AN INTEGRATED ASSET PERFORMANCE FRAMEWORK FOR OPERATIONAL BUILDINGS - Preliminary results of focus group validations in Hong Kong and Australia.

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Abstract

Business performance is contingent upon effective use and management of all resources to enhance competitive advantage. However, whilst the resource value of finance, human resources and technology is widely recognized, that of the supporting physical asset (i.e. building or real estate) that houses these resources is not obvious to many corporate managers who see building-related expenses as a drain on profit. Operational buildings are at the same time, a physical asset, a functional facility, as well as a business resource. Literature on the subject suggests a wide range of views which tended to polarize towards either the measurement of the physical (technical) performance or the financial (cost) performance. Contemporary resource management supports the view that building assets are an essential resource just as human resource, technology; finance and knowledge are business resources needed to achieve corporate objectives. An integrated resource management approach views an optimum real estate or facility solution as one which is derived from consideration of all corporate resources to meet business needs. In this respect, the prime focus in measuring operational building performance must be viewed in the context of the relationship of building assets in relation to their contributions to business outcomes. This is the premise upon which an integrated asset performance framework for performance of operational buildings has been developed. The paper will explain the conceptual basis of an integrated asset performance framework and the preliminary results of two validation workshops conducted in Hong Kong and Australia.

Keywords: Asset Performance, Integrated Framework, Operational Buildings.

Introduction

One of the key business performance issues for both business and government is the ability to leverage maximum performance from resources and drive effective management of resources for long term sustainability. Building facilities or assets are business resources in the same manner as ICT, people and business capital. In many cases, investment in building assets ranks closely in value to the investment in people. Hence the performance of building assets as a business resource is increasingly becoming a focus for management in both the private and public sectors.

Competitive pressures and tight economic conditions are driving the search for competitive advantage beyond a focus on costs and budgets alone. Business and government need to develop an informed view of what customers and end-users of services value and the level of performance expectations. These business drivers have a direct influence on business performance. They also drive the need to explore with a more searching attitude, the performance of other aspects of the business, including the key resources supporting the business - people, property and technology (Then, 1994).

The need and desire to monitor the performance of operational building as a class of assets deserves management attention because of a number of unique attributes:

- the capital intensive nature of building assets (usually worth many millions of dollars which could potentially be applied more profitably elsewhere);
- their durable nature (often lasting up to 20-50 years or more);
- their relative inflexibility in responding to changes in business directions and technology;
- the significant accompanying stream of recurrent expenditure burden associated with maintaining and operating them at a desired service standard;
- the potential liabilities due to deterioration and depreciation over time;
- their impact on productivity and business performance; and
- their exposure to a wide range of legal requirements and risks.

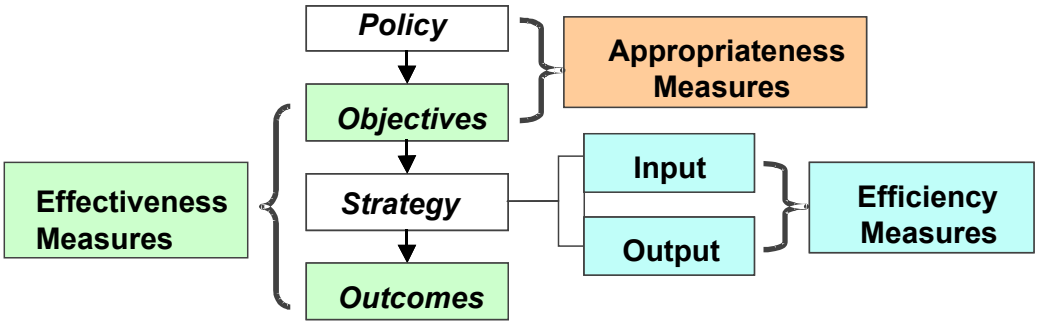
The importance of performance measurement as a tool for effective management of such an important business resource is also a key driver in the search for an effective performance measurement regime for building assets (Amaratunga & Baldry, 2002). However, the practical implementation of a performance measurement regime that delivers the desired management outcomes efficiently and effectively is more problematic. (Tan, Then and Barton, 2000). A wide range of methods and frameworks for performance measurement of building assets have been proposed (McDougall, et al. 2002). They range from the detailed technical assessments of physical aspects of buildings to surveys of user satisfaction with the occupied space and quality of the internal environment. Despite this, there appears to be no commonly adopted framework for buildings against which performance measures of operational assets can be established to meet the particular needs of corporate management requirements and expectations.

This paper proposes an integrated framework for assessing building performance (Then & Tan, 2004) and reports on the preliminary results of two validation workshops held in Hong Kong and Australia.

AN INTEGRATED ASSET PERFORMANCE MODEL

The Theory

The starting point of performance measurement is a conceptual model that can be applied as a framework for identifying and developing the necessary performance indicators that meet the objectives of any performance measurement effort. As a broad principle, performance measures can generally be divided into effectiveness measures, efficiency measures, and appropriateness measures (Figure 1).



Source: Adapted from Parker, W.C. (1993) *Performance Measurement in the Public Sector* and ANAO. *Best Practice Principles for Performance Information*. pp.8

Figure 1: Principles of a Performance Measurement System

Figure 1 highlights the need to clearly understand the purpose of performance measurement. Choosing the right measures for the right purpose is fundamental to any performance monitoring system.

The Need

The development of a conceptual framework for evaluation of performance of operational building assets must recognise at least three important characteristics of buildings as a product, and as a business resource:

- Buildings have a much longer life than most other assets in business. A building represents a special class of durable assets requiring high initial capital investment and subsequent running costs and reinvestment – a regime of life cycle management is required to optimise its efficient operation;
- A building's value is represented by its effectiveness as a supporting resource in the overall value chain of an organisation's productive process. Its role as an enabling resource is increasingly seen as crucial in raising staff productivity - an integrated resource management approach incorporating the delivery of an enabling workplace environment must be acknowledged; and
- Buildings involve a number of stakeholders: owners, managers, service providers and users throughout their operational lives. Existing buildings are also being changed and renovated more often in response to new owners, organisational changes, and new occupant requirements – buildings as dynamic entities which must be managed proactively in order to respond to changing users' expectation and rapid technological development.

Evidence from the literature reviewed suggests that building performance monitoring is an amalgam of at least four aspects of facilities provision and their ongoing servicing as functional facilities:

- The appropriateness of the current asset base in meeting business objectives;
- The provision of a satisfactory working environment for occupants and customers;
- The minimisation of operating and maintenance costs by managing the condition of the existing facilities,
- The performance of the facilities as functional, operational assets supporting business processes.

In optimising the performance of building assets, an organisation must balance the interdependent and, often competing, outcomes of the above four aspects of asset performance in order to achieve their optimum service potential.

The EPFS Model

Taking the above constraints into consideration, Then and Tan (1998, 2000, 2002, 2004) proposed that asset performance indicators used by organisations from both the public and private sectors can be grouped under five broad categories or facets of performance measures:

- **Economic measures**

  The Economic facet of asset performance is concerned with decisions at a strategic level that optimises on value for money from property resources. Economic asset management requirements are governed by the need to relate physical facilities provision to longer-term business plans. The objective of measurement here is to ensure optimum resource allocation and affordable and economic provision of property resources in line with market offerings and business plans.

- **Functional measures**

  The Functional facet of asset performance is concerned with management decisions that relate to the creation of the desired working environment in line with the preferred organisational culture and workplace standards. The objective of measurement here is to ensure continuous alignment of supply of appropriate functional space to anticipated service demands as far as possible. Fitness of purpose for property resource in meeting business requirements may be measured in terms of locational distribution, type, form and size of buildings.

- **Physical measures**
  The Physical facet of asset performance is concerned with efficient and effective management of operational aspects of ongoing asset management. The objectives of measurement here are driven by the need to preserve asset value, ensure asset condition does not lead to unnecessary operational risks and liabilities, and to ensure occupancy costs are reasonable.
- **Service measures**
  The Service facet of asset performance is concerned with decisions and actions relating to quality perception by end users and quality of service delivery by service providers. The objective of measurement here is to ensure that the business context and organisational culture are appropriately reflected in aspects of service delivery and are aligned with core business requirements. Measures in this facet of asset performance are generally surrogate, often subjective indicators of performance derived from clients' and end users' perceptions of corporate facilities and support services.
- **Environmental measures**
  The Environmental facet of asset performance is concerned with the role of building assets and their impact on facilities users, the community and the ecological environment. Measures in this facet are likely to involve monitoring against prescribed sustainability targets at project / state /national levels.

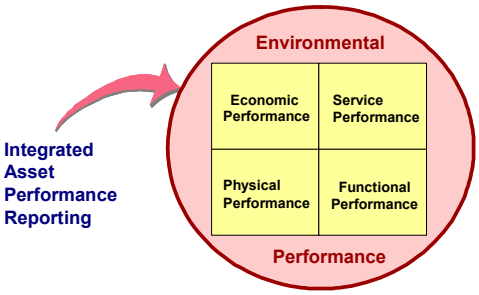


Figure 2: Integrated Asset Performance Reporting (Then & Tan, 2002)

The premise taken is that any integrated asset performance reporting must incorporate these five facets of measurement in order to obtain a balanced view of the contribution of building assets as an operating resource, as illustrated in Figure 2. However, this paper only reports on four of the five facets of asset performance measurement. The Environment facet is the subject of another study.

The above five categories of performance measures form the cornerstones of our integrated asset performance concept that can be applied to:

- Fulfil specific stakeholder perspectives of asset performance;
- Guide selection of appropriate key performance indicators;
- Assist in defining data requirements for specified key performance indicators; and
- Provide a balanced view of asset performance.

Table 1 summarises the key management focus of the five facets of asset performance measures. Each facet of asset performance is governed by a different set of variables with its associated key performance indicators. The proposed model provides a basic structure for considering the many dimensions of built assets performance and critically reviewing the suitability of currently available measures.

Table 1: Asset performance facets and management focus

Performance Facets	Management focus	Focus of performance monitoring
Economic	Value for money	Efficiency in allocation of resources
Functional	Fit for purpose	Effectiveness in utilisation of resources
Physical	Operational risk and liability	Appropriateness in type and condition
Service	Customer satisfaction	User/client's Quality perception
Environmental	Workplace & environmental sustainability	Meeting prescribed targets at project / state / national levels

Then, S.S. & Tan T.H. (2002)

The necessity for a conceptual framework is supported by the need to explain, communicate and justify the need for data collection and analysis. A logical and consistent framework facilitates the process of focusing data collection on the asset performance parameters that are currently deficient or lacking from asset information systems.

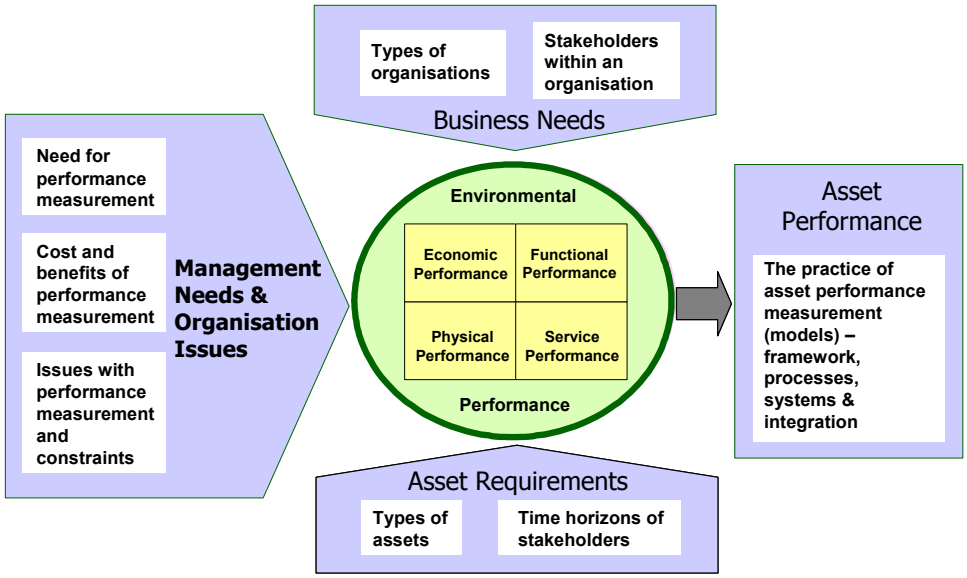


Figure 3: Factors influencing the Practice of Asset Performance Management

Having a performance concept is only the first step in the implementation of an asset performance framework that is useful and cost-effective. There are a number of further steps which have to be navigated before full realization of a credible and sustainable asset performance measurement system (Then, S.S. & Tan T.H., 2000, 2002). Figure 3 illustrates the parameters within an organisational setting in which an asset performance measurement system must take into consideration. They are the factors that will influence the practice of asset performance management. (modified from Then & Tan, 2004).

The EPFS Model – Variables and KPIs

Through a series of brainstorming sessions with research collaborators, it was decided that a structured approach is required to identify the appropriate key asset performance indicators. The alternative is a linear approach which has the potential disadvantages of being almost a random selection of measures or a selection that is technically driven by professional inclination.

The structured approach adopted comprised of a two-stage analysis. Stage one involved the identification of all possible variables associated with each of the four facets (i.e. Economic, Physical, Functional and Service performance). These are illustrated in Figure 4. Stage two involved identification of possible performance indicators that are measures of each of the variables identified. A total of 95 Key Performance Indicators (KPIs) were selected for validated in two focus groups workshops held in Hong Kong (July 2004) and Brisbane (August 2004). Table 4 lists the 69 validated KPIs.

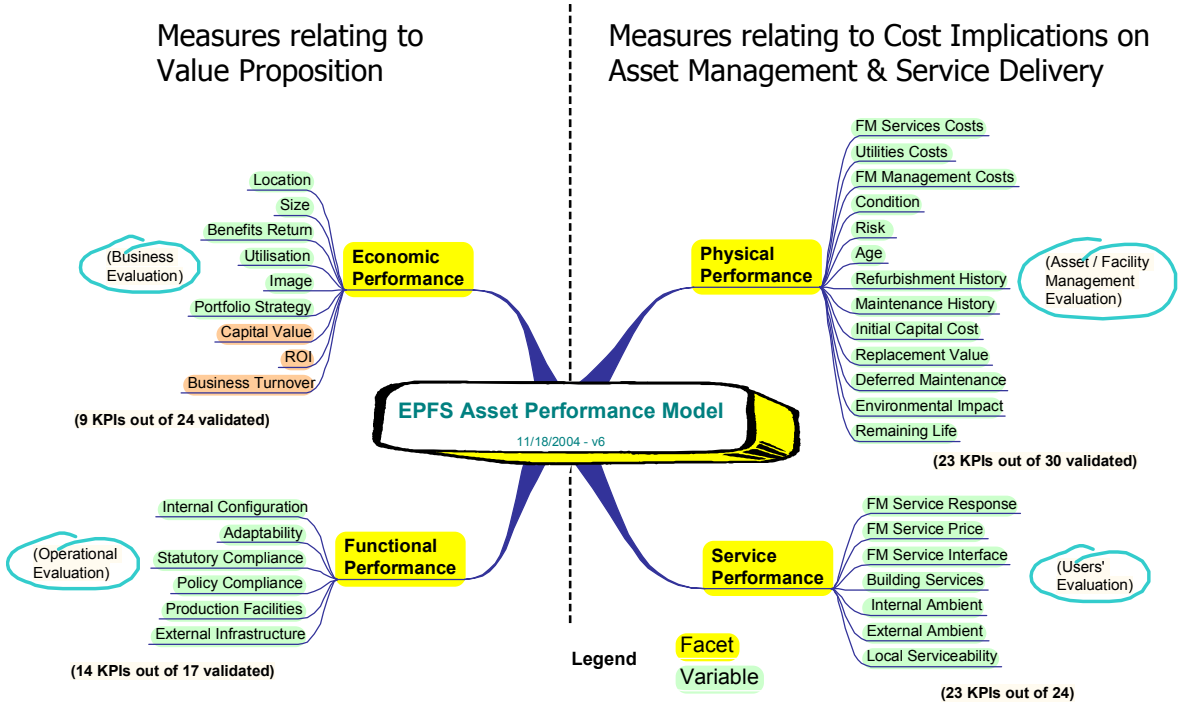


Figure 4: EPFS Model showing Facets and associated Variables

The sample of the Hong Kong focus group (N=20) consisted of middle/senior managers with responsibilities for property and facilities services representing commercial buildings, airports, universities and banks. The sample of the Brisbane focus group (N=21) consisted of middle/senior managers with responsibilities for property and facilities services representing public sector facilities. In both locations, initial contacts were made via telephone and email, explaining the purpose of the workshop and who from the organisation should participate.

The deliberation of each validation workshop followed a structured format that comprised the following:

Session 1 – Introduction, background and purpose of workshop - 10-15 minutes,

Session 2 – Concept Validation:

a. EPFS Model Presentation by research collaborators – 30 minutes including questions,
b. Validation of EPFS Model by respondents via structured questionnaire – 30 minutes,
c. Validation of EPFS Variables via structured questionnaire – 30 minutes.

Session 3 – Practice Validation:

a. KPIs Presentation by research collaborators – 10 minutes including questions,
b. Validation of KPIs for each Variable via structured questionnaire – 60 minutes

Session 4 – Summary and Feedback.

In summary, both the workshops were well received by the participants who expressed keen interest in the outcomes of the research and analysis from the workshop questionnaires. A summary of the results of the research will be provided as feedback to participants of the validation workshops.

RESULTS FROM ANALYSIS OF RESPONSES FROM VALIDATION WORKSHOPS

1. Concept Evaluation of EPFS Model

The concept evaluation comprises a two-part analysis. Table 1 shows the results of the attributes evaluation of the combined sample of both sets of respondents from Hong Kong (N=20) and Australia (N=21). Respondents were requested to evaluate the EPFS model on five different attributes, each against a 5-point Likert scale. The model was highly rated against the attributes of

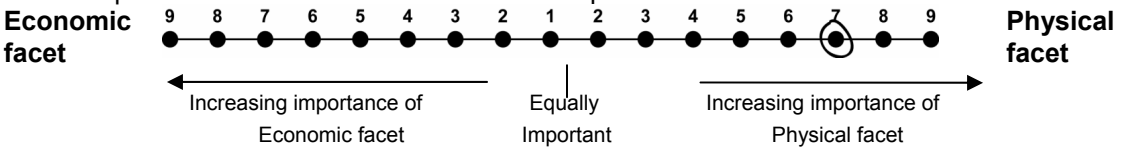
Completeness, Robustness, Importance and Practical Relevance, scoring more than 4.0 on a 5-point Likert scale, with degrees of variation between 4.0 and 4.6.

Table1: Concept Evaluation of EPFS Model

Attributes	Mean	S.D.	Rank
Completeness – Degree of completeness in coverage of elements of asset performance	4.585	0.4988	1
Robustness – Degree of robustness in concept and practice of asset performance	4.439	0.5024	1
Usefulness – Degree of usefulness in making more informed decision on issues in asset performance	4.317	0.7563	1
Importance –Degree of importance in asset management practice.	4.317	0.7563	1
Practical Relevance –Degree of relevance in the practice of asset performance.	4.049	0.669	2

A pairwise analysis was also conducted to evaluate the respondents' opinions on the relative importance of the four different facets of asset performance: Economic, Functional, Performance, and Service. Six pair-wise importance questions with a nine-point linguistic scale were used (Sataay, 1977; Xu, 2000).

Example of Pairwise Evaluation of Relative Importance between Asset Performance Facets:



The individual respondents' results on each individual pairwise question are aggregated using the geometric mean method before inputting into the necessary computation matrices. The final relative importance weightings of the four different facets of asset performance are shown in Table 2.

No significant differences in the perceived importance of the four facets of the EPFS model were found for both groups of respondents in Hong Kong and Australia. A check on the consistency of responses was also performed to ensure the validity of the computed results.

A consistency ratio of 0.0067 (<0.1) was obtained from the analyzed responses, which indicated that the responses given by all the respondents were quite consistent.

Table 2: Relative Importance Weightings of Four Different Asset Performance Facets

Asset Performance Facet	Relative Importance Weight
Economic	0.236
Physical	0.182
Functional	0.319
Service	0.262

2. Validation of Asset Performance Variables

For each of the asset performance facets, their corresponding asset performance variables were identified via brain storming sessions by the research collaborators. The degree of perceived relevance of each of the asset performance variables were evaluated using a. 5-point Likert scale type questions with '1' indicating not relevant and '5' indicating very relevant. An asset variable is considered to be relevant if it has a mean value greater than 3.5. Table 3 shows those variables that are identified to be relevant under each of the four asset performance facets.

Table 3: Mean Relevance Values for Different Asset Performance Variables

***ECONOMIC* Performance**	**Perceived Relevance** (1- not relevant, 5 – very relevant)
Variables	**Mean** (Standard Deviation)
Location	3.93(1.17)
Capital Value	3.61(1.36)
Size	3.59(1.14)
*Return on Investment	3.18(1.45)
*Benefits Return	3.95(0.88)
Utilisation	4.27(0.87)
*Image	3.73(0.99)
Portfolio Strategy	4.12(0.81)
Business Turnover	3.17(1.34)

	Mean<3.5
	N=41
	*N=40

***PHYSICAL* Performance**	**Perceived Relevance** (1- not relevant, 5 – very relevant)
Variables	**Mean** (Standard Deviation)
FM Cost	4.44(0.87)
Utilities Costs	4.27(1.05)
*FM Management Costs	3.98(0.97)
Condition	4.29(0.78)
Risk	4.56(0.87)
Age	3.54(0.95)
Refurbishment History	3.68(0.88)
Maintenance History	3.98(0.88)
*Initial Capital Cost	3.20(1.11)
Replacement Value	3.78(1.11)
Deferred Maintenance	4.02(0.94)
Environmental Impact	3.95(0.89)
Remaining Life	3.98(1.06)

***FUNCTIONAL* Performance**	**Perceived Relevance** (1- not relevant, 5 – very relevant)
Variables	**Mean** (Standard Deviation)
*Internal configuration & Services	4.53(0.78)
Adaptability	4.07(1.08)
Statutory Compliance	4.59(0.87)
Policy Compliance	4.24(0.86)
Production Facilities	4.22(0.99)
External Infrastructure	4.10(0.89)

***SERVICE* Performance**	**Perceived Relevance** (1- not relevant, 5 – very relevant)
Variables	**Mean** (Standard Deviation)
FM Service Response	4.39(0.92)
FM Service Price	4.15(0.85)
FM Service Interface	4.24(0.97)
Building Service	4.20(0.98)
Internal Ambient	4.32(0.85)
External Ambient	3.66(0.94)
Local Serviceability	3.88(0.90)

3. Validation of Asset Performance Indicators

For each of the asset performance facets, and their corresponding asset performance variables, Key Performance Indicators (KPIs) were selected via brain storming sessions by the research collaborators. A total of 95 KPIs were selected and workshop respondents were requested to rate their relevance via a series of dichotomous questions with 'Yes' and 'No' options. An indicator is considered to be relevant if the percentage of respondents choosing 'Yes' is greater than 75%.

Table 4: Relevant Key Performance Indicators

Facet	Asset Variable	Key Performance Indicators	Mean (Standard Deviation)	Number of KPIs
ECONOMIC PERFORMANCE	Location	Customers / tenants / visitors / clients	95.1% (0.218)	9
		Access to essential business services	85.4% (0.358)	
	Size	Floor space	92.7% (0.264)	
	Benefit Return	*Business	80.0% (0.405)	
		Community	80.5% (0.401)	
	Utilisation	Space (% of space/capacity used compared with available space/capacity)	97.6% (0.156)	
	Image	Customers	95.1% (0.218)	
	Portfolio Strategy	Different types of assets	85.4% (0.358)	
		Location of assets	90.2% (0.300)	
PHYSICAL PERFORMANCE	FM Services Cost	per unit area (sq m)	92.7% (0.264)	23
	Utilities Cost	per unit area (sq m)	92.7% (0.264)	
	FM Management Costs	per unit area (sq m)	82.9% (0.381)	
	Condition	Component / Element	82.9% (0.381)	
		Asset overall	82.9% (0.381)	
	Risk	Exposure to security issues	100.0%	
		Exposure to contamination & health issues	100.0%	
		Exposure to legislative changes	78.0% (0.419)	
	Age	*Building level	80.0% (0.405)	
		*Component level	85.0% (0.362)	
	Refurbishment History	Date of last refurbishment	80.5% (0.401)	
		Nature of last refurbishment	80.5% (0.401)	
	Maintenance History	*$ expenditure (total)	92.5% (0.267)	
		$ per annum as % of replacement value	87.8% (0.331)	
		Major replacements (dates and costs)	95.1% (0.218)	
	Initial Capital Cost	Similar asset	90.2% (0.300)	
		Industry standards	80.5% (0.401)	
	Replacement Value	*Depreciated book value	75.0% (0.439)	
	Deferred Maintenance	*Total Value of Deferred Maintenance	77.5% (0.423)	
	Environmental Impact	Compliance with Environmental legislation	97.6% (0.156)	
		Appropriate environmental rating system (e.g. HKBEAM)	82.9% (0.381)	
	Remaining Life	Physical and functional conditions	90.2% (0.300)	
		Economic viability	80.5% (0.401)	

Table 4: Relevant Key Performance Indicators (cont'd) Note: * implies N=40)

Facet	Asset Variable	Key Performance Indicators	Mean (Standard Deviation)	Number of KPIs
FUNCTIONAL PERFORMANCE	Internal Configuration and Services	Layout	95.1% (0.218)	14
		Services	92.7% (0.264)	
		Amenities	92.7% (0.264)	
	Adaptability	Major changes	85.4% (0.358)	
	Statutory Compliance	Building codes and regulations	100.0%	
		Workplace Health and Safety	97.6% (0.156)	
	Policy Compliance	Space allocation	95.1% (0.218)	
		Quality of fit-out and furnishings	87.8% (0.331)	
		Security	100.0%	
	Production Facilities	Capacity	78.0% (0.419)	
		Efficiency	85.4% (0.358)	
		Quality of outputs/outcomes	85.4% (0.358)	
	External Infrastructure	Capacity	80.5% (0.401)	
		Function	90.2% (0.300)	
SERVICE PERFORMANCE	FM Service Response	Response time to request	97.6% (0.156)	23
		Time to resolve problems	97.6% (0.156)	
	FM Service Price	Fit with budget	95.1% (0.218)	
		Comprehensiveness of services	87.8% (0.331)	
	FM Service Interface	Communication	90.2% (0.300)	
		Resolution of issues	100.0%	
	Building Services	Range of services available	75.6% (0.435)	
		Quality (meeting prescribed parameters)	97.6% (0.156)	
		Reliability	97.6% (0.156)	
	Internal Ambient	Statutory compliance	92.7% (0.264)	
		Comfort	97.6% (0.156)	
		Ambience	87.8% (0.331)	
		Work environment (e.g. noise, safety, etc.)	100.0%	
	External Ambient	Appearance	82.9% (0.381)	
		Amenities	82.9% (0.381)	
		Clean air	87.8% (0.331)	
		Noise	87.8% (0.331)	
	Local Serviceability	Range of services available	82.9% (0.381)	
		Quality	95.1% (0.218)	
		Reliability	92.7% (0.264)	
		Responsiveness	92.7% (0.264)	
		Cost	82.9% (0.381)	

Table 4 lists the selected KPIs against each asset performance variable and the corresponding asset performance facet. The sample size for the combined respondents from Hong Kong and Australia is 41 (i.e. N=41).

Conclusions

The quality of an asset performance measurement regime is subject to the proper definition, selection and organization of KPIs to provide relevant and reliable information for management decisions and actions. An unstructured and haphazard selection of KPIs is likely to lead to a waste of time and effort in data collection and incomplete or misleading performance information. This paper proposes a structured and logical framework for the development and selection of key performance measures. The EPFS Model provides a rationale and robust methodology for the organization of the KPIs selected and justification for the data requirement. Through a thorough literature review and follow-up brain storming sessions, the research collaborators identified possible variables corresponding to each of the four facets. For each of the variables identified, potential relevant performance measures or indicators were listed. Two workshops [in Hong Kong (N=20) and Australia (N=21)], comprising of professional practitioners in the field of property/asset/facility management, were conducted to test the validity of the EPFS model. The workshops comprised a combination of explanatory presentations followed by respondents completing three separate sets of questionnaires.

In the main, the EPFS model was statistically validated in term of the following attributes: completeness, robustness, usefulness, importance and practical relevance. In terms of the ranking of the four facets; the Functional facet was ranked as most important, followed closely by both Service and Economic facets, with Physical facet rated the lowest. The statistical analysis of the chosen performance indicators for the four facets confirmed 69 of 95 possible indicators as important measures.

Overall, the proposed EPFS model can be considered to be statistically validated relative to the sample of respondents in Hong Kong and Australia. The exercise has opened the doors for further development for practical use of the concepts underlying the evaluation of asset performance and the implementation of asset performance measurement towards best practice. It is anticipated that the EPFS Model will be further developed and refined through detailed case studies.

The valuable assistance of the participants in the validation workshops in Hong Kong and Brisbane is gratefully acknowledged by the research collaborators.

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