

# **THE ROLE OF MULTI-CRITERION DECISION METHODS (MCDM) IN SECURING BEST VALUE FROM BUILDINGS PROCURED THROUGH PPP/PFI**

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Multiple Criteria Decision Methods (MCDM) in various guises, have been in use in industry for some time. The emphasis, however, has generally been on the process of establishing value criteria and reaching the preferred choice, be it a design proposal or contractor selection. Very little attention, however, has been given to the performance of buildings over their intended lives. One possible reason for this lack of attention is the absence of accountability for non-performance. This is to be expected, since no clear statement of life-time performance criteria has been established across all built facilities. As a consequence it is extremely difficult to determine exactly where the responsibility lies for non-performance. The matter of performance has taken on greater urgency with the introduction of PPP/PFI projects. Judging by the experience of users of the facilities, many of the disputes over non-performance seem to revolve around the lack of clarity in the framing of performance criteria. It is only by giving sufficient attention to the framing of performance criteria based on MCDM methodology, that a robust and workable set of performance criteria may be developed.

**Keywords:** accountability, evaluation, multiple criteria decision methods, PFI, value for money.

## **INTRODUCTION**

As more public sector projects are procured through PPP/PFI, the question of Value for Money (VFM) has been given greater weight, although VFM is not always given adequate definition. Without a set of performance criteria, it is almost impossible to establish a basis for VFM. Value to the client may be seen as those benefits obtained from the use of a building against the cost of securing those benefits. Nevertheless, Value for Money is built on three aspects of delivering a service, known as the three Es (Butt & Palmer 1985). These three Es were economy, efficiency and effectiveness. Economy related to the cost and quality of resources, efficiency was the ratio of output gained for the amount of resource used, and *effectiveness* was the extent to which the actual results matched the desired results. *Economy* reflects the quality and cost of resources obtained through the procurement processes both initially and at subsequent stages throughout the useful life of the building. This would include the selection of materials and components in the design process and the selection of those charged with executing the contract. *Efficiency* reflects the management of the delivery and operation of the building throughout its useful life and *Effectiveness* reflects the level of performance achieved throughout the useful life of the building.

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This paper will attempt to link the above aspects of VFM with life-time performance through a multi-criteria approach and thereby provide a basis for evaluating performance against the right set of criteria and to enable the appropriate action to be taken in the event of outcomes failing to meet the required standards.

## PFI/PPP PROJECTS

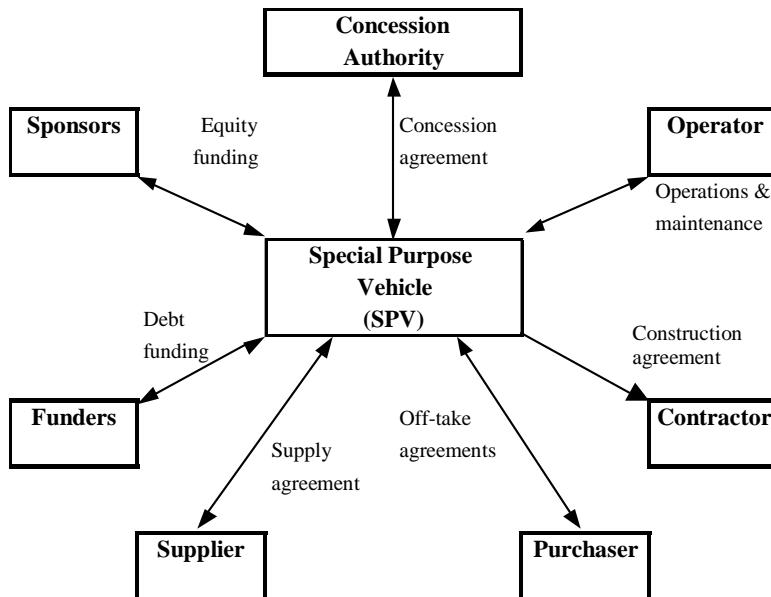
One of the essential characteristics of PFI/PPP projects is that the private sector is responsible for the long-term performance of the project. As a consequence it is essential that the consortium responsible for preparing the bid takes full account of the long-term requirements of the client and price them accordingly. The factors (variables) to be considered when preparing the bid are shown in figure 1. The estimated whole-life cost to be borne by the consortium plus their profit margin is converted into a monthly unitary charge to the client in return for the building and operating the facility for the agreed period. The fundamental aspects of PFI/PPP contracts, which are of concern in this paper are those which set out the framework for establishing the relationship of accountability and the mechanisms securing the right level of service delivery throughout the concession period. This relationship depends on the contracts between the parties as shown in Figure 1, where a Special Purpose Vehicle (SPV) is created and enters into contractual agreements with a number of parties as well as entering a concession agreement with the client known as the concession authority. Crucial to the concession agreement is the structure and format of the specification. Material emanating from Office of Government Commerce (OGC) places great emphasis on the need for output specification, but does not explain how this is to be done. This paper seeks to show that MCDM is well suited to the task. In particular it will show how best value is linked to performance in the context of built facilities.

## THE LINK BETWEEN PERFORMANCE AND VFM

Best value in the context of Facilities Management is the attainment of the required level of performance from the facilities at the least whole-life cost. The required level of facilities performance must be related to the performance of the client organization. In the context of PPP/PFI projects, it is the task of the client organization to derive the required set of facilities performance targets from its organizational performance targets.

Whilst there is much discussion on the linkage between facilities and user performance, the evidence does not appear to be sufficiently developed to establish a causal or quantitative link. For example, the link between physical conditions and user satisfaction does not automatically lead to improvement in efficiency.

According to Hinks (1999), there is a mis-match between the performance indicators preferred by the FM industry and those of interest to the core business. If this is so, there is a clear need, for a methodology that ensures that both sets of indicators are at least compatible. Keeney (1994), has identified two fundamental approaches to solving problems with multiple objectives: *value-focused thinking* and *alternative-focused thinking*. These roughly correspond to the top-down approach and the bottom-up approach to problem solving. Keeney nevertheless makes the point that the two approaches are not just alternatives but rather *value-focused thinking* is to be preferred since it is free from constraints and therefore the decision is likely to be closer to what is wanted.



**Figure 1:** IPFA (2002) Contractual Relationship between the Parties to a PFI project

While this paper is confined to examining facilities performance targets and how they can be derived to ensure best value for the client, it nevertheless seeks to show that they can stand in relation to each other in a coherent fashion.

With the introduction of output specifications, the link between performance and VFM is more explicit, as clients are able to relate outputs to their own organizational requirements. Furthermore, output specifications enable clients to set out the circumstances when service failure would lead to “unavailability” of the relevant facility (McDowell 1999).

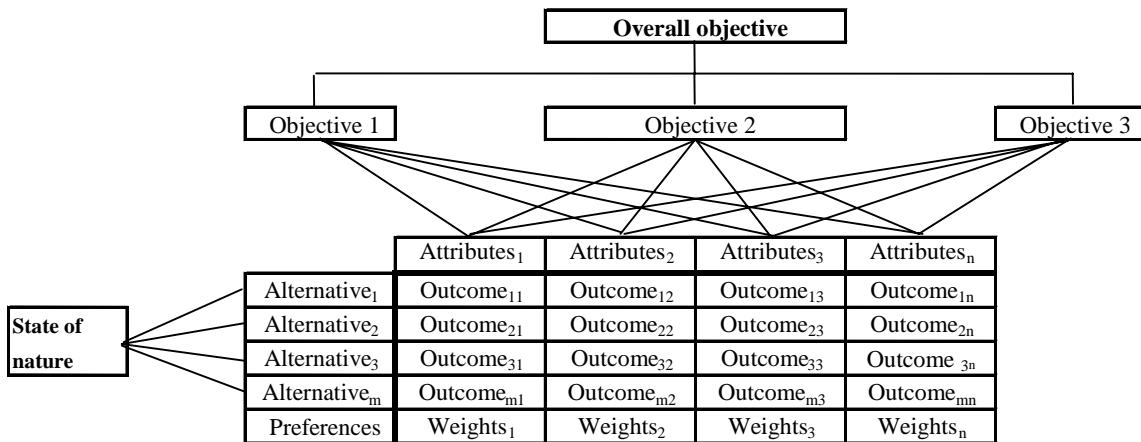
## MULTI-CRITERIA DECISION METHODS (MCDM)

MCDM, as a methodology, has developed a precise language regarding the components of a problem and the relationship between them. Its main advantage is to be found on its demand for clarity in thinking and communication regarding the structure and communication of requirements and the achievement of consistency in the order of preferences. Figure 3 is a decision matrix characteristic involving a range of alternatives evaluated against multiple criteria.

Industry is becoming increasingly aware of the complex nature of major decisions where the impacts are of such a magnitude that a more systematic approach is required.

Examples include Value Management and the Analytic Hierarchy Process (AHP). MCDM has also been used to devise a rational method of selecting trade contractors or key management personnel against a set of criteria.

Problems can be defined as the process of evaluating *alternatives* in the light of their *outcomes* expressed as *attributes* against a set of *criteria*. It is necessary, however to establish the set of criteria. Performance attributes are characterized by indicating, through some measurement, the degree to which objectives can be met. The prescribed measure required from the attribute constitutes the performance criteria.



**Figure 2:** Framework for Multicriteria decision analysis (based on Malczewski 1999).

## ORGANIZATIONAL PERFORMANCE

Any organization, regardless of the nature of its business, performs three fundamental functions. These are:

- Marketing, whereby it secures and maintains a client/customer base.
- Procurement, whereby it acquires resources.
- Operations, whereby it delivers goods and services

These functions represent the commercial and operational needs of an organization from a facilities management perspective (CFM Briefing 1997). They are made possible through the arrangement of finance and are monitored through the costing and budgetary functions. The costing information should mirror the above-named functions in order to make the correct assessment of their performance.

Costs constitute the informational equivalents to the resource inputs of the other functions. Each area of performance contributes towards the overall financial performance of the organization. Cost is therefore a proxy attribute for the three main areas of organizational performance identified above. The performance of the facilities should be judged in terms of its contribution towards the three organizational functions.

In the case of PPP/PFI projects, it is the client's task to make the link between organizational performance and facilities performance and then produce an output specification that sets the performance standards to be met by the SPV.

## MCDM AND PERFORMANCE STATEMENTS

Performance Statements form the basis of satisfying objectives. It is important therefore, that the objectives are expressed in a manner that indicates the means for their achievement. In particular it is necessary to make implicit objectives explicit. As most problems involve multiple objectives, it is necessary to structure them in such a way that the right balance is achieved. In order to establish the right balance of objectives, Keeney (1994) has made the following recommendations:

### 1. Identify fundamental objectives

A clear distinction must be made between fundamental objectives and means objectives. This can be done examining the reasons for including the objectives for consideration. Once the fundamental has been identified, it is necessary to specify the

extent or scope of the objective. In the case of seeking to minimize waste, for example, it should be clear what kind of waste is to be included in the objective.

## 2. Structure the objectives

Structuring helps to clarify the decision context and to define the set of fundamental objectives. As objectives are hierarchical in nature, it is necessary to establish the right kind of hierarchy. The objectives hierarchy indicates the set of objectives over which attributes should be defined. When developing a structure, it is important to establish the right elements of the structure and the relationship between them. In other words the structure should be coherent. An incoherent structure is one that fails to distinguish between objectives, constraints, alternatives and attributes.

Keeney (1994) has identified two types of structure that can be considered: *the Fundamental Objectives Hierarchy (FOH)* and *the Means-End Objectives Network (MEON)*. The FOH specifies in detail the reason for having an interest in the problem and would be used where decision-maker is concerned to know who and what to include the achievement of the overall objective whereas the MEON specifies how the objective is to be achieved.

In the FOH the family of lower level objectives define the parent objective and should, as far as possible, be mutually exclusive and should collectively exhaust the intentions of the parent objective. In the case of the MEON however, the relationship between the adjacent levels is causal. Whereas the FOH has a clear and simple order, the MEON may have a complex relationship. For example, in the case of MEON, some of the means objectives are means to more than one higher level objective as illustrated in Figure 4.

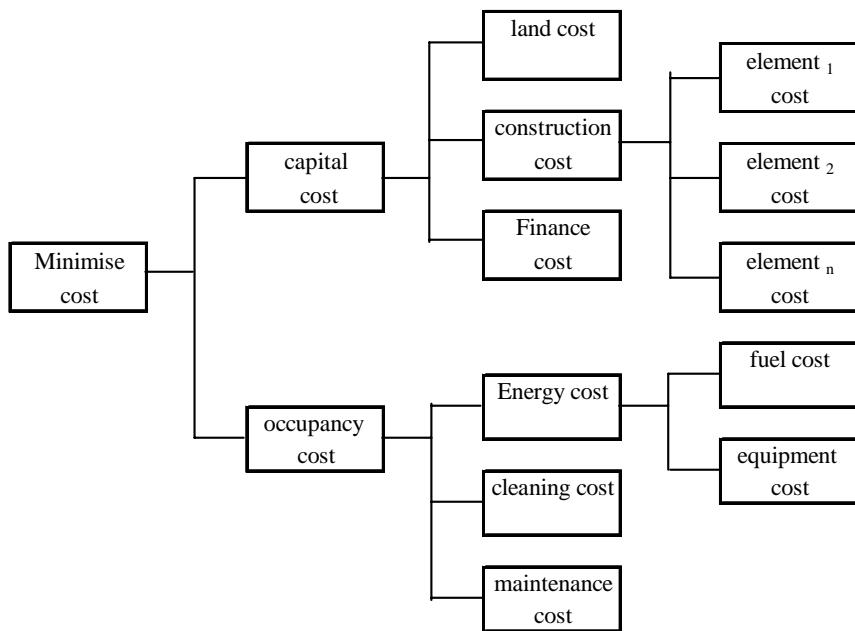
Problems can be defined as the process of evaluating *alternatives* in the light of their *outcomes* expressed as *attributes* against a set of *criteria*. It is necessary, however to establish the set of criteria.

What is evident from the Means-End Objectives Network is the primary importance of design in securing the required level of performance, both in the execution of the project and the efficient use of the building throughout its intended life. There is as yet, however, no well-established index of design performance. In their study on hotel design, Ransley and Ingram (2001) considered the effects of design on what are termed the soft factors, which include:

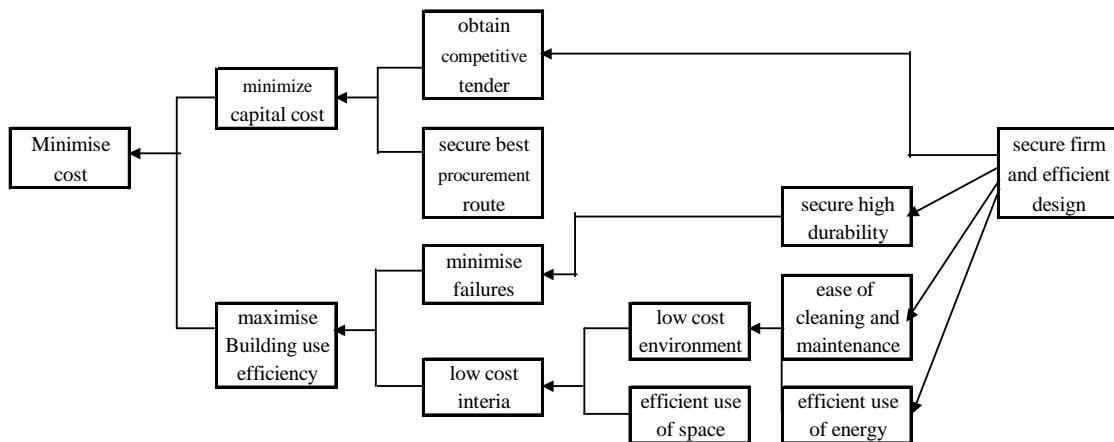
- image
- style
- comfort
- marketing
- ambience

as well as the harder factors such as:

- operational efficiency
- costs
- safety
- cleanability and maintenance
- ergonomics
- noise
- space allocation



**Figure 3:** Fundamental Objectives Hierarchy (FOH) for establishing the minimum whole-life cost of a built facility, (adapted from Keeney 1994).



**Figure 4:** A means-end objectives network (MEON) for establishing the minimum whole-life cost of a built facility, (adapted from Keeney 1994)

The two lists as they stand are unhelpful in establishing coherent sets of performance criteria, since some are means to others. For example it is reasonable to suppose that the soft factors are a means to operational efficiency, albeit the precise nature and strength of the relationship may not be firmly established. Soft factors are the psychological responses to the hard factors. As such they are the intervening factors, which provide the link between the hard or physical factors and the efficient operation of the organization.

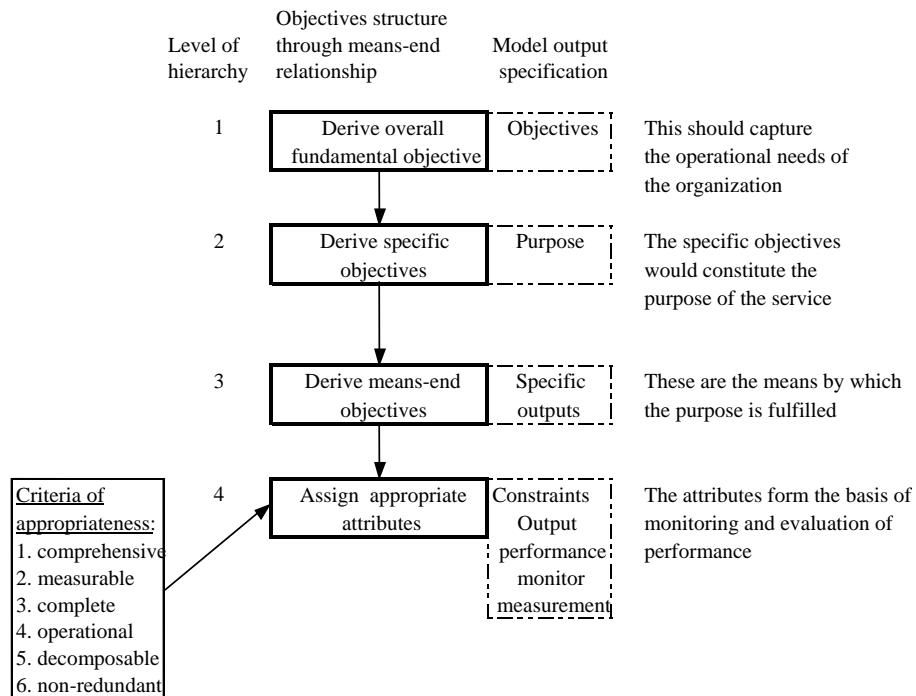
Furthermore, once the building is complete, design ceases to be a relevant causal factor in maintaining standards, unless changes are contemplated at various stages of the life of the facility.

The Means-End Objectives Network provides a better opportunity to establish performance indices than does the Fundamental Objectives Hierarchy. What becomes relevant is the maintaining of the required performance standards that are understood by both the provider and the recipient. In order to establish the appropriate standards, it is necessary to ensure they measure the degree to which the client objectives are achieved. In other words the standards should be expressed in terms of attributes of the client objectives.

To ensure the appropriate attributes are selected Keeney and Raiffa (1993) have proposed that they should be:

- *Comprehensive*. From the known level of attribute, it should be possible to know the extent to which the associated objective is achieved, In other words it should be relevant to a particular course of action.
- *Measurable*. It should be possible to relate the client's requirements to particular levels of an attribute. This being so a judgement can be made regarding the extent to which an aspect of the requirement is met.
- *Complete*. A set of attributes is complete if it covers all relevant aspects of a decision problem. Given each attribute is *comprehensive*, they should indicate the degree to which the overall objective is met.
- *Operational*. It should be possible for the decision maker to know the full consequences of the various alternatives. Further, the decision maker must be aware of the non-technical problems that render the set of attributes non operational such as existing policy.
- *Decomposable*. It is sometimes necessary to simplify the decision by disaggregating the problem into parts of smaller dimension. This becomes necessary when dealing with environmental issues where, the attributes describing air pollution can be grouped in terms of contributing to global warming and a threat to human health.
- *Non-redundant*. An outcome may be scored in terms of energy consumed and cost. Clearly cost is a proxy for the energy used and should not be included in addition to the consumption of energy.

Given client requirements are characterized by objectives with attributes containing the above properties, it should be possible to evaluate the outcomes against the required standards and to take appropriate action in the event of failing to meet the standards.



**Figure 5:** A suggested link between Keeney's means-end approach and the model output

## OUTPUT SPECIFICATION

The development of output specification removed the need for an understanding of the technical inputs associated with conventional (input) specifications. It also allowed specialist to develop new and more economical ways of achieving the desired outputs.

In their CFM Briefing (1997), The Centre for Facilities Management developed a model output specification linking the organization's commercial and operational needs with specific outputs.

Both approaches offer a framework, which attempt to link the commercial and operational needs of the organizations and to judge the extent to which specific outputs are met. Keeney's means-end approach, however, is derived from general Multi-Criterion Decision Methods (MCDM), which is a highly structured approach to the derivation of the specific outputs and the assignment of attributes. It is this aspect, which ensures that the client is able to articulate what constitutes best value by being confronted with establishing the right balance of outputs and their respective attributes from the facility.

## CONCLUSION

Best value to the client organization is achieved through the selection of the appropriate performance criteria that reflects the organization's commercial and operational needs within specified cost constraints. Where the services are provided on a contractual basis, as with PPP/PFI projects, it is imperative that the performance of the service delivery is capable of being evaluated in terms of acceptability by both parties to the contract. There are two adverse consequences for failing to derive the right set of performance statements: One is the perverse action by the provider, where the actual performance is in strict accord with the statement but falls well below what was required. The other is ambiguity, which results in costly disputes. The complex

nature of buildings designed to satisfy conflicting requirements requires a systematic approach to deriving performance standards. MCDM was developed precisely to deal with this type of problem. It does not absolve the client team from making the decision, rather it compels the decision makers to adopt a highly disciplined approach in setting out the outputs demanded of the service provider. It does this by ensuring that each specified output is causally related to the overall requirement of the facility and the attributes constitute the right measure of the output. It is by establishing a coherent set of outputs with appropriate attributes that best value can be achieved.

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