



Cost-Benefit Analysis (CBA)

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Introduction

Cost-benefit analysis (CBA) is an economic evaluation method that involves estimating the key benefits and costs from a program or policy. The analyst converts benefits and costs into monetary terms and compares them to determine if a proposal is worth pursuing.

A distinctive feature of CBA is the conversion of all benefits and costs into a dollar value. Even things that are not usually thought about in financial terms are converted to a dollar value. For example, social, environmental and cultural benefits and costs.

CBA is generally used before deciding whether to invest in or implement a proposal (often referred to as ex ante or pre-implementation analysis). It can help to assess if a proposal is worth funding or to compare different implementation options. A similar approach can also be used post-implementation to assess the cost-effectiveness and cost-efficiency of a proposal that is already operating.

Because CBA is usually used to inform an investment decision before implementation commences, it relies on the analyst making careful assumptions. This can make CBA more difficult to use than other economic evaluation methods because if assumptions are poorly chosen, the results will be inaccurate.

When to use cost-benefit analysis

CBA is a method that can be used to evaluate any program, policy or project. It is particularly common in some contexts:

- CBA is often used in fields where it is possible and meaningful, to convert non-monetary benefits into dollar values. For example, government spending on infrastructure projects, trade projects, or projects with a clear economic benefit. There are also CBA methods used to convert non-monetary concepts to dollar terms. For example, by using surveys that elicit individuals' 'willingness to pay' for a specific outcome.
- CBA is often useful when a program involves various, quite different, benefits (or costs) that need to be compared. For programs where there is a single benefit that is the main purpose of the program (for example, 'lives saved'), other methods like cost-effectiveness evaluation may be preferred.
- CBA is often used prior to program implementation to help decision-makers decide on whether to proceed with a project.
- CBA is often used in fields where there is very specific guidance and established methods on how a CBA can be conducted. In general, CBA guidance tends to be the most prescriptive for transport and general infrastructure interventions. Social programs tend to have less well-established and documented methods for CBA.

See the [ACE guidance on different evaluation methods](#) for common uses of each method.

Key concepts

The base case and options

A CBA usually compares potential options. For example, options for a decision about whether to build a new train line may be:

- Option 1: Do nothing or 'business-as-usual' (the base case)
- Option 2: Upgrade existing train line
- Option 3: Knock down existing train line and build a new one

The analyst estimates the costs and benefits of each option compared to the base case.

Costs and benefits

There will be both direct and indirect costs and benefits of an intervention. Costs and benefits may be financial, economic, social, environmental or cultural. For each option, the analyst usually calculates costs and benefits relative to the base case.

The table provides examples of the benefits and costs that may be relevant to a project in the roads, education and court infrastructure fields:

Example	Benefits	Costs
Roads	Travel time savings Lower vehicle costs Reduced accidents Reduction in emissions	Construction costs Maintenance costs Noise, air pollution, and lower amenity around new road
Education	Benefits to employers from higher productivity Reduction in crime and other social costs	Cost of delivering education services Student costs including income foregone and out-of-pocket expenses
Court Infrastructure	Reduced court delays Avoided capital, operating, and maintenance costs	Disruption costs during construction

Source: Adapted from [NSW Government Guidance on Cost-Benefit Analysis](#)

The discount rate (r)

CBA involves comparing all the costs and benefits of a program over a significant period of time (such as the expected life of an asset). This can be difficult because often the costs of a program are incurred immediately, while the benefits come later, often over several years or decades.

To make things comparable, the analyst converts costs and benefits to their 'present value'. That is, their value in today's dollars.

The analyst does this using a process called 'discounting'. This accounts for the fact that spending \$100 today is not the same as spending \$100 in 1 years' time because if money is invested in a safe asset at interest rate r today, it would be worth $\$100(1 + r)$ in 1 years' time.

Another way to describe this is that receiving \$100 in 1 years' time is equal to $\frac{\$100}{(1+r)}$ today.

Similarly, receiving \$100 in 2 years' time is equal to $\frac{\$100}{(1+r)^2}$ today.

In practice, the assumed discount rate, r , that is used in a CBA is greater than the interest rate on a safe asset. This accounts for the fact future benefits are more uncertain than the returns on a safe asset. The Office of Impact Analysis requires the calculation of net present values at an annual real discount rate of $r = 7\%$ (with sensitivity calculations using $r = 3\%$ and $r = 10\%$).

Calculating 'present values'

The analyst calculates the present value of benefits for each individual year using the discounting procedure described above. The analyst then sums the benefits together to find the total present value of benefits. The analyst repeats the same procedure for costs.

$$\text{Present Value Benefits} = \frac{B_0}{(1+r)^0} + \frac{B_1}{(1+r)^1} + \frac{B_2}{(1+r)^2} + \dots + \frac{B_n}{(1+r)^n}$$

$$\text{Present Value Costs} = \frac{C_0}{(1+r)^0} + \frac{C_1}{(1+r)^1} + \frac{C_2}{(1+r)^2} + \dots + \frac{C_n}{(1+r)^n}$$

where

B_t = the total benefits for year t

C_t = the total costs for year t

r = the discount rate

n = The last year of the appraisal period

Result metrics

Calculating the Net Present Value (NPV) and Benefit Cost Ratio (BCR)

Once the analyst has calculated the present value of benefits and the present value of costs, they use these numbers to calculate the following key result metrics.

Net Present Value (NPV) = Present Value Benefits – Present Value Costs

Benefit Cost Ratio (BCR) = $\frac{\text{Present Value Benefits}}{\text{Present Value Costs}}$

Interpreting results

NPVs and BCRs allow you to determine if the benefits of a proposal outweigh the costs, and hence whether an individual proposal increases social welfare. These metrics also allow you to compare the base case to alternative options.

Metric	Interpretation	Benefits outweigh costs if...
Net Present Value (NPV)	The total net value the proposal will create over its lifetime, valued in today’s dollars.	NPV > 0
Benefit-Cost Ratio (BCR)	The benefit per unit of cost of the proposal.	BCR > 1

Sensitivity analysis

There are inherent uncertainties in any CBA due to:

- Uncertainty around the best assumptions to use for estimating costs and benefits, including into the future
- Uncertainty around the best assumptions for converting non-monetary items into dollar values
- Uncertainty about the most appropriate discount rate to use for calculating the present value of costs and benefits

Sensitivity analyses are a way of determining how much these uncertainties impact the results, and understanding how widely the results may vary. To conduct a sensitivity analysis, the analyst modifies some of the most uncertain and most critical assumption values and then re-calculates the NPV and BCR with these alternative values.

For example, the Office of Impact Analysis requires that in addition to calculating the NPV and BCR with an annual real discount rate of 7 per cent, a sensitivity analysis is also calculated for discount rates of 3 per cent and 10 per cent.

Items that should be excluded

There are some items that should be excluded from a CBA when calculating costs and benefits:

- **Sunk costs** – All costs in a CBA should relate to new future expenditures. All past or sunk costs relating to the proposals should be excluded from the analysis.
- **Depreciation** – The depreciation of assets should not be included as a cost in a CBA because this would double count capital costs. Capital costs are already counted at the time of expenditure so they do not need to also have a depreciation cost counted.
- **Interest** – Interest costs or returns should be excluded from a CBA. Discounting is used in CBA to bring future costs and benefits to present values, so the discount rate already reflects potential interest costs or returns.
- **Transfers** – Any transfer where the provider and recipient of a financial benefit places the exact same value on the benefit, the cost and benefit cancel out and should not be included in a CBA. Where the parties place different values, a 'surplus' may be included in the CBA. Transfer payments should however be included in any distributional or equity analysis.

Key steps in producing a cost-benefit analysis

1. Define the parameters of your project

- **Define the scope:** Clearly define the scope of the project or intervention you are evaluating. Why are you evaluating this intervention? What decision will it inform?
- **Identify the objectives:** What is the purpose of the intervention, policy or program you are evaluating?
- **Set the time frame:** Establish the time-period over which you want to evaluate the costs and benefits. This could vary depending on the nature of the project (could be short-term or long-term).
- **Specify the options available:** Identify the set of intervention options that are genuine and viable alternative policy options. Clearly define a base case of “do nothing” or “business as usual approach” depending on the context.

2. Identify and measure costs and benefits

- **Identify costs and benefits:** Based on the identified scope and timeframe of interest, brainstorm the set of impacts. These could be financial, economic, social, environmental or cultural.
- **Find or collect relevant data sources:** For identified costs and benefits, gather relevant data sources to forecast use of the asset/program and capture the value of the costs and benefits.
- **Convert non-monetary costs and benefits to monetary values:** Use the data sources collected and assumptions to convert to monetary values.

3. Calculate Net Present Value (NPV) and Benefit-Cost Ratio (BCR)

- **Calculate the net present value:** For each intervention option bring future costs and benefits into the present value using a discount rate. Refer to the Key Concepts section for calculation details.
- **Calculate the benefit-cost ratio:** For each intervention option, find the per unit benefit of a unit of cost invested. Refer to the Key Concepts section for calculation details.
- **Interpret the NPV and BCR metrics:** Identify the intervention option that represents the best cost-effectiveness and cost-efficiency using the CBA metrics.

4. Perform sensitivity analysis

Test your results by changing key assumptions: Calculate the CBA metrics based on a range of “best-case” and “worse case” scenarios for the key assumptions.

5. Interpret the results and report the findings

Clearly present the results of the CBA: Present all results and recommendations in a transparent and clear manner. This should include:

- Summary of costs and benefits
- Relevant metrics of NPV and BCR for all options
- Sensitivity analysis of key assumptions
- Limitations of the analysis and any particularly critical assumptions
- Distributional analysis – Explains how results vary for different sub-populations like marginalised communities
- Qualitative costs and benefits that were not quantifiable and so were not incorporated into the NPV or BCR
- Ethical considerations of intervention options

Resources

Commonwealth of Australia, [Handbook of Cost-Benefit Analysis](#), Financial Management Reference Material No. 6, January 2006

NSW Health, [Guide to Cost-Benefit Analysis of Health Capital Projects](#)

NSW Treasury, [NSW Government Guide to Cost-Benefit Analysis](#)

Office of Impact Analysis, [Cost Benefit Analysis Guidance Note](#)

Productivity Commission, [Valuing the future: The social discount rate for cost-benefit analysis](#)