

# Knowledge Capture and Utilisation in Facilities Management Context: A Case Study

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**Abstract:** Knowledge is an important resource for organisations, especially for facilities management practitioners. Knowledge about the facilities holds the key for an optimum FM service delivery. This paper explores the concept of knowledge capture and its utilisation in FM discipline while positioning it with regards to the organisational strategy. The paper also investigates the knowledge capture techniques in CAFM environment and identifies how data mining from building management system is utilised in a condition-based maintenance of the assets of the facility.

The concept of knowledge capture and sharing in FM discipline and its application in a live organization was explored. Case studies were undertaken in an FM service provider environment to identify and enumerate knowledge capture methods to form a knowledge base while positioning FM in a changing strategic perspective. The experience and knowledge of employees in organisations were analysed for appropriate positioning of FM. CAFM tool was utilised to find out the knowledge capture methods used in the service delivery. BMS is another tool which is investigated for knowledge base generation for use in maintenance purposes, in addition to the role of the system as a building asset monitor and control system.

The main findings from the case study are that knowledge capture and its utilisation is a continuous process even in the absence of formal knowledge management system or active support from senior management, when service delivery is critical. The knowledge on facilities in terms of its services, assets and its operational uniqueness is captured from the experience of personnel at all levels of management and they are shared and used while making decisions. The CAFM system is the media by which the knowledge is generated and disseminated with the active help of facilities manager providing the role of knowledge developer. The information from building management system is manipulated to maintain the assets using condition base maintenance against the routine periodic maintenance practices.

Case study has provided insight to the methods of knowledge capture and how they are used to deliver services when it is critical due to the nature of the client and the unique cultural environment. The study was conducted in a non-profit organisation and hence the impact of knowledge capture and its use is not certain in normal business environment where FM adds value to the business.

**Keywords:** Facilities Management, Knowledge capture, CAFM, BMS, UAE.

## Introduction

In facilities management function knowledge management makes a significant contribution. This ranges from the contractor's performance, assets' performance, benchmarking and many others that would help the facility to be available to its users. The economic crisis in the early 1990s was the triggering factor which led to downsizing of many organisations to reduce the operating costs. FM concepts and its practice became widespread thereafter. Hari et al (2008) established that organizational growth and innovation depend on the knowledge and expertise the staff of the organisation have. Knowledge is a commodity when used grows unlike other resources which gets depleted. Staff turnover thus impacts the knowledge possessed by an organisation and can be detrimental for its survival. Therefore, knowledge capture and its effective utilisation are very

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important for the organisation to remain competitive. Tai and Ooi (2001) conclude that there are three building blocks of FM professionalism including: a discipline that provides a performing workplace; professionals to get the facilities enhance the performance of the firm and thirdly FM must develop its own knowledge and toolbox in managing the facilities.

The British Institute of Facility Management (BIFM) defines Facilities Management as “the integration of processes within an organisation to maintain and develop agreed services which support and improve the effectiveness of its primary activities.” FM undertakes all functions which do not fall under the core business category (Goyal and Pitt, 2007; Waheed and Fernie, 2009; Bainbridge and Finch, 2009). For FM to be considered as a major discipline, it must contribute to the strategy of the organisation while making strategic decisions. FM contributions in the operations and other aspects of facilities have gained sufficient importance and have become an integral part of any organisation.

Tai and Ooi (2001) suggest that the specialist tools for FM should be built around the location of the organizational premises by developing a model for location choice based on the business performance. The other issue that requires FM concern is the type of the facility by understanding the requirements of work place for facility users.

One of the fundamental question's facility directors and managers in an organisation face is how to align the FM services with the organisation's strategy. Thus, appropriate facility management services are to be selected considering the requirements of the organisation and its stakeholders. (Chotipanich and Nutt, 2009). Knowledge built using data and information from the CAFM Computer Aided Facilities Management system are used to improve response, client satisfaction and optimise costs of services.

The use of Building Management System (BMS) allows introduction of various innovations in managing building services and other assets inside the facilities. Knowledge derived from the interaction with the BMS system and its exploitation in daily operations of the building services is also used extensively in delivering the services in all facilities.

Knowledge capture and use are ensured by the use of SAP solutions in the execution of the business. Knowledge is captured from the various studies provided to the management from various levels of management in the form of reports, memos, policies procedures forms the major part of the knowledge base. These are generated from staff, workers, clients and client representatives and close observation of the requirements of the client. The knowledge base available in the intranet formed the basis for various decisions by the senior management in the execution of the business. Knowledge capture and use in the strategic positioning of FM within the organisation strategy and its application in the business operation in the FM discipline is essential.

This paper provides a concept review of knowledge management with particular emphasis on knowledge capture and its utilisation applied to the FM sector, evaluate their extent when positioning the FM organisation, investigate the importance of knowledge capture and utilization in the conduct of FM operations.

## **Positioning Facilities Management**

Facilities Management discipline came into prominence in the 1990s and steadily gained foothold as a profession and discipline within the built environment. This led to the formation of professional bodies around the world like IFMA in the USA, JFMA in Japan, BIFM in the UK, FMA in Australia and MEFMA in UAE. These international professional bodies elevated the discipline to appropriate levels, so that the FM concept is considered essential in forming business strategies of any business organisation.

Nutt, (2000) contemplates that the basic function of FM is managing the resources in the strategic and operational level of support. He considers four basic trails to the future that corresponds to the resources that are central to facilities management. These are namely: financial, human, property and knowledge resources. Strategy is about preserving the ongoing options while being flexible and providing new options and to prepare for contingencies by providing responses with an intelligent system. Strategy is also to be aware of the capabilities and limitations of all the sides and should be ready with choices of option directed to achieve the operational success against competitors.

Fitting FM to a particular form of demand of the organisation is crucial and generally measured in terms of profit. Such needs should be compatible and can be detrimental to the conduct of the core business. FM involves the management of facility resources and the services that support the organisation in both operational and

strategic levels. The primary part of FM is the conduct of day to day task of providing a safe and productive working environment for the performance of the business. Besides, FM involves strategic issues like facility planning and development, property asset portfolio management and strategic property decision. To achieve this, it is essential to understand the importance of the position of FM in the organisation. Hence, the need for positioning FM as it responds to the organisation needs in many ways, influenced by culture, business objective, nature of organization and location of the facility. FM services are listed in Figure 1.

### **Factors in Aligning FM**

FM practice depends on a number of internal and external factors. The internal factors consist of organisational characteristics, features of the facility, and the sector in which the business operates. The external factors are the economy, society, environment, legislation and local regulations. Other external factors are the FM market peculiarities

and the local culture and context (Chotipanich, 2004). Quality and standards should also be taken into account apart from the customer expectations and tolerance. Furthermore, capacities and conditions of FM market, supplier capability and technology available in countries. National and regional priorities regulating FM practice and arrangement depends on the cultural, legal, environmental and social context of country or region. The FM practices that should be adopted in each place should reflect the priorities of the customers of that area, preferences, social belief and values and the local practice.

Fig 2 shows the relationship between the external and internal factors that determines the FM practice. Property, facilities and services are becoming directly aligned with business since they are important resources and need to be managed for long term strategic advantage. To manage the infrastructure resources and services that would sustain operations can only be achieved by positioning FM as an integral part of business. The supply chain management should also be streamlined to meet the business needs.

### **Aligning FM to the Organization**

Price (2004) highlights that FM impacts on core business but the degree of impact varies widely from business to business depending on the sector and competence. Chotipanich (2004) suggests a framework for aligning the global and generic knowledge, the best practices that evolved with the local and specific requirements of the organization that functions in a unique environment of its sector, country, location and social factors.

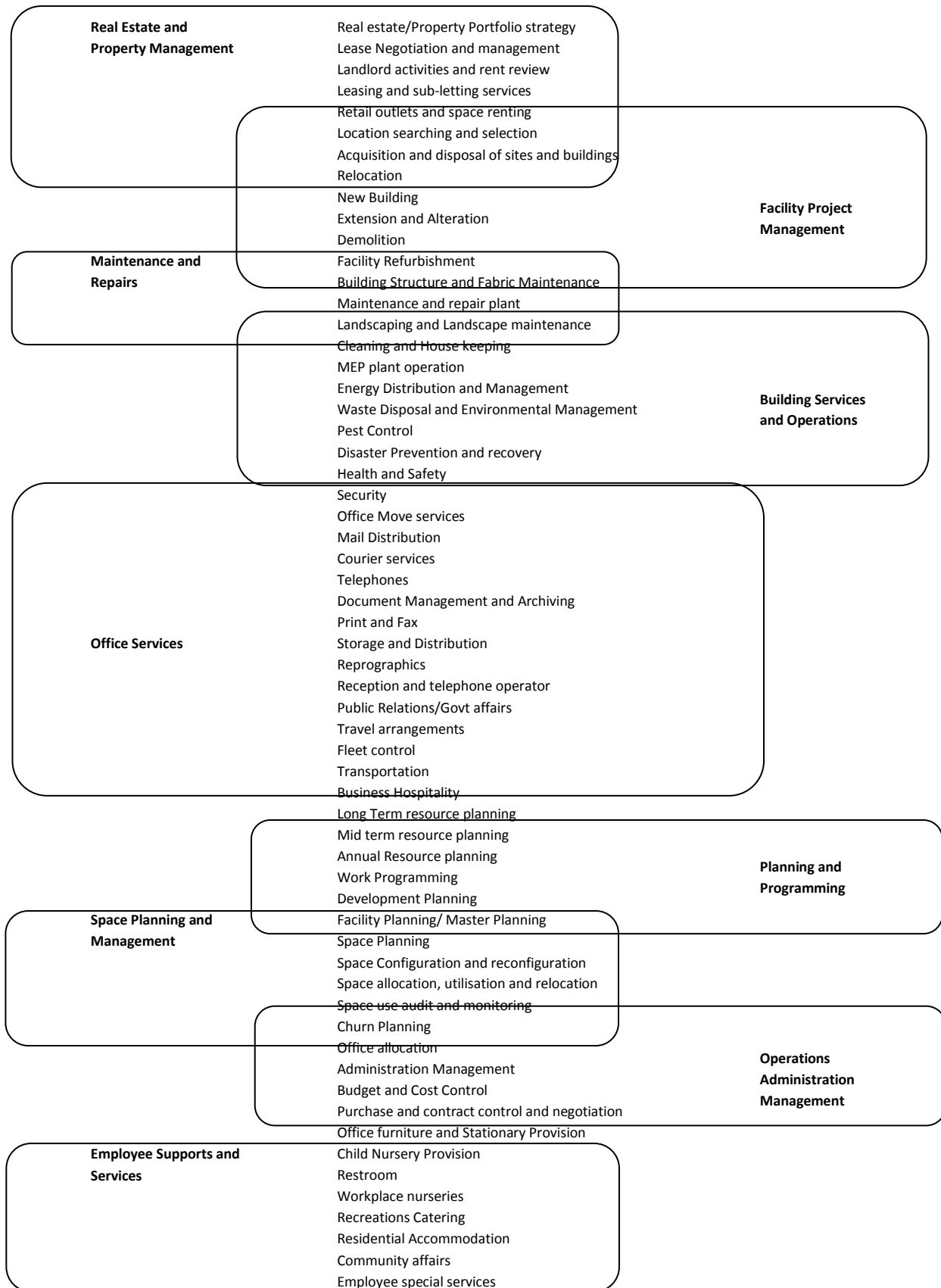
The proposed framework adopts a stepped approach. The first stage, deals with the identification of the features of the facilities and its operation process and thereby determining the scope of support services needed for the organisation. How critical is the availability of the facility to the core operations is then determined. The decision-making criteria throughout the process is determined by the internal and external factors. A framework for positioning the FM in an organisation is depicted in Fig. 3.

### **Knowledge Categories and Components**

Knowledge is a mixture of job experience, values, information on a particular context, expertise and intuition which provides an ambience and frame work to incorporate new experience and information. It is generated from people mind and entrenched in the process, routines, and practices of the organisation. Knowledge is an understating gained through experience. It is a set of knowhows for an individual to perform a specialized task in an organisation. Knowledge cannot be generalized and it varies from situation to situation (Awad and Ghaziri, 2007). Knowledge is one resource that when used gets more refined and open to further growth and marketability. (Awad and Ghaziri, 2007)

Knowledge can be classified in four dimensions namely:

1. technological or business oriented or even the environment.
2. operational or strategic.
3. complexity in the tacit or explicit category.
4. perishable over time.



**Fig. 1:** Support Service Configuration (Chotipanich, 2004).



**Fig. 2:** Environment of FM Practice (Chotipanich, 2004).

Tacit knowledge takes many years to acquire. Values, beliefs and integrity are related to knowledge. The integrity of knowledge shows its reliability, trustworthiness and confidentiality (Awad and Ghaziri, 2007).

Knowledge is categorized into tacit and explicit. Tacit knowledge is personal and relates to a particular context. Such type of knowledge is difficult to put on record or encode or to formalize or even articulate. Tacit knowledge resides in the heads of the people. The components of tacit knowledge are intuition, ground truth, experience, beliefs and intelligence. It requires a rich medium for communication and it is hard to manage share or support with IT. This component of knowledge is developed by means of trial and error that is encountered in practice. Explicit knowledge on the other hand can be codified and made available in a systematic and formalized document, databases, webs etc.? It is developed through explication of tacit understanding and interpretation of information. It is well supported by IT and can be disseminated through conventional media. (Awad and Ghaziri, 2007)

The key components of knowledge are ground truth, judgment, experience, values, assumptions, beliefs and intelligence. Any action or decisions taken in a business is made on a set of assumptions or conditions. This could be related to markets, customers' choices, competition etc. Information is facts, but knowledge has a component of judgment attached to it. It allows knowledge to go beyond an opinion and refines every time it is applied and acted upon. Knowledge is derived from experience and this allows developing subconsciously, the rules of thumb while working over a period of time.

A company's knowledge can be viewed in four levels. They are know-what, know-how, know-why and care-why. Know-what represents the cognitive knowledge. Know-how is the level where the theory can be put into practice through repeated exposure to complex real-world problems. Know-why level allows competing ahead of rules that might be common or existing knowledge. Sufficient incentives need to be provided to everyone in the organization to willingly share the knowledge.

### **Knowledge Creation**

Knowledge Management System is based on: knowledge acquisition, knowledge sharing and knowledge utilization. Data capture tools with filtering abilities support knowledge acquisition.

Knowledge management consists of 3 basic components namely the people, processes and technology. The people are the most vital for the success of KM, since knowledge has meaning only in the human concept and moves only amongst the people. KM can be processed in five steps namely: assess, design, develop, pilot and implement. Each of these steps has several interconnected activities. Technology includes hardware and software tools and collaborative tools like chat, white boarding, virtual learning, and professional forums form a part of the technology. Expertise location tools helps to find the subject matter experts while data

mining tools support data analysis that identifies patterns which can establish relationship among the data elements. Search engine tools and expertise development tools are also used in technology. (Awad and Ghaziri, 2007).

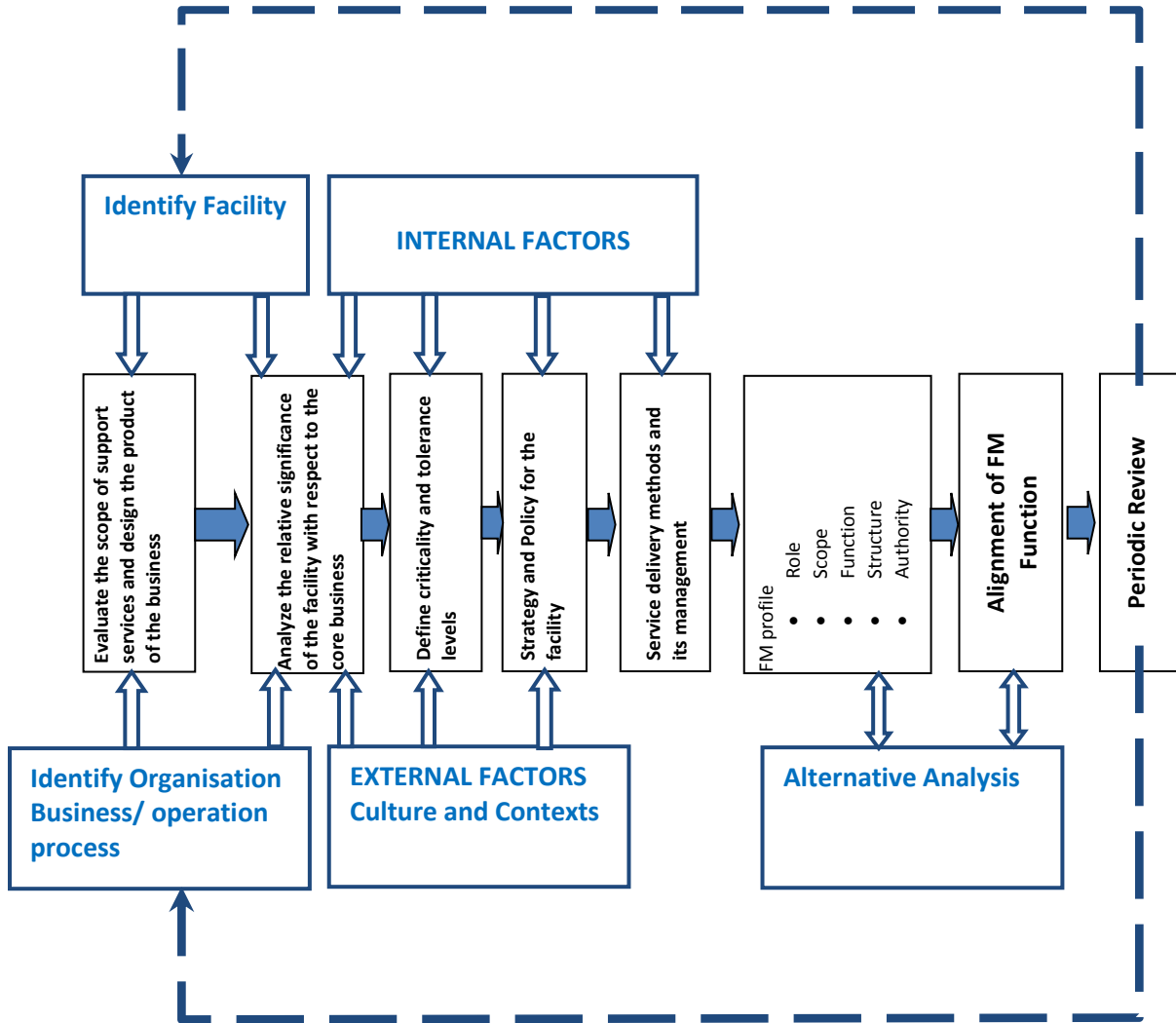


Fig. 3: Framework for positioning FM (Saropanich, 2004).

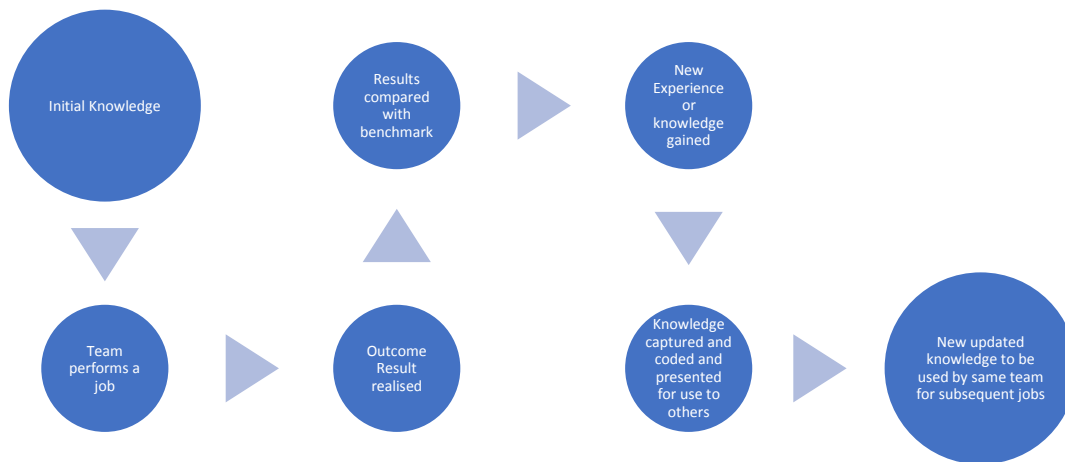


Fig. 4: Knowledge Transfer via Team Work.

Knowledge needs to be updated else it would be outdated. It grows when a team uses and learns new possibilities from it and updates their knowledge. The sequence for knowledge creation process by knowledge transfer among a team is shown in Fig. 4. There should be enough motivation to the employees to share their knowledge; else the chance of succeeding in the KM process is remote. For example, people who are extroverts are ready to share knowledge more easily than those who are introspective, self-centered or security conscious. In short, attitude, work culture, and individual personality determine how best the knowledge transfer and sharing is viewed by the team members.

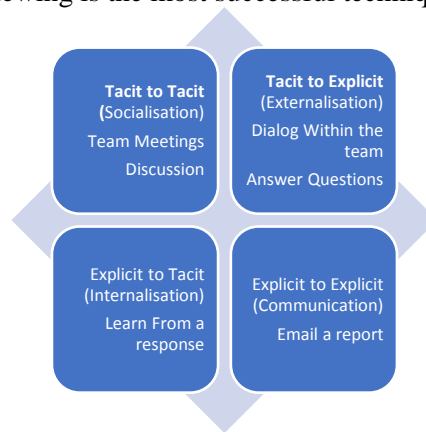
### Nonaka’s Model of Knowledge Creation

Nonaka (1995) divided human knowledge into tacit and explicit. Knowledge creation thus is to mobilise the tacit knowledge and converted with the help of technology to explicit knowledge as shown in Fig. 5. Tacit to tacit communication is generally the socialisation between people in meetings and discussions. Tacit to explicit communication is externalisation of the knowledge and can be extracted from the dialogues within the team by means of brainstorming or by answering questions.

Explicit to explicit communications is a form of communication where in the knowledge transformation is best supported by technology. Sending reports using email or webpage provides the knowledge to the needed beneficiaries and often considered as best form of transmitting explicit knowledge. Explicit to tacit communication is internalization where explicit knowledge is taken from reports and memos providing new ideas and constructive ideas. New tacit knowledge is generated while these ideas are put into practice. The focus, however, is on capturing and transmitting tacit knowledge to others. Current technology for capturing tacit knowledge faces many challenges.

### Capturing Tacit Knowledge

Tacit knowledge capture extracts problem solving skills from humans thereby forming the basis of a knowledge management system. Interviewing is the most successful technique to capture tacit



**Fig. 5:** Conversion of Knowledge between Tacit and Explicit Forms (Awad and Ghaziri, 2007).

knowledge. Concept mapping, interruption analysis, actions based on representation of knowledge, cognitive structure analysis, problem discussion, data flow modelling, entry-relation diagram and decision flow diagramming are some of the methods of interviewing with a purpose to capture the tacit knowledge.

Another knowledge acquisition technique is onsite observation. Often, experts are uncomfortable being observed, causing loss of desired result while performing the task. Brainstorming between experts by can result in a wealth of knowledge but can generate unwanted knowledge. Using electronic brainstorming helps capture relevant knowledge. Protocol analysis is a process whereby experts speak whatever thoughts that go through their mind while confronting a problem. Consensus decision making is used to arrive at a ‘best solution’ amongst the experts, but this process is tedious and time consuming. Nominal group technique is an alternative to consensus technique and is an idea generating technique. Delphi method is a series of surveys that poll experts’ responses in order to solve a difficult problem. Blackboarding is another technique which provides problem solving on common language for interaction. Knowledge developers should be able to

exploit management support and demonstrate the advantages of the knowledge management system. (Awad and Ghaziri, 2007).

### Knowledge Codification and System Implementation

Captured knowledge needs to be organised and codified to enable accessibility and transfer and effective use. Codification of knowledge is essential for knowledge transfer. The resulting knowledge base has uses in diagnosis, scheduling, planning and supply chain. Codifying tacit knowledge is complex and the methods used are knowledge maps, decision tables, decision trees, frames, production rules and software agents. Knowledge developers are more than software programmers.

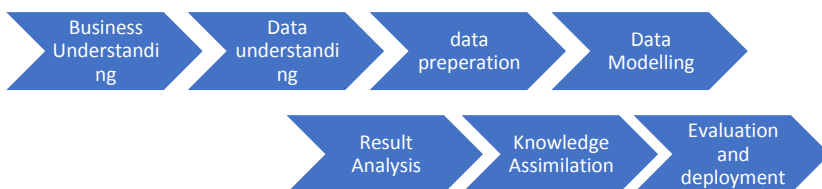
For knowledge to be shared it must be captured codified and deployed in a manner where the user can exploit it. Knowledge transfer means that knowledge derived from one individual or team is packaged so that they can be used by others. Knowledge transfer may be inhibited by: lack of trust, time, quality, presentation of the knowledge and the status of the knower. Knowledge is transferred by means of collective sequential transfer, explicit inter-team knowledge transfer and tacit knowledge transfer. Tacit knowledge transfer is unique especially where the projects are non-algorithmic as in construction or FM, where knowledge is stored mentally.

Technology has a profound impact on knowledge management systems. Intranet, extranet and internet provide platforms for idea generation and data exchange. Groupware, such as networking, video conferencing, customer relationship management, workflow systems, e-mail, calendar and scheduling support the value chain by organizing the activities of business so that each activity is accounted and adds value to productivity.

Processing data provides information and when information is interpreted and used to one's advantage it becomes knowledge. Data and information is available in the database, unlike tacit knowledge that resides in people. Utilizing data provides another form of knowledge capture. Using data and information in the decision-making process and applying to work tasks is also a form of knowledge management or in particular knowledge capture.

### Learning from Data

Learning is an iterative process utilising a combination of previous knowledge with added information. Data driven learning tools can create a model based on the pattern of the data that is available. The model operates on types of associations such as Boolean rule, quantitative rule, multidimensional rule and multilevel association rules. Neural network is a knowledge-based tool which uses electrically connected basic processing elements which are termed neurons. It can solve complex problems by having association rules and can continue learning as problem scenarios change. It provides an adaptive threshold while making decisions and this threshold varies as per the inputs. Classification tree is yet another tool for the prediction which also uses data. Data Mining is a process that produces knowledge and new patterns to describe the data. A typical DM process is as shown in Fig. 6.



**Fig. 6:** Data Mining Process in KM Context (Awad and Ghaziri, 2007).

Knowledge can be derived from the data and information with the help of human intervention and this knowledge largely remains with the individual who had generated it. Once this knowledge is shared and made available for others to use the knowledge grows and knowledge system would be in place. Computer



Aided Facilities Management (CAFM) has become a basis for any FM organisation to perform. CAFM provides data and business processes across departments to help attain knowledge and achieve the FM goals.

Similarly, automated systems such as Building Maintenance System (BMS) can provide maintenance data, as well as control and monitor energy requirements for thermal control, lighting, water, indoor air quality, fire safety system and distribution of information technology systems within the premises.

### **Knowledge and Facilities Management**

A knowledge base for FM which is evolved due to its peculiar nature is at its starting stage. Knowledge management in FM became necessary hence the need for FM in the strategy and operations of the organisation. One of the reasons for the success of the Japanese business is the culture of serving the company for long periods by the employees often for the entire life time. Such work culture and team building attitude provided a platform for knowledge sharing and dissemination. The total quality concept used by companies also enforced the preservation of knowledge and its dissemination to all employees. The concept of knowledge management came into being from this attitude towards work by the Japanese society. (Cole, 2005)

Knowledge management is significant in facilities management activities for two reasons. FM is a multidisciplinary function where the knowledge needs to be interconnected between the disciplines. The other reason is that FM is a knowledge intense industry and the amount of data and information created must be efficiently managed.

FM is a support service and is significant in today's management as they form the second highest cost after the cost of labor (Appel-Muelenbroek, 2010). FM adds value to the organization in five ways. Lindholm and Lavainen (2006) identify five ways where FM adds value to organisations. These are, reducing cost; increasing innovation; promoting sales and marketing techniques; increasing employee satisfaction; and increasing productivity.

Heerwagen et al, 2004 highlighted that space design in buildings can add value to knowledge sharing by increasing interaction between employees. Rashid et al (2005) confirms that employees behavior in use of space at work affects people. Designers can provide workspaces that can stimulate knowledge sharing by effectively providing space for individual, open areas and space for casual and formal meeting amongst them.

### **CAFM and BMS in FM**

Modern CAFM evolved from earlier space management tools and is used for knowledge generation through data generated from functions such as customer relationship management (CRM), room booking, front office management, space management, asset management, human resources, inventory management and logistics, procurement functions, preventive and breakdown maintenance, financial management, fleet management and others.

BMS is a platform that monitors and controls building services namely HVAC, energy management system, thermal and shades control, lighting and dimming, water quality and usage, irrigation and water pump control, safety and security systems, indoor air quality and audio and visual systems. BMS also provides data and information which is used for planning and execution of maintenance activities and also for knowledge capture. The backbone of the building management system is the structured cabling which can effectively transport the information efficiently and effectively.

### **Computer Aided Facility Management (CAFM)**

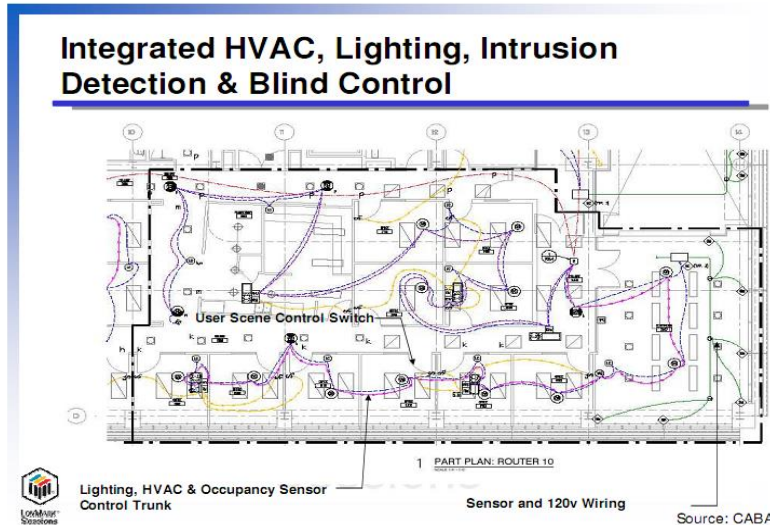
The main features of CAFM are the interactive database, interactive graphics and data management tools. CAFM is widespread in the FM industry, although it requires customization to meet the needs of clients. CAFM explorer, Archibus, QFM, Apollo, Axiom, Impact and Concept are some of the types of software. Bainbridge and Finch (2009) found that functions using CAFM most widely were: work order management, asset maintenance, reactive maintenance and planned maintenance. Geographical information system, fleet management and the mailroom services are the least used functions. CAFM tools generates data and

reporting used by higher management.

CAFM applications adapt and change as per the requirement of stakeholders depending on the information it generates. CAFM has the capacity to provide vast amounts of data. Conversion of these data into information and knowledge depend on the economics of attention (Davenport and Beck 2001).

### BMS and Intelligent Building

BMS by virtue of its use provides data on the systems that are installed at the building. HVAC system in a building is the most critical equipment that needs constant attention as well as strict maintenance regime. Other systems that requires attention is the water distribution network, swimming pool and waste water recycling and sewage treatment plant. Fire detection and suppression systems are also monitored on a continuous basis with the help of BMS and provide a database on this account for analysis.



**Fig. 7:** Typical Building Automation System Source: Lonmark Session 2008.

Building Energy Management System (BEMS) use the BMS and controls and actuates various energy consuming equipment so that the energy is least consumed taking into account of the various penalty clauses while using energy. BMS is also an advantageous tool in maintenance of the assets so that they are at optimum conditions all times. Fig. 7 shows a typical building automation system that uses occupancy sensors so to optimise the use of lights and thermal comfort system so that the energy usage is controlled. The BMS, BEMS and BAS functions can be integrated with CAFM.

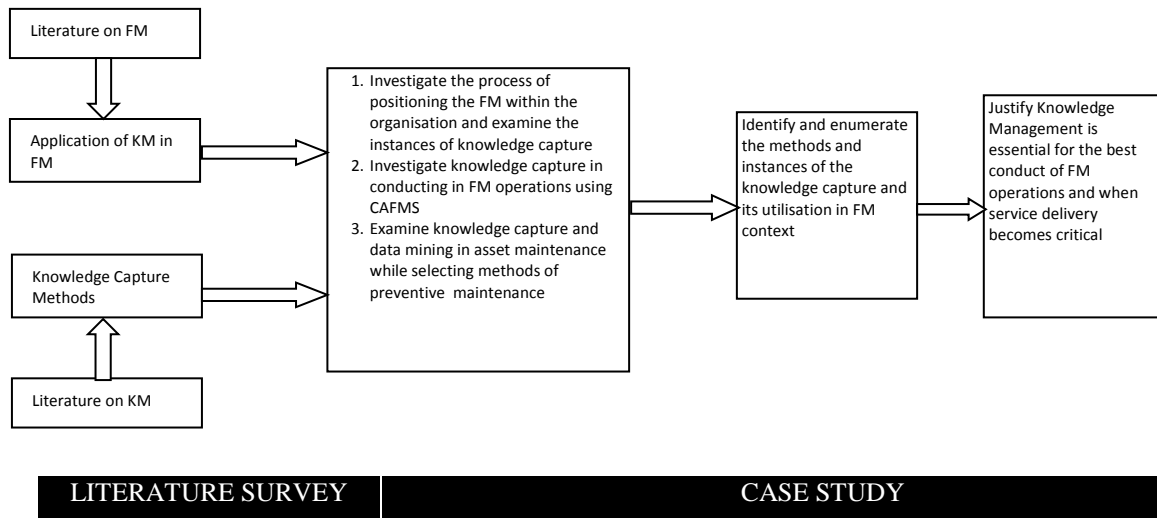
### Research Methodology

The information used for the study is based on a major case study in Dubai. The case study is conducted in an organisation responsible to provide facilities for the Dubai royal ruling family for their living, leisure, business and private activities. Facilities like Palace, Luxury Villas, Sports Complex, offices, island resorts, horse stables, camel pens, race tracks, grand stands and research centres for horses and camels are the types of facilities being managed. The research explores the concepts of knowledge management systems used in FM within the organisation. The organisation grew with good information and technology infrastructure to support the design and construction of future facilities and a Facilities Management department was added to it. All FM operations were done in-house due to the large number of facilities and critical nature of the service delivery. The use of Computer Aided Facility Management (CAFM) was a natural requirement for the conduct of operations. Use of CAFM and the conversion of vast amount of data and information into knowledge became a necessity to provide services to the level required by the client. Most of the times the service delivery becomes mission critical due to the special nature of the client and the service is to be delivered with perfection and in time. Therefore, knowledge capture and its utilisation in the provision of such levels of service became an integral part of the FM operations.

Building Management System (BMS) is a tool used to control and operate various building utilities system especially the Power, Heating Ventilation and Air-condition (HVAC), Water Distribution system, Fire Safety and suppression system and security systems. BMS also allows the control and monitor of the building systems from remote locations. This allows effective asset management so that the assets are available whenever it is required. The data and information received from this system can be manipulated so that the assets are maintained in an effective way. They can be used in the condition-based maintenance so that the costs involved can be minimised and also the replacement of assets can be planned much in advance. Knowledge on the assets can be developed using the BMS and decisions on various aspects of the assets can be taken accordingly.

### Knowledge Base

The use of intranet to conduct the business helped building a knowledge base over time. This base was used for exchange of various policies and procedures and reports from the various heads of department on most of the issues of the conduct



**Fig. 8:** Case Study Method.

of the business. Access to this folder was restricted only to the intended users. The generation of such reports is based on the inputs from the lowest level of the organisation by means of meetings and other interactions with the client and other users of the facility. Knowledge base improved when SAP system is introduced. All the processes starting from the design of the facility, project management of the construction, procurement and contracting the job packages, human resources management and facilities management have been integrated into the SAP platform providing information of all aspects of the conduct of the business. This helps in the retrieval and archiving of all the documents that the organisation uses for its conduct of business. The complete facilities management package in terms of the call centre, asset management and tracking, work order generation, manpower utilisation, daily work scheduling, supply chain management and procurement processes. Quality control processes of the service delivery and customer satisfaction monitoring is also done with this package.

Building Management System is widely used in all the facilities for the control and monitoring of the HVAC and other electrical system. HVAC systems forms the core of the building asset that needs good care and directly affect the living of the client. Knowledge base from this system plays an important role in the maintenance. It can help to streamline the Planned Preventative maintenance in the long way.

As the organisation depends on the intranet network for the conduct of the business, major decisions by the management in the set up of the FM functions and its positioning in the organisation with respect to the other functions like the supply chain management and other functions of the organisation are examined. This study examines strategy changes in the organisation and establishes the existence of the knowledge base at every level for the delivery of service. The documents which made the path to such decisions were analysed and the methods of knowledge capture from various levels is brought out. The knowledge management system is

new in the organisation and knowledge base established to fit the nature of both culture and work environment of the organisation.

All FM functions are managed and operated using CAFM in this organisation. Several changes in the mode of service delivery were put into practice depending on the facilities managers and director who assumed this position. The FM director was changed four times since the FM department was formed. Each director brought in several changes in the service delivery depending on the strategic brief he receives from the senior management and the experience he had in this field. A knowledge base for FM was built due to these changes while implementing changes in processes and procedures to incorporate the directions the new team brings in. The client also demands new requirements at the facility, which would require refurbishment, extensions etc to the facility. The process of providing these additional requirements also provides knowledge base pertaining to the facility. These additional requirements are carried out using the SAP platform incorporating the processes that are used in the organisational level. This provides a knowledge base on the facilities that are managed. Knowledge capture using the CAFM package and the SAP is examined and its dissemination among the FM operators and managers.

The Building Management System is used to control and monitor the HVAC, power, lighting and water in a facility. The system provides plenty of data on the operation of these assets in the villa. We do get alarms, fault notification and usage details of the above systems at the facility and at a remote central control centre. The central control centre helps to monitor several sites and this can optimise the service delivery and plan the preventive maintenance effectively. One of the facilities the organisation provides FM services is a central kitchen which provides food and beverages for all the palaces and royal facilities. The kitchen caters Continental, Chinese and Arabic type of foods for about 2000 persons twice a day. The kitchen has several equipment which uses a state-of-the-art extraction system consisting of several filters. A gas and fire safety system are the nerve centre of the safety system of the kitchen. The cooling, fresh air circulation and extraction system at the kitchen requires constant monitoring and control of the mentioned system. BMS plays an important part in the maintenance of these assets. The filters for the extraction system require constant regeneration and renewal which constitutes the major expenditure in the maintenance. Instead of periodic renewal of the filters, a condition-based change of filters was introduced with the help of data from BMS. This brought considerable savings in the maintenance of these assets. Later this concept was extended to the HVAC system and provided more cost optimisation in the operation of the system.

## **The Case Study**

One of the important factors for the delivery of services is access to the facilities especially for the services inside the facilities. The design of the building and its services provides access to many of the assets without disturbing the occupants. Remote monitoring and control of building assets also help to minimize the access problems to the facilities.

Case studies are conducted in three different areas while positioning the FM organization within the overall business environment, FM operations based on the CAFM system and the use of BMS in optimizing the preventive maintenance cost. SAP, Intranet network and close interaction with the FM operators and managers formed the foundation of the case study.

## **Organization Background and Strategy**

The requirements of the royal family in the initial period were for the creation of horse stables and expansion and refurbishment works of existing two palaces. As the family started expanding new palaces and villas were to be constructed. The maintenance and asset management were also part of the construction team. This made the construction cost too high and the organisation found that all activities including the facilities management were clubbed into each project and control measures were difficult to implement.

As the royal family requirements grew in terms of new buildings and resorts the number of projects rose rapidly. The organization have a full-fledged design department, construction department, joinery factory, landscape, transport and plant equipment and all of the construction were done by this organization. Each department had its own procurement and stores function. As the number of facilities increased requirements also increased. To

meet the client’s requirement, it was decided by the senior management that a new department was formed which would manage all the facilities with function like other departments. The responsibility of the FM department was to operate and maintain all the facilities and deliver the services as per the client requirement.

**Positioning FM**

The various factors and the phases involved in the decision-making process for positioning FM in the organization is tabulated in Table. 1.

The necessity of having a FM department in the organization was brought out by an external audit in the year 2006. This audit document became the basis for the provision of ERP based system for the daily operations of the organization. SAP system was chosen for this purpose. This ensured that the intranet network is firmly in place. To facilitate the exchange of communication in the form of memos and reports and easy access for the department directors a folder with rights for them is made. This folder with all the documents formed the knowledge base for the senior management in formulating policies.

Use of intranet within the organisation helped in exchange of knowledge which was built by each department based on the experience of the persons involved in the department.

The knowledge about the facility resides with the operators who are on the field. The operators are the interface between the organisation and the client. The important step of the knowledge management is to identify and validate the knowledge. This is done by the facilities manager. Unlike other products where there are several methods for the user to get attracted by providing improved quality of the product, service delivery in FM context is to meet the need of the user when the user wants. Facilities Manager identifies the knowledge pertaining to the facility when he observes the work done by his operators at site. He also receives the feedback from the site by way of customer satisfaction and by interacting with the client. The tacit knowledge of the operators at site is converted to explicit knowledge when the Manager uses them to make reports or memos to ask for resources to complete his task. He also takes information from CAFM and analyse them and provides reports to the director so that he can provide necessary inputs to the senior management for resources. Use of intranet within the organisation helped in exchange of knowledge built by each department based on the experience of the persons involved in the department. CAFM also have provision to capture all documents that are being exchanged in the organisation. This can be searched and accessed by users as and when required.

**Table 1:** Summary of process while positioning and repositioning FM in an organisation.

	1	2	3	4
Strategy	Setting up Facility Management Department	SAP Software Implementation	Restructuring of organization due to the recession	Complete outsourcing of all activities including Facilities Management
Significance of the facility	Facilities for the living, leisure and business for the ruling royal family	No Change in the Significance of the facility	No Change in the significance of the facility	No changes in the significance of the facilities
Criticality and Tolerance	FM functions are very critical. Being the royal family, it is necessary that the facility is always available and modern methods of service delivery needed. The response time need to be the quickest possible for the royal family. The service delivery for other places where the royal family does not visit is not critical	FM functions are critical. The tolerance level also did not have any change. There are no changes in the criticality and tolerance	FM Functions are still critical in this changed scenario especially for the facilities for the royal family. In all the facilities the tolerance level of the client changed	An FM function continues to be critical for the living of royal families. The tolerance levels by the clients from the various facilities also changed.

	but the quality of service need to be high. Availability of the facility is always very high and the systems should be functional at all times			
Facility Policy and Strategy	A separate department would implement all the FM functions needed for the facility at the most optimal cost. The facilities are divided into categories as per the client. The client being the royal family, the standard of service need to be determined as per the position of the client in the royal family. The purpose of the facility also is to be considered. The strategy of service delivery is to be done using the resources the organization has.	All business processes concerning FM is also included in the SAP. The procurement, supply chain, budgeting, logistics etc are centralized and streamlined using SAP.	All business processes are streamlined to reduce the checks and balances in the system. 20% of manpower is reduced. As per the senior management the facilities which are independent business units like stables, Grandstands and Laboratories which reduced the number of facilities.	The business processes are changed so that outsourcing of functions could be done in a professional way. Hence separate procurement teams are made to handle for each department
FM Profile	The role of FM is to ensure the availability of the facilities that is used by the royal family. It is responsible for the provision of all services that includes the comfort, safety and security of the occupants. The living of the royal family is the core function. To support this, FM function is to provide the requirements of the client in all aspects. The requirements which need to be completed also depend on the approval from the royal family. The organization structure should also be tailored to that need. In some facilities there is a requirement of providing the services without interruption. In such places quick response team is to be positioned. Hence an organization structure with in-house team and outsourced team for specialized services are to be used in providing the services. The director of FM is authorized to take decision	In addition to the above role, event management also became an FM function. The events ranged from Royal Wedding, Private theme parties, Official Royal Functions and other charity functions.	The role of FM continued to remain the same. The in-house team continued to bear all the tasks concerning the service delivery. However, outsourcing also continued on a case by case approach so that the effect of reduced manpower is nullified.	All facilities management functions are outsourced. Appropriate SLAs, KRAs and quality inspection procedures are put in place for the smooth function of Facilities.
Position of FM Function	FM function is positioned along with Construction, Project and other departments.	FM function became more important but continued to be treated like other departments. FM functions are also included in the SAP	FM functions became even more important in and cost optimization became very critical. The FM functions are also positioned in such a way that the	FM department became more important as all the activities at each facility is carried out by FM department so that coordination and utilization of existing

			functions are performed with direct involvement from senior management	resources at site could be implemented.
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**Knowledge Capture and Utilisation using SAP**

The SAP platform provides the CAFM for the conduct of FM operations. Work orders provide huge amount of data and information with respect to the FM service delivery which can be accessed from SAP. An overview of CAFM process in the SAP package is shown in Fig. 9. The data and information available from the CAFM system provides a knowledge base that can be utilised for service delivery. The organisation’s policy is to outsource all the FM functions. For this purpose, SLAs for each facility, the assets on each facility, response time and other details of the facility is to be spelt out clearly. CAFM provides this knowledge base. In addition, it gives the details of the resources the organisation have. Several reports are available so that decisions at all levels can be taken with confidence. Data mining concepts used in the knowledge management is used abundantly.

**Knowledge from BMS and its Utilization**

All the facilities use BMS to control and monitor all building services functions so that the facility is always available. For example, BMS used in the central kitchen is subjected to close scrutiny, the airflow in the kitchen is most important so that the environment is kept healthy as well as comfortable for the preparation of food. Continuous conditioned fresh air is required to be allowed inside the kitchen. The air at the hoods needs to be extracted efficiently so that cleanliness is maintained. BMS is used so that the right environment inside the kitchen is maintained. Fire safety its suppression and gas safety is also managed using the BMS. BMS monitors filters normally changed after 5000 hours of operation. The air flow after the filter is monitored and the reduction of the flow to about 30% determines the criteria of the cleaning and change of filters. 30% criteria were chosen based on the condition of filters that completed 5000 hours of operation. The replacement of bag filters is done based on the condition of the filter.

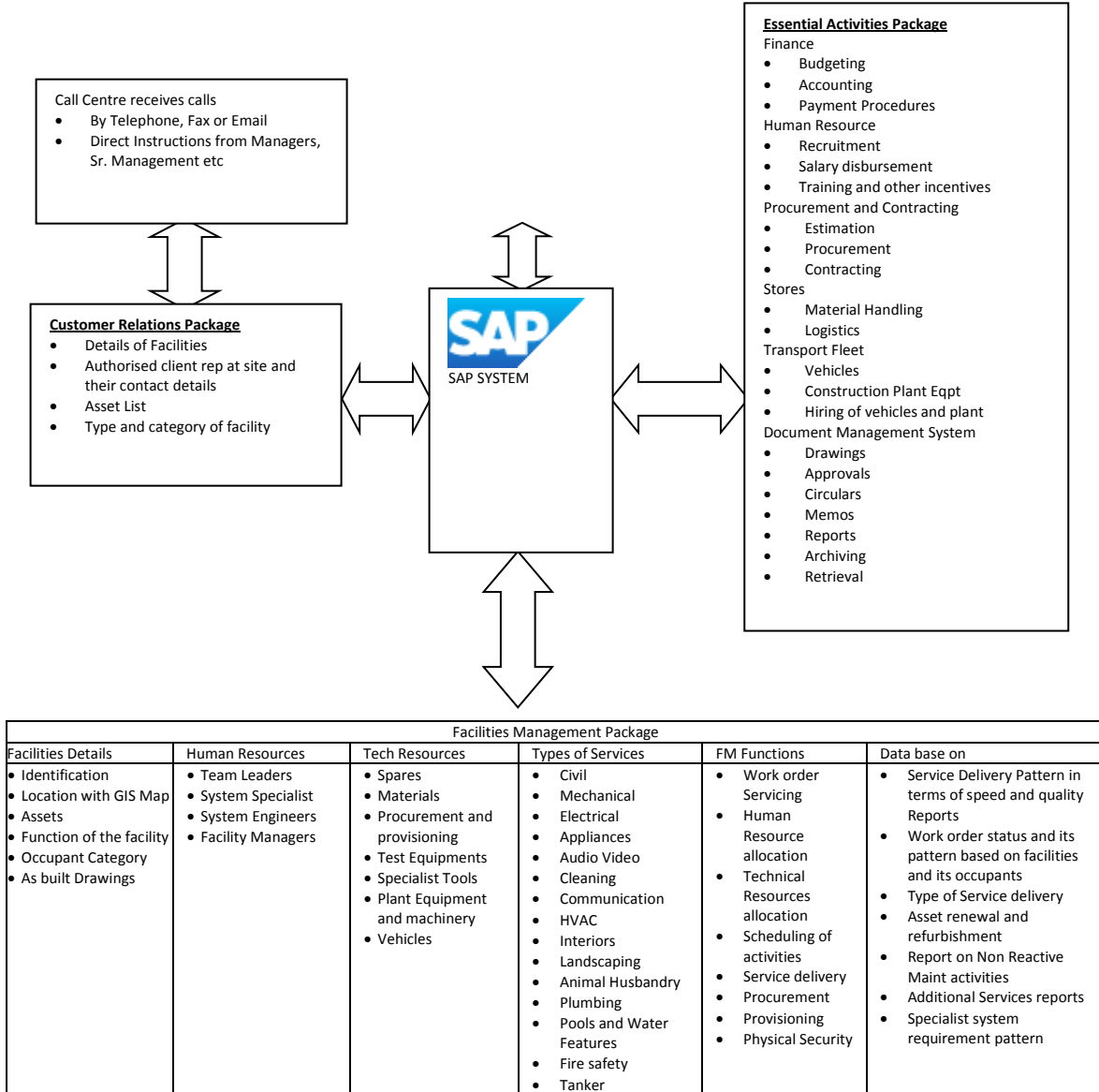
The above study shows that optimisation in operation is possible by manipulating the BMS data and the information it gives. Several instances of energy management is also done using BMS. The facilities which are used only when it is required use the BMS to manage the energy usage. Swimming pool temperature management is done remotely. Light and temperature control inside the facilities is also done using BMS. A control centre with remote monitoring and control helps to manage human and technical resources. Since BMS data and information is facilities specific it gives a knowledge base on particular facility.

SAP provides the platform for the FM operations. An overview of the business processes and a general overview of the process flow with emphasis on FM package are given in Fig. 9.

**Discussion**

The study was conducted in the organisation to ascertain the methods of knowledge capture using the organisation intranet and SAP enterprise software. The organisation changes very rapidly and the changes are brought in without any overlap period. The service delivery to the clients in spite of the abrupt changes in the organisation did not suffer any setback but continued to be normal. Several changes were made in FM organisation. The introduction of CAFM and use of BMS helped to provide the service delivery without fail so that the client satisfaction level is maintained.

Hard and difficult economic situation led to workers losing their jobs. The situation provided unskilled manpower the opportunity to learn new skills and perform so that they can look for other avenues. All critical facilities had permanent FM operators especially where client is in direct contact with the operators. Most of these operators have about an experience of over ten years and had the knowledge about every aspect of the facility. In spite of the difficult work environment they continue to be with the organisation. They provide valuable inputs to the facility managers and director so that the service delivery is not affected. Facility mangers

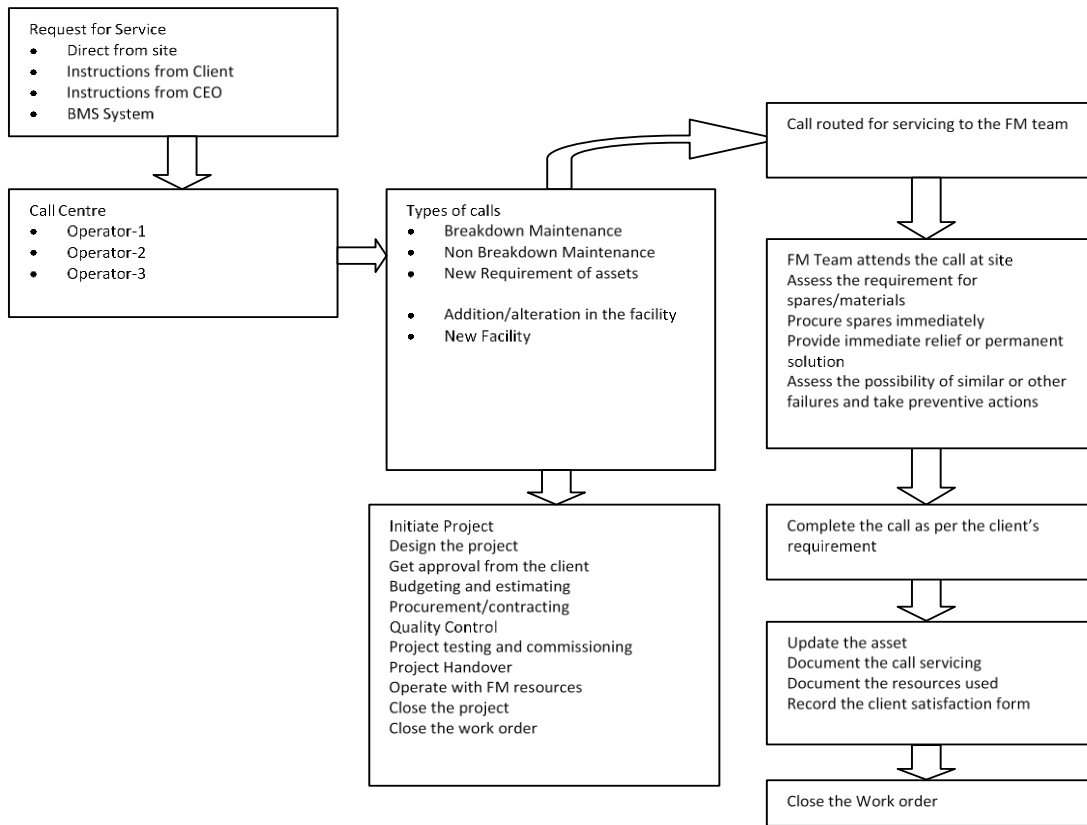


**Fig.9:** Overview of SAP and General Business Process of the Organisation.

who accept the job are forced to learn about the facilities and the mode of service delivery quickly and need to perform within a short time. Knowledge base from the CAFM and the intranet gives them a quick start and for their own benefit is updated as per the conditions. At the facilities the workforce who looks for better opportunities in their career tries to exploit the BMS and the intranet available at the site to learn from the system and consequently contribute to the knowledge base.

The senior management did not make any effort to provide an environment for a formal knowledge management system. However, the introduction of enterprise software helped to manage the business in such a way that they use the knowledge that was built up in the system. This was evident in the circular when the latest changes in the organisation were introduced. The circular mentions that there existed organisational gap





FM KNOWLEDGE BASE DERIVED FROM CAFM INFORMATION		
Outsourcing criteria	Resources Optimisation	Types of knowledge generated
<ol style="list-style-type: none"> <li>Determining the SLAs for each facility depending on the type and occupant</li> <li>Enumerating the assets with its specification</li> <li>Availability of assets at sites for the client</li> <li>Response time</li> <li>Use of BMS</li> </ol>	<ol style="list-style-type: none"> <li>Human resources in deployment, scheduling, recruiting and retrenchment</li> <li>Availability of Plant Machinery and test equipment</li> <li>Availability of specialist equipment</li> <li>Priorities of service delivery</li> <li>Quality of service offered</li> <li>Proactive service delivery in special circumstances</li> </ol>	<ol style="list-style-type: none"> <li>Expenditures on each facility and its details</li> <li>Resource utilisation</li> <li>Asset renewal/ refurbishment</li> <li>Response time analysis and its improvement</li> <li>Utility Bills analysis</li> <li>Energy Management</li> <li>Availability of assets</li> <li>Client Satisfaction report analysis</li> <li>Client requirement analysis</li> <li>Feed back to the design specifications while providing new facilities to the same client</li> </ol>

**Fig. 10:** CAFM Package Process - Knowledge Capture and its use.

based on the past performance and the organization is determined to correct them. A thorough study and accurate analysis of the organisational situation forced them to align with the depleted resources so that optimum output from the organisation is achieved in the prevailing adverse economic conditions. The organisation has also found that in the present situation it is to focus on facilities management so that the operating cost of the facilities is brought to optimum level from the knowledge it has acquired over the past years. It is also envisaged that all the functions of the facilities management is to be outsourced so that the organisation is kept lean.

On studying the function of facilities management in the organisation it was found that a facility manager has an important role as a knowledge manager and effectively absorbs the tacit knowledge prevalent at the site by means of close working and observation at site. This would have profound effect on the memos, reports the

manager makes to the higher management. To introduce or to identify the accurate model for the FM operation the facility manager requires excellent knowledge on the facilities and this knowledge is available with the operators or the technicians who are at the facility. It is the responsibility of the facilities manager to acquire the knowledge from the site and make a knowledge base for the use of higher management and also for the subordinates and peers. Knowledge capture and utilisation is built in an environment where intranet, CAFM and BMS is in use. The facilities manager and his team can act on this knowledge base so that their tasks can be completed in a professional manner.

## Conclusions

In conclusion it can be seen that knowledge capture and its utilisation is an important factor in facilities management. Facilities Management has two roles in knowledge management: ambience and space management. Furthermore, for the facility managers to perform their tasks they need a knowledge base and systems to conduct FM operations and service delivery. FM is a provider of knowledge as well as an exploiter of its own knowledge base. FM service providers need to use knowledge management techniques in order to resolve the challenge of making customer facilities on time when needed. Also, FM discipline is more competent by gaining formalized knowledge from experience and by actively involving in the delivery of the final product. This has elevated FM discipline as a significant contributor to the value of organisation. Facilities management has gained strategic importance in the conduct of business.

The space created for the conduct of business and its continuity to meet user requirements is possible only if adequate knowledge about the facility is available and can be accessed when required. As FM permeates the boundaries of many of the primary activities of the organisation, it interacts with external supply chain of various service providers, internal users like owners, clients or decision makers and also context specific external stakeholders like consultants. This generates a knowledge base which holds the most strategic value of knowing the relationship between the performance of physical assets and their impact on the clients and others using them. For an effective KM system such knowledge has to be identified, captured, codified and disseminated for use.

The capture of tacit knowledge in FM is most challenging. This is captured by means of observation by a knowledge developer, narration by the worker and reports to the developer or his superiors. The other forms of tacit knowledge capture are interviews, meetings and brainstorming. Tacit knowledge is then converted to explicit knowledge. Explicit knowledge is to be identified and filtered and needs to be codified. The codified knowledge is then put in an intranet environment so that they can be accessed by others. What is the most used method to capture tacit knowledge in the case study? Data from ICT network can be manipulated using data mining techniques to provide knowledge on the facility data using tools such as CAFM and BMS. The data is expandable.

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