



# EERHPOLICYBRIEF

## Multicriteria Analysis and the Emperor's new clothes Leo Dobes<sup>1</sup> and Jeff Bennett<sup>2</sup>

*Despite its popularity, Multicriteria Analysis is arbitrary and fundamentally methodologically flawed ...*

Multicriteria Analysis is prevalent within government<sup>3</sup>. Major proponents are the Sustainable Ecosystems Division of the Commonwealth Scientific and Industrial Organisation (CSIRO) and the Bureau of Resource Sciences, both of which make available software toolkits based on Multicriteria Analysis.

Many other government agencies employ Multicriteria Analysis, either sporadically or as a matter of course. However, as Luskin and Dobes (1999, p. 203) noted, such analyses are rarely available for review, even by Public Servants in other government agencies. Requests by academics for access to analyses, such as that used to justify the Victorian Sugar-loaf pipeline for transferring water from agricultural uses along the Goulburn River to Melbourne urban usage, have also invariably met with lack of success.

Notwithstanding a general lack of transparency, the key concern relates to the underlying methodology. Indeed, the flaws in the approach are so fundamental that it is only fair to ask whether the use of Multicriteria Analysis is a case of the Emperor having no clothes<sup>4</sup>.

### What is Multicriteria Analysis?

The most common approach to undertaking Multicriteria Analysis is through a Goals Achievement Matrix. As its name suggests, its purpose is to indicate the relative contribution of a selected group of impacts to the achievement of an overall objective or goal.

A simplified version in the table below deals with the hypothetical example of conserving a particular area of bush-land. In this example, a total weight-adjusted score of +140 has been calculated. A cursory examination, such as may be made by a busy Minister or other decision-maker, might indicate that the project has scored "highly", and should therefore be implemented. More detailed examination, however, reveals a number of fundamental problems.

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<sup>3</sup> A quick search under "multicriteria analysis" on the Department of Finance and Deregulation website [http://agencysearch.australia.gov.au/search/search.cgi?collection=agencies&form=advanced&profile=finance&query=multicriteria%20analysis&scope=&scope\\_disable=on&start\\_rank=71](http://agencysearch.australia.gov.au/search/search.cgi?collection=agencies&form=advanced&profile=finance&query=multicriteria%20analysis&scope=&scope_disable=on&start_rank=71) on 5 June 2010 produced a list of over 70 documents, but the true extent of usage is likely to be far greater, including in state governments.

<sup>4</sup> The allusion is to a story in which an emperor is tricked by rogue tailors into believing that he has acquired a suit of finest cloth, but one that is invisible to anyone not worthy of their position, or simply stupid. Being vain and confirmed in his delusion by his sycophantic ministers, the emperor parades before his subjects in his non-existent suit. It is left to a child in the crowd to point out that the emperor in fact has no clothes.



TABLE 1: HYPOTHETICAL GOALS ACHIEVEMENT MATRIX FOR EVALUATION OF AN ENVIRONMENTAL CONSERVATION PROJECT

| attribute (criterion)   | units    | impact | score<br>(-4 to +4) | weight<br>(per cent) | weight-<br>adjusted<br>score |
|-------------------------|----------|--------|---------------------|----------------------|------------------------------|
| vegetation area         | ha       | 1,500  | +2                  | 20                   | 40                           |
| number of species saved | #        | 3      | +4                  | 40                   | 160                          |
| water savings           | ML       | 15     | +1                  | 10                   | 10                           |
| people employed         | #        | 7      | +1                  | 10                   | 10                           |
| cost                    | \$ (000) | 14     | -4                  | 20                   | -80                          |
| total                   |          |        |                     | 100                  | +140                         |

## What is wrong with Multicriteria Analysis?

Conceptually, Multicriteria Analysis is no better than adding apples and oranges. While it is generally recognised that the addition of incommensurable units such as apples and oranges is invalid, the sequential manipulation of data in a Goals Achievement Matrix does just that. Whatever sophisticated mathematical techniques may be applied by academics or consultants, the fact remains that the procedure relies on a logically and mathematically flawed methodological base.

The first problem is the selection of the attributes or criteria that should be considered in assessing any particular project. Because there is no theoretical basis to guide the choice of criteria, analysts are left to make highly individual selections. No matter how objective the analyst's intent, the criteria chosen will inevitably suffer from subjectivity.

In an attempt to avoid such subjectivity, the views are sometimes sought of 'key stakeholders'. However, those with a personal interest in the outcome of the project, whether in favour of it or opposed, are likely to choose criteria which best suit their own interests.

While seemingly sensible from a political perspective, choosing stakeholders with a major interest in a project can exclude the equally valid interests of those with less political influence, or who may not be considered to have a major interest in the outcome. Even if a 'focus group' of people is used to assist in selecting criteria, there is little guarantee that all of the interests of society as a whole will be reflected in the criteria used. There is therefore a very real risk that decisions will be made, or even manipulated, on the basis of narrow vested interests.

Each of the impacts that have been selected is measured and recorded by the analyst, as in the second and third columns of the table. Note that various physical, numerical (e.g. count data for attributes such as number of species saved) and financial units have been used.



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In order to express the degree or significance of each of the impact categories, the analyst attaches a score to each. Again, the score awarded may be entirely personal, or determined by a focus group, or a set of stakeholders. Except by coincidence, scores are unlikely to reflect the preferences of society as a whole. Whatever their real intentions, government analysts and decision-makers (society's 'agents') will only take into account the priorities and preferences of society (the 'principal') by chance, and can readily contrive to ignore them deliberately.

Scoring is usually carried out using a Likert scale such as -4 to +4 in the tabular example above, but larger ranges such as -7 to +7 or smaller ones such as -3 to +3 are also used. There is no definitive theory to guide the selection of the range. Obviously, a smaller range will limit the variability of the scores awarded, making it more difficult to distinguish between the degree of incidence of the various impacts.

In the next step, the analyst, a focus group, or even 'key stakeholders', specify a weight for each category to indicate the relative importance of the impact. In the example above, employment creation receives a weight of 10 per cent, and the number of species saved a weight four times greater. Specifying such weights in the absence of any supporting theory means that the procedure is not only highly arbitrary but can also be open to both conscious and unintended manipulation.

Lest it be thought that this emphasis on the arbitrariness of Multicriteria Analysis has been overstated, it is worth recording the experience of a self-selected focus group conducted in Canberra on 9 November 2009 to set weights for an index involving environmental impacts of building and construction materials. The focus group having completed its task of attaching weights to a large number of criteria, it became clear that none of the (mostly public servant and consultant) participants had actually understood the meaning of categories such as 'terrestrial ecotoxicity' or the presence of 'radionuclides'. However, the facilitators did not consider this to be a major issue. More notably, there was no criterion at all to reflect the costs of alternative building products!

Ironically, Multicriteria Analysis also ends up monetising impacts, despite the avowed objection to doing so by many analysts who use it in preference to Cost-Benefit Analysis. For example, equal weights have been allocated in the table to the area of vegetation saved and to the cost of the project. By implication, the hypothetical analyst considers that saving 1500 ha of vegetation is equivalent in value to \$14,000. No reputable economist doing a Cost-Benefit Analysis would dare to calculate such a simplistic monetary value.

Finally, the weighted scores are aggregated to provide a single figure that is used by decision-makers to assess the desirability of proceeding with a project. In other words, Multicriteria Analysis begins by taking cardinal values (the physical, numerical or financial units in which impacts have been expressed, multiplies them by an ordinal scoring system and then an interval scale (the weights). The result is a unitless quantity that can only be compared with alternative projects (including a 'do nothing' option) of the same kind, with the same set of impacts, but cannot provide guidance on the social value of undertaking the project.

### Some popular uses of the Multicriteria Analysis approach

One reason why Multicriteria Analysis has gained such unquestioning acceptance within government decision-making processes may be its wider popularity. The regular publication of indexes purportedly measuring 'quality of life' in different countries, the 'most liveable cities' across the world, Green Star awards for 'environmentally sustainable' buildings, and league tables of universities, for example, attracts significant, albeit generally uninformed media interest.

<sup>5</sup> Part of a series of workshops, held predominantly in capital cities under the auspices of the Department of Innovation, Industry, Science and Research: 'Buildings and Environment: Full Life Cycle Assessment National Environmental Weightings Workshops'. <http://www.edgeenvironment.com.au/index.php?a=weightings> viewed 4 November 2009.

Such indexes are a form of Multicriteria Analysis. For example, The Economist Intelligence Unit (2010) ranked Vancouver, Vienna and Melbourne as the top three 'most liveable' cities in the world. The index is composed of five broad categories that subsume over 30 qualitative and quantitative factors, with percentage weights attached to each. The 'infrastructure' category aggregates incommensurable quantities such as the 'quality of energy provision' and the 'quality of international links'. For qualitative variables, scores are simply determined by 'in-house analysts and in-city contributors'. How valid such scores may be is anyone's guess.

It is possible that indexes produced serially (e.g. on an annual basis) can usefully signal changes in circumstances or conditions when overall scores or ranks change. However the underlying methodological flaws and subjectivity of the constituent components of such indexes mean that users cannot be confident that a change in score or rank is actually significant. It may also be difficult to discern the reason for any change if the producer of the index does not provide sufficient information on the construction of the index and the data sources used.

### **Cost-Benefit Analysis: the preferable alternative**

Despite a number of conceptual challenges of its own, Cost-Benefit Analysis does not suffer from the same fundamental flaws and biases as Multicriteria Analysis. It is the most rigorous methodology available for evaluating the social worth of a project. In particular, the choice of variables and the valuation methodologies are well established within a coherent analytical framework. In contrast to Multicriteria Analysis, the results generated by Cost-Benefit Analysis are broadly reproducible, irrespective of the analyst undertaking the evaluation.

### **REFERENCES**

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