Cost Benefit Analysis Guide

Business Case Development Framework

Release 3

FURTHER GUIDANCE

Queensland Government

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Copies of this publication are available on our website at www.statedevelopment.qld.gov.au and further copies are available upon request.

CONTRIBUTORS

The following resources have been used as references in the development of this guide:

- Victorian Department of Treasury and Finance: Infrastructure investment, investment lifecycle and high-value, high-risk guidelines
- Infrastructure Australia: Assessment Framework
- NSW Treasury: The NSW Government Business Case Guidelines

CONTACT US

T +61 7 3328 4811
or 13 QGOV (13 74 68)

E info@dsdmip.qld.gov.au

W www.statedevelopment.qld.gov.au

P PO Box 15009, City East, Queensland 4002

A 1 William Street, Brisbane 4000

The Business Case Development Framework guides the development of business cases for infrastructure proposals. This guide supports the Stage: 2 Options Analysis and Stage 3: Detailed Business Case as illustrated in Figure 1.

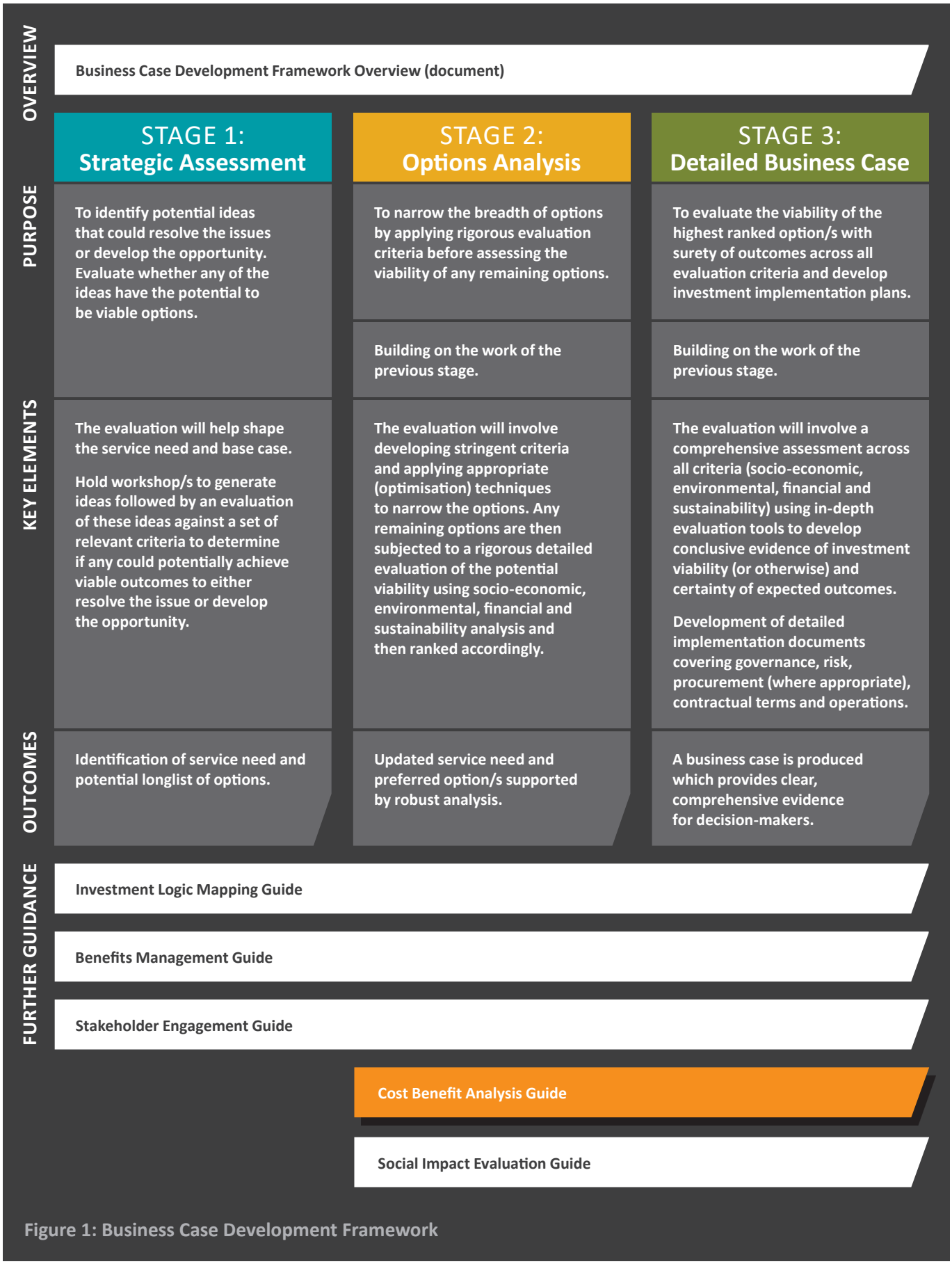

Figure 1: Business Case Development Framework

Contents

Introduction

How to use this guide

This guide is a supporting supplementary guide to the business case analysis.

The contents of this document are important—they will help you develop a business case that supports a robust, transparent and comparable evaluation.

The government understands that each proposed investment is unique. Therefore, you should tailor the strategic analysis to fit the project.

Support any changes with a rigorous and transparent process.

The following key content indicators have been included in call-out boxes to help you use this guide.

REFERENCE

TARGET/EXPECTATION

FLAG/IMPORTANT TO NOTE

1 Purpose

This guide details the approach to creating a robust and transparent cost benefit analysis (CBA) to inform investment decision-making.

It is intended to:

- provide an approach and methodology for the CBA of infrastructure investment proposals. This will enable comparability
- highlight the level of analysis required for a CBA for quality assurance and peer review
- offer guidance and a detailed methodology on documentation and reporting requirements, with a full explanation of all calculations, ensuring any parameter values are robust and fit for purpose
- inform a qualitative and quantitative analysis of costs and benefits for the economic analysis section, supported by the following analyses:
  - strategic assessment
  - service need and demand analysis
  - social impact evaluation
  - sustainability and environmental assessment
  - financial analysis
  - risk and benefits analysis.

This guide forms a key part of Queensland Government's Business Case Development Framework (BCDF). A graphical representation of the way CBA underpins both an options analysis and a detailed business case is presented in Figure 1.

The additional supporting guides: Social Impact Evaluation Guide and Benefits Management Guide should be read in conjunction with this CBA Guide.

2 Queensland Government and cost benefit analysis

2.1 Overview and purpose of cost benefit analysis (CBA)

CBA is a widely used, methodical and logical approach to economic evaluation. It is the primary method of economic evaluation and assessment for infrastructure proposals by national infrastructure bodies, including. A CBA:

- offers a rigorous approach to assessing the economic viability of investment proposals
- has wide-ranging applicability to investment evaluation across many sectors and economic activity, including infrastructure
- enables expected costs and likely benefits of proposal options to be compared[1]
- ensures costs and benefits have been assessed based on a whole-of-life, whole-of-system and whole-of-state[2] perspective
- supports the evaluation of options
- allows for direct comparison between options, combinations of options and their further development
- plays a critical role in informing investment decision-making by providing key pieces of evidence about the potential investment of funds across competing proposals.

2.1.1 CONTEXT AND APPLICATION OF CBA

All state and national infrastructure advice agencies, including Queensland Government, use CBA to evaluate the economic viability of investments proposed within business cases. Queensland Government requires a CBA that takes a wide, societal view with an economy-wide and system-wide social perspective. It must consider the costs and benefits across all affected members of society over the life of the proposal, including the construction period.

The CBA should be at a whole-of-system, whole-of-state level, with the entire liability to the state. As an example, when evaluating the costs and benefits of additional prison capacity, the full costs for remand prisoner injuries to Queensland Health are ultimately funded by the state government, and should be documented and included in wider effects.

Traditionally, a key role for government policy is addressing market failures or regulating public goods. In parallel, private investment in infrastructure also takes place, recognising that within market-based economies, benefit streams must offer attractive rates of return. That is, rates of return in terms of expected revenue/benefit streams are sufficiently attractive compared with other investment choices. This fundamental extends across both private and public sectors.

In the case of commercial government-owned corporations (GOCs), the primary consideration for investment decision-making is commercial feasibility incorporating quadruple bottom-line considerations – economic, social, environmental and financial. However, for government shareholders, the primary consideration includes robust analysis of the socio-economic costs and benefits.

A lag between investment timing and the accruing of project-benefit streams characterises many infrastructure proposals. Investment expenditures are often significant and occur early in the project life cycle, and ongoing annual operating costs may be typically small in comparison[3]. Maintenance and rehabilitation costs are usually episodic, preserving the service delivery capacity of the infrastructure asset.

Returns on infrastructure investments—in the form of proposal benefits—are often realised over the long term. Benefits accruing may be small relative to both the proposed capital outlay and ongoing costs of infrastructure, or alternately, may accrue very rapidly where delivery achieves rapid and pronounced benefit. Ultimately, these benefits are typically driven by underlying social, economic and demographic trends.

[1] CBA considers allocative (or 'real') effects of a proposal as distinct from its distributional (or 'transfer') effects, which represent transfers in welfare between different groups in society. Distributional ('transfer') effects should not be included as they have no net impact on society. Other CBA exclusions include interest payments, accounting depreciation, taxation and irrevocable sunk costs.

[2] Noting that in some instances benefits and costs of infrastructure proposals may include national and international beneficiaries e.g. cruise shipping port expansion increasing national and international visitor arrivals.

[3] Except, e.g. hospitals where large amounts of expected expenditures are operational.

2.1.2 QUEENSLAND GOVERNMENT CBA GUIDE AND OTHER GUIDES

In developing this CBA Guide, other national and international CBA guides have been considered including:

- Queensland Government's Project Assessment Framework (PAF) (2015)
- Infrastructure Australia's Assessment Framework (2018)
- Commonwealth of Australia (2006), Handbook of Cost Benefit Analysis
- Austroads Project Evaluation Series
- Australian Transport Assessment and Planning (ATAP) Guidelines (2018)
- Victorian Department of Treasury and Finance (2013), Economic Evaluation for Business Cases—Technical Guidelines August 2013
- HM Treasury (2018), The Green Book—Appraisal and Evaluation in Central Government
- New Zealand Treasury (2015), Guide to Social Cost Benefit Analysis
- Productivity Commission (2014), Public Infrastructure, Inquiry Report No. 71
- Queensland Productivity Commission (2018), Whole-of-economy modelling: Beyond the Black Box.

Several government agencies have developed CBA manuals and approaches that provide significant supporting information. These manuals address:

- specific classes of infrastructure
- cost and benefit estimation techniques relating to those asset classes
- relevant engineering and technical information
- standard economic values.

2.2 CBA in business case analysis

The CBA forms a key part of evaluating investment proposals and is the preferred method to account for investment cost and benefit.

CBAs have a high level of rigour and are subject to professional scrutiny. Several concepts are necessary to achieve a thorough CBA including, but not limited, to:

- **service need demand analysis**—considers macro-economic drivers such as population, demographics, globalisation, technology and climate change, policy and regulatory changes
- **scope**—the extent of the study area and those affected within it
- **base case**—the business-as-usual (BAU) situation which pre-exists the proposed project case, inclusive of demand forecasts/projection expectations, demographic growth, policy and operational settings
- **option/s**—the choices between alternative investment options with differing levels of demand composition, costs and benefits
- **reference project/s**—the investment, or combination thereof, to be delivered, and the specific design of each of the proposal options
- **central case**—the dominant or most likely realistic representative analysis outcome that incorporates the most robust and defensible central parameters and assumptions across growth rates and whole-of-system, whole-of-life, whole-of-state costs, benefits and risks etc.
- **sensitivity and scenario analysis**—including appropriate consideration of climate risk and alternative futures to test the resilience and design of proposal options.

The base case is an essential element of the CBA. The CBA is based on expected and documented differences between the base case and business case option/s. Ultimately, CBA is based on a defined and documented central case[4], compared with the incremental changes from the proposed investment change, applying a discounted cash flow approach.

Broadly, only those costs and benefits directly attributable to the relevant option should be considered relative to the base case (i.e. incremental net benefits and costs). If they were to occur regardless, then they should be ignored. Avoided costs or benefits should also be considered, provided they are a consequence of the investment decision and are not double counted.

Interactions between the CBA and other broader business case elements are shown in Figure 2. The grey box shows the interactions between elements and analyses making up the core analysis, including the CBA.

The overarching service need driving demand for the proposed investment leads to the evaluation of key analytical components, as shown within the grey-shaded box. Of note are the interactions between these key analytical assessments and evaluations with the business case risk elements. Key proposal benefits feed into benefits management[5]. Within the BCDF, social impacts, economic, financial and commercial, and environmental assessments also form the basis for sustainability considerations.

The diagram demonstrates how each component contributes to the development of the business case. Several activities across all three stages within the BCDF contribute to the CBA. Figure 3 provides a high-level illustration of these activities and inputs into the CBA.

[4] Central case: being a realistic representation depicting the most likely outcomes of future net economic costs and benefits.

[5] Capturing the identification, definition, monitoring, optimisation and realisation of community benefits i.e. KPIs.

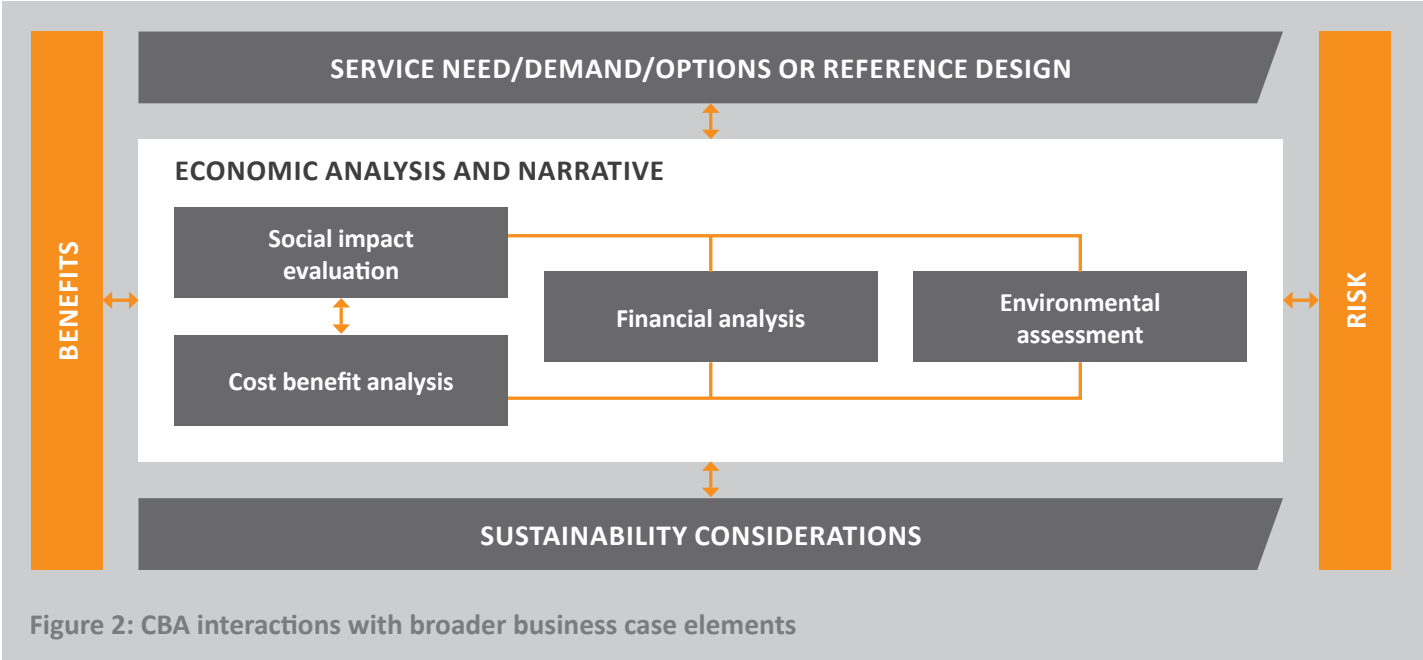

Figure 2: CBA interactions with broader business case elements

Within the BCDF, a CBA may not have a direct role at Stage 1: Strategic Assessment. However, it may be useful for economic analysts to participate in initial project team scoping meetings to familiarise themselves with proposal benefits, scoping and analytic methodologies. Further, there is benefit when teams conducting the CBA are involved in the early stages of business case development. This is because valuation of benefits streams can give early indications of the extent of (monetised) value of identified problems and, therefore, potential investment viability.

2.3 CBA methodology and assumptions

Importantly, there should be early agreement on the methodology, assumptions, parameter values, sensitivity analysis, scenario analysis, the base case, demand and evaluation period, and the nature of options (reference design) prior to CBA analysis and modelling. Such an approach offers mutual understanding and ongoing positive engagement. The level of detail required should be agreed and fully documented before commencing the economic analysis.

Additional approaches to economic appraisal

Cost-effectiveness analysis (CEA) relies on developing a metric involving the quantitative (un-monetised) benefit and total costs of the options being assessed. Proposals are then compared in terms of the developed cost-effectiveness criterion. CEA compares the costs of alternative ways of producing the same (or very similar) benefit outcomes. Only use CEA where options have very similar benefit outcomes. Always use CBA to inform the socio-economic viability of any option e.g. preferred options at Stage 2: Options Analysis which are recommended for further consideration at Stage 3: Detailed Business Case.

Cost utility analysis (CUA) constructs an outcome measure to use as a proxy for changes in individual utility. Discussion of CUA is outside the scope of this guide but may be worth considering if benefits cannot be definitively monetised.

Importantly, a limitation of both these approaches is that neither CEA nor CUA provides insight into whether the selected option delivers a net socio-economic benefit (socio-economic viability).

Figure 3: Integration of CBA within the BCDF

[6] Outputs of Stage 2: Options Analysis are key inputs for Stage 3: Detailed Business Case.

[7] For proposals which are likely to be considered by Infrastructure Australia include two options for progression to Stage 3: Detailed Business Case.

[8] P50 value is a 50 per cent confidence that the estimated cost will not be exceeded.

[9] P90 value is a 90 per cent confidence that the estimated cost will not be exceeded.

3 Principles for cost benefit analysis

Several principles underpin a quality, impartial and robust CBA. These principles include concepts relating to the objectivity, scalability and modularity of the analysis. Appropriate tailoring and internal consistency are other critical quality principles.

3.1 Robust evidence and objectivity

The relevance of a CBA depends on the strength of the evidence base and on practitioners using an impartial, unbiased, independent approach. The analysis should not be driven by arbitrary preference for any specific option. Instead, objective, robust and evidence-based analysis should underpin CBA assessment, that is, analysis should be conducted in a methodical and impartial manner.

Some practices that may lead to doubt about the objectivity of the CBA include a structural mismatch at the organisational level between analysts and decision-makers, and an approach of 'seeing what the results look like' before adjusting analytical elements to achieve a higher benefit cost ratio, or some other arbitrary number. These are unsatisfactory practices for an impartial and independent analysis, and procedures should be in place to avoid artificially inflating results e.g. using independent peer reviews.

3.2 Tailoring

A CBA requires sophisticated analysis. This analysis must be fit for purpose, iterated and refined to match the level of rigour required for investment-grade decision-making. Modelling and reporting should be tailored to support a robust and transparent analysis to inform the decision-maker.

3.3 Scalability

CBA is scalable as it may be applied with increasing detail as proposals move through the various phases of development (including scoping, option definition and refinement, option evaluation, and selection and detailed proposal evaluation). Throughout the development process, CBA relies on escalating levels of data collection and analysis to ensure enough detail is available to guide decision-making. This interaction may be an iterative process. At each stage of the development, CBA must be applied with consistent levels of rigour, particularly in analysing options, to avoid asymmetry and distorted results. A complete, substantiated and well-documented process is essential to ensuring credible analysis. This process should be scaled proportionate to the assessment stage, and the size and nature of the proposal.

3.4 Modularity

CBA is not modular. All component cost and benefit streams should be included throughout the analysis if they are measurable and are attributable to the proposal. Component cost and benefit streams cannot be removed, with the aim of achieving 'reasonable' results, as the analysis progresses.

For options analysis, symmetrical consideration of scalability should be applied to avoid biasing any option or combination of options. Proposal benefits should be developed proportionate to the development of the estimates of proposal cost and apply a very similar level of rigour including incorporating uncertainty and risk.

Methodical approach to CBA

Importantly, the CBA and report should set out a logical and methodical approach to its development, and incorporate a relevant and applicable evidence base.

Fundamentally, the central case covers the expected outcomes from the delivery of the proposal or option/s including climate risk.

Sensitivity analysis highlights key parameter uncertainty ranges, while scenario analysis highlights macro uncertainties which can impact on options and/or design.

Sensitivity and scenario analysis can enhance decision-making and are presented as additional to this central case, with key outputs and the associated reporting. This approach presents an integrated quality CBA.

3.5 Professional judgement and research

The competence, relevant experience and professional judgement of the economic analyst conducting the CBA contributes greatly to its overall quality. Where professional judgement is used, it is essential to document this to provide context for the make-up and elemental components of the CBA. Similarly, research conducted to support the CBA development is to be documented and explained.

3.6 Internal consistency

An elementary requirement for a robust CBA is that the information used for the analyses is accurate and consistent. Given the definition of project scope, all analyses are derived from, and informed by, the documented demand assessment and the central case. Developing the business case in a methodical way builds elements of analysis for this level of consistency, thereby providing confidence the information has been compiled in a logical, reliable and rigorous manner.

4 Cost benefit analysis requirements

This section outlines the guiding principles and methodology for developing a robust and transparent CBA—its processes, components and reporting requirements.

Develop the CBA with enough detail to adequately inform decision-making. It should incorporate high levels of rigour and evidence related to the socio-economic viability.

Early in the proposal life cycle, the outcomes and initiatives may be very broad and an investment logic mapping (ILM) workshop may help start the conversation on benefits[10].

4.1 Approach

The CBA incorporates other important business case elements such as service need, demand/benefits assessment and cost estimates. It is essential that you fully develop and finalise these prior to completing the CBA. You may commence the CBA before finalising these elements; however, it is critical to incorporate the latest service need, demand/benefits assessment and cost estimates.

Importantly, the CBA (and underlying methodology) can and should be refined over time as detailed data and clarity presents itself within the development of the business case.

Broadly, the approach involves the following considerations and analysis:

1. Articulate the **service need/demand**, which incorporates effective stakeholder engagement.
   - › Consider all stakeholders who are impacted by the problem or may be impacted by the response to the problem/service. This should occur early in the development of the business case analysis. Effective stakeholder engagement also informs benefits/outcomes sought and the relative importance to the desired outcomes.
2. Identify **benefits/outcomes** sought in the response to the **problem/service need/demand.**
3. Identify potential **options** or combinations of options.
4. Establish a robust and transparent BAU **business case** which incorporates uncertainty and climate risk.
5. Conduct a **social impact evaluation (SIE)** and also consider additional benefit analysis workshops to classify likely impacts/benefits as qualitative, quantifiable/non-monetised and monetised.

A robust and transparent CBA will:

- clearly define the service need (problem/opportunity/demand)
- identify critical success factors related to achieving the expected outcomes and addressing the service need
- describe the service need, outcomes and base case, independent of any specific option or solution (this enables wider consideration of the possibilities)
- establish the basis for government intervention on efficiency or equity grounds
- clearly identify expected outcomes (benefits)
- identify high relevance to government policy
- describe potential options and their expected benefits compared with a designated BAU base case
- identify potential costs including direct project costs and wider economic costs and benefits
- include sensitivity analysis of key variables and scenario analysis of uncertainty and risk
- provide a transparent documentation of the analysis methodology, formulas etc. to allow duplication of results.

Identifying the problem, in the form of an infrastructure service need, comes before the analysis of costs and benefits, and their associated outcomes.

[10] For further information about ILM workshops, see the Investment Logic Mapping (ILM) Guide.

6. Document **marginal incremental benefits** between the base case and options (for each option or combination of options). These are then calculated using a discounted cash flow approach.
7. Complete a **detailed evaluation of option/s** for the quantifiable and monetisable cost and benefits.
    - Document an appropriate evaluation period, residual value and base case consistent with the principles outlined in Section B2. Base case in the Stage 3: Detailed Business Case Guide. The evaluation period should be in line with the limits of credible demand forecasting and increasing uncertainty, and the economic life of the investment. For all proposals, a credible evaluation period will be less than 30 years and the economic merit will not be determined by the residual value.
    - Calculate key economic indicators (NPV, BCR and IRR) applying a discount rate of 7 per cent to the central case, full economic NPV and BCR profile including values using P50 and P90 cost, while also reporting these values using a 4 and 10 per cent discount rate.
    - Conduct sensitivity analysis on key parameter values and variables in the analysis to inform key project drivers. Conduct scenario analysis, as appropriate, for alternate futures etc.
    - Incorporate quality assurance and peer review close-out including confirming CBA against Section 6.1 Quality and Section 6.2 CBA Health Check.
    - Conclusions/recommendations.

The steps outlined in Figure 4 show interactions and analytical outputs that are essential in the development of CBA.

Although shown sequentially, there are several interactions and additional considerations necessary for the development of a robust, transparent, fit-for-purpose and repeatable CBA.

These include quality assurance considerations as outlined in Section 6 Quality assurance.

Feedback loops between steps support the refinement and robustness of the analysis and incorporate quality assurance. For example, in identifying costs, it may become apparent that further work is required upstream in refining the base case and nature of project options.

In this way, elemental development steps to conduct the CBA may need repeated revisitation and refinement. Put another way, CBA offers a methodical approach and should be viewed as an opportunity to explore and fully comprehend the nature and implications of a proposed investment or policy changes, as opposed to simply following basic steps.

4.2 Demand assessment

To ensure consistency from the outset and across all analyses (not just the CBA), use the same contemporary demand profiles (which may differ across options) throughout the business case.

The economic life (and evaluation period) of the option should be robustly developed, defensible and clearly articulated.

You also need to provide statements and detailed discussions of variables, assumptions and project drivers. While probabilistic analysis is preferred for all key variables, it is possible to designate high, medium and low scenario-based analysis where probabilistic profiles are difficult to justify. Document such an approach in the proposed methodology and confirm it prior to commencing detailed CBA assessment.

Within the analysis, applied principles should include that the business case has a focus on uncertainty/risk/benefits and fit-for-purpose assumptions and parameters.

Ensure you thoroughly articulate the robust and detailed methodologies and approaches used to capture all user (new, existing and induced demand) effects, and you present a strong evidence base.

4.3 Evaluate the base case

Developing and analysing a robust and transparent BAU base case is an essential component of CBA. This is because the base case is the benchmark against which all other options are compared. The base case is a detailed and fully articulated description of realistic BAU in the absence of the proposed project over the evaluation period, which is less than 30 years (for additional guidance refer Section B2. Base case in the Stage 3: Detailed Business Case Guide).

The base case must be tightly specified and modelled on a whole-of-life, whole-of-system, whole-of-state basis including all expected expenditures and benefit/impacts. For infrastructure projects, the base case involves maintaining realistic service levels, and accounts for the full life cycle costs required to maintain them.

Key characteristics of a base case scenario include:

- a description of what will occur should the proposed project not proceed, including implications for the expected level of service
- impacts of the continuation of the existing situation with all relevant costs and benefits.

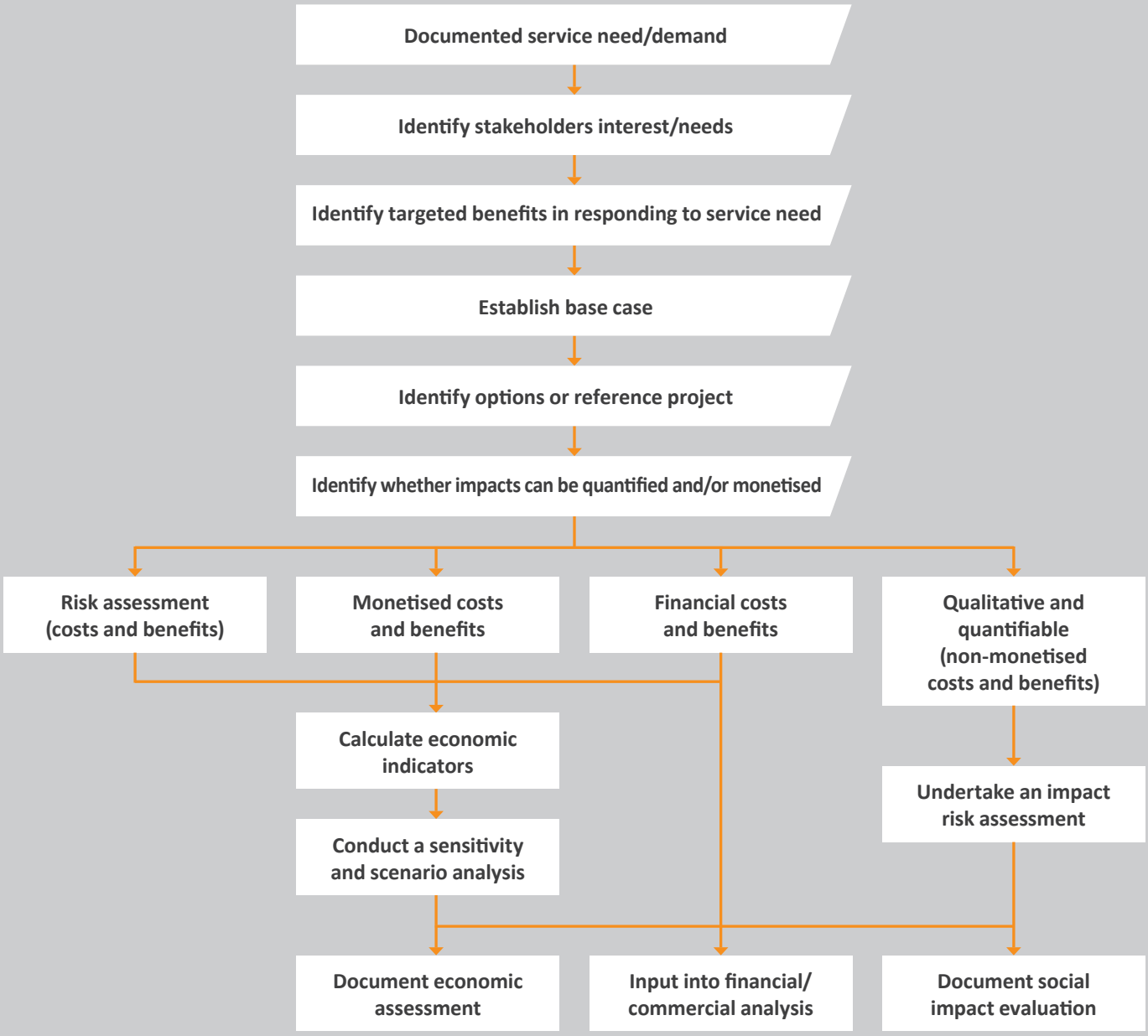

Figure 4: Iterative parts of a CBA including subsequent related outputs

The base case is not a 'zero spend' or 'dummy' option. It should include all expected actions to be taken if none of the proposal options are implemented and service levels are reasonably maintained[11]. This allows decision-makers to understand what situation will exist in the absence of the project being approved. Continuing with budgeted patterns of expenditure may prove to be a viable alternative, especially where gains from project options are not significant relative to the base case[12].

A critical benefit of having a clearly defined base case is to highlight ongoing costs and/or benefits that would be incurred and/or realised in the absence of any intervention. The cost and/or benefits of the identified problem or issue are estimated during the valuation of the base case. This information can then be compared (netted) against the incremental capital, operating and maintenance costs of a proposed intervention/investment, measured against the incremental benefits.

[11] Defined as a reasonably expected level of service by the community. This may mean that with population growth, at some point in the future the reasonable level of service may deteriorate below current community expectations.

[12] For example, where results indicate marginal economic viability.

Base case specification

Examples of oversights include incorporating 'interim solutions' delivered in the absence of the project as part of the proposed cost and benefit streams, rather than (correctly) specifying them as elements of the BAU base case. Such practices have the unfortunate effect of over-representing the performance of the proposal, leading to a distortion and misrepresentation of results, which may also lead to poor decision-making.

4.3.1 BASE CASE REPRESENTATIVENESS

A rigorous CBA depends on clear articulation and base case specification. The base case must be presented accurately and considered as a potentially viable option.

A common problem in CBAs is the under-specification of the base case, which is then compared with proposed investment options. Under-specification (i.e. not including all reasonable costs) of the base case leads to misguided comparison, or the expected spending patterns, levels of service and infrastructure performance are not authentic and accurate representations. For example, it is essential to include all planned and committed works as well as additional investment needed to maintain the current service provision. Where the base case is not representative, any comparison between the base case and proposal option/s will produce misleading results.

A base case should identify all costs and detailed subcomponents including fixed, variable, semi-variable and stepped elements. A dual cost analysis of this kind enables opportunity costs to be fully considered and sensitivity analysis to be conducted later.

4.4 Options development and selection

The Stage 2: Options Analysis Guide outlines the process for developing an options shortlist from a longlist. It also outlines the requirement for a robust service need demand assessment and a robust and defensible BAU base case.

At the options selection and analysis stage, the primary purpose of the CBA is to develop a robust and transparent filter to shortlist options (including the preferred option or combination of options) for potential consideration at the detailed business case stage (within the BCDF, this is known as the Reference Project/s).

4.4.1 OPTIONS DEVELOPMENT

Alongside the specification and evaluation of the base case, options are similarly developed. This step involves developing a range of reform, policy setting, operational and infrastructure options as a critical element in determining the best solution for an identified infrastructure service need.

Investments in infrastructure assets rarely happen in isolation. During this stage, give careful consideration to non-built solutions including regulatory reform, demand management policy options and operational changes. Such consideration can either yield innovative solutions that offer higher economic returns or sharpen the analysis and justification for built asset responses.

Analyse potential options in detail and directly compare them with the base case. These options should all be practical, viable alternatives i.e. each option should be inherently feasible in a technical sense. Base innovative options and solutions on a clear understanding of the proposal objectives and expected outcomes.

As part of the options analysis, it is important to remove potentially arbitrary restrictions on the search for solutions. For example:

- focus options identification on benefits to be achieved, rather than ways to improve or expand existing facilities
- do not limit options to those that are under the control of a specific agency or jurisdiction
- link options to infrastructure capital improvements; this may address asset operational opportunities, which are a subset of the potential set of solutions.

4.4.2 OPTIONS SELECTION

For a Stage 2: Options Analysis, the CBA takes key operating information, including cost estimates, into a discounted cash flow analysis. Initial streams of benefits that can be quantified and valued in economic terms are discounted to present-day values and compared with expected options costs. In choosing between proposed investment choices, IBCR assists with shortlisting options and confirming the economic viability of the preferred option/s. At a minimum, CBAs should report:

- the central case BCR, the NPV and IRR using a real discount rate of seven per cent
- the level of design used for the cost analysis
- NPV, IRR and BCR values for P90 cost, using a P90 equivalent contingency (if robust and defensible cost benchmarking data is available)
- alternatively use probabilistic Monte Carlo estimates reporting full NPV/BCR profiles and P50 and P90 cost NPV, IRR and BCR values
- sensitivity analysis of all key parameters and scenarios for the central case and for P50 and P90 level cost, including 4 per cent and 10 per cent discount rate.

At this stage, many quantitative direct benefits and costs are assigned economic values. In addition, qualitative analyses of indirect benefits and costs are often refined to provide quantitative estimates and economic valuations, using a defensible applied methodology.

The longlist of options is filtered against service need, benefits sought, and socio-economic, legal, environmental and financial considerations, potentially using a robust multi-criteria analysis approach. Shortlisted options will be evaluated in more detail using CBA, including using IBCR to identify the preferred option. The increasingly detailed CBA should continue to examine the proposal, program or portfolio from the community perspective, rather than a government or departmental one.

The CBA is a full consideration and evaluation of societal and systems-level costs and benefits reflecting real resource usage. At this stage, the CBA should identify the people who are affected by a decision (these are the people to whom the costs and benefits will apply).

Following the economic evaluation of refined options, some will appear more favorable than others in terms of their economic performance and these will be selected for further refinement and development. Ultimately, these developed options contribute towards the broader conclusions, recommendations and executive summary of the relevant business case stage (Stage 2: Options Analysis or Stage 3: Detailed Business Case).

4.5 Identify costs and benefits

Costs and benefits need to be identified early and as comprehensively as possible (informed by the social impact evaluation, demand analysis, financial analysis, benefits and risk assessments and/or benefits/risk workshops). Costs and benefits are:

- characterised by impacts on people, rather than impacts on organisations, agencies or decision-makers
- characterised by observable consequences
- checked to ensure there is no double counting.

As a general principle, only real direct costs and benefits (that is, changes in real resources) should be considered.

Payments to suppliers, while technically financial transfers, are proxies for the consumption of real resources.

Accounting depreciation expenses should not be considered, since this would double count the capital investment already incurred as a cost[13]. Where appropriate, depreciation as a tax-deductible expense for companies could be considered.

Interest and capital charges are payments for the time value of money and should be ignored (as this is represented by the discount rate). A large portion of rent or lease payments also compensate for the time value of money, so take care when incorporating rental charges into a CBA. Where private investment is involved, calculate return on investment after debt servicing.

Capital gains, particularly as they relate to the market value of the infrastructure investment's assets, should generally be ignored. They either reflect a change in the discount rate or the net present value (NPV) of future increased earnings, which are recognised within the CBA.

A common fault in the CBA is to consider benefits and costs in both real and nominal terms, with an intermingling of the two. This leads to faulty analysis. If expected (real) growth in demand e.g. traffic volume or patient needs, is included in the CBA, an inflation figure should not be applied to the analysis. This is because the process of discounting benefit and cost streams would cancel out the inflationary effect, thus making the process of adding in inflation—merely to just take it away again—superfluous. The preferred approach uses real (present day) amounts and real discount rates.

EVALUATION PERIOD AND TERMINAL/ RESIDUAL VALUE

Infrastructure investment tends to involve proposals with long physical and economic lives with increasing uncertainty (refer Section B2. Base case in the Stage 3: Detailed Business Case Guide). Therefore, appropriate and correct treatment of a realistic and credible evaluation period and terminal value is essential for a robust CBA.

A rigorous and defensible residual or terminal value will be linked to the evaluation period and will, in many cases, be nil or negative due to technological, socio-economic and environmental uncertainty (benefits and costs), exit costs, impaired assets and/or if the proposal has low measured net economic benefits i.e. BCRs less than one. Importantly, an asset's residual value based on financial accounting methods is generally not relevant for a CBA, as an economic analysis focuses on real resource usage.

[13] Other than for the purposes of accounting for terminal values.

Prior to the valuation of costs and benefits, use the social impact evaluation (SIE) to identify the scope, scale and expected effect of social impacts. All affected by a proposed investment should be recognised in the analysis including in their role as taxpayers. However, there are situations where defining the 'gainers' and 'losers' is not straightforward.

The focus of the CBA should, therefore, be on those directly and ultimately affected by the investment. However, there are times when the impact on intermediaries may prove to be a reasonable proxy[14].

CBAs of public infrastructure proposals are intended to measure the first-round direct impacts, costs and benefits to the community.

4.6 Estimating costs, benefits and non-market values

4.6.1 ESTIMATING COSTS

For infrastructure proposals, the relevant costs equate to the full whole-of-life economic cost of providing the associated services over the economic life of the assets. The full economic cost should be calculated for each option (with revenues expressed as benefits in the CBA). This includes direct costs, indirect costs, attributable overheads and end-of-life costs.

Cost estimation for the CBA should include input from accountants, economists, engineers, expert cost estimators and other specialists sourced from the financial, cost and risk analysis. Estimation should be based on whole-of-life, whole-of-system and whole-of-state cost, including negative impacts (disbenefits) prior to service delivery e.g. during the construction period.

Ensure all specialists provide relevant cost information and thoroughly explore project opportunities.

To aid in enhancing the amount of detail around cost structures, it can be useful to distinguish between different types of costs[15]:

- fixed costs—which remain constant over wide ranges of activity for a specified time e.g. a train station
- variable costs—which vary according to the volume of activity e.g. energy for train services
- semi-variable costs—which include both a fixed and variable component e.g. maintenance, which may involve a planned maintenance program and a responsive maintenance plan
- semi-fixed or step costs—which are fixed for a given level of activity but increase by a certain amount at some critical point e.g. train control systems that need to be automated for higher service levels.

Identify and express all costs in terms of relevant resource costs and opportunity costs. Examples of opportunity costs could include using land in a different, more valuable way, or making alternative use of an employee's time.

Ignore costs that have already been incurred and are irrevocable, as these are 'sunk' costs. For clarity, costs that have already been incurred but are recoverable (either in full or partially) are not sunk costs and should be included in the evaluation.

Align proposal cost estimates with the CBA requirements above, namely risk-adjusted, including risk contingency and reporting the level of design used, full NPV profile, P50 and P90 cost. These cost estimates need to fully and faithfully consider all cost contingency risks.

Ensure the calculated outputs, such as risk-adjusted central case cost, represent the best possible robust/expected parameters or assumptions. These calculated outputs should consider the cost of contingencies including:

- the stage of development
- the level of definition (design) or class (categories) used.

Therefore, the level of project definition (design) should inform the typical contingency ranges applied to an estimate, during its development at each business case stage.

[14] An example of this may be that better airport infrastructure that reduces freight costs may benefit a retailing business, but in a competitive environment most or all the benefit will be passed on to consumers as lower prices. The workers or shareholders of the retailing business may not benefit directly, but reduced freight costs may be a reasonable proxy for the impact on consumers.

[15] Note that this categorisation can help with sensitivity analysis but must be used with care. A cost that is fixed relative to one factor may change with another, and more complex modelling may be required to describe how costs change over time and with different variables.

Additional considerations

Contingent liabilities

Some proposals expose the government to contingent liabilities. That is, to commitments of future expenditure if certain events occur. Appraise any contingent liabilities (and monitor these if the proposal goes ahead) as part of usual risk analysis procedures, and include them in the project risk register.

One class of contingent liabilities is any cancellation costs the government body may be liable for if it terminates a contract prematurely. You must include these liabilities and their likelihood in the initial proposal. This analysis should extend to wider social and economic consequences. Also consider any legal and commercial contractual risk (though this may be outside of the scope of the CBA).

Limitations

Include detailed analysis of whole-of-life operating costs. The derivation of operating costs should be clearly articulated including the basis of any calculation applied to the CBA. Timings should be clear, precise and unambiguous, without mixing between nominal and real amounts. A clear way to present such data is in table form, with expenditure amounts broken down across investment periods. Naturally, the increments should tally to the total amounts.

4.6.2 ESTIMATING BENEFITS

In an economic CBA, all benefits should be valued unless it is clearly not practicable to do so. Costs and benefits estimates should be based on whole-of-life, whole-of-system and whole-of-state perspectives. However, when estimating benefits, alternative options can be systematically compared in terms of their net benefits or net costs.

All effects (including all costs and benefits, both direct and indirect) on the community and business should be identified and quantified separately, where it is reasonable to do so.

VALUATION

The value of benefits (and costs in some cases) can be referenced against real or estimated market prices using shadow pricing, in the first instance. However, there are some exceptions where valuing at market prices will not be suitable, and the use of a shadow price (as an approximation of the efficient market price) is required, such as when the market is dominated by monopoly or oligopoly suppliers or is significantly distorted by taxes or subsidies. In these circumstances, prices will not reflect the opportunity costs, so adjustments within the CBA will be required. An example of this is the effect of subsidies, tariffs and taxes in certain markets.

Counting costs as benefits

A common trap is counting costs as benefits e.g. the use of resources such as labour is often counted as an employment benefit. However, this almost always has a cost (i.e. an opportunity cost) if such resources can be used elsewhere in the economy.

CALCULATION

The calculation of benefits may also be based on estimates that result from the outcomes of previous studies. As databases and records expand, there is increasing scope for using this benefit transfer method. However, take care to allow for different circumstances, as the characteristics of the consumers in the database may differ from those relevant for the option under consideration.

In the absence of an existing, robust monetary valuation of an impact/benefit, the project's proposer must decide whether to commission a detailed study incorporating further research. If research is not appropriate, the CBA should include a central estimate, together with a maximum and minimum plausible valuation.

Include these figures in sensitivity analyses to provide assurance that the valuation of that benefit is not critical to the decision being made. A plausible estimate of the value of a benefit or cost can often be drawn out by considering a range of issues.

The benefits included in the CBA may include avoided future capital and operating costs (which might be incurred in the base case scenario) plus initial estimates of direct-user benefits and other benefits that might be readily valued.

WIDER ECONOMIC BENEFITS

Wider economic benefits (WEBs), or wider economic impacts (WEIs) as they are sometimes referred, are associated with indirect disbenefits and benefits such as land-use impacts, impacts on industry competitiveness and any wider environmental costs.

WEBs could be considered for inclusion in the CBA appraisal. However, the analysis and the reporting metrics such as central case, NPV and BCR should be presented without WEBs. For network and agglomeration WEBs, the CBA results should be shown as a sensitivity analysis. In all cases, clearly describe all these WEBs taking care not to include double counting.

Economic impact assessments

Economic impact assessments (EIA) using input-output models and multipliers should not be used for business case analysis and CBA. EIA is a method by which market economic impacts of typically very large policy changes or events can be evaluated, typically prior to acting. Importantly, EIA is a distinct form of analysis, separate to CBA, and is not a form of efficiency analysis.

EIA can be useful to understand the effect of large-scale policy changes or events on economic activity indicators and relative price changes.[16] In these instances, a carefully calibrated and tested computable general equilibrium (CGE) approach may generally be considered appropriate. However, approaches using input-output models and multipliers (I-O analysis) are not appropriate for policy or project assessment due to a range of severe limitations, including:[17]

- lack of supply-side constraints and fixed prices—I-O analysis assumes that a new project can obtain unrestricted quantities of goods and labour without altering the pre-project market prices for these inputs, which would not be realistic in many cases
- oversimplification of market responses to economic events—e.g. fixed ratios for intermediate inputs to production and outputs from production or no allowance for household purchasers' marginal responses to change
- absence of budget constraints—I-O analysis assumes that changes in household or government consumption occur without reducing demand elsewhere.

In addition, the following considerations bear relevance when undertaking EIA:

- Although any expenditure of funds will generate economic activity, directly and indirectly, these effects could also be generated by an alternative use of those funds.
- In EIA, increased expenditure often leads to increased output (which may not necessarily be a benefit). Conversely, in CBA, increased expenditure represents increased costs.
- A local project can have a positive economic impact on a small region (at the expense of other regions). This may simply represent a distributional effect and not necessarily an increase in economic welfare for the overall community.
- While increases in gross state product may enhance economic welfare, gross state product is not a satisfactory measure of social welfare for evaluation of public sector projects as it does not allow for the measurement of externalities, non-market goods and consumer surplus.

[16] For guidance on use and limitations of CBA, CGE and I-O modelling refer 'Whole of Economy Modelling: Beyond the Black Box' Queensland Productivity Commission, April 2018 and 'Project Assessment Framework', Queensland Treasury, 2015.

[17] Adapted from Gretton, P. 2013 'On input-output tables: uses and abuses', Staff Research Note, Productivity Commission, Canberra.

Watch out for

Limitations

Arguments that data 'comes out of the model' without sufficient explanation or idea on the generation of such figures. Such approaches limit the quality and transparency required to support a robust evaluation and assessment.

Double counting

It is crucial to ensure benefits are not double counted. This is usually because they are inherently reflected in the pricing of other benefits e.g. the benefits from transport time savings from a project and resultant higher house prices both represent time savings, therefore, only one should be included.

PRODUCTIVITY BENEFITS

The productivity impacts across various infrastructure proposals are highly variable and difficult to measure. Productivity is the efficiency of converting inputs to economic value (that is, the conversion of inputs to outputs).

Proposals that lead to more efficient use of assets can result in productivity increases[18]. For example, a more efficient transport sector drives productivity benefits by reducing freight transportation times, reducing freight costs, enhancing business opportunities and increasing profitability. This may also lead to lower cost goods and services, and increasing exports. When measuring productivity benefits ensure there is no double counting of benefits.

4.6.3 ESTIMATING NON-MARKET VALUES

Non-market impacts should be considered and included in the analysis, even though their costs and benefits may not be readily identifiable because they do not involve a clear transaction or market price. Examples of non-market impacts include environmental externalities (such as increased pollution or reduction in native vegetation) or social externalities (such as impacts on heritage values or improvements in social cohesion).

Non-market impacts are generally harder to anticipate and quantify and are, therefore, more likely to be overlooked if not considered in a systematic and methodical way. Documenting all impacts, and estimating relevant costs and benefits early in the process, as well as all affected parties, should be attempted as part of the SIE and early options development.

APPROACHES TO NON-MARKET VALUATION

When non-market impacts can be identified, the following economic approaches may be used to estimate their value:

» hedonic pricing—based upon inferred pricing from observed near-market behaviours or proxies

» stated preference analysis—where consumers provide indicative price equivalents, often reliant on extensive survey work

» willingness to pay—revolving around a valuation for goods or services, whereby a non-market valuation may be used if there is no market for those goods or services

» willingness to accept—compensation following the occurrence of an action or outcome.

BENEFIT TRANSFER METHOD

The benefit transfer method uses existing and accepted economic information to predict the effects of new proposals, and may be applicable where there is good correlation to the project under study.

Examples include the potential application of a shared price of carbon, pollution parameter value or the application of the estimated cost of sediment run-off into a catchment. Notably, such data will have been subject to extensive research, detailed survey work and expert scientific panel and/or peer review.

Figure 5 shows a decision flowchart to conceptualise what possible attributes of a service provide value to users and non-users. The analysis requires extensive consultation, survey work or research to establish credibility for the approach used to monetise benefits.

Some of the approaches may be time and resource intensive, and the decision about whether to undertake analysis should be based on whether the values obtained are likely to make a material difference to the overall analysis. When monetisation is not feasible, the CBA should include a qualitative description of the impacts and the extent of anticipated benefits. Refer to the Social Impact Evaluation Guide for further information.

[18] Likewise, projects that lead to less efficient use of assets can result in lower productivity (clearly more likely when impacts [cost] outweigh outputs [benefits] i.e. projects with BCRs less than 1).

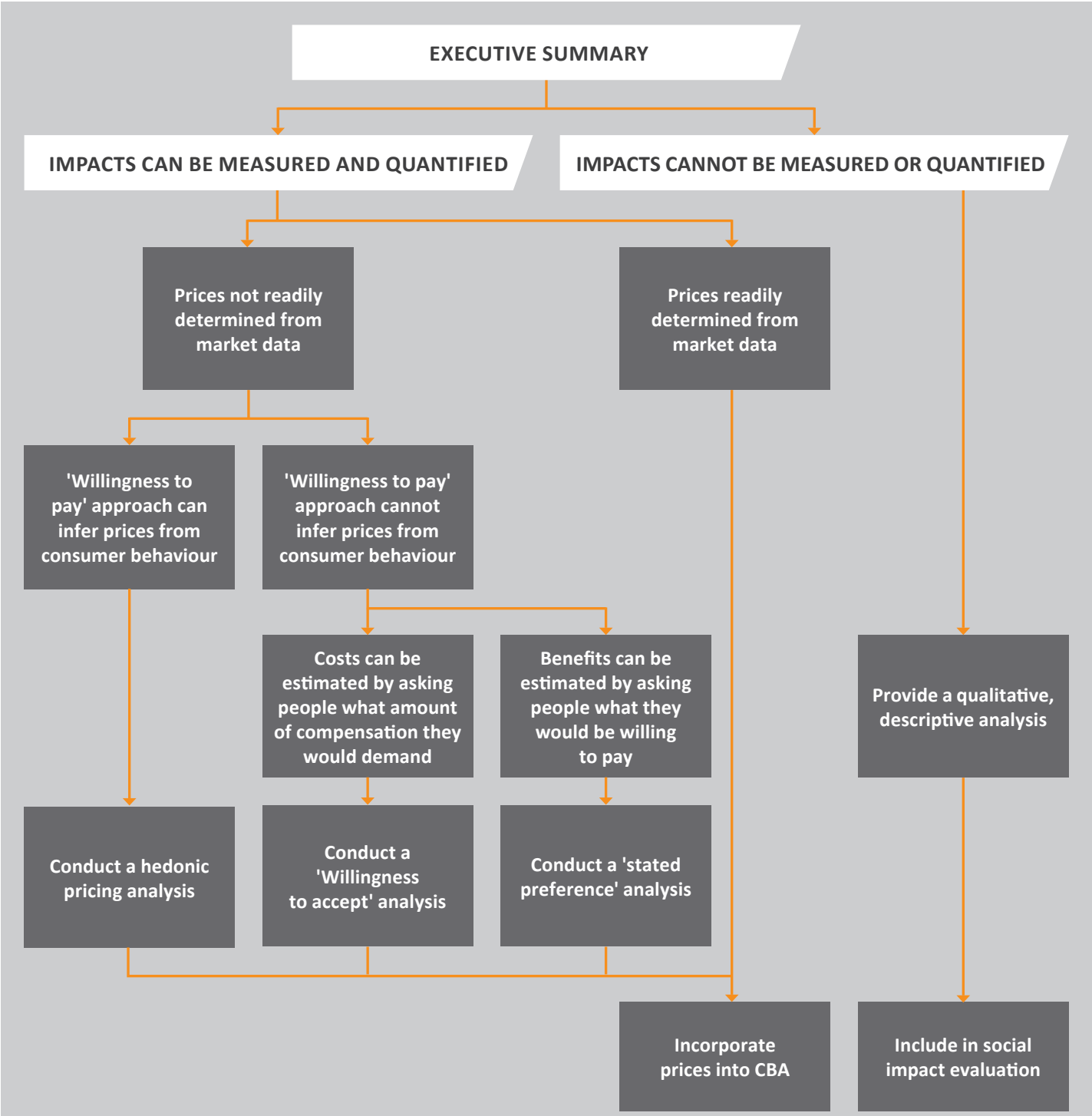

Figure 5: Logic map for non-market valuation

4.7 Calculation of economic indicators

Economic indicators are developed and calculated after moving through the steps of evaluating the service need/demand, base case, option/s, costs and benefits, including any necessary contingent evaluation. These indicators account for the time value of money, and adjusting cost and benefits streams to present-day values using discounting.

4.7.1 DISCOUNTING THEORY AND PRACTICE

CBA evaluates public sector projects from a societal perspective. To do this, the costs and benefits of proposals are monetised and their values occurring in different time periods are discounted to present-day values. Expected costs and benefits should be displayed in the form of investment schedules for both base and project cases. This is to articulate the nature, structure and timings of investment cost and benefit profiles analysed within the CBA. These are attached as detailed discounted cash flows. Use of a consistent discount rate[19] allows direct comparison of proposals.

This net present value (NPV) approach is the standard method of valuing costs and benefits that occur at different times and assumes that a dollar today is worth more than a dollar tomorrow. This approach reduces a future stream of costs or benefits to an equivalent amount in a specific price year. This is the year the dollar units all represent the same purchasing power. It is usually the same as the base year, which is usually the year for which the evaluation is conducted.

In preparing a CBA, this process is known as the discounted cash flow (DCF) method and is readily set up in spreadsheet software such as Microsoft Excel. The time period across which benefits and costs are analysed, commonly known as the evaluation period, will have an impact on the overall result of the CBA. However, toward the end of longer time frames, the present value of costs and benefits will be less in present value terms.

4.7.2 NET PRESENT VALUE (NPV)

The valuing of (risk-adjusted) NPV is normally undertaken from an economy-wide perspective. Benefits are streams of economic gains that accrue to direct users and third parties. Costs reflect the economic consumption of resources or imposts on third parties (disbenefits) as a result of the proposal[20]. As noted earlier, these may be reflected in market values where the relevant market captures the full economic cost in the transaction.

Relevant cash flows in the NPV analysis should be reconcilable with the financial analysis because they are drawn from the same sources. This is particularly relevant for infrastructure construction and operation costs, as well as infrastructure service revenue streams.

4.7.3 BENEFIT COST RATIO (BCR)

The (risk-adjusted) BCR divides the present value of estimated benefits by the present value of estimated costs. A ratio of one or more indicates economic viability where the assessed benefits to society are greater than the assessed costs.

4.7.4 OTHER ECONOMIC INDICATORS

While the minimum key economic indicators[21] to be calculated for business cases and publication requirements are NPV, BCR and internal rate of return (IRR), other economic indicators may be used. For example, incremental benefit cost ratio (IBCR) calculates the increase in benefit from additional augmentations to the selected option, including sub-option combinations e.g. scope. This indicator can be extremely useful during options analysis in assessing options and selected combinations of proposed sub-components. Other economic indicators such as net benefit investment ratio—the present value of net benefits generated per dollar of investment—could also be considered and applied throughout the analysis.

In general, options with an NPV greater than zero and a BCR greater than one are viewed as economically viable. Options of similar scope with larger NPVs and higher BCRs are preferred over options with smaller NPVs and BCRs, because they demonstrate superior measurable economic returns. For options with differing scope and size, consider using IBCR to assist in filtering in a constrained budget environment. Where additional economic indicators are used, these are documented by the analyst, including the justification use, calculation and the implications to the proposal results.

4.8 Sensitivity and scenario analysis

Sensitivity analysis is used to account for crucial economic risks and uncertainties with key parameters used in the analysis (this includes demand profile, volume and value parameters). This then shows how much results deviate due to changes in key proposal drivers.

Sensitivity analysis can help to identify where the greatest risk and uncertainty lies in the CBA (this can include the use of Monte Carlo analysis to identify key cost and benefit parameter values e.g. probability tornado or spider diagram). Further work may enable the confidence interval around a cost or benefit to be reduced, improving the robustness of the analysis to inform the central case.

[19] Necessary discount rates are commonly designated by assessment bodies as part of funding applications and may also be applied across project investments at a program and portfolio level. The Queensland Government applies a discount rate of seven per cent for the central case in evaluating potential investments.

[20] Including economic costs during the construction period.

[21] Key indicators may include net present value (NPV), benefit cost ratio (BCR), incremental benefit cost ratio (IBCR) and internal rate of return (IRR), as well as other indicators developed in the CBA. The term NPV has been used throughout this document and refers to the net present value calculated specifically during an economic CBA. It has the same meaning as the term 'ENPV' used in the PAF.

Take care to avoid the testing of dependent and correlated variables without due regard for their effects on the modelled variable outputs.

Several different approaches can be used to account for risk including single variable testing, scenario analysis, break-even analysis and Monte Carlo analysis.

4.8.1 SINGLE VARIABLE TESTING

Single variable testing involves varying each cost or benefit variable, one at a time, holding all others constant. This analysis can determine which variable most affects results. If variables are correlated, they may need to be varied together.

This analysis allows for key drivers affecting option viability to be tested e.g. an assumption around expected demand growth rates over the evaluation period. Key benefits driver/s, such as projected growth rates, can be tested here and may necessitate the revisiting of upstream analysis, such as demand assessments, network or program-level performance.

4.8.2 SCENARIO ANALYSIS

Scenario analysis involves analysis of alternative futures or situations to examine different combinations of input changes. In some instances, likely scenarios are built on the base case. In other instances, variations on options are modelled to allow for exploration of the relationships between different variables.

Risk and uncertainty

The costs and benefits included in a CBA are estimated forecasts of the future. This means there is risk that actual, realised streams of costs and benefits will deviate from expectations.

In this guide, the terms 'risk' and 'uncertainty' are used interchangeably. Some CBA guides make a distinction between risk and uncertainty, suggesting risk occurs where the probability distribution is known, and uncertainty occurs where the probability distribution is not known with certainty. For the purposes of infrastructure proposals, this distinction may be irrelevant because any analysis of uncertainty can be assigned a probability distribution.

The main sources of risk for CBAs include:

- base case and options demand forecasts (and hence options benefits and some variable operating costs) that differ from expected, with increasing risk over time as future estimates become less certain
- dated service need/demand forecasts. The business case should use the most contemporary population/demographic and demand forecasts and projections
- social impacts that differ from expected or were unforeseen, thereby diminishing 'social licence'
- construction costs that differ from expected because of changes in input costs or unforeseen events such as labour disputes, wet weather or unforeseen technical factors
- construction cost estimates which may be subject to optimism bias resulting in under-estimated cost and overstated BCRs
- operating costs that differ from expected because of changes in input costs or unforeseen technical factors
- network effects, where an asset is part of the network (e.g. an individual road) and decisions made elsewhere in the network impact on the project
- environmental impacts and trends (e.g. climate change) which impact across all aspects of the CBA.

In developing options, the proposal should use probability analysis to adequately consider its interaction with risk and uncertainty drivers that interplay with the option and impact outcomes. This work should be informed by the risk assessment for social, economic, environmental and financial impacts. Critical drivers, such as key demographic or price data should be tested to confirm likely impacts early on.

This approach relies on detailed examination of probable situations that may occur over time e.g. provisioning for a range of community services following master-planning designation of key housing developments. Another example is the requirement to investigate 'alternate futures' e.g. accounting for technological or climate change as part of the scenario testing of various options, or changes to reference design.

4.8.3 BREAK-EVEN ANALYSIS

Break-even analysis tests key variables to see what values attain an overall NPV of zero or if the IRR equals the discount rate. This approach can highlight how much the construction costs could vary before an option becomes unviable. It can also show the level of revenue that would be needed to establish an option's viability.

The 'Goal Seek' function in Microsoft Excel is often used within the spreadsheet model to arrive at the combination of input values to calculate a single desired result. Similarly, the 'Solver' add-in is applicable where more than one input value is considered. Break-even analysis is widely applicable, including in the natural resource sector.

4.8.4 MONTE CARLO ANALYSIS

Monte Carlo analysis is a computer-based technique that uses statistical sampling and probability distributions to simulate the effects on model outcomes of uncertain variables. It provides a systematic assessment of the combined effects of multiple sources of risk in each of the costs and benefits, and can also allow for known or assumed correlations between variables.

Additional analyses using a Monte Carlo technique can consider multi-variable simulations, potential correlation of variables and non-normal distribution of variables.

4.9 Results

CBAs should report the BCR, NPV and IRR of the central case. They should apply a real discount rate of 7 per cent and report the level of design used. They should also provide full NPV and BCR profiles for the central case, including P50 and P90 cost values. Reporting should also include sensitivity analysis of all key parameters (including 4 per cent and 10 per cent discount rates) and scenarios for the central case, and for estimates using P50 and P90 cost.

Where qualitative economic, social and environmental impacts are identified as significant, these should be contrasted against the NPV/BCR result. Such information should be captured in the socio-economic narrative in the economic analysis section and in the appraisal summary table (AST), as outlined in the Stage 3: Detailed Business Case Guide.

Detailed reporting should also include sensitivity and scenario analysis results which test uncertainty as informed by advice from technical experts e.g. quantity surveyor (QS), climate change scientist and demand analysis expert. It should not be based on simplistic variations of aggregate benefits, capital and operating cost lines, as these approaches do not provide useful information on the most significant key parameters for further analysis and refinement.

5 Reporting

Present the results of the CBA in a formal written report. The information should reflect the context and stage of the business case and include all supporting material, including annual cash flows, model spreadsheets and mathematical equations used in benefit and demand analysis calculations.

As an example, a CBA at options analysis stage may not have fully investigated contingent valuation procedures or conducted the necessary research or background work required to provide full valuation of benefit streams.

The CBA report should provide an appropriate level of detail as a stand-alone report and identify key information including its source. The appropriate level of detail is that which allows for comprehensive understanding and replication[22] of the conducted and reported CBA, inclusive of all reported results, any conducted scenarios and sensitivity testing.

Including technical discussions not directly related to the CBA is usually not required (that information should sit in the relevant technical chapter).

Routine requirements for reporting include a highly-detailed breakdown of benefits by category, the economic indicator results and the sensitivity testing at different levels of discount rate.

These require a central case with a real discount rate of 7 per cent applied, plus sensitivity testing conducted at discount rates of 4 and 10 per cent for all costs and benefits categories.

The following sections are typically included in a CBA chapter and report.

Define the base case

Under-articulation and non-discussion of the base case reduces confidence in the analysis. Avoid taking passages verbatim from guidance that are elementary and definitional in nature. Instead, use descriptive and useful information that will help decision-makers understand the evaluated proposal. Base cases should be written as they directly relate to the investment proposal.

5.1 Executive summary

The executive summary provides:

- an overview of the problems/issues
- an outline of the outcomes sought
- a summary of options considered
- the details of the recommended option and the economic viability of the option/s with the key supporting findings.

5.2 Description of the outcomes sought

This section of the CBA report summarises the proposal:

- outcomes, objectives and outputs desired
- strategic alignment in terms of governmental priorities and proponent roles, responsibilities and goals
- reasons for government intervention to achieve the objective i.e. why the market is not providing the goods or services at the desired cost or quantity, and how this restriction can be addressed.

5.3 Base case

The CBA report should include a tightly defined, justifiable and well-articulated BAU base case including uncertainties. The base case section details the scope and spending expected in the absence of the proposal. It is also a key reference point for the CBA analysis of incremental costs and benefits.

5.4 Summary of options

Summarise the considered options in detail. Also, briefly describe additional options that were identified but which did not progress to detailed consideration. These may include:

- key assumptions common to all options
- assumptions specific to an individual option
- each option assessed in detail, including how each option would address the outcome sought
- the extent of each option specified in terms of detailed scope.

[22] Peer reviews routinely allow for the independent replication of key analytical elements as a quality cross-check.

5.5 Methodology

Describe the procedures and processes conducted to generate key economic indicators. This section should include sufficient depth to explain how the CBA was conducted, so it can be understood, evaluated and replicated if required. Sensitivity testing of key proposal elements is an essential part of any robust methodology.

It is important to demonstrate the methodology is appropriate for the proposal and the desired results have not encouraged the adoption of a particular methodology.

5.6 Sensitivity and scenario testing

Carry out sensitivity analysis and scenario testing and reporting on the proposal's key drivers. The derivatives of these key drivers should be informed by complete analysis of the risk elements within the CBA.

5.7 Quality assurance review

Describe the procedures and processes to confirm the robustness and transparency of the CBA analysis. This section should include a report on the effective and adequate consideration of any peer review and/or Gateway review comments and recommendations. It should confirm that the CBA was conducted in a manner consistent with the CBA Health Check in Section 6.2.

5.8 Results and outputs

Present the CBA results in detail, particularly where overall benefits are aggregations of benefits streams. Show the results in tabulated form, with clearly designated headings and detailed breakdowns of any aggregated results. Clearly document all monetised benefits and costs in sufficient detail so the NPV and BCR can be replicated.

Clearly display inputs used to generate results. Use appropriate graphs to effectively convey information visually. Include an appendix with fully detailed benefits and cost streams over the full evaluation period.

Outputs should include the full NPV distributions for economic indicators (as outlined in Section 4), with details of skewness, kurtosis, mean, and the ranges and values of probabilistic economic indicators.

5.9 Summary of evaluation

Summarise the key results of the CBA for each option/ reference project/s with an outline of the positive and negative factors of each. This may include:

- the impact of sensitivity and scenario analysis on the results of the CBA for each option
- the key risks associated with each option, measures taken to address those risks, and how the risks are reflected in the values of the costs and benefits evaluated
- key qualitative factors, where appropriate, discussed and contrasted against the quantitative analysis.

5.10 Conclusion and recommendations

Provide a concise conclusion of the supporting analysis and recommendations on the proposal's economic viability and risks. Recommendations should be unambiguous within the context of the CBA. Drawing from the evaluation, the CBA should identify the option/s which would deliver the outcome sought and achieve the greatest economic value.

The CBA should also set out the reasons for recommending the preferred option and include discussion of the opportunities realised or problems solved as a result, limitations, constraints and uncertainty (informed by the sensitivity and scenario analysis).

5.11 Data sources

Data used within the analysis should be:

- obtained from credible sources e.g. using local parameter values relative to the proposal
- contemporary, consistent and transparent
- referenced throughout the report

Referencing should include any required manipulation such as interpolation and extrapolation activities conducted to generate input data for economic modelling purposes.

5.12 Documentation of procedures

Document all technical processes, associated procedures and data sources made in the CBA. This includes all calculations made.

Examples include, but are not limited to:

- any interpolations and extrapolations
- calculation of growth rates
- application of real growth rates
- removal of escalation
- essential procedures to calculate real monetised values
- calculations made within the CBA.

Importantly, these should be documented prior to any modelling in the form of a detailed and finalised methodology, describing all intended treatments and approaches to be applied within the CBA.

6 Quality assurance

6.1 Quality

Characteristics of a complete, effective and high-quality CBA and report include:

- appropriate, self-contained quantitative and qualitative analyses of risks and impacts (financial, economic, social and any other identified risks or impacts associated with the proposal)
- consistency with all other business case elements
- a logical and critically rigorous methodology
- concise and relevant information
- a well-defined and consistent terminology
- a clearly articulated central case and all other analysed elements
- a whole-of-life, whole-of-system and whole-of-state approach
- clear parameter values on which the analyses are based and a robust and defensible basis for those values
- climate change risks (as appropriate)
- referenced data sources for validation purposes
- sensitivity test key proposal drivers (parameter values)
- uncertainty and alternate futures, strategic foresight methods and scenario analysis
- information that is collated in useful packages to address stakeholder requirements including downstream CBA users
- clear reporting on the implications of calculated economic indicators
- detailed, clear and logical arguments to substantiate any conclusions and recommendations
- clearly articulated limitations of the conducted work including addressing peer review feedback.

The quality of your CBA will be enhanced by active and effective consideration of peer review feedback. Ensure the business case analysis project management plan includes enough time for the analysis to effectively incorporate this feedback. This should include the initial methodology, participation in key working groups, feedback on early analysis and modelling, feedback on close-to-complete drafts, and adequate time for final drafts to effectively incorporate and respond to feedback.

Conduct your CBA in the early stages of the proposal lifecycle and continually refine it as new data is acquired and analysed. CBA techniques may also be applied in assessing actual, realised benefit and cost streams following project delivery and finalisation at some future time[23].

[23] Known as ex-post evaluation.

6.2 Cost benefit analysis (CBA) health check

#	HAVE YOU COMPLETED THE FOLLOWING TASKS?	COMPLETED
1	Does the structure and quality of the information in the CBA align with appropriate guidance material? If not, why not?	☐
2	Does the analysis develop a logical argument towards substantiated conclusions and recommendations?	☐
3	Is there a justifiable, evidenced-based and strategically aligned demand for the investment proposal?	☐
4	Has the BAU base case been well specified and documented?	☐
5	Have appropriate forecasting techniques been applied, accounting for uncertainty, and has this informed a robust/defensible[24] evaluation period, sensitivity and scenario analysis?	☐
6	Has a realistic set of options been incorporated and evaluated?	☐
7	Have the costs and benefits been specified and documented?	☐
8	For each option analysed, is the risk-adjusted NPV/BCR calculation sound? That is: » Estimates of risk-adjusted whole-of-life capital and operating costs are justifiable and documented including contingencies. » All legitimate and monetised whole-of-life costs and benefits, including disbenefits costs during the construction period, are incorporated. » No invalid costs and benefits (e.g. multiplier effects) are included. » All costs and benefits are valued at their market value or economic value where appropriate and based on reasonable and verifiable information.	☐
9	Costs and benefits forecast reasonably and transparently over the evaluation period including consideration of the effects of induced demand. Does the economic analysis evaluation period include the costs and benefits prior to delivery e.g. EIS and approvals and economic disbenefits during construction period?	☐
10	Has a reasonable, numeric-based selection criterion been applied in shortlisting of options?	☐
11	Is the offered information and data provided in the CBA self-contained and internally consistent?	☐
12	Is there consistency with other business case elements e.g. demand, social, environmental, financial and commercial?	☐
13	Has appropriate sensitivity testing of key parameters been conducted, not simply arbitrary +/- 20% or 30% changes of aggregated cost or benefit estimates e.g. total CAPEX and/or OPEX?	☐
14	Has the analysis adequately considered uncertainty, alternate futures and climate risk, and incorporated this into the central case economic analysis to inform options selection and reference design (central case, sensitivity analysis, strategic foresight methods and scenarios)?	☐
15	Is the data used in calculating economic indicators contemporary and transparent?	☐

[24] Informed by the credible limits of the demand forecasts/projections.

6.2 Cost benefit analysis (CBA) health check (continued)

#	HAVE YOU COMPLETED THE FOLLOWING TASKS?	COMPLETED
16	Does the analysis and documentation have a high level of transparency to allow verification, validation and replication of results e.g. does it provide full working models for quality assurance and peer review?	☐
17	Does the depth of analysis offer quality assurance that the generated results are credible?	☐
18	Does the structure and presentation of the CBA allow easy interpretation and validation of the information and data provided (transparency)?	☐
19	Does the language and terminology used throughout the reporting give confidence the analysis is sufficiently informed and authoritative?	☐
20	Have any limitations been sufficiently justified and documented, including materiality on CBA results?	☐
21	Is the level of detail provided sufficient to complete ex-post evaluation?	☐
22	Has an appropriately detailed and tailored methodology been applied?	☐
23	Have full and complete undiscounted and discounted cost and benefit streams for the full evaluation period been attached as an appendix?	☐

Abbreviations

AST	Appraisal summary table
BAU	Business as usual
BCDF	Business Case Development Framework
BCR	Benefit cost ratio
CBA	Cost benefit analysis
CEA	Cost effectiveness analysis
CGE	Computable general equilibrium
CUA	Cost utility analysis
DCF	Discounted cash flow
EIA	Economic impact analysis
GOC	Government-owned corporation
IBCR	Incremental benefit cost ratio
ILM	Investment logic map
I-O	Input output
IP	Intellectual property
IRR	Internal rate of return
KPI	Key performance indicator
NPV	Net present value
PAF	Project Assessment Framework
QPC	Queensland Productivity Commission
QS	Quantity surveyor
SIE	Social impact evaluation
WEB	Wider economic benefit
WEI	Wider economic impact

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