PART IV

Chapter 18

CBA and other decision-making approaches

A significant array of decision-guiding procedures is available. This chapter shows that they vary in the degree of comprehensiveness where this is defined as the extent to which all costs and benefits are incorporated. In general, only multicriteria assessment (MCA) is as comprehensive as CBA and may be more comprehensive once goals beyond efficiency and distributional incidence are considered. All the remaining procedures either deliberately narrow the focus on benefits, e.g. to health or environment, or ignore cost. Procedures also vary in the way they treat time. Environmental impact assessment and life-cycle analysis are essential inputs into a CBA, although the way these impacts are dealt with in "physical terms" may not be the same in a CBA. Risk assessments, of which health-health analysis and risk-risk analysis are also variants, tend to be focused on human health only. The essential message is that the procedures are not substitutes for each other.

18.1. Introduction

This volume is concerned with recent developments in environmental cost-benefit analysis (CBA). Chapters 16 and 17 also identified that one of these developments is extensive use of CBA to assist actual policy formulation and actual decision-making, whether this be in choosing between policies or investment options for projects. A point made in Chapter 17 is that understanding this use needs to be based on a realistic understanding of the policy process, and the political economy of CBA. One manifestation of how CBA is actually used is that it is seldom, if ever, the only input to a decision. This will not be news to anybody, and most – including most economists – will view this as a perfectly healthy situation. Where different actors in this analytical process reasonably might disagree, however, is over the weight which evidence from a CBA should receive in making recommendations relative to the other tools which jostle for attention in policy and project formulation.

There are many reasons for emphasising a range of tools, rather than one in particular, including (not restricted to) the following:

- A desire for procedures which address different facets of evidence relevant to the decision-making process. This might reflect a recognition that no single policy formulation tool alone is adequate for such a task and that an array of tools might mitigate against the perceived shortcomings on any one. For example, some tools may be more suited for considering the minutiae of options available, while others are better suited for helping strategic choices about the future from which these more detailed options might follow.
- A need to fill information and evidence gaps left by an incomplete implementation of a particular procedure such as CBA. For example, Dudley et al. (2017) identify a number of points on a "checklist" as to whether consideration of costs and benefits in policy formulation[1] follows commonly accepted guidelines about best practice. Actual implementation might fall short in one or several of these points either by accident (e.g. the difficulty of valuing certain impacts) or design (e.g. a policy culture that takes a different standpoint on the merits of valuing certain impacts or the proportional information needs of the decision at hand). In at least some of these cases, other procedures may play an important part too.[2]
- A (related) desire to ensure that the tools used in policy formulation reflect a plurality of understandings (and perhaps "belief systems") about the world in which policy decisions are being made. So, for example, if a particular tool rests on conceptual foundations which some find unpalatable, then other approaches can provide a "voice" for different perspectives. Of course, it is a challenge for the policy process to consider all these perspectives side-by-side but considering a range of tools acknowledges explicitly the complexity of reality, rather than seeking to circumscribe evidence gathering to one approach.
- A desire to have procedures that can be widely understood and which are not reliant on experts, and so which are perhaps more participatory or deliberative. Given the need for decision-makers to be accountable and for decisions often needing to command broad support this deliberation provides an important function.

- A (pragmatic) desire to have decision-aiding procedures that are not so demanding in informational terms. This might, in turn, derive from a desire to have "rapid" procedures given that political decisions cannot always wait for the results of more informationally demanding approaches.

Over the years, various techniques of appraisal have emerged in the environmental field in addition to CBA. A (non-exhaustive) list includes:

- Cost-effectiveness analysis (CEA)
- Risk assessment
  - Comparative risk assessment
  - Risk-benefit analysis
  - Risk-risk analysis
  - Health-health analysis
- Environmental assessment
  1. Environmental impact assessment
  2. Strategic environmental assessment
  3. Life-cycle analysis
- Multi-criteria analysis
- Participatory approaches
- Scenario analysis.

In this chapter, each of these procedures is looked at. Space forbids a detailed assessment (see the edited volume by Jordan and Turnpenny, 2015, for such detail). But – given the focus of this volume – the main idea in what follows below is simply to "locate" CBA in this range of procedures. It is important to understand that the procedures vary significantly in their comprehensiveness and that it cannot be assumed that each is a substitute for the other. Indeed, as set out above, it is important not to succumb to the temptation of viewing these approaches simply as a menu of alternatives for one another. That is, some of these tools and procedures may be essential inputs for another on this list. Some procedures may involve a combination of approaches (for example, using participative procedures to shape "scenarios" or "cost-benefit" assessments). Different procedures may "come into their own" at different points in the policy cycle. And, as previously mentioned, the practical counterpart of the frequently made general (but reasonable-minded) statement – that any single policy formulation tool is only one input to making recommendations about decisions – is surely that these procedures usually need to be considered side-by-side.

18.2. A (select) gallery of additional procedures

18.2.1. Cost-effectiveness analysis

The easiest way to think about cost-effectiveness analysis (CEA) is to assume that there is a single indicator of effectiveness, E, and this is to be compared with a cost of C. Suppose there is now just a single project or policy to be appraised. CEA would require that E be compared with C. The usual procedure is to produce a cost-effectiveness ratio (CER):

$$CER = \frac{E}{C} \qquad [18.1]$$

Notice that E is in some environmental unit and C is in money units. The fact that they are in different units has an important implication which is, unfortunately, widely

disregarded in the literature. A moment's inspection of [18.1] shows that the ratio is perfectly meaningful – e.g. it might be read as dollars per hectare of land conserved. But the ratio says nothing at all as to whether the conservation policy in question is worth undertaking. In other words, CEA cannot help with the issue of whether or not to undertake any conservation. It should be immediately obvious that this question cannot be answered unless *E* and *C* are in the same units.

CEA can only offer guidance on which of several alternative policies (or projects) to select, given that one has to select one. By extension, CEA can *rank* any set of policies, all of which could be undertaken, but given that at least some of them must be undertaken. To see the limitation of CEA, equation [18.1] should be sufficient to show that an entire list of policies, ranked by their cost-effectiveness, could be adopted without any assurance that any one of them is actually worth doing. The notion of "worth doing" only has meaning if one can compare costs and benefits in a manner that enables one to say costs are greater (smaller) than benefits. In turn, that requires that costs and benefits have a common *numeraire* which, in principle, could be anything. In CBA, the numeraire is money.

If it is supposed that there are i = 1….n potential policies, with corresponding costs C_i and effectiveness E_i then CEA requires that the policies are being ranked according to

$$CER_i = \frac{E_i}{C_i} \qquad [18.2]$$

This ranking can be used to select as many projects as fit the available budget $\bar{C}$, i.e.:

$$Rank \quad by \quad CER_i \quad s.t \quad \sum_i C_i = \bar{C} \qquad [18.3]$$

A further issue with CEA is the process of selecting the effectiveness measure. In CBA the principle is that benefits are measured by individuals' preferences as revealed by their willingness-to-pay for them. The underlying value judgement in CBA is "consumer" or "citizen sovereignty". This amounts to saying that individuals are the best judges of their own well-being. Technically, the same value judgement could be used in CEA, i.e. the measure of effectiveness could be based on some attitude survey of a random sample of individuals. In practice, CEA tends to proceed with indicators of effectiveness chosen by experts. Rationales for using expert choices are (a) that experts are better informed than individuals, especially on issues such as habitat conservation, landscape protection, etc. and (b) that securing indicators from experts is quicker and cheaper than eliciting individuals' attitudes.

18.2.2. Risk assessment

As discussed below, there are a number of variants on this approach. Common to all is placing the "riskiness" of policy actions or new projects at the front and centre of appraisal (relative to the risks of not acting). And while a cost-benefit practitioner might argue that CBA has a variety of ways in order to reflect risk and uncertainty in making recommendations about options for policy and investments project, a virtue of this risk-based approaches is that these consider such matters in a more straightforward and transparent way. As such, these approaches merit consideration alongside more general tools for policy formulation such as CBA.

A general approach to this problem is summarised under the heading of risk assessment (RA). This involves assessing either the health or environmental risks (or both) attached to a product, process, policy or project. A RA may be expressed in various ways:

- As the probability of some defined health or ecosystem effect occurring, e.g. a 1 in 100 000 chance of mortality within a certain timeframe from continued exposure to some chemical;

- As a number of incidences across a defined population, e.g. 10 000 premature deaths per annum out of some population;
- As a defined incidence per unit of exposure, e.g. X% increase in premature mortality per unit air pollution;
- As a "no effect" level of exposure, e.g. below one microgram per cubic metre there may be no health effect.

RAs may not translate into decision-rules very easily. One way they may do this is if the actual or estimated risk level is compared with an "acceptable" level which in turn may be the result of some expert judgement or the result of a public survey. A common threshold is to look at unavoidable "everyday" risks and to judge whether people "live with" such a risk. This may make it acceptable. Other procedures tend to be more common and may define the acceptable level as a no-risk level, or even a non-risk level with a sizeable margin of error. Procedures establishing "no effect" levels, e.g. of chemicals, define the origin of what the economist would call a "damage function" but cannot inform decision-making unless the goal is in fact to secure that level of risk. Put another way, "no effect" points contain no information about the "damage function".

Comparative risk assessment (CRA) involves analysing risks but the distinction in this approach is to look at this for several alternative projects or policies. The issue is then which option should be chosen and the answer offered by CRA is that the option with the lowest risk should be chosen. Efforts are made to "normalise" the analysis so that like is compared with like. For example, one might want to choose between nuclear energy and coal-fired electricity. One approach would be to normalise the risks of one kilowatt hour of electricity and compute, say, the expected number of deaths per kWh. The option with the lowest "death rate" would then be chosen. However, in this case, the normalisation process does not extend to cost, so that CRA may want to add a further dimension, the money cost of generating one kWh. Once this is done, the focus tends to shift to cost-effectiveness analysis – see above. An issue here concerns the nature of risk. "One fatality" appears to be a homogenous unit, but if people are not indifferent to the manner of death or whether it is voluntarily or involuntarily borne, then, in effect, the normalisation does not adequately reflect this. Of course, this assumes that context (in this case, of mortality risk) matters and Chapter 15 indicates that there is ambiguous evidence for this, although the existence of "dread risks" cannot be ruled out entirely.

Risk-benefit analysis (RBA) tends to take two forms, each of which is reducible to another form of decision-rule. In other words, RBA is not a separate procedure. The first meaning relates to benefits, costs and risks, where risks are treated as costs and valued in money terms. In that case, the formula for accepting a project or policy would be:

[Benefits – Costs – Risks] > 0

This is little different therefore to a CBA rule.

In the second case, the RBA rule reduces to CRA. Benefits might be standardised, e.g. to "passenger kilometres" and the risk element might be fatalities. "Fatalities per passenger kilometre" might then be the thing that should be minimised. As with CRA, cost may or may not enter the picture. If it does, then RBA tends to result in CBA or cost-effectiveness analysis.

Two further variants of these risk-centred approaches look more closely as health risks. For example, risk-risk analysis (RRA) asks what would happen to health risks if some policy was adopted and what would happen if it was not adopted. The "with/without focus" is familiar in CBA. The novelty tends to be the fact that not undertaking a policy may itself

impose costs in terms of lives or morbidity. For example, a policy of banning or lowering consumption of saccharin might have a justification in reducing health risks from its consumption. But the with-policy option may result in consumers switching to sugar in place of the banned saccharin, thus increasing morbidity by that route. The advantage of RRA is that it forces decision makers to look at the behavioural responses to regulations. Once again, however, all other components in a CBA equation are ignored, so the procedure is not comprehensive.

In this respect, health-health analysis (HHA) is similar to RRA but instead of comparing the risks with and without the behavioural reaction to a policy, it compares the change in risks from a policy with the risks associated with the *expenditure* on the policy. As such, it offers a subtle focus on policy that is easily overlooked. Since policies costs money, the money has to come from somewhere and, ultimately, the source is the taxpayer. But if taxpayers pay part of their taxes for life-saving policies, their incomes are reduced. Some of that reduced income would have been spent on life-saving or health-enhancing activities. Hence the taxation actually increases life risks. HHA compares the anticipated saving in lives from a policy with the lives lost because of the cost of the policy. In principle, policies costing more lives than they save are not desirable. HHA proceeds by estimating the costs of a life-saving policy and the number of lives saved. It then allocates the policy costs to households. Life risks are related to household incomes through regression analysis, so that it is possible to estimate lives lost due to income reductions. Once again, the procedure is not comprehensive: policies could fail an HHA test but pass a CBA test, and vice versa.

18.2.3. Environmental assessment

Just as in the case of risk assessments, there are a number of variants of approaches that focus on environmental impacts of policies and projects under the broad heading of "environmental assessment". As discussed below, one of these approaches fulfils the task of quantifying these environmental impacts in physical terms (or where this is not possible perhaps the analysis is in qualitative terms). As such, this is critically important basic information without which subsequent approaches – such as CBA – simply could not be conducted. Just as importantly, this environmentally focused assessment might turn up invaluable information about the criticality of environmental changes arising from policy or project proposals. In doing so, this provides information crucial for the sort of sustainability concerns set out in Chapter 12. Other environmental assessment tools add to this picture by perhaps considering how proposals contribute to cumulative pressures on the physical environment or the way in which environmental impacts have a life-cycle (and so a range of indirect impacts become relevant to quantify).

A starting point for thinking about these environmental tools are systematic procedures for collecting information about the environmental impacts of a project or policy, and for measuring those impacts. This is usually known as environmental impact assessment (EIA). Of course, given its focus, EIA is not a comprehensive evaluation procedure given that it does not consider non-environmental impacts or policy and project costs. Less obvious, but also important, is whether environmental impacts are recorded in a way that signals the ways in which impacts vary with time. Nonetheless, EIA is an essential part of any evaluative procedure. If CBA is used as a benchmark, then EIA is an essential input to CBA.

CBA covers the other impacts of projects and policies, and it goes one stage further than EIA by attempting to put money values on the environmental impacts. Most EIAs do make an effort, however, to assess the significance of environmental impacts. Some may

go further and give the impacts a score (the extent of the impact) and a weight (its importance). Weights might be derived from public surveys but more usually are determined by the analyst in question. Unlike CBA, EIA has no formal decision-rule attached to it (e.g. benefits must exceed costs), but analysts would typically argue that its purpose is to look at alternative means of minimising the environmental impacts without altering significantly the benefits of the project or policy.

In general, then:

- EIA is an essential input to any decision-making procedure;
- Impacts may be scored and weighted, or they become inputs into a CBA;
- EIA would generally look for ways to minimise environmental impacts without changing (significantly, anyway) the benefits or costs of the project or policy.

Strategic environmental assessment (SEA) is similar to EIA but tends to operate at a "higher" level of decision-making. Instead of single projects or policies, SEA would consider entire programmes of investments or policies. The goal is to look for the synergies between individual policies and projects and to evaluate alternatives in a more comprehensive manner. An SEA is more likely than an EIA to consider issues like: is the policy or project needed at all; and, if it is, what are the alternative options available? In this sense, SEA is seen to be more pro-active than EIA, which tends to be reactive. Proactive here means that more opportunity exists for programmes to be better designed (from an environmental perspective) rather than accepting that a specific option is chosen and the task is to minimise environmental impacts from that option. Again, while it encompasses more issues of concern, SEA remains non-comprehensive as a decision-guiding procedure. Issues of time, cost and non-environmental costs and benefits may not figure prominently. Relative to the benchmark of CBA, SEA goes some way to considering the kinds of issues that would be relevant in a CBA – e.g. the "with/without" principle and consideration of alternatives. A crucial point that SEA might pick up on is the degree to which an apparently marginal policy or project has a cumulative impact on the physical environment generally or some natural capital asset specifically.

Life-cycle analysis (LCA) offers a further perspective in that it does not only look at the impacts *directly* arising from a project or policy, but also at the whole "life-cycle" of impacts. For example, suppose the policy problem is one of choosing between the "best" forms of packaging for a product, say fruit juice. The alternatives might be cartons, bottles and cans. LCA would look at the environmental impacts of each option but going right back to the materials needed for manufacturing of the container (e.g. timber and plastics, glass, metals) and the ways in which they will be disposed of once consumers have drunk the juice. Included in the analysis would be the environmental impacts of primary resource extraction and the impacts from landfill, incineration, and so on.

LCAs proceed by establishing an inventory of impacts and then the impacts are subjected to an assessment to establish the extent of impact and the weight to be attached to it. Relative to the benchmark of CBA, LCA is essentially the physical counterpart to the kind of environmental impact analysis that is required by a CBA. In itself LCA offers no obvious decision-rule for policies or projects. Though sometimes advocated as comprehensive decision-guidance, LCA does not (usually) consider non-environmental costs and benefits. However, if the choice context is one where one of several options has to be chosen (we must have cans or bottles or cartons, but not none of these), then, provided other things are equal, LCA operates like a cost-effectiveness criterion (see above).

18.2.4. Multi-criteria approaches

Multi-criteria approaches look at manifold and diverse dimensions of policies and investment projects. A virtue of these approaches is that these are considered within the same analytical framework. So, for example, if metrics reflecting various decision relevant parameters relating to "efficiency", "effectiveness", "equity" as well as "administrative simplicity and governance" need to be considered under the one umbrella then multi-criteria techniques provide a useful framework for doing this in a coherent way. As such, this goes further than CBA which can only consider such parameters to the extent these can be reflected in robust monetary valuation. But as with CBA, this comprehensiveness might come at a cost in that manifold impacts are not easy to disentangle and important debates about the "parts" relating to the options relating to decisions become lost in what is happening to the "whole".

One such approach – multi-criteria analysis (MCA) – is similar in many respects to CEA but involves multiple indicators of effectiveness. Technically, CEA also works with multiple indicators but increasingly resembles simple models of MCA since different effectiveness indicators, measured in different units, have to be normalised by converting them to scores and then aggregated via a weighting procedure. Like CEA, policy or scheme cost in an MCA is always (or should always be) one of the indicators chosen. The steps in an MCA are as follows:

- The goals or objectives of the policy or investment are stated.
- These objectives are not pre-ordained, nor are they singular (as they are in CBA, which adopts increases in economic efficiency as the primary objective) and are selected by "decision-makers".
- Generally, decision-makers will be civil servants whose choices can be argued to reflect political concerns.
- MCA then tends to work with experts' preferences. Public preferences may or may not be involved.
- "Criteria" or, sometimes, "attributes" which help achieve the objectives are then selected. Sometimes, objectives and criteria tend to be fused, making the distinction difficult to observe. However, criteria will generally be those features of a good that achieve the objective.
- Such criteria may or may not be measured in monetary terms, but MCA differs from CBA in that not all criteria will be monetised.
- Each option (alternative means of securing the objective) is then given a score and a weight. Pursuing the above example, a policy might score 6 out of 10 for one effect, 2 out of 10 for another effect, and 7 out of 10 for yet another. In turn, experts may regard the first effect as being twice as important as the second, but only half as important as the third. The weights would then be 2, 1 and 4 respectively.
- In the simplest of MCAs, the final outcome is a weighted average of the scores, with the option providing the highest weighted score being the one that is "best". More sophisticated techniques might be used for more complex decisions.
- To overcome issues relating to the need for criteria to be independent of each other (i.e. experts' preferences based on one criterion should be independent of their preferences for that option based on another criterion), more sophisticated techniques might be used, notably "multi-attribute utility theory" (MAUT). MAUT tends to be over-sophisticated for most practical decision making.

The formula for the final score for an investment project or policy using the simplest form of MCA is:

$$S_i = \sum_j m_j . S_{ij} \qquad [18.4]$$

where i is the i^{th} option, j is the j^{th} criterion for selection, m is the weight, and S is the score.

MCA offers a broader interpretation of CEA since it openly countenances the existence of multiple objectives. Issues relating to MCA and which are the subject of debate are as follows:

- As with CEA, when effectiveness is compared with cost in ratio form, MCA cannot say anything about whether or not it is worth adopting any investment project or policy at all. Its domain is restricted to choices between alternatives in a portfolio of options, some of which must be undertaken. Both MCA and CEA are therefore "efficient" in the sense of seeking to secure maximum effectiveness for a given unit of cost, but may be "inefficient" in the sense of economic efficiency. Annex 18.A1 illustrates the problem further and shows that MCA produces the same result as a CBA only when (a) the scores on the attributes are the same, (b) the weights in the MCA correspond to shadow prices in the CBA, and (c), which follows from (b), the weight on cost is unity.
- MCA generally proceeds by adopting scores and weights chosen by experts. To this extent MCA is not as "accountable" as CBA where the money units reflect individuals' preferences rather than expert preferences. Put another way, the raw material of CBA is a set of individuals' votes, albeit votes weighted by income, whereas experts are unelected and may not be accountable to individual voters.
- MCA tends to be more "transparent" than CBA since objectives and criteria are usually clearly stated, rather than assumed. Because of its adoption of multiple objectives, however, MCA tends to be less transparent than CEA with a single objective.
- It is often unclear how far MCA deals with issues of time discounting and changing relative valuations.
- Distributional implications are usually chosen as one of the objectives in an MCA and hence distributional impacts can be clearly accommodated in an MCA.

18.2.5. Participatory approaches

Where the political system is sensitive to the public interest there is likely to be emphasis on consultation and participation, perhaps based on more deliberative approaches to policy formulation. This is something that should concern cost-benefit practitioners too. The reason for this is that lack of participation can easily engender opposition to a project or policy, making it difficult to implement and costly to reverse. Participation may also produce better policy and project design since those most affected are closer to the issue than analysts and decision makers.

While there is a case for saying that some of the valuation techniques used in environmental CBA – notably, stated preference approaches – involve consulting people directly as well as eliciting their preferences about policy changes and new projects, this is not the same thing as a truly participative or deliberative approach. For example, the elicitation approach in stated preference studies tends to be between (independent) interviewer and a single respondent or increasingly via cost-effective but impersonal on-line platforms). Nevertheless, Chapter 4 does indicate a handful of studies which show the potential to adapt these approaches to incorporate more deliberative aspects.

In order to assess whether particular tools are sufficiently participative, it is useful to take a step back and define what this means. At least three versions of the term seem relevant here: (a) participation as consultation, i.e. taking account of the preferences of affected parties; (b) participation as influence, i.e. ensuring that affected parties influence the direction and form of the project or policy; and (c) participation as benefit-sharing, i.e. ensuring that affected parties receive a share of the resulting benefits. Frequently what is meant by participation is not the recording of public preferences, but the need to consult with pressure groups who would otherwise stand in the way of policy. It is senses (b) and (c) above that matter in political decision-making rather than sense (a). Yet (a) is what underlies CBA whereas (b) and (c) are not accorded status in CBA. Again, there is a rationale to secure that participation by seeking out additional tools for policy formulation.

As Hisschemöller and Cuppen (2015) identify there is not necessarily a formal characterisation of participatory tools. However, what links approaches that are participative according to these authors, are efforts to meaningfully build in dialogue – in some forum – rather than rely on expert (and political) judgement alone. On this view, a number of familiar policy formulation tools are participative if implemented in ways fitting this emphasis on dialogue. This could include MCA where participants (e.g. stakeholders in a decision) enter into an interchange with analysts perhaps over the dimensions of the policy or project choice as well as the weights with which to attach to these dimensions. It might also include CBA depending on how it is conducted with stakeholders (such as making use of deliberative approaches based on focus groups and citizens' juries, for example).

As an illustration, the Environment Agency in England uses CBA extensively to guide its decisions on options for meeting policy objectives especially on water catchment management. A notable element of these applications is the EA's use of participation, with the aim of boosting transparency and engagement regarding the CBA that it conducts, the benefit valuation toolkit that it uses for valuing changes in water quality and the way in which this evidence will be used.[3] Specifically, stakeholders (which include environmental and conservation charities, water companies and other affected groups) are invited to deliberate on how this analysis is undertaken, including being invited to recommend inputs to toolkits such as the appropriate environmental values being used. Of course, as in any such deliberation, here is a risk of stakeholders suggesting evidence that suits their own interests. However, combined with suitable scrutiny of recommendations, what this deliberation can do is take advantage of new information about policy or project options as well as legitimating decisions.

18.2.6. Scenario analysis

Tools such as CBA provide a forecast of the future. This might involve forecasting the costs and benefits involved when specific options involving some policy change or investment project are implemented. But, in principle, this forecast also could look at these impacts at an earlier stage of the policy cycle. That is, perhaps when the policy problem (and suitable responses) is still being defined. Forecasting is a relatively precise exercise for this purpose given the degree of quantification that this modelling entails. And it may be that the policy formulation process would also benefit from tools which have a greater degree of an exploratory or even abstract nature, especially if policy responses (and their consequences) are not yet well-defined.

Scenario analysis (SA) is one such tool is this respect, defined by Pérez-Soba and Maas (2015) as lying somewhere between speculation and forecasting. That is, the latter is suited

for those problems where both complexity and uncertainty are relatively low (or presumably where uncertainty is analytically tractable – see Chapter 9 in particular) whereas the latter is characterised by the converse (i.e. a high degree of complexity and genuine uncertainty). Hence, according to Pérez-Soba and Maas, SA suits those policy problems where these characteristics are present at intermediate levels. The explorative nature of SA provides a means of probing the implications of possible futures that are plausible (in that they may happen) but diverse involving novelty such as surprises and shocks. Getting a sense of credible strategy and narrative (rather than detailed plans) might be a strong feature of such exercises, although the broad implications of chosen scenarios on socioeconomic or environmental outcomes are clearly of significant interest too. Looking forwards in this way is not the only of conceptualising scenarios. It may also involve "backcasting" or starting from a specified future scenario (perhaps one which is judged to sustainable or desirable) and working backwards to how that outcome might be achieved.

One example of the use of SA is the UK National Ecosystem Assessment (NEA) (2011). This defined six scenarios in all – described as "story-lines" – with each of these exploring a different path for deliberate management of ecosystem services. Some of these scenarios, for example, privileged economic growth (narrowly defined as GDP growth) or national security. In doing so, the role of ecosystem services in development is downplayed perhaps at the expense of agricultural expansion and intensification. In other scenarios, enhancing ecosystem services is at the front and centre of these futures. However, the ways in which those storylines are developed are several. For example, one scenario stressed making these services work better for the whole economy (as direct or indirect inputs to economic activity) while another compartmentalised ecosystem services as largely the domain of a protected countryside supplying amenity (as well as perhaps intrinsic beauty) rather than asking what ecosystems "can do" for the economy.

In turn, each of these scenarios implies particular paths for policies, plans and human behaviour. Understanding the differences and similarities across scenarios then is an important part of this SA. For cost-benefit practitioners it may be that this approach lacks the precision of a CBA. Of course, this is the point; the SA is arguably all the more useful because this precision is not attainable given the characteristics of the problem. However, it may be that it is possible to be precise about components of the problem. To use the above illustration once more, a further chapter in UK NEA (2011) explored how elements of the scenarios could be turned into forecasts. Given that each scenario implied a different path for ecosystem services and if some of these could be quantified and valued then the size of ecosystem benefits – arising in a particular scenario – could be ascertained in this way. Specifically, this valuation was applied to carbon storage, nature recreation and compared to the value of agricultural food production under these different scenarios, thereby further helping to shape policy thinking about these possible futures.

18.3. Conclusions

A significant array of decision-guiding procedures is available. This chapter shows that they vary in the degree of comprehensiveness where this is defined as the extent to which all costs and benefits are incorporated. In general, only MCA is as comprehensive as CBA and may be more comprehensive once goals beyond efficiency and distributional incidence are considered. All the remaining procedures either deliberately narrow the focus on particular impact categories, e.g. to health risks or environment, or ignore cost. Procedures also vary in the way they treat time. Some approaches such as EIA are essential inputs into

a CBA, although the way these impacts are dealt with in "physical terms" may not be the same in a CBA.

The message here is that these various procedures are not substitutes for each other. And in a very real sense, this is the key point. Cost-benefit practitioners are comfortable with the idea that CBA is only one input to making recommendations about decisions on policies and investment projects. These additional approaches represent other candidate tools to provide those further inputs. In fact, it may be that these can help not hinder the usefulness of CBA, for example, by legitimating its recommendations by greater use of deliberation in its practical execution in policy formulation.

Nevertheless, this conciliatory conclusion should not be interpreted as a case of "anything goes". Much of the debate about CBA in relation to other procedures starts with critical reflections on the limitations of the former. That is, what is it that the CBA approach misses and so how other complementary approaches might address these apparent shortcomings? Of course, just as it is crucial to consider critically CBA, any recommended other approaches also should be subjected to similar critical analysis as well as practical applications being evaluated against relevant benchmarks such as official guidelines.

Notes

1. Specifically, the context in that paper is (US) regulatory impact analysis.
2. For example, with reference to some of the procedures discussed late on in this chapter, perhaps this might involve identifying policy targets in physical terms, using some form of environmental or risk-based assessment, and formulating policy with reference to options which provide the most cost-effective ways of achieving those outcomes.
3. Steve Arnold, UK Environment Agency, personal communication.

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ANNEX 18.A1

Multi-criteria analysis and the "do nothing" option

For the "do nothing" option to be included correctly in an evaluation it is necessary for costs and benefits to be measured in the same units. When MCA adopts the form of cost-effectiveness, with the multiple criteria of effectiveness being compared *in ratio form* to cost, then MCA cannot evaluate the "do nothing" option. This is because the units of effectiveness are weighted scores whilst the measure of cost is money. Numerator and denominator are not in the same units. The "escape" from this problem is for costs to be given a score (usually the absolute level of money cost) and a weight. If we think of the weighted scores as "utils" (or any other unit of account) then MCA can handle the "do nothing" option. If the ratio of benefits to costs is less than unity, the "do nothing" option is rejected. Similarly, if utils of benefits minus utils of costs is negative, the do something option would also be rejected.

In this way, MCA can be modified to handle the do nothing option. However, it can easily be shown that MCA will give the same result as CBA under very limited conditions.

Table 18.A1 shows the procedure adopted in a simple MCA. Let the score for E1 be 10, E2 = 5 and E3 = 30. The scores are multiplied by chosen weights, assumed to be W1 = 4, W2 = 6, W3 = 10. Cost is weighted at unity. The sum of the weighted scores shows that "do something" is a "correct" choice. If the weights W1…W3 are prices, then Table 18.A1 would appear as a CBA, i.e. MCA and CBA would produce formally identical results.

Table 18.A1. **Weighted input data for an MCA: cost weighted at unity**

	Do something: raw scores	Do something: weighted scores
Cost	- 50	- 50
E1	+10	+ 40
E2	+ 5	+ 30
E3	+30	+300
Sum of (weighted) scores	- 5	+320

Table 18.A1 shows that the selection of weights is important. An "unweighted" approach (which means raw scores are weighted at unity) would reject the policy but the weighted approach would accept it. As long as the weights in Table 18.A1 correspond to the prices in a CBA, however, then CBA and MCA would generate the same result.

Finally, if it is assumed that shadow prices and MCA weights are the same, but that the weight applied to cost in the MCA is, say, 8, then weighted cost would appear as -400 in Table 18.A1 and weighted MCA would reject the do something option.

The conditions for CBA and MCA to generate the same result can be summarised in this way:

1. Attribute scores must be the same;
2. MCA weights must correspond to shadow prices and, in particular:
3. Costs must be weighted at unity.