial planning, monitoring and control to ensure that expenditures are kept within budget.
SF-F-4	Leverage of technology in the FM processes with a view to improving speed and accuracy and minimising operational costs.
SF-F-5	Strategic use of outsourcing to minimise operational costs.

Results for research objectives 4 (continued)

Practical solutions for addressing Future (F) challenges - Occupational health and safety

Code	Practical solutions for addressing Future Challenges (F)
G	Occupational health and safety: Challenge of providing conducive, safe and healthy work environment that supports productivity and excellence in the key activities of the institution, especially research, teaching and learning and how to manage compliance with security, ergonomics and occupational health and safety issues such as poor indoor air quality and musculo-skeletal disorders (MSD).
SF-G-1	Develop effective policies, decision-making processes and standards.
SF-G-2	Establish metrics to better measure and allocate space.
SF-G-3	Create effective organizational governance structures.
SF-G-4	Implement incentives to encourage smart space management.
SF-G-5	Provide high level of services over a minimum facility and encourage users to manage a lot more of their own needs through user-education. with users.
SF-G-6	Facilities departments must provide and maintain as far as practicable, a healthy and safe place at work.

Practical solutions for addressing Future (F) challenges - Leadership and innovation in FM

Code	Practical solutions for addressing Future Challenges (F)
H	Leadership and innovation in facilities management: How to lead and motivate the workforce to greater levels of productivity and performance amidst organisational socio-cultural and political barriers
SF-H-1	Articulate sound vision and winning strategies and ensure buy-in by top management and workforce.
SF-H-2	Implement problem-solving tools in the FM department in concert with industry innovators.
SF-H-3	Ensuring that personal development remains a key performance objective for all staff.
SF-H-4	Creating cross-disciplinary learning opportunities.
SF-H-5	Matching the competencies needed for achieving organizational objectives against the skill inventories of incumbents.
SF-H-6	Keeping the development and advancement of subordinates a meaningful metric for the assessment of leaders.
SF-H-7	Maintaining close ties between hiring managers and recruitment professionals; in cases in which core competencies are in short supply in the labor pool, internal training programs might be an economical solution.
SF-H-8	Monitoring performance appraisal tools for trends in employee development needs.
SF-H-9	Considering the value of knowledge management programs to identify, harvest, archive, retrieve and transfer organizational knowledge.
SF-H-10	Delivering a vibrant work environment that attracts and retained talented staff or labour.
SF-H-11	Creating a "learning culture" in which opportunities for formal and informal learning can occur among employees up and down the organization chart.
SF-H-12	Building learning opportunities into every post-project evaluation.

Results for research objectives 4 (continued)

Practical solutions for addressing Future (F) challenges - Space management

Code	Practical solutions for addressing Future Challenges (F)
I	Space management: The challenge of optimising the utilisation of space, plant, equipment and grounds; elimination of redundancy in asset use.
SF-I-1	Align space management to the mission of the university: (i) assess how well the facilities department and university mission, master plan and space management program are in alignment today; (ii) identify key priorities from the mission and master plan need to be incorporated into space management; (iii) build relationships between groups and individuals in charge of updating and implementing both the master and the space management plan; (iv) deal with the challenge of integrating space planning and scenario-based strategic planning for the future.
SF-I-2	Make space one of the top assets of the university: (i) understand how the space is valued now within the university; (ii) reach out to the right individual; (iii) gather data about the value of space to make the case.
SF-I-3	Change the culture of space: (i) assess the current culture of space; (ii) describe the sort of changes the facilities department and university want to see and (iii) develop concrete steps to move toward the vision.
SF-I-4	Develop effective policies, processes, and organizational structures to manage space: (i) assess current processes, policies and organizational structures; (ii) prioritize what should change in the campus space management system and (iii) emphasize key best practices.
SF-I-5	Implement a space inventory system to understand resources and identify needs: (i) outline priorities for a space inventory system; (ii) assess the pros and cons of the current system; and (iii) move toward a robust, flexible, accessible inventory.
SF-I-6	Address space utilization by assembling credible data and adopting best practices: (i) integrate inventory and scheduling systems to automate utilization tracking; (ii) examine best practices for improve utilization.
SF-I-7	The future needs single service space control as opposed to multi user space control. Space would be managed with the mandate for efficient use and run a timetabling service. Flexible space is also key to future space.
SF-I-8	Ensure all existing space is fully utilised and regularly assess the utilisation of space through audits, teaching room utilisation surveys and comparison with standards.
SF-I-9	Encourage communal rather than territorial attitudes to space.
SF-I-10	Explore innovative ways of meeting space and facility needs that are based around existing assets e.g. development of furniture and layout options to use corridor spaces as informal learning spaces.
SF-I-11	All developments designed as generically as possible, providing a range spaces (type, size, function) to enable space to be easily re-allocated or adapted.
SF-I-12	Encourage units to identify desk space for new positions from within existing allocations.
SF-I-13	Ensuring timetabling policies optimise usage of teaching rooms.
SF-I-14	Specialised rooms to be fully utilised before a duplicate is built.

Results for research objectives 4 (continued)

Practical solutions for addressing Future (F) challenges - Outsourcing

Code	Practical solutions for addressing Future Challenges (F)
J	Outsourcing: The challenge of striking an intricate balance between outsourcing of peripheral facilities services and the in-house provision of core FM operations.
SF-J-1	Preparing for outsourcing: established Client's mandate to outsource services, gathered baseline information and established the business case at the early stage for a better guide to building a solid service contract.
SF-J-2	Understanding current Client operations: To obtain good picture of current operations which includes developing and documenting a baseline from financial, performance and service level perspectives in order to measure possible gains in efficiency as well as cost savings from outsourcing.
SF-J-3	Effective communication at service level and budget expectations to a service provider: critical systems and services must be clearly identified, required operating procedures documented and critical service levels established.
SF-J-4	Verify the best fit service provider in terms of the service provider's organization and capabilities; and evaluating the service provider's proposed service delivery solution.
SF-J-5	Negotiate a contract structure with strong Client rights and service provider obligations. Transfer risk with responsibility.
SF-J-6	Actively manage the transition as it sets the tone for the relationship.
SF-J-7	Have a longer term transformation plan as well as the near term transition (or implementation) plan.
SF-J-8	Ensure post-deal continuity. Manage according to the contract and ensure that there good communications across multiple levels in the partnering relationship. Define and follow an agreed upon dispute resolution process.
SF-J-9	Create a post-deal service provider management program. Include regular reviews of performance and have a clear process to resolve disputes.
SF-J-10	Need to improve service delivery by specialist.
SF-J-11	Need to improve management of existing resources and transformational initiatives.
SF-J-11	Need to have better attraction and retention of staff.

APPENDIX I: ETHICAL CLEARANCE FOR THE STUDY



MASSEY UNIVERSITY
ALBANY

2 June 2010

Myzatul Aishah Kamrazaly
c/- Dr Jasper Mbachu
College of Sciences
Massey University
Albany

Dear Myzatul

HUMAN ETHICS APPROVAL APPLICATION – MUHECN 10/014
"Challenges in strategic facilities management"

Thank you for your application. It has been fully considered, and approved by the Massey University Human Ethics Committee: Northern.

Approval is for three years. If this project has not been completed within three years from the date of this letter, a reapproval must be requested.

If the nature, content, location, procedures or personnel of your approved application change, please advise the Secretary of the Committee.

Yours sincerely

Dr Dianne Gardner
Deputy Chair
Human Ethics Committee: Northern

cc: Dr Jasper Mbachu
College of Sciences

Tē Kunenga
ki Pārehuroa

Office of the Assistant to the Vice-Chancellor (Research Ethics)
Private Bag 102 904, North Shore City 0745, Auckland, New Zealand Telephone +64 9 414 0800 ex 9539
humanethicsnorth@massey.ac.nz



School of Engineering & Advanced Technology
Private Bag 102 904
North Shore City 0745
Auckland, New Zealand

INFORMATION SHEET

Project Title

Challenges in strategic facilities management: Analysis of the problems faced by institutional facilities managers.

Researchers

This project is undertaken and supervised by the following researchers at Massey University:

- Myzatul Aishah Kamarazaly, provisional PhD student, School of Engineering & Advanced Technology (Researcher);
- Dr Jasper Mbachu, Senior Lecturer, School of Engineering & Advanced Technology (Supervisor).

The purpose of the research is to investigate the problems faced by institutional facilities managers. The specific objectives of the study are to identify:

8. The key internal and external constraints impacting on the achievement of strategic facilities management goals (PESTEL: Political, Environmental, Social, Technological, Economic, Legal/Regulatory, Institutional).
9. The relative levels of impact of the constraints on the achievement of the strategic management goals.
10. The practical and conceptual solutions for addressing the constraints.

Project Description and Invitation

The facilities manager's role contributes significantly to the economy by improving the gross domestic product (GDP) – a key economic indicator - in two ways: First, by improving the long-term worth of the nation's infrastructure asset through proper maintenance, adaptation and upgrade; secondly by creating a conducive workplace or environment that promotes productivity and worker's health and safety. Like any other set of professionals, the facilities managers face several challenges that constrain performance of their crucial role ranging from internal managerial and technical issues to external PESTELI constraints, i.e. political, economic, social-cultural, technological, environmental, legal, and institutional constraints. In-depth understanding of the nature of these constraints to the strategic facilities management

(FM) role constitutes a crucial risk identification and analysis process – which is a fundamental step towards proper facilities/ property risk management and risk response development. Unfortunately, the existing literature offers little insights on these constraints as applicable to the FM discipline. Therefore there is the need to explore these challenges and their relative influences on the performance of facilities/ property management role. The outcome of the study is expected to be of benefit to facilities and property managers in formulating appropriate response to the identified risks with a view to achieving more satisfactory outcomes in their operations.

To achieve the goal of this research, we need your voluntary participation by responding to the attached questionnaire, which is expected to take 15 – 30 minutes of your time. Your feedback will be kept anonymous and used solely for academic research purposes. By participating, you will be contributing to the growth and development of the facilities management in tertiary institutions through your valuable inputs. The questionnaire package includes a stamped self-addressed envelope for returning the completed questionnaire. We look forward to receiving your completed questionnaire as soon as possible to enable the researcher meet the deadline for the study, but within three weeks of the receipt of the questionnaire.

Participant Identification and Recruitment

Please note the following:

- You have been contacted for participation in this research as a member of the Tertiary Education Facilities Management Association (TEFMA).
- To give each member opportunity of being selected for participation, stratified random sampling technique was used.
- However, participation is entirely voluntary.
- We aim to achieve representative sample sizes from the various membership categories. We could only think of the discomforts or risks to a participant in terms of the time and inconvenience involved in responding to the questionnaire

Project Procedures

The study comprises two phases. The first phase involves the open-ended self-administered questionnaire survey to TEFMA members as provided in the TEFMA membership directory. The second phase will involve testing the developed model in in-depth case study conducted with three tertiary institutions in New Zealand for triangulation purposes.

The outcome of the study will be published in conferences and/ or journals without revealing individual identify.

Data Management

Feedback from the questionnaires will be anonymous and used solely for academic research purposes; it will be treated with strict confidence and disposed of at the end of the research. No revealing details of the participants will be associated with the responses.

For participating, respondents will be provided with the summary of the research findings, whether or not interest is signified by completing the Request form.

Participant's Rights

Please note that you are under no obligation to accept this invitation. If you decide to participate, you have the right to:

- decline to answer any particular question;
- withdraw from the study at any time without the need for prior notification;
- ask any questions about the study at any time during participation;
- provide information on the understanding that your name will not be used unless you give permission to the researcher;
- be given access to a summary of the project findings when it is concluded.

Project Contacts

If you have any questions about the project, you may wish to contact the researchers as follows:

- Myzatul Aishah Kamarazaly (researcher), Tel: +64 210 779 067; Email: M.A.Kamarazaly@massey.ac.nz; Fax: +64 9 443 9774.
- Dr Jasper Mbachu (supervisor), Tel: +64 9 414 0800 ext. 9843; Email: J.I.Mbachu@massey.ac.nz; Fax: +64 9 443 9774.

Committee Approval Statement

This project has been reviewed and approved by the Massey University Human Ethics Committee: Northern, Application 10/014. If you have any concerns about the conduct of this research, please contact Dr Dianne Gardner, Acting Chair, Massey University Human Ethics Committee: Northern, telephone 09 414 0800 x41225, email humanethicsnorth@massey.ac.nz.

APPENDIX J: PUBLICATIONS OF RESEARCH FINDINGS

J1: CHALLENGES FACED BY FACILITIES MANAGERS IN THE AUSTRALASIAN UNIVERSITIES

J1a: Paper published in the Journal of Facilities Management (Vol.11 No.2, 2013, pp. 136-151; 1472-5967; DOI: 10.1108/14725961311319755)

J2: RISK ANALYSIS OF THE KEY CONSTRAINTS IN THE FACILITIES MANAGEMENT FUNCTIONAL AREAS: CASE STUDY OF AUSTRALIA AND New Zealand UNIVERSITIES

J2a: Paper published in the proceedings of 16TH PACIFIC ASSOCIATION OF QUANTITY SURVEYORS CONGRESS: Pacific Association of Quantity Surveyors (PAQS), July 2012

J3: CURRENT AND FUTURE CHALLENGES FACED BY INSTITUTIONAL FACILITIES MANAGERS: CASE STUDY OF THE AUSTRALASIAN TERTIARY EDUCATION FACILITIES MANAGEMENT

J3a: Paper published in the proceedings of 37th Annual Conference of the Australasian Universities Building Educators Association (AUBEA), New South Wales, July 2012

J4: KEY CHALLENGES FACING TERTIARY EDUCATION FACILITIES MANAGERS: COMPARISON BETWEEN TERTIARY INSTITUTIONS IN NEW ZEALAND AND AUSTRALIA.

J4a: Paper published in the proceedings of 16TH PACIFIC ASSOCIATION OF QUANTITY SURVEYORS CONGRESS: Pacific Association of Quantity Surveyors (PAQS), July 2012

J5: CHALLENGES IN STRATEGIC FM: PESTELI ANALYSIS OF THE PROBLEMS FACED BY INSTITUTIONAL FACILITIES MANAGERS

J5a: Paper published in the proceedings of 7th International Cost Engineering Council World Congress & 14th Pacific Association of Quantity Surveyors Congress, Singapore June 2010.

J1a: CHALLENGES FACED BY FACILITIES MANAGERS IN THE AUSTRALASIAN UNIVERSITIES

Paper published in the Journal of Facilities Management
(Vol.11 No.2, 2013, pp. 136-151; 1472-5967; DOI: 10.1108/14725961311319755)

CHALLENGES FACED BY FACILITIES MANAGERS IN THE AUSTRALASIAN UNIVERSITIES

*Myzatul Aishah Kamarazaly, Jasper Mbachu and Robyn Phipps
School of Engineering and Advanced Technology, Massey University,
Auckland New Zealand*

Abstract

Purpose – The purpose of this paper is to (i) identify the current and future challenges faced by university facilities managers, (ii) analyse their associated risk levels, and (iii) establish practical ways to address the identified key challenges.

Design/methodology/approach - Personal interviews were conducted with 25 members of the Australasian university facilities managers (UFMs). The constructs generated at the pilot interviews were used to design a structured but open-ended questionnaire with which the Tertiary Education Facilities Managers Association (TEFMA) members were surveyed. The multi-attribute method was used in the data analysis.

Findings - Results showed that the critical challenges currently facing the UFMs comprised issues relating to the following (in diminishing order of significance): inadequate funding, emergency management and business continuity planning, statutory compliance, sustainability and environmental stewardship, keeping up with rapid changes in technology, operational efficiency, identifying and meeting stakeholder needs, maintenance and manpower. Preparing for and responding to disaster/ emergency was perceived as the most critical challenge of the future, perhaps, due to the recent natural disasters. Overall, poor funding was identified as the root of all other issues faced by the UFMs, hence suggested strategies for addressing the key challenges harped on financial improvement measures. Other key measures included optimized asset utilization, supporting business case for capital investment with demonstrable returns on investment, improving FM's strategic relevance through linking FM and corporate strategies, and investment in efficient technologies such as the building automation and management systems.

Originality/value - The findings have contributed to filling an important knowledge gap by not only identifying the current and future challenges facing the UFMs, but also prioritising them based on their relative influences on the achievement of the strategic goals of the FM department. This way, the limited resources at the disposal of the UFMs could be disbursed more cost-effectively in addressing the critical challenges in line with their identified risk levels. This would be of practical benefit to the facilities and property managers in formulating appropriate responses to the identified critical constraints with a view to achieving more satisfactory outcomes in their operations.

Keywords: Australasia, facilities managers, risk analysis, strategic facilities management, university facilities.

J2a: RISK ANALYSIS OF THE KEY CONSTRAINTS IN THE FACILITIES MANAGEMENT FUNCTIONAL AREAS: CASE STUDY OF AUSTRALIA AND New Zealand UNIVERSITIES

Paper published in the proceedings of 16TH PACIFIC ASSOCIATION OF QUANTITY SURVEYORS CONGRESS: Pacific Association of Quantity Surveyors (PAQS), July 2012

RISK ANALYSIS OF THE KEY CONSTRAINTS IN THE FACILITIES MANAGEMENT FUNCTIONAL AREAS: CASE STUDY OF AUSTRALIA AND New Zealand UNIVERSITIES

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ABSTRACT

Organizations can achieve high levels of competitiveness and success by leveraging the potentials of strategic facilities management (sFM) to meet corporate goals. However, these potentials may not be optimally leveraged due to inherent constraints. The university facilities present an ideal case for studying the inherent constraints in the sFM due to their complexity and uniqueness. Motivated by little research in this area, this study aimed at analyzing the risk levels of the key constraints in the 5 main functional areas of university facilities management (uFM): strategic management, project management, operations and maintenance management, and capital asset management. Based on a two-stage survey of facilities management professionals feedback was received and analyzed using the multi-attribute method. Results showed that the strategic management was the most important function in the uFM process since decisions made at this level shape the outcomes in other functional areas. Finance, micro- and macroeconomic dynamics and leadership jointly contribute over 80% of the constraints to the achievement of uFM strategic goals. Risk levels of the key constraints in the uFM functional areas and the mitigation measures were reported. The findings are expected to benefit facilities managers in understanding and responding cost-effectively to the key challenges they face.

Keywords: Facilities management, organisational analysis, performance improvement, risk analysis, university facilities management.

J3a: CURRENT AND FUTURE CHALLENGES FACED BY INSTITUTIONAL FACILITIES MANAGERS: CASE STUDY OF THE AUSTRALASIAN TERTIARY EDUCATION FACILITIES MANAGEMENT

Paper published in the proceedings of 37th Annual Conference of the Australasian Universities Building Educators Association (AUBEA), New South Wales, 4th – 6th July 2012

Current and future challenges faced by institutional facilities managers: Case study of the Australasian tertiary institutions

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ABSTRACT

Facilities constitute a huge chunk – about 80% - of the fixed assets of most well established organizations. Efficient facilities management therefore is critical to the competitiveness and success of most organizations, including being an avenue to achieve strategic corporate objectives. Given the variety of stakeholders that need to be served, and who may have diverse and often conflicting interests, as well as the diverse range of facilities that are involved, the management of institutional facilities attracts plethora of challenges that cut across all spheres of facilities management. Institutional facilities therefore provide an ideal case study for gaining insights into the comprehensive range of issues faced by facilities managers in general. Motivated by little research in this crucial area, this study aims to explore the current and future challenges faced by institutional facilities managers and the innovative responses to the key challenges. Using pilot interviews for construct generation and pre-tested questionnaires, feedback was received from the Australasian institutional facilities managers who were members of the Tertiary Education Facilities Management Association (TEFMA). The empirical data were analyzed using the multi-attribute analytical method. The main report will highlight the current and future challenges having the most profound impact on the achievement of the institutional facilities management objectives. Innovative ways suggested by the respondents for addressing the key challenges will also be reported. The study findings are expected to be of benefit to facilities and property managers in formulating appropriate response to the identified critical constraints with a view to achieving more satisfactory outcomes in their operations.

Keywords: Facilities management, Institutional facilities, Organisational analysis, Property management, Strategic facilities management.

J4a: KEY CHALLENGES FACING TERTIARY EDUCATION FACILITIES MANAGERS: COMPARISON BETWEEN TERTIARY INSTITUTIONS IN NEW ZEALAND AND AUSTRALIA.

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KEY CHALLENGES FACING TERTIARY EDUCATION FACILITIES MANAGERS: COMPARISON BETWEEN TERTIARY EDUCATION IN NEW ZEALAND AND AUSTRALIA

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Abstract

Tertiary education facilities management is increasingly faced with challenges in keeping pace with the ever-increasing changes in the institution's core business of teaching, learning and research. It is crucial for tertiary education facilities managers (TEFM) to be able to forecast and respond proactively to the emerging trends and issues impacting on the way they manage the institutional buildings and facilities and the impact this has on the vision, mission, strategy, values and goals of their institutions.

This paper reports the preliminary findings of a work-in-progress aimed at exploring the key challenges facing facilities managers in the Australasian universities. Based on personal interviews, feedback was received from 30 Australasian institutional facilities managers - who were members of the Tertiary Education Facilities Management Association. The feedback was analyzed using the multi-attribute analytical method. The report presents the internal and external challenges having profound impact on the achievement of the institutional facilities management goals in Australia and New Zealand. The report also presents practical solutions suggested by the interviewees for addressing the identified key challenges. The outcome of the study is expected to be beneficial to the TEFM for developing a comprehensive risk-based approach towards sustainable management of facilities and optimization of FM services.

Keywords: Facilities management, property management, risk management, strategic facilities management, tertiary education facilities management

**J5a: CHALLENGES IN STRATEGIC FM: PESTELI ANALYSIS OF THE PROBLEMS
FACED BY INSTITUTIONAL FACILITIES MANAGERS**

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**CHALLENGES IN STRATEGIC FACILITIES MANAGEMENT:
PESTELI ANALYSIS OF THE PROBLEMS FACED BY
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ABSTRACT

The facilities manager's role contributes significantly to the economy by improving the gross domestic product (GDP) – a key economic indicator - in two ways: First, by improving the long-term worth of the nation's infrastructure asset through proper maintenance, adaptation and upgrade; secondly by creating a conducive workplace that promotes productivity and worker's health and safety. Like any other set of professionals, the facilities managers (FMgrs) in tertiary institutions face several external challenges that constrain performance of their crucial role. These can be structured as PESTELI (i.e. political, economic, social-cultural, technological, environmental, legal, and institutional) constraints. This paper presents a preliminary report on the PESTELI constraints faced by FMgrs in tertiary institutions. Based on a convenience sample survey of 31 institutional FMgrs, the relative levels of impact of the underlying constraints to each PESTELI broad category were analysed. Results showed that, at the broad category level, economic set of factors were perceived as the most influential constraint accounting for about 23 percent of the problems faced by FMgrs. The two most significant challenges facing tomorrow's institutional FMgrs relate to leadership and innovation, and information technology applications. The relative levels of impact of the underlying constraints and of the key challenges faced by FMgrs in the future are reported.

Keywords: Facilities management, institutional facilities, property management, strategic facilities management, PESTELI analysis.