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### Original Citation

Amaratunga, Dilanthi and Baldry, David (1998) Appraising the total performance of higher educational buildings : a participatory approach towards a knowledge-base system. In: Proceedings of the COBRA 98 RICS (Construction and Building Research Conference), December 1998, Oxford Brookes University, Oxford, UK. (Unpublished)

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# **APPRAISING THE TOTAL PERFORMANCE OF HIGHER EDUCATIONAL BUILDINGS : A PARTICIPATORY APPROACH TOWARDS A KNOWLEDGE-BASE SYSTEM**

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## **Abstract**

The results of building evaluation and feed back have been used for centuries, particularly following a major building failure. These evaluations have resulted in regulations that historically have often been the only systematic and research-based source of direction to building design. Regulations evolved into building codes, which began to control critical aspects of buildings. Over the years, new building types emerged, construction grew more complex, and additional aspects of design were codified. When psychological and sociological considerations were linked to design, the study of environment and human behaviour became a new discipline and knowledge from this discipline was also applied to building evaluations.

Assessment of the performance of buildings of institutions delivering higher educational services has become a matter of particular interest to the government seeking to increase the effectiveness of educational provision and maximise value for money.

This paper presents initial findings of the study of Post Occupancy Evaluation (POE) : the process of evaluating buildings in a systematic manner after they have been built and occupied for some time, including testing a methodology developed for use as a standardised POE method for evaluating in particular the teaching spaces of universities. The paper also highlights the potential of the development of a POE database.

**Keywords** : Facilities Management, Building Performance, Post Occupancy Evaluation, Teaching Spaces, Building Elements.

## **1 Introduction**

Buildings are for people. They are also facilitators of organisational performance. Buildings, facilities, people and organisations are interrelated to the extent that a failing in one link of the chain will affect overall building performance (Barrett 1992). In times of high operating costs, increasing competition and rising user expectations, organisations must seek to maximise the return on their investment in both facilities and people, which are arguably the greatest assets of any organisation (Barrett 1992). The ongoing research project from which this paper is drawn attempts

to set out a methodology for defining and measuring the level of fit between an organisation and its facilities. Particular emphasis is given to the teaching spaces of higher educational institutions upon which the research in question is initially focused.

Post Occupancy Evaluation (POE) is the process of evaluating buildings in a systematic and rigorous manner after they have been occupied for some time (Preiser 1998). The concept of POE is now accepted as being of value to the development and occupation process of buildings.

This paper summarises:

- the ongoing study aimed at the application of the detailed POE process into higher educational buildings and will identify the importance of the performance evaluation with special emphasis to the major parties concerned in the delivery of higher education, their interests and expectations;
- the role of POE as the diagnostic tool and system which allows it to identify and evaluate critical aspects of building performance, to establish a framework to ensure POE measurements relate to the building performance concept ensuring their validity as performance measures, and to evaluate the total performance of higher educational buildings from their technical, functional, behavioural, economical and timing perspective, in order to ascertain how well they are serving the needs of the occupier;
- the means of identifying any major deficiencies in overall performance and to promote facilities which will be comfortable to occupy, cost effective and efficient to run and will remain valued assets;
- the development of a “balanced score card” to overcome the defects inherent in the use of organisations of the more traditional performance measures, which, while giving educational authorities a balance of information from a variety of different perspectives vital to all organisations, will also explore the relationship between energy efficiency, client and occupant satisfaction and building management;
- the development of a knowledge base system that can be used by designers and others to accomplish better designs by learning from past experiences. The information in the database will be derived using the approaches from POE

The research carried out to date has identified numerous benefits of such a detailed POE process including immediate feedback to existing building clients for immediate problem solving, direct input into the next building cycle, and feed forward to a database for improved design criteria (Preiser 1988).

A detailed literature search has generated evaluation criteria pertaining to the various elements of building evaluation, the feasibility of introducing the concept of POE in

the facilities management process, and a critical analysis of uses and benefits of the POE process. The study is to emphasise issues of user satisfaction in relation to construction and operational costs and building performance.

## **2 Theoretical Background**

### **2.1 Brief Introduction to Facilities Management**

Facilities management is based on the premise that the efficiency of any organisation is linked to the physical environment in which it operates and that the environment can be improved to increase efficiency (Grimshaw et al 1993). Increased competition, both nationally and internationally, has meant that many organisations have had to look inwardly with greater intensity than before to be more competitive. Harmer (1998) argues that facilities are the largest single class of asset on the balance sheet and that managers now have an opportunity to encompass a new awareness of the strategic opportunity presented by facilities management.

The function of facilities managers should be that of managing the property in the best interests of the core business (Spedding et al 1994). Thus, a long term view, coupled with techniques such as life cycle costing, may indicate to a facilities manager that more money should be spent selectively on a building in order to maximise returns rather than the more conventional view of cutting building costs without carefully considering the effects on the users or the occupants. Therefore, the aim of facilities management should be not just to optimise running costs of buildings, but to raise efficiency of the management of space and related assets for people and processes, in order that the mission and goals of the organisation may be achieved at the best combination of efficiency and cost.

#### **2.1.1 The Scope of Facilities Management**

The focus of facilities management skills and techniques should be in the area that contributes to the overall management of a business by relating accommodation and support infrastructure issues to business, financial and personal criteria (Barrett 1992). Table 1 gives a classification of facilities tasks that may be carried out in an organisation. Every item represents a category of decisions that have to be made at various management levels with skills required to make them and implement them or to assess their effectiveness and performance.

	Executive Responsibilities	Management Roles	Project Tasks
<b>Strategic</b>	mission statement	investment appraisal	strategic studies
	business plan	real estate decisions	estate utilisation
		premises strategy	corporate standards
		facility master	FM operational
		planning	structure
		IT strategy	corporate brief
<b>Tactical</b>	corporate structure	setting standards	guide-line documents
	procurement policy	planing change	project program
		resource	FM job description
		management	prototypical budgets
		budget management database control	database structure
<b>Operational</b>	service delivery	managing shared facilities	maintenance procurement
	quality control	building operations	refurbishment/fitout
		implementation	inventories
		audits	post occupancy audits
		emergencies	furniture procurement

Table 1 - Classification of facilities management tasks (Barrett 1992)

Thomson (1990) states that the size of the organisation is the starting point for deciding how any facilities department should be structured. Another major consideration for the facilities manager is what services should be provided by the facilities department. As a rough guide, any facilities department is likely to perform some of the activities listed in Table 2.

Facility Planning	Building Maintenance & Operation
strategic space planning	run and maintain plant
set corporate planning standards and guidelines	maintain building fabric
identify user needs	energy management
furniture layouts	security
monitor space use	voice and data communication
select and control use of furniture	control operating budget
define performance measurers	monitor performance
computer aided facility management	supervise cleaning and decoration
Real Estate and Building Construction	General/Office Services
new building design and construction management	provide and manage support office purchasing
acquisition and disposal of sites and buildings	non-building contract services
negotiation and management of leases	reprographic services
advice on property investment	housekeeping standards
control of capital budgets	

Table 2. - Typical facilities management activities (Thomson 1990)

## 2.2 Building Performance Evaluation and Facilities Management

## 2.2.1 Why are Buildings Important?

Buildings create environments. They provide the temperature, humidity, lighting and ventilation necessary for people to live and work productively (Barrett 1992). Bell(1997) queries when is building a success? Some cynics would say, for commercial examples, when it's fully let. Others would disagree, pointing to more functional or aesthetic priorities. At one time buildings were considered merely as an expensive overhead (Douglas 1996). The property boom and slump of the 1970s encouraged the consideration of buildings as a hidden resource as well as a potential liability. With the emergence of facilities management, buildings were seen more as an enabler to the core business. In financial terms, over thirty per cent of many an organisation's total asset value is related to the business premises. As a major part of facility-related costs for most organisations they represent the second largest cost centre after salaries (Varcoe 1992). There is also an increasing awareness, substantiated by a growing body of research (Lynch et al 1991, Peters 1989), that there is a direct link between quality of work place and the effect it has on the performance of its most critical resource- its employees.

## 2.2.2 What is Building Performance?

In simple terms, building performance has been defined in BS 5240 as behaviour of a product in use. It thus relates to a building's ability to contribute to fulfilling the functions of its intended use (Williams 1993). Facilities represent a substantial percentage of most organisations' assets and their operating costs. Thus, it is hardly surprising that building performance appraisal is becoming a formal and regular part of the facilities management process.

Traditionally, the term "building performance" has been used in the context of noise control, fire safety, thermal efficiency etc. Each of these "micro level" criteria is important in understanding how well a building is satisfying user or functional requirements. To assess how well a building is behaving overall and in the long term, a more holistic approach is needed. This is where total building performance can play an important role. However, as figure 1 suggests, the predictability of total building performance is relatively low, therefore provides a sound basis for research (Douglas 1996)

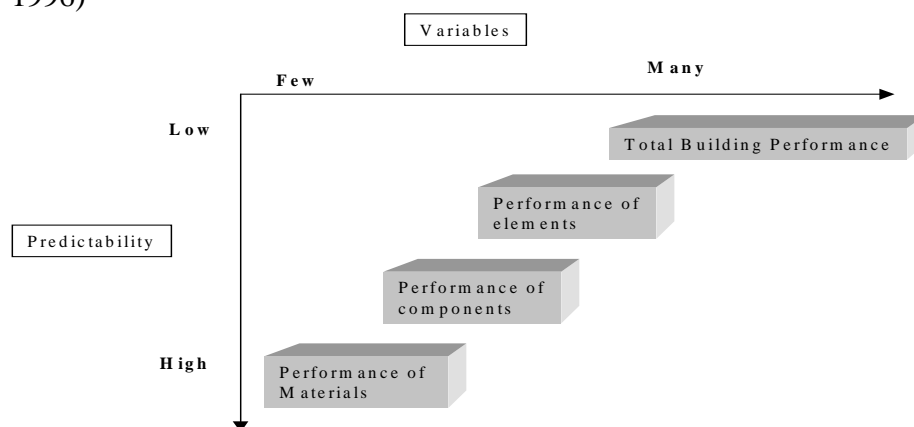


Figure 1 - Degrees of Performance Predictability (Douglas 1996)

This may be the reason for most researchers to consider only the performance of a single elements or a single building product, rather than the total building itself.

Expectations, standards, and requirements of building occupiers have dramatically increased and clients require their buildings to be attractive, long lasting and to provide stable and efficient internal environments, some of the reasons why total building performance is taking a higher profile nowadays.

### 2.2.3 The Performance Concept

The performance concept as depicted in figure 2, is an act of evaluation, performance measures are compared with appropriate performance criteria, and a conclusion is reached on how successful the building performance has been (Preiser 1988). An evaluation, combined with recommendations for improvement, is used for feed back and feed forward regarding the performance of similar buildings.

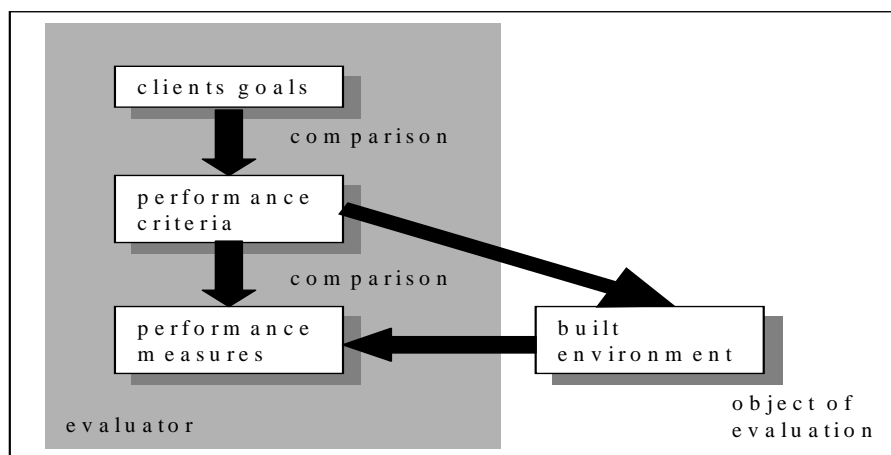


Figure 2 - The performance concept

A meaningful evaluation focuses on the values behind the goals and objectives of clients. The performance concept in the building process views buildings as dynamic entities and indicates a comprehensive attitude towards the management of buildings. Performance is measured, compared to criteria, and the valuation results are used to feed back to improve the evaluated building performance and the planning, programming, design and construction of future buildings can be improved through the feed forward of evaluation results. (Figure 3)

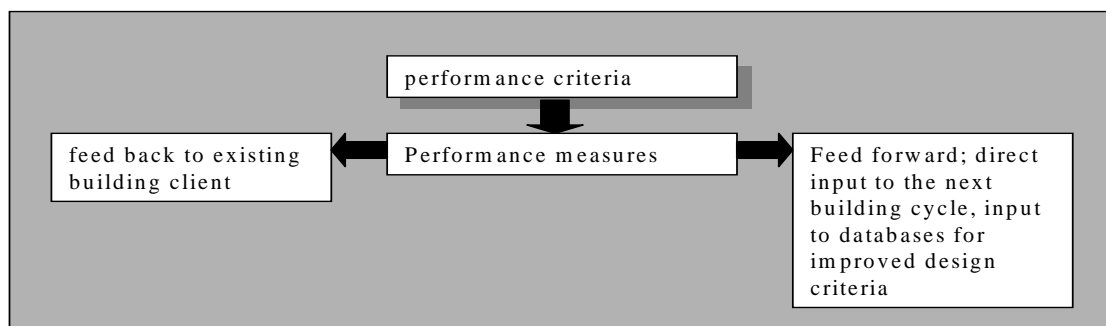


Figure 3 - The Building Process and the Performance Concept.

### 2.2.4 The Facilities Management Context

Facilities management is taken to be the co-ordinating management function that concentrates on the interface between the physical use, place, and people. Facilities managers need to have some way of determining the extent to which the buildings under their control affect the performance of the business. The interface between building performance and facilities management is illustrated in figure 4 (Douglas 1993)

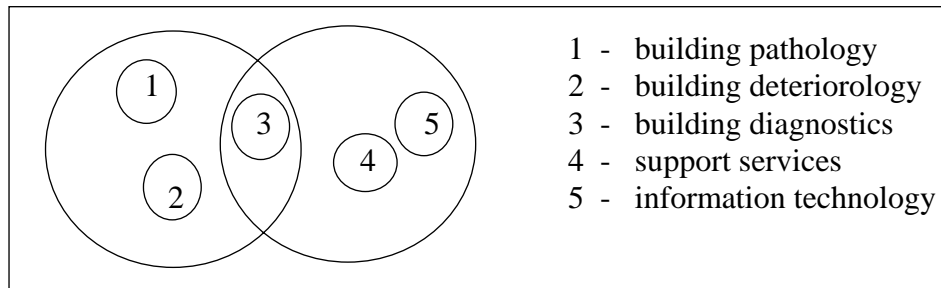


Figure 4 - The Building Performance and Facilities Management Interface

Building diagnostics is the systematic study and evaluation of building performance (Preiser et al 1988), thus is the most immediately relevant to facilities management.

Facilities management is an organisational change agent (Becker 1995). Building performance is an important aspect of that change. Despite the relative infancy of total building performance as both a concept and a model, it has great potential as a valuable tool for decision makers at both strategic and operational levels.

### 2.3 Post Occupancy Evaluation - A General Overview

The concept of building performance is the major philosophical and theoretical background for POE (Preiser et al 1988). It is the comparison of client's goals and performance criteria against actual building performance, measured both subjectively and objectively. This is an attractive concept, not only for designers and users, but also for the long term benefit of those concerned with the built environment - but only if it leads to an overall improvement in design standards. POE is a diagnostic tool and system which allows facility managers to identify and evaluate critical aspects of building performance systematically (Barrett 1993)

POE enables building designers and users to analyse the performance of facilities under conditions such as functional and social environments. In addition, it creates a feed back mechanism to allow comparison of true performance with initial user goals. This is valuable in allowing the generation of a design data base, but the more immediate benefit to the user is the ability to fine tune the built environment. Perhaps the most important purpose of POE and, without question the most pragmatic, is to act as a tool which allows the fit between user and building to be tightened, thus ensuring a more supportive environment for user activities (Riley et al 1995)

#### 2.3.1 Benefits of POE



Depending on the objectives of the client’s organisation and the time frame involved, POE has uses and benefits over the short, medium, and long term (Rabinowitz et al,1988)

Short Term Benefits
Identification of and solutions to problem in facilities. <sup>1</sup>
Proactive facility management responsive to building performance.
Improved space utilisation and feedback on building performance.
Improved attitude of building occupants through active involvement in the evaluation process.
Understanding of the performance implications of changes dictated by budget cuts. <sup>2</sup>
Informed decision making and better understanding of consequences of design.
Medium Term Benefits
Built-in capability for facility adaptation to organisational change and growth over time, including recycling of facilities into new uses. <sup>3</sup>
Significant cost savings in the building process and throughout the building life cycle.
Accountability for building performance by design professionals and owners.
Long Term Benefits
Long-term improvements in building performance. <sup>4</sup>
Improvement of design databases, standards, criteria, and guidance literature. <sup>5</sup>
Improved measurement of building performance through quantification.

Table 3 - Benefits of POE

### 2.3.2 The Application of POE

<sup>1</sup> Success and failures in the performance of buildings are identified and recommendations made for the appropriate action required to resolve any problems.

<sup>2</sup> Post Occupancy Evaluations can help to show the implications of various design alternative devised to meet lowered budgets, enabling the achievement of the best level of quality and performance within these constraints.

<sup>3</sup> Post Occupancy Evaluations can provide the justification and information base for adaptive reuse, remodelling, or major construction in order to resolve problems that have been identified in existing buildings.

<sup>4</sup> Long-term benefits result when the lessons learned from the failures and successes of building performance are applied to the design of future buildings

<sup>5</sup> Its application in Quality Assurance. Although each post occupancy evaluation typically focuses on only a few aspects of building performance, taken together, post occupancy evaluation provides an indication of how well buildings work generally, and therefore, post occupancy evaluation studies have been potent enough to influence codes, standards and design decisions.

If is to be useful, POE should measure the performance of a building in use providing the decision makers with information relating to a series of key performance criteria. Any such evaluation must comprise the following key stages (Barrett 1992):

- establishing the purpose;
- definition of the key performance criteria;
- planning the POE process;
- measurement of the criteria;
- evaluation of data/making assessment;
- feedback/stating the lessons learnt

### 2.3.3 Frame work of POE

There must be some framework established to ensure POE measurements relate to the building performance concept ensuring their validity as performance measures. There are various elements of building performance evaluation related to economic and functional perspective etc. Therefore, it can be argued that POE provides a sound basis for future research in the field of facilities management at large.

Ultimately, as figure 5 illustrates, facility managers may become the keepers of expertise and databases/information systems on building performance. Being on-site and familiar with the everyday problems and issues of building performance, facility managers may also be aided by building user manuals which should be developed to be operable at a given point of time (Preiser 1995)

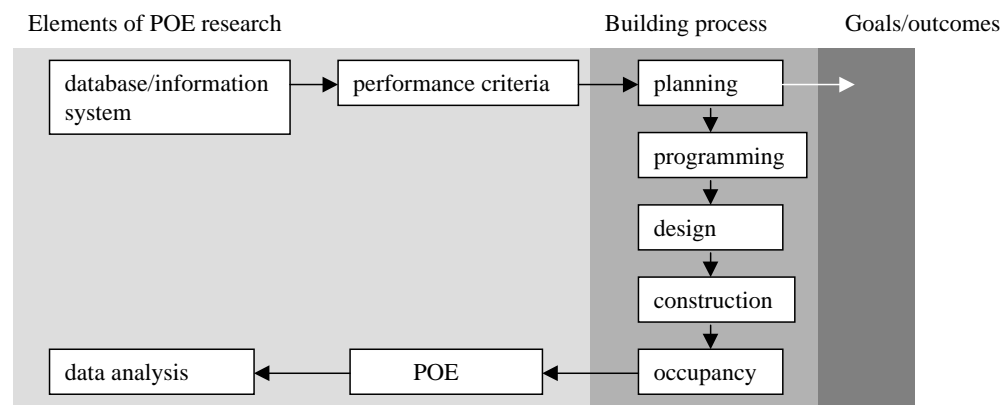


Figure 5 - POE as a facility management tool

## 3 Methodology/Scope and Limitations

### 3.1 Methodology

The overall purpose of the research being reported on is to develop a building evaluation tool using POE techniques and instruments to solicit data on higher educational buildings and, in the process, facilitate learning about building performance evaluation and the outcomes. This prototype could then be used for collecting feed back on facilities planning in such a way that the higher educational establishment learns from its own experiences as it constructs or remodels the organisation. In the following, a detailed review of critical methodological issues in conducting POE is undertaken. The resulting methodology is intended for the application in higher educational building performance evaluation.

### **3.1.1 Literature Search and Evaluation**

A detailed review of existing literature on the practice and theory of building performance evaluation with particular emphasis to POE and on evaluation criteria pertaining to the state-of-the art in the given facility type was undertaken. Reviewing and evaluating the literature serves to identify the key relational concepts that are operational in the given building type including the elements to be dealt with and the criteria to be addressed.

### **3.1.2 POE Methodology**

POE methodology offers the opportunity to measure five aspects of building performance of higher educational buildings. Standardising POE's is, however, a relatively new concept, so the search for standardised methodologies is presently in progress. Limiting the study to five aspects; economical, behavioural, technical, functional and timing, made it possible to concentrate on the development of a standardised, well documented method and to test and improve the method through case studies. The case studies will explore whether the organisation has moved from only a professional/technical approach to its buildings stock to one where the user and the user's objectives are supported not only by the physical condition of the facilities, but also (and probably more importantly) the functional effectiveness. The development of a schedule of case studies is in the earliest stage of development.

### **3.1.3 Data Gathering Methods**

The five areas under consideration will be examined both objectively and subjectively. Focus groups will then be identified as the explicit use of group interaction to produce data and insights would be less acceptable without the interaction found in a group (Morgan 1988). They are particularly useful where there are a large number of users of a facility perhaps with conflicting needs, as in universities. Questionnaire studies, walk through studies, series of interviews of various personnel at the establishments concerned will be some of the methodologies applied to gather data by using the POE to obtain very efficient and satisfactory data.

### **3.1.4 Evaluation of Data**

The purpose of analysing data is to identify response patterns or in other ways differentiate among the findings of POE. Data evaluation in the POE process will try to make sense of the data in terms of the research questions asked at the outset of the POE. Data can help predict the performance of the building type so that the outcomes can be used to feed forward information into the database and, subsequently, into the design guidance and criteria literature. There are several data analysis techniques proposed to be used ranging from common sense to sophisticated statistical techniques such as correlation of subjective responses with physical measures. The extent of the detail that is to be collected still needs further consideration.

### **3.1.5 Achieving the Total Performance and the Data Base Development**

The findings of the POE will be organised, and an effective reporting framework will be devised. Finally, actions resulting from the POE are reviewed to ascertain that benefits envisaged in initiating the evaluation have, in fact, been achieved.

Following the initial assessment, each building's performance will be compared with similar buildings and current best practice in performance and occupant satisfaction will be assessed.

Case studies will be the commencement of the database. Data collected with appropriate measurement technology will be fed into databases, information systems which will contain the results of the POEs. Developing the appropriate taxonomies, categories of information pertaining to performance requirements in higher education facilities, levels of information retrieval and use and other parameters of databases will need to be devised, as well as means to update such databases on a continuing basis.

## **3.2 Scope and Limitations**

The following points are the main factors to consider:

- the type of higher educational buildings is restricted to the variety of teaching spaces of universities;
- building performance evaluation under consideration deals only with the post construction process, but acknowledges the development history of the project;
- purely technical matters are not dealt with, but considered only in terms of their effect on the occupants;
- the study is limited only to five elements of building performance evaluation.

## **4 Performance Evaluation in Teaching Spaces of Universities**

## **4.1 Background**

The university system as any other organisation is trying to improve its efficiency in the face of rising operating costs and increasing user expectations. When a particular university is taken into consideration, it has perhaps a wider range of differing building types with more diverse operational needs than most organisations. (only the teaching spaces will be dealt with in this proposed study) Whilst the teaching spaces can contribute to high quality education, it is the interrelationship between organisational context that provides the catalyst for improved performance. The research attempts to build from the broad principles of building performance evaluation by developing a methodology for assessment of a facility's ability to satisfy the objectives of teaching spaces of universities.

## **4.2 Why Evaluate Teaching Spaces?**

Buildings are key functional, as well as economic resources. They need to be seen more as assets than as liabilities (Douglas 1996). One thing is certain: change is constant. In particular, the future for university properties is not totally predictable. The pace of change affecting buildings, primarily through technological and economic influences, is likely to increase, rather than slow down. Proliferation and diversity of technology in the teaching spaces, adaptation of sharing facilities, greater emphasis on quality in the study place, are some of the potential implications of the changes for universities. Externally, they may inevitably suppress the demand for teaching spaces of universities. This in turn will increase the need to adapt redundant spaces to new uses. On the other hand, the recent massive expansion in higher education participation has forced universities to achieve more economic use of their facilities.

Post occupancy evaluation will play an ever increasing role in building design as external and internal factors place more demands upon the facility. This is especially true with universities and institutions which are entrusted with the responsibility of utilising public funds judiciously (Preiser 1995). POEs provide a mechanism to both learn from the past and evaluate contemporary trends in teaching spaces of universities. It is hoped that the collection, interpretation, and analysis of information about teaching spaces will provide the key to better planning and design for the future.

It is certain to advocate that universities take a more progressive commercial approach to resource allocation than has been the case in the past (Clarke 1997). As such it is, therefore, suggested that university models of building performance evaluation if developed sensitively can be more useful to inform not only resource allocation in universities but also to lead to development of new resource-based approaches for commercial competitive advantage. Assessment of the performance of institutions delivering educational services has become a matter of particular interest to governments around the world seeking to increase the effectiveness of educational provision and maximise value for money (Belcher 1997)

## **5 Application of the POE Process**

The building and the operation enabling facilities which it provides have a unique relationship and influence on the performance of an organisation's most important asset - it's people (Varcoe 1993). Any study of facilities performance should therefore have due regard for the overall performance of the operation as a whole, and must not pursue expenditure savings without an appreciation of the wider organisational impact.

An evaluation of an existing work environment should be seen as an integral part of any construction or remodelling project. This way, a POE of the existing teaching environment can serve the role of a pre-occupancy survey in the design process of buildings not yet built.

### 5.1 POE Process Model

Based on the collective and cumulative experience in literature review carried out (Preiser et al 1988) a POE process model was developed which outlines the route POE goes through (Figure 6)

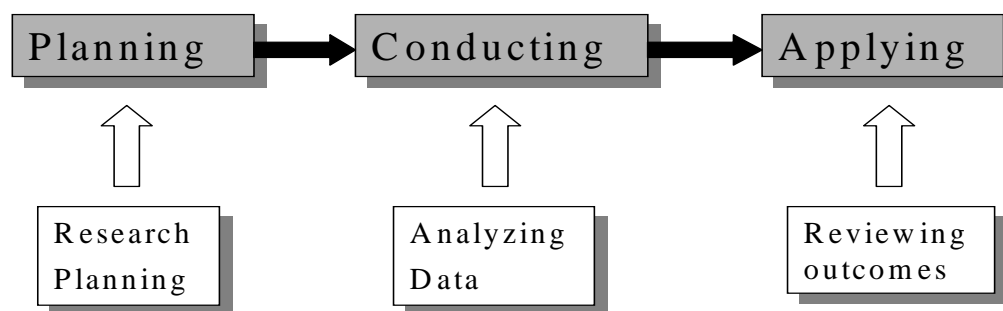


Figure 6 - POE Process Model

It should be however noted that the emphasis of the POE is on understanding both positive and negative aspects of the facility with the thought that negative performance aspects would be resolved in subsequent years, while positive performance aspects would be fed into a database for future use.

### 5.2 Elements of Building Evaluation

The elements of building performance are those aspects of facilities that are measured, evaluated and used to improve buildings (Preiser et al 1988). There are other elements in building evaluation : economical, technical, functional, behavioural and timing will be dealt with, since they carry a high weight in terms of facilities performance implications.

#### 5.2.1 Economic Elements of Building Performance

As an administrative and operations function, facility management performance will always be under pressure to reduce costs (Becker 1990). It is this relationship that defines cost effectiveness. Cost effectiveness is frequently assessed on the basis of the degree of competitiveness achieved in the procurement of services (Williams 1996). To demonstrate that the facilities are cost effective, it is necessary to quantify the contribution they make to bottom-line profits-or productive output in the case of non-profit making bodies. For a facility manager to achieve cost control, he must identify the significant, controllable, and negotiable costs of operating facilities and delivering support services (Spedding et al 1994). To demonstrate cost effectiveness within the environment requires the facility manager to have the ability to systematically collect and record expenditure in an accurate and readily accessible manner (Spedding et al 1994). In the proposed research project, therefore, economic measures of efficiency and productivity of operation of facilities will be dealt with.

The final outcome will be the development of a cost strategy in terms of facilities performance by taking into consideration: how the current facilities are provided; what the optimum facility structure will be; how to move between these two points and to emphasise issues of user satisfaction in relation to operational costs of facilities.

### **5.2.2 Technical Elements of Building Evaluation**

Technical elements can be categorised as the background environment, a kind of “stage off” for activities (Preiser et al 1988), and as such are often unnoticed. This includes basic survival issues such as fire safety, sanitation. The definition of POE for the research concerned excludes purely technical evaluation, for example, heating systems or new building materials, and are only considered in terms of their effect on occupants’ health, safety, functional performance and physical comfort.

In order to truly evaluate the degree of achievement of technical standards, some objective system of measurement is desirable, but is often difficult to achieve, particularly in areas of quality and aesthetic value where opinion is influenced by various factors (Ruck 1989)

In addition, these aspects of building performance become more than the owner’s scrutiny as the impact will extend to include project users and occupiers. A building may succeed in achieving a high level of functionality yet fail to meet prescribed technical standards. Alternatively, the building may conform to the highest technical standards but have been so inadequately conceived that it fails to deliver the functional satisfaction which stimulated the original need.

### **5.2.3 Behavioural Elements of Building Evaluation**

Behavioural elements of performance link occupants’ activities and satisfaction with the physical environment (Preiser et al 1988). Behavioural elements deal with the perceptions and psychological needs of the users and how they interact with the

facility, as there is undoubtedly an association between the performance and behaviour of the organisation's most important asset, its users, and the effectiveness of the building which they occupy (Moss et al 1998). It is therefore important that the organisation provides accommodation which satisfies the needs of the occupiers throughout the facilities management life cycle. Issues such as privacy, security, the symbolism of buildings, social interactions, perceptions of density etc. are to be included in the POE as behavioural elements.

#### **5.2.4 Functional Elements of Building Evaluation**

The functional elements of the building directly support the activities within it, and they must be responsive to the specific needs of the organisations and occupants, both quantitatively and qualitatively (Preiser et al 1995).

Functional elements deal with the fit between the building and the clients' activities. Therefore, clients' organisations and activities should be supported by the performance of a wide range of functional building attributes and elements such as access, parking, spatial capacity, utilities, communications, change/growth/circulation, equipment etc.

#### **5.2.5 Timing Element of Building Evaluation**

In the life of the building, building evaluations are conducted to identify the reactions to changes, for example, deterioration of the building and functional change. Evaluations such as these, will often provide details of specified time frame of activities to take place, and help to overcome the immediate problems of the built environment. The aspects of this area of project evaluation are history, planning intention, reasons for any delays-impact on organisational disturbances, expansion needs, tolerance/loose fit, preservation/adaptability. Users are becoming less tolerant of deficient or unsuitable buildings, therefore may require to identify the changes to the existing building cycle. Thus, an evaluation of a building's total performance needs to show the change in performance over time, even throughout the building's life cycle. Available information on the condition of buildings and their costs makes this more achievable (Douglas 1996)

Maintenance costs account for some 10-15% of annual running costs of most buildings (Menzies 1997) These can be mitigated and properly controlled by a planned and timed maintenance programme, whereby repairs and maintenance work are carefully targeted by also considering the user expectations.

## **6 The Total Performance**

Facilities represent a substantial percentage of most organisations' assets and also a substantial proportion of their operating costs. Thus it is hardly surprising that building performance appraisal is becoming a formal and regular part of the facility management process (Becker 1990). Facilities managers therefore need to have some



way of determining the extent to which the buildings under their control affect the performance of the business. Therefore it is important that the measured data is practically applied to improve the performance.

The findings of POE will be primarily oriented towards four objectives:

- identifying problems and evaluating successful and unsuccessful performance in existing facilities - the comparison with peers and best practice;
- achieving short term problem solving by identifying and resolving minor building and space problems;
- resolving major environmental and space problems in existing facilities;
- affecting the long term operation of the organisation - the focus will be on the development of design criteria to be used in databases.

It will be argued that through the evaluation of teaching places in use and the feed back of performance data into future building performance evaluation studies, it is possible to establish a cycle of learning within the organisation. Furthermore, it will be argued that as part of a long term, ongoing process the learning cycle enables the organisations concerned to implement policies of progressive improvement in the procurement of their buildings.

The adoption of the proposed programme of POE as the tool of building performance evaluation, coupled with the feed back of data into the value management process, will establish a continuing cycle of learning within the organisation and promote a systematic search for solutions that provide greater cost effectiveness, without compromising function or service. Such an approach ensures that building design decisions are continually evaluated in the light of strategic business objectives. Furthermore, in highlighting the effects of previous design decisions, the learning cycle encourages the progressive improvement of the organisation's decision-making in the future.

## **6.1 Achieving the Balance**

It is proposed to develop a "balanced score card" (a management system) that can channel the energies, abilities and specific knowledge held by people through out the organisation towards achieving the organisational goals (Kaplan et al 1993), in terms of teaching spaces of universities. This will aim to achieve a balance between short and long term objectives and between financial and non-financial measures. The proposed system will provide the organisation with the instrumentation they need to navigate to future competitive success in terms of performance of its teaching spaces. The system complements the performance measures of past performance with measures of the drivers of future performance. The measures represent a balance between performance measures of different elements and will be balanced between the outcome measures - the results from past efforts - and the measure that drive future performance. The proposed scoreboard will be balanced between objective, easily quantified outcome measures and subjective, somewhat judgmental, performance drivers of the outcome measures.

The proposed scorecard will fill the void that exists in most organisations - the lack of a systematic process to implement and obtain feedback about building performance (Norton et al 1992) The proposed system will retain financial measurement as the critical summary of building performance, but will highlight a more general and integrated set of measurements such as, technical, behavioural and functional, that link current occupiers, internal process and system performance to long term financial success. The comprehensive nature of the proposed scorecard is demonstrated by the interlinking perspectives shown in figure 7.

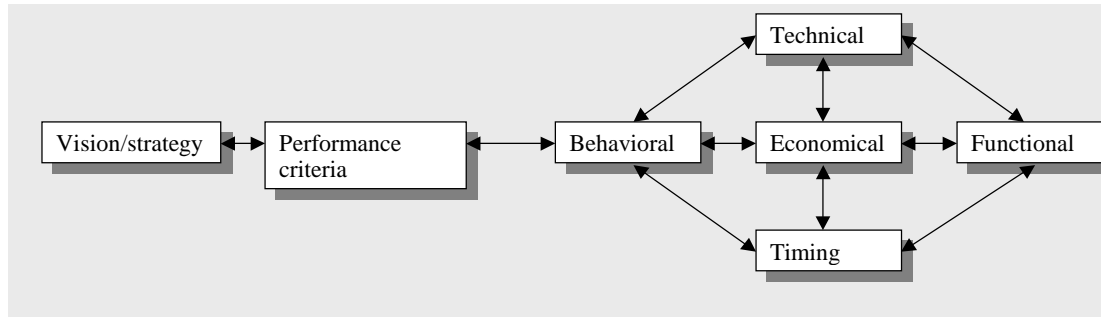


Figure 7 - The performance perspectives linked by the scorecard

It is claimed that the scorecard is much more than a measurement exercise, rather, it is suggested, it should be viewed as a management system which can act as a motivating focal point for the organisation (Kaplan et al 1996)

## 7 The Knowledge Based System

Decisions about managing the occupancy of the building stock require comparable and reliable data (Becker 1990). When the facilities management organisation lacks reliable and comparable data on building performance and costs, its ability to make its most basic decisions is impaired, as is its ability to make a convincing case for its recommendations. The ability to demonstrate the facility unit's organisational effectiveness is hampered without such information and a procedure for generating, maintaining and manipulating it to answer questions is vital.

The proposed database development project will involve the development of a knowledge base system that can be used by designers and planners to accomplish better designs by learning from past experiences. The cost benefits from the implementation of the system, especially with an integrated facilities program, can be very significant for large institutions like universities with varied and recurring programs for new and remodelled facilities.

### 7.1 Design Database Development Overview

An overview of the proposed system design phases of the project is shown in figure 8.

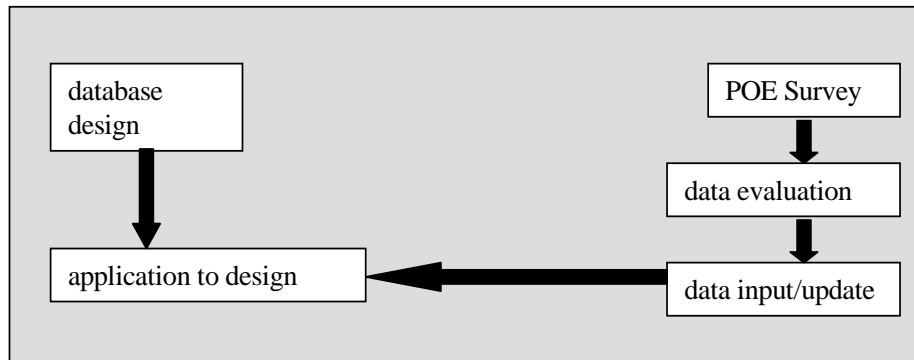


Figure 8 - Database development overview

Development of the proposed knowledge bases is a process of collecting information from user responses through POE, and collating them to be of effective use in the design process. The knowledge bases will consist of information categorised under various building performance elements. The knowledge base system to be developed will be an independent system for it to be useful in design related work. Apart from its value to designers, a desired application of the POE system will give the impetus towards planning an integrated facilities management programme, particularly with reference to teaching places of universities, which will be of great impact not only in terms of impressive benefits in planning and operation, but also in terms of long term cost savings.

## 8 Summary

It is clear that total building performance and its evaluation is continuing to attract a considerable degree of interest among building professionals. As was noted: “the performance concept will be the most crucial development in property and building in the next decade” (Grimshaw 1993).

Measurement and assessment are the two elements of the performance approach:

- Measurement stage, the identification and selection of the required standards are undertaken;
- The assessment stage, a comparison of the actual findings with the optimal standards is carried out.

POE will play an ever increasing role in building design as external and internal factors place more demands upon the facility. POE provides a mechanism to both learn from the past and evaluate contemporary trends.

The arguments presented in this paper suggest that facility management may benefit greatly from applying POE to gather data on facility performance, in analysing that data, and in making recommendations for facility improvements, thereby to assist in closing the information loop in facility management, which in the past largely ignored the experiences and feed back from existing facilities in a systematic manner. This is particularly true when POE results are fed into a database which focuses on

building performance from the end user perspective. There is however, still much research to be undertaken to test and validate building appraisal techniques such as POE as well as to refine benchmarks.

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