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**FACILITIES MANAGEMENT KNOWLEDGE IN
PRIVATE FINANCE INITIATIVE (PFI)
HEALTHCARE PROJECTS**

by

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ABSTRACT

An organisation's accumulation of knowledge has been identified as a key factor in its progress and survival. This is particularly the case for a business that involves service delivery and is very pertinent to the construction industry. The key to success in managing organisational knowledge is recognising the importance of managing (and maintaining) the knowledge of the staff in the face of staff retention challenges. Knowledge retention is integral to ensuring that the experience and tacit knowledge acquired by the staff during their service will not be lost when the staff leave the organisation. The concept of Knowledge Management (KM) is seen as the solution through the inculcation of knowledge sharing via various tools and techniques in managing the knowledge within parties in construction.

The aim of this research is to identify where and how KM initiatives being used within PFI-FM healthcare projects as a result of the unique character of the associated PFI contracts and a wide range of FM services. The complexities involved in managing and delivering services at the operational stage of PFI projects and the vast amount of tasks and services stipulated in the FM context, particularly regarding the planning, types of services, time, place, tools and resources needed, make it a suitable area for KM adoption. This research, which involved exploratory studies, literature reviews, analyses of three case studies involving PFI-FM healthcare projects and structured interviews with the Facilities Managers, has managed to discover the adoption of KM tools in managing FM healthcare services among Facilities Managers in PFI healthcare projects. However, KM has not been used to its fullest potential; the incomplete application of KM initiatives has, thus, created some problems with regard to delivering PFI-FM healthcare services. The outcome has resulted in the formulation of a framework that combines the best practices of KM initiatives with practical approaches of managing organisational knowledge of FM healthcare services which derived from the case studies. The framework has been validated by experts evaluated from the industry and refined to ensure that the framework developed is practical.

The most pertinent achievements of this research include demonstrations of the needs for KM initiatives in delivering PFI-FM healthcare services and the development of a framework to enable better service delivery among the PFI-FM healthcare service providers, particularly with regard to addressing the challenges derived from PFI contracts and the vast scope of FM healthcare services. Overall, the study provides a clear justification and indication from a theoretical point of view and empirical evidence from the facilities managers' perspective of the significance of KM initiatives in delivering PFI-FM healthcare services in the UK. Furthermore, recommendations have been made to improve and enable comprehension of the framework application and facilitate its implementation in the construction industry.

Keywords: Facilities management, Knowledge Management, PFI, healthcare services

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LIST OF ABBREVIATIONS

4ps	Public Private Partnerships Programme
BIFM	British Institute of Facilities Management
BOOT	Build, Operate, Own, Transfer
BSI	British Standard Institution
CAFM	Computer Aided Facilities Management
CSF	Critical Success Factor
DBFO	Design, Build, Finance and Operate
DLP	Defect Liability Period
DMCF	Design, Manage, Construct and Finance
e-O&M	Electronic Operation and Maintenance
FM	Facilities Management
HM Treasury	Her Majesty's Treasury
IDEF-0	Integration DEFinition language 0
IFMA	International Facility Management Association
IT	Information Technology
KM	Knowledge Management
LOPs	Local Operating Procedures
NAO	National Audit Office
NHS	National Health Services
PFI	Private Finance Initiative
PFU	Private Finance Unit
PPP	Public Private Partnership
PUK	Partnerships United Kingdom
RIBA	Royal Institute of British Architects
SPV	Special Purpose Vehicle
UK	United Kingdom
VfM	Value for Money

Chapter 1 Introduction

This chapter discusses the background and rationale for the research and describes the subject area in which the research is based. Firstly, the research focuses on knowledge management (KM) initiatives that have the potential to improve delivery of services. It highlights the importance of managing the knowledge attained by people in an organisation as one of the key elements for sustaining long term competitiveness. Secondly, this project focused on the problem of the Private Finance Initiative (PFI) projects, which are discussed in the literature review, by highlighting the problem in Facilities Management (FM), especially on service delivery at the operational stage, and in managing people involved in carrying out the contracted tasks. The research aim and objectives are also described, followed by a brief summary of the research programme and the adopted methodology. This chapter ends with a brief description of the thesis's contents presented to provide guidance on the overall direction and content of the thesis.

1.1 Background of Research

The construction industry is well-known for its unique characteristics that require skills and expertise from a wide array of disciplines such as civil, mechanical, electrical and built environment engineering (Ofori, 1990). It is a fragmented industry in which employees work in settings that are unfavourable to good communication (Yahya, 2006). Development of a typical construction project requires a team effort that involves several inter-organisational activities and information at different development stages (Egan, 1998). Hence, the industry suffers from poor project and programme

performance that derives from a lack of integration and coordination between the industry's distinct professions (Faniran et al., 2001, Gumn et al., 2005).

According to Abdullah and Ramly (2006), upon defining a successful project, they have outlined the importance of successful project management as key to project success. A critical factor for success is managing human management, which includes components such as team and leadership and communication. Hence, the way forward is by improving the communication between the parties involved in a construction project. Although communication is an important factor for project success, the underlying factor is sharing knowledge through communication between various parties (Yahya, 2006).

Many construction firms as well as their clients have realised the importance of managing knowledge across the supply chain, as it has a huge impact on their performance and efficiency in the construction process (Mohamed, et al., 2006). Consequently, many research projects were undertaken to realise the importance of managing knowledge integration in construction. These research projects focused on either specific types of knowledge (e.g. C-SanD, 2001), project phases (e.g. KLICON - McCarthy et al. 2000), evaluate business impact (e.g. IMPaKT - Carrillo et al., 2003; Robinson, 2004), facilitate the development of KM strategies, (e.g. CLEVER - Anumba et al., 2005; and Kamara et al., 2002), assessment of the maturity of KM in organisations (e.g. STEPS - Robinson et al., 2006), enhance knowledge transfer capacity in PPP/PFI projects (e.g. KT Learning Toolkit - Carrillo et al., 2006) and facilitates the project knowledge (e.g. CAPRIKON - Tan et al., 2004).

Similarly, according to Suresh and Egbu (2004), one way to renew and sustain a competitive edge in today's business environment is to capture and utilise most of the organisation's knowledge and skills within and across projects. Abdul Rahman et al., (2006) expressed a similar view, noting that the critical success factors of an organisation depend on the quality of knowledge applied by the organisation. This reflects the importance of having good knowledge sharing between parties involved in project development.

Additionally, as pointed out by Newcombe (1993) and Argote et al. (2000), transferring knowledge within the construction sector has proven to be a rather difficult challenge in practice. Consequently, construction organisations have had difficulty creating well-defined and systematic methods for the creation, capture, storage, sharing and reuse of a professional's domain knowledge of people, processes and product (Robinson et al., 2004). Moreover, findings from Kamara et al. (2000) showed that knowledge needs to be managed at different, interrelated levels in the construction organisation including (i) management of knowledge within projects - across different stages of a project and (ii) management of knowledge in individual firms (e.g. consultants, contractors, etc.) in the construction industry to enhance their capability to adequately respond to client requirements.

Knowledge is an asset in today's businesses, especially when it provides the key vehicle to enhance organisation performance. This occurs when explicit knowledge exists on how to design and implement tools, processes, systems structures and cultures to improve the creation, sharing and use of different knowledge that is central in making decisions (Lee and Abdul Aziz, 2006). Many tools and techniques have been developed to improve knowledge management in the construction development

process. Knowledge Management (KM) is one of the strategies developed through a systematic management approach to identify and capture the knowledge assets of a firm so that they can be fully exploited and protected as a source of competitive advantage and can increase productivity (Scarborough et al., 1999; Webb, 1998). KM has techniques and tools to capture, maintain and manage information and knowledge acquisition of staff during their employment (Al-Ghassani, 2005).

The main objective of KM implementation in an organisation is to enable personnel to capitalise on their individual knowledge with others for the benefit of the organisation (Mohamed, 2006) to ensure organisational success, because people (personnel) and information are the hearts of organisations (Johnson and Scholes, 2000). These people perform their tasks daily with challenges on issues about the function, department, division or project team (Johnson and Scholes, 2000), which makes them more knowledgeable and able to perform more efficiently through experience. Mohyin et al. (2009) confirmed this notion in construction firms, describing the importance of relying heavily on knowledge workers and their reputation for delivering the services promised, rather than focusing on products such as other organisations.

The practice of managing information within an organisation is known as organisational knowledge, and it was identified by Nonaka (1991) and Bohn (1994) to be the necessary trait to become competitive and later, be able to perform efficiently. Additionally, organisational knowledge enables organisations to understand the market, assess the customers' needs and translate them into products and services by integrating various organisational resources (Davis and Botkin, 1994). Therefore, a KM system in construction is viewed as a means of identifying and exploiting corporate

individual knowledge assets: individual experiences, lessons learned, and best practices (Whetherill et al., 2002; Mohamed and Anumba 2005).

1.2 Problem Definition and Research Justification

Many government projects in the United Kingdom (UK) have adopted PFI as an alternative way to procure public services since it was introduced in 1992 (HM Treasury, 2003). However a changing economic climate has had an impact on how PFI is perceived. A recent UK Parliamentary Treasury Select Committee report criticised PFI as an 'extremely inefficient' method of financing projects (Treasury Committee Report, 2011). This is due to the higher cost of finance and does not provide taxpayers with good value for money. Despite much criticism on PFI, the drawbacks focus only on cost but not on the PFI as a procurement method. Hence, it is important that appropriate policy, strategic and implementation structures and processes are in place to address the key objectives of the public sector in PFI projects in future (Robinson et al, 2010).

During the conduct of this research between 2007 - 2010, PFI was still regarded as UK's government financial solution to provide public facilities and services. The relationship between the public and the private sectors in PFI contracts were regarded as a mutual or 'win-win' agreement. The public sector showed a commitment to purchase services, monitor performance against the output specification of the private sector and had a role in regulation. Meanwhile, the private sector accepted the risk of designing, building, financing and operating the facility, which was transferred by the public sector with the opportunity to obtain long-term income.

The introduction of this new concept is backed by restraint on public expenditure in the provision of public facilities and services (HM Treasury, 2000; Grout, 1997). By using PFI as a form of procurement, governments can reduce public sector borrowing requirements and simultaneously increase the flow of capital projects in public infrastructure and services (HM Treasury, 2003). In other words, the government appoints a private service provider to carry out public infrastructures through the process of outsourcing, meaning that they externalise tasks and services previously performed in-house (Hickman, 2000; Bing et al., 2005). In the UK, the provision of PFI involves projects related to core public services such as education, health services, transport infrastructures and many more. PFI contracts have been signed in over twenty different sectors and by over one hundred different public sector organisations within central and local government and the National Health Service (Corner, 2006).

By utilising PFI, the government could achieve best practices, improve cost discipline skills of managers, improve the quality of service and help senior managers to focus more on core competencies of their organisations (Kakabadse and Kakabadse, 2002, Burnes and Anastasiadis, 2003; Bing et al., 2005a). This could lead to high quality and cost-effective public services in PFI projects (Akintoye et. al, 1998; Birnie, 1999). Although PFI is one of the solutions sought by the government to reduce public spending and improve public services delivery, noteworthy challenges and issues of implementation arise due to several problems.

A study by Burnes and Anastasiadis (2003) showed that public sector organisations have more stringent relationships that result in a gap between the client and the service provider. Hence, ensuring the success of a PFI project requires careful management of the relationship between the client and the service provider. Wechsler

(2002) suggested that defining the function, procedures and supporting processes are the main criteria for the success of outsourcing through PFI projects. Mustapa (2004) also noted that managing understanding, efficacy and transparent relationships between the service provider and the client are crucial to achieving the aims and objective of both parties.

Additionally, there are a number of challenges associated with executing FM at the operational stage of PFI projects. The challenges and issues vary, including lack of resources, unachievable service quality, difficulty in specifying the quality of services, difficulty in pricing FM services and managing long-term relationships (El-Haram and Agapiou, 2002; Akintoye et al. 2003; HM Treasury, 2000). Since PFI projects deal with long-term operational and strategic levels, it is also interesting to monitor the issue on labour turnover involved at the operational stage of a PFI project (Partnership UK, 2006).

Study by Robinson et al, (2004) and Carrillo et al. (2006) provide a motivation for this research. Their researches have highlighted the importance of KM for the success and continuous improvement in PFI projects. The knowledge transfer framework developed (CLEVER and the KT Learning Toolkit) help organisations involved in PFI projects to better manage their corporate and collective knowledge. However, there is still scope for improvement on this framework especially in the operational phase of PFI projects due to a few completed and operational PFI project during the conduct of their research. Hence, this research seeks to address the gap highlighted by improving the efficiency of facilities management services delivery at the operational stage of Private Finance Initiative (PFI) healthcare projects.

Managing PFI projects, especially those involving Facilities Management (FM) healthcare services, is fraught with challenges in executing the operational and maintenance functions, as they involve high operational risks of failure (Chotipanich, 2004) and a demanding level of maintenance services activities. The reason for these challenges are that FM healthcare services cover all aspects of clinical and non-clinical activities, estate maintenance, space, environment, Health and Safety and support services (Nutt, 2000; Barrett, 2003). Moreover, FM embraces the provision and operation of stakeholders (people), premises (place) and business support (process) (Akhlagi, 1994). Facilities management involves a wide range of services and tasks involving multi-disciplinary activities within the built environment that need to be managed, especially with respect to the impact on people and the workplace (BIFM, 2007).

FM has two types of services, namely soft and hard services (Avis, 1999). Soft service includes the activities of maintaining assets, such as cleaning services, catering, reception, security, linen and laundry. Hard services refer to maintaining the asset in terms of repairing defects in the building, which involves maintaining the equipment and the building itself. Both services have different maintenance schedules with respect to frequency, level, quality and time, according to the services' specifications in the contract.

It is important to note that to ensure successful project delivery requires successful management of knowledge and information integration between different parties in construction. Delivering FM healthcare services according to a stipulated PFI contract is central to ensuring successful project delivery. Taking into account the special characteristics of PFI-FM services that involve a wide range of service specifications

and information, they form a suitable context to adopt knowledge management tools and techniques to ensure successful service delivery.

Hence, for the course of this research, it is anticipated that development in KM tools and techniques could lead to better management and implementation of PFI-FM healthcare projects. This is attributed to the complexity of the PFI contract specification, long contract duration combined with wide range of FM scope and context which confine the complexity of carrying out FM healthcare services during the stipulated PFI contract duration.

1.3 Aim and Objectives of the Study

This research aims to develop a framework which will improve knowledge sharing for facilities management (FM) within the operational and maintenance stages of PFI projects. This will be achieved through the following objectives:

- 1) To review existing literature and theories on the management and operation of construction projects and their relation to PFI contract arrangements;
- 2) To understand and examine current industrial practices in PFI-FM with a view to ascertaining the underlying problems, challenges and potential areas for improvement;
- 3) To investigate the relevance of knowledge management initiatives at the FM operational stage of PFI projects;
- 4) To develop a framework to enable organisations to efficiently manage service delivery and performance; and
- 5) To evaluate the framework using industry practitioners.

All in all, the objectives of this research encourage FM participants to learn and share FM knowledge, focussing on the operational stage through knowledge management adoption in PFI-FM practices.

1.4 Overview of the Research Methodology

To achieve the research objectives, a combination of research methods were adopted mostly from qualitative research methodology. This combination of research methods consists of four activities, namely data collection through literature review and case study interviews, data analysis, action required through framework development and, finally, reliability and validity through evaluation. All of the activities were conducted concurrently rather than sequentially. To ensure that the research aim and objectives were achieved, the relationship between the research objectives and the research methods are defined in Chapter 5, section 5.4.

Data collection was performed using different types of sources through several methods to achieve the first objective, which is to establish understanding of management and operation of construction projects in the context of the PFI. Additionally, to achieve the second objective, literature and exploratory study were also made on understanding the current practices of PFI-FM projects to ascertain the underlying problems and identify gaps in knowledge to determine areas for improvement. Case study interviews were conducted to achieve the third research objective, which is to investigate the possibility of adopting KM principles in FM operation of PFI projects. It was using case study protocol to make the analysis of the case studies of similar theme (Refer to Chapter 5, section 5.4.3).

Data analysis was conducted by content analysis of the transcribed interviews collected during the case study. Repeating ideas and relevant text derived from the transcribed interviews were extracted, creating the code and theme of research findings. An example on how this was conducted is depicted in Chapter 6, section 6.2 on cross-case synthesis of the case studies. A summary of the findings were then tabulated in Table 6.2 and 6.3. The table canvassed the results from the respondents on problems in managing organisation knowledge. Later, the findings from the case study analysis were used as a framework development for integrating KM into PFI-FM operational practices (Chapter 6, section 6.3). This led to establishment of research objective four, which is to develop a framework to enable FM service provider organisations to manage service delivery and perform efficiently as stipulated in the PFI contract (Chapter 7).

Reliability and validity confirmation was the final activity of the research project. It was conducted by gaining feedback from informants through the hermeneutic (Grbich, 2007) approach to acquire their opinion on the framework proposed as in Chapter 7. Based on the feedback, the framework was refined, thereby addressing the last research objective of evaluating the framework using industry practitioners as in Chapter 8. Finally, conclusions were summarised and recommendations were made for further research as in Chapter 9.

1.5 Structure of Thesis

The thesis is structured into nine chapters that document the work undertaken. A brief description of each chapter is given below. In addition, Figure 1.1 shows the overview of the research process carried out to achieve the outlined aim and objectives.

Chapter 1: Introduction - This chapter gives an overview of the research conducted. It gives the background and justification for the project. It then outlines the research aim and objectives. The research methodology is also described, followed by the thesis guidelines, describing the research contents.

Chapter 2: Private Finance Initiative (PFI) Projects - This chapter reviews recent studies relating to the operational process of PFI-FM projects. It starts with reviews of the conceptual process of PFI policy and provides an understanding of PFI business processes in terms of the features, procedures, roles and responsibilities of the parties involved. It also discusses the common problems that occur at the operational stage of PFI projects, especially those involving healthcare services.

Chapter 3: Facilities Management in PFI Projects - This chapter reviews the character and context of FM. It describes the type and nature of FM services and highlights the common issues and challenges that occur in delivering FM services in PFI projects. This chapter concludes by identifying aspects of FM that could be improved most by implementing KM tools.

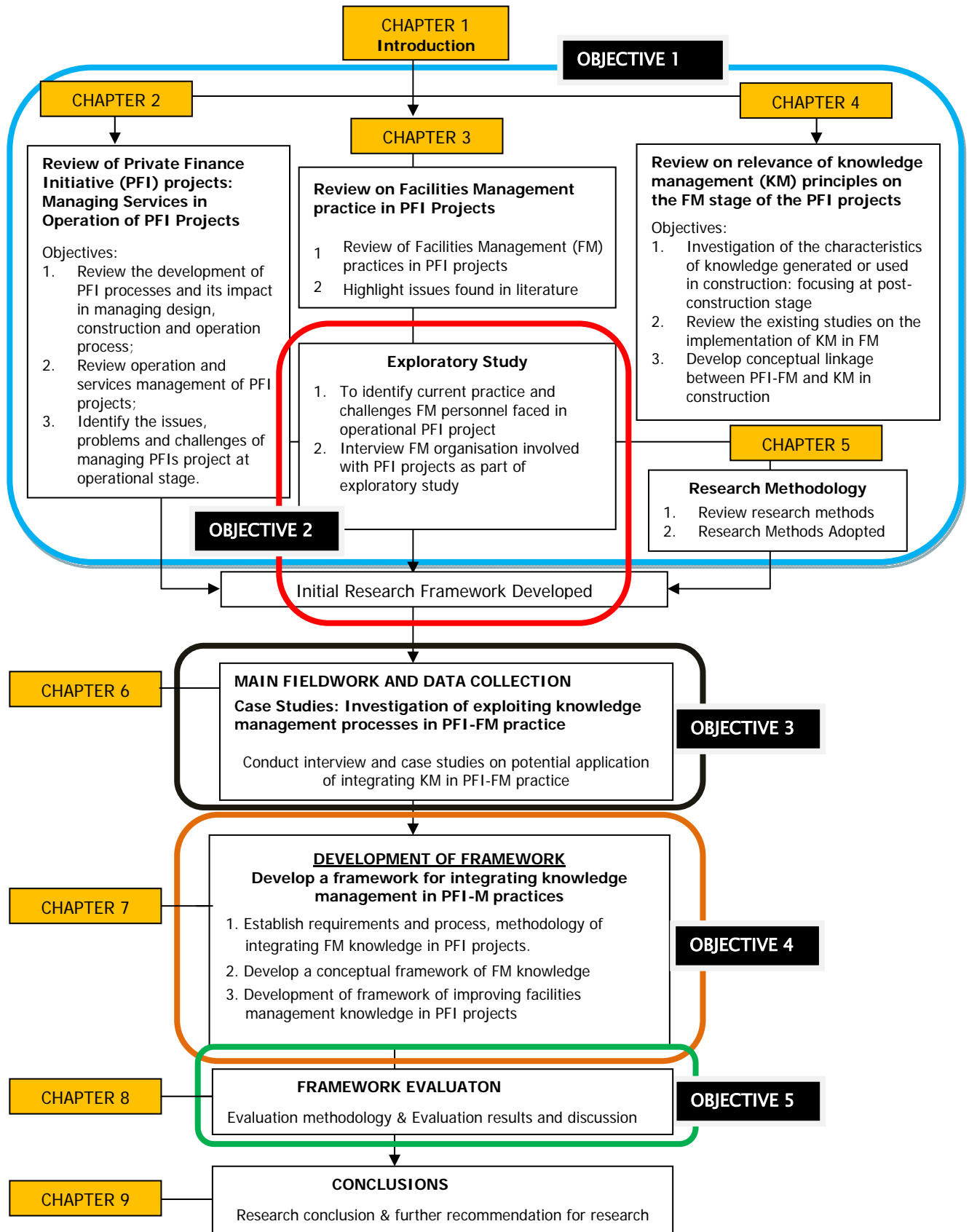


Figure 1.1 Overview of the Research Process

Chapter 4: Knowledge Management in Construction Projects - This chapter is devoted to support the research argument, which states that KM techniques could improve the execution of FM service delivery within PFI healthcare projects. It reviews the key concepts of knowledge, definition, types and forms, knowledge management process, techniques and the relationship of these concepts to the construction project industry. This is followed by a discussion of the information and knowledge made available in PFI projects. It concludes by identifying relevant knowledge management processes that can be integrated with FM in the operational stage of PFI projects.

Chapter 5: Research Methodology - This chapter discusses the methodology adopted to achieve the research aim and objectives. A brief introduction on the research process, methodology and methods are briefly described to justify the selection of research methodology and method adopted. The relationship between the research objectives and the research methods is established, and the methods used to conduct the research are explained.

Chapter 6: Case Studies on Operational PFI-FM Projects - This chapter covers the findings obtained from three case studies. It demonstrates the actual problems and shortcomings of current facilities management practices in PFI projects. In addition, an analysis of KM tools is presented with respect to facilities management service delivery in PFI-FM healthcare in the analysed cases. The findings are used to lead the discussion and recommendations for the development of a framework for sharing and learning facilities management knowledge in PFI-FM practice.

Chapter 7: Framework Development for Knowledge Management Integration - This chapter presents the framework developed for knowledge management integration in PFI-FM practice. It then describes in detail the process used to develop

the framework using the IDEF-0 model as a tool for modelling facilities management knowledge in PFI projects. It also presents an integrated KM framework that reflects the specific context of FM services and provides for both explicit and tacit knowledge. The objectives, features, development process and potential benefits of integrating KM are also highlighted.

Chapter 8: Framework Evaluation - This chapter focuses on the framework evaluation process. It starts with the evaluation aim and objectives followed by the evaluation methodology adopted. It then discusses the results of the framework evaluation by highlighting the strengths and weaknesses of the framework. This chapter concludes with a discussion of feedback and suggestions for improvements of the framework.

Chapter 9: Conclusion - This chapter concludes the research undertaken to develop a framework for better service delivery in PFI-FM healthcare projects utilising KM techniques. It presents a summary of the findings of the study, its limitations and its contributions to the existing literature. It also provides recommendations for further research.

Chapter 2 Private Finance Initiative (PFI) Projects

This chapter describes the background by examining Private Finance Initiative (PFI) schemes. This is to obtain a better understanding of the PFI business process, its characteristics and the roles and responsibilities of the involved parties. Later, the relationship between PFI and facilities management is addressed by analysing the challenges faced at the PFI operational stage.

2.1 Background of Private Finance Initiative

The Private Finance Initiative (PFI) in the UK was introduced by the Conservative Government in 1992. Since 1997, the Labour Government has preferred to use the term Public Private Partnership (PPP). The term PPP is broader and encompasses a range of financial and organisational forms. This includes joint ventures between the public and private sectors, partial privatisations, sale and lease-back arrangements, as well as the Private Finance Initiative (4Ps, 2007).

According to the HM Treasury (2000), both PFI and PPP are designed to establish arrangements that will bring benefits to both sectors and are a key element in the Government's strategy for delivering modern, high quality public services. However, this is not the preferred strategy beginning from August 2011 due to many critics on the weaknesses of the PFI contract (Treasury Committee Report, 2011). It is anticipated that the development of PFI in the coming years will involve consolidating some of the existing practices and ensuring the long-term variability of PFI procurement as an alternative, offering best solutions for construction and value for

money to the taxpayers (National Audit Office, 2011). Hence, this research is still relevant in the UK construction industry where most of the PFI projects are currently in their operational stage.

Traditionally, the Government delivered public sector construction projects through exchequer funding. The PFI scheme represented an alternative way of delivering the same services through private finance. The aim of PFI is to increase the flow of capital projects against a background of restraint on public expenditure by utilising private-sector money and management (Kerr, 1998). However, in all cases, the Government remains responsible and accountable for delivering services and projects in a manner that protects and furthers the public interest and benefit (Chan et al., 2008).

Through PFI, the private sector will provide the funding for capital projects and operate a facility for public benefit. As a return on its investment, the public sector has an obligation to sign long-term contracts with the private sector to purchase the services provided. Therefore, the public sector is able to purchase the services without the need for an initial capital investment (Private Finance Panel, 1995). In addition, PFI was seen as a means of reducing government borrowing and increasing investment in public infrastructure (Dixon et al., 2005). Subsequently, no additional issues in future maintenance costs arise under public sector responsibility (Birnie, 1999).

PFI is intended to transform the public sector from being owners and operators of assets into purchasers of services from the private sector (Treasury Taskforce, 1997). The Private Finance Panel (1995) reported that PFI is focused more on procuring a service rather than acquiring an asset. As a result, this approach changes the role of the public sector to a procurer of services and a regulator (Kerr, 1998). This differs from

the privatisation policy in which, in the case of PFIs, the public sector still retains an important role by making a long-term commitment to purchase the service from the private sector. However, there are similarities between privatisation and contracting-out policies relating to gains in efficiency and effectiveness and reduction in costs (Kerr, 1998; HM Treasury, 2000).

In principle, PFI emphasises two inter-related aspects. First, PFI must offer value for money. Secondly, PFI must bear risks. Value for money is important because the projects procured under PFI reflect public benefits. Value for money in the PFI context can be associated with economy, efficiency and effectiveness (HM Treasury, 2003). Value for money is defined by the HM Treasury (2004) as 'the optimum combination of whole life cost (capital and operating costs) and quality of services to meet the requirement of the public sector'. The challenge for both the private and public sectors is to minimise whole life cycle costs. The ultimate objective of value for money is to find an optimum strategy to trade-off higher capital cost for lower recurring operating and maintenance costs.

The UK Government has issued guidelines to all procuring authorities to ensure that all procured new buildings under PFI schemes must demonstrate value for money over the long term, and not to concentrate on the design solution which is the least expensive (National Audit Office, 1999; OGC, 2004; ODMP, 2005). Henjeweile et. al, (2011) reveal that the current value for money assessment of PFI projects is often carried out under conditions of considerable uncertainty with frequent changes in costs, timescales and client requirements. However, Patel and Robinson (2010) show that larger PFI/PPP schemes undertake rigorous governance structures to succeed in achieving value for money. They show that project governance influences project

delivery for PFI/PPP schemes in terms of cost, speed of completion, quality and its financial viability.

Value for money is thought to be achieved through the involvement and adoption of private sector practice, resources, expertise and skills in controlling costs and making use of economy of scale (Akintoye et. al, 1998; Birnie, 1999). Thus, involvement by the private sector leads to high quality and cost-effective public services in PFI projects. In addition, value for money might arise from integration and synergy between design, build and operation of facilities, better material management, allocation of risks to the parties, and more intensive exploitation of assets (Treasury Taskforce, 1997). Moreover, the best value for money can be achieved through the management of whole-life costs, innovation and quality to meet the user requirement (4Ps, 2006).

With regard to risks, the PFI procurement scheme is intended to optimise the allocation of risk between the public and private sector. The PFI paradigm is based on the fact that the risk should be transferred to the party best able to manage it (Boussabaine, 2007). The public sector needs to transfer sufficient risk to the private sector to make the project viable. Bing et al. (2005) further states that mutual acceptable risk allocation between the private sector and the public sector is essential to achieve the value for money objectives. For example, poor build quality directly increases the risk profile of the PFI and also has the potential to significantly damage the stakeholder of private sector relationships, as the building suffers performance and availability issues. Thus, deductions for poor performance and unavailability of facilities can be sought by the public sector (i.e., the client).

Generally under PFI, the private sector is led by a consortium that takes a number of risks. According to the Private Finance Panel (1995), the risks that need to be considered are associated with design and construction, commissioning and operating, performance, finances, technology, regulation and project planning. Therefore, risk transfer is a critical feature of many PFI projects. Standard documents and tools have been developed for risk allocation which is continuously evolving based on best practices to capture the different types of risks, and determine which party is best able to manage those risks at different key PFI stages. Akintoye et al. (2002) developed a comprehensive framework for risk assessment in the management of PFI projects.

The PFI market can be categorised into a number of market sectors, namely Health, Transport, Education, Defence, Waste, Office, Courts, Accommodation and Training sectors. The dominant public sectors in the market at present are Health, Defence, Education and Transport. This dominance is based on the total capital value of their projects. There are currently around 700 signed projects and 540 operational PFI deals in the UK (National Audit Office, 2011). The total capital value of current PFI projects is £63 billion. The main sectors involved in signed PFI projects are the healthcare and transport sectors which jointly account for 20% of the total capital value (HM Treasury, 2011).

Depending on the project, the parties involved in the management of the contract will vary. Typically, there are two main parties involved in the PFI procurement process: the public sector client; and the private consortium that acts as service provider from the private sector. In the private sector, the PFI consortium, known as SPV (Special Purpose Vehicle), comprises contractors, lenders, a team of advisors and a facilities

management provider to deliver the PFI service. The SPV is the main contractor to the client organisation (Transfield et al., 2005). Under this arrangement, the contractor is the principal initial shareholder in the SPV and usually acts as the design and construction contractor. This situation is known as a contractor-led consortia arrangement, wherein the contractor, through large contracting organisations, leads the bidding project. However, contractor involvement in a PFI is depend on the type of PFI project (Owen and Merna, 1997) and sector competency (El-Haram and Agapiou, 2002; Owen and Merna, 1997).

Figure 2.1 illustrates the PFI teams in the typical arrangement of a construction project. There will be a series of agreements and subcontracts between different parties.

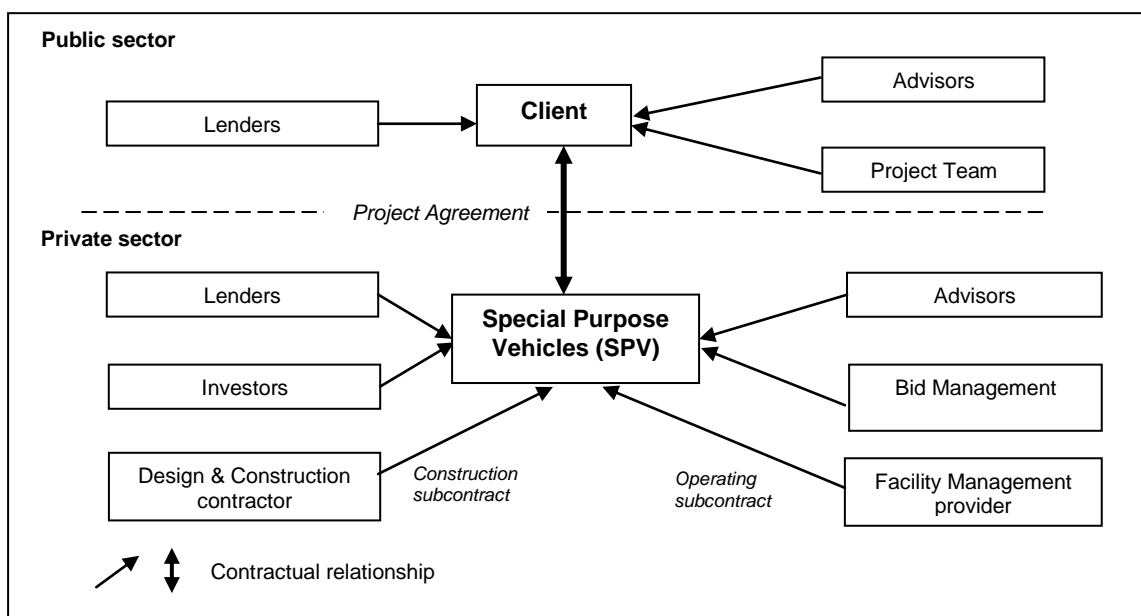


Figure 2.1 PFI Teams (adopted from El Haram and Agapiou, 2002)

The Royal Institute of British Architects (RIBA) introduced the Outline Plan of Work for a PPP/PFI project in November 2008 to address the activities involved in PFI

contracts. This Plan of Work was based on the Office of Government Commerce (OGC) PFI model. The Plan of Work Stages describes activities from planning and design development, construction to operation and service delivery in the PFI contract. Figure 2.2 outlines the key stages of a generic PFI contract and the activities that the client and provider undertake at each stage.

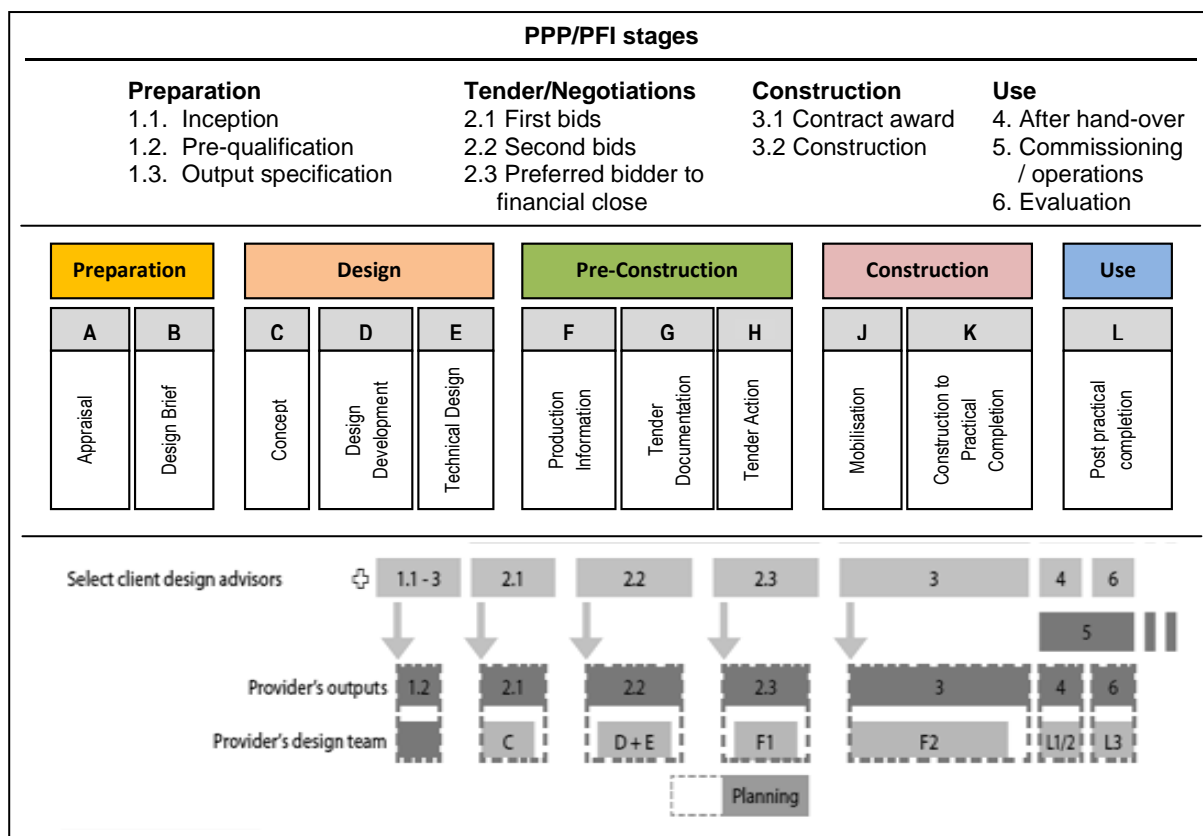


Figure 2.2 The RIBA Outline Plan of Work 2007 (RIBA, 2008)

Typically, a PFI consists of 14 stages (Treasury Taskforce, 1999), these stages can be grouped into four main stages (RIBA, 2008), namely i) Preparation stage; ii) Tender/Negotiations stage; iii) Construction stage; and iv) Use stage.

The preparation and tender/negotiations stage examines the technical and financial issues such as preparing the business case for the project, invitation and pre-

qualification of potential bidders, design, solution, evaluation of bids to determine value for money and affordability, selection and negotiation of a contract with the preferred bidder, financial close and developing the full business case for the PFI project. The construction stage focuses on specific issues relating to awarding the contract, completing and translating the design into facilities, availability of resources, scheduling of key construction activities and phasing of project.

Meanwhile, the use stage focuses on key issues relating to delivering various FM services, evaluation and performances monitoring to ensure services are delivered in accordance with output specification, mode of payments and penalties for service failures. Given that the aim of this research is to develop a framework which will improve knowledge sharing for FM within operational and maintenance stages of PFI projects, this chapter focuses on the last stage of a PFI, the Use stage.

The Use stage can be further divided into three sub-stages including i) After Hand-Over; ii) Operation and iii) Evaluation. The After Hand-Over sub-stage refers to the situation where facilities are handed over to facilities management service providers from the construction project team.

Consequently the facilities management team needs to be actively involved during the later stages of construction (i.e., 3-6 months prior to handover). At this stage, FM service providers need to conduct regular site inspections, monitor the installation of plants and equipment, and continue acquisition of information from various parties, i.e., construction project team, designers, installation sub-contractors and manufacturers. However, transfer of design and construction information to facility managers from the design and project teams remains a challenge. Often facility

managers are faced with the complexity of re-creating information about their building; as time and again very little information from design and construction phases is habitually not transmitted to later phases in a consistent, methodical manner (Smith and Tardif, 2009).

At the Operation sub-stage, the FM processes consist of managing production of services strategies, production of contracted services, delivering the services and maintaining the facilities. At the Evaluation stage, the goal is to improve services for users, thus determining the successful delivery of long-term services in PFI projects. Activities consist of monitoring level of services and receiving and processing feedback by either performing benchmarking exercises or market testing arrangements.

PFI with its emphasis on operational issues could be seen as an ideal opportunity for the involvement of facilities managers in the design process. Involving the facilities manager in the design process could result in facilities that are better suited to meeting business needs; more attractive to clients; easier to commission and maintain; easier to control and manage; more cost effective to operate; and better able to respond to the needs of the occupants (Jauzens et al., 2001). Similarly, Nutt (1993) states that too much emphasis has been on the design brief and more time should be spent on the organisational and the management brief. This is to ensure a balanced approach is undertaken. Thus, the involvement of FM in the strategic briefing exercise ensures the facility is more adaptable to future change. This necessitates an improved understanding of the customer requirements and allows performance feedback as feedback loop in FM is essential for improved performance (Kelly et al., 2005).

2.2 Characteristics of PFI Contracts

The characteristics of PFI contracts are the transfer of liability of design, build, finance and the operation of a public facility or service from the public sector client to the private sector for a long-term contract arrangement, typically lasting 30 years. At the end of the contract, the building either reverts back to the public sector or the contract is renewed. PFI contracts share some common features with the DBFO (Design, Build, Finance and Operate) procurement strategy. Other approaches associated with PFI include BOOT (Build-Operate-Own-Transfer), DMCF, (Design-Construct-Manage-Finance) and Concessions.

Robinson and Scott (2009) identified three key components affecting service delivery in PFI projects as shown in Figure 2.3. The single arrows show the components that contribute to success in service delivery. Meanwhile the dotted/double arrows demonstrate the interdependence and dynamics between the different components of service delivery.

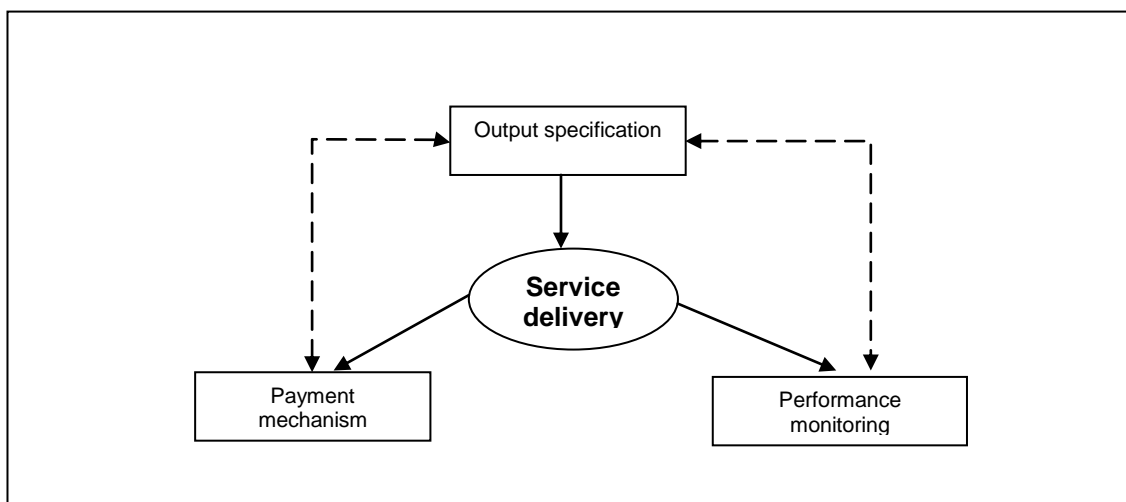


Figure 2.3 Key components affecting service delivery (Robinson and Scott, 2009)

Key characteristic of PFI is output specification (Audit Commission, 2001). Output specification is the basis by which the client or government defines the services and outputs that the PFI consortium needs to provide. In other words, the public sector client, by procuring authority, specifies the services it wants as well as some basic standards. However, the consortium has control over how the services are delivered.

Consequently, the consortium may implement innovative approaches to service delivery during the contract period, but not open to misinterpretation of specifying a wide range of services (Robinson et al, 2010). Robinson and Scott (2009) further explained the problem in misinterpretation of specification: “...if the output specifications are subjective it can create different interpretations and disagreements, such that one party has one view on the performance requirements specified in the output specification and another party interprets differently”. A well-drafted output specification is therefore crucial in design, construction, operation of PFI projects and the successful delivery of long-term services (4Ps, 2005; Robinson and Scott, 2009).

Another characteristic of PFI is performance monitoring. A monitoring mechanism is needed to provide incentives and sanctions for the service provider to deliver the level of services stipulated in the output specification (Ng and Wong, 2007; Robinson et al, 2010). In the PFI health sector, project performance is measured against the output specification and patient satisfaction surveys, patient flow audit and spot checks (McDowall, 2000). However, user satisfaction surveys can create problems where there are multiple layers of users. Therefore, developing a robust performance measurement system with relevant metrics to capture a wide range of services and choosing appropriate monitoring methods is a major challenge (Partnership UK, 2006).

The payment mechanism is another important agreement in the PFI. In PFI contracts, the provider does not receive a payment until the facilities are available for use. Repayments on services delivered will be made either directly from the user or in accordance with a payment mechanism such as unitary charges imposed in the contract by the public sector. This payment mechanism is revised periodically as the contract progresses based on performance, availability of assets, quality of services provided and sometimes level of use by the public sector.

PFI contracts also include penalty clauses to ensure that service is provided at the required level, as stipulated in output specifications. Thus, as the private sector is contracted under the PFI, it can be penalised for failure to perform on time or up to a certain quality and a guaranteed price for the contract. Such penalties include deduction of payments and contract termination. Thus, payment arrangements are seen by the public sector as an effective risk allocation tool (Boussabaine, 2007).

With the emergence of the PFI procurement system, the private sector has a primary role in delivering services for the whole duration of the contract. Thus, the parties involved in PFI procurement have had to amend their approach away from traditional contracting to a wider view (Payne, 1997). The next section addresses differences between PFI and traditional contracting procurement to better understand how PFI differs in terms of the responsibilities of the parties involved and the effects of long term service delivery in PFI projects.

2.3 Differences between PFI and Traditional Procurement

PFI schemes differ from traditional contracting procurement in number of ways. Under traditional procurement, the different stages of an infrastructure project are contracted

out separately to different private firms and an input specification approach is followed, with the government keeping ownership of the facility both throughout the contract period and after the contract ends (HM Treasury, 1998). Caldwell et al, (2009) conducted a comparative study by two case studies of a PFI project and a traditional project. By examining the procurement mechanism in PFI project, they suggested the choice of interfaces for the governance of upstream supply relationships had a critical relationship to the subsequent performance, and the traditional procurement method seemed unsuitable for complex projects.

Other differences are in the finance and output specification. In terms of financing the project, these take the form of equity stakes and debts. Thus in PFI schemes, private sector consortiums have an opportunity to take an equity share in the project as part of the concessionaire agreement with other stakeholders (HM Treasury, 1997). In contrast, in traditional procurement, the client is responsible for initiating the project and providing the overall funding. In terms of output specification in PFI, the public sector client specifies its requirements in terms of service needed, whereas the private sector provider designs and constructs a facility to meet the output specification.

PFI contracts involve integration of the construction process over the project life-cycle. However, Akbiyikli and Eaton (2006) stipulates that the post-construction stage is the main element in operating and maintaining the services. They raise the point that the operational and maintenance phases are the most important phases in the majority of PFI projects because that is when service and payment occur. Clearly, this dynamic differs from traditionally procured projects in which the private sector construction organisation has no interest in the long-term performance of the projects in the operation and maintenance stages. This difference highlights the continuation and whole life-cycle of a PFI project.

A report by HM Treasury (1997) also highlighted the main differences that differentiate PFI and traditional procurement of public sector construction projects in value for money, risk transfer and services delivery. In cases of PFI procurement, the value for money processes impact the procurement process at the beginning of the construction phase. Prior to selecting PFI as the procurement option, the procuring public authority should provide sufficient evidence that private sector consortiums offer value for money on their project proposal. In terms of the bidding process, PFI was seen to be more rigorous than traditional contracting procurement. A study by Dixon et al., (2005) summarised some of the differences between PFI and traditional procurement, as illustrated in Table 2.1.

Table 2.1 Comparison of Traditional Contracting Procurement and PFI (Dixon et al, 2005)

ELEMENTS	TRADITIONAL PROCUREMENT (DESIGN & CONSTRUCT)	PRIVATE FINANCE INITIATIVE
Specification of buildings	Building design are subject to client / authorities' specification and approval.	PFI bidder to come-up with a building design
Output specification	No output specification outlined by the client / public sector.	More concern about output specification rather than input specification (i.e. design). Public sector client specifies their requirements in terms of service needed. Meanwhile private sector design and construct a facility to meet the output requirements.
Funding	Obtained fund from public resources	Provide private finance to fund the project
Risks	Risk allocation and transfer according to the agreed contract.	Private sectors have to bear most of the risks associated with the project. e.g. Risk of a time overrun
Bidding process	Each bidder provides a cost of the building from the design.	Involves negotiation between public sector and PFI bidder on costs based on building design and its operation and maintenance

Organisation structure	Normally consortium or joint-venture company are formed for the large scale project to design and construct the capital asset. Operating the services is procured under different contract.	Comprises of consortium (Special Purpose Vehicle - SPV) to undertake design, construct, fund and continuing operation and maintenance of the capital asset
Value for money (VfM)	No value for money demonstrated in the contract.	Benchmarking and market testing are method used in PFI contracts to value test the cost and quality of certain services being provided by PFI contractors in order to ensure that the authority is getting VfM.
Payment mechanism	Payments are based on construction progress, called interim payment.	Involves payment on commencement of service subject to performance level.
Performance of works	Public sector has a role in monitoring the performance and progress of contractor's works.	Public sector has a role in monitoring and inspecting the performance of contractor's deliverables.
Contract period	Involves short period of time (2 to 5 years) for design until completion of project subject to size and nature of the project.	Involves long-term contract period. Up to 40 years' time to handed-back to public sector.

Some examples of the differences between the traditional and PFI procurement can be seen in certain elements. For example, in terms of the building specification in the traditional procurement; the design of the building is subject to client's or local authorities' specification and approval whereas in PFI procurement route, the PFI bidders will have to come out with their own building design. The PFI bidders are required to plan and provide sufficient design and construction details to enable the procurer to assess and evaluate the proposal (4Ps, 2007).

The most significant character of the PFI contract can be seen in the output specification elements whereby each of the output has been designed specifically to meet the required standard by the client. There is no such element in the traditional procurement that curtails the output specification as in the PFI contract. Another significant difference is that the contract duration of the PFI contract has been made purposely in the long-term period to encourage the PFI bidder and the public sector

body to consider costs over the whole life of the contract, rather than considering the construction and operational periods separately. This was to achieve efficiencies through synergies between design and construction and its later operation and maintenance.

Briefly, although the provision of a facility is involved in PFI projects, the essence of the PFI mechanism is the provision of a service. Hence, it is vital that bidder PFI bidder must provide comprehensive service statements on how they are planning to maintain the asset and meet the output specification over the contract period (Boussabaine, 2007). In addition, the long-term service delivery nature of PFI projects demands that a private consortium as service providers, properly considers whole life costing issues in order to minimise the contract period costs. Meanwhile, as the client, the public sector has to think more clearly about the services it requires and must develop techniques to evaluate the complex private-sector bids.

2.4 Challenges and Success Factors of PFI Projects

This section examines the challenges and success factors that are characteristic of PFI projects in general. For the challenges of PFI projects, this section focuses on the Use stage of PFI contracts, in which operation and maintenance of service delivery commences in the built facilities. Many practitioners and researchers have addressed challenges in the early stages of PFI contracts, such as procurement issues, entry barriers, market capacity, political and economic uncertainties, risk management, and integration of FM in PFI (Bing et al, 2005; Robinson et al., 2004; Dixon et al., 2003; El Haram and Agapiou, 2002; Spackman, 2002; McLennan, 2000; Burnes and Coram, 1999; Ezulike et al, 1997).

However, less research has been done on the challenges at later stages of PFI contract. This dearth of research is understandable because few PFI projects have been completed and most experience to date has occurred in the procurement stage rather than during the subsequent operation of facilities (Carrillo et al, 2006). Thus, it is timely to look into challenges faced by private consortiums at the operation and maintenance stage.

The operation and maintenance stage of PFI projects brings uncertainty in terms of risk and impact to the project because many changes will occur, particularly technological and functional demands (Alexander, 1997; Nutt, 2000), over the life of a PFI contract. Wordsworth (2001) recognised a significant gap occurring in standards of demand from users over a period of time. The operational and maintenance stage of PFI projects, such as hospitals, clearly involves a high operational risk of failure (Chotipanich, 2004) and a demanding level of maintenance service activities. Thus, through the FM service provider, the private consortium has to accept the challenges in defining and providing the maintenance services in order to cope with their facilities' performance.

Studies by Akintoye et al, (2003) highlighted some issues that impact private contractors' performance during the operational phase of their contract. These include difficulty in specifying the quality of services and pricing facilities management services. During the bidding stage, the precise definition of high quality service may be indefinable. For example, defining how clean is considered to be clean, with respect to cleaning service performance may be challenging.

Different interpretations can result in post-contract disputes between the client and private contractors. A study by Partnership UK (2006) reported a similar issue in PFI school projects, in which there existed differences in the interpretation of the level of service between service providers and the public sector. Therefore, it is important to define the scope, the need for concise definition of services required in the output specifications and clarity of the performance standards in the PFI contract.

With regard to difficulty pricing FM services, lack of information on products and components (in terms of usage and cost) can lead to difficulties in focusing the role of FM and establishing the supply chain within it (El-Haram and Agapiou, 2002). El-Haram and Agapiou also point out difficulties in projecting future costs of a facility in terms of establishing replacement trends and performance of certain types of equipment. Subsequently, these difficulties can lead to inefficient budget control and inaccurate estimation of work, contract and purchase management by the FM service providers.

A study by Ali (2004) also noted that at the operational stage of PFI, facilities managers found difficulties in obtaining relevant information from documents and drawings due to the large amount of paperwork generated during the project lifecycle. In addition, delay of information exchange between the construction and facilities management teams is also one of challenges experienced by the FM teams (Mustapa and Carrillo, 2007). Accordingly, more attention is needed during the operational stage to ensure an effective and timely service delivery. This can be accomplished through the effective management of information (Ruikar et. al., 2007; Frutcher, 2002).

Furthermore, the HM Treasury (2000) recognises that long-term relationships are an issue during the operational stage. The report states that success can be achieved only if the public authority and the contractor approach the project in a spirit of partnership. This can be best accomplished by understanding the other's business, sharing a common vision, good knowledge transfer and trust between the parties. In other words, the key to success in a PFI project is the establishment of a collaborative working or partnering relationship, in addition to systems and communications that actively support and enhance the relationship throughout the duration of PFI project.

2.5 Summary

This chapter has discussed the essential elements of PFI projects in terms of its key features, nature of PFI projects and success factors of PFI projects. Through the PFI, the responsibility for design, construction, operation and financing of infrastructure assets is transferred to the private sector usually for a period ranging from 20 to 30 years. The process involves creating an asset but the core objective is to deliver services to the public sector client in return for a performance-related payment reflecting the level of services provided. This chapter also provides the context for the subsequent chapters in Chapter 3 on the facilities management aspects in PFI and its application, and Chapter 4 on knowledge management theories, principles and practices. In this chapter, aspects of facilities management and its relation with operation and maintenance stages on PFI projects are discussed. The review of the literature identified the key problem areas and scope for learning to acquire the knowledge required to continuously improve the facilities management processes in PFI projects. Therefore the facilities management team should be prepared to deal with challenges and risks in a systematic and efficient manner.

Chapter 3 Facilities Management in PFI Projects

This chapter presents the definition of facilities management followed by a review of its provisions, importance, adoption and implementation in the construction business industry. It focuses on the type of services within its scope of work and highlights the need to properly plan and manage tasks as well as the resources needed to execute the tasks. Additionally, the important roles of facilities managers are highlighted, and the key issues and challenges faced by facilities managers in PFI healthcare projects are reviewed.

3.1 An Overview of Facilities Management

The importance of managing an asset or facility after commissioning or the occupation stage is widely recognised within the construction industry. This is especially true among private clients, who encounter the high costs of maintaining an asset or facilities during their occupation of a building. This is due to the perception among business organisations that traditional FM is a mere support service that is estranged from the core service of a business (Olomolaiye et al., 2004).

In response to the problem, many business organisations have outlined their business core as opposed to their supporting services. This was done after realising the importance of FM, especially in 'gluing' the organisation to achieve flawless output provided that the facilities are operated under the best conditions (Olomolaiye et al., 2004). In so doing, they have managed to achieve their business goal successfully.

Much research has been conducted to study the impact of operation and maintenance costs on total construction development costs. The findings have managed to reveal the cost distribution of each development stage of construction. For example, Nesje (2002), upon examining the FM expenditures distribution of St. Olavs Hospital in Norway, found that the total costs of maintenance, energy and cleaning account for 1/3 of the total operation costs. A study conducted by Mustapa (2004), revealed similar findings regarding the total operational costs of healthcare support services in Malaysia. The operational costs accounted for almost 2/5 of the total average operational costs.

Figure 3.1 represents the general distribution of construction costs in a typical project development. The figure below depicts the distribution of operating, occupancy, energy and maintenance costs represented as an iceberg to show the distribution of operational and maintenance costs, which account for almost 2/3 of total development costs.



Figure 3.1 Distribution of Operation and Maintenance Costs of Total Development Costs (Value Management Academy, 2011)

The figure clearly indicates that the provision of maintenance and operations costs accounts for more than the initial costs of construction. It also reflects the need for the proper planning of facilities management to ensure the value for money of the development made. Hence, the emergence of facilities management as a discipline has evolved from the increasing pressures surrounding the economic operation of construction projects (Shohet and Lavy, 2004).

Many researchers have begun to study the impacts of FM on the total costs of projects. As noted earlier, the cost of the operation and maintenance of an asset building costs more than the initial total development costs. Figure 3.2 shows the results of a study on the comparison of FM costs in a financial/administrative organisation with the costs of FM in a healthcare organisation. This indicates the degree of intensity and complex nature of healthcare services.

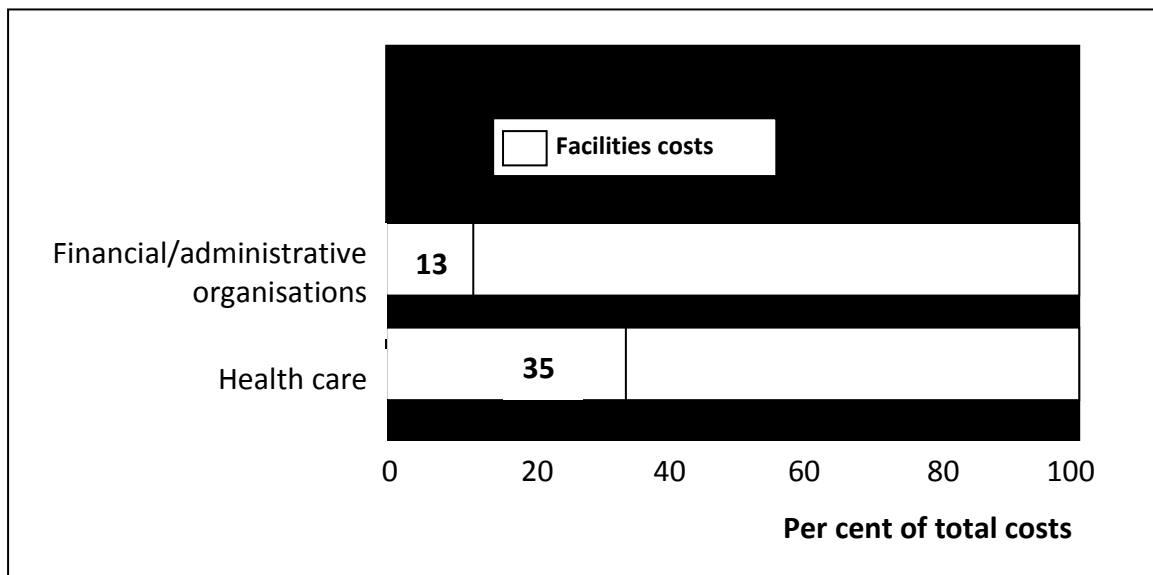


Figure 3.2 Cost of FM in Healthcare Services (Source: CFM, 1996)

FM is known to be an integrated approach in maintaining, improving and adapting the assets of an organisation in providing an environment that supports the core business of the organisation (Barrett, 1995) with the ability to have a strong influence on the physical environment of an organisation to achieve its business objectives (Olomolaiye et al., 2004).

3.2 Definition of Facilities Management

To understand the concept of facilities management (FM), it is necessary to develop a distinct definition of facility. Facility is a term commonly used to describe an asset being built or created under a given project (Hickman, 2000). Facilities are also described as buildings that are constructed and established to serve a particular purpose. In a business context, the term 'facilities' is defined as "*the premises and services required to accommodate and facilitate core business activity*" (Alexander, 1997).

The core business activities of an organisation are those that constitute the organisation's main purpose. Such pursuits are normally followed in direct contact with the client. For examples, the core business activity of a hotel is to provide accommodation, including catering. Moreover, the core business activity of a hospital is to provide healthcare services. As a facility becomes an asset to an organisation, there becomes a need to plan and organise its use and maintenance, which is the essence of 'facilities management'. All facilities require, throughout their lifetime, a level of performance and a standard of management that can provide and sustain conditions suitable for the well-being of their users. Thus, through an effective and well-planned approach, 'facilities management' could support core business activities and enhance the lifetime of facilities.

The literature offers many definitions of the term 'facilities management'. Owen, (1994) defined facilities management as: *"The active management and co-ordination of an organisation's non-core business services, together with the associated human resources and its buildings, including their systems, plant, IT equipment, fittings and furniture; necessary to assist that the organisation achieves its strategic objectives"* (Owen, 1994).

Another definition from Barrett (1995) stresses the physical infrastructure and the contribution of facilities management to primary business activities: *"An integrated approach to maintaining, improving and adapting the buildings of an organisation in order to create an environment that strongly supports the primary objectives of that organisation"* (Barrett, 1995). This view of facilities management is centred around the physical work place arrangement and its affect to the organisational success.

From a professional institution's standpoint, The International Facility Management Association (IFMA) recognised FM as *"a profession that encompasses multiple disciplines to ensure functionality of the built environment by integrating people, place, process and technology"*. This definition clearly illustrates the holistic nature of the discipline and the interdependence of multiple factors that is important to its success.

Moreover, the British Institute of Facilities Management (BIFM), a leading body in the UK facilities management field, defines FM as: *"The integration of multi disciplinary activities within the built environment and manages the impact upon people and the workplace"* (BIFM, 2003).

Additionally, the British Standard Institution (2006), EN 15221-1:2006 defines facilities management as: *“Integration of processes within an organisation to maintain and develop the agreed services which support and improve the effectiveness of its primary activities”*.

The different definitions above imply that facilities management is gradually and dynamically developing, especially regarding the broad range of aspects it deals with and changes in the built environment (Lavy and Shohet, 2007). Common to almost all of the definitions above is the idea that facilities management somehow concerns on provision of enabling working environment where the issues of people, place and processes are elements of the same problem seeking a common solution. Each of these three main provisions must be managed efficiently to ensure successful service delivery (Nutt, 2000). To ensure effective FM service delivery, proper planning and execution of services that combines both resources and activities is required (BIFM, 2003).

In describing the categories of facilities management, there are two (2) categories, namely soft and hard services. Hinks (2003) distinguishes the two categories by classifying FM services related to the management and maintenance of property as hard FM while soft FM refers to support services. In healthcare public services context, Mustapa (2004) refers to soft services as activities that assure that a building or an area is properly cleaned while the hard services refer to the work carried out with respect to building maintenance.

Meanwhile, Olomolaiye et al., (2004) define soft FM as the people involved in FM services and hard FM as the technological issues in FM. Because there are several interpretations of the soft and hard services of FM, for the purpose of this research, hard FM refers to the maintenance and management of property while soft FM refers to the support services of FM.

To conclude, the major purposes of FM can be distinguished in two aspects: to support and sustain the operations work and activities of organisations and their staff, and to manage work environment (hard services), and support services (soft services). Nowadays, facilities management is gaining greater recognition and acceptance as a significant influence upon organisational success and goal achievement which can enhance business performance.

3.3 Facilities Management Level

Kelly et al., (2005) recognised three distinct level of facilities management: a) strategic FM, b) tactical FM and c) operational FM. Strategic FM is concerned with the long-range aim and direction of FM functions. This includes setting objectives in response to the purpose of the FM functions and carrying out long-term planning and considering the external requirements. For example, the planning decisions made by an organisation at the top management level regarding the core business strategy and how to generate return on investments.

The tactical FM level is concerned with making the FM organisation function as a whole. This level is known as the planning function, which includes space planning, building projects, building management systems, resource management, health and

safety and continuity planning. The facilities manager is required to act on strategic demands and develop tactical plans in line with the strategy of a given organisation. Tactical plans include, for instance, controlling, analysing, programming and budgeting, often on a yearly basis. The plan includes defining routines and methods, setting standards, drawing up schedules and securing resources.

Moreover, operational FM is concerned with the day-to-day decisions in operating facilities. An effective operational FM provides a safe and efficient working environment, which is essential to the performance of any business. It can be said that the primary function of FM is an operational function, which is the most visible aspect of FM (Chotipanich, 2004). This operational function supports the basic routine and regular needs of an organisation such as cleaning, security, photocopying services, and telephone services.

These all levels are the same in most organisations and also have different corresponding issues and challenges. Such issues related to strategic FM include business organisation, corporate strategy and business objectives. Issues at the tactical level include those related to capital cost, development value and costs in use. Moreover, issues such as construction and maintenance, post-occupancy management of facilities and support services can be categorised under operational FM.

The following section discusses the importance of facilities management, the role of facilities manager, successful delivery of FM, maintenance specification and strategies. A review of facilities management in PFI healthcare projects is also discussed by highlighting the problems and challenges that arise.

3.4 The Importance of Facilities Management

Throughout the years, the importance of the facilities management has grown from many organisations. Design, construction and facilities management skills are necessary for developing innovative projects and for the operation of the completed assets or facilities (Robinson et al, 2010). Generally, different organisations are differently reliant on their facilities and support services, and affected by environment and context (Chotipanich, 2004). This is supported by Schindler (1998), who discovered that the differences in needs for FM are derived from the different cultures, business objectives and nature of organisations. Therefore, facilities managers need to define a management strategy in compliance with their organisation's strategy.

FM literature suggests that FM should be a strategic function with a connection with strategic objectives of core business (Barrett, 2000). In addition, many researchers such as Nutt (1999); Price and Akhlagi, (1999) have suggested that facilities management must evolve to a higher strategic level if an organisation is to extract the best value from it. Similarly, facilities management is widely seen to have a focus on the strategy of the client organisation. Therefore, Hinks et al. (1999) concluded that an opportunity exists to those involved in facilities management to capitalise on the strategic aspects rather than the technical areas of FM service. This point demonstrates the importance of using facilities management knowledge at the strategic stages of a project.

Hence, the use of facilities management knowledge is becoming increasingly significant to cope with the current demands at both the operational and strategic level. Kincaid (1994) states that within facilities management, managers must be equipped with knowledge of facilities and management to exhibit an effective FM function. Eley

(2001) also suggests that facility managers with plenty of experience and knowledge in FM would help any project by making decisions during the early stages of project inception or briefing.

McLennan (2000), outlines the importance of the business brief, the operational brief and the design brief in the integration of facilities management. This echoed by Smith et al. (2009) who state that strategic client briefing at early stages of project is now an essential component of best practice in facilities management. In the briefing process, facilities management can provide reliable life-cycle cost data from the design stage through the operational FM brief (Kelly et al, 2005; El Haram and Agapiou, 2002).

Decisions made during design can have a significant impact upon the future running and maintenance costs of buildings (Nutt, 2000). Ideally the facilities manager would be able to assist with accounting for the added value of buildings that are require less maintenance and are likely to result in fewer complaints by occupants (CIBSE, 2000). This suggest that a facilities manager and his team play a significant role in the inception stage to operational stage, where facilities manager is responsible for planning required for the maintenance of the facility and the day-to-day operation throughout a building's lifetime especially in the case of PFI project.

It is widely accepted that there is a lack of information and data on the costs of running buildings, making it difficult for designers to be realistic when advising clients of the real costs of ownerships. Nutt (2000) has identified management of information and knowledge resources as a generic type of resource management central to the facilities management function. Svensson (1998) in his study proposes a Knowledge Based System (KBS) framework model for facilities management purposes by

integrating IT with facilities management. The framework developed supports an integrated information system for FM, but also data exchange with core business.

Clearly, the practice of facilities management gradually matures as the shift has been towards resource integration in facilities management (Shiem and Then, 1999) Facilities management is also become more importance as affected by the growth of a new procurement route such as PFI, which fundamentally changes the nature of the construction industry from a product to service base (Khosrowshahi et al., 2004).

3.5 The Scope and Role of Facilities Management

Numerous researchers (Nutt, 1993; Preiser, 1995; Nutt and McLennan, 2000; El Haram, 2002) have attempted to list the main roles played by facilities managers in the overall building process. Alexander (1997) suggests that the role of FM should be defined by the relationship between facilities and the core business of an organisation, in which success is measured by the degree and quality of support it provides in achieving key business objectives.

Furthermore, the function, roles and responsibilities of FM tend to differ between different organisations. These differ depending on the size of their teams, the split between in-house and out-source services, and the type of the organisation itself. Hence, selecting an appropriate role for FM within an organisation has become very crucial. The following Table 3.1 illustrates the scope of services according to their corresponding activities played by facilities managers.

Table 3.1 Services and activities of facilities management (Adapted from Nutt, 1993; Preiser, 1995; Nutt and McLennan, 2000; El Haram, 2002).

Scope of Services	List of Services
Building Operation and Maintenance	Building Enclosure - Structure and fabric, components and finishes Building services - Electrical, Mechanical - Plumbing, Waste disposal - HVAC, Fire protection - Telecommunication Building grounds (landscaping, car parks)
Business Support Services	Human resource management & administration Finance Business development Corporate communication & information system Quality assurance
Support services	Cleaning Security courier services Library Office support services, i.e. printing, binding Reception Catering
Information technology & telecommunications	CAFM systems Network services & management (LAN,WAN) IT advisory services System administration & management Information Services & Customer support Computer/server/data centres Technical services (Install/operate/maintain)
Property management	Asset management Space planning Design/Construction Disposals/Acquisition Relocation management
Environmental management	Energy management Waste management Hygiene services Health & safety
Transport management	Site transport Fleet management Vehicle renting & leasing
Infrastructure	Utilities Road

From the Table 3.1, the vast number of activities that correspond to the services under FM provision indicates the great amount of information required for each activity, which requires special attention that can be further elaborated as the provision and operation of people, place and process, especially with respect to the need for proper planning and execution.

One of the largest areas of growth in facilities management has been in the development and use of Private Finance Initiative (PFI) projects based on 25-30-year facilities management contracts (Hinks et al., 1998). In this context, facilities managers have comprehensive responsibilities for providing, maintaining and developing many services. These activities require a facilities manager to perform different functions in accordance to users' needs, services requirements and the contract. Despite the ever-growing demand for lower operational costs, facilities managers must ensure that facilities are constructed, managed and maintained efficiently without compromising their performance (Shohet and Lavy, 2004).

As discussed earlier in Chapter 2, PFI contract comprised the key stages and the activities that the client and provider would undertake. Based from the RIBA Plan of Work (2008), the role and responsibilities of facility manager are varies and throughout the key stages. The roles and responsibilities of facilities managers are listed below, but not limited to those, as follows:

- Providing information by contributing to the briefing of the design team;
- Establishing a maintenance strategy;
- Undertaking an ongoing review of the facilities lifecycle performance; and
- Providing project teams with feedback on building and systems performance.

The RIBA Plan of Work (2008) describes the input required from each of the management of sub-processes, of which facilities management included at each stage. The facilities manager has a valuable role to play in all PFI stages. The following Table 3.2 illustrates the ideal involvement of facilities managers in the PFI stages.

Table 3.2 Ideal involvement of facilities managers in PFI procurement process
(Adapted by Jauzens et al., 2001)

Stages as denoted by RIBA			Activities to be undertaken
Preparation	A	Appraisal	<ul style="list-style-type: none"> • Contributing to pre-briefing discussions
	B	Design Brief	<ul style="list-style-type: none"> • Inputting to strategic requirements relating to operational issues • Giving advice on the requirements setting within the brief • Ensuring that end user's needs are incorporated into the planning process
Design	C D E	Concept Design development Technical design	<ul style="list-style-type: none"> • Ensuring that any strategic facilities requirements have been incorporated into the design • Contributing to assessment of design • Checking that the cost plan considers operational costs where this is required • Reviewing the design and ensuring that operating costs meet financial criteria
Pre-Construction	F G H	Production information Tender Documentation Tender Action	<ul style="list-style-type: none"> • Ensuring that the chosen tenders comply with key requirements
Construction	J K	Mobilisation Construction to Practical Completion	<ul style="list-style-type: none"> • Ensuring that the commissioning procedures are appropriate • Witnessing that commissioning has been properly carried out
Use	L	Post practical completion	<ul style="list-style-type: none"> • Ensuring that handover documentation is adequate and complete • Ensuring that facilities staff and end-users have been instructed in using facilities • Ensuring that post-handover services are in place • Obtaining information on building performance; ensuring that feedback is given to the design team and appropriate follow-up action is taken.

3.6 Ensuring successful Facilities Management

The successful delivery of FM services depends very much on the previously mentioned service provision of FM that comprises three (3) main elements, namely, people, place and process. Successful FM also highly depends on cost effectiveness and performance management, that is, by controlling and delivering low cost of the service maintenance and at the same time achieving a specific level of quality. In doing so, the role of facilities manager is very crucial in delegating the tasks that fall under the corresponding service type. The following sub-section discusses the seven steps that ensure the successful delivery of FM services stated by the Centre for Facilities Management (1996).

3.6.1 Appointing a client representative

An organisation should appoint a person that has a good understanding of the nature and long-term business direction runoff the organisation as well as the ability to identify opportunities for improvement. He or she should occupy an executive post and be able to convey information regarding FM to the organisation's board. This very much reflects the function of facilities manager.

3.6.2 Reviewing existing services

It is important to review and understand existing services in the context of company culture before planning for future FM services. It is the duty of the facilities manager to canvass services for the assessment of specification criteria before translating them to technical performance to decide whether services should be kept in house or outsourced. Should a service be contracted out, a contract between users and the service provider will be prepared by specifying what the service is that users need and how and when it should be delivered.

3.6.3 Option appraisal

Should the type of FM services required be determined, the organisation should decide to do it on its own or to contract it out to external experts. Organisations that have started to employ FM programmes must decide whether to contract services out or concentrate on carrying out FM services on their own. Once decisions regarding FM have been made, organisations must decide whether to use a single-service contract or a packaged deal or draw together several services. It should also be determined whether total FM service will be provided or hands-on management will be relinquished.

3.6.4 Managing the relationship

Once the decisions regarding FM have been made, several negotiations are necessary, especially during the integration of FM resources. This may include the need to transfer staff to an external provider for the first time or from one supplier to another. It is important to establish the right relationship at the start. Managing the relationship will require translating the documents tendered into effective working manual and managing the risk/reward relationship. The need for this relationship also requires an investment in time to understand the working culture, establish lines of contact, provide conflict management as well as make sure that the people involved are properly informed.

3.6.5 Developing the service

FM is a continuous process that requires making changes and improvements, strategic planning, and auditing. It is important to obtain user feedback on requirements and performance. It is also important to benchmark an organisation's services against those of its competitors and determine how the provisions of FM services compare.

Quality and price should be balanced and perhaps re-examined. Priority should be given to services with high value or complexity or those that carry a high core business risk. In some cases, it may be useful to commission an independent review by a third party.

3.6.6 Specifying

Upon assessing current FM provision, the identification of user demand and the need for services is needed and results in the need for specifications to formalise the conclusions. At this point, understanding how people work is a prerequisite for establishing levels of performance.

3.6.7 Selecting FM supplier

It is advised that an organisation re-tender outsourced FM services on a regular basis to ensure the latest updates on FM servicing. However, a FM client may be looking for a long-term partnering arrangement with a chosen supplier to secure cost effectiveness and stability. The organisation should have a clear view of how it would conduct the selection process and how it will test competitive bids for quality.

3.7 Maintenance Specification

As noted in the previous sections, FM involves the execution of tasks with regard to the services rendered by the FM service provider. Hence, it is very important to outline the elements of maintenance specification in each of the associated tasks. According to BSRIA (2003) there are two types of maintenance specifications:

- i. The work schedule, which states the type of work that must be completed in technical terms.

- ii. General requirements, which states the restrictions and other relevant details that apply.

With respect to the elements of maintenance specification, there is no guidance regarding the technical aspects of the work schedule provided. However, BSRIA (2003) suggests 14 topics on the general requirements for specific standards of maintenance specification.

- i. Scope of work
- ii. Sites and equipment
- iii. Related documents
- iv. Regulations
- v. Definitions
- vi. Facilities to be provided by the client
- vii. Access to site and plant
- viii. Noise, nuisance, pollution and interference
- ix. Hours of attendance
- x. Call-out/emergency procedures
- xi. Personnel
- xii. Quality assurance
- xiii. Materials, equipment and spares
- xiv. Site documentation

According to BSRIA, (2003), each of the elements of maintenance specification are further defined as being input or output performance based. For instance, the work specification based on input depends very much on the levels of effort. This is usually reflected by the maintenance work of the facilities. On the other hand, the work

specification based on the output performance requires a statement of the desired services by denoting the outcome, standard of performance, quality, performance monitoring and related incentives. The following provides an overview of the maintenance strategies that are usually adopted by the facilities manager in managing FM services.

3.8 A strategic approach to maintenance

Operational and maintenance costs play an important role in the procurement of PFI facilities. A maintenance strategy that is based on a rational assessment of reliability and predictability of the service life of building components and on real-time knowledge of the condition of assets components will help to ensure effective management of whole life cycle decisions (Boussabaine, 2007). This will reassure the client that the quality of building is being kept to the standard required. In addition, this will enable the FM service providers to plan more accurately for life cycle expenditure and develop strategies for making decisions on maintenance prioritisation.

With regard to the different levels of FM services, there are several strategies that can be used to maintain facilities, particularly the hard services outlined to ensure that the components are functioning in a safe and efficient manner. This is important in reducing overall operating costs and enhancing the productivity of a given business plan (Prasad and Kanaka, 2009). Additionally, many maintenance models have been designed to overcome problems derived from equipment breakdown. A facilities manager may be required to give strategic information on maintenance-related matters. The following are the types of maintenance strategies that can be implemented.

3.8.1 Breakdown maintenance

This type of maintenance refers to the need to repair malfunctioning or out-of-order machinery. It involves several specific steps to rectify the problems. Breakdown maintenance is usually initiated by the occupier and will be categorised by a number of factors such as type of work required, nature of fault and seriousness (Holmes, 1994). In terms of economic value, this type of maintenance techniques is suitable for equipment with low repair costs.

3.8.2 Preventive maintenance/periodic maintenance

As opposed to breakdown maintenance, this type of maintenance has a specific schedule for maintaining work that focuses on preventing machine breakdown or failure. It requires special maintenance steps and is time based.

3.8.3 Predictive maintenance

This is condition-based maintenance. This is useful for the operation of equipment, energy costs and increasing reliability. It requires the constant monitoring of machines with skilled manpower.

3.8.4 Condition-based maintenance (CBM)

This is a sub-set of predictive maintenance that requires the installation of tools or the implementation of methodologies to maintain equipment in operating conditions. It focuses on extending the lifetime of machinery and increasing productivity. It calculates the exact condition of equipment on a real-time basis thanks to the fact that most CBM systems are now computer controlled. CBM can aid not only in predicting the frequency of faults but also in helping to determine the causes of problems that may arise.

3.8.5 Pro-active maintenance

This type of maintenance sets out to monitor and correct defects that cause failure. It is designed to prolong the lifetime of equipment, similar to the CBM. However, this type of maintenance concentrates on rectifying the cause of the problem by utilising a high level of operating precision.

3.8.6 Total Productive Maintenance (TPM)

TPM on the other hand concentrates on optimising machine effectiveness by eliminating breakdowns and promotes automated maintenance on a daily basis. It aims to increase productivity by ensuring zero accidents, defects, failures in systems and machines and at the same time achieve maximum productivity at normal costs.

3.8.7 Computerised Maintenance Management System (CMMS)

With the advent of the computer, CMMS are able to store, retrieve and analyse information. CMMS store organisations' database of maintenance operations. This helps organisations expedite the process of FM by aiding the staff in charge in executing their jobs effectively by making informed decisions regarding the use of the right tools.

3.8.8 Reliability Centred Maintenance (RCM)

This is a maintenance technique that has been developed by understanding the reliability of various machines. It involves a process for analysing system failure mode and defines it to prevent or identify failure before it occurs. By adapting RCM, the ownership cost of the system is reduced. However, it requires at least 4-5 people a week per system as opposed to 1-2 working hours by a single person.

3.8.9 Effectiveness Centred Maintenance

This type of maintenance aims at “doing the right things” rather than “doing things right”. It combines the core concepts of quality management, TPM and RCM. It also combines people participation via quality improvement and maintenance strategy development for performance measurement.

3.8.10 Strategic Maintenance Management

This maintenance service is based on quantitative business models that integrate maintenance with other decisions such as those related to production. It is a multidisciplinary activity and combines both RCM and TPM but overcomes their deficiencies. It engages the process of re-engineering and increases resource effectiveness.

3.8.11 Risk-based maintenance

This maintenance minimises the hazards due to the unexpected failure of equipment. It employs defect evaluation to ensure minimum damage in the event of a disaster. It is comprised of three modules a risk estimation module, risk evaluation module and maintenance planning module. By adapting this method, effective maintenance is possible, and the cost of repair becomes less expensive than that of a conventional plan.

3.8.12 Turnaround Maintenance (TAM)

This type of maintenance is periodic, especially during the shutdown of a plant to allow inspections, repair, replacements and overhauls to be executed. TAM aims to keep the costs of maintenance as low as possible due to corrective maintenance and managing resources efficiently. TAM is mostly used in petroleum companies.

3.8.13 Lean Maintenance

This method of maintenance seeks to maintain equipment uptime and reliability at almost 100% while cutting maintenance costs by approximately 50% or more. It is an operation that employs planned and scheduled maintenance through a combination of TPM practices, RCM decision logic applications and the 5S process, Kaizen improvement events and autonomous maintenance through the committed use of their work order system and their CMMS or EAM system (Prasad and Kanaka, 2009).

From the different type of maintenance techniques, it can be summarised that the strategies that are adopted are usually based on the types of machines used and services tendered. More complex and expensive machinery requires more frequent maintenance. This refers to not only hard services but also soft services. Likewise, the more critical need for soft support services entails frequent maintenance.

In PFI, the budget for planned maintenance, repair, renewal or replacement relating to the maintenance of buildings and engineering services should be developed prior to Financial Close stage and is embedded in the service level agreement. Hence, it is importance of having a long-term maintenance and repair strategy to maximise efficient use of the building and keep maintenance and running costs as low as possible.

3.9 Facilities Management in PFI

In the UK, there are several sectors of different nature of project under the PFI contract arrangement that utilise the FM service provision. The following are the sectors that require FM services at their operational stage of PFI projects (Armstrong, 2002):

- Education;
- Health services;
- Transport infrastructure;
- Defence;
- Prisons;
- Information Technology (IT);
- Property portfolio management;
- Waste management;
- Housing;
- Flood defence.

The list shows that many business organisations in different sectors have chosen to emphasise their core business competencies and outsource their FM support services to external service providers to ensure a better environment for their support services and thus success in achieving their business goals. As noted in the previous section, different needs and approaches are required in managing facilities of organisations within similar sectors. Hence, each sector requires not only a different scope and services under FM but also different levels of quality and specification.

Given that the scope of this research is in PFI healthcare sector, the following section will discuss in detail the nature and scope of FM in PFI healthcare projects.

3.9.1 FM in PFI healthcare project

The PFI in the healthcare sector in England and Wales is under the Department of Health (DoH). The client for a PFI hospital project is by default a National Health Service (NHS) Trust. PFI is currently being used in the health sector to deliver projects, services, and equipment provision (e.g. magnetic resonance imaging scanners, simulators, radio, etc.). The nature of health PFI facilities provision includes new build, conversions, redevelopment, site rationalisation, centralisation, and modernisation works to meet projected demands (Akintoye and Chinyio, 2005)

In PFI healthcare projects, the client (Trust) is responsible for providing all clinical healthcare services. Thus, core staff of nurses, doctors and various medical specialists are retained or employed by public sector. However, the consortium involved in the project is responsible for delivering non-clinical services in the hospital, i.e. catering, laundry, portering, domestics, estates and building maintenance, transportation, energy supply and telecommunications. The components of the hospital business are depicted in Figure 3.3.

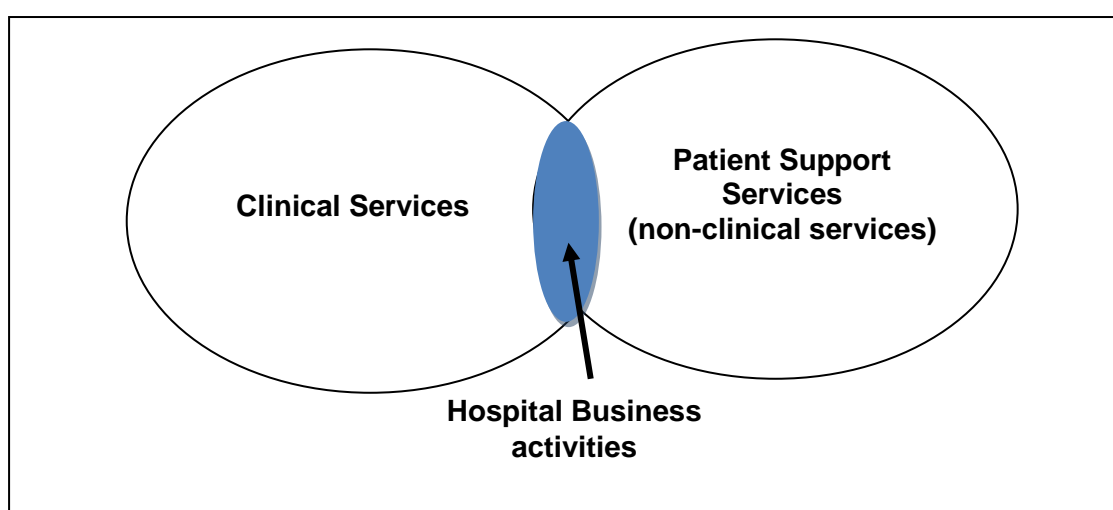


Figure 3.3 Components of Hospital Business (Oni, 1994)

Shohet and Lavy (2004) have managed to integrate the five elements in healthcare FM and develop a state-of-the-art review on the core domains of healthcare facilities management. All these five elements comprise of maintenance management; performance management; risk management; supply service management; and development are interconnected by an integrated facilities management model (IFMM) through the application of ICT. The IFMM provides an integrated knowledge-base environment for healthcare FM and is shown in Figure 3.4

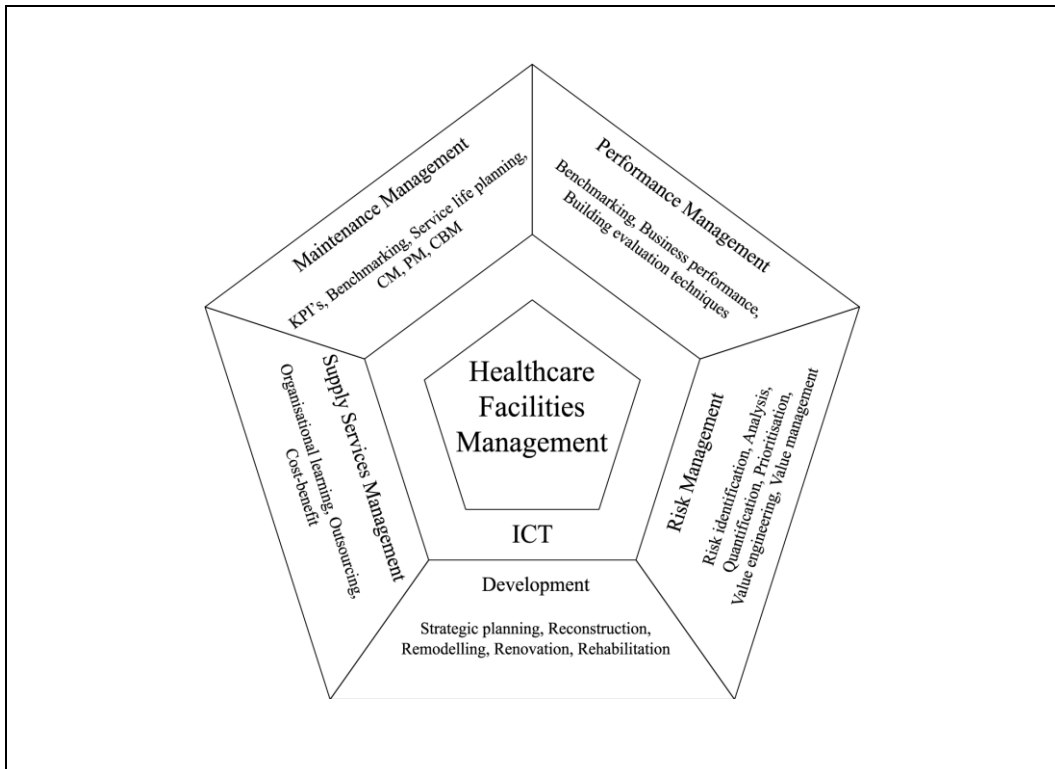


Figure 3.4 Healthcare facilities management core domains (Shohet and Lavy, 2004)

Gelnay in Shohet and Lavy (2004) regards FM as one of the key elements for the successful delivery of healthcare services. Gallagher (1998), after reviewing the main areas for successful implementation of National Health Services (NHS) in the UK, managed to outline six main areas of FM in healthcare:

- Strategic planning;
- Customer care;
- Market testing;
- Benchmarking;
- Environmental management; and
- Staff development.

From this list, it can be concluded that all of the sources outlined strongly indicate that the growth and development of the FM profession can be increased through the provision of effective healthcare services. A study conducted by Rees (1997) on the development of the FM profession within the NHS in the UK reports that NHS Trusts tend to integrate non-core healthcare services (e.g., risk management, energy efficiency, cleaning, and security) under the umbrella of a FM department.

As explained earlier, there are soft and hard FM services. While the soft services refer to the support services of an organisation, hard services refer to the maintenance and management of estates and property. The following Table 3.3 lists the services provided by NHS healthcare services in the UK.

Table 3.3 Types of FM Services in NHS Health Care Services

Soft services	Hard services
Catering Domestic Laundry & Linen Security Sterile Supplies Portering Window Cleaning Waste disposal	Building and Engineering Maintenance Car parks Grounds & gardens maintenance Pest Control Reception/switchboard Residential staff accommodation Transport hire Transport maintenance

According to Clark and Rees (2000), 172 NHS facilities managers were responsible for 74 different services. Out of 74 services rendered, 24 services which include domestic services, catering, laundry, portering, maintenance of buildings and services, utilities, security and car parking, were controlled by over 90 percent of the managers. The relevance of these managers' responsibilities to the efficient running of their trusts' core business was illustrated by the fact that 65 percent of them were responsible for

more than 50 separate services. This reflects the vast amount of tasks needed to be controlled and executed to achieve the objectives of FM. In addition, it also echoes the needs to manage all of the information needed in terms of the three provisions of FM stated earlier for each of the different tasks categorised under each type of service.

3.10 Summary

After having reviewed the provisions of FM and thus understanding its related services and activities, it is concluded that FM covers a wide range of services in built environment. The importance of FM is derived from the high operational and maintenance costs related to the total development costs of typical construction projects.

Additionally, the activities that fall under FM are further divided into the provision of four aspects of FM provision, namely, people, place, process and level of standards. Hence, it involves a great amount of information to be not only managed but also used by several people at different levels of FM services. Each of the tasks needs to be clearly specified under various work specifications, which require different input and output performance bases. These two specifications are further divided into levels of performance for the input-based specification that delineate the type of maintenance needed to be carried out.

On the other hand, the output-based specification requires a statement of the desired output, which can be further divided into several categories, namely, the output performance standard, quality, performance monitoring and incentives. FM also involves different levels of services that reflect the needs of different people at the operational, managerial or tactical level and strategic level, which involves the

stakeholder of the business organisation. Overall, the service delivery requires proper planning and incorporates much information into each specific task. Thus, it is important to identify information and knowledge applied in order to improve the facilities management process.

Chapter 4 Knowledge Management in Facilities Management Practice

This chapter explores the relevance of knowledge management (KM) concepts to the facilities management stage of Private Finance Initiative (PFI) projects. It begins with the definition of knowledge and its characteristics and examines the current literature on KM practices in construction. The importance of KM in an organisation is also highlighted. Next, information and knowledge flows during the operational stage of a PFI construction project are discussed. This chapter concludes with a discussion of the application of knowledge management systems during the operational stage of a construction project. Integrating knowledge management concepts into the facilities management processes is expected to lead to further improvements in service efficiency and performance.

4.1 Defining Knowledge

The foundation of knowledge is closely related to data and information (Bhat, 2001). Data can be in the form of numbers, text, letters or graphics and is the means through which information and knowledge is stored and transferred (Ahmed et al., 2002). Data has been defined as a set of discrete and objective facts about events (Davenport and Prusak, 2000). However, it provides no judgment, perspective, interpretation or context (Huseman and Goodman, 1999). Thus, although data lacks any meaning, it is the foundation for the creation of information. On the other hand, information can be defined as interpreted data which is put into context with an added perspective and delivered to people's minds (Huseman and Goodman, 1999; Martensson, 2000). Hence, data becomes information when it is given meaning. Nonaka and Takeuchi

(1995) define information, as the 'flow of message'. The message is usually in the form of a document conveying audible or visible communication. Put simply, information is data endowed with relevance and purpose, which can be created by adding value to data (Drucker, 1988).

Various writers have defined the term 'knowledge' by using broad concepts and perspectives. Bhat (2001) suggests that knowledge is considered to be meaning made by the mind, and that without meaning, knowledge is information or data. Bhat further emphasised the interpretation of a set of information to convert it to knowledge. He defined knowledge as an organised combination of data assimilated with a set of rules, procedures and operations learnt through experience and practice. Wigg (1993) agreed that knowledge is accumulated and integrated and held over long periods. Subsequently, knowledge is applied to handle specific situations and problems. Davenport and Prusak (2000) acknowledge that knowledge derives from information as information derives from data through comparison, consequences, connections and conversation. Thus, they perceive that knowledge is a broader, deeper and richer concept than information and data.

In distinguishing the concept of knowledge from information, McDermott (1999) lists six characteristics:

- Knowledge is a human act;
- Knowledge is the residue of thinking;
- Knowledge is created in the present moment;
- Knowledge belongs to communities;
- Knowledge circulates through communities in many ways; and
- New knowledge is created at the boundaries of old.

Nonaka and Takeuchi (1995) further define knowledge as being related to a process, which is often thought to involve human action. It is a dynamic human process of justifying personal beliefs towards the truth that is created by the flow of information. Probst et al. (2000) claim that knowledge is a whole body of cognition and skill which individuals use to solve problems in their social interaction. It includes theories, practical everyday rules and instructions for action.

Davenport and Prusak (2000) then discovered the difficulty of defining knowledge is that it exists in various forms in individuals, groups and organisations. They stated that knowledge is 'a fluid mix of framed experiences, values, contextual information and expert insights that provide a framework for evaluating and incorporating new experiences and information'.

In organisations, it often becomes embedded not only in documents but also in organisational routines, processes, practices and norms. Egbu (1999) added that knowledge is the ideas and wisdom that are acquired through experience, theory and practice and which gives the acquirer the ability to understand. He further stated that knowledge can be potential or manifested in performance. Further discussions on the types of knowledge provide a useful perspective on the concept of KM as a whole, as described in the next section.

4.2 Types of Knowledge

The most widely accepted classification of knowledge is that of Nonaka and Takeuchi (1995), who classify knowledge as either 'explicit' or 'tacit' (Table 4.1).

Table 4.1 Categories of Knowledge (Nonaka and Takeuchi, 1995)

Explicit knowledge	Tacit knowledge
Fact based, publicly available and beyond dispute.	Personal knowledge embedded in an individual.
Possibly recorded in documents, also includes scientific and technical knowledge, common understandings, 'the right way of doing things' and socially accepted norms.	Experience and involving such intangible factors as personal belief, perspective and values.
Easily verbalised and stated in the form of rules or notes. Includes knowledge of organisational structures, business rules, etc.	Informal action and discourse orientated.
Easier to deal with in ICT developments as it is easily articulated, communicated and represented in formal languages	'Acting with' rather than 'acting on'.
Formalised	The real key to getting things done.

According to Nonaka and Takeuchi (1995), explicit knowledge is that which can be easily shared, codified and stored. Most explicit knowledge is technical or academic data or information that is present in documents, manuals, copyright, patents and reports. It can also be found in organisational documents, such as organisational charts, process maps, mission statements and others. Explicit knowledge can be a good catalyst for connecting people together, as it can be stored and searched. Some captured knowledge can be of enormous value if it easy to share, easy to read, easy to add to, and if it provides a connection to others. Once codified, explicit knowledge assets can be reused to solve many similar types of problems or connect people with valuable and reusable knowledge. Explicit knowledge is technical and requires a level of academic knowledge or understanding that is gained through formal education (Bollinger and Smith, 2001).

Meanwhile, tacit knowledge refers to knowledge that has a personal quality and is therefore difficult to codify, formalise and communicate since it is arguably held within people's heads (Polanyi, 1966). Whilst codified, explicit knowledge lends itself easily to sharing, tacit knowledge must go through a number of processes before any sharing can occur. Thus, the key to acquiring tacit knowledge is experience. Tacit knowledge is wholly embodied in the individual, rooted in practice and experience, expressed through 'watching' and 'doing' forms of learning. In addition, tacit knowledge is the most important, proprietary and difficult to replicate knowledge for others, such as organisations and project stakeholders to access as it is invisible and difficult to imitate (Johannessen and Olsen, 2003).

Acquiring tacit knowledge requires having considerable experience in an activity, preferably while working with experts. Observing how experts address problems, along with having practice addressing problems and receiving feedback on our method of doing so, fosters the development of tacit knowledge. The tacit form exists in the form of skills, the 'know-how' of individuals, the norms and rules of an organisation and the organisational culture (Nonaka and Takeuchi, 1995). Thus, tacit knowledge is personal, context-specific knowledge that is difficult to formalise, record or articulate. Tiwana (2002) explained that tacit knowledge is personal knowledge embedded in individual experience and shared and exchanged through direct, face-to-face contact.

4.3 Knowledge Management

Knowledge management (henceforth KM) is a term with many definitions and perspectives. Thus, it is difficult to formulate a definition of KM that satisfies everyone involved with it. Briefly, the concept of KM consists of the management of knowledge as an asset. Webb (1998) states that KM is the identification, optimisation and active

management of intellectual assets to create value, increase productivity and gain and sustain competitive advantage. Knowledge assets are the knowledge regarding markets, products, technologies and organisations, that a business owns or needs to own and which enable its business processes to generate profit (Civi, 2000).

KM is not only about managing those assets but managing the processes that act upon the assets. Further, KM is considered as a continuous and integrated process (Tiwana, 2002). Tiwana added that in a business context, the aim of KM is to facilitate the opportunistic application of fragmented knowledge through integration. Management entails all of those processes associated with the identification, creation, capturing and sharing of knowledge (Egbu and Robinson, 2005). Darroch and McNaughton (2002) further state that KM is a management function that creates or locates knowledge, manages the flow of knowledge and ensures that knowledge is used effectively and efficiently for the long-term benefit of the organisation. KM further allows collaboration, knowledge sharing, continual learning and improvement. These processes are then reflected to enhance learning and performance in organisations.

4.3.1 The Knowledge Management Process

The KM process involves many stages and addresses many different needs and perspectives. Table 4.2 tabulates the KM processes with a comparison between authors and perspectives. In observing these different perspectives of the stages in the KM process, there appears to be certain noticeable similarities. The elements of knowledge capturing, gathering, storing, sharing and use are common among the perspectives.

Table 4.2 Different Perspectives of the Knowledge Management Processes
(Adapted from Mohamed, 2006)

Author(s)	KM Processes	Perspective
Robinson et al (2001)	KM consists of five distinct but interrelated processes: <ul style="list-style-type: none"> • Discovery and capturing • Organisation and storage • Distribution and sharing • Creation and leverage • Archiving and retirement 	Construction industry
Kululanga and McCaffer (2001)	KM consists of five processes: <ul style="list-style-type: none"> • Acquiring • Creating • Storing • Sharing • Utilising 	Construction industry
Davenport and Prusak (2000)	KM systems which involve the following processes: <ul style="list-style-type: none"> • Generation • Codification and coordination • Transfer 	Management science
Bhatt (2001)	Divided KM processes into five main areas: <ul style="list-style-type: none"> • Creation • Validation • Presentation • Distribution • Application 	Business management
Tiwana (2002)	Three basic processes of KM are: <ul style="list-style-type: none"> • Acquisition • Sharing • Utilisation 	Business and information management
Vorbeck and Fenke (2001)	Divided KM process into four main areas: <ul style="list-style-type: none"> • Creation • Store • Distribution • Utilisation 	Organisation management

All the KM processes mentioned enable an organisation to learn, reflect and re-learn. Thus, knowledge management could be defined as *“the effective learning processes associated with exploration, exploitation and sharing of human knowledge (either tacit or explicit), that use appropriate technology and cultural environments to enhance an organisation’s intellectual capital and performance”* (Jashapara, 2004).

Based on the various definitions, it can be concluded that the main stages in the KM process are as follows: 1) Knowledge Creation; 2) Knowledge Organisation and Storage; 3) Knowledge Distribution and Sharing. These three processes are derived from the KM process in the context of construction suggested by Robinson et al. (2001) and Kululanga and McCaffer (2001). KM includes a broad process of creating, organising and storing, distributing and sharing knowledge to achieve the organisations’ goals. This is used as the working definition of KM in this study. A brief explanation of each process is provided below.

4.3.1.1 Knowledge Creation

Knowledge creation is driven by the types of information that an organisation needs in its business process (Chun, 1998). Knowledge is pulled and captured from various sources either through experience, sharing thoughts and feelings during socialisation or getting new knowledge from recorded materials.

4.3.1.2 Knowledge Organisation and Storage

Knowledge organisation and storage deals with a process that requires information to be edited, summarised or codified before it is stored in the knowledge base. Processes that are involved in this stage include cataloguing, indexing, filtering, refining or linking related pieces of information with each other. Knowledge that has been organised will be stored in a database and updated when required.

4.3.1.3 Knowledge Distribution and Sharing

The aim of knowledge distribution is to increase the sharing of information. Knowledge is to be shared and utilised to improve competitive advantage. Knowledge sharing across the organisation is used as a strategic tool to decrease product development times and to share best practice. The more the knowledge is shared, the more valuable the knowledge becomes.

4.4 Knowledge Management Tools

As discussed in the previous section, knowledge management (KM) is the entire process of creating, organising and storing, distributing and sharing knowledge to achieve organisations' goals. During the process, tools that support the performance of applications, activities or actions of knowledge processes are needed (Ruggles, 1997). According to Robinson et al., (2001) KM tools enable an organisation's KM processes to be executed and consist of both information technology (IT)-based and non-IT based systems.

However, Al-Ghassani (2005) preferred the terms 'KM techniques' and 'KM technologies' in the construction industry context, as these terms provide a better understanding of the corresponding contents. The main differences between KM techniques and technologies are presented in Table 4.3.

Table 4.3 A Comparison between KM Techniques and KM Technologies
(Al-Ghassani, 2005)

KM Tools	
<p>KM Technologies Require IT infrastructure Require IT skills Expensive to acquire / maintain Difficult to implement / maintain More focus on explicit knowledge</p>	<p>KM Techniques Require strategies for learning More involvement of people Affordable to most organisations Easy to implement and maintain More focus on tacit knowledge</p>
<p>Examples of Tools Groupware Data warehouse Document management systems Data and text mining Internet, extranet and intranet E-mails, Electronic discussion forum</p>	<p>Examples of Tools Communities of Practice (CoP) Brainstorming Training Peer assist workshops Mentoring / Coaching Post Project Reviews</p>

4.4.1 KM Technologies

Ruggles (1997) stated that KM tools are technologies that enhance and enable sub-processes of KM through the use of IT. They can also be used to speed up communications, elicit tacit knowledge and construct insights and catalogues (Grantham and Nichols, 1993). Many researchers have cited IT as one of the key enablers of successful KM (Choi and Ibbs, 1995; O'Dell and Grayson, 1998; Weill and Broadbent, 1998).

Although IT is not the solution to an organisation's KM needs, it is clearly required to enable the organisation's KM processes. This is supported by Weill and Broadbent (1998): *"IT facilitates the rapid dissemination of knowledge and improves communication and collaboration among employees at all levels, all locations, and even with those in other organisations"*. Within the knowledge management context, IT includes a broad range of applications.

The following are several examples of KM technologies applications that have had critical implications for KM.

- **Groupware** is a technology that can overcome space and time barriers for group interaction. Its focus is to help knowledge workers share their expertise, particularly in a physically dispersed environment. The purpose of groupware is to support the collaborative works of a group of people. It includes software for information sharing, electronic meetings, scheduling, workflow management, and an e-mail network to connect the members of the group.
- **Data warehouse** is a data management technology that integrates information from multiple data pools and that makes it easier to explore the hidden meanings of data (Chase, 1997; Skyrme and Amidon, 1997). In the other words, data warehouse technology can be used to store and structure knowledge. Those who benefit from the use of data warehouse are people who access large amounts of information that can be analysed from different perspectives; thus, it can enhance decision-making quality.
- **Document management systems** allow people to share knowledge in many applications (Junnakar and Brown, 1997). Document management systems are a *“repository of important corporate documents and are therefore important stores of explicit knowledge”* (Offsey, 1997). Documents provide users knowledge with more context and details. It can include manuals, best practices, policy books and even drawings.
- **Data and text mining** technology is an emerging technology used to extract meaningful information from a large pool of data to support business decisions (Mitchell, 1999). Data mining technology finds patterns, trends or relationship in

large pools of data and predicts future behaviours from them. These patterns and rules can be used to extract hidden knowledge about customer behaviour. Data mining can be used to locate the specific needs of a market or customers.

- **Internet, intranet, extranet** and web technology enables the capturing, sharing and leveraging of information and knowledge throughout the organisation. In the past few years, intranets have emerged as an important KM tool (Ruggles, 1998). The majority of company intranets now host corporate information accessible to employees and has formal corporate roles and responsibilities to ensure that key information is captured timely and accurately and updated regularly.

4.4.2 KM Techniques

In recent years, there has been a move away from the largely IT-based solutions for knowledge management. Current KM initiatives are more interested in the management of knowledge embodied in people. According to Hwang (2003 in Hai Chen), people are regarded as a source for knowledge creation and knowledge sharing in a learning organisation. As a result, the most important objective to keep in mind when creating IT-based knowledge networks is to put people at the centre. The followings are examples of KM techniques that can be used to support organisations' goal with emphasis on people-based activities.

- **Communities of Practice (CoPs)**. These are groups of people formed to share knowledge, which helps to prevent key knowledge from being lost when an individual departs. According to Dent and Montague (2004), CoPs are considered ideal ways to manage knowledge as an asset. This is by utilising the inherently context-dependent nature of 'know-how' and experience required for collaborative problem solving in project-based organisations.

- **Brainstorming** sessions are used to develop staff competencies to access and update of knowledge. According to Nonaka and Takeuchi (1995), a brainstorming session is an informal meeting for detailed discussions to solve difficult problems in development projects.
- **Training** helps to improve staff skills and consequently increase knowledge. There are two types of training and development (Jashapara, 2004). Training can be either external or internal. In internal training, senior members of a company train new or junior employees within the organisation. In external training, employees attend courses managed by professional organisations (Al-Ghassani et al., 2005).
- **Peer assist workshops** are generally used to enable a project team to share knowledge, experience and insights with other teams, particularly where problem solving is required. These activities support the development of problem-solving skills and expose individuals to new ways of thinking and methods of approach.
- **Mentoring or coaching** process provides every employee with access to a structured development programme by identifying relevant subject matters for which senior management could serve as mentors and assigning newer employees appropriately. This is one way to ensure that there is a continuous transfer of knowledge in an organisation.

The next section highlights the importance of knowledge management and the barriers to implementing knowledge management in a construction organisation.

4.5 Importance of KM in a Construction Organisation

Knowledge management is a management process that embraces the entire system within which technology operates. This includes the people, processes, strategy and culture of the organisation (Ahmad et al., 2002). The interactions between these elements will allow an organisation to manage knowledge effectively and sustain a competitive advantage (Bhatt, 2001).

There are three stages where organisational knowledge is important: (1) strategic level; (2) tactical level; and (3) operational level (Civi, 2000). At the strategic level, the organisation needs to be able to analyse and plan its business in terms of the knowledge it currently has and the knowledge it needs for future business processes. At the tactical level, the organisation is concerned with 'identifying and formalising existing knowledge, acquiring new knowledge for future use, storing it in organisational memories and creating systems that enable effective and efficient application of the knowledge within the organisation (Civi, 2000). At the operational level, the 'know-how' and the experiences of construction personnel are the most valuable as it is used in everyday practice. Since most project-related problems, solutions, experiences and know-how are in the heads of construction personnel and organisations during the construction and operational phase, capturing them and reusing them in future projects can create advantages for an organisation.

KM in a construction context mainly deals with identifying, capturing, evaluating, retrieving and sharing all of an organisation's information assets (Noordin and Chowdhury, 2003; Kululanga and McCaffer, 2001; Carrillo et al., 2000). These assets may include project databases, project reports, drawings, specifications, policies, project procedures and previously uncaptured expertise and experiences of trade

workers. It also involves various tasks and activities that are performed to ensure that knowledge is elicited, stored, shared and updated. These activities include all the stages of construction, including conceptual design, advance development, detailed design and production, termination and operational processes and procedures (Shtub et al., 1994).

The main drivers for KM in construction organisations are various. Amongst them are the needs for innovation, improved project performance, reduced project duration and improved quality and customer satisfaction (Kamara et al., 2002; Love et al., 2003; Ahmad et al., 2002; Al-Ghassani et al., 2006). Construction organisations can benefit from KM by implementing initiatives that help in capturing knowledge that is generated during the different stages of a project lifecycle. Further, this makes it available and accessible in a timely fashion, throughout the organisation (Al-Ghassani et al., 2006). KM processes help exploit an organisation's intangible assets and create both valuable internal and external knowledge (Davenport and Prusak, 2000; Liebowitz and Megbolugbe, 2003). KM can also assist project personnel in a project environment to improve within-team communication by providing knowledge to project team members. This could lead to fewer misunderstandings in the contract and improve greater interaction between personnel.

Further, KM can enhance sharing of best practice documents, lessons learned, project management and system engineering methodologies, as well as clarifying the rationale for strategic decision-making (Liebowitz and Megbolugbe, 2003). KM also helps an organisation to gain insight and understanding from its own experience. The activities in KM will also help the organisation in problem-solving, dynamic learning, strategic planning and decision-making (Ahmad et al., 2002). KM makes an

organisation more productive, more effective and more successful. Srikantaiah et al., (2000) concluded that the implementation of KM enhances collaboration, improves productivity and encourages innovation within organisations. These potential benefits of KM should be sufficiently convincing for construction organisations to venture into adopting KM practices. Therefore, there is a need for an approach that facilitates knowledge sharing within the construction industry.

Despite the interest and the efforts put into KM by many organisations, the discipline is still in its infancy (Carrillo et al., 2000). Many practitioners and researchers have acknowledged the limitations of current approaches to the management of the information and knowledge relating to a project (Choi and Ibbs, 1995; Rezgui, 2001).

The key reasons for these limitations are as follows:

- Knowledge is generated within one project and then lost. This is due to much of the construction knowledge residing in the minds of people working in the organisation or project;
- Individuals who have knowledge about the project are likely to leave for another project at the end of the construction stage. Hence, their input is not captured;
- There is little effort or no recorded or documented intent behind the decisions made;
- Lessons learned are not well organised and are buried in details. Thus, it can be difficult to compile and disseminate useful knowledge to other projects;
- Difficult to predict the future and specific needs of data users.
- Difficulties in understanding the hidden meaning of historical project data due to the possibility that the people who record and have knowledge about the project data have left for another project or organisation.

All these limitations indicate the importance of the concept of KM in a construction organisation. Therefore, failure to capture and transfer the knowledge within and across the organisation leads to wasted activity and impaired project performance (Siemieniuch and Sinclair, 1999). Existing literature has demonstrated the importance and benefit of knowledge management applications in the construction organisations. Many construction organisations realised and began to develop more structured ways for managing knowledge that has led to the management of knowledge and learning as a core competency, fundamental to sustaining competitive advantage.

The next section of this chapter reviews the applicability and relevant uses of KM for construction projects, especially during the operation and maintenance stage.

4.6 Knowledge Management in Project Operations

The construction industry is a knowledge-based industry. The production and management of knowledge is therefore highly essential for businesses operating within this industry and for the projects on which they work. Egbu and Robinson (2005) state that much knowledge in the construction industry is experience-based and a mixture of explicit and tacit knowledge. During the construction phase of a project, explicit knowledge is easier to collect and manage because the information and knowledge are available in document form, thus can be captured and may be transferred within the organisation (Jacob and Ebrahimpur, 2000). Meanwhile, tacit knowledge is a product of experiences, skills, beliefs and intuition, which could be technical or cognitive (Nonaka and Takeuchi, 1995). The tacit knowledge is relatively difficult to access to, and organisations may not gain from it unless it is made explicit. Tacit knowledge can be extracted from the sources using questionnaires, interviews, or leveraging a collaborative environment.

In addition, during the construction phase, most project-related problems, solutions, experiences, know-how and know-what are in the minds of individual professionals. Therefore, an effective means of improving construction management is to share experiences among professionals, which helps to prevent mistakes that have already been encountered in past projects. Drawing on experience avoids the need to solve problems from scratch. Problems that have already been solved do not need to be solved again. When the project professionals complete projects or leave the company, they normally take domain knowledge with them and leave little or nothing that will benefit subsequent projects or the company (Rezgui, 2001). These scenarios provide an initial idea of construction knowledge. It is perceived that tacit knowledge is more difficult to access and collect than explicit knowledge.

In relation to the operational phase in construction projects where the facilities management function takes place, a number of academics and practitioners have expressed an interest in its relationship with knowledge management. Several researchers (Ahmad et al., 2002; Gray, 2001; and Liao, 2002) have described the importance of having KM present in facilities management practice. They considered KM as a strategy for improving organisational competitiveness and performance. The adoption of applicable KM processes can help facilities managers and their organisation to incorporate and exploit knowledge as part of their projects.

The limitations of knowledge management are identified at personal, organisational and project levels (Anumba et al., 2005). There is lack of effective mechanisms for the appropriate transfer of knowledge between these three levels. Thus, various tools and efforts developed by previous researchers to improve and support KM implementation in construction. These include CLEVER (Cross-sectoral LEarning in the Virtual

enterprise), IMPaKT (Improving Management Performance through Knowledge Transformation), STEPS, CAPRIKON and KT Learning Toolkit.

The most relevant tools were developed in PFI project environment is the KT Learning Toolkit (Carrillo et al., 2006). This tool was specifically developed for PPP/PFI projects to encourage organisations to transfer knowledge on all aspects of the PPP/PFI process. In this toolkit, it allows organisations to identify key issues requiring knowledge transfer and to create an action plan, identifying key elements, resources and personnel, to transfer the knowledge required. Figure 4.1 illustrates the knowledge transfer framework flow chart of this toolkit. With regard to the PFI form of procurement, where finance and operating a building over a 20-30 year period are involved, the expertise of the facilities manager in the operational phase is invaluable. The experience and skills generated through processes and practices developed within PFI-FM project organisations could generate knowledge that FM organisations need to manage.

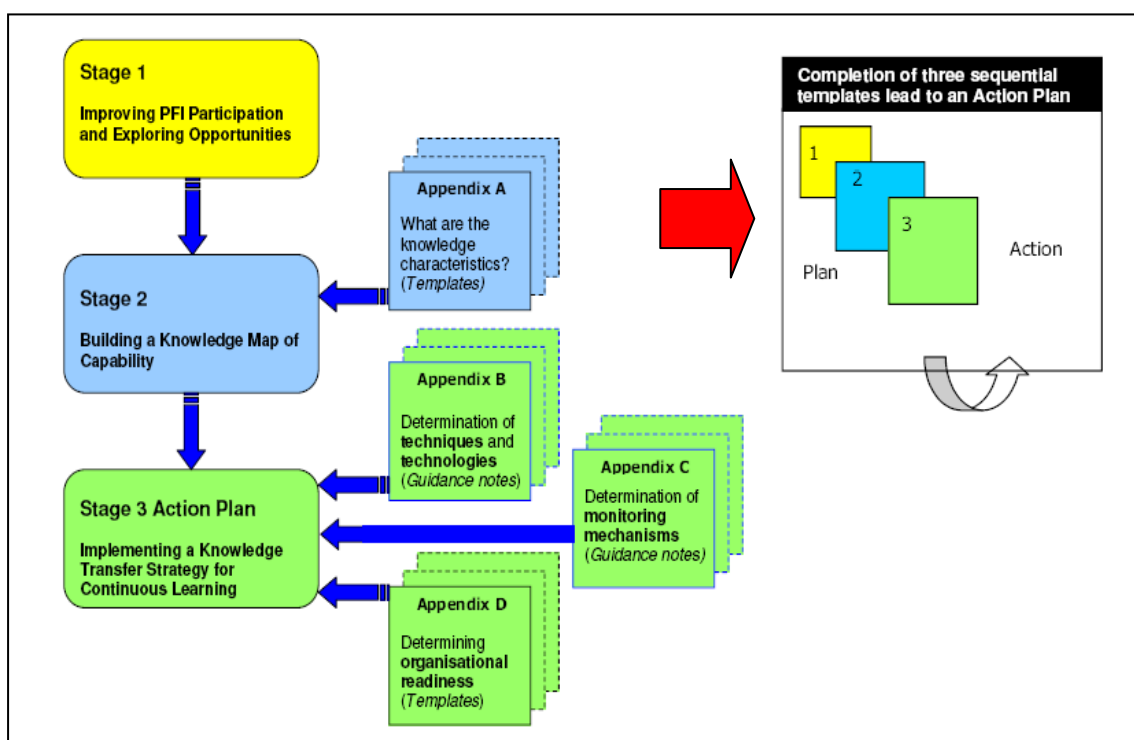


Figure 4.1: The KT framework flow chart (Carrillo et al., (2006)

In the facilities management context, knowledge of managing facilities, processes and approaches for dealing with problems and the management of day-to-day operation can help the facilities manager to be effective, both in operational and managerial terms. Further, numerous researchers (e.g. Nutt, 2000; McLennan, 2000; Barrett and Baldry, 2003) recognised the importance and appreciation of KM in facilities management, especially with the use of information technology.

Currently, construction processes rely heavily on information produced by others in separate phases or views of a project, and are dependent on the quality, efficiency and timeliness of fragmented construction inputs (Hao et al., 2003). This also applies in PFI projects. Information flow has been seen to exist in construction processes and this cumulatively builds on the knowledge an organisation possesses.

Bjarni (1994) has looked into construction experience as knowledge that is based on information about methods used to perform construction tasks, field operations and the results of prior projects. He considers such an experience as knowledge that provides technical, operational, contractual or administrative guidance for subsequent projects. He conceptualises relationships between construction experience, construction knowledge and expertise in construction such that, past and current projects generate experience that is put into context with the help of an evaluation process and becomes construction knowledge.

The next section will discuss the information and knowledge available in PFI projects, and looks into how organisations and personnel use this information and knowledge

4.7 Information and Knowledge Used in PFI-FM Practice

In PFI construction projects, there are many professionals and organisations working on different aspects of a project and sharing information. However, some information and knowledge sets are important and used at one particular stage of the construction process, but then may be ignored. Figure 4.1 illustrates the inclusion of the project management and facilities management functions across the PFI project lifecycle.

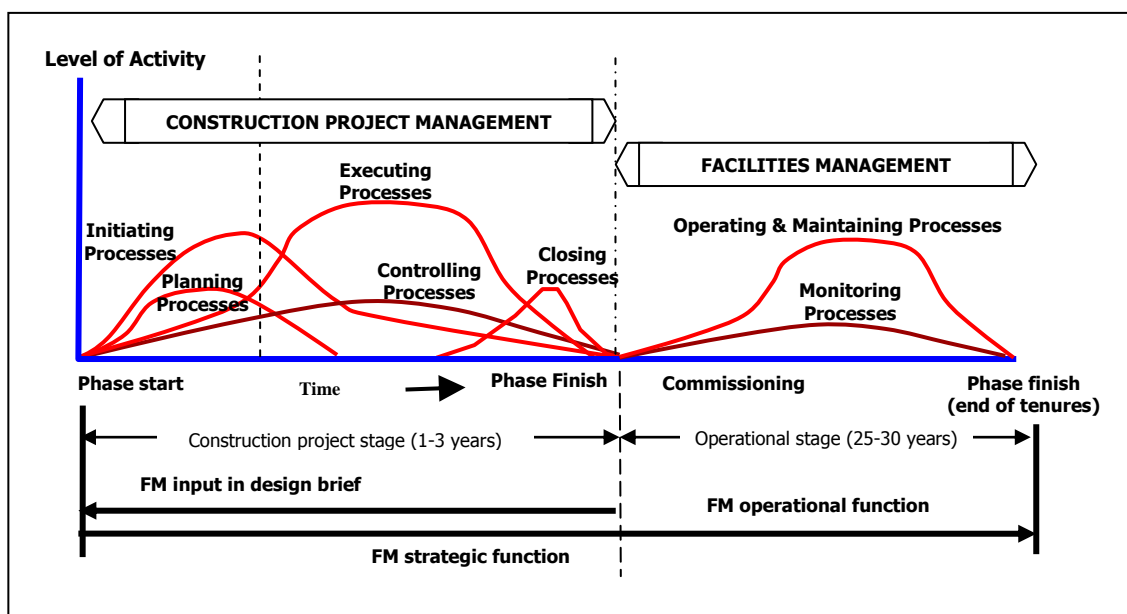


Figure 4.2 Inclusion of the FM function in the PFI project lifecycle

Construction project management involves the organisation of the project structure and its implementation so as to secure the completion of the project. Subsequently, at later stages, this involves the facilities management function. Once the facility is completed, this function involves operating, maintaining and monitoring the services. Within the PFI construction life cycle, there are two main domains of knowledge. These are project management knowledge and facilities management knowledge. Both of these are interconnected and include knowledge about the end product, the

processes involved in its creation and the resources needed. Knowledge requirements therefore include knowledge of the participants within the communities of interest that come together to share knowledge that affects the project performance (Ramaprasad and Prakash, 2003).

The development of a project starts from the initial planning and continues to the project close-out and its typical activities pass through successive and distinct stages that require the project managers to effectively plan, organise, monitor and control the tasks. Mustapa (2005) discussed the crucial stages of a project for applying the project managers' knowledge. It has been identified that the project manager's knowledge is relatively crucial throughout the project phases. Thus it is essential for project managers to rely on and apply the knowledge and skills they possess during each phase.

In relation to PFI construction projects, facilities managers are those persons responsible for managing and performing the service delivery of the project. Thus, it is claimed that the facilities managers must be equipped with knowledge of facilities and management to carry out their integrated support role (Kincaid, 1994). Mustapa and Carrillo (2007) conducted an exploratory study on PFI-FM service providers with a view to assessing the critical stage of FM in PFI projects. The study also aimed to highlight the information and knowledge used during that stage. They identified two key stages that involve substantial amounts of facilities management knowledge. These are the mobilisation stage and the operational maintenance stage.

At the mobilisation stage of the PFI projects, the facilities managers need to plan and deliver the services based on the requirements stated in the output specifications. At the operational and maintenance stage, facilities managers are required to deal with

issues such as defects, the changing nature of the project, legislation issues, benchmarking exercises and market testing. Study by Ali (2004) also noted that the operational stage of a construction project involves plenty of information and requires managers to make decisions and demand an efficient level of communication. Thus, information at each stage of PFI project needs to be shared and transferred between team members to ensure successful project delivery.

The nature of facilities management practice present challenges for the integration of KM within the PFI-FM practice context, especially at the operational and maintenance stage. These challenges can be addressed by the development of an effective framework for integrating the relevance of KM practice within the FM stage of PFI projects. An understanding of the potential offered by KM and the way in which it can be used effectively within FM organisation will become increasingly crucial for the organisations that have to manage services delivery and performance effectively. Indeed KM in different organisations may serve different organisational purposes. Impact studies in this area may be extremely valuable, especially in organisations that have distinct KM programmes.

4.8 Summary

A review of the existing literature indicates that it has been beneficial to adapt KM in an organisation that operates in the construction environment. Having highlighted the challenges and issues facilities management (FM) organisations face in the course of managing facilities and delivering services, KM is seen as beneficial and a potential solution to the problems. Facilities management knowledge facilitates a better understanding of both operational and managerial strategy and an integrated approach to the effective management of services. Knowledge transfer through

effective communication helps organisations to understand each other's requirements and working practices, subsequently; this could lead to fewer misunderstandings of the contract and improve the interaction between personnel. By doing so, this facilitates the effective management of services and overcomes the shortcomings in meeting expectations and achieving the levels of performance required of FM organisations.

Chapter 5 Research Methodology

This chapter reviews a range of research methods, including those adopted for this study. It focuses on illustrating the methods employed to achieve the aims and objectives. The discussion begins with a review of the range of research methodologies, followed by a justification of the techniques adopted for collecting, analysing and interpreting data for each objective outlined in this study.

5.1 Definition of Research

Research methodology is the term for the principles and logical sequence of thought processes that are applied to scientific investigation (Fellows and Liu, 2003). Research can be defined as a process in which a researcher engages in a small set of logical steps (Creswell, 2005). It is also a process of sequences used to collect and analyse information in order to increase understanding of a topic or issue (Creswell, 2005). Research methodologies are designed to accomplish the research objectives (Holt, 1998). From the definition, it can be concluded that research is a well-designed process of collecting and analysing data in order to achieve better understanding of a problem or issue. This involves several steps or processes.

5.2 Steps of the Research Process

There are many types of research that require different approaches. There are a few research processes outlined for different research approaches. However, a general process of conducting scientific research (Creswell, 2005) is as follows:

- a) Identify research problem;
- b) Conduct literature review;
- c) Justify purpose of research;
- d) Data collection;
- e) Data analysis and interpretation; and
- f) Evaluation and reporting of research.

Figure 5.1 below depicts the overall research process as a spiral that can be started at any point. It is a process that never stops, will cause one to consider one's practice and will return to a different starting place (Blaxter et al., 2006).



Figure 5.1 The Research Spiral (adapted from (Blaxter et al., 2006))

5.3 Research Methodology

The definition of research methodology is the philosophy, system of methods and principles used in a particular discipline. Such methodologies are considered to be systems of explicit rules and procedures and upon what purpose of research is based (Othman, 2004). Research can also be classified by the method used. Generally, research methods can be classified into two main categories: quantitative and qualitative research (Punch, 1998). Both quantitative and qualitative data collection have advantages and disadvantages that require consideration. Many research projects have used methods from more than one category. For example, the use of mixed-method approaches that utilise both qualitative and quantitative methods has become widely accepted and is known as triangulation (Neuman, 2006; Creswell, 2003). Details on the methodologies and their definitions are described in the subsequent sections.

5.3.1 Purpose of Research

Purpose of research can be defined as rationale and motivation behind the research (e.g. what the study is trying to achieve or why is it being done). Several numbers of researchers (Robson, 2002; Maxwell, 2005; Fellow and Liu, 2008) classified different further categories according to their purpose of research.

Robson (2002) identifies three of these categories as exploratory, descriptive and explanatory. 'Exploratory study' is used when the researcher has a limited amount of knowledge about the research topic. According to Fellow and Liu (2008), a central feature of exploratory study is the use of hypotheses. 'Descriptive study' is to portray or provide an accurate profile of a phenomenon (e.g., a person, event, situation or institution) whilst 'Explanatory study' seeks to provide an explanation and report of a

situation or a problem (Robson, 2002; Gray 2009; Fellows and Liu, 2008). In addition, Maxwell (2005) discussed another purpose of research as 'Interpretive study', which explores peoples' experiences and the views, perceptions and beliefs of those experiences. Further, Fellows and Liu (2008) state another purpose of research as 'Instrumental study' which is to "construct/calibrate a research instrument, whether physical measuring equipment or as test/data collection (e.g., questionnaire or rating scale)".

In practice, it is often that multiple methods will be used. The researchers have a wide choice of research methods and each method can be used to elicit a specific type of information or combined to support and complement each other. The reason for this according to Gray (2009) is that a research usually includes multiple questions; so a method appropriate for one question may be inappropriate for another.

5.3.2 Quantitative Research Methods

The term 'quantitative' is concerned with the collection and analysis of data in numeric form (Blaxter et. al., 2006). It is about an 'objective' nature and is described as 'an enquiry' into a social or human problem, based on testing a hypothesis or a theory (Creswell, 1994). Quantitative research methods utilise mainly scientific and statistical methods for data collection and analysis (Kumar, 1999) to determine whether a hypothesis holds true (Creswell, 1994).

Quantitative research methods are the preferred strategy when 'how many' and 'how much' questions are being posed. Generally, the focus of quantitative research is on objective measures rather than subjective experience. The following are the two most commonly used quantitative research methods:

- ***Experimental research***

Experimental research involves a process of collecting, analysing and interpreting observations in the form of data. Thus, an experiment is conducted by selecting samples of individuals from known populations and allocating them to different experimental conditions (Robson, 2002). According to Keppel (1991), this method measures the effect of manipulating one variable against other variable to find causal relationships between the variables.

The main advantage and strengths of experiments lie in the strong claims of causality that can be established between variables (Bryman, 2004). However, a drawback of this method is that it is difficult in a study involving human individuals and organisational levels (Alasuutri, 1998). If the experiments involve humans, it is difficult to control the factors or variables that are crucial to drawing a valid research conclusion. Humans' emotions, opinions and organisational processes restrict the ability to examine the exploratory elements of the research being undertaken.

Moreover, experiments are very rigid in their variables. Any variables in experiments need to be known or hypothesised with confidence (Fellows and Liu, 1997). Change of variables can affect the causal relationship with another variable. This would pose a problem if the variables need to be altered during the course of research. For example, if emergent themes are discovered in the literature, the experimental approach offers no flexibility to accommodate this variable. This could hinder the ability to examine the facilities management processes and knowledge management initiatives or strategies within a particular individual or organisational setting.

- **Survey**

The purpose of surveys is to explain the relationship between multiple variables by using statistical sampling (Fellows and Liu, 2003). This methodology uses cross-sectional and longitudinal studies to collect data by using either questionnaires or structured interviews and examining them to identify relationships between variables. Generally, collected data focus on 'how many' or 'how much' questions (Yin, 1994). McClintock et al., (1979) and Babbie (1990) both acknowledged that using this method permits statistical analysis of data and generalisation of results to larger populations. Large numbers of people can be asked the same questions and their responses can be recorded systematically using this method (Neuman, 2006).

However, a survey method offers poor depth of information due to the narrow and standardised data obtained (McClintock *et al.*, 1979). This depth would be insufficient for this study. Such information requires understanding the facilities management processes in detail, which in turn involves a sequence of activities and actions by individuals or organisations. Similar to experimental research, surveys are also inflexible and require that the variables remain unchanged throughout the data collection period.

5.3.3 Qualitative Research Methods

The qualitative approach to research has its origin in the social sciences area. Therefore, qualitative research is more socially and philosophically oriented (Ali, 2004). It is concerned with collecting and analysing information in non-numeric forms (Punch, 2005). Thus, it is more 'subjective' in nature and is described as having an emphasis on meanings, experiences and description (Naoum, 1998). It tends to achieve depth of

research rather than breadth and to focus on exploring examples in as much detail as possible (Fellows and Liu, 2003).

Cook and Reichardt (1979) describe qualitative research as being holistic, inductive, dynamic, subjective, humanistic, exploratory and process-oriented. Denzin and Lincoln (2004) stressed that a qualitative approach allows the researcher to understand elements of behaviours by becoming acquainted with those involved and learning about their values, beliefs, and emotions. Qualitative strategies also enable the researcher to record and understand people in their own terms, and the data collected consist of detailed descriptions of people, events, situations and conversations. Thus, qualitative research is the term often used to describe the study of people, systems and phenomena in their specific contexts.

Common tools for qualitative research are action research, ethnographic research, grounded theory and case study (Myers, 1997). The following describes the tools adopted for qualitative research methods:

- ***Action Research***

According to Creswell (2005) and McQueen and Knussen (2002), the main aim of Action Research is to identify problems in a particular social setting, define solutions, implement those solutions and evaluate their impact to the problem. This would include generating hypotheses after problem identification.

Action Research is based on the principle that the researcher is within the field of that research and becomes a partner in the action and process of change (Wood-Harper, 1985). This means that involvement, interaction and participation of the researcher are central to the process of action research; which requires

cooperation and active collaboration between the group and the researcher (Robson, 2002; McQueen and Knussen, 2002). According to Robson (2002), Action Research does not differ in principles in terms of data collection and can use the same types of data collection and analysis methods as available in other social research such as observations and interviews.

The key advantages of using Action Research are: i) it provides an opportunity for researchers to work closely with the practitioner community; ii) it uses many research modes and iii) it can be combined with other research methods for diversifying a research programme as recognised by Abdullah (2003). However, there are some disadvantages and limitations cited of Action Research and these include the researcher's capability of facilitating the research and being able to inter-relate with the participants. Thus, as mentioned earlier, Action Research is only ideal when the researcher is employed by a participant organisation, in which case accessibility and confidentiality are not an issue. The use of this approach would also lead to biases where it comes from the inability to generalise findings due to its restricted application to a single project or organisation (Galliers, 1992).

- ***Ethnographic research***

Ethnographic research studies a subject within a natural setting but is considered more appropriate in an intact cultural group and in cases where the study takes place over a prolonged period of time. For a clearer definition, Creswell (2003) defined ethnography as “a research methodology that describes and interprets a culture, a social group or a system through examining the group's learned patterns of behaviour, customs and way of life based on fieldwork”.

The ethnographic research methodology is primarily based on observational data. Data collection methods involve site-based fieldwork and participation observation. The data collected are primarily observational and involve person-to-person interaction, language, rituals, belief, social cultures and cultural patterns. Ethnographic research presents the results of a holistic research method founded on the idea that a system's properties cannot necessarily be accurately understood independently of each other. Thus, this method has a different level of abstraction and meaning of distinctions as compared to other statistical social research.

Alasuutari (1998) asserts that the advantage of ethnographic research methodology is that it gives a detailed view of an entire cultural scene by pulling together the learning about all aspects of the group and showing its complexity. However, the disadvantages of ethnographic research are that it may have limited generalisability to other topics or domains. Another disadvantage of this approach is that it requires and consumes more time than other research tools.

- **Grounded Theory**

Grounded Theory is characterised by the insistence that theoretical concepts and hypotheses must emerge from the data as they are uncovered or gathered in the research process itself (Layder, 1993). Grounded Theory uses a systematic set of procedures in an attempt to develop an inductively-derived theory about a phenomenon by using multiple stages of data collection, the interrelationship of categories and the refinement of information (Strauss and Corbin, 1998). The dynamic relationship between data analysis and data collection is a significant characteristic of the grounded theory approach. In a simple definition, Grounded

Theory is a methodology for developing theory that is grounded in data that are systematically gathered and analysed.

Grounded Theory has become increasingly popular in social research because it enables processes to be explored systematically, and it does not require large sample sizes (McKenzie, 1998). Its real advantage, however, is that it offers earlier result analysis as soon as data collection begins (Allan, 2003). In other words, the analysis can start with the first interview. However, the data have to be analysed in a systematic and rigorous manner to discover the concepts leading to the categories. There are noteworthy criticisms of this method; namely, it lacks rigour due to careless interview techniques; can lead to bias; requires a great deal of time, patience and analytic skill; and demands more data analysis.

- **Case studies**

Case studies are used widely in the social sciences as well as in practice-oriented fields such as construction engineering, science and education. A case study is a detailed examination of an event (Yin, 2003). It is an examination of a specific phenomenon such as a programme, an event, a person, a process, an organisation or a social group (Merriam, 1998). The researcher conducting a case study attempts to analyse the variables relevant to the subject under study (Key, 1997). It involves a detailed investigation that attempts to provide an analysis of the context and processes (Johnston *et al.*, 1999).

According to Robson (2002), the use of case studies enables researchers to collect data in their rawest form. Moreover, it allows a high level of abstraction to be undertaken from the data. Yin (1994) described a case study as the preferred

research method when “how” or “why” questions are being posed. The advantage of using case studies is that they can be tailored during the course of research to take account of any changing circumstances in an investigation of a particular contemporary phenomenon (Simister, 1995).

Bryman (2004) classifies case study research into single and multiple case studies. A multiple case approach is generally viewed as more robust than a single case approach (Yin, 1994). The multiple case approach enhances the generalisability of findings and offers greater opportunity to identify features through comparisons (Bryman, 2004).

However, the case study method also has drawbacks. One of the main criticisms derives from the belief that the study of a small number of cases cannot establish reliable or generalisable findings. This is especially true when only single cases are studied. However, according to Key (1997), the focus of a case study may not be on generalisation of the findings, but rather on understanding the particulars of that case in its complexity. Thus, the validity of the findings is not affected.

Other criticisms of the case study approach include its lack of rigour, unclear evidence, lack of controls, tendency to lead to bias and that it can be time-consuming (Yin, 1994; Meredith, 1998). These shortcomings are addressed by Johnston et al., (1999). They suggested that case studies become theory-based, rigorous and more objective if the case study design considers three important elements: (i) it must define the units of analysis; (ii) it must select the appropriate cases to study; and (iii) it must decide on what data to collect and how to collect it. In order to avoid biases, the case study organisations selected should contain a

mixture of different backgrounds and roles. To avoid the time-consuming aspects of the case study approach, care needs to be taken with respect to the research design.

5.3.4 Triangulation Methods

Triangulation is the application and combination of various research methodologies in the study of the same observable fact (Burns, 2000). It is a method that can be employed in both qualitative and quantitative research. By combining multiple observers, theories, methods and empirical materials, the triangulation method can overcome the weaknesses and the problems that derive from depending on a single method (Fellows and Liu, 2003). The purpose of triangulation is to improve the reliability and validity of research outcomes as they contribute to verification and validation of qualitative analysis by: i) checking the consistency of findings generated by different data-collection methods and ii) checking the consistency of different data sources within the same method (Othman, 2004). Using the triangulation method, theories can be developed qualitatively and tested quantitatively (Khalfan, 2001). Generally, triangulation allows the researcher to gain complete insights and results to assist in making inferences and also in drawing apparent conclusions (Dainty, 2004).

In this study, the triangulation methods were used in the data collection and evaluation stage. During data collection data stage, data was collected from different sources (case studies), using different methods (literature review, interviews, documentary data and questionnaire) to achieve objectives outlined. Discussion regarding the data collection process and methods chosen to conduct the research in this study can be found in the following section.

5.4 The Data Collection Process and Methods

Data collection was a principal activity in the research process. Data was collected from different sources, using different methods to achieve certain objectives. Selecting a method or data collection process was based on type of information was sought to achieve the research objectives, from whom and under what circumstances (Robson, 2002). Hence, different types of research methods were used for data collection. As mentioned earlier in this chapter, quantitative methods dealt with numbers and used statistical methods to explain the data, where qualitative methods dealt with words, described situations, processed and interpreted relationships.

Both approaches of research methods were adopted for this research. The major and primary mechanism of data collection adopted in this research was based on qualitative methods. The qualitative methods used were literature review, exploratory study, case study, documentary data, open-ended questionnaire, and semi-structured interview. Meanwhile quantitative methods used were close-ended questionnaire during the framework evaluation.

In order to achieve the research aim and objectives, the choice of research methodology and technique for each specific objective were tabulated to ensure that the right research objective was assigned to the right method. Table 5.1 tabulates the methods applied to address specific research objectives in this study.

Table 5.1 Research Methods assigned to achieve the research objectives

Research Method			Research Objectives				
			1	2	3	4	5
Data Collections Method	Literature review	PFI, FM, KM, Healthcare projects	*	*	*	*	*
	Exploratory study	4 personnel interviewed	*	*			
	Case study	3 case studies			*	*	
	Structured interview	9 personnel interviewed			*	*	
	Documentary data	Technical project files; Administrative files		*	*		
	Questionnaire	6 personnel for framework evaluation					*
Data analysis	Qualitative	Cross-case Synthesis: i. Current FM practices ii. Process of managing knowledge + strategies adopting knowledge iii. Problems in operating FM services			*	*	*
		Thematic analysis				*	*

The following section discusses the data collection methods adopted were used for this study.

5.4.1 Literature review

The literature review was mainly used to achieve the first research objective (see Chapter 1, section 1.3 and Figure 1.1). Further, the literature review helped define the problem and indicated the areas, i.e. relevance of knowledge management initiatives at the FM operational stage of PFI projects (Objective 3) that should be further investigated in order to satisfy the research objectives.

Different sources were used for data collection during the literature review stage such as textbooks, journal articles, conference proceedings, government and organisations' publications, workshop reports, technical reports, doctoral dissertations, handbooks and industrial manuals. Additionally, regular keyword searches, automatic keyword search alerts and table of contents alerts on the Internet were used to find any new information on subject areas to ensure that the research remains up-to-date.

The literature review commenced by reviewing the background of PFI contractual arrangements. This includes the importance and relationship between PFI and FM; the characteristics and sectors of PFI projects; current issues and challenges in the PFI, which covers a wide range of operational issues. Subsequently, the theoretical background of facilities management and its processes during the operation and maintenance stage of PFI projects were also highlighted. This provided the basis for an informed investigation into current industry practices in PFI-FM. This was deemed necessary, as the literature would provide a background and justification for the research. In addition, it would help in identifying any gaps in the theory and provide some potential research areas (Holt, 1998).

5.4.2 Exploratory study

Exploratory study provides a rich source of information and enabled a deeper understanding of the PFI-FM practices. The objective of the exploratory study was to establish the prevalence of knowledge sharing and learning practice in facilities management organisations, prior to the investigation. The exploratory study was conducted using four (4) key selected facilities management personnel from PFI consortium and FM service providers and also from different PFI market sectors (school and healthcare). The chosen personnel were selected on the basis of their

roles and responsibilities in their organisations, namely Estates General Manager, Project Director, Regional Facilities Director and Monitoring Facilities Manager. A series of discussions and interviews with these four personnel were conducted to identify current practices and challenges FM personnel faced in operational PFI projects. All interviews were recorded and to allow for the verification and transcription for subsequent analysis. All interviews were conducted face-to-face meeting on the interviewee's own premises. The average length of the interviews was approximately 75-90 minutes.

Interviews were designed to reveal the current trends of facilities management practices in PFI projects in order to identify common issues related to managing assets and identify the information needs of FM personnel. Figure 5.2 shows the flow diagram in conducting an interview during exploratory study. Questions are more focused on understanding the nature of PFI projects and measures taken by the organisation to share and promote the acquisition of knowledge throughout the PFI project stages. Data collected during the exploratory study interviews were analysed and interpreted by identifying themes within the feedback given by the respondents.

The following outlined the key findings from the exploratory study conducted. The outcomes from the exploratory study are essential for the formulation of the questions for later study in the research.

- ***Information and knowledge generated:*** The amount of information generated and transferred during PFI construction contracts are enormous at every stage. Thus, a continuity of the information and knowledge is must. All information and knowledge needs to be captured and stored in proper documentation. Such knowledge includes design knowledge, construction knowledge and operation

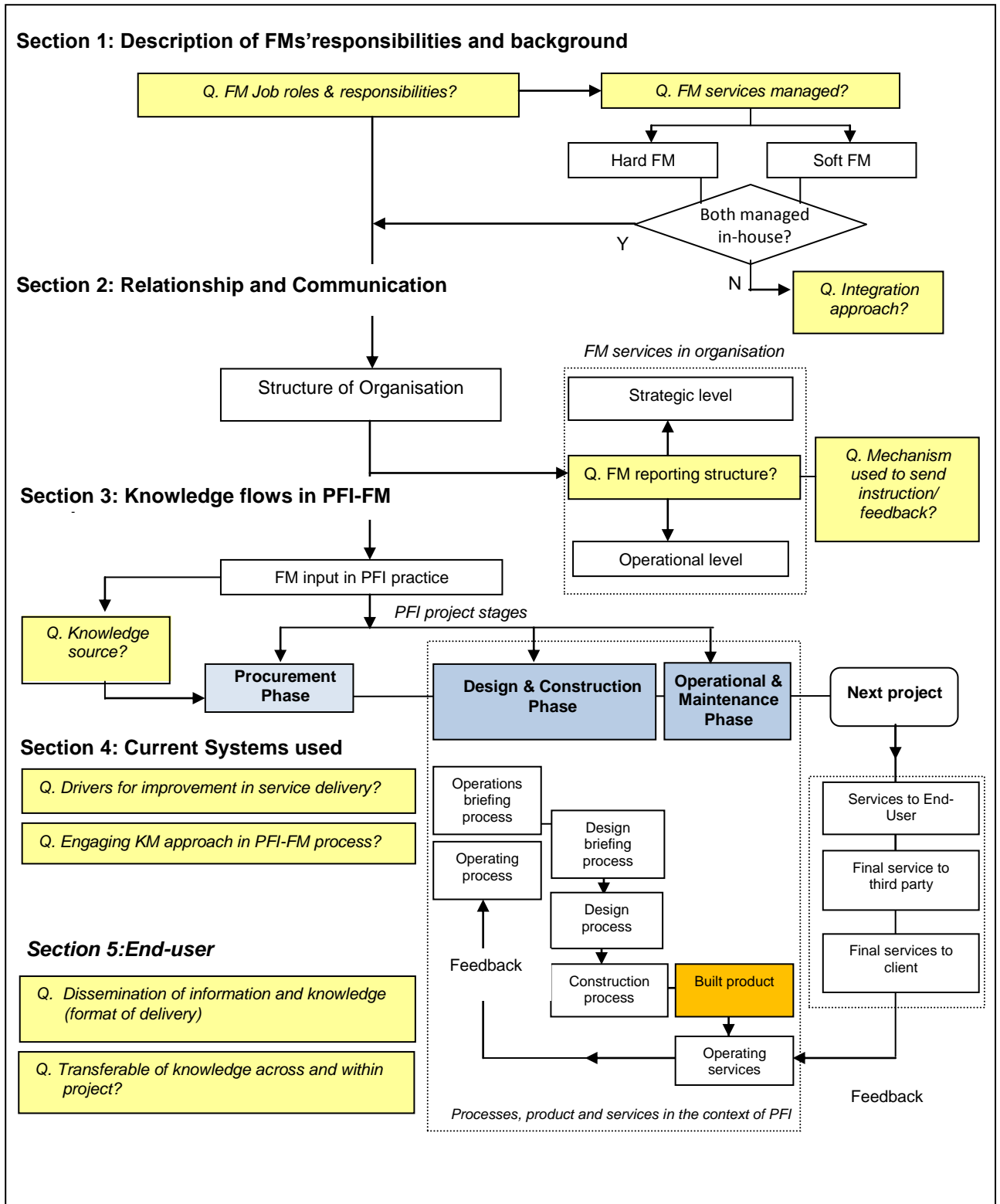


Figure 5.2 Flow diagram in conducting an interview during exploratory study

knowledge. Contractual matters, business and commercial operation and technical capabilities are those areas of knowledge that require attention by both managerial and operational level.

- **Issues and challenges in managing FM in PFI projects:** Such problems identified by FM organisations are establishing end-users needs; delay of information on Trust's requirement; lack of efficient knowledge exchange and difficulties in collating various source of information.
- **Dissemination of information and knowledge:** Information and knowledge is communicated to FM operatives through formal and informal meetings. The delivery of regular meetings facilitates the effectiveness of managing services and overcome the shortcomings in meeting expectation and level of performance by FM operatives and managers. Several FM organisations studied use knowledge management tools such as lesson learned seminar, FM software system and maintenance database to record and share the information and knowledge.
- **KM approach in PFI-FM process:** Various KM method adopted by organisation in capturing FM knowledge such as apprenticeship training, personal mentoring. Meanwhile on transferring the knowledge within the project, the organisation identified lesson learned seminars and in-house training system, called 'toolbox talk' as a best mode. Transferring knowledge across project requires significant efforts and strategic partnership from other stakeholders, as well as capability and willingness of sharing the knowledge and experience.

5.4.3 Case study

As a result of the nature of the research and its purpose, case study was chosen as the primary research strategy of inquiry. The main factor for selecting case study was

to enable an in-depth examination and analysis facilities management processes and relevant knowledge management tools as applied in the context of PFI projects. The selection of the cases was based on the purpose of the research, the data collection methods, available time to conduct the research, resources and accessibility to the cases' environment.

Initially, Action Research and case studies were both considered as research methodologies for this objective. However, the use of Action Research was impeded by several factors, such as confidentiality issues, time constraint and the accessibility of information. Hence, the Action Research approach was deemed inappropriate for addressing this research objective. Qualitative methods (interviews and documentary data) have been used as techniques for the data collection of this research to establish current knowledge management practices, the nature of knowledge used or required, the tools and models used for sharing knowledge and learning, and the gaps existing in current practices with a view toward introducing better alternatives. From this approach, crucial insight into the gaps and opportunities that can contribute to developing a conceptual framework can be identified, which can enhance facilities management knowledge processes for PFI contracts.

The activities involved in the case study were: i) preparing semi-structured interview questions; ii) identifying the case study organisations; iii) agreeing on interviewing arrangements and iv) conducting interviews. Semi-structured interviews were conducted using a set of questions designed specifically to generate findings as a basis for proposing a framework. Each interviewee was supplied with outline questions that were used as a guideline for the interviews. The formulation of themes and questions for the interview was supported by literature review on knowledge

management and facilities management as outlined in Objective One (see Chapter 1, Figure 1.1) and the findings from the exploratory interviews (see section 5.4.2).

Multiple case studies were chosen as they offer the potential of gaining access to rich sources of data and a detailed understanding of the PFI-FM organisations. The three case studies were selected from PFI healthcare projects across the UK from the Partnerships UK (PUK) database, an official government department for managing the PFI sector. These were mainly PFI healthcare projects due to their dominance market sectors based on the total capital value of signed projects at present. Selection of the case studies was on the basis of the following criteria:

- *Median project value* - The case studies are identified according to the median values of their PFI contracts, which range between £250 million and £400 million. The selection of case studies with similar median values enabled comparisons based on similarities in the contract costs and characteristics of the projects.
- *Segregation of FM service providers* - The segregation process excludes case studies from the same project organisation to maximise understanding of different knowledge management approaches within different organisations. The interviewees were selected from practising facilities managers principally working with FM service provider organisations; and
- *Project location*

Another criterion used in selecting case studies required that projects had at least reached the Financial Close stage of their PFI schemes. The Financial Close stage indicates the commencement of the project after the end of the competitive tendering

process of preferred bidders. Thus, the private consortium can possess the site, commence construction and provide facilities services.

For confidentiality purposes, the three case studies are referred as Organisation case study A, B and C. Each organisation case study had a minimum of three respondents, and nine total respondents were interviewed. Their experience in facilities management and PFI projects ranged from 2 to 27 years. Detailed background information on each case study, the roles of interviewees, each project's value and the FM project stage in each PFI project are included in Table 5.2.

Table 5.2 Case Study Details

Project	Organisation background	Project Value	Current FM service delivery	Contract Period	Person (s) Interviewed
A	FM Services Provider	£335M	At initial stage of service delivery of new facilities	35 years	A1. Associate Project Director; A2. Facilities Support Planning Manager; A3. Site Facilities Manager
B	FM Services Provider	£343M	At operation and maintenance services of existing facilities (new facilities not completed yet)	32 years	B1. Facilities Management and Services Planning Manager; B2. Facilities Manager; B3. Site IT Manager
C	FM Services Provider	£335M	At full operational stage of FM service delivery	30 years	C1. Assistant General Manager; C2. Estates Facilities General Manager; C3. Systems (IT) Co-ordinator

5.4.4 Documentary data analysis

Document analysis of repositories including both soft and hard copies was conducted to provide an understanding of current practice on how facilities management organisations document, store and communicate their information and knowledge throughout PFI projects stage. Project related documents such as project brief reports, service performance evaluation reports, output specifications, and project schedules were examined.

Table 5.3 shows the different documents that were collected and analysed. For the purpose of commercial sensitivity, some of these cannot be published in this thesis; however, their analyses will be presented. The table also indicates the types of information contained in those documents and the significance to their collection and analysis with respect to facilities management knowledge. A sample of service performance report used in this research is appended in Appendix 3.

Table 5.3 The different document collected and analysed

Types of documents	Information captured and examined	Significance
Project brief report	<ul style="list-style-type: none"> • Business case / project scope • Delivery of PFI requirements processes and activities 	<p>To reveal how PFI private sector dealt with public sectors' requirements and look into strategic FM decision towards the operational period of project</p> <p>Relationships between requirements, processes and activities help understand the link and dependency between requirements. Use for mapping the FM service delivery processes</p>

Service performance evaluation reports / Key performance indicator (KPI)	<ul style="list-style-type: none"> • Mode of performance monitoring • Users involved 	To understand appropriate metrics and monitoring methods to determine performance scores; and whether a service has passed or failed.
Output specifications	<ul style="list-style-type: none"> • Scope and level of requirement for each service category • Priority for service delivery 	Necessary to understand how exactly FM services delivery are evaluated and look into decisions by FM organisations producing strategy on delivery of services
Project Agreement	<ul style="list-style-type: none"> • Contract and responsibilities of parties contracted 	To understand contractual obligation and responsibilities parties contracted.
Minutes of meeting	<ul style="list-style-type: none"> • Attendees • Distribution • Content (relating to relevant knowledge management issues) 	FM approach and its integration with knowledge and information used

5.4.5 Semi-structured interviews

Interviews were conducted as primary data collection to discuss different issues on requirements, process and methodology of integrating facilities management knowledge within PFI projects; structure for the framework and incorporate the existing problems and challenges. The topics emerged from the literature review, the exploratory study and the outcome of those interviews supplemented the exploratory study.

The following formed the content and the flow of the interview questions in this research:

- *Background and responsibility of a facilities manager* - This part was aimed at capturing general information about the personnel being interviewed such as the

roles and responsibilities of facilities managers, years of experience, educational level and the type of PFI project.

- *Current practices on managing knowledge at operational FM stage by the facilities managers.* - This part was designed to understand actual practices and characteristics of the knowledge embedded in personnel and organisations at the operational stage of PFI projects. The practice of managing knowledge was investigated in order to understand the current approach the interviewees' organisations had adopted with respect to knowledge management activities.
- *Problems occur in facilities management practice.* - This part sought to find significant issues and challenges faced by FM personnel in PFI-FM projects. Problems identified from the organisations studied were investigated to find out how organisations use their knowledge activities to help them solve problems. The interviewers also encouraged interviewees to discuss practical suggestions for improving their existing practices with respect to facilities management knowledge.

In total, nine individual interviews were conducted from the case study projects. All interviews were audio recorded and transcribed which resulted in large amount of qualitative data (samples are shown in Appendix 4) to facilitate the analysis of the data. These lasted more than an hour for each interview sessions. Further, the findings from the interviews were used to design and develop a framework for optimisation and enhance the facilities-management knowledge in PFI projects. Interviewees were selected based on individual's involvement in PFI, FM and role within the case study projects.

5.4.6 Evaluation Questionnaire

A questionnaire was defined as a set of written questions for respondents to complete themselves (Othman, 2004). In this study, the evaluation questionnaire survey was undertaken at after the framework was produced. The evaluation questionnaire (Appendix 5) was designed and developed to enable the respondents to give their feedback. A detailed description of the evaluation procedures is discussed in Chapter 8, section 8.3.

There are two types of questionnaire were used namely, i) close-ended questions; and ii) open-ended questions. The close-ended questions allowed the respondent to select a single feedback from a list. This type of questions was easier and quicker to answer and responses were easier to be analysed. Meanwhile, the open-ended questions gave the respondents the opportunity to express their feels, beliefs and provide recommendations.

5.5 Analysis

Research requires interpreting and analysing data. According to Creswell (2007), this involves making sense of the data. Information drawn from the case study interviews was analysed using qualitative methods through thematic analysis to determine the themes to develop a conceptual framework. Thematic analysis has been accepted as a way of presenting textual investigation. Themes are more or the less the same as codes and the process involves constructing themes and subthemes which are often generated after thorough reading of the transcription and field notes that make up the data (Silverman, 2006).

After the case study was undertaken, the data collected were transcribed and organised before being analysed. Once data were organised, they were coded and later classified in defined categories or themes. Coding is the process of segmenting and labelling text to form descriptions and broad themes in the data (Creswell, 2005). Similarities in the data were identified which resulted in the grouping of similar data under different categories. These categories were further classified, coded and subdivided into different key themes relevant to providing answers to the investigation.

Table 5.4 shows a tabulation of the different themes under which the analysis was conducted. Since the data collected from the case studies are based on the same issues, similar findings emerged under the themes in the cases. It was found essential to group the emerging issues from all cases under the themes to enhance the interpretation and analysis of the data. Next, the researcher analysed the data to identify patterns and processes, commonalities and differences. The outcome of the study resulted in the clear segmentation of the facilities-management processes in the PFI projects. The processes describe the functions and activities that need to be undertaken, the tools and techniques required and the people responsible for the action plan at the operational FM stage.

Table 5.4: Data analysis themes

Theme	Rationale
Current FM practices	<p>To understand current practice of case studies organisation in delivering FM services in PFI project.</p> <p>To draw process maps of FM activities that embedded within the PFI-FM practice.</p>

Processes for managing knowledge	To understand the mechanism of knowledge sharing in case studies organisation. To identify the different KM tools used in managing knowledge during FM operational stage.
Problems occur	To find out how organisations use their knowledge activities to help them solve problems.

In designing and developing a framework, the study reviewed the literature on process modelling. According to Koskela and Haajanen, (2007), ideally process modeling is used to draw a business process diagram (process maps) and visually represented in models. Griffith (2011) indicates that the concept of the process modelling is fundamental to structuring an organisation, its activities and their management. Amongst other important use of the models include communication, knowledge sharing, process re-design or optimisation, precise instructions for executing business task or to enable performance review and improvement (Polyvyanyy, 2010). Process modelling also helps to map and identify all fundamental aspects of a company and is to facilitate understanding and communicating what really happens in existing processes (Lyridis et al., 2005).

There are several process modelling tools can be used to develop process maps such as standard flowchart, Data Flow Diagrams (DFD), Unified Modelling Language (UML), Structured Analysis and Design Techniques (SADT) / Integrated Definition for Function Modelling (IDEF-0). All these modeling tools provide a means of representing the Facilities Management Knowledge Framework. However for the purpose of this research, IDEF-0 was considered to be most appropriate modeling tools because it is used widely in construction and is becoming a de facto standard for process modeling of the business process diagram (Marca and McGowan, 1988).

In addition, the choice of using the IDEF-0 is to support more detailed process-modelling (Wu, 1994). Wu added that IDEF-0 provides a mechanism for decomposing a function into a number of smaller sub-functions. According to Kamara (1999), IDEF-0 is easy to use and understand, and has been proven to be suitable for use in construction since its ability to model complex business processes in greater level of detail.

Hence, the IDEF-0 was used to develop a Facilities Management Knowledge Framework because it helps to facilitate analysis of facilities management processes in detail and in a logical order and to learn about factors it relies upon in the process. Details of this IDEF-0 can be found in Chapter 7, section 7.3.1. The completed framework provides a structured approach and guide to how framework users manage and share the knowledge that is embedded within the PFI-FM practice. It aims to enable FM service providers and facility managers to adopt a knowledge management solution and thereby optimise their knowledge through learning and sharing processes.

5.6 Evaluation

This study focuses on the development of a framework that will improve knowledge sharing for facilities managers and their organisations to learn and share facilities management knowledge within the operational and maintenance stage of PFI projects as well as to evaluate the framework to ensure that it meets the research aim and objectives as outlined earlier in Chapter 1, section 1.3. The evaluation process in this research is conducted by using industry practitioners' feedback. A critical evaluation of the framework would determine its potential for improving and promoting knowledge sharing and learning at the facilities management stage of PFI projects.

The evaluation questionnaires (Appendix 5) were specifically designed to assess aspects of the usability, practicality, reliability and validity of the framework. In addition, interview questions were designed to explore the extent to which the framework is acceptable and reflects the users' organisational needs. The interviews were also designed to collect suggestions for the improvements to the framework and posed questions on the benefits and barriers to using the framework. Based on the findings of the evaluation, the framework was further refined by addressing the critiques and suggestions received from the industry practitioners.

5.7 Summary

This chapter discussed the research methodology and its implementation to achieve the overall aim and objectives. A description of commonly used research methodologies was introduced to establish the proper approach of this research at the outset. The methods used for data collection: literature review, exploratory interviews, semi-structured interviews, case studies, survey questionnaires and evaluation interviews, were described. The combination of methods is important to ensure that the research findings are reliable and valid. The next chapter discusses the case study findings and analysis, based on the methodologies used.

Chapter 6 Case Studies on Facilities Management Practices in PFI Projects

In the previous chapter, the challenges and success factors of PFI, the relationship between facilities management and knowledge management, and knowledge-sharing strategies were discussed. This chapter presents the findings of case studies that were conducted to determine the knowledge-sharing strategies that are actually being used and to investigate the relevance of knowledge management (KM) initiatives at the operational stage of PFI projects. Three facilities management case studies from PFI hospital projects, all at the operational stage, were chosen for the study. The cases are presented individually, and the results are determined via cross-case analyses. In reviewing the results, the current practices of facilities management are discussed, and the potential role of knowledge management in improving facilities management practices is explored. This chapter concludes with discussion regarding the KM approach practised in the case studies. Thus, this study develops the development of a framework for sharing and learning facilities management knowledge in PFI-FM practise.

6.1 Case Study Findings

This section focuses on the data collected from the three case studies during interviews and provides a detailed analysis of these data. The sample of interviews transcriptions with respondents are appended in Appendix 4.

6.1.1 Project A

Project background

Project A is a dual-site project, which involves the provision of three new healthcare facilities on two sites. The three facilities are expected to be completed in the following three phases: 1) a new Integrated Care Centre (ICC), 2) a new mental health unit and 3) a new acute hospital. Completions of the first two facilities are expected in 2008 and 2010. At the time of this study, the ICC and the new mental health unit were both just beginning implementation of the FM services delivery stage. The respondent was a contracted FM service provider, Associate Project Director (A1), who had three years working experience since the commissioning of the project. The two other respondents for this project held the positions of Facilities Support Planning Manager (A2) and Site Facilities Manager (A3).

Processes for managing knowledge

- ***Meetings***

In this project, the FM team shared their knowledge through both formal and informal meetings. The respondent stated that formal meetings were held fortnightly. Meanwhile, informal meetings were scheduled every 3 months between FM operatives and the top management level. Discussion focused on developing facilities management service solutions and implementation strategies. Any problems or concerns were solved during these meetings. All information gathered was produced in document format and distributed electronically using the file attachment facility.

- ***Documentation***

In project A, the respondents were asked what systems they used for FM service delivery and how they ensured it was successful.

One of the respondents, the Site Facilities Manager (A3) stated:

“... [The] client prefers a process that ensures smooth exchange of information of documents like method statements and output specifications. However, if an event necessitates delivery of services, there is often a substantial delay before all parties are informed of the changes. ...the difficulty is that the person responsible for storing the documents is not knowledgeable about its contents”.

Clearly, although documents such as output specifications and method statements were shared, the documents were kept in the Associate Project Director's office because of restrictions on commercially sensitive information. The respondent (A3) was concerned that this practice inhibited the efficient exchange of information (or documentation) and the proper monitoring of document changes.

When asked how this concern could be resolved, respondent A3 insisted that the organisation should have a system, such as a database for recording and sharing captured knowledge that ensures timely and appropriate action with regard to managing information for the project team.

To quote A3's comments, *“...Going forward, we do need to look into the system internally and how we are going...to store relevant knowledge and the experience of personnel. I think it (information and knowledge) will grow very much. ...they have to come through the process and protocol”.*

Interestingly, the Associate Project Director (A1), who is responsible for storing the relevant documents, agreed with the need for a structured procedure by which to process, store and exchange appropriate information and knowledge. It was

agreed that such a process would facilitate a collaborative working environment for project members.

- ***Knowledge sharing through ‘open-door’ policy***

In this case study, corporate culture at the organisation has been described by the interviewee as open and less hierarchical. There is free flow of knowledge due to the openness of the culture in the organisation. According to respondent A1, he believes in knowledge sharing policy which is related to transparency of information, sharing knowledge and works experience between FM team and top management. This would promote trust and confidence between parties involved apart from facilitates a collaborative working environment. Similar observation was made by Dent and Montague (2004) who agreed knowledge sharing is effective in an open culture with a high degree of trust and support at senior corporate levels. Thus, people-to-people communication is considered an important element for fostering knowledge sharing in this case study.

As explained by the respondent A3, he always held informal meetings with their own FM team in a relaxed environment. Informal meetings can provide the type of relaxed work environment that might motivate individuals to express their views and share their experiences. To quote A3's comments, *"...as our team members were more open with one another, they even shared knowledge during lunch or in their leisure time through general conversation with me"*. This closer relationship was maintained and thus created a good environment for knowledge sharing more effectively.

Open knowledge sharing policy via informal meeting set by Case A organisation allowed direct communication between site facilities manager and FM operatives. The FM team usually discussed construction problems on site. Each member had a better understanding of the practical work as it was clearly visible on site, as opposed to trying to foresee problems from verbal description or drawings. It was easier for them to locate problems and solve them more efficiently. Thus, developing good relationships between top management and operatives is required to enhance knowledge sharing.

- **Code of standards**

To ensure the highest services delivery standards, standard operating procedures called LOPS (Local Operating Procedures) were developed to ensure that all operatives follow the same standards with regard to delivering services within this project. Respondent A2 is responsible for developing this procedure.

During the visit to the respondent A2's office, the hard copy documents of LOPS in three volumes can be seen on shelves outside the meeting room. For Case A, LOPS is partly driven by Project Agreement. LOPS were considered a medium to communicate contractual requirements to FM operatives and were derived from method statements that specified work details according to service specifications.

As quoted by the A2, "*... We also have the method statement, which tells you how services are going to be managed and delivered. From there, you have information from LOPS, which mentions work scheduled for each staff and area they are working. Separate from that, there are monitoring, audit and validation that run*

along side. So, this shows the flow of information is going and how knowledge is shared”.

As explained earlier by respondent A2, LOPS could also be used as part of a performance monitoring system by the PFI service provider and the Trust once the facilities are fully operational. Basically, LOPS were used as performance parameters between those two parties as set out in the schedule and specification.

- ***On-job Training***

Currently, most of the FM operatives participate in on-job training provided by the Estates Department of the FM service provider. This training enables FM operatives to enhance their technical knowledge regarding handling specific equipment/tools. Respondent A1 stated: *“Outputs from knowledge management processes can assist in the training of new staff but clearly their relevance is dependant on circumstances”*. In order to deliver the project successfully, FM operatives require knowledge consisting of technical knowledge, contract understanding and communication skills.

Problems and challenges

The respondents were asked to describe their challenges with regard to facilities services management at the PFI operational stage. At the top of their list were difficulties in managing information in terms of collating information from various parties at the handover stage. Respondent A3 was concerned with the fact that design teams were leaving a project at handover stage, with little thought to its subsequent operation. Therefore, input and requirements from facilities managers are essential

towards providing design teams with feedback on the operational and maintenance of the building.

The poor transfer of project information often means that decisions are made on the basis of imperfect knowledge. Piles of documents which contain lots of information need to be checked, monitored, directed and transferred throughout the construction process by the facilities managers to the FM operational team. Because PFI projects are based on output requirements, all decisions made by the facilities managers depend heavily upon the timely transfer of information.

Other challenges stated by the respondent include potential services changes in future and a new ways of working in the PFI-FM environment. These challenges are stated by respondent, A2 as follows: *"...there is no doubt there will be services changes in the future, in such a place as hospitals; dealing with human beings (people), and the requirement by NHS.you will going towards different field and different aspect of management (PFI-FM practices) such as new ways of working, new technology to work with where there is a guideline, contract, specification that needs to follow"*.

All respondents interviewed appreciate the fundamental problems of managing information and knowledge and acknowledge that finding solutions would go a long way towards reducing costs and duplications, thus increasing quality and sustaining profitability to the project and organisation.

6.1.2 Project B

Project background

This project comprises the redevelopment for two hospital facilities sites. The redevelopment consists of a new acute in-patient hospital at the existing hospital site and a new Diagnostic and Treatment Centre (DTC) at another site. Throughout the redevelopment period, the existing healthcare facilities must remain fully operational, and the PFI consortium through FM organisation, must provide provisions of estates services. The financial closure of this project was signed in June 2007 and the commencement of construction started thereafter. The redevelopment of facilities was expected to be complete in mid-2010.

The PFI consortium's Facilities Management and Services Planning Manager (B1), who has 20 years' experience in facilities management and four years' experience in managing this project, was the respondent for this project. Currently, respondent B1 works closely with the FM service provider and leads the FM service provider's team in developing the specifications for facilities management service delivery. The other two respondents interviewed were the Facilities Manager (B2) and the Site IT Manager (B3), both of whom are responsible for coordinating the day-to-day operation of services and managing IT facilities, respectively.

Processes for managing knowledge

- ***Intranet and Helpdesk***

In this project, knowledge and experience are shared via regular meetings and the intranet (known as the Central Project File), the latter of which is particularly relevant as a medium to share project files and documentation. The IT system in Project B can be considered as being at a satisfactory level as stated by

respondent B3, a Site IT manager. According to B3, throughout the PFI process, open and regular communications with all PFI consortium staff including FM service providers have been provided to ensure they are aware of progress.

B3 quotes “...in the early stages of this project, such information that is available on company intranets include electronic company newsletters, advertisements, periodic question and answer sessions and briefings, standard company forms and project reviews”. Clearly, the main role of the intranet in this project B has been used to inform current updates to FM team and other related parties with regard to delivering facilities services.

The Helpdesk is also used as an approach to manage facilities management information. Project B uses IBM MAXIMO Asset Management system, which is a customised off the shelf (COTS) helpdesk system as key management tool that is available 24 hours a day and 365 days per year. The provision of Helpdesk system is to ensure delivery of service standards, monitoring of performance and provision of management reports.

Information and knowledge exchange with the construction team are key to the successful delivery of FM services throughout the concession period of this project. However, having intranet technology without understanding the process and flow of information could hinder the effective knowledge sharing within the project organisation. To quote B1, he stated: “...in project B, we are beginning to look at the process first and then use the intranet to guide FM team through it, identifying where they can find knowledge related to their task more efficiently”.

Meetings

The face-to-face meetings were the knowledge-sharing medium most mentioned by the respondents in project B. There were generally three kinds of meetings: 1) Strategic meetings known as Jointly Liaison meetings between PFI consortium, FM service providers and NHS Trust. This meeting was held once a month to discuss specific issues such as FM's performance, health and safety issues, finance, contractual and commercial issues; 2) Operational meetings between the PFI consortium and the FM service provider. This fortnightly meeting is an example where information and strategic decisions were passed down to the general manager of FM service provider and FM operatives; and 3) On-site meetings which were held once in every three months. These meetings were attended by Estates General Manager and FM operatives. These helped FM operatives to discuss any operational problem from their workplace and channel it to top management level.

Strategic meetings and operational meetings were formal, while on-site meetings were informal. Through regular meetings, it helped the organisation to understand each other's requirement, expectations and working practices. This is supported by Nonaka & Takeuchi (1995), who found that individuals share knowledge with each other effectively through face-to-face dialogues. Face-to-face communication allows immediate feedback between the sender and the receiver.

The study in Case B organisation revealed that the face-to-face meetings or interaction were effective sharing medium as suggested by all respondents apart from utilising IT-tools such as Intranet and Helpdesk system. In the context of KM, both KM technologies (IT-tools) and techniques (non-IT tools) were used in Project

B and deemed equally important to support knowledge sharing among operational FM team members and FM at strategic level.

Problems and Challenges

The predominant problem mentioned by the respondents is difficulties in meeting service performance levels at interim services. The problem occurs when the Trust (client) requires existing healthcare facilities to remain fully operational throughout the construction of new facilities. Thus, the PFI consortium, through the FM service provider needs to provide interim services to existing facilities. However, the interim services are currently under-maintained because of the limited funds being invested in existing operational facilities, since the facilities will soon be demolished and shifted.

In another problem, respondent B2 pointed out although the schedule for specifications of electrical and mechanical equipment was allocated and followed accordingly, this was done by selecting the device randomly. This detrimentally affects service quality and causes difficulties for the facilities management team with regard to meeting the service performance required by the PFI consortium and the client.

Another issue was observed in Case B is the insufficient information at early operational stage of this project. Respondent B2 finds it difficult to acquire all the manuals from the manufacturers and the construction team and designers responsible for the healthcare equipment, especially during the Defect Liability Period (DLP) of the project. The suppliers and manufacturers retain most of the manuals during this period. However, this information is required for maintenance records purposes.

To solve this problem, B1 suggests that the facilities management team needs to possess most of the pertinent information about the facilities, in particular the building layout, space and functionality. For instance, the facilities manager's presence and involvement during the construction stage could provide an advantage in terms equipment and infrastructure locations, such as locations of piping and concealed wiring and mounting in ceiling enclosures, walls and floors. This knowledge could then be shared with the FM operational team, thereby improving the facilities manager's knowledge.

6.1.3 Project C

Public Private Finance Awards named the private consortium for this project the Best Private Sector Consortium for 2004. Meanwhile the Building Magazine named the facilities management service provider of this project, the PFI Contractor of the Year for 2004 and 2005. This recognition indicates that the Case C organisations has delivered the expected FM services quality.

Project Background

The project comprises two phases situated at the same site. The first phase includes a reconfiguration of an existing facility to include a hospital emergency unit. Beginning immediately after its financial close in 2003, the first phase was completed in 2006 and began its operation thereafter. The second phase includes development of new facilities anticipated to be complete by Spring 2009. The second phase involves the development of an emergency unit to be transferred to a single new site.

Three respondents were interviewed for this project. The interviewees included the Assistant FM General Manager of the PFI consortium (C1), the Estates Facilities General Manager (C2) and the Systems IT Coordinator (C3). C1 had three (3) years'

experience with the project. C2 had 27 years' of managing facilities management and began working on the aforementioned projects since at the bidding stage in 2000. C3 had two (2) years' experience on this project.

C1 is the liaison officer who transfers the information received from the client to the FM service provider. Information received will be channelled to the facilities management service provider. C2, who works for the FM service provider, is responsible for providing, maintaining and developing a number of services. He and C3 are responsible for managing the information systems of the project.

Processes for managing knowledge

- ***Meetings***

At the operational stage of the project, the modes of delivery of information from the FM organisation to its FM operatives are largely based on document communication and direct instruction from the latter's immediate supervisor from time to time. Jointly Liaison meetings (held once a month) are used to help transfer and share information between the PFI Consortium and the FM organisation. Fortnightly meeting with senior management is an example where information and strategic decisions were passed down to the General Manager. Later, information and decisions were passed through to the operatives through the line supervisor.

Another mode of delivery of information and dissemination of knowledge is on-job meetings. Regular on-job meetings facilitate the effectiveness of managing services and help to overcome shortcomings with regard to meeting the level of standard services by FM operatives and managers.

- **Databases and software**

For this project, a dedicated department was assigned to manage data and information across the operational stage. The System Coordinator (C3) headed the department and was supported by the Estates Facilities General Manager (C2). C3's task is to record and disseminate the data and information from the design and construction stage in order to enable the FM project team to use them in delivering their services.

As quoted by the C2, *"...in term of managing large quantities of information and knowledge, we use available IT tools in our organisation"*. This task is aided by CONCEPT, a computer aided facilities management software system used to log all information regarding operation and maintenance services, such as calls, assets, tasks, time allocated, costs and history of the assets. At the moment, C3 is in the process of developing several systems for the NHS Trust and a Private Consortium to monitor the performance of service delivery provided by the FM service providers.

In this project, design and construction information are stored in a project database called the EOM (Electronic Operation and Maintenance). The EOM is a database used to document the information and data electronically. Information gathered in this way included drawings, technical information, preventive maintenance plans, health and safety documents and all related paperwork. Both softwares, CONCEPT and EOM are not integrated with each others as both softwares have different functions and purpose. However, these two softwares are accessible to all FM staff in this project.

- ***Training and mentoring programme***

Various methods were adopted by this project to capture facilities managers' knowledge, such as in-house training system, apprenticeship training and personal mentoring. According to respondent C2, an in-house training system called '*toolbox talk*' is used to share and disseminate any specific subject on operation, equipment, information or any job instruction to operatives level.

Organisation C also carries out a mentoring system, in which one senior facilities manager mentors to a maximum of three new employees. These new employees will be assigned to different departments (e.g., estates maintenance, helpdesk or other non-clinical departments) to expose them to different tasks. The employees will subsequently be allocated to certain departments depending on their capabilities. The human resource department has played an important role in arranging this system.

- ***Lesson-learned seminars***

As stated by respondent C2, the design, construction and maintenance team in this project are under the same group of parent organisation that led this PFI project consortium. A2 stated "*In this project, ABC (not an actual name) build, ABC designed, and ABC maintained ...which is our FM team. We have liaison with design team and builders ...pass the information over the operational team. When the building is finished, all (design and builders team) are left except maintenance unit (our FM team) due to deliver FM services for 35-years in this PFI contract*".

Clearly, Case C as FM organisation is benefited from this project where information and knowledge is readily available from their parent consortium. Thus, the FM organisation team have the opportunity to receive timely information on any changes that could alter their current activities. For example, the use of lesson learned seminar information.

The PFI consortium identified lessons learned seminars as the best mode by which to transfer facilities managers' knowledge within the project. The PFI consortium used lessons learned seminars to share knowledge between the project team and the construction team and FM operatives and the consortium's board meetings as well to disseminate lessons learned results to the client.

Lessons learned seminars are conducted at every stages of handover in the project. All the key participants (e.g., facilities managers, line supervisor, operatives) for the project are gathered together to discuss and evaluate the projects in detail. Mistakes are highlighted during the meeting so that they will not occur in the future. All the knowledge and experiences gained from the past project are captured and documented in both hard and electronic copy. In this context, the PFI organisation's strategy was to keep people and teams together as they sought to develop knowledge and experiences from previous projects.

Problems and challenges

Because of its completion, Project C experienced different types of problems and challenges as compared with the other two case studies. Particularly relevant problems and challenges included a delay of information, meeting and maintaining the

level of services, difficulties with regard to the FM operational team's interpretation of contract documents, and lack of knowledge retention.

The Assistance General Manager (C1) highlighted the current practices' limitations regarding communication from the PFI consortium to the FM service provider. At the moment, there is no direct contractual relationship between NHS Trust (the client) and the FM service provider in this particular PFI contract. The only line of communication with Trust is via the PFI consortium. Thus, delays in the conveyance of information from Trust to the FM services provider can lead to difficulties in implementing satisfactory services delivery to the facilities. However, as FM service provider is under same group of parent organisation with PFI consortium, this issue is minimal.

Respondents C1 indicated that the main problem at the FM operational and maintenance stage is meeting and maintaining the level of standards set by the PFI consortium and the client. For example, regarding soft FM services such as cleaning, the PFI consortium representative's interpretation of 'clean' is unclear during performance service review exercises. The "how clean is clean" argument is recurring problem for the facilities manager's service provider. Only the frequency of cleaning per day and per room is delineated in the Service Level Agreement, yet the definition of clean is constantly debated between the PFI consortium and the client.

Another problem stated by respondent C2, are the difficulties encountered by the FM operational team regarding the interpretation of the contract document. This situation largely occurs at the operational level when the team involved in the day-to-day operation is isolated and based on-site. In such circumstances, they are not aware of (and lack of understanding of) the impact of their jobs on the organisation's business

goals and strategies. Thus, ignoring the contract leads to a lack of understanding of the operational scope.

To quote C2's *"...there is huge change from current traditional services operation to PFI services delivery. For example, risk of facilities or services availability. Unavailable room or operation theatre for patient need to be treated in stipulated time, otherwise there is penalties (cost deduction from payment received) imposed by Project Co. ...we can't close the wards/theatre, potentially affecting the life and death of patients."*

During the fully operational stage of this PFI project, vast amounts of information and knowledge are generated and shared. Although supported systems (i.e., databases) are available for this project, all respondents are still very concerned about the lack of knowledge retention in this project.

As quoted by respondent C2, *"...we believe in people as our main resources. The transfer of knowledge is like the chain, where the chain is people along the process. Breaking the chain could cause loss of valuable information and knowledge. Although new people brought in, there are a lot of hiccups on the continuity of the whole process of service delivery operation."*

Thus, it is important for the PFI consortium to capture knowledge regarding the project and the people involved and to make it easy for others to access and utilise this knowledge.

6.2 Cross-Case Synthesis

Having explained the backgrounds of all three case studies, a cross-case synthesis can now be performed to identify any themes or patterns in current practices related to managing facilities and management knowledge. Thus, this section elucidate any similarities and differences that may suggest general ways to improve the situation.

Any approach to managing knowledge is based on a number of factors, such as the level of management support, available resources, and organisational culture (Hansen et al., 1999). It is, therefore, important to understand why the case study organisations have opted for certain approaches. This section categorises the case study findings under three main themes as shown in Table 5.4: 1) Current FM practices in PFI contract; 2) Processes for managing knowledge and their strategies in adopting knowledge; and 3) problems that have emerged in currently operating FM services.

6.2.1 Current FM practices in case studies

In most recent operational PFI projects, the delivery of FM services falls under one of the following categories: 1) provision of a new facility (as for Case A); 2) rebuilding of existing facilities (as for Case C); and 3) maintenance and operation of existing facilities (as for Case B). Although each case study is in a different category, all three cases share similar characteristics with regard to the PFI contract, which is driven by output specifications from the client.

Because the provisions of FM services are contracted up to 35 years on average, for all case studies, most of the respondents showed concern regarding the continuity of information and knowledge throughout the contract period.

Two respondents stated:

Respondent A2: *“...within the specification, they (PFI providers) give a lot of information for that month ...my role is to audit, validate and report. After that, invoices can be signed off and you start the process again (month by month until the end of concession period; 35 years) - doing auditing, monitoring, validating”.*

Respondent C2: “...input and requirements from facilities managers are essential towards providing design team with feedback on building and systems performance. Our concern is to have cost savings in later stages during operation and maintenance period”.

This manifested the importance given the significant amount of knowledge required by FM service providers to deal with the highly demanding, day-to-day operational tasks stipulated in the PFI contract. Consequently, all the decisions made by the facilities managers depend heavily upon the timely transfer of information and the knowledge possessed by the FM personnel to carry out their job. All of this is to ensure the project’s smooth operation and service delivery.

Results from all case studies (Case A, B and C) indicate that successful delivery of services through a PFI scheme depends on clarity of the output specifications at the contract stage. The output specifications were determined by the hospital Trust (client of the project), the guidelines from the Private Finance Unit (PFU), and the NHS Standard Service Level Specifications from the Department of Health (DH). These output specifications will later become part of a Project Agreement.

In the Project Agreement, the output specifications dictate the required level of services and a range of scheduled maintenance throughout the operational stage of the project. To achieve the output specifications targeted, these must all be defined and further developed to in more detailed level as job specifications. The job specifications are used by FM operatives to carry out their tasks. Thus, output specifications are considered a knowledge source in the PFI healthcare projects scheme.

According to one of the respondent's interviewed (B1), the preparation of job specifications must be carefully written. This involves a search for information regarding the preparations of standards and guidelines for the services provision in order to meet certain rules and requirements for the services. Respondent B1 also suggested that the role of developing job specifications need to be carried out by facilities management personnel of the PFI consortium bidding team as early as the procurement stage of the PFI project. This shows a clear indication of the direct effects of the PFI on facilities management practices from the beginning of the contract.

From the three case studies analysed, only Case C retained the same FM personnel, (C2), who had been working since the bidding stage of the project. However, for Cases A and B, the personnel involved in defining and developing the job specifications have either been reassigned to other projects or have left the organisation. It has been noted by C2 that his vast knowledge and experience with regard to defining job specifications helps both the operational and management teams to reach a clear understanding of their tasks description and content and awareness of their PFI business scope. These job specifications include the required services to deliver, the number of operational staff required for each task, the tasks to be completed and the level of service performance needed. The operational FM

team's inability to understand such specifications could result in the failure in services delivery and performance.

For Case A, respondent A1 believed that, although he has worked since the commissioning of the project, his input and clarity on some service specifications have remained quite limited because of his minimal knowledge and capability of interpreting the rationale and justification of the service specifications developed. However, respondent B2 from Organisation B seeks help with regard to interpreting the specifications outlined in the contract from the PFI consortium (respondent B1). This is due to B1's knowledge and experience in managing and developing the job specifications of the project.

In a situation such as this, effective knowledge sharing among personnel becomes a critical success factor, and knowledge management (KM) becomes an enabler of organisational learning in these case studies. Similar observation was made by Abdul Rahman et al., (2006) that the critical success factors of an organisation depend on the quality of knowledge applied by the organisation. Thus, when applied to facilities management practices, KM encourages facilities managers to learn from others and share best practices amongst their peers.

6.2.2 Processes for managing knowledge

The management of knowledge is regarded as a main source of competitive advantage for organisations (Webb, 1998; Bhat, 2001). To keep facilities management organisations competitive and to sustain the market, developing effective ways of managing FM knowledge is of considerable importance to FM organisations. In the case studies conducted herein, knowledge has been managed through varies of KM

tools, mainly based on KM techniques (non-IT; people centred activities) and KM technologies (technology-centred activities) as discussed earlier in Section 4.4. The details of the knowledge management activities in case studies are shown in Table 6.1 below.

Table 6.1 Details of knowledge management activities in case studies

KM Tools	Processes of managing knowledge		
	Case Study A	Case Study B	Case Study C
KM Technologies (IT Tools)	E-mails	Intranet system - use of Central Project File as a medium to share project file and documentation Establish a Service Desk (Helpdesk) to manage facilities management information	Databases (EOM) - use as information directory, aimed to standardise information and reduce duplicated efforts Adopted computer aided FM software (CONCEPT) - to assist FM and operatives in managing facilities
KM Techniques (non-IT Tools)	Meetings Documentation Open policy in sharing knowledge and information Code of standard On-job training	Meetings - formal - informal meetings	Meetings Training and mentoring - to assist less experienced and new employees Lesson-learned seminars held at every project stage

Technology-centred activities

In all three cases studied, it can be concluded that various activities and tools such as information technology (IT) related applications have been used by the facilities management organisations to proactively manage their assets and knowledge. Such IT-related applications use email, the intranet, databases as information directory and computer-aided facilities management systems. However, these various knowledge

management activities mostly consist of knowledge-sharing activities. This is not surprising, as IT has been closely associated with knowledge management and knowledge sharing. IT provided a platform not only for storage and access of information but also for communication (McCampbell et al., 1999)

Generally, all the respondents recognised the benefits of IT, particularly as they relate to storing drawings and services specifications on the project server and intranet. Thus, this information becomes accessible to all levels of the organisation and expedites their service delivery. However, the respondents from Organisation B (B2, B3) feel that the advantage of knowledge sharing through IT is best implemented between the parties in a PFI consortium but not across the project. This is because different PFI projects have different practices regarding the implementation of operational activities and communication structure(s) and the level of influence from the top management level.

Two of the case study Organisations (B and C) heavily emphasised technology-centred activities in managing their knowledge while Organisation A focused more on people-centred activities. From the analysis, it was found that Organisation C managed to balance the usage of people and technology in delivering FM healthcare services. In the case study of Organisation A, the only technology-centred activity in use is email, and this is primarily used for external communication. This is due to the absence of intranet facilities in this project.

In Organisation B and C, document management systems such as the 'Central Project File' and the 'EOM database' were used to capture and store the project file and its associated information/knowledge. Despite the documents being stored and the key

learning points having been made available, often it is difficult for the facilities managers and their operational team to retrieve the knowledge. The respondents from Organisation C, (C1), point out an example to emphasise the point where most of the problems often occur on site, thereby requiring immediate attention. On the other hand, the FM operational team usually discussed the solution based on their experience on site and often abandoned the practical solution that had been recorded in their database. Hence, databases containing solutions or key learning points were not made readily available to them. In addition, the service response time stipulated in the PFI contract also limited the utilisation of the database.

The study found that Organisation C had developed their knowledge management system and shared knowledge through the intranet system. A dedicated unit is formed, led by personnel with IT backgrounds to establish the organisation knowledge asset base. These enable reports to be generated electronically and accessed by the Trust and the PFI consortium. From observation, all case studies except case study Organisation A rely on information technology (IT) to manage their knowledge. The reason given by Organisation A is because of the IT system is procured under different services provider and also due to an early stage of service delivery of new built facilities.

Clearly, all respondents in Organisation B and C recognised the benefits of IT, which increased efficiency in utilising information and reflected knowledge management initiatives currently in practice. Such applications as project central database and facilities management software (i.e., CONCEPT, EOM, and IBM MAXIMO) are used to communicate information sharing among parties within the organisation and projects. These respondents also realised the benefits of keeping the information in a database

accessible to all organisation levels to expedite their service delivery. However, the respondents' feel that the advantage of communicating through IT is that it is best implement within parties in a PFI consortium.

People-centred activities

Two of the case study Organisations (A and C) heavily emphasised people-centred activities (non-IT tools) of sharing knowledge. Although the approach for each organisation is different, the motivation for sharing knowledge is found similar to all three case study organisations. Most respondents claimed that their motivation for sharing knowledge was to ensure that all project team members were able to perform their tasks at a similar level.

The respondent from case study Organisation A pointed out that the approach used to manage knowledge within this project relied on people: *"People are the source for knowledge creation and knowledge sharing. It is the people, their search for answers and their desire to innovate and improve that creates all knowledge"*. In short, people were a particularly important asset to Organisation A, which, thus, adopted a people-centred activity to encourage and facilitate knowledge of their employees.

It is noteworthy that management at Organisation A practiced an open culture policy to promote knowledge sharing and learning among their employees. The study found that the top management level has heavily promoted standards and a policy to improve service delivery. While respondents from Organisation A believed that processes of managing knowledge would improve the quality of the services they produced, it was apparent that the current practices in use were inadequate compared with Organisation C.

In Organisation C, the apprenticeship and mentoring approach were used to acquiring knowledge. Knowledge gained from participating in apprenticeship training and mentoring could be applied immediately and was relevant to their working environment, particularly when compared with formal training programs.

As explained by respondent C1, *“apprenticeships improve the knowledge and skills of the individuals so that they can later perform tasks on their own. ... [T]his process later creates a conducive work environment where there is a close relationship between operational and management team”*. In short, through this process, all parties involved know what is expected according to the output specifications and the contract.

In addition, Organisation C also implemented a lessons-learned seminar and held a meeting to document and disseminate their knowledge. Lessons learned from the project were compiled in a database containing lessons from the post-project review, which were sorted according to sub-contract packages and discussed with the project team, construction team and the managerial board. This initiative was developed in order to capture and store relevant knowledge regarding design, construction and operation. Respondents from Organisation C believed that the implementation of lessons learned within this project had enabled the facilities manager to ensure optimum performance of the building from the earliest stage of occupation.

In all case studies, the facilities management team shared their knowledge through formal and informal meetings. They reflected the advantage of face-to-face meetings within their internal organisation as a means of translating output specification to job specification, particularly from the facilities manager to operatives. Subsequently, this could lead to fewer misunderstandings in the contract and interaction between personnel.

6.2.3 Problems occur

Based on the findings from analyses of three case studies involving PFI healthcare projects, the current state of managing organisation knowledge was recognised in term of managing facilities services.

As discussed in the previous section, the three case studies are adopting several practices of knowledge management during the operational stage of PFI. However, most of the case studies emphasised only knowledge sharing and knowledge dissemination. It is obvious that the potential of knowledge management initiatives in delivering facilities services is limited and has not been fully explored. Details regarding the potential of KM initiatives in general, have been discussed previously in Chapter 4.

A summary of the problems in managing organisation knowledge among the three case studies is depicted in Table 6.2. Most of the projects managed by the respondents are still in the relatively early phases of their operations; the project managed by Organisation C is the only one to have reached three years of operation.

From Table 6.2, it can be found that the problems highlighted by all respondents are different across the case studies. However, it was noted that the longer the duration operational service delivery of the PFI-FM project, the greater the problems or challenges faced by the organisations.

Table 6.2 Problems in managing organisation knowledge in case studies

	Case Study A	Case Study B	Case Study C
<i>What is the problem?</i>	1) Difficulties in managing information in term of collating information from various parties 2) Difficulty in interpreting contract document 3) Difficulty in identifying the personnel responsible for storing the documents	1) Difficulties in meeting the service performance at interim services 2) Little information available 3) Existing facilities under maintained due to limited investments in the existing operational facilities before being demolished and shifted	1) Delay of information 2) Meeting and maintaining the level of services 3) Lack of knowledge retention over lengthy period 4) No direct contractual relationship between Trust (client) and FM service provider organisation
<i>To who?</i>	Facilities manager; Operational FM team	Facilities manager; Operational FM team	Facilities manager and operational team
<i>When is occur?</i>	At early operational stage (after handover)	During partially completed facilities	At full operational service delivery

Problems identified from the case studies were then categorised into three major problems, namely; poor quality information; poor communication; and lack of knowledge sharing. These problems were investigated to determine how organisations use their knowledge activities to help them solve these problems. This is shown in Table 6.3, which tabulates the problems that have occurred in all three case studies and proposes the best practice by combining the most preferred application of KM processes among the case studies and the most appropriate KM tools to overcome the problems.

Table 6.3: Tabulation of case study results related to KM processes

	Related KM Processes			Application in managing knowledge								
				Technology-centred activities			People-centred activities					
Problems highlighted	¹ Acquisition (creation)	² Organisation & Storage	³ Distribution & sharing	Email	Intranet	Database	sharing policy	Meetings	On-job training	Lesson-learned	Mentoring	Documentation
Poor quality of information		x	x			x		x				x
• Inadequate handover process: <i>difficulties in collating information from various parties</i>												
• Insufficient information context		x	x	x	x	x	x					x
• Difficulties in meeting the service performance	x							x	x	x		
Poor communication	x		x				x	x				
• Delay of information												
• Meeting and maintaining the level of services		x	x						x	x	x	
• Services specifications are open for interpretation	x		x		x				x			x
Lack of Knowledge sharing		x	x			x					x	
• Lack of knowledge retention <i>High levels of staff turnover relate to knowledge retention</i>												
• Difficulty in identifying the personnel responsible for storing the documents												

Notes

¹**Knowledge Acquisition:** Knowledge Acquisition is driven by the types of information that are related to a given organisations' business process. Knowledge is acquired from various sources, either through experience, sharing thoughts and feelings during socialisation or getting new knowledge from recorded materials.

²**Knowledge Organisation and Storage:** Knowledge organisation and storage deals with a process that requires information to be edited, summarised or codified before it is stored in the knowledge base. Processes that are involved in this stage include cataloguing, indexing, filtering, refining or linking related pieces of information with each other. Knowledge that has been organised is stored in a database and updated when required.

³**Knowledge Distribution and Use (sharing):** Knowledge distribution is designed to increase the sharing of information. Knowledge is to be shared and utilised to improve competitive advantage.

As shown in Table 6.3, more than one approach or activity can be used for solving the problems highlighted. The most appropriate tools and technique(s) for supporting KM processes were discussed earlier (Chapter 4, section 4.4). By combining both practical KM processes in the studied organisation and recommended KM tools to support the KM process, a holistic approach of managing the organisation's knowledge in PFI-FM healthcare services can be made. Further discussion regarding the development of the proposed framework on managing facilities knowledge can be found in Chapter 7.

6.3 Towards Framework Development

The literature review conducted in Chapters 2 and 4 highlighted various difficulties encountered in managing information and sharing knowledge in PFI working environment. The literature (in Section 2.4 and Section 4.6) also suggests some solutions to these issues. In the case studies herein, knowledge has been managed through several approaches through knowledge management initiatives based on people and technology-centred activities.

The knowledge management initiatives are used either partially or as a combination in most of the case studies investigated. Thus, none of the case studies followed a complete best practice of KM initiative as discussed earlier in Chapter 4. However, most of the respondents from the case studies realised that managing facilities knowledge will ensure successful service delivery for both in the short and long-term.

All three case studies addressed here are of facilities management service providers in PFI healthcare projects and are related with services-based and maintenance works. Each maintenance project is loaded with valuable information and involves people whose knowledge and skills has been built over time, along the process. Thus, FM

organisations realised the importance of knowledge assets to them especially with the long period of maintenance and service delivery in PFI contracts. Knowledge management involves people, processes, technology, techniques (strategy) and also culture (Ahmad et al., 2002; Bhat, 2001) as discussed earlier in Chapter 4. Although it is not a simple question of capturing, storing and transferring information, it is an area worth looking into by FM organisations in order to manage knowledge effectively and sustain their competitive advantage (Bhat, 2001).

6.3.1 Understanding the FM business process

As process is one of the elements in knowledge management, Figure 6.1 will look into the FM business process in PFI healthcare projects at PFI - Use stage taken from the case studies. From Figure 6.1 below, each group of processes is carried out by different groups of people and supported by technology at different processes and stages. Hence, it enables the information and knowledge to be fed back to the previous process. A similar observation was made by Disterer (2002) who stated that “...each processes produces information and knowledge that is useful for subsequent processes, subject to where and when it needed”.

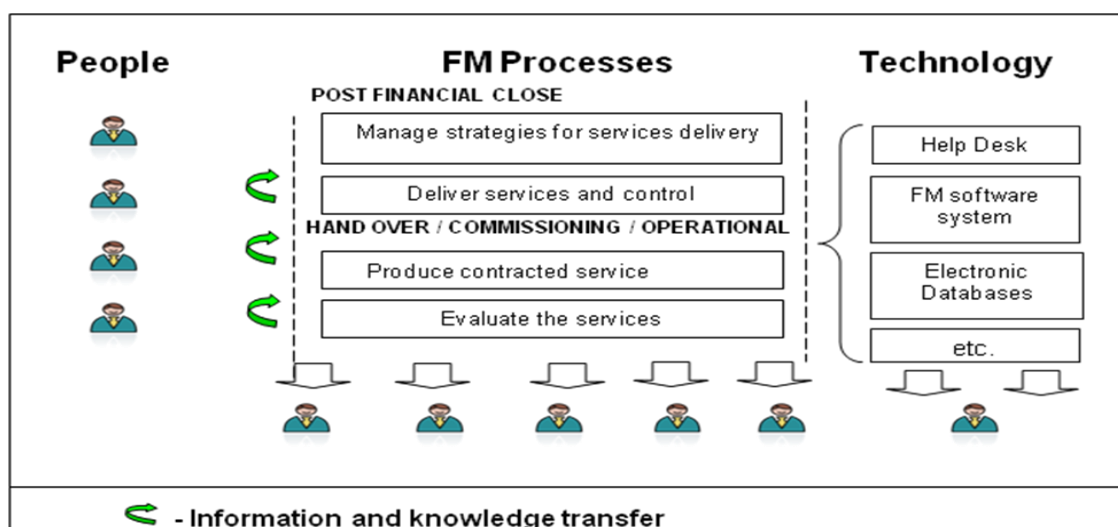


Figure 6.1 Overview of the FM business process at PFI - Use stage

As discussed earlier (in Section 6.2.1), all three case studies shared similar FM business processes due to the same business guidelines adopted by PFI consortiums from the Private Finance Unit (PFU), and the Department of Health (DH). The output specifications derived from NHS Standard Service Level Specifications were the main input of this FM business process. However, there are a few important elements in the notion of business process to be included to make a full FM business process model, i.e. people in the organisation, activities, mechanism, goals or output (Ould, 1995) and resources as an input (Harrington, 1991)

The process modelling technique adopted for this study is a technique suitable to illustrate key activities in all case studies organisations involved, including the interaction between them, the mechanism or approach and the information flows. As discussed earlier in Section 5.5, this research adopted IDEF0 process model as a tool to understand the FM business process in all case studies. In mapping the business process, it provides a better understanding of FM business in PFI projects. This is related on the problems related to FM activities along the process and approach to solve the problems and eventually to improve the process.

Figure 6.2 shows the FM business process model at PFI - Use stage using IDEF0 model. More detailed process diagrams of IDEF-0 can be found in Section 7.3.1. The process starts from the Output Specification and Project Agreement agreed between PFI consortium where consist of FM service providers and public sector client (NHS Trust). As quoted by respondent A2, *“The Private Finance Unit outlines the specification is used as guidance for all hospital Trust throughout UK ...we just follow and only use the Project Agreement (PA) and documentation ...Nothing more and nothing less”*.

FACILITIES MANAGEMENT SERVICES DELIVERY PROCESSES

POST FINANCIAL CLOSE

FULLY OPERATING

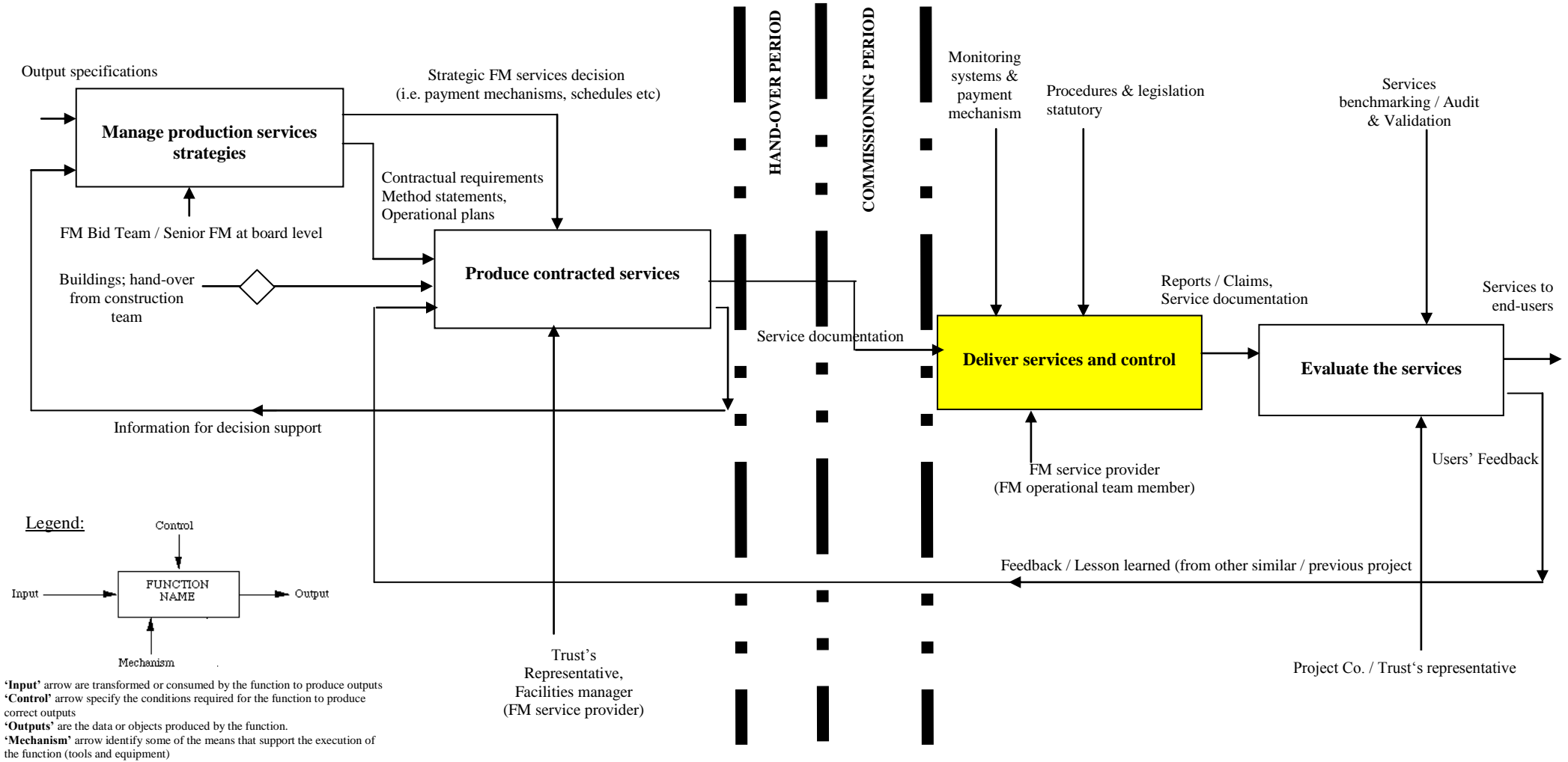


Figure 6.2: FM Business Process Model at PFI - Use stage (Source: compilation of case studies)

In the Use-stage of the PFI projects, the FM processes consist of managing the production of services strategies; production of contracted services; delivery and control of the services; and evaluation of the services. Each process has a different set of activities and information needed as follows:

- Manage production service strategies - Activities involved in the decision making of the FM services provided to users, as specified in the output specification;
- Produce contracted services - Activities involved in managing assets and resources of the organisation;
- Deliver services and control - Activities involved in managing, implementing and monitoring services provided to end-users; and
- Evaluate the services - Activities consist of monitoring the level of services through receiving and processing feedback and by performing services benchmarking exercises or market testing arrangements.

6.3.2 Towards developing FM business improvement strategy

The key focus of FM processes mentioned earlier was to develop a framework in order to enable organisations to improve knowledge sharing among their FM team. Therefore, the IDEF0 model used to map the whole FM process has made it clear enough to be analysed. The problems and issues highlighted by the parties involved in this research can be summarised as 1) poor communication; 2) poor quality of information; and 3) lack of knowledge sharing. This has consequently opened up the potential and opportunities for improvement particularly in the area of knowledge management in PFI-FM practices within the case studies.

The following form the key criteria and information gathered from both literature review and case studies in supporting the FM business improvement strategy with aid from knowledge management initiatives.

- *Continual information flow*

Throughout the duration of the contract, there is a need to ensure continual service delivery by all respondents in case studies. Therefore, sustaining information management and information flows as illustrated in KM's principles allow for the continuation of information flow among the organisation studied.

- Recording and storing tacit knowledge

There seems to be a need to establish relevant KM tools either IT-based or non-IT-based to tackle undocumented information and experience usually possessed by either the facilities managers or operatives involved at operational FM stage. It is crucial to store the tacit knowledge required by the personnel in-charge during their service to prevent knowledge loss should the personnel leave the organisation. Thus, appropriate KM tools are considered fundamental to aiding and increasing knowledge retention and channelling communications within the organisation. Utilising KM tools for the different needs and stages of PFI projects will enhance successful service delivery.

- *Easy to use documentation*

It has been suggested that the information and knowledge available for sharing should be documented in a systematic way for future reference and re-use. This documentation would guide users through decision-making processes. The stored information (either via documentation or database) can be made available as

guidelines should similar problems occur with other similar projects. These guidelines could also enhance knowledge retention when a facilities manager or operative leaves the organisation.

- *Effective knowledge sharing through systematic communication*

Knowledge is important, but the key to ensuring that knowledge is retained within an organisation is systematic communication. Many common mistakes are problems that have been repeated as a result of a lack of communication.

- *Clear definition of work scope and responsibilities required*

On aspects of responsibilities and work scope, clearer job specifications and tasks need to be addressed among the FM personnel. This is to avoid duplications of tasks and confusion over job descriptions among the personnel involved.

6.4 Summary

From the case studies considered herein, it can be concluded that KM is seen as the key tool for realising the criteria (as discussed in previous section). This conclusion is based on the characteristics of the PFI contract, itself, as well as the problems at hand. However, knowledge has to be captured, codified, shared and distributed in order to make the information available throughout the PFI-FM business process model. Most PFI contracts last for thirty years and, thus, require continual information flow within the FM organisation. The next chapter will discuss the development of a knowledge management framework for the FM business process at Use stage of PFI projects based on the problems (discussed in this chapter) to help efficient FM service delivery and ideal knowledge sharing and learning in the current PFI-FM practice.

Chapter 7 Framework Development for Knowledge Management Integration

This chapter discussed the developed framework which intended to encourage facilities managers to adopt a knowledge management approaches when addressing facilities management problems or issues highlighted from the literature and case studies. The result of the data collected from the case studies highlighted the importance of: improving the service delivery at operational stage of PFI project; continual information flow; documentation and systematic communication; and effective knowledge sharing processes. However, the framework is not designed to be prescriptive. It encompasses a set of notes to guide the user in developing a solution by use of knowledge management strategies to suit their organisation's individual needs in facilities management processes.

The chapter includes the framework background, as well as its aims, features, benefits, conceptual description and contents. The chapter also demonstrates the use of the framework using several problems taken from case studies as worked example in managing FM knowledge in PFI healthcare projects. The knowledge learned from the solution to the problems can be shared between the users, within projects and between projects.

7.1 Background

One of the most compelling challenges for any organisation, including facilities management (FM) organisation, is how to most effectively capture, utilise and learn from the knowledge that is constantly being generated through its processes and by its

employees. Employing this knowledge in future projects can create an advantage for the organisation. Because PFI projects involve continuity of services for a long duration, managing the knowledge within the organisation allows for services to be provided in a more efficient manner.

The processes of facilities management in PFI projects generate important knowledge that is made available at different project stages. This knowledge is in the form of project-related problems, solutions, experiences, and know-how in the minds of personnel. Therefore, an effective means of improving facilities management knowledge is to share this information among the personnel in the project organisation. Failure to utilise the knowledge within and across the organisation leads to waste and impaired project performance (Siemieniuch and Sinclair, 1999).

This created the need to develop a framework that is capable of managing knowledge generated from facilities management for the benefit of facilities management organisations. This can be achieved through adoption of a knowledge management approach, such as knowledge creation and knowledge sharing processes.

7.2 The Aim of Framework

The framework is designed to manage and improve facilities management knowledge through adoption of knowledge management processes. This improvement is achieved by encouraging facilities management personnel to learn and share their knowledge, especially at the operational and maintenance stage and subsequently offer solutions to its users (i.e., facilities management personnel). Thus, this framework can help to prevent similar issue or problem from occurring in the future.

This framework attempts to provide a structured approach for managing issues or problems related to facilities management knowledge by demonstrating actual problems or issues (discussed under Action Plan) and their potential solutions (discussed under Implementation Plan). The Action Plan delivers the required outcomes and identifies key activities / tasks (process) in terms of the personnel involved, transfer mechanisms, and to map the knowledge required by using KM technology or techniques available.

The Implementation Plan addresses the activities that need to be undertaken as a solution based from the Action Plan. Benefits are also identified and deemed as part of lesson learned. This is due to an approach taken by the framework user(s) when addressing an issue stems from the personnel's knowledge and experience together with available IT tools. Details of the framework developed is discussed in the following section.

7.3 Developing the Integrated Knowledge Management Framework

The development of an integrated knowledge management framework process builds on the findings from the literature (in Chapter 2, 3 and 4) and interviews from three case studies undertaken as discussed earlier in Chapter 6, section 6.2. A literature review identified the key issues in knowledge management and facilities management. Case studies were undertaken to identify FM practices in the application of KM.

In the following, the generic framework for integrated knowledge management in facilities management processes is presented. The framework is generic in the sense that it models FM processes that are always present; however, the processes may be

performed by different parties under different contractual agreements in different PFI sectors. The framework was further developed, reviewed and refined through an evaluation session with industrial practitioner.

Figure 7.1 illustrates the basis for the guidelines used in constructing an integrated knowledge management framework for PFI-FM projects. The framework did not try to duplicate what KT Learning Toolkit (Carrillo, et al., 2003) did, but simplify the locating KM process and attempts to provide users a structured approach with guidance notes (in form of questions) to manage issues or problems related to facilities management knowledge by demonstrating actual problem/issues in FM process.

The aim of incorporating the issues within the developed framework is to allow the FM healthcare provider to understand the KM and enhance their service delivery through utilisation of KM initiatives embedded in their organisational practice.

Each FM process is carried out by different groups of people and supported by technology. These three elements (people, process and technology) are the most influencing factors to manage knowledge effectively in construction organisations (Egbu and Robinson, 2005). The combination of people, process and technology provides the relevant linkages to consider and allows one to anticipate potential issues that may arise in each FM process during the Use stage of PFI projects. The overview of process and linkages between research findings towards the development of research framework is graphically presented in Figure 7.2.

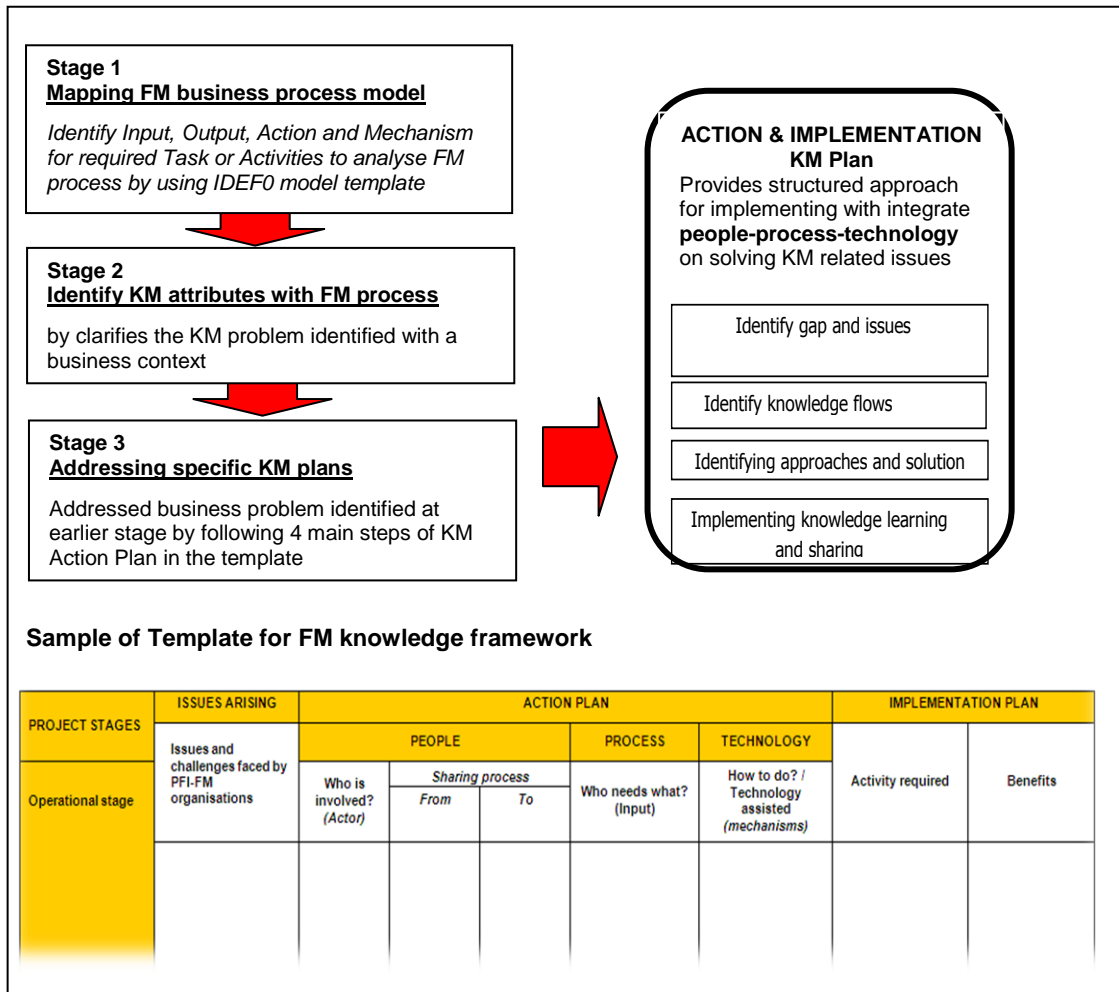


Figure 7.1: Stages in developing conceptual FM knowledge framework

7.3.1 The framework process

The following section describes the functional representation of the Facilities Management Knowledge Framework preceded by a discussion of the IDEF-0, the selected modelling tools. IDEF-0 is a modelling technique and a graphical approach to process description. An IDEF-0 model is used to facilitate the hierarchical decomposition of detail in a system until the subject is described at a level necessary to support the goals of the project. The top-level diagram in the model (known as node A0) shows the context level diagram, which represents the entire system and a general description of the subject. This is followed by a series of child diagrams (e.g. node A2 - A3.2) that provide more detail about the subject, as illustrated in Figure 7.3

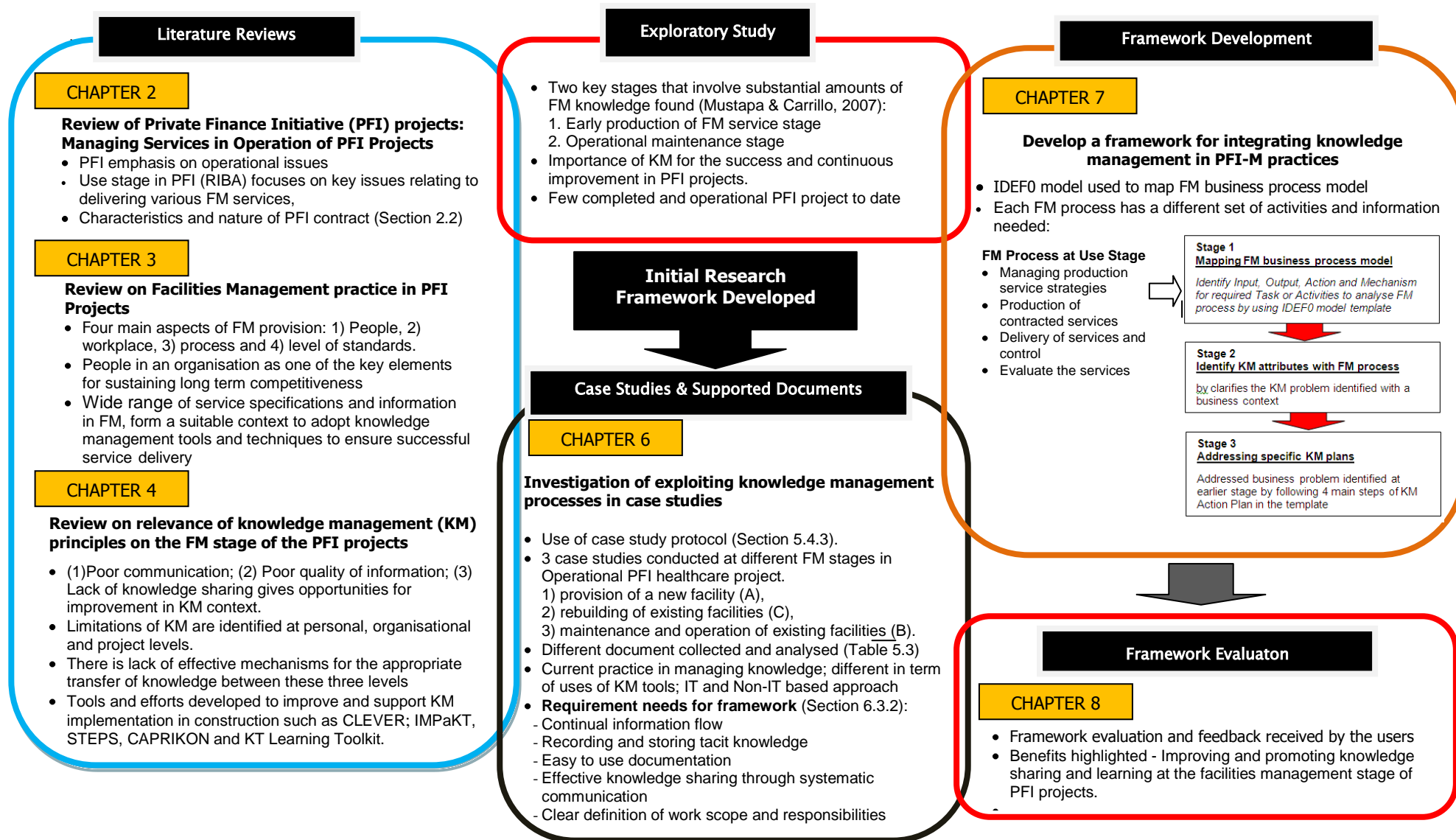


Figure 7.2 Overview process and linkages between research findings towards the development of research framework

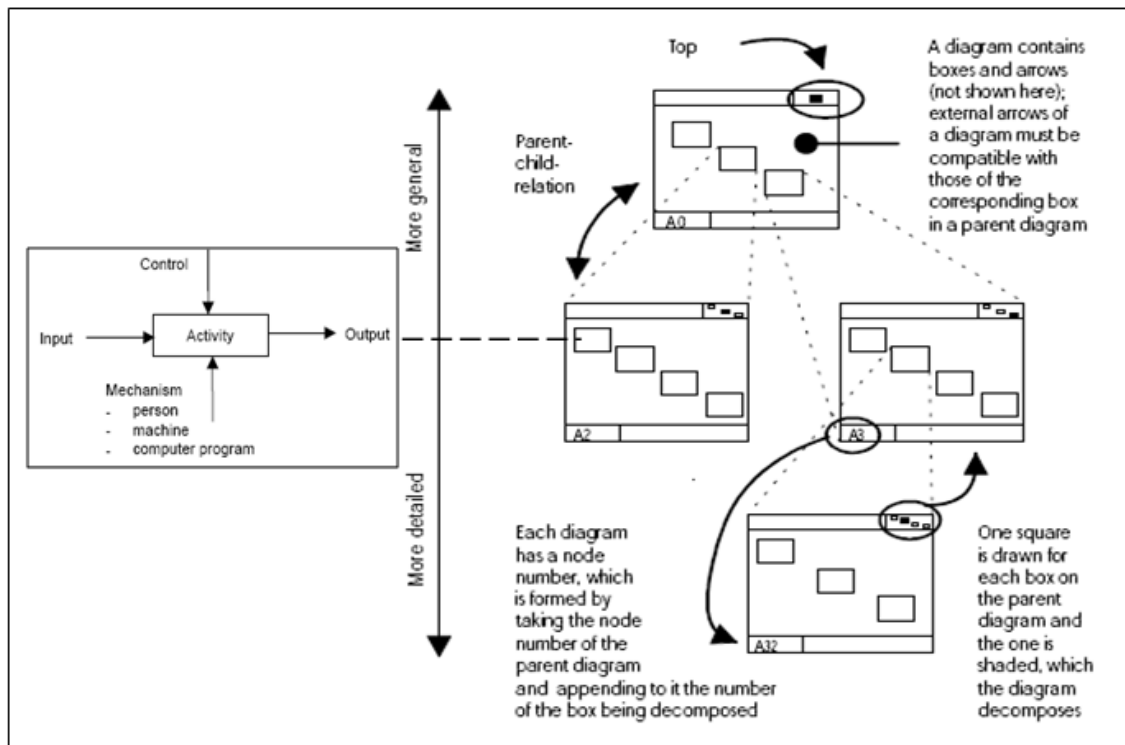


Figure 7.3 Decomposition structure of an IDEF-0 model (Feldman, 1998)

IDEF-0 uses arrows, which represent Inputs, Outputs, Controls, and Mechanisms. A box represents a main function or activity of a subject. The arrows connect the boxes and represent interfaces between the boxes. The activity uses some inputs and transforms these inputs into outputs using machines or people in the organisation. The activities are described using verbs or verb phases. The resources that an activity needs to transform inputs into outputs are named mechanisms. Controls constrain this activity by specifying which conditions regulate the performance of an activity.

The framework commenced by transferring the key features of knowledge management attributes into the IDEF-0 modelling method to indicate the proposed process of integrating knowledge management approaches into facilities management practice. Because the process description is based on findings from case studies at

the Use stage of the PFI projects, the facilities management activities during pre-Financial Close (preparation, tender and construction stages) were excluded when developing this framework. In this framework, the top level of the IDEF-0 model consists of a single box (A0), which illustrates the entire FM process at the Use stage from the collected findings of the case studies and supported document such as Full Business Case and the Project Brief reports. Figure 7.4 illustrates the facilities management process in the facilities management's organisation, which is used as the starting point for the modelling.

On the second level of A0, as shown in Figure 7.5, a relation to facilities management processes is described using four main functions or activities. The activities reflect the tasks stipulated in the contract agreement between the FM organisation and the Client. These activities are the service strategies production process, production of contracted services process, operation and maintenance process, and evaluation of building use and services process.

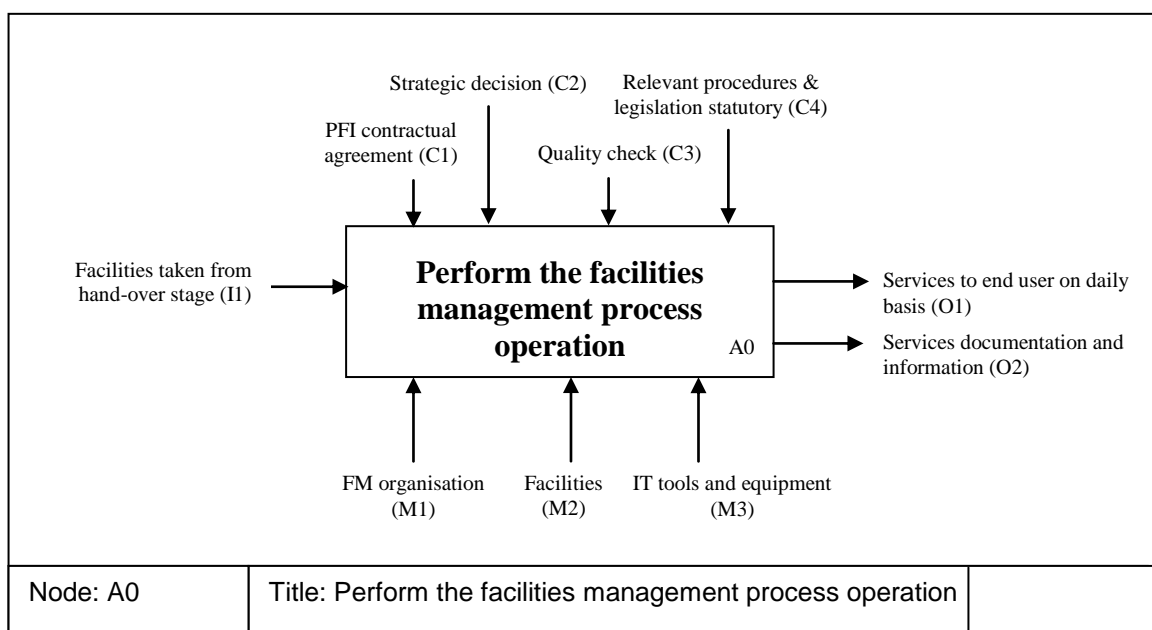


Figure 7.4 Facilities management process operation in IDEF0 model

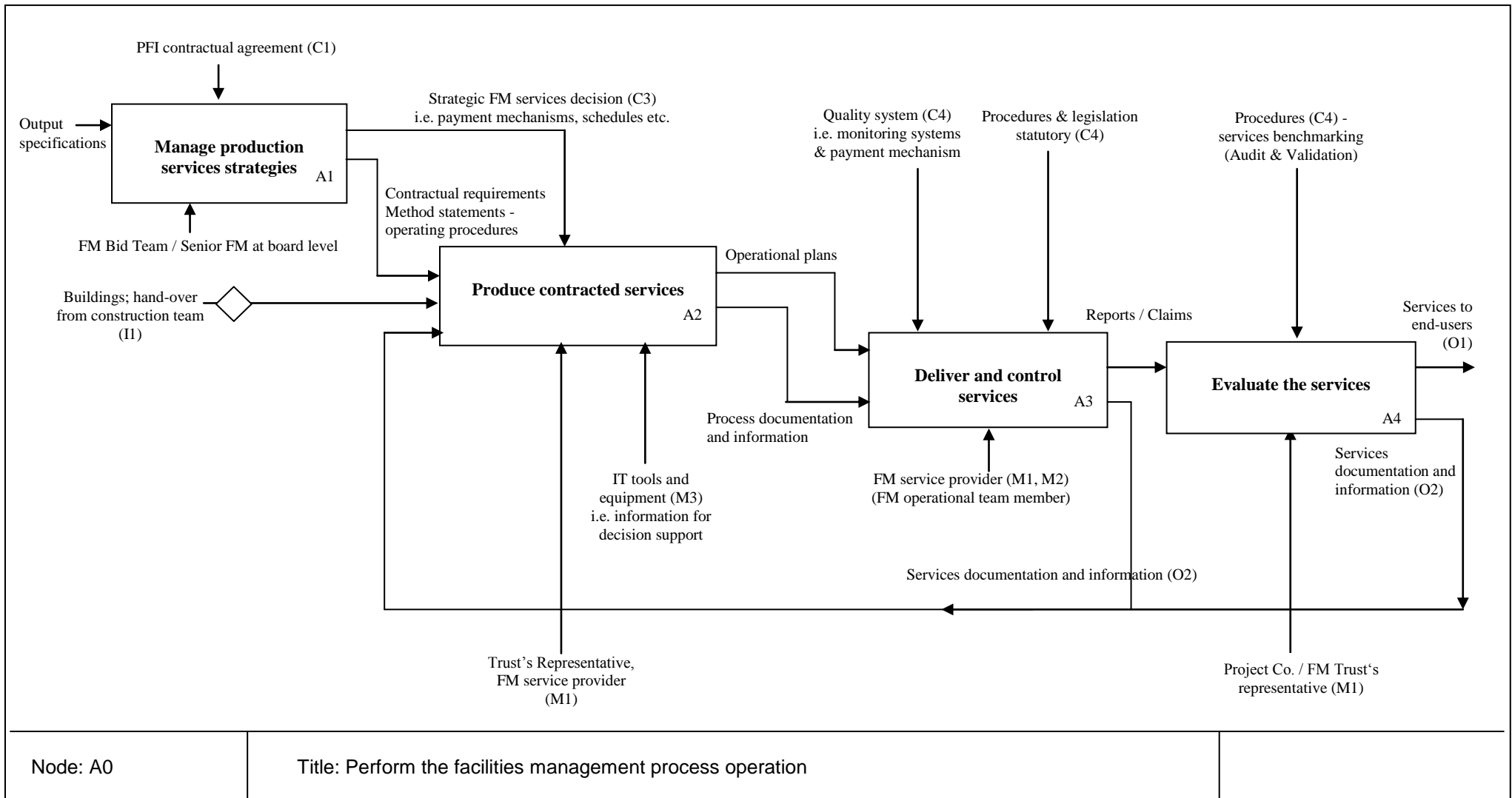


Figure 7.5 Facilities management services delivery processes across PFI project stages

In the activity *Manage production services strategies* (A1), the production of FM strategies is defined. The main outputs are decisions and detailed requirements for the services as stipulated in the output specification. The second activity, *Produce contracted services* (A2), focuses on managing the assets and resources of the organisation. The main outputs are process documentation and information that help the FM operational teams perform their tasks.

The third activity, *Deliver and control services* (A3), describes the maintenance activities in the organisation and consists of managing, implementing and monitoring services throughout the long duration of the PFI services operation. The main outputs are reports and service documentation. The other outputs are producing and maintaining the operational knowledge for the organisation. These outputs are in the form of feedback and lessons learned from the tasks performed by the FM operational team. Resources used by this process are facilities, information technology (IT) tools and equipment needed in the daily operations such as helpdesk system.

The fourth activity, *Evaluate the services* (A4), focuses on improving the level of service provided to the building's users. This can be achieved by performing a services benchmarking exercise through audit and validation or market testing arrangements.

On the next level of A3 (see Figure 7.6), the main activity *Deliver and control services* involves four additional activities:

- a) Define contracted services (A3.1)
- b) Manage and control services delivery (A3.2)
- c) Maintain operational knowledge (A3.3)
- d) Maintain and use of facilities (A3.4)

The activities shown are modelled throughout the duration of contracted services and derived from literature and case studies conducted. The inputs and outputs are still the same as on the previous level (A3), but there are several intermediate outputs, such as information to the database and project file. This output is generated by the *Manage and control services delivery* (A3.2) and the *Define contracted services* (A3.1) activities.

The information needs to be retained and reused as decision support for the framework's user when making decisions, so that the information can be available if problems related to this activity arise at later stages of the project. The information flow, as seen in the IDEF-0 diagram, contains valuable operational facilities management knowledge. Although the process is clear, it is not easy to manage due to various issues with the facilities management process activities.

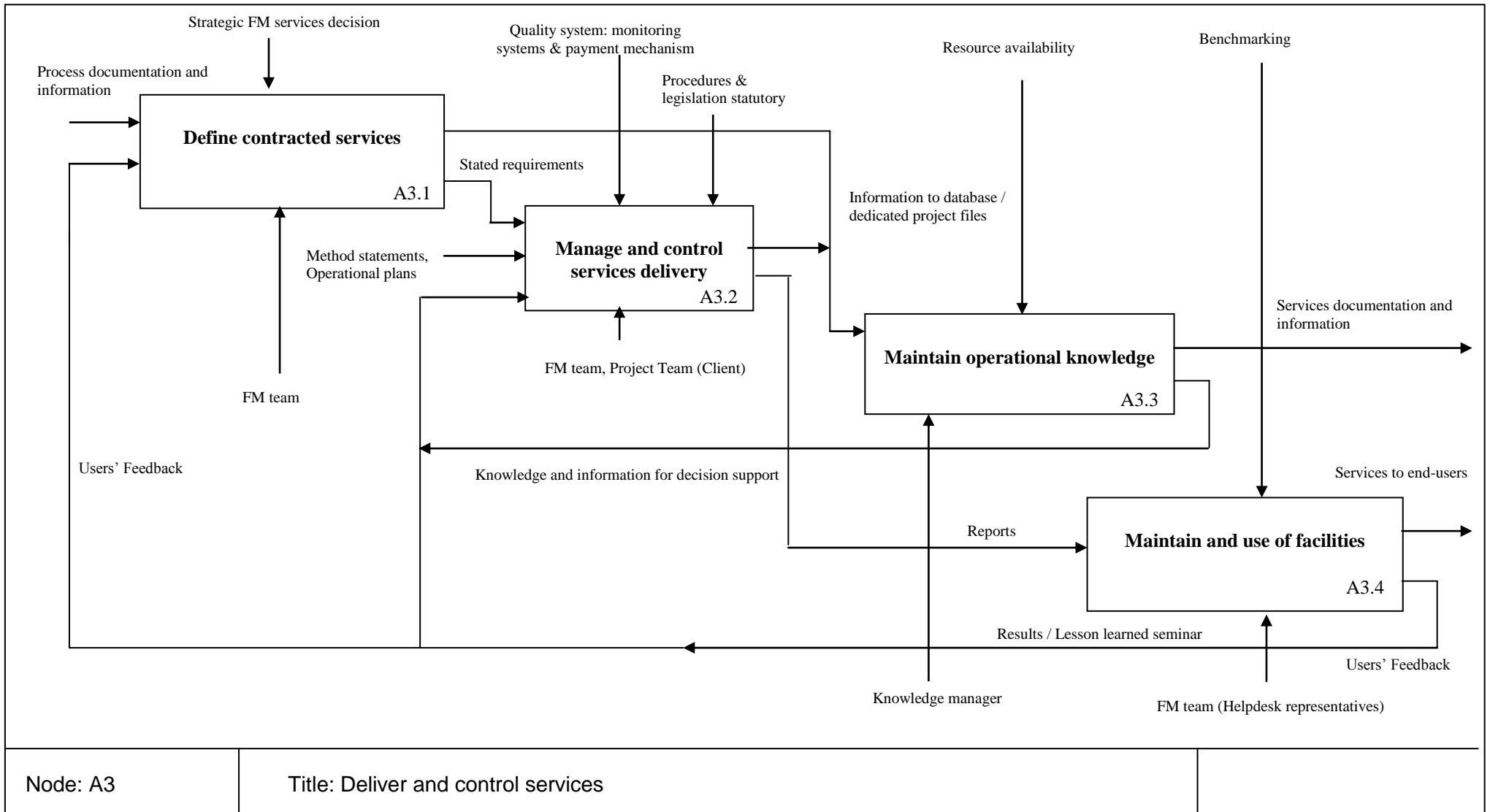


Figure 7.6 Deliver and control services

7.4 Facilities Management Knowledge Framework Action and Implementation Plan

The contents of the framework are based on literature review, cases studies and supported documents as listed in Table 5.3 and by using the step-by-step decision-making process to guide the framework's users to the appropriate Action Plan. The Action and Implementation Plan consist of four main steps that adopted from varies KM Toolkit (CLEVER; IMPaKT; KT Learning Toolkit):

- Identifying gap and issues;
- Identifying knowledge flows;
- Identifying approaches and solutions; and
- Implementing knowledge learning and sharing.

The *Identifying gaps and issues* step includes the issues and the related knowledge required to resolve the issues. During the *identifying knowledge flows* step, a clear Action Plan for users is presented to identify the communication flows of information and knowledge. Next, at the *identifying approaches and solutions* step, a set of alternative measures are outlined that address the resources available to solve the highlighted issues. In addition, relevant knowledge management tools and techniques are selected. Thus, all knowledge learned from the Action Plan can be shared at the final step of this framework; the Implementation Plan, which is during *implementing knowledge sharing and learning*. The users of this framework, including the FM operational team, are fed comments and lessons learned in order to improve their knowledge for future projects.

Table 7.1 indicates the node index (the context-level diagram represents the top-level diagram), which is 1 - Manage Facilities Management Knowledge for the framework. This top-level diagram then illustrates the other sub-diagrams. These include 1.1-

Identify issues, 1.2 - Identify knowledge flows, 1.3 - Identify approach and solution and 1.4 - Implement knowledge sharing and learning. In addition, Table 7.1 illustrates the steps in integrating knowledge management attributes in each facilities management process. This provides a better understanding for the framework users on how the KM implementation plan is used in managing FM knowledge.

Table 7.1 Steps in integrating knowledge management attributes with facilities management processes

Code Ref.	Description	Aim(s)	Outcome(s)
1	Manage Facilities Management Knowledge		
<i>1.1</i>	Identifying gap and issue	To identify a facilities management process and to anticipated issues that may arise for the facilities manager and FM team	Clarification of issues and the associated knowledge required
<i>1.2</i>	Identifying knowledge flows	To identify KM initiatives to assist the facilities manager in resolving the highlighted issues	Clear action plan for knowledge sharing and learning; Identify the communication flows of information and contain knowledge necessary for assist solution
<i>1.3</i>	Identifying approaches and solutions	To identify available measures for the issues highlighted	A set of alternative measures to avoid specific issue occurring when addressing the resources available
		To identify KM technologies and techniques to resolve the issues	Appropriate KM strategies consist of technology and techniques selected
<i>1.4</i>	Implementing knowledge learning and sharing	To adopt and implement measures (approach and solution)	Implemented KM initiatives for highlighted issue

These four steps are then integrated into FM processes. Figure 7.7 illustrates the KM implementation plan for managing FM knowledge in the *Deliver and control services* activity.

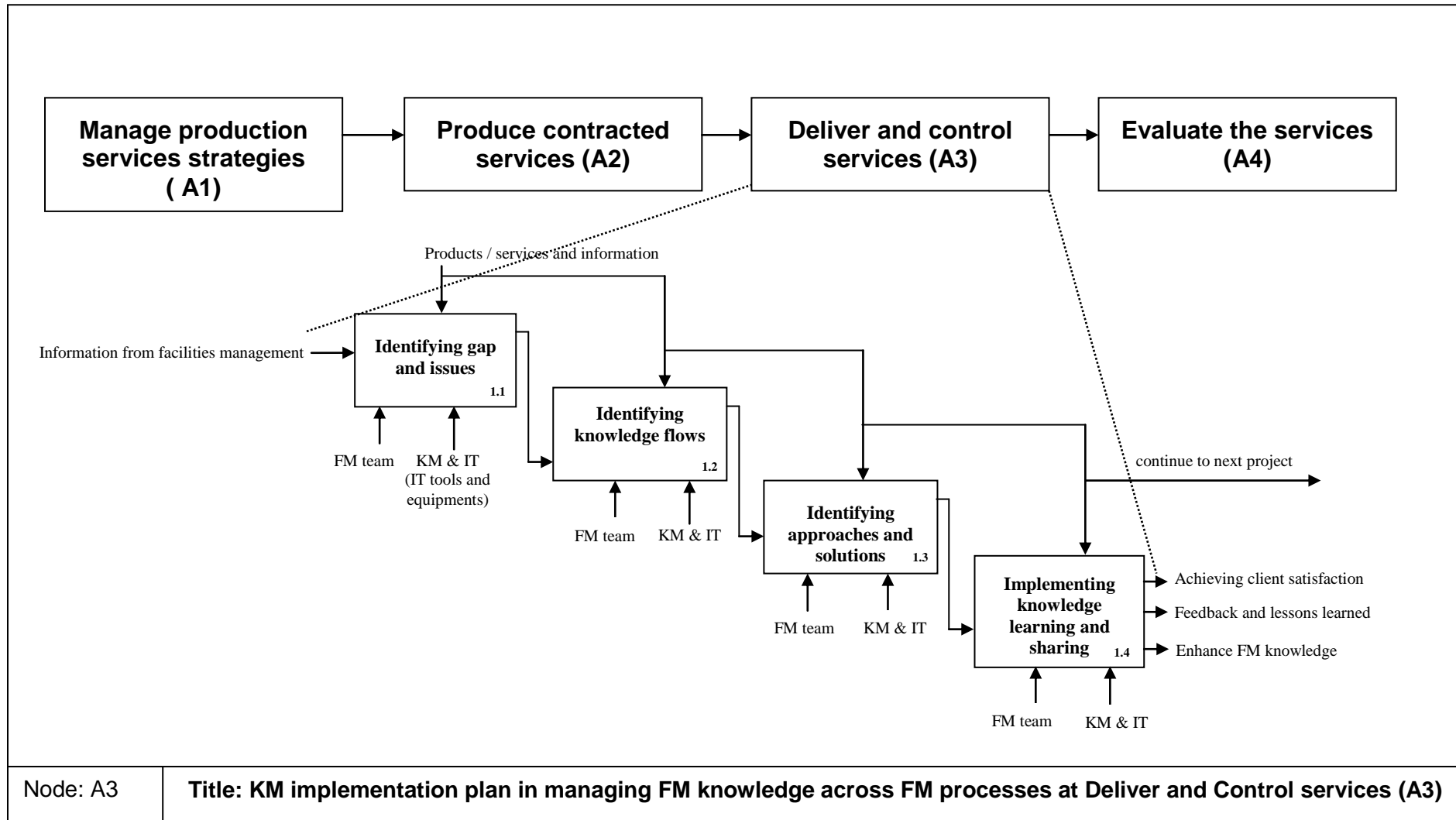


Figure 7.7 IDEF-0 process model in implementing KM for managing facilities management knowledge

Based on the studies conducted, the activities for the framework Action Plan were identified. Table 7.2 presents worked examples that outline the Action Plan that the framework will implement. Data from Table 7.2 is an example from the case studies conducted to show how the Action Plan would work. Detailed discussion related to each issue can be found in Chapter 6 (Case Studies on Operational PFI-FM Projects). The following issues are discussed.

- Information overload;
- Establishing end-users needs;
- Lack of resources;
- Lack of retention and loss of knowledge from FM team members;
- Difficulties in collating information and difficulty in identifying information from various parties;
- Limited access and sharing of project information and reports;
- Lack of efficient knowledge exchange between the construction team and FM service providers; and
- Lack of control and monitoring of work quality.

In this worked example, it briefly describes the activities required for the implementation plan and its benefits to the framework. The relationships for the three main steps of the KM approach, which consist of people, process and technology elements, are presented in Table 7.2.

Table 7.2 Worked Examples of Facilities Management Knowledge Framework Action Plan

PROJECT STAGES / FM PROCESS	ISSUES ARISING	ACTION PLAN				IMPLEMENTATION PLAN		
		PEOPLE		PROCESS	TECHNOLOGY			
Use IDEF0 model FM process with ref. node	Issues and challenges faced by PFI-FM organisations	Who is involved? (Actor)	Sharing process		Who needs what? (Input / Output)	How to do? / Technology assisted (mechanisms)	Activity required	Benefits
			From	To				
Manage and Control Services Delivery (A3.2)	Information overload <i>Lots of information needs to be transferred from the construction stage to the operational FM stage.</i>	FM team	Facilities manager Contractors	FM team	Need systematic communication line	Use of database as information repository for decision support	Gather FM teams to capture and share learned knowledge – documented lessons learned workshop	Clarity and systematic information resources
	Establishing end-users needs. <i>Due to inadequate client brief, unknown requirements, such as scope, numbers and expected level of services to be agreed</i>	FM team Client	Client	FM team	Provide and issue clear provision of FM services and implementation strategy		Create interaction between FM and client at early stages - meetings, seminars, workshops, induction Implement end user analysis	Ability to link improved service levels directly to business needs. Improved user satisfaction
	Lack of resources - <i>Due to lack of experience and knowledge on undertaken services</i>	FM team	Facilities manager	FM team (operational)	Review methods of resourcing the provision of each contracted service	Use of automate help desk system	Share project file and documentation through internal network system database	Adequate number of personnel to manage the contracted services
Maintain Operational Knowledge (A3.3)	Lack of retention / loss of knowledge	FM team System / IT manager; or Knowledge Manager	FM team	FM team	Prepare for personnel succession plan – On-job training for identified FM personnel in specific training courses	Use of 'shared drive' (central database system) Online courses and training	Coordinate and monitor knowledge sharing among team during project reviews, team reviews, and personal reviews	Systematic knowledge retention and storage
Manage Production Services Strategies (A1)	Difficulties in collating information and difficulty in identifying information from various parties	FM team Client Designer Builders	Client Designer Builders/	FM team (operational)	Progress information from designers, installers, manufacturers, builders	Use of central database & information system	Establish clear policy for sharing knowledge and information in the organisation	Improved information on FM assets and usage

Table 7.2 Worked Examples of Facilities Management Knowledge Framework Action Plan (Continued)

PROJECT STAGES / FM PROCESS	ISSUES ARISING	ACTION PLAN				IMPLEMENTATION PLAN		
		PEOPLE		PROCESS	TECHNOLOGY			
Analyse FM process with IDEF0 model	Issues and challenges faced by PFI-FM organisations	Who is involved? (Actor)	<i>Sharing process</i>		Who needs what? (Input / Output)	How to do? / Technology assisted (mechanisms)	Activity required	Benefits
			<i>From</i>	<i>To</i>				
Maintain Operational Knowledge (A3.3)	Limited access to and sharing of project information and reports	FM team System / IT manager; or Knowledge Manager	Facilities manager	Client, FM team	Use a database as information directory. Aim to standardised information and reduce duplicated effort	Intranet system: shares project file and documentation through internal network system database	Establish a helpdesk that links the communication between Client and Facilities Manager and FM team. Helpdesk is equipped with telephone devices, facsimile machine and computer system	Reduces risk of data loss and speedy recovery times when failures occur
Maintain and Use of Facilities (A3.4)	Constant request for changes in design and equipment once facilities are complete	Client / Users Facilities manager	Client / Users	FM team Facilities manager	Log information and create close communication between parties	Online collaboration system	Create interaction between FM and client / users - meetings, seminars, workshops	Clear and timely communication sharing
	Lack of control and monitoring of work quality	Facilities manager Client	Facilities manager	FM team Client	Develop a number of systems to electronically monitor and access. i.e., performance monitoring system	Database system, intranet	Assigned personnel and/or unit for managing data and information	Service level improvements
Manage Production Services Strategies (A1)	Lack of efficient knowledge exchange between construction team and FM service provider due to detachment of FM service provider from the PFI consortium	FM team, Contractor	Facilities manager	Client FM team Contractor	Regular meetings with FM team Employ IT personnel to manage and create the database system	Database system, intranet	Assigned personnel and/or unit for managing data and information	Efficient knowledge sharing and transfer across project stage

7.5 The Potential Benefits of the Integrated KM Framework

It is essential at this point to analyse the use of the framework on case studies and show how the framework helped to achieve the learning and sharing of knowledge with respect to the highlighted issues.

- a) The main benefits of the framework are enabling the FM organisation and FM personnel to make proper decisions and to use a structured guide to manage facilities management knowledge.
- b) Able to generate, evaluate and select an appropriate KM strategy for the Action Plan in PFI-FM practice. Thus, knowledge can be shared among the FM personnel and organisations.
- c) Improving the knowledge generation and sharing processes through lessons learned and feedback.
- d) Fostering a creative work environment through building a KM solution based on people, process and technology approaches. KM techniques, such as mentoring, help FM team members to find the right level of knowledge and information.
- e) The framework also helps to clarify users' needs and objectives and eliminate misunderstanding through people-centred approaches, such as meetings, technical reviews and workshops. This ensures that end-users' needs are clearly defined.

7.6 Summary

This framework aims to encourage FM participants to learn and share facilities management knowledge across different facilities management processes at different project stages through adoption of knowledge management processes. The framework promotes a systematic approach to manage knowledge in PFI-FM practice. This includes the development of a conceptual framework using an IDEF-0 process model.

The framework integrates the underlying issues in each FM process activity. This leads to the implementation of a knowledge management Action Plan, consisting of four main steps. These steps are Identifying gaps and issues; Identifying knowledge flows; Identifying approaches and solutions; and Implement knowledge learning and sharing. Further, these steps are formulated into a framework Action Plan, which consist of people, process and technology elements, shows work examples integrated with highlighted issues from the case studies.

Relevant knowledge strategies help FM organisation solve issues, such as lack of control and monitoring of work quality, information overload and lack of efficient knowledge exchange. The use of integrated KM strategies in FM processes enables the FM organisation to manage their knowledge efficiently and to perform services delivery throughout the contract.

The next chapter discusses and presents the results from the evaluation of the framework. The chapter includes examination of feedback and suggestions for improvement of the framework.

Chapter 8 Framework Evaluation

The previous chapter discussed the development of the integrated knowledge management framework necessary to address the problems and issues identified during the maintenance and operation period of the PFI project. This chapter discusses the evaluation of the developed framework, starting with the aim and objectives of the evaluation. Next, the design process for the evaluation questionnaire is discussed. The design process of the evaluation questionnaire consists of background personnel information, a questionnaire, and open-ended questions to the targeted respondents. This is then followed by the approaches and procedures adopted for this evaluation. The findings of these evaluations are then presented. From these findings, some practical suggestions from all evaluators are discussed.

8.1 Evaluation Aim and Objectives

This evaluation aimed to test and address the adaptability and reliability of the developed framework from the industry's perspective with the following objectives:

- To demonstrate the framework has achieved the aim of the research;
- To recognise the weaknesses and strengths of the framework; and
- To obtain comments and recommendations as a guide for future development.

8.2 Questionnaire Design

This framework intends to address knowledge sharing and learning against various practical issues of managing facilities management in PFI projects. Thus, the design of this evaluation is aimed to test the practitioners on dealing with appropriate ways of sharing and learning their knowledge across the project stages.

The following section will describe details of the design process of evaluation questionnaire. The design of this evaluation questionnaire ensured the validity and reliability of the study. The checklist of questionnaire design was divided into a three main sections as follows.

8.2.1 Background Personnel Information

This section was intended to gather background information, such as the evaluator's name, position in their organisation, business address and length of experience, to classify the different categories of respondents. The indication of years given is the years of experience served by the evaluator as facilities manager in a PFI project only. Thus, the number of years experience outside PFI projects is not represented in this section. By categorising such limitations, responses given could be gathered and assessed to meet the objectives outlined in this study.

8.2.2 Questionnaires

This section aims to gather responses from the evaluators on their assessment of attitude questions and assertions. The evaluators have to respond according to the Likert scale from 1 to 5, where 1 = poor, 2 = fair, 3 = satisfactory, 4 = good and 5 = excellent. The same scale was used for all attitude questions and assertions to avoid confusing the evaluators (Kervin, 1992). This scale was used because it helps to quantify evaluators' responses. All the questionnaires were analysed and are presented in the statistical methods for discussion purposes.

The details of each sub-section of the questionnaires are as follows:

- **Section A - Representation of the framework**

This section aimed to gather information on evaluators' perception of the framework in terms of ease of use and understanding of the framework in general.

- **Section B - Problem solving**

This section was aimed at assessing the elements and features of the framework in terms of how the framework works. This section consisted of six questions related to the issues highlighted and also assessed the available measures for the issues.

- **Section C - Sharing and learning of knowledge**

This section attempted to assess the ways for knowledge sharing and learning at the facilities management stage of PFI projects by adopting the KM process. The KM process refers to the developed IDEF-0 process model in managing FM knowledge. Based on the exercise and highlighted issues given in the framework sample, the evaluators were asked to assess the usability and effectiveness of the framework.

The four main areas to be completed by each evaluator include the following:

- a) Understanding the concept of knowledge sharing and learning among FM personnel;
- b) Transferability of shared and learned knowledge to other stages or projects;
- c) Improvement in facilities management practice; and
- d) Adaptability of the framework to an organisation.

Other than the specific questions asked, evaluators were encouraged to write feedback on the questions with the highest and lowest rating scores. This allowed the researcher to gather evaluators' ideas and thoughts behind the scores given. On average, each evaluator spent approximately 15-20 minutes to complete the questionnaire. The results of the questionnaires and feedback were analysed and are discussed in Section 8.4.

8.2.3 Comments on improvement of the overall framework

This section contained open-ended interview questions. The objective of this section was to obtain comments and recommendations as a guide for future developments of the framework. The questions were divided into several categories as listed below:

- a. Suggestions for improvement of the framework;
- b. Benefits and positive impact of the framework to the users; and
- c. Barriers and challenges identified to adapt the framework to an evaluator's organisation.

8.3 Evaluation Procedures

The selection of an interview approach with industry practitioners was based on the amount of information the practitioner could add regarding managing the projects. This evaluation only focuses on a group of practitioners because their experiences are related directly to their areas, roles and levels of involvement in PFI-FM projects.

A total of six individuals were involved in this evaluation. The people chosen were those responsible for managing PFI projects at the operation and maintenance stages. All the evaluators had three or more years of experience on PFI projects. Three evaluations were undertaken by a selection of industry practitioners who participated in the case study described in Chapter 6, which aided in the development of the framework. The involvement of the same personnel sought to test the internal validity of the research (Burns, 2000)

The other three evaluators were new to this study and offered different perspectives to avoid bias in the evaluations. This removal of bias created an external validity for this research. The three evaluators selected were from the facilities management service

providers' organisations. Of these three, two were facilities managers from PFI hospital projects, while one came from a PFI school project. The selection of different PFI projects, such as the school, was used to assess the practicality and extend the applicability of the developed framework. Initially, three evaluators from PFI school projects were to participate in the evaluation, but only one evaluator participated while the other two were unwilling to participate due to scheduling conflicts.

The evaluations conducted were on a one-on-one basis in the evaluators' offices. All the evaluators were asked to respond to an evaluation questionnaire to collect feedback and suggestions. During the evaluation, all interviews were voice recorded with the evaluator's consent. These verbal data were later analysed and transcribed. Table 8.1 provides a summary of the background of the participating evaluators.

Table 8.1 Details of the evaluators involved in the research.

Evaluator	Organisation background	Role of Interviewee
A	FM Services Provider	Associate Project Director
B	FM Services Provider	Facilities Management and Services Planning Manager
C	PFI Consortium	Estates Facilities General Manager
D	FM Services Provider	Facilities Support Services Manager
E	FM Services Provider	Site Facilities Manager
F	FM Services Provider	Facilities Manager (School project)

The evaluations consisted of three parts. The first part was a presentation on the concept of knowledge sharing and learning in a PFI-FM project environment. This would give the evaluators the overall background and rationale for the study, which led to the framework development. This also gave the evaluators not previously involved

in the study an indication of the evaluation's purpose and the opportunity to discuss and raise general issues about the framework.

The second part covered a demonstration on the use of the framework with the IDEF-0 model. The evaluators were shown the three sections in the Framework Action Plan Table, which refers to the Issues, Action Plan and KM Implementation Plan. Under the Issues section, a sample of related issues and problems on knowledge sharing and learning at the facilities management stage were selected. Next, the issues were demonstrated through the Action Plan process where the IDEF-0 process model was used and analysed in detail for each issue. Then, possible KM implementation plans were recommended and its benefits were presented for each issue. For a better understanding, each evaluator was supplied with brief notes that covered the contents of the demonstration.

All evaluators were then given an exercise of trying out the framework according to the operational and maintenance process of the PFI facilities. The evaluators were given a blank template of the framework table and invited to fill in the framework table on the issues related to knowledge sharing and learning that organisations needed to address. This exercise aimed to test evaluators' understanding of the use of the framework and whether it was viewed as beneficial.

In the third part of the evaluation, the evaluators were asked to complete the questionnaires after the demonstration and exercise. The questionnaires mostly asked them to state their opinions on the framework. In another section of the questionnaire, the evaluators were also asked to give suggestions and ideas for improvement of the framework. A sample of the evaluation questionnaire is provided in the Appendix 5. A few suggestions were made to further improve the framework. These suggestions are included in the recommendations section of this chapter.

8.4 Evaluation Results

Table 8.2 shows the ratings for each question from all respondents using the rating scale from poor (1) to excellent (5). On average, the framework scored 3.9 out of 5.0 in the evaluation. The average ratings of the various sections are presented in subsequent sections.

Table 8.2 Ratings of the framework

Sections	Average Rating (Out of 5)
<i>Section A: Representation of the framework</i>	
A1 How useful do you consider the overall framework?	4.1
A2.1 Relevant to issues highlighted at each project stage	3.8
A2.2 Relevant to the Action Plan	3.5
A2.3 Relevant to the Implementation Plan	3.8
A3 How well does the framework represent the knowledge shared?	4.1
A4 To what extent does the framework achieve the aim of sharing knowledge?	4.1
<i>Section B: Methodology in solving issues</i>	
B1 How well do the examples of issues in the framework represent the actual problems in your organisation?	4.3
B2 Do the contents of the framework address issues at the right level for FM organisations?	4.1
B3 How appropriate are the categories of People, Process and Technologies for the Action Plan?	4.8
B4 How well does the framework help in identifying the source (from) and destination (to) of knowledge?	4.0
B5 How well does the framework help in developing the action plan required for solving the PFI-FM related issues?	3.8
B6 To what extent does the framework help in developing a Knowledge Management (KM) implementation plan for a specific issue?	4.0
<i>Section C: Sharing and learning of knowledge</i>	
C1 To what extent does the framework achieve the concept of knowledge sharing and learning among the FM personnel?	3.7
C2 How reusable is the shared knowledge for transfer to another project stage or on another project?	3.7
C3 To what extent does the framework represent an improvement in facilities management practices?	3.5
C4 To what extent can the framework be adapted to your organisation?	4.1
Total Average rating	3.9

8.4.1 Results for section A - Representation of the framework

Overall, the evaluators rated the framework as representable and the features or elements of the framework as high. A high average rating of 4.1 was given to this question. The evaluators were also highly satisfied with the relevancy of the issues addressed, the Action Plan, and the Implementation Plan in the framework during the evaluation process. They gave ratings of 3.8, 3.5 and 3.8 for these sections, respectively. The ratings were above satisfactory due to the fact that most of the issues highlighted were very similar and relevant to all evaluators' experiences. The responses highlighted for some of the evaluators included "...mostly very close to and relevant to our current experiences, "...some good learning tools" and "...examples issue match real practice".

On how well the framework represents the knowledge shared, the framework scored a rating of 4.1. Related to this, the evaluators also gave an average of 4.1 for whether the framework achieved the aim of sharing knowledge. In some of the feedback related to knowledge sharing, the evaluators highlighted that the framework was able to illustrate the need for mechanisms to aid knowledge transfers across different project phases among facilities management personnel, clients and the construction team.

8.4.2 Results for section B – Methodology in solving the issues

A rating of 4.3 was received on how well the examples of issues shown in the framework represent the actual problems in the evaluators' organisation. The content of the framework was also found to address the relevant issues at the right level for facilities management organisations. This was evident by the average rating of 4.1 for this question.

The highest average rating of 4.8 was received on appropriateness of the Action Plan used in the framework. Evaluators described the framework “as a *structured approach to manage facilities management knowledge*”, “...*well identified the concept of People, Process and Technology embedded within PFI-FM practice*”, and “*very beneficial from continuous Action Plan*”. These responses revealed that the evaluators were confident that once categorised, People, Process and Technology in the framework could help to solve PFI-FM related issues in their organisations.

The framework was also found to be useful and appropriate in identifying the Action Plan. This was evident by the average rating of 3.8 given by the evaluators to this question. In terms of how the framework could help an organisation to develop a knowledge management Implementation Plan, most of the evaluators rated this question at average rating of 4.0, with one evaluator rating it at excellent (average rating of 5.0).

8.4.3 Results for section C - Sharing and learning of knowledge

To assess whether the framework achieved knowledge sharing and learning among the facilities management personnel, question C1 was asked to all evaluators. A rating of 3.7 was subsequently given by the evaluators. As reiterated by one of the evaluators, “...*the framework has highlighted what knowledge is required to share amongst the FM team*”. Moreover, the evaluators also gave an average rating of 3.7 if the framework enabled the knowledge to be shared and transferred to another project or stage.

The lowest average rating of 3.5 received for question C3 on the possibility of the framework representing an improvement in facilities management practices. This result may reflect that the framework is limited to the ‘After Hand-over Stage’ and

'Commissioning Stage' of the PFI-FM practice. However, a high average rating of 4.1 was received on whether this framework could be adapted to evaluators' organisations. This indicated that most of the evaluators were confident that the adopted framework could help their organisation adopt the knowledge management solution and optimise their knowledge through learning and sharing across project stages and organisations. According to the one of the evaluators on his feedback of this question, he acknowledged the framework "...provides structure and guidance to FM team and organisation on what knowledge required for sharing and learning". As a result, the idea of adopting the framework in his organisation was very feasible.

8.5 Suggestions for Improvement

This section discusses the comments and feedback regarding framework implementation and suggestions on how to improve the framework. Overall, the findings revealed that the evaluators' gave positive feedback during the evaluation process.

One of the evaluators suggested integrating the framework into the existing intranet of his organisation for better knowledge access and for managing information and knowledge more efficiently. This proved that the framework had the right approach of adopting KM tools to facilities management issues and challenges. Other suggestions included adding the capability of extending the original diagram of facilities management services and delivery processes to the framework. This would create the PFI sub-phases of "Hand-over Period" and "Commissioning Period" between the Post-Financial Close phase and the Fully Operational phase. This suggestion sought to make the framework more generic and reflect actual FM processes in PFI projects.

Others suggested refining and improving the framework into a web-based software system. This requires implementing IT in the framework to facilitate better management of project data and information flow. Another suggestion was to develop and integrate the framework into existing PFI knowledge web portals for NHS and other PFI projects, such as schools, to benefit from knowledge sharing and learning.

8.6 Benefits of the Framework

The completed framework provides a structured approach to manage facilities management knowledge embedded within PFI-FM practice. The framework encompasses a set of notes to guide the user into developing a solution through knowledge management strategies suitable to their organisation's individual needs in selected facilities management processes. They can thus optimise their knowledge through learning and sharing across the project organisation and project timeline. Throughout the evaluation process, the evaluators identified several benefits of the framework:

- The framework provides facilities managers with a well-documented Action Plan that highlights the People and Processes for solving the issues highlighted. The person responsible for the specific process is then required to undertake the Action Plan in the framework.
- The framework illustrates the need for mechanisms to aid knowledge transfer among PFI-FM personnel.
- The framework enables sharing of positive knowledge and is useful in transferring information to other sites. However, this may depend on contractual conditions and characteristics of the project.

- The framework can be used as a learning tool for solving facilities management issues and offer solutions to users. This helps prevent a similar issue or problem from occurring in the future.
- The framework can increase the likelihood of client satisfaction at handover of the building and during the early years of the contract. This is realised from continuous Action Plan development from the construction team to the FM operational team during the Hand-over Period.

8.7 Challenges of Framework Implementation

To establish challenges for users in the implementation of the framework, the evaluators were invited to suggest and specify their views and opinions on the barriers. The results suggested that factors such as time, lack of commitment from management in implementing the framework and ensuring engagement across the organisations were major barriers to framework implementation. Related to this, personnel may be reluctant or even unable to accept new lessons, insights, ideas or observations. As a result, the organisations may have to overcome severe barriers to share knowledge with others, particularly in PFI-FM projects. Furthermore, the different contractual conditions for every PFI project are also regarded as barriers to the adoption of the framework.

8.8 Summary

This chapter has addressed the evaluation of the framework process, findings, benefits and the limitations to the implementation of the framework. The research adopted a questionnaire in the evaluation of the framework. The findings from the evaluation showed that the framework is highly representable, useful and appropriate

in identifying the action plan. The framework also promotes a structured approach to manage facilities' management knowledge embedded within PFI-FM processes by describing the issues with potential solutions and activities that need to be undertaken, tools and techniques required and persons responsible for the action plan. This chapter has also laid out the benefits of the framework. The main benefits include improving and promoting knowledge sharing and learning at the facilities management stage of PFI projects. The limitations to implementation of the framework are highlighted and encompassed time, lack of commitment and different contractual conditions for every PFI project. The next chapter presents the conclusions drawn from the research.

Chapter 9 Conclusion and Recommendations

Overall, this research was conducted as an attempt at improving the process of knowledge sharing and transfer within the operational and maintenance stages of PFI-FM projects. In the UK, the provision of PFI involves projects related to core public services such as education, health services, transport infrastructures and many more. This research concentrated on the facilities management of healthcare support services.

Within the PFI contracts covering prisons, transport infrastructure, hospitals and schools, the details of output specifications for hospitals are of top priority. This is due to the minimum requirements stated by the NHS Trust. Moreover, the services provided by the healthcare sector must be available 24 hours a day for 7 days a week for the lives and comfort of their patients. In the PFI context, the role of facilities managers in the operation, building services and asset management are more critical and demanding. The operation and maintenance functions in hospitals clearly involve high operational risk of failure and a demanding level of maintenance service activities.

Several case studies of PFI healthcare projects were conducted to determine the underlying problems of managing knowledge and information within the facilities management work at the operational stage of PFI projects. Any problems identified in delivering FM healthcare services, especially in their daily activities, were investigated to find possible improvements in the implementation of knowledge management tools and techniques.

To conclude this thesis, this chapter starts by presenting the summary of the research by discussing how the aim and objectives of the research were achieved. It then follows by presenting the benefits of the framework and highlighting the improvements made to existing practices in industry. The chapter continues with a discussion on the implications that the research made to those directly involved and highlights the limitations and recommendations for future research. This chapter concludes with a set of closing remarks.

9.1 Summary of Research

This research focused on the benefits of adopting KM in daily business operations to become more competitive and improve business performance by using relevant KM tools and techniques. Based on this, the research investigated the potential of adopting KM in delivering FM services in PFI healthcare projects, especially when the scope of the work in FM healthcare services involve a wide range of recurring tasks.

Several methodologies and techniques were used to achieve the research aim and objectives. Studies on the process of managing knowledge at operational stage were conducted among the facilities managers of the selected case studies. The studies resulted in the development of a framework for delivering PFI-FM healthcare services with the application of KM initiatives, which was demonstrated and evaluated by practicing facilities managers.

The outcome from the specific tasks undertaken with regards to the research aim and objectives is summarised as follows:

9.1.1 Research Aim

To develop a framework that will improve knowledge transfer for the facilities management (FM) stage of PFI projects.

The rationale behind conducting this research was the need to capture the knowledge of people involved in managing facilities management knowledge in PFI healthcare projects. This was derived from the special character of PFI projects, which usually last longer than the normal construction development period and is reflected in changes of the people involved in managing the facilities.

To achieve this need, the research developed a well-defined and structured framework for knowledge sharing during the operational stage of PFI projects using case study findings. The aim was achieved through several research objectives designed to tackle the problem mentioned earlier.

9.1.2 Objective 1

Review existing literature and theories on management and operation of construction projects and their relation to PFI contract arrangements

A review of the literature and theories on the nature and special character of PFI projects was conducted to provide background knowledge on the concept of PFI. The results were presented in Chapter 2 and managed to reveal the differences between traditional contracting procurement and PFI allocation of risk bearing and processes in each type of procurement. It also highlighted the special provision in PFI projects where the operational stage in the construction development process is involved. This indicated a much bigger challenge in delivering FM services throughout the contract duration.

Healthcare projects were chosen to narrow the research scope, as other types of PFI projects (e.g., prison and schools) have different contexts and require less critical aspects in facilities management. Moreover, the literature showed that PFI healthcare projects have more problems in managing FM due to the nature of the business of a hospital. It was also found in the literature that FM organisations face problems in managing facilities and in delivering services. The literature analysis explains the scope of work embedded in facilities management and its relation to the operation and maintenance stages in PFI healthcare projects. The vast amounts of work involved in FM projects were highlighted, particularly the differences between the frequency of maintenance in hard and soft services. Any issues and challenges faced during the operation and maintenance phases of a PFI healthcare project were highlighted to identify the gap in knowledge and to define the key problems that needed to be addressed in framework development.

The outcome of the research gap from the literature review was published at two difference conferences. The first paper was published at the Third Scottish Conference for the Postgraduate Researchers of the Built and Natural Environment (PROBE 07) in Glasgow (Mustapa and Carrillo, 2007), and the second paper was presented at the ASEAN Postgraduate Seminar in Built Environment, 2007 (ASEAN PGS 2007) (Mustapa and Carrillo, 2007) in Kuala Lumpur.

9.1.3 Objective 2

To understand and examine current industrial practices in PFI-FM with a view to ascertain the underlying problems, challenges and potential areas for improvement

This objective was achieved through a literature review and exploratory study with regards to understanding the various challenges and issues in managing facilities

management knowledge in PFI healthcare projects. Existing literature on current practices in PFI-FM projects were studied and analysed to understand the process, the people and technologies that surround PFI-FM subjects, especially those within the UK.

From the literature on FM, a conclusion was made in identifying the nature and challenges of executing FM healthcare services. This included identification of vast amounts of tasks involved in FM services. This translates into a massive amount of information that needed to be delivered for the services stipulated in a PFI contract. All the problems and issues encountered in the literature review were highlighted and became the focus of the study to suggest improvements and solutions. Hence, the need for information management is central in ensuring the success delivery of services.

Findings from the exploratory study showed that FM service providers face two key challenges in managing and operating PFI facilities. The first challenge emerged from conforming to demanding performance requirements, and the second was managing stakeholder expectations. It was found from the exploratory study that during the operational stage, FM organisations have little control in managing changes in legislation and requirements imposed by the legislative authority. This leads to difficulty in FM service providers managing and delivering services according to stakeholders' perspectives. Additionally, another problem that occurs at the operational stage of PFI projects emerged from the differences in interpretation of the quality of service between the service providers and the public sector. This makes the assessment of service performance of PFI service providers for PFI projects difficult (Partnership UK, 2006).

Another concern of FM service providers during the operational phase is the performance measurement mechanism. It can be concluded that delivering the service according to a client's expectations is the main challenge in the operational stage of PFI projects. The way forward is through detailing the level of standards in each task under the FM services and informing staff to comply with the client's expectations. This will also help in benchmarking standards for the evaluation of service performance of the PFI-FM service provider.

Details of the literature review on PFI and FM can be found in Chapters 2 and 3. Part of this research was published at the CIBW070 Conference in Facilities Management in Edinburgh (Mustapa and Carrillo, 2008) in Appendix 1.

9.1.4 Objective 3

To investigate the relevance of knowledge management principles at the FM operational stage of PFI projects

The third objective was achieved by conducting a series of case study interviews with key people involved in the management facilities maintenance of PFI healthcare projects. To make a similar basis for case study analysis, this research concentrated only on PFI-FM healthcare projects that had reached the operational stage and had a contract value in the range of £250 to £400 million. Three case studies were subsequently made by interviewing key personnel in charge of the facilities management department. The outcomes of the interviews addressed the need for managing FM knowledge to deliver the services as stipulated in the PFI contract.

The results of the case studies indicated that it was beneficial to adopt knowledge management in a PFI-FM project environment. Having highlighted the challenges and

issues facilities management organisations face in the course of managing facilities and delivering services, the adoption of knowledge management was seen as beneficial and a potential solution to these problems. Facilities management knowledge enables the effective management of services through better understanding and creates an integrated approach based on operational and managerial strategy. The process of detailing the level of quality of each task can be achieved through KM initiatives, especially from adopting KM techniques in capturing, sharing and reusing knowledge.

These techniques help an organisation be more effective by enabling knowledge capture, especially the tacit knowledge of their staff. It is important to recognise the experience of the staff to more efficiently deliver the service from their knowledge gained through their everyday tasks. This agreed with findings in the literature that organisation knowledge is central in ensuring service performance of a company.

Moreover, the long duration of PFI projects indicates the need for facilities management organisation to manage and retain knowledge within the organisation, as there is a tendency for the high staff turnover within the organisation. Hence, by managing the organisation knowledge using KM initiatives the organisation can retain, reuse and reproduce knowledge created during the contract for PFI-FM healthcare. The case study analysis can be found in Chapter 6; this set the limitations and defines a thorough understanding of the best knowledge management tools applicable among PFI healthcare projects in the UK.

9.1.5 Objective 4

To develop a framework to enable organisations to efficiently manage service delivery and performance

Objective four was achieved by combining some of the lessons learned cited by the respondents. Recorded interviews were transcribed, analysed and later used to formulate the framework for effective knowledge sharing through good communication practice, collating information and knowledge sharing at the operational stage of a PFI-FM healthcare project. It has been noted that by understanding the job specifications of all parties within the organisation and the knowledge needed to deliver the service according to the stipulated contract are the keys to deliver successful PFI-FM healthcare services. Hence, the framework was developed to encourage FM participants to learn and share facilities management knowledge during the operational and maintenance stages. The framework promotes a systematic approach to manage knowledge in PFI-FM practice. This includes the development of a conceptual framework using an IDEF0 process model.

The process model incorporates underlying issues at each FM process activity. This leads to the implementation of a knowledge management Action Plan consisting of four main steps. These steps are (1) identifying gaps and issues, (2) identifying the approach and solution, (3) identifying knowledge flows, and (4) implementing knowledge sharing. Furthermore, the steps of the KM Action Plan were formulated into a framework showing work examples which highlighted issues from the case studies.

Relevant knowledge strategies help FM organisations solve issues such as lack of control, monitoring of work quality, information overload and lack of efficient knowledge exchange. Through the use of integrated KM strategies in FM processes,

the FM organisation can manage their knowledge efficiently and perform services delivery throughout the contract. The details of the framework development were presented in Chapter 7.

9.1.6 Objective 5

To evaluate the framework using industry practitioners

The final objective was achieved through evaluation from experts in PFI-FM healthcare services, especially those involved in managing FM healthcare PFI projects. Some of the interviewed personnel were sceptical of the delivery of the framework, but did not deny the possibility of implementing the proposed framework. This evaluation was presented in Chapter 8. Additionally, the framework was refined by combining the recommendations for the best practice in managing knowledge management and facilities management in healthcare PFI projects. Adjustment of the framework was made according to comments received with justification from literature reviews and interviews.

The limitations of the research are detailed, and the conclusions and recommendations for future work are presented in the following sections.

9.2 Limitations of the research

Despite several efforts in ensuring that this research provides holistic and practical measures to manage organisational knowledge of PFI-FM healthcare services through KM initiatives, it is not without its limitations. Several limitations encountered are detailed below.

9.2.1 Limited number of case studies

As this research concentrates on addressing the operations of FM healthcare services in PFI projects, a similar basis in the case studies was required. Hence, the number of PFI-FM healthcare projects that had reached the operational stage set the limit on the number of case studies. Additionally, the wide range of contract amounts in the PFI-FM healthcare projects made it difficult to find a huge number of case studies.

For this research, however, PFI-FM healthcare projects with a contract amount in the range of £250 - £400 million were chosen. Thus, this research does not reflect the whole PFI-FM healthcare perspective in the UK, but merely a snapshot of problems occurring within the studied PFI-FM healthcare projects. However, this was overcome by conducting in-depth data collections through case studies interviews with the Facilities Manager of the PFI-FM healthcare project. This enabled the research to gain actual problems in delivering FM services at the operational phase of PFI-FM healthcare with a perspective to solve the problems utilising the KM tools.

9.2.2 Application of the Framework

The effective application of the framework depends to a large extent on the PFI-FM consortium. This is especially true in ensuring the application of the framework in the daily operation of FM healthcare services. Should the organisation refuse to adopt the framework, the application of the framework then becomes limited. In addition, the application of the framework requires its users to capture a large amount of information derived from daily operations of the staff into explicit knowledge. Additionally, due to the nature of PFI-FM projects, the amount of information and knowledge that needs to be recorded is substantial.

This is time consuming especially when each task needs to be specified in writing with a description of the tools, time and most efficient ways to perform the task. Furthermore, the process of sharing the organisation knowledge might not be fully welcomed by the Facilities Manager, as it will make their job description more challenging. They will become responsible for the adoption of the framework, which will require them to not only ensure service delivery but also manage the organisation knowledge through the process of capturing, storing and reusing. However, the problem can be minimised by recoding the delivery of everyday tasks in video format and also in the flow chart processes.

9.2.3 Limited duration of operations

Due to constraints in time, the evaluation of the framework somehow manages to address the problems of delivering PFI-FM healthcare services. This is due to the fact that during the conduct of the data collections, the longest operational duration of the case study was only 15 years. Hence, not many challenges were identified, especially on the importance of retaining organisation knowledge among staff.

9.2.4 Research Scope

This research did not address the problems of managing the relationship between the PFI consortium with the clients as that would be tackling organisation management issues. Hence, this research concentrates only on enhancing the capability and service performance of the PFI consortium in providing FM healthcare services.

9.2.5 PFI contract

The fact that there is no clause that requires utilisation of the KM body of knowledge in the PFI-FM contract creates no urgency in adopting KM tools despite the benefits to

the FM healthcare service provider. This makes it more challenging to persuade the Facilities Manager to adopt the suggested framework. Despite the many constraints, this study has yielded preliminary evidence on the importance and benefits of KM tools in the delivery of FM healthcare services within PFI projects. Because this study attempts to acknowledge the importance of managing KM within PFI-FM, this research naturally possesses the aforementioned limitations. However, it is believed that the conclusions of this research create substantial opportunities for further research.

9.3 Research Contributions and Implications

A research gap was identified and revealed the contribution that current knowledge makes on an organisation's ability to sustain a competitive business edge through the adoption of KM initiatives to manage organisational knowledge. Currently, a gap in the literature exists concerning how knowledge management can play a role in facilities management in PFI projects. This resulted from the underdevelopment of knowledge management in the construction industry and FM areas particularly in PFI-FM healthcare projects. A few number of PFI projects have been completed, thus it is timely to include knowledge management to improve the facilities management stage during the operational stage of PFI-FM healthcare projects. This was achieved through the adoption of KM initiatives as systematic tools and techniques in capturing, storing, reusing and re-inventing organisational knowledge, especially in FM healthcare services.

As this study attempts to discuss the impact of combining knowledge management theory with facilities management in PFI projects, it produces both theoretical justification and empirical data that might have some practical relevance for PFI

projects. Accordingly, this section reviews the contributions and implications of this research.

9.3.1 Construction Industry

The present research fills in an important gap in both PFI-FM healthcare projects and the knowledge management theory. First, the primary contribution of this study is as an eye-opener for FM companies governing healthcare facilities management to the importance of knowledge retention among PFI-FM healthcare projects. This becomes particularly important because the people managing healthcare facilities tend to change due to the long duration of the PFI-FM contract.

For operational stages, which are where the facilities management functions take place, a number of academics and practitioners have expressed an interest in its relationship with knowledge management (Ahmad et al, 2002; Wong and Aspinwall, 2006; and Liao, 2002). The academics and practitioners considered knowledge management as a strategy for improving organisational competitiveness and performance. Although the importance of having knowledge management in practice was mentioned, limited empirical studies exist on knowledge management in PFI-FM areas. Despite the fact that recent research has been carried out on governance and knowledge management for Public Private Partnership (PPP, the main umbrella of PFI) by Robinson et al. (2010), this research largely concentrated on the issues and necessity to capture and share knowledge in PPP/PFI projects.

9.3.2 PFI-FM healthcare service provider

This study may benefit PFI-FM healthcare providers when designed to understand their business delivery and when trying to improve the current management and quality of services. The discussion on management and KM initiatives provides

technical guidance to the FM manager involved in managing the PFI-FM healthcare, particularly when deciding to adopt the proposed framework to improve the current condition. Moreover, by understanding the nature and character of FM healthcare service delivery, a better KM can be adopted to suit their specific problems and limitations.

By examining the current FM healthcare service delivery process, new KM tools can include better knowledge retention and hence faster service delivery, which will be reflected in cost savings to the PFI-FM healthcare service provider. Any changes in personnel managing FM will have difficulties managing the organisation knowledge lost and lead to delays in the delivery of FM services. Second, this research provides a comprehensive understanding of the current management of PFI-FM healthcare service delivery, the agencies involved in managing the service and the rules and regulations imposed within the PFI-FM contract. Third, this research on PFI-FM healthcare and knowledge management will add a new dimension to incorporating and managing KM within PFI-FM practice in the UK. This will help the FM healthcare provider to understand the KM and enhance their service delivery through utilisation of KM initiatives embedded in their organisational practice.

9.3.3 Existing PFI-FM Healthcare Contract

The justification of PFI projects as a selected area of research was based on the idea that a PFI contract arrangement concentrates on the operational value of facilities, especially on the support requirements, operational performance and asset strategy. Additionally, the processes and practices embedded within a PFI project and a FM organisation utilises a significant amount of knowledge that needs to be managed efficiently. All of these benefits offer the opportunity to improve the organisation. Thus,

integration of FM in a PFI contract could lead in a new direction of research or fill in existing gaps.

It is recommended that policy makers involved in preparing and drafting the PFI-FM healthcare contract make some additional requirements to the FM service provider by including clauses to adopt KM initiatives in daily service delivery. This is to ensure continuity in service delivery should the person in charge of managing the FM services transfer to another company or otherwise be unable to remain in their position throughout the contract. The need to adopt KM initiatives is to ensure all the tacit knowledge gained through managing PFI-FM healthcare services are recorded and made available to others. This will increase the PFI-FM contract costs slightly, but in the long run, it will help to reduce the costs of trial and error during the delivery of services.

9.4 Recommendations

Based on the research limitations, the following highlight some recommendations for improvement in future research in term of data collection strategies and methods.

9.4.1 Recommendations for Limited Number of Case Studies

Future research should consider conducting similar research involving a significant portion of UK practice to understand any similarities or differences within the issue. Furthermore, the willingness of the Facilities Managers to participate in this study contributed to the small number of case studies.

9.4.2 Recommendations for Framework Application

The benefit of the framework should be presented in detail to not only the top management but also the staff in charge of delivering the services to increase the usage of the framework. In this way, the process of capturing, restoring and reusing knowledge will be faster and more effective with computers and IT tools. This will enhance the usefulness of the framework to facilitate the process of managing organisation knowledge.

9.4.3 Recommendations for Selection of Case Studies

Because not many PFI project contracts last more than 15 years, it is suggested that future studies should include projects that have been operating for a minimum of 15 years. As the normal contract duration of PFI projects is 30-35 years, it is beneficial to study the problems and challenges arising in managing the organisational knowledge and delivering PFI-FM healthcare services in this longer time frame.

9.4.4 Recommendations for Research Scope

As this study concentrates only on how the Facilities Manager manages the organisational knowledge within the PFI consortium, it will be interesting to study the management of organisational knowledge within the parties involved in PFI-FM healthcare projects. Particular attention can be paid to how knowledge is captured, shared and reused in preparing another PFI-FM contract document.

9.4.5 Recommendations for PFI contract

It has been noted that managing organisational knowledge will lead to organisation success. Thus, it is beneficial to study the possibility of including KM initiatives in preparing a PFI contract. As the contract specialisation involves a long list of tasks that

entails a massive amount of information (e.g., how, when, where and the tools needed), it will be beneficial to utilise KM initiatives in preparing such a contract.

The research project has managed to identify several areas for further research, which include the following:

- Explore the integration of the framework with other existing information systems of an organisation to enable better knowledge access as well as managing information and knowledge more efficiently.
- Due to an economic climate changes issue and its impact on PFI, it is important that further research conducted to find out the suitability of this framework in the early stages of the project lifecycle to address the much debated issues.
- There has been an increasing awareness on the importance of IT use in the construction industry especially on how the technology can help boost performance. Thus, there is a possibility to refine and improve the framework into a web-based software system.
- Construction project extranets have been and still actively used in facilitating project information and document management. Therefore, it is crucial to explore the possibility of incorporating this framework within project extranets such as PFI knowledge web portals for NHS and other PFI project such as schools.

9.5 Contribution to New Knowledge

The framework was seen to accomplish its purpose in identifying the benefits of adopting and applying knowledge management tools and techniques at the operational of PFI healthcare projects. However, the benefit of applying KM in PFI projects could be expanded to other phases.

The next section highlights the benefits of the framework as well as its contribution to new knowledge particularly to Clients (NHS Trust) and Facilities Managers as they play active roles in PFI healthcare services.

9.5.1 Client

- **Review FM service provider's performance.**

Mapping FM processes onto an IDEF0 model presents the spectrum of FM service delivery in a more user friendly document. This will also help the clients to retrieve the knowledge on how to deliver the services up to the level of how, where and when it needed. The framework could also be used by the client to check whether the delivery of services has been met to the standard stated in the PFI contract.

9.5.2 Facilities Manager

- **Clear feedback**

Feedback on the current system of managing information to deliver their services efficiently has been established and to some extent, the current system used to deliver the service by conveying the messages did not utilise appropriate KM tools especially at early production of FM services stage. For instance, it was found that the some of the cleaning services job specifications were not clearly expressed to the operatives (cleaner) as they have to rely on the manual. Hence, the interpretation of the job specification could be misunderstood especially in the aspect of hygiene level. This is where KM tools are needed to clearly specify the job specification to the operatives.

- ***Simplify information process***

This framework has managed to simplify the information in operating processes where the job specification is kept by the operatives who needed the manual and refer to it on daily and ad-hoc basis. This expedites the process of current practice where the manuals of the job specification are kept by the Facilities Manager's office or in database. This is vital as the numbers of tasks stipulated in the PFI contract to deliver the services, especially soft-services, are numerous, and ranging from the need to provide clean environment on daily basis as well as handling ad-hoc emergencies.

- ***Decision making***

The framework helps the facilities manager as well as the operatives to make timely decision on pending jobs and ad-hoc jobs. It also helps FM operatives to prepare for scheduled maintenance jobs. With the detailed information given in the manual and services level document (output specifications), the FM operatives could prepare themselves with appropriate tools to perform their tasks. This will help them anticipate any shortages in their tools and avoid delay due to shortages of work supply.

- ***Reduce duplication of tasks***

Operatives can now specify their scope of work and find better and faster ways to deliver their job.

9.6 Concluding Remarks

A framework that incorporates KM initiatives in managing FM healthcare services in PFI projects was designed to improve organisation knowledge within PFI-FM practices at the operational stage of PFI healthcare projects. The need for the proposed framework derived from understanding that KM, through its initiatives, includes systematic tools and techniques to effectively manage organisation knowledge. This is central in ensuring the organisation is competitive and effective in delivering either the products or services of the organisation.

This aim was achieved through a set of interrelated objectives of adequate understanding of the nature and context of PFI-FM healthcare projects as well as the advantages of KM initiatives for better management of organisational knowledge. The vast amount of tasks embedded in an FM environment requires a huge amount of information for deciding how, when, where and the tools needed to execute each task. This makes it an area suitable for improvement via KM initiatives. Moreover, the long contract duration stipulated in PFI projects, especially at the operational stage, dictates the need for more effective management of organisational knowledge as staff turnover is expected to be high.

The framework was developed by incorporating suitable KM initiatives and by gathering insights into how the knowledge of FM healthcare services was managed by the Facilities Manager. This was done to ensure that the framework was practical and useful to the industry. The framework was developed utilising the IDEF-0 template to describe the information flow within a FM healthcare service provider. This method exhibits the way in which information on delivering FM healthcare services is supposed to be captured, stored and utilised, ensuring good service delivery. To confirm that the

framework developed was applicable to the Facilities Manager of a PFI-FM consortium, an evaluation of the framework was done through an expert opinion survey. The respondents were selected from those managing FM work in healthcare projects, especially those involved in PFI projects. By evaluating the proposed framework, this research was not only technically feasible but also applicable and acceptable to the industry. This observation demonstrated that KM initiatives do play an important role in managing FM service knowledge within the PFI-FM consortium (service provider) and indicated that this research contributed to the better practice of PFI-FM healthcare services.

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APPENDIX 1

List of publications arising from the research

1. Mustapa, M. and Carrillo, P.M., (2007). Facilities management knowledge in PFI projects. In: Egbu, C. and Tong, M., (Eds.). *Proceedings of 3rd PROBE Conference*, 20-22 November 2007. Glasgow, pp. 361-369.
2. Mustapa, M. and Carrillo, P.M., (2008). The potential of knowledge management processes for facilitating PFI project. In: *CIB W070 Conference in Facilities Management*, 2008. Herriot Watt University, Edinburgh, pp. 493-499.

APPENDIX 2

Template for Semi-Structured Interviews for Case Studies

Interview Questions

Research Background

Facilities Management (FM) now has an increasingly important role to play in Private Finance Initiative (PFI) projects. It is therefore important within the PFI-FM context, to manage knowledge for facilities, particularly on its processes, the approaches to dealing with problems, and the management of day-to-day operations. This allows facilities managers to be more effective at both the operational and managerial levels.

Aim

The aim of this paper is to identify knowledge management's potential and its relevance to the integration of facilities management practice in PFI projects.

Objectives

1. To capture the existing system adapted by the facilities manager
2. To identify problems emerged in operating FM services especially at disseminating the FM strategic requirements to FM operatives
3. To review the FM organisations on their implementation of KM in operating the services, related to strategy, framework and tools used.
4. To identify any practical suggestion towards improving the FM knowledge documentation and information flows

This **open-ended interview** is designed to collect data as follows:

1. Background and responsibility as facilities manager
2. System used for FM services delivery (process, content, format, delivery)
3. Determining information and knowledge flows

Note:

Confidentiality is assured and all information provided will be used to inform the research only. No reference will be made to individuals or their companies

(RESPONDENT TO COMPLETE)

Personal details

Surname: Forename:

Nationality: Age:

Title of your Job:

Years on this Job: Total length of experience:

Employer's Name & Address:

.....
.....
.....

Duration of project operation:

Educational qualifications

Details of your further educational qualifications

Title of basic degree: PhD / MSc / MA / BA / BSc / GCSE's / A level

Other qualification:

Major subject of study:

Completion Date:

Membership of other professional engineering institutions :

.....

A. Responsibilities and background

- 1.1 Could you brief me more about your background? (education, experience, no of projects)
- 1.2 What is your role and responsibilities as a FM & Services Planning Manager in your organisation?
- 1.3 **Could you describe your communication chain in this project** (from whom to whom you report and get report from)? - company's hierarchy

B. Delivery of PFI requirements

- 2.1 What challenges do you have experienced / anticipate in managing this project?
- 2.2 **Who 'translates' (in term of formulating) contract requirements to 'work-list'?** i.e FM at strategic level communicating their needs (PFI-FM required services) to their operational level?
 - 2.2.1 Is there any sample of the said documentation (activities involves, flows, format, etc)
- 2.3 **Is/Are there any problem/s or gaps in communicating the FM contractual requirements to the operatives to perform their tasks?**
- 2.4 How operational team and management team particularly at strategic level, could be best work together in order to achieve the level of services targeted? (*Measures to closing the gaps*)

C. System used for FM services delivery (Content, Format and Delivery)

- 3.1 **What systems are used for managing FM information and documentation in this project** (i.e. IT tools, FM system) and what is the purpose?
- 3.2 Is there any dedicated FM personnel / team who deals with project system in this project?
- 3.3 **Who uses the system? (User) and; how does the systems disseminate the information and knowledge to its users?** - *push and pull format i.e. How information is being delivered*
- 3.4 **What type of input and information needed** to be retained in this system? (**contents**)
- 3.5 **What would you say is the most important element / *most frequently used to ensure efficient FM services delivery**

D. Information and Knowledge Flows

- 4.1 **What does the cycle of FM information and knowledge in the project organisation (FM) look like? (mechanism of send instruction and receive feedback in this system)** *N.B: needs supported by diagram or information flows chart – tabulation info*
- 4.2 **As a FM manager, how do you ensure a smooth knowledge and information flows across the project lifecycle** (till the end of operational stage)?
- 4.3 **How do you capture the information and knowledge in each construction stage** (i.e Please explain in detail for each different phases - i.e procurement, design, construction, maintenance phase)
- 4.4 What tools, system or documentation used to record lesson learnt (**within the project**)
- 4.5 **How FM input or FM knowledge at certain tasks can be passed on to the next stage** (i.e tasks can be replicate for further use - **within the project**)
- 4.6 To what extent, could the **information and knowledge** of this particular project be **transferred, or shared with another project**? *i.e. any possibilities for your staff to use the applied system (contents and format) and replicate it to the another project*

E. Towards improving FM knowledge system - operational

Improvement within the organisation

- 5.1 **Are there any measures which can be taken to improve the efficiency, effectiveness of FM knowledge from the services operation of this particular PFI project?**
- 5.2 If you had to plan and organise another capital project on a similar scale, **what changes you would make to the FM planning, organisation, and management of the project.**

Improvement for future project (outside organisation)

- 5.3 Are there any advices that can be **learned from for future project** from your organisation's experience in FM planning, organising and managing capital project?

End of Questions

Thank you for your time and co-operation

APPENDIX 3

Sample of Documentation

Service			Monitoring Period Frequency
Response Category	Definition		W
Response Time	Make Safe Time	Rectification Time	Weekly

QF=Quality Failure

FE=Failure Event

Monitoring Method	Audit Summary	Project Co	Trust Audit
7	Review reports by Statutory bodies	3	3
	Pass, but Improvements Required	0	5
	Pass	233	228

22 Jul

QUALITY FAILURE PERFORMANCE PARAMETERS

Type	Ref	Schedule 14	Description	QF Type	Category	Performance Monitoring Period Freq	Response	Rectification	Monitoring Method	Notes
General	GP01a	Leadership	Management structure established & operating in accordance with Project Co's proposal	QF	Low	M	n/a	n/a	2, 4, 5, 8	
General	GP01x		Management structure established & operating in accordance with Project Co's proposal - Consort to inform the Trust Rep of any changes	QF	Low	M	n/a	n/a	2, 4, 5, 8	
General	GP01b	Leadership	Appropriate Project Co Staff attend management meetings, & reports & information are supplied as required in the agreed format	QF	Medium	M	n/a	n/a	2, 4, 5, 8	
General	GP01x		Appropriate Project Co Staff attend management meetings, & reports & information are supplied as required in the agreed format - Consort propose reports	QF	Medium	M	n/a	n/a	2, 4, 5, 8	
General	GP01c	Leadership	All agreed systems & controls in place to safeguard property, cash & commodities are functional	QF	Medium	M	n/a	n/a	2, 4, 5, 8	
General	GP01d	Leadership	Management reports required by the General Services Spec are provided to the Trust in the agreed timescale, format & quality	QF	Medium	M	n/a	n/a	2, 3, 4, 5, 8	
General	GP01e	Leadership	Proposed Variations to Services are clearly defined in the correct manner & have received written consent from the Trust prior to their implementation	QF	High	PR	n/a	n/a	2, 3, 4, 5, 8	
General	GP01f	Leadership	Information relating to internal & external public relations is supplied in the format, timescales & quality as agreed from time to time by the parties	QF	Medium	PR	n/a	n/a	2, 3, 4, 5, 8	
General	GP01g	Leadership	A procedure for disseminating hazard & Safety warnings is operational & warnings are disseminated in a timely manner as appropriate	QF	Medium	M	n/a	n/a	2, 3, 4, 5, 7, 8	
General	GP01k		A procedure for disseminating hazard & Safety warnings is operational & warnings are disseminated in a timely manner as appropriate - Consort identify hazards and report as per agreed procedures	QF	Medium	M	n/a	n/a	2, 3, 4, 5, 7, 8	
General	GP01x		A procedure for disseminating hazard & Safety warnings is operational & warnings are disseminated in a timely manner as appropriate - Consort take appropriate action and record any Hazards they have been informed about	QF	Medium	M	n/a	n/a	2, 3, 4, 5, 7, 8	

AUDIT MONITORING

Suggested Monitoring Period (A, Q, E, M, W, D)	Project Co Audit Pass / Fail	Comments	Audit Pass / Fail	Audit Date	Trust Audit by	Evidence	Audit Comment
M	Pass		Pass	07/07/2009	JM	Viewed Structure 8001 Issue No 16 Issued 28/04/09	
M	Pass		Pass	07/07/2009	JM		
M	Pass		Pass	07/07/2009	JM	Monthly Service Contract Monitoring Meeting attended 05/06/09. Service Selection Committee 16/06/09. FM Catch-up. Regularly to review Trans services & Steady State issues for Nov 09	
M	Pass		Pass	07/07/2009	JM		Next Service Contract draft monitoring meeting 7th July 2009.
M	Pass		Pass	07/07/2009	JM		Cash systems to be agreed for steady state nothing to monitor at present. Security LCP's in place for pathology
M	Pass		Pass	07/07/2009	JM	Monthly reports issued. Performance monitoring report 06/06/09, Payment Notice 07/06/09. Monthly maintenance Report 02/06/09	
PR	Pass		Pass	07/07/2009	JM	VET 026a, 027, 026, 025, 030 issues for pricing during May. VET 025 confirmation received 11/6/09	
PR	Pass		Pass	07/07/2009	JM		No requests made
M	Pass		Pass	07/07/2009	JM	BBW have visited the DH website for all Estates and FM Alerts. 1 Alert raised in Feb	
M	Pass		Pass	07/07/2009	JM	No record of any Hazards reported to the Trust. PE confirmed as the contact point.	
M	Pass		Pass	07/07/2009	JM	No Alerts during the monitoring period.	Feedback to ensure loop closed by recording all alerts on Maximo.

Type	Ref	Schedule 14	Monitoring Method description	Description	QF Type	Category	Performance Monitoring Period Freq	Response	Rectification	Monitoring Method	Notes	Suggested Monitoring Period (A,Q,G,M,M,W,D)	Project Co		Trust Audit & Validation			Audit Comment
													Audit Pass / Fail	Comments	Audit Pass / Fail	Audit Date	Audit by	
Estates	SP25	Estates		Project Co staff have been trained in HTM63 processes	QF	Low	M	n/a	n/a	2, 4, 5, 6		M	Pass		Pass	07/07/2009	JM	2 new recruits this month. 2 estates staff now Fire Wardens (sleeve bairnbridge & Hugh cutting)
Estates	SP26	Estates		Annual Report is provided to the Trust on the anniversary of the Contract Commencement Date in the agreed format, quality & standard	QF	Medium	A	n/a	n/a	3, 4, 6		A	Pass		Pass, but Improvements Required	07/07/2009	JM	Viewed Annual fire report dated 31st March from BBW to Consort. Compiled following meeting with Tony Sedgewick
Estates	SP26a			Annual Report is provided to the Trust on the anniversary of the Contract Commencement Date in the agreed format, quality & standard	QF	Medium	A	n/a	n/a	3, 4, 6		A	Pass		Pass	07/07/2009	JM	Monitoring due Mar FM building & Path in July 09. Meeting to be arranged JM to raise RFM Meeting to include Equipment responsibility for extinguishers and report format 6/6/09 update - trust awaiting date from BBW Meeting to take place and report to be issued by BBW in the improved format in July
Estates	SP27	Estates		All statutory estates Early Services Facilities data is accurately recorded, regularly updated & available for inspection by the Trust	QF	High	Q	n/a	n/a	3, 4, 5		Q	Pass		Pass	07/07/2009	JM	Pathology FM Monitoring due Jun, Sept, Dec & Mar 5/6/09 Due to review with JM in June - take random ppm's suggest smoke dampers for June, Ifts
Estates	SP28	Estates		All Quality Assurance data requirements are accurately recorded, stored & are available for inspection	QF	Low	Q	n/a	n/a	1, 2, 3, 4, 5, 6, 7, 8		Q	Pass		Pass	07/07/2009	JM	viewed condition survey report dated 27th March carried out by BBW
Estates	SP29	Estates		Project Co has an up-to-date record of the latest HTMs, MHRA Notices & Safety Notices, & has traceable evidence that relevant action has been taken to comply	QF	Medium	PR	n/a	n/a	4, 7, 8		PR	Pass		Pass	07/07/2009	JM	5/6/09 Viewed the safety notices and systems as part of the General services. BBW demonstrated their access to IIS.com system confirming access to all HTMs. We looked up HTM 63 as an example. Viewed summary record of alerts
Estates	SP30	Estates		not used	n/a	n/a	n/a	n/a	n/a	n/a		n/a	Pass		Pass	07/07/2009	JM	n/a
Estates	SP31	Estates		Requests for information from the Trust are provided by the agreed date, quality & format	QF	Low	M	n/a	n/a	1, 3, 4, 7, 8		M	Pass		Pass	07/07/2009	JM	No requests
Estates	SP32	Estates		not used	n/a	n/a	n/a	n/a	n/a	n/a		n/a	Pass		Pass	07/07/2009	JM	n/a
Estates	SP33	Estates		Valid licenses are held for Project Co for all hardware & software used in the delivery of the Estates Services	n/a	Low	E	n/a	n/a	3, 4, 7, 8		B	Pass		Pass	07/07/2009	JM	Monitoring due March & September - difficult to access, last time trust agreed to relax as held corporate
Estates	SP34	Estates		not used	n/a	n/a	n/a	n/a	n/a	n/a		n/a	Pass		Pass	07/07/2009	JM	n/a
Estates	SP35	Estates		ACT Passive Network responses are carried out within the Response Time, & faults are rectified within the agreed Rectification Time	FE	A-E	PR	As per table 4	As per table 4	1, 2, 3, 4, 5, 6, 7, 8		FR	Pass		Pass	07/07/2009	JM	No requests recd
Estates	SP36	Estates		ACT Passive Network policies & procedures are in place to keep rooms/areas containing ACT Passive infrastructure secure at all times	QF	High	Q	n/a	n/a	4, 5, 7, 8		Q	Pass		Pass	07/07/2009	JM	No reported breaches
Estates	SP27	Estates		ACT Passive Network is maintained to be compliant with the CAT-6 Standard	QF	Medium	D	n/a	n/a	4, 5, 7, 8		D	Pass		Pass	07/07/2009	JM	Viewed summary report from a company called Rectstone who carried out the testing. Plus no reported failures
Estates	SP36	Estates		ACT Passive Network policies & procedures are in place & operated to ensure Trust requests are actioned appropriately	QF	Medium	M	n/a	n/a	4, 5, 7, 8		M	Pass		Pass	07/07/2009	JM	Viewed LQP and no requests made
Estates	SP39	Estates		All redundant ACT Passive Network to be decommissioned & disposed of in a timely & safe manner, redundant infrastructure is removed in accordance with legislation, Trust Policies, Good Industry Practice & manufacturers guidelines	QF	Low	M	n/a	n/a	1, 2, 4, 5, 7, 8		M	Pass		Pass	07/07/2009	JM	No requests made
Estates	SP40	Estates		not used	n/a	n/a	n/a	n/a	n/a	n/a		n/a	Pass		Pass	07/07/2009	JM	n/a
Utilities	SP01a	Utilities		not used	n/a	n/a	n/a	n/a	n/a	n/a		n/a	N/A		N/A	07/07/2009	JM	n/a
Utilities	SP01c	Utilities		not used	n/a	n/a	n/a	n/a	n/a	n/a		n/a	N/A		N/A	07/07/2009	JM	n/a
Utilities	SP02a	Utilities		not used	n/a	n/a	n/a	n/a	n/a	n/a		n/a	N/A		N/A	07/07/2009	JM	n/a
Utilities	SP02b	Utilities		not used	n/a	n/a	n/a	n/a	n/a	n/a		n/a	N/A		N/A	07/07/2009	JM	n/a
Utilities	SP02c	Utilities		not used	n/a	n/a	n/a	n/a	n/a	n/a		n/a	N/A		N/A	07/07/2009	JM	n/a
Utilities	SP02d	Utilities		not used	n/a	n/a	n/a	n/a	n/a	n/a		n/a	N/A		N/A	07/07/2009	JM	n/a
Utilities	SP02e	Utilities		not used	n/a	n/a	n/a	n/a	n/a	n/a		n/a	N/A		N/A	07/07/2009	JM	n/a
Utilities	SP02f	Utilities		The integrity and functionality of the sewage disposal systems are maintained at all times	QF	High	M	n/a	n/a	4, 8		M	Pass		Pass	07/07/2009	JM	No non-conformities reported
Utilities	SP02g	Utilities		not used	n/a	n/a	n/a	n/a	n/a	n/a		n/a	N/A		N/A	07/07/2009	JM	n/a
Utilities	SP02h	Utilities		The integrity and functionality of the surface water systems are maintained at all times	QF	High	M	n/a	n/a	4, 8		M	Pass		Pass	07/07/2009	JM	No non-conformities reported
Utilities	SP03a	Utilities		Establish Continuity Plans for standby provisions in the event of the loss of Utilities & ensure that they have been reviewed within the last 12 months	QF	High	A	n/a	n/a	4, 8		A	Pass		Pass	07/07/2009	JM	Contingency plan issued 30th March 2009
Utilities	SP03b	Utilities		Implement Continuity Plans for standby provisions in the event of the loss of Utility provision (other than water & sewerage)	FE	A-E	At any moment in time	As appropriate	As appropriate	1, 8			Pass		Pass	07/07/2009	JM	No requests to implement any contingencies made

Type	Ref	Schedule 14	Description	Type	Category	Performance Monitoring Period / Freq	Response	Rectification	Monitoring Method	Notes	Suggested Monitoring Period (A,Q,W,M,N,D)	Project Co		Trust Audit / Validation			
												Audit Pass / Fail	Comments	Audit Pass / Fail	Audit Date	Audit by	Evidence
Utilities	SP04	Utilities	Seek agreement from the Trust prior to implementing scheduled interruptions to Utilities which are controlled by Project Co	QF	High	per event	n/a	n/a	2, 3, 4, 7, 8		per event	Pass	Pass	07/07/2009	JM	No adverse comments or confirmed breaches	BEW run generator test 12/5/09
Utilities	SP05	Utilities	not used	n/a	n/a	n/a	n/a	n/a	n/a		n/a	N/A	N/A	07/07/2009	JM	n/a	n/a
Utilities	SP06	Utilities	Project Co shall, in conjunction with the Trust, regularly review (at least annually) & amend as required, the Utility supply specifications such that they are consistent with the requirements of the Clinical Services, subject to the Trust's obligation to procure Energy	QF	Medium	Q	n/a	n/a	2, 3, 4, 7, 8		Q	Pass	Pass, but improvements Required	07/07/2009	JM	No requests from the Trust. Meeting held on 15th June	Pathology Monitoring due Jun, Sept, Dec & Mar. Look to take notes for Sept
Utilities	SP07	Utilities	not used	n/a	n/a	n/a	n/a	n/a	n/a		n/a	N/A	N/A	07/07/2009	JM	n/a	n/a
Utilities	SP08	Utilities	Ensure, subject to any documentation held or provided by the Trust, pursuant to the Trust's obligation to procure, all test certificates & appropriate documentation & records (relating to Safety or statutory requirements) are maintained accurately, updated regularly & available for inspection by the Trust or any other relevant party	QF	Medium	At any moment in time	n/a	n/a	2, 3, 4, 7, 8		At any moment in time	Pass	Pass	07/07/2009	JM	Documentation in place.	
Utilities	SP09	Utilities	Ensure all information & records held by Project Co are up to date, precise, accurate & available for inspection by the Trust or any other relevant party	QF	Low	At any moment in time	n/a	n/a	2, 3, 4, 7, 8		At any moment in time	Pass	Pass	07/07/2009	JM	Documentation in place.	
Utilities	SP10	Utilities	Other than as set out in Clause 5.3.8 & where held or obtained by Project Co, prepare & supply information reasonable required by any party to whom the Trust are obliged to present information relating to the performance of the Utilities Management Services	QF	Low	PR	n/a	n/a	2, 3, 4, 7, 8		PR	Pass	Pass	07/07/2009	JM	Energy report based on ERIC requirements. No additional information requests made	
Utilities	SP11	Utilities	not used	n/a	n/a	n/a	n/a	n/a	n/a		n/a	N/A	N/A	07/07/2009	JM	n/a	n/a
Utilities	SP12	Utilities	Provision of ad hoc reports as reasonably required by the Trust relating to the Utilities Management Service	QF	Low	M	n/a	n/a	2, 3, 4, 7, 8		M	Pass	Pass	07/07/2009	JM	No request made to the helpdesk	
Utilities	SP13a	Utilities	Monitor & control the performance of Plant. Subject to the Trust's use, to minimise Utilities consumption whilst achieving the environmental Data Sheets	QF	Medium	M	n/a	n/a	2, 3, 4, 7, 8		M	Pass	Pass	07/07/2009	JM	Monitor and control via BMS, viewed temperatures. Consumption report viewed with energy readings for both Trust and Pco responsibilities.	5/6/09 path temp never exceeded 25 degrees according to BMS during warm weather in late may on level 3 (was some concern at the time from path lab). BEW send copies of temp controls from BMS to path mgt.
Utilities	SP13b	Utilities	Project Co staff records clearly indicate staff as Suitably Qualified Persons	QF	Low	Per Occasion (at least Annually)	n/a	n/a	2, 3, 4, 7, 8		Per Occasion (at least Annually)	Pass	Pass	07/07/2009	JM	Viewed training records and approvals for AP's 5/5/09	
Utilities	SP13c	Utilities	not used	n/a	n/a	n/a	n/a	n/a	n/a		n/a	N/A	N/A	07/07/2009	JM	n/a	n/a
Utilities	SP13d	Utilities	Management & operation of the Building Management System	QF	High	At any moment in time	n/a	n/a	2, 3, 4, 7, 8		At any moment in time	Pass	Pass	07/07/2009	JM	BMS system in operation	BMS Station is now monitored in BEW tech office - out of hours at security desk. Email alerts under test 5/6/09 - now monitored on blackberry to duty engineer
Utilities	SP13e	Utilities	Provide annual Utility Report to the Trust in the agreed format & quality	QF	Low	A	n/a	n/a	2, 3, 4, 7, 8		A	Pass	Pass	07/07/2009	JM	RFM to discuss with Trust/BEW format for report	RFM for Energy meeting by JM to be issued. To agree report content and format. Meeting date 11/6/09. Linked to SP06
Utilities	SP13f	Utilities	Provide Monthly Performance Report to the Trust in the agreed format & quality	QF	Low	M	n/a	n/a	2, 3, 4, 7, 8		M	Pass	Pass	07/07/2009	JM	Report as per schedule 18 requirements 06/03/09	RFM for Energy meeting by JM to be issued. To agree report content and format. Meeting date 11/6/09. Linked to SP06
Utilities	SP13g	Utilities	not used	n/a	n/a	n/a	n/a	n/a	n/a		n/a	N/A	N/A	07/07/2009	JM	n/a	n/a
Utilities	SP13h	Utilities	All Project Co staff are aware of the aims of the Trust Policy on Energy, & given advice on its implementation	QF	Low	A	n/a	n/a	2, 3, 4, 7, 8		A	Pass	Pass	07/07/2009	JM	Viewed the training record for Eason and Corbett	Monitoring due Mar. Trust to issue policy - issued May 09
Utilities	SP13i	Utilities	All Project Co staff are aware of the aims of the Trust Policy on Energy, & given advice on its implementation	QF	Low	A	n/a	n/a	2, 3, 4, 7, 8		A	Pass	Pass	07/07/2009	JM		Monitoring due Mar. Trust to issue policy
Utilities	SP13j	Utilities	not used	n/a	n/a	n/a	n/a	n/a	n/a		n/a	N/A	N/A	07/07/2009	JM	n/a	n/a
Domestic	SP01a	Scheduled Cleaning	Cleaning schedules have been produced in agreement with the Trust & are available for inspection at all times	QF	High	PR	n/a	n/a	1, 2, 3, 4, 8		PR	Pass	Pass	07/07/2009	JM	All schedules agreed and on the notice boards in FM building. Pathology agreed schedules on 07/07/08	Reverted to original cleaning times
Domestic	SP01b(i)	Scheduled Cleaning	Scheduled cleaning in Very High Risk Areas has been completed during the relevant scheduled times	FE	C-E	W	n/a	As per table 4	1, 2, 4, 7, 8		W	Pass	Pass	07/07/2009	JM		
Domestic	SP01b(ii)	Scheduled Cleaning	Cleaning in Very High Risk Areas has been completed to the relevant standard	FE	C-E	W	n/a	20 mins	1, 2, 4, 7, 8		W	Pass	Pass	07/07/2009	JM		
Domestic	SP01c(i)	Scheduled Cleaning	Scheduled cleaning in High Risk Areas has been completed during the relevant scheduled times	FE	C-E	M	n/a	As per table 4	1, 2, 4, 7, 8		M	Pass	Pass	07/07/2009	JM		
Domestic	SP01c(ii)	Scheduled Cleaning	Cleaning in High Risk Areas has been completed to the relevant standard	FE	C-E	M	n/a	As per table 4	1, 2, 4, 7, 8		M	Pass	Pass	07/07/2009	JM		
Domestic	SP01d(i)	Scheduled Cleaning	Scheduled cleaning in Moderate Risk Areas has been completed during the relevant scheduled times	FE	B-E	M	n/a	As per table 4	1, 2, 4, 7, 8		M	Pass	Pass	07/07/2009	JM	Scheduled cleaning carried out as per scheduled times	Maximiser agreed awaiting date for implementation BEW to advise shortly & JM to have user training
Domestic	SP01d(ii)	Scheduled Cleaning	Cleaning in Moderate Risk Areas has been completed to the relevant standard	FE	B-E	M	n/a	As per table 4	1, 2, 4, 7, 8		M	Pass	Pass	07/07/2009	JM		Pathology 2 Cleaning audits carried out for Pathology on 12th & 19/06/09 (100% & 96.93%). BEW rectify via planned requests for early services. Building users issued copies

Type	Ref	Schedule	Description	IC Type	Category	Performance Monitoring Period (PM)	Response	Rectification	Monitoring Method	Notes	Suggested Monitoring Period (A,Q,M,W,D)	Project Co		Trust Audit & Validation			
												Audit Pass / Fail	Comments	Audit Pass / Fail	Audit Date	Audit by	Evidence
Domestic	SP01e	Scheduled Cleaning	Scheduled cleaning in Low & Minimal Risk Areas has been completed during the relevant scheduled times	FE	A-E	B	n/a	As per table 4	1, 2, 4, 7, 8			Pass		07/07/2009	JM	Scheduled cleaning carried out as per scheduled times	
Domestic	SP01e	Scheduled Cleaning	Cleaning in Low & Minimal Risk Areas has been completed to the relevant standards	FE	A-E	B	n/a	As per table 4	1, 2, 4, 7, 8			Pass		07/07/2009	JM	Carried out to the relevant standards. BBW to rectify via planned requests. Building users issued copies	Cleaning audits carried out for FM Building 12/06/09 99.22% BBW to rectify via planned requests. Building users issued copies
Domestic	SP01f	Scheduled Cleaning	All cleaning practices comply with the Trust's Infection Control Policy	QF	High	M	n/a	n/a	1, 2, 4, 5, 8			Pass		07/07/2009	JM	No reported non-compliance	BBW off-site infection control Advisor meet up with Trust Infection Control to build partnership and relationships. Regular meeting schedule developed & HSM to attend. Attending workshop with Trust next month.
Domestic	SP01g	Scheduled Cleaning	not used	n/a	n/a	n/a	n/a	n/a	n/a			Pass		07/07/2009	JM	n/a	n/a
Domestic	SP02a	Scheduled Cleaning	Emergency cleaning requests are dealt with in the allocated Response Time, Response & Make Safe Time & Rectification Times as described in Appendix B Table 4	FE	C-E	PR	As per table 4	As per table 4	1, 4, 8			Pass		07/07/2009	JM	No reported non-compliance	
Domestic	SP02b	Scheduled Cleaning	Urgent cleaning requests are dealt with in the allocated Response Time, Response & Make Safe Time & Rectification Times as described in Appendix B Table 4	FE	B-E	PR	As per table 4	As per table 4	1, 4, 8			Pass		07/07/2009	JM	No reported non-compliance	
Domestic	SP02c	Scheduled Cleaning	Routine cleaning requests are dealt with in the allocated Response Time, Response & Make Safe Time & Rectification Times as described in Appendix B Table 4	FE	A-E	PR	As per table 4	As per table 4	1, 4, 8			Pass		07/07/2009	JM	No reported non-compliance	11 routine requests
Domestic	SP03	Scheduled Cleaning	Planned cleaning, including clinically cleaning prior to the start of Clinical Services are undertaken at frequencies & times as agreed between Project Co & the Trust	FE	A-E	per event	n/a	As per table 4	1, 2, 4, 5			Pass		07/07/2009	JM	No reported non-compliance	all planned cleaning completed
Domestic	SP03a	Scheduled Cleaning	Planned cleaning, including clinically cleaning prior to the start of Clinical Services are undertaken at frequencies & times as agreed between Project Co & the Trust	FE	A-E	per event	n/a	n/a	1, 2, 4, 5			Pass		07/07/2009	JM	No reported non-compliance	
Domestic	SP04	Scheduled Cleaning	not used	n/a	n/a	n/a	n/a	n/a	n/a			Pass		07/07/2009	JM	n/a	n/a
Domestic	SP05a	Equipment	not used	n/a	n/a	n/a	n/a	n/a	n/a			Pass		07/07/2009	JM	n/a	n/a
Domestic	SP05b	Equipment	All equipment & materials used in the provision of the Domestic Service is compliant with NHS colour-coding to indicate specific areas of use	QF	High	Q	n/a	n/a	2, 3, 4, 8			Pass		07/07/2009	JM	No reported non-compliance	Pathology Monitoring due Jun, Sept, Dec & Mar. JM to send out link for Paul. Now received & in sync
Domestic	SP05c	Equipment	All equipment used within the sensitive areas of the Early Services Facilities is appropriately noise restricted & fitted with high quality & HEPA standard dust filters	QF	Medium	Q	n/a	n/a	2, 3, 4, 8			Pass		07/07/2009	JM	No reported non-compliance	Pathology Monitoring due Jun, Sept, Dec & Mar
Domestic	SP05d	Equipment	All materials used in the provision of the Domestic Service are available as required	QF	Medium	D	n/a	n/a	2, 4, 8			Pass		07/07/2009	JM	No reported non-compliance	
Domestic	SP05e	Equipment	All cleaning materials used in the provision of the Domestic Service are approved, procured, maintained, cleaned & stored in accordance with Trust Infection Control Policy, stock levels as required to meet the requirements of this Service Level Specification & COSHH requirements	QF	Medium	M	n/a	n/a	2, 4, 8			Pass		07/07/2009	JM	No reported non-compliance	
Domestic	SP05f	Equipment	All forklift hygiene dispensing machines are supplied, emptied & replenished in accordance with the agreed schedule	QF	High	M	n/a	n/a	2, 4, 8			Pass		07/07/2009	JM	replenished on 05/06/09 at FM Building & 05/06/09 in Pathology	No dispensing m/c at present. Schedule for public areas to be agreed for steady state. Disposal units emptied 05/05
Domestic	SP07	Equipment	All evidence of Pests & Pest activity are promptly reported to the Helpdesk, all Pest contaminated areas cleaned & disinfected as agreed	FE	A-E	per event	As per table 4	As per table 4	1, 2, 4, 8			Pass		07/07/2009	JM	No reports of pests	
Domestic	SP08a	Equipment	Project Co staff within the Pathology Building & the FM Building bag/clean security, segregate & store waste in accordance with Trust Policies, in the appropriate receptacle in the designated area prior to collection	QF	Medium	D	n/a	n/a	1, 2, 4, 8			Pass		07/07/2009	JM	FM - Building only produces domestic waste. No reports of non-compliance. Pathology - verbal agreement around waste disposal being exchanged at night.	Trust to review the clinical waste containers and have sent it to BEW.
Domestic	SP09a	Equipment	not used	n/a	n/a	n/a	n/a	n/a	n/a			Pass		07/07/2009	JM	n/a	n/a
Domestic	SP09b	Equipment	not used	n/a	n/a	n/a	n/a	n/a	n/a			Pass		07/07/2009	JM	n/a	n/a
Domestic	SP09	Equipment	All internal & external windows are cleaned in accordance with Quality Standards in Appendix A	QF	Medium	per event	n/a	n/a	1, 2, 4, 8			Pass		07/07/2009	JM	No reported non-compliance	Pathology and FM building windows cleaned on 20th March 2009 & monthly internal cleans completed May 09
Pest Control	SP01	Pest Control	Planned Early Services Facilities Assessment is undertaken bi-annually at a time agreed with the Trust	QF	Medium	B	n/a	n/a	1, 2, 3, 4, 8			Pass		07/07/2009	JM	Some proofing carried out	Night time visit by Rentokil on 22nd January - no sign of infestation - Next planned visit July 2009
Pest Control	SP01a	Pest Control	Emergency requests are attended to in accordance with Appendix A & Rectified with the Response & Rectification Times	FE	A-E	PR	As per table 2	As per table 2	1, 4, 8			Pass		07/07/2009	JM	No requests	
Pest Control	SP01b	Pest Control	Urgent requests are attended to in accordance with Appendix A & Rectified with the Response & Rectification Times	FE	A-E	PR	As per table 2	As per table 2	1, 4, 8			Pass		07/07/2009	JM	No requests	
Pest Control	SP01c	Pest Control	Routine requests are attended to in accordance with Appendix A & Rectified with the Response & Rectification Times	FE	A-C	Pr	As per table 2	As per table 2	1, 4, 8			Pass		07/07/2009	JM	No requests	

APPENDIX 4

Sample of Interviews Transcription

APPENDIX 4: Interview Transcription

Interview on improving knowledge transfer at facilities management stage of Private Finance Initiative (PFI) projects

Researcher : Muzani Mustapa
Respondent Code : A2
Date : 20th August 2008

This **open-ended interview** is designed to collect data as follows:

1. Background and responsibility as facilities manager
2. Delivery of PFI requirements (process)
3. System used for FM services delivery (content, format) in PFI projects
4. Determining information and knowledge flows in PFI-FM projects

Note:

Confidentiality is assured and all information provided will be used to inform the research only. No reference will be made to individuals or their companies

A. Responsibilities and background

1. *Could you brief me more about your responsibilities and background?*

A2: My position as FM & Services Planning Manager requires me to report to the Hospital Manager.

I'm responsible for the development of Schedule 14: Facilities Management service level specification, which is part of the project agreement. I develop this part of services. The schedule is national specification, where issued by the PFU (Private Finance Unit) in PFI projects. My responsibilities is to develop the specification in the best way of facilities management services delivery in this project, which required by Trust. Thus, make a bespoke specification.

Another responsibility is to act as liaison between current facilities in term of bringing in facilities manager and general facilities, the Head of Estates to the planning process on how to develop a system and services and the way forward. My link is very much with the General Manager of Facilities and Head of Estates. So that they are aware and knew what on planning and thinking they are doing. They have an influence on that and their decision make. I also lead a lot of evaluation works, at the bidding stages against the set criteria in the documentation (Schedule 14). This lead to the stages of preferred bidder by the Trust and reach the stage of Financial Close.

At post Financial Close stage, I'm now working with the facilities management provider. Currently I'm developing hard and soft FM services on operational on particularly on small buildings. Working with them (FM service provider) I develop Local Operating Procedures (LOPS), begun with audit and validation of all works. I also take a lead on a lot of work with staff sites. Talking with them and do communication. Do a lot of time in presentation to both a staff and public. (internally and externally)

APPENDIX 4: Interview Transcription

B. Delivery of PFI requirements

2. *Assessing facilities management practice in healthcare project; scope and boundary of facilities managers tasks*

A2: The PFI providers develop the method statement and LOPS during the construction stage. Going forward, they start to produce report for us (Trust) i.e. monthly performance report. What we do, is we (Trust and providers) meet and discuss that draft of performance review. We discuss the performance for that month, whether they cheat on the performance parameter as set on the schedule / specification. From that, we agree or disagree and pass or fail, and then we meet formally with the directors (Trust's project director, providers' director) to issues the invoice for that month; for Unitary Payment. Within the Unitary Payment, there have FM elements, where any deduction for the services performance failed.

A2: Currently, both hard and soft services are in-house with the Trust. I actually don't get involve with day to day running the hospital. I'm more working at strategic level, developing services. We would like to see as we move forward and shown as there going to be in place as planned them. When we move to the new PFI hospital, there will be an external contract with XYZ (FM contractor) of both hard and soft FM services. In the case of PFI, the hard services / estates always go to contractor. Because they (contractor) built the building and they know the building. The estates staff will transfer to service provider. Some PFI projects do not hand over the soft services, they retain in house. Decision was made many years ago, that soft services will also go to private contractor.

3. *What challenges do you have experienced / anticipate in managing this project?*

A2: Over the 30 years period, there going to be a change to fit in the future. We might need to change something, but we got to be very clear that it is the building and we are using it. There is no doubt there will be a services changes in the future, such a place of hospitals; living breathing of organisation, dealing with human being (people), and the requirement by NHS. The main things will be you going towards different field and different aspect of management (PFI-FM practices). In particular, new ways of working, new technology to work with where there is a guideline, contract, specification that needs to follow. All about risk taking in PFI and how you quantify that risks.

In term of Specification, this is what you ask for and what you delivering and is always very much on spirit of negotiation on working in sort of partnership working. Through my experience, we follow and use the Project Agreement (PA) and documentation. Is this what we going to do, nothing more and nothing less. Another big challenge will be on monitoring and actually keeping and checked on what they (service provider) are doing and ensure the standard has been maintained and having processes and protocol in a way or means to do and developing that.

I would like to think, we could develop a partnership spirit, partnership working and body charter (working between us). So, striking that balance will be the difficult part. I think that will be a lot of issues. For example, working environment (service-performance related); staff get into culture, contractors going to be using new method, new machinery, etc; staff can feel barriers that time, on changing the way their works with all that happening like that. I also think finance will be very-very tight. Financial are ensuring the resources but the majority of the money goes to the healthcare and we often got what left (i.e. allocation to staffs).

APPENDIX 4: Interview Transcription

4. *How the documentation (bespoke specification) at strategic level be shared among the operational level?*

A2: PFU (Private Finance Unit) outlining the specification and used as guidance for all hospital Trust throughout UK. The specification then modified to become bespoke and be used to suit what will be required. At the stage of developing the FM specification, all parties are involved and informed through each specification / documents and through meetings. When we working on bespoke part, we do it in conjunction with PFU. Because, there is a certain thing when you altered or changed, the changes should also involved FM service provider, legal team and financial input to the project. Other parties includes the Trust, the PFI provider, management consultant, general manager and Head of Estates to make sure that it will reflecting what requires by the services and what PFI provider need to do. Any amendment or reiteration, changes should liaise with PFU and go through the whole process... until everybody in the contract agreed the contents of the documents (reach the Financial Close stage)

C. System used for FM services delivery

5. *What systems are used for FM information and documentation?*

A2: The system and processes should be with FM provider. I think they (service provider) got a good system and it called Local Operating Procedures (LOPS). There are sort of details on work need to do on deliver the services, i.e. LOPs pull from the method of statements that PFI provider has to give us. From the agreed Schedule of 14 from Project Agreement, service provider then produce method of statement, which tell us on how they going to do the work according to specification. From the method statement, they produces these LOPS. So, that gives me information and also gives me a work schedule for each area. Thus, I can review it.

6. *How do you document what knowledge you have?*

LOPS is not computerised, because that only give you a procedure. But they have a Helpdesk (FM system) which is computerised. Any users of the building or the services can ring the Helpdesk. So, the reactive task can be taken from helpdesk based on the information (input) required. The FM work system of proposed by the PFI provider is much better (the services more professional) than the current practice of the existing hospital.

I set up an audit and monitoring tools which is computer based. We use that, but I actually agree with you. In going forward, we do need to look into some system internally, and how we are going to do it. Because I think it will grow very much. Until the users get into the building and understand the new way of working, they (PFI provider) can't just put something up. They have to come through the process and protocol to get something. I think it will grow very much. So we got some control and consistency and management in there knowing whose doing what and where. So, they (PFI provider) can't go out there and doing maintenance without our agreement and access time, particularly in clinical area i.e. shut down the operation theatre

APPENDIX 4: Interview Transcription

D. Information and Knowledge Flows

7. *What does the cycle of FM information and knowledge in the project organisation look like?*

A2: Is always driven by the Project Agreement (PA) and the Schedule 14 of facilities management within the PA. In total, there are 36 schedules in PA. So, its driven by the services level specification (in Schedule 14). We also have the method statement, which is tell you how services going to be managed and delivered. From there, you have information from LOPS, where mentioned about work scheduled for each staff and area there are working. Separate from that, there are monitoring, audit and validating that run along side. So, there is how flow of information is going.

In addition, within the specification, they (PFI providers) give a lot of information for that month. For example, they produced the report on statutory and mandatory maintenance for the estates; pest control; and volumes of catering. All reports need to be agreed and review or otherwise. My role is to audit, validating and reporting for those reports. After that, invoice can be signed off and you start the process again (month by month until the end of concession period; 35 years) - doing audit, monitoring, validating.

After 3 years, Trust has an opportunity to market test (Schedule 17 on Project Agreement) the service. We can benchmark or put the services to tender. Thus, FM provider could be changes to somebody else. What we actually do, we / Trust will be benchmark the services against other PFI schemes and make a informed decision on whether the services is value for money for Project Co. Then, we award the contract through Project Co. for the next couple of years. We do a lot on KPI (Key Performance Indicators). Again, we refer to specification on Schedule 14, and what it requires in KPI. We are going to agree target for them and we will set performance target for them, and we expect them to reach the set performance.

8. *How do you ensure a smooth knowledge and information flows across the project lifecycle?*

A2: With working on the specification, my knowledge is quite extensive on the project agreement. What I done is, sort of disseminate my knowledge. We produce Schedule of 14, and I reproduce that and give to each manager copy of Schedule 14. I can call the Schedule as a bible. Facilities managers see all the specification plus the method of statement and important part on how is going to be delivered. So they (managers) have all the information. I also put into the *central drive (computer: shared drive)*. They can access and look at any documentation anytime; across the managers can look at that. PFI providers will be doing the same. They have a general manager and he will be shared that information with all his side. I tend to put my information through that way. I also develop different style of system for different area, on what required.

End of Questions

Thank you for your time and co-operation

APPENDIX 4: Interview Transcription

Interview on improving knowledge transfer at facilities management stage of Private Finance Initiative (PFI) projects

Researcher : Muzani Mustapa
Respondent Code : C2
Date : 11th April 2008

This **open-ended interview** is designed to collect data as follows:

1. Background and responsibility as facilities manager
2. Delivery of PFI requirements (process)
3. System used for FM services delivery (content, format) in PFI projects
4. Determining information and knowledge flows in PFI-FM projects

Note:

Confidentiality is assured and all information provided will be used to inform the research only. No reference will be made to individuals or their companies

A. Responsibilities and background

1. *Could you brief me more about your responsibilities and background?*

C2: My position in this PFI hospital project is as Estates Facilities General Manager. I am responsible on strategic demands, and develop tactical plans in line with the output requirements outlined by the Project Company (Co.) and the Trust (client). Generally, I am responsible for the project as the whole in term of delivery the facilities services.

Our facilities management (FM) team consists of Operational Manager who responsible for supervised all operation and technical works; Maintenance Manager who responsible for the maintenance tasks, liaised and report to General Manager of FM; and Commercial Manager who responsible for commercial issues, contractual sides e.g. claim, invoices etc. In addition, we have Technical Manager as key personnel between construction and facilities team to ensure all documents, drawing are kept safely and transferable of information to operational team.

B. Delivery of PFI requirements

2. *Assessing facilities management practice in healthcare project; scope and boundary of facilities managers tasks*

C2: In term of assessing the delivery of PFI requirements for this project, PFI contract is based on agreed years of operating and maintaining the facilities. There is similar in nature and standard of PFI procurement route. Project Co. has the contract with Trust to pay the unitary charge over the 35 years. But no link of contractual relationships between FM service provider and Trust. Thus, there is a loss opportunity in gather updated information between two parties.

The initial PFI output specifications are developed at a high level and are based chiefly on financial concerns ...although PFI documentation must eventually get down to a more detailed level. Technical manager is the links between the contract and operational team. He has to liaise with all documentation, method statements, procedures and

APPENDIX 4: Interview Transcription

legislation statutory contained in the contract. Subsequently, all the information needs to be cascade down to the operational team. He also needs to inform FM team on any changes imposed by Project Co. or Trust regarding the delivery of services.

In this project, ABC's build, ABC's designed, and ABC's maintained (which is our FM team). We have liaison with design team and builders ...pass the information over the operational team. When the building finished, all (design and builders team) are left except maintenance unit (our FM team) due to deliver FM services for 35-years in this PFI contract.

Our FM team focus on hard FM services such as building enclosures and network communication for this hospital project. Hard services comprise all the building (except clinical services / equipments and IT). Need to maintain according to the contract. We outsourced specialist services to subcontractors such as lifts, alarms, water system, air-conditioning plants etc. Other soft services such as caterings are under different contract with different service provider. Clinical services also contracted under different service provider.

3. *What challenges do you have experienced / anticipate in managing this project?*

C2: I would say difficulty in proof of defects, in term of overlaps and problematic issues between defect liability period (DLP) and defects of building or design liability. In this case, supplier and manufacturer refuse to accept and replace faulty equipments even under warranty. Another challenges faced by us (FM team) are little FM input during design stage. Usually, design teams leave a project on handover having given little thoughts to its subsequent operation. Input and requirements from facilities managers are essential towards providing design team with feedback on building and systems performance. Our concern is to have cost savings in later stages during operation and maintenance period.

Incapability to understand contract needs by operational team is another main issue. They are not commercially aware of this type of business (PFI-FM). There is huge of change from current traditional services operation to PFI services delivery. For example, risk of facilities or services availability. Unavailable room or operation theatre for patient need to be treated in stipulated time, otherwise there is penalties (cost deduction from payment received) imposed by Project Co. Like PFI hospitals, need to operate in 24/7. Involve critical equipment in term of life. We can't close the wards/theatre ...potentially affecting the life and death. Overall, hospital is place where manage life and death situation. Loss of power supply (electric) potentially can cause death, compared to other facilities like hotel block, offices and schools. Hospital is a few facility types that involve high risks of catastrophes. The risk is very challenging.

We also have to deal with issues such as takeover of existing staff in replace facilities and dealing with existing people (operational team) whom working with new system, technology and approach.

C. System used for FM services delivery

4. *What systems are used for FM information and documentation? (IT implementation or approach into managing services)*

C2: The modes of delivery of information and knowledge to FM operatives' level are largely based on document communication and through direct instruction from their line supervisor from time to time... in-house training system called 'toolbox talk' is used to

APPENDIX 4: Interview Transcription

share and disseminate the any specific subject on operation, equipment, information or any job instruction to operatives level.

We also use FM base software system, called as CONCEPT. The system logged all information regarding operation and maintenance services such as calls, assets, tasks done, time allocated, costs, history of the assets, etc. We also use software called *electronic Operation & Maintenance (e-O&M)*. This gathered project information and electronically documented it as support system. e-O&M's package provider collected information from manufacturer, designer, etc.

Even we have two software, e-O&M not linked with CONCEPT as no requirement to do so. Such information gathered including; drawings, technical information, plan preventive maintenance, health and safety document, and all related paperwork. These two softwares are accessible to all FM staff in order to review and use together with CONCEPT software.

5. *How do you document what knowledge you have?*

C2: I would like to rank three important areas needs attention in FM services; i) contract, ii) communication, and iii) business strategy. All these three areas document what knowledge we should focus and possessed. In term of managing large quantities of information and knowledge, we use available IT tools in our organisation. Besides, we also use meetings to document and capture the knowledge. Through regular meetings, it gives information to FM personnel on what to deliver. We also did job assessment or knowledge review to our personnel periodically.

Regarding the contract document, it communicates the required services to deliver, mode of software intended for use, the number of operational staff required for each task, tasks to be done and level of services performance needed. The successful delivery of services through a PFI scheme depends on clarity of the output requirement at the contract stage.

D. Information and Knowledge Flows

6. *How do you ensure a smooth knowledge and information flows across the project lifecycle?*

C2: We believe in people as our main resources. The transfer of knowledge is like the chain, where the chain is people along the process. Breaking the chain could cause loss of valuable information and knowledge. Although the new people brought in, there is lot of hiccups on the continuity of the whole process of service delivery operation.

...facilities manager is responsible to communicate the required services to their staff at operational level. This helps both the operational team and management team to draw a clear understanding of the content and awareness of their business scope. Thus, this is best arranged by establishing a meeting with both operational and management level. For example, twice monthly meeting with senior management level is conducted where all information and strategic decision cascaded down to the General Manager before passed down to the middle level of operation manager.

Once a month meeting with Project Co, other FM service providers and Trust representative called as Jointly Liaison Meeting is held. This meeting discusses more specific issues such as FM's performance, health and safety, finance, contractual and commercial issues.

APPENDIX 4: Interview Transcription

Informal meeting with the operatives every 3 months time is also planned. This two way communication approach involves lot of question and answer session. ...specific instruction from the top management level is cascaded down to this meeting. Unlike regular meeting with operatives' line supervisor, this meeting helps operatives to arise any operational problem from their workplace to the top level management. The delivery of regular meeting helps organisation to understand each other's requirements, expectations and working practices. Subsequently, it could lead to fewer misunderstanding in the contract and interaction between personnel.

C2: In my opinion, apprenticeship is the most preferred type of training for knowledge capture in order to influence operational team to do their work efficiently. ...the operational team learned from their line manager or supervisors. Thus, improve the knowledge and skills of the individuals, so that they can later perform tasks on their own. Other method to capture and enrich organisational knowledge is by personal mentoring/coaching, and job rotations. As a General Manager, I also involves in mentoring and coaching of my staff on contractual aspect. I realise this is a slow process, but over the period of time it brings a benefit to the organisation. The benefit is reflects to the number of staffs who have experience and immense knowledge within this organisation.

We believe by provide regular training to our operational FM team such as job specification and systematic information can lead to effective services delivery. Unfortunately, few training courses in PFI-FM are available in market. This is important due to PFI-FM require specific information on managing contract services and PFI contracts differ from project to another project. Another reason is because most of PFI project currently in early stage in operation and maintenance stage.

End of Questions

Thank you for your time and co-operation

APPENDIX 5

Evaluation Questionnaires

FRAMEWORK EVALUATION QUESTIONNAIRE

(The completion of this questionnaire should follow an explanation on the framework table)

Background Information

Name : _____

Position : _____

Company Name / Address : _____

: _____

: _____

Experience in PFI-FM (years) : _____

Email / Contact No. : _____

Date : _____

Research Aim

The framework was aimed to encourage FM participants to learn and share their FM knowledge across the different project stages through knowledge management adoption in PFI-FM practice.

QUESTIONNAIRES

Please circle the box that best indicate your opinion to a question. Larger score reflect greater rating.

RATING 1 - Poor 2 - Fair 3 - Satisfactory 4 - Good 5 - Excellent

A. Representation of the framework

1	How useful do you consider the overall framework?	1	2	3	4	5
2	Please rate based on how relevant you found the following elements:					
	a. Issues highlighted at each project stage	1	2	3	4	5
	b. Action Plan	1	2	3	4	5
	c. Implementation Plan	1	2	3	4	5
3	How well does the framework represent the knowledge shared?	1	2	3	4	5
4	To what extent does the framework achieve the aim of sharing knowledge?	1	2	3	4	5

B. Issues solving

1	How well do the examples of issues in the framework represent the actual problems in your organisation?	1	2	3	4	5
2	Do the contents of the framework address issues at the right level for FM organisations?	1	2	3	4	5
3	How appropriate are the categories of People, Process and Technologies for the Action Plan?	1	2	3	4	5
4	How well does the framework help in identifying the source (from) and destination (to) of knowledge?	1	2	3	4	5
5	How well does the framework help in developing the action plan required for solving the PFI-FM related issues?	1	2	3	4	5
6	To what extent does the framework help in developing a Knowledge Management (KM) implementation plan for a specific issue?	1	2	3	4	5

Please add further comments should you have given either highest or lowest score at any of the above questions

C. Sharing and learning of knowledge

1	To what extent does the framework achieve the concept of knowledge sharing and learning among the FM personnel?	1	2	3	4	5
2	How reusable is the shared knowledge for transfer to another project stage or on another project?	1	2	3	4	5
3	To what extent does the framework represent an improvement in facilities management practices?	1	2	3	4	5
4	To what extent can the framework be adapted to your organisation?	1	2	3	4	5

Please add further comments should you have given either highest or lowest score at any of the above questions

D. General Comments

1	What are the positive reasons for using the framework?
2	What are the barriers and challenges to adapt this framework to your organisation?
3	What improvements can be made to the overall framework? and in what ways

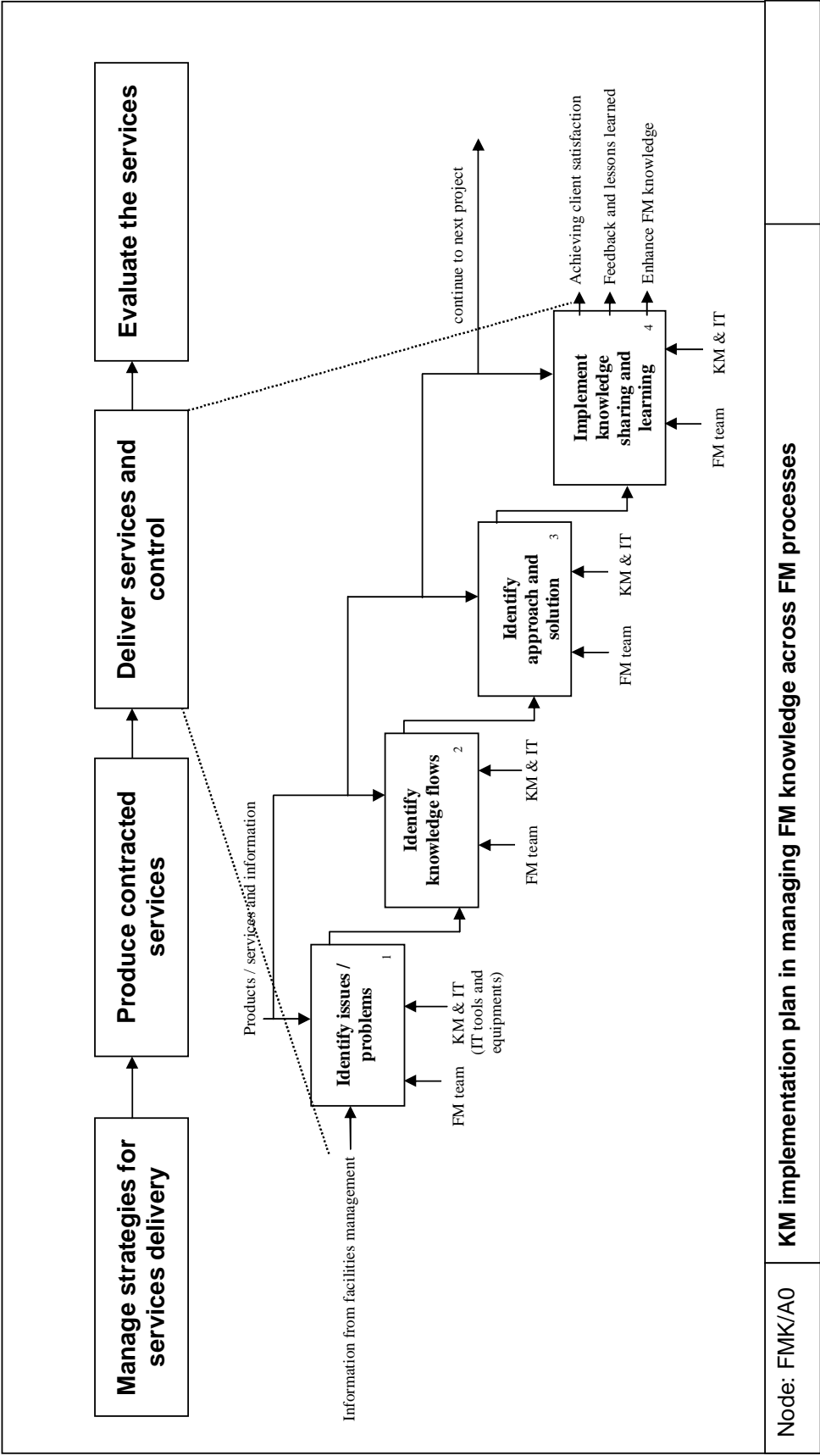
Further comments and suggestions

APPENDIX 6

Facilities Management Knowledge Framework

Steps in integrating knowledge management attributes with facilities management processes.

Code Ref.	Description	Aim/s	Outcomes
FMK/A0	<i>Manage Facilities Management Knowledge</i>		
FMK/A1	Identify issue in PFI-FM practice	To identify a facilities management process and anticipated issues arise by facilities manager and FM team	Clarification of issues area and its associated knowledge required
FMK/A2	Identify knowledge flows	To identify KM initiatives to assist the facilities manager in resolving the highlighted issues	Clear action plan for sharing and learning knowledge; Identify the communication flows of information and contain knowledge necessary for assist solution
FMK/A3	Identify approach and solution	To identify available measures for the issues highlighted	A set of alternative measures to avoid a specific issues occurring with addressing the resources available
		To identify KM technologies and techniques to resolve the issues	Appropriate KM strategies consists of technology and techniques selected
FMK/A4	Implement knowledge sharing and learning	To adopt and implement measures (approach and solution)	Implemented KM initiatives for a highlighted issues



Node: FMK/A0

KM implementation plan in managing FM knowledge across FM processes

