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A study of facility management knowledge classification for the effective stewardship of existing buildings

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A study of Facility Management knowledge classification for the Effective Stewardship of Existing Buildings

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USE OF THESIS

The Use of Thesis statement is not included in this version of the thesis.

ABSTRACT

The aim of the study was to establish the Facility Management knowledge categories within the life cycle of a building context. The significance of the study stemmed from research undertaken into the compliance to Australian Standards 1851-17:2005 Maintenance of Fire and Smoke Doors within West Australian nursing homes, which demonstrated 87 per cent non-compliance. The level of non-compliance appeared to identify a lack of knowledge, and appropriately qualified and experienced personnel involved within the management of nursing homes (Doleman, 2008). The issues identified prompted the question on how facility management knowledge categories evolves and develops throughout the life cycle of a building.

The research used a three Phase, Grounded Theory interpretive analysis of the Facility Management knowledge construct. Phase One involved the examination of 21 international tertiary undergraduate Facility Managers courses. The course content was analysed and assessed through linguistic analysis to extract the knowledge categories and subordinate concepts. The findings identified 14 primary knowledge categories which were presented to 10 Facility Management experts for validation. Phase Two presented the findings of Phase One in a Multi Dimensional Scaling (MDS) survey instrument to Facility Management experts for dissimilarity assessments. The results from the 56 completed surveys were embedded within MDS software to present spatial knowledge proximity cluster analysis. The final phase was the validation of the research findings through semi-structured interviews of 10 industry experts, selected with consideration of heterogeneity in order to validate the findings of the previous phase.

The outcome of this study was to develop an understanding of the Facility Management knowledge categories within the life cycle of a building context and the identification of 14 core knowledge base, required as a Facility Manager practitioner. Core knowledge categories included *Finance* as a central theme within the Facility Management domain with *Building Services* and *Business* providing an indication as to the broad nature of Facility Management knowledge construct. Also identified within the research was the lack of legislative harmonisation between different states and territories within the Facility Management domain and the disparity between

Facility Management practitioners with regards to knowledge context and application.

The role of Facility Management and their involvement within the lifecycle of a building was also identified within the research as being little or none during the design and construction phases of the building. The handover and management of the buildings to Facility Managers occurs within the occupancy phase of the buildings life cycle meaning that the building was inherited without due consideration of continued operational efficiencies or functionality affecting the overall cost effectiveness of the building.

Such outcomes lead to a number of recommendations such as a the introduction of central knowledge standard in order to provide context of definitions and well as the continued development and drive of Facility Management practitioners and associations to establish the Facility Management profession as a respected body.

DECLARATION

I certify that this thesis does not, to the best of my knowledge and belief:

(i) incorporate without acknowledgment any material previously submitted for a degree or diploma in any institution of higher education.

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The support provided by my family my step father John and my mother Pam for their continued support. The support of my two children Gemma, my darling daughter for her assistance with the research and my son Simon, whose personal strength and loyalty continues to amaze me and encourage my progress.

I would also like to acknowledge the support and encouragement provided by my late father Tom Doleman. He allowed me to see that our destinies are within our control and we come this way but once. *"Drink wine. This is life eternal. This is all that youth will give you. It is the season for wine, roses and drunken friends. Be happy for this moment. This moment is your life".* Thanks Dad.

To my lifelong buddy Steve for his continued support, insight and voice of reason. Thanks for acting as a sounding board through the ranting and loss of objectivity. Thumbs up.

Finally my wife Janet my love and soul mate who has suffered though this journey with the long days lost to the research. You are my rock and my love this research would not have been possible without your support. Thank you.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

PUBLICATIONS AND CONFERENCE PRESENTATIONS

A number of conference proceedings were generated from this research. The list follows together with the abstracts.

Publications

Doleman, R, G., & Brooks, D. J., (2011). **A strategy to articulate the Facility Management knowledge categories within the built environment**: Knowledge based analysis of research findings. Paper presented at the 5th Australian Security and Intelligence Conference, Perth, Western Australia.

Security is applied in the built environment and this requires a close relationship with facility managers. Therefore, this study puts forward an approach to establish the facility management knowledge categories within the built environment. In part, the significance of the study stemmed from research undertaken into the compliance to Australian fire door maintenance within nursing homes, which demonstrated 87 percent non-compliance. This *high* level of non-compliance appeared to identify a lack of facility management knowledge, among other issues (Doleman & Brooks, 2011).

The article uses a method to test the supposition of facility management knowledge construct in a three-phase Grounded Theory analysis. Phase-one examines international tertiary Facility Management courses, where course content is critiqued through linguistic analysis to extract the knowledge categories. Phase-two of the study further analyses these findings through the use of multidimensional scaling to present underlying conceptual knowledge interrelationships. The final third-phase uses experts in order to validate the findings of the previous two phases. A pilot study identified 18 common knowledge concepts, for example project management, space planning, budgeting and principles of facility management.

The study outcomes will improve the understanding of building knowledge requirements within the built environment, resulting in a framework of facility management knowledge categories. Such an outcome will support the consensual development of a facility management body of knowledge. The specific outcomes put forward for this research includes establishing the primary knowledge categories

found within the Facility Management Industry. In addition, the outcomes will support the consensual development of a facility management body of knowledge, support policy, education and the relationship with security.

Doleman, R, G., & Brooks, D. J., (2009). **Study of Compliance in Aged Care Facilities With Regards to Australian Standards 1851:2006 Maintenance of Fire Protection Systems and Equipment Section 17**: A Risk based approach to nursing home management. Paper presented at the 3th Australian Security and Intelligence Conference, Perth, Western Australia.

The management of risk within a nursing home environment is widely viewed as an undertaking performed by the owners or managers of nursing homes. The residents of these homes are reliant upon the owners and managers to keep them safe, due in part to a traditional belief that they are the experts and have a greater understanding of risk. To establish risk it is first a requirement to have an understanding of levels of risk and risk management techniques. Risk appreciation is often influenced by heuristic representativeness, as well as social and cultural influences. The higher level of risk within a nursing home environment is due in part to the demographic of the residents as well as health issues experienced by elderly people. This increase in risk level places a greater importance on risk mitigation systems. Fire and smoke doors form a pivotal part of the defence in depth principles central to risk minimization and therefore need to be maintained in order to perform correctly.

The study measured aspects of fire and smoke door maintenance compliance by undertaking audits on 160 doors in 22 nursing homes within Western Australia. The results of the auditing process were then evaluated to establish the non-compliance levels. The results were set against the research question to allow interpretations and assumptions to be made.

The study demonstrated a non-compliance level of 87% on the fire and smoke doors audited, with 935 failure items identified. The study also demonstrates that despite the requirement for nursing homes to be accredited and audited, there are still unacceptably high levels of non-compliance. As a result of the study's findings,

assumptions were able to be drawn to the increased risk exposure for residents and staff with consideration made on the reasons for such a high rate of non-compliance.

CHAPTER 1
INTRODUCTION

1.1 Introduction

This chapter considers the research topic of establishing the knowledge categories for Facility Managers and identifying their involvement within the life cycle of a building. The background to the study will be considered, along with the significance of the problem, the purpose of the study, research questions and study objectives. The research methodology is then considered, through a three phase study approach within a building life cycle context and the interrelationship of Facility Management knowledge. A brief overview of the thesis will also be discussed before a summary of main points conclude the chapter.

1.2 Background to the study

There has been relatively little research undertaken on compliance to Australian Standards within a building environment. Research undertaken by Doleman (2008) into the compliance of owners and/or managers to maintain fire and smoke doors in compliance with AS 1851-17-2005 found that there was 87 per cent non-compliance. The research established that the needs of the elderly are much greater than those of a younger demographic from lack of mobility of ill health conditions reflected within the nature of the age care facilities. Nursing homes are required, by their very nature, to provide a high degree of safety and security.

To establish such a failure to maintain safety critical equipment despite the statutory requirements for registration and fire safety declarations introduced for all residential aged care service providers (Australian Government, 2008), allowed several assumptions to be made. One such assumption was a potential lack of suitably qualified and experienced owners and/or managers within the nursing home industry (Doleman 2008). The lack of compliance with statutory requirements raised the question as to why the apparent lack of expertise and what was the minimum knowledge requirement to perform the role of Facility Management.

The purpose of the current research was to develop a framework that identifies the Facility Managers knowledge categories in the life cycle of a building and examine

the way that knowledge applied throughout the building life in an attempt to identify knowledge short falls within the Facility Management industry within and Australian context.

The Facility Management industry in Australia is not recognised as an industry by the Australian Bureau of Statistics, resulting in a lack of statistical data on the exact size of the industry. It is thought that the Facility Management (FM) industry in Australia accounts for $8.2 billion of gross value and employs 112,000 full time equivalent people (Access Economic Pty Ltd, 2007). The difficulty in valuing the Facility Management market also occurs within the United Kingdom where the Facilities Management industry market size is estimated at ranging from £4.5 billion to £187 billion (Moss, 2007).

Despite the size of the Facility Management industry there is lack of agreement between FM practitioners as to the true definition of Facility Management, with polarised opinion by the practitioners as to what constitutes Facilities Management (Tay and Ooi, 2001). The lack of consensus appears within the definition of Facility Management provided by industry organisation such as the International Facility Management Association (IFMA) and British Institute of Facility Management (BIFM) (Wiggins, 2010).

A lack of definition for the Facility Managements role including the knowledge interpretation and application was identified in the research and supported by the variance in definitions by Facility Management related organisations. The European Standard defined FM as an integration of processes within an organisation to maintain and develop the agreed services which support and improve the effectiveness of its primary activities (2006). Kamaruzzaman and Zawawi (2010) define Facility Management as a balance between technical and business management that may be associated with the strategic decision making process. While Pitt and Tucker (2008) state that Facility Management is the integration and alignment of non-core services, required to operate and maintain a business in order to fully support the main objectives of the organisation.

Chotipanich (2004) considers that part of the difficulty providing a true definition of Facility Management lies in the number of influencing factors affecting the FM role, such as organisational strategic function to define its role, the necessary objectives to meet this role and a definition for the type of facility being managed.

In order to address the global Facility Management identity, consolidation of the industry knowledge and working practices, the British Standards Institute applied to the International Organisation for Standardisation (ISO) in 2011 asking for a review on the feasibility of creating a global Facility Management Standard. British Standards applied for the standards development with justification of economic and social advantages:

- Improve communication between Facility Management providers and clients
- Improve the Facility Management processes
- Improve wellbeing and employee satisfaction
- Reduction in energy usage and waste
- Maintain and develop Occupational Health and Safety factors
- Improve contract and agreement quality (Smith, 2011 p. 3)

Creating correct terminology and understanding is fundamental to context of functions. Without consolidation and meaningful definition, Facility Management practitioners are unable to apply consistency within an industry context. The lack of agreement on function and definition by practitioners underlines the need for the research to identify a core body of knowledge pertinent to the Facility Management role. This allows the identification of a strategic knowledge base while underpinning the businesses knowledge requirements for contemporary FM practitioners (Hinks, 2001).

Further support for undertaking the study was provided by the research conducted by Warren and Heng (2005), which analysed university Facility Management course content of three universities. The research identified the need for a larger scale study to provide a valuable foundation for the development of education for future generations of Facility Management practitioners.

1.3 Purpose of the study

The theoretical challenge of this study was to identify the Facility Management (FM) knowledge categories within the context of the building life cycle and the role that knowledge plays within the different stages of the buildings life cycle. According to Lehtonen and Salonen (2006), FM has gradually become accepted as a service profession within the property and construction industries during the early 1980s. Nevertheless academic research, publications and theoretical investigation into FM did not start in earnest until the 1990s (Price and Akhalghi, 1999) and remained under researched during that time (Nutt, 1999). This increase in FM research has allowed for a repositioning of the Facility Management function as an overhead to a vehicle adding value through identifying the importance in academic FM publications by procurement and relationship management (Salonen, Lehtonen, & Ventovuori, 2005).

The lack of a defined body of knowledge, together with knowledge shortfalls within nursing home management (Doleman, 2008), recognised the requirements to conduct further research. Further support for the study was provided by Warren and Heng (2005) qualitative research of professional skills and undergraduate course knowledge raising the need for a more in depth study to address the needs of the industry.

1.3.1 Study objectives

The outcome of the study should lead to a better understanding of what Facility Management knowledge categories and subordinate concepts that influence the management of buildings. The goal of the study was to deepen the understanding of the Facility Management knowledge categories, and their roles and knowledge requirements within the life cycle of a building. The dissemination of the information to a wider audience within the Facility Management industries will allow a better understanding of the role Facility Managers play within the process and the mechanics behind the knowledge interaction within the building life cycle context.

The specific outcomes expected from this research study included:

- Identification of factors that promote the exchange of subordinate knowledge concepts within the Facility Management domain
- Improve the understanding of the Facility Management knowledge requirements and understand areas that may be lacking within the building life

cycle

- Provide a framework for Facility Management knowledge categories within the life cycle of a building to provide a better platform where Facility Management knowledge interaction is involved
- On the basis of the results obtained during the course of the study and through data analysis, shortcomings in Facility Management knowledge categories may be identified and strategies for moving forward offered

Consideration of the outcomes as they apply to the research will be identified from the research findings and presented within the content of this thesis.

1.4 Research questions

The three research questions were designed to guide the establishment of knowledge categories within the occupancy phase of the life cycle of a building in order to respond to the Overarching Research Question. The phases of the study and related research questions were embedded within each phase.

Overarching Research Question: Define the structure of Facility Management body of knowledge and its utilization within the role of Facility Managers.

- *Phase One: Facility Management knowledge categorisation (discussed in Chapter 5)*

Research Question 1: Can the Facility Manager's knowledge categories and subordinate concepts be identified and role established within the life cycle of a building context?

- *Phase Two: MDS knowledge structure (discussed in Chapter 6)*

Research Question 2: What are the knowledge categories and subordinate concepts interaction and interrelationships within the Facility Management domain as measured by Multi Dimensional Scaling?

- *Phase Three: Expert knowledge structure validation (discussed in Chapter 7)*

Research Question 3: What are the expert knowledge categories and subordinate concepts within the facility management domain as measured by interviews?

1.5 Methodology of the study

The study used Grounded Theory as the research methodology, designed with three distinct phases in order to establish the underlying Facility Management knowledge construct. Phase One, involved the examination of 21 international undergraduate tertiary Facility Management courses examined through linguistic analysis to extract the knowledge categories. The categories were then presented to 10 Facility Management experts for validation. Phase Two, of the study embedded 54 Multi Dimensional Scaling (MDS) completed surveys into the MDS software to produce spatial proximity relationships. The final phase, involved semi-structured interviews of 10 industry peer selected to validate the findings of the previous two phases.

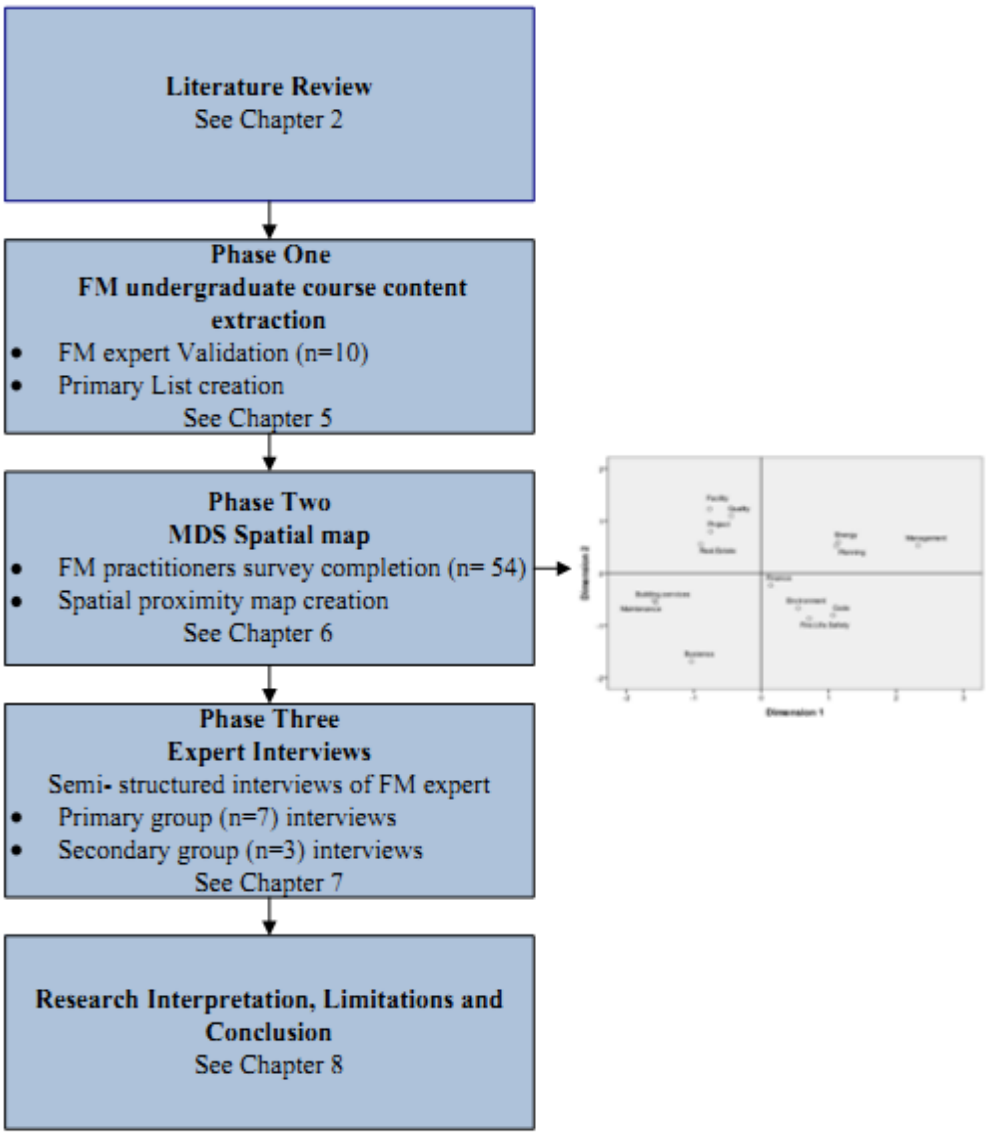


Figure 1.1

Research study stages

1.6 Thesis overview

The research was developed around three phases, culminating in a response to the Overarching Research Question. Chapter Two considered the underlying theory of the study through pertinent literature analysis for learning theory, knowledge definition and acquisition, knowledge transfer and the nature of expertise, as well as consideration of knowledge communities within an organisational environment. Also pertinent to the theoretical foundation of the study is the reference literature on the role of Facility Management within the life cycle of a building. Factors such as legislative control, state and federal building regulation, harmonisation were considered, as well as identification of concepts and definitions of the Facility Management role.

The methods and material used within the study design were considered in Chapter Three. A mixed methodology approach of qualitative and quantitative research techniques were discussed within the chapter, as well as consideration of the research instruments and population sample. The mixed methodology approach was considered appropriate for the research as it combines the two techniques in a single study, while broadening the research and addressing weaknesses in any one research methodology (Gorman and Clayton, 2005; Johnson & Onwuegbuzie, 2004).

The study design comprised of three distinct phases, each with its own research question. The culmination of results from each phase allowing a response to the Overarching Research Question. Population sample was considered in line with the non-probability nature of the experts selected by peer review as well as consideration of the research instruments Multi Dimensional Scaling (MDS) and expert knowledge structure validation through semi-structured interviews. MDS was selected for use within the research as it allows an analysis of similarities in judgments to be represented by a spatial proximity map of underlying dimensions (Shepard, 1980).

Chapter Four presents the pilot study, which described the assessment of the research methodology for each research phase and the research instruments. The reliability and validity assessment of the methodology and instruments assessment within the Pilot Study identified them as being appropriate with modifications for the Primary Study. The outcome of the Pilot Study Phase One knowledge category extraction provided

commonality to the extracted content of the Primary study. Phase Two MDS spatial representation provided commonality in that the category of Finance had a central positioning in the Primary and Pilot Study, identifying it as a central theme to the Facility Management function and as validation of the Study process. Phase Three of the pilot study, expert validation presented the findings from the previous two phases for validation of the MDS spatial representation to allow incorporation of the process within the Main study.

Phase One, presented in Chapter Five, was the identification of international undergraduate Facility Management related courses and content extraction to establish a *Master List* for use within the study. The Facility Management expert validation of the data content culminated in the creation of a *Primary List,* allowing a response to Research Question one. The *Primary List* was then embedded into Multi-Dimensional Scaling survey instrument for use within Phase Two of the research.

Chapter Six describes the Phase Two development and distribution of a Multi Dimensional Scaling (MDS) survey instrument to 313 Facility Management experts. The 56 completed surveys were then embedded into the MDS software for data analysis. The output from the MDS analysis produced spatial proximity relationships of the categories as assessed by the expert group in response to Research Question Two. The resultant spatial map allowed interview questions to be generated based on proximity assessment for expert validation by Facility Management experts within Phase Three.

Phase Three, presented in Chapter Seven, considered the expert validation through semi-structured interviews of 10 Facility Management (FM) experts split into two groups. The Primary and Secondary expert groups were both provided with same 24 interview questions. The Secondary group had five additional interview questions developed from the restricted consensus within the Primary group expert's interviews. The outcome of the interview process provided a response to the Research Question three.

Chapter Eight considered the research overview through the Research Questions embedded within each phases. The extraction and development of Facility Management knowledge construct as well as the interpretation of the research findings. The research recommendation, limitations and future research propositions were considered along with the research conclusion.

1.7 Conclusion

The research identified that the Facility Management industry is a relatively new industry still evolving despite the size of its annual revenue in Australia of $8.2 billion. The industry has a multitude of definitions as to the exact function and role of Facility Management (Wiggins, 2010).

The primary design for the research was to establish the Facility Management knowledge construct, as applied within the context of the occupancy phase a buildings life cycle. The research consisted of three phases, each developed around the embedded research questions. The research questions presented within each of the study phases were addressed by the findings from each phase designed to address the Overarching Research Question.

The outcomes from the research should lead to a better understanding of the Facility Management knowledge categories and subordinate concepts together with their definition with regards to the concept meaning at enhance practical application by Facility Management practitioners. A greater and more in-depth understanding by the Facility Management industry would allow a more effective knowledge dissemination transfer to a wider audience. Whilst also allowing for a better understanding of the role Facility Managers play within the occupancy phase of a buildings life cycle.

The lack of defined Facility Management knowledge makes the application and function of the practitioners of Facility Management extremely difficult through lack of context. Without consistency regarding legislative and prescriptive obligations, risk exposure to practitioners, organisations and occupants is increased to untenable levels.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

The literature review will consider pertinent literature within a Facility Management context to allow analytical summary of Facility Management knowledge development. The foundation of the study is the literature defining Facility Management, Facility Management Organisations and factors affecting its role within the life cycle of a building (2.2). The concept roles of knowledge will be discussed, namely; Learning Theory (2.3) with the underlying principles of cognitive memory and its development and categorisation. Knowledge definition (2.4), knowledge acquisition, expert knowledge, subordinate groupings and knowledge communities are considered. Also identified within the literature are factors such as legislative control, state and federal building regulation and the impact upon the Facility Management role (2.5). A summary of the main points will conclude the chapter (2.6).

2.2 Facility Management

Facilities Management (FM) is a general term covering a broad spectrum of services from real estate management, building maintenance, financial systems, health and safety, and contract management, facility maintenance, and domestic services (Atkin & Brooks, 2000; Amaratunga, Baldry & Sarshar, 2000). Hamer, (1988) refers to Facility Management as a tailored platform for the planning, implementation, maintenance of space within a building with a value adding focus. Kamaruzzaman and Zawawi (2010) suggest Facility Management has strategic positioning while balancing business and technical management processes and services. With Facility Management services service solutions covering a variety of areas such as knowledge transfer, encountering, productivity, mobility, hospitality, accessibility, safety, representation, distinction and sustainability. (Kok, Mobach, & Omta p. 259, 2011).

Facility Management is becoming more accepted as organisations see the attraction with Facility Management, allowing clearly defined objectives within the organisations strategic commercial domain (Haigh, Amaratunga & Baldy, 2008).

The role of Facility Management can be defined as a key function in managing facility resources, support services and the working environment and supporting the core business of organisations (Tay & Ooi, 2001; Chotipanich, 2004). Facility Management within the service sector accounts for 30-40 percent of an organisation's annual budget and can add value to an organisation by improving delivery of service, resource control and supply chain (Amaratunga & Baldry, 2002). Barrett and Baldry (2003) states that the function of Facility Management has three principal aspect; support of the organisations core business through management support; focus of the organisations workplace interface and the adoption of a multi-skill approach. The shift in focus within the Facility Management domain is to make the function a continuous process allowing a deeper involvement as an integrated resources management platform within the organisational context (Pathirage, Haigh, Amaratunga, & Baldy, 2008).

The development of FM as a high level business support function has seen outsourcing introduced in order to reduce operational cost by 15-20 precent (Shah, 2007). The management of outsourcing services has become a large portion of the FM role. More than 90% of organisations utilise outsourcing of such activities as Housekeeping, Security and maintenance (Langston & Lauge-Kristensen, 2002). The Facility Manger will select and monitor the level of services provided as well as the contract negotiations and review (Best, Langston & de Valance, 2003).

2.2.1 Facility Management Organisations

There are a variety of Facility Management global organisations and professional bodies with their own strategic outreach programs designed to increase the standing of the Facility Management industry within a global arena.

2.2.1.1 British Institute of Facilities Management

The British Institute of Facilities Management (BIFM) was founded in 1993 and represent the UK professional Facilities Management industry. The Institute delivers a range of information, educational development courses and well as an industry network mechanism for its 13,000 members. The mission of the BIFM's is to advance

the Facilities Management profession by development of stakeholder and Government relationships (BIFM, 2012).

2.2.1.2 International Facility Management Association

International Facility Management Association **(**IFMA) is the world's largest professional Facility Management association with over 22,655 members from 78 countries. The association was founded in 1988 with its mission to advance the Facility Management profession. The IFMA provides support services to its members, through industry knowledge and competency standards, academic course development and assessment, as well as holding a global annual Facility Management conference exposition (IFMA, 2012).

2.2.1.3 European Facility Management Network

European Facility Management Network (EuroFM) is a network vehicle for more than 23 national associations based in 27 countries who together work within the largest Facility Management market in the world, valued at 650 billion Euros. The associations focus is the promotion of Facility Management across Europe, the dissemination of knowledge and information, and to facilitate networking in order to share best practice guidelines and add value to its members (EuroFM, 2011).

2.2.1.4 Global Facility Management Association

Global Facility Management Association (Global FM) was formed in 2000 as a worldwide federation of organisations with the goal of advancement through promotion of the Facility Management industry. Global FM mission is to utilize the associations' knowledge and expertise of members through networking to provide leverage for the Facility Management industry within a global platform context and add value to the member organisations (Global FM, 2013).

2.2.1.5 Facility Management Australia

The Facility Management Association of Australia Ltd (FMA) was established in 1989 to represent Facility Management professionals in both the private and public sectors within Australia involved at a strategic and operational management level of an organisation. The FMA provides support for the Facility Management industry through industry and member's representation to Government and regulatory bodies,

as well as encouraging the continued academic knowledge development and promotion of the Facility Management industry across business and the wider community (FMA, 2011).

2.2.2 Facility Management practitioners

Organisations have recognised the strategic value of Facility Management and the contribution made towards the business success (Alexander, 1996). Facility Management when managed as an integrated commercial, manufacturing and marketing continuous process provides a competitive advantage to an organisation (Amaratunga, 2001; Puddy, Price & Smith, 2001). The acceptance of Facility Management by an organisation as the management of a company's assets and non-core activities which allow efficiencies of the core business, places the integration of Facility Managers at a strategic management level within an organisation (Pathirage et, al., 2008). A premise reflected in the definition of Facility Management is the practice of integrating the management of people and business process of an organisation with the physical infrastructure to enhance corporate performance (FMA, 2012). In order to operate as a strategic partner within an organisational structure it is imperative that the Facility Management practitioners have an appropriate skill set and knowledge base to perform the role at a high level.

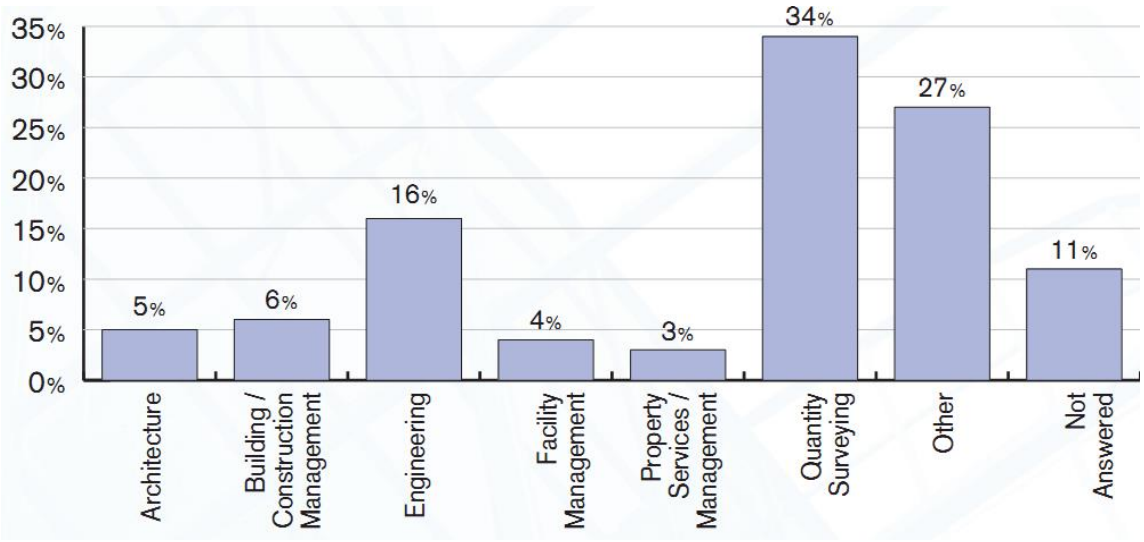
Research undertaken by the Facility Management Association of Australia demonstrated that over 83 percent of practitioners within the Facility Management industry survey were male with 63.3 percent aged over 46 years. The survey also showed that 61 percent had over ten years industry experience with nearly 60 percent of practitioners earning an average salary package of over $100,000 Australian Dollars, with the top 5 percent of earning over $250,000 (FMA, 2012).

The academic background of the Facility Management practitioners was shown as varying dependent upon the role being performed. The survey showed that 49.5 percent of practitioners held a diploma in a related discipline with 20 percent currently undertaking some form of further education (FMA, 2012). The survey did not provide distinction between the types of qualifications held. A survey undertaken by the Facility Management Association of Australia and Hays Facility Management in 2006, showed that of the 89 percent of participants held a degree qualification with 68

percent being in a related discipline (Table 2.1).

Table 2.1

Practitioners related degree categories.



(Hayes Facility Management, 2006)

The presence of Facility Management partitioners with appropriate experience and qualifications imbeds within organisations at a strategic level provided a Facility Management knowledge base, which can be drawn upon for organisational advancement. Without suitably qualified staff the organisations objectives and goals are undermined. Nutt (1999) suggests that Facility Management knowledge has three primary knowledge sources, Construction and Property, Facility Management and Facility design and use. Without these knowledge areas an organisation is without the ability to identify and manage its Facility Management knowledge.

There are also concerns that many organisations associated with Facility Management have a limited understanding of knowledge identification and capture or its importance and relevance to their own organisations (Pathirage et, al., 2008). Understanding knowledge is of the utmost importance for organisations as knowledge management protects the competitive edge within a global arena (Hebert & Chaney, 2011).

2.3 Learning theories

Learning theory consists of four primary theories; behaviourism, cognitivism, constructivism and social constructivism. The comparison of these learning theories is summarised within Table 2.2, which identifies the philosophies of each theory. The speed at which the theories develop varies from instantaneous processing right the way through to learning processes which are passed from generation to generation (Newell, Liu, Mayer-Kress, 2001).

Table 2.2

Traditional distinctive attributes of the major learning theories

	Behaviourist	**Cognitivism**	**Constructivist**	**Social Constructivism**
Learning	Stimulus and response	Transmitting and processing of knowledge strategies	Personal discovery and experimentations	Mediation of different perspectives through language
Type of learning	Memorizing and responding	Memorising and application of rules	Problem solving in realistic and investigative situations	Collaborative learning and problem solving
Instructional strategies	Present for practice and feedback	Plan for cognitive learning strategies	Provide for active and self-regulated learner	Provide for scaffolds in the learning process
Key concepts	Reinforcement	Reproductive and elaboration	Personal discovery generally from first principle	Discovering different perspective and shared meaning

(Hung, 2001, p. 284)

2.3.1 Behaviourism and Cognitivism

Behaviourism views learning as a consolidation of the relationship between stimuli and response theory, which provides conditioned responses based on a stimuli (Hothersall, 2004). Skinner (1974) argued that as the inner processes are not available with current scientific procedures, researchers should focus observations on the cause-and-effect relationship. While cognitivism views the growth of conceptual cognitive structures such as reasoning and problem solving (Hung, 2001).

2.3.2 Constructivism and Social Constructivism

Constructivism refers to the learning process where meaning is searched for by individuals and the mind constructs knowledge. Knowledge in this theory emanates from experiences rather than being a state of mind (Prawat, 1996; Reese, 1991; Roschelle, 1989; Dewey, 1981).

The social constructivism philosophy, as a band of constructivism, focuses on human knowledge and the relationship between situational analysis and negotiation where the participants reach shared meaning in a social context (Barwise & Perry, 1983). The interpretation of knowledge and cognitive development is dependent on the cultural and social context, prior knowledge, beliefs and an individual's interaction with other people either as children, parents or teachers (Vygotsky, 1978).

2.4 Knowledge

The term *knowledge* has been a topic of discussion for some time. Bhatt (2002) refers to knowledge as being intangible and fuzzy in nature, while Davenport, Long and Bears (1998, p. 207) refer to knowledge as a "combination of information combined with experience, context, interpretation, reflexion and perspective".

Knowledge and learning is developed through social interaction and is constantly evolving as ideas are extracted and developed (Allee, 2000). Medical research has shown that there are different functions performed by the two hemispheres of the brain and that knowledge as an internal sensation with a tenuous link to reality (Müller-Merbach, 2008). Knowledge is a process of disproving hypotheses and never expresses reality (Popper 1963). While Winograd and Flores (1986) refer to knowledge as the storage of representations which when called upon can be translated into language through access to information within the short- term and long-term memories.

2.4.1 Knowledge categorisation

There are two dimensional categories of knowledge, *tacit knowledge* and *explicit knowledge*. Tacit knowledge is seen as an amalgam of components both cognitive and technical, which when combined with behaviour and perception establishes the human mind in the form of evaluation, attitudes, points of view, commitments and motivation (Boisot, 1998; Pathirage, et, al., 2008). Tacit knowledge forms the

background necessary for assigning structure to develop and interpret explicit knowledge (Alavi & Leidner, 2001, p. 112).

Explicit knowledge is described as being codified and able to be articulated in a symbolic manner (Zack 1999; Alavi & Leidner 2001; Salis & Jones, 2002). Polanyi (1966) claimed that tacit knowledge can only be obtained by experience in a given domain and is personal in nature. Nevertheless, it has been suggested that explicit knowledge can be shared and generated through interaction between explicit and tacit knowledge in continuous and spiral manner. The knowledge categories are then compartmentalised within the knowledge acquisition process (Nonaka & Tekeuchi, 1995).

2.4.2 Knowledge Acquisition

Rogers, (1969) suggests that learning is a natural predisposition for human beings initiating personal development, forward moving and growth. The gaining of knowledge such as learning vocabulary or statistics data is cognitive, whereas acquiring knowledge such as learning about machinery in order to repair it is experiential.

Adults have a higher propensity to learn than young people. This motivation is driven by depth and variety in previous life experiences (O'Brien, 2004). The use of this natural motivation to learn is establishing the most receptive moment (Zemke & Zemke, 1995). Cognitive learning emphasises cognition, whereas experiential learning addresses the needs and wants of the learner.

Lieb (1991) suggest that there are six principles to facilitating learning a reduction from the ten principles of facilitating learning suggested by Rogers (1969):

- Social Relationships: to make new friends; to meet a need for associations and friendships
- External Expectations: to comply with instructions from someone else; to fullfill recommendations of someone with formal authority
- Social Welfare: to improve ability to serve mankind; to improve ability to participate in community work

- Personal Advancement: to achieve higher status in a job; secure professional advancement
- Escape/Stimulation: to relieve boredom; provide a break in the routine of home or work
- Cognitive Interest: to learn for the sake of learning; to satisfy an inquiring mind

The acquired knowledge is the compartmentalised into working and long-term memory compartments to be drawn upon as required.

2.4.3 Working Memory

It has been suggested that the phrase short-term memory should be replaced with working memory (Smith & Jonides, 1999). Working memory allows a limited amount of information to be available for recall, as use for short periods of time (Baddeley, 1992). The most important component of working memory is the central executive, which deals with cognitive tasks. These systems are used by the central executive when required, but are limited with regards to their ability and capacity. The working memory system is of primary function in the area of activities such as comprehension and verbal reasoning (Eysenck & Keane, 2000).

2.4.4 Long Term Memory

The difference between long-term and working memory is that long-term memory relates to information retained in the conscious after analysis to form part of the psychological presence. Long-term memory contains information that is part of the physiological past and has left the consciousness (James, 1890). Long-term memory can be split into two distinct divisions, the episodic memory and semantic memory. Episodic memory refers to the storage of specific memory relating to place, time and specific events that may have occurred (Tulving, 1972). Tulving goes on to define semantic memory as; "a mental thesaurus, organised knowledge a person possesses about words and other verbal symbols, their meaning and referents" (1972 p. 386). Experts are able to draw on both working memory and long-term memory to facilitate the gathered knowledge in their specialist domain.

2.4.5 Knowledge Management

Knowledge management is a technique to consolidate, maximise and organise human knowledge allowing it reuse (Zyngier, 2002). Knowledge management comprises of a complex multi-faceted function with distinct interdependent processes of knowledge creation and maintenance, knowledge storage and retrieval and knowledge distribution and application (Alavi, & Leidner, 1999). Organisations are adopting knowledge management as part of the overall strategic function (Cole, 1998). Although there is no evidence that organisations refer to knowledge management systems (Chauvel & Despres, 2002).

An organisations assets fall into two categories property based and knowledge based (Miller & Shamsie, 1996). The value of knowledge base assets to an organisation is the organisations ability to manipulate, store and distribute existing knowledge in order to create new knowledge creating a competitive advantage within the market place. Without the ability to adapt to changing market needs the competitive edge is lost (Alavi & Leidner, 1999). By introduction of robust flexible knowledge management systems the true value of knowledge cannot be realised (Miller & Shamsie, 1996).

2.4.6 Knowledge Transfer

Communicating professional knowledge is a key activity for today's specialised workforce. The transfer of insight and experience in an efficient and effective manner between experts allows for informed decision making culminating in a high quality decision making (Straub & Karahanna, 1998). King (2006) suggests that although there is no universal agreement on how knowledge can be transferred, there are two views with regards to the way knowledge is transferred. Transfer can only take place when it has been both communicated and applied; the second stance if that transfer can only occur if the recipient has the capacity to apply the knowledge. In an organisational setting Berends, Van der Bij and Weggeman (2006) suggest that members of an organisation should have an elevated level of involvement in the recipe of knowledge which they can apply within their organisational domain and establish full integration of the knowledge. Two conditions are the corner stone of full integration of knowledge; opportunities for knowledge integration are recognised by

the members (Galunic & Rodan, 1998) and of a well-developed transactive memory system (Wegner, 1987).

Barriers to knowledge transfer and integration are common. King (2006) suggests that reasoning for these barriers can stem from individuals lack of confidence, personal domain protection with the most effective tool to improve knowledge transfer and integration being motivation. The development of organisational member's expertise embeds within organisations a knowledge pool of depth and expertise used for reference by the organisational members (Carlile, 2002).

2.4.6.1 Knowledge Transfer between Facility Management industry and academia

Knowledge transfer between academia and industry is considered by many strategic managers and researchers as a core economic development tool as industry increasingly relies on input of knowledge through external sources to maintain their competitive advantage (Hofer, 2005). With universities continuing to be the primary drivers for the development of knowledge, the strategic alliances provide between industry and academia allows knowledge transfer to develop environments ripe for innovation (Godin & Gingras, 2000). While Van Looy, Callaert & Debackere (2006) refers to Knowledge-generating institutions, like universities and research laboratories, industrial public and private research and more recently, government agencies, as being key actors in stimulating and influencing the innovative potential of any society. Facility Management undergraduate courses accredited by industry organisation such as the bachelor degree offered by Sheffield Hallam accredited by the British Institute Facility Management and the Wentworth Institute of Technology bachelor degree accredited by the International Facility Management Association fosters the cross pollination of knowledge allowing industry and academia to maintain their relevance in a rapidly moving industry.

2.4.7 Expert Knowledge

Expert performance may be defined as performance to a consistent level on a task specific domain (Ericsson & Charness, 1997), although expertise is not easily quantified. Expertise requires a number of abilities starting with knowledge and experience within the domain with the ability to problem solving and to form

conceptual understanding in the domain (De Groot, 1978). Experts see and know the world but only in their domain, in ways that a fundamentally different to a lay person stemming from a difference in perception, knowledge and knowledge organisation (Simon & Chase, 1973). Whilst experts have a different knowledge structure, they share the same reality as the layperson (Shaw, 1988).

A novice, when compared with an expert, will classify problems differently (Chi, Feltovch, & Glaser, 1981). Novices are only able to group problems together based commonality or similarity of features (schema). However, experts classify problems based on deep structure, such as problems that could be solved with the same or similar principles (Kellogg, 2003). In addition they have a superior ability to construct arguments and analogies required perception of implicate patters (Feltovich, Ford & Hoffman, 1997). Experts tend to work forwards to a solution, whereas novice's work backwards attempting to apply concepts as a best-fit solution to the problem, until they find a suitable concept fit (Chi et al., 1981).

2.4.8 Knowledge Communities

The ability of organisations to obtain and deploy knowledge over their specific domain is seen as being vital to maintaining a competitive advantage (Hahn & Subramani, 2000). Knowledge needs to be shared and is best undertaken by the acquisition and storage of knowledge in knowledge bases, followed by countless and costless sharing (Ras, Avram, Waterson & Weibelzahl, 2005). Bringing together as *communities of practice*, describing it as a people with shared interest about a domain that interact with each other on a constant basis to deepen understanding of the domain (Wenger, McDermott & Snyder, 2002).

The concept of community of practice evolves from the shared learning experience and a common overriding premise to improve not only the individual's understanding and knowledge, but the whole group (Wenger et al., 2002). The priority for most organisations is the "capture of employee's knowledge" in order to exploit knowledge as a resource or asset (Quintas, 2002, p.23). Knowledge management is seen by some as being a platform from which organisations can have greater innovation, cost reductions and process improvements (Wilson, Jackson & Smith, 2003). McAdam and Reid (2001) suggest that knowledge and its management by their nature follow a

socially constructed model, which represents knowledge as being intrinsically linked to an organisations social and learning process. The process is not considered as a chain which is as strong as its weakest link, but rather fibres which are sufficiently numerous and intimately connected (Menand, 1997).

While collaboration, partnering and alliances, allow enormous opportunities for companies by ensuring long-term relationship benefit in which collaboration forms a substantive part it takes time to develop and understand the way to utilise the resources and the people and professionals involved (Jagdev & Thoben, 2001). The whole process must culminate to bring partners to the same point at the required time through effective communication, sharing, integration, cooperation, co-ordination and contracting (Fawcett, Osternhaus, Magnan, Brau & MaCarter (2007). According to Allee (1999, p. 7) "every industry is a knowledge industry, everyone is in the information business and almost everyone is a knowledge worker".

The use of collaborative alliance by organisations is becoming more readily adopted with almost 50 per cent of US companies considering knowledge collaboration as a strategic policy of their organisation (Allee, 1997), with Europe in the region of 89 per cent (Murray, & Myers, 1997). Despite these figures, the knowledge process and management as a concept is not been widely used despite it being seen as a pivotal subject within the construction industry (Palaneeswaran, Ng, Kumaraswamy & Ugwu, 2005).

2.5 Australian Building Legislation and Standards

This section identifies the Australian legislation, both Federal and State, which is involved within the life of a building cycle both directly and indirectly. These legislations include; the Building Regulations 1989, Local Government (Miscellaneous Provisions) Act 1960, Fire Brigade Act 1942, Occupiers Liability Act 1985, Occupational Safety and Health Regulations 1996 and Occupational Safety and Health Act 1991.

The Australian federal system allows powers to be divided between a central government and regional governments, specifically, the Commonwealth Government and States by the Constitution. Specific areas of legislative power such as taxation,

defence, foreign affairs, postal and telecommunications services reside with the Commonwealth Government (Australian Government, 2005). Statutory and regulatory requirements for the life cycle of a building have been laid down at both the regional and federal government levels. Such legislation can range from the initial building application through to occupancy on completion of the construction phase (Table 2.3).

Table 2.3

Example of Australian State and Federal Government departments involved within the life cycle of a building

State Department	Federal Department
Department of Local Government & Regional Development	Department of Health
Fire and Emergencies Services Authority	Department of Commerce
Local Council	Sustainability Energy Development Office
Disability Services Commission	Housing Association of Australia
Western Australian Building Commission	

A difficulty of this form of divided legislative control is the integration or legislative harmonisation of the laws and regulations (Brown & Furneaux, 2007).

2.5.1 Harmonisation

Harmonisation is referred to as a way of reducing differences in laws and policies between two jurisdictions, overcome by adopting similar laws and policies (Leebron, 1997). Fox (1992) goes on to state that complete harmonisation can only occur if agreement is made on the central benchmark for use. The best known example of harmonisation within the construction industry in Australia is the Building Code of Australia, which seeks to set a minimum standard of performance for buildings and building materials across Australia at federal and state levels. The existent to which the Commonwealth and State Governments are involved within the building life cycle stages varies between each state and building phase (Brown & Furneaux, 2007).

2.5.2 Building Code of Australia

The Building Code of Australia is described as a uniform set of technical provisions for the design and construction of buildings and other structures throughout Australia, while allowing for variations in climate and geographic conditions. The Building Code of Australia (BCA) document is produced and maintained by the Australian Building Code Board (ABCB) on behalf of both the Australian Federal Government and each State and Territory Government. Legislative support is given to the BCA by the implementation of a legislative framework passed by an Act of Parliament and subordinate legislation, empowering the regulation of certain aspects of buildings and structures. The ABCB'S mission is, "to achieve community expectations of safety, health and amenity in design, construction and use of buildings throughout the nation" (Australian Building Code Board, 2012, p. 7).

The BCA has a maintenance requirement embedded in part I. This part defines the safety measures which must perform to a standard and for these safety measures to perform to a standard not less than that determined using the corresponding BCA provision (Australian Building Code Board, 2012). The BCA is designed to align Australian Standards, International Standards, British Standards and other informative practice global documentation.

There are 81 referenced documents within the Building Code of Australia 2011, although not all the standards content is used. The Building Code Board of Australia chooses sections within the respective codes pertinent to the design, construction and management of buildings thus removing the need for the whole standard to be considered. The selected Australian Standards considered are varied (Table 2.4), ranging from Australian Standard 1038 Coal and coke – Analysis and Testing through to Australian Standards 4859 Materials for thermal insulation of buildings.

Table 2.4

Example of Australian Standards sections within the Building Code of Australia 2011

Standard Reference	Date	Title
AS/ISO 717	2004	Acoustic – Rating of sound insulation in buildings and elements Impact sound insulation

AS 11170	2007	Structural design actions
		Earthquake action in Australia
AS 1684		Residential timber-framed construction
	2010	Non-cyclone areas
	2010	Cyclonic areas
	2010	Simplified – non-cyclonic areas
AS 2293		Emergency escape lighting and exist signs for buildings
	2005	System design, installation and operation
AS 2665	2001	Smoke/heat venting systems – Design, installation and commissioning

(Australian Building Code Board, 2011)

The reference documents referred to within the BCA are a combination of not only Australian Standards, but also International Organisation for Standards (ISO) and European Standards (EN) document as well as international testing and material documentation by ASTM International, formerly known as the American Society for Testing and Materials.

The list of Australian Standards and international reference documents within the Building Code of Australia are comprehensive but not inclusive of all reference documentation which may be seen as relevant to the role of Facility Manager. Other reference documents that would support the FM role through working knowledge support are:

- Australian Standards 1851-2006. Maintenance of Fire Protective Systems and Equipment
- AS/NZS 2201.1:2007 Intruder Alarm Systems - Client premises – design, installation, commissioning and maintenance.
- AS 2201.2-2004 Intruder Alarms Systems – Monitoring centres
- ISO 31000:2009. Risk management - Principles and guidelines
- ISO 50001:2011. Energy management systems - Requirements with guidance for use

- ISO/IEC 20000-1:2011. Information technology - Service management - Part Service management system requirements
- ISO 14001:2004. Environmental management systems - Requirements with guidance for use
- ISO 16175-2:2011. Information and documentation - Principles and functional requirements for records in electronic office environments - Part 2: Guidelines and functional requirements for digital records management systems
- ISO 9000:2005. Quality management systems - Fundamentals and vocabulary
- ISO 9001:2008. Quality management systems – Requirements

Within Australia, Australian Standards fall into one of two categories, mandatory and voluntary compliance. Mandatory standards have a legal requirement for compliance if referred to in regulations, legislation or contracts. If the standards are not mandatory they are referred to as having a voluntary compliance requirement. One of the major standards within the Facility Management domain having a voluntary compliance stance is the Australian Standards 1851-2012 Maintenance of Fire Protective Systems and Equipment.

2.5.3 Australian Standards 1851-2012 Maintenance of Fire Protective Systems and Equipment

This standard relates to all fire protective systems which set out requirements for inspection, test, preventive maintenance and survey of fire protection system and equipment. The objectives of the standard are:

> "to maximise the reliability of fire protection system and equipment such that the system and equipment meet the requirements of the relevant design, installation and commissioning Standards and are likely to continue to do so until the next scheduled activity" (Standards Australia, 2006, p. 10).

A lack of harmonisation between the framework for maintenance of fire protection systems and equipment between States and Territories has resulted in many not adopting the new AS 1851 2012 which provides the latest information, technical knowledge, guidelines and expertise available to industry, government and public. The existence of older editions of the standard currently has meant that many states

still require compliance with the old standard. Legislation for maintenance of fire protection systems and equipment is not restricted to buildings, but proving risk mitigation strategies for work health and safety, mining, dangerous, emergency management planning and aged care (Fire Protection Association Australia, 2012).
Policing adoption for voluntary standards such as AS1851 where no statutory requirements exist has proved to be quite difficult for regulatory authorities who rely on provisions laid down is Special regulatory offence provisions within local government Acts or powers to specified authorities such as the Fire Brigade Act (Fire Protection Association Australia, 2012).

The Fire Protection Association Australia identified a common law duty of care levelled at owners, manager's occupiers and service providers to maintain fire protective systems and equipment and continue by stating:

> In a greater sense the building owners, occupiers and essential service providers must also consider their relationship with the community and the obligations owed to ensure adequate protection of property and life as required specifically by the Building Code of Australia and the common law. This new Australian Standard must be considered to be the most recent benchmark for maintenance of Fire Protection Systems and Equipment. As such the building owner, building occupier and essential service provider must determine whether by not adopting the new standard they may be considered to be negligent (2012, p.2).

Other Australia reference documents designed to assist in providing safe environments for staff and occupiers are National Codes of Practice.

2.5.4 National Codes of Practice

The National Codes of Practice are documents created by the National Occupational Health and Safety Commission under the National Occupational Health and Safety Commission Act 1985 to guide employers and workers through the process of dealing with the elimination, reduction or management of specific workplace hazards. The National Codes of Practice and Standards are designed to increase the uniformity of occupational health and safety regulation throughout Australia as advisory best

practice standards except where supported by State and Territory legislation (National Occupational Health and Safety Commission, 2002). The release of the Work Health and Safety Act 2011 and the Work Health and Safety Regulations 2011 were adopted on the 1st of January 2012 replacing:

- the Occupational Health and Safety Act 1991
- the Occupational Health and Safety (Safety Standards) Regulations 1994
- the Occupational Health and Safety (Safety Arrangements) Regulations 1991 (Australian Government, 2012)

The list of National Codes of Practice pertaining to the construction is extensive (Table 2.5) covering most aspects of safe working standards and guidelines within the work environment.

Table 2.5

An Example of National Codes of Practice and National Occupational Health and Safety Commission Standards

First aid, workplace amenities and personal protective clothing, 2002
Manual handling, 2000
Safe design of buildings and structures, 2008
Managing noise at workplaces, 2002
The Prevention of falls at workplaces, 2004
Working hours, 2006
Violence aggression and bullying at work, 2006
Building Regulations 2012
Dangerous Goods Safety Act 2004
Work Health and Safety Regulations 2011
Electricity Regulations 1947
National Standard for Construction Work (2005)
National model regulation for the control of scheduled carcinogenic substances (1995)
National Standard for Manual Tasks (2007)
National OHS Certification Standard for Users and Operators of Industrial Equipment - 3rd Edition (2001)
National Standard for the Storage and Handling of Workplace Dangerous Goods (2001)
National Model Regulation for the Control of Workplace Hazardous Substances
National Standard for Licensing Persons Performing High Risk Work
National Standard for Occupational Noise (2000)]

The availability of pertinent information to perform the role of Facility Management is substantial in nature within the public domain, as shown within the research. The identified disagreement between practitioners with regards to their statutory requirements and obligations would be reconciled through the dissemination of Federal and State extracted legislative content relevant to the Facility Management industry.

2.6 Conclusion

This chapter presented the definition of Facility Management within the context of the study as well as the role within the life cycle of a building and the focus behind the industry. Facility Management organisations and their mission statements were considered with a driver to assist the establishment of Facility Management as a recognised industry which adds value at a senior strategic management level. The chapter also identified the demographic of the practitioners.

The literature review discussed learning theories, and knowledge concepts and categorisations. The four major models of learning: behaviourism, cognitivism, constructivism and social constructivism, and the philosophies of each were discussed and presented. The concepts of knowledge definition, categorisation, acquisition, and underlying principles of cognitive memory and its development were considered as well as the role of knowledge management and knowledge transfer within an organisational context between the Facility Management industry and academia. The chapter then considered the expert knowledge communities and their value as organisational assets.

The chapter also considered the impact of a lack of legislative harmonisation on practising Facility Managers, preventing constancy and context definition. Statutory federal and state building legislations requirements and guidelines were also considered that are involved within the building cycle, specifically, National Codes of Practice, the Building Code of Australia and the Australian Standard 1851 2006.

CHAPTER 3
METHODS AND MATERIAL

3.1 Introduction

This chapter examines the methodology and Study Design used to undertake the research (3.2). The study consisted of two stages, the Pilot Study and the Main Study, with each stage divided into distinct phases. Phase One considers the body of knowledge found within international tertiary undergraduate Facility Management (FM) courses with expert validation. Phase Two, the examination of the Phase One findings, through completion of Multi Dimensional Scaling survey instrument by FM experts to produce a spatial representation. Phase Three involves semi-structured interviews of FM experts to validate the findings from Phase Two. This chapter also considers the population size (3.3) and research instruments (3.4). The study's research methodology (3.5) as well as the research philosophy (3.6) were also considered, with the chapter concluding with the study's limitations (3.7) and conclusion (3.8) being addressed.

3.2 Study design

The study used a three phase Grounded Theory interpretive analysis of the Facility Management knowledge construct. Phase One involved the examination of 21 international tertiary undergraduate Facility Management courses. Undergraduate courses were selected over post graduate course content as there is a knowledge prerequisite for entry on the the post graduate course removing transparency of the contents knowledge content. The course content was examined and assessed through linguistic analysis to extract the knowledge categories and subordinate concepts. The findings were then presented to 10 experts for validation. Phase Two of the study further analyses the top 14 knowledge concepts from Phase One through the use of Multi Dimensional Scaling (MDS) to present knowledge cluster analysis validation by experts. The final phase involved semi-structured interviews of 10 Facility Management industry experts, selected with consideration of heterogeneity in order to validate the findings of the previous two phases.

3.2.1 Two-staged study: Pilot and Main study

The study was divided in to two distinct stages. The first being a pilot study and the

second being the main study. The pilot study was undertaken to test the reliability and robustness of the study methodology, instruments and context that were used. Any issues identified with the methodology or instruments were changed and applied to the main study as required.

3.2.2 Phase One: Facility Management Knowledge Extraction

Phase One involved the investigation and critique of 21 international tertiary undergraduate courses in Facility Management. The course selection was made initially on the strength of the Facility Management related concepts found within the title of the course, however, validated by an expert group. The findings from the course content analysis were then subject to a linguistic inquiry to develop the knowledge categories for Facility Management.

Linguistic Inquiry and Word Count (LIWC), a computer-based text analysis program, was developed by Francis and Pennebaker (1993) as a method for studying the structural content and components present in individual's language. LIWC allowed, on a word by word basis, the analysis of written text against a known dictionary match. This system allowed calculations on word matches within the text (Pennebaker & Francis, 1999). The use of a full linguistic analysis was not required for this study, as word frequency and word content was the primary focus.

3.2.3 Phase Two: Multi Dimensional Scaling Knowledge Structure

The second phase of the study took the 14 most prevalent Facility Management knowledge categories and subordinate concepts from Phase One and embedded into the Multi Dimensional Scaling survey instrument. The instrument was then sent to 56 Facility Management experts in order to establish underlying MDS dimension.

The study used two-dimensional MDS spatial representation produced by the use of Alternative Least Square Scaling (ALSCAL) algorithm. The development of the ALSCAL algorithm by Takane, Young and Leeuw in the late 1970s allowed scaling of nominal data to test empirically to establish whether the order thought to exist in the data actually exists (Young & Null, 1978; Mead, 1992). The motivation for the development of the algorithm came from the work undertaken by Takane, Young and De Leeuw (1977) on non-metric multiple and canonical regression by combining

available primary MDS algorithms in to one algorithm and creating the most common algorithm used for MDS analysis (Young, Leeuw & Takane, 1977).

3.2.4 Phase Three: Expert Knowledge Structure Validation

The third and final phase of expert knowledge structure validation involved the assessment of the results from Phase Two by 10 Facility Management experts. The experts were selected from a cross section of the Facility Management industry. Semi-structured interviews were conducted, with the process being audibly recorded and transcribed verbatim. According to Wuest (cited in Munhall, 2007), the interview starts with an overview question, with some follow up probes. Follow-up probes are of utmost importance, essential for opening a broad line of questioning (Wuest, Ericson & Stern, 2006). The opinions of each respondent allowed assumptions to be made for comparison.

The interview phase also allowed internal validity to be examined by triangulation of the research findings, described by Gliner (1994) as a method of high priority. The semi-structured expert interviews were presented as a paper-based analysis of the knowledge concepts obtained in Phase Two. The interviews quantified the confidence in the Facility Management knowledge concepts by expert judgment. The interview questions were based on the research questions, which facilitated analysis of the data patterns to be made.

3.3 Population

The principal cohorts had to be chosen to achieve an appropriate sample size in an attempt to make the findings representative of the Facility Management domain. The population sample size required for each phase differed dependent upon the phase being examined. Johnson (1959, p. 167) asserts that no one sample size fits all research methodologies, the decision must be made considering goals of the study while considering research design. The sample size should be dependent on the population characteristics. A completely uniform population may allow a sample size of one, while a larger sample is obviously required where the required characteristics display wide heterogeneity (McGraw-Hill, 1986). As a general rule of thumb the sample size should be large where there are small relationship differences and the dependant reliability variable are not known (Borg & Gall, 1979).

In qualitative research, samples are chosen to elicit meaning rather than frequency. The sample selection uses two criteria, a process called purposive sampling, the fit between experience and the research questions and secondly, the presence of characteristics of a good informant (Munhall, 2007, p. 530). Henry (1990) asserts that samples are drawn from a larger population, in non-probability sampling techniques, without the requirement of random selection and have a distinguishing characteristic of subjective judgments playing a role in the selection of the sample. The nature of the target samples which does not represent the wider population is what drives the choice of non-probability sampling for use within a study (Cohen, Manion & Morrison, 2002).

A sample size of 21 international tertiary undergraduate courses were considered appropriate for Phase One due to the method of selection and the criteria of Facility Management undergraduate courses, although the sample size is not a random mathematical sample of the larger community (Krejcie & Morgan, 1970). To further support the selection process and reliability, the universities were selected from the list within the European Facility Management Education Guide 2009 that identified 30 Bachelor courses, in 15 European countries (EuroFM, 2009), and the North American Facility Management Degree Guide 2009 which identified 21 institutions offering Facility Management degree programs from 12 North American States producing (IFM Foundation, 2009). Additional courses were identified through the use of the world-wide-web (www). A 10 member expert panel to validate the above courses content was considered appropriate due to the non-probability nature of the expertise available.

In Phase Two the 14 most common Facility Management knowledge categories and subordinate concepts were chosen and embedded into the Multi Dimensional Scaling survey instrument. The instrument was then distributed to 56 Facility Management experts who were chosen by non-probability sample selection due to the nature of the industry and the expertise available with the process further supported by peer selection. It allowed the research population to fall in line with the recommendations for minimum population sample size for MDS as being 30 (Martinez-Torres, Garcia, Marin & Vazquez, 2005; Cohen, Manion & Morrison, 2002). The use of 14 knowledge categories and subordinate concepts was selected as an appropriate

number as it allowed the completion of the survey instrument to be more timely and less onerous on the participant while retaining depth of content for analysis.

A sample size of 10 participants deemed by peers to be Facility Management experts were selected for Phase Three through the use of non-probability sampling. The targeted sample size was due to the nature of the industry, as the true expertise of participants restricted the sample market and the non-probability nature of the market segment. Ericsson and Charness (1997) suggest that experts in a specific domain are two standard deviations above the general domain population that cannot be sought out by researchers who assume they have a greater skill set. Shanteau (1992) asserts that those within the domain should select who they consider to have appropriate skills and abilities to be considered an expert.

3.4 Research Instruments

The two instruments used for this study was Multi Dimensional Scaling (MDS) applied to Phase Two and Expert Validity applied to Phases One and Three.

3.4.1 Research instrument 1: Multi Dimensional Scaling

The research instrument used in Phase Two of the study was constructed using the Facility Management knowledge concepts and subordinate categories from Phase One and embedding these into a MDS survey instrument. The imbedded concepts were paired and assessed by the 56 Facility Management Experts on a sliding scale of which concepts they considered were related or unrelated to each other.

3.4.2 Research instrument 2: Expert knowledge structure validation

Expert knowledge structure was used in Phase One and Phase Three to validate the phases. The 25 experts from a cross section of the industry were selected for the assessment of the results from Phase One and Phase Three. Assessment by the experts allowed comparisons to be made which along with triangulation were used to validate the findings, a process of extreme importance according to Gliner (1994). The semi-structured expert interviews using questions based on the research outcomes and analyses of the knowledge concepts obtained in Phase Two allowing expert judgment to grade the confidence of the extracted data.

3.5 Research Methodology

The study applied a mixed methodology approach (Creswell, 2003), namely the use of a combination of qualitative and quantitative approach which allowed different aspects of the methodologies to be used to address the research questions (Gorman & Clayton, 2005).

3.5.1 Qualitative Research

Qualitative research is not a single universal defined stance or concept, it requires philosophical understanding by the researcher to direct and develop the research (Sandelowski, 2002). Sandelowski and Barroso (2002) assert that qualitative research can only be judged and evaluated on its own individual merits, making it incumbent on the researcher to formulate and build a robust study. The strength of qualitative research comes from its inductive approach (Maxwell, 1996, p. 17), providing a comprehensive overview of the informant in a natural setting (Creswell, 1998). The analysis of qualitative data provides an understanding of a concept view of social realities (McMillan & Scumacher, 1993, p. 95). The interpretation can then be laid against the role of the social actors with data being words rather than numbers (McMillan & Scumacher, 1993, p. 45).

3.5.2 Quantitative Research

Quantitative research is used in the response to questions about relationships among measured dependant variables with the purpose of explaining, predicting, and controlling phenomena. This approach is sometimes referred to as the traditional, experimental, or positivist approach (Leedy & Ormrod, 2005, p. 94). The sample size for quantitative research is large with the data being collected by survey method as it provides more reliable findings (Denscombe, 2003, Simpson, 1990).

There are further fundamental differences within the process and application of research utilising Qualitative and Quantitative Research methodologies (Table 3.1).

Table 3.1

Traditional distinctive attributes of quantitative and qualitative research

	Qualitative Research	**Quantitative Research**
Philosophical Background	Reality is subjective, constructed Social anthropological world view A rationalist's view of knowledge Phenomenological Interpretive	Reality is objective Natural science world view An empiricist's view of knowledge Positivistic Positivist
Guiding principles	Accepts subjectivity Holistic Data-driven Theory emerging Inductive Exploratory Sensitising concepts Process-oriented	Claims objectivity Atomistic/aggregative Theory-driven Theory testing Hypothetic-deductive Prediction Definitive concepts Outcome-oriented
Usage	Small-scale studies in depth	Large-scale studies
Data collection	Natural settings Purposive Representative perspective sample Soft, rich, nuanced, deep data Textual Researcher as own instrument Open (ecological validity)	Artificial settings Probabilistic Representative population sample Hard, reliable, replicable data Numerical Measurement, testing instruments Closed (experimental control)
Data analysis	Insider perspective Interpretative Discovery Understanding participants' views Dependent on the researcher	Outsider perspective Statistic Verification Seeking facts and causes Independent of the researcher
Quality criteria	Trustworthiness Contextual account Dependability/consistency Transferability Credibility Confirmability	Rigour Generalisable account Reliability External validity Internal validity Objectivity

(Tan, 2009, p. 55)

3.5.3 Mixed Methodology

Although mixed methodology research technique are still in the early stages of evolution and development (Creswell, 2003), it allows the combination of qualitative and quantitative research techniques for a single study (Johnson & Onwuegbuzie, 2004). The researcher is able to address different aspects of the same research questions while expanding the studies breadth and to compensate for weaknesses of respective approaches (Gorman & Clayton, 2005). During data analysis, the study followed the inductive and deductive stages as proposed by Erickson (1986). Assertions were generated during the inductive stage of data analysis. Assertions are propositional statements that indicate relationships and generalizations in the data (Erickson 1986).

3.6 Research Philosophy

The methodology selected for the research centred around Grounded Theory. A methodology developed as a midrange research theory with data being collected through social interaction. The social interaction of Facility Management knowledge categories and subordinate concepts involved within the buildings life cycle, would allow Grounded Theory to be used with confidence.

3.6.1 Grounded Theory

Grounded Theory (GT) as a research methodology was seen as a suitable, pivotal methodology which would allow credible research to be undertaken within the context of this study. GT was first established by Barney Glaser and Anselm Strauss in their 1967 text *The Discovery of Grounded Theory* (Cited in Tan, 2007) in which they used this theory as a new approach to the study of death and the dying. GT has since been successfully employed in other disciplines including sociology, organisational science marketing and information sciences (Mansourian, 2006; Sornes, 2004), but has found extensive acceptance in nursing research (Stern & Covan, 2001). Although the cofounders - Glaser with a quantitative research tradition and Strauss, with a tradition in qualitative research - were from different philosophical research traditions (Tan, 2009), it is widely recognised that original theoretical underpinnings in Grounded Theory were from pragmatic and symbolic interactionism theories (Alvesson & Skoldberg, 2000; Hutchinson & Wilson, 2001; Milliken &

Schreiber, 2001; Crooks, 2003; Corbin & Strauss, 1990; Pickard, 2007; Strauss & Corbin, 1998).

3.6.1.1 Grounded Theory History

Glaser and Strauss (1967) wrote little to address the philosophical roots of Grounded Theory (GT) other than a brief reference by Strauss (1987) to pragmatism influence informing the development of the theory. In addition Glaser (1992) stated that the world is actively shaped by the symbolic interaction moulding changes in circumstances and variables, which confirms the presence of pragmatism and interactionism. Glaser (2008) changed this stance by asserting that symbolic interaction was a dominant theoretical guide to analysis, not a founding component of GT. This research process was refined by Charmaz (2000) through the use of the constructivism approach allowing Grounded Theory to retain the fluidity and open-ended character of pragmatism (Charmaz, 2006, p. 184). Mjoset (2005, p.379) suggests that Grounded Theory is a case of the explanation-based type of theory reflecting a pragmatist attitude. Glaser (2008) disagreed with Charmaz asserting that it was a misnomer to refer to constructivist Grounded Theory.

The Pragmatic philosophical approach originates from the term "*pragmatism",* derived from the Greek *pragma* ("action," or "affair"). The Greek historian Polybius called his writings *pragmatic* meaning that they were intended to be instructive and useful to his readers (Encyclopaedia Britannica, nd). Charles Peirce was the first to introduce pragmatism in 1878. According to Bird (1986, p. 47), William James was the most famous philosopher of pragmatism and contended that the ideas and beliefs have a value when and if they work.

Gramsci (1971) suggests that everyone is a philosopher, although the process is an unconscious practice and shaped by the researchers understanding of which approaches are appropriate to the application. Pragmatic reflection begins with the interaction process of individuals in their social and natural environment (Siegfried, 1998, p. 51). Reasoning can be considered to be a chain, not one that is dependent upon the weakest link but rather a series of woven fibres which as a whole provides a stronger interdependent entity (Peirce, 1868).

Grounded Theory is described as being simply a set of integrated conceptual hypotheses systematically generated to produce an inductive theory about a substantive area, as well as being a highly structured but eminently flexible methodology (Glaser, 2008, p. 2). The aim is to generate theory rather than verification of theory (Glaser & Strauss, 1967). Flinders and Milles (1993, p. 9) refer to Grounded Theory as being a complex process of both inductive and deductive, guided by prior theoretical commitments and conceptual schemes. It is not simply a methodological scheme for initiating and guiding enquires the researcher is required to draw on an educated imagination (Frye, 1963), taking a strategic approach to the research (Punch, 1998). Mansourian (2006) suggests that research which uses GT as the method is not testing or verifying a preconceived hypothesis but developing new theories which are established by the collection of data, with the theories grounded within the data and that the data is systematically collected and analysed (Strauss & Corbin, 1998). Glaser (1978, p. 93) goes on to state that the goal of Grounded Theory is to generate theory that accounts for patterns of behaviour which is relevant and problematic for those involved.

According to Glaser and Strauss (1967, p. 169) it is of primary importance for the researcher to start with and maintain an "*open mind*" in order to fully utilise materials relevant to the area of study. Researchers are encouraged to ignore the use of prior theories and concepts (Goulding, 2002); nevertheless, this does not mean having an empty head (Seidel & Kelle, 1995, p. 56). Heath and Cowley (2004) acknowledge that background reading into topics provides prior knowledge content but it is important not to let that influence the direction of the study, even at a subconscious level. Chenitz and Swanson (1986) suggest however that to be a passive inert participant is not appropriate, as the researcher needs to participate as well as being an independent observer.

Within the Grounded Theory process, questions need to develop the true context of the concepts by establishing the data development and what is actually happening with the data as it develops the theory. The process also places the research in a social scene allowing consideration of social psychological problems faced by the participants and what are the basic problems in the social structural (Glaser, 1978, p. 57).

A constant directional push is required within Grounded Theory methodology in order to allow the data and research development to shape the research process, while elucidating the social interaction involved within the process (Charmaz, 1983). The GT data collection and analysis is a simultaneous, sequential, subsequent, scheduled and serendipitous, forming an integrated methodology, which enables the emergence of conceptual theory as distinct from the thematic analysis characteristics of qualitative data analysis (Glaser, 2008, p. 2).

3.6.1.2 Straus V's Glaser

There are differences within the Glaser and Strauss perceived use and application (Table 3.2) of Grounded Theory (Strauss & Corbin, 1998; Glaser, 1992). According to Locke (2001) this difference is fundamental to any study as the application and epistemology of each study shapes the foundations on which the research is built and therefore its outcome. Providing that the researcher explains what they have done and how they did it, staying outside of the boundaries of one particular version is less of an issue than limiting the potential depth of understanding that strict adherence to one version would produce (Cutcliffe, 2000, p. 1483).

Table 3.2

Glaser and Straus application of Grounded Theory

Glaserian	**Straussian**
Beginning with general wonderment (an empty mind)	Having a general idea of where to begin
Emerging theory, with neutral questions Development of a conceptual theory	Forcing the theory, with structured questions Conceptual description (description of situations)
Theoretical sensitivity (the ability to perceive variables and relationships) comes from immersion in the data	Theoretical sensitivity comes from methods and tools
The theory is grounded in the data	The theory is interpreted by an observer
The credibility of the theory, or verification, is derived from its grounding in the data	The credibility of the theory comes from the rigour of the method
A basic social process should be identified	Basic social processes need not be identified
The researcher is passive, exhibiting disciplined restraint	The researcher is active

Data reveals the theory	Data is structured to reveal the theory
Coding is less rigorous, a constant comparison of incident to incident, with neutral questions and categories and properties evolving. Take care not to 'over-conceptualise', identify key points	Coding is more rigorous and defined by technique. The nature of making comparisons varies with the coding technique. Labels are carefully crafted at the time. Codes are derived from 'micro-analysis which consists of analysis data word-by-word'
Two coding phases or types, simple (fracture the data then conceptually group it) and substantive (open or selective, to produce categories and properties)	Three types of coding, open (identifying, naming, categorising and describing phenomena), axial (the process of relating codes to each other) and selective (choosing a core category and relating other categories to that)
Regarded by some as the only 'true' GT method	Regarded by some as a form of qualitative data analysis

(Onions, 2006, pp. 8-9)

3.6.1.3 Social interaction

Symbolic interactionism as suggested by Lee (2006, p. 18) explains that as people interact with each other meaning is attached to situations. Such attachment provides the premise that no object, situation or person has meaning of itself, as the meaning is attached to the experience of that situation. While Blumer (1962, p. 179) goes on to identify symbolic interaction as the interaction between human, with each having their own peculiar and distinctive character of interaction.

Blumer (1969) suggests that with symbolic interactionism assumptions can be made with regards to the way people continue to evolve their meaning of things through the continued evaluation of experiences, from interaction with people and things and from which meaning in drawn. Chenitz and Swanson (1986, p6) refer to the way society interaction occurs as individuals form alliances and act towards a common shared meaning. According to Munhall, (2007) symbolic interaction, within a Grounded Theory study is to direct the researcher to make assumptions that meaning is made within the study through the constant changing state of interaction. When a study is underpinned by symbolic interaction there has to be examination of both symbolic meaning of the interaction and the human behaviour with the verbal and non-verbal interactions being observed in various settings (Lee, 2009).

Due to the social interaction of the knowledge categories and disciplines involved within the life of a building cycle symbolic interaction was seen as a focal point of the study, allowing Grounded Theory to be used confidently. This claim is further supported by Glaser (1992) who defines Grounded Theory (GT) as an approach that results in the development of a middle range research theory that is based on systematically allowing theory to evolve from social research data and collection process (Glaser & Strauss, 1967; Strauss, 1992). Morse (1997, p. 164) suggests that theory has many forms varying in structure, sophistication and modes of derivation.

The Grounded Theory approach is well suited to organisational settings because of the complexities of the organisational context (Orlikowski, 1993, p. 312). Further justification for the use of Grounded Theory within the Facility Management domain is identified by Sornes (2004), who suggests that Grounded Theory is appropriate in the study of information communication technologies within organisations when overarching organisational and management content are identifiable.

From an organisational stance, organisations are often referred to as having cultures embedded within them. It is not that the organisation is a culture, but as referred to by Morey (1986) is operating from an ethnographic analysis and Grounded Theory stance, as if they were cultures when studies in organisational cultures are conducted (Maznevski & Chudoba, 2000; Partington, 2000; Martin & Turner, 1986; Orlikowski, 1993; Strauss & Corbin, 1990; Turner, 1983).

Grounded Theory's capture of social processes in a social context makes the approach useful where the goal is to explain human behaviour in a social context (Glaser & Strauss, 1967; Glaser, 1978). Therefore Grounded Theory is well suited to human behavioural research related to health issues, development transitions and situation challenges as well as research in nursing. According to Locke (2001, p. 45) Grounded Theory is particularly useful for examining those situated processes. Grounded Theory based research is being undertaken in the technology and oil industries, and managing diversity within an organisational context (Simmons & Gregory, 2004, p. 87) and managing the working environment. This makes Grounded Theory an appropriate methodology within the context of this study and supporting its use.

3.6.1.4 Theoretical Sampling

Grounded Theory sampling requires the researcher to make choices regarding where and how the data will be best collected to suite the research being undertaken. The researcher selects subsequent groups of subjects on the basis of these questions, gaps and for specific emerging theory, while driving concepts that have proven theoretical relevance to the evolving theory (Strauss & Corbin, 1990, p 176; Glaser & Strauss, 1967). Sampling as suggested by Silverman, (2006) has two purposes, allowing the researcher to consider the samples relevance to be assessed and thereby, allowing confidence to be established.

The requirement to have a wide or narrow sample needs to be justified (Cutcliffe, 2000). Lincoln and Grub (1985) suggest that a wide sampling process ensures that a wide variety of data as possible is obtained to cover a variety of situations. While Morse (2000) subscribes to the narrow sample approach by asserting that only people with the most experience should be interviewed.

Data analysis through the guidelines laid down within Glaser and Strauss (1967) allows for concept development and modelling in the field environment through experience and interaction deepening the context and data. Constant comparative analyses of the data can then be undertaken (Glaser, 1998). Constant analysis by reducing the data to strengthen its content through predictability allows progressive data identification and abstraction (Browning, 1978; Stemler, 2001).

There is a widely held perception that the use of a computer helps to ensure rigour in the data analysis process (Bazeley, 2007). Gibbs (2002) suggested paper and pen, and other traditional methods used by researchers have been replaced by computer based systems. The research can benefit from data analysis software, according to Pakenham (2005), as it allows a systematic analysis from the outset and adds value to the study by facilitating the systematic data analysis and assessment to capture and enhance theory. Computers are useful for administrative functions and at arranging and sorting data but are unable to apply to qualitative research analysis. The inability of the computer to think, frees the researcher to drive the research through the established findings (Ereaut, 2007).

Nevertheless there are some concerns regarding the use of computer software to conduct research. Fischer (1994, p. 199) suggest computers are able to encourage the researchers to adopt procedures due to ease rather than being appropriate, which may isolate the researchers from fundamentals underpinning the research. The analysis to be undertaken within this research will use the NVivo software, a Window's based program that allows documents to be imported directly into the package to allow coding to occur. Analysis of the data by coding, memoing, naming and renaming, allowed assumptions to be made of the data and interpretation development. The analysed documents can be linked, ordered and studied for compatibility and themed attributes. Gibbs (2002) suggests that NVivo can assist with the analysis by probing the developing theory and help building theoretical ideas. NVivo will be used to assist consistency in the organisation, examination and analysis of the data.

3.6.2 Multi Dimensional Scaling

MDS is a collection of methods which allows examination into the underlying relationship between objects in a geometrical representation (Van Deun & Delbeke, 2000). According to Bennet and Bower (1977), MDS is a way in which an analysis of similarities in judgements can be made to allow dimensionality to be identified, and is one of the best known grouping techniques (Kerlinger, 1970). MDS can be considered an alternative to factor analysis and refers to a class of techniques which uses proximities among any kind of objects as inputs. The goal of the analysis is to detect meaningful underlying dimensions while providing explanations of observed similarities or dissimilarities (distances) between the investigated objects, as well as allowing the analysis of similarity or dissimilarity matrixes (Kruskal & Wish, 1978). MDS roots trace back within psychology and psychophysics field and in psychometrics is a more general category of multivariate data analysis (Borg & Groenen, 2005; Cox & Cox, 2000; Kruskal & Wish, 1978).

These object similarity ratings represent agreement of judgements by a person recording the number of times a person is unable to differentiate between stimuli and similarities to produce dimensionality perception traits (Rosenberg & Kim, 1977). Young and Householder (1941) extrapolated the methodology further by developing a model which allowed the simultaneous scaling of several characteristics. Guttman (1954) moved away from the more restrictive factor analytic model and adopted a

systematic approach of formulating hypothesis to assess underlying structure variables. The most fundamental step in the development of MDS came from Shepard (1957) models that focused on the low-level, continuous sensory stimulus domains of human conceptual structure.

Spatial relationships representations of similarities existing between stimulus sets are developed with MDS techniques (Kruskal, 1964b; Cox & Cox, 1994). Each stimulus is identified as a point in dimensional space and as the distance between respective points decreases, it can be said that the similarity of the corresponding stimuli increases the context of data visualisation and cognitive modelling (Lee, 2001; Lowe & Tipping, 1996; Mao & Jain, 1995).

Research has shown that MDS allows clear and concise representation of the operation of the cognitive process through the generation of spatial representation of a stimulus domain (Myung & Shepard, 1996). The psychological similarity can then be visualised as a gradient to show dimensional representation in space approximated by the decay functionality (Shepard cited in Lee, 2001). Nosofsky (1992) states that several models such as Context Model and ALCOVE, given the generic term of *cognitive process models*, have been successfully used with MDS representations as the foundation of the models (Nosofsky 1984, 1986; Kruschke, 1992).

MDS inputs can be considered from any comparison between pairs of objects which are able to be translated into proximity measure or dissimilarity measure (Borg & Groenen, 1997). The spatial representation type chosen and the MDS algorithm applied are considered to be the most important part of the modelling of the set of proximities (Cox & Cox 1994; Everitt & Rabe-Hesketh, 1997).

MDS is not just one method of data analysis. Borg and Groenen (2005) suggest MDS algorithms belong to taxonomy and different algorithms can be used to obtain the geometrical representation of the proximities. This goes together with the existence of a number of MDS models. Classical MDS, also referred to as Torgerson Scaling or Torgerson-Gower scaling (Borg & Groenen, 2005,) allows input matrix dissimilarities of pairs producing an output coordinate matrix minimized loss function called s*train.* Metric MDS is subset of classical MDS applying a variety of loss functions and input

matrices of known distances with weights. The loss function in this context is called stress, which is able to be minimized by stress majorization.

Non-metric Multi Dimensional Scaling finds both a non-parametric monotonic relationship between the dissimilarities in the object matrix and the Euclidean distance between objects, and the location of each objects in the low-dimensional space. The relationship is typically found using isotonic regression (Borge & Groenen, 2005 p. 212). Non-metric analysis is seen as more appropriate for the study of social sciences (Kruskal, 1964a) and adopted for this research.

Symbols, according to Van Deun and Delbeke (2000) can be used to represent the proximity measure between entities such as *i* and *j* (Figure 3.1). If perceived dissimilarities between entities on a rating scale are identified, then this rating can be considered to be a reversed measure of the proximity between stimuli. The coefficient between variables *i* and *j* can be considered to be a proximity measure for these two variables. The proximities are then represented in a geometrical Euclidean space. The distance between two points *i* and *j* in an *m*-dimensional Euclidean space are related to the observed proximities by a suitable transformation depending on the measurement characteristics considered as appropriate for these proximities.

$$d_{ij} = \left[\sum_{a=1}^{m} \left(x_{ia} - x_{ja} \right)^2 \right]^{1/2}$$

Figure 3.1 Proximity Measure Equations
(Van Deun & Delbeke, 2000)

The Stress measure indicates the proximity of the data to the best possible fit or a goodness-of-fit measure; however, in reality the higher the stress scores the worse the fit (Kruskal & Wish, 1978; Schiffman, Reynolds, & Young, 1981) stress scores are represented by the square root of a normalised residual sum of square (Buja, Swayne, Lithman, Dean, Hofmann & Chen, 2008). A high Stress value may indicate that the

chosen number of dimensions does not portray the relationship between objects or that the objects have no tangible relationship (Sturrock & Rocha, 2000).

Kruskal (1964b) asserts that Stress can be calculated by measuring the fitness of the output while considering the dissimilarities between the distances of the low dimension points. The analysis of the stress function of the dimension allows the target number of dimensions to be defined with a reduction to 5-8 dimensions being found to provide acceptable results (Safonova, Hodgins & Pollard 2004). A larger number of dimensions will lead to a lower value of Stress aiming for the prefect dimensional fit value of zero (Kruskal & Wish, 1978). The goal is to find optimal numbers of dimensions and an acceptable level of Stress. Plotting the stress value against the number of dimensions to ascertain where an elbow is present on the curve indicates the optimal number of dimensions at that point. Exceeding the elbow has shown that the number of dimensions will increase, but has little effect on the Stress reduction (Buja et, al., 2004). Kruskal and Wish (1978) developed a methodology which applied a series of rule of thumb interpretations of the curve shape using the expertise of the person performing the interpretation.

However, Spence and Ogilvie (1973) suggest that the Stress value is not determined by fit of the configuration, but the number of points in the configuration. An increase in the number of points provided a larger Stress value. The need to provide accurate data without the influence of noise is implicit to prevent the curve of the Stress masking the optimal number of dimensions (Machado, Duarte, & Duarte, 2011). The reduction in stress and removal of noise influence will allow clarity to observe the interrelationship identified within the 21 international tertiary Facility Management knowledge concepts extracted from the Facility Management undergraduate courses.

An alternative solution to the problem was to algorithmically minimize a fit measure of Stress by an iterative algorithm (Figure 3.2). Stress is calculated and minimised through identification of optimal coordinates and the optimal monotonic transformation of the data (Kruskal 1964a).

$$Stress_1^2 = \frac{\sum_{i,j}(d_{ij} - \tilde{d}_{ij})^2}{\sum_{i,j} d_{ij}^2}$$

Figure 3.2 Iterative Algorithm
(Shepard, 1962, p.9)

Van Duen and Delbeke (2000) developed a four step approach (Figure 3.3) to describe iterative algorithms, dimension and initial coordinate matrix determination, optimal scaling, estimation of parameters and finally a goodness of fit determination.

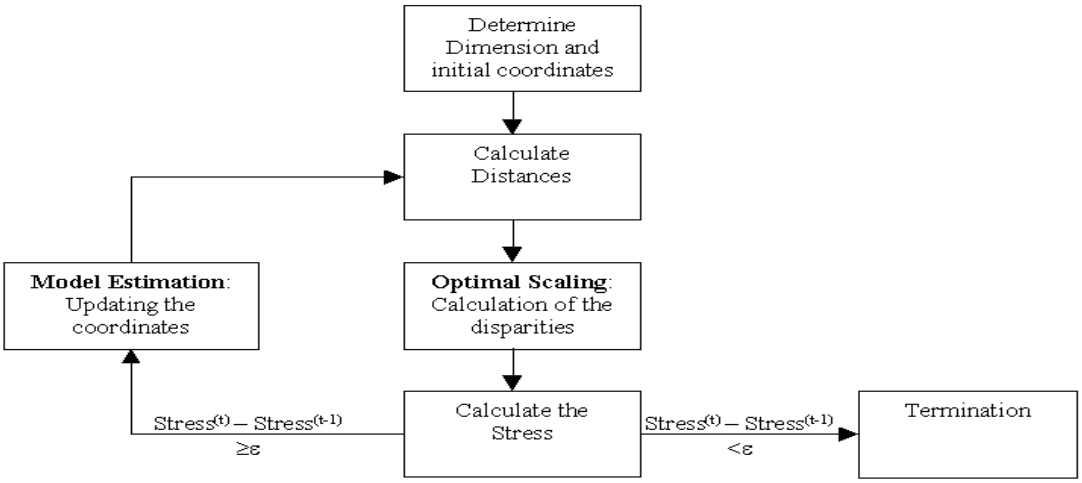


Figure 3.3 The iterative MDS-Algorithm
(Van Deun & Delbeke, 2000, p.43)

The most popular algorithm to perform MDS is the Alternative Least Squares Scaling (ALSCAL) and was chosen for this research (Takane, Young & De Leeuw, 1977). The benefit of ALSCAL, according to Cox and Cox (1994), is that analysed data may be nominal, ordinal, internal or ratio, allow missing or incomplete object measures, be asymmetric or symmetric, be unconditional or conditional and continuous or discrete, making this algorithm versatile

The Phase Two use of MDS meant that the selected sample size as indicated by Borg and Gall (1997) could be selected on a work-up rather than work-down approach, which combined with non-probability sampling, removed the need to define the sample size based solely on population (Brooks, 2008). Cohen, Manion and Morrison

(2002) consider 30 to be the minimum sampling size for MDS analysis, which supported similar studies that had used MDS analysis (Cheng, 2004; Martinez-Torres, Garcia, Marin & Vazquez, 2005). The selected sample size was maintained, as an increase in possible sample bias may occur with an increase non-probability sampling (Kalton, 1983).

3.6.3 Interviews

Interviews as a data collection process within social research, has become a more readily accepted form of data collection. Nevertheless despite opponents suggesting that there are built in limitations within the social research realm, more "*inspired*" forms of interviewing techniques have emerged departing from the acknowledged interview models (Brenner, Brown & Canter, 1985 p. 1). The value of interviews as a process allowed expression from both parties to explore the meaning of the questions and answers (Brenner, 1985). The questions asked during the course of an interview were directed to the outcome requirements of the research process (Patton, 2002). Such topics as background, opinions and perceptions will help build the foundations for knowledge gathering to respond to the research questions. Laing (1967) suggests that an interview is an interaction where the interviewer and interviewee can participate in a discussion to establish opinion on world and everyday life events.

Interviews are seen as a relatively quick process with little expense and are useful when a particular issue needs to be explored in-depth (Law, Stewart, Letts, Pollock, Bosch & Westmorland, 1998). Nevertheless Scott and Chanlett (1973) suggest that there is a high degree of skills involved within the interviewing process. The suitable skill set is required to allow the interview structure to have consistency and parity across the interviewees and the process needs to be undertaken by suitably trained field staff which can attribute substantial cost in training and assembling. This leads on to the premise made by Brenner et al., (1985) that interviews makes the assumption that people only comment upon their lives and from every day experiences, being a "conversation with a purpose" according to Bingham and Moore (1941, p. 1).

In order to maintain continuity and consistency within the interview process, they should be conducted in similar ways with a checklist for the interview process

(McNeill & Chapman, 2005). Such an approach will allow reproduction of the interview process while maintaining integrity and consistence (Brenner 1985; Mason 2002).

Interviews allow for in-depth exploration and data collection. The interview questions presented open-ended questions allow for elaboration on the responses with more than a yes or no reply from the interviewee (Law et al, 1998). Closed questions may also be used which limit the answer choices from which they must choose to answer the question (Dillman, Smyth & Christioan, 2009).

A semi structured interview format is utilised within social sciences allowing a flexible interview with the interviewer is able to develop the interview process by soliciting further questions from significant replies (Lindlof & Taylor, 2002; Newman, Jarlais, Turner, Gribble, Jay, Cooley & Paone, 2002).

Interviews undertaken within Grounded Theory research are generally semi-structured, using open-ended questions. This methodology allows the interviews to vary to accommodate the individuality of the interviewee enriching the data obtained by shaping and generating theory (Hoepfl, 1997). Face-to-face interviewing may be affected by so-called psychological distress, using open-ended questions to collect data from the identified experts for validity of the findings (Newman, Des Jarlais, Turner, Gribble, Pooley & Paone, 2002). As Seidman (1998 p. 4) suggests the semi-structured method provides "access to the context of people's behaviour and thereby provides a way for researchers to understand the meaning of that behaviour". Therefore, according to the research purpose, individual one-on-one, face to face interviews rather than focus groups or group interviews as primary data sources were selected. This approach will attempt to support the finding of the knowledge categories within the life of a building and the social interaction.

Increased reliability of the interviews can be achieved by reducing bias. Bias refers to factors which alter the results of the study and can lead to incorrect conclusions being drawn from the findings making accurate interpret difficult (Macnee, 2004). Interviewer and respondent characteristics are the primary sources of bias, which may be added to by content of the questions. The characteristics are able to be broken

down into attitudes and expectation of the interviewer that may see the interviewer attempting to search for a response that support preconceived notions. Interviewee misconception may form part of the overall bias on what is being asked by the interviewer (Cohen, 2000). As Oppenheim (1992) identified several causes of bias within the interview including biased sampling, poor communication between parties, lack of constancy in sequencing of questions and format, wording of questions, prompting from one interview to another, coding responses, inconsistent data recording and analysis of transcripts.

In order to support both reliability and validity in this study the following steps were undertaken. The interviews were conducted in a quiet and private room to allow a rapport between the participant and interviewer to be established. This approach will allowed open and free expression through engagement and to allow balanced and objective considerations of the interview questions. Utilisation of an interview schedule will provide a structured and consistent approach. Such an approach will reduce, to some degree, bias within the interview phase (Oppenheim (1992).

3.7 Study limitations

To avoid errors within mixed method research it is of the upmost importance that the data collection and data analysis processes are beyond reproach. The researchers must ensure rigour which will reflect the overall quality and consistency of data collection and data analysis, interpretation and the trustworthiness of the data (Macnee, 2004).

Lincoln and Guba (1985) refer to trustworthiness as the honesty of the participants data collected. The researcher must immerse themselves within the data and establish a rapport with the participants which allows full access through openness to the data. Trustworthiness is also maintained by using a consistent data collection structure as a broad framework to ensure a similar interaction without structuring the data collected (Creswell & Miller, 2000). The reproduction of the interview process as well as the consistency within the setting, will add to the overall trustworthiness and conformability of the obtained data. Lincoln and Guba (1985) suggest that credibility also needs to be present in a study and can be addressed by prolonged engagement in the field, persistent observation. This process highlights the characteristics for the focus, triangulation by using more than one source to include different views or to

consider the phenomena from a different angle and member checking which involves respondent validation of the data for factual errors and to allow respondents to add any further information surrounding the topic.

Confirmability refers to the consistency and replicability of the decision-making process of data collection and analysis (Creswell & Miller, 2000). One way of achieving conformability is to develop and maintain an audit trail. An audit trail is an ongoing documentation of decisions made during the collection and analysis of data.

The audit trail was maintained to allow ongoing documentation of decisions about data collection and data analysis processes. This audit is undertaken through the use of field notes about the process of data collection and analysis, and any problems noted. The NVivo computer software was used to allow for consistency in the organisation, examination and analysis of the data, allowing to some degree for conformability of the data as explained by Macnee (2004).

The researcher needs to be able to depend upon the data findings and involve reflexivity where they are viewed as the research instrument. This issue can lead to observer bias, in which the researcher's views and preconceptions can insulate the experiment. In order to maintain the dependability of the data collected it is important to disclose preconceptions and assumptions that may have influenced the data during the gathering and processing stages (Crabtree & Miller, 1992).

The data identification and collection process raised questions as to the content relevance in the Facility Management industry and how up to date the curriculum had been maintained, raised questions regarding the reliability of the data source in that it is the responsibility of the respective universities (Miller, 1984).

The lack of clearly defined Facility Management role and the discrepancy within expert categorisation (Wiggins, 2010) raised concerns regarding the validity and accuracy of the expert assessment. The peers selection and non-probability sampling of the expert group allowed questions to be raised regarding their true level of expertise. The introduction of judgement error was also considered as a limitation of

the study as expert groups have similar qualities though out the group and may affect the quality of the validation process.

3.7.1 Reliability Validity and Triangulation

The Reliability, Validation and Triangulation were addressed within the research set against the landscape of the mixed methodology approach. The use of Reliability allowed the replication of the research process to be assessed while Validation demonstrate the instruments measure what they purports to measure and Triangulation demonstrates concurrent validation particularly in qualitative research (Cohen, 2000; Campbell & Fiske, 1959).

3.7.1.1 Reliability

Reliability, as stated by Guildford (1950), is the application of an instrument to a specific population allowing the same measurement to be obtained from individuals under different conditions to produce similar results. Survey research can go some way towards presenting the participant with standard stimulus eliminating unreliable observations (Babbie, 1992, p. 279). Internal consistency is the key to reliability with the degree to which instrument items reflect the same underlying constructs (Cooper & Schindler, 1998, p. 171).

Quantitative research reliability addresses how accurately the research methods and techniques produce data (Fink, 1995). By contrast, in qualitative research there needs to be established procedures to allow quality of work to be assessed (Wimmer, & Dominick, 2006). There has been some debate over the past years on how qualitative research can demonstrates validity and overcome bias by incorporating rigour, subjectivity and creativity (Johnson, 1999). As Slevin and Sines (2000) suggest accuracy and repeatability increase rigour and relevance. Nevertheless Rigour is also referred to a as an empirical analytical term which cannot fit the grounded approach (Smith, 1993; Denzin & Lincoln, 2000).

Lincoln and Guba (1985) refer to qualitative work having trustworthiness, which is established when the findings closely reflects the meaning. Trustworthiness does not occur naturally but rather comes from rigorous scholarship (Padgett, 1998). For the management of trustworthiness a variety of strategies need to be implemented to

maintain authentication of the participants input and include prolonged engagement, peer debriefing, triangulation, member checking, audit trail and reflexivity (Litez et al., 2006). Denzin and Lincoln (2000) suggest qualitative research requires four factors to produce trustworthiness of data and findings namely credibility, transferability, dependability and confirmability.

Reliability was maintained within this research by the implementation of consistency through rigorous application of reproducible processes and procedures. The search parameter for the data content was the same for each of the undergraduate tertiary institutions. This parameter allowed consistency within the data collection and collation process. The use of computer based software with Nvivo and Qualtrics allows for constancy in the data analysis and as such, the produced findings. Peer selection was applied to this study for expert selection and interviews conducted with a consistent environment and predetermined questions in order to remove bias and provide a consistent process.

3.7.1.2 Validity

Content validity refers to the instruments used within the research measuring what it is supposed to measure and comprehensively covers the research domain (Cohen, 2000; Babbie, 1992). Construct validity refers to the representativeness of the content of the instrument used in the study and the degree to which the measure covers the range of meanings including concepts and calls for the continued accumulation of information from various sources (Babbie, 1992, p. 133). While Cooper and Schindler (1998) refer to content validity as being the adequacy of the data content and it being representative of the items under consideration. The validation of the instruments used within the research such as the Multi Dimensional Scaling survey was assessed through the Pilot Study and face validity and convergence, with face validity assessed by expert judgment.

Validity within this study was established by undertaking a number of steps. A quiet and private room for the interviews was used along with a structured interview schedule to produce the same format, sequence of words and questions for each interview being conducted. The NVivo computer software was used to reduce the bias with coding and recoding of data. Misconceptions by the participants were reduced by

the opportunity being given for the interviewee to clarify questions before providing an answer. Factual errors were reduced by member checking and the facility to allow the respondents to add any relevant information surrounding the topic. Through the use of these steps, validity for the study examining Facility Management knowledge categories and subordinate concepts will be achieved.

3.7.1.3 Triangulation

Triangulation has a number of methodologies (Table 3.3) and described as a cross-validation or verification methodology in qualitative research and not a theoretical approach, which may take a number of forms (Cavana, Delahaye & Sekaran, 2001). Nevertheless, Glesne and Peshkin (1992**)** assert that its use increases confidence in the research findings.

Table 3.3

Triangulation Methodologies

Method	**Description**
Triangulation through data sources	Data collection by various data sources or different times or places
Investigator triangulation	Different investigators using the same research methodology
Theory triangulation	Multiple perspectives and theory to interpret data
Methodological triangulation	Multiple methodologies to examine an issue such as observations, interviews
Interdisciplinary triangulation	Multiple disciplines such as art, sociology, history and psychology
Triangulation via data type	Combined qualitative and quantitative approach

(Adapted from Janesick, 1994; Miles & Huberman, 1994)

The approach chosen for this study was Methodology Triangulation and data type (Figure 3.3) that allowed Facility Management knowledge categorisation to be identified. Multi Dimensional Scaling analysis will be used to examine the accumulated knowledge content identified from tertiary courses, validated through cross correlated with expert analyse. Further cross references with expert opinion analysis in the form of semi-structured interviews was undertaken, completing the

triangulation model.

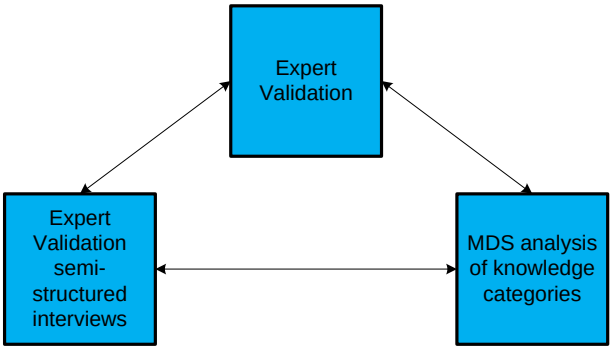


Figure 3.4 Validity cycle
(Adapted from McMillen & Schumacher, 1993)

3.8 Conclusion

This chapter presented the design of the study, research methodology, the research instrument and population used for each phase of the study. In addition the study limitations were also considered. The three distinct phases of the study were discussed through the study design. Justification was provided for population and non-probabilistic sample sizes for each phase of the study.

Phase One considered the data identification and extraction from 21 undergraduate Facility Management courses content Phase Two of the study used the Multi Dimensional Scaling research instrument, which had the Facility Management knowledge concepts and subordinate categories from Phase One paired for similarity by 56 Facility Management experts. Research instrument expert knowledge structure was used to validate the findings of Phase One and Phase Three through the use of semi-structured interviews.

The methodology of the research allowed the use of both quantitative and qualitative research techniques to produce an MDS knowledge construct of Facility Management knowledge categories and produce a spatial representation of the knowledge clustering. The spatial representation then allowed assumptions to be drawn regarding proximity of knowledge categories to each other.

Phase Three of the study presented expert validation of the Phase Two findings by 10 Facility Management experts.

Limitations within the study were considered through the data identification and collection process, content relevance, Facility Management role definition and the expert categorisation discrepancy. Also considered within the research limitations were the nature of non-probability sampling and peer reviewed expert selection and the introduction of judgement error.

The reliability, validity and triangulations process were also considered within the context of the study and the relevance to replication of the research process, relevance of the research instruments and concurrent validation of the research.

CHAPTER 4
PILOT STUDY

4.1 Introduction

The Pilot Study is described within this chapter, along with the assessment of suitability of the methodology of each research phase and the instruments used throughout the study. The Pilot Study was split into three distinct phases each with its own research questions. The outcome of the three phases when combined will allow a response to the Overarching Research Question: *Define the Facility Management knowledge construct and its utilization within the role of Facility Managers?*

Phase One was designed to establish and extract the Facility Management knowledge category and subordinate concepts from three international tertiary institutes, which were then validated by two Facility Management experts. The findings from Phase One were presented for assessment to 11 Facility Management Experts as a Psychometric Multi Dimensional Scaling (MDS) Survey instrument. The results from the survey were then embedded within the SPSS software package to provide spatial representation of the Facility Management knowledge categories (Phase Two). The MDS spatial map was then examined by a further two Facility Management experts for knowledge validity (Phase Three). The reliability and validity of the Pilot Study, as well as limitations, are then presented along with modifications to the research methodology and instruments for the Primary Study. A summary of main points will conclude the chapter.

4.2 Pilot study: Phase One Knowledge categorisation

Phase One involved the investigation and critique of three international tertiary Facility Management courses to identify the knowledge categories and subordinate concepts in response to Research Question*: Can the Facility Manager's knowledge categories and subordinate concepts be identified and role established within the life cycle of a building context?* Three tertiary courses were selected as a cross section of the overall list of universities that offer an undergraduate course in Facility Management. The tertiary institutions chosen were Ferris State University, USA, Sheffield Hallam University, England and Hanze University Groningen, The Netherlands (Table 4.1). The selection of the courses was made on the basis of

convenience sample with a focus on selecting the courses from as wide a demographic as possible to give a boarder overview.

Table 4.1

Facility Management international tertiary courses

University	Award	Qualification
Farris State University	BSc (Engineering Technology)	Bachelor Degree
Sheffield Hallam University	BA (Sheffield Business School)	Bachelor Art (Honours)
Hanze University Groningen	BBA (University of Applied Science, School of Facility Management)	Bachelor Business Administration International Facility Management

The Facility Management undergraduate course content from each institute was identified and the knowledge categories and concepts extracted through linguistic analysis (Francis & Pennebaker, 1993). The 1,995 extracted concepts of 679 individual knowledge categories and subordinate concepts extracted were tabulated (Appendix A) and arranged in order of frequency. The 15 most prevalent Facility Management knowledge categories and concepts were then tabulated (Table 4.2) and presented to two Facility Management experts. The experts were then interviewed in order to validate the Facility Management knowledge categories

Table 4.2

Pilot Study: Phase One facility management knowledge categories and subordinate concepts

Word	Frequency	Percentage (%)
Management	69	3.43
Facility	55	2.73
Change	48	2.39
Planning	45	2.24
Development	35	1.74
Service	34	1.69
Business	27	1.34
Organisation	24	1.19
Analysis	23	1.14
Quality	23	1.14
Communication	19	0.94
Skills	17	0.85

Product	16	0.80
Systems	16	0.80
Finance	15	0.75

During the linguistic analysis process several semantics issues were considered to provide consistency. *Plan* was considered in the context of all the tertiary course content overviews, to be the same as *Planning* and *Facilities* was considered the same as *Facility*. There was also consideration made to change the structure of concepts in order to remove the articles of *the* and *an.* This change was due, in part, to the presence of the articles within the word count providing a skewed result of frequency.

The experts involved within this phase of the study (Table 4.3) were selected from a cross section of the Facility Management industry and based on their standing within the Western Australian Facility Management community. Semi-structured interviews were conducted with the Facility Management experts with the proceeding audibly recorded. A series of predetermined questions were given to the expert for review to allow time for reflection prior to the interview being undertaken.

Table 4.3

Pilot Study Phase One: Facility Management practitioner's overview of experience and qualifications

Pseudonyms	**Years Within the Profession**	**Current Position**	**Industry Qualification**
Ray	22 Years	Facility Engineer	BEng Mechanical Services
Alan	16 Years	Hospital Engineer	BEng Electrical Engineering

The 15 Facility Management Knowledge most prevalent categories and subordinate concepts were then presented to the interviewee (Table 4.2) and the questions worked through in the numbered sequence. By having the predetermined questions and a formatted process, it allowed reliability of the interviews to be strengthened by having a repeatability process.

The interview recording was then transcribed (Appendix B) and examined to identify and extracts themes and concepts as they were presented. Both interviewees commented on the absence of the category of Client from the list. Ray suggested that although the phrase client can be distributed through several meanings such as customer or consumer the whole premise of Facility Management is as a business, providing a service to the end-user with a financial driver throughout the process. He went on to state that "as Facility Management practitioners and business our ultimate goal is to make money while providing a service". Alan acknowledged that Finance was an important driver, but went on to state that "the financial aspect of the business should be placed second to the service provided to the end user as without the end-user there is no business".

Ray suggested that "there are always jobs within any industry that require a certain amount of additional expertise. This can be said of any Facility Manager who manages a building or type of facility which is outside the main stream and has a requirement for a unique set of skills". He went on to question whether any undergraduate Facility Management course would equip a practitioner with a skill set to perform the role facility manager adequately. Industry training that is specific to particular needs is as important and an undergraduate degree, in his opinion, to provide a suitable base for development as experience is acquired within the role. This view was acknowledged as a proposition and the concept introduced as a revised question within the MDS survey process, *"Are there any other Facility Management knowledge categories not covered in question one which you feel needs to be included as Facility Management practitioners?"*

Alan agreed that the overall content with regards to the Facility Management knowledge categories and subordinate concepts was comprehensive and would allow the role of Facility Management to be performed to a reasonable level; however, qualified his comment by stating that there would need to be additional training focussing more on the legislative, financial and strategic planning requirement. Ray agreed with the content and added that he saw the category of policies and procedure as being most important to the role of Facility Management; without the policies and correct procedures to perform each role within the function then the process would be fundamentally flawed.

4.3 Pilot study: Phase Two Multi Dimensional Scaling (MDS) knowledge structure

Phase Two developed the MDS knowledge structure survey instrument from Phase One knowledge concepts. The 15 most prevalent Facility Management concepts (Table 4.4) were embedded into MDS survey instrument then presented to 11 Facility Management Experts. The expert's responses were then inserted into Multi Dimensional Scaling (MDS) algorithm to gain an understanding of their interrelationships and relevance in response to Research Question Two: *"What are the knowledge categories and subordinate concepts interaction and interrelationships within the Facility Management domain as measured by Multi Dimensional Scaling?"*

The MDS survey instrument (Appendix C) was distributed to the Facility Management experts electronically by e-mail with a request for the completed survey to be returned either electronically or by mail within three days. The e-mail was followed by a phone call to verify and confirm that the process was clearly articulated and understood. The distribution of the survey instrument electronically allowed contemplation of the requirements as outlined in the introductory letter and providing a reliably repeated and constancy process. At the end of the survey instrument there is prevision for requesting additional comments regarding the process or the content of the instrument.

The main concern from the experts was the length of the instrument, the lack or guidance for its completion and the required outcome of the process. It was stressed that the instrument had been reduced to the minimum possible number of concepts to still achieve the required validity and reliability. Overall positive feedback was given regarding the layout of the instrument and its clarity. The lack of guidance was addressed, though a concern of not influencing the decision making process and completion of the instrument by alluding to the required outcome was noted. It was seen as of the upmost importance to allow the pairing assessment of the Facility Management Knowledge categories and subordinate concepts to be as interpreted solely by the Facility Management Experts, without which reliability and validity of the findings could not be guaranteed.

The findings from the completed survey instrument were then analysed using a Multi Dimensional Scaling (MDS) ALSCAL algorithm with the SPSS Version 6 software to produce an interrelationship spatial map of Facility Management knowledge concepts (Figure 4.1). The MDS ALSCAL stress measure (STRESS1=0.27, RSQ= 4.7) was seen as an appropriate goodness-of-fit, as ≤0.15 represented a moderate representation for two-dimensional spatial map (Cheng, 2004).

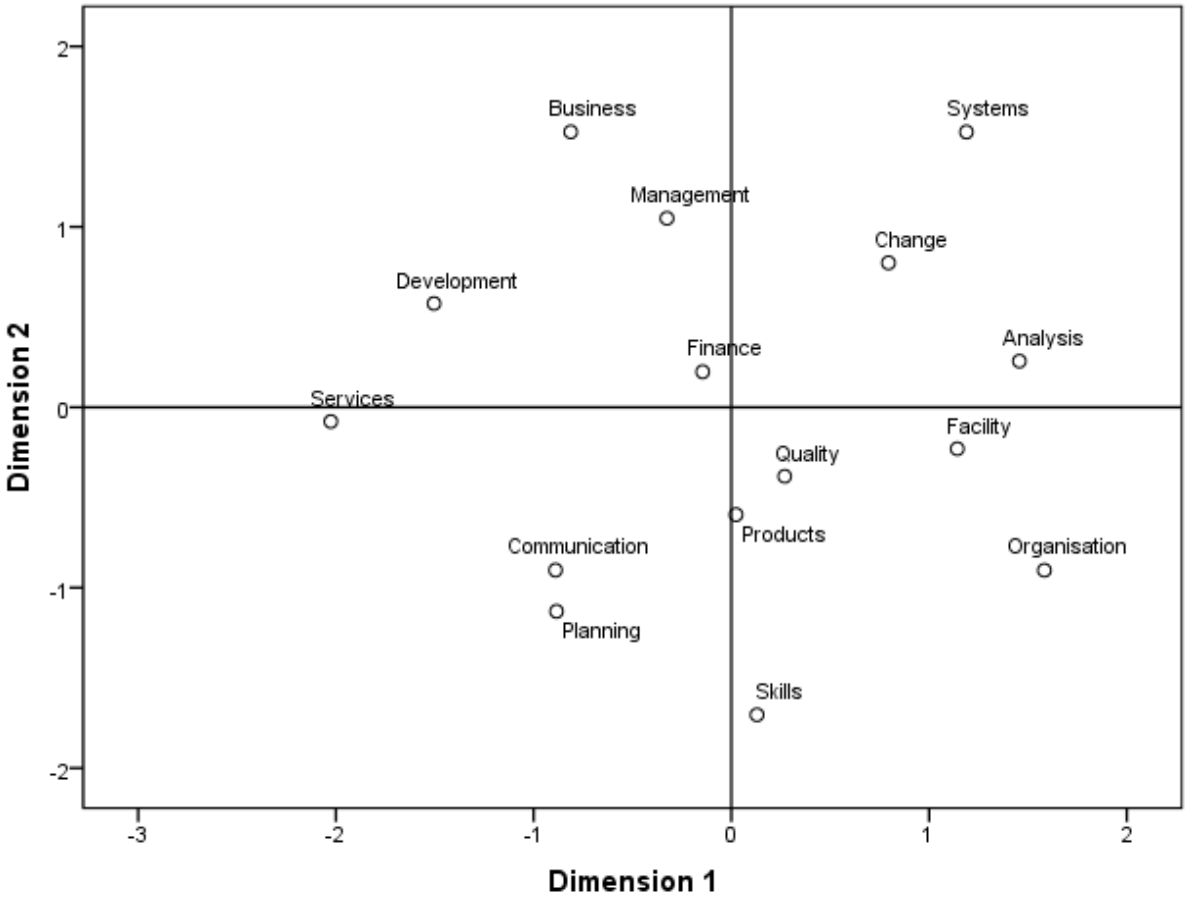


Figure 4.1 Pilot Study: MDS Facility Management knowledge structure

The spatial representation produced by the MDS algorithm allowed the results to be presented as a two-dimensional chart of the Facility Management knowledge categories and subordinate concepts for assessment by the Facility Management experts. The spatial representation allowed assessment of the identified categories, and their relationships and proximities to each other in Phase Three.

4.4 Pilot study: Phase Three Facility Management Expert knowledge validity

Phase Three of the Pilot Study involved the Facility Management knowledge categories and subordinate validation assessment of the MDS Spatial map produced from Phase Two (Figure 4.1) by two Facility Management experts in order to address Research Question Three, *What are the expert knowledge categories and subordinate concepts within the facility management domain as measured by interviews?* Semi-structured interviews were conducted with the Facility Management experts, with the procedure audibly recorded and transcribed. This approach allowed the interview content to be examined for data content and pertinent themes extracted. The Facility Management Experts were selected from a cross section of the industry (Table 4. 4), with their names changed and pseudonyms given to protect their identity.

Table 4.4

Pilot Study Phase Three: Facility Management practitioner's overview of experience and qualifications

Pseudonyms	**Years Within the Profession**	**Current Position**	**Industry Qualification**
Paul	26 Years	Senior Facility Manager	BA Accounting
Sean	19 Years	Major Account Manager	Electrical Trade

The interview process consisted of predetermined questions, asked in a set order based around the spatial relationship outcomes of the MDS Facility Management knowledge structure results (Figure 4.1). Sean commented on the perceived disparity between *Organisation* and *Business*. He felt that organisations are more closely related to business within the MDS spatial chart. He went on to suggest that most organisational requirements mean that there is a close correlation between the business entity, philosophy, values and the organisation needs. Paul did not identify the issue or comment on the apparent disparity.

Paul suggested that *Communication* was a fundamental part of Facility Management and that the relationship with *Management* and *Change* were not clearly represented within the results, stating that "without effective communication one's ability to manage is severely diminished". Effective communication was seen as the key to day to day running of a facility or building. Paul went on to say that occupants have a degree of expectation that they will be able to work in a comfortable well maintained

building without disruption and indeed that was part of the service they pay for. When instances arise or there is an incident which affects the "status quo", it is imperative that clear and concise communication occurs.

Sean commented that he felt that Skills was misplaced and appeared to have no belonging to the others knowledge categories. There are fundamental components of all the knowledge categories that are required by the Facility Management practitioner in order to perform the role correctly. He then questioned whether Skill was indeed a knowledge category or attribute, which is a component of the other knowledge contents such as *Management, Finance* and *Planning* etc. The word Skill is a noun, as are the other Facility Management knowledge content, but is defined within the Oxford English Dictionary (Oxford University Press, 2012) as competence, ability and aptitude. The relevance of Skill within the context of this study appeared to be restricted, which is supported by its proximity to other knowledge categories within the spatial map. The proposed ranking of the produced concepts by the Facility Management experts and the identification of additional knowledge categories and subordinate concepts would increase the validation process and provide expert judgement to be analysed.

4.4.1 Assertions

The analysis of the interview transcripts comprised of a two-stage approach with inductive and deductive analysis (Erickson, 1986). Assertions were able to be generated during the inductive stage of the data analysis. Assertions, as referred to by Vrasidas and McIsaac (1999), are generalised judgements which indicate the interrelationship between data. The data was analysed with several salient points, drawn from the Facility Management expert's comments regarding certain aspects of the individual phases. Once the assertions were generated, the deductive stage was undertaken that involved the detailed examination of the data content in order to support or disprove the assertions.

4.4.2 Assertion 1: Was the data source for the Facility Management and subordinate knowledge concepts representative of the industry?

The source and validity of the knowledge concepts was raised by Sean, asking if the source of the data presented for Phase One objective enough for the study or had the content of the undergraduate courses been driven by the industry perception of the Facility Management core concepts? He suggested that in his experience the market drivers are what influence the market and this directs the offering of universities. Paul stated he was comfortable with the data source as they were taken from different countries and therefore the influence applied from the Facility Management industry would not be seen as consistent or substantial. In addition he was also aware that universities are businesses and as such, need to provide what the market requires so will have influences that are specific to the market it targets and therefore are inextricable. It was explained that the three international tertiary undergraduate courses in Facility Management were selected based on the strength of the Facility Management related concepts found within the title of the course.

The selection process was further support with the universities being selected from the European Facility Management Education Guide 2009 (EuroFM, 2009) and the North American Facility Management Degree Guide 2009 (IFM Foundation, 2009). The methodology provided substance to the claim that methodology would support a response to Research Question One: *Can the Facility Manager's knowledge categories and subordinate concepts be identified and role established within the life cycle of a building context?*

4.4.3 Assertion 2: Are 15 Facility Management Knowledge concepts sufficiently representative of the role of the Facility Management practitioner?

Paul questioned the total number of concepts that were extracted from the undergraduate course contents of the three targeted universities and suggested that the concept list may not be sufficiently broad enough to catch all pertinent categories. Some concepts are of the utmost importance, but may only be referred to infrequently such as Procedures and Legislation. Sean stated that consideration should be given that practitioners decide what concepts are to be more prevalent than others, but warned that this could be skewed, dependent upon the background of the participant

and the role the participant was performing at the time the assessment was made.

The selection of peer reviewed experts chosen from a combination of practitioners and academics was felt, by Sean, to be sufficient in allowing a comprehensive overview of the knowledge categories from within the industry. Sean acknowledged that "each person brings to the table different skill based on their background and qualification, but the basic premise of Facility Management knowledge concepts should be within reason consistent as all concepts are used or taught".

Assertion 2, raised concerns regarding the 15 Facility Management knowledge concepts being appropriate to encapsulate the diverse role of Facility Management and whether the 15 knowledge categories and subordinate concepts would provide a reliable and robust enough overview in response to Research Question Two: *What are the knowledge categories and subordinate concepts interaction and interrelationships within the Facility Management domain as measured by Multi Dimensional Scaling?* The detailed deductive assessment of the interview transcripts for Phase Three identifies areas of concern, raised by Sean and Paul, regarding the number Facility Management knowledge categories presented as being too restrictive and the fact that they were chosen purely through frequency count. No consideration had been made for the less frequent, but equally as vital, Facility Management knowledge categories missed from the list of 15. The list of 15 concepts was assessed against the eleven knowledge categories used by the International Facilities Management Association (IFMA) as eleven core competencies (see table 4.5).

The assessment identified *Communication, Management, Business, Quality, Services, Planning*, and *Finance* as having the same meaning or a strong correlation to the IFMA competencies. The additional IFMA's competencies such as *Real Estate* and *Property Management* was considered by Paul to sit well with *Facilities* while *Services* and *Products* would encompass *Technical* and *Systems*, *Change* and *Analysis* categories would be incorporated in the core competencies of *Emergency Preparedness* and *Business Continuity* and *Environmental Stewardship* and *Sustainability*. The overlay of the undergraduate tertiary Facility Management knowledge categories and IFMA's core competencies produced a close correlation.

Table 4.5

IFMA's Facility Management knowledge core competencies

Communication
Emergency Preparedness and Business Continuity
Environmental Stewardship and Sustainability
Finance and Business
Human Factors
Leadership and Strategy
Operations and Maintenance
Project Management
Quality
Real Estate and Property Management
Technology

(Pavick, 2010)

4.4.4 Assertion 3: Does Finance represent a central concept within the role of the Facility Management practitioner?

The positioning of *Finance* within the MDS special map provided an insight into the centralised nature of the knowledge category. Paul commented on the central theme of the map being *Finance* and agreed with its pivotal nature to providing effective Facility Management and suggests that the nature of Facility Management as a business entity meant that more and more focus was levelled at finance as one of the largest business drivers for the profession. He went on to say that the open tender market and the drive to win volume contracts at low margins have driven the market profitability down as contracts are being won at pricing levels which are unprecedented. Sean supported this view and referred to the central location of the *Finance* as a good barometer of how the market thinks and what the priorities are seen as by the Facility Management practitioners.

Support of the assertion that *Finance* is a central theme to Facility Management practitioner is prevalence shown by it within Facility Management Literature. Teicholz (2001, p. 46) asserts that "financial analysis and management is a key skill set for all Facility Managers to have and is important for Facility Managers to push facility services and projects to the forefront of their organisations agendas by using accepted financial practises".

4.4.5 Assertion conclusion

Although there were questions raised regarding the source of the base data, it was considered that the selection process used for each of the tertiary institutions provided suitable reliability and validity of the content, while maintaining objectivity and protection from potential external influences resulting in the selection process being maintained without change. There were also concerns that the 15 Facility Management knowledge categories and subordinate concepts did not fully represent the Facility Management industry from a practitioner's stance. There needed to be consideration made for the less common concepts, which were of considerable importance within the Facility Management domain such as the legislation. Such concepts are seen as pivotal to the role; however, appear to have restricted reference in the reviewed course content.

The overall option of the instruments used and the way each phase was reviewed by the Facility Management experts were found to be sound with some small changes recommended for consideration within the full study. The MDS survey instrument, although of concern to both Facility Management experts, was agreed to be of suitable length and appropriate layout to achieve the required goal of providing spatial representation of the Facility Management knowledge categories and subordinate concepts.

4.5 Pilot Study: Reliability and validity

The research methodology and instruments were measured for reliability and validity. These measures allowed any weaknesses to be identified and altered before commencement of the Main Study. Phase One used face validity of the Facility Management experts to validate the Facility Management knowledge categories and subordinate concepts. The reliability of the extracted knowledge content was established by the experts reviewing the Facility Management knowledge categories for appropriateness and relevance. Of the undergraduate courses selected for the Pilot Study, only one of the courses was validated by the IFMA. The International Facility Management Association (IFMA) Foundation applies an accreditation process to Facility Management higher education courses, which are assessed against the IFMA core competencies. There are currently seven North American and six global institutions which have received the foundations accreditation (IFMA Foundation,

2009). Such diversity was considered an item of the utmost importance that the market sample should be as broad as possible and free from influence of any one entity. The selection process undertaken in this manner gave additional independent validation.

The selection of 15 knowledge categories and subordinate concepts within Phase One and used within Phase Two MDS survey instrument was seen as being an appropriate number for MDS analysis. The sample size within the study was seen as appropriate, as selection could be performed on a work-up rather than work-down approach, which when combined with non-probability nature of the Facility Management expert removed the need to define the sample size based solely on population (Borg & Gall, 1979). By maintaining the 15 knowledge categories being assessed it allowed the completion of the survey instrument to be timelier and less onerous on the participant. Although a minimum sampling size of 30 is recommended for MDS analysis (Cohen, Manion & Morrison, 2002), the sample size was maintained. Any increases in sample size may increase the possibility of bias being introduced with the increased non-probability sampling (Kalton, 1983). The sample size was further strengthened, as according to Borg and Groenen (1979) the number of objects to be scaled needs to be four times the number of dimension. Therefore, a two-dimensional representation requires at least eight objects.

The MDS Facility Management knowledge spatial representation (Figure 4.1) produced a goodness-to-fit of slightly above moderate stress value (STRESS1 = 0.27), as ≤ 0.15 is referred to by Cheng (2004) as appropriate goodness-of-fit for two-dimensional special map. This result supports the Facility Management expert validation that the knowledge concepts were appropriate.

The validity of Phase Three was accessed through Face validity, being expert judgement. Pre-constructed response coding was used to maintain consistency and reliability, and assessable using expert judgement. Increased reliability of the interview process was achieved by reducing bias introducing several repeatable steps. The interviews were conducted in quiet and private room that allowed balanced and objective responses of the interview questions. An interview schedule was used to

provide a structured repeatable approach reducing bias within the interview phase (Oppenheim, 1992).

4.6 Study interpretations

The Pilot Study was designed to test the suitability of the research methodology and the instruments used within each study phase. The interpretation of the findings from each phases allowed changes to be implemented for the Main Study. Phase One presented a concern by the Facility Management experts that the use of 15 categories for validation was not large enough. By increasing the quantity of categories a stronger response to Research Question One could be made. Phase Two results identified a need to expedite the Multi Dimensional Scaling survey process by electronic sending the survey. Also identified was the need to increase participation by the recipient by explaining the process and personalising correspondence to them. The increase participation would support the response to Research Question Two. Phase Three of the Pilot Study identified a lack of facility to add additional categories thought to be of sufficient importance to merit inclusion for comment. The interpretation of each phase allowed changes to be made to the instruments and methodology utilised within the research.

4.7 Study modifications

The analysis of the finding from the Pilot Study resulted in only minor changes to the Study methodology and instruments. Broadening the number of selected Facility Management knowledge categories and subordinate concepts presented to the Facility Management experts in Phase One to 35 allowed a more representative overview of the knowledge categories and subordinate concepts. There was also an additional section within the predetermined Phase One Interview Questions, requesting the Facility Management experts review and rank the Facility Management knowledge categories and subordinate concepts in order of importance. They were also asked to add any additional knowledge concepts, which they feel should be present but was not captured within the 35 presented concepts. The addition of these steps within the Facility Management knowledge Phase One expert validation process increased the reliability and validation of the Phase by broadening the identification of Phase One knowledge concepts.

Phase Two MDS survey instrument became electronically based, with the instrument sent to the participant by e-mail with a covering introductory and direction letter. The participants were then contacted by phone to ascertain whether any additional information or support was required. This approach allowed the auditing process to be more efficient with the electronic collection and analysis of the data increasing reliability.

Phase Three had a predetermined list of questions as well and the Facility Management Survey instrument representation map sent in an electronic format by e-mail. This approach allowed international Facility Management experts who are not within Australia and as such, are precluded from a Face to Face, semi-structured interview. It was important that the interview be conducted verbally rather than as a questionnaire, as it added to the input by the participant and allowed additional concepts to be extracted that may not be present as an audit. The distribution of the Phase Three information was followed by a phone call when the interview aspect can be undertaken. The benefit of forward dissemination of the map and questionnaire allowed contemplation by the participant, strengthening their input and adding greater depth to the research.

4.8 Pilot Study limitations

The limitations of the Pilot Study were considered for each of the Phases. Phase One examined the undergraduate tertiary Facility Management course content of three tertiary institutes. This sample, although small, allowed the methodology and instrument selected for the research to be examined for suitability. Phase Two population sample of 11 Facility Management experts and through the use of non-probability sampling, removed the need to define the sample size based solely on a boarder population (Brooks, 2008). Although a sample size of 30 was considered to be the minimum sampling size for MDS analysis (Cheng, 2004), the selected sample size of 15 was appropriate as an increase non-probability sampling can increase in possible sample bias (Kalton, 1983).

Multi-dimensional scaling techniques can be attribute based or non-attribute based (Kaczynski, 2003). The non-attribute scaling techniques, where participants are asked to assess similarities or dissimilarities were used within this study. Attribute based

assessments involve the assessment of specific attributes of assessed items for comparison. Lovelock (1996) describes how the halo effect may work positively or negatively during the use of attribute assessments by causing perceptions on one attribute to reflect poorly or badly on another attribute.

Bias considers factors which alter the results of the study and can lead to incorrect conclusions being drawn affecting the accuracy and interpretation of data. Interviewers are the primary sources of bias through the content of questions being misleading or personal opinions clouding the content of the question or interview process (Macnee, 2004). This aspect was highlighted as an issue to pay particular attention to when Alan stated,

> "Hospital Facility Management is a far more complex proposition than building management, there are a plethora of services and knowledge requirements from providing technical and consultative support to both clinical and administrative functions as well as performing contracts management, asset and services management and waste management, which often is hazardous in nature and has completely separate environmental management and legislative requirements".

The major disadvantage of the attribute based approach is that interpretation of the dimensions does not have attributes as a guide; the assessment is based purely around the expertise of the participant and as such strengthens the call for selection of Facility Management experts to be rigorously undertaken. Such selection will avoid attributes being missed calling for dimensions to be inferred intuitively or obtained from external sources (Batra, Myers & Aaker, 1996).

4.9 Conclusion

The chapter examined the Pilot Study process and the instruments and methodology used throughout the three phases. Each of the three phases within the research method was considered to ascertain the suitability of the instruments and process proposed for each phase. The findings were examined and improvements made as identified. The Phase One changes recommended through the Facility Management expert participants were to use a larger sample base of 35 Facility Management knowledge

categories and subordinate concepts. In addition, introduce a section for the ranking of the concepts by Facility Management expert. The predetermined interview questions will have an additional question regarding any concepts that are considered to be relevant as a Facility management practitioner, but not on the provided listings. The Phase One of the Pilot Study was found to provide the appropriate level of robustness to respond to Research Question One, *Can the Facility Manager's knowledge categories and subordinate concepts be identified and role established within the life cycle of a building context?*

After the Pilot Study phase of the research was considered appropriate that the MDS survey instrument for Phase Two was distributed to the Facility Management experts electronically with a covering introductory requesting the completion of the survey and return within three days. The distribution of the survey instrument was followed by a phone call to verify and confirm that the process was clearly articulated and understood. The introduction of an electronic on-line Multi Dimensional Scaling survey instrument for Phase Two, along with a direction letter and phone call, will expedite the data collection process and provide greater levels of efficiency, reliability and validation. The survey instrument electronic distribution allowed contemplation of the requirements as outlined in the introductory letter and providing a reliably repeated and constancy process. At the end of the survey instrument there is prevision requesting additional comment regarding the process or the content of the instrument. These changes allowed a response to Research Question Two: *What are the knowledge categories and subordinate concepts interaction and interrelationships within the Facility Management domain as measured by Multi Dimensional Scaling?*

Phase Three of the Pilot Study has adopted a slight change in the dissemination of the Facility Management spatial map and predetermined interview questions. In the Main Study these were sent to the participants on line and electronically to incorporate participants who were not based within Australia and who were precluded from participating. The implementation of stringent and repeatable interview processes for Phase Three and introduction of predetermined questions allowed additional concepts, which were seen by the Facility Management experts as relevant, but did not appear on the lists, added greater depth to the research strengthening the response to Research Question Three: *Can the Facility Manager's knowledge categories and*

subordinate concepts be identified and role established within the life cycle of a building context? The Pilot Study affirmed the reliability, validity and suitability for the research methodology and instruments used within the primary study after the identified modifications.

CHAPTER 5
PHASE ONE: FACILITY MANAGEMENT KNOWLEDGE CATEGORISATION

5.1 Introduction

The aim of Phase One was to develop a Facility Management knowledge categorisation, which allowed Research Question, one to be addressed: *Can the Facility Manager's knowledge categories and subordinate concepts be identified and role established within the life cycle of a building context?* The initial step (5.2) was to identify international undergraduate Facility Management related courses. Identification of the course content was undertaken through the unit title, course overview and syllabi. The Facility Management concept extraction (5.3) was undertaken to establish and tabulate a *Master List* for use within the study. Facility Management expert validation (5.4) of the Facility Management concept *Master List* was then undertaken, allowing correlation of the list and the expert survey. Data were further correlated to establish validity and reliability of the data content and culminated in the creation of a *Primary List* to be embedded into Multi-Dimensional Scaling survey instrument in Phase Two of the research. The outcomes of the phase will be considered in the chapter's conclusion.

5.2 International undergraduate tertiary Facility Management courses critique

A critique was undertaken for this stage of the research to identify international undergraduate tertiary Facility Management courses. The initial selection was made through examination of the course title, which was then further examined for specific content. The selection process was further supported with identification of universities from the European Facility Management Education Guide 2009 (EuroFM, 2009) and the North American Facility Management Degree Guide 2009 (IFM Foundation, 2009), as well as the use of the world-wide-web (www).

There were a total of 21 undergraduate (Appendix D) Facility Management courses identified for incorporation within the study. Phase One of the study used 18 courses, while three were used within the initial Pilot Study Phase (Chapter 4).

5.2.1 North American Facility Management Undergraduate course Selection

The North American Facility Management Degree Guide 2009 identified a total of 21 tertiary institutions across the United States and Canada (IFM Foundation, 2009), which offered Facility Management related courses. Of the 21 institution, 12 offered fulltime Facility Management Bachelor or Associate Degrees courses. The study used 10 of the 12 institutions for the extraction of data within Phase One, while one institution was previously used within the Pilot Study (see Chapter 4). The remaining institution was excluded from the research as the information available from their web site was sparse. In addition the institutions were contacted via e-mail and phone, but were not forthcoming with any substantive information regarding their course content.

5.2.2 European Facility Management Undergraduate course Selection

The European Facility Management Education Guide 2009 was also used to identify institutions that offered Facility Management related programs. There were a total of 20 institutions identified (Table 5.1) as offering Facility Management undergraduate Bachelor programs, with nine institutions offering English speaking programs. Two of the institutions were selected for the Pilot Study with six used within the Main Study.

Table 5.1

European undergraduate and full English speaking Facility Management program

Number of Undergraduate Courses	Country	Fully English Speaking Courses
8	The Netherlands	3
1	Switzerland	0
1	Norway	0
3	Germany	0
1	Belgium	0
3	United Kingdom	3
2	Finland	2
1	Austria	1

The total quantity of Facility Management undergraduate courses identified from both the North American Facility Management Degree Guide 2009 and the European Facility Management Education Guide 2009 for use within Phase One the study was 16 institutions. Additionally two undergraduate Facility Management courses were identified through use of the world-wide-web (www) with the search criteria of

Facility Management, Real Estate, Property Management and Building Management undergraduate courses from the USA and Malaysia.

The final lists of 18 Facility Management undergraduate courses were selected for Phase One of the main study from a selection of countries (Table 5.2). The broad data base provided a global demographic representation of the international tertiary undergraduate degrees offering Facility Management and removed the possibility of influence by outside sources. Of the total 18 selected degree programs, ten were accredited by the International Facility Management Association (IFMA) suggesting that the assessment process conducted by the IFMA was not considered appropriate by all institutions or that the content of the course offered by the institutions fell outside the 11 Facility Management core knowledge competencies of the IFMA.

Table 5.2

Origins of tertiary undergraduate Facility Management courses

Country	**Number of Institutions**	**Number IFMA Accredited Institutes**
United Kingdom	1	1
United States	11	4
Finland	2	2
The Netherlands	2	2
Malaysia	1	
Austria	1	1

5.3 Undergraduate Facility Management concept extraction

The list of 18 institutions identified for use within Phase One had their course content extracted from the institutions web sites to identify the Facility Management undergraduate courses and knowledge content. The initial course content was identified through assessment of the courses title and overview, as well as the syllabi. The course literature from each institution was reviewed and had all their Facility Management knowledge categories extracted to refine the content. A basic course content analysis was undertaken through a Linguistic Inquiry and Word Count (LIWC) to establish the Facility Management knowledge category frequencies (Pennebaker, Francis & Booth, 2001).

Francis and Pennebaker (1993) developed and validated a computer-based text analysis program as a practical method for studying the emotional and structural

components present in an individual's language. LIWC analyses written text files to contrast against dictionary matches on a word by word basis by calculating the percentage of words in the text that match (Pennebaker & Francis, 1999). A full linguistic analysis was considered inappropriate for this study; rather a word frequency count was utilized to allow tabulation based on frequency of content within the literature analyses.

Within the Pilot Study phase, several semantics issues were identified and addressed such as removal of articles such as *the* and *an*. These issues were avoided through the Facility Management knowledge categories list of the main study being sanitised through removal of non-knowledge categories such as nouns prior to the commencement of the knowledge category extraction, providing consistency and preventing skewed frequency of results.

The Facility Management undergraduate course content from each institute was identified and tabulated before amalgamation of all concepts from the source data into a *Main Study Data List* (Appendix E). There were 2586 individual knowledge categories and subordinate concepts extracted which was higher than the 1995 within the Pilot Study (see Chapter 4). The categories were arranged in alphabetical order and word frequency count undertaken. The 33 most prevalent Facility Management knowledge categories and concepts were then tabulated (Table 5.3) in order of frequency and referred to as the *Master List.* Management was the most prevalent category with a frequency of 140, followed by Building and Facility with frequencies of 98 and 96 respectively. The 33 most prevalent Facility Management knowledge categories accounted for 1258 (48.6%) of the total Facility Management knowledge concepts extracted from the international undergraduate Facility Management tertiary courses.

Table 5.3

Phase One Master List of Facility Management knowledge categories and concepts

Categories	Frequency	%	Categories	Frequency	%
Management	140	5.41	Quality	21	0.81
Building	98	3.79	Maintenance	20	0.77
Facility	96	3.71	Accounting	18	0.70
Systems	94	3.63	Energy	18	0.70
Real Estate	86	3.33	Interior	18	0.70
Construction	81	3.13	Social	17	0.66
Design	66	2.55	Fire	16	0.62
Project	55	2.13	Operation	16	0.62
Planning	53	2.05	Information	15	0.58
Environment	47	1.82	Architecture	15	0.58
Business	31	1.20	Property	15	0.58
Computer	31	1.20	Human	14	0.54
Air-conditioning	31	1.20	Development	13	0.50
Codes	30	1.16	Scheduling	12	0.46
Material	23	0.89	Structural	12	0.46
Analysis	22	0.85	Cost	12	0.46
Law	22	0.85			

A cut off point of 33 concepts was selected, having considered the percentage frequency of the knowledge categories from *Cost* onwards, despite the recommendations of the Pilot Study (Chapter 4) to expand the knowledge categories to 35. On examination of the *Main Study Data List* it was found that there was very limited reduction in the frequency percentage from the 34th Facility Management knowledge category *Drafting* (0.43%) through to the 99th concept *Institute* (0.19%), produced a reduction of 0.24% over 65 concepts. This approach allowed a reliable assessment to be made regarding the cut of point at 33 concepts, as it was considered that the frequency percentage of the removed concepts would have no substantial bearing on the research findings due to the consistently low percentage values involved.

5.4 Expert validation

In order to remove any undue influence upon the assessment process, the Facility

Management knowledge categories were retabulated in alphabetical order. This removed any indication as to the most prevalent categories prior to the survey being forwarding to the Facility Management experts. The 33 tabulated Facility Management knowledge categories were then inserted within Qualtrics survey instrument software. The Phase One survey was e-mailed to the Facility Management experts with an introductory outline of the research aims and objectives. In the interest of obtaining a breadth of feedback from the Facility Management experts, the survey instrument had two additional questions in-line with the finding from the Pilot Study (Chapter 4) phase.

These additional questions would allow greater discourse in an attempt to catch all pertinent categories not included within the knowledge categories and increase the validation and reliability of the process. The additional survey questions were:

1. Are there any other Facility Management knowledge categories not covered in Survey Question 1, which you feel needs to be included for Facility Management Practitioners?
2. Is there anything you would like to add that you feel may assist with this survey?

The Phase One Facility Management knowledge categories survey instrument (Table 5.4) was forwarded to 10 Facility Management experts, with a request to review the Facility Management knowledge categories and assign a value of importance to each of the categories.

Table 5.4

Example Facility Management knowledge survey instrument

	Not at all important	Very unimportant	Somewhat unimportant	Neither important or unimportant	Somewhat important	Very important	Extremely important
Accounting							
Air-conditioning							
Analysis							
Architecture							

This process allowed validation of the findings from the extracted International Undergraduate Facility Management knowledge categories, while reviewing the tabulated list. The Facility Management experts identified to review the list for appropriateness were selected based on the study's definition of expertise (Chapter 3). Experts comprised of four academics with industry experience in Facility Management and six Facility Management practitioners. Each expert was individually contacted by phone during which time a brief discussion of the survey and its findings were undertaken with reiteration of the additional two survey questions.

Of the 10 Facility Management experts forwarded the survey instrument, only seven agreed to respond and complete the survey. The non-probability nature of the Facility Management expert removed the need for the sample size based to be defined solely on population (Borg & Gall, 1979) inasmuch as the experts were not representative of the wider community. This approach allowed the population sample of seven to be acceptable for validation purposes.

On completion of the survey instrument, the Facility Management experts were advised that the survey software automatically submits the survey to the Edith Cowan University (ECU) research resource site. The Qualtrics survey software tabulated the results of the survey, allowing them to be presented in descending order according to the Mean value (Table 5.5).

Table 5.5

Phase One Expert Survey results

Categories	**Mean**	**SD**	**Categories**	**Mean**	**SD**
Facility	6.71	0.49	Analysis	5.43	1.13
Management	6.57	0.53	Systems	5.43	0.98
Cost	6.57	0.53	Air-conditioning	5.29	0.49
Business	6.29	0.76	Real Estate	5.29	1.38
Environment	6.29	0.76	Law	5.14	0.90
Human	6.29	0.76	Interior	5.14	1.07
Operations	6.00	0.58	Information	5.14	1.35
Fire	6.00	0.83	Social	5.14	1.68
Planning	6.00	0.83	Construction	5.14	1.77

Quality	6.00	0.83	Design	5.00	0.58
Property	6.00	1.15	Development	5.00	0.82
Accounting	5.86	0.38	Architecture	4.71	1.25
Maintenance	5.86	0.69	Structural	4.71	1.70
Energy	5.86	0.38	Materials	4.57	1.62
Codes	5.86	1.07	Computer	4.43	2.07
Building	5.71	0.76	Scheduling	4.43	1.27
Project	5.57	1.27			

On completion of the survey instrument all participants comments for survey questions 1 and 2 were collated for analysis. The response to question 1, which asked if there were any additional categories not included within the survey, included: *continuity management, risk management, green rating* and *philosophy, efficiency, sustainability, security, emergency preparedness* and *business continuity and communication,* as a fundamental component to project and management work.

After submission of their survey, each expert participant was contacted by phone and asked their opinion on the additional categories supplied for question 1. There was overall consensus that the majority of the additional concepts had a place within the overarching knowledge categories for Facility Management practitioners. Furthermore their importance is determined upon the type of facility managed and the business drivers applied to the practitioners Facility Management model.

A comment made by an expert was that the drive for profitability is acting as an artificial driver for the Green/Sustainability industry. The reduction in usage and waste by its nature increases profit, water charges are reduced through the use of gray water and power consumption is reduced through smart lighting and reduction in heating and cooling costs. The question was asked “wasn’t the set up cost to install the sustainable systems higher than the cost savings made”. This factor was agreed with, but was identified as coming not within the Facility Management sphere but the construction phase of the building and so would be factored into the construction cost. If the works were as a refurbishment the cost would fall into Facility Management responsibilities with the project needing a total cost analysis examination and feasibility study.

Sustainability is defined by ecological, economic and social impact of "embodied energy" measured as the amount of energy consumed, from the extraction of the raw material to the manufacturing process required to produce a building (Gonzalez, 2006). While according to the World Commission on Environment and Development (WCED), sustainability is the meeting of today's needs without impacting on future generation's ability to meet their own needs. That means that the main concept of sustainability is to design buildings with long service life, low operating and maintenance costs and high energy efficiency (Bob, Dencsak & Bob, 2009).

The *Phase One Expert Survey results* placed Cost and Accounting in positions 3 and 12 respectively. While the the *Master list* placed Accounting 21 and Cost 33 indicating that the frequency of the categories within the extracted content was lower than the relevance of the categories as assessed by the Facility Management experts.

For survey question 2, no further information was provided from the Facility Management experts. This result was considered positive feedback for the survey as there appeared to be no further contribution considered appropriate by the Facility Management experts.

5.5 Master list and expert survey tabulation

After tabulation of both the Facility Management knowledge categories extracted from tertiary undergraduate course content (Table 5.3) and the results of the Facility Management expert survey (Table 5.5), it was possible to cross correlate the tabulated results in order to identify the commonality of categories. The top 21 Facility Management knowledge categories from each table were extracted and compared (Table 5.6). The selection of 21 as the cut off for the Facility Management knowledge categories expert survey was made after analysis of the Mean value for each category, which fell by 1.42 between 1, *Facility* (6.71) and 21 *Air-conditioning* (5.29). From 22, *Law* (5.14) through to 33 *Scheduling* (4.43), there was little variance of the Mean (0.7). By maintaining a broad knowledge category base of 21, it allowed a more detailed analysis and comparison of the original *Master List* and the Facility Management expert validation to be undertaken.

Table 5.6

Facility Management knowledge categories frequency count and expert survey comparison

Master List (Table 5.3)	Expert Survey (Table 5.5)
Facility	Facility
Management	Management
Accounting	Accounting
Business	Business
Environment	Environment
Project	Project
Planning	Planning
Real Estate	Real Estate
Systems	Systems
Maintenance	Maintenance
Building	Building
Analysis	Analysis
Air-conditioning	Air-conditioning
Codes	Codes
Quality	Quality
Energy	Energy
Material	Interior
Law	Fire
Construction	Human
Computer	Property
Design	Operations

The cross correlation established that from the Facility Management knowledge categories frequency count and Facility Management expert survey, 16 out of the 21 categories were common to both lists that equated to 76% of the knowledge categories. The categories which did not appear on both lists were: *Construction, Design, Computer, Materials* and *Law* from the *Master List* and from the *Expert Survey List*: *Cost, Human, Fire, Property and Operations*.

5.6 Master list and survey instrument Reliability and Validation

Within the research methodology, the use of triangulation (see Chapter 3) was identified as an appropriate validation tool for this research as it allowed the use of multiple methodologies to examine such issues as observations and interviews (Miles & Huberman, 1994). Morse (1991, p. 121) refers to triangulation as having a central core attempting to identify whether the theory that drives the research is developed *inductively* or *deductively* as in quantitative inquiry. As the inductive process is commenced without a hypothesis and is based around observation alone, the use of triangulation as an additional validation methodology was seen as appropriate for this research. In order to achieve a robust triangulation model the previous findings from the Facility Management undergraduate frequency count (Table 5.3) and the Facility Management expert survey (Table 5.4) were cross correlated against the Facility Management knowledge categories and subordinate concepts identified within the Pilot study (Table 4.2). The resulting correlation allowed triangulation analysis to be undertaken (Table 5.7) where categories where aligned to demonstrate similarities.

Table 5.7

Methodological Triangulation of Main Study frequency count, expert survey and Pilot Study

Master List Table 5.3	**Expert Survey Table 5.4**	**Pilot Study Table 4.2**
Facility	Facility	Facility
Management	Management	Management
Accounting	Accounting	Finance
Business	Business	Business
Environment	Environment	Environment
Project	Project	Development
Planning	Planning	Planning
Real Estate	Real Estate	Organisation
Systems	Systems	Systems
Maintenance	Maintenance	Service
Building	Building	Skills
Analysis	Analysis	Communication
Air-conditioning	Air-conditioning	Analysis
Codes	Codes	Product

Quality	Quality	Quality
Energy	Energy	Interior
Material	Fire	Processing
Law	Human	Change
Construction	Property	Research
Computer	Operations	Customer
Design		Marketing

Of the 15 Facility Management knowledge categories utilised within the Pilot Study (Table 4.2, see Chapter 4) an additional six Facility Management knowledge categorises were added from the tabulated results (Table 5.7) to provide parity across all tables. This approach allowed the triangulation to be completed by the assessment of three tables, each with the same quantity of assessed categorises. With cross correlated *facility, management, accounting, business, environment, systems, planning, analysis* and *quality* appeared on all three lists. The cross correlation provided commonality of nine Facility Management knowledge categorises from the 21 (43%) appearing on all three lists, *Finance* was accepted as an overarching knowledge category for *accounting*.

5.7 Facility Management knowledge categorise list consolidation

From the assessment made by the Facility Management experts it was possible to remove several of the knowledge categories. The categories removed were not present on both lists, defining a consolidated *Primary List* for progression onto later phases of the research. The removal of the knowledge categories from the *Expert Survey List* was made after assessment by the experts of their ranked position and the standard deviation (SD) value of the knowledge categories (Table 5.8). The higher the standard deviation value the greater the lack of consensus by the experts. A context approach was also used to assess and remove concepts that had a significantly low ranking ($\geq$ 21).

Table 5.8

Knowledge category expert ranking and standard deviation value.

Knowledge Category	Expert Ranking	Standard Deviation
Construction	26	1.77
Design	27	0.58
Development	28	0.82
Architecture	29	1.25
Structural	30	1.70
Materials	31	1.62
Computer	32	2.07
Scheduling	33	1.27

The Facility Management knowledge category of *Accounting* was considered in the context of Facility Management. Langston and Lauge-Kristensen (2002) suggest that Facility Management is about improving quality, reducing cost and minimising risk; with financial management being a core role of the Facility Manager. Klammt (2001, p. 5.1) argues that a Facility Managers overall goal is to take care of the physical assets of the organisation to avoid disruption to ongoing business operations and leverage assets (extend the assets life). Leveraging involves financial management skills focusing on two main areas of project capital evaluation and operating budget.

The Financial Management framework is formed by accounting categories referred to as *Cost Centres* and cover areas such as salaries, space cost, energy cost, information technology cost and maintenance cost. The types of cost centres vary from one organisation to another, with each facility having its own individual drivers and business model (Langston & Lauge-Kristensen, 2002). Consideration was then given to the Facility Management knowledge category *Accounting*, when compared against financial management. The definition of *Accounting* has a broader meaning than *financial management* in that it is referred to by the Australian Accounting Standards Board (Australian Government, 2012), as the identifying and measuring of economic or financial activities of a business or organisation in order to allow informed decisions to be made. This categorization of accounting supports the clustering and renaming of *Accounting* and *Cost* into an overarching category of *Finance*.

Facilities are defined as infrastructure to support business activities and incorporate land, buildings, equipment, security, catering, homes and work environment (Langston & Lauge-Kristensen, 2002, p. 3). This definition leads to the assertion that building and properties are sub-classes of category which falls within the overarching knowledge category of Facilities and allowed categorises to be amalgamated to form a single concept.

Consideration was given to the suitability of the term *Human* within the Facility Management context, by questioning whether it was an underlying philosophy of Facility Management rather than a knowledge category. One of the primary functions of the Facility Management role is to provide a work environment which can affect the health, safety, security, quality of work life and performance of employees (International Facilities Management Association, 2009). This function supports the use of *Human* as an overriding philosophy and not as a knowledge category in that there is a deeper understanding required of occupational health and safety, security systems, office and space management, lighting systems and heating all contributing to the increased comfort of the staff. As a result, the knowledge category of *Human* was considered not to be appropriate for the knowledge categorises list and removed.

The presence of *Fire* as the Facility Management knowledge category was considered implicit to the understanding of fire protection systems within a Facility Management context. Therefore, the concept *Fire Life Safety* more explicitly defined and introduced a knowledge category relevant to the management of facilities. The legislative and prescriptive guidelines to be followed by Facility Managers, such as Building Regulations 1989, Local Government (Miscellaneous Provisions) Act 1960, Fire Brigade Act 1942, and Occupational Safety and Health Act 1991 (see Chapter 2) meant that *Fire Life Safety* was appropriate for inclusion into the *Primary List.*

Operations and *Systems* were both considered not suitable for inclusion within the Facility Management knowledge category and removed. After consideration of the definition provided by The Oxford English Dictionary (2012), which referred to *Operations* as the action of functioning or the fact of being active or in effect; and *Systems* as a set of things working together as parts of a mechanism or an interconnecting network.

Air-conditioning is a system within a building context responsible for humidity and temperature control, commonly referred to as the Heating, Ventilation and Air-conditioning (HVAC) system (Loftness, Hartkpf, Lee, Sharankavaram & Aziz, 2001). The HVAC falls under an overarching concept of Building Services, which according to the Charted Institute of Building Service Engineers (CIBSE) is what makes a building come to life**.** Building Services also encompasses energy supply, heating and ventilating, water, drainage and plumbing, day lighting and artificial lighting, escalators and lifts, communications, telephones and IT networks, security and alarm systems and fire detection and protection (CIBSE, 2012). The use of *Building Services* within the Facility Management knowledge category list provided a more implicit category than the use of *Air-conditioning*.

Analysis appears on both lists, but was considered not to be a knowledge category. It is defined as the process to "examine or study something in detail and to discover more about it" (Oxford English Dictionary, 2012), indicating that *Analysis* is a verb or action undertaken by a person and not a knowledge category.

5.8 Primary List construct

The phase attempted to achieve an outcome which allowed a response to Research Question one: *Can the Facility Manager's knowledge categories and subordinate concepts be identified and role established within the life cycle of a building context?* Through the selection, extraction and review of Facility Management undergraduate tertiary course content by Facility Management expert group for validation and creation of the Primary List.

The modification to the *Expert Survey List* provided Facility Management knowledge categorise theoretical threshold of 14. The 14 Facility Management knowledge categories, referred to as the *Primary List* (Table 5.9) were tabulated in alphabetical order to remove any perception that the list and its order reflected any ranking in order of importance. The *Primary List* was then embedded within the Phase Two portion of the research Multi-Dimensional Scaling (MDS) survey instrument to be disseminated to Facility Management experts for assessment.

Table 5.9

Phase One Facility Management knowledge categories Primary List

Categories	Categories
Building Services	Fire Life Safety
Business	Maintenance
Codes	Management
Energy	Planning
Environment	Project
Facility	Quality
Finance	Real Estate

5.9 Conclusion

The chapter presents Phase One of the research study; the identification, extraction and tabulation of the Facility Management knowledge categories and subordinate concepts from international tertiary undergraduate Facility Management courses (N=18). The Management courses were originally sourced through a search of the European Facility Management Education Guide (2009) and the North American Facility Management Degree Guide (2009), as well as the World Wide Web. The course content was analysed and concepts extracted utilising Linguistic Inquiry and Word Count with frequency word count providing the source document referred to as the Master List.

The Facility Management knowledge categories were sanitised and the categories extracted (N=1156). The 33 most prevalent concepts were established and tabulated alphabetically in order to remove the possibility that the list is in order of importance, and then presented to 10 Facility Management experts for assessment and validation.

The survey was distributed by e-mail to the Facility Management experts via the Qualtrics survey instrument research source site. The resultant data received from the Facility Management expert survey produced a tabulated list based on the resultant Mean score (Table 5.4). The top 21 Facility Management knowledge categories obtained from the Master List and the expert survey were cross correlated to identify the common concepts. These lists were further validated by Methodological Triangulation with the result from the pilot study.

The final stage of the phase resulted in the consolidation into a *Primary List* of the 14 Facility Management knowledge categories (Table 5.9) responding to Research Question one. The analysis of the data allowed for a more reasoned list to be embedded into the MDS survey instrument for use within Phase Two of the research.

CHAPTER 6
PHASE TWO: MDS KNOWLEDGE STRUCTURE

6.1 Introduction

The aim of Phase Two of the study was to respond to Research Question Two, with the development of a Multi Dimensional Scaling (MDS) survey instrument and data analysis of the Facility Management knowledge categorisation. In order to achieve the required outcomes, the chapter was divided into distinct sections (Figure 6.1). The Phase One Facility Management knowledge structure was be embedded into the MDS survey instrument and disseminated to 313 Facility Management practitioners selected via peer review (6.3).

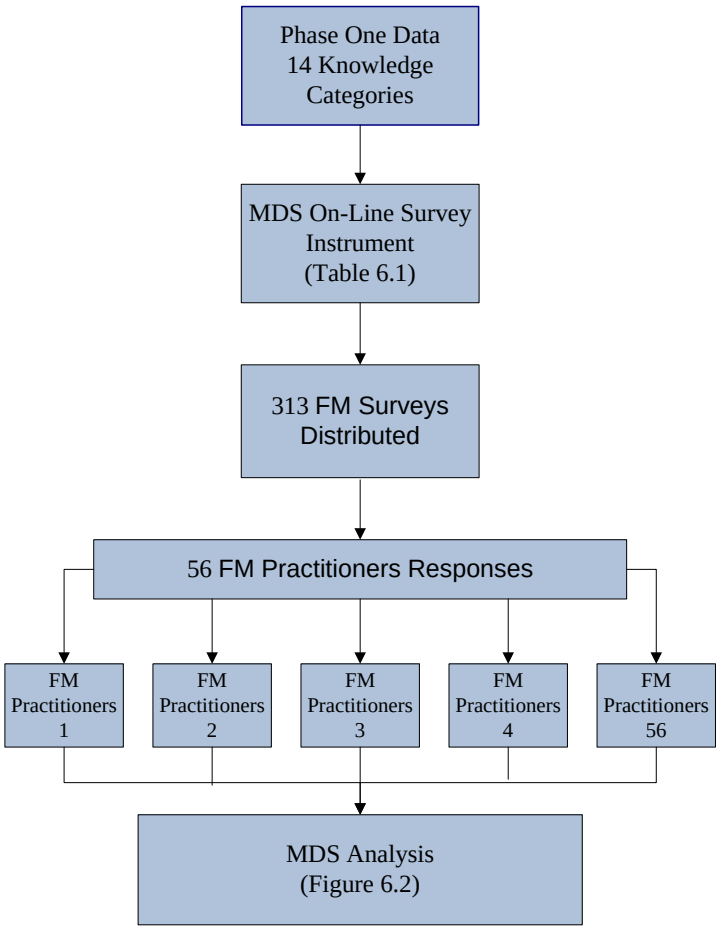


Figure 6.1 Phase Two. MDS Facility Management knowledge structure methodology

The survey was completed by 56 Facility Management practitioners and the results collected and processed (6.4). The MDS resultant spatial representation (6.5) of the Facility Management knowledge category relationship was presented, allowing

commonality and relationship to be discussed. The reliability and validity of the data were presented (6.6), followed by the chapter's conclusion (6.7).

6.2 Multi Dimensional Scaling knowledge structure

Phase One produced 14 (Table 5.8) Facility Management knowledge categories, which were used for the development of the Multi Dimensional Scaling (MDS) survey instrument. The Phase Two survey instrument (Appendix F) consisted of paired concepts resulting in a 91 question survey, which attempted to find how dissimilar or similar the Facility Management experts considered the concepts, using a sliding scale. The survey instrument (Table 6.1) was forwarded to the Facility Management practitioners through the Edith Cowan University research resource site utilising the Qualtrics survey software. The survey was accompanied with a covering e-mail introducing the research and providing the participant with directions on how the survey was to be completed.

Table 6.1

Facility Management MDS knowledge survey instrument

When compared to			*Unrelated*											*Highly related*
Management		Facility	*Unrelated*											*Highly related*
Management		Building	*Unrelated*											*Highly related*

The Qualtrics survey software was selected for use within this portion of the research as it allowed automatic correlation. The results could then be embedded within the MDS software to allow analysis and comparison of relationships between the Facility Management knowledge categories.

6.3 Facility Management practitioner selection

The Facility Management practitioners were selected based on their standing within the Facility Management industry. Reference was also made to the European Facility Management Education Guide 2009 which identified 30 Bachelor courses (EuroFM, 2009), and the North American Facility Management Degree Guide 2009 which identified 21 institutions offering Facility Management degree programs (IFM, 2009). The course information was examined to identify the appropriate point of contact for

the course. An e-mail of introduction was then forwarded to the contact with a request to assist with the research. A secondary search was undertaken based on the participants of the European Facility Management 2011 conference, where a comprehensive list of attendees was obtained. In addition, Facility Management practitioners were identified through the use of both Australian and International Facility Management industry associations. The generated list was further refined through assessment by practitioners and academics. The assessment asked who they felt had sufficient standing within the Facility Management domain to constitute being classed as an expert, based on the practitioners description outlined within the research (see Chapter 3) and through peer recommendation.

A list of Facility Management experts was obtained (N=313) and tabulated in alphabetical order, removing any association with organisations, industry association or country of origin. The identification and selection of the practitioners through the use of the peer review process provided confidence in the generated list. Each of the identified Facility Management practitioners had the Phase Two survey sent via a personally addressed e-mail using the first name of each recipient make the request more personal in an attempt to increase the number of surveys completed. Of the 313 distributed surveys 71 (23%) surveys were returned with a total of 56 being fully completed, resulting in 18% being completed. A return which due to the unsolicited nature of the survey was seen as acceptable. The balance of 15 surveys were either not started or fully completed by the Facility Management practitioners.

Of the 15 practitioners who returned an incomplete survey, four of them were able to be contacted by phone in an attempt to establish the reasoning for the survey not being completed. The feedback obtained from the Facility Management practitioners varied in their reasoning, but all mentioned that the survey was extremely long. Participant One stated “the concepts were all overlapping so I found it extremely difficult to split the concepts from each other”. She also went on to state that the length of time required to complete the survey and put the required amount of application needed was difficult to accommodate at work. Participant Two and Four both stated that finding time at work was the underlying reason for not completing the survey. Participant Three found issues with the survey not being relevant to Facility Management practitioners. He referred to *“On the job training”* as being the only way

to obtain the required skill set for Facility Management and that the pressures applied today were primarily financially drivers, so considered the survey as unnecessary and too time consuming.

6.4 Survey result collation and analysis

The survey results were collated, providing a list of Facility Management Knowledge category comparisons based upon the Mean result and the Standard Deviation. The survey output from the software was then exported to an excel format and referred to as *Phase Two Survey Results* (Appendix G), where the category comparisons could be tabulated in descending order of Standard Deviation. The 14 lowest Standard Deviation scores, as selected by the Facility Management practitioners, were presented as a snapshot (Table 6.2) while also depicting the Standard Deviation (SD) value for comparison. Fourteen knowledge categories were selected as there was little depreciation (0.3) within the Standard Deviation value from number 15, Energy to Facility (1.4) through to number 62, Building Services and Environment (1.7), providing a natural demarcation point for the snapshot.

Table 6.2

Top Standard Deviation knowledge category comparison

Knowledge Category Comparison	**Mean**	**SD**
Building Services to Maintenance	9.2	1.0
Business to Finance	9.1	1.1
Building Services to Facility	9.2	1.2
Energy to Environment	9.1	1.2
Building Services to Quality	8.3	1.2
Building Services to Fire Life Safety	9..1	1.2
Facility to Project	8.5	1.2
Building Services to Quality	8.3	1.2
Building Services to Energy	8.9	1.3
Codes to Environment	8.0	1.3
Fire Life Safety to Maintenance	9.2	1.3
Codes to Maintenance	8.5	1.3
Facility to Maintenance	9.0	1.3
Building Services to Planning	8.2	1.3
Business to Project	8.1	1.3

Of the 91 Facility Management knowledge category comparisons within the survey instrument a Mean of 9.2 was the highest value obtained for three comparisons, Building Services to Maintenance, Building Services to Facility and Fire Life Safety to Maintenance. From category comparison 1 to 44, only a 1.0 point value drop was experienced. Such a result further supported the selected Facility Management knowledge categories identified within Phase One. This high level of relationship provided a robust level of assessment by the Facility Management practitioners. The lowest recorded value of Mean (6.2) was for the category comparison of Energy to Fire Life Safety, a value indicating that the two knowledge categories were seen by the Facility Management practitioners as unrelated to each other for the purposes of this research.

Also considered within the analysis was the Standard Deviation value of the Facility Management knowledge category comparisons (Table 6.3). The high Mean value within the context of this research indicated a high correlation between the category comparison and the Facility Management practitioners assessment, whereas a high Standard Deviation identified the variance from the Mean of a set of numbers (Ley, 1972, p. 12). A greater variance represented a lack of consensus between the participants within the survey when assessing the category comparisons.

Table 6.3

Bottom Standard Deviation v Mean category comparison value

Knowledge Category Comparison	**SD**	**Mean**
Fire Life Safety to Real Estate	2.6	6.9
Energy to Real Estate	2.6	7.1
Quality to Real Estate	2.5	6.4
Maintenance to Real Estate	2.5	7.2
Planning to Real Estate	2.5	7.2
Management to Real Estate	2.4	7.1
Environment to Fire Life Safety	2.4	6.3
Facility to Real Estate	2.3	7.7
Codes to Real Estate	2.3	6.5
Fire Life Safety to Quality	2.2	7.6
Energy to Fire Life Safety	2.2	6.2

Codes to Quality	2.1	7.4
Project to Real Estate	2.1	6.9
Building Services to Real Estate	2.1	7.1
Environment to Management	2.1	7.5

The 15 highest Standard Deviation (SD) values had a frequency count of 10 (67%) for the Facility Management knowledge category of Real Estate. The 15 lowest Mean values, as selected by the Facility Management practitioners, within the MDS survey also had a frequency count of 10 for Real Estate. The presence of Real Estate within the lowest portion of the Mean average combined with the categories high value for the SD raised a suggestion that Real Estate was considered to be relatively unrelated to the other knowledge categories.

6.5 Multi Dimensional Scaling data analysis

The Multi Dimensional Scaling (MDS) survey instrument completed by the Facility Management practitioners exceeded the intended sample of 30 (see Chapter 3), for a total sample size of 56 (+87%). The sample quantity of ≥30 falls within the recommendations for MDS population sample size (Martínez Torres, Barrero Garcia, Toral Marin, & Gallardo Vazquez, 2005). The greater sample size and the non-probability sample selection, due to the nature of the expertise available within the industry, enhanced the surveys reliability and allowed commencement of data analysis. Consideration was given to not allow the introduction of increased bias through the increase in sample size (Kalton, 1983).

The *Phase Two primary data* extracted from the Multi Dimensional Scaling (MDS) survey instrument was formatted into a half matrix. MDS analysis was applied in order to address Research Question Two: *What are the knowledge categories and subordinate concepts and their interaction and interrelationships within the Facility Management domain as measured by Multi Dimensional Scaling.* MDS analysis used ALSCAL, with moderate reliability STRESS measure of 0.27 to produce a spatial outcome (Figure 6.2).

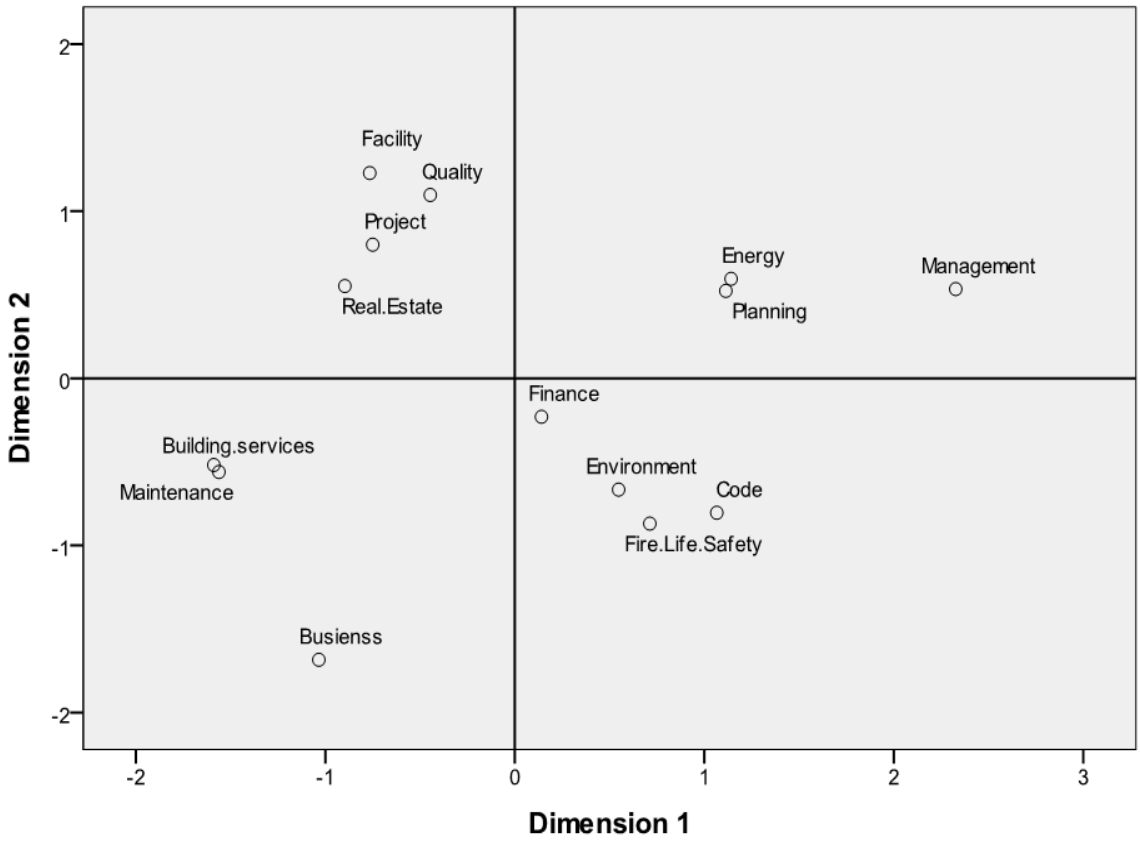


Figure 6.2 Multi Dimensional Scaling spatial map of Facility Management knowledge categories

The MDS spatial map produced a two-dimensional relationship between the Facility Management knowledge categories and subordinate concepts for assessment. The positioning and proximity measure of the categories presented conceptual relationships of the knowledge categories.

Finance was positioned within the centre of the map, the same location in the Pilot study (Chapter 4) that suggested a central focus for the Facility Management role. Such spatial locality indicate that *Finance* has a strong relationship with many parts of Facility Management, although how and to what extent this is explicit to the Facility Manager has to be further explored within Phase Three.

The close proximity of *Building Services* and *Maintenance* suggested a high degree of correlation, indicating that these concepts are closely interrelated to each other. It could be argued that this view is explicit in Facility Management understanding. The high Mean and low Standard Deviation values of *Maintenance* to *Fire Life Safety*

(9.2; 1.0) suggested a higher correlation than represented within the spatial map as the categories fall into different quadrants. *Maintenance* of *Fire Life Safety* systems is seen as a fundamental function that is designed to maximize the reliability of fire protection systems and equipment, such that the systems and equipment meet the requirements of the relevant design, installation and commissioning (Standards Australia, 2012).

The Mean value for the category of *Building Services* to *Fire Life Safety* (9.1) indicated a high correlation as assessed by the Facility Management experts, but appears within different quadrants of the spatial map. Also having a high Mean value but what appears to be a disproportionate spacing within the map was *Building Services* to *Facility* (9.2) second on the Mean value list, *Building Services* to *Fire Life Safety* (9.1) fourth on the list and *Building Services* to *Energy* (9.0) tenth on the list. *Building Services* as referred to by the Chartered Institute of Building Services Engineers (2012) include heating, ventilating, lighting, security and fire detection and protection systems which are considered requirements for *Environment*, *Fire Life Safety* and *Energy* control.

The categories of *Energy*, *Planning* and *Management* fall within the same quadrant indicating a close correlation to each other. *Project*, *Facility* and *Real Estate* fell within a different quadrant. The relationship between project failures is directly linked to poor project definition and project planning according to Kharbanda, & Pinto, (1996), providing a commonality which suggests a closer relationship within the map. The relationship between *Management* and *Project* is closer than indicated by proximity within the map, as according to Kotnour (1999, p. 33) project managers apply the project management process to make sure the project meets the client's needs and specifications. Other considerations according to Pinto and Kharbanda (1996) within the project design phase are product selection and consideration of the design intent through selection of products appropriate for the occupants needs with consideration of maximizing efficiencies and reductions in running costs?

The category of *Real Estate* appeared to have little correlation with the other knowledge categories when the Mean and Standard Deviation values resulting from the Facility Management expert's survey results. The spatial map produced a close

correlation between *Real Estate*, *Facility*, *Quality* and *Project* raising questions regarding it relationship with other categories and the need for further investigation within the next phase.

The concepts of *Code, Environment* and *Fire Life Services* are clustered in the spatial map, indicating a close correlation. Environment appears to have a better correlation from a Facility Management operational stance with Building Services and Facility than represented within the map. Facility performance for organisational success is based on environmental influence of human and organisational performance (Gajendran & Sabaratnam, 2002) by creating an environment conducive for users of the facility. The disparity in proximity of *Facility, Environment* and *Building Services* requires more clarification from the Facility Management experts within the next study phase.

The positioning of Business and Management at different poles within the map was a substantial change from the Pilot study results (Figure 4.1), where these two concepts had a close proximity. The Mean value of Business to Management was 8.6, positioning the concepts fifteenth on the highest Mean list (Table 6.2) and suggesting a higher correlation than spatially presented within the MDS map. Therefore considering the close Mean value but the opposing spatial relationship, the relationship between the two concepts needs to be investigated further.

6.6 Phase Two: Reliability and validity

The *Phase Two primary data* from the MDS survey was tested for reliability and validity. Reliability was tested using Cronbach's Alpha, which produced a high (α=0.90) value. The closer the Cronbach's Alpha coefficient is to 1.0, the greater the internal consistency of the items in the scale (Gliem & Gliem, 2003). George and Mallery provide the following rules of thumb: $\geq$ 0.9 – Excellent, and $\leq$ 0.5 – Unacceptable (2003, p. 231).

The MDS ALSCAL STRESS measure (STRESS 0.27) was seen as an appropriate goodness-of-fit, as $\leq$0.15 represented a moderate representation for two-dimensional spatial map (Cheng, 2004). Furthermore at the stress measure result was the same as the Pilot Study (Chapter 4) measure 0.27. Kruskal and Wish (1978) argue that a

perfect stress value is 0, a good stress value is 0.05 and a poor value is 0.20. This stance is disputed by Borg & Leutner (1985) who suggest that this guiding principle is too simplistic and that there is a direct correlation between the increased number of stimuli and the reduced number of dimensions increasing the stress value. Trochim (1993) suggested that 0.285 reflects the goodness of fit for less stable or abstract data content. This was supported by Rakshit and Ananthasuresh (2008) who presented a STRESS value of 0.54 for 2 dimensions as being a good stress value. The STRESS value indicated further analysis was required which would be completed in Phase Three expert through semi structured interview analysis of the spatial map.

6.7 Phase Two Results

The resultant MDS spatial map represented the Facility Management practitioner's assessment, placing a proximity correlation between Facility Management categories to address Research Question Two: *What are the knowledge categories and subordinate concepts interaction and interrelationships within the Facility Management domain as measured by Multi Dimensional Scaling?* The main findings from the Phase Two results were the identification of *Finance* as a pivotal category for the role of Facility Management and the proximity of several of the categories. Also identified was the close proximity between *Building Services* and *Maintenance* represented a high correlation and the proximity of *Building Services* and *Fire Services.* The categories fell within different quadrants of the spatial map a result not expected from the Mean survey results.

The disparity in spacing of the Facility Management knowledge categories, which appears to have a closer correlation then represented within the spatial map, requires further examination. This examination will take the form of questions to be presented to the Facility Management practitioners during the semi-structured interviews in Phase Three. The knowledge categories were collated and tabulated, (Table 6.4) for ease of reference, and used as a template for the creation of the interview questions. The underlying reasoning for further investigation was identified after consideration of proximity and the pairings Mean value and Standard Deviation (SD) rating. Also considered was literature based areas for further investigation including a number of categories such as *Business* to *Management* (Table 6.4).

Table 6.4

Facility Management knowledge categories

Categories	Reason for further investigation
Fire Life Safety to Maintenance	High Mean, low SD & Map proximity
Maintenance to Environment	Map Proximity
Maintenance to Codes	Map Proximity
Management to Quality	Map Proximity
Project to Management	Map Proximity
Planning to Projects	High mean, low SD & Map proximity
Building Services to Fire Life Safety	Map Proximity
Building Services to Facility	High mean low SD & Map proximity
Building Services to Environment	Map Proximity
Building Services to Energy	High Mean, low SD & Map proximity
Building Services to Codes	High Mean, low SD & Map proximity
Energy to Facility	High Mean, low SD & Map proximity
Facility to Planning	Map Proximity
Facility to Management	High Mean, low SD & Map proximity
Facility to Quality	Map Proximity
Facility to Business	Map Proximity
Planning to Real Estate	Proximity on Map
Management to Business	High Mean, low SD & Map proximity
Facility to Real Estate	High SD, High Mean & Map proximity
Project to Real Estate	High SD, High Mean & Map proximity
Quality to Real Estate	High SD, High Mean & Map proximity

6.8 Conclusion

This chapter described the Phase Two development of a Multi Dimensional Scaling (MDS) Facility Management knowledge categories spatial map and allowed a response to Research Question two. The Facility Management knowledge categories were embedded into the MDS survey instrument and distributed to 313 peer selected Facility Management practitioners. A total of 56 completed surveys were received, with the data analysed and correlated by Mean in descending order.

The MDS Phase Two (Figure 6.2) spatial map indicated similar proximity in structural commonality between concepts such as *Building Services* and *Maintenance*

and *Codes* to *Fire Life Safety*, indicating highly correlated relationships. The structural similarity supported the robustness of the Facility Management map correlation and linkages which in turn supported the decision to progress the study to Phase Three.

The spatial maps reliability and validity were examined producing a high (α=0.90) Cronbach's Alpha measure. The MDS STRESS produced a moderate STRESS measure (STRESS1=0.27, RSQ=0.57), In need of further examination by the Facility Management practitioners was the spatial proximity between some of the Facility Management categories such as *Building Services, Facility, Fire Life Safety and Energy*. These will be introduced in the form of interview questions in the Phase Three semi-structured interviews.

CHAPTER 7
PHASE THREE: EXPERT KNOWLEDGE VALIDATION

7.1 Introduction

Phase Three of the study presents expert validation through semi-structured interviews of the Facility Management spatial map (Figure 6.2) in response to Research Question Three (7.2). The interviews were divided into two discreet sections of Primary expert group (7.4) and Secondary expert group (7.6). The Primary interview questions were development though the Phase Two findings of the research (7.3). The content analyses of the Primary expert group interviews were reviewed, allowing content extraction and analysis (7.5). The Secondary expert interviews were developed through use of the Primary interview questions results with additional questions obtained from lack of consensus between the experts of the Primary group (7.6). This validation allowed interview content analysis (7.7) of the Secondary expert group interviews in order to produce Phase Three results (7.8) and the phase conclusion (7.9).

7.2 Facility Management expert interviews

Phase Three of the research was the semi-structure Facility Management expert interviews designed to elicit a response to Research Question Three: *What are the expert knowledge categories and subordinate concepts within the facility management domain as measured by interviews?* The selection of the Facility Management experts for participation of Phase Three were made through peer selection as specified in Chapter 6 (6.3) from the Australian Facility Management industry as the study due to the Australian context. The selected participant's names were changed and pseudonyms given to protect their identity (Table 7.1). The interviewees were split into two distinct groups of seven and three chosen by random sample selection, forming the Primary and Secondary expert groups for interview. The use of the Primary and Secondary expert groups during the interview phase provided additional validation within the interviews and transcript analysis, through allowing deeper analysis of the interview outcomes.

Table 7.1

Phase Three: Primary expert group profiles

Expert pseudonym	Profile
Bill	Health Care Facility Manager, with 19 years experience in hospital / health Facility Management. Tertiary undergraduate degree
Geoffrey	Facility Management academic with a PhD and tertiary undergraduate degree in Facility Management. 11 years commercial Facility Management experience and 12 years academic experience.
Bret	A Facility Manager practitioner with 31 years experience with in Government, Heath and Private Facility and possesses a tertiary degrees
Alan	Facility Management consultant with 18 years experience with an international Facility Management company, and tertiary undergraduate degree.
Paul	Academic and head of school at an Australian Tertiary Institution within the School of Built Environment within 24 years experience with Facility Management field. Holds a tertiary undergraduate degree in Facility Management and a PhD.
Simon	National Property Operations Manager for an International property management company based in Australia and 10 years experience. Tertiary undergraduate degrees.
Helen	National Property & Facilities Manager for an International property management company based in Australia. 23 years experience with a tertiary undergraduate degree. Member and actively involved within the Facility Management associations at both local and international levels.

7.3 Facility Management expert interviews development

The interview questions were developed from concepts extracted from MDS spatial map (Figure 6.4) in order to validation or clarify category correlation, relationship and spatial proximity. This approach allowed the interviews to be examined for content and themes extracted. After content analysis of the Primary expert transcripts, additional interview questions were developed from themes that showed a lack of expert consensus. These concepts were then presented to the Secondary expert group interviews for comment. The additional interview questions were presented to the three remaining Facility Management expert's to illicit a more in-depth understanding of the knowledge category. The Primary group interview comprised of 24 questions

and sub-questions (Table 7.2) and was conducted in line with the process applied to the Pilot Study (see Chapter 4).

The Facility Management experts were provided with the questions for the semi-structured interview a week before the agreed date of the interview. This pre-interview preparation was considered the most appropriate method for allowing a thorough reflection of the interview questions and formulation of meaningful responses.

Table 7.2

Phase Three: Primary Expert group interview questions

No	Interview Questions
1	My research has shown *Finance* as a central theme to the Facility Management domain. What is your opinion of its importance and what relationship do you feel it has to other knowledge categories?
2	*Building Services* is an overarching category within the context of Facility Management. Findings have shown a close correlation between *Building Services* and *Maintenance*, but a disconnect between *Fire Life Safety, Environment* and *Codes*. Therefore, what is your understanding of the relationship of: *Building Services* to *Maintenance*? *Building Services* to *Fire Life Safety?* *Building Services* to *Codes?* *Building Services* to *Environment?* *Maintenance* to *Environment?* *Maintenance* to *Fire Life Safety?* *Maintenance* to *Codes?* *Fire Life Safety* to *Codes?* *Environment* to *Codes?*
3	Considering the categories of *Management and Business*, comment on what *Management* and *Business* mean to you in the context of Facility Management?
4	A close relationship between *Management, Energy* and *Planning* and a disconnect between *Projects, Facility and Quality* was presented in my research. What is your understanding of the relationship between the categories: *Facility* to *Management?* *Project* to *Management?* *Project* to *Planning?*

	Project to *Quality?*
	Facility To *Quality?*
	Facility to *Energy?*
	Facility to *Planning?*
	Facility to *Business?*
	Management to *Quality?*
5	*Real Estate* has been shown within the research to have a low correlation to many of the other categories. Explain what you understand of the term *Real Estate* to represents in the context of Facility Management?
6	Do you have anything to add or final comments to make?

7.4 Primary expert group interview content analysis

The Primary expert group interviews were transcribed verbatim (Appendix H) from the audio recordings allowing for the Facility Management knowledge concepts to be extracted for in-depth analysis of consensus or disagreement. The identified concepts were then collated to provide an overview of the Facility Management expert's responses to the interview questions.

7.4.1 The role of Finances within Facility Management context

The Facility Management (FM) experts were asked to consider if *Finance* was pivotal to the role of Facility Management. The experts unanimously believed that *Finance* was a central theme to the role of Facility Management and that a fundamental understanding of the budgets, profit and loss accounts as well as costing calculations and project planning was crucial to the role. Bill stated "by using best business practice, a company's operating costs can be reduced while at the same time, its productivity increased. In short, it's the one discipline that ensures that the building, services and personnel, all perform together efficiently". While Geoff suggested that "you don't need to be an accountant but the whole of the Facility Management function is finance driven we are a business after all. If we don't make money from out FM contract we don't stay in business". The Facility Management experts had full agreement that Finance was a central theme within the FM domain.

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7.4.2 Building Services relationships within the Facility Management domain

The Facility Management experts were asked to consider the relationship of the knowledge categories Building Services and Maintenance in an attempt to establish a rational for the high correlation to each other, but an apparent disconnect to Building Services and Fire Life Safety, Environment and Codes.

7.4.3 Building Services to Maintenance

The relationship between Building Services and Maintenance was considered by all the Facility Management experts as pivotal to providing reliable and efficient services to the buildings occupants. Paul stated that he felt "they go hand in hand in my opinion; building services do not run without maintenance either proactive or preventative". Three of the experts referred to the requirement of maintenance of Building Services and its link to Legislative requirements, either state or federal. Brett mentioned that "there is a requirement under the Building Code of Australia to have maintenance undertaken on certain system within a building." Helen referred to "a duty of care under the Occupational Health and Safety Act 1996 to provide a safe environment for staff and visitors to the building". She went on to state that "some states like Queensland have the Workplace Health and Safety Act 1995 placing a greater level of legislative leverage on organisations that do not fullfill the requirements of the act and provide a comfortable productive and safe environment for the occupiers". The Facility Management experts reached consensus considering the close correlation between Building Services and Maintenance to be fundamental to providing a safe environment in line with legislative requirements and conducive to the occupant's activities.

7.4.4 Building Services to Fire Life Safety

The correlation between Building Service and Fire Life Safety was seen by all participants as a fundamental component of effective Facility Management. Alan suggested that:

> "the Building Service term was an overarching category which covered such things as fixed fire systems and mechanical services fundamental component of Fire Life Safety. The ability to detect fire and smoke while controlling its spread throughout the building is critical in providing a suitable period of time

for the safe evacuation of the occupants as well as protecting the fire brigade when they enter the building to fight the fire".

Bill commented that "the relationship between Building Services and Fire Life Safety is based around the design intent and evacuation strategy and is essential to provide safety and wellbeing of the buildings occupants". The Facility Management experts unanimously agreed Building Services were an integral component to provide Fire Life Safety coverage within facilities.

7.4.5 Building Services to Codes

Five of the seven participants agreed that a close correlation within the spatial map between Building Services and Codes was critical in providing fulfilment of statutory conformance requirements in order to ensure a safe and compliant building. Simon suggested "codes and legislation covering buildings which are site specific hospitals have standards for electrical, plumbing and the air-conditioning". Helen stated that "it was unlawful in some instances not to comply with the current legislative or best practice guidelines. If something was to occur within the building you manage and people get hurt because of the failure of a systems which was due to non-compliance of the appropriate maintenance codes the liabilities are massive for both individuals and organisations".

Nevertheless Geoff and Paul disagreed with this stance. Geoff stated "the correlation is close but not critical to the Facility Management function as it becomes the greatest need driven by costs". Agreement was reached by all of the Facility Management experts that the there was a close correlation between the categories with five out of the seven, stating that the main driver was the legislative requirements and best practice.

7.4.6 Building Services to Environment

Of the seven participants interviewed, six of them referred to the *Environment* as having different possible connotations. Helen referred to the environment in the context of internal built environment. She stated that "building service running at their optimum capacity makes the building environment more comfortable for the occupants and helps to maintain productivity work environment". The second

reference to the tern *Environment* was in the context of the amount of energy used to maintain the most conducive building environment often came at an environmental cost. The use of high volumes of electricity has global environmental ramifications. Bret stated "the relationship between the installed building engineering and infield devises is critical in order to ensure the efficient operation of the building and ensuring reduced environmental impact." Geoff commented that "If environment means the Built Environment then Building Services has a close relationship with the environment of the building. There is also a real correlation between the global environment and the building environment from a green perspective, air-conditioning and power usage has an impact upon the green house gasses so I think either definition of environment is affected by Building Services".

The Facility Management experts agreed that Building Services were critical to maintaining a comfortable environment for the occupants and indirectly could impact upon the global environment through high power usage caused though inefficient badly designed systems.

7.4.7 Maintenance to Environment

There was total consensus between the participant with regards to the relationship between *Maintenance* and *Environment.* Bill suggested that "maintenance continues to restore an item to a state in which it can perform its required design function, ensuring minimal or reduced impact on the environment". Paul commented "you have to maintain the environment and the systems which make the environment comfortable for users while being focused on costs. Maintenance can save costs on systems working to their most effective capacity. Waste through bad maintenance and inefficiencies are a consideration that can be addressed through maintenance". Alan stated that "maintaining for example of fuel pump and associated bunds are critically important to ensuring no spillage into the environment. This has not only environmental effect but also community and company reputation within the industry". Total agreement was reached with the Facility Management experts that maintenance of the systems controlling the internal environment was crucial to optimal operation.

7.4.8 Maintenance to Fire Life Safety

The correlation was seen by all of the Facility Management experts as a fundamental for FM practitioners. Simon commented that:

> "fire safety systems as well as other life safety systems are the key to providing a safe facility. In hospitals you cannot afford to lose life safety systems such as pressurised or smoke extraction systems. You can also not afford to loose essential service power supplied that may be feeding power to critically ill patients. A failure of these systems would be fatal in some instances so a way to minimise this potential is to have regular prescribed maintenance to the system".

Geoff referred to maintenance of fire life safety equipment as "allowing an item to be maintained at a state in which it can perform its required function, to ensure the safety and wellbeing of the building occupants". Alan stated "saving lives comes to mind when talking about maintenance in this area, from a Facility Managers perspective it is their responsibility to ensure the works are carried out to the required standard within Australian Standard 1851. I get the frequency of the maintenance requirements from the product manufacture". Complete agreement was reached by the Facility Management experts that Maintenance and Fire Life Safety had a close correlation in that the Fire Life Safety systems are required from an operational and legislative stance to be maintained to the level they were originally designed.

7.4.9 Maintenance to Codes

The Facility Management experts were asked to consider the correlation between Maintenance and Codes. There was disagreement between the Facility Management experts in relation to this question. Comments were made by three of the experts that codes are not tied to any legislation and that they are only a best practice guideline with no real legislative support. Of the remaining four participants, all agreed with the close relationship between the knowledge categories. Bill stated "it was a misunderstood area among most Facility Managers in Australia. There is a belief that Australian Standards have no legislative powers, but they do. There are now provisions within the Building Code of Australia as well as the Occupational Health and Safety Act to maintain a building to the level they were originally designed and

provide as safe working environment". Bill further commented that "there is also the Occupiers' Liability Act 1985 in Western Australia, which requires the occupier, which included landlord of premises to provide safe premises for people entering. Facility Managers are seen as custodians and landlords of building".

Simon suggested "Codes to Maintenance, Fire Life Safety and Environment all form part of the same thing. Light globes being changed water dripping from a tap or even a chair with a broken leg are all part of the way we maintain a good environment. I think then that these three questions are all one". The lack of consensus and high degree of disagreement required further examination of these categories correlation in the interview of the Secondary expert group.

7.4.10 Fire Life Safety to Codes

There was consensus from the participants with regards to the relationship of *Fire Life Safety* and *Codes*. All the Facility management experts agreed that Fire Life Safety and *Codes* were closely related in that *Codes* provided guidelines for the management, frequency and maintenance of *Fire Life Safety* equipment. Bill stated "there is a direct correlation between *Fire Life Safety* and *Codes*, as both are intended to ensure the safety and wellbeing of the building occupants, albeit the codes set the minimum level of requirement, while Fire Life Safety considerations may necessitate enhanced measures, procedures or systems to be installed". Bret commented "the consequences of not complying with codes on fire prevention equipment and complying with the gridlines are massive to Facility Management practitioners and organisations and is a key function to a contract Facility Management success". The Facility Managers reached consensus that the correlation between Fire Life Safety and Codes was close and required to provide safe environments for the occupants of the building.

7.4.11 Environment to Codes

The relationship comparison between Environment and Codes identified several differences of opinion between the participants, with four of the participant's agreeing with the closeness of the relationship. Bill stated "the modern day Facility Manager or Environmental & Sustainability Manager, is required to submit a variety of mandatory reports to show a company's corporate environmental performance. Often, merely

ensuring compliance to code when a facility is designed or modified is not enough to ensure compliance with ever tightening environmental compliance requirements". While the remaining three disagreed, Alan stated "there are not real compliance requirements within the Facility Management domain. The only obligations we have are under the Occupational Health and Safety Act is to make sure employees are not injured". The interviewer then asked "what are the obligations as you see them under Australian Standards? Alan replied that "these are only best practice guidelines and have no legislative support so do not need to be adhered to within WA". Bret considered the correlation from a broader perspective than from purely FM stance, stating "environment is an emotive topic today with a drive to more sustainable facilities and the reduction of carbon foot print. Environmental pressures have driven the Facility Management industry to consider environmental effects, but also community and company reputation within the industry as well as having substantial statutory compliance requirements". The Facility Management experts were unable to agree on the correlation between Environment and Codes with three of the experts disagreeing on the closeness of the correlation. This disagreement required further examination in the interview of the Secondary expert group.

7.4.12 The relationship between Management and Business within a Facility Management context

The Facility Management experts were asked to comment on the relationship between *Management* and *Business* and on what these concepts meant to them in the context of Facility Management. There was a lack of consensus from the participants regarding their understanding of *Management* and *Business*. Four of the experts referred to the correlation as fundamental to the role of Facility Management being performed effectively. While the remaining three Facility Management expert's categorised *Management* as a role within the overarching category of *Business*. Bret suggested that "the category of management, I believe, relates to the management of people and the facility you are responsibility for. The business portion essentially means running the business from a safety, financial, quality and a timeline perspective which also includes the reporting function". Bill stated,

> "effective understanding of Management and Business allows the modern FM to understand the latest practices and gives a perspective on key issues such as

> change, innovation and technology, quality and employee performance. In addition, by studying management and business, we can seek to develop the generic management skills of communication, problem solving, planning, organising, change management and working co-operatively with other decision makers".

Simon referred to Management being as a "function within the business that allows you to deliver the ultimate goal of the business we undertake mainly the management roles during the day to day operation of our business". A sentiment agreed with by Helen who stated that "our business is managing facilities which we provide a service to do. Part of our business role is to maintain and building for the owners and make the occupant comfortable while attempting to make money".

7.4.13 Analysis of knowledge category and spatial disconnect

The Facility Management experts were asked to consider the findings presented in the research by considering the perceived close relationship between *Management, Energy* and *Planning* and the disconnect with *Projects, Facility* and *Quality*. The knowledge categories were paired to allow a defined assessment to be made.

7.4.13.1 Facility to Management

The relationship of Facility to Management had consensus by the Facility Management experts on the close correlation between the categories. Paul referred to "the importance of the relationship in ensuring the facility has the life cycle plan to ensure efficient management is developed and executed". While Helen stated that "none performing or inefficient facility can create negativity opinion resulting in a drop of occupancy rates and loss of revenue which inevitably impacts on the overall business model".

7.4.13.2 Project to Management

On consideration of the relationship between *Project* and *Management* the overriding opinion of the Facility Managers was that without effective management project failure is common. Paul stated that "the management of finance, subcontractors, disruption to the building occupant and program is fundamental to successful project." Alan commented that "project teams are also a fundamental component of the

managing the project as the group is able to drive the project in a clear direction rather than buildings being architecturally impressive but extremely difficult to manage".

7.4.13.3 Project to Planning

All the Facility Management experts agreed on the importance of *Project* to *Planning*. Bill commented on the relationship that "in any project thought is given to planning the FM requirements of the building, after it has reached Practical Completion. Statutory testing requirements can be easily satisfied, if at the design stage, thought is given to installing smart systems, to automatically monitor and check the as installed equipment." Helen referred to the relationship as "essential particular in building structure and infrastructure. It is my belief that there must be a substantial planning group to assist in the having a project plan. Typically the planning section is overlooked".

7.4.13.4 Project to Quality

The Facility Management experts were in total agreement that the relationship between *Project* and *Quality* was critical to the outcome of all projects. Alan stated "there is an expectation from investors that quality is what they are paying for and that the outcome should reflect that expectation". Geoff suggested that "inspection and testing plans are essential to providing a quality out come. They allow quality control processes to be implemented and the addressing of any issues as they occur to provide quality outcome for all projects while controlling pricing".

7.4.13.5 Facility to Quality

The entire group of participant agreed with the close proximity of *Facility* and *Quality*. The primary role of a Facility Manager was seen as providing an efficient facility creating a working environment which allows productivity from the occupants. Simon stated that "often our customers are tenants who pay large amounts of money to and demand a quality environment to work in".

7.4.13.6 Facility to Energy

Alan stated that "the association between *Facility* and *Energy* was of the upmost importance for Facility Managers. At the planning phase of the construction or refurbishment energy efficient equipment, control systems and best practice

guidelines should be applied to have a positive impact on the energy efficiency and thus energy use of a building". This stance was agreed with by the all Facility Management experts.

7.4.13.7 Facility to Planning

The consensus from the Facility Management experts was that the correlation between *Facilities* and *Planning* was strong. Bill stated that "by studying how well an existing facility performs, it is possible to create a "Specification Blueprint" in order to improve the functionality of future projects. These "lessons learnt", both in the form of building design and operation and just as importantly, in equipment selection, are invaluable in ensuring mistakes made in one build, are not replicated in the next". Helen referred to the importance that "equipment receives the correct planned maintenance to ensure fewer breakdowns, generally trying to achieve the Pareto's 80/20 theory. That is 80 percent planned maintenance and 20 percent reactive maintenance".

7.4.13.8 Facility to Business

The premise that the Business of the Facility Manager is to manage a facility was unanimous among the experts. Bill commented that "the categories facility to quality, facility to energy and facility to planning all combine to encompass facility to business. Good planning of a facility, a low energy profile and a quality working environment, all assist in ensuring a successful business". Geoff referred to "the difficulty in balancing costs against requirement to have equipment perform when required. Life cycle analysis is required and a baseline derived from a full equipment survey in order to provide the best business model for the facilities management".

7.4.13.9 Management to Quality

Agreement was reached with the responses by the Facility Management experts with regards to the close proximity of *Management* to *Quality* Bret stated "in order to provide a quality facility all the components within its day to day operation need to be manager. Without those systems imbedded into the business model than accountability cannot be maintained and thus profitability reached". Alan reiterated Bret's comments.

7.4.13.10 The relationship between Real Estate and Facility Management

The Facility Management experts were asked to comment on understanding of the term *Real Estate* within the context of Facility Management. There was a high degree

of disagreement between the participants as to the true meaning of *Real Estate*. Bill stated,

> "to most people, the term real estate refers to the buying, selling, or renting of land, buildings or housing. In FM terms, I believe that Real Estate refers to the entire facility package. Of course it includes the buildings and grounds that make up the visible facility, but it also includes the hard infrastructure, not normally considered in real estate terms, such as underground services, power, hydraulics and HVAC, as well as the Soft infrastructure items, such as waste removal, equipment servicing and occupant wellbeing. To an FM professional, all of these items are equally as important as the visible entity and are equally important to the efficient and economical operation of a facility. In a well managed facility, the soft issues should also be as inconspicuous to the occupants of the building, as the hard issues".

Geoff referred to *Real Estate* as being "more of a role within the selling and buying of buildings. You use a real estate manager for those functions. I don't see its relationship with FM like the other categories have." While Paul stated "real estate in FM in my mind represents the ability to maintain or improve on the value of the facility. With the correct strategy and planning real estate should grow in value".

7.5 Primary expert group interview theme extraction

The themes from the Primary expert group interview transcripts were then examined and tabulated (Table 7.3) for ease of reference. The table considered the expert consensus for each knowledge category correlation, the number of interviews that were required before saturation was reached, the primary concepts and the outcome. It was considered advantages to continue the interviews despite saturation to further strengthen the findings. The outcome considered the primary concepts extracted from the interviews represented as a one line settlement.

Table 7.3

Facility Management expert interview outcomes

Section	Expert Agree	Consensus Disagree	Saturation of Data	Concept	Outcomes
7.4.1	7	0	4th interview	Finance	A central concept for FM Pivotal for efficient Building.
7.4.3	7	0	3rd interview	Maintenance	Services operation within a facility.
7.4.4	7	0	5th interview	Fire Life Safety	Integral component of facilities Building Services.
7.4.5	5	2	6th interview	Codes	Statutory and legislative compliance for Building Services.
7.4.6	7	0	6th interview	Building Services	Key to providing optimum internal Environment.
7.4.7	7	0	5th interview	Environment	Remaining comfortable and productive through Maintenance.
7.4.8	7	0	4th interview	Maintenance	Key to Fire Life Safety systems and liability reduction.
7.4.9	4	3	None	Maintenance to Codes	No consensus reached further examination required.
7.4.10	7	0	3rd interview	Fire Life Safety	to be code and legislative compliant to reduce liabilities.
7.4.11	4	3	None	Environment to Codes	No consensus reached further examination required.
7.4.12	4	3	None	Business to Management	No consensus reached further examination required.
7.4.13.1	7	0	4th interview	Management	A key to viable efficient and effective Facility.
7.4.13.2	6	1	6th interview	Management	Projects key to financial control and project success.
7.4.13.3	7	0	5th interview	Planning	of Projects is key to project organisation and success.
7.4.13.4	7	0	5th interview	Quality	Key part of Project fulfilment and owners and investors expectation.
7.4.13.5	7	0	4th interview	Quality	A key to providing a productive environment within a Facility.
7.4.13.6	7	0	5th interview	Energy	Management helps reduce Facility running costs.
7.4.23.7	7	0	3th interview	Planning	The key to maintain a high Facility standard and effective work space.

7.4.13.8	7	0	4th interview	Facility	Management of is the core of the FM business.
7.4.13.9	7	0	4th interview	Management	Key to Quality facility.
7.4.13.10	3	4	None	Real Estate	No consensus reached, further examination required.

7.6 Secondary Facility Management expert interviews development

The Primary expert group interview analyses identified little consensus between four Facility Management knowledge category correlations, namely; *Maintenance* and *Codes*, *Environment* and *Codes*, *Management and Business*, and *Real Estate.* The categories led to the formation of five additional questions (Table 7.4), which were added to the Primary expert interview questions and presented to the Secondary expert group for contemplation to elicit a deeper understanding and validation of the areas identified.

Table 7.4

Phase Three: Additional Secondary expert group interview questions

No	Interview Questions
1	There was some disagreement regarding the correlation between Maintenance to Codes within the first round of interviews. Some of the participant suggested that there were no Code requirements for Maintenance. What is your understanding of their relationship?
2	What do you consider to be the legislative requirements for Code and Maintenance to be in Western Australia relevant to the Facility Management domain?
3	The correlation between Environment and Codes also resulted in disagreement between the Primary expert group. What do you understand, within the context of Facility Management, to be there relationship and any Statutory Requirements?
4	Management was seen as function of the over arching category of Business by some of the Primary expert group while others referred to Management being fundamental to the role of FM. What is your understanding of the correlation between the two?
5	Real Estate created a high degree of disagreement between the Primary group. The category of Real Estate was seen by some of the participants as the selling of houses and buildings. The others referred to it as part of the whole FM package. What is your understanding of the Real Estate in a FM context?

The Secondary expert group members were selected at random from the pool, adopting the same peer selected applied adopted for the Primary expert group selection. The participant's had their names changed to pseudonyms (Table 7.5) to protect their identity.

Table 7.5

Phase Three: Secondary expert group profiles

Expert pseudonym	**Profile**
Sam	Facilities Manager in a Health Care Facility with 25 year experience in Facility and Health Care Management Tertiary undergraduate degrees.
Gemma	Commercial Portfolio Manager in a Global Real Estate company with 14 years industry experience. Tertiary Undergraduate degree and Post Graduate qualification in Facility Management.
Sean	National Facilities Manager for an Australian property management company and 32 years experience. Tertiary postgraduate degrees.

7.7 Secondary expert group interview content analysis and theme extraction

The Secondary expert group interviews were transcribed (Appendix I) verbatim to allow for content analysis. The analysis of the transcripts allowed assessment of the interviewee's responses. The collated data showed significant consensus with the Primary expert group answers with no additional themes or comments made. The Secondary questions identified several additional comments.

7.7.1 Maintenance and Codes

From the Primary expert interviews there was some disagreement in the correlation between *Maintenance* to *Codes.* The Secondary expert group were asked to comment on their understanding of the correlation within a Facility Management context, as well as the responses provided by the Primary participants. Gemma stated that

> "one of the greatest areas of concern as far as I am concerned within the Australian Facility Management industry is the lack of understanding from a section of the industry on what our statutory requirements are. There needs to be a concerted effort by the industry to drive these requirements home. It is much larger than just the individual, corporate responsibilities stretch deep into

many aspect of business".

Sam and Sean agreed with the premise that there seems to be a lack of true understanding as to the statutory requirements as FM practitioners. Sam went on to state that "if you consider the European model for FM and look at some of the literature coming out of Europe, legislation forms a primary pillar of the industry. If you read Frank Booty, Facility Management Hand Book the first 100 or so pages is all about compliance with the law and such areas as OH&S and criminal sanctions. We just don't put enough credence on it". Sean added "the phrase governance is a prime sales tool used by global FM organisation to present their organisation as one which considers and mitigates risk from an organisational stance, which covers legislative requirements and maintenance and is missing on a practical application level here in Australia". The Facility Management experts identified a lack of understanding within the FM industry as to the statutory requirements and obligations of the Facility Management practitioner's.

7.7.2 Environment and Codes

The secondary expert group were informed of the disagreement between the Primary group participants and asked to comment on their understanding of the correlation between *Environment* and *Codes* within the context of Facility Management. Sean considered the relationship of environment and codes to be somewhat disconnected as the need to comply with maintenance codes to provide a safe environment was not a real issue for FM. To maintain the equipment operation at its optimal level is the key driver for cost reduction and profitability. Gemma and Sam disagreed with that in that Gemma stated "this has the same fundamental issue as the previous question. There are maintenance standards incorporating produce within the built environment such as smoke extraction and detection system which need to be maintained in line with Australian Standards. To not maintain that standard make you liable if an event occurs in which someone are injured. There are also section I in the Building Codes of Australia which identifies a need to maintain buildings and systems within them. They are best practice guidelines". Sam agreed but added this is again the generalised lack of understanding within the industry compounded by the different state legislative controls.

7.7.3 Management and Business

The experts were asked to comment on their understanding of the relationship between *Management* and *Business* and informed that Management was seen, by some of the Primary expert group as a function of the over arching category of *Business,* by whilst others referred to *Management* being fundamental to the role of FM. All participants agreed that Facility Management was the Business function performed by the organisations they worked in. Gemma commented that "our organisation supplied a service in line with the business model that is Facility Management. Our organisations strategies are aimed at value adding to our clients as part of a strategic offering which is managed through policies and procedures geared at achieving the organisational goals. So I think Management is a function covering many facets of the FM role which allows the business to be successful". Sam agreed with Gemma's comments but reiterated the importance of the organisations strategic plan and outlook.

7.7.4 Western Australian Legislative requirements

The experts were asked to comment on what their understandings of the Western Australian legislative requirements for maintenance were pertinent to Facility Management practitioners. All participants mentioned the Occupational Health and Safety Act 1991, stating that there is a duty of care under the act to provide a safe workplace with substantial ramifications for injuries sustained within the work place. Sean and Gemma both identified the Occupiers' Liability Act 1985 needing to be better understood and considered by the FM practitioner. Gemma stated "the act demands that people entering a building are protection from injury due to actions or omissions by the person occupying or controlling the premises. The common law powers for breach of the act can have substantial corporate and personal consequences"**.**

Gemma went on to comment that,

> "it has been long acknowledged within the industry that there is a lack of clearly defined statutory requirements for the FM practitioners to follow. Generally they are based around the understanding of the practitioners and their industry background. This issue is exacerbated through the role Property Managers have within the industry. I feel that Property Managers are

> caretakers of buildings, a first point of call for the occupant. They have no real input in to the development and management of the facility and are there to put out fires. Their understanding of the maintenance and statutory requirements are minimal and in some ways are products of the push for management of buildings to be price driven rather than from a strategic business approach".

Sam stated that "from a maintenance perspective there are Australian Standards and different policies and guidelines designed to provide optimum operating conditions through maintenance and quality systems. Within the health care facility management context there are some council regulatory requirement covering trade waste water policies which require management and sampling of water quality and usage". Sam went on to state "the two most substantive support frameworks for FM practitioners I believe are the Australian Standard 1851-2005 relating to maintenance of all fire systems and the Australian Building Code 200, section I which relates to the maintenance of a building to maintain the buildings systems through prescribed maintenance regimes to the original design level for a building".

7.7.5 Real Estate as a knowledge category within Facility Management domain

Real Estate was identified to the participants as being a knowledge category which had a high degree of disagreement between the Primary expert group and asked their understanding of *Real Estate* in the Facility Management context. There was a lack of consensus from the Facility Management experts as to the relevance of the category. Sean stated,

> "I see real estate and the buying and selling of houses. They become involved within the properties management by default. They are utilised by the owners of the property to lease out areas for occupancy. As the building becomes occupied they inherit the role of point of contact and as such the managers of the property. They have no strategic outlook or business drivers from an FM perspective other than being paid to fill the building. This is the fundamental difference between FM partitioners and property managers. It's more of an Americanism introduced by the real estate industry".

Sam and Gemma agreed with the origins of Real Estate being an American based description, but disagreed with Sean's stance in that they both agreed with Real Estate's relevance to the FM industry. Sam stated "real estate is an overarching term used to identify property, grounds, outbuilding, rental agreements, development, management of real estate investment and as well as the management of different types of buildings from homes to factory's and even office blocks. Within a FM context I feel that Real Estate is a general term FM is more specific to the life cycle and usage of the building from a more strategic stand point". Gemma made the same comments as Sam adding that: "the term real estate is general it's a broad brush approach designed to cover everything property. Facility Management on the other hand if a clearly defined function of the day to day operations of a building with the primary goal of value adding to the occupant as well as achieving the business goals of making money. You could say that FM is a component of real estate or Corporate Real Estate".

7.8 Phase Three Results

The resultant extracted concepts from the Primary and Secondary Facility Management expert interview allowed analysis and several assumptions to be made in order to address the Research Question Three: *What are the expert knowledge categories and subordinate concepts within the facility management domain as measured by interviews?* There was overriding consensus with both Primary and Secondary expert groups that of the knowledge comparison presented by the MDS spatial findings from Phase Two were closely related such as Facility to Business, Facility to Planning and Project to Planning. There were four areas in which disagreement identified were the categories and correlation of *Maintenance* and *Codes, Environment* and *Codes, Business* and *Management* and the definition of the term *Real Estate* within the Australian Facility Management industry context.

The primary areas of disagreement were understanding or definition of the terms *Codes* and statutory requirements, and the role that these categories play within the Facility Management Domain. The term *Legislation* had general consensus by the participants that is had a close correlation with *Building Services* and *Maintenance, Building Services* and *Codes.* Identified as being a integral to provide a safe working environments for the occupant as well as fullfill the statutory requirements of the

Occupational Health and Safety Act 1996. The contradiction then appears with regards to the role of *Maintenance* and *Codes* and *Environment* and *Codes* where a lack of consensus appears. This indicated a degree of disagreement or lack of understanding within the expert panel. The assumption can then be made that a level of confusion will show a linear increase within the wider more open Facility Management market, identifying a weakness within the Facility Management industries understanding of statutory requirements within the Facility Management domain.

The Primary group of interviewees disagreed over the relationship between *Business* and *Management*. It was considered by several of the experts that Management was a subcategory of the overall arching category of Business but also formed an integral component of *Management* of *Project, Management* of *Maintenance, and Management* of *Energy* usage within the building. This was supported by the comments made by the Secondary expert interview group who unanimously agreed that Business was an overarching framework of which management of different entities within the Facility Management role were required to be performed.

The term *Real Estate* was identified as an area of disagreement with the Facility Management experts. The term within an Facility Management domain was seen as refereeing to infrastructure, such as grounds and services, waste removal and equipment servicing by some of the Facility management expert while others considered it as an Americanism refereeing to buying and selling of property. This disagreement within the Facility Management expert group indicated that even within a specialist group, it was unclear to the exact context of Real Estate within the Facility Management domain. The Oxford English Dictionary (2012) refers to Real Estate as a, noun, chiefly North American, referring to *property consisting of land or buildings* while the Roget's 21st Century Thesaurus (2012) refers to Real Estate as meaning property and buildings for sale.

7.9 Conclusion

Phase Three of the research was the semi-structured interviews of Facility Management experts. The interviews were separated as Primary and Secondary expert groups. The separation was done in order to allow any disagreement within the

Primary expert group to be analysed and further examined by the Secondary expert group. The results obtained via concepts extraction from the interview transcripts included a high degree of consensus for the majority of the Facility Management knowledge category correlations.

There were certain categories which presented disagreement between the Primary expert group, namely *Maintenance* to *Codes, Business* to *Management* and *Real Estate*. From the identification of these categories an additional five questions were presented to the secondary expert group. The final outcome of Phase Three produced a significant consensus by the Primary and Secondary expert interview groups on the correlation between all of the Facility Management categories, other than the categories of *Maintenance* to *Codes, Environment* and *Codes* and *Business* and *Management* and the uncertainty by Facility Management experts as to the true definition of Real Estate and its context within the Facility Management domain requiring further investigation.

Chapter 8
INTERPRETATION, LIMITATIONS AND CONCLUSIONS

8.1 Introduction

This chapter presents the interpretation of results within the context of each of the Phases to allow a response to the Overarching Research Question: "*Define the structure of Facility Management body of knowledge and its utilization within the role of Facility Managers".* Phase One considered the extraction of knowledge categories from undergraduate tertiary Facility Management course content from identified knowledge categories with validation by Facility Management experts, in order to respond to Research Question One (8.2). Phase Two built upon the 14 knowledge categories identified within the first Phase, by embedding its results into the Multi Dimensional Survey instrument to allow a spatial representation to be presented for analysis in response to Research Question Two (8.3). A response to Research Question Three (8.4) was presented through the Phase Three process of undertaking semi-structured interviews of the Facility Management experts in order to validate the findings of the previous phase.

The Overarching Research Question (8.5) is addressed though a critique of the response of the research questions within each phase, as well as consideration of additional specific research outcomes. The theoretical research recommendations (8.6) are discussed. The primary recommendation is the introduction of a Facility Management (FM) registration scheme and framework for knowledge development, along with consolidation of Australian Standards and current construction relevant Legislative being integrated in order to provide a practice guideline for FM practitioners. Future research (8.7) opportunities are considered through the use of knowledge based development instruments and the integration of academia within the FM industry. The study's limitations (8.8) are presented, along with a summary of salient points that will conclude the chapter (8.9).

8.2 Research Questions

The research consisted of three research questions embedded into three discreet phases, the outcomes of which were designed to allow a response to the Overarching Research Question (Table 8.1)

Table 8.1

Research questions

Research Question One	Can the Facility Manager's knowledge categories and subordinate concepts be identified and role established within the a building context?
Research Question Two	What are the knowledge categories and subordinate concepts interaction and interrelationships within the Facility Management domain as measured by Multi Dimensional Scaling?
Research Question Three	What are the expert knowledge categories and subordinate concepts within the facility management domain as measured by interviews?
Overarching Research Question	Define the Facility Management knowledge construct and its utilization within the role of Facility Managers

8.3 Facility Management knowledge identification

Phase One of the study involved the extraction of international tertiary undergraduate Facility Management courses (N=18) content. The course content was analysed and concepts extracted, providing the source document referred to as the *Main Study Data List* (Appendix D). The 1,156 extracted Facility Management knowledge categories were reduced to 33 of the most prevalent concepts though a frequency count. The 33 concepts were then presented to 10 Facility Management experts for assessment and validation to produce 14 knowledge categories, referred to as the *Primary List.* The *Primary List* was embedded within the Phase Two portion of the research Multi-Dimensional Scaling (MDS) survey instrument to be disseminated to Facility Management experts for assessment.

This study phase attempted to achieve an outcome which allowed a response to Research Question One: *Can the Facility Manager's knowledge categories and subordinate concepts be identified and role established within the life cycle of a building context?*

In order to address the research question in this phase, it was first essential to identify a core pool of institutions from a broader market as possible for the data extraction. This approach prevented the influence by any organisations or affiliations providing a

clear and transparent data base. Three independent sources were selected for the identification of international undergraduate tertiary Facility Management courses with appropriate course content.

The pertinent Facility Management knowledge categories, knowledge extraction and validation of the categories developed a *Primary List* from Phase One was validated through cross correlation of the *Primary List* and International Facility Management Associations (IFMA) 11 core competencies (Table 8.2) and relevant literature review.

Table 8.2

IFMA and Primary List knowledge categories correlation

IFMA Table 4.5	**Primary List Table 5.8**
Communication	
Emergency Preparedness and Business Continuity	Management and Planning
Environmental Stewardship and Sustainability	Energy, Codes and Environment
Finance and Business	Finance and Business
Human Factors	Management of Environment, Building
	Services and Fire Life Safety
Leadership and Strategy	Management and Planning
Operations and Maintenance	Maintenance, Building Services
Project Management	Management, Project and Planning
Quality	Quality
Real Estate and Property Management	Facility, Building and Real Estate
	Management
Technology	Building Services and Fire Life Safety

The cross correlation of the two tables presented overlays of several of the *Primary List* categories and IFMA competencies. Technology is a constantly developing

category with continued advances with products selected within the Facility Management Domain. A pivotal function when running a reliable and efficient facility lies within the advancement of information and technology systems through integration of building control systems such as lighting, temperature and power usage, via a generalised Information Technology (IT) platform (Wiggins, 2011). This broad approach to the Technology category is apparent within other IFMA categories when compared to the *Primary List* outcome.

Communication within the context of the Facility Management function and role is fundamental to improve organisational medium to long term facility planning processes with a need to increase participation and communication by staff members (Goldstein, 1980). Nousiainen and Junnila (2008) however, suggest there is a lack of communication between building end-user companies and Facility Management companies regarding the facility's internal environmental management. The role communication plays within all aspect of Facility Management through implementation of Emergency Preparedness and Business Continuity, Environmental Stewardship and Sustainability and Project Management are fundamental to the dissemination of policies and procedures for effective Facility Management.

Project Management is the art of directing and coordinating human and material resources thought the life of a project by utilisation of management techniques in order to achieve project objectives on time, cost, quality and project satisfaction (Pinto & Pinto 1990). The clear correlation between the organisation of resources and the communication process within the Project Management role is a core component of the Project Management function. Without effective communication, the project outcome will be in jeopardy as the landmarks and project objectives will not be met, increasing project risk (Turner & Cochrane, 1993). The same interrelationship applies across the knowledge categories competencies being mutually inclusive within the *Primary List* categories.

In consideration of the study Research Question One, the process used for selection, extraction and assessment of the Facility Management knowledge categories was appropriately validated. Supporting evidence through strong expert opinion on the Facility Management knowledge categories and subordinate concepts selection and

extraction, allowed validation of the process. Further expert assessment through the completion of the expert survey produced strong expert agreement for the majority of the concept linkages with a 43% cross correlation of categories from the *Master List, Expert survey* and *Pilot Study* (see Table 5.7). The concept linkages supported the premise that a response can be made to Research Question One, in that a defined knowledge construct can be identified for Facility Management.

There is however a disconnect between Facility Managements knowledge and the life cycle of a building as Facility Managers are involved primarily in the occupancy phase not the design or construction phases (Vanlande, Nicolle, & Cruz, 2008). The involvement of Facility Managers as an integral component of the design team will produce a facility easily maintained and managed (Mohammed, & Hassanain, 2011).

The Codes of Practice for Safe Design of Buildings and Structures (2008), discusses the consultative process of the design of buildings to include developers, builders, owners, project managers, purchasers, clients, end users designers, architects, civil, services, mechanical and structural engineers, landscape architects, building designers and drafters and industrial designers other groups who can influence design decisions, such as quantity surveyors, insurers, occupational safety and health professionals, and ergonomics practitioners, and suppliers including manufacturers, importers and plant hire, constructers, installers, trades and maintenance people, but make no mention of the involvement of the Facility Management industry (Commission for Occupational Safety and Health, 2008) without recognition of the Facility Management role within the full lifecycle of a building the development of a professional industry will be hindered.

8.4 Facility Management knowledge categories interrelationships

Phase two of the study, involved the dissemination to 313 Facility Management experts of the Multi Dimensional Scaling (MDS) survey instrument containing the 14 Facility Management knowledge categories produced from Phase One, and referred to as the *Primary List*. The survey instrument consisted of paired concepts (N=91) attempting to establish how dissimilar or similar the Facility Management concepts were considered to be to each other. The survey was returned, fully completed by 56 FM experts. The results were then embedded within the MDS software to produce a

spatial map of commonality and relationships allowing a response to Research Question Two: *What are the knowledge categories and subordinate concepts interaction and interrelationships within the Facility Management domain as measured by Multi Dimensional Scaling?*

The identification and selection of the Facility Management experts to participate in the research was done through peer review, a process allowing confidence in the selection process (Shanteau, 1992). The output from the MDS analysis of the 56 Facility Management expert surveys provided a spatial representation of the interrelationship between the categories (STRESS 0.27; α=0.90). The positioning of *Finances* within the MDS special map presented it as a central knowledge category, a position confirmed by the Facility Management experts who all agreed with its central location with Paul suggesting that *Finance* was one of the largest business drivers for the profession. The Pilot Study (Chapter 4) also had *Finance* as a central theme, supporting the assertion of its central importance for Facility Management practitioners.

The centralised nature of *Finance* within the Facility Management practitioner domain was further supported by its prevalence within Facility Management Literature. Facility Management professionals manage technology, buildings, structures, interiors, exteriors and grounds accounting for a significant financial investment, 30 to 40 precent of the annual organisational budget (Amaratunga & Baldry, 2002). The ability to analyse and manage financial aspects of a business is a key skill set for all Facility Managers, who by using accepted financial practises can project Facility Management into the forefront of their organisations agenda (Teicholz, 2001, p. 46).

The MDS spatial map indicted the proximity relationship and interaction between the Facility Management knowledge categories, allowing an interpretive response to Research Question Two. The outcomes within the spatial map were considered to have a highly correlated relationship between the concepts, supporting the robustness of the outcomes and the decision to progress to the next phase of the study.

8.5 Facility Management expert knowledge categories

Phase Three of the study presents Facility Management expert validation through semi-structured interviews. The interviews were split into two discreet sections, which formed the Primary and Secondary expert groups. The Primary interview questions had five additional questions added in order to elicit further clarification from the Secondary expert group. The additional questions were extracted from the Primary group interview, where disagreement was experienced between the experts. Such an approach allowing a deeper analysis of the interview content by the Secondary expert group in order to respond to Research Question Three: *What are the expert knowledge categories and subordinate concepts within the facility management domain as measured by interviews?*

8.5.1 Knowledge Expertise

There 77 Facility Management experts participating in this research were selected by peer review having been recommended by Facility Management industry practitioners and academics within the Facility Management domain. The nature of expertise provides a unique perspective within the expert's domain, resulting in the application of knowledge organisation and structure in a different way to the lay person (Chase & Simon, 1973). This unique perspective allows experts to share the same reality as the layperson with a different knowledge structure (Sternberg, 1995). A process developed over many years of layered learning in order to achieve domain expertise in knowledge and skill (Ericsson & Charness, 1997). The communication of knowledge within the expert's domain allows insight to be shared whilst striving for common goals to develop knowledge base within their domain (Browne & Ramesh, 2002).

There is a distinction between personal knowledge and the expert role, which allows acknowledgement of the socially and culturally nature of expertise while maintaining individual content and constructions **(**Agnew, Ford & Hayes, 1994**)**. It can be argued that this domain of experience leads to a better implicit understanding of how concepts integrate and apply (Brooks, 2008, p. 25), providing an ability of the Facility Management expert to consider the domain of knowledge at a higher level than the lay person presents. The research placed the categories into a practical setting as the experts compared the relevance of the categories to each other based upon their experience within the Facility Management industry. This approach allowed

assumptions to be made based on the consensus of the Facility Management experts with the participants having appropriate knowledge within the domain. This allowed the assessment to be considered as robust providing confidence in response to a Research Question Three.

The outcome of the semi-structured interviews was to produce a high degree of consensus on all the related concepts such as *Building Services* to *Fire Life Safety* and *Facility* to *Business*. However, disagreement by the Facility Management experts of categories, *Maintenance, Codes, Environment* and *Codes* and the definition of the term *Real Estate* within the Australian Facility Management industry context were produced. Such lack of consensus within the Facility Management expert group's assessment of some of the knowledge categories allowed assumptions that differing context exists regarding the definition and application of knowledge categories within the Facility Management industry.

8.6 Overarching Research Question and research outcomes

The design intent of the research was to allow the Overarching Research Question to be addressed by utilising results from the three research questions in each phase: "*Define the Facility Management knowledge construct and its utilization within the role of Facility Managers".*

The research was designed around research drivers, in the form of three research questions set within the specific phases, with each phase designed around providing a platform that allowed a response to each research question. The premise of the research was to follow the Facility Management knowledge from inception within a formal academic environment (Phase One), through the creation of a Primary List of knowledge categories (Table 8.3) to practical application within the Facility Management setting by expert validation in the form of semi-structured interviews (Phase Three).

Table 8.3

Facility management knowledge categories Primary List

Categories	Categories
Building Services	Fire Life Safety
Business	Maintenance
Codes	Management
Energy	Planning
Environment	Project
Facility	Quality
Finance	Real Estate

8.6.1 University undergraduate course selection

The justification for selection of universities course content as the source of the data extraction lies within the role universities perform in the development and transfer of knowledge. Universities facilitate and encourage learning and community formation (Bennett, 2007; Temple, 2007) through knowledge transfer within the class room environment designed to support face-to-face teaching and learning (Brown & Lippincott, 2003). The social setting and features of the class room allows interaction between teachers and students for mutual benefit (Temple, 2007).

The selection of tertiary undergraduate courses as the source of the knowledge categories was further supported by universities providing content previously validated by the design and development of the course by academics and practitioners, providing an in depth understanding of the Facility Management domain. Gardener (1963) states “the purpose of educational systems is to shift the burden of perusing education to individuals” (p. 21). Such relocation provides the appropriate skill capability to self-regulate academic learning and develop their ability to acquire knowledge and skills (Zimmerman, 1990). Fioriello (2009) suggests all universities should target the employment of suitably skilled and qualified staff allowing the development of student’s skills for future use.

The integrity of the university course content is of upmost importance. Without content attraction for students the course is unlikely to succeed. The course relevance

and content as well as the teaching staff's experience and ability to deliver should be constantly evaluated by educational facilities. The evaluation process is primarily the responsibility of the individual universities, the Australian National University models its course assessment on the works of Falk and Dow developed in the early 1970's to evaluate course content, teaching and assessment methods in order to development and improve courses (Miller, 1984).

Other universities apply the university survey of Student Assessment of Teaching (SAT) or the Student Evaluation of Teachers (SET) which evaluates teaching staff through student surveys. The evaluation of teachers by students is widely used in developed country and becoming more prevalent in developing countries, being used for a variety of reasons (Pounder, 2007). The evaluation of teaching staff by students has been questioned as a suitable tool to provide course content delivery. Feldman (1996) suggests the process of student evaluation is flawed as they lack maturity and experience thus preventing consistency. The assessment should only be undertaken by colleagues with proven record in publication, experience and topic expertise.

8.6.2. University course content accreditation

The assessment of university course content has been introduced by professional bodies to remove the subjective nature of the in-house or student assessment process. Undergraduate Engineering courses offered within Australia are accredited programs by Engineers Australia. The accreditation process ensures academic consistency by the institutions in order to meet national and international benchmark standards which focus on promoting and disseminating best practice guidelines and stimulation of innovation and diversity (Engineers Australia, 2012). The accreditation of university course content is not restricted to Engineering. Medical School courses are assessed for accreditation by the Australian Medical Council (AMC) who validate standards and peer review designed to promote high standards of medical education (AMC, 2013). Architects Accreditation Council of Australia (AACA) provides accreditation of academic courses in architecture to enable registration with relevant State and Territory architectural authorities (AACA, 2013).

Within the Facility Management domain external course content analysis and accreditation has been implemented by the British Institute of Facility Managers

(BIFM), The Royal Institute Chartered Surveyors (RICS) and International Facility Management Association (IFMA) to accredit the tertiary courses content (Warren & Heng, 2005) and method of delivery similar to the process adopted by the AMC and AACA. The research identified 21 undergraduate courses for content extraction of which twelve (57%) were accredited by the IFMA. The use of non-accredited and accredited courses allowed a broad base for the data extraction free from external organisational or association. The selection of tertiary undergraduate courses content for this research provided a robust and objective outcome data source.

The outcome of the research was in response to the Overarching Research question. The Research question was formed by two aspects, the first "*Define the Facility Management knowledge construct..."* which was addressed through creation of the *Primary List* of knowledge categories as previously discussed, the second more complicated aspect was to consider the "*..utilization within the role of Facility Manager".*

A lack of definition of the Facility Management (FM) role and knowledge interpretation and application was identified in the research and supported by the variance in definitions by Facility Management related organisations. The British Institute of Facilities Management (BIFM, 2012) describes FM as multi-disciplinary activities within the built environment which supports the people and the workplace, while The International Facility Management Association (IFMA, 2012) refer to FM as a coordination role managing people and the work place in an organisational context. The lack of a clear definition makes valuation of the FM markets subjective in nature.

The size of the United Kingdom FM market is valued at between £40 billion and £95 Billion by the British Institute of Facility Management (2013). The estimated value of the Australian Facility Management market is around $15 billion although the true valuation of the Australian market size is difficult to predict as Facility Management is not a recognized industry in Australian Bureau of Statistics (ABS) statistics (Access Economics Pty Ltd, 2007).

The role of a Facility Manager is site and organisational specific based on the strategic and operational outlook of organisations, which combined with each site specific design, use and services provided, determining how the Facility Management role is defined and performed. Wiggins (2010, pp. 4-5) identified a variety of definitions of Facility Management by established Facility Management organisations (Table 8.4), which fail to reach consensus as to a definitive definition in the Facility Management role.

Table 8.4

Facility Management Organisational FM Definition

Facility Management Organisation	**Facility Management Definition**
International Facility Management Association (IFMA)	The practice of co-coordinating people and the work of an organisation into the physical workplace. An integrated management process that considers people, process and place in an organisational context.
Association of Facilities Managers (AFM)	The management of premises and buildings together with the facilities, services and people contained therein; this has implications in respect of initial design, maintenance, the day-to-day administration and control of manpower, energy and related resources (1986).
Strathclyde Centre for Facilities Management (CFM)	Facilities Management is a process by which an organisation delivers and sustains agreed support levels within a quality environment to provide full values in use to meet strategic objectives.
Royal Institution of Chartered Surveyors (RICS)	Facilities Management (FM) involves the total management of all services that support the core business of an organisation. It deals with those areas that the managers of the organisation consider to support their fundamental activities. FM focuses on the interaction between the core business, the support functions, and the facilities throughout all sections of industry, commerce, and services.
British Institute of Facilities Management (BIFM)	Facilities Management is the integration of multi-disciplinary activities within the built environment and the management of their

	impact upon people and the workplace.
European standard established, EN 15221.1 2006	The integration of processes within an organisation to maintain and develop the agreed services which support and improve the effectiveness of its primary activities.

(Wiggins, 2010)

Additional research considerations were also addressed to produce additional research outcomes. The research also aimed to produce additional specific research findings will support the Overarching Research Question to strengthen the overall research outcome.

8.6.3 Exchange of knowledge concepts within the Facility Management domain

The relevance of knowledge and transfer within the Facility Management arena can be found with the importance laid against knowledge communication as a key activity within the work force. Effective communication allows the transfer of experience in order to make better informed decisions to support the Facility Managers strategic commercial role within an organisation (Straub & Karahanna, 1998; Pathirage et, al., 2008).

Nutt (1999) suggests there are three primary Facility Management knowledge sources, Construction, Property Facility Management and Facility design. Facility Management service providers with a limited understanding and experience of Facility Management knowledge construct prevents pertinent knowledge categories relevant to their organisations core business strategy, being identified and captured (Pathirage et al., 2008). This lack of in-depth knowledge understanding prevents an organisation maintaining its competitive edge (Hebert & Chaney, 2011) and prevents Facility Management provider supplying solutions such as knowledge transfer, productivity, mobility, hospitality, accessibility, safety, representation, distinction and sustainability (Kok, Mobach, & Omta, p. 259, 2011).

8.6.4 Improve Facility Management knowledge understanding within the buildings life cycle.

Throughout the research the legislative requirements presented interpretive issues of defined meaning and thus context of application within the Facility Management role. Without clear definition of the FM role, the meaning of the knowledge categories is without substance. The semantic understanding of categories such as *Environment* and *Codes* will vary dependent upon building and location. Australia's Federal and State legislative framework applies different regional statutory requirements upon Facility Managers dependent upon which state they work in, adding to the confusion of legislative obligations. The issue is supported by the need for harmonisation of legislation and policies (Leebron, 1997) to assist in an overarching framework conducive to defining Facility Management knowledge meaning and application.

In order to create a standard definition and meaning the European Committee for Standardization (CEN) is developing a Facility Management (EN 15221-2011) standard which has its focus on Space and Infrastructure, and People and Organisation and makes no reference to the Facility Management knowledge definition or context. The standard will attempt to consolidate the Facility Management role under a standardised content meaning and application framework assisting in defining a European framework. The International Organisation for Standardisation (ISO) is assessing the feasibility for the development of a global standard for Facility Meaning (Smith, 2012), which will further enhance the standing and ultimately service offering within the Facility Management context. This absence of uniformity in context of Facility Management knowledge categories and the lack of current harmonisation of Australian legislation provide an extraordinarily complex Australian FM industry profile.

8.6.5 Provide a Facility Management knowledge framework within the life cycle of a building

A limited framework of knowledge for use by Facility Management practitioners is currently provided within the Building Code Australia (BCA), National Codes of Practice, Federal and State and Territory legislative guidelines. The framework would be substantially strengthened when combined with the proposed Facility Management

international standards providing a clearly defined category meaning, to aid the role of Facility Management practitioners.

The Australian Building Code Board produced the Building Code Australia (BCA) to consolidate national legislative implication for control over the initial design, construction and continued use of buildings within Australia. The BCA integrates with the building regulations within each state and territory by an Act of Parliament and subordinate legislation, empowering the regulation of certain aspects of buildings and construction within the context of states and territory legislation (Australian Building Code Board, p. 8, 2012). The BCA also incorporates Australian Standards, International Standards, British Standards, and American Society for Testing and Materials documents as a reference based of global best practice documents for guidance. The BCA has also allowed each individual aspect of State and Territory legislation and building regulations to be identified through a State and Territory Appendices. The content of the BCA is comprehensive and ranges from Structure, Fire Resistance, Access and Egress, Health and Amenities through to Maintenance of building structure and equipment (Australian Building Code Board, 2012).

The Victorian government have created a guideline document to supplement the Building Regulations 2006, which requires adequate levels of fire safety and protection of people in a building or place of public entertainment. The Essential Safety Measures Maintenance Manual (2006) identifies the BCA reference clauses and Australian Standards for Maintenance of Fire and protective systems and equipment, to be adopted where applicable, as well as a general overview of equipment, requirements, method of operation and creation of a maintenance schedule and the keeping of records (Building Commission Victoria, 2006).

The National Codes of Practice were created as a guide to employers and workers in an attempt to unify the implementation of procedures and controls on workplace hazards, in line with Occupational Health and Safety regulation throughout Australia (National Occupational Health and Safety Commission, 2002). The release of the Work Health and Safety Act 2011 and the Work Health and Safety Regulations 2011, supersedes all other Occupational Health and Safety regulations such as Occupational Health and Safety Act 1991. The addition of the new legislation along with State and

Territory legislative requirements allows Facility Management practitioners to develop systems and procedures for a safe building and work environment providing a reference platform of knowledge for Facility Management practitioners.

8.6.6 Shortcomings in Facility Management knowledge categories identified and strategies for moving forward offered

Within the context of this research several recommendations regarding the development of knowledge, knowledge transfer and knowledge understanding were able to be identified from the research outcomes. Semantic knowledge category meaning and the creation of a Facility Management terminology directory, industry based development mechanism and integration of industry with academia to aid communication and knowledge transfer, were both identified as development strategies within the industry. The development and advancement of the industry through continued industry association, industry practitioners, federal and state government integration as well as academic integration are presented through the researches recommendations and further research.

There is a real need for continued development of the Facility Management industry to establish itself as a primary contributor to the Australian economy. Consultation with the Facility Management industry at the design stage of buildings life cycle needs to be considered as a matter of priority. Embedded efficiencies within the building design based on the occupancies needs rather than at the time of occupancy would produce buildings fit for purpose. Although it is recognised that changes in occupancy and lack of occupancy at the time of building design and approval, makes this process difficult to achieve in all instances.

8.7 Research Recommendations

The research findings presented Facility Management knowledge categories, selected and reviewed by Facility Management experts, to form a *Primary List*. The nature of the selection and processing of the categories throughout the research provided a validation process. This general nature of the referenced categories such as *Building Service, Finance, Management* and *Project,* allowing the list to be utilised as a central core of future Facility Management literature for delivery into the Facility Management market as a practitioners guidance and development of knowledge tool

within the FM domain. The research also provided areas of disagreement on context and application between the FM experts of knowledge categories *Codes, Maintenance* and *Real Estate*. These identified areas need clarification by the Facility Management industry within an Australian context for further practitioner development. The final format and market offering needs to be on a State and Territory basis or as in the nature of Work Health and Safety Act 2011 a Commonwealth basis, subject to full consultation with the industry bodies and practitioners.

The participation of industry by bodies such as the Facility Management Association of Australia (FMA), International Facility Management Associating (IFMA), British Institute of Facility Management (BIFM), The Royal Institute of Chartered Surveyors (RICS) and EuroFM will continue to drive the knowledge development and transfer to the Facility Management (FM) practitioners, along with the implementation of developmental and registration frameworks within the industry.

8.7.1 Facility Management practitioner's registration scheme

The introduction of a compulsory industry lead registration program would allow Facility Management practitioners to develop their knowledge framework by continued monitoring and development. The program to have integrity and viability will need to be monitored by and accredited authority. For example the security industry within Western Australia is governed by the Security and Related Activities (Control) Act 1996 and the Security and Related Activities (Control) Regulations 1997 specifying statutory requirements are for individual wishing to work within a related field of security. The premise of the security licensing process is to develop professional competency, professional security, industry integrity and accountability which are provided and maintained at a high standard (Western Australian Government, n.d.).

There are parallels within the Facility Management role and security practitioners in that the American Society for Industrial Security (2000) identifies Facility Management as a pertinent knowledge category within the security domain. It may also be argued that both professions deal with primary assets which are defined by Lock (2001, p. 78) as, "any items of value and can be classified into one of three asset groups namely, personnel, property and information". The introduction of a Facility

Management registration scheme would increase the professional profile and market standing by improving professional development and service offering. However it could be argued that it would also lower the industry to the lowest common denominator.

It is acknowledged that the implementation of such a registration scheme would, without legislative support, prove extremely difficult to implement and monitor. It has also been identified by the Facility Management experts participating within this research that the Facility Management industry is driven by cost and that the large volume contracts are being won by Facility Management companies at low margins, making the implementation of a registration scheme or other service provider framework extremely difficult to fund. The scheme has to be Government driven and self-funded allowing charges to be levelled at practitioners who wish to be registered through the scheme. A system currently utilised by the security industry as the licensing authority is the police who charge a fee to site examinations and become a registered security practitioner (Western Australian Government, n.d.).

8.7.2 Facility Management knowledge development framework

As a mechanism to produce and maintain knowledge communities and devolvement within the Facility Management industry, a framework is proposed where practitioners continue to develop through an industry recognised platform. The platform would require accreditation as a Facility Management practitioner with evidence of knowledge development. There is a real need for FM practitioners to develop their knowledge base by obtaining specific qualifications to perform the business driven discipline effectively. The FM academic offering by institutions were primarily offered at a post graduate level with the requirement for qualifications within a related discipline, such as Building Surveyor and Construction. Although these disciplines provided a strong foundation they lack depth of knowledge for related disciplines knowledge needed to be a successful Facilities Manager (Warren & Heng, 2005).

The introduction of knowledge development courses, portfolio development records or evidence based practice, as referred to within the nursing industry (Australian Nursing and Midwifery Council, 2006) would help the Facility Management industry

recognition as a professional discipline. One advantage of the framework introduction would be to provide added value to the client through increased relevant knowledge and a greater understanding of the Facility Management (FM) domain.

Areas such as the introduction and application of maintenance regimes, business continuity management strategies, risk management protocols and a general overall understanding of finance frameworks and statutory regulatory requirement would increase FM efficiency in line with the core business function. Nutt (2000) suggest that Facility Managers of the future will be knowledge workers able to align business and property to provide improved facilities solutions.

8.7.3 Legislative and Code consolidation

Consolidation of the legislative codes, National Codes of Practice along with other State and Territory guideline documents for Facility Management would allow core requirements and statutory requirements to be defined with regards to the role and expectations of the industry from a compliance perspective. Such consolidation would allow greater understanding of the Facility Management requirements within the FM domain.

The creation and implementation of an Australian legislative directory for FM practitioners would provide definition of meaning and context removing ambiguity and differences in views by the Facility Management practitioners. A clearly defined Australian definitions such as the Australian Standard Industrial Classification (ANZSIC) for Real Estate Services as being primarily engaged in valuing, purchasing, selling (by auction or private treaty), managing or renting real estate to others (Australian Bureau of Statistics, 2013) would remove personal interpretation of definition.

8.7.3.1 Australian Standard

A lack of Facility Management (FM) Standards (Smith, 2011) for the industry has been identified through the preliminary feasibility study by the International Organisation for Standardization to develop a standard, based on European standards. A new ISO committee has been established, with the cooperation of international association, which includes the International Facility Management Association as well

as FM associations from Britain, Australia, the Middle East, South Africa, Hungary, France, and India (Smith, 2012). The incorporation of Australian Standards with Global Standards within the FM framework would create a best practice document, which along with consultation with insurance providers and other key stakeholders would allow reduction in risk and exposure from incidents, while also potentially reducing operating and business disruption impact.

8.7.3.2 Australian Legislation

The consolidation of Federal and State legislation pertinent to the Facility Management industry would prevent disparity of opinion by the Facility Management practitioners, as identified within the research through lack of consensus with regards to the statutory obligations for compliance with *Maintenance* of *Fire Safety Systems* and *Building Services*. To achieve synergies between the jurisdictions a reduction in legislative and policy framework differences or harmonisation is required (Leebron, 1997). Harmonisation can only be effective through central and regional government agreement of central mode of control for the use of benchmarking (Fox, 1992).

8.8 Further Research

While undertaking this research, future research opportunities were identified that would add to the knowledge development within the Facility Management domain. These included the development of an evidence based practice platform and the further integration of the Facility Management industry within academia are recommended as future research opportunities that would add to the Facility Management industry development.

8.8.1 Evidence based practice instrument development

The principle behind evidence based practice within the nursing domain is the continued on the job training, resulting in increased standards of nursing care (Niederhauser & Kohr, 2005) while developing registered nurses personal and professional growth (Hommelstad & Ruland, 2004). Many education reformers over the last decade have argued that learning in the workplace forms a significant component of higher education system (Bailey, Hughes & Moore, 2004, p. 3).

In 2006 national standards for Registered Nurses and Midwifes were introduced, designed to produce safer patient care. The platform requires Registered Nurses to identify current research areas pertinent to their environment and to undertake a study of the research (Australian Nursing and Midwifery Council, 2006). There is no requirement for individual participation in the research, but nursing staff must follow current research developments and treatment through review of journals or publications. The mechanism allows advances in technologies, strategic outlook and practices to be disseminated to the wider audience within the discipline allowing application within practical setting and evolving best practice.

The implementation of a competency based frame work (Australian Nursing and Midwifery Council, 2006) practitioners continue to develop their skill set by building their knowledge base. The knowledge framework evolves with the implementation of clinical technologies and equipment advancements as well as promoting the development of knowledge communities within the hospital setting. The system is monitored through auditing of nursing staff by the Nursers and Midwives Board to maintain compliance.

Further research could be to undertake by examination of current global evidence based practice and other development frameworks in order to identify a current model that has parallels compatible with the Australian Facility Management industry. The application of a development framework can take the form of continued training and portfolio management of evidence based research. There are currently many disciplines which use evidence based practices or frameworks designed to continue development of practitioners, Surgeons, Physiotherapists, Accountants, Occupational Health and Safety Managers, Engineers and Pilots all require continued vocational advancement to renewed membership or to reach a higher level seniority within their discipline.

8.8.2 Academic and Facility Management Interface

While it is acknowledged that Facility Management is a relatively new discipline (Tay & Ooi, 2001), and according to Lehtonen & Salonen, (2006) has a limited academic research history, continued industry's research development needs to occur. The proposition of further research will explore a framework, where academic staff can

have a dual role within academia and the Facility Management industry through the industry associations. Within the nursing clinical environment, there is a framework for continued development and research participation by Registered Nurses (RN), through interaction and collaboration of nursing staff and academics within Australia, UK and United States (Campbell & Taylor, 2000). Such active academic integration benefits personal development and the provision of a recognised career development path acknowledged within the academic arena as well as by industry bodies.

A secondary benefit for the active integration of academics into the Facility Management industry is the transfer of learning between the two domains. The benefit for Facility Management (FM) practitioners is understood; however, it is less clear as to how critical the exchange knowledge is for academic development from an industry perspective. The exposure to new technologies, industry trends and client drivers could be identified and included within the development of the tertiary FM course content creating an evolutionary loop which then feeds back into the industry though student learning.

8.9 Limitations

Study limitations were identified within the context of this study to include the breadth and relevance of the Facility Management undergraduate course content, the nature of Facility Management expertise and sample size, category definition and interpretation and the ability of Multi Dimensional Scaling to provide a spatial proximity map representation of cognitive knowledge structure for Facility Management. The semantic interpretation of knowledge meaning and its application raised disagreement between practitioners within this research. Wiggins (2010) identified the lack of clarity as to the role of Facility Management (FM) with comment that the role was site and organisational specific, driven by strategic corporate policies and the nature of the facility managed.

The difficulty in clearly defining the role of FM and the absence of FM context and meaning directory makes the interpretation applied by the practitioners subject to a lack of constancy and reliability which needs to be considered within the context of the research. Also in need of consideration is the broad spectrum of facilities managed within the Facilities Management domain and the market size. For example it is

unclear within the UK with estimates ranging from £4.5 Billion to £187 Billion (Moss, 2007) and Australia suffers the same issue. With organisations providing Facility Management services originating from a variety of backgrounds such as construction, technical, property devolvement and service providers (Wiggins, 2010) the breadth of the Facility Management domain is subjective and thus difficult to define.

8.9.1 Course identification and date extraction

The identification of 21 tertiary undergraduate Facility Management course (Appendix G) and course content extraction was undertaken in late 2009 and early 2010. Through the findings identified in Phase One of the research (Chapter 5), a question mark was raised regarding how current the course content of the Facility Management course content of each institutions are. The ability of universities to constantly adapt the content of their courses to facilitate development of technology and strategic direction of the industry is not measured with collected data being out of date or not relevant within the real time Facility Management domain. Therefore, the conclusions drawn from this research are specific to the data collected and subject to the constant review of course content by the respective universities (Miller, 1984).

8.9.2 Nature of expertise and sample size

The number of experts used within the three Phases of the study could have been larger allowing increased quality statistical analysis, although saturation of the expert validation was reached within each phase somewhat negating the study's need to increase the sample size. The characteristics of the participants and the nature of their expertise were subject to the perceived standing within the Facility Management industry by their peers, leaving room for judgment errors as to their true level of expertise. The non-probability nature of the expert group, in that the groups have the same qualities, may affect the quality of their validation within the phases. The conclusions have to be considered within the context of the research and its findings.

8.9.3 Facility Management Definition

The Facility Management knowledge categories and subordinate concepts used within the study were selected through frequency count and validated by expert opinion as suitable for use within the research. There were categories not included within the

research which were identified by the experts as relevant to today's Facility Management practitioners, such as *Continuity Management*, *Risk Management* and *Sustainability.* These categories were not identified within the frequency count as substantial enough count for inclusion within the study. Therefore the Facility Management knowledge categories need to be considered within the context of the study, as the relevance to the Facility Management industry of the undergraduate tertiary Facility Management course may lag the industry drivers and current trends.

8.10 Conclusion

Recommendations were presented regarding the implementation of a registration scheme for Facility Management practitioners, as well as the introduction of a framework which would allow the continued development of practitioner's knowledge base. The final recommendation was to align the Facility Management industry with other industries which have implemented best practice guideline documentation development from Australian Standards, Federal, State and Territory Legislative and guidelines, National Codes of Practice and Building Code of Australia to compliment current international pertinent documentation as a catalyst for the future development of the Facility Management industry. The implementation of an all-encompassing ISO standard for Facility Management would still need to be supplemented with Australian specific information. The prudent path would be to create an Australian based FM standard and supplement it with ISO produced documentation. Such an approach would provide true context of definition while dealing with Australian statutory domain requirements.

The outcome of this study produced a list of Facility Management categories and a spatial Multi Dimensional Scaling proximity map, both complex and providing deep interpretation and insight into the knowledge structure as seen by the Facility Management experts. The Facility Management knowledge domain is still a work-in-progress, not fully understood by many of its practitioner's. This research has helped towards the development and presentation of a Facility Management knowledge construct, allowing greater understanding of categories at an implicit level while providing a greater understanding of meaning that will help the development and integrity of the Facility Management industry and its practitioners moving forward.

The development and current relationship of the Facility Management industry with legislative bodies and government policy departments is of critical importance for the industry to achieve the appropriate recognition. Integration of the Facility Management industry and industry associations at a high level will validate the industry further, as well as adding value to building construction and occupancy management outcomes. The incorporation of Facility Management (FM) experts within such bodies as the National Codes of Practice Board and Building Codes of Australia Board and local and federal government building code boards will provide an industry platform for continued development of building design, performance and operation as well as the continued development of Facility Management knowledge base.

Without high level engagement of senior FM academics and practitioners within the Australian building market, the advancement of the FM industry and its acceptance as a major role player and economic driver within the Australian economy will fail to achieve the recognition and standing it deserves. In a commercial market, where running costs and performance are intrinsically linked to profit as well as energy usage and sustainability, the added value of prolong and early engagement with government, developers, builders, architects and engineers will be unrealised.

The introduction of Aged Care Act (1997) by the Australian Government placed requirement that an annual fire safety declaration is submitted by service providers to obtain registration and certification of residential aged care premise. Despite the statutory requirements laid down within the Act some Western Australia nursing homes have been designed as non-compliant with regards to the fire safe fire and smoke doors (Doleman, 2008). These findings identify that unless appropriate government or industrial policing is applied, the non-compliance and safety of building's can be undermined regardless of the legislative requirements of owners, managers and care providers, preventing advancement of the industry.

The research has shown that great strides have been made over the last two decades as the FM industry started its growth and recognition process. The introduction of an industry knowledge development framework, as well as drivers from industry bodies and practitioners will continue to reduce the identified discrepancy in FM

practitioner's knowledge interpretation. There is also a requirement for an industry driven strategic push to have more accountability for organisations providing services referred to with generic terms such as Property and Building Managers, and Building Supervisor. The ability for organisations to provide FM services should be encompassed within a defined strategic industry registration platform where all practitioners either organisational or individuals are certified as accredited FM service providers.

Interesting time in the next decade to develop and continue to drive the Facility Management industry in to a professional body, respected by other industry members, Government and the broader community as a whole.

REFERENCES

Alavi, M., & Leidner, D. E. (1999). Knowledge management systems: issues, challenges, and benefits. *Communications of the AIS, 1*(2es), 1.

Alavi, M., & Leidner, D. E. (2001). Review: Knowledge management and knowledge management systems: Conceptual foundations and research issues. *MIS quarterly*, 107-136.

Alexander, K. (1996). *Facilities management: theory and practice*. Taylor & Francis.

Aliva, M., & Leidner, D. E. (2001). Knowledge management and knowledge management systems: Conceptual foundations and research issues. *MIS Quarterly, 25*(1), 107-136.

Allee, V. (1997). *The knowledge evolution: Expanding organisational intelligence*. Routledge.

Allee, V. (2000). Knowledge networks and communities of practice. *OD Practitioner Online, 32*(4), 1-15.

Alvesson, M. & Skoldberg, K. (2000). *Reflexive Methodology: New Vistas for Qualitative.*

Amaratunga, D., & Baldry, D. (2002). Performance measurement in facilities management and its relationships with management theory and motivation. *Facilities, 20*(10), 327-336.

Amaratunga, D., Baldry, D., & Sarshar, M. (2000). Assessment of facilities management performance what next? *Facilities, 18*(1/2), 66-75.

Atkin, B., & Brooks, A. (2000). *Total facilities management.* Oxford: Blackwell Science.

Australian Accounting Standards Board. (2012). *Glossary of Defined Terms.* Retrieved from http://www.aasb.gov.au/Pronouncements/Glossary-of-defined-terms.aspx

Australian Accreditation Council of Architect. (2013). *Recognised architectural qualifications.* Retrieved from http://www.aaca.org.au/architect-registration/recognised-architecture-qualifications/

Australian Bureau of Statistics (2013). *Real estate services.* Retrieved from http://www.abs.gov.au/ausstats/abs@.nsf/Latestproducts/26CF7C5AF3581666CA25711F00146FFD?opendocument

Australian Building Code Board. (2011). *Building Code of Australia.* Canberra: Australia.

Australian Government. (1942). *Fire Brigade Act.* Canberra: Australian Government.

Australian Government. (1988). *Privacy Act.* Canberra: Australian Government.

Australian Government. (1991). *Occupation Safety and Health Act.* Canberra: Australian Government.

Australian Medical Council (2013). *Accreditation & recognition.* Retrieved from http://www.amc.org.au/index.php/ar

Babbie, E. R. (2007). *The practice of social research*: Belmont CA: Wadsworth Pub Co.

Baddeley, A. (1992). Working memory: The interface between memory and cognition. *Journal of Cognitive Neuroscience*, *4*(3), 281-288.

Bailey, T. R., K. L. Hughes, and D. T. Moore. 2004. Working Knowledge: Work-Based Learning and Education.Reform. New York: Routledge/Falmer.

Barrett, P., & Baldry, D. (2003). *Facilities management: Towards best practice*. Blackwell Science.

Barwise, J., & Perry, J. (1983). *Situations and attitudes*. Cambridge, MA: MIT Press

Bazeley, P. (2007). *Qualitative data analysis with NVivo*. London: Sage Publications Limited.

Bennett, S. (2007). First questions for designing higher education learning spaces. *The Journal of academic librarianship*, *33*(1), 14-26.

Best, R., Langston, C., & de Valence, G. (2003). *Workplace strategies and facility management*. Routledge

Bhatt, G. D. (2002). Management strategies for individual knowledge and organisational knowledge. *Journal of Knowledge Management, 6*(1), 31-39.

Bingham, W. V. D. & Moore, B. V. (1941). How to interview. New York: Harper & Brothers.

Bird, G. (1986). *William James*. London: Routledge & Kegan Paul

Blumer, H. (1962). *Society as Symbolic Interaction*. In A.M. Rose (Ed.), *Human behaviour and social processes: An interactionism approach*. (pp. 179-192). Boston, MA: Houghton Mifflin.

Blumer, H. (1969). Symbolic interactionism. perspective and method. Englewood Cliffs, NJ: Prentice Hall.

Bob, C., Dencsak, T., & Bob, L. (2010). *Sustainability of buildings*. Paper presented at the 4th WSEAS International conference on energy, planning, energy saving, environmental education (EPESE'10) and 4th WSEAS International Conference on renewable energy sources (RES '10), Kantaoui, Sousse, Tunisia.

Boisot, M. H. (1998). *Knowledge Assets: Securing competitive advantage in the information economy*. London, Oxford University Press.

Borg, I., & Groenen, P. J. F. (2005). *Modern multidimensional scaling: Theory and applications*: Springer Verlag.

Borg, I., & Leutner, D. (1985). Measuring the Similarity of MDS Configurations. *Multivariate Behavioural Research, 20*(3), 325-334.

Borg, W. R., & Gall, M. D. (1979). *Educational research: An introduction* (3rd ed.). London: Longman.

Borg, W., & Gall, M. (1989). *Educational research: An introduction*. NY: Longman.

Brenner, M. (1985). Survey interviewing. In: Brenner, M. et al. (Eds.), *The Research Interview: Uses and Approaches*, pp. 9-36. London: Academic Press.

Brenner, M. Brown, J. Canter, D. (1985) *The research interview: Use and approaches*, London: Academic Press.

British Institute of Facility Management. (2013). *Facilities management today*. Retrieved from http://www.bifm.org.uk/bifm/about/facilities

Brooks, D. J. (2008) *The development and presentation of psychometric concept maps within the knowledge domain of security risk management*. Unpublished doctoral dissertation, Curtain University, Bentley, Western Australia.

Brown, K., & Furneaux, C. (2007). *Harmonising construction regulation in Australia*: *Potentials and problems*. Paper presented at the Public Policy Network Conference, Adelaide.

Browning, L. D. (1978). A grounded organisational communication theory derived from qualitative data. *Communications Monographs, 45*(2), 93-109.

Campbell, D. T., & Fiske, D. W. (1959). Convergent and discriminant validation by the multitrait-multimethod matrix. *Psychological bulletin, 56*(2), 81.

Carlile, P. R. (2002). A pragmatic view of knowledge and boundaries: Boundary objects in new product development. *Organisation science, 13*(4), 442-455.

Cavana, R. Y., Delahaye, B. L., & Sekaran, U. (2001). *Applied business research*. Brisbane: John Wiley & Son Australia Ltd.

Charmaz, K. (2000). Grounded theory: objectivist and constructivist methods. In: Denzin, N.K. & Lincoln, Y.S. (eds.), *Handbook of Qualitative Research*, pp. 509-536. London: Sage.

Charmaz, K. (2006). *Constructing Grounded Theory: a Practical Guide Through Qualitative Analysis.* London: Sage Publications.

Calloway, Kathy (1983) The grounded theory method: an explication and interpretation. In Emerson, R.M., ed., *Contemporary field research: a book of readings*. Boston: Little, Brown. [pp 109-126]

Chase, W. G., & Simon, H. A. (1973). Perception in chess. *Cognitive psychology*, *4*(1), 55-81.

Chauvel, D., & Despres, C. (2002). A review of survey research in knowledge management: 1997-2001. *Journal of knowledge management*, *6*(3), 207-223.

Cheng, C. C. (2004). Statistical approaches on discriminating spatial variation of species diversity. *Botanical Bulletin of Academia Sinica, 45*, 339-346.

Chenitz, W.C. & Swanson, J.M. (1986) *From Practice To Grounded Theory: Qualitative Research in Nursing* (eds.). Menlo Park, CA: Addison-Wesley.

Chi, M. T. H., Feltovch, P. J. & Glaser, R. (1981). Categorization and representation of physics problems by experts and novices. *Cognitive Science, 5*, 121-152.

Chotipanich, S. (2004) Positioning facilities management, *Facilities*, *22*(13/14), 364–372.

CIBSE (2012) *TM49: Probabilistic design summer years for London*

Cohen, L. (2000). *Research methods in education*. Ro Cole, R.E. (1998). Introduction. *California Management Review*, *45*(3), 15-21

Cooper, D. R., & Schindler. P. S. (1998). *Business research methods* (6th ed.). Boston: Irwin McGraw-Hill.

Corbin, J. M., & Strauss, A. (1990). Grounded theory research: Procedures, canons, and evaluative criteria. *Qualitative sociology*, *13*(1), 3-21.

Cox, T. F., & Cox M. A. A. (2000). *Multidimensional scaling: monographs on statistics and applied probability.* (2nd ed). Boca Raton: Chapman & Hall/CRC.

Creswell, J. W. (2012). *Qualitative inquiry and research design: Choosing among five approaches*. Thousand Oaks, CA: Sage Publications.

Creswell, J. W. (2003) *Research Design: Qualitative, quantitative and mixed methods approach.* Thousand Oaks, CA: Sage Publications.

Crooks, D. (2003). The importance of symbolic interaction in grounded theory research on women health. *Health Care of Women International, 22*(1-2), 11-27.

Cutcliffe, J. R. (2001). Methodological issues in grounded theory. *Journal of advanced nursing*, *31*(6), 1476-1484.

Davenport, T. H., Long, D. W. D. & Beers, M. (1998). Successful knowledge management projects. *Sloan Management Review*, 43-57.

De Groot, A. D. (1978). *Thought and choice in chess* (Vol. 4). The Netherlands: Walter de Gruyter.

Cohen, L., Manion, L. & Morrison, K. (2002). *Research methods in education* (5th ed.) London: Routledge Falmer.

Cohen, L. (2000). *Research methods in education*. RoutledgeFalmer.

Denscombe, M. (2003). *The Good Research Guide for Small-scale Social Research Projects.* Maidenhead: Open University Press.

Denzin, N. K., & Lincoln, Y. S. (2000). The discipline and practice of qualitative research. *Handbook of qualitative research*, *2*, 1-28.

Dillman D., Smyth J., & Christioan LM. (2009) Internet and Mixed-Mode Surveys. The Tailored Design Method. John Wiley & Sons. New Jersey

Doleman, R. G. (2008). *A study of compliance in aged care facilities with regards to Australian Standards 1851:2005 Maintenance of Fire Protection Systems and Equipment Section 17.* Unpublished Manuscript Edith Cowan University, Western Australia

Engineers Australia. (2013). *Program accreditation. R*etrieved from http://www.engineersaustralia.org.au/about-us/program-accreditation accessed 11.08.12

Engineers, C. I. o. B. S. (2012). Building Service Engineering Research and Technology: An International Journal.

Ereaut, G. (2007). *What is Qualitative Research?* QSR International Pty Ltd 2007. Retrieved from http://www.qsrinternational.com/what-is-qualitative-research.aspx

Erickson, F. (1986). Qualitative methods of research on teaching. In M. Wittrock (Ed.), *Handbook of Research on Teaching* (3rd ed.). New York: Macmillan.

Ericsson, K. A., & Charness, N. (1997). Cognitive and developmental factors in expert performance. In P. J. Feltovich, K. M. Ford & R. R. Hoffman (Eds.),

Expertise in context: Human and machine (pp. 4-41). Menlo Park, CA: The MIT Press.

EuroFM, (2009). *European facility management education guide.* (2nd ed). The Nedlands.

Eysenck, M. (2000). *Psychology: A student's handbook.* East Sussex, UK: Psychology Press.

Fawcett, S. E., Osternhaus, P., Magnan, G. M., Brau, J. C., & MaCarter, M. W. (2007). Information sharing and supply chain performance: The role of connectivity and willingness supply chain management: *An International Journal*, *12*(5), 358-368.

Feldman, K. A. (1996). Identifying exemplary teaching: Using data from course and teacher evaluations. *New directions for teaching and learning*, *1996*(65), 41-50.

Feltovich, P. J., Ford, K. M., & Hoffman, R. R. (1979) *Expertise in context: Human and Machine.* Menlo Park, CA: The MIT Press.

Fink, A. (1995). *The survey kit: How to sample in surveys.* (3rd ed.). Boston: Elsevier Butterworth-Heinemann.

Fioriello, D. P. (2009, December 3). *Suggestions for Successful Teacher Evaluation by Students*. Retrieved from, http://drpfconsults.com/.

Fire Protection Association Australia. (2005). *Australian Standard AS1851: 2005 Maintenance of Fire Protection Systems and Equipment, the New Australian Standard. What does it mean for Owners, Occupiers and Service Providers?* Retrieved from http://inspectapedia.com/hazmat/AS1851WhitePaper.pdf

Fire Protection Association Australia, (2012). *Position Statement- Adaptation of use of AS1851-2012*. Retrieved from http://www.fpaa.com.au/media/63495/ps_03_v1_adoption_and_use_of_as1851.pdf

Fischer, M.D. (1994) Applications in computing for social anthropologyists. London; Routledge

Flinders, D. J., & Milles, G. E. (1993). *Theory and concepts in qualitative research: perspective from the field.* New York: Teachers College Press.

Fox, E. M. (1991). Harmonisation of Law and Procedures in a Globalized World: Why, What, and How. *Antitrust LJ*, *60*, 593.

Francis, M. E., & Pennebarker, J. W. (1993). *LIWC: Linguistic inquiry and word count. Technical Report*. Dallas, TX: South Methodist University.

Francism M. E., & Pennebarker, J. W. (1993). LIWC: Linguistic inquiry and word count. Technical Report. Dallas, TX: South Methodist University.

Frye, N. (1997). *The educated imagination*. House of Anansi.

Gajendran, T., & Sabaratnam, R. (2002). *An integrated approach to assess facilities performance.* Paper presented at the CIB Working Commission 070, Facilities Management and Maintenance, Global Symposium Glasgow, Scotland.

Galunic, D.C. and Rodan, S.A. (1998), ``Resource recombinations in the firm: knowledge structures and the potential for Schumpeterian innovation'', *Strategic Management Journal*, *19* (12). 1193-201.

George, D., & Mallery, P. (2003). *SPSS for Windows step by step: A simple guide and reference. 11.0 update* (4th ed.). Boston: Allyn & Bacon.

Gibbs, G. R. (2002). *Qualitative Data Analysis: Explorations with NVivo*. Buckingham.

Glaser, B. (1978). *Theoretical Sensitivity*. California: The Sociology Press.

Glaser, B. (1992). *Basics of Grounded Theory Analysis*. Mill Valley: Sociology Press.

Glaser, B. (1998). *Doing Grounded Theory: Issues and Discussions*. Mill Valley.

Glaser, B. G. (2004). Naturalist Inquiry and Grounded Theory. In *Forum Qualitative Sozialforschung Forum: Qualitative Social Research 5*, (1).

Glaser, B., & Strauss, A. (1965). *Awareness of Dying*. California: Aldine Publishing

Glaser, B. G., & Strauss, A. L. (1967). The Discovery of Grounded Theory: Strategies for Qualitative Research. New York: Aldine Publishing Company.

Glaser, B.G. (1992). *Basics of Grounded Theory Analysis: Emergence vs forcing.* California: Sociology Press.

Glaser, B. G. (2008). Conceptualization: On theory and theorizing using grounded theory. *International Journal of Qualitative Methods*, *1*(2), 23-38.

Glesne, C., & Pashkin, P. (1992). *Becoming qualitative researchers: An introduction.* New York, NY: Longman.

Gliem, J. A., & Gliem, R.R. (2003). *Calculating, interpreting, and reporting Cronbach's alpha reliability coefficient for Likert-type scales.* Paper presented at the Midwest Research to Practice Conference in Adult, Continuing, and Community Education.

Gliner, J. A. (1994). Reviewing qualitative research: Proposed criteria for fairness and rigor. *The Occupational Therapy Journal of Research 14*(2): 78–90.

Godin, B., & Gingras, Y. (2000). The place of universities in the system of knowledge production. *Research policy*, *29*(2), 273-278.

Gonzalez, M., J. (2006). Assessment of the decrease of CO2 emissions in the construction field through the selection of materials: Practical case study of three houses of low environmental impact. *Building and Environment, 41* 902-909.

Gorman, G. E., & Clayton, P. (2005). *Qualitative research for the information professional* (2nd ed.). London: Facet.

Goulding, C. (2002). *Grounded theory: A practical guide for management, business and market researchers*. London: Sage Publications Limited.

Gramsci, A. (1995). *Further selections from the prison notebooks*. University of Minnesota Press.

Guildford, J. P. (1950). *Fundamental statistics in psychology and education* (2nd ed.). New York: McGraw-Hill Book Company Inc.

Hahn, J., & Subramani, M. R. (2000). *A framework of knowledge management system. Issues and challenges for theory and practice*. International Conference on Information Systems. Minnesota, USA.

Hamer, J. M. (1988). *Facility management systems*. New York. Van Nostrand Reinhold Company.

Heath, H. & Cowley, S. (2004). Developing a grounded theory approach: a comparison of Glaser and Strauss. *International Journal of Nursing Studies, 41* (2), 141-150.

Henry, T. H. (1990). *Practical Sampling: Applied research methods series volume 21,* Newbury Park, Ca: Sage Publications.

Hinks, J. 2001, *All FM is non-core, But some FM is less non-core than others? A discussion on realising the strategic potential of FM*. Retrieved from http://www.fmlink.com/article.cgi?type=Magazine&title=25%20Years%20of%20FM&pub=Premises%20&%20Facilities%20Management&id=41386&mode=sourc.

Hoepfl, M.C. (1997). Choosing qualitative research: a primer for technology education researchers". *Journal of Technology Education 9* (1). Retrieved from http://scholar.lib.vt.edu/ejournals/JTE/v9n1/hoepfl.html

Hofer, F. (2005). Knowledge transfer between academia and industry. *Encyclopedia of Knowledge Management,* New York.

Hothersall, D. (2004). *History of Psychology* (4th ed.). Boston: McGraw Hill.

Hung, D. (2001). Theories of learning and computer mediated instructional technologies. *Educational Media International, 38*(4), 281-287.

Hutchinson, S. & Wilson, H. (2001) Grounded Theory: The Methos. In P. Munhall (Eds), *Nursing Research: A qualitative perspective* (3rd ed.) (pp. 209-244). Sudbury, MA Jones and Bartlett.

IFMA Foundation, (2009). *North American facility management degree guide*. Houston, TX: International Facility Management Foundation.

Jagdev, H. S., & Thoben, K. D. (2001). Anatomy of enterprise collaborations. *Production Planning & Control*, *12*(5), 437-451.

Jagdev, H., & Wulf, V. (2006). Anatomy of enterprise collaborations. *Productions Planning and Control, 12*(5), 437-451.

James, W. (1890). *Principles of psychology*. New York: Holt.

Janesick, V.J. (1994). The dance of qualitative research design: Metaphor, methodolatry, and meaning. In N.K. Denzin & Y.S. Lincoln (Eds), *Handbook of qualitative research.* Thousand Oaks, CA: Sage Publications.

Johnson M. (1999). Observations on positivism and pseudoscience in qualitative research. *Journal of Advanced Nursing, 30*(1), 67–73.

Johnson, P. O. (1959). Development of the sample survey as a scientific methodology. *Journal of Experiential Education*, *27*, 167-176.

Johnson, R. B., & Onwuegbuzie, A. J. (2004). Mixed methods research: A research paradigm whose time has come. *Educational researcher, 33*(7), 14-26.

Kalton, G. (1983). *Introduction to survey sampling*. London: Sage Publications.

Kamaruzzaman, S. N, and E. M.A Zawawi. (2010). Development of facilities management in Malaysia. *Journal of Facilities Management 8*(1): 75–81.

Kellogg, R. T. (2003). *Cognitive psychology* (2nd ed.). Thousand Oaks: Sage Publications.

Kerlinger, F. N. (1973). *Foundations of behavioural research*. New York: Holy, Rinehart, & Winston.

Kharbanda, O. P., & Pinto, J .k. (1996). *What made gerty gallop? Lessons from project failures*. New York: Van Nostrand Reinhold.

Klammt, F. (2001). Financial management for facility managers. *In E. Teicholz, Facility Design and Management Handbook* (pp. 5.1). New York, N.Y: McGraw-Hill.

Kok, H. B., Mobach, M. P., & Omta, O. S. (2011). The added value of facility management in the educational environment. *Journal of Facilities Management*, *9*(4), 249-265.

Kotnour, T. (1999). A learning framework for project management. *Project Management Journal, 30*, 32-38.

Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. Educ Psychol Meas.

Kruskal, J. B. (1964a). Multidimensional scaling by optimizing goodness of fit to a nonmetric hypothesis. *Psychometrika*, *29*(1), 1-27.

Kruskal, J. B. (1964b). Nonmetric multidimensional scaling: a numerical method. *Psychometrika*, *29*(2), 115-129.

Kruskal, J. B., & Wish, M. (1978). *Qualitative applications in the social sciences: Multidimensional scaling*. Beverly Hills CA: Saga Publishing.

Laing, R.D. (1967) The policies of Experience and the Bird of paradise. Harmondsworth: Penguin.

Langston, C., & Lauge-Kristensen, R. (2002). *Strategic Management of Built Facilities*. Boston, MA: Butterworth-Heinemann.

Law, M., Stewart, D., Letts, L., Pollock, N., Bosch, J., & Westmorland, M. (1998). *Guidelines for critical review of qualitative studies*. McMaster University. Occupational Therapy Evidence-Based Practice Research Group.

Lee, S. (2006): *Controlling involvement to promote confidence in palliative care decisions: A grounded theory from the patient's perspective*. Unpublished doctoral dissertation, Faculty of Computing, Health and Science, Edith Cowan University.

Leebron, D.W. (1997). Lying down with Procrustes: An analysis of harmonisation claims. In J. Bhagwati & R.E. Hudec. *Fair trade and harmonisation: Prerequisites for Free Trade? Volume 1: Economic Analysis*. Cambridge, MA: The MIT Press.

Leedy, P.D., & Ormrod, J.E. (2005). *Practical research: Planning and design.* (8th Ed.). Upper Saddle River, N.J.: Pearson Merrill Prentice-Hall.

Lehtonen, T., & Salonen, A. (2006). An empirical investigation of procurement trends and partnership management in FM service – A Finish survey. *International Journal of Strategic Property Management 10*, 65–78.

Ley, P. (1972). *Quantitative aspects of psychological assessment*. London: Duckworth.

Lieb, S. (1991,). *Principles of adult learning. Vision*. Retrieved from http://honolulu.hawaii.edu/intranet/committees/FacDevCom/guidebk/teachtip/adults-2.htm

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry.* Beverly Hills, CA: Sage.

Lindlof T.R., & Taylor, B.C. (2002), *Qualitative Communication Research Methods* (2nd ed.), Thousand Oaks, CA: Sage Publications.

Locke, K. D. (2001). *Grounded theory in management research*. Thousand Oaks, CA: Sage Publications Limited.

Loftness, V., Hartkpf, V., Lee, S., Sharankavaram, J., & Aziz, A. (2001). Smart buildings, intelligent buildings. *In E. Teicholz, Facility Design and Management Handbook* (pp. 5.1). New York, N.Y: McGraw-Hill.

Mansourian, Y. (2006). Adaption of grounded theory in LIS research. *New Library world, 107* (1228/1229), 386-395.

Martin, P. Y., & Turner, B. A. (1986). Grounded theory and organisational research. *The Journal of Applied Behavioural Science, 22*(2), 141-157.

Martinez-Torres, M. R., Garcia, F. J. B., Marin, S. L. T. & Vazquez, S. G. (2005). A digital signal processing teaching methodology using concept-mapping techniques. *IEEE Transactions on Education, 48*(3), 422-429.

Mason, J. (2002). *Qualitative Researching.* (2nd ed.). London: Sage Publication.

Maxwell, J.A. (1996). *Qualitative Research Design: An Interactive Approach.* London: Sage Publications.

Maznevski, M. L. & Chudoba, K. M. (2000) Bridging Space Over Time: Global Virtual team dynamics and effectiveness. *Organisation science, 11*(5), 473-492.

McAdam, R., & Reid, R. (2001). SME and large organisation perceptions of knowledge management: comparisons and contrasts', *Journal of Knowledge Management, 5*(3), 231- 241.

McMillan, J., & Schumacher, S. (1997). *Research in education: A conceptual introduction* (4th ed.). New York, NY: Addison-Wesley.

McNeill, P. & Chapman, S. (2005). *Research Methods.* London: Routledge Tylor & Francis.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook.* Beverly Hills, CA: Sage Publications.

Miller, A.H. (1984). The evaluation of university courses. *Studies in Higher Education, 9.* 1-15

Miller, D., & Shamsie, J. (1996). The resource-based view of the firm in two environment: The Hollywood film studio from 1936 TO 1965. *Academy of management journal, 39*(3), 519-543.

Milliken, P.J. & Schreiber, R.(2001) Can you "do" grounded theory without symbolic interactionism? In R.Schriber & P.N. Stern (Eds.), *Using grounded theory in nursing*. 177-190. New York: Springer.

Mjøset, L. (2005). Can grounded theory solve the problem of its critics? *Sosiologisk tidsskrift 13,* 379-408. Retrieved from http://www.globelics.org/downloads/BRICS+workshop06/Mjoset.pdf

Morey, N. C., (1986). *The process and product of organisational ethnography: An anthropological approach*. Doctoral dissertation, The University of Nebraska, Lincoln.

Morse, J. M. (2000). Determining sample size. *Qualitative Health Research, 10*(1), 3.

Morse, J.M. (1991). Approaches to qualitative-quantitative methodological triangulation. *Nursing research, 40*(2), 120.

Morse, J.M. (1997). "Considering theory derived from qualitativee rsearch". In: Morse, J.M. (Ed.), *Completing a Qualitative Project: Details and Dialogue,* (pp. 163-188). London: Sage Publications.

Müller-Merbach, H. (2008). Kant's reciprocity of sensations and concepts. *Knowledge Management Research & Practice, 6*(1), 100-101.

Munhall, P.L. (2007). *Nursing research: A qualitative perspective*. Massachusetts: Jones & Bartlett.

Murray, P., & Myers, A. (1997). The facts about knowledge, *Information strategy, (9)* 31- 33.

Newell, K., Liu, Y. T, Mayer-Kress, G. (2001). Time scales in motor learning and development. *Psychological Review, 108*(1), 57-82.

Newman, J.C. Jarlais, D. C. D., Turner, C. F., Gribble, J., Cooley, P. & Paone, D. (2002). The differential effects of face-to-face and computer interview mode.

American Journal of Public Health, *92* (2), 294-297. Retrieved from http://www.ajph.org/cgi/content/abstract/92/2/294

Nonaka, I., & Takeuchi, H. (1995). *The knowledge-creating company: How Japanese companies create the dynamics of innovation*. USA: Oxford University Press,

Nutt, B. (1999). Linking FM practice and research, *Facilities, 17*(1/2). 11–17.

Nutt, B. (2000). Four competing futures for facility management. *Facilities*, *18*(3/4), 124-132.

O'Brien, G. (2004). *Principles of adult learning*. Health Organisation Southern Melbourne, Australia. Retrieved from http://www.southernhealth.org.au/cpme/articles/adult_learning.htm

Odis E. Simmons & Toni A. (2004, May). Gregory Grounded Action: Achieving Optimal and Sustainable Change. *The grounded Theory Review 4*, (1).

Onions, P.E.W. (2006). *Grounded Theory Application: In Reviewing Knowledge Management Literature.* Paper presented at the Postgraduate Research Conference on Methodological Issues and Ethical Considerations. Leeds Metropolitan University.

Oppenheim, A.N. (1992) Questionnaire Design, Interviewing and Attitude Measurements. London: Pinter Publishers Ltd

Orlikowski, W. J., (1993). CASE tools as organisational change: investigating incremental and radical changes in systems development. *MIS Quarterly, 17*(3), 309-340.

Oxford English Dictionary. (2012) (Eds.). *Oxford English Dictionary*. Oxford: Oxford University Press.

Padgett, D. K. (1998). *Qualitative methods in social work research: Challenges and rewards*. Thousand Oaks, CA: Sage Publications.

Pakenham, K. I. (2005). Relations between coping and positive and negative outcomes in carers of persons with multiple sclerosis. *Health Psychology, 24*, 123-132

Palaneeswaran, E., Ng, T., Kumaraswamy, M., & Ugwu, O. (2005). *Value networking in construction scenarios with appropriate information and knowledge management frameworks*. *Paper presented at the CIB W102-2005 Meeting and International Conference, Lisbon.*

Partington, D. (2000). Building grounded theories of management action. *British*

Pathirage, C., Haigh, R., Amaratunga, D., & Baldry, D. (2008). Knowledge management practices in facilities organisations: a case study. *Journal of Facilities Management, 6*(1), 5-22.

Patton, M.Q. (2002). *Qualitative Research & Evaluation Methods.* 3rd ed., London: Sage Publications.

Peirce, C. S. (1868). Some consequences of four incapacities. *Journal of Speculative*

Pennebaker, J. W., & Francis, M. E. (1999). *Linguistic Inquiry and Word Count (LIWC)*. Mahmah, N. J: Erlbaum Publishing.

Pickard, A.J. (2007). *Research Methods in Information.* London: Facet.

Pinto, J. K., & Kharbanda, O.P. (1996). How to fail in project management (without really trying). *Business Horizons, 39*(4), 45-53.

Pitt, M., & Tucker, M. (2008). Performance measurement in facilities management: driving innovation? *Property Management 26*(4): 241-254.

Polanyi, M. (1958). *Personal Knowledge: Towards A Post-critical Philosophy.* New York: Harper & Row.

Pounder, J. S. (2007). Is student evaluation of teaching worthwhile?: An analytical framework for answering the question. *Quality Assurance in Education, 15*(2), 178-191.

Prawat, R. S. (1996). Constructivism, modern and postmodern. *Educational Psychologist, 31*(3-4), 215-225.

Price, I., & Akhlaghi, F. (1999). New patterns in facilities management: Industry best practice and new organisational theory, *Facilities*, *17*(5/6), p. 159–166.

Puddy, J.R., Price, I. and Smith, L. (2001). FM policies and standards as a knowledge management system. *Facilities, 19*(13/14), 504-15.

Punch, K.F. (1998). *Introduction to Social Research: Quantitative and Qualitative Approaches.* London: Sage Publications.

Quintas P. (2002). Managing knowledge in a new century. In S. Little, P. Quintas and Tim Ray (Eds.), *Managing knowledge*. *An essential reader* (pp. 1-14). London: Sage Publications.

Rakshit, S., & Ananthasuresh, G. K. (2008). An amino acid map of inter-residual contact energies using metric multi-dimensional scaling. *Journal of Theoretical Biology.* (250) 291- 297

Ras, E., Avram, G. Waterson, P., & Weibelzahl, S. (2005). Using weblogs for knowledge sharing and learning in information spaces. *Journal of Universal*

Computer Science, 11 (3), 394-409. Retrieved from http://www.jucs.org/jucs_11_3/using_weblogs_for_knowledge/Ras_E.pdf

Reese, H. W. (1991). Contextualism and developmental psychology. In H. W. Reese (Ed.), *Advances in child development and behavior* (pp. 187-230). New York: Academic Press.

Rogers, C.R. (1969). *Freedom to Learn*. Columbus, Ohio: Charles E. Merrill.

Roschelle, J. (1989). *The construction of shared knowledge in collaborative problem solving*. Working Paper of the Institute for Research on Learning. University of California. Berkeley, CA.

Rosenberg, S., & Kim, M. (1975). The method of sorting as a data-gathering procedure in multivariate research. *Multivariate Behavioural Research, 10*, 489-502.

Sallis, E., & Jones, G. (2002). *Knowledge management in education: enhancing learning & education*. London: Kogan Page.

Salonen, A., Lehtonen, T., & Ventovuori, T. (2005). *A review and classification of empirical research in facilities management*. Paper presented at the 4th European Research Symposium in Facilities Management, p. 477–485.

Sandelowski, M., & Barroso, J. (2003). Writing the proposal for a qualitative research methodology project. *Qualitative health research*, *13*(6), 781-820.

Sandelowski, M. (2002). Reembodying qualitative inquiry. *Qualitative Health Research*, *12*(1), 104-115.

Schiffman, S. S., Reynolds, M. L., & Young, F. W. (1981). *Introduction to multidimensional scaling: Theory, methods and application*. London: Academic Press.

Scott, J. & Chanllett, E. (1973). *Planning the research interview*. Chapel Hill, NC: University of North Carolina.

Seidel, J. & Kelle, U. (1995). Different function of coding in the analysis of textual data. In: Kelle, U. et al. (Eds.), *Computer-aided Qualitative Data Analysis: Theory, Methods and Practice*, pp. 52-61. London: Sage Publications.

Seidman, I. (1998). *Interviewing as Qualitative Research: A guide for Researchers in Education and Social Sciences.* 2nd ed., London: Teachers College Press.

Shah, S. (2008). *Sustainable practice for the facility manager*. Willey-Blackwell.

Shanteau, J. (1992). Competence in experts: The role of task haracteristics. *Organisational Behaviour and Man Decision Processes, 53,* 252-266.

Shepard, R. N. (1980). Multidimensional scaling, tree-fitting, and clustering. *Science, 210*(4468), 390-398.

Siegfried, J. (1994). *The status of common sense in psychology*. Ablex Publishing Corporation.

Simpson, I.S. (1990). *How to Interpret Statistical Data: A Guide for Librarians and Information Scientists.* London: Library Association.

Skinner, B. F. (1974). *About behaviorism*. London: Penguin.

Slevin E., & Sines D. (2000). Enhancing the truthfulness, consistency and transferability of a qualitative study: Utilising a manifold of approaches. *Nurse Researcher, 7*(2), 79–89.

Smith J. (1993). *After the demise of empiricism: The problem of judging social and educational inquiry*. Norwood, NJ: Ablex.

Smith, E. E., & Jonides, J. (1999). Storage and executive processes in the frontal lobes. *Science, 283*(5408), 1657-1661.

Smith, M. (2011). ISO/TS/P 223 Facility Management. Retrieved from http://www.standards.co.nz/NR/rdonlyres/AFA7CFDE-A4A6-4EE0-BE9A-C39ADF727CF1/0/ISOfacilitiesmanagementproposal.pdf

Sørnes, J.-O. (2004). *Information and communication technologies in practice: A study of advanced users in the workplace in Norway and the United States*. Unpublished Doctoral Thesis, Norwegian University of Science and Technology, Trondheim, Norway.

Standards Australia. (2012). *Australian Standards 1815. Maintenance of Fire Protection System and Equipment*. Sydney: Standards Australia.

Stemler, S. (2001). An overview of content analysis. Practical Assessment, *Research & Evaluation, 7*(17). Retrieved from http://pareonline.net/getvn.asp?v=7&n=17

Stern, P.N., & Covan, J. (1990). *Basic Qualitative research: Grounded Theory procedures and techniques.* Newbury Park, CA: Sage Publications.

Straub, D., & Karahanna, E. (1998). Knowledge worker communications and recipient availability: Toward a task closure explanation of media choice. *Organisation Science, 9*(2), 160-175.

Strauss, A. & Corbin, J. (1998). *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory.* (2nd ed.), Thousand Oaks: Sage Publications.

Strauss, A., & Corbin, J. (1990). Basics of Qualitative Research: Grounded Theory, Procedures and Techniques. Newbury Park, CA: Sage Publications.

Takane, Y., Young, F. W., & De Leeuw, J. (1977). Nonmetric individual differences multidimensional scaling: an alternating least squares method with optimal scaling features. *Psychometrika*, *42*, 593-600.

Tan, J. (2009). *Higher education students' learning and knowledge sharing: a grounded theory study of blog use.* Unpublished doctoral dissertation, University of Sheffield, Sheffield, England.

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

Teicholz, E. (2001). *Facility design and management handbook*: McGraw-Hill Professional.

Temple, P. (2008). Learning spaces in higher education: an under-researched topic. *London Review of Education, 6*(3), 229-241.

Torgerson and Gower, W. S. (1958). *Theory & Methods of Scaling*. New York: Wiley.

Trochim, W. (1993). *Reliability of concept mapping.* Paper presented at the Annual Conference of the American Evaluation Association, Dallas, Texas.

Tulving, E. (1972). Episodes and semantic memory. In E. Tulving & W. Donaldson. (1972). *Organisation of memory*. London: Academic Press.

Turner, B. A. (1983). The use of grounded theory for the qualitative analysis of organisational behaviour. *Journal of Management Studies, 20*(3), 333-348.

Van Deun, K., & L. Delbeke. (2000). *Multidimensional scaling, ODL-open and distance learning.* Germany: Open and Distance Learning, Department of Social Psychology, University of Bonn. Retrieved from http://www.unibonn.de/Mathpsyc/doc/delbeke/delbeke.htm

Van Looy, B., Callaert, J., & Debackere, K. (2006). Publication and patent behavior of academic researchers: Conflicting, reinforcing or merely co-existing?. *Research Policy, 35*(4), 596-608.

Vanlande, R., Nicolle, C., & Cruz, C. (2008). IFC and building lifecycle management. *Automation in Construction*, *18*(1), 70-78.

Vygotsky, L. S. (1978). *Mind and society: The development of higher mental processes*. Cambridge, MA: Harvard University Press.

Warren, C. M., & Heng, S. K. (2005). *FM Education, Are we meeting industry needs.* Paper presented at the Pacific Rim Real Estate Society 11th Annual Conference, Melbourne.

Wegner, P. (1987). *Dimensions of object-based language design.* Paper presented at the Object-Oriented Programming Systems, Languages, and Applications Conference Florida.

Western Australian Government. (1960). *Local government miscellaneous provisions.* Perth: Western Australian Government.

Western Australian Government. (1989). *Building regulations.* Perth: Western Australian Government.

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

Wilson, G., Jackson, P., & Smith, W. (2003). *Knowledge management strategies in small and medium size organisation: A take of two systems*. Western Australia: Australian Company Incorporation Services.

Winograd, T., & Flores, F. (1986). *Understanding computers and cognition: A new foundation for design*. Ablex Pub.

Wuest, J., Merritt-Gray, M., Berman, H., & Ford-Gilboe, M. (2002). Illuminating social determinants of women's health using grounded theory. *Health care for women international*, *23*(8), 794-808.

Wuest, J., Ericson, P. K., & Stern, P. N. (2006). Becoming strangers: the changing family caregiving relationship in Alzheimer's disease. *Journal of Advanced Nursing*, *20*(3), 437-443.

Young, F. W., & Null, C. H. (1978). Multidimensional scaling of nominal data: the recovery of metric information with ALSCAL. *Psychometrika*, *43*(3), 367-379.

Young, F. W., de Leeuw, J., & Takane, Y. (1976). Regression with qualitative and quantitative variables: An alternating least square method with optimal scaling features. *Psychometrika 41,* 505-529.

Young, G., & Householder, A. S. (1941). A note on multidimensional psychophysical analysis. *Psychometrika*, *6*(5), 331-333.

Zack, M. (1999). Managing codified knowledge. *Sloan Management Review 40*(4), 45-58.

Zemke, R., & Zemke, S. (1995, June). Adult learning: What do we know for sure? *Training 32*(6), 31-38.

Zyngier, S. (2002). *Knowledge management obstacles in Australia*. Paper presented at the 10th European Conference on Information Systems, Poland.

APPENDIX A

PILOT STUDY KNOWLEDGE CATEGORIES AND SUBORDINATE CONCEPTS

abstracting
academic
accommodation
account
accounting
acoustics
actions
activities
actors
administration
advanced
advertising
advice
advisors
aerial
aesthetic
against
agreements
aggregated
air conditioning
allocation
ambition
analyse
analyses
analysing
analysis
application
applied
appraisal
assessment
assurance
attitude
attributes
audience
awareness
backgrounds
balance
balanced
banking
bargaining
basic
behaviour
benchmarking
benefit
board
break
bubble
budget
budgeting
budgets
building
business
businesses
calculation
capacity
capital
cases
cash
corporate
correctness
correlation
cost
costing
creative
creativity
criteria
cultural
culture
cultured
curator
customers
cycle
data
dealing
decisions
defining
delivered
delivery
demands
demographic
demographics
description
descriptions
design
designed
designing
designs

approach
approaches
approval
architectural
architecture
argumentation
articles
aspects
core
disciplinary
dispersion
distinguish
distribution
diverse
drawing
dynamic
ecological
economics
economy
editing
education
effective
effects
efficiency
efficient
elasticity
employee
employer
employment
energy
engage
engineering
enrichment
catalogue
central
change
changes
changing
characteristics
chart
choices
clients
external
externally
facility
factors
facts
feasibility
feasible
finance
financed
financial
financially
findings
finish
finishes
flow
fluctuation
forecast
forecasting
forma
formal
formation
formulate
formulating
formulation
determination
develop
developing
development
diagnosis
diagnostics
diagram
dimensional
dimensions
growth
guidelines
handle
handling
hardware
health
healthy
heating
horizon
housing
human
hvac
identification
identity
impact
implement
implementation
implemented
implementing
improve
improvement
inclination
income
indicators

enthuse
environment
environmental
equilibrium
ergonomics
estate
estimating
ethical
ethics
European
evaluation
evolution
evidently
executives
existing
expansion
expense
experience
internally
international
internationalisation
interpret
interpretation
interpreting
intervals
intervention
interviewing
introductory
inventory
investment
issues
job
judgment
forth
foundation
framework
free
from
function
functions
fundamental
funding
furniture
gaming
Gantt
gathering
globalization
goals
government
graphical
group
management
manager
managing
manpower
manufacturers'
maps
market
marketing
markets
material
materials
matrix
means
measurement
individual
industry
inflation
influence
influences
information
innovate
innovation
innovative
input
inside
inspire
institutions
instruments
insurance
integral
interaction
interior
internal
operating
operation
operational
operations
opportunities
optimize
optimum
organisation
organisational
organisations
organisations
organizing
oriented
others

key
knowledge
landlord
law
layouts
leader
leadership
leading
leasing
legal
legislation
letters
level
levels
liability
life
lifecycle
light
limitations
linear
liquidation
locations
loss
maintainability
maintenance
major
makers
making
manage
premises
present
presentation
price
measurements
measures
media
meeting
memorandum
mental
method
methods
mission
model
models
modes
money
monitoring
mood
moral
motivate
move
multiple
national
needed
needs
negotiable
negotiating
negotiation
number
objective
objectives
office
quantify
quantitative
rates
ratios
output
outsource
outsourcing
overall
parts
patterns
peculiarities
people
performance
performer
permits
personal
personality
personnel
phases
physical
planet
planning
plans
policies
policy
political
positioning
positions
possible
potential
power
practices
preconditions
salary
sales
sample
sampling

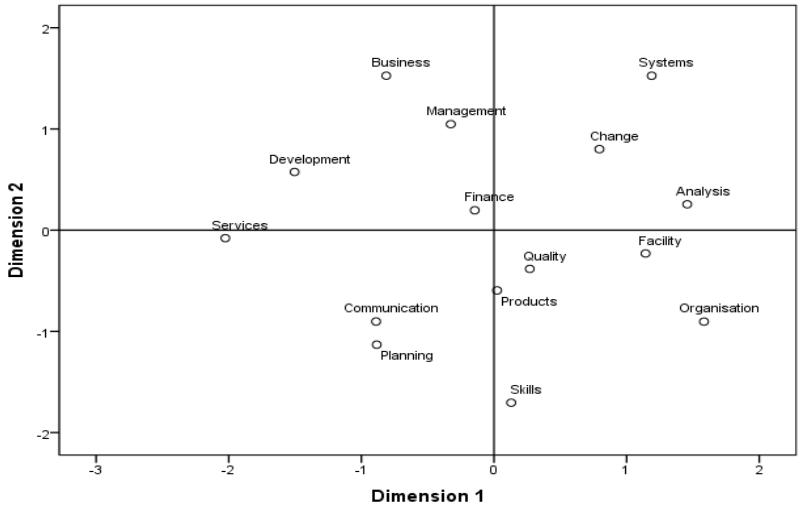
pricing
primary
principles
probability
problems
procedures
process
processes
processing
procurement
product
production
productivity
professional
professionals
profits
programme
programming
programs
progress
project
projects
promotion
properties
property
proportions
proposal
proposals
prosperity
provider
provision
psychological
public
react
real
reasoning
reasons
recession
recommendations
reduce
reflect
reflection
refrigeration
registered
regression
regulations
regulatory
related
relation
relations
relationship
reliability
reliable
relocation
renew
report
reporting
reports
requirements
research
resistance
resource
resources
responsibilities
responsibility
results
satisfaction
scenario
scenarios
schedule
schedules
scheduling
scheme
scientific
scorecard
sector
selected
selection
sensibility
sequencing
server
service
setting
share
sheet
sign
simple
situation
situations
skills
small
social
society
software
solutions
sound
space
spot
staff

publication
purchase
purchased
purchasing
qualitative
quality
strategic
strategies
strategy
strengths
strong
structural
structures
structuring
studies
success
successful
suitable
supervise
supplier
suppliers
supply
support
sustainability
sustainable
swot
system
systems
tactical
target
team
technical
techniques
return
review
risk
roles
rules
safety
technological
technologies
technology
telecom
temporary
tenant
tendency
tender
tendering
terminology
text
theoretical
theories
theory
thermal
tools
total
training
transfer
treats
trends
types
understand
unemployment
urgency
users
utility
staffing
stakeholders
standards
statements
statistics
standards
utilization
validity
valuations
value
values
ventilation
view
vision
visual
wage
wall
walls
weaknesses
well
which
willingness
wishes
within
work
worked
working
workplace
writing
written
zoning

APPENDIX B

PILOT STUDY PHASE THREE INTERVIEW TRANSCRIPT

Interview Participants	Recorded Questions and Answers
Interviewer	Start time: 15.05 on Monday 26th August 2011. Do you give me permission to record this interview in order that I may review it later and transcribe the comments
Sean	That Fine
Interviewer	(1) On examination of the spatial MDS map what is your consideration as to the proximity relationships of some categories and their positions and dose it shows the overall knowledge structure for the Facility Management role?



Sean	The role of FM is more complex than is often thought there are always jobs within any industry that require a certain amount of additional expertise. This can be said of any Facility Manager who managers a building or type of facility which is outside the main stream and has

a requirement for a unique set of skills.

I see the disparity between *Organisation* and *Business* is not what I thought I would see. I feel that the organisation category is more closely related to business than is shown on the MDS map. He Most organisational and the business requirements mean that there is a close relationship between the business entity, philosophy, values and the organisation needs than is reflected here.

Skills I think is also a misnomer or misplaced with it appearing to have no belonging to the others knowledge categories. There are fundamental components of all the knowledge categories that are required by the Facility Management practitioner in order to perform the role correctly. I actually am starting to question whether Skill is a knowledge category or an attribute which is a fundamental component of the other knowledge contents present within the map such as Management, Finance and Planning, Quality, Change and Services

Interviewer (2) The data source for the Facility Management and subordinate knowledge concepts representative of the industry?

Sean Is the source of the data presented from Phase One objective enough use here and I think than the undergraduate courses are driven by FM practitioner's perception of the Facility Management core concepts. In my experience the market drivers are what influence the market and this directs the offering of universities

present to their respective market segments allowing for bias in opinion.

Interviewer (3) Do you consider 15 Facility Management Knowledge concepts sufficiently representative of the role of the Facility Management practitioner?

Sean I think there needs to be more Facility Management categories and the number of categories chosen by the considering should be decided that practitioners decide what concepts are to be more prevalent than others, but that can be dangerous as the results can be skewed dependent upon the background of the participant and the role the participant is performing at the time the assessment was made.

I also think the peer reviewed experts chosen from a combination of practitioners and academics was sufficient in allowing a comprehensive overview of the knowledge categories from within the industry and each person brings to the table different skill based on their back ground and qualification, but the basic premise of Facility Management knowledge concepts should be within reason consistent as all concepts are used or taught.

APPENDIX C

PILOT STUDY SURVEY

INSTRUMENT

when compared to			Unrelated	1	2	3	4	5	6	7	8	9	10	Highly Related
Management		Facility												
Management		Change												
Management		Planning												
Management		Development												
Management		Service												
Management		Business												
Management		Organization												
when compared to			Unrelated	1	2	3	4	5	6	7	8	9	10	Highly Related
Management		Analysis												
Management		Quality												
Management		Communication												
Management		Skills												
Management		Product												
Management		Services												
Management		Systems												
when compared to			Unrelated	1	2	3	4	5	6	7	8	9	10	Highly Related
Facility		Change												
Facility		Planning												
Facility		Development												
Facility		Service												
Facility		Business												
Facility		Organisation												
Facility		Analysis												
when compared to			Unrelated	1	2	3	4	5	6	7	8	9	10	Highly Related
Facility		Quality												
Facility		Communication												
Facility		Skills												
Facility		Product												
Facility		Services												
Facility		Systems												
when compared to			Unrelated	1	2	3	4	5	6	7	8	9	10	Highly Related
Change		Planning												
Change		Development												
Change		Service												

Change		Business												
Change		Organisation												
Change		Analysis												
when compared to			Unrelated	1	2	3	4	5	6	7	8	9	10	Highly Related
Change		Quality												
Change		Communication												
Change		Skills												
Change		Product												
Change		Services												
Change		Systems												
when compared to			Unrelated	1	2	3	4	5	6	7	8	9	10	Highly Related
Planning		Development												
Planning		Service												
Planning		Business												
Planning		Organisation												
Planning		Analysis												
Planning		Quality												
when compared to			Unrelated	1	2	3	4	5	6	7	8	9	10	Highly Related
Planning		Communication												
Planning		Skills												
Planning		Product												
Planning		Services												
Planning		Systems												
when compared to			Unrelated	1	2	3	4	5	6	7	8	9	10	Highly Related
Development		Service												
Development		Business												
Development		Organisation												
Development		Analysis												
Development		Quality												
when compared to			Unrelated	1	2	3	4	5	6	7	8	9	10	Highly Related
Development		Communication												
Development		Skills												
Development		Product												
Development		Services												
Development		Systems												
when compared to			Unrelated	1	2	3	4	5	6	7	8	9	10	Highly Related
Service		Business												

Service		Organisation												
Service		Analysis												
Service		Quality												
Service		Communication												
when compared to			Unrelated	1	2	3	4	5	6	7	8	9	10	Highly Related
Service		Skills												
Service		Product												
Service		Services												
Service		Systems												
when compared to			Unrelated	1	2	3	4	5	6	7	8	9	10	Highly Related
Business		Organisation												
Business		Analysis												
Business		Quality												
Business		Communication												
Business		Skills												
Business		Product												
Business		Services												
Business		Systems												
when compared to			Unrelated	1	2	3	4	5	6	7	8	9	10	Highly Related
Organisation		Analysis												
Organisation		Quality												
Organisation		Communication												
Organisation		Skills												
Organisation		Product												
Organisation		Services												
Organisation		Systems												
when compared to			Unrelated	1	2	3	4	5	6	7	8	9	10	Highly Related
Analysis		Quality												
Analysis		Communication												
Analysis		Skills												
Analysis		Product												
Analysis		Services												
Analysis		Systems												
when compared to			Unrelated	1	2	3	4	5	6	7	8	9	10	Highly Related
Quality		Communication												
Quality		Skills												

Quality		Product												
Quality		Services												
Quality		Systems												
when compared to			Unrelated	1	2	3	4	5	6	7	8	9	10	Highly Related
Communication		Skills												
Communication		Product												
Communication		Services												
Communication		Systems												
when compared to			Unrelated	1	2	3	4	5	6	7	8	9	10	Highly Related
Skills		Product												
Skills		Services												
Skills		Systems												
when compared to			Unrelated	1	2	3	4	5	6	7	8	9	10	Highly Related
Product		Services												
Product		Systems												
when compared to			Unrelated	1	2	3	4	5	6	7	8	9	10	Highly Related
Services		Systems												

APPENDIX D
UNDERGRADUATE TERTIARY COURSES

1 Leeds Carnegie (Metropolitan) University Bachelor of Facility Management

2 Brigham Young University, School of Technology, Bachelor Facility and Property Management

3 Community College of Philadelphia, Associate of Applied Science (A.A.S.) degree in Facility Management

4 Conestoga College, School of Architecture – Bachelor Project and Facility Management

5 Cornell University, College of Human Ecology Bachelor Facilities Planning and Management

6 College of DuPage Associate in Applied Science (A.A.S.) degree in Facility Management.

7 Delaware County Community College, Associate of Applied Science Degree in Facility Management Technology

8 Ferris State University, Bachelor Degree, Architecture Technology and Facility Management

9 Hochschule Kufstein Tirol University of Applied Science, Bachelor Facility and Real Estate Management

10 Hanze University Applied Science. Bachelor Facility Management

11 JAMK University of Applied Sciences, Bachelor Hospitality Management and Facility Management

12 Laurea Universities of Applied Sciences Bachelor Facility Management and Hospitality Management

13 Limkokwing Institute of Creative Technology, Bachelor Facility Management

14 Lone Star College Associate in Applied Science (A.A.S.) Facilities Management

15 Breda University of Applied Bachelor of International Real Estate and Facility Management

16 Southeast Missouri State University, Bachelor of Facility Management

17 Sheffield Hallam University, Bachelor of Facility Management

18 University of Wisconsin-Stout, Bachelor Property Management

19 University of Texas and San Antonio, Bachelor Real Estate Finance and Development with a Minor in Facility Management

20 Wentworth Institute of Technology, Bachelor Facilities Planning & Management Degree

21 Saxion University of Applied Sciences Bachelor Facility Management

APPENDIX E

MAINS STUDY DATA

access
accessibility
accident
accounting
accounts
accreditation
accruals
accuracy
acoustic
acquisition
act
activities
activity
administration
aesthetics
agency
agreement
air conditioning
airport
alarm
algebra
algebraic
allocation
alloys
ambient
amortization
analysis
analytical
ancillary
animation
annealing
anthropometrics
appearance
applied
appraisal
approvals
arbitration
architects
architecture
area
arts
assemblies
assembling
assessing
assessment
asset
audits
automation
auxiliary
axonometric
bar
barriers
behaviour
bid
bill
biological
blueprint
boards
boilers
bond
breakdown
budget
building
built
business
cad
calculating
capacitor
capacity
capital
cash
centre
central
ceramics
chain
change
characteristics
chart
chemical
client
climate
code
cogeneration
cold
collaboration
collaborative
comfort
commerce
commercial
commitments
communities
company
competitiveness
compliance
components
composite
computer
concrete
condensers
conflict
conservation
constitutional
constraints
construction
consultant
consulting
consumption
containment
contemporary
contingency
continuous
contracting
contractor
contractual
conveyance
cooling
coordinate
corporate
corporation
corrosion
cost
council
course
court
creditors
critical
cultural
culture
curtain

custodial
customer
cycle
dangerous
data
database
deferrals
deformation
department
depletion
depreciation
dermatitis
design
designers
designing
detailing
detection
development
diagram
diagrams
digital
dimensional
direction
directors
disciplines
displacements
disposal
dispute
distribution
documentation
drafting
drainage
durability
dynamics
easements
ecology
editing
efficiency
egress
elderly
electric
electricity
electromagnetic
electronic
elevators
emergency
employability
employment
energy
engineering
engineers
entrepreneurship
envelop
environment
equipment
ergonomics
estimating
estimation
ethical
evaporators
excavation
exchangers
exterior
extremes
extrude
facility
failure
fair
fans
feasibility
federal
files
finishes
fire
firms
flame
floor
flow
fluid
fluids
flux
force
foundations
framing
fuels
function
furnaces
furniture
gases
geographical
geometry
glazing
goals
goods
gothic
governing
governmental
green
grounds
habitation
hardware
harmonic
hazard
healthcare
healthy
heat
heating
height
hiring
historic
historical
history
hospitality
house
housing
human
humanities
humidity
hvac
hydraulics
hygiene
illumination
improvement
income
incorporation
individuals
indoor
induction
inequalities

inertia
inflation
information
injury
innovation
inspection
installation
institute
instruction
instrumentation
instruments
insulation
insurance
integrating
integration
intelligent
intentional
interior
interiors
internal
interviewing
interviews
intrusion
inventory
investments
ionizing
job
jurisdiction
kinetic
kirchhoff
labour
ladder
land
landlord
law
laws
layout
leadership
learning
leasing
legal
legislation
lenses
leveling
liabilities
light
lighting
litigation
loads
loft
logarithms
logic
loss
magnetic
maintenance
making
management
manipulation
manufacture
manufacturing
marketing
masonry
material
materiality
materials
mathematics
matrices
measurement
mechanical
mediation
metal
metallurgy
microeconomics
modelling
money
monitoring
mortgage
mortgaging
motors
negotiations
network
noise
objectives
occupancies
occupancy
occupant
occupational
occupations
office
operation
operations
optics
oral
order
orthographic
oscillating
outside
overhead
owners
ownership
parametric
partnership
partnerships
path
payroll
penalties
people
perception
performance
performances
performing
personal
personnel
physical
physics
pipes
piping
plan
plane
planning
plant
plants
plastics
plumbing
pneumatics
policies
policy
political
possession

standpipes
state
statement
statements
statically
statics
station
statistics
statutory
steam
steel
stock
store
storm
team
techniques
temperature
tenant
thermal
thermodynamics
time
title
torts
transactions
transfer
transformers
transportation
treatment

APPENDIX F

PHASE TWO SURVEY INSTRUMENT

Q1 The below category comparisons are attempting to find how similar you as a Facility Management Expert consider the
concepts to be to each other. Please indicate with a mark, how related or unrelated you feel each item may be

	Unrelated	2	3	4	5	6	7	8	9	Highly Related
Building Services to Business	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Building Services to Codes	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Building Services to Energy	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Building Services to Environment	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Building Services to Facility	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Building Services to Finance	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Building Services to Fire Life Safety	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Building Services to Maintenance	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Building Services to Management	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Building Services to Planning	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Building Services to Project	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Building Services to Quality	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Building Services to Real Estate	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Business to Codes	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Business to Energy	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Business to Environment	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Business to Facility	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Business to Finance	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Business to Fire Life Safety	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Business to Maintenance	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Business to Management	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Business to Planning	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Business to Project	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Business to Quality	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Business to Real Estate	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Codes to Energy	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Codes to Environment	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Codes to Facility	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Codes to Finance	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Codes to Fire Life Safety	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Codes to Maintenance	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Codes to Management	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Codes to Planning	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Codes to Project	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

Codes to Quality	O	O	O	O	O	O	O	O	O	O
Codes to Real Estate	O	O	O	O	O	O	O	O	O	O
Energy to Environment	O	O	O	O	O	O	O	O	O	O
Energy to Facility	O	O	O	O	O	O	O	O	O	O
Energy to Finance	O	O	O	O	O	O	O	O	O	O
Energy to Fire Life Safety	O	O	O	O	O	O	O	O	O	O
Energy to Maintenance	O	O	O	O	O	O	O	O	O	O
Energy to Management	O	O	O	O	O	O	O	O	O	O
Energy to Planning	O	O	O	O	O	O	O	O	O	O
Energy to Project	O	O	O	O	O	O	O	O	O	O
Energy to Quality	O	O	O	O	O	O	O	O	O	O
Energy to Real Estate	O	O	O	O	O	O	O	O	O	O
Environment to Facility	O	O	O	O	O	O	O	O	O	O
Environment to Finance	O	O	O	O	O	O	O	O	O	O
Environment to Fire Life Safety	O	O	O	O	O	O	O	O	O	O
Environment to Maintenance	O	O	O	O	O	O	O	O	O	O
Environment to Management	O	O	O	O	O	O	O	O	O	O
Environment to Planning	O	O	O	O	O	O	O	O	O	O
Environment to Project	O	O	O	O	O	O	O	O	O	O
Environment to Quality	O	O	O	O	O	O	O	O	O	O
Environment to Real Estate	O	O	O	O	O	O	O	O	O	O
Facility to Finance	O	O	O	O	O	O	O	O	O	O
Facility to Fire Life Safety	O	O	O	O	O	O	O	O	O	O
Facility to Maintenance	O	O	O	O	O	O	O	O	O	O
Facility to Management	O	O	O	O	O	O	O	O	O	O
Facility to Planning	O	O	O	O	O	O	O	O	O	O
Facility to Project	O	O	O	O	O	O	O	O	O	O
Facility to Quality	O	O	O	O	O	O	O	O	O	O
Facility to Real Estate	O	O	O	O	O	O	O	O	O	O
Finance to Fire Life Safety	O	O	O	O	O	O	O	O	O	O
Finance to Maintenance	O	O	O	O	O	O	O	O	O	O
Finance to Management	O	O	O	O	O	O	O	O	O	O
Finance to Planning	O	O	O	O	O	O	O	O	O	O
Finance to Project	O	O	O	O	O	O	O	O	O	O
Finance to Quality	O	O	O	O	O	O	O	O	O	O
Finance to Real Estate	O	O	O	O	O	O	O	O	O	O
Fire Life Safety to Maintenance	O	O	O	O	O	O	O	O	O	O
Fire Life Safety to Management	O	O	O	O	O	O	O	O	O	O
Fire Life Safety to Planning	O	O	O	O	O	O	O	O	O	O
Fire Life Safety to Project	O	O	O	O	O	O	O	O	O	O

Fire Life Safety to Quality	○	○	○	○	○	○	○	○	○	○
Fire Life Safety to Real Estate	○	○	○	○	○	○	○	○	○	○
Maintenance to Management	○	○	○	○	○	○	○	○	○	○
Maintenance to Planning	○	○	○	○	○	○	○	○	○	○
Maintenance to Project	○	○	○	○	○	○	○	○	○	○
Maintenance to Quality	○	○	○	○	○	○	○	○	○	○
Maintenance to Real Estate	○	○	○	○	○	○	○	○	○	○
Management to Planning	○	○	○	○	○	○	○	○	○	○
Management to Project	○	○	○	○	○	○	○	○	○	○
Management to Quality	○	○	○	○	○	○	○	○	○	○
Management to Real Estate	○	○	○	○	○	○	○	○	○	○
Planning to Project	○	○	○	○	○	○	○	○	○	○
Planning to Quality	○	○	○	○	○	○	○	○	○	○
Planning to Real Estate	○	○	○	○	○	○	○	○	○	○
Project to Quality	○	○	○	○	○	○	○	○	○	○
Project to Real Estate	○	○	○	○	○	○	○	○	○	○
Quality to Real Estate	○	○	○	○	○	○	○	○	○	○

APPENDIX G

PHASE TWO SURVEY RESULTS

Knowledge Comparison	Mean	SD
Building Services to Business	8.7	1.5
Building Services to Codes	8.7	1.4
Building Services to Energy	8.9	1.3
Building Services to Environment	8.5	1.7
Building Services to Facility	9.2	1.2
Building Services to Finance	8.4	1.6
Building Services to Fire Life Safety	9.1	1.2
Building Services to Maintenance	9.2	1.0
Building Services to Management	8.4	1.6
Building Services to Planning	8.2	1.3
Building Services to Project	8.3	1.6
Building Services to Quality	8.3	1.2
Building Services to Real Estate	7.1	2.1
Business to Codes	7.1	1.7
Business to Energy	8.3	1.5
Business to Environment	7.9	1.6
Business to Facility	8.5	1.4
Business to Finance	9.1	1.1
Business to Fire Life Safety	8.1	1.8
Business to Maintenance	7.6	1.8
Business to Management	8.6	1.7
Business to Planning	8.4	1.4
Business to Project	8.1	1.3
Business to Quality	7.6	2.0
Business to Real Estate	7.6	2.1

Codes to Energy	7.8	1.5
Codes to Environment	8.0	1.3
Codes to Facility	8.4	1.7
Codes to Finance	6.8	2.0
Codes to Fire Life Safety	9.0	1.4
Codes to Maintenance	8.5	1.3
Codes to Management	7.7	1.5
Codes to Planning	7.8	1.6
Codes to Project	7.9	1.5
Codes to Quality	7.4	2.1
Codes to Real Estate	6.5	2.3
Energy to Environment	9.1	1.2
Energy to Facility	9.0	1.4
Energy to Finance	8.4	1.5
Energy to Fire Life Safety	6.2	2.2
Energy to Maintenance	8.1	1.5
Energy to Management	7.9	1.6
Energy to Planning	7.8	1.7
Energy to Project	7.4	1.6
Energy to Quality	7.6	1.9
Energy to Real Estate	7.1	2.6
Environment to Facility	8.5	1.5
Environment to Finance	7.1	1.7

APPENDIX H

TRANSCRIPT OF PRIMARY INTERVIEW GROUP PHASE THREE

The following transcript was taken during the recorded interview of one of the six security experts

	Facility Management expert Bill Recorded Questions and Answers
Interviewer	Start time: 8.45am on Thursday 11th July 2012. Do you give me permission to record this interview in order that I may review it later and transcribe the comments
Bill	That Fine
Interviewer	[Question 1] My research has shown *Finance* as a central theme to the Facility Management domain. What is your opinion of its importance and what relationship do you feel it has to other knowledge categories?
Bill	Finance is a key measurable of Facilities Management, as good FM should encompass all areas of service that support the core business of an organisation. Good facilities management can make a huge difference to the efficiency and productivity of a company and the wellbeing of its staff. By using best business practice, a company's operating costs can be reduced while at the same time, its productivity increased. In short, it's the one discipline that ensures that the building, services and personnel, all perform together efficiently. Efficient FM can impact favourably on most knowledge categories. By using best practice techniques when servicing equipment and by replacing end of life equipment with more energy efficient options, the total required energy of a business can be reduced, so reducing operating costs and its environmental impact, whilst improving the day to day life of its employees and displaying a positive environmental image to its customers.
Interviewer	[Question 2] *Building Services* is an overarching category within the context of Facility Management. Findings have shown a close correlation between *Building Services* and *Maintenance,* but a disconnect between *Fire Life Safety, Environment* and *Codes*. Therefore, what is your understanding of the relationship of:

Interviewer
Bill

1. *Building Services* to *Maintenance*?
This is the relationship between the as installed building engineering, to the safe and efficient operation of in in field devises.

Interviewer
Bill

2. Building Services to *Fire Life Safety?*
This is the relationship between the as installed building engineering, to the safety and wellbeing of the building occupants.

Interviewer
Bill

Building Services to *Codes?*
This is the relationship between the as installed building engineering to the statutory conformance required to ensure the safety and wellbeing of the building occupants, and is directly related to life safety.

Interviewer
Bill

3. Building Services to *Environment?*
This is the relationship between the as installed building engineering to the in field devises, in order to ensure the efficient operation of the building and ensuring reduced environmental impact.

Interviewer
Bill

4. *Maintenance* to *Environment?*
This is restoring an item to a state in which it can perform its required function, ensuring minimal or reduced impact on the environment

Interviewer
Bill

5. *Maintenance* to *Fire Life Safety?*
This is restoring an item to a state in which it can perform its required function, to ensure the safety and wellbeing of the building occupants.

Interviewer
Bill

6. *Maintenance* to *Codes?*
This is restoring an item to a state in which it can perform its required function, ensuring conformance to minimum codes of practice, so ensuring the wellbeing of the building occupants.

Interviewer
Bill

7. *Fire Life Safety* to *Codes?*
There is a direct correlation between Fire Life Safety and codes, as both are intended to ensure the safety and wellbeing of the building occupants, albeit the codes set the minimum level of requirement, while Fire Life Safety considerations may necessitate enhanced measures, procedures or systems to be put installed.

Interviewer 8. *Environment* to *Codes?*

Bill The modern day Facility Manager or Environmental & Sustainability Manager, is required to submit a variety of mandatory reports to show a company's corporate environmental performance. Often, merely ensuring compliance to code when a facility is designed or modified is not enough to ensure compliance with ever tightening environmental compliance requirements.

Interviewer [Question 3]Considering the categories of *Management and Business*, comment on what *Management* and *Business* mean to you in the context of Facility Management?

Bill An effective understanding of management and business allows the modern FM to understand the latest practices and gives a perspective on key issues such as change, innovation and technology, quality and employee performance. In addition, by studying management and business, we can seek to develop the generic management skills of communication, problem solving, planning, organising, change management and working co-operatively with other decision makers.

Interviewer A close relationship between *Management*, *Energy* and *Planning* but a disconnect with *Projects*, *Facility and Quality* was presented in my research. What is your understanding of the relationship between the categories:

Interviewer *Facility* to *Management?*

Bill It's important that any building performs as designed and in a way that it is reasonably expected to. A troublesome, unreliable or non performing facility can create negativity amongst the building occupants, causing morale issues for management.

Interviewer *Project* to *Management?*

Bill From personal experience, I have found a fair amount of disconnect between "Project Teams", (Architects), and Management. Experience has taught me that many new buildings are designed and built to be Architecturally impressive, at the expense of its functionality.

Interviewer *Project* to *Planning?*

Bill It's important that as part of any project, thought is given to planning the FM requirements of the building, after it has reached Practical Completion. Statutory testing requirements can be easily satisfied, if at the design stage, thought is given to installing smart systems, to automatically monitor and check the as installed equipment.

Interviewer	*Project* to *Quality?*
Bill	When designing a new facility or installation, price is often a major consideration when equipment and systems are specified. It is not unusual for a building to be designed, employing new technologies, and best practice solutions, only to find many of them value engineered out when the cost estimate is received. The removal of these new technologies negatively impacts on the performance of the facility, which affects the quality of output from its occupants.
Interviewer	*Facility* To *Quality?*
Bill	A modern, well designed, and efficient facility can create a working environment which encourages its occupants to perform well.
Interviewer	*Facility* to *Energy?*
Bill	A well designed facility, employing best practice techniques, state of the art equipment and modern control systems, can have a major positive impact on the energy efficiency of any complex.
Interviewer	*Facility* to *Planning?*
Bill	By studying how well an existing facility performs, it is possible to create a "Specification Blueprint" in order to improve the functionality of future projects. These "lessons learnt", both in the form of building design and operation and just as importantly, in equipment selection, are invaluable in ensuring mistakes made in one build, are not replicated in the next.
Interviewer	*Facility* to *Business?*
Bill	The category comparisons detailed immediately above, Facility to Quality, Facility to Energy and Facility to Planning, all combine to encompass Facility to Business. Good planning of a facility, a low energy profile and a quality working environment, all assist in ensuring a successful business.
Interviewer	*Management* to *Quality?*
Bill	It's the responsibility of all facets of business management, Facility Managers, Operational Managers and Senior Managers, to ensure a quality output from their own area of influence. Continuous improvement by all ensures that a business continues to move forward.
Interviewer	*Real Estate* has been shown within the research to have a low correlation to many of the other categories. Explain what you understand of the term *Real Estate* to represents in the context of Facility Management?
Bill	

	To most people, the term “Real Estate” refers to the buying, selling, or renting of land, buildings or housing. In FM terms, I believe that Real Estate refers to the entire facility package. Of course it includes the buildings and grounds that make up the visible facility, but it also includes the “Hard” infrastructure, not normally considered in Real Estate terms, such as underground services, power, hydraulics and HVAC, as well as the “Soft” infrastructure items, such as waste removal, equipment servicing and occupant wellbeing. To an FM professional, all of these items are equally as important as the visible entity and are equally important to the efficient and economical operation of a facility. In a well managed facility, the soft issues should also be as inconspicuous to the occupants of the building, as the hard issues.
Interviewer	Do you have anything to add or final comments to make?
Bill	I think I have waffled on for long enough!
Interviewer	Thank you for taking the time to do the interview time finished 9.30am
Bill	No Problem at all

APPENDIX I
SECONDARY EXPERT GROUP INTERVIEW TRANSCRIPTS

No.	Interview question
Interviewer	My research has shown *Finance* as a central theme to the Facility Management domain. What is your opinion of its importance and what relationship do you feel it has to other knowledge categories?
Gemms	Finance, project finance and their understanding are essential in the delivery of a successful FM. It is critical from a Contract Mangers perspective to understanding the life cycle of equipment to relate that back to financial projections and current expenditure. All other specifics in FM fall in line with finance as the central theme. Eg performing a holistic current life expectancy of current equipment.
Interviewer	*(Question 1)Building Services* is an overarching category within the context of Facility Management. Findings have shown a close correlation between *Building Services* and *Maintenance,* but a disconnect between *Fire Life Safety, Environment* and *Codes*. Therefore, what is your understanding of the relationship of:
Interviewer	Building Services to Maintenance?
Gemma	Without the continued building services could result in failures which are not only costly but be a safety hazard.
Interviewer	Building Services to Fire Life Safety?
Gemma	Very similar to the previous answer although the consequences of not servicing fire prevention equipment are far greater. This is key to a contract manager's success.
Interviewer	Building Services to Codes?
Gemma	Unlawful in some instances to not service equipment to the appropriate code. This in the mind of a contract manager is part of his core business to ensure these types of services are completed to the required standard.
Interviewer	Building Services to Environment?:
Gemma	The ever growing nature of ensuring all services are completed to ensure no environmental damage occurs is essential. Eg the annual inspection of Fuel tank must be carried out.
Interviewer	Maintenance to Environment?
Gemma	Maintaining for example of fuel pump and associated bunds are critically important to ensuring no spillage into the environment. This has not only environmental effect but also

community and company reputation within the industry.

Interviewer Maintenance to Fire Life Safety?

Gemma Saving lives comes to mind when talking about maintenance in this area, from a contract managers perspective it is his responsibility to ensure the works are carried out to the required standard AS 1851 I think from memory

Interviewer Maintenance to Codes?.

Gemma Unlawful in some instances to not service equipment to the appropriate code. This in the mind of a contract manager is part of his core business to ensure these types of services are completed to the required standard.

Interviewer Fire Life Safety to Codes?

Gemma Very similar to the previous answer although the consequences of not servicing fire prevention equipment are far greater. This is key to a contract managers success

Interviewer Environment to Codes?

Gemma Maintaining for example of fuel pump and associated bunds are critically important to ensuring no spillage into the environment. This has not only environmental effect but also community and company reputation within the industry

Interviewer Considering the categories of *Management and Business*, comment on what Management and Business mean to you in the context of Facility Management?

Gemma The category of management I believe relates to the management of people and the facility you are responsibility for. The business portion I believe essentially means running the business from a Safety, Financial, Quality and timeliness perspective which also includes the reporting function

Interviewer A close relationship between *Management, Energy* and *Planning* but a disconnect with *Projects, Facility and Quality* was presented in my research. What is your understanding of the relationship between the categories:

Interviewer Facility to Management?

Gemma Response: Ensure the facility has the life cycle plan to ensure a efficient management plan is developed and executed

Interviewer Project to Management?

Gemma Ensure the correctly skilled individual is managing the project.

Interviewer Project to Planning?

Gemma Essential particular in building structure and infrastructure. It is my belief that there must be a substantial planning group to assist in the having a project plan. Typically the planning section is overlooked

Interviewer	Project to Quality?
Gemma	Area that could improve immensely generally the urgency required to complete the task leaves this important area behind. ITP's are essential to ensure good quality workmanship
Interviewer	Facility To Quality?
Gemma	The requirement for a high quality facility is an expectation from our clients and of the utmost importune.
Interviewer	Facility to Energy?
Gemma	Becoming more prevalent now, but should be accounted for in the planning phase. Energy efficient
Interviewer	Facility to Planning?
Gemma	Not as obvious as in the project area but still an huge requirement to ensure that Equipment receives the correct planned maintenance to ensure fewer breakdowns, generally trying to achieve the Pareto's 80/20 theory. 80% Planned 20% reactive.
Interviewer	Facility to Business?
Gemma	Generally hard to balance with costs against requirement to have equipment perform when required. Life cycle analysis is required and a baseline derived from a full equipment survey. Management to Quality? Response: Again hard to gauge quality, generally measured via Breakdown maintenance.
Interviewer	There was some disagreement regarding the correlation between Maintenance to Codes within the first round of interviews. Some of the participant suggested that there were no Code requirements for Maintenance. What is your understanding of their relationship?
Gemma	One of the greatest areas of concern as far as I am concerned within the Australian Facility Management industry is the lack of understanding from a section of the industry on what our statutory requirements are. There needs to be a concerted effort by the industry to drive these requirements home. It is much larger than just the individual, corporate responsibilities stretch deep into many aspect of business.
Interviewer	What do you consider to be the legislative requirements for Code and Maintenance to be in Western Australia relevant to the Facility Management domain?
Gemma	it has been long acknowledged within the industry that there is a lack of clearly defined statutory requirements for the FM practitioners to follow. Generally they are based around the

understanding of the practitioners and their industry background. This issue is exacerbated through the role Property Managers have within the industry. I feel that property managers are caretakers of buildings, a first point of call for the occupant. They have no real input in to the development and management of the facility and are there to put out fires. Their understanding of the maintenance and statutory requirements are minimal and in some ways are products of the push for management of buildings to be price driven rather than from a strategic business approach

Interviewer The correlation between Environment and Codes also resulted in disagreement between the Primary expert group. What do you understand, within the context of Facility Management, to be there relationship and any Statutory Requirements?

Gemma this has the same fundamental issue as the previous question. There are maintenance standards incorporating produce within the built environment such as smoke extraction and detection system which need to be maintained in line with Australian Standards. To not maintain that standard make you liable if an event occurs in which someone are injured. There are also section I in the Building Codes of Australia which identifies a need to maintain buildings and systems within them. They are beast practice guidelines.

Interviewer Management was seen as function of the over arching category of Business by some of the Primary expert group while others referred to Management being fundamental to the role of FM. What is your understanding of the correlation between the two?

Gemma There is no doubt that Management is an overarching term generically used within the context of business function as well as involvement with all the knowledge categories within these lists.

Interviewer Real Estate created a high degree of disagreement between the Primary group. The category of Real Estate was seen by some of the participants as the selling of houses and buildings. The others referred to it as part of the whole FM package. What is your understanding of the Real Estate in a FM context?

Gemma Real Estate being an American based description, but disagreed with Sean's stance in that they both agreed with Real Estate's relevance to the FM industry. Sam stated "real estate is an overarching term used to identify, property, grounds, outbuilding, rental agreements, development, management of real estate investment and as well as the management of different types of buildings from homes to factory's and even office blocks. Within a FM context I feel that Real Estate is a

	general term FM is more specific to the life cycle and usage of the building from a more strategic stand point. Gemma made the same comments as Sam other than adding: "the term real estate is to general it's a broad brush approach designed to cover everything property. Facility Management on the other hand is a clearly defined function of the day to day operations of a building with the primary goal of value adding to the occupant as well as achieving the business goals of making money. You could say that FM is a component of real estate or Corporate Rea Estate.
Interviewer	Do you have anything to add or final comments to make?
Gemma	No That about does it