

# Multi-Criteria Analysis: "Good Enough" for Government Work?

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## Abstract

*Multi-criteria analysis (including Triple Bottom Line approaches) is fundamentally flawed in principle, and is open to abuse by special-interest groups. Its increased use poses a significant risk to the quality of policy formulation by Australian governments.*

## Introduction

There has been considerable discussion in recent years, both within and outside government, about issues of 'governance'; the institutional and administrative structures and processes for taking decisions and implementing them. But comparatively little, if any, attention has been given to the type or quality of the underlying methods of analysis on which governments and parliaments base those decisions.

A key message of this article is that current practice of governance remains insufficient or, at best, superficial, unless government and parliamentary proposals for legislation (including both funding and regulatory measures) are based on rigorous analytical methods of assessment before decisions are taken. No matter how sophisticated the institutional and administrative superstructures, a lack of rigorous assessment of proposals can only result in decisions that reduce the well-being of all Australians, except perhaps for favoured special interests.

Reflecting our concern for rigour in assessment, this paper focuses on the increasing use of 'multi-criteria analysis' by Australian governments. The principal question addressed below is simple: is multi-criteria analysis a sufficiently rigorous tool to ensure an understanding of societal impacts and to avoid misallocation of resources due to rent-seeking behaviour by special interests?

In addition to answering this question in the negative, we advance cost-benefit analysis as the preferred alternative technique for providing advice to

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decision-makers regarding the relative performance of alternative public-sector policies.

The focus of the argument is on methodology and analytical rigour.

We readily acknowledge that studies involving both cost-benefit analysis and multi-criteria analysis, particularly in the hands of amateurish or ignorant practitioners, can generate results that might justifiably horrify more-expert proponents of either approach. And Ergas (elsewhere in this issue) provides a comprehensive comparative assessment of the key features of the two methodologies. Unfortunately, the apparent lack of any suitable comparative studies does not make it possible to comment on whether the application of cost-benefit analysis and multi-criteria analysis to the same project might, in practice, yield similar recommendations to decision-makers.

Our contention, however, is that cost-benefit analysis has the underpinnings of methodological rigour that enable any application to be critiqued and thereafter either accepted as sound or rejected. In contrast, the merits of specific multi-criteria analysis applications cannot be assessed because it is founded in conceptual quicksand.

## **The emergence of cost-benefit analysis**

Individuals make decisions about the use of their limited resources with the aim of maximising personal happiness. The expectation is that governments do the same but with respect to the well-being<sup>2</sup> of the community as a whole. However, the task of governments is more complex, because they inevitably need to balance the conflicting wishes and wants of many different individuals in society. They also need to take account of spill-overs that one particular section of society may inflict on others.

In particular, governments invariably lack readily-available data that reflect adequately the values placed by the individuals on non-marketed goods and services. Estimation of the value of clean air, the preservation of a threatened species, or the social costs of traffic congestion can represent a challenge in this regard. To assist governments in the process of considering the trade-offs involved in resource-allocation decisions, the economics profession has developed 'cost-benefit analysis'.

The key underlying principle of cost-benefit analysis is the comparison of social benefits with corresponding costs. If benefits exceed costs, decision-makers have a case for proceeding with a project. If costs exceed benefits, and the

<sup>2</sup> The terms 'happiness' and 'well-being' are used here as non-technical synonyms with 'utility'. In his classic work on welfare economics, Little (1950: 7) discusses the interchangeability of these terms, as well as others such as 'social welfare', 'the happiness of society', etc, in the context of utilitarian principles.

decision-maker proceeds with the project, then she or he is at least informed of the net cost that society needs to bear.

Despite popular misconceptions, cost-benefit analysis is *not* founded on market prices. Benefits to society are measured as an aggregation of individuals' willingness to pay, and social costs reflect opportunities forgone. An individual's willingness to pay for water, for example, may be several thousands of dollars a year. But the price actually paid for that water by an individual may be far lower (perhaps just several dollars per year). The difference between the individual's willingness to pay and the price they pay is defined as the benefit generated from the consumption of the water. Thus price alone does not define the benefit. It is the willingness to pay net of the price. The net social benefit of making water available to all the individuals in a community is the present value of the difference between the sum of the residents' net willingness to pay (their 'consumers surplus') and the sum of the opportunity costs of the resources used in supplying the water. Simply because a good or service is not marketed, and hence is not priced, does not mean that it does not generate a benefit to society. So long as there is a willingness to pay for the non-marketed good or service, there will be a benefit enjoyed.<sup>3</sup>

Cost-benefit analysis thus provides a framework that allows governments to assess and compare the social costs and benefits of the full range of impacts of a proposed action, whether they involve marketed goods, environmental impacts, or regulatory controls. This framework brings with it a lineage extending back to writers such as Dupuit, Marshall, and Pigou, who founded the discipline in the nineteenth century (Mishan & Quah 2007: 243). These economists, and their numerous twentieth-century successors, have assiduously debated and refined the underlying concepts within the broader and coherent analytical construct of welfare economics.

North American textbooks on cost-benefit analysis invariably contain some reference to the 1936 US Flood Control Act. Under this legislation, Congress required flood-control projects undertaken by the US Army Corps of Engineers to be preceded by an analysis of costs and benefits.<sup>4</sup> The landmark Flood Control Act contains the famous phrase that the Federal Government should improve streams for flood-control purposes 'if the benefits to whomsoever they may accrue are in excess of the estimated costs, and if the lives and social security of people are otherwise adversely affected ...'. Subsequent presidential Executive

<sup>3</sup> Markets provide information on consumers' willingness to pay where goods and services are bought and sold. Where no markets form, as is the case for public goods, economists have developed alternative 'non-market valuation' techniques to estimate willingness to pay (see Hanley & Spash 1993).

<sup>4</sup> The antecedents of attempts in the United States to establish an assessment methodology for government projects are probably older. For example, Reuss (1922: 105) cites the 1808 Gallatin report as demonstrating that Congress generally 'supported public works whose benefits contributed an "annual additional income to the nation"'.

Orders (12291: Reagan 1980 and 12866: Clinton 1993) have stipulated government requirements for the analysis of costs and benefits of regulatory proposals prior to their adoption.

Australia too has some history of the application of rigorous assessment of government projects, although the extent of its use in the past is not clear. But the use of analytical tools to fashion input to the political decision-making process has never been institutionalised to the same degree that has been the case in America.

In giving evidence to a committee of the Victorian colonial parliament discussing a Railways Bill in 1871, for example, the Resident Engineer of the Railway Department provided the committee with an illustration of discounted cash-flow estimates of the costs for alternative projects (*Evidence taken at the Bar of the Legislative Council ... 1871*, appendices K and L). His example demonstrated that it would be cheaper to build a wooden viaduct that would last for only 10 years and would be rebuilt every decade thereafter, than to build a stone structure with steel girders that would last 100 years. He also claimed to have used the method in 1868 when a wooden bridge was in fact built.

But it was only in 2006 that the Council of Australian Governments agreed that the quality of regulatory impact statements should be improved through the use of cost-benefit analysis, and the Commonwealth Government established the Office of Best Practice Regulation to provide training, advice and technical assistance to government agencies (see Harrison in this issue). However, this requirement for economic analysis has not been extended to proposals that are not specifically regulatory in nature.

Throughout its history, cost-benefit analysis has been subjected to critical scrutiny and attack for being overly focused on economic efficiency. Wildavsky (1966: 310), for example, argued that economic perspectives should not 'swallow up political rationality', and Peter Self argued (Coleman & Hagger 2001: 120–6) that government-employed town planners, rather than 'econocrats', should determine the character and amenity of new towns. As part of this reaction, according to Lichfield (1993: 206), Italian and Dutch researchers in the 1970s began to work increasingly with multi-criteria analysis, and Quinet (1993: 193) reports the same shift away from cost-benefit analysis in France. In the UK, the then Department of Environment, Transport and the Regions (1998) set out a 'new approach to appraisal' of road projects that was based on five principal criteria: environmental impact, safety, economy, accessibility, and integration. Considerable effort has been made over the last decade within European Union countries to reconcile cost-benefit analysis with the multi-criteria analysis approach (for example, Sugden 2005; Diakoulaki & Karangelis 2007; and Prokofieva *et al.* 2008).

Multi-criteria analysis has also become increasingly popular in Australia (Proctor 2009: 74–5) over the last two decades or so. The Resource Assessment Commission (1992) published an overview of the approach, and the Commonwealth Scientific and Industrial Research Organisation (CSIRO) in particular has actively promoted its use in areas such as natural resources management, climate change and adaptation, and water management (<http://www.csiro.au/science/Social-Economic-Sciences.html>).

The Commonwealth Government itself has encouraged a simplistic version of multi-criteria analysis in the form of the so-called Triple Bottom Line<sup>5</sup> approach (for example, Environment Australia 2003) that is popular in some quarters of the Public Service. State and local governments and their agencies have also made use of it. For example, the business case developed by Melbourne Water (2008: 4) to justify the diversion of rural water from the Goulburn river to Melbourne was based on the Triple Bottom Line approach, but the study itself is classified as Cabinet-in-Confidence by the Victorian Government and therefore not publicly available. In an amusingly acerbic review, Ergas (2009) notes that a 2008 report by Infrastructure Australia (the body established to advise Australian governments on the relative merits of potential infrastructure projects) employs the Triple Bottom Line approach, despite also advocating the fundamental importance of cost-benefit analysis to rigorous assessment.

A relatively recent development appears to be the injection of prior political considerations as a prelude to undertaking cost-benefit analysis. Guidelines issued by the National Transport Council (NTC 2006), for example, introduced the concept of a Strategic Merit Test that is to be undertaken as a preliminary step in consideration of transport projects. One objective of the test is to 'identify how well the initiative is expected to contribute to jurisdictional objectives, policies and strategies' (NTC 2006 volume 3, 'Appraisal of initiatives': 15), with one of the rationales being that it 'provides an efficient means to filter proposals before considerable resources are spent on development'. The concept appears to have now been adopted by Infrastructure Australia (2008, section 4.2: 66) in the form of the 'strategic fit' criterion.

<sup>5</sup> Sometimes colloquially referred to as People, Planet, Profit (social, environmental and financial aspects), the Triple Bottom Line approach purportedly provides a comprehensive assessment of all aspects of interest to commercial or government decision-makers. The three aspects are variously given numerical scores, allocated 'traffic light' (green, yellow, red) categories for risk or importance, or just discussed qualitatively. There is no underlying principle or methodology involved, and the data used invariably depend on what happens to be readily available to the proponent. While this approach may have made some sense in a private-sector context (although not necessarily for shareholders) seeking to broaden the traditional focus on profits alone to a wider social perspective, it is superfluous in a cost-benefit analysis undertaken from a national social perspective by a government agency. In particular, the economic component of a cost-benefit assessment would already include social and environmental effects so that their separate presentation would constitute 'double-counting'. Common misperceptions that equate 'economic' with 'financial' aspects undoubtedly contribute to the confusion involved in the Triple Bottom Line approach.

Unfortunately, there has been a marked absence of debate or analysis within Australian government circles and academia as to the validity or relative merits of cost-benefit analysis and multi-criteria analysis. We therefore feel that a more open discussion is both timely and necessary. Because both cost-benefit analysis and multi-criteria analysis can be, and often are, subjected to misuse and erroneous application by practitioners, the focus below is on methodology rather than irrelevant straw men.

The first two sections below outline briefly the key features of both cost-benefit analysis and multi-criteria analysis. These are followed by a section that compares key features of the methodologies used, including various misconceptions about them. A penultimate section explores some of the implications for government. Finally, some policy conclusions are drawn in the hope of generating debate among Australian policy analysts and decision-makers about the appropriateness of using multi-criteria analysis.

## **The theory and practice of cost-benefit analysis**

Cost-benefit analysis is a methodology that is used to compare the costs and benefits of a government policy or action from the perspective of society as a whole. In its broadest sense, it compares the value of the resource uses (goods and services) that the community must forgo to implement a government action or policy against the resulting benefits over time.

In essence, it seeks to determine whether society overall could be made better off or not, after taking into account all the impacts, including environmental and social effects, on the individuals in that society. It is for this reason that economists often use the term 'social cost-benefit analysis', although the abbreviated term 'cost-benefit analysis' is more commonly used nowadays. Non-economists are often unaware of the comprehensive nature of cost-benefit analysis (or confuse the term 'economic' with purely commercial or financial considerations) and seek to complement it with further environmental or social perspectives.<sup>6</sup>

Nevertheless, a fundamental issue regarding cost-benefit analysis is that it aggregates the utilities (as measured by willingness to pay) of individuals. This aggregation of benefits, adjusted to take into account corresponding costs, reflects the utilitarian concept of potential Pareto improvement: although there will be winners and losers as a result of most government projects, if winners gain more than losers lose, the project is considered to be of net benefit to society.

There are significant problems with the concept of potential Pareto improvement, and most textbooks address them explicitly (for example, Sugden

<sup>6</sup> The attempt to compensate for environmental and social perspectives is found most clearly in the Triple Bottom Line approach, which seeks to add them to so-called 'economic' variables.

& Williams 1978: chs. 7, 13, 14). In particular, it is argued that a benefit or a loss to one person cannot simply be added to benefits or losses incurred by others. For example, a millionaire will gain far less utility from an additional dollar of income than will a poor person (referred to technically as differing marginal utilities of money). Although the debate remains unresolved, it can be argued that governments tend to reduce differences in marginal utilities of money among individuals through separate taxation policies designed to reduce income differences, and that individual utilities can therefore be aggregated in cost-benefit analysis without significant loss of rigour.<sup>7</sup>

A basic tenet of cost-benefit analysis is that it provides information to decision-makers about the effect on the whole of society. Analysts using the technique understand that decision-makers may well choose to ignore the results (as in the case of the Darwin–Alice Springs railway, for example) for purely political reasons. But its advantage even in these cases is that it permits a decision-maker to weigh up more clearly the opportunity costs to society, in terms of net benefits lost, of an action or policy that is implemented for purely political reasons.

Published examples of detailed cost-benefit analyses are readily available in numerous Bureau of Transport Economics (<http://www.btre.gov.au/>) reports and in studies covering topics that range from the costs and benefits of a single aviation market between Australia and New Zealand (Commonwealth of Australia and Government of New Zealand 1991), the V8 car races in Canberra (ACT Auditor-General 2002), health warnings on tobacco products (Applied Economics 2003), the funding of Rural Transaction Centres in country towns (Dobes 2007), the pharmaceutical industry investment program (Productivity Commission 2003), gambling (Productivity Commission 1999) and the management of river red gum forests along the Murray River (Bennett, Dumsday and Gillespie 2008). The underlying methodology has been developed over many years of debate and controversy among economists and is now reasonably well settled, although refinements continue to be made. Texts such as Gramlich (1981) and Boardman *et al.* (2006) provide a comprehensive overview of the key issues, and a practical beginner's introduction is presented in Dobes (2009).

## Multi-criteria analysis: atheoretical and impractical

In its simplest form, multi-criteria analysis involves an analyst selecting a set of 'impacts' or 'goals' to be achieved by a project or policy proposal, and assigning a score to each predicted impact on the extent of the effect and measured in a range of different and typically incompatible units. The scores are adjusted by

<sup>7</sup> Alternatively, cost benefit analysis can be 'supplemented' through the application of 'equity weights' to the benefits and costs experienced by different groups within society. The source of these weights remains problematic as they necessarily embody value judgements, unless they can be sourced from the preference of the community itself (Scarborough & Bennett 2008).

multiplying them by subjective weights that are chosen to represent the analyst’s assessment of the relative importance of each impact. The scores are then “standardised” mathematically, and summed arithmetically to provide an indication of net benefit.

A Goals Achievement Matrix is the most common form of presenting multi-criteria analysis. As its name suggests, the principal purpose of a Goals Achievement Matrix is to identify a set of key objectives or ‘impacts’ to be achieved by a project, with an indication of the relative contribution of each impact to the achievement of the project as a whole.

Ideally, an actual example of a multi-criteria analysis would be used to illustrate the methodology. However, the authors have not been able to obtain a detailed, *publicly available*, case study used in a government decision. A decade ago, Dobes (1999: 203) bemoaned the fact that it had not been possible to obtain officially a ‘live specimen’ of a multi-criteria analysis, although such analyses were routinely used by a number of state road authorities. There appears to be a similar dearth today of publicly available analyses undertaken by the Federal or State governments. For this reason, the example of the Goals Achievement Matrix presented in the table below is necessarily a hypothetical one, and used purely for illustrative purposes.

The first column in the table lists the attributes or criteria determined by the hypothetical analyst or decision-maker to be relevant to deciding whether to subject an area of bushland to a conservation measure. A second column has been included here to illustrate clearly that the various criteria can differ significantly in the units of measurement used. The scores in the third column show the ‘value’ placed by the analyst on the attributes of the specific area being considered for conservation. Similar tables could have been developed for alternative areas of bushland being considered for conservation, but are not shown here, in order to keep the example simple.

**Table 1: Hypothetical goals achievement matrix for evaluation of an environmental conservation option**

attribute (criterion)	Units	Impact	score (-4 to +4)	weight (per cent)	weight-adjusted score
vegetation area	ha	1,500	+ 2	20	40
number of species recovered	#	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

In the example shown here, a weight-adjusted score of +140 has been recorded. This score could be compared to a similarly derived score of alternative projects, including a 'do nothing' scenario where current activities (for example, logging) continue unchanged. However, any such comparison would only be valid if different areas of bushland were subjected to identical activities and the impacts (criteria, attributes) used in the analysis were also the same.

## Some comparisons: cost-benefit analysis versus multi-criteria analysis

In 1772, Benjamin Franklin, one of the Founding Fathers of the United States of America, offered some advice to his English acquaintance, Joseph Priestley, in the following terms:

In the Affair of so much Importance to you, wherein you ask my Advice, I cannot for want of sufficient Premises, advise you *what* to determine, but if you please I will tell you *how*. When these difficult Cases occur, they are difficult chiefly because while we have them under Consideration all the Reasons *pro* and *con* are not present to the Mind at the same time; but sometimes one Set present themselves, and at other times another, the first being out of Sight. Hence the various Purposes or Inclinations that alternately prevail, and the Uncertainty that perplexes us. To get over this, my Way is, to divide half a Sheet of Paper by a Line into two Columns, writing over the one *Pro*, and over the other *Con*. Then during three or four Days Consideration I put down under the different Heads short Hints of the different Motives that at different Times occur to me for or against the Measure. When I have thus got them all together in one View, I endeavour to estimate their respective Weights; and where I find two, one on each side, that seem equal, I strike them both out: If I find a Reason *pro* equal to some two Reasons *con*, I strike out the three. If I judge some two Reasons *con* equal to some three Reasons *pro*, I strike out the five; and thus proceeding I find at length where the Ballance lies; and if after a Day or two of farther Consideration nothing new that is of Importance occurs on either side, I come to a Determination accordingly. And tho' the Weight of Reasons cannot be taken with the Precision of Algebraic Quantities, yet when each is thus considered separately and comparatively, and the whole lies before me, I think I can judge better, and am less likely to make a rash Step; and in fact I have found great Advantage from this kind of Equation, in what may be called *Moral* or *Prudential Algebra*. Wishing sincerely that you may determine for the best, I am ever, my dear Friend, Yours most affectionately

<<http://www.historycarper.com/resources/twobf3/letter11.htm>>

This missive is cited frequently by proponents of *both* cost-benefit analysis (for example, Gramlich 1981: 1–2) and multi-criteria analysis (for example, Hajkowicz 2006) as an early forerunner of their respective analytical approaches. It therefore provides a convenient point of departure for comparing the two methods.

Clearly, Franklin was describing a qualitative approach to decision-making of the sort that many people use intuitively in their personal lives, but rarely undertake in such a systematic fashion. The question therefore arises as to how Franklin or some other intelligent observer might have advised a relative to proceed if they wished to adopt a quantitative analysis, not from their individual perspective, but from the perspective of society as a whole (or the perspective of a government on behalf of the society which it represents).

### Whose perspective?

Cost-benefit analysis is always carried out from the perspective ('standing') of the whole of society within a specific jurisdiction. The perspective adopted is usually a national one, but can also be at the state or local level. The inclusion of all members of society is the key principle, because an analysis from a whole-of-society perspective is fundamentally different from one from a personal perspective (like Benjamin Franklin's advice) or for a sub-section of society. A holistic perspective requires that any spill-over effects, for example, be taken into account and gains by one section of society be offset against losses by another.

Multi-criteria analysis is less inclusive about 'standing'. Frequently, those who are consulted about the determination of weights or the attribution of scores to specific impacts are subject-matter experts, focus groups (which may self-select if general invitations to participate are issued) or members of specific interest groups. The probability of a result that is biased in favour of a proposal can thus be very high, and the analytical method is certainly open to the influence of interest groups and special pleading.

In the case of the Sugarloaf Pipeline Project (the diversion of Goulburn River water to Melbourne), for example, the analysis of options for the specific route of the pipeline — considered after the initial (publicly unavailable) business case had been accepted — was based on scores and weights 'based on advice' from the Agency Reference Group. This advisory group comprised state government departments such as Planning and Community Development, state government agencies such as VicRoads, local government such as the Shire of Yarra Ranges, and water and catchment authorities (Sugarloaf Project Alliance 2008: 13).

The very selectivity of the general approach of using so-called stakeholders in multi-criteria analysis belies its claim to better represent a wider set of social and environmental values and perspectives than cost-benefit analysis. While

the government authorities that contributed to the assessment of the Sugarloaf pipeline proposal may have had different professional, and possibly contradictory, views, they would all have been broadly attuned to the overall intention of the Victorian Government to divert water from country to urban areas. It is more likely than not that the nature of such analysis comes close to 'second-guessing the Minister'.

Even if great care is taken to avoid bias, and even if focus groups have been objectively constituted (for example, based on a random sample of the population) an analyst may simply select from focus-group discussions only those views about impacts, scores or weights that appeal most to him or her. Where this occurs, the results of the analysis will tend to confirm the analyst's preconceptions or favoured results because the choice of impacts, scores and weights is so instrumental to the final results in multi-criteria analysis.

Confirmation bias can also creep into the analysis where a focus group self-selects; for example, in response to an advertisement inviting participation. If time is an important consideration, the views of those with spare time to attend (for example, retirees) may predominate, or those with strong motivations or self-interest (for example, property developers who stand to gain from a project) may find themselves in a majority.

A good example of the problems associated with using focus groups on which to base decisions is that of a proposal by the Victorian Government to upgrade the road from Melbourne north through Shepparton. The Victorian Government at the time used community discussion groups to help determine priorities in its road-building program. Anecdotal material recounted by a well-placed source in the 1990s was that a community meeting in Shepparton had insisted strongly that the Government's priority should be to upgrade the road from Shepparton to Melbourne to improve access to urban facilities such as cinemas. Because of its reliance on such community groups in the decision-making process, the Victorian Government was faced with a dilemma because it recognised that upgrading the road beyond Shepparton to the New South Wales border was equally important to interstate trade, and hence the overall welfare of Victorians as a whole.

Consideration of the views of 'stakeholders' has become almost *de rigueur* in public service advice to Ministers over the last few decades. 'Stakeholder' is a fairly loose concept that can include those who have significant influence or are substantially affected (often termed 'key' stakeholders) or any number of categories of those who are affected or can influence policies. While seemingly sensible from a political perspective, this approach tends to exclude those with only minor political influence or who are considered to have some lesser degree of 'interest'. The interests of taxpayers, for example, are usually ignored by

spending agencies, ostensibly because they may individually only suffer a small additional increase in taxation to pay for a large project.

Unfortunately, the veneer of respectability or objectivity that is bestowed by terms such as 'stakeholder' may simply mask the influence on analysts of those with strong vested interests or loud voices. The issue is particularly relevant to multi-criteria analysis, because it tends to focus on key impacts and stakeholders, rather than analysing the effect of a policy or project on society as a whole.

## Choice of impacts or effects of government policies and actions

Multi-criteria analysis has no single or overriding principle on which the impacts (or so-called criteria or attributes) of a policy proposal are determined. Proctor (2009: 83), for example, states that 'the decision-makers select the criteria, but criteria can be suggested by the analyst so that the decision-makers are not starting from scratch'.

Proctor (2009: 81–3) uses a hypothetical forestry-management problem to illustrate the selection of criteria/impacts to be considered. However, it is unlikely that any two analysts or decision-makers will choose exactly the same criteria on which to base their analyses. In the case of a forestry-management example, an analyst in a government agency that represents loggers is likely to choose different criteria from a colleague working on the same issue in an agency charged with environmental responsibilities.

One of Proctor's (2009: 83) criteria illustrates an additional, important problem. She includes the criterion of 'change in tourism revenue' as an impact of less logging in the forest, and therefore of greater access to bushwalking areas. (Note, too, that in the very similar example in our own table above, the impact on tourism revenues was not included, although there was no intention of deliberately setting up a difference with Proctor.) Because the impacts in multi-criteria analysis are chosen without first determining a rigorous approach to the issue of 'standing', or the analytical frame of reference, the tourism criterion is ambiguous.

Revenues from tourism may indeed increase at the local level where logging of a forest has been reduced. But the bushwalkers who visit that area are now no longer visiting alternative bushwalking sites, perhaps elsewhere in the same state, so that tourism revenues elsewhere are reduced commensurately. The logical flaw is obvious: if analysts in every forest area in Australia carried out a similar analysis simultaneously, then total revenue from tourism could be increased by many thousands of per cent, and all on the basis of the same group of bushwalkers!

In contrast, cost-benefit analysis requires the inclusion of all the material costs and benefits that are directly attributable to a policy or project. Benefits and costs are, in turn, defined with reference to impacts on individual well-being, as established under the analytical framework of welfare economics. Assuming that 'standing' had been specified as 'national' in this case, only *additional* demand generated for bushwalking would have been included as a benefit, to avoid including bushwalkers who merely switched location. The benefit itself would have been estimated as bushwalkers' willingness to pay to use the forest in question, probably using a non-market valuation technique such as the 'travel cost' method (see Boardman *et al.*: 354–61).

However, some adjustment would also have been made in a cost-benefit analysis to reflect the additional use of society's resources (a cost): for example, additional damage to walking tracks, the costs of additional labour and fuel in supplying local restaurants, and possibly increased traffic congestion and noxious emissions and noise around the local tourist resort, and so on. From the more comprehensive perspective of social cost-benefit analysis, the financial impacts arising from tourism are only part of the equation. By considering both benefits and costs in commensurable units, cost-benefit analysis provides a measure of the net benefit.

Note also that, in this example, cost-benefit analysis, rather than multi-criteria analysis, would have taken account of the complexities of a wider range of social and environmental impacts. Their inclusion would have been transparent to a decision-maker, and their selection 'standardised' through the reliance on the definitions of well-being provided by welfare economics.

Treating local job creation as a benefit of a project has become virtually standard practice in the 'Do It Yourself' brand of economic analysis increasingly practised by Australian governments, especially in departmental advice to Ministers about the expected effects of government programs. It is therefore unsurprising that Proctor (2009: 85, table 4.2) includes the criterion of 'change in jobs (number)', presumably meaning that jobs created represent a benefit.

In conditions of general unemployment, it is true that Australian society may gain if unemployed resources are used productively.<sup>8</sup> If local residents are already employed, however, then the creation of more jobs locally will either require an influx of workers, or skills shortages will occur, as was the case in non-urban areas in recent years. If workers arrive from other towns to take up the new jobs, both positive and negative effects may be felt by locals: for

<sup>8</sup> Generation of employment which has no value (because no-one is willing to pay for the work performed) would not in itself be socially beneficial. A job filling and then emptying sandbags, or digging and filling in holes, for example, would not be productive. However, there may be beneficial effects such as maintaining the esteem of the unemployed (which should be taken into account in cost-benefit analysis although some creativity would be required in terms of valuation), and macroeconomists may regard such activity to be essential 'pump-priming' to lift an economy out of recession.

example, landlords may receive higher rents if accommodation is scarce, but locals will also pay higher rents. And if there is a shortage of workers in other towns, those towns will find that their local skills shortages are exacerbated. One town's gain may simply be another town's loss; an effect that would be recognised within cost-benefit analysis, but not generally by multi-criteria analysis.

A persistent canard regarding employment creation is that it is socially beneficial because the payment of unemployment benefits is thereby reduced. While it is true that government budgetary outlays may be reduced, unemployment benefits are a so-called transfer payment that has no net effect on the well-being of society as a whole. Some members of society (taxpayers) lose, while others (the recipients of the payments) benefit to an equal extent. Society as a whole is neither richer nor poorer because transfer payments simply redistribute income between residents.

## Alternative policies

An essential aspect to decision-making in government is the opportunity to consider the relative merits of alternative courses of action. Even if a Minister champions a particular proposal as potentially the best thing since sliced bread, his or her colleagues will often wish to know what alternatives are feasible and available, or whether the resources could be better used elsewhere.

Multi-criteria analysis is incapable of comparisons between unrelated programs, because their impacts or attributes are so different. For example, there is no sensible means of comparing the conservation initiative in our table above with some unrelated alternative such as improving the health of the population through the introduction of a vaccination program. Governments cannot therefore be certain that the pursuit of a conservation initiative is the best use of society's limited resources. Over time, the community will become worse off than it could have been with a more rational decision-making approach.

A distinct advantage of cost-benefit analysis, on the other hand, is that it permits comparisons between projects as diverse as hospital construction, new schools, roads, environmental conservation, and so on, because it evaluates all projects and policies on the basis of a common numeraire underpinned by a common theoretical construct. Cost-benefit analysis therefore complements the system of Cabinet deliberation used by Australian governments and other democracies to choose between competing priorities.

## Valuation of effects or merits of proposals

Multi-criteria analysis grew in part from a distaste for benefit-cost analysis largely arising from the practical difficulties (and, for some, the philosophical

qualms) of using money as a metric for comparing net benefits from competing resource use options.

But this critique of economic analysis is misplaced, because willingness to pay — albeit expressed in monetary units — in fact represents a consumer's willingness to sacrifice one bundle of goods or resources for another: money simply represents a claim on resources. Money is just a common expression of value, a numeraire, just as a physicist may measure energy in joules (convertible to calories, electron-volts, and so on), even for different physical systems (food, sunlight, fossil fuels, kinetic energy of an electron, and so on). It would be just as valid to express the value of bundles of goods or services in terms of hamburgers, conch shells or Mars bars that would need to be given in exchange to obtain them.

The techniques used in modern cost-benefit analysis to estimate the willingness to pay for various non-monetary attributes such as environmental amenity are well developed. For example, Bateman *et al.* (2002) is a manual for the application of the so-called stated-preference techniques, notably Contingent Valuation and Choice Modelling, for the estimation of non-marketed benefits and costs in monetary terms. The manual was originally commissioned by the UK Department of Environment, Transport and the Regions to facilitate the use of such techniques within the cost-benefit framework.

Ironically, the use of weights in multi-criteria analysis can itself place an implicit monetary value on an attribute. In the table above, an equal weight of 20 per cent has been assigned to both cost (in \$ thousand) and to the area covered in vegetation (in hectares). The decision-maker can therefore be said to consider a thousand dollar increase in cost to be of equal importance to an increase of a hectare of vegetation. The implicit value of a hectare of vegetation is therefore a thousand dollars. Similar implicit values can be determined by comparing other weights such as species recovered against jobs.

Even more incongruous is the frequent use in multi-criteria analysis of market prices, presumably because they are readily observable. Examples include the cost of materials or wages. Where market prices are used, implicit values will also be based on market prices. But market prices do not always reflect the true opportunity cost to society of a good or service. Cost-benefit analysis on the other hand — and despite misconceptions by those not fully familiar with the technique — will normally use shadow prices to adjust for externalities, taxes and other non-market distortions in order to more accurately capture *social* values.

Again, the impacts specified by Proctor (2009: 83) for her forest-management example are ambiguous. She lists both the change in jobs (presumably increases in local employment) and the change in wage levels. An increase in the number of local jobs may be a benefit to those who are unemployed (but only to the

extent that a job is preferred to leisure time), but in a tight labour market it may also result in a shortage of workers in areas such as the local restaurant.

Similarly, increased wage levels may benefit some locals, but may also result in some of them losing their jobs if employers cannot pay higher wages, or reduced enjoyment by local residents of restaurant meals because tourists have driven up prices. And higher wages for local workers will be offset by correspondingly lower profits (income) for their employers, so that the local community as a whole will not gain. Again, this illustrates the systemically selective nature of multi-criteria analysis: there is no clear methodology that guides the analyst in choosing between criteria that represent workers or employers or between costs and benefits where two sets of stakeholders have diametrically opposed interests. Cost-benefit analysis, on the other hand, would include the effect on both, because both have equally valid interests as participants in a democratic society.

## Efficiency versus equity

A key issue that has not been satisfactorily resolved in welfare economics (the branch of economics on which cost-benefit analysis is largely based) is Jeremy Bentham's utilitarianist principle that actions should be evaluated on the basis of whether they generate the greatest amount of overall happiness for society. Aggregation of individual 'happiness' or utility is problematic because of the lack of a common numeraire for the fairly nebulous concept of utility. Utility is not measurable or comparable.

In practice, standard cost-benefit analysis tends to assume that a given change in costs or benefits (for example, \$100) arising from a policy or project is valued equally by rich people and poor people and that individuals' benefits and costs can therefore be aggregated to give an overall measure of net benefit to society. (In technical language, the marginal utility of money is assumed to be constant.) This approach (see, for example, Sugden & Williams 1978: ch. 16) implicitly accepts that the analyst's role is principally that of an adviser on the efficiency aspects of a policy or project, and that value judgements about equity considerations should be the province of the political decision-maker.

Nevertheless, economists do sometimes advocate the use of income or other equity weights in cost-benefit analysis where it would be helpful to explore adjustments for poorer groups. But such calls are invariably tempered by a strict reminder that a non-weighted analysis should also be provided, to allow the decision-maker to easily determine the effect of including 'equity' weights.

Pearce & Nash (1981: 10–11), however, point out that even standard cost-benefit analyses make a value judgement by not using weights because they accept implicitly that the existing distribution of income is an equitable one. While this is true, the standard, unweighted approach is still generally

preferable because the current distribution of income in a democratic society reflects (albeit imperfectly) existing social preferences. To introduce any other set of weights risks the adoption of a paternalistic or authoritarian approach by the individual analyst or decision-maker. And where weights are used, transparency requires that the same analysis be presented to the decision-maker without weights so the effect of weighting is clearly discernible.

If the distribution of income across society is considered to be inequitable, the correct solution is to rectify it directly through progressive taxation or other policies, not by distorting the analysis of highly specific projects that may in any case affect only a small section of the community.

In more recent times, the issue of effect on different socio-economic groups has also been addressed more directly by disaggregating the results of cost-benefit analysis to show the potential incidence of the costs and benefits of a government program on various sections of society. This approach is more transparent and allows the decision-maker to weigh equity and political considerations against the overall social benefit achieved.

## Why multi-criteria analysis is fundamentally flawed

Most schoolchildren have learned that it is illogical to try to add apples and oranges. And few biologists would propose adding the mass of a flea to the length of a rat in advancing a new theory, although there is no problem in adding the weight of a flea to the weight of a rat.

In other words, to add or subtract, or to use some other mathematical operator to aggregate quantities, the quantities in question must have the same dimension. It is possible to add 1 kg to 0.5 kg to get 1.5 kg, for example. It is also possible to add 1 kg to 1 pound but the answer cannot be expressed as 2; it must remain as 1kg + 1 pound. Plausible aggregation would require a conversion factor that expresses kilograms and pounds in a ratio of like-dimensioned quantities such as 2.2046 pounds/kg.

Multi-criteria analysis breaches this principle of dimensionality. It is not possible, as in the tabular example above, to add hectares of vegetation saved to the number of species recovered. Multiplication by a score and a weight does nothing to correct the problem of incompatible dimensions, so that any aggregation of the results is logically flawed. Cost-benefit analysis solves the problem by converting all costs and benefits to a standard dimension — the quantity of resources that \$1 will command.<sup>9</sup>

<sup>9</sup> One of our referees has questioned whether cost-benefit analysis similarly converts heterogeneous attributes (for example, access to a national park vs access to good health care) to a single 'willingness to pay' measure. With respect, we do not agree. The weighted scores used in multi-criteria analysis are unitless and have no meaning beyond the limited context of a specific set of arbitrary attributes. Use of monetary units, while often confused with simple cash or market prices, provides a common unit of

Added to this problem is the issue of multiplying cardinal numbers such as hectares by an ordinal number scale (−4 to +4) and then an interval scale (weights expressed as a number between 0 and 100) and treating the result as a cardinal number that can be added to other cardinal numbers. There is some room for debate about this particular aspect, because it could be argued that the scoring system is akin to a Likert scale, and therefore not clearly an ordinal or an interval scale. If the difference between, say, +2 and +3 is perceived by the person allocating the score to be equal to the difference between +3 and +4, then it could be argued that the scale is an interval one. Where such differences are not considered equal (for example, the step up from +3 is much bigger than the step from +2 to +3) then the scale is better regarded as an ordinal measuring system. And, clearly, different people will perceive the scales differently.

Whether the flaw of incompatible dimensionality is compounded by problems with the interaction of cardinal and ordinal number systems is not entirely clear. However, the flaw of incompatible dimensionality is sufficient to deny any legitimacy in the use of multi-criteria analysis. And no amount of sophisticated mathematical superstructure can remedy such a basic defect.

## Analytical rigour

Despite the fundamentally flawed methodology that underpins multi-criteria analysis, its proponents have developed mathematically sophisticated superstructures which may give the appearance of increasing its validity and rigour. However, no amount of sophisticated mathematics can compensate for fundamental flaws in the methodology.

For example, the number of attributes used in a multi-criteria analysis may affect the overall and relative scoring of attributes. This could change the alternative deemed to be most desirable, but only because of a procedural issue. Likewise, different mathematical procedures for converting unit measurements to scores can impact on the ranking of alternatives. These procedures range from the very simple (assign a ranking score — 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, and so on — to alternative attributes) to the more sophisticated (based on statistical distributions about the mean of the attributes). Again, these are matters of process that have no basis in any underlying analysis of society's well-being and should not be permitted to have a material impact on the policy recommendation so determined.

A disappointing development in recent years has been the use made by agencies such as CSIRO (for example, <http://www.csiro.au/science/Social-Economic-Sciences.html>) and the Bureau of Resource Sciences (for example, <http://adl.brs.gov.au/mcass/index.html>) of multi-criteria analysis. Multi-criteria analysis not only lacks any rigorous foundation, it is also fundamentally

measurement that represents the value of alternative goods and services that are forgone. It is therefore valid to aggregate costs and benefits to obtain a measure of net benefit.

unscientific because its arbitrary nature makes any analytical results non-replicable. Australian society would be likely to benefit more if CSIRO and Bureau of Resource Sciences resources were channelled into areas of more relevant core expertise, particularly into 'hard-edged science'.

Particular cost-benefit analyses sometimes lack rigour too. A particular analyst may misunderstand the economic implications of an effect, or may misuse econometric methodology to estimate the extent of the effect, or may succumb to political pressure.

However, while there may be disagreements about precise estimates used for specific variables in a cost-benefit analysis, the choice of variables and valuation methodologies is well established within a coherent analytical framework. The results of a cost-benefit analysis are therefore capable of rigorous review by peer analysts, and are reproducible.

## **Implications for government**

Although cost-benefit analysis has a number of practical and methodological limitations, multi-criteria analysis is fundamentally flawed. The lack of a coherent analytical framework also makes it susceptible to misuse by analysts and special interest groups.

Attempts to reconcile the two methods have not proved successful (for example, Prokofieva 2008; Sugden 2005). There is no indication that an acceptable synthesis is any more likely to be achieved in the future either. Despite the greater degree of specialised effort, and hence cost, that cost-benefit analysis may entail, its ability to produce rigorous and coherent evaluations mean that it should be the preferred analytical approach of governments.

However, cost-benefit analysis is also open to misuse in the hands of insufficiently trained or knowledgeable users. For this reason, governments should consider implementing the following measures to increase the degree of consistency and transparency of analyses of policy proposals:

- Conduct rigorous analysis before a decision is made.
- Publish all analyses of policy proposals, once a decision has been taken. This may sound far-fetched, but the practice of publishing central bank deliberations in recent years has not resulted in the fall of any government.
- Standardise as far as possible the use of key variables and assumptions in analyses, in order to allow more meaningful comparisons between competing policy proposals. For example, projections of GDP or population growth that are used should, as far as possible, be those published by the Australian Bureau of Statistics. Where they are not, the analysis should explain specifically why different numbers were used.

- Establish a central database for 'plug-in values' such as values of environmental effects, in order to minimise duplication of effort.<sup>10</sup>
- Establish a system of peer review of technical aspects of analyses of policy proposals.
- Establish an awards scheme to encourage agencies to produce best-practice analyses.

## Conclusions

There is no doubting the complexities of cost-benefit analysis, especially in estimating non-marketed benefits and costs in monetary terms. But policy analysis should not be expected to be straightforward. The task is tough.

However, using multi-criteria analysis because it provides an easy 'short cut' around the fundamental complexities of benefit-cost analysis is a weak strategy. Nor is the expense of a cost-benefit analysis commissioned from an expert practitioner a valid consideration, because government procurement of goods and services is based not on cost but, rather, on value for money. And the social cost of taking a misguided decision based on 'junk evaluation' techniques can also be high, albeit often unnoticed because of the general lack of rigorous *ex post* evaluation.

By avoiding the analytical complexities, and resorting to a technique devoid of a rigorous and replicable analytical framework, the decision-making process is placed in greater jeopardy — the jeopardy of exposure to the special pleadings of interest groups. And because of the apparent sophistication of multi-criteria analysis, these special-interest groups are offered the opportunity to disguise their pleadings as rigorous and comprehensive analysis.

Multi-criteria analysis is certainly *not* 'good enough', not even for government work. It's time to engage in a serious review of its use in the decision-making process.

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<sup>10</sup> For example, the Canadian Government maintains EVRI, an international database of environmental value estimates: <http://www.evri.ca/>. Missingham (elsewhere in this issue) addresses the issue in an Australian context.

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