Benefit: Cost Analysis and Strategic Decision Making for Water-Sensitive Cities

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Contents

Introduction

Benefit: Cost Analysis (BCA) is widely used to support decision making about investments in projects or policies, and to underpin business cases for investment (Brent 2006; Hanley and Barbier 2009). There have been countless applications of BCA, to projects or policies as wide ranging as: wastewater management in Sri Lanka; construction of the Three Gorges Dam in China; hosting the Beijing Olympics; preservation of the Amazon rainforest; an immunisation program for avian influenza; and the Jamuna Bridge project in Bangladesh (Quah and Toh 2011). Clearly, BCA is a highly flexible tool.

The importance of economic analysis is widely recognised within the realm of water sensitive cities. Partners in the CRC for Water Sensitive Cities (CRCWSC), including state government agencies, local governments and water utilities, identified an increased capacity for economic analysis as one of their highest priorities. In response, we have developed the Investment Framework For Economics of Water Sensitive Cities (INFFEWS), including a BCA Tool and a Value Tool (for estimating non-market values).

This report does not provide comprehensive information about BCA and how to conduct it. Instead, this document aims to:

- outline the various components of the INFFEWS BCA Tool and explain their relevance to different user groups
- provide a brief introduction to BCA, including the key challenges of completing a BCA
- provide information to help organisations make strategic decisions about BCAs – whether to commission a BCA, what is required for a BCA to be reliable and useful, what a manager should ask for when commissioning a BCA, and how to interpret and use the results of a BCA effectively
- discuss the role of BCA, and economics more generally, in a balanced and systematic process for making decisions about projects and policies.

This document is part of the package of materials that make up the INFFEWS BCA Tool (Box 1). The INFFEWS BCA Tool has been developed as part of a broader project on the economics of water sensitive cities, funded by the CRCWSC.

Users

The tool is targeted to three different groups of users, each with different needs:

Experienced economists. For this group, the aim is to provide a standard BCA tool that is flexible, convenient and easy to use. The tool should foster good BCA practice and enhance the comparability of different BCAs.

Non-economists who have been trained. For this group, the aim is to put BCA within the hands of sufficiently trained users who lack a previous background in economics. The tool should help these users avoid common errors and overcome challenges. However, it is not recommend that non-economists try to use it without economist support. For many parts of the process, non-economists should be able to provide the necessary information based on the guidelines provided. However, for certain aspects, experience shows that guidelines are not sufficient, and a level of training, experience and expert guidance is needed. This guidance is particularly important when specifying the “with project” and “without project” scenarios, using those scenarios to determine project benefits, and estimating the benefits of particular outcomes in monetary terms.

Managers who wish to understand BCA better. For this group, the aim is for them to become well-informed and effective purchasers of BCA services. They are unlikely to use the full BCA spreadsheet tool themselves, but the other resources provided should help them to understand BCA well enough to commission reliable and useful BCAs, and to use BCA results to support sound investment decisions or recommendations. They may benefit from conducting a “rough BCA”, to help shape their thinking about a project, and as the first step towards potentially commissioning a full BCA.

Box 1. Resources included in the INFFEWS BCA Tool

The BCA Tool is a package consisting of the following components. This is the recommended order for accessing the components (apart from the training resources).

INFFEWS BCA Tool: Benefit: Cost Analysis and Strategic Decision Making. Provides guidance on: BCA basics; strategic issues related to BCAs; whether to conduct a BCA; use of economic information, including BCAs, in strategic decision making.

INFFEWS BCA Tool: Rough BCA Tool. Provides guidelines and a spreadsheet for a "rough" BCA, useful as a first step towards a full BCA, and a test of whether a BCA is feasible.

INFFEWS BCA Tool: Guidelines. Explain key concepts behind BCA, and pitfalls to avoid when doing a BCA.

INFFEWS BCA Tool: User Guide. Provides detailed step-by-step instructions and advice for completing a BCA in the spreadsheet tool.

INFFEWS BCA Tool Spreadsheet. Captures the qualitative and quantitative information, calculates BCA results and conducts a sensitivity analysis to test the robustness of results.

INFFEWS BCA Tool: Comparison Tool. Makes it easy to compare the results from BCAs for multiple projects, or different versions of the same project.

INFFEWS BCA Tool Training Resources. Contains videos and slide sets used in training courses.

The various resources that make up the BCA Tool package have different relevance to these three user groups, as outlined in Table 1. For economists, the main tools of relevance are the spreadsheet and the User Guide, although exploring the other resources will give them an overview of the package and help them understand the approach. For non-economists (or economists who are inexperienced at BCA) who aim to be hands-on users of the tool, all parts of the package are relevant and need to be mastered. For managers, the key component is this document, and potentially the Rough BCA Tool, but additional insights can be gained by reading the Guidelines, and exploring the User Guide.

Table 1. Relevance of the various BCA Tool resources to different user groups (✓✓ = highly relevant, ✓ = somewhat relevant)

	Economists	Non-economists (trained)	Managers
Benefit: Cost Analysis and Strategic Decision Making for Water Sensitive Cities (this document)	✓	✓✓	✓✓
Rough BCA (Guide and Spreadsheet)	✓	✓✓	✓✓
BCA Guidelines	✓	✓✓	✓
BCA User Guide	✓	✓✓	✓
BCA Spreadsheet	✓✓	✓✓	
BCA Comparison Tool	✓✓	✓✓	✓✓
Training resources		✓✓	✓✓

Benefit: Cost Analysis basics

The basic idea of BCA

The basic idea of BCA is deceptively simple: compare the benefits of a project or policy with its costs to assess whether it is worthwhile. Putting this simple idea into practice involves a range of challenges and requires collecting and integrating various types of information into an analysis.

A BCA "is primarily about organising available information in a logical and methodical way" (The Treasury, 2015).

The main steps

We assume that the user has a specific project in mind. The project may have already been defined in a high level of detail, or in only general terms. If it has only been defined generally, the BCA Tool leads you through a process of defining it more specifically. The project needs to be defined quite specifically to conduct a BCA.

Even if the project is already defined, the BCA Tool helps to ensure that it is logically consistent, meaning that the on-ground actions specified will be consistent with the project goal, the project mechanisms will bring about the on-ground actions, and the costs will accurately reflect the project mechanisms. Internal consistency is crucial so that the project can be accurately and fairly assessed.

The various government guides to BCA (e.g. The Treasury, 2015; Commonwealth of Australia, 2006) list up to 10 steps in conducting a BCA. Table 2 synthesises these different lists.

Table 2. Summary of key steps in conducting a Benefit: Cost Analysis.

Step	Description	Where included in INFFEWS
1	Understand the issues and the context	Guidelines, User Guide, Spreadsheet
2	Define project alternatives and baseline	User Guide, Spreadsheet
3	Identify types of benefits and costs, who benefits and who bears the costs or is adversely affected	User Guide, Spreadsheet
4	Quantify the benefits and costs, monetise them as far as possible Estimate project risks and people's adoption of changes promoted by the project	Guidelines, Spreadsheet, INFFEWS Value Tool
5	Discount future costs and benefits to obtain present values.	Guidelines, Spreadsheet
6	Compute decision metrics: Net Present Value and Benefit: Cost Ratio	Spreadsheet
7	Address uncertainty, including sensitivity analysis	Guidelines, Spreadsheet
8	Report results	BCA and Strategic Decision Making (this document)

A range of challenges arise throughout that process, as outlined in the next section.

Challenges

Monetising non-market values

In conducting a BCA, we should aim to represent as many of the benefits and costs in monetary terms (or monetary-equivalent terms) as possible. We need to include information about social and environmental values in BCAs because (a) the importance to the community of different social and environmental outcomes varies enormously, and (b) ignoring this when making decisions about which projects will receive public funding is very likely to result in poor decisions about how to spend resources.

If a valuation study feeds into an assessment showing that a particular investment is highly beneficial to the community, this could then be used to make a stronger case for funding.

For many benefits and most costs, expressing their values in monetary terms is relatively straightforward, but for some environmental and social benefits it is more challenging. Economists have developed a range of tools for addressing this challenge (Baker and Runting, 2014). We call these tools "non-market valuation methods".

As part of the INFFEWS project, we have developed a database of past non-market valuation studies that are relevant to water-sensitive cities projects. Together with guidelines on their use, these will be available as part of the INFFEWS Value Tool.

Dealing with missing information and uncertainty

Uncertainty and knowledge gaps are unavoidable realities when evaluating and ranking projects. The available information is almost always inadequate for confident decision making. Key information gaps often include: the "cause and effect" relationship between management actions and environmental outcomes; the likely behavioural responses of people to the project; and the values resulting from the project – what is important or valuable about the outcomes and how important or valuable are they?

See the last section of this document ("Using economics in decision making") for suggested strategies to deal with missing information and uncertainty.

Addressing equity

The focus of BCA, as recommended by Australian governments and implemented in the BCA Tool, is on the overall merits of a project or policy, based on whether the benefits attributable to the project outweigh its costs. As outlined by the Australian Government:

> *The costs and benefits to all people are added without regard to the individuals to whom they accrue: a $1 gain to one person cancels a $1 loss to another. This 'a dollar is a dollar' assumption enables resource allocation to be separated from distribution effects—or efficiency from equity effects. That does not mean that distributional considerations are unimportant or should be neglected. It means that they should be brought into account as a separate part of the overall analysis of the proposal in question. (Australian Government, 2016, p. 5).*

Some BCA specialists advocate that the various benefits generated by a project should be weighted depending on which groups in society they accrue to, and judgements made about how appropriate or important it is for those groups to receive benefits. That approach is not advocated in the guidelines prepared by Australian governments, and it is not implemented in the INFFEWS BCA Tool. Rather, a more subjective approach can be used:

> *If the information is available, a [BCA] can identify potential winners and losers and the magnitude of their gains and losses. It is then up to decision makers to decide whether distributional impacts or equity issues are important and need addressing. (Australian Government, 2016, p. 13).*

It is not realistic to expect that a project will benefit everybody. In practice, every publicly funded project benefits only a sub-section of the community. However, those who miss out in one project are likely to benefit in another. Most economists would argue that for any single program or project, the distribution of benefits to different groups should not be a particular concern, as long as the benefits exceed the costs. If there are concerns about inequality in society, these should be dealt with by measures that specifically target that problem (like welfare payments or a progressive tax system) rather than by trying to address them in other types of programs (such as water-related programs).

Optimism bias and self-serving bias

Research has shown that groups of people who are developing projects are often much too optimistic about what the resulting benefits will be and they may underestimate the costs (Kahneman, 2011). In its guidelines, the Australian Government notes that "Optimism bias … is an endemic problem in cost-benefit analysis" (p. 78). It seems to result from a natural human tendency to get excited about a potential project, resulting in a tendency to overlook risks or problems, underestimate costs and exaggerate how many people will benefit, or how much they will benefit. This happens unintentionally and unwittingly, even among people who are aware of the risks or overoptimism. In Behavioural Economics this tendency is known as the "Planning Fallacy".

A different problem, with similar consequences, is self-serving bias. This is where people intentionally and knowingly bias the numbers in a BCA to favour a project that they wish to see funded.

It is important to try to counter the Planning Fallacy and self-serving bias to reduce the risk that projects receive funding even though they are not the best projects. Various strategies can be used to do this, most of which are built into the BCA Tool, and one of which needs to be implemented by the analyst.

Strategies built into the INFFEWS BCA Tool:

- Explicit questions about negative factors that tend to be ignored. The BCA Tool spreadsheet asks the user to quantify the project risks – the probability that the intended benefits will not be delivered. Reasons for non-delivery could include technical failures, socio-political factors, insufficient funding for maintenance, or poor management. The estimated risk factors are used to scale down the expected benefits.
- Logical consistency checks. In the User Guide, users are asked to check whether the answers to some later questions in the spreadsheet are logically consistent with their answers to specific earlier questions. This helps to flush out some biased responses.
- Transparency about the assumptions used. All information used in the BCA can be viewed in the spreadsheet. There is a facility in the spreadsheet to record the sources for each data item.
- Review of assumptions by independent experts. Kahneman (2011) found that people are much better at being realistic when judging other people's projects, rather than their own. Using a system of peer review of a BCA is recommended best practice. The BCA Tool includes the facility for reviewers to comment on each part of the analysis, and for the analyst to respond to those comments.
- Sensitivity analysis. The spreadsheet automatically generates a range of Sensitivity Analysis results. Users or decision makers can look to see whether the project is still attractive when relatively pessimistic assumptions are used. For example, if costs turned out to be higher than currently expected, would the project still be worthwhile?

Strategy the analyst can implement:

- Feasibility assessment or pilot testing. For large projects, it is often wise to conduct a feasibility assessment or pilot test as the first phase of project funding, with further funding depending on the results of the feasibility assessment. This process should involve collecting additional information about those aspects of the project that were most uncertain in the project assessment phase, followed by revision of the original assessment, before making a final decision about support for the project.

Experience shows it is crucial to include measures like these to counter the planning fallacy. Without them, the project plans developed are of little value to decision makers who genuinely wish to support projects that will deliver the best outcomes with the available resources.

Complexity

In many cases, the process of assessing a project using BCA is inherently complex:

- Information of different types needs to be collected, including information about: various types of benefits, various types of costs, human behaviour in response to the project, various risk factors that might jeopardise the project, the patterns of benefits and costs over time, etc.
- The volume of information needed can be daunting.
- Difficult predictions have to be made, both about the baseline scenario and one or more project scenarios. Typically, uncertainty about what will happen in each scenario is high.
- Some of the economic methods involved in estimating benefits are specialised and difficult to master.

Of course we wish to avoid unnecessary complexity. The BCA Tool includes some carefully considered simplifications to limit the complexity of the analysis. But it may be that the project being evaluated is inherently complex and there is no option but to try to grapple with the complexities.

A later section in this document presents the idea of conducting a highly simplified BCA. This can be useful as a way to get the thinking straight about a project. It may be that the results of a highly simplified BCA are clear enough that no formal BCA is needed, at least for decision-making purposes. (It may still be needed for a formal business case.)

Requirement for economics expertise

Dealing with the complexities outlined above is one reason why economics expertise is needed to conduct a BCA. As outlined earlier, there are three target audiences for the BCA Tool: experienced economists, non-economists who have been trained, and managers who wish to understand BCA better. We recommend that even trained non-economists should use an experienced economist in a mentor role to check that their decisions about the analysis are sound. In fact, using a mentor in this sort of role can be good for experienced economists as well, as some of the necessary judgements can benefit from broader discussions.

For managers, our aim in this document is to provide sufficient knowledge of the various aspects of BCA to allow them to commission useful and reliable BCAs and to interpret and use their results appropriately.

Resource requirements

Given the complexities discussed above, it is clear that conducting a full BCA requires an investment of resources and will take time. As well as the analyst who has overall responsibility for the BCA, time inputs will be required from people who understand the proposed project in detail, and experts who can provide advice on appropriate numbers to use. In some cases there may be a need to purchase data, or even to conduct original research (e.g. estimation of non-market values), to complete the BCA.

BCA results may not support favoured projects

The reality is that not all projects or policies are worth doing, and some projects and policies are much better than others: they generate much greater or more valuable benefits for the money spent. Sooner or later, all BCA analysts face the experience of disappointing their clients by concluding that a particular project is not nearly as good as its advocates believe. (See the section above on overoptimism about projects.) The fact that a project is not worth funding is important information that should prompt a deep discussion and lead to better decision making. Sometimes the disappointed advocates may be tempted to dismiss the BCA results unfairly. This is not to say that all BCAs are done well and should be believed, but disappointing results should lead to an engaged debate with open minds and perhaps further analysis, rather than a decision to support a poor project despite the evidence.

BCA in the context of water-sensitive cities

Water-sensitive-cities projects can be very complex and multifaceted, but there is nothing about these projects that makes them a special case when it comes to BCA. Many BCAs in the environment sector or public health are similarly complex.

More specific to the water sector is the range of benefit types that projects are like to generate. In the BCA Tool, the specification of benefits is highly flexible, but has been designed with the water sector in

mind. It should cope with any type of benefit likely to emerge in a project related to water or green infrastructure.

Further, the INFFEWS Value Tool, which complements the BCA Tool, has been designed specifically to provide estimates of benefits arising from water sensitive cities projects.

The importance of BCA is widely recognised in the sector, both to support sound decision making about investment priorities, and to support business cases for investment. It is hoped that INFFEWS can enhance economic literacy in the sector generally, not just assist economists undertaking BCAs.

Deciding whether to conduct a full BCA

Factors to consider when deciding whether to conduct a full BCA of a potential project include the following.

Requirement for a full BCA. If a business case for a project is being developed, a full BCA may be a requirement. This varies by organisation. In some organisations a highly simplified BCA may be sufficient.

Results of Rough BCA. If a highly simplified BCA has already been done, did the results indicate that the project is likely to be good, bad or indifferent? If the results indicate a low probability of the project providing good value for money, spending the required resources on a full BCA probably cannot be justified.

Scale and importance of the project. It is more likely to be worthwhile investing in a full BCA if the project is large and is considered important. For small project, a Rough BCA may be sufficient.

Resources and time available to do a BCA. Conducting a full BCA requires resources and time, including the resource of expertise. Is conducting a full BCA the best use of the resources? Is there sufficient time to complete a full BCA before decisions about the project will be made?

Costliness of doing a BCA. The cost of conducting a full BCA depends on how clearly the project has already been defined, the complexity of the project, the availability of required information (see next section) and the cost of consulting experts to gather information or to conduct the BCA.

Figure 1 provides a suggested flow chart or decision tree that may help users decide whether to conduct a full BCA, a rough BCA or no BCA. It is assumed that any project being considered for a BCA has been assessed to be potentially worthwhile.

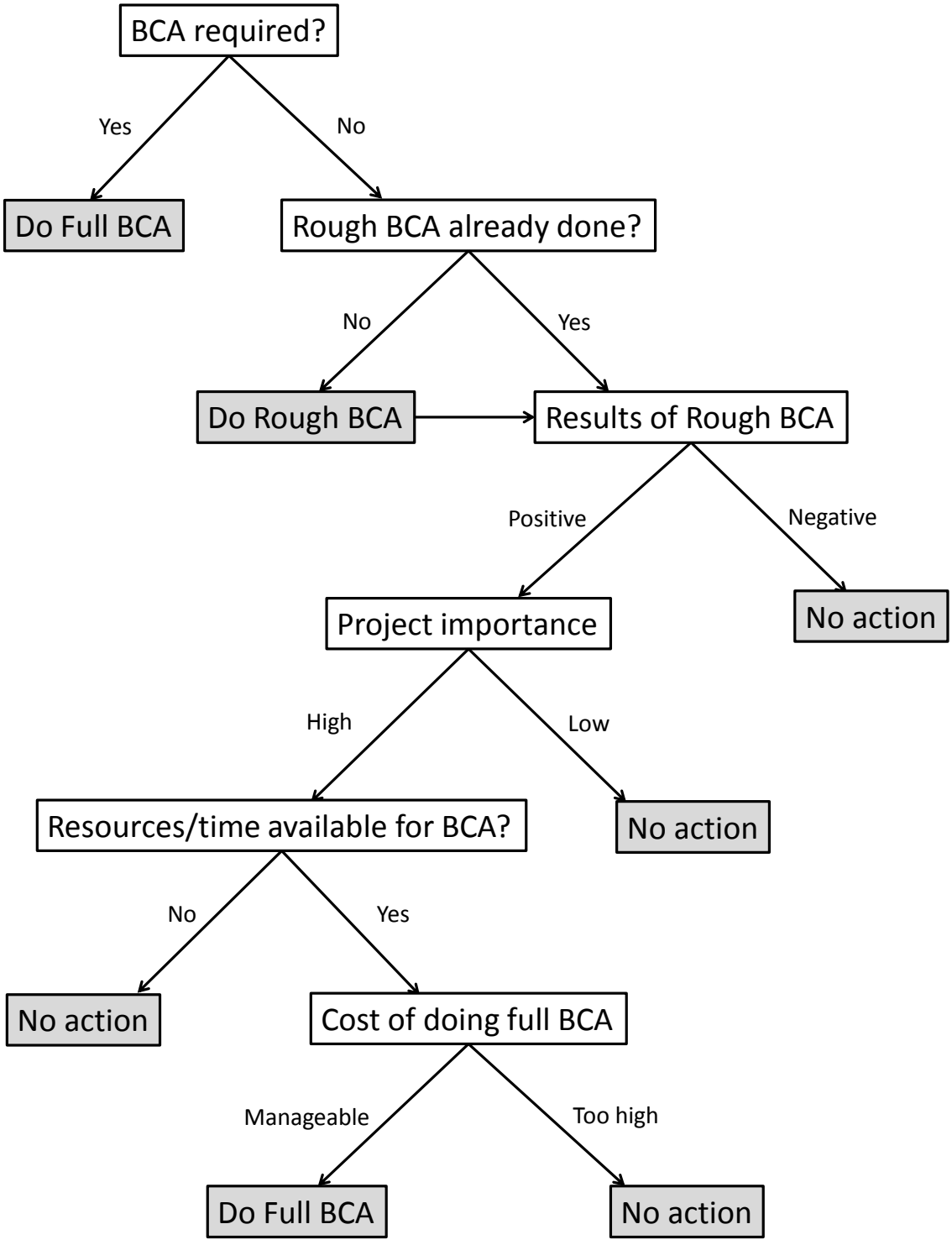

Figure 1. Decision tree – whether to conduct a full BCA.

Information requirements

In considering the costliness of conducting a full BCA (see previous section), one of the key drivers is the requirement for various types of information. To help you judge the level of effort and expense required to complete a full BCA, here we discuss the various information types required, their potential sources and how to obtain them.

Types of information required for a full BCA

In summary, the information required for a full BCA consists of:

- the project definition, including actions and goals
- the types of benefits expected to be generated, and who captures the benefits
- what would happen to the benefit-related variables without the project
- what would happen to the benefit-related variables with the project – the benefits are the difference between this scenario and the without project scenario
- the monetary or monetary-equivalent values of the benefits generated by the project
- the pattern of benefits over time
- if the project depends on behaviour change by individuals or businesses, the extent to which the required behaviour change is likely to occur
- the risk that the project may not deliver the expected benefits
- negative spin-offs from the project
- the pattern and level of costs of the project over time, including the initial project, and the operational or maintenance phase
- the discount rate used to convert future benefits and costs to present values, so that they can validly be compared.

Potential sources of information

The basic information about the project should be obtained from the project proponents or designers, including the project definition, actions, goals, benefit types, general information about the with-project and without-project scenarios, and potential negative spin-offs from the project.

Specific quantitative information about the with project and without project scenarios is needed to estimate the benefits. Potential sources include: existing computer models, published research or reports, technical experts or scientists, and people who have experience implementing or monitoring similar projects. These sources can also provide information about the pattern of benefits over time.

Information sources for benefits in monetary terms include: the Value Tool for non-market values, existing publications and reports, economists and business managers. In some cases it may be worth conducting original economic modelling or surveys.

Experienced project managers are the most likely source of useful information on project risks, and project costs.

There are many books and research articles on behaviour change, but they mostly attempt to explain past behaviour change, or to describe behaviour change in qualitative terms. For that reason, they may not be especially helpful for making quantitative estimates of the likely extent of behaviour change that will result from a particular project. There is a tool for making quantitative predictions of behaviour change by farmers (Kuehne et al., 2017) but it is of limited relevance in other contexts. The most practical sources of this information are probably managers who have experience with similar projects, or social scientists who have studied the impacts of similar projects.

Costs to individuals or businesses from complying with regulations have had limited study. The most fruitful source of information on this is likely to be the individuals or businesses that would be affected.

Each organisations may have its own policy about which discount rates to use. In the absence of that, the BCA Tool Guidelines include information about discount rates recommended by treasury departments in each Australian state and nationally.

Potential processes for information collection

The previous section has implied or referred to several different processes for obtaining information. Apart from the most obvious option (obtaining the information from existing publication, reports or databases), the main processes are as follows.

- undertake original surveys of the public or relevant groups to inform the BCA
- undertake biophysical modelling or economic modelling, using existing or purpose built models
- elicit judgements from experts of various types, including scientists, social scientists, engineers, experienced managers, and field staff.

We would prefer to use high-quality information from existing publications, new research or modelling, but in practice we often have to rely on expert judgements, especially when the circumstances are unique. Burgman (2016) provides excellent advice on effective approaches for data elicitation from experts.

Overall, obtaining the best-available information, including project definition, is the most time-consuming and costly part of undertaking a BCA. It potentially involves multiple strategies for data collection and it always involves many different types of information.

Checklist for a good BCA

Even if you do not expect to conduct a BCA yourself, it can be helpful to understand the requirements for a BCA to be reliable and useful. Having this understanding can assist managers to commission high-quality BCAs, and to make judgements about the quality of BCA results that they are asked to consider. Figure 2 provides a simple checklist for a good BCA. The individual elements are expanded on below.

Drawing on this checklist, Appendix A provides a standard text that could be adapted and included in project briefs or requests to quote. It informs analysts who will conduct the BCA of the requirements they must meet. It also provides a checklist for reviewers of a BCA.

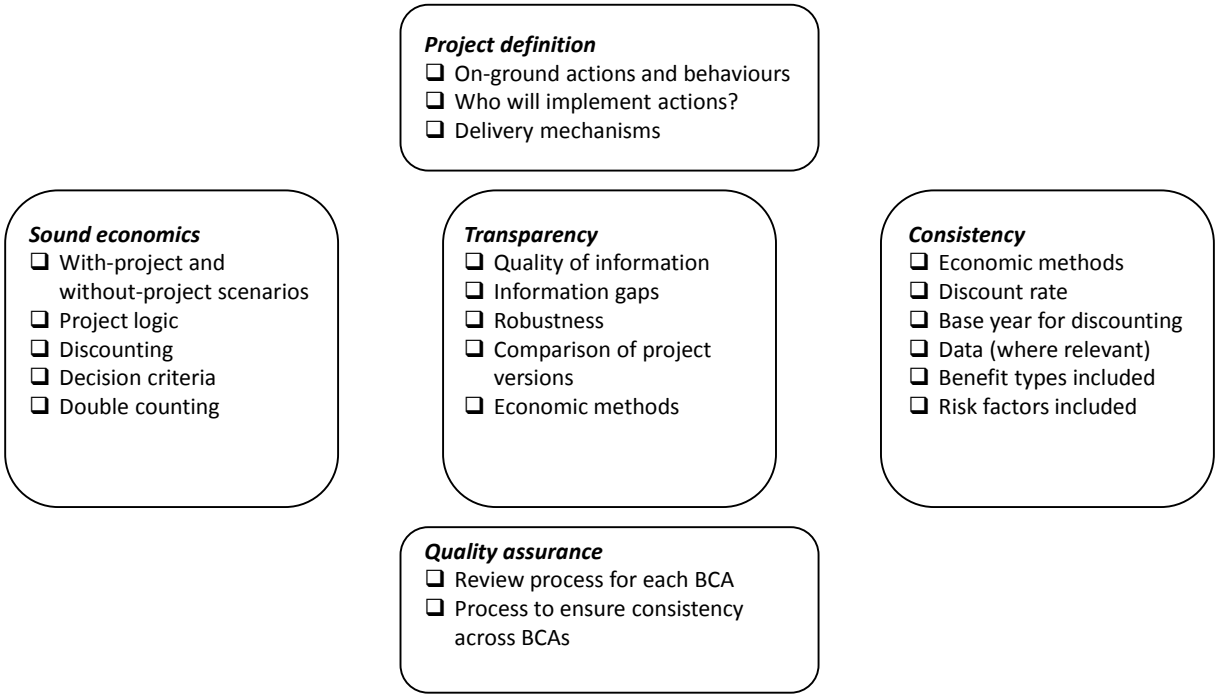

Figure 2. Checklist for a good BCA

Project definition

A BCA evaluates a project or policy, which consists of a set of actions and interventions. Clear definition of these actions and interventions is needed for BCA to be possible. It is not possible to undertake a BCA of a general issue, like water pollution in general or provision of green infrastructure in general. But we can evaluate a particular project that would improve water pollution or would provide green infrastructure within a defined project boundary. In defining the project, it is important to be explicit about the following.

On-ground actions and behaviours. What changes in management actions or behaviour are envisaged to deliver the benefits?

Who will implement actions? The actions could be undertaken as part of the project itself, or by somebody else (e.g., private citizens, businesses or other organisations). If it is somebody else, the role of the project is to influence their decisions such that they do actually adopt the new actions or behaviours.

Delivery mechanisms. What will this project actually do? Is it undertaking the actions itself? If so, what are they? Is it attempting to influence decisions by others about what actions they will undertake? If so, what will the project do to influence them?

Early consultation and cooperation with a range of stakeholders can be very helpful in defining these aspects of the project, especially for projects that involve multiple beneficiaries.

Sound economics

The analysis should be consistent with accepted sound economic practice. Key requirements are as follows.

With-project and without-project scenarios. A without-project scenario is clearly defined and used as the baseline. Benefits are calculated based on comparing with-project and without-project scenarios, not a comparison of before-project and after-project scenarios.

Project logic. The project must be logically defined and internally consistent. The defined delivery mechanisms can reasonably be expected to cause the desired actions and behaviours on the required scale. The defined actions and behaviour changes can reasonably be expected to deliver the goal of the project. The budgeted costs are sufficient to fully cover the project actions.

Discounting. Has the analysis been done in real terms or nominal terms? What approach to discounting and what discount rates have been used?

Decision criteria. Standard decision criteria for BCA are reported: Net Present Value and Benefit: Cost Ratio (BCR). In calculating the BCR, the costs consist only of short-term project costs, and operating or maintenance costs. Other costs (such as costs to other stakeholders or external costs arising from the project) are deducted from the benefits rather than including them in the denominator of the BCR. (See the Costs section of the INFFEWS BCA Tool Guidelines for an explanation of this.)

Pitfalls. The Guidelines document includes a range of pitfalls in the economic methods that must be avoided.

Transparency

To judge how much confidence decision makers can have in the BCA results provided, the analysts should report on the following items.

Quality of information. How reliable is the information that was used to conduct the analysis? For example, was it based on peer-reviewed research, or expert advice, or informed judgements made by the analyst?

Information gaps. Which particular pieces of information were lacking, and so may be candidates for further investigation?

Robustness. Given our uncertainty about the numbers used in the analysis, can we reach a firm conclusion about the project's performance? For example, is it clearly a very good project, with favourable results even when more pessimistic assumptions are used? Or is there a 50: 50 chance that the BCR is greater than one?

Comparison of project versions. It is a good idea to define several versions of the same project and do BCAs of each. The different version of the project could use different on-ground methods, or different delivery mechanisms, or be of different scales. It usually is not obvious in advance which version will be best.

Economic methods. There are some aspects of BCA practice over which the economics community does not universally agree. Three examples are: whether to weight the benefits depending on which groups within society capture them, whether to include the excess burden of taxation in the calculation of costs, and what approach to selecting discount rates should be used. It should be clear in the report what choices have been made about these economic methods.

Consistency

In many cases, BCA results need to be compared. Where organisations need to prioritise among competing projects, BCAs provide a practical way of integrating most of the relevant information in a way that facilitates comparison. However, for such comparisons to be valid, the different BCAs need to have been conducted in the same ways, using consistent assumptions and methods. Important aspects that need to be consistent include the following.

The economic methods outlined in the “Sound economics” section above need to be applied consistently in all BCAs.

The same approach to discounting and the same discount rate needs to be used for all BCAs. Future benefits and costs need to be discounted to the same base year and the number of years included in the analysis needs to be consistent.

Where the same variable is relevant to multiple BCAs (e.g. the marginal value of potable water), the same values should be used in each BCA, unless there are clear reasons to vary them.

The range of benefit types should be included. It would not be valid to compare results from a study that included only benefits related to market goods with another study that included both market and non-market benefits.

Recognition of project risks is important to limit the risk of overoptimism. The set of risk types being assessed should be consistent in each BCA (e.g. technical, socio-political, financial and managerial risks).

Delivering consistency across BCAs requires a concerted effort. It is unlikely to happen if the organisation that will use the BCAs does not give explicit guidance on how consistency should be achieved, and check that it has been delivered. The explicit guidance should include specification of the values to use for variables that will appear in multiple BCAs, and specification of a consistent set of methodological choices. The standard text for commissioning a BCA provided in Appendix A can contribute to this end.

Quality assurance

Peer reviewing draft BCAs before they are finalised is crucially important, but sometimes does not receive the emphasis that it deserves. In most guides to BCA, peer review is mentioned only in passing, if at all. For example, New South Wales Government (2017) says “Where possible and before finalisation, some form of peer review should be undertaken of the methodology and the completed CBA”, while Commonwealth of Australia (2006) says nothing about it.

Agencies that commission or undertake BCAs should require a peer review of the completed first version of every BCA. Experience with many different users of BCA has revealed that peer review can often make a major difference to the quality and comparability of BCAs. Common problems that can be picked up by an independent expert reviewer include (but are not limited to): overoptimism in the assumptions used (as discussed earlier), lack of awareness by the original analyst of improved or more recent data sources, weaknesses in the definition of the without-project scenario, and errors in or omissions from the economic methods used.

Conducting a Rough BCA

A good decision maker does a mental BCA to weigh up the benefits and costs of different decision options. The Treasury (2015) in New Zealand recognises this reality, and argues that there is potential to benefit from systematising and organising this mental BCA approach, putting it down on paper in an organised way to produce a "rough" BCA. They explicitly state that "A rough [BCA] is better than no]BCA]" (The Treasury, 2015, p.6).

There are several reasons why conducting a highly simplified or "rough" BCA could be a good idea:

1. A rough BCA may be sufficient. The results may be so clear that a full BCA is not needed to make a good decision. Especially if there are many project options but only sufficient resources to fund a few of them, it would not be sensible to do full BCAs of all of them. Rough BCAs could be used to help select which projects should be evaluated with a full BCA.
2. A rough BCA helps to organise the thoughts of whoever is doing it, and prepare them for doing a full BCA later. Doing a rough BCA could be a good first step in completing a full BCA.
3. If a rapid decision is required, lack of time may mean that a rough BCA is the only option (other than no BCA at all).
4. The organisation may lack the resources or expertise to do a full BCA, but a rough BCA can be done much more easily.
5. A rough BCA may help identify the information requirements to do a full BCA on the project.

Little attention has been paid in the past to the best approach for conducting a highly simplified BCA. Apart from the ideas put forward by the New Zealand Treasury, the only attempt that the author is aware of is step 2 of the INFFER model (Pannell et al., 2012). The INFFER process involved using simple criteria (based on the criteria used in a BCA) to filter out less attractive project options before selecting projects for full BCAs.

The proposed approach presented in Table 3 and in the Rough BCA Tool combines the two approaches mentioned: the New Zealand Treasury approach and the INFFER approach.

Table 3. Suggested steps for conducting a "rough" Benefit: Cost Analysis.

Step	Description
1	Understand the issues and the context.
2	Define project alternatives (one or more with project scenarios) and baseline (the without project scenario).
3	Complete a Rough BCA for each project scenario.
4	Identify types of benefits and costs, who benefits and who loses. Prepare a table that lists the benefits and costs, describing them as well as is possible given the available information. Benefits and costs need to be thought of as the difference between a with-project scenario and a without-project scenario. Considering what would have happened without the project is crucial to get a realistic estimate of the benefits that can reasonably be attributed to the project.
5	Quantify the benefits (*B*) and costs (*C*) using simple five-point scales: 1 = very low through to 5 = very high.
6	Quantify the project risks (*R* = the probability of project failure) on a similar five-point scale: 1 = very low risk through to 5 = very high risk.

7	Estimate the time lag (L) in years until the main benefits of the project would be delivered. Identify the real discount rate (D). (Refer to INFFEWS BCA Tool Guidelines for information about discount rates recommended by Australian governments.)
8	Calculate a metric to support decision making. Rough BCR = $B^*(1.5 - R/5)/C/(1+D)^L$.
9	Make a recommendation or decision regarding the need for a full BCA or, in some cases, about the project itself.

A score of at least 1 for the Rough BCR would be viewed as a positive initial indication about the project, while a score below 0.5 is discouraging.

The Rough BCA Tool template (a Word File) provides a series of prompts for collecting the required information. The results can be fed into the provided spreadsheet to calculate the Rough BCR.

The completed rough BCA can help to structure the thinking behind a project, even if a full BCA is not conducted. Of course, a full BCA would be more informative, but it may or may not be worth doing.

Managing the BCA process

The benefits to an organisation from conducting Benefit: Cost Analyses depend on how the process is managed, organised, and linked to other processes in the organisation. Here are some perspectives on this issue, based on personal observations of BCA being used in a range of organisations.

Structure

It is important for completion of a high-quality BCA to be the responsibility of a particular person. This person is responsible for ensuring the required information is collected, for consulting with relevant experts, and for making final decisions about the assumptions, or else for managing the process by which those decisions are made. The organisation needs to make sure that the responsible person is allowed sufficient time to do this job well.

As noted earlier, at the project definition stage, early consultation and cooperation with a range of stakeholders can be very helpful in defining the project, or different versions of the project, especially for projects that involve multiple beneficiaries. Different stakeholders are likely to have different priorities and expectations for the project, and these need to be discussed when the project is being defined. An initial discussion about who will pay for which parts of the project is useful at this stage, although this is an issue that may be revisited once the BCA is completed, showing which stakeholders benefit and how much.

Given the diversity of information types needed to complete a BCA (technical, social, economics, etc.), if time and resources allow, it can be helpful to form small teams with diverse skills to work on each BCA.

Another important task is ensuring consistency in the approach and assumptions used between different BCAs that are going to be compared. For example, if the comparison is to be valid, each BCA should use the same numbers for the same variables, such as prices. This task, too, needs to be allocated to a particular person who is empowered to impose consistency on the various BCAs being conducted.

Culture and expectations

Sometimes, people or even organisations develop an expectation that a particular project is a very good project and should be supported, before collecting and analysing the information in a BCA. In this case, people or organisations may be tempted to make assumptions that exaggerate the benefits or understate costs and risks. This is not conducive to good decision making about which projects should be supported. It is better for society and probably for the organisation if the BCA provides an accurate picture of the merits of a project.

Ideally, managers should communicate this as an expectation to their analysts. They should say that the BCA should be undertaken in a way that helps with sound decision making, rather than trying to justify a predetermined decision. This approach encourages a culture that values accuracy, honesty and decision support.

Expertise

Conducting a sound BCA requires knowledge, expertise, judgement, and strong communication processes. Organisations should recognise that they cannot allocate the task of completing a BCA to someone who lacks sufficient skills and training and expect that it will provide useful and defensible information. Ideally, people should be given the opportunity to develop the required expertise and experience, and be rewarded for doing so.

Preliminary project development process

Conducting a BCA requires a clear definition of the project being evaluated. Before specifying project details, it can be helpful to have a preliminary project scoping stage, where you review project needs and generate potential ideas. Once a potentially attractive project idea has been identified, some initial thinking about its benefits, risks, costs, and possible side effects is helpful. Both of these processes work best in a team environment, with different people working together to think through project possibilities. A good team size for these processes is 4 to 6, although you might also employ broader consultation processes with larger groups of stakeholders.

Questions to consider in the project scoping stage include the following.

- What are the needs or opportunities for which projects could be developed?
- What projects could be undertaken to meet the needs or pursue the opportunities? Do not think too narrowly. Use brainstorming[1] to try to come up with different types of projects.
- How big could the project be? Again, consider several possible scales, that will have different costs and will deliver different levels of the benefits.
- Of the project ideas we have come up with, which seem to be worth looking more closely at? Do not get too narrow with your thinking too quickly.

[1] https://www.projectmanagement.com/wikis/233029/Brainstorming

https://blog.toggl.com/13-brainstorming-techniques-for-kickstarting-projects/

Having selected projects to look more closely at, before starting to do BCAs of the project options, preliminary group discussions about each project's benefits, risks, costs and side effects are useful. Questions to consider at this stage include the following.

- What types of benefits will the project generate?
- Who are the beneficiaries?
- How long would it take from project commencement until the benefits would be delivered?
- How long would the benefits persist?
- What types of costs will be incurred to implement the project and for longer-term maintenance and operations?
- How long will it take to implement the project?
- What could go wrong? What factors could cause the benefits to be less that intended or the costs to be more than expected?
- What negative effects might the project have?

The decision process

The organisation should have a clearly defined and well-articulated role for BCA in its decision processes. This does not mean that BCA should dominate the decision process. It should be clear to people that **BCA is an important input to decision making, but is not the sole determinant of decisions**. People involved in the decision process need to know how to interpret the results of a BCA, and particularly how to use sensitivity analysis to form judgements about the robustness of the BCA results. The process should include giving the decision makers the opportunity to discuss each BCA with the analysts, during which pointed questions should be asked to further assist with judgements about the robustness of the results.

Using economics in decision making

We now consider how economics, including BCA, can enhance the quality of decision making about which projects and policies for water-sensitive cities should be given the highest priority.

Principles of good decision making

Much has been written about how to make decisions that have a good chance of delivering good outcomes. The following list of key principles (adapted from Kinrade et al. 2012) encapsulates much of the thinking about what should underpin decision making.

1. Objective focused: Make decisions with the purpose of meeting clear, measurable and prioritised objectives.
2. Effectiveness: Choose options that make a difference and are effective.
3. Efficient use of resources: Choose options that deliver objectives most cost-effectively.
4. Avoidance of adverse side effects: Avoid choices that adversely impact or increase the vulnerability of other systems, sectors or social groups.

5. Adaptive management: Encourage adaptation strategies that are flexible and reversible or modifiable.
6. Relevance: Use data, methods, criteria and assumptions appropriate to the nature of the decision and that meet the expectations and requirements of stakeholders.
7. Completeness: Consider all potential implications of decisions – direct and indirect costs and winners and losers. Consider a wide range of decision options.
8. Consistency: Use data, methods, criteria and assumptions that allow for meaningful and valid comparisons with other decisions of a similar nature.
9. Consultation: Undertake meaningful consultation and engagement to ensure that decisions reflect stakeholder and community values and preferences. The level of engagement should reflect the significance of the decision.
10. Collaboration: Make decisions collaboratively, involving close cooperation with other relevant decision makers.
11. Transparent: Provide clear and sufficient information for reviewers to assess the credibility and reliability of the decision.
12. Compliance: Ensure decisions comply with relevant national and State legislation, policies and guidelines.

There is a high level of consistency between this list of principles and the information about BCA that is provided here and in the INFFEWS BCA Tool Guidelines. BCA has support of decision makers as its core purpose. The BCA Tool is intended to be both practical and rigorous. Its design is based on a wealth of practical experience and wide consultation with potential users.

Key aspects of this report and the BCA Tool more broadly, in terms of supporting sound decision making, include the following.

- Being clear about what the potential projects are, and defining each project clearly.
- Defining the without-project scenario and using it as the baseline for measuring benefits from projects.
- The need to integrate information of diverse types (physical, biological, social, and economic) to make sound overall decisions about projects.
- Knowing how to assess whether a project or policy is cost effective (using Net Present Values or Benefit: Cost Ratios) and which of a number of potential projects are most cost-effective (using Benefit: Cost Ratios).
- Recognising the value of comparing various versions of a particular project to find the project design that delivers the greatest benefits for the resources used.
- Recognising uncertainty and dealing with it systematically through sensitivity analysis and other methods.
- Understanding the importance of transparency and consistency in analysing potential projects.

We have also covered a range of challenges in completing a good BCA. An additional challenge is finding a way to consider BCA results within existing decision processes. The challenges are greatest where an organisation's existing decision processes are less systematic and rigorous, as BCA enforces a level of system and rigour that may not currently be present. In those cases, bringing economic thinking into the process can require cultural change within the organisation – which can be difficult. Even if a full BCA is not undertaken, the idea of preparing a "rough" BCA has many advantages and should be undertaken in many or most cases.

BCA can help to improve the decision making process by making it structured and systematic. It leads an organisation through several steps before making a decision, including: define the project, identify project options, identify information requirements, confront information limitations, and build joint understanding in the organisation.

Usually the decision makers are not the people doing the BCA. However, the decision makers should engage closely with the analysts. The decision makers should make sure they understand the assumptions underpinning the BCA, and the main uncertainties about those assumptions. They should consider addressing the main knowledge gaps and uncertainties, by research, or a pilot test, or adaptive management. They should feel free to ask for adjustments to a project, rather than accepting the way it

was initially defined. And they should make sure that all relevant considerations about the project have been captured, either in the BCA itself, or at least in words.

Of course, BCA is an input to decision making, not a substitute for decision making. Decision makers are likely to want to consider factors that have not been captured in the BCA, so their ranking of projects may be different from the ranking implied by the BCA.

Criteria for decision making

BCA is not fundamentally different from what decision makers in the water sector already do – they weigh up the pros and cons and try to identify which choices will deliver the best outcomes. The difference is that, compared with the sort of subjective decision making that we all do, BCA if done well is more systematic, transparent, balanced, evidence-based and consistent with important principles that do not necessarily come naturally to people.

This is not to say that BCAs necessarily include all relevant information. The INFFEWS BCA Tool and INFFEWS Value Tool help users to express many non-market values in monetary-equivalent terms, but there may be considerations that cannot be factored in, such as certain social, administrative or political factors. Even so, BCA can be extremely useful in establishing which choices would best deliver particular outcomes. Ranking projects using BCA is the recommended first step, after which any adjustments can be made. The advantage of this approach is that the cost of making adjustments for social, administrative or political reasons becomes transparent.

There are two main criteria used in BCAs to evaluate projects, the Net Present Value (NPV) and the Benefit: Cost Ratio (BCR). The NPV is simply the difference between the aggregate benefits and the aggregate costs (after they have been discounted to express them in present value terms). The BCR uses the same information, but expresses it as a ratio rather than a difference: the aggregate benefits are divided by the aggregate costs.

There are two factors to consider when deciding whether to use NPV or BCR to evaluate projects. One is whether there is a limited amount of money available to allocate to projects (there almost always is), and the other is whether the projects being compared are mutually exclusive. Sometimes you wish to compare different versions of the same project (e.g. at different scales, or using slightly different sets of actions). These projects are mutually exclusive – you can select only one of them. A rule of thumb for selecting the best of these projects is to choose the one with the largest NPV that can be afforded within the available budget. (If comparing multiple versions of multiple projects, things are trickier. See the INFFEWS BCA Tool Guidelines for advice.)

Next assume that we are evaluating separate, independent projects. They are completely different projects, not different versions of the same project. If the budget available for funding projects is not limited, all projects with NPVs greater than zero (or, equivalently, BCRs greater than one) should be funded. In practice, it is rarely the case that the budget is not limited. When there is a limited budget, separate, independent projects must be ranked by BCR. In that situation, ranking by NPV can give highly inferior results.

See the “Pitfalls and errors to avoid” section in the INFFEWS BCA Tool Guidelines for more detailed discussion of these two decision criteria and when to use them.

Accounting for uncertainty

There is always uncertainty about the future performance of a project being considered for investment. The uncertainty can be greater or smaller depending on the time frame, the state of scientific knowledge, past experience with similar projects, and so on.

There are economic techniques to give negative weight to uncertainty when evaluating projects. However, in the interests of simplicity, these are not built into the BCA Tool. Instead we adopt a simpler and more intuitive approach:

1. Providing several different types of sensitivity analysis, to help users judge the robustness of results in the face of uncertainty (on the *Sensitivity* sheet of the BCA Tool), and
2. Rating the level of uncertainty for each project (in part 8.2 of the BCA Tool); and considering those ratings subjectively when ranking projects (along with information about the BCR, and other relevant considerations).

Another aspect of uncertainty is the question of what, if anything, the organisation should do to reduce it. It is good for project managers to be explicit about the uncertainty they face, and what they plan to do about it (even if the plan is to do nothing). Simple and practical steps that can be helpful include the following:

- Record significant knowledge gaps (Part 1.10 of the INFFEWS BCA Tool).
- Identify the knowledge gaps that matter most through sensitivity analysis (Pannell, 1997). This is supported in the BCA Tool Spreadsheet by providing sensitivity analysis showing the responsiveness of results to changes in each component of the project, and break-even values for each component (*Sensitivity* sheet).
- Have an explicit strategy for responding to key knowledge gaps as part of the project, potentially including new research or analysis (Part 1.10). There are various ways of addressing this, as outlined below.

In some cases, a wise strategy is to start with a detailed feasibility study or a pilot study, with the intention of learning information that will help with subsequent decision making about whether a full-scale project is worthwhile, and how a full-scale project can best be designed and implemented. A related idea is “active adaptive management”, which involves learning from experience in a directed and systematic way. Implementation efforts get under way, but they are done in a way which is focused on learning.

Particularly for larger projects, one of these approaches should be used if possible. They imply that initial support for a project is tentative. Decisions may need to be altered once more information is collected. We should be prepared to abandon projects if it turns out that they are not as good as we initially thought.

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Appendix A. Text for commissioning a BCA

The aim in providing this appendix is to assist managers to commission BCAs that satisfy the items on the "Check list for a good BCA". It consists of a standard text that could be adapted and included in project briefs or requests to quote.

Project definition

On-ground actions and behaviours. Clear specification of the changes in management actions or behaviour that are envisaged to deliver the benefits.

Who will implement actions? Clear specification of who will undertake the actions or behaviours needed to deliver the benefits.

Delivery mechanisms. If the project is attempting to influence decision by others about what actions they will undertake, specification of the mechanisms the project will used to influence them.

Economic methods

With-project and without-project scenarios. Clear specification of a without-project scenario (to be used as the baseline) and one or more with-project scenarios. Assessing variations on the project design (each with their own set of BCA results) is encouraged.

Project logic. The project is logically defined and internally consistent.

Discounting. Constant real discount rate of X% [probably 7%]. Time frame of XX years [perhaps 30 years].

Decision criteria. Report Net Present Value (NPV) and Benefit: Cost Ratio (BCR). In calculating the BCR, the costs consist only of short-term project costs, and operating or maintenance costs. Other costs (such as costs to other stakeholders or external costs arising from the project) are deducted from the benefits, not included in the denominator of the BCR.

Double counting. Outline the steps taken to avoid double counting of benefits.

Jobs. Creation of jobs is not treated as a benefit.

Multipliers. Multiplier effects should be ignored.

Project risks. Benefits to be weighted by the probability of project failure, meaning the probability that the project is implemented but substantially fails to deliver the intended benefits. The probability should be selected based on consideration of technical, socio-political, financial and managerial risks.

Transparency

Quality of information. Comment on the reliability of the information that was used to conduct the analysis. For example, was it based on peer-reviewed research, or expert advice, or informed judgements made by the analyst?

Information gaps. Identify any key pieces of information that were lacking, and so may be candidates for further investigation.

Robustness. Provide a sensitivity analysis that provides insight into the robustness of the NPV and BCR. Comment on the robustness. For example, considering the range of sensitivity analysis, how confident can we be that the BCR will be greater than 1, or greater than 2?

Economic methods. Do not apply weights to the benefits depending on which groups within society capture them. In the standard results, include the excess burden of taxation at a marginal rate of X% [probably 8%], and provide a sensitivity analysis that shows results that exclude the excess burden of taxation.

Consistency

Variables across BCAs. Where multiple BCAs are conducted that depend on the same variables, consistent values for those variable will be used. Prepare a list of those variables and their values to facilitate this.

Benefits included. Include both market benefits and non-market benefits. The non-market benefits are to be monetised as far as possible. If not able to be monetised, describe them qualitatively.

Quality assurance

Peer review. Each BCA undergoes peer review by an experienced BCA analyst who was not involved in this BCA. Preferably the reviewer should have some existing knowledge of the context for the BCA.

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