FACILITIES MANAGEMENT

Case Study

AN INTEGRATED COLLABORATIVE APPROACH FOR FM – SYDNEY OPERA HOUSE FM EXEMPLAR

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ABSTRACT

This paper presents an integrated collaborative approach for facilities management (FM), which utilises the Sydney Opera House (SOH) as an exemplar case study. The approach deals with *Benchmarking*, *Procurement* and *Digital Modelling* as a whole and develops collaboration between them. It aims to achieve innovative FM strategies and models that will possibly have a direct benefit role for the Australian facilities management industry.

The *Benchmarking* theme focuses on the asset maintenance of the performing art centre, iconic building and facilities with similar functionalities. Critical success factors in the functional areas of asset maintenance are identified against organisational objectives of the SOH and key performance indicators are developed. The *Procurement* theme focuses on the maintenance service procurement, especially for outsourcing. Procurement methods and a multi-criteria assessment approach for supporting decision making are discussed. Suggested collaboration between *Benchmarking* and *Procurement* includes sharing of the benchmarking data and utility of key performance indicators to support procurement strategies. The *Digital Modelling* theme develops building information modelling for facilities management and investigates the potential of state-of-the-art information systems to enable a future integrated platform to support facility management collaborative activities and processes.

Keywords: facilities management, benchmarking, procurement, digital modelling

1.0 INTRODUCTION

A unique opportunity has arisen whereby the Sydney Opera House, the Australian Government, the CRC Construction Innovation, the Facility Management Association of Australia (FMA) and industry participants are in a position to jointly support the Sydney Opera House as a FM Exemplar Project (Facilities Management Action Agenda, 2005) that showcases innovative methods for improving FM performance and promotes best practice within the facilities management industry.

The Sydney Opera House FM Exemplar Project consists of three key research themes: benchmarking, procurement and digital modelling for FM. Whilst each of these themes represents a key area of research, the goal of the research is to link each of these themes together to produce an integrated Facilities Management framework.

This paper presents the research to date of the Sydney Opera House Facilities Management Exemplar Project. Section 2 presents a benchmarking framework to identify the best practice and establish benchmarks of interest by the SOH and the FM industry, which includes the development of key performance indicators and data collection. Section 3 discusses the procurement strategies based on the SOH cases and a possible future collaboration between benchmarking and procurement through data sharing and references of key performance indicators. The development of digital modelling for FM and recommendations for an integrated platform for facility management that provides data sharing and supports collaborative FM activities are presented in Section 4. The final section provides a conclusion.

2.0 A BENCHMARKING FRAMEWORK

2.1 BENCHMARKING IN FACILITIES MANAGEMENT

Clearly, the role of facilities management is to support the fundamental activities of an organization or a facility in particular. Hence, the objective of the facilities management functions should be compatible with and reflect those of the organisation.

Benchmarking systems in facility management can be employed to monitor, control and improve or to simply to rank the organisation and its assets according to its performance targets. Benchmarking can be performed by an organisation internally; or as an external exercise between comparable partners; or to assess and evaluate the development of a performance indicator over time. Figure 1 illustrates a proposed benchmarking system to assist the SOH in achieving their strategic objectives with respect to asset maintenance.

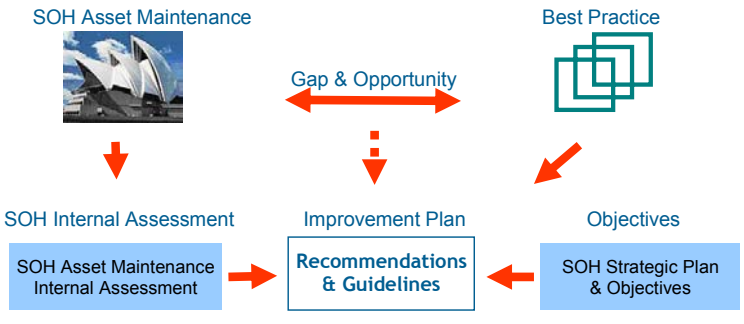

Figure 1. A proposed benchmarking system to assist the SOH in achieving their strategic objectives.

A classification scheme for applications of benchmarking in facility management was developed in this project, in order to be able to identify typical and especially successful benchmark types for specific objectives. The scheme is shown in Figure 2 for the example of the Building Fabric Index (BFI), as used in Sydney Opera House. The BFI is used with the objective of "monitoring and controlling": it is a quality benchmark, it looks at the trend of performance over time ("historic"), it is related to a specific function ("functional") and it has no driver ("none").

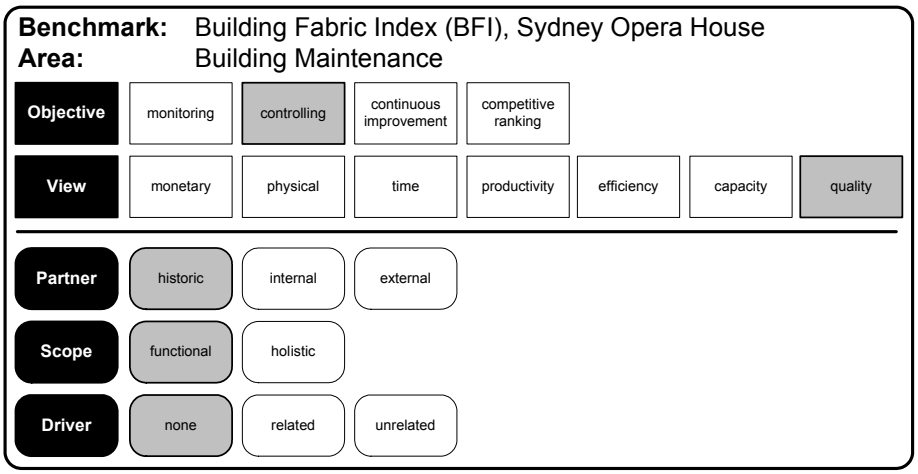

Figure 2. A classification scheme for benchmarks using the Building Fabric Index (BFI) of the SOH as an example.

2.2 A BENCHMARKING PROCESS FOR THE SOH CASES

Based on the standard benchmarking process structure (Camp, 1989), a benchmarking process for the SOH cases has been developed, see Figure 3.

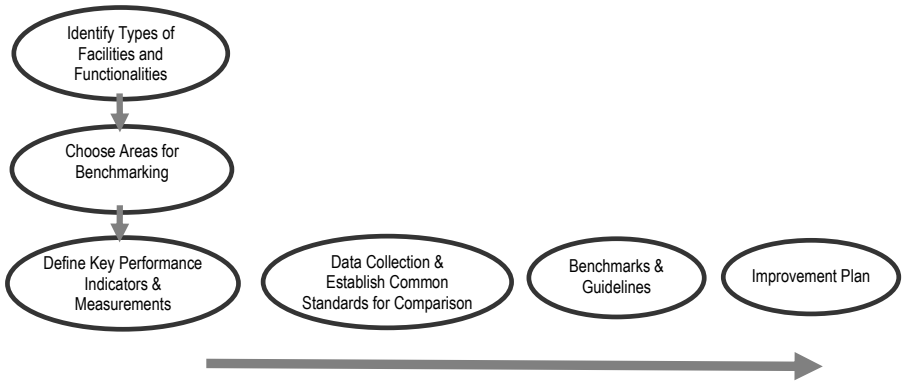

Figure 3. A benchmarking process structured for the SOH cases.

Identifying types of facilities and functionalities refers to finding a group of facilities with similar characteristics, core business or comparable functionalities for benchmarking.

Choosing areas for benchmarking selects features which are most valuable and relevant to the SOH for benchmarking.

Defining key performance indicators & measurements describes performance objectives in terms of key performance indicators and establishes measurement methods and metrics.

Data collection and establishing common standards for comparison refers to collecting data from a group of benchmarking partners and establishing common standards such as data structure and format for comparison.

Benchmarks and guidelines identify benchmarks in the areas of interest and delivers recommendations and guidelines for the SOH and the FM industry in general.

Improvement plan assists the SOH or the FM industry in improving performance in the asset maintenance area in terms of the benchmarking outcomes.

2.3 DEVELOPMENT OF KEY PERFORMANCE INDICATORS

The Sydney Opera House has the primary function of a "Performing Arts Centre". It is at the same time an "Architectural Masterpiece" and a "Heritage Building" and further is of "iconic" value for 20th century architecture and contributes to the tourism value of Sydney. These values bring objectives and requirements with them, which have to be integrated with or aligned to the objectives of the facilities management functions.

The development of key performance indicators (KPIs) is presented following a systematic structured approach as it is illustrated in Figure 4.

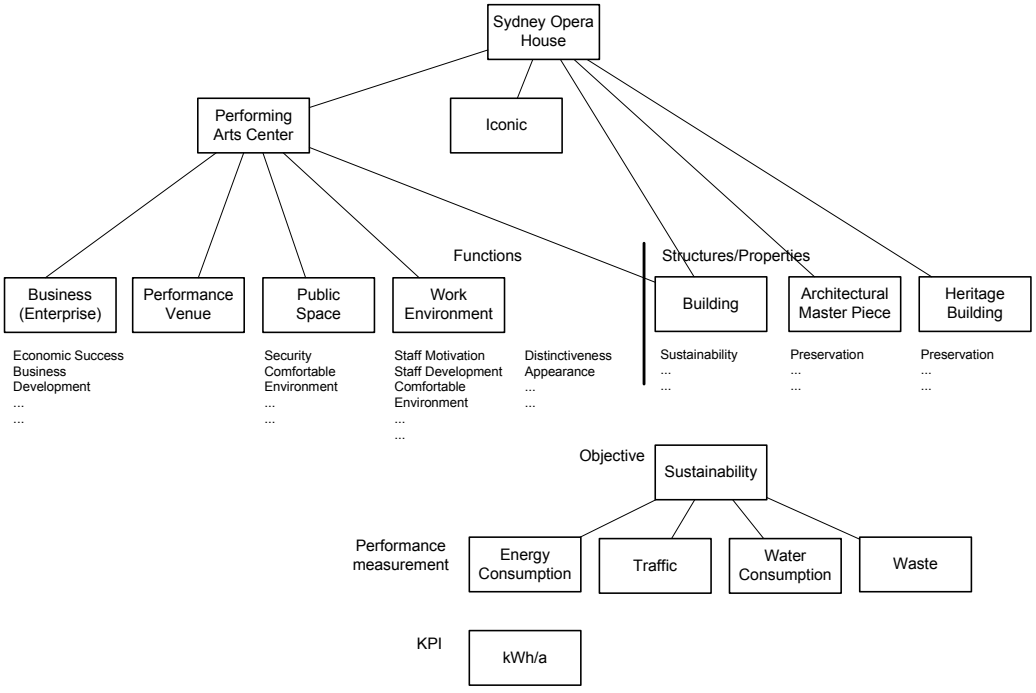

Figure 4. Illustration of the KPI development.

Firstly the key organisational functions, and their corresponding function areas, their critical success factors and key performance indicators have been identified from available business documents such as reports and strategy plans. For instance, as a performing arts centre the Sydney Opera House functions as a business with the objective of attracting and holding sponsors and partners. Its critical success factors include being attractive to

sponsors and the branding of the Sydney Opera House name while some key performance indicators may include the number and value of supporting sponsors.

This is followed by the identification of the high-level objectives of facility management functions. According to the Sydney Opera House Trust Annual Report (2004), the key objective of facility management function is: "Providing first class venues, facilities and services that support our artistic and business aspirations."

Secondly functions of facility management and its specific objectives are identified; for instance these include the building and custodial maintenance functions of facilities, are identified and their KPIs are derived.

Thirdly, these indicators are allocated to each of the perspectives. As an exemplar they have been categorist into four perspectives: financial; internal business processes; visitor and staff satisfaction; and innovation, growth and leaning.

The systematic objective development from high-level objectives to facilities management KPIs indicates which objective areas are relevant for the organisation and shall be employed to structure the benchmark system. Further it provides a hierarchical structured framework to identify the KPIs themselves.

2.4 DATA COLLECTION

The project made an initial contact with national and international organisations responsible for other "iconic" facilities seeking their participation with the SOH project as international comparators. Involvement will include an audit of the data that they are currently collecting, and it's availability for benchmarking. The development of better data collection, quality assurance of data, standardised vocabulary, and comparable collection methods will be recommended to the participants.

3.0 DEVELOPMENT OF PROCUREMENT STRATEGIES

3.1 PROCUREMENT STRATEGIES

The procurement research aims to introduce a procurement strategy for asset maintenance services and works. In particular, it will be developed from case studies of the Sydney Opera House as an exemplar.

Procurement strategies consider the achievement of strategic objectives, and operational requirements and constrains when deciding which procurement model is appropriate for providing a service. Figure 5 illustrates that the current Asset Maintenance Strategic Plan (AMSP) and the Operational Asset Maintenance Plan (OAMP) of the SOH generate 'demand statements' as evaluation criteria and strategic and operational requirements as performance criteria in the procurement process.

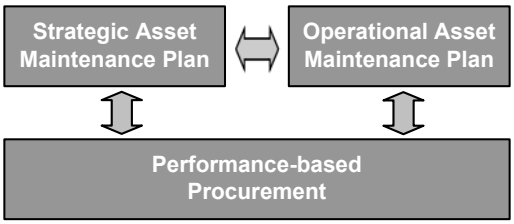

Figure 5. Illustration of the development of procurement strategies to meet the strategic and operational objectives of the SOH.

In the procurement process provision, options for required maintenance services and works are assessed and appropriate procurement routes are identified. The criteria of the multi-dimensional evaluation process consider the requirements formulated in the AMSP and the OAMP in the context of the prevailing market and the service provision reliability and risk, see Figure 6. The criteria are considered in the steps of the tender process by the various stakeholders of the process.

An important notion of this framework is the integration of a common evaluation system, founded on the strategic high-level objectives and the identified operational requirements, into the design phase and the sourcing, bidding and contracting phases.

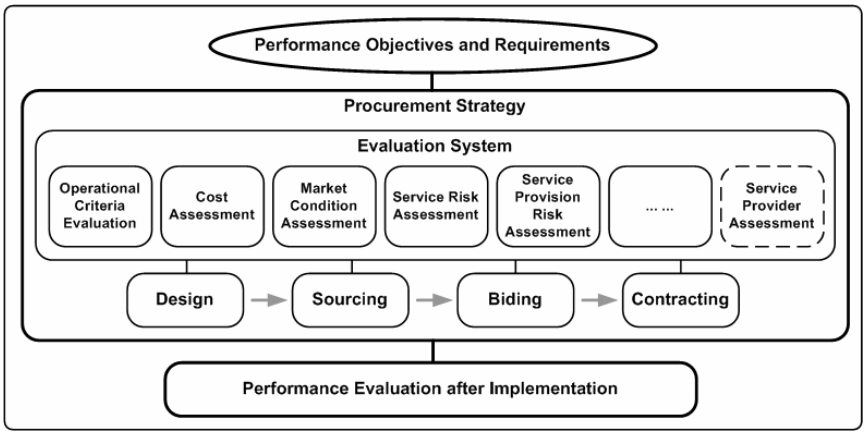

Figure 6. Development of a multi-dimensional assessment evaluation system for the procurement.

3.2 PROCUREMENT VISION

In order to ensure that the organization's procurement approach is developed properly, it is necessary to outline how it will procure, i.e. to 'envision' targets against which performance could be judged. The following presents some examples of procurement visions:

- Maximise efficiencies and effectiveness in how SOH makes purchases, avoiding unnecessary purchases;
- Ensuring that procurement decisions are made on the basis of whole-life costs, cultural fit and not solely short term financial criteria;
- Ensuring that purchasing will be coordinated between departments where possible; in order to improve efficiency, appropriately planned and timed so as to increase overall value without increasing cost;
- Being fair and just in how and what it purchases and how the organizations 'treats' their service providers and contractors;
- Providing leadership and building capability;
- Improving partnering and collaboration with our peers, and service providers and contractors.

These visions can in turn be met by applying principles that provide strategic direction in how and what it procures, e.g. minimizing risks, being open and accountable, and being informed by customers' needs.

3.3 PROCUREMENT PRINCIPLES

The following procurement principles may be developed to support the organization's procurement strategies:

- Justification of business case;
- Developing clear and concise specifications, and good contract administration principles/guidelines;
- Appropriate balance between quality and price;
- Flexibility in developing alternative procurement and partnering arrangements, e.g. fostering a culture of partnership, collaboration, and cooperation;
- Transparency and accountability;
- Compliance with legislation;
- Value for money;
- Equality of opportunity;
- Sustainability of procurement ('whole-life' consideration);
- Inculcate a culture of continuos improvement (i.e. to provide for evaluation, improvement and change of circumstances during contract duration);
- Provision of professional work, moral and ethical attitudes.

3.4 SYDNEY OPERA HOUSE CASE STUDIES

This section presents the Sydney Opera House case studies with some examples.

Service Procurement

The current SOH asset maintenance framework enables the following to occur:

- In-house (Facilities and Precinct Development Portfolio team): to focus on strategic issues, such as performance analysis, energy, environmental management and other strategies with the aim of resulting in better longer-term operational performance and reduced costs.

- Outsourcing (External service providers and contractors): for issues other than strategic issues, with the aim of achieving long term efficiencies and cost benefits, e.g. maximized or increased life expectancy of plants, structures and major systems.

The procurement routes in the SOH for the following operational assets are outsourcing:

- Mechanical;
- Electrical;
- Building Maintenance;
- Fire Services;
- Security and Surveillance Systems;
- Transportation Systems;
- Stage Machinery Systems;
- Sanitary Plumbing and Plant;
- Consultant Services

Tender Evaluation System: Evaluation Process and Criteria

A robust tender evaluation system supports an organisation making the appropriate assessment and selection of service providers and suppliers. The SOH has the following

tender evaluation criteria for their cleaning services and select the appropriate criteria for each cleaning contract.

- Price;
- Compliance with specifications;
- Understanding requirement of work;
- General cleaning and management expertise (such as knowledge, communication skills, OHS, customer relations, standard of cleanliness, experiences, quality of references, capacity);
- Expertise in providing similar services;
- Quality of references;
- Capability to provide required services.

Performance Measurement

It is necessary for clients to be able to continually monitor their progress and subsequently understand whether their service providers meet the client's requirements in terms of performance criteria and user's expectations. There should also exist the opportunity for continuous performance improvement and / or criteria modification over time to enhance satisfaction levels. Such information could be used by organizations to learn from their experiences and use them to facilitate their decision making process for future projects. The SOH sets out key performance indicators (KPIs) to regularly measure the performances of its service providers. Some examples from the contracts for the Maintenance of Mechanical Building Services are:

- No unauthorised disruption of operations;
- Work completed within time;
- Work completed to or better standards;
- Agreed budgets.

3.5 DISCUSSIONS

The trends in procurement appear to be pointing towards less adversarial procurement methods such as performance-based contracting, alliancing and relationship contracting which are believed to assist in the reduction of overall project costs and timeframes, to promote innovation and best practice, to enhance client/customer relations, user experiences and provide more satisfactory outcomes. However, all existing procurement methods may not be ineffective or under-performing. Services and works 'projects' are likely to possess a mix of characteristics from a range of contractual solutions. This affects the mode in which organizations may choose to select and manage their service provider and supplier relationships. There may be a need to examine multi-criteria decision-making tools/methods which enable organizations managing facilities to assess and select the appropriate providers in a more holistic manner.

Holistic assessment may be made with the aid of checklists where weighted scores are given to the criteria in relationship to their importance. The development of a multi-criteria analysis tool linked to data analysis referencing the Key Performance Indicators (KPIs) could aid in the decision making process.

The diagram in Figure 7 addresses a relationship between an organisation's assessment of services procurement and benchmarking data collected, which could use KPIs as a link. The strategic decision determining the KPIs and the services and works procurement could be supported by the benchmarking data collected.

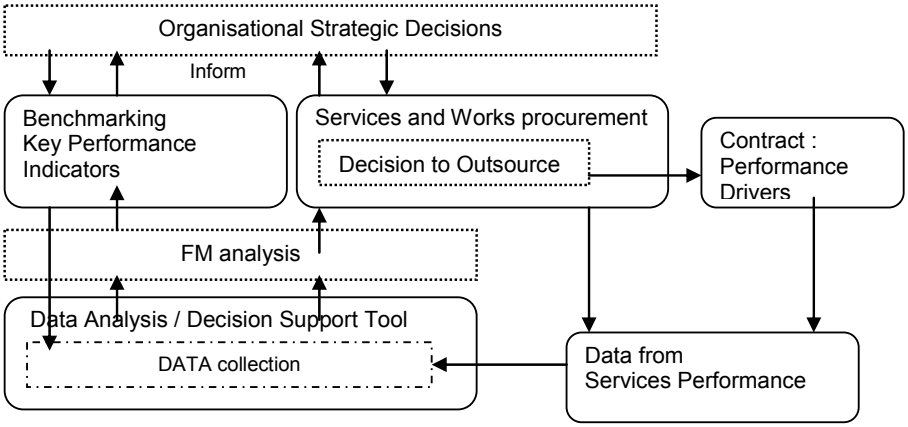

Figure 7. Illustration of the collaborative relationship between the procurement and the benchmarking data collected.

4.0 DIGITAL FACILITY MODELLING FOR THE SOH

The SOH has a design life of 250 years and a very high quality of construction and finish appropriate for NSW's most prestigious entertainment facility. The building comprises 7 theatres, 37 plant rooms, 12 lifts, over 1000 rooms. Sydney Opera House employs 300 full-time staff and a further 300 part-time staff, delivering over 2500 performances per annum. Obviously to track and plan all the activities including facility management operations, such as regular and incidental maintenance, cleaning, building updates, etc., an information system is necessary. The digital modelling part of this project investigates the potential of building information modelling and state-of-the-art information systems to innovate and support facility management processes.

4.1 EXISTING FM SYSTEMS OF THE SOH

Commencing in 1958, building documentation was based on hardcopy paper and pencil/ink drawings, pre-dating even the introduction of two dimensional computer aided design (2D – CAD) technology. While excellent catalogues of this information are available, accurate data is extremely limited, in hardcopy, microfilm or digital format. At the end of Stage I of the construction in 1966, accurate surveys (in imperial units) of the current infrastructure of the ground works and podium was carried out and to date these are the definitive data of those parts of the building. The lack of consistent, reliable data has become a major problem after 30 years of occupancy, particularly many services system modifications, numerous small works projects and now, the need for significant renewal and related building updates. To work without accurate drawings, the SOH has developed a pragmatic and very useful way of dealing with that information. Basically the Opera House itself is used as "information system". For example, many external pipes and ducts have been colour coded, objects such as equipments and installations have been labelled and almost all objects (doors, rooms, etc) have a unique ID. Several information systems for tracking maintenance operations and keeping track of assets have been installed and make use of the unique IDs.

Figure 8 gives an overview of key facility management systems currently used by SOH:

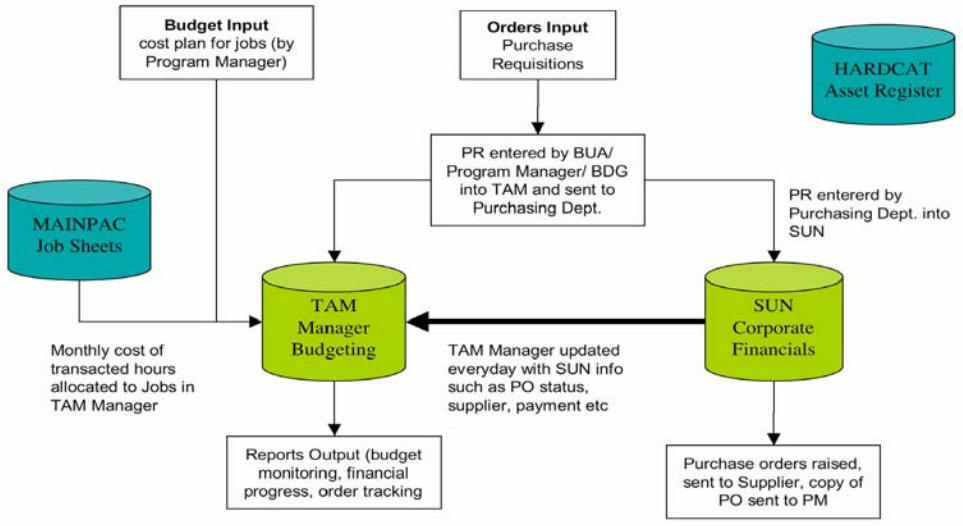

Figure 8. The key facility management systems currently used by SOH.

The building has reached a milestone age in terms of the condition and maintainability of key public areas and service systems, functionality of spaces and longer term strategic management. The current "documentation" of the facility is comprised of several independent systems, some overlapping and is inadequate to service current and future services required. A number of key concerns are evident for this situation:

- The existing information systems are still "paper-based" which can result in outdated documents and data re-entering in different (independent) systems;
- the current information systems cannot be readily adapted to support benchmarking processes;
- the current information systems only handle limited procurement information;
- The information system comprises several distributed information sources containing a mix of current and redundant information;
- The information systems are not linked together. Linking or integrating the information systems will support the alignment of facility management operations with business processes. For example maintenance planning can be optimised by taking business activities into account.

4.2 BUILDING INFORMATION MODELLING (BIM)

An important consideration in this context is the use of an integrated model of the building, i.e. a Building Information Model (BIM) to support in a comprehensive manner all the asset and facility management operations required by the SOH.

BIM is an integrated digital description of a building and its site comprising objects, described by accurate three dimensional (3D) geometry, with attributes that define the detail description of the building part or element, and relationships to other objects, e.g. a Duct *is-located-in* Storey Three of the building named Block B.

The key generic features of BIM are presented as follows:

- *Robust geometry* - objects are described by faithful and accurate geometry, that

is measurable;

- *Comprehensive and extensible object properties* - any object in the model has some pre-defined properties or extended properties to be customised by users. Objects thus can be richly described, e.g. a manufacturers' product code, cost, or the date of last service;
- *Semantic richness* - the model provides various types of object relationships that can be accessed for analysis and simulation, e.g. is-contained-in, is-related-to, is-part-of, etc.;
- *Integrated information* - the model holds all information in a single repository ensuring consistency, accuracy and accessibility of data;
- *Life cycle support* - the model supports the FM data over the complete facility life cycle from conception to demolition, extending current over-emphasis on design and construction phase.

The guidelines of BIM for the SOH have been developed stating how contractors and other parties should supply their design information to the SOH. Adopting these guidelines enables the SOH to build up a digital repository of their facility which can be merged and re-used for different purposes.

4.3 TOWARDS FUTURE INTEGRATED FM SYSTEMS

The integration of different sources of information such as building information, maintenance information, service history and performance information, benchmark information, and business information can improve facility management operations in general. For example, queries retrieving bad performing objects can be cross checked with maintenance schedules. A scenario of a future integrated FM system based on the integration of information resources is illustrated in Figure 9.

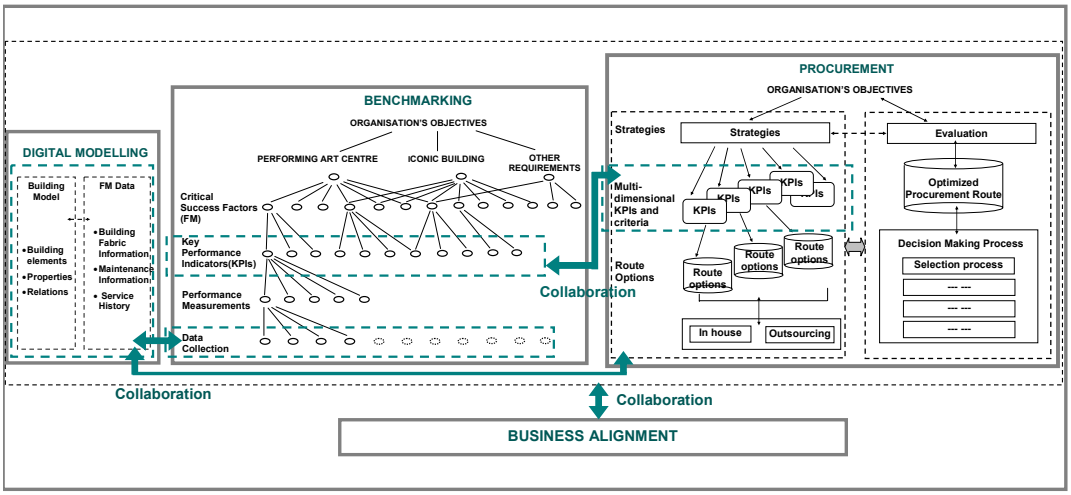

Figure 9. Illustration of a scenario of a future integrated FM system based on the integration of information resources.

It is suggested that the benchmark data collected be kept in a digital format for comparison and be able to integrate with the digital building models. Maintenance information, service history and performance, and business information are able to be easily retrieved from a data repository to enable an optimised maintenance schedule and procurement route. Key performance indicators (KPIs) and benchmark data in the data repository can be utilised for references by procurement managers to enable procurement strategies to be collaborated with the benchmarking outcomes.

The future integrated FM system supports collaborative FM activities and processes. It provides integrated information resources for sharing and use by facility managers, contractors and staffs employed. This enables improvement of collaborations on the operational level and faster and more effective facilities management processes.

The future integrated FM system can be implemented using a centralised approach, or a decentralised approach. The centralised approach develops a central database that provides a common model for data sharing. The common model is complicate since it contains all relevant FM information to enable collaborative FM activities. The decentralised approach develops interoperability between different applications. Information sources can be communicated from one application to another for access and queries from different departments.

5.0 CONCLUSIONS

The Sydney Opera House FM Exemplar Project represents an excellent opportunity to leverage off the iconic nature of the Sydney Opera House's international and national profile to identify and develop best practice within the FM industry. This project provides a broad range of practical input from client, consultants and service providers. The project's outcomes will in turn support the Australian Government's Facilities Management Action Agenda. The innovative methods delivered by this project can be implemented across the Facilities Management industry at the strategic, management and operational levels, with clear training and educational benefits leading to improved service delivery.

6.0 ACKNOWLEDGEMENTS

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